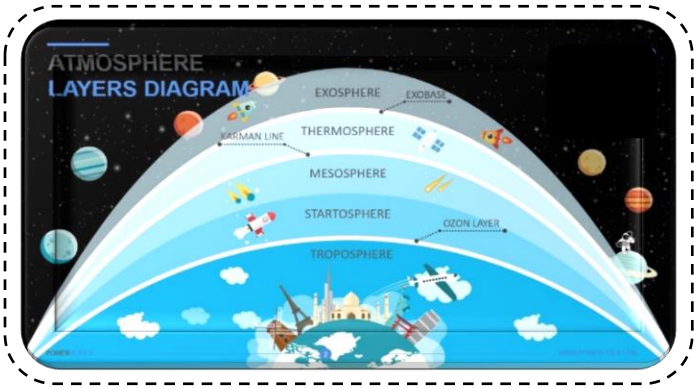
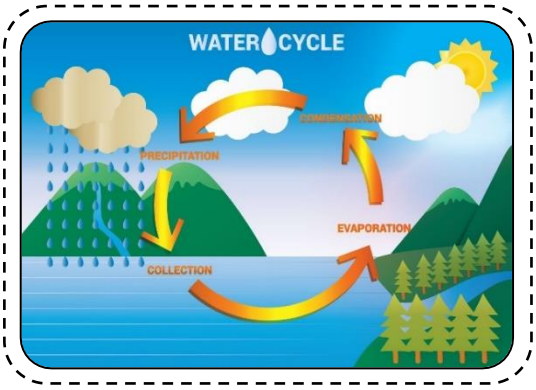
December, The Doorway to Winter: Types of Winter Precipitation

Explore the many different forms of precipitation that we can experience in the winter.

There are many different forms of precipitation in winter, including rain, freezing rain, sleet, snow, and hail. The type of precipitation that forms above us compared to which type we receive on the ground is dependent of the air temperature(s) of the atmosphere that the precipitation falls through on the way down. The troposphere is the layer of the earth's atmosphere where we live, where clouds are, and where weather happens. All forms of precipitation go through the water cycle, to learn more about the water cycle watch this short video.



Layers of the earth's atmosphere. Source.



A diagram of the water cycle. Source.

Activity: Water Cycle Demo - Adults

Do this demonstration to help learners better understand the water cycle! You can simulate a tiny atmosphere to observe how the water cycle works.

Materials:

- Stove top or hot plate
- A small pot filled about ½ of the way with water
- Glass bowl or glass lid
- Oven mitts

NOTE - *Use caution while operating stove or hot plate*

Instructions:

Fill your pot with water, this will represent all the water in the water cycle.

1. Place your pot on your heat source, your heat source will represent the heat from the sun.
2. Turn your heat source on low and wait for the water to start steaming (it does not need to be boiling), once you reach the point where your water is steaming, this shows the process of **evaporation**.
3. Using your oven mitts place the glass bowl over your pot and *pay close attention to the inside surface of the glass bowl*. The bowl represents a cloud. Once you see water droplets collecting on the surface of the glass bowl, this shows the process of **condensation**.
4. Keep watching the glass bowl. Once the water droplets start to fall, this shows **precipitation** – it is raining! If it were freezing or below it would be snowing!
5. Once the precipitation falls back into the pot, this represents **collection**. You have just witnessed the whole water cycle up close! This cycle will continue to go through the steps of evaporation, condensation, precipitation, and collection.

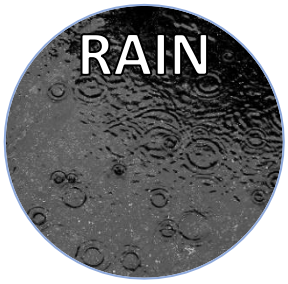
Different Types of Precipitation and How Each Forms

The higher up in the atmosphere you go the more the temperature drops and the colder it gets. In this case, we are going to be thinking about how weather forms so we will be focusing on the troposphere. When a cloud is full and the accumulated droplets start to fall, because it is so cold at the upper layer of the troposphere, most of those droplets freeze and form ice crystals, or snow. What happens after that is dependent of the air temperature that the crystals fall through on the way down.

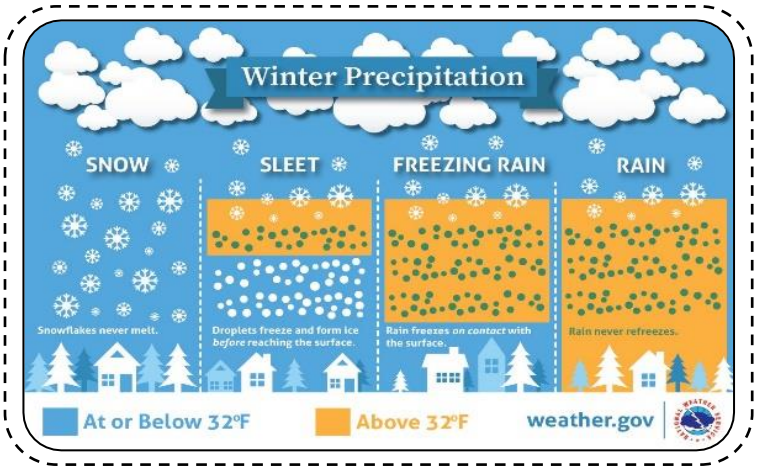
As stated above, most precipitation begins as snow! If the temperature of the air stays at or below 32°F from the clouds to the ground, then those ice crystals will remain in the same structure and continue to fall as snow.

Sleet forms when those initial ice crystals fall through a smaller layer of warm air, above 32°F, and then fall the rest of the way through a larger layer of cold air, 32°F or below. These droplets freeze on the way down, which is important to note when exploring the difference between sleet and freezing rain.

Freezing rain is formed similarly to rain, the only difference is that the air temperature needs to drop down to or below ***freezing*** closer to the ground. This distinguishes freezing rain from sleet because freezing rain will refreeze once it reaches cold surfaces like a car or roadway, whereas sleet droplets refreeze while still in the air.



While rain is not a form of *frozen* precipitation, we do still experience rain in the winter months, because temperatures aren't always below freezing. From the clouds, these falling ice crystals turn from snow to rain only when the temperature consistently rises to above freezing, or any temperature over 32°F.



How different types of precipitation form. Source.

Click here to view a short video that explains this diagram further.

Hail is formed a little differently than the precipitation forms shown above. When thunderstorm updrafts push raindrops up towards very cold parts of the atmosphere those raindrops will freeze. These frozen droplets can collide with other liquid droplets and freeze together. Eventually the hail will become too heavy to stay lifted with the wind currents and fall to the ground. Hail can have a diameter as small as 5mm, but some can grow to be the size of a baseball!

Different Types of Snow Crystals

There are various types of snowfall that we can experience in the winter. This can be because of many factors including air temperature, surface temperature, and humidity.

Snowflakes are individual ice crystals or groupings of ice crystals. If you look really close at your gloves or jacket while you're outside and snowflakes are falling from the clouds, you might be able to see various snowflakes that are all 6-sided, but are all still uniquely created.

These sphere-shaped ice crystals can sometimes be confused with hail due to their shape and size. Graupel starts off as a snowflake, and then it must travel through ***supercooled*** water droplets. Those droplets freeze immediately as they hit the snowflake, giving it that distinct round shape. At this point that initial snowflake has now turned into graupel. Graupel can be between 2-5mm in size.

Polycrystals form when many individual ice crystals, or snowflakes, combine to form a grouping of numerous ice crystals in one.

You will spot hoarfrost only when the surface temperature of objects on the ground are lower than the frost point of the air. These ice crystals generally will form on smaller objects, such as wires, plant stems, and tree branches, and will transform directly from a vapor to a solid, skipping the liquid stage.

Vocabulary

Freezing – the freezing point is at or below 32°F, or 0°C.

Supercooled – this term is used to describe a liquid that is below its freezing point but has not solidified.

Activity: What's the Weather? Data Station Exploration

Gain an understanding of local weather patterns and changes through guided exploration of public weather data.

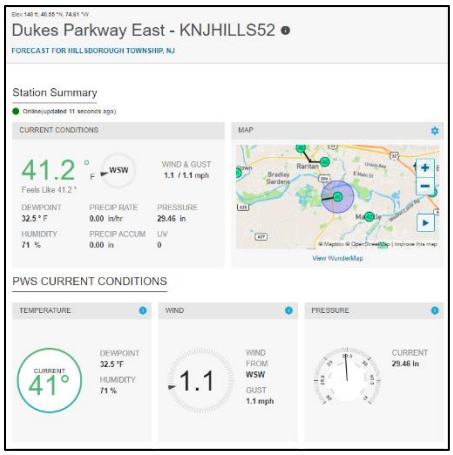
Materials:

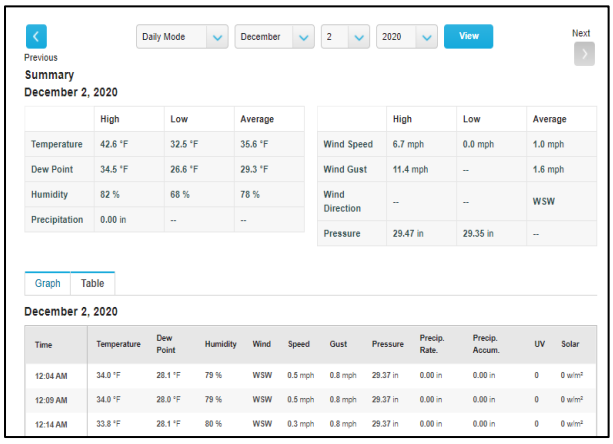
- Access to the Weather Underground website
- The Duke Farms weather station data page
- Optional notebook/graph paper and writing utensil

Background Information: Precipitation rates in an area are dictated by many natural factors, the most common of which is temperature. The temperature is also a key factor in which type of precipitation occurs. Weather Underground is a free resource for weather and climate data around the globe that is collected from individual weather stations; here at Duke Farms we have one such station on the property and it allows us to track local trends and easily compare and contrast them to local historical data and the data of any other location around the world.

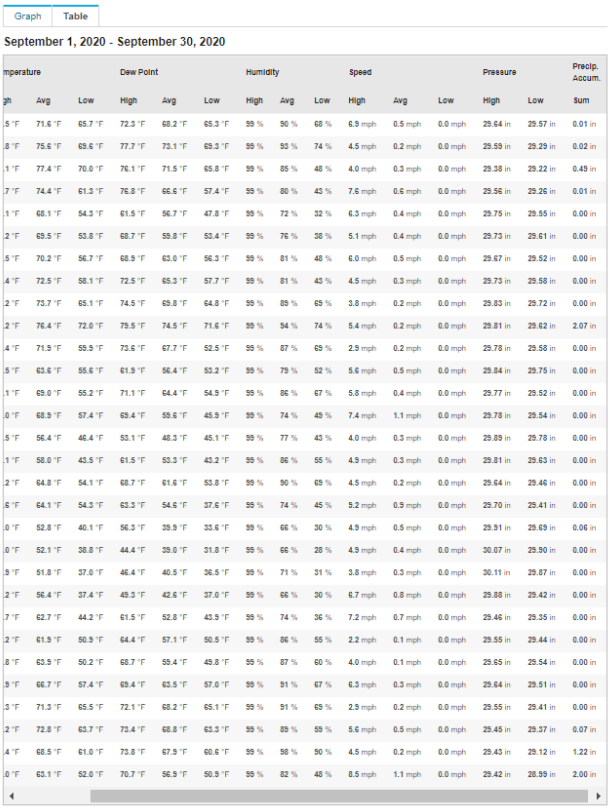
Instructions:

1. Access the Duke Farms weather station data page here. Explore the various features of the dashboard, including the live weather updates and data graphs and tables. When first accessed, the searchable graph/table data toward bottom of the dashboard will be on default search settings: "Daily Mode" and whatever date you are currently online.
2. Change the search criteria to "Monthly Mode" and choose, for example, "September 2020", then click the blue "view" button. The data will change to display the overall collection of various data points throughout that time period.
3. Toggle between the "Graph" tab and the "Table" tab to explore the different presentation types.

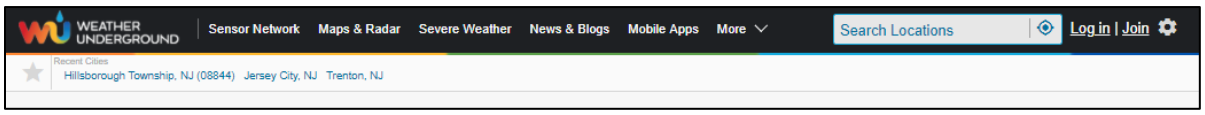




4. While on the "Table" tab, use the bottom scroll bar to see all the way across the table. Pay attention to the date the data was collected, the temperatures reached, and the amount of precipitation (the final column in the table).



5. Search any dates and date ranges you would like to see represented at the Duke Farms weather station, and then use the search bar in the top right corner of the Weather Underground site to search for your town. Repeat the investigation into the data collected to compare and contrast trends between locations!



Discussion:

- Can you predict what type of precipitation might have occurred on each of the following dates?
  - May 29th, 2020
  - January 5th, 2019
  - December 21st, 2018
- Can you find a series of dates where precipitation occurred for more than (x) days in a row? What type of precipitation was it? How do you know?
- Find a series of dates where no precipitation occurred. What is the longest series of continuous dates that you can find?

Teaching About Precipitation

Teaching about precipitation provides learners the opportunity to be involved in the world around them. Many schools begin their weather - based curriculum as early as the preschool years, extend that learning to middle school earth science topics and then on to high school AP level courses. It is one of the content areas that every learner can experience not matter where or how they live and in this way those in urban, suburban or rural communities may all participate equally.

Collecting weather data is readily accessible via real time and individual observations can be taken with simple instruments. Temperature and precipitation type could even be a feature during a virtual morning meeting or be completed by the learners themselves. Additionally, every traditional news service and web-based services include weather reports that can be accessed.

Weather data can also be a bridge to teaching a wide array of process skills, strands in mathematics, as well as having strong connections to Language Arts, geography, world languages and fine and performing arts. Weather related topics truly can be incorporated in every grade and subject area.

For more ideas, contact Kate Reilly, Manager of Education, Duke Farms at kreilly@dukefarms.org.