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STUDY GUIDE: WEATHER

The study of weather is called **meteorology**, and the scientist who studies the weather is a **meteorologist**. Weather is defined as the "condition of the earth's atmosphere."

Scientists divide the earth's atmosphere into four layers.

1. **Troposphere**: The lowest layer nearest the earth, approximately 18 kilometers thick. Weather occurs in the troposphere.
2. **Stratosphere**: The second layer which reaches from the troposphere to about 50 kilometers above the earth's surface. Jets usually fly in the stratosphere.
3. **Mesosphere**: The third layer.
4. **Thermosphere**: The uppermost layer extending to about 500 kilometers from the earth's surface.

FOUR MAIN ATMOSPHERIC FACTORS AFFECT THE WEATHER AND CAUSE IT TO CHANGE.

1. temperature 2. air pressure 3. wind (moving air) 4. humidity

Temperature is a measure of the heat energy. The majority of our heat energy comes form the sun, and it is called radiant energy. Part of the sun's energy is reflected away from the earth by the ozone layer in the stratosphere. The rest of the sun's energy is absorbed by the earth, and it is spread through the atmosphere. There are three basic ways the sun's energy is spread throughout the atmosphere:

1. **Conduction**: Heat energy is directly transferred from the warm ground to the air directly above it.
2. **Convection**: Heat is transferred within the air or other fluids. The warmed air near the earth's surface becomes less dense and rises. Cooler air moves in

toward the earth's surface. As it becomes heated, it also rises, causing convection currents.

3. **Radiation**: Heat is transferred through empty space from the sun to the earth.

Temperature is measured in degrees by using a thermometer. On the Celsius scale, water freezes at 0 degrees and boils at 100 degrees. On the Fahrenheit scale, water freezes at 32 degrees and boils at 212 degrees.

The wind chill index (wind chill factor) measures how cold it feels, and the heat index indicates how warm the air temperature feels.

Isotherms: Lines drawn on a weather map that connect places with the same temperatures.

Air pressure is a measure of the force of air that's pushing down on the earth's surface. Denser air exerts more air pressure than less dense air.

Three Main Factors that Affect Air Pressure:

1. **Temperature**: Warm air is less dense than cold air. The molecules are spread farther apart, and therefore, the mass of a volume of warm air is less than the mass of a similar volume of cold air.
2. **The Amount of Water Vapor in the Air**: As the amount of the water vapor in the air increases, the mass of the air decreases, and the air becomes less dense.
3. **Elevation (Altitude)**: Air becomes thinner and less dense as the altitude increases. The air pressure decreases as one travels higher into the atmosphere.

In most cases, **high air pressure** usually means **fair weather**. **Low air pressure** usually brings **cloudy, rainy weather**.

Isobars: These are curved lines on a weather map that connect places having the same air pressure.

Winds are moving air. Winds flow from areas of high pressure to an area of lower pressure. A large body of air having approximately the same temperature and moisture content is called an **air mass**. The boundary between two air masses is called a **front**.

Four Types of Fronts

1. **Warm Front**: Warm air moves into a cold air mass. Because the density of the warm air is less than that of the cold, the warm air mass slides up over the cold air mass. Rain and showers are common. The weather becomes hot and humid. Warm fronts are marked on a weather map by placing semi-circles above a line.

2. **Cold Front**: Cold air moves toward a warm air mass, forcing the warm air up over the colder air. Violent storms accompany cold fronts. Cold fronts are shown on a weather map by putting triangles under a line.
3. **Stationary Front**: Two air masses meet, and neither mass moves. Such fronts may cause several days of rain.
4. **Occluded Front**: A cold front overtakes a warm front and pushes the warm front upward. As it does, the cold front comes in contact with cool air, and the two masses merge.

Four Major Types of Air Masses that Affect U.S. Weather

1. **Maritime Tropical Air Mass**: Forms over the ocean near the equator and contains warm moist air that causes high humidity.
2. **Maritime Polar Air Mass**: Forms over the Pacific Ocean and the North Atlantic waters, causing fog in California, and cooler temperatures to eastern sections of our country.
3. **Continental Tropical Air Mass**: Forms over Mexico in the summer and brings hot, dry air to the southwestern United States.
4. **Continental Polar Air Mass**: Forms over land in northern Canada, and brings extremely cold air and temperatures to the United States in the winter.

Humidity is the amount of moisture, or water vapor, in the air. Warm air can hold more water vapor than cold air. **Relative humidity** is the percentage of moisture that is in the air, compared to the amount that same air could hold at a particular temperature. If a volume of air is holding all the water vapor that it can hold at that temperature, the relative humidity is 100%.

Clouds are formed when water vapor begins to condense. The temperature at which the vapor condenses is called the **dew point**.

Four Basic Types of Clouds

1. **Cumulus Clouds**: These are thick, puffy, white clouds that resembles piles of cotton in the sky. They are usually associated with fair weather.
2. **Stratus Clouds**: These clouds appear in layers. They cover the entire sky, and often block the light from the sun, causing it to be overcast. Light rain accompanies these clouds.
3. **Cirrus Clouds**: These high curly clouds are usually filled with ice crystals. They were once called "mare's tails" because of their curved shape. They are most often associated with rain or snow.
4. **Nimbus Clouds**: These are the black, rolling, rain clouds that develop when cumulus clouds get dark on the bottom, forming thunderheads that are often called cumulonimbus clouds.

Precipitation is moisture that falls from the clouds to the earth. There are four main types of precipitation: **rain, snow, sleet, and hail.**

Frost is water vapor that turns to ice on an object.

Acid rain is caused when water vapor condenses on sulfate and nitrate particles in the atmosphere. These sulfate particles come from sulfur dioxide, which is released when fuels are burned. Nitrates are added to the atmosphere through the release of automobile exhaust and natural sources like volcanoes. When water vapor attaches to these particles, they fall to the ground as acid rain, causing the soil and water to become acidic.

BASIC WEATHER INSTRUMENTS:

1. **Thermometer**: Measures the temperature of the air.
2. **Anemometer**: Measures the wind speed.
3. **Barometer**: Measures the air pressure.
4. **Wind Vane**: Identifies the direction the wind is moving.
5. **Hygrometer**: Measures the relative humidity by measuring the amount of stretch in a human hair.
6. **Psychrometer**: A special type of hygrometer that uses the differences between the readings on a wet and dry bulb thermometer to determine the relative humidity.
7. **Rain Gauge**: Measures the amount of precipitation.

INTERESTING WEATHER FACTS AND ADDITIONAL TRIVIA

1. The hottest temperature ever recorded in the United States was 134 degrees in Death Valley, California on July 10, 1913.
2. To convert a Fahrenheit temperature to the Celsius scale, subtract 32 degrees from the Fahrenheit temperature, and then multiply the results by 5/9.
3. A tornado is a whirling wind that moves over land. Most tornadoes occur in the late afternoon or early evening hours. More tornadoes occur in the United States than any other country. Winds have reached speeds up to 300 miles per hour in a tornado.

4. July is the warmest month in the Northern Hemisphere. January is the coldest month in this hemisphere.

5. Although Chicago is called the Windy City, it is not the windiest place in the United States. Mt. Washington, New Hampshire is considered the windiest location in our country, having an average wind speed of 35.3 miles per hour. At one time, winds were clocked at 231 miles per hour at Mt. Washington.

6. The least windy city in the United States is Oak Ridge, Tennessee, which has an average wind speed of 4.4 miles per hour.

7. According to daily temperatures, the two hottest cities in our country are Yuma, Arizona and Phoenix, Arizona.

8. Hilo, Hawaii has the record for the most number of rainy days in a year, with 278.

9. April is the only month that tropical storm has not formed on the Atlantic Ocean.

10. The national groundhog appears every year on February 2. His name is Punxsutawney Phil. According to American tradition, the groundhog leaves his burrow where it has been hibernating to see if cold weather will continue. If he sees his shadow, there will be six more weeks of cold weather, and he returns to his burrow. The national groundhog is fed a regular diet of dog food.

11. The Gulf Stream is a warm ocean current in the Atlantic Ocean which flows from the tip of Florida to the outer edge of North Carolina, where it turns toward Europe.

12. The jet stream usually blows from west to east.

13. The cricket can help predict the temperature of the air. To determine the air temperature, count the number of chirps a cricket makes in 15 seconds. Add this number to 67 degrees Fahrenheit, and you will have an accurate estimate of the air temperature.

14. January is the only month of the year that a 100 degree temperature has not been recorded in any U.S. state. The highest January temperature that has been recorded is 98 degrees Fahrenheit in Laredo, Texas.

15. David Letterman was a TV forecaster and meteorologist during his early career years.

16. The foggiest location in our country is Cape Disappointment, Washington. It has three and a half months of dense fog each year.

17. In 1953, we began to name hurricanes after women!

18. The amount of electricity in a single bolt of lighting would cost about $30 if purchased from your power company.

19. The average speed of a snowflake is ½ mile per hour.

20. Strangely enough, it is usually warm and sunny in California just prior to an earthquake.

21. The first weather satellite was called Tiros I, and it was launched from Cape Canaveral, Florida in 1960. It raveled about 500 miles above the earth's surface.

22. On a typical summer day, the relative humidity is at its highest at about 6 a.m.

23. Sir Edmund Halley discovered more than just his comet. He also discovered the Gulf Stream near England.

24. Spiders survive the winter by creating a chemical compound within their circulatory system that keeps their bodies from freezing during the winter. It works in a similar way to antifreeze.

25. In Antarctica, almost all the mountains are snow covered, but Mount Erebus, which stands nearly 12,000 feet, has no snow-capped top. It is an active volcano, and its crater is filled with hot lava, which melts all snow!

26. One million cloud droplets are needed to make one average-sized raindrop.