GLOBE Educator One-Week Pacing Guide: Clouds Types

Phenomenon: Cloud Types **Grade Level:** 3-8	**Guiding Question:** What are the different types of clouds in Earth's atmosphere?	**Contact:** Reach out to the NASA GLOBE Clouds Team if you have questions.
Further Investigation: NASA GLOBE Clouds main website and The GLOBE Program's main website		
Optional: Interested in Becoming a GLOBE Trained Teacher Contact the NASA GLOBE Clouds Team		
Access GLOBE Pacing Guides: https://www.globe.gov/web/nasa-langley-research-center/home/resources		
Revision Date: 3/01/2025		

Standards - These standards are supported by the activities in this guide but do not provide complete mastery.		
Elementary	**Performance Expectations:** ● 3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	**Disciplinary Core Ideas:** ● ESS2D Weather and Climate: Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)
	Science and Engineering Practices: ● Analyzing and Interpreting Data: Represent data in tables and various graphical displays to reveal patterns that indicate relationships (3-ESS2-1)	**Crosscutting Concept:** ● Patterns: patterns of change can be used to make predictions (3-ESS2-1)

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<table>
<tr>
<td rowspan="3">Middle</td>
<td>Performance Expectations:
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.
MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.</td>
<td rowspan="3">Disciplinary Core Ideas:
ESS2.C The Roles of Water in Earth’s Surface Processes
Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)
Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)
The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
ESS2.D Weather and Climate
Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)</td>
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<tr>
<td>Science and Engineering Practices:
Developing and Using Models: Develop and use a model to describe phenomena. (MS-ESS2-6)
Planning and Carrying Out Investigations: Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)</td>
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<tr>
<td>Crosscutting Concepts:
Energy and Matter
Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)
Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural systems. (MS-ESS2-5)</td>
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</table>

The NASA "Why" and Cloud Types Background Information

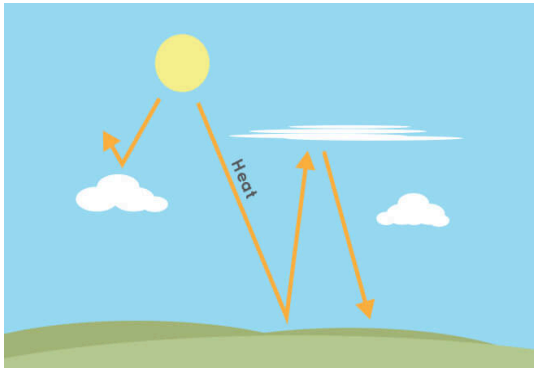
Why NASA Studies Clouds

NASA studies clouds to better understand Earth's climate and weather, and to learn how clouds affect other aspects of life on Earth:

- **Climate and weather**: Clouds impact weather and precipitation, and play a role in climate. NASA studies how clouds form and function, and how they interact with the climate system.
- **Air quality and pollution**: Clouds impact air quality and pollution.
- **Wildfire detection**: Clouds can help with wildfire detection.
- **Other planets**: NASA also studies clouds on other planets, such as Mars, Titan, and Jupiter.
- **Satellite data**: NASA uses ground, airborne, and satellite instruments to collect data on clouds. NASA also compares ground cloud observations with satellite data to better understand the satellite data.

Cloud Types Background Information

Clouds are a familiar part of Earth's environment. Clouds affect our daily plans, and even young children pay attention to them because of the many shapes they can take. Clouds can change rapidly, and different types of clouds have different effects on local climates. Where lower, cumulus clouds tend to have a cooling effect on the Earth, cirrus clouds higher in the atmosphere warm the planet by reflecting more outgoing radiation back towards the ground. By observing clouds, we can get information about temperature, moisture, and wind conditions at different heights in the atmosphere. This information helps in predicting the weather.



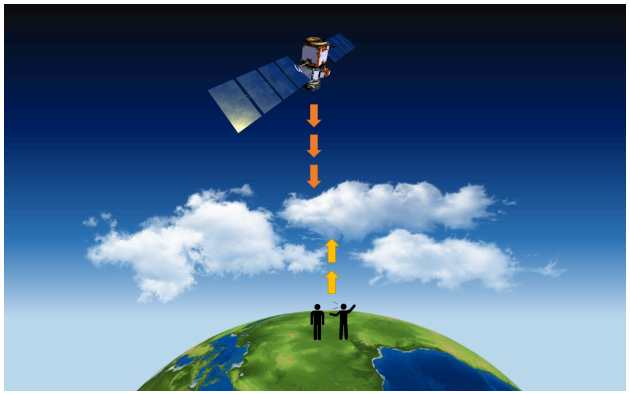
Observations of clouds also help us know how much sunlight is reaching the ground and how easily heat from the ground and lower atmosphere can escape to space. Clouds play a central role in controlling the exchange of heat in the atmosphere and changes in clouds over time can have significant climate impacts. To understand the impact of clouds over time, satellites observe Earth's clouds and energy from space. Data from multiple research and weather satellites have made and continue to make significant contributions to our understanding of clouds.

Specific cloud types can indicate patterns in the weather. Which types of clouds you see often depends on the weather conditions you are experiencing or will soon experience. Some clouds form only in fair weather, while others bring showers or thunderstorms. Clouds play a complex role in

climate; they are the source of precipitation, affect the amount of energy from the Sun that reaches Earth's surface, and insulate Earth's surface and lower atmosphere.

Key cloud types and their characteristics:

- CIRRO or high clouds
- ALTO-cumulus and ALTO-stratus or middle clouds
- CUMULUS or white puffy clouds
- STRATUS or layered clouds
- NIMBO-stratus or Clumulo-NIMBOS clouds from which precipitation is falling
- Additional cloud types and their characteristics



Why NASA Benefits from Your Data

While satellites deployed by NASA and worldwide space agencies give us a big picture of climatic cloud effects, they struggle at times to provide a detailed analysis of what's happening in specific locations. That's why it's so crucial for researchers to have observations from the Earth's surface. Additionally, when you submit frequent observations over time, your data provides NASA with details on how our climate is changing.

The GLOBE Program is NASA's largest and longest lasting citizen science program about the Earth. When you use the program's GLOBE Observer app, you can submit cloud reports and photographs of clouds and sky. Sky photographs are one of the most requested portions of a GLOBE Clouds observation. Details within a photograph can be used to compare with satellite data, confirm dust or haze observations, and give insight to unique cloud types like lenticular and noctilucent clouds over the polar regions.

After you submit your observations, the NASA GLOBE Clouds team at NASA Langley Research Center compares your observations with satellite data to determine key areas for further investigation. The results of these investigations are then sent to you via a NASA personalized email.

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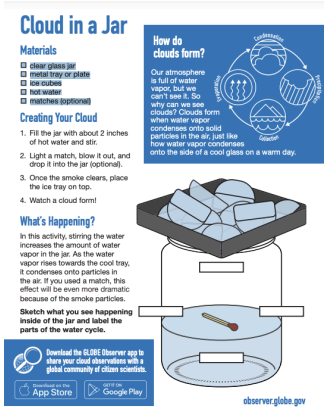
Activities		Assessment Options
Day 1: How a Cloud Forms ● Watch the GLOBE Observer Cloud Science video with NASA scientist Jessica Taylor ● Display an image of the water cycle and ask learners to compare what happens in the jar to the role a cloud plays in the water cycle. Demo the Cloud in a Jar activity with the students to see how a cloud forms. Ask them to document their thoughts, observations, and any questions they may have in their journal. **Materials:** links to video, activity, large clear glass jar, metal tray or plate, ice cubes, hot water, and (optional) matches.		Discuss as a class students' observations of the Cloud in a Jar activity ***Connection to guiding question:*** How does a cloud form? ***Answer:*** *Clouds form when water vapor condenses onto solid particles in the air* ***Resources:*** GLOBE Cloud Chart NASA - What are Clouds? Grades 5-8
Day 2: GLOBE Cloud Types ● Option 1: Take learners outside and have them complete the Do You See What I See Activity looking at the different levels of clouds in the sky. ● Option 2: Walk through the My NASA Data Cloud Sort and complete the online activity. This can be done on computers or projected on an interactive white board. **Materials:** Journal, Colored pencils, Clip boards, GLOBE Cloud Identification Charts; or online Cloud Sort activity		***Connection to guiding question:*** 1. *How can you tell the different types of clouds apart from each other?* ***Answer:*** *Cumulus-type clouds are all puffy, stratus-type clouds are all flat, and cirrus-type clouds are all thin or wispy.* 2. *Do the types of clouds we see change by season?* ***Answer:*** *During particular seasons you might see more of a specific type of cloud than another.* **Formative Assessment**: Completed cloud sort activity.

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<table>
<tr><th colspan="2">Activities</th><th>Assessment Options</th></tr>
<tr><td>Day 3: Observe Clouds

Use the GLOBE Observer App OR GLOBE Clouds Data Sheet to record sky observations. Remember to enter your data if you use the paper data sheet.
Materials: Recommendations found in Figure 3 of NSTA paper Making Science Come Alive with Clouds.

Only make observations if you can do so safely and legally.</td><td>Only make observations if you can do so safely and legally.

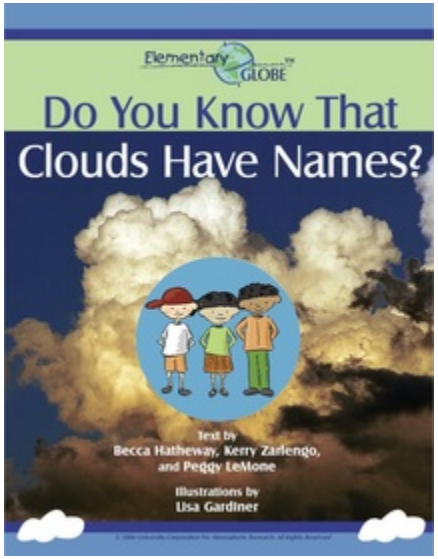
  </td><td>Within groups, develop consensus on observations using evidence.

Submit observations.

Connection to guiding question:
Discuss the cloud observations based on the three main cloud types.

Optional Instructional Video: How to use the GLOBE Observer Clouds Tool</td></tr>
<tr><td>Day 4: Did You Know Clouds Have Names?

● Read-aloud Elementary GLOBE Book Did You Know Clouds Have Names?
● As a class, find a large area where you can safely do the Cloud Dance. (First Steps, Advanced)

Materials: Elementary GLOBE Book Did You Know Clouds Have Names?</td><td> 
</td><td>Check for Understanding:
1. Review the shape and altitude of different cloud types.
2. Discuss the texture of different cloud types and the relationship with their names and altitudes.
3. Review ingredients necessary to create a cloud.

Connection to guiding question:
What information does a cloud name give you?
Answer: The name of a cloud gives you the altitude (low, mid, high) and how they look (puffy = cumulus, flat = stratus, wispy = cirrus).</td></tr>
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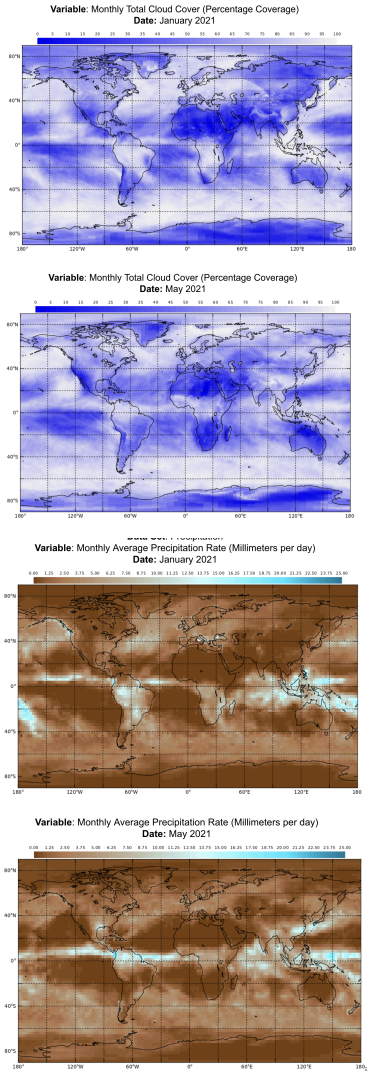
Activities		Assessment Options
Day 5: Comparing Cloud and Precipitation Data Analyzing Global Patterns with Earth System Satellite Images Select 2021 Global Data and start by looking at just cloud cover data. Compare January 2021 and May 2021. Note that the whiter the map, the more cloud cover there is in that region. 1. Look in the region you are located in and compare the values between the two months. 2. Discuss how the values compare with the observations taken in Day 3. 3. Choosing one month, look for regions that have no cloud cover. Discuss similarities and differences with this and your region. 4. Repeat steps 1-3 and do the same with precipitation. 5. Discuss the following question: *Do regions with the most cloud cover have the most precipitation?* **Materials:** online; link to activity and cards. ***Optional***: Use other variables available.	**Data Sets:** 	*Project the NASA GLOBE Clouds Satellite Collocation (MatchTable) received from making cloud observations on Day 3. Point out which satellite(s) matched the observation. Discuss if total cloud cover observed matches the total cloud cover reported by satellite(s). What might be an explanation for any differences between the two?* ***Connection to guiding question:*** *Why is it important to study clouds?* ***Answer****: Clouds play a complex role in climate. They are the source of precipitation, affect the amount of energy from the Sun that reaches Earth's surface, and insulate Earth's surface and lower atmosphere.* ***Connection to NASA:*** *Why does NASA study clouds?* ***Answer:*** *Clouds have an impact on weather and climate. Different cloud types have different effects on weather and Earth's energy budget.* ***Resource****: The Science of Clouds Video: How to Read Your Satellite Matches?*

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Additional Resources		
Online Activities	Audience	Description
Interactive Weather Observations	Elementary Daily observations	Students track weather over time and create an online bar chart to track their data. English and Spanish versions of the interactive slides are now available.
Modeling Cloud Cover	Upper Elementary through High School	Using the Interactive Google Slides, select a percentage as a multiple of 10% (or fraction) of cloud cover to approximate and estimate percent cloud cover of a particular area.
Hands-On Activities	Audience	Description
Elementary GLOBE Clouds Module	Elementary Storybook	This module includes a story book on cloud types, activities, and coloring sheets. The book is available as a PDF and eBook. Students will be able to classify clouds based on their shape, determine what kind of weather is associated with each cloud, and identify the three different types of contrails.
Estimating Cloud Cover	Upper Elementary through High School Individual, group and large group settings	Students use construction paper to simulate cloud cover. They estimate the percentage of cloud cover represented by torn pieces of paper on a contrasting background and assign a cloud cover classification to the simulations created by their classmates.
Weather Adds up to Climate	Elementary Multi-day classroom activity	This activity consists of five parts that occur over the course of a school year. In Part 1 of this activity, students are introduced to different ways to describe weather. In Part 2, students record weather observations each day in bar graphs made out of interlocking plastic cubes. In Part 3, at the end of each month, students summarize the information in bar graphs. In Part 4, at the end of the

		school year, students use the data they collected to describe the patterns of weather through the year. In Part 5, students compare regions with different patterns of weather (climate).
Our World: Designing a Cloud Cover Estimator	Elementary	Students think and act like engineers and scientists as they follow five steps of a Design Process to successfully complete a team challenge. Students view the NASA Spotlite Clouds video that corrects the misconception that: a cloud's only purpose is to produce precipitation. Within this work, students design, measure, build, test, and re-design a cloud cover estimator to measure the amount of cloud cover in the sky. Once the cloud cover estimator is built, students discuss the role clouds play in Earth's energy budget.
NASA Spotlite Challenge: Cloud Detectives	Upper Elementary through High School	Student teams create a 90-120 second video to address common misconceptions about clouds.
Additional Resources (continued)		
Videos and Reading	Audience	Description
Science of Clouds Videos	Ages 9-adult	Join different NASA scientists and learn how to look at clouds with a new perspective. Follow along with a GLOBE educator on how to do a cloud related activity. Topics include: *what is citizen science?, How to read your satellite matches?, Your Cloud observations in Research, Clouds & Weather, Clouds & Earth's Climate,* and *Clouds & Aerosols.*
EOKids From School to NASA Earth Scientist	Ages 9-14	NASA EO (Earth Observatory) Kids is written for audiences aged 9 to 14. In this issue, find out what three NASA scientists wanted to be when they were young and discover what they do now. Then, be a scientist yourself! Learn how to use the GLOBE Observer app to collect your own scientific observations.
EO Kids Clouds or Snow	Ages 9-14	NASA EO (Earth Observatory) Kids is written for audiences aged 9 to 14. In this issue, EO Kids is investigating how similar snow and clouds look from space. Discover how satellites measure light to help scientists know which is which.

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Our World: Cloud Inspection	Ages 8-12	Find out why scientists and meteorologists study clouds and what tools they use to collect data about the effect of clouds on Earth's climate. Learn to tell the difference between cirrus, stratus and cumulus clouds.
Our World: Cool Clouds	Ages 8-12	Learn how clouds are formed and watch an experiment to make a cloud using liquid nitrogen. Find out how scientists classify clouds according to their altitude and how clouds reflect and absorb light, giving them different colors.

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