

Earth Science

Chapter 24

Section 3 – Weather Instruments

E.Q.: *What instruments are used to measure weather in the lower and upper atmospheres.*

STANDARDS:

SES5. Students will investigate the interaction of insolation and Earth systems to produce weather and climate.

- b. Explain the relationship between air masses and the surfaces over which they form.**
- c. Relate weather patterns to interactions among ocean currents, air masses, and topography.**
- e. Describe the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming).**

Objectives

- Identify four instruments that measure lower-atmospheric weather conditions.**
- Describe how scientists measure conditions in the upper atmosphere.**
- Explain how computers help scientists understand weather.**

Measuring Lower-Atmospheric Conditions

Air Temperature

***thermometer* - an instrument that measures and indicates temperature**

- A common type of thermometer uses a liquid—usually mercury or alcohol—sealed in a glass tube to indicate temperature.**
- A rise in temperature causes the liquid to expand and fill more of the tube. A drop in temperature causes the liquid to contract and fill less of the tube.**
- Another type of thermometer is an *electrical thermometer*.**

- As the temperature rises, the electric current that flows through the material of the electrical thermometer increases and is translated into temperature readings.
- A *thermistor*, or thermal resistor, is a type of electrical thermometer that responds very quickly to temperature changes.

Air Pressure

barometer - an instrument that measures atmospheric pressure

- Changes in air pressure affect air masses.
- The approach of a front is usually indicated by a drop in air pressure.

Wind Speed

anemometer - an instrument used to measure wind speed

- A typical anemometer consists of small cups that are attached by spokes to a shaft that rotates freely.
- The wind pushes against the cup and causes them to rotate. This rotation triggers an electrical signal that registers the wind speed in meters per second or in miles per hour.

Wind Direction

wind vane - an instrument used to determine direction of the wind

- The wind vane is commonly an arrow-shaped device that turns freely on a pole as the tail catches the wind.
- Wind direction may be described by using one of 16 compass directions, such as north-northeast. Wind direction also may be recorded in degrees by moving clockwise and beginning with 0° at the north.

READING CHECK

Which instrument is used to measure air pressure?

A barometer is used to measure atmospheric pressure.

Measuring Upper-Atmospheric Conditions

Radiosonde

Radiosonde - a package of instruments that is carried aloft by balloons to measure upper atmospheric conditions, including temperature, dew point, and wind velocity

- The radiosonde sends measurements as radio waves to a receiver that records the information.
- When the balloon reaches a very high altitude, the balloon expands and bursts, and the radiosonde parachutes back to Earth.

Radar

radar - radio detection and ranging, a system that uses reflected radio waves to determine the velocity and location of objects

- For example, large particles of water in the atmosphere reflect radar pulses.
- The newest Doppler radar can indicate the precise location, movement, and extent of a storm. It can also indicate the intensity of precipitation and wind patterns within a storm.

Weather Satellites

- Satellite images provide weather information for regions where observations cannot be made from ground.
- The direction and speed of the wind at the level of the clouds can also be measured by examining a continuous sequence of cloud images.
- Satellite instruments can also measure marine conditions.

Computers

- Before computers were available, solving the mathematical equations that describe the behavior of the atmosphere was very difficult, and sometimes impossible.

- **In addition to solving many of these equations, computers can store weather data from around the world. These data can provide information that is useful in forecasting weather changes.**