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Weather or Not

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PHILOSOPHY

My students are often amazed by the various climatic conditions of nature and they are searching for some scientific data to explain the different phenomena of nature. They are not content with the traditional folklore, even though the folklore piqued their curiosity and stimulated their critical and analytical thinking abilities.

In expanding one's knowledge, the use of technology is essential in today's society. As with the use of weather, technology makes predicting weather more accurate.

To motivate the students I will introduce my unit with folklore. Early man used stories to explain weather. Early Greek believed that gods caused the weather, and traditionally in some cultures it was believed that the groundhog could predict weather.

Prior to making a weather forecast there are many elements to be considered. Elements that affect or cause weather are heat, air, pressure, wind, and moisture. Data on these elements are continuously being collected from various locations throughout the country and world in order for the meteorologist to make a weather prediction.

Meteorologists use many instruments to collect weather data. These instruments play a very important role in accurate weather predicting. The instruments that raised the highest level of interest to my students in the areas of critical thinking and problem solving skills as related to weather were the aneroid barometer, the weather satellite, the computer, the anemometer, the rain gauge, the thermometer, and the hydrometer.

One cannot think about weather without thinking about climate. Climate is weather, but at a given place over a long period of time. Climate is affected by physical conditions and classified according to average temperature, rainfall and seasonal cycles.

Weather predictions require rapid communication which is vital to accurate forecasting. It requires a network of people collaborating together around the world collecting and sending out weather data. This continuous cycle of weather data affects the lives of many people in many different ways.

It is through the network method of communicating weather data that we come to realize even more that weather affects our lives. Weather lets the farmer know when to plant and when to harvest. Weather dictates

around the world what to wear as well as what not to wear, types of houses to build, types of industry, recreation, and the list goes on. Weather does indeed have a great affect on life.

The effect of the weather on the lives of my students have prompted them to ask many questions. They have very little faith in the predictions of the meteorologist. Their multiple questions ad concerns have directed me in selecting the topics in this unit. My objective was to address all of their concerns scientifically and stimulate their critical thinking through the use of manipulatives, observations, hands-on-activities, resources and visual aids.

Some problems that may arise out of this unit are the ability of students to work in groups, following written directions, using manipulatives, comprehension of weather terminologies, reading graphs and charts as well as making them, field trips, securing resources and making predictions.

An asset to teaching this unit is the possibility that a student may choose meteorology as a career. This unit can be used in grades 7-9 and for a duration of 2-3 weeks. This unit includes a career— meteorology, resources, vocabulary, a pretest/post test, hands-on activity, lesson plans, teacher and student reading lists and bibliography.

Folklore

Over the years man has used many devices or techniques to predict weather. Weather watching is considered to have been one of the earliest past-times. Early Greeks believed that the god Thor caused thunder and lightening. They believed that Thor rod through the heavens striking clouds with a huge hammer making loud noises and causing sparks to fly. Folklore was one of the early methods used to predict weather. Traditionally it was believed that if the groundhog saw his shadow there would be six more weeks of bad weather. Groundhog Day, February 2nd, is the day this observation is suppose to take place. The American Indians believed that rain dancing while chanting would cause rain. Weather lore such as:

Red sky at night shepherd’s delight Red sky at morning, shepherd’s warning.

Such weather lore is interesting to listen to, but it is better to rely on science for accurate forecasts. However, there are some weather rhymes and rules that are reliable:

Rain before seven Fine before eleven.

Rain belts usually last about four hours in the summer.

The moon and the weather May change together, But a change of the moon Does not change the weather.

The moon’s appearance is useful in predicting rain. Present in rain clouds are ice crystals that produce a halo around the moon.

Today we use more sophisticated technology. The ability to quickly collect weather data from many surrounding areas make it possible to give more accurate weather forecast.

WHAT CAUSES WEATHER?

Weather is always moving and changing. This is due greatly to high pressure, low pressure and the wind. The elements of which weather is made are heat, pressure, wind and moisture. Without the interacting of these elements there would be no changes in the weather. Without winds there would be changes in air pressure, no storms, rain nor snow.

Heat is the source that mixes the atmosphere to make weather. The sun's energy is transmitted as waves that are similar to radio waves. Most of the solar energy is lost in space, only traces reach the earth. Approximately 43% of the sun's radiation reach our planet and is changed to heat, the remainder stays in the atmosphere or is reflected into space.

The earth's atmosphere acts like a greenhouse. The earth's atmosphere admits most of the solar radiation and when it is absorbed by earth's surface it is re-radiated as heat waves. These heat waves are trapped by vapor in the atmosphere and the earth is kept warm.

Local winds and breezes are caused by convection. Different land and water surfaces absorb different amounts of heat. Dark soil absorbs more heat than grassy fields. During the day, mountains absorb more heat than valleys and lose it faster at night.

The air is heated primarily by its contact with the warm earth. When air is warmed it expands and becomes lighter. As a layer of air is warmed, it rises and is replaced by colder air which flows in under it. This cycle is called convection. So warm air at the equator is replace by colder air flowing in from the north and south poles. The light air rises and moves poleward where it is cooled and sinks, replacing the cool surface air which moves toward the equator.

The air atmosphere that surrounds the earth is made up of layers of gases that protect us from extreme cold or heat. The lowest layer is the troposphere. The troposphere contains water vapor and is where our weather occurs.

INSTRUMENTS FOR COLLECTING WEATHER DATA

Weather stations use many instruments to collect weather data in order to make good weather predictions.

Satellite: The first weather satellite was put into orbit in 1960. Weather satellites send back pictures of clouds and storms around the earth.

As the satellite orbits the earth, it turns like a wheel. Pictures taken by the satellite are put together to show cloud patterns. Special cameras aboard the satellite can take infrared pictures to show different surface temperatures. The difference in surface temperature is indicated by different colors. Satellites are especially helpful in areas where there are no weather stations to record weather conditions.

TIROS (Television and Infra-Red Observation Satellite) is equipped with cameras, radiometers, and various measuring devices. The photographs transmitted to earth show clouds land forms, sea ice, snow, and hurricanes. Radiometers measure infrared radiation from the earth and its atmosphere. The data gathered are

radioed to earth and converted to temperature maps. The information gathered is used to study the heat balance of the atmosphere from radiation measurements.

Certain types of air masses contain certain cloud patterns. Weather satellites are capable of taking pictures of clouds covering a large area. Once the data is gathered it will aid the meteorologist to formulate what kind of weather the clouds and air masses are likely to bring.

Aneroid Barometer: Air pressure can be measured with an aneroid barometer. This instrument has no liquid in the barometer. The word aneroid means dry. Most of the air is removed from the thin, flexible metal box, diaphragm. The metal box is then closed so that the inside has lower air pressure.

When the outside air pressure increases, it will cause the diaphragm to push in by the higher outside pressure. Higher pressure inside the box pushes the diaphragm outward when the outside pressure is low. When the air pressure changes, a needle will move along a dial indicating. When the outside air pressure increases, the diaphragm pressure inside the box pushes the diaphragm outward when outside pressure is low.

Anemometer: The speed of wind is measured by using an anemometer. An anemometer has spokes and cups on the ends of each spoke to catch the wind. The spokes turn on an axis. The higher the velocity of the wind, the faster the cups move. A cable connects the anemometer and the measuring device. A needle is attached to the anemometer, and a dial moves across a scale to indicate the speed.

Rain Gauge: A rain-gauge is used to measure rainfall. The rain gauge is made up of a funnel and a bucket. Rain is caught in the funnel and drained into the bucket, and a measuring stick is dipped into the bucket to measure the amount of precipitation. Thermometer: Thermometers measure the temperature of air. In the U. S. the common one used is the Fahrenheit scale. On the Fahrenheit scale, water freezes at 32 Fahrenheit and boils at 212 Fahrenheit. At 70 Fahrenheit, air temperature is comfortable.

The Celsius scale is another scale used to measure temperature. On the Celsius scale, water freezes at “0” Celsius and boils at 100 Celsius. 20 is the most comfortable weather.

Meteorologists use the Celsius scale, but the temperatures are made known to the public as Fahrenheit temperatures because of familiarity.

The principle that thermometers work on is that most things expand when heated and contracts when cooled. The common household thermometer is a hollow glass tube closed on both ends and a liquid inside. Heat causes the liquid to expand and move up the tube.

Computer: Computers gather information from around the world. They draw complex weather maps indicating the location of air masses and how they are likely to move. The maps that are shown by the television

CONDITIONS (FACTORS) AFFECTING WEATHER

Moisture in the air: Water exists in three states; in the air, solid, liquid and invisible water vapor. Water vapor or moisture in the air is known as humidity.

After rain has fallen there are some standing puddles of water. When water is heated the molecules move

apart. It heated enough, the molecules will break off and fly into space. We call this process evaporation. Seventy-eight percent of the earth is covered with water. Warm air over bodies of water evaporates some of the water into the air in the form of water vapor.

Other than lakes, streams, and oceans sending up steady streams of water vapor, green plants send up an amazing amount also.

Relative humidity is the amount of vapor the air is holding expressed as a percentage of the amount the air could hold at that particular temperature. Relative humidity goes up when air with a given amount of water vapor cools and drops when the air is warmed. Warm air can hold more water than cold air.

Warm moist air rises and will slowly cool. When it cools to the point where the relative humidity reaches 100%, clouds will form. The process of evaporation, condensation, and precipitation is called the water cycle.

Heat energy: In order for the air to be mixed, heat is needed. All of the changes that take place in the atmosphere are due to temperature changes in different parts of the atmosphere.

The sun is a glowing ball of gas that radiates 74 million watts from each square meter of ratio. This energy can illuminate 740,000 one hundred watts light bulbs. Most of the sun's radiant energy misses the earth because it radiates in all directions. About 43% of the radiant energy reaches Earth's surface and is changed to heat. The earth is warmed by absorbing, storing and recycling radiant energy.

The sun's energy that is absorbed by the Earth is spread out in the atmosphere in three ways: (1) conduction: direct transfer of heat energy from one substance to another; (2) convection: transferring of heat energy in a fluid such as gas or a liquid, and (3) radiation: the transfer of heat energy through empty space.

Winds: Winds are caused by convecting currents of air. The hot air at or near the equator rises. The hot air then circles around the upper atmosphere, cools, and drops near the tropics. Sometimes the hot air drops as far north as the Arctic or as far south as the Antarctica. The hot air that falls at the tropics spread south and north forming surface winds. The winds that blow back toward the equator are called "trade winds". Those winds that blow away from the equator are called "westerlies".

The cold heavy air that sinks, causing regions of air pressure, are the source of major winds. The main winds of the world all blow from high pressure regions to low pressure regions.

At 50 degrees north and south the westerlies are the main winds. In the northern hemisphere the main winds are the south westerly and in the south they are north westerly; meaning they blow from the southwest or northwest. Winds get their names from the direction from which they blow. Trade winds are north easterly in the northern hemisphere and south easterly in the southern hemisphere.

Air masses of North America often move from west to east. This is also the direction of the prevailing westerlies wind. The great flow of air is caused by the rotation of the earth and planet wide patterns of heating and cooling. The turning of winds is known as the Coruolis effect, which is due to the rotation of the earth.

Air pressure: Air is an invisible gas and has weight. The weight of the atmosphere when pressed down on the earth causes force on each square inch of surface it touches. The face is referred to as atmospheric pressure of air pressure.

Air pressure changes with altitude and temperature. At sea level, per square inch, the atmospheric pressure is

about 14.7 pounds. At higher elevations there are fewer air molecules spread out and as the air is cooled the molecules come closer together. The more molecules there are in the same space, the greater the atmospheric pressure. Warm air has less pressure than cold air.

CLIMATE—PHYSICAL CONDITIONS

When we talk about climate we are referring to weather at a given place over a long period of time. The general measurements of climate are the average yearly temperature and the average yearly rainfall, and the seasonal cycle.

There are differences in the climate between towns and surrounding country sides. Urban areas are warmer than rural areas because all the buildings soak up heat and retain it. Heat is also being given off by central heating and by people. There is more sunshine in rural areas than in towns because of the pollutants in the atmosphere.

Local climatic patterns are called microclimates. Microclimate is the study of local weather of a small area. Plants create microclimatic differences, primarily by their use of water and their effect on winds. In farm areas, wind breakers are gown to make favorable microclimates.

Latitude: The physical conditions that affect climate are latitude, prevailing winds, ocean currents, nearness to the sea, altitude, and mountains. The affect latitude has on weather is the way that the earth is heated by the sun. Temperature varies with distances from the equator. The distance from the equator is measured in degrees of latitude, which are the lines across a map. The equator is 0° around the equator, and there is no winter season.

The North Pole is 90° north latitude and the South Pole is 90° south latitude, and the sun’s rays strike at a slant and are without direct sun for half the year. In the temperature zone, 30° to 60° latitudes north and south are the middle latitudes. Here summer temperatures can equal that in the tropics and winter temperatures are almost equal to that near the poles.

Prevailing winds: The United States major air flow is from slightly southwest to slightly northwest. The air flows in this manner because of the repeated invasion of cold air from the polar front coupled with the complications caused by air that is forced over mountains that the weather of the United States is unstable. Violent weather changes are caused by polar fronts and other factors. Most of North Americans live in the belt of “Prevailing Westerlies Winds”. Prevailing Westerlies are air masses often from west to east.

Ocean Currents: Bodies of water do not heat up as quickly as bodies of land. Over the period of summer, bodies of water become warmer and warmer. Bodies of water maintain their heat longer than bodies of land. In the winter the ocean is warmer than the land.

Ocean currents are caused by convecting currents in the ocean. The unequal heating of the ocean causes the currents to rise. The winds push the surface currents along. As ocean currents move they warm or cool the air above them and consequently the warm or cold currents near land can affect the climate. Areas where the wind blow from the ocean toward land have more annual rainfall than area where the winds blow toward the water.

Nearness to sea: Nearness to the sea has a part to play in the climate because air masses change with seasons and warm or cool ocean currents off shore.

Altitude: Altitude is distance above sea level. Consequently altitude affects air pressure. The higher you ascend above sea level the air gets thinner or less dense and the air pressure also decreases with increasing elevations.

Mountains: A contributing factor that determines the weather or climate, are the mountains. When air masses collide with high mountains they may either rise above the mountains or turn aside.

CLIMATE

The earth has three major climate zones; polar, temperate and tropical. The four seasons are fall, winter, spring and summer. The seasons are caused by the tilt of the earth. The earth rotates from west to east on its axis once about every twenty-four hours. The imaginary axis of the earth has a diagonal tilt of a 23.5° angle. As the earth rotates around the sun for several months it tilts toward the sun and for the equal amount of time it tilts away from the sun.

When the Northern Hemisphere tilts toward the sun, it is considered summer. When the Southern Hemisphere tilts away from the sun that will be winter in that area. The greatest amount of heating occurs when the sun is most direct, therefore summer and winter do not occur simultaneously around the world. It is during spring and autumn when neither hemisphere is tilted toward the sun.

Temperature: Climate can be referred to as the generalized weather of an area. There are many factors that affect climate and are often times classified by a combination of temperature (torrid, temperature, frigid) and rainfall (wet, humid, sub-humid, semi-arid). In the most commonly used systems, rainfall for the torrid and temperature zones and temperatures for the colder zones are stressed.

Rainfall: Due to the general direction of wind, land surface near the water usually have more rainfall than the inland. Climate is also dependent upon the amount of annual rainfall. Arid or very dry area receive an annual rainfall of 0-10 inches of rain. Semi-arid areas receive 10-20 inches. Areas receiving 20-40 inches of rain annually are considered humid. Over 40 inches of rainfall annually are considered very humid.

Wind-belts move slightly with seasons. This shifting causes one season to have more rain than the other. Temperature is an element that makes weather. All weather is dependent upon the temperature changes in different parts of the atmosphere.

PREDICTING WEATHER

The upcoming weather is important to many people for a myriad of reasons. The governments set up weather stations all over the world to observe and record weather on a daily basis. The ships at sea carry weather instruments to aid in gathering at the same time. The gathered information is then sent to other weather stations. Computers are used for rapid preparation of maps and charts. Weather information is recorded using

symbols. (See diagram #1)

After weather data has been collected, meteorologists draw lines between weather stations reporting the same barometric pressure. Lines indicating equal pressure are the isobars. They also do the same for stations with equal temperatures. Theses lines are called isotherms. Isobars help locate the high and low pressure areas. Isotherms help to locate warm and cold air masses.

It is through the studying and comparing of maps showing cold and warm fronts, highs and lows over several days that weathermen can predict weather. Weather can be predicted from the past direction with the speed of highs and lows the kind of weather in different localities can expect.

In order for the meteorologist to predict weather, he must find the air masses, identify them, discover how fast and in what direction they are moving. Because of the size of masses, it requires many weather stations all over the world working together in tracking them down. Weather data is sent daily to the three world Weather Centers; Suitland, Maryland, USA; Moscow, USSR, (before the split) and at Brisbane, Australia.

Forecasting is based on knowledge and there is never enough information available to be absolutely sure about what the weather is going to do next. Weather forecasting for the next few hours are normally very good, but if made for 2 or 3 days ahead they are less likely to be accurate. General forecasts about the likely-hood of weather does not give precise details. They are based on studies made from past conditions.

AFFECT ON LIFE

Weather is very much a part of our lives. In agriculture and industry climate data is very important. There are many decisions in our personal lives that can be better made if climate data is taken into consideration. An example is whether or not to bring an umbrella on a particular day.

Some extremes of weather are near the equator and the polar area. Near the equator it is always warm during the day and cool at night, and the people wear light clothing. In the polar area it is always cold. The local inhabitants of the Arctic wear warm clothing year round.

Because of the variations of weather, people in different parts of the world live in houses different from people in other parts of the world. In Switzerland, the roof of houses have gentle slopes that allow snow to stay without falling off. This helps to insulate the house and keep the warmth from escaping.

Weather is an important factor in the life of the farmer because he needs to know the length of growing seasons, extremes of temperature and rainfall for a successful growing crop. A cold spell can be disastrous to a crop and cause a financial burden on the farmer, and the consumer will also feel the affects by paying higher prices.

Meteorologists have found that the same weather occurs repeatedly over the same place. Records show that Florida has warm winters and that Illinois has cold winters. Some winter days in Florida are cool and some winter days in Illinois are warm. Nevertheless, weather in Florida is usually warm and Illinois is usually cold.

CONCLUSION

Many have said, “the winter of 1993 and 1994 in New England was unusual”. Many households listened attentively to what the meteorologist had to say about the weather. The deep concern was how to prepare for the day or days to come. These preparations included dress, work, recreation, food, and shelter. In the back of a lot of minds was the question, “can we really trust the meteorologist”?

Weather is always changing and the changes are due greatly to high air pressure, low air pressure, and wind. The radiant energy from the sun is the invisible source that mixes the air, and makes our weather what it is.

VOCABULARY

1. Troposphere—the lowest level of the atmosphere which extends outward from the earth’s surface, and in which generally temperature decreases rapidly with altitude, clouds form, and convection is active.

2. Air pressure—pressure exerted on the earth by gravity pulling the air toward earth’s surface.

3. Wind—convecting current in air.

4. Local winds—blow from any direction and cover a short distance.

5. Global winds—blow from a specific direction and usually travel long distances.

6. Radiant energy—visible and invisible energy from the sun that moves in waves. The process by which heat is transferred through a substance.

7. Conduction—from one substance to another by direct contact of one molecule with another.

8. Convection—transfer of heat energy in a fluid (gas or liquid). 9. Radiation—the transfer of heat energy through space.

10. Barometer—an instrument for measuring air pressure.

11. Air mass—large body of air that has the same temperature and humidity throughout.

12. Humidity—the amount of water vapor in the air.

13. Condensation—the changing of gas into a liquid.

14. Cumulus cloud—a puffy white cotton ball-like cloud with a flat base.

15. Cold front—a boundary formed when a cold air mass slides under a warm air mass and pushes the warm air along.

16. Warm front—the boundary formed when a warm air mass slides over a cold air mass and pushes the cold air along.

17. Climate—average weather in a given area over a long period of time.

18. Meteorology—the science that deals with the study of the atmosphere and the weather.

19. Microclimate—the smallest climate zone.

20. Altitude— height above sea level.

21. Latitude—distance north or south of the equator in degrees.

22. Weather—a condition of the atmosphere.

23. Anemometer—instrument used to measure wind speed.

24. Rain gauge—instrument used to measure rainfall.

25. Thermometer—instrument used to measure temperature.

26. Folklore—stories handed down from generations past.

27. Forecast—foresight of consequences and provision against them.

PRE-TEST/POST-TEST

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1. Where does the heat in the atmosphere come from?
2. In which part of the atmosphere does our weather occur?
3. How did the Ancient Greek explain thunder and lightening?
4. How does moisture get into the atmosphere?
5. Which gives the most heat, vertical rays or slanted rays?
6. How are weather changes predicted?
7. What is climate?
8. Why does evaporation change to a gas?
9. How many thermometers does a psychrometer need to show relative humidity?
10. What is condensation?
11. What is dew point?
12. Describe a cumulus cloud.
13. Define precipitation.
14. What is the surface between different air masses called?
15. What is the name of a tropical storm with very strong winds?
16. What is altitude?
17. Where is the tropical zone located?
18. What are the major climate regions of the U. S. ?
19. At what degree does water freeze/boil in fahrenheit and celsius? 20. What conditions affect climate?

21. What is the use of a thermometer?
22. How does weather affect your life?
23. Which heats up faster, the ocean or land?
24. What is Earth's source of energy?
25. What are the three forms that water can exist?

RESOURCES

Video: The Geography Tutor
Vol. 5 Weather and Climate
Tell Me Why Sales Company
730 Washington Street
Marina Del Rey, CA 90292
(213) 821-3329
* Answers questions concerning weather and climate.

Classroom Presentation: Local TV Meteorologist

Topic: "Weather Forecasting"

Career: Meteorology, is the science dealing with the atmosphere. Meteorologist study the various forces that keep the atmosphere in motion. The study of climate and weather is the most outstanding part of meteorology. Weather Forecasting can emerge out of meteorology. The weather forecaster collects information about current weather conditions and makes a prediction based on that information.

LESSON PLAN I

After reviewing the topic Folklore, the students will be able to: 1) verbally relate to folklore as a traditional method used to predict weather; 2) list 4 layers of the atmosphere; and 3) verbalize the causes of weather.

I. Weather folklore
    A. Weather myths (gods)
    B. Traditional myths
        1. Caribbean
        2. U. S.
        3. Other countries
II. What causes weather
    A. Sun
    B. Greenhouse effect
    C. Convection
III. Diagrams
    A. Layers of the atmosphere
    B. Greenhouse effects
IV. Class activities
    A. Ditto—Weather Term Puzzle (Part 1)
    B. Heat absorption by gases—2 days
V. Homework
    A. Do Part 2 of ditto

(figure available in print form)

LESSON PLAN II

After completing the topic, Factors Affecting Weather, the students will be able to: 1) list 3 forms of water; 2) explain relative humidity; 3) recite earth's source of energy; and 4) explain what causes wind.

1. Conditions affecting weather
    A. Moisture in the air
    B. Heat energy
    C. Winds
    D. Air pressure

II. Activities (Allow the class to work in groups of not more than 4)
    A. Predictions about air pressure (see ditto)
        1. Review the activity orally twice with the class
        2. Be sure to ask for questions
        3. Stress safety precautions
    B. Activity *10-10 Measuring Humidity With Hair*
        1. Same groups
        2. Same precautions and procedures

III. Have the groups share their answers

IV. Length of class and activities (2 days)

LESSON PLAN III

Upon completing the topic, Predicting Weather, the students will be able to: 1) explain 10 weather symbols; 2) explain why collecting and sharing weather data is important; and 3) explain how weather persons are able to predict weather.

I. Predicting weather
    A. Draw and explain the weather symbols (see ditto) you may want to expand to more symbols.
    B. Explain what goes into collecting data
        1. Collected from around the world
        2. Once data reaches weather station it goes into computer, and maps are made with the various symbols
        3. The job of the meteorologist
II. Activity: *A Cloud In the Bottle Is Worth Two In The Sky* .
    A. Two groups
    B. Stress safety precautions
    C. Review the activity

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