Cloud Trunk Content Checklist (Grades 3-6)

Lesson Plans	Investigating Clouds	Discovering Water Vapor & Raindrops
Demonstration Equipment (Please return these items to the trunk for the next user)	Clear container Smaller clear container NOAA Cloudwise poster 'Hole' Lot of Clouds discs with cloud picture cards (set) Cloud Spotter wheels (set) Cloud Cycle wheels (set) LCD temperature strips (set) Minature fog machine	Hot plate Tongs Cookie sheet Spray bottle Ruler Plush raindrop
Consumable Supplies (Please return unused items to the trunk for the next user)	Plastic wrap Tape Fog solution	Salt Matches 3x5 cards Yarn
Not Included (We have not included these items because of size, weight, perishability, or they are commonly found in the classroom.)	Cell phone/digital camera Ice cube	Can of Sprite/7-Up Flour Markers Water Empty 2-liter bottle

PLEASE GIVE US YOUR FEEDBACK

Help us improve this traveling trunk by completing this short survey. Your input matters and will help us better serve other teachers and students. Scan the QR code or visit http://bit.ly/ciwro_clouds

Questions about this trunk? Email annette.price@ou.edu

Find more weather lesson resources at https://ciwro.ou.edu/outreach

NORMAN FIELD TRIP OPPORTUNITIES

National Weather Center tours: www.ou.edu/nwc/visit/tours
National Weather Festival: www.ou.edu/nwc/nwf
National Weather Museum and Science Center: https://nationalweathermuseum.com/

Investigating Clouds

Compelling Question	**What can clouds tell us about weather?**
Learning Objectives	• Students will **investigate** the roles of evaporation and condensation in the water cycle and **measure** results. • Students will **identify** and **compare/contrast** different types of clouds. • Students will **observe** and **distinguish** different types of clouds, and **collect** and **organize** data. • Students will **predict** the weather conditions in a region by examining different types of clouds to **create** their own short-term forecast. • Students will **create** their own indoor clouds and assess their artistic value. • Students will **classify** cloud conditions and share their results with NASA.
Academic Standards	**SOCIAL STUDIES 4.2.4 Describe how physical processes of the Earth's surface impact humans and their environment.** **SCIENCE 5.ESS2.1 Develop a model to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** Disciplinary Core Idea: Winds and clouds in the atmosphere interact with landforms to determine patterns of weather. **SCIENCE 6.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.** Disciplinary Core Idea: Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, and crystallization, and precipitation, as well as downhill flows on land. **MATH 4.D.1.2 Organize data sets to create tables, bar graphs, timelines, and Venn diagrams.** **FINE ARTS 5.VA.ARCM.1.2 Critique personal art based on teacher-established criteria and/or artworks from various periods and cultures.**
Staging the Question	How does rain fall out of the sky? If precipitation comes from clouds, how can fluffy-looking clouds hold water? Why do some clouds produce rain while others do not?
Suggested Time	Three 50-minute periods Day 1: Compelling Questions, Supporting Questions 1 & 2 Day 2: Review of Previous Questions, Supporting Questions 3 & 4 Day 3: Summative Performance Task

Supporting Question 1

Where does rain come from?

Formative Performance Task 1: Evaporation & Condensation

Supplies needed: Clear container, smaller clear container, hot water, plastic wrap and an ice cube.

Students will investigate the roles of evaporation and condensation in the water cycle and measure results.

Place the small container in the larger one. Fill the large one with hot water, keeping the inside of the smaller container dry. Cover large container with plastic wrap and secure with tape if needed. Place an ice cube in the middle of the plastic wrap. As hot water evaporates into water vapor, the ice will cause it to condense onto the bottom of the plastic wrap and precipitate into the cup.

Featured Sources 1

"Kay's Water Cycle Experiment" video (3:10 duration) https://www.youtube.com/watch?v=FmTh0ECGPCY
"Water Evaporation Experiment" video (2:54 duration) https://www.youtube.com/watch?v=kmmEV4ohSDA

Supporting Question 2

Why do clouds look different?

Formative Performance Task 2: Different Types of Clouds

Supplies: NOAA Cloudwise Poster, Introduction to Clouds Handout, 'Hole' Lot of Clouds identification disc, tape, cloud picture cards.

Students will identify and compare/contrast different types of clouds.

Read about the Four Core cloud forms: Cirro-form, Strato-form, Cumulo-form and Nimbo-form and the heights they appear at in the atmosphere. Where do hybrid clouds like Cumulonimbus fit into the cloud forms? Ask students to attach the cloud picture cards to the 'Hole' Lot of Clouds indentification disc by correctly placing clouds at the correct altitude. Do the shapes match the diagram on the wheel? Why or why not?

Featured Sources 2

Introduction to Clouds (web version) https://www.weather.gov/jetstream/clouds_intro
NOAA Cloudwise Poster: https://www.weather.gov/jetstream/noaawise
'Hole' Lot of Clouds disc (K-3) https://www.weather.gov/media/jetstream/clouds/holeclouds1.pdf
'Hole' Lot of Clouds disc (4-6) https://www.weather.gov/media/jetstream/clouds/holeclouds2.pdf

Supporting Question 3

What can atmospheric observations tell us about the clouds we see in the sky?

Formative Performance Task 3: Cloud Observation

Supplies: Completed Hole Lot of Clouds disc, Cloud Observation Form and Cloud Spotter Wheel.

Students will observe and distinguish different types of clouds, and collect and organize data.

Allow students to go outside and observe clouds using the disc. Ask students to log their cloud observations on the Cloud Observation Form for four days. Using the Cloud Spotter Wheel, review the characteristics of each cloud recorded. Do the descriptions align with each cloud observed?

Featured Sources 3

Cloud Spotter Wheel: https://www.weather.gov/media/jetstream/clouds/cloudwheel.pdf

Summative Performance Task: Short-Term Forecasts

Supplies: Completed Cloud Observation Form, Cloud Cycle Wheel, How Clouds Form handout.

Students will collect and organize data, then analyze the results to create their own short-term forecast.

Review the Cloud Observation Form and record average temperature, precipitation, wind speed, relative humidity and sky cover from the last four days using the Daily Data Retrieval tool on the Oklahoma Mesonet website. Compare it to characteristics on the Cloud Cycle Wheel. What hypothesis can you form based on the data you collected and what you know about clouds? Compare your hypothesis to the How Clouds Form handout. Watch a weather forecast on TV and look at the hourly weather forecast for tomorrow. Did the forecast mention fronts? Can you predict what types of clouds you *might* see in the sky? Observe again tomorrow. Were you correct? Why or why not?

Summative Featured Sources

https://www.mesonet.org/index.php/past_data/daily_data_retrieval
Your local news station's televised weather forecast (most can be found online)

Extension: Photograph Indoor Clouds (Optional)

Supplies needed: Minature fog machine, fog solution, digital camera/cell phone camera.

Students will create and photograph their own indoor clouds with a fog machine.

Examine the works of Dutch artist Berndnaut Smilde, who creates indoor clouds for photographs using a fog machine. To him, the clouds represent becoming, loss and the temporary nature of time. Visit his website to see his art gallery. Then view the BBC news story about him. What processes do you think are happening in the machine to produce fog? Why do you think the artist sprays water into the room before using the fog machine? Why do the clouds dissipate so quickly? Can you photograph cloud art in your classroom? What art value does a cloud bring to you?

Featured Sources -- Extension

The Nimbus Works   https://www.berndnaut.nl/works/nimbus/
How to Make Clouds Indoors: The Art of Berndnaut Smilde   https://www.youtube.com/watch?v=1XKXlZgqr_I

Taking Informed Action: Globe Observer (Optional)

Supplies: Globe Observer app on a tablet or cell phone: https://observer.globe.gov/about/get-the-app

Students will classify cloud conditions in their area and share their results with NASA.

Use the “Clouds” function on the Globe Observer app to record clouds and sky conditions in your area. Did you use the Cloud Wizard, or could you identify the cloud types on your own? Be a citizen scientist and send your report to NASA. How do your observations compare to ones taken by NASA satellites?

From GLOBE: “Clouds are a major component of the Earth’s system that reflect, absorb, and scatter sunlight and infrared emissions from Earth. This affects how energy passes through the atmosphere. Different types of clouds have different effects, and the amount of cloud cover is also important. Clouds can change rapidly, so frequent observations are useful to track these changes. Such observations are able to see change over time and help with interpretation of satellite cloud data.”

For more information, visit https://observer.globe.gov/do-globe-observer/clouds/science#satellitematching

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Teacher Background Sheet

Without clouds, we would not have rain or snow, lightning or thunder, or even rainbows! As your students may learn in the companion lesson “Discovering Water Vapor and Raindrops,” cloud formation and dissipation are closely related to temperature and pressure changes in the atmosphere. Vertical motions play a primary role as air rising or sinking in the atmosphere experiences pressure changes. These pressure changes, in turn, bring about temperature changes that can result in **condensation** and cloud formation, or **evaporation** and cloud dissipation. Condensation and evaporation are key concepts when discussing a cloud’s role in the water cycle.

In the bowl experiment, students will review the basics of the water cycle and observe how water changes form with temperature. The experiment re-creates evaporation and condensation in much the same way that clouds hold liquid cloud drops until the droplets collide with each other, creating larger droplets, and precipitation occurs.

In 1803, scientist Luke Howard classified clouds into categories often referred to as the Core Four: cirrus (wispy), cumulus (fluffy), stratus (layered), and nimbus (raincloud) at three basic levels in the sky: low, medium and high.

Cirrus clouds usually signal clear, fair weather. Their shape often indicates the direction the wind is blowing high in the atmosphere.

Cumulus clouds can stretch vertically into the atmosphere up to 12,000 meters high in mid-latitudes. Cumulus clouds are created by strong updrafts of warm, moist air. Most forms of heavy precipitation fall from cumulus clouds. The weather they bring depends on their height and size. The higher the base of a cloud is, the drier the atmosphere and the fairer the weather will be. Clouds located close to the ground might mean heavy snow or rain. Cumulus clouds and precipitation frequently are associated with cold fronts.

Stratus clouds often form at the boundary of a warm front, where warm, moist air is forced up over cold air. The presence of stratus clouds usually means a chilly, overcast day.

More than one type of cloud can be present in the atmosphere at a time. In 1887, scientists expanded the Core Four into 10 different types. Today, scientists recognize 27 different types of clouds within the Core Four, with additional special clouds making rare but breathtaking appearances. It is not necessary for students to memorize the names of over 30 kinds of clouds. It is more important for them to appreciate that our lower atmosphere (the troposphere) is multi-dimensional. Varying cloud types are observable proof of the different effects that temperature and pressure have at different altitudes. We can also empower students to understand more about present and incoming weather based on the scientific clues they see in the sky.

Observation and data recording are key lessons in this packet. If possible, plan lessons within four days of an upcoming cold front. This will help maximize the variety of clouds students will observe. Cloud-watching can be an awe-inspiring activity for scientists of any age, and students are encouraged to appreciate the artistic qualities of clouds as well their scientific function. Clouds take on many shapes, textures, groupings and colors. Students do not need a lab or a controlled environment to observe clouds or hypothesize about the weather -- all they have to do is look up.

Fog Machine Instructions

1. Do not allow children to operate fog machine.
2. Place machine on a level surface. Plug machine into an electrical outlet, and ensure the remote is also plugged in to the back of the unit.
3. Do not incline the machine more than 15 degrees when plugged in.
4. Fill the tank with the water-based fog solution provided. Tank holds approximately 250 mL.
5. Power machine on.
6. When the green light comes on, the fog is ready to go. Push the red button on the remote to operate.
7. Fogger will shut off after long bursts in order to heat back up to temperature. The green light will indicate when it is ready again.
8. Only use the fog machine in well-ventilated areas.
9. Do not touch the nozzle or place anything close to the nozzle to prevent burns.
10. Do not operate the machine without fog solution or it will damage the machine.
11. If you experience low output, pump noise or no output at all, unplug. If you are unable to determine the cause of the problem, please discontinue use and alert us.

Packing Up

1. Empty fog solution from machine before repacking into the trunk.
2. Double-check that caps are tightly screwed onto unused fog solution bottles.
3. Wait until fog machine has completely cooled before repacking into the trunk.
4. Don’t forget to repack the electrical cord and remote for the next user.

Introduction to Clouds

Clouds are a visible cluster of tiny particles of water and/or ice that form when water vapor condenses onto aerosols in the atmosphere.

Clouds can grow very tall or appear flat as a pancake. They are typically white in color but can also be different shades of gray or brilliant yellow, orange, or red. They can have a mass of thousands of kilograms yet float in the atmosphere.

Clouds can be harbingers of good weather or bad. Their absence can be a good thing after a flooding rain or bad during a drought. They provide relief from the heat of direct sunlight but can also act like a blanket when the ground is experiencing higher temperatures. Without clouds reflecting incoming sunlight, the temperature of the Earth would be much warmer.

Precipitation from clouds helps crops to grow but can reduce visibility and make travel dangerous. Clouds come in many shapes and sizes, and we often recognize more familiar objects or animals in their shapes.

Clouds can be carried along by winds of up to 150 mph (240 km/h) or can remain relatively stationary when winds are weak.

Clouds can form behind high flying aircraft or can dissipate as planes fly through them. Clouds are not confined to Earth but are found on other planets too.

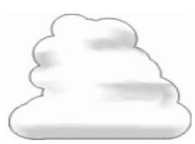
Content for this handout is adapted from https://www.noaa.gov/jetstream/clouds/four-core-types-of-clouds

Cumulonimbus cloud seen from 38,000 feet. (NOAA)

The Core Four

While clouds appear in many shapes and sizes, they fall into some basic forms. Clouds are divided clouds into four core categories.

Cirro-form
The Latin word "cirro" means curl of hair. Composed of ice crystals, cirro-form clouds are whitish and hair-like. There are the high, wispy clouds to first appear in advance of a low-pressure area such as a mid-latitude storm system or a tropical system such as a hurricane.



Cumulo-form
Generally detached clouds, they look like white fluffy cotton balls. They show vertical motion or thermal uplift of air taking place in the atmosphere. They are usually dense in appearance with sharp outlines. The base of cumulus clouds are generally flat and occurs at the altitude where the moisture in rising air condenses.

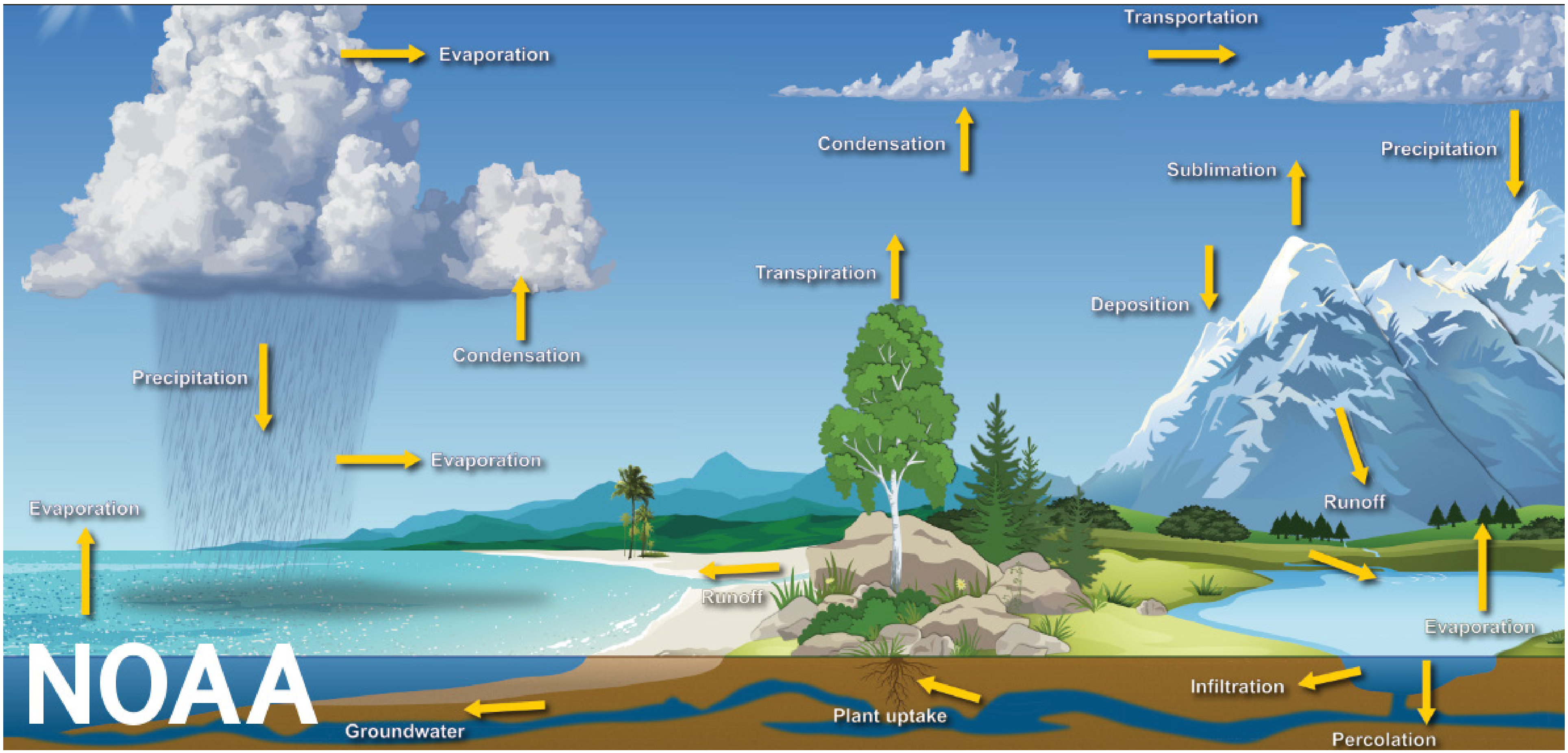
Strato-form
From the Latin word for "layer", these clouds are usually broad and fairly wide spread, appearing like a blanket. They result from non-convective rising air and tend to occur along and to the north of warm fronts. The edges of strato-form clouds are diffuse.

Nimbo-form
This special raincloud category combines the three forms cumulo + cirro + stratus. Nimbus is the Latin word for "rain." The vast majority of precipitation occurs from nimbo-form clouds; therefore, these clouds are generally the thickest.

The water cycle is often taught as a simple circular cycle of evaporation, condensation, and precipitation. Although this can be a useful model, the reality is much more complicated. The paths and influences of water through Earth's ecosystems are extremely complex and not completely understood. NOAA is striving to expand understanding of the water cycle at global to local scales to improve our ability to forecast weather, climate, water resources, and ecosystem health.

The water cycle on Earth

Water is essential to life on Earth. In its three phases (solid, liquid, and gas), water ties together the major parts of the Earth's climate system — air, clouds, the ocean, lakes, vegetation, snowpack, and glaciers. The water cycle shows the continuous movement of water within the Earth and atmosphere. It is a complex system that includes many different processes. Liquid water evaporates into water vapor, condenses to form clouds, and precipitates back to earth in the form of rain and snow. Water in different phases moves through the atmosphere (transportation). Liquid water flows across land (runoff), into the ground (infiltration and percolation), and through the ground (groundwater). Groundwater moves into plants (plant uptake) and evaporates from plants into the atmosphere (transpiration). Solid ice and snow can turn directly into gas (sublimation). The opposite can also take place when water vapor becomes solid (deposition).



Text and image retrieved from http://bit.ly/3UFIsu8 Image credit: Dennis Cain/NWS

Cloud Observation Form

Name ____

Class ____

DATE	CLOUD TYPES OBSERVED	AVERAGE AIR TEMPERATURE	PRECIPITATION IN INCHES	AVERAGE WIND SPEED	RELATIVE HUMIDITY	SKY COVER

To record data in the gray columns, retrieve daily reports for your area from the Oklahoma Mesonet at https://www.mesonet.org/index.php/past_data/daily_data_retrieval

Discovering Water Vapor & Raindrops

Compelling Question	**What are clouds made of, and how do clouds form?**
Learning Objectives	• Students will **demonstrate** the existence of invisible water vapor and **examine** its role in the water cycle. • Students will **investigate** how aerosol particles are needed to form gas bubbles, in much the same way aerosols are needed to form liquid droplets. • Students will **simulate** their own raindrops, and **measure** and **record** their findings. Advanced students will **represent** data by **creating** a graph. • Students will **identify** the shape of a real raindrop. Advanced students will **describe** force caused by a balance of surface tension, drag and gravity. • Students will **create** their own clouds in a controlled environment by introducing pressue to water vapor and aerosols. • Students will **design** a cloud formation timeline, explaining each step of how a cloud forms, following the principles of the water cycle.
Academic Standards	**SOCIAL STUDIES 4.2.4 Describe how physical processes of the Earth's surface impact humans and their environment.** **SCIENCE 5.ESS2.1 Develop a model to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** Disciplinary Core Idea: Winds and clouds in the atmosphere interact with landforms to determine patterns of weather. **SCIENCE 6.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.** Disciplinary Core Idea: Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, crystallization, and precipitation, as well as downhill flows on land.
Staging the Question	How does rain fall out of the sky? If rain comes from clouds, how can fluffy-looking clouds hold water? Why do some clouds produce rain while others do not?
Suggested Time	Three 50-minute periods Day 1: Compelling Questions, Supporting Questions 1 & 2 Day 2: Review of Previous Questions, Supporting Questions 3 & 4 Day 3: Summative Performance Task

Supporting Question 1

Besides ice and liquid water, what other types of water occur in the atmosphere? How do we know it exists?

Formative Performance Task 1: Can Implosion

Supplies needed: Empty Sprite/7-Up can (reserve soda in a clear cup for next task), hot plate, tongs, cookie sheet, cold water.

Students will demonstrate the existence of invisible water vapor and examine its role in the water cycle.

Fill can with 25mL water and place on high heat. Pour cold water into cookie sheet, so it is 0.5 cm deep. Water in can will boil in approximately 5 minutes. Watch for the water vapor and the boiling sound. Using tongs, flip can upside-down into cookie sheet. Can will implode. Allow burner to cool before touching.

Featured Sources 1

"OU CIWRO Science Class: Clouds in the Kitchen" (mark 1:36-12:48; 14:59-17:35)
https://youtu.be/vehXIKsW_9s

"Water Cycle: How the Hydrologic Cycle Works" video (6:46 duration)
https://www.youtube.com/watch?v=al-do-HGuIk

Water Cycle graphic/handout (in Investigating Clouds lesson)

Supporting Question 2

How does invisible water vapor turn into clouds we can see?

Formative Performance Task 2: Salt in Sprite

Supplies needed: Clear cup of Sprite/7-Up (or other clear carbonated liquid) and salt.

Students will investigate how aerosol salt particles are needed to form gas bubbles in liquid Sprite. In much the same way aerosols are needed to form liquid droplets in the gaseous atmosphere that includes water vapor.

Slowly pour salt into the cup of Sprite. A "cloud" will form and then dissipate. Experiment can be repeated until the liquid is saturated with salt.

Featured Sources 2

"OU CIWRO Science Class: Clouds in the Kitchen" (mark 19:45-23:27)
https://www.youtube.com/watch?v=6gsRJJhZzvA

Supporting Question 3

How does a cloud produce rain? How do scientists observe clouds and measure rain drops?

Formative Performance Task 3: Measuring Raindrops

Supplies needed: Flour, cookie sheet, spray bottle with water, and ruler.

Students will simulate their own raindrops, and measure and record their findings. Advanced students will represent data by creating a graph of their measurements.

Spread flour on cookie sheet and spray water onto flour to simulate rain. Use a ruler to measure the dough balls in centimeters. This is similar to how scientists measured raindrops in the mid-20th century.

Featured Sources 3

"OU CIWRO Science Class: Clouds in the Kitchen" (mark 23:29-44:02)
https://www.youtube.com/watch?v=6gsRJJhZzvA

Supporting Question 4

What are the shapes of raindrops?

Formative Performance Task 4: Shape of Raindrops

Supplies needed: Supplied raindrop plush

Students will identify the correct shape of a raindrop. Advanced students will describe force caused by a balance between surface tension, drag and gravity.

As the video illustrates, raindrops are not tear-shaped. Raindrops evolve from spherical to oblate sphereoids (like hamburger buns) as the raindrops get larger. Allow students to squash the plush into the correct shape.

Featured Sources 4

"What Shape Is a Raindrop?" (mark 2:22-3:52) https://www.youtube.com/watch?v=UNc3pAa6p3Q

Summative Performance Task: Cloud in a Bottle

Argument

Supplies needed: Empty 2-liter bottle with cap, liquid crystal temperature strip, tape, water, and matches.

Students will create their own clouds in a controlled environment by introducing pressure to water vapor and aerosols.

Part 1: Secure the temperature strip with a piece of tape to hang in the center of the bottle. Screw cap on tightly. Exert pressure on the bottle so its volume decreases. Try pressing on the side of it while it lays on a table. Read the temperature strip after a few seconds. Release pressure so the bottle expands again. Record the temperature. Repeated trials confirm a relationship between temperature and changes in air pressure.

Part 2: Pour a few milliliters of water in the bottle to wet the inner surface. Pour out excess water. Cap the bottle and let stand for a couple of minutes to allow the air to evaporate and saturate the air inside. Next, introduce smoke to the air inside. The smoke is added because atmospheric water vapor requires aerosols on which to condense. Open the bottle, place it on its side and flatten the bottle to half its normal diameter. Have another person light a match, blow it out and insert the smoking end into the bottle. Quickly release pressure so the bottle returns to its normal size and cap tightly. Apply and release pressure as before, noting temperature changes. When the bottle is allowed to spring back to its original shape, the temperature lowers and a cloud appears in the bottle. Repeating the process of applying and releasing pressure will cause the cloud to appear and disappear.

Video: www.jpl.nasa.gov/edu/learn/project/make-a-cloud-in-a-bottle/

Extension: Cloud Formation Timeline (Optional)

Supplies needed: Markers, 3x5 cards, yarn, tape.

Students will design a cloud formation timeline, explaining each step of how a cloud forms, following the principles of the water cycle.

With students working in teams, ask them to explain each step of the cloud formation process on a 3x5 card. Teams will then put the steps in order by taping the cards to a cut piece of yarn. Encourage students to finish the water cycle by tying the ends of the yarn together.

Taking Informed Action: Researching Air Quality (Optional)

Students will investigate types of aerosols in the atmosphere and research the air quality in their community.

https://earthobservatory.nasa.gov/features/Aerosols
https://www.weather.gov/safety/airquality-aqindex
https://www.weather.gov/safety/airquality
https://www.airnow.gov/sites/default/files/2018-04/aqi_brochure_02_14_0.pdf

Teacher Background Sheet

Water exists in three forms in the atmosphere. We see clouds in the sky with the naked eye due to the presence of **ice (solid)** and **water (liquid)**, and see precipitation at the ground in the form of snow, hail, graupel, and rain. Another form of water in the atmosphere, which is invisible to us, is **water vapor (gas)**. Water vapor is a significant part of and the first step of the water cycle. Water vapor is always present in the atmosphere from the **evaporation** of liquid water on the surface to vapor, but its amount can vary considerably. When air rises in the atmosphere where pressures are less, the air **cools** as it loses energy -- air molecules are doing the work to expand the air volume. As water vapor molecules cool in the higher atmosphere, they **condense** onto **aerosol** particles generating tiny liquid water droplets or **freeze** onto aerosols generating ice crystals. As the cloud droplets grow bigger, they collide with each other, generating larger drops. When the drops become large enough, **precipitation** falls from the cloud, most likely in the form of rain or snow. The liquid water or ice can subsequently evaporate or **sublimate**, continuing the water cycle.

As seen in the imploding can experiment, the majority of liquid water molecules are held to the liquid water surface by intermolecular bonds. When the liquid water is heated, the internal energy of the liquid molecules increases so that more are able to escape the intermolecular bonds and become gaseous water vapor molecules in a process called **evaporation**. When the can is removed from the heat source and flipped over in the cool water, the temperature decreases and the molecules have less internal energy. With their reduced energy, some are not able to escape the intermolecular bonds when they collide with the liquid surface, so they **condense** into liquid water. Thus, there are fewer vapor molecules inside the can and less pressure exerted on the can walls compared to the pressure of the air outside the can pressing inwards so that the can is crushed.

As seen in the salt experiment, carbon dioxide is trapped in the soda. When salt is added, the carbon dioxide attaches to the salt and forms bubbles in much the same way that water vapor condenses onto aerosols forming cloud drops in the atmosphere, with the aerosol dissolving in each drop. **Aerosols** are tiny solid or liquid particles in the air. The aerosols provide a surface on which the water vapor can **condense** and form liquid drops. Clouds are visible collections of liquid drops or ice crystals.

When small cloud droplets collide, they form bigger drops, which eventually grow big enough to become raindrops that fall out of the cloud. Raindrops typically measure 0.5 mm to 5 mm, with the largest ones up to 8 mm. Raindrops are an oblate spheroid shape like the tops of hamburger buns.

In the 1950s, scientists measured cloud droplets under microscopes in much the same way as the flour experi¬-ment. Now scientists use electronic probes at the ground, on aircraft, or on balloons to measure the sizes and images of cloud particles, ice crystals, and raindrops. This information is used to improve how cloud properties and processes occurring in clouds are represented in weather models, allowing better predictions of rainfall intensity and location, as well as storm evolution.

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