



GLOBE Atmosphere “Clouds” and NGSS

(Elementary & Middle School)



Atmospheric conditions are important because they play a role in soil formation and influence the types of plants and wildlife that can survive in a particular area. Measuring atmospheric conditions is important for scientists studying weather, climate, land cover, phenology, ecology, biology, hydrology, and soil. To make sure this data is comparable from site to site, GLOBE students and [scientists use GLOBE-approved instruments](#) and [follow rigorous protocols](#).

[**Clouds Protocol \(pdf\)**](#)

Observe and report which types of clouds are visible, how much of the sky is covered by clouds, and the opacity of clouds. Also report sky and surface conditions. Each observation is matched to satellite data of clouds taken about the same time and location. Cloud observations can be taken at any time! This Protocol is designed to be flexible and fit into your schedule, classifying, observing, and reporting cloud observations when it works for you. If you observe while a satellite is overhead, you can then receive an email from NASA comparing your observations to satellite data.

[NASA Support Page for GLOBE Clouds and Satellite Comparison](#)

Your cloud observations help NASA to better understand the different types of clouds and the effects they have on our Earth’s climate. NASA matches cloud observations to corresponding satellite data. Satellites only see the top of the clouds while you see the bottom. By putting these two vantage points together we get a much more complete picture of clouds in the atmosphere.

Find Satellite Overpass Times by accessing the [NASA Cloud Satellite Portal](#).

GLOBE Clouds Educator Resources

Why Study Clouds?

- [NASA's Earth Minute: Cloudy Forecast](#): *With this short and engaging whiteboard animation, you can learn about the complex role clouds play in our climate and why it is important to study clouds.*

Cloud Identification

- [GLOBE Clouds Chart](#): *Use this tool to help you identify cloud types. Test your knowledge with this [Blank Cloud Chart](#).*
- [Sky Window](#): *Use this tool to help you identify cloud types, visibility, and sky color.*
- [Cloud Sort Activity | MyNASAData](#) and [Cloud Sort Activity - Key](#): *Learn about the different cloud types and their names. Match cloud photos and names by cloud type and for all types. Evaluate the types of clouds represented in various data displays.*
- [GLOBE Cloud Type Practice](#): *Use this key to identify clouds in the field.*

GLOBE Clouds Observations

- [Observation Tips to Determine Cloud Altitude](#): *Determining if a cloud is at a low, mid, or high level can be tricky. Use these easy and practical tips to help you out!*
- [Cloud Clues](#): *Learn about cloud opacity through a fun hands-on challenge.*
- [Cloud Cover Estimation Activity Demo](#): *Jessica Taylor of NASA Langley Research Center and her two daughters show you how to do a Cloud Cover Estimation activity using simple materials.*
- [GLOBE Cloud Cover Practice](#): *Help train your eye for estimating cloud cover in the field with this interactive.*
- [GLOBE Observer: Clouds - Getting Started](#): *The GLOBE Observer app provides a step-by-step process that helps you learn about clouds and their classification through simple observations and photography.*

GLOBE Clouds Satellite Matching

- [ARSET - Fundamentals of Remote Sensing](#): *Learn the basics of how satellites work with this online, self-paced course.*
- [Satellite Matching](#): *Marilé Colón Robles (GLOBE Clouds project scientist, NASA Langley) and Tina Rogerson (GLOBE Clouds data manager, NASA Langley) share why satellite matches to GLOBE cloud observations are important and how they are done. Then, Heather Mortimer (GLOBE Observer graphic designer and science writer, NASA Goddard) walks us through her own cloud observations and satellite matches.*
- [How to Read a Terra, Aqua, NOAA-20 or GEO Satellite Match](#): *The satellite match table summarizes your ground observations of clouds and sky conditions with data from satellites collected at about the same time over or nearby your location.*

GLOBE Clouds Implementation Strategies

- [GLOBE Educator One-Week Pacing Guide: Cloud Types](#): *Implement GLOBE Clouds in your classroom following this 5-day sequence of activities that target students in grades 3-8.*
- [GLOBE Educator One-Week Pacing Guide: Clouds and Energy Budget](#): *Implement GLOBE Clouds in your classroom following this 5-day sequence of activities that target students in grades 6-12.*
- [Making Science Come Alive with Clouds \(NSTA Paper\)](#): *Tips and tricks to facilitate student environmental observations using technology.*

Field Guides

Step-by-step instructions for collecting data according to the protocols.

[Cloud and Contrail Visual Opacity Field Guide \(pdf\)](#)

[Cloud Cover and Contrail Cover Field Guide \(pdf\)](#)

[Cloud Type and Contrail Type Field Guide \(pdf\)](#)

[Sky Color and Sky Visibility Field Guide \(pdf\)](#)

Data Sheets

Sheets to be filled out during data collection

[Atmosphere Investigation Clouds 1-Day Data Sheet \(pdf\)](#)

[Atmosphere Investigation Site Definition Sheet \(pdf\)](#)

Learning Activities

Activities to help students learn more about the instruments and protocols

[Cloud Watch \(pdf\)](#)

Students monitor clouds and weather to begin to understand the connections between the two.

[Estimating Cloud Cover- A Simulation \(pdf\)](#)

Students practice estimating how much of the sky is covered by clouds.

[Observing, Describing, and Identifying Clouds \(pdf\)](#)

Students begin to learn cloud types and their names.

Additional Resources

Additional documents or tools related to the protocol

[Blank Cloud Chart \(pdf\)](#)

[Cloud Chart - French \(pdf\)](#)

[Cloud Chart - Spanish \(pdf\)](#)

[Cloud Chart-Japanese \(pdf\)](#)

[GLOBE Cloud Chart \(pdf\)](#)

[GLOBE Cloud Sky Window \(English\) \(pdf\)](#)

[Observing Cloud Type \(pdf\)](#)

[GLOBE Data Entry App](#)

[GLOBE Observer App](#)

[Cloud Protocol eTraining](#)

[Contrail Formation Tutorial](#)

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[Sky Window - Ventana Del Cielo \(Spanish\) \(pdf\)](#)

[GLOBE Teachers Guide: Clouds](#)

Informational, games, videos, and simulations

[NOAA SciJinks \(Information, games, and simulators\)](#)

[National Institute of Aerospace \(NIA\) K-12 Classroom Resources](#)

[USGS Water cycle interactives](#)

Supported NGSS Performance Expectations for K-5

Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App](#) - to practice entering data

[NASA eClips™ Educator Guide - Our World: Designing a Cloud Cover Estimator](#)

Kindergarten

K-PS3 Energy

K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds.

Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[NOAA SciJinks \(Information, games, and simulators\)](#)

Go outside and make a cloud observation.

Clouds block some of the Sun's energy and keep it from reaching the surface of the Earth. Clouds also reflect some of the Sun's energy back up into the atmosphere. Make cloud observations when there are no clouds in the sky, a few clouds in the sky, and a lot of clouds in the sky. Discuss with students the similarities of standing in the shade of a cloud and standing in the shade of a tree. Ask students what it feels like when standing in direct sunlight and in the shade. Students can touch a surface that is in direct sunlight and also a part of the surface that is in the shade to compare how warm they feel. Students should recognize that the Sun warms things up, and clouds can block the

Sun and make them colder. Pour a small amount of water out on a concrete or paved surface. Observe as heat energy from the Sun causes the water to evaporate.

K-ESS2 Earth's Systems

K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds.

[NOAA SciJinks \(Information, games, and simulators\)](#)

Go outside and make a cloud observation.

Ask students to describe the sky; sunny, cloudy, partly cloudy, a few clouds, a lot of clouds. Many locations have a general direction of flow of their weather patterns. (Example: from west to east). Ask the students what they think the weather will be like later in the day, that night, or the next day based on what they know about the weather in their area. Students can draw pictures of their observations and their predictions of weather for the future. By studying the cloud types and making observations, students will be able describe the general weather patterns in their area.

K-ESS3 Earth and Human Activity

K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds.

[NOAA SciJinks \(Information, games, and simulators\)](#)

Go outside and make a cloud observation.

By studying the cloud types and making observations, students will be able to better predict weather in their area. Students will also be able to recognize the types of clouds that could produce severe weather in their area. Students can draw pictures to show what the weather was like and to show

what they think the weather will be like tomorrow or next week. Students can draw pictures or make models of the different types of clouds using cotton balls, stick glue and paper.

First Grade

1-ESS1 Earth's Place in the Universe

1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds.

[NOAA SciJinks \(Information, games, and simulators\)](#)

Go outside and make a cloud observation.

Have students go outside to make cloud observations at approximately the same time every day. Have students draw a diagram to show the location of the Sun once each week. After several weeks or months, have the students compare the location of the Sun in their diagrams.

The teacher could take a picture of the sky without the Sun in it and print it for the students. Then, stickers or drawings could be added to the picture to show the location of the Sun on the same day and time once per week.

- **Do NOT look directly at the Sun.**

Second Grade

2-ESS2 Earth's Systems

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds. Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App - to practice entering data](#)
[NOAA SciJinks \(Information, games, and simulators\)](#)
[USGS Interactive Water Cycle Diagrams for Kids](#)

Go outside and make a cloud observation.

Analyze the cloud types and their levels in the atmosphere to determine if they are most likely made out of liquid water or frozen water crystals. If possible, compare the student information to Satellite match data for the same cloud observation.

Record the Relative Humidity for the time of the cloud observation or check online with a local weather source for the relative humidity reading.

Third Grade

3-ESS2 Earth's Systems

3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds. Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App - to practice entering data](#)
[NOAA SciJinks \(Information, games, and simulators\)](#)

Go outside and make a cloud observation.

Students could create a data chart to show days with precipitation and the total cloud cover percentage range in their area. Then students could compare their information with a local online weather source. Record air temperature several times during the day, at regular intervals. Then, record air temperature for several days at the same time each day. Create a line graph to display the results. When is the hottest part of the day? This could be conducted several times during the school year. Create a line graph to compare results from each month or for fall, winter, and spring.

Fourth Grade

4-PS3 Energy

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds. Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App](#) - to practice entering data

[NOAA SciJinks \(Information, games, and simulators\)](#)

Go outside and make a cloud observation

Record the surface temperature. If possible, make several cloud observations during the day, or week. Analyze the surface temperature readings to illustrate that the Sun's light energy heats up the surface of the Earth. Collect surface temperature readings several times during the day. Create line graphs to display the results. Students could also compare cloudy days to sunny days.

Fifth Grade

5-ESS2 Earth's Systems

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds. Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App](#) - to practice entering data

[NOAA SciJinks \(Information, games, and simulators\)](#)

[USGS Interactive Water Cycle Diagrams for Kids](#)

Go outside and make a cloud observation.

Check a local weather link to find out if precipitation is in the forecast. Make several cloud observations to compare the cloud cover for the time period of impending precipitation. Record and compare the cloud cover, types of clouds, barometric pressure, temperature, and relative humidity as precipitation chances increase. (If you do not have the instruments to record the weather data, use a weather link from a local weather channel to access the information for your area).

[NASA eClips™ Educator Guide - Our World: Designing a Cloud Cover Estimator Just Passing Through Activity](#)

5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds. Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App](#) - to practice entering data

[NOAA SciJinks \(Information, games, and simulators\)](#)

[USGS Interactive Water Cycle Diagrams for Kids](#)

Go outside and make a cloud observation.

What types of clouds do you see most often in your area?

What are the types of surface water sources in your area? (ponds, lakes, rivers, swamp, ocean)

Create a graph or model to illustrate the total amounts and types of water found on Earth, (surface, ground, ice caps, atmosphere, fresh, salt).

How much of the total water on Earth is freshwater that is easily accessible?

Supported NGSS Performance Expectations for Middle School

MS-ESS2 Earth's Systems

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds. Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App](#) - to practice entering data

Go outside and make a cloud observation.

Discuss the types of clouds and what type of precipitation, if any, they might produce.

What types of water sources are in your area?

Do the [Just Passing Through Activity](#).

[USGS Interactive Water Cycle Diagrams for Kids](#)

[NOAA SciJinks: Water and Ice](#)

[NASA eClips™ Educator Guide - Our World: Designing a Cloud Cover Estimator](#)

MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

ACTIVITY: Access the GLOBE Clouds Protocol Field Guides, Learning Activities, and Resources to help students understand what clouds are made of and the different types of clouds. Discuss what clouds are made of: liquid water droplets or ice crystals for the higher cirrus clouds. Discuss with the students about the basic different types of clouds: cumulus, stratus, cirrus, (rain clouds: cumulonimbus and nimbostratus). Show the GLOBE Cloud chart and use other GLOBE Cloud resources to enhance student understanding of clouds. Use whole class instruction to go over:

[Cloud Cover Practice](#)

[Cloud Type Practice](#)

[GLOBE Data Entry App](#) - to practice entering data

[USGS Interactive Water Cycle Diagrams for Kids](#)

[NOAA SciJinks: What's the Difference Between Weather and Climate?](#)

[NASA eClips™ Educator Guide - Our World: Designing a Cloud Cover Estimator](#)

Go outside and make a cloud observation.

Record the air temperature, barometric pressure, humidity, and wind speed and direction.

(Access the weather information from a local weather link for your area if needed)

What is the general pattern of weather flow for your area? (from east to west, west to east, northwest to southeast, etc.)

Does the general flow of weather in your area change during different times of the year?

Are there any geographic features in your area that might affect the weather patterns? (mountains, large lakes, ocean).

Based on your cloud observations, what do you think the weather will be in the next few days?

Acknowledgement:

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