



SCIENCE

STUDENT BOOK

▶ **7th Grade | Unit 6**

SCIENCE 706

Weather

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Weather

Introduction

The ocean of air surrounding the earth is the atmosphere. Only in the lowest layer, the troposphere, do daily changes occur. These changes continually affect man and the activities he has planned. Each day we make decisions that are affected by the weather. In the morning we decide which clothes we will wear to keep us cool or warm. We look at the clouds to see if we will need an umbrella or raincoat. If the morning is cold, we may need extra time to scrape the frost off the windshield of the car. If the afternoon is hot, we may need to run the air conditioner in the house or car.

Businesses also must make decisions affected by the weather. In rainy weather farmers cannot work in the fields, carpenters cannot build houses, and shoppers may stay home. People must be warned about tornadoes, hurricanes, blizzards, and floods.

Since the beginning of time, man has been interested in the weather. Most religions of the world worship gods that are supposed to control the weather. God's Word shows us that God created the earth and the atmosphere and is in control of the weather. Job summed up the power God has over nature in Job 42:2. "I know that thou canst do every thing, and that no thought can be withholden from thee."

Since we are continually affected by the weather, it would be helpful to have an understanding of what things make up weather and how they work together. From this understanding we can make forecasts about the weather. These forecasts can help us make better decisions about the activities we plan.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAK. When you have finished this LIFEPAK, you should be able to:

1. Name the main elements of weather and explain how temperature affects weather.
2. Explain what wind is, how it is produced, and how wind patterns are formed.
3. Explain what air pressure is and how it produces air movement around cyclones and anticyclones.
4. Describe the kinds of moisture in the air and how they are measured.
5. Describe the different air masses and where they are formed.
6. Describe the three basic cloud types and how they are formed.
7. Describe the four types of fronts and the weather that is associated with them.
8. Describe the characteristics of different storms.
9. Explain how weather information is gathered and put onto maps.
10. Explain how the meteorologist and the amateur can predict weather.
11. Explain why some weather sayings are useful and others are not.

1. ELEMENTS OF WEATHER

Weather is a description of the atmosphere: hot or cold, wet or dry, calm or stormy, clear or cloudy. The study of these conditions of the atmosphere is **meteorology**. Men who study weather are called meteorologists. The main

elements of weather are **temperature, wind, pressure, and moisture**. These elements work together to produce the conditions of the atmosphere we experience from day to day.

SECTION OBJECTIVES

Review these objectives. When you have completed this section, you should be able to:

1. Name the main elements of weather and explain how temperature affects weather.
2. Explain what wind is, how it is produced, and how the wind patterns are formed.
3. Explain what air pressure is and how it produces air movement around cyclones and anticyclones.
4. Describe the kinds of moisture in the air and how they are measured.

VOCABULARY

Study these words to enhance your learning success in this section.

air pressure (ār presh' ur). The weight of the air pushing down on the earth.

anemometer (an u mom' u tur). An instrument for measuring the speed of the wind.

barometer (bu rom' u tur). An instrument for determining the air pressure.

bimetallic (bī mu tal' ik). Made of two kinds of metal.

condensation nuclei (kon den sā' shun nu klē ī). Particles of dust, soot, or salt on which water vapor can condense.

Coriolis effect (kōr ē ō' lis u fekt'). The tendency of a moving object to curve due to the rotation of the earth.

dew point (dü point). The temperature to which the air must be cooled to become saturated with water vapor.

highs, or anticyclone (hīz; an tē si' klōn). A system of winds that rotate clockwise around the center of a high-pressure area.

humidity (hyü mid' u tē). The amount of water vapor present in the atmosphere.

jet stream (jet strēm). A ribbon of fast-moving air in the upper troposphere traveling often over two hundred fifty miles per hour.

lows, or cyclone (lōz; sī' klōn). A system of winds that rotate counterclockwise around the center of a low-pressure area.

meteorology (mē tē u rol´ u jē). A study of the atmosphere, especially weather and weather forecasting.

precipitation (pri sip u tā´ shun). Moisture falling from the clouds as snow, rain, sleet, or hail.

relative humidity (rel´ u tiv hyü mid u tē). The ratio of the amount of water vapor in the air to the maximum amount of water vapor that the air could hold. Relative humidity is expressed as percent and varies with temperature.

temperature (tem´ pur u chur). The measure of the amount of heat an object possesses.

thermometer (thur mom´ u tur). An instrument for measuring temperature.

weather (weth´ ur). The state of the atmosphere.

wind (wind). The movement of air over the surface of the earth.

wind vane (wind vān). A movable instrument for showing the direction of wind.

Note: All vocabulary words in this LIFEPAK appear in **boldface** print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.

Pronunciation Key: hat, āge, cāre, fār; let, ēqual, tērm; it, īce; hot, ōpen, ōrder; oil; out; cup, pūt, rüle; child; long; thin; /ʃh/ for then; /zh/ for measure; /u/ represents /a/ in about, /e/ in taken, /i/ in pencil, /o/ in lemon, and /u/ in circus.

TEMPERATURE

Temperature is the measure of the amount of heat an object has. The higher the temperature, the more heat an object has. Temperature, more than anything else, affects the **weather**. To understand how weather is affected by temperature, we must look at the source of heat energy and how the heat of an object can be measured.

Solar radiation. Like many things in nature, weather needs energy to keep it going. The energy necessary for weather changes is heat energy. Nearly all heat energy comes from the sun. Some of the solar radiation received by the earth is reflected back to space by the atmosphere, clouds, and earth's surface. The rest is absorbed by the atmosphere and earth and is changed into heat energy. The troposphere is heated from *below* by the surface of the earth. As a result, the troposphere is warmer at the bottom than at the top.

Not all parts of the earth's surface receive the same amount of solar radiation. The equator is heated more by the direct rays of the sun.

The sun's rays strike the polar regions at a low angle and heat the surface much less than at the equator. These *differences in temperature* are the main cause of weather conditions.

Thermometer. Words like *hot* or *cold* may mean different things to different people. A hot day to an Eskimo may be a cold day to someone living in the Sahara Desert. Scientists have devised a way of measuring the heat of an object so that people all over the earth can know exactly how hot it is. This instrument is called the **thermometer**. *Thermo-* means *heat* and *meter* means *an instrument for measuring*; *thermometer* means *an instrument for measuring heat*.



Fahrenheit and Celsius Temperature Scales

All objects are made up of tiny particles called *atoms*. Atoms are continually in motion. The more heat an object has, the faster the atoms move. As the atoms move, they bump into one another and spread out. Heat causes an object to spread out, or *expand*. **Bimetallic** and liquid thermometers measure temperature by measuring how much the metal or liquid expands as it is heated.

In measuring the temperature of different objects, scientists use different temperature scales. Two common temperature scales are Fahrenheit and Celsius. In the Fahrenheit scale, water freezes at 32°F and boils at 212°F. On the Celsius scale, water freezes at 0°C and boils at 100°C. Although the numbers are different, they mean the same thing. Numbers like 72° and 100° are meaningless unless the scale used is also given.



Match these items.

- | | | | |
|-----|-------------------|----|--|
| 1.1 | _____ meteorology | a. | means <i>heat</i> |
| 1.2 | _____ thermo- | b. | study of the atmosphere |
| 1.3 | _____ thermometer | c. | an instrument for measuring temperature |
| 1.4 | _____ temperature | d. | a measure of the amount of heat in an object |
| | | e. | means <i>an instrument for measuring</i> |

Write the letter of the correct choice.

- 1.5 Weather is affected more by _____ than by any other element of weather.
 a. temperature b. wind c. pressure d. moisture
- 1.6 Energy for weather changes comes from the _____.
 a. top b. sun c. center of earth d. clouds
- 1.7 The warmest part of the troposphere is the _____.
 a. top b. middle c. bottom d. clouds
- 1.8 The part of the earth that receives more solar radiation than any other part is the _____.
 a. equator b. middle latitudes c. poles d. axis

**Complete these sentences.**

- 1.9** Common temperature scales are the a. _____ scale and the b. _____ scale.
- 1.10** The freezing point of water is a. _____ °F and b. _____ °C.
- 1.11** The boiling point of water is a. _____ °F and b. _____ °C.

Answer these questions.

- 1.12** What are the main elements of weather?
 a. _____ b. _____
 c. _____ d. _____
- 1.13** How is the troposphere heated? _____

- 1.14** Why do the poles receive less solar radiation than does the equator? _____

- 1.15** How does heat affect the atoms in an object? _____

- 1.16** How do thermometers work? _____

Use Data Table 1 to organize the weather information you will gather each day. The information can be obtained in many different ways. Weather reports are usually included as a part of news programs. Some newspapers print a record of the weather facts of the previous day. Many areas of the country have twenty-four-hour weather stations, which broadcast weather data continuously. You can gather

information by using a high-low thermometer, **barometer**, hygrometer (for measuring humidity), **wind vane**, **anemometer**, and a rain gauge.

Gather the weather information for two weeks. A longer period is more desirable. Record the month, day, year, and hour the facts are recorded. Take all readings at the same hour each day.

Data Table 2							
	Temperatures		WInd		Rain or Snow	Humidity	
	Colder	Warmer	SW-N	NE-S		Incr.	Decr.
Rising barometer							
Falling barometer							



Answer these questions.

1.17 What weather conditions occurred most often with a rising barometer?

1.18 What weather conditions occurred most often with a falling barometer?

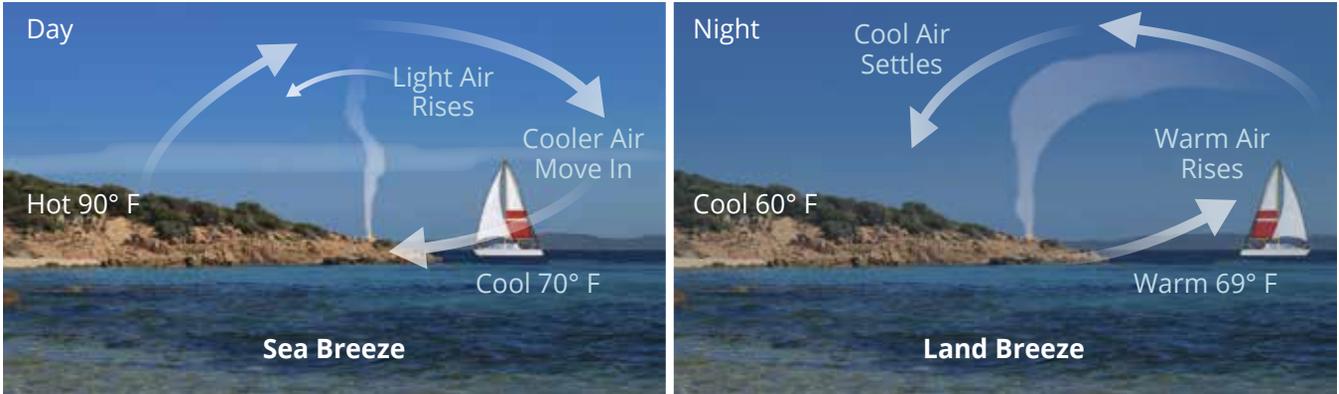
WIND

Wind is the movement of air over the surface of the earth. The energy necessary for air movement comes from uneven heating of the earth and the resulting temperature differences. As air is warmed, it expands and becomes less dense (lighter) than surrounding air. Cooling air contracts and becomes more dense (heavier). Warm air rises, and cold air sinks to fill in the space left by the rising warm air. These differences in temperature and the resulting air movement produce wind.

Air movement plays an important role in weather. Meteorologists use instruments to

measure the direction and speed of the wind. Air movement occurs on a small, local scale and on a large, worldwide scale.

Instruments. Wind vanes are instruments used to measure the direction from which the wind is coming. For example, a north wind is coming *from* the north. The arrow on the wind vane points in the direction *from* which the wind is coming. Winds coming from a direction between the points of a compass are named by using both directions, such as *northeast*, *southeast*, *northwest*, and *southwest*.



| Coastal Breezes

Anemometers are used to measure the speed of the wind. An anemometer has spokes with cups attached to the ends. As the wind blows, the cups spin. By measuring how fast the cups are turning, the meteorologist can determine the speed of the wind. In the United States the speed is measured in miles per hour.

Local winds. Uneven heating in a small area can create gentle breezes. Not all parts of the earth's surface absorb heat equally. During the day air over water is cooler than air over land. Air over land covered by grass and trees is cooler than air over land that is barren.

Coastal breezes are caused by the differences in temperature over land and water during the

day and night. At night the land cools faster than the water. Air over the land cools and sinks while air over the water rises. Warm and cool air move to fill the space left by the other. During the day the temperatures are reversed (warm land and cool water) and the air movement is reversed.

Differences in temperature over land can produce the same results as coastal breezes. Over cultivated fields, rocky mountain slopes, and paved cities, air is heated during the day and rises. Over the surrounding vegetation, air is cooler and sinks to fill the space left by the warm air.



Complete these sentences.

- 1.19 Wind is _____
_____.
- 1.20 Wind is caused by _____.
- 1.21 Air that is warmed becomes a. _____ and it
b. _____.
- 1.22 Air that is cooled becomes a. _____ and it
b. _____.
- 1.23 A wind vane is _____.



Complete these statements.

- 1.24** An anemometer is _____ .
- 1.25** In the United States wind speed is measured in _____ .
- 1.26** During the day the air over a. _____ is cooler than air over
b. _____ (land, water).
- 1.27** During the day the air over a. _____ is cooler than air over
b. _____ (vegetation, bare ground).
- 1.28** During the night the air over a. _____ is cooler than air over
b. _____ (land, water).

Answer these questions.

- 1.29** What is meant by a *south wind*? _____

- 1.30** How are wind directions named if the wind is coming from a direction between the points of a compass? _____

- 1.31** What causes a coastal breeze? _____

- 1.32** What might happen to the winds if the earth became cooler? _____

World-wide winds. Air is heated more at the equator than at the poles. Equatorial air usually rises to the upper part of the troposphere. Air over the poles is colder and sinks. Therefore, the general flow of air near the earth's surface is from the poles to the equator. Higher in the troposphere, the air is moving from the equator to the poles.

Ocean currents and air currents are affected by the earth's *rotation*, the turning of the earth on its axis. Objects moving in the Northern

Hemisphere tend to curve to the right; those in the Southern Hemisphere tend to curve to the left. This tendency to curve produced by the rotation of the earth is called the **Coriolis effect**. Winds, instead of blowing directly from the north to south, are broken up into smaller parts.

The uneven heating of the earth's surface and the Coriolis effect produce overall wind patterns. Air rising over the equator moves in the upper troposphere toward the poles. At about

SELF TEST 1

Match these items (each answer, 2 points).

- | | | | | |
|-------|-------|-----------------|----|--|
| 1.01 | _____ | air pressure | a. | a study of the atmosphere and the weather |
| 1.02 | _____ | anticyclone | b. | a measure of the amount of heat in objects |
| 1.03 | _____ | Coriolis effect | c. | the movement of air over the earth's surface |
| 1.04 | _____ | cyclone | d. | the tendency of a moving object to curve due to the earth's rotation |
| 1.05 | _____ | dew point | e. | the weight of the air pushing down on the earth |
| 1.06 | _____ | humidity | f. | a high-pressure area; a high |
| 1.07 | _____ | meteorology | g. | a low-pressure area; a low |
| 1.08 | _____ | precipitation | h. | the amount of moisture in the air |
| 1.09 | _____ | temperature | i. | the temperature at which the air becomes saturated |
| 1.010 | _____ | wind | j. | the moisture that falls from the clouds |
| | | | k. | an instrument for measuring temperature. |

Write the letter of the correct choice (each answer, 2 points).

- 1.011** The element that affects the weather most is _____.
a. temperature b. wind c. pressure d. moisture
- 1.012** The energy necessary for weather changes to occur comes from _____.
a. evaporation b. condensation
c. heat in the center of the earth d. the sun
- 1.013** The instrument used for measuring the temperature of an object is the _____.
a. thermometer b. barometer c. anemometer d. wind vane
- 1.014** Temperature differences on the surface of the earth produce _____.
a. rain b. clouds c. humidity d. wind
- 1.015** As air is warmed by the surface of the earth it _____.
a. rises b. sinks c. condenses d. boils
- 1.016** The general flow of air from the poles to the equator occurs _____.
a. in the stratosphere b. in the upper troposphere
c. at the surface of the earth d. only on a nonrotating earth
- 1.017** Objects tend to curve to the right _____.
a. in the Southern Hemisphere b. in the Northern Hemisphere
c. only in North America d. only in South America
- 1.018** The jet stream affects _____.
a. the movement of weather patterns b. the humidity
c. the temperature d. the dew point
- 1.019** The instrument used to measure air pressure is the _____.
a. thermometer b. barometer c. anemometer d. wind vane
- 1.020** The movement of air around an anticyclone is _____.
a. upward b. inward c. counterclockwise d. clockwise
- 1.021** Lows generally have _____.
a. bad weather b. clear skies
c. little precipitation d. fair weather
- 1.022** As air is cooled it _____.
a. rises b. sinks c. evaporates d. freezes
- 1.023** An instrument used to determine the direction of air movement is the _____.
a. thermometer b. barometer c. anemometer d. wind vane
- 1.024** The general flow of air from the equator to the poles occurs _____.
a. in the stratosphere b. in the upper troposphere
c. at the surface of the earth d. only on a nonrotating earth
- 1.025** An instrument for measuring the speed of the wind is the _____.
a. thermometer b. barometer c. anemometer d. wind vane

Write true or false (each answer, 1 point).

1.026 _____ Highs are generally accompanied by fair weather.

1.027 _____ The movement of air around a cyclone is counterclockwise.

1.028 _____ Relative humidity is affected by temperature.

Complete these sentences (each answer, 3 points).

1.029 Particles of dust, soot, and salt on which water vapor condenses are called _____.

1.030 The main forms of precipitation are a. _____, b. _____, c. _____, and d. _____.

1.031 The main elements of weather are a. _____, b. _____, c. _____, and d. _____.

Answer these questions (each answer, 4 points).

1.032 What is relative humidity? _____

1.033 In which direction does air always move? _____

71
88

SCORE _____ **TEACHER** _____
 initials date



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