USU 4-H Weather Tote

BIG IDEA:
Weather is an observable natural phenomenon.

UNDERSTANDINGS:
People can make predictions based on observable patterns.

ESSENTIAL QUESSTIONS:
How can making predictions enable people to make decisions about how to prepare for various types of weather?
How do observations help people to learn more about the natural world?

THREE DIMENSIONS, UTAH SCIENCE STANDARDS, AND INTENDED LEARNING OUTCOMES:
See pg. 13-16

Supplies

- Paper*
- Pencils*

Tornado Tubes (p. 2)

- 2 plastic soda bottles*
- Tornado tube connectors
- Water*
- Stopwatch*
- Glitter & beads (optional)*

Rain in a Bottle (p. 4)

- Clear mason jars and lids*
- Water*
- Ice Cubes*

Barometer (p. 6)

- Scissors*
- Balloon (uninflated) *
- Mason jar*
- Rubber band*
- Straw*

Erosion (p. 8)

- Shallow baking pan*
- Soil/sand*
- Leaves and grass*
- Popsicle sticks*
- Markers*
- Ruler*
- Watering can and water*
- Straw*

Clouds (p. 10)

- Weather Window Folder
- Inflatable Clouds
- Paper*
- Popsicle sticks*
- Markers/crayons*

*Not included in tote

Activity 1: Tornado Tubes

Time: 30 min

Grade Level: 2-4

Materials:

- Paper and pencil
- 2 plastic soda bottles*
- Tornado tube connectors
- Water*
- Stopwatch*
- Glitter & beads (optional)*

To Do:

1. Ask students, "Who has seen a tornado?" Discuss what makes tornados, where they happen, why they are very uncommon in Utah, etc.
2. Prepare your tornado tubes. Fill the soda bottle to the top with water (and glitter if desired). Connect it to the other soda bottle using the tornado tube connector.
3. Make predictions. How long will it take to empty all the water from one bottle into the other without spinning it? Will spinning it faster make it empty faster or slower? Have students write their questions and predictions down.
4. Conduct the control test. Turn the bottle upside down and without squeezing or spinning the bottle, time how long it takes the water to empty out. Record the results and do the test two more times.
5. Next, have students rotate the bottle in a circle. Stop rotating the bottle when what looks like a tornado starts forming. Again, time how long it takes the water to empty out of the container and the method you used. Repeat the experiment and record your results each time. Feel free to add new tests with different variables, like speed and angle. Be sure to record the results.
6. Compare the results from each test. Analyze what was most successful.

REFLECT:

- How does the tornado tube work?
- Which method allowed the water to exit the mottle more quickly?
- How does a real tornado start?
- Where do tornadoes usually happen? Why do they not happen more in Utah?

APPLY:

If you have ever seen a dust devil on a windy day or watched the water drain from a bathtub, you've seen a vortex. A vortex is a type of motion that causes liquids and gases to travel in spirals around a center line. A vortex is created when a rotating liquid falls through an opening. Gravity is the force that pulls the liquid into the hole and a continuous vortex develops. Swirling the water in the bottle while pouring it out causes the formation of a vortex. The vortex looks like a tornado in the bottle. The formation of the vortex makes it easier for air to come into the bottle and allows the water to pour out faster. If you look carefully you will be able to see the hole in the middle of the vortex that allows the air to come up inside the bottle. If you do not swirl the water and just allow it to flow out on its own, then the air and water have to essentially take turns passing through the mouth of the bottle, thus the glug-glug sound.

Real tornadoes can form beneath a super-cell thunderstorm cloud when the upward rising air slowly rotates at mid-levels of the storm. Winds that vary in direction and speed in the layer below the clouds help generate this rotation. Other tornadoes form along small-scale fronts when winds shift directions across them. These shifting winds become the source of rotation when they are drawn closer together by the air that flows into the updraft.

Tornados are not as common at higher elevations mainly because the air is cooler and more stable. Additionally, as storms move eastward they are weakened by the friction and terrain of mountains lowering the chance of a tornado forming.

Activity 2: Making Rain

Time: 25 min

Grade Level: K-3

Materials:

- Paper and pencil
- Clear mason jars and lids
- Water
- Ice Cubes

To Do:

1. Pour enough water into the jar to cover the bottom. The water will simulate a lake or an ocean. (It helps if the water is warm.)
2. Place the lid firmly over the opening of the jar. Think of this lid as a cumulonimbus cloud.
3. Put four or five ice cubes on top of the lid. The ice acts like the cooler air found high in the Earth's atmosphere. Wait 10-15 minute to see what happens. As students wait, have students reflect on what they did and what they think will happen.
4. Discuss the water cycle addressing evaporation, condensation, and precipitation.
5. Experiment with changing the temperature of the water and bottles. (For example, chill one bottle with water in the fridge and heat another up in the microwave.) Conduct the experiment and record the results.

REFLECT:

- What happened in the jar?
- How did you make it "rain?"
- How do raindrops form?
- What about snow and hail? How is their formation similar to rain? What is different?

APPLY:

You should have noticed that water formed on the inside of the lid, just like the rain forms in the clouds. This jar experiment shows some of the same processes that occur in nature. The warm air inside the jar rises, carrying moisture from the water at the bottom. On Earth, warm air carries moisture up from the lakes, oceans, and other water sources. As the air in the jar reaches the top, it cools because of the ice on the lid. In a similar way on Earth, the warm air cools the higher it rises in the atmosphere. When air cools it drops the moisture it is

holding. In the jar we see this moisture collect on the inside of the lid. On Earth it is seen every time it rains. You made it rain! Rain is very important to Earth. Rain supplies Earth with water, one of the most important resources. You know that rain is formed by warm air rising from Earth and cooling in the clouds.

Activity 3: Barometer

Time: 30 min

Grade Level: 3-6

Materials:

- Paper and pencil
- Tape
- Scissors
- Balloon (uninflated)
- Mason jar
- Rubber band
- Straw

To Do:

1. As a class, talk about how weathermen gather information about and predict the weather. Tell students about barometers and what they measure.
2. Begin making the barometer. Cut off the neck of the balloon. Then cut off the tip of the straw diagonally so it comes to a point.
3. Stretch the balloon around the mouth of the jar very tightly so the surface is flat. Put the rubber band around the mouth of the jar and balloon to keep the balloon from slipping.
4. Tape the uncut end of the straw to the center of the balloon, so the pointed tip extends far out from the jar. Try pushing on or pulling the balloon to see how the pointed end of the straw moves.
5. To measure the straw's position exactly, tape a vertical piece of paper and put the jar near it so the straw is very close to the paper. You can draw a line on the paper to mark exactly where the straw is today and then check back daily or weekly to measure how it changes. Write the date and take note of the weather each time you measure the straw's height. (If desired, make multiple bottle barometers and place them in various locations and record the straw's height.)
6. Use the information you have collected to make a graph of how the weather and barometer changed.

REFLECT:

- What does a barometer do?
- Did the straw show there was high pressure or low pressure?

- How much did the air pressure fluctuate over time?
- Did you test the barometer in different rooms and temperatures? What happened?

APPLY:

A barometer measures the pressure of the air around it. When air pressure drops, clouds and rain form. Higher pressure leads to clear skies. Barometers can help us forecast the weather in days ahead. Air is trapped in the jar, pushing outward, and air in the room is pushing inward. When the air pressure in the room changes, it will push harder or less hard on the balloon. If the pressure increases, it pushes harder on the balloon. If the pressure decreases, it won't be pushing down on the balloon as much as the air inside the jar is pushing up. The straw will move one way or another. The change in barometric pressure will help you to forecast the weather. Decreasing air pressure often indicates the approach of a low pressure area, which often brings clouds and precipitation. Increasing air pressure often means that a high air pressure area is approaching, bringing with it clear or fair weather.

Activity 4: Erosion

Time: 20 min

Grade Level: 2-5

Materials:

- Shallow baking pan
- Soil/sand
- Leaves and grass
- Popsicle sticks
- Markers
- Ruler
- Watering can and water
- Straw

To Do:

1. Tell students that they will be learning about erosion. Ask students what erosion is, why it is a problem, how it can affect the land, etc.
2. Create a landscape to learn about erosion. Begin by filling the baking pan with a thin layer of sand or soil. On one end of the pan, build up a mound of soil. Create a change in elevation by tilting one side of the pan on a book or other object.
3. Mark popsicle sticks in ½ inch intervals. These will be your rulers. Place popsicle sticks throughout the baking pan, burying them at least 1 ½ inch deep.
4. Cover one side of the mountain with leaves and grass clippings.
5. Simulate weather elements. Use the straw to blow on both the covered and uncovered sides of the mountain. Use the watering can to make it rain on both sides of the mountain. Simulate different forces of wind and rain. Use various items to try to prevent erosion and see what works the best.
6. Record your experiments and observations.
7. Discuss as a class their findings. What have they heard of or seen in the real world involving erosion? (Talk about wildfires, trail, roads, over-grazing, urban development, deforestation, etc.)

REFLECT:

- What is erosion?
- What side of the mountain model eroded the most?

- How can erosion harm an ecosystem?
- What can be done to prevent erosion?

APPLY:

Erosion happens most quickly on bare sand, soil, or rocks. Wind, water, sun, even our footsteps, can cause things to wear away. Whether we are talking about farm crops in a field, beach grass on the dunes, or the lawn in our backyard, plants do an excellent job of holding soil in place. When vegetation is removed (construction, road building, agriculture, wildfires, over-grazing, etc.), the rate of erosion is increased. Or if we divert surface water or concentrate its flow, the rate of erosion is increased. If builders increase slope angles (again usually some form of construction) there is increased potential for erosion. Erosion can be harmful when nutrient-rich soil is lost or when the eroded materials are deposited somewhere we wouldn't necessarily want them, like gravel in a stream bed where fish spawn. There are numerous ways to prevent or reduce erosion. Better land use decisions help us determine areas we shouldn't disturb, and help to control erosion and deposition. Preventing human-caused wildfires also helps to reduce the potential for erosion.

Activity 5: Clouds

Time: 30 min

Grade Level: 3-6

Materials:

- Weather Window Folder and Contents
- Inflatable Clouds
- Paper
- Popsicle sticks
- Markers/crayons

To Do:

1. Begin by talking about one way meteorologists, and people all throughout history, have predicted weather is by learning about and recognizing different types of clouds. Inflate the inflatable clouds and talk and learn about each one. Information about clouds can be found in the Weather Window Folder.
2. After learning about the main types of clouds create cloud viewers. Instructions and information for the cloud viewers can be found in the Weather Window Folder. Consider having students research the different types of clouds on the internet. Have them print and use the pictures they find for their cloud viewer. Alternatively you can copy the cloud picture from the Weather Window Worksheet or draw the different types of clouds. Decorate the cloud viewer with markers or crayons.
3. Use the cloud viewers to go outside on a cloud watch and identifying the different clouds you see.

REFLECT:

- What are clouds made of? How are they made?
- How does the sun affect the earth's temperature? How do clouds change that?
- Why are there so many different types of clouds?
- Why was it important for people to learn how to predict weather? Why is it important to predict weather now?

APPLY:

Clouds are made when water evaporates and condenses. When it condenses, water forms water droplets. This is called the dew point. It takes billions of water droplets to make up a cloud. Clouds form at different temperatures and in different weather conditions so there are many types of clouds. Because of this, different clouds bring different weather. The sun

warms up the earth. Clouds affect temperature by shielding the earth from the sun during the day and insulating the earth at night. Clouds also give us precipitation, different types of water that falls from the clouds. Cumulonimbus clouds can produce thunder and lightning as well as rain. Cumulonimbus clouds also can create tornados and hurricanes.

Throughout history it has been important for people to predict weather in order to take care of their crops and travel safely. People continue to use weather forecasts to plan wisely and protect themselves. Meteorologists are constantly working to predict weather more and more accurately to protect people from extreme weather.

Additional Activities

- Play Weather Bingo
- Use posters to learn about Tornadoes, Volcanoes, Earthquakes, Hurricanes, Droughts, and Floods
- Play and learn with the inflatable Clever Catch Weather ball
- Engineer structures to withstand earthquakes
- Build and test dams in large plastic totes using sand, gravel, rocks, sticks, and leaves. Measure how much water the dams can withstand.

Contents of Weather Tote

- Weather Bingo
- Posters: Tornadoes, Volcanoes, Earthquakes, Hurricanes, Droughts, and Floods
- 10 Tornado tube connectors
- Clever Catch weather with answer key
- Nature watch, type of clouds guide (has instructions for making a cloud viewer too)

Three Dimensions, Utah Science Standards, and Intended Learning Outcomes

Note: These applications of National and State Science Standards are not comprehensive. They are meant to serve as suggestions. While only standards for elementary levels have been listed, standards for more advanced grade levels can also be applied. Additionally, this tote is an excellent tool to facilitate inquiry for any age group.

THREE DIMENSIONS

K-PS3-1. Weather and Climate (Activity 5: Clouds)

Make observations to determine the effect of sunlight on Earth's surface.

Science and Engineering Practices:

- Make observations (fist hand or from media to collect data that can be used to make comparisons.
- Scientists use different ways to study the world.

Disciplinary Core Ideas:

- Sunlight warms earth's surface.

Crosscutting Concepts:

- Events have causes that generate observable patterns.

K-ESS2-1. Weather and Climate (Activity 3: Make a Barometer)

Use and share observations of local weather conditions to describe patterns over time.

Science and Engineering Practices:

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.
- Scientist look for patterns and order when making observations about the world.

Disciplinary Core Ideas:

- Weather is the combination of sunlight, wind, show or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

Crosscutting Concepts:

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

K-ESS3-2. Weather and Climate (Activity 1: Tornado Tubes, Activity 5: Clouds)

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

Science and Engineering Practices:

- Ask questions based on observations to fine more information about the designed world.
- Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.

Disciplinary Core Ideas:

- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.

Crosscutting Concepts:

- Events have causes that generate observable patterns.
- People encounter questions about the natural world every day.
- People depend on various technologies in their lives; human life would be very different without technology.

2-ESS2-1. Earth's Systems: Processes that Shape the Earth (Activity 4: Erosion)

Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Science and Engineering Practices:

- Make observations from several sources to construct an evidence-based account for natural phenomena

Disciplinary Core Ideas:

- Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.

3-ESS2-1. Weather and Climate (Activity 3: Barometer)

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

Science and Engineering Practices:

- Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.

Disciplinary Core Ideas:

- 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.

Crosscutting Concepts:

- Patterns of change can be used to make predictions

3-ESS3-1. Weather and Climate (Activity 4: Erosion)

Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

Science and Engineering Practices:

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Disciplinary Core Ideas:

- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.

Crosscutting Concepts:

- Cause and effect relationships are routinely identified, tested, and used to explain change.
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

4-ESS2-1. Earth's Systems: Processes that Shape the Earth (Activity 4: Erosion)

Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Science and Engineering Practices:

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

Disciplinary Core Ideas:

- Rainfall helps to shape the land and affects the types of living things found in region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
- Living things affect the physical characteristics of their regions

Crosscutting Concepts:

- Cause and effect relationships are routinely identified, tested, and used to explain change.

UTAH SCIENCE STANDARDS

K-Grade 2

Standard 1 (Activity 1: Tornado Tubes, Activity 2: Rain in a Bottle, Activity 3: Barometer, Activity 4: Erosion, Activity 5: Clouds):

- The Processes of Science, Communication of Science, and the Nature of Science. Students will be able to apply scientific processes, communicate scientific ideas effectively, and understand the nature of science.

Standard 2 (Activity 1: Tornado Tubes, Activity 2: Rain in a Bottle, Activity 3: Barometer, Activity 4: Erosion, Activity 5: Clouds):

- Earth and Space Science. Students will gain an understanding of Earth and Space Science through the study of earth materials, celestial movement, and weather.

Grade 4

Standard 1 (Activity 2: Rain in a Bottle, Activity 5: Clouds)

- Students will understand that water changes state as it moves through the water cycle.

Standard 2 (Activity 3: Barometer, Activity 5: Clouds):

- Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.

Grade 5

Standard 2 (Activity 4: Erosion):

- Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.

INTENDED LEARNING OUTCOMES (ILO'S):

1. Use science process and thinking skills.
2. Manifest science interests and attitudes.
3. Understand important science concepts and principles.
4. Communicate effectively using science language and reasoning.
5. Demonstrate awareness of the social and historical aspects of science.
6. Understand the nature of science.