UDL Teacher Guide: Intermediate Clouds

"Have you ever, looking up, seen a cloud like
to a Centaur, a Part, or a Wolf, or a Bull?"
— Aristophanes

Driving Question: Why are there clouds?

This unit explores the water cycle using models and simple hands-on investigations.

Introduction

Using the UDL approach, students explore the water cycle in multiple ways: from a fictional story to data collection with probes, and from hands-on inquiry investigations to computer models. Data collection using computer-based probes is displayed using smart graphs, allowing students to dissect elements of the graph for further understanding. Students are provided with scaffolded assistance to questions and offered choices for demonstrating what they have learned through text or drawings. Coaches offer prompts, hints, and model responses to engage students in the science content. Teacher resources allow the teacher to control the student scaffolding for their class and for individual students. Teachers can also access results of the multiple-choice section of the pre-test to make recommendations about which activities students should complete. While all the activities provide learning opportunities for students, teachers can help students focus on areas they need to work on.

Technology

The technology used in the clouds unit is designed for students to discover the story told by the data as they investigate clouds. A humidity probe is used in the activity "Humidity."

Smart graphs allow students to analyze data in a meaningful and supported way. The graphing tools are the same, regardless of the activity.

The technology in UDL does not supplant the teacher. Instead, students are individually supported throughout the unit. One example of this support is that students can highlight the text and the computer will vocalize the words. Definitions for highlighted words (in blue) are also built into the program. A complete glossary for the unit can be found at the bottom each page using the book icon. In some of the units you will also find three robot helpers. These robots help the student understand the material by asking them to make predictions, asking guided questions, and by clarifying or predicting what will happen next.

The teacher can manage certain features of the units for both the class and individual students. Once a class is set up the teacher can go to the UDL Portal-Info page and click on the "View a report on this class" icon. At the top of the report page there are two options, one that allows you to configure the parameters for students. This allows you to control the font size and set the initial scaffolding level for students. The option on the class report page allows you to enable/disable activities within the units.

The default setting for lesson order when setting up your classes will be a sequenced order of lessons. When students enter the menu page they will complete the Pre-test. When they have submitted the Pre-test they will be able to access the next lesson in the sequence. If you want to allow students to choose their own sequence you can set up your class so that once they have completed the Pre-test and Introduction they can move between lessons in whatever order they like. (A more detailed explanation can be found at http://udl.concord.org/share/teacher-guides/Dashboard.pdf)

Scaffolding in UDL Units

Scaffolding in education has traditionally been done by the teacher as a way to assist students as they are learning new skills or content. The scaffolding is done not to provide answers or do the work for them but as a way for the students to gain confidence and develop understanding of skills and concepts. The goal of scaffolding is that over time the level of assistance that a student needs will gradually be reduced until the minimal amount of support is needed and used. To use a cooking analogy: a chef will use a recipe the first few times he makes a dish. After he has made it several times, he may have the recipe out for reference and then after more time, it becomes so natural he no longer needs the recipe.

In the UDL units different levels of support are offered to students when answering questions. As with the cooking analogy, the scaffolding is intended to provide support for those students who need it with the goal that with time they will be able to work with minimal scaffolding. When scaffolding prompts are available they are accessed by clicking on the green question mark icon. Students may answer the open-ended question as presented. Or, if they are unable to do so, they can click on the question mark and access the first level of support. At this level they are given a hint that may lead them to the correct response. If the student is still unable to answer the question, they can click the question mark again for the answer with key words left out and they can fill in the blanks. If they need additional help, they receive a multiple-choice list. The final level of scaffolding offers the student a model response; they are given the answer and asked to provide their own ideas about the response.

Standards/Benchmarks

NSES Content Standard A: Science as Inquiry

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    - Design and conduct a scientific investigation.
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    - Develop descriptions, explanations, predictions, and models using evidence.
    - Think critically and logically to make the relationships between evidence and explanations.
- Understandings about scientific inquiry.
    - Mathematics is important in all aspects of scientific inquiry.
    - Technology can be used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

NSES Content Standard D: Earth and Space Science (5-8)

- Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.
- Clouds, formed by the condensation of water vapor, affect weather and climate.

Benchmarks for Science Literacy—AAAS

- 1B Scientific Inquiry
  - Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological, and social questions.
  - Scientists do not pay much attention to claims about something they know about works unless the claims are backed up with evidence that can be confirmed, along with a logical argument.
- 4B The Earth
  - The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the oceans.

Alaska state standards (http://udl.concord.org/share/teacher-guides/TG_Clouds_Intermediate-AK-Standards.pdf)

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Learning Goals

General learning goals relating to scientific process are present in all activities. Refer to each activity for more specific content goals.

Students investigate clouds while:

- making explanations and predictions from evidence and drawing logical conclusions;
- identifying variables that can affect the outcome of an experiment and learning which variables must be controlled to isolate the affect of another variable;
- designing and conducting a scientific investigation;
- gaining skills and confidence in using scientific measurement tools, models, and graphs to represent and analyze data;
- valuing accuracy and precision in scientific investigation.

Background Information

Weather is one of the most visible and most easily observed parts of the natural world. In addition to affecting the non-living parts of the environment, it also controls much of the activity of the living world. We also know that other planets in our solar system have their own weather that affects them.

Clouds are one part of weather that we can see around us. Clouds are formed when water vapor in the air condenses and may best be described as *visible aggregates of minute droplets of water or tiny crystals of ice.* They change shape and form as part of a continual process we call weather.

To understand clouds we first need to understand the phase changes that water goes through. Water exists on earth as a solid (ice), a liquid (water), and a gas (vapor). If we start with fresh water that has been cooled below 0 degrees Celsius (32°F), the movement of molecules slows until a solid is formed. If we reverse the process and reheat the water, it will become a liquid again. Water enters the air through **evaporation**. This can happen at almost any temperature. In any given quantity of water, individual molecules are moving at different speeds. Low energy/low temperature molecules move slowly; high energy/high temperature ones move quickly. Even though the average temperature of the liquid may be below boiling, some molecules build up enough speed as a result of random collisions to break free from the liquid's surface and enter the surrounding air. This process is reversed as the molecules of water in the air are cooled; they slow down and collect. We call this process **condensation**. We can see this on the outside of a cold glass of soda on a warm day. Water vapor in the air collects on the outside of the glass, making droplets that make the glass wet.

Before the beginning of the 19th century there were no generally accepted names for the clouds we regularly see. Luke Howard, an English naturalist, developed and published a classification for clouds in 1803. His system of classification became the basis for the system we use today.

Today we classify clouds based on two criteria: *form* and *height.* We have three basic cloud forms, which are then broken down by height. **Cirrus** clouds are high, white, and thin. They are separated or detached, often looking like thin wispy fibers or feathery. **Cumulus** clouds form globular individual masses. Usually they form with a flat base and then rise in large dome-like structures some describe as looking like heads of cauliflower. **Stratus** clouds form sheets or layers that cover the sky. There may be some small breaks, though they generally form one continuous cloud mass.

The second aspect of the classification is height. Three levels are defined as high, middle, and low. **High** clouds are those that have a base above 6000 meters (20,000 feet). **Middle** clouds occupy heights from 2000 to 6000 meters. **Low** clouds form below 2000 meters (6500 feet). These heights are not hard and fast, and may vary somewhat by season and latitude.

To understand clouds and their formation we also need to understand how the water cycle works. The water cycle is the set of processes that move water in and around the planet earth. In its simplest form the cycle is water evaporating, then condensing in the atmosphere, and then falling again to the ground. The energy for this movement comes from the energy from the sun. As water is heated or as air moves over it, water molecules enter the atmosphere as vapor. In addition some water enters the air through transpiration and a result of burning various fuels by humans. Once the vapor enters the air the water moves as the result of the rising of heated air, cooling air, and wind currents. As the water moves and is cooled the molecules begin to condense. As they condense, if there is enough water, they become visible in the form of clouds. These clouds may or may not result in precipitation. The forms of precipitation vary depending on temperature. If the air near the ground is warm enough, the water may fall as rain. If the air is colder, the water may fall as snow. In addition to these common forms of precipitation other forms include mist, drizzle, sleet, glaze, rime, hail, and graupel. Each is defined by its state and the size of the droplet.

Reference: Lutgen, F. K., & Tarbuck, E. J. (2001). *The Atmosphere* (8th ed.). New Jersey: Prentice Hall.

Advanced Preparation

Before starting this unit send out a call to parents in your class to begin collecting and saving one- or two-liter clear plastic bottles. Depending on the size of your class you may need bottles. In addition, if you have access to a color printer, print and laminate the cloud charts.

Unit Overview

Activity Title	Activity Length	Materials	Overview
Pre-test	20 minutes	▪ Computer with Internet access	The pre-test allows students to demonstrate what they know about topics related to clouds and the water cycle. Students complete the pre-test and are then given access to the rest of the activities in the unit.
Introduction	30-40 minutes	▪ Cloud map (laminated if possible) (http://udl.concord.org/artwork/cloud_34/cloud_map/cloud_map.pdf) ▪ Computer with Internet access	Students are introduced to clouds as they watch a short video showing the development of clouds. They are asked to use their prior knowledge to explain how clouds are formed. Then using the cloud map they watch the video and identify the various cloud types.
What Are Clouds Made Of?	two or three 30-minute sessions	▪ Computer with Internet access ▪ Printout of story (optional) (http://udl.concord.org/share/teacher-guides/Clouds_56_v6.pdf)	Students read the story "What are clouds made of?" Marc and Natasha are at the beach and begin to wonder about clouds. Elvira, who seems to have magical powers, shows up and helps them understand energy, how clouds form, and the water cycle.
Cloud Detectives	30-40 minutes	▪ Computer with Internet access	Students are introduced to six cloud types. They will learn the names, identifying features, and how energy from the sun helps create these cloud types.
Water Cycle Model	45 minutes	▪ Computer with Internet access ▪ Embedded computer model (NetLogo)	Students investigate how water moves through the water cycle by using a computer model. They use controls to change the energy input from wind speed and ocean temperature.
Making Clouds	30-45 minutes	▪ Computer with Internet access ▪ Embedded computer model (Molecular Workbench)	Students use the computer model of water in its liquid and vapor state. They use the model to show how temperature (energy) affects water molecules.
Humidity	45-60 minutes (can be done in two 30-minute sessions)	▪ Computer with Internet access ▪ Humidity sensor ▪ water ▪ sand ▪ clear plastic bottle, .5 l	Students use four cups with different materials and a control cup to model different environments. Using the humidity sensor students measure the humidity around each and create

		(16 oz) ▪ 5 clear 250 ml (8 oz) plastic cups ▪ grass clippings, leaves, or other plant material ▪ ice cubes ▪ clay ▪ masking tape ▪ permanent marker	a graph for each.
Cloud Cover	30 minutes outside collecting data 40 minutes graphing and analyzing data 15 minutes presenting weather report	▪ Computer with Internet access ▪ Convex mirror (such as stick-on rearview mirrors for trucks) ▪ Dark colored tape ▪ Paper and pencil ▪ PDF of Percent Cloud cover chart (http://udl.concord.org/artwork/cloud_56/cloud-cover/percent-cloud-cover-table.pdf)	Students use a convex mirror to determine the amount of cloud cover. Then they graph and analyze their data to create a class weather report.
Wrapping Up	Ongoing	▪ Computer with Internet access	Students can visit and revisit “Wrapping Up” during their completion of the unit activities. In Wrapping Up they have the opportunity to review and clarify their thinking.
Post-test	20 minutes	▪ Computer with Internet access	Students complete the post-test, which contains the same set of question as the pre-test, as well as student feedback questions.

Unit Activities

Pre-test

Time: 20 minutes

Materials: computer with Internet access

This unit begins with a short pre-test. The pre-test allows students to share what they already know about the learning goals. Students must complete the pre-test and press the “Submit” button before proceeding to any activity. The post-test at the end of the unit contains the same set of questions. Based on student responses to the multiple-choice questions, teachers are able to make recommendations about which activities each student should complete.

Introduction

The driving question "Why are there clouds?" is introduced. Students explore the water cycle. To start students thinking about clouds they use a **cloud map** to identify clouds in a time-lapsed video. After practicing with the video they look for clouds either outside or by looking out the classroom window.

Time: 30-40 minutes

Standards/Benchmarks:

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NSES Content Standard D: Earth and Space Science (5-8)

- Clouds, formed by the condensation of water vapor, affect weather and climate.

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- 4B The Earth
  - The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the oceans.

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Advanced Preparation:

The cloud map should be downloaded and printed. If possible, the cloud map should be printed in color. The cloud map can be laminated for repeated use by students.

Materials:

- Cloud map (http://udl.concord.org/artwork/cloud_34/cloud_map/cloud_map.pdf) (laminated if possible)
- Computer with Internet access

Student Activity:
Students begin by using the cloud map to identify clouds on a time-lapsed video. Students can stop and start the video so that they can look at specific clouds. There are a series of questions that help students begin to think about the water cycle and clouds.

When they have completed their work with the video, they have the opportunity to use the **cloud map** to identify clouds in the sky outside their classroom.

What Are Clouds Made Of? *Story*

Discovery Question: What are clouds made of?

Natasha and Marc are at the beach when they notice how quickly they dry off in the sun. This leads them to talk about where the water goes and what clouds are made of. Elvira, who seems to have magical powers and a robust knowledge of clouds, arrives on the beach. Elvira takes Natasha and Marc on an adventure to understand energy, how clouds form, and the water cycle.

Time: two or three 30-minute sessions (or chapters can be read as time allows)

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        - Earth's surface; it powers winds, ocean currents, and the water cycle.

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Materials:

- Computer with Internet access (story can be downloaded for offline reading; students can read the chapters and write their responses to questions, and then type them into the answer spaces in the unit as computer access allows)

Student Activity:

Students read a story about Natasha and Marc. They are introduced to some basic information about the water cycle and clouds. Students are prompted to respond to questions throughout the story.

Scaffolding is available using the "robot" helpers, which provide prompts to help students understand the story.

Teacher Notes:
It is important that you take some time while the students are reading the story to talk about how what the characters are doing is imaginary, but the concepts related to clouds and the water cycle are real.

Cloud Detectives *Hands-on*

Discovery Question: Where does water go as it moves through the water cycle?

Time: 30-40 minutes

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Materials: computer with Internet access

Student Activity:

In this activity students learn to identify six different cloud types based on shape, color, and altitude.

Engage:
Students are asked to look at clouds outside their classroom window, or if there are not any clouds to use the image provided, and draw and describe the clouds they observe.

Explore:
Students next learn about how clouds are formed and how we name different cloud types. They see how shape, color, and height are used in the process of naming six basic cloud types. They use the basic cloud forms of cumulus, stratus, and cirrus and are shown how we combine prefixes and suffixes to further identify cloud type.

Explain:
Using cloud images and what they have discovered, students are asked to identify the cloud types.

Elaborate:
Students now look out the classroom window or use the image provided again to draw and identify the cloud types.

Discussion:
Lead the whole class in a discussion using the questions below to start the conversation. Allow students time to clarify their ideas and encourage them to explain their thinking

"Can there be more than one cloud type in the sky at one time? If there is, how would you decide which was going to have the greatest impact on the weather?"

"If you look overhead and there is a solid bank of clouds what would you look for to help identify them?"

Water Cycle Model *Computer model*

Discovery Question: How does water travel around the earth?

In this activity, students use a model to explore how water moves around the earth.

Time: 45 minutes

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Materials: computer with Internet access,

Student Activity:

This activity uses a model that was created using NetLogo, a general-purpose modeling language for complex systems. Based on the ideas behind Logo, NetLogo is easy to use yet very powerful. If students or teachers wish to investigate this model further, modify the model, write their own model, or look at other NetLogo models that cover a wide variety of phenomena, go to the links shown below the model in the activity.

Engage:
Students begin by making a list of places where water is found on earth and then explaining how water moves around the earth.

Explore:
Students are then introduced to the model of the water cycle. The model shows water moving between land, air, and oceans/lakes. Students can change wind speed and ocean temperature to see how these impact the movement of water. Students can isolate one water droplet to make it easier to follow through the system. They are asked to describe their observations.

Students are then challenged to make it rain over just the mountains or just the ocean.

Explain:
Using what they have discovered students explain how the water cycle is a cycle. They also describe what is happening to the water at different places in the cycle.

Elaborate:
Having explored the water cycle students use the drawing tools to draw and label their picture of the water cycle.

Discovery Question: How are clouds made?

In this activity, students explore a computer model that shows how water goes into the air and forms clouds.

Time: 30-45 minutes

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Materials: computer with Internet access

Note: When using the computer model be aware that there may be some time spent "playing" with the model. Some students may need encouragement to move on with the activity.

Student Activity:
Computer models are one of the tools that scientists use to understand processes that may be difficult to observe in real time.

Engage:
Students begin by thinking about what clouds are made from and how they form. They answer two questions to share their thinking. If you have a group of students who are working on this activity at the same time, have them share their ideas. These could be collected on chart paper.

Explore:
Students run the molecular model and describe what they see. The model shows movement of one water molecule in each system (in two situations or phases). Students are asked to think about which of the two sides represents water as a liquid and which represents water as a gas.

Explain:
Then, using the model students observe what happens when heat is added. Students take snapshots to add to their lab book and answer questions about what they are observing. Students explore what happens when they heat or cool the system.

Note: This model does not show water as a solid.

Elaborate:
The model is expanded to include dust particles as condensation nuclei. Students learn that dust particles play a role in the formation of clouds. They explore this using the molecular model. As they explain what they have learned, they take snapshots to add to their lab book.

Humidity — *Computer model & Hands-on (humidity sensor)*

Discovery Question: What does humidity have to do with clouds?

In this activity, students investigate the humidity over several simulated environments: marine, grasslands, tundra, and desert.

Time: 45-60 minutes (can be done in two 30-minute sessions)

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Alaska state standards (http://udl.concord.org/share/teacher-guides/TG_Clouds_Intermediate-AK-Standards.pdf)

California state standards (http://udl.concord.org/share/teacher-guides/TG_Clouds_Intermediate-CA-Standards.pdf

Materials:

- computer with Internet access
- humidity sensor
- 4 clear plastic cups
- 1 clear plastic soda bottle
- water
- sand
- plant material (grass clipping, leaves, etc)
- ice cubes
- masking tape
- clay

- permanent marker

Student Activity:

Technical hints are provided for connecting the sensor and the data collection graph.

Engage:
Students are introduced to the concept of humidity as “a measure of the amount of water vapor in the air.” It is explained that the water in the atmosphere is very important to our planet and is one of the things that makes our planet unique.

Explore:
Students begin by thinking about what environment in each cup of material represents. For example, the cup of sand represents the desert. Then students use a humidity sensor and plastic bottle to create a humidity chamber.

Before they begin taking their own measurements they complete a short tutorial in reading a broken line graph.

Students take five readings with the humidity sensor and record the results.

Note: Once the bottles have been cut they can be reused by other students.

Explain:
Using their data students begin by putting the environments in order from most to least humid. Using what they know about clouds they are asked to predict which environment would be most likely and least likely to have clouds form over it.

Elaborate:
Students are introduced to the idea of “heat islands” that are often found in large cities. Using their experience with the humidity sensors, they are asked to explain what large surfaces of asphalt and concrete that cause these heat islands might do to the humidity and therefore cloud formation near or over large cities.

Teacher Notes: As a follow-up, students might start collecting the humidity measurements for their local community and try to predict whether clouds are likely to form.

Discussion:
Have students think about their own school grounds. Ask them to think of an area where, based on their experience in this activity, they would expect the humidity to be higher. What is it about this area that would cause higher humidity? How might having a large area with this type of ground covering affect whether clouds will form?

Cloud Cover — *Math*

Discovery Question: How much of the sky is cloudy?

In this activity, students develop a method to calculate cloud cover in the sky and give their own weather report.

Time:

30 minutes outside collecting data
40 minutes graphing and analyzing data
15 minutes presenting weather report

Standards/Benchmarks:

NSES Content Standard A: Science as Inquiry

- Abilities necessary to scientific inquiry.
    - Identify questions that can be answered through scientific investigation.
    - Design and conduct a scientific investigation.
    - Use appropriate tools and techniques to gather, analyze, and interpret data.
    - Develop descriptions, explanations, predictions, and models using evidence.
    - Think critically and logically to make the relationships between evidence and explanations.
- Understandings about scientific inquiry.
    - Mathematics is important in all aspects of scientific inquiry.
    - Technology can be used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

NSES Content Standard D: Earth and Space Science (5-8)

- Clouds, formed by the condensation of water vapor, affect weather and climate.

Benchmarks for Science Literacy—AAAS

- 1B Scientific Inquiry
    - Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological, and social questions.
    - Scientists do not pay much attention to claims about something they know about works unless the claims are backed up with evidence that can be confirmed, along with a logical argument.
- 4B The Earth
    - The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the oceans.

Alaska state standards (http://udl.concord.org/share/teacher-guides/TG_Clouds_Intermediate-AK-Standards.pdf)

California state standards (http://udl.concord.org/share/teacher-guides/TG_Clouds_Intermediate-CA-Standards.pdf

Materials:

- convex mirror (4-5 inch mirrors can be purchased at auto equipment suppliers)
- dark tape (electrical tape)
- PDF of Percent Cloud Cover Table (http://udl.concord.org/artwork/cloud_56/cloud-cover/percent-cloud-cover-table.pdf)

Note: Caution students not to look directly at the sun.

Student Activity:
This activity may require students to work over several days.

Engage:
Students begin thinking about how weather forecasters measure cloud cover. Then they look at the sky and try to estimate cloud cover. They explain how they decided on the amount of cloud cover.

Explore:
Students begin using the mirrors to estimate cloud cover by using images provided in the activity. The mirror is divided into eight sections; students give each section a rating of 0-2 to indicate the cloud cover in that section. This results in a fraction that can be compared to the Percent Cloud Cover Table to determine the percent of cloud cover.

Students now have the opportunity to use their own mirror to collect data outside and begin to analyze the data they collect.

Explain:
Students use their data to explain what the cloud cover tells them. They can then use the data, plus other weather data (temperature, humidity, etc.) that may be available at the school to create their own weather forecast to present to the class.

Elaborate:
Students now use what they have learned about clouds and cloud cover to decide whether clouds mean rain. They are asked to describe factors that might determine whether it will rain on a cloudy day.

Wrapping Up

Driving Question: Why are there clouds?

Students use their drawings, text responses, snapshots of models, and probe data in their lab books to answer the question "Why are there clouds?"


Time: Ongoing


Materials: computer with Internet access

Students look back through their lab book and reflect on what they learned in the unit.
When students are finished they should let the teacher know so that they can get the password to access the post-test.

The password is: **clouds**

Post-test

 **Time:** 20 minutes

 **Materials:** computer with Internet access

In the post-test, students have an opportunity to rethink their answers to the same set of questions as the pre-test. Once students open the post-test, they will not be able to return to previous activities.

Note: When students finish the post-test, a box comes up saying they have finished and should tell the teacher. At that moment, their data is *not yet saved*. They must close the unit for the data to be saved. Students cannot just walk away from the computer. They can close the unit by going to the File menu and selecting Exit, or simply clicking the red circle (upper left) to close it.

Additional Resources

Vocabulary

Analogy: comparison between two situations or things that are alike in some ways, but different in others.

Atmosphere: the layer of air that surrounds the earth. It is made up of a mixture of gases, including nitrogen, oxygen, carbon dioxide, and water vapor.

Atom: a very small piece of matter. Several atoms joined together are called **molecules.**

Average: the middle of a set of values. To calculate it, add up the values and divide by how many there are.

Cloud: water in the air in the form of tiny water droplets or ice crystals.

Cloud cover: the proportion of the sky that is filled in with clouds, usually expressed as a percent.

Computer model: a program that runs on a computer and imitates the real world in some way.

Condensation: the process of changing from a gas to a liquid, for example, water changing from water vapor into a liquid.

Condense(d): to change from a gas to a liquid, for example, water changing from water vapor into a liquid.

Cycle: something that repeats over and over again, like traveling around in a circle or swinging back and forth.

Energy: a property of materials that can be used to heat things. It can take many forms, such as motion, electrical or chemical energy. The total amount of energy in a system doesn't change.

Estimate: to make a careful guess of the numerical value of something.

Evaporate: to change from a liquid to a gas, for example, water changing from a liquid into water vapor.

Evaporation: the process of changing from a liquid to a gas, for example, water changing from a liquid into water vapor.

Evidence: what you observe or measure to support an idea.

Fog: a cloud near the ground.

Freezing: the process of changing from a liquid to a solid.

Gas: a state in which matter has no definite shape or volume, for example, air.

Grid: a square pattern of lines.

Heat: a form of energy that consists of the movement of molecules. The faster the molecules wiggle, the hotter the material.

Humid: a state when a lot of water vapor is in the air.

Humidity: a measure of the amount of water vapor in the air. It is measured as the percentage relative to the maximum amount of water vapor the air can hold at that temperature.

Hypothesis: a prediction or careful guess about how something will work.

Ice: water in its state as a solid. Ice is a crystal.

Kinetic energy: the energy of motion. If an object is not moving, its kinetic energy is zero.

Liquid: a state in which matter has a definite volume but no definite shape, for example, drinking water.

Matter: anything that takes up space. Solid, liquid, and gas are all states of matter.

Melting: the process of changing from a solid to a liquid.

Moist: air that is very humid.

Molecule: a group of atoms that are joined together.

Monitor: to observe something carefully over a period of time.

Outlier: in a collection of measurements, an outlier is one that is very different from the others.

Percent: "out of 100" or "compared to 100." For example, if 30 kids in a class of 100 have brown hair, then 30 percent have brown hair.

Potential energy: stored-up energy, such as a stretched rubber band, chemical energy in a battery, or a car at the top of a hill.

Precipitation: any form of water that falls on the earth. It includes rain (water droplets), snow (ice crystals), sleet (frozen water droplets), and hail (big frozen water droplets).

Predict: to make a careful guess about how something will happen.

Prediction: a careful guess about how something will happen.

Relative humidity: a measure of the amount of water vapor in the air compared to the maximum the air can hold at that temperature.

Solid: a state in which matter has a definite volume and shape, for example, earth.

Temperature: the measure of how fast molecules in a material are wiggling or vibrating.

Water cycle: the continuous movement of water on, above, and below the surface of the earth.

Water vapor: water in its state as a gas.

