Atmosphere

Aerosols

Calculating Relative Air Mass (pdf)
Students are introduced to the concepts of solar elevation angle and relative air mass and learn how to determine relative air mass from measurements of solar elevation angle.

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)
Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

Air Temperature

Making a Contour Map (pdf)
Students construct one or more contour maps using GLOBE data.

Studying The Instrument Shelter (pdf)
Students explore how the placement and design of instrument shelters can influence temperature measurements taken from thermometers located inside them.

Building a Thermometer (pdf)
Students construct simple thermometers to understand how and why liquid-in-glass thermometers work.

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)
Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

How Do Seasonal Temperature Patterns Vary Among Different Regions of the World (pdf)
Students use GLOBE visualizations to display student data on maps and to learn about seasonal changes in regional and global temperature patterns.

What Are Some Factors That Affect Seasonal Patterns (pdf)
Students use GLOBE data and graphing tools to compare the influence of latitude, elevation, and geography on seasonal patterns.

Iowa's Highs and Lows- A GLOBE Data Exploration (pdf)
Students interpret a frequency distribution of GLOBE temperature data to decide whether statements about the weather are accurate, citing the parts of the graph they used as the basis of their decision.

Making a Climograph- A GLOBE Data Exploration (pdf)
Students learn how to construct, read, and analyze climographs and understand how climate differs from weather.

Climate and Latitude- A GLOBE Data Exploration (pdf)

Students match GLOBE temperature data with its location given what they know about the relationship between latitude and seasonal temperature variations.

Data at Altitude- A GLOBE Data Exploration (pdf)
Through explorations of GLOBE temperature data from two nearby locations in Germany, students learn how temperature varies with altitude.

Weather Tourists- A GLOBE Data Exploration (pdf)
Students build geography skills while learning how to find data using the GLOBE Data Visualization tool, sharing what they have learned in a tourism poster for a GLOBE school location.

Comparing Croatia Climates- A GLOBE Data Exploration (pdf)
Through explorations of GLOBE atmosphere data from Croatia, students will build understanding of two climate zones. **This activity has an option to get students analyzing data in spreadsheets. The spreadsheet file (and answer key) can be found here: https://www.globe.gov/do-globe/globe-teachers-guide/atmosphere/data-exploration-learning-activities

An Alaskan Spring Mystery- A GLOBE Data Exploration (pdf)
Students learn about the timing of spring budburst, develop multiple working hypotheses about why timing differs year to year, and test hypotheses using environmental data collected by GLOBE students in Alaska to come to a conclusion about the factors that most impact timing of budburst on paper birch trees. **This activity has an option to get students analyzing data in spreadsheets. The spreadsheet file (and answer key) can be found here: https://www.globe.gov/do-globe/globe-teachers-guide/atmosphere/data-exploration-learning-activities

Barometric Pressure
Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)
Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

Clouds
Estimating Cloud Cover- A Simulation (pdf)
Students practice estimating how much of the sky is covered by clouds.

Precipitation
Making a Contour Map (pdf)
Students construct one or more contour maps using GLOBE data.

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)
Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

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Weather Tourists- A GLOBE Data Exploration (pdf)
Students build geography skills while learning how to find data using the GLOBE Data Visualization tool, sharing what they have learned in a tourism poster for a GLOBE school location.

Monsoons and Health- A GLOBE Data Exploration (pdf)
Students learn about the relationship between three infectious diseases and rainfall in the country of Benin.

Rainfall in the GLOBE Africa Region- A GLOBE Data Exploration (pdf)
Through explorations of GLOBE rain depth data from Africa, students learn about seasonal patterns in locations affected by monsoons. **This activity has an option to get students analyzing data in spreadsheets. The spreadsheet file (and answer key) can be found here: https://www.globe.gov/do-globe/globe-teachers-guide/atmosphere/data-exploration-learning-activities

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Relative Humidity
Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)
Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

Surface Ozone

Constructing a Model of ppbv of Surface Ozone (pdf)

Students construct and compare cubes of different volumes to gain insight into small concentrations such as a part per million and a part per billion.

Surface Temperature

How Do Seasonal Temperature Patterns Vary Among Different Regions of the World (pdf)

Students use GLOBE visualizations to display student data on maps and to learn about seasonal changes in regional and global temperature patterns.

What Are Some Factors That Affect Seasonal Patterns (pdf)

Students use GLOBE data and graphing tools to compare the influence of latitude, elevation, and geography on seasonal patterns.

An Alaskan Spring Mystery- A GLOBE Data Exploration (pdf)

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Water Vapor

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)

Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)

Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

Wind

Making a Contour Map (pdf)

Students construct one or more contour maps using GLOBE data.

How Do Seasonal Temperature Patterns Vary Among Different Regions of the World (pdf)

Students use GLOBE visualizations to display student data on maps and to learn about seasonal changes in regional and global temperature patterns.

What Are Some Factors That Affect Seasonal Patterns (pdf)

Students use GLOBE data and graphing tools to compare the influence of latitude, elevation, and geography on seasonal patterns.

Biosphere

Carbon Cycle

D. Carbon Travels Game (pdf)

Students play a dice game to follow a carbon atom as it travels through the Earth's carbon pools.

G. Percent Cover (pdf)
Students practice the skill of estimating percent cover.

H. Allometry (pdf)
Students measure their height, arm span, and foot length to show how living organism's parts are related to the whole. Students use this concept to understand how circumference of trees can be used to estimate biomass.

Enhancement Materials: Allometry Example (xls)

Modeling Activities
Computer models (at varying levels of complexity) predict the change in biomass and carbon storage or size of carbon pools and fluxes over time, and give students the opportunity to use an important scientific tool.

B. Paperclip Simulation and Model- Introduction to Systems Thinking (pdf)
Introduce students to systems thinking through a classroom simulation, and model a system using the '1-box model'.

Enhancement Materials: Paper Clip Simulation Spreadsheet (xls) Online Model Link

C. Carbon Cycle Adventure Story (pdf)
Students follow a carbon atom through the carbon cycle using a choose your own adventure storybook.

Enhancement Materials: Carbon Cycle Adventure Story Booklet (pdf)

E. Getting To Know the Global Carbon Cycle (pdf)
Students learn the basics of the carbon cycle through diagrams.

Enhancement Mini-Activities

Turnover rate and residence time (pdf)
How big is a petagram? (xls)
Human Carbon Pool (xls)
How Much Carbon is Stored in a Pencil? (xls)

Global Patterns in Green-up and Green-down (pdf)

Students will analyze visualizations and graphs that show the annual cycle of plant growth and decline.

An Alaskan Spring Mystery- A GLOBE Data Exploration (pdf)
Students learn about the timing of spring budburst, develop multiple working hypotheses about why timing differs year to year, and test hypotheses using environmental data collected by GLOBE students in Alaska to come to a conclusion about the factors that most impact timing of budburst on paper birch trees. **This activity has an option to get students analyzing data in spreadsheets. The spreadsheet file (and answer key) can be found here: https://www.globe.gov/do-globe/globe-teachers-guide/atmosphere/data-exploration-learning-activities

Land Cover Classification

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)
Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

Bird Beak Accuracy Assessment (pdf)
Students learn how to evaluate the accuracy of a classification they perform.

Land Cover Change Detection (pdf)
Using MultiSpec, students compare two images of their GLOBE Study Site; one from the 1990's and one from the 2000's, to determine how the land cover has changed in that time span.

Accuracy Assesment Tutorial (pdf)
Students learn how to evaluate the accuracy of a classification they perform in this tutorial.

Using GLOBE Data to Analyze Land Cover (pdf)
Students find another GLOBE school that reported the same MUC class and systematically compare the other GLOBE measurements that they each reported.

Change Detection Tutorial (pdf)
Using MultiSpec, students compare two images of their GLOBE Study Site; one from the 1990's and one from the 2000's, to determine how the land cover has changed in that time span in this tutorial.

Computer-aided Land Cover Mapping (pdf)
Students use MultiSpec to perform unsupervised clustering of their Landsat TM image and then assign MUC classes to every cluster to create a land cover map.

Odyssey of the Eyes Intermediate Level (pdf)
To familiarize students with the concept of modeling as it is related to remote sensing and to the process of digitizing images.

Manual Mapping- A Tutorial for the Beverly, MA, Image (pdf)
Students outline and label different areas of land cover as seen on their Landsat TM image to create a land cover map in this tutorial.

Getting to Know Your Satellite Imagery and GLOBE Study Site (pdf)
Students use the satellite image of their GLOBE Study Site to become familiar with the different types of land cover in their area.

Manual Land Cover Mapping (pdf)
Students outline and label different areas of land cover as seen on their Landsat TM image to create a land cover map.

Site Seeing Intermediate Level (pdf)
To investigate the idea that every dynamic system has energy and matter in several different forms. Inputs and outputs will vary depending upon the physical components of the site, the plant and animal life, the determined boundaries or scale of the study and the season.

Global Patterns in Green-up and Green-down (pdf)
Students will analyze visualizations and graphs that show the annual cycle of plant growth and decline.

Temperature and Precipitation as Limiting Factors in Ecosystems (pdf)
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.

Do You Know Your MUC (pdf)
Students classify land cover by visually examining their site as well as mapping and recording ground cover onto graph paper as they walk across their site. Students will use a GPS to locate the site in addition to photographing their site.

Earth as a System

Earth as a System

Regional Connections- earth systems at a Regional Level RC2- Effects of Inputs and Outputs on a Region (pdf)
Students examine the inputs and outputs of a regional scale Earth system and predict what would happen to that system if any of those inputs or outputs were changed.

Global Connections- Earth systems at the Global Scale GC1- Your Regional to Global Connection (pdf)
Using global scale maps of winds and ocean currents students predict what region(s) in other parts of the world might be affected by their region.

Global Connections- Earth systems at the Global Scale GC2- Components of the Earth system Working Together (pdf)
Using data about the components of the Earth system at the global scale, students discuss how the components interact to form the Earth system as a whole and use the water cycle to explore this in more detail.

Local Connections- earth systems in the Local Study Site LC2- Representing the Study Site in a Diagram (pdf)
Students, either individually or in small groups, use their knowledge of their study site develop a diagram that illustrates the most important connections between the different components of the Earth system.

Local Connections- earth systems in the Local Study Site LC3- Using Graphs to Show Connections (pdf)
Students use GLOBE student data to explore, understand, and communicate the connections between the components of the Earth system exist at the study site they are investigating.

Local Connections- earth systems in the Local Study Site LC4- Diagramming the Study Site for Others (pdf)
Students compare and contrast the diagrams of their study site developed by individuals or small groups, and develop a class diagram of their study site that best communicates the most important connections between the components of the Earth system that exist there.

Local Connections- earth systems in the Local Study Site LC5- Comparing the Study Site to One in Another Region (pdf)
Students compare and contrast diagram of their study site with a diagram developed for a region that is biogeographically different than their own.

Regional Connections- earth systems at a Regional Level RC1- Defining Regional Boundaries (pdf)
Students broaden their understanding of the Earth system by expanding their view of the Earth system from the local site to a regional system by identifying the boundaries of a regional Earth system.

S5- Seasonal Change on Land and Water (pdf)

Students use visualizations to compare the effects of incoming solar energy in the two hemispheres, furthering their understanding of seasonal change and climatic effects of land and water.

S1- What Can We Learn About Our Seasons (pdf)
Students develop a qualitative understanding of the characteristics and patterns of seasons and highlight the relationship of seasons to physical, biological and cultural markers.

S2-What Are Some Factors That Affect Seasonal Patterns (pdf)
Students use GLOBE data and graphing tools to compare the influence of latitude, elevation, and geography on seasonal patterns.

S3-How Do Seasonal Temperature Patterns Vary Among Different Regions of the World (pdf)
Students use GLOBE visualizations to display student data on maps and to learn about seasonal changes in regional and global temperature patterns.

S4- Modeling the Reasons for Seasonal Change (pdf)
Students use color visualizations and a 3-D paper model of the Earth to explore the causes of seasons, with a focus on Earth's tilt and its spherical shape.

Hydrosphere

Alkalinity

Hydrosphere Learning Activities (pdf)
Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)
Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

Conductivity

Hydrosphere Learning Activities (pdf)
Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)
Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

Dissolved Oxygen

Hydrosphere Learning Activities (pdf)
Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)
Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

Freshwater Macroinvertebrates

Hydrosphere Learning Activities (pdf)
Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)

Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

Nitrates

Hydrosphere Learning Activities (pdf)

Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)

Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

pH

Hydrosphere Learning Activities (pdf)

Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)

Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

The pH Game (pdf)

Students will create mixtures of water samples, soil samples, plants and other natural materials to better understand the importance of pH levels.

Water Detectives (pdf)

Students will investigate how they use their senses for observation and why we use instruments to collect data.

Salinity (including Titration)

Hydrosphere Learning Activities (pdf)

Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)

Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

Water Temperature

Building a Thermometer (pdf)

Students construct simple thermometers to understand how and why liquid-in-glass thermometers work.

Hydrosphere Learning Activities (pdf)

Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)

Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

How Do Seasonal Temperature Patterns Vary Among Different Regions of the World (pdf)

Students use GLOBE visualizations to display student data on maps and to learn about seasonal changes in regional and global temperature patterns.

What Are Some Factors That Affect Seasonal Patterns (pdf)
Students use GLOBE data and graphing tools to compare the influence of latitude, elevation, and geography on seasonal patterns.

Water Detectives (pdf)
Students will investigate how they use their senses for observation and why we use instruments to collect data.

Water Transparency
Hydrosphere Learning Activities (pdf)
Introduction document to the Hydrosphere Investigation Area Learning Activities.

Model a Catchment Basin (pdf)
Students will make a 3-dimensional model of a catchment basin to understand how water moves through the basin and explore how water is affected when there are changes in the basin.

Water Detectives (pdf)
Students will investigate how they use their senses for observation and why we use instruments to collect data.

Pedosphere
Bulk Density
Soil Makers (pdf)
Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Characterization
The Data Game (pdf)
Teams of students play a game in which they gather data and distort the values of certain measurements. They then estimate the values of the measurements taken by other teams and try to detect their errors.

From Mud Pies to Bricks (pdf)
Students make mud pies by adding water to the various soil components, letting them dry and observing the pie's characteristics.

Why Do We Study Soil (pdf)
An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Soil Makers (pdf)
Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Fertility

Why Do We Study Soil (pdf)

An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Soil Makers (pdf)

Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Infiltration

Why Do We Study Soil (pdf)

An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Soil Makers (pdf)

Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Moisture - Gravimetric

Soils as Sponges- How Much Water Does Soil Hold (pdf)

Students explore soil moisture by weighing and drying sponges and then they explore their soil samples in the same way.

Why Do We Study Soil (pdf)

An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)

Students use visualizations to explore the relation between elevation and temperature and begin learning how to make important patterns evident in visualizations.

Draw Your Own Visualization (pdf)

Students draw a visualization and learn about all the design choices involved and how these choices affect what is communicated by the visualization.

Soil Makers (pdf)

Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Moisture - Sensors

Why Do We Study Soil (pdf)

An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
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Draw Your Own Visualization (pdf)
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Soil Makers (pdf)
Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Moisture - SMAP Block Pattern
Soils as Sponges- How Much Water Does Soil Hold (pdf)
Students explore soil moisture by weighing and drying sponges and then they explore their soil samples in the same way.

Why Do We Study Soil (pdf)
An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

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Soil Makers (pdf)
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Soil Particle Density
Why Do We Study Soil (pdf)
An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Soil Makers (pdf)
Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Particle Size Distribution
Why Do We Study Soil (pdf)
An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Soil Makers (pdf)
Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil pH
Why Do We Study Soil (pdf)
An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Soil Makers (pdf)
Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

Soil Temperature
Why Do We Study Soil (pdf)
An activity which highlights the importance of learning about the soils on Earth. In this activity students explore some of the many uses of soils, learn the five soil-forming factors, and gain a better understanding of how little of Earth's surface is covered in soil.

Making a Contour Map (pdf)
Students construct one or more contour maps using GLOBE data.

Learning to Use Visualizations - An Example with Elevation and Temperature (pdf)
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Draw Your Own Visualization (pdf)
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Soil Makers (pdf)
Students will understand the geologic phenomena of weathering and erosion. These processes, along with deposition, shape our landforms and contribute to the development of parent material in the soil formation process.

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