Assignment Discovery Online Curriculum

Lesson title:
Planetary Weather

Grade level:
6-8

Subject area:
Earth Science

Duration:
Two class periods

Objectives:
Students will do the following:
- Learn about weather conditions on planets in our solar system
- Create a visual display of weather conditions on the planets

Materials:
- Internet access
- Print resources
- Poster board
- Art supplies: markers, colored pencils, stickers, and scissors
- Optional: string, hole puncher, and hangers for a mobile

Procedures:

1. Ask students what they know about weather. To spark conversation, ask the following questions:

- What is weather?
- What are some examples of weather conditions or patterns?
- Where does weather take place?
- How does weather occur on Earth?
- What are at least two elements of weather?

2. After the preliminary discussion, tell students that they might be surprised to learn that weather doesn't just occur on Earth. They'll find different types of weather on every planet in our solar system. Explain that in this lesson they'll research planetary weather but that first it's important to understand the basics of weather. Share this background with the class:

- Weather is the state of the atmosphere at a given time in a particular place. It is a mix of heat or cold, wetness or dryness, calm or storm, clearness or cloudiness.

- The atmosphere is the layer of air that surrounds Earth. Earth's atmosphere is made up of nitrogen (about 78 percent), oxygen (about 21 percent), and miscellaneous gases (about 1 percent). Technically speaking, weather takes place in the troposphere, or the lower portion of the atmosphere.
- The three key factors that determine our weather are air temperature, air pressure, and humidity.

  Air Temperature
  - Air temperature is the measure of the amount of heat in the atmosphere.
  - Radiation from the sun is responsible for the constant heating and cooling of Earth.
  - The variation of temperature in the troposphere creates movement in the air, resulting in wind.
  - Air temperature also fluctuates from day to night and from season to season because of variations in the amount of radiation reaching Earth.
  - Altitude, or elevation, affects the amount of heat energy reaching Earth; the temperature drops about three degrees Fahrenheit for every thousand feet of elevation.

  Air Pressure
  - Air pressure refers to the pressure resulting from the weight of the atmosphere.
  - Air pressure decreases with increasing altitude because the higher up you go, the less air is above you.
  - Temperature variations also result in changes in air pressure. Cold air is dense, so it exerts relatively high pressure. Warm air exerts relatively low pressure.
  - In general, high pressure usually brings fair weather, while low pressure brings cloudy, stormy weather.

  Humidity
  - Humidity is the amount of water vapor or moisture in the air.
  - Air that contains the maximum amount of water vapor is referred to as saturated.
  - When meteorologists (scientists who study the weather) refer to relative humidity, they are comparing the amount of water vapor actually in the air with the amount of water present at saturation. In other words, relative humidity is the amount of water vapor present in the air compared to the greatest amount possible at the same temperature.
  - When the air is at saturation, clouds form, and there is a good chance that it will soon rain.

3. After you feel that students have grasped these key concepts, tell them that they are going to conduct research about weather on the other planets in our solar system. Divide students into four groups. Assign the following planets to each group:

   Group 1: Mercury and Venus
   Group 2: Earth and Mars
   Group 3: Jupiter and Saturn
   Group 4: Uranus, Neptune, and Pluto

4. Tell students to use the following Web sites to complete their research:

All Planets
http://www.wilders.force9.co.uk/BeyondEarth/planets.htm
http://www.space.com/scienceastronomy/solarsystem/solar_system_weather_010306-1.html

Mercury and Venus
http://sci.esa.int/content/doc/a0/2208_.htm
http://www.rog.nmm.ac.uk/leaflets/solar_system/section3.5.html
http://www.space.com/scienceastronomy/solarsystem/solar_system_weather_010306-2.html

Earth and Mars
http://dsc.discovery.com/convergence/planetstorm/report/report.html
http://www.space.com/scienceastronomy/solarsystem/solar_system_weather_010306-3.html
http://explorezone.com/weather/pressure.htm
http://ga.water.usgs.gov/edu/earthhowmuch.html

Jupiter and Saturn
http://www.space.com/scienceastronomy/solarsystem/jupiter_weather_000209.html
http://www.wilders.force9.co.uk/BeyondEarth/planets.htm
http://www.hawastsoc.org/solar/eng/jupiter.htm

Uranus, Neptune, and Pluto
http://www.wilders.force9.co.uk/BeyondEarth/planets.htm
http://www.space.com/scienceastronomy/solarsystem/solar_system_weather_010306-5.html

5. After students have found information about weather on each of the planets, challenge each group to develop a visual display showing the weather on each of the planets. Students can draw the planets on one piece of poster board or create individual renderings of each planet. (Or students can create a planet mobile using string and coat hangers.) Students should depict the weather on each planet. For example, students could show dust swirling on the surface of Mars because this planet has severe dust storms. Students should write a brief caption for each planet highlighting the following features:

   - Its atmosphere, temperature, air pressure, and humidity (information for each of these elements may not be available, but students should record as much information as possible)
   - Any unusual weather that occurs on that planet
   - Any explanations scientists have for unusual weather

6. Have each group present its completed display. Then hang them up to create a gallery of weather on the planets.

7. Review the key weather features of each planet. For your information, those facts are listed below:
    - Mercury is the second smallest planet and closest to the sun. The planet experiences scorching temperatures on the side exposed to the sun and freezing temperatures on the side facing away from the sun. Less extreme temperatures exist at the planet's poles. Observations from radar suggest that frozen water may be underground near the poles, but at this point scientists have little information about this phenomenon.
    - Venus has a thick atmosphere made up of much carbon dioxide, which scientists think is one key reason why the planet is so hot. The temperature on Venus is 860 degrees Fahrenheit, which is hot enough to melt lead.
    - Earth is the only planet with a breathable atmosphere and water in three phases—solid, liquid and vapor. Earth's weather is stable enough to support a large variety of life forms.
    - Mars is home to intense dust storms and tornadoes that can tower up to 5 miles high. In comparison, a tornado on Earth usually doesn't rise any more than 2,000 feet. Mars has seasons, too. Temperatures can vary widely on the surface of Mars, but it is usually well below freezing. Mars has clouds, and ice is at the poles; other traces of moisture are in the atmosphere, too.
    - Jupiter's Great Red Spot is a giant, hurricane-like storm that is 15,400 miles across at its widest point. Storms last a long time on Jupiter—300 years or longer! One theory for this phenomenon is that Jupiter has no solid surfaces that could stop storm activity. Jupiter receives little solar energy. Some of the energy for Jupiter's storms comes from the planet's own internal heat.
    - Saturn is so far away from Earth that scientists know little about its weather. The planet is made up of gases, and storm centers exist on its surface, including very strong winds. While all four gas giant planets have ring systems, Saturn's is the most prominent--shaped by the gravity of Saturn and its moons.
    - Uranus's atmosphere contains methane, hydrogen, and helium. Under the atmosphere may be an ocean of hot water and ammonia. Like Saturn, Uranus has a ring system and many moons. But, unlike other planets, the axis of Uranus is tilted so that it is almost parallel with the plane of the solar system known as the ecliptic.
    - Neptune looks much like Uranus, with clouds and storm centers in its atmosphere. One of its moons, Triton, is one of the coldest places known in the solar system. Neptune also has volcanoes, which release liquid and gaseous nitrogen. These substances freeze and give the landscape a snowy look.
    - Pluto, the smallest planet in the solar system, is a frigid place. Because the planet has relatively low gravity, its atmosphere is extremely thin. But scientists have detected nitrogen gas and small amounts of carbon monoxide and methane. Pluto has seasons, and winter is significantly colder than summer. The planet's high winds cause a tremendous variation in temperature.

8. Conclude the lesson by asking student why they think weather is so much more extreme on other planets than it is on Earth. Help students understand that the lack of

water, varying geological features such as mountains, proximity to the sun, and the lack of a protective atmosphere result in extreme weather systems.

Discussion Questions:

1. Why are scientists interested in learning about weather on other planets in our solar system? What can they learn about our own planet by studying the weather elsewhere?

2. On what planet is the weather most like that on Earth? Why?

3. How have scientists learned about weather in space? Be sure to include both space missions and types of tools used.

Evaluation:

Use the following three-point rubric to evaluate how well students conducted research, created their displays, and participated in class discussions.

Three points: showed strong research skills; developed a creative and innovative way to present information; participated actively in class discussions.

Two points: showed on-grade research skills; developed competent ways to present information; somewhat engaged in class discussions.

One point: showed weak research skills; did not complete the display; was not engaged in class discussions.

Extension:

The History of Meteorology

Since the beginning of recorded history, people have been fascinated with the weather. As a result, they have developed interesting ideas about what causes weather and how to measure it. Early on, people developed tools to measure temperature, air pressure, humidity, and other elements of the weather. Have students trace the history of the science of meteorology, using the following Web sites:

www.geography.ohio-state.edu/classdocs/120/hennon/notes/lecture_history.html
http://weather.ou.edu/~metr1014/chapter1/met_hist.html
http://isu.indstate.edu/welsh/ua/hist-metro.html

Working in small groups, have them create a timeline showing major advances, write biographical sketches of pioneers in the study of the weather, or trace the development of more sophisticated tools to study the weather.

Suggested Reading:

Millions of Miles to Mars: A Journey to the Red Planet
Joseph W. Kelch.
Julian Messner, 1995.
Take an imaginary trip to Mars in this well-illustrated book. Learn what would be needed for such a trip and how long it would take. Picture landing on the surface of Mars and exploring its varied surface. This resource includes numerous photographs from the National Aeronautic and Space Administration, colorful charts, a short glossary, and a list of further reading.

The Mystery of Mars
Sally Ride and Tam O'Shaughnessy.
Crown Publishers, 1999.
In this dramatic presentation, color photographs and illustrations float on black pages with white text. The authors, the nation's first woman astronaut and a science teacher, explain what is known about Mars today. They point out all the similarities that Mars shares with its nearest neighbor, Earth, and what scientists hope to learn in the future. A Mars mission time line outlines the various spacecraft that have explored Mars from 1964 to the present.

Destination Jupiter
Seymour Simon.
Morrow Junior Books, 1998.
Jupiter is something of a mystery planet with its blanket of clouds that completely surround the surface. Recently, a spacecraft penetrated this cloud cover and briefly sent back information about the temperature, pressure, wind speed, and radiation on Jupiter and the chemical makeup of the clouds, helping scientists learn more about this giant gaseous planet. Pictures and text present an exciting view of this large planet and its many moons.

Jupiter (The Galaxy series)
Gregory L. Vogt.
Bridgestone Books, 2000.
Jupiter is a simple introduction to a complex planet and its moons. This resource is well illustrated, complemented with an easy experiment on magnetic fields. A short glossary is an additional feature.

Vocabulary:

air pressure
Definition: The weight per unit of area of a column of air that reaches to the top of the atmosphere.
Context: Fluctuations in air temperature result in changes in **air pressure**, which in turn bring different kinds of weather.

air temperature
Definition: The measure of the heat energy of the gases in the air.

Context: We use a thermometer to measure **air temperature**.

atmosphere
Definition: The layer of air that surrounds Earth and is made up of nitrogen (about 78 percent), oxygen (about 21 percent), and miscellaneous gases (about 1 percent).
Context: Earth's weather takes place in the lower **atmosphere**, known as the troposphere.

humidity
Definition: A measure of the amount of water vapor in the air.
Context: Some areas in the southern United States are known for their summers with high **humidity**.

meteorologist
Definition: A scientist who studies the weather.
Context: Part of the job of a **meteorologist** is to make predictions about the weather.

weather
Definition: The state of the atmosphere at a given time in a particular place.
Context: **Weather** has always fascinated people, who have studied it since the beginning of recorded history.

Academic standards:

This lesson adheres to the National Science Education Standards for students in grades 5-8:

- Earth Science
- Space Science

Credit:
Marilyn Fenichel, a freelance writer and curriculum developer.

This lesson was developed in consultation with Mark Herzog, a science coordinator in Harford County, MD.