

# SCIENCE

Student Book

► **4th Grade | Unit 7**

.....

# SCIENCE 407

## WEATHER

Introduction	3
<b>1. Causes of Weather</b>	<b>4</b>
Atmosphere	6
Temperature	10
Air Pressure and Movement	13
Moisture	17
Self Test 1	20
<b>2. Forces of Weather</b>	<b>23</b>
Rainstorms, Thunder, and Lightning	25
Hurricanes	26
Tornadoes	28
Hail and Snowstorms	29
Sand and Dust Storms	33
Geographic Changes	35
Self Test 2	36
<b>3. Prediction of Weather</b>	<b>39</b>
Observing Weather	40
Using Weather Instruments	41
Self Test 3	46
LIFEPAC Test	Pull-out

**Author:**

Merton B. Osborn, Ed.D.

**Editor-in-Chief:**

Richard W. Wheeler, M.A. Ed.

**Editor:**

Janet Monseu

**Consulting Editor:**

Harold Wengert, Ed. D.

**Revision Editor:**

Alan Christopherson, M.S.

**Media Credits:**

**Page 3:** © iStock; Thinkstock; **4:** © (FPO)Zoonar RF,Zoonar, Thinkstock; **23:** © Stockbyte, Thinkstock; **25:** © Kushnirov Avraham, Hemera, Thinkstock; **29:** © Mouse Sonya, iStock, Thinkstock; **33:** © Karen Foley Photography, iStock, Thinkstock; **39:** © fotandy, iStock, Thinkstock;



**804 N. 2nd Ave. E.,  
Rock Rapids, IA 51246-1759**

© MCMXCVI by Alpha Omega Publications, Inc. All rights reserved.  
LIFEPAK is a registered trademark of Alpha Omega Publications, Inc.

All trademarks and/or service marks referenced in this material are the property of their respective owners.  
Alpha Omega Publications, Inc. makes no claim of ownership to any trademarks and/or service marks other than their own and their affiliates, and makes no claim of affiliation to any companies whose trademarks may be listed in this material, other than their own.

# WEATHER

On the second day of Creation, God separated the earth and sky. God made the atmosphere. All life on earth depends upon this ocean of air. Without air, people, animals, and plants would all die within a very short time.

Changes in the air around the earth, such as changes in the temperature or in the pressure, cause different kinds of weather. In this LIFEPAK® you will learn about the causes and forces of the weather. You will also find out something about weather prediction, both by observation and by the use of special instruments.

## Objectives

**Read these objectives.** The objectives tell you what you will be able to do when you have successfully completed this LIFEPAK. Each section will list according to the numbers below what objectives will be met in that section. When you have finished this LIFEPAK, you should be able to:

1. Tell three reasons why weather conditions are different.
2. Tell about the forces of weather.
3. Relate the importance of weather in God's plan.
4. Describe the different types of storms, their dangers and their benefits.
5. Explain the relationship between weather and geography.
6. Identify instruments used in predicting weather.

# 1. CAUSES OF WEATHER

Many times you can know what the weather is like outdoors or by either stepping outside or by looking through your window. You will know whether it is windy or calm, clear or cloudy, raining or snowing.

Why is the weather the way it is? What are the causes of different weather conditions? What are the effects of weather upon the earth on which we live? How can the weatherman tell you what may happen to the weather tomorrow?

In this section of your LIFEPAK, you will discover answers to these questions.

## Objectives

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

1. Tell three reasons why weather conditions are different.
3. Relate the importance of weather in God's plan.

## Vocabulary

**Study these new words.** Learning the meanings of these words is a good study habit and will improve your understanding of this LIFEPAK.

**altitude** (al' tu tüd): Height above the earth's surface.

**atmosphere** (at' mu sfir): Air that surrounds the earth.

**Celsius** (sel' sē us): A thermometer scale of 100 degrees (C).

**cycle** (sī kul): A period of time or action that repeats itself.

**evaporate** (i vap' u rāt): To change from a liquid to a vapor.

**exosphere** (ek' su sfir): The part of the atmosphere that begins to blend into space

**expand** (ek spand'): To spread out.

**extend** (ek stend'): To stretch out.

**Fahrenheit** (far' un hīt): A temperature scale for a thermometer (F).

**ionosphere** (ī on' u sfir): A layer of air above the earth.

**layer** (lā' ur): One thickness or fold.

**ozone** (ō' zōn): A gas present in the air.

**pressure** (presh' ur): Weight or force upon something.

**pressurized suit** (presh' u rīzd sūt): An airtight suit that can be blown up to keep normal pressure.

**radiation** (rā de ā' shun): Giving out rays of light, heat, or electricity.

**stratosphere** (strat' u sfir): The upper part of the atmosphere.

**transparent** (tran spār unt): Easily seen through.

**troposphere** (trō' pu sfir): The layer of the atmosphere nearest the earth.

**ultraviolet** (ul tru vī' u lit): Unseen rays from the sun.

**vapor** (vā' pur): Moisture in the air.

**Note:** All vocabulary words in this LIFEPAC appear in **boldface** print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.

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

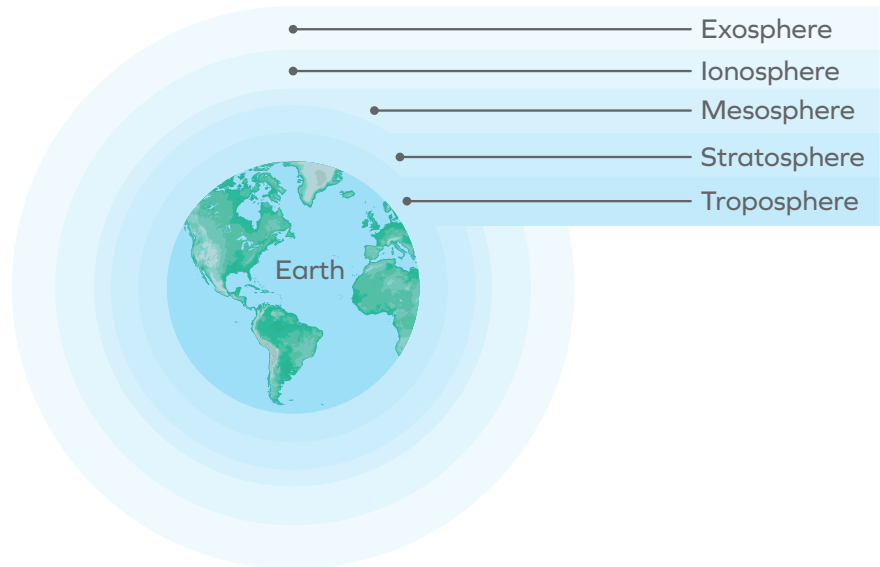
# Atmosphere

Do you know that when you came to school this morning, you were walking through an ocean of air? You live at the bottom of a huge ocean of air called the **atmosphere**.

You cannot see the air. Scientists do not know exactly how far into space the air **extends**. Scientists do know that the airplanes that take off and land every day at busy airports depend upon air. Clouds float on air. Birds fly through it. All living things, including man, animals, and plants, have to have air in order to live.

You feel air moving when you go outdoors. You see the result of air when you look at the swaying treetops or at rustling corn. You feel the air blowing across your face. Sometimes you see the damage it can cause to buildings and trees that happen to be in its path when it blows with force.

Although scientists do not know the exact limits of our atmosphere, they know that air is about one thousand miles (1,600 kilometers) in all directions around our earth. By using weather balloons, planes, and rockets, weathermen have studied the atmosphere. They have found out many exciting facts about it, and they are learning more every year.



| Layers of the atmosphere

Scientists have named the levels of the atmosphere. Air nearest the earth is called the **troposphere**. The word *troposphere* comes from a Greek word that means to *turn* and *mix*. In this **layer** the mixing and turning of the air takes place. The troposphere contains almost all the air and most of the water **vapor** in the atmosphere. The great wind belts, the clouds, and the weather are all part of the troposphere.

The lower part of the troposphere, which is the earth's weather zone, extends only about ten miles (about 16 kilometers) in all directions from the earth. The air not only moves across the land, but it moves up and down, causing wind belts.

As we travel outward from our earth, the next layer of atmosphere is the **stratosphere**. The stratosphere reaches a height of about thirty miles (about 48 kilometers) above the earth. Very few clouds are found in the stratosphere. The air is very thin. In this layer jet planes fly at fast speeds.

In the upper part of the stratosphere is a layer of gas called **ozone**. This gas acts as protection against the **ultraviolet** rays of the sun. Ultraviolet rays can be dangerous to people. The rays give you a bad sunburn if you are in the hot sun too long.

Beyond the stratosphere are the **mesosphere**, **ionosphere**, and the **exosphere**. Beyond these layers the atmosphere blends into space where no air exists.



### Complete these statements.

- 1.1** The air that surrounds the earth is called \_\_\_\_\_ .
- 1.2** The layer of air that lies closest to the earth is called the \_\_\_\_\_ .
- 1.3** The layer of gas in the upper part of the atmosphere is called \_\_\_\_\_ .
- 1.4** The ozone layer of gas protects us from the ultraviolet rays of the \_\_\_\_\_ .



### Answer these questions.

- 1.5** What are four of the five zones of atmosphere around our earth?
- a. \_\_\_\_\_ b. \_\_\_\_\_
- c. \_\_\_\_\_ d. \_\_\_\_\_
- 1.6** In what two general directions does air travel over land and water?
- a. \_\_\_\_\_ b. \_\_\_\_\_
- 1.7** As the air that surrounds our earth reaches higher and higher levels, what happens to it? \_\_\_\_\_



- 1.8** Can you think of three man-made objects that depend on air to operate?  
 a. \_\_\_\_\_ b. \_\_\_\_\_ c. \_\_\_\_\_
- 1.9** On which day of Creation did God make the air? \_\_\_\_\_  
 \_\_\_\_\_

## DOES AIR TAKE SPACE?



View 407

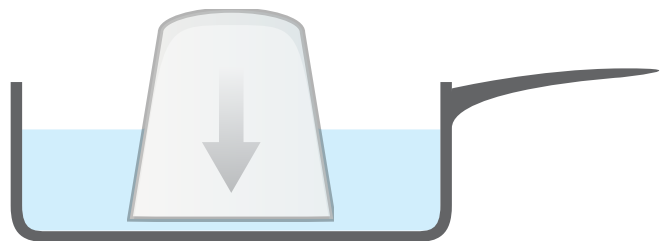
**Air:** Grade 4 Science experiments video

### These supplies are needed:

- a water glass
- a pan full of water

**Follow these directions.** Check the boxes as you do each step.

- ☐ **1.** Turn the glass upside down in the water.
- ☐ **2.** Push the mouth of the glass straight down into the water as far as possible.
- ☐ **3.** On the drawing show the level of the water inside the glass compared with the level of the water in the pan.

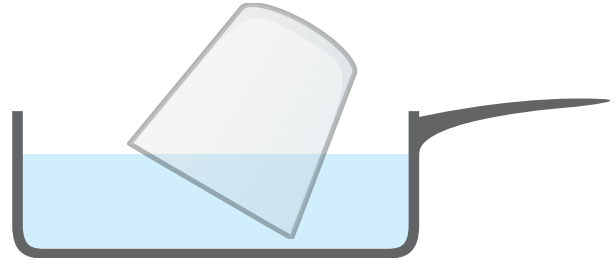


**Answer this questions.**

- 1.10** Why were the two levels of water different? \_\_\_\_\_  
 \_\_\_\_\_

**Repeat the experiment.** Check the boxes as you do each step.

- ☐ 1. Turn the glass upside down in the water.
- ☐ 2. Push the mouth of the glass straight down into the water as far as possible.
- ☐ 3. Tip the glass so that one edge of the mouth is above the water.



**Answer these questions.**

- 1.11** What happened to the level of the water in the pan? \_\_\_\_\_  
\_\_\_\_\_
- 1.12** When the glass contained air, could the water fill it? \_\_\_\_\_
- 1.13** Why could not the water fill it? \_\_\_\_\_
- 1.14** What does this experiment show us about air and space? \_\_\_\_\_  
\_\_\_\_\_



**Teacher check:**

Initials \_\_\_\_\_ Date \_\_\_\_\_

## Temperature

The first part of a weather report is usually the temperature. Why does the air have different temperatures? Why are some places on the earth hot and others cold? What heats the air?

To answer these questions, you need to know something about the sun and how it heats the earth.

Heat travels from sun to earth by **radiation**. When heat goes through **transparent** material, such as glass, the material is heated very little.

## EXPERIMENT!

### These supplies are needed:

sheet of black paper  
window  
sunlight shining through the window

**Follow these directions.** Check the boxes as you do each step.

- ☐ 1. Place the sheet of black paper near a closed window where the sun is shining brightly.
- ☐ 2. Let the sun shine on the sheet of paper for a few minutes.
- ☐ 3. After a few minutes, touch the paper.
- ☐ 4. Touch the window glass.
- ☐ 5. Notice whether the glass feels warm.

**Answer these questions.**

- 1.15** Did the sheet of black paper feel warm? \_\_\_\_\_
- 1.16** Did the window glass feel warm? \_\_\_\_\_
- 1.17** What is the difference between the window glass and the paper? \_\_\_\_\_  
\_\_\_\_\_

The rays of the sun that went through the window glass heated the paper. The glass was not heated because the glass is transparent. That is, the light shines through it. Light *does not* shine through the paper. The paper is not transparent.

The rays of the sun come through the transparent air. They have to pass through both space and the earth's atmosphere. They lose very little heat as they pass through the atmosphere. How then, does air get warmed by the sun?

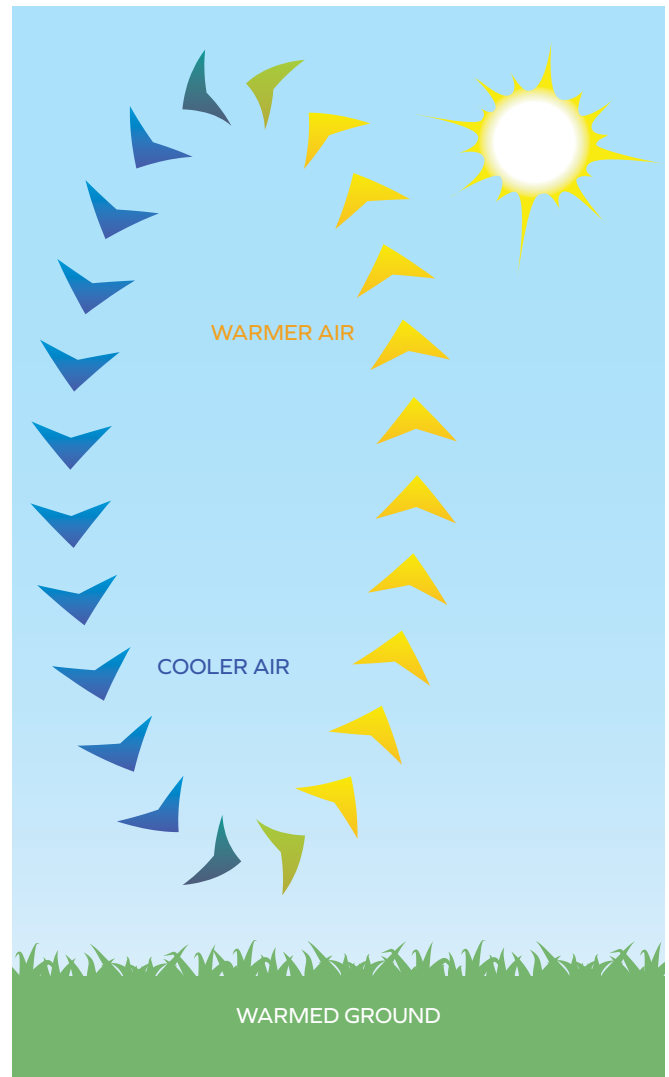
The answer lies in the fact that the heat rays strike the surface of the earth. The earth absorbs them and holds them. In this way the earth becomes heated and, in turn, heats the air close to it.

The closer we are to the ground, the more heat we will feel. When we want to find a cooler spot, we sometimes go to the mountains. The mountain areas are often cooler when weather conditions are normal, because the temperature drops about three and one-half degrees **Fahrenheit** (2° Celsius, 2°C) for every 1,000 feet (305 meters) of **altitude**.



**Complete the following sentences.**

- 1.18** Heat travels from the sun to earth by \_\_\_\_\_ .
- 1.19** Rays of sunlight come through the \_\_\_\_\_ to the earth.
- 1.20** Anything that lets light through it so that objects can be seen easily is said to be \_\_\_\_\_ .
- 1.21** Glass is \_\_\_\_\_ .
- 1.22** The air that is \_\_\_\_\_ to the ground is usually warmest.
- 1.23** When we go to the mountains, the temperature is often several degrees \_\_\_\_\_ there.
- 1.24** The temperature, in normal weather conditions, drops \_\_\_\_\_ degrees Fahrenheit for every 1,000 feet of altitude.
- 1.25** This temperature (in question 1.24) is the same as \_\_\_\_\_ degrees Celsius.



| Air goes up when warmed by the earth



**Put these statements in the correct order.**

The ground absorbs heat from the sun.

Heat rays from the sun pass through the earth's atmosphere.

The ground heats the air above it.

Heat rays from the sun pass through space.

Heat rays strike the ground and warm it.

**1.26**

---

**1.27**

---

**1.28**

---

**1.29**

---

**1.30**

---



## **Air Pressure and Movement**

After lunch, Rick and Mary were waiting for Uncle George. He had promised to see them and to talk with them in the den as soon as he had finished a phone call.

They wanted to learn more about the weather.

They were getting a little discouraged. After looking and looking through many of Uncle George's magazines they could not find even one article or picture about weather.

His books seemed to be all about plants and flowers. They found none about weather.

Then Uncle George came in. "Rick and I have a lot of questions about weather. We cannot find the answers anywhere. When I get back to school, I have to write a paper about weather and what causes it," Mary said.

"What would you like to know?" asked Uncle George.

Rick had the first question.

"We found out at school," he began, "that we live in an ocean of air hundreds of miles deep. When we were flying to visit you and Aunt Martha our ears went 'pop.' We both noticed it. What happened to our ears?"

Uncle George smiled. "The **pressure** inside your ears was adjusting to the pressure outside of them. That adjusting caused the popping."

"The higher you flew the less air pressure you had pushing down on you. The captain had to make the pressure on the inside of the plane equal to the pressure on the outside. I could show you how it works if we had a large tin can," their uncle continued.

"I know," Rick exclaimed. "I remember when my brother, Bob, had that experiment at school. Mary and I begged him to do it for us at home."

Rick began to tell about the experiment.

"We put a cup of water in an old, empty tin can," Rick began. "Then we heated the can with the cap off until the water was boiling."

"Then," Mary broke in, "we let it boil for about five minutes until the can was full of steam."

"Then what happened?" asked Uncle George.

"When the can was full of steam, we put on the cap and poured cold water over the can. It surprised us when the can began to..." continued Rick.

"Let me tell the rest," interrupted Mary. "The can caved in."

"What happened to the can in the experiment happened when you flew on the plane last week," Uncle George continued.

"As you went up, the air pressure around you caused the inside of your ears to bulge. Perhaps you thought you were going deaf. Sometimes if you yawn or swallow, your ears will open! God has made a way to make the pressure equal on both sides of the eardrum."

"Is it true that the higher we go the less air pressure we find?" asked Rick.

"That is right," Uncle George replied. "God created our bodies for the air pressure we would have here on earth. When you went up in the airplane to higher altitudes, the pressure had to be changed. When the first man stepped on the moon, he was wearing a **pressurized suit**. If his suit had not been pressurized, the man would not have lived more than a few seconds. The moon has no air, and therefore, it has no air pressure."

"What does this pressure have to do with the weather?" Mary asked.

"That is easy," Uncle George answered.

Uncle George went to get some small paper charts.

"These charts", he told them, "show us how winds are made. When air is next to a warm part of the earth, it **expands**. Less pressure or weight is on this warm part of the earth. The weather becomes colder. Along a lake or ocean on a warm day, the air over the hot land rises. It makes room for the heavy water-cooled air next door. In comes a refreshing sea breeze. The warm air goes up. The cold air is pushed down. In this way winds are made," Uncle George concluded.

## PROVE THAT AIR HAS PRESSURE



**View 407**  
**Air Pressure:**  
Grade 4 Science  
experiment video

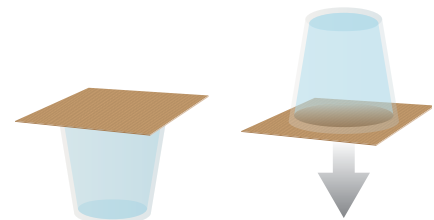
### These supplies are needed:

drinking glass full of water

piece of cardboard large enough to cover the glass sink or large basin to catch the water after the experiment

**Follow these directions.** Check the boxes as you do each step.

- ☐ 1. Fill the glass with water.
- ☐ 2. Press the cardboard over the top of the glass.
- ☐ 3. Carefully turn the glass of water upside down.
- ☐ 4. Take your hand away from the cardboard.







**Answer these questions.**

- 1.31** Does the cardboard fall off? \_\_\_\_\_
- 1.32** Does the water pour out? \_\_\_\_\_
- 1.33** Something is pushing against the cardboard to hold the water in. What do you think it is? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



**Write the correct letter and answer on the blank.**

- 1.34** No air exists on the \_\_\_\_\_.  
 a. earth                                      b. ocean                                      c. moon
- 1.35** When we travel at higher altitudes, our eardrums are not broken or damaged because the pressure inside them is \_\_\_\_\_ that outside.  
 a. greater than                                      b. less than                                      c. equal to
- 1.36** The earth's atmosphere is a large ocean of \_\_\_\_\_.  
 a. water                                      b. air                                      c. ozone
- 1.37** The distance above sea level is called \_\_\_\_\_.  
 a. altitude                                      b. atmosphere                                      c. troposphere



**Write true or false.**

- 1.38** \_\_\_\_\_ Air pressure becomes greater the higher we go.
- 1.39** \_\_\_\_\_ Jets that fly at high altitudes must be pressurized.
- 1.40** \_\_\_\_\_ The air pressure on the moon is greater than that on the earth.
- 1.41** \_\_\_\_\_ The men who walked on the moon had to wear pressurized suits to stay alive.
- 1.42** \_\_\_\_\_ The air over hot land usually rises.
- 1.43** \_\_\_\_\_ When air is warmed by the earth, it rises and becomes cooler.

**1.44** \_\_\_\_\_ When air becomes colder, it expands and spreads out.

**1.45** \_\_\_\_\_ Cold air rises.

## Moisture

Radiation from the sun, changes in temperature, and moving air all play an important part in causing the weather. The amount of moisture in the air also causes different weather conditions. If you have walked in fog, you have been walking in a low cloud. Tiny water droplets are all around you. You cannot see very far ahead.

At home you have probably watched water boiling and steam rising from a teakettle. The water in the teakettle gets very hot. Soon some of the water turns to steam. The steam settles against the cold window and turns to drops of water again.

In the sky, billions of water droplets also get close together. When they hit the cold upper air, they form a cloud.



| Water Cycle

When the clouds are white, they have little water vapor in them. When they become dark and heavy, they are loaded with droplets of water. As the droplets of water become larger and heavier, they begin to fall out of the cloud. The droplets become rain.

These rain clouds sometimes send down gentle showers. At other times fierce winds blow, and rain comes down in large amounts. This heavy rainfall is called a “cloudburst.”

The clouds and the rains are a part of a great water **cycle** that God has provided to water the earth. Clouds are one step of changing moisture in the air to rain. Some of the water runs from the land into the lakes and finally into the ocean. Here it **evaporates**, or changes from liquid to a gas, and rises to begin the wonderful cycle all over again.

In this way, God provides us with water to drink, with moisture to help plants grow, and with water to keep large areas of the earth green. In the Bible we read (Ecclesiastes 1:7), “All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again.”



**Fill in the blanks, using words from the Word Bank.**

fog  
cloud

moisture  
steam

vapor

- 1.46** A very important cause of weather is \_\_\_\_\_ .
- 1.47** A cloud on or close to the ground is called \_\_\_\_\_ .
- 1.48** When water gets very hot, it turns to \_\_\_\_\_ .
- 1.49** When billions of water drops get close together in the sky, they form a \_\_\_\_\_ .
- 1.50** Clouds that are dark and heavy usually have a great deal of water \_\_\_\_\_ in them.



**Match these items.**

- |             |   |                               |
|-------------|---|-------------------------------|
| <b>1.51</b> | _____ warm air                              | a. unseen sun rays            |
| <b>1.52</b> | _____ three and one-half degrees Fahrenheit | b. 2°C                        |
| <b>1.53</b> | _____ troposphere                           | c. gas                        |
| <b>1.54</b> | _____ ozone                                 | d. rises                      |
| <b>1.55</b> | _____ ultraviolet                           | e. 4°C                        |
|             |   | f. layer closest to the earth |



**Review the material in this section to prepare for the Self Test.** The Self Test will check your understanding of this section. Any items you miss on this test will show you what areas you will need to restudy in order to prepare for the unit test.

# SELF TEST 1

Match these items (each answer, 3 points).

- 1.01

\_\_\_\_\_ space
- 1.02

\_\_\_\_\_ stratosphere
- 1.03

\_\_\_\_\_ air
- 1.04

\_\_\_\_\_ God
- 1.05

\_\_\_\_\_ C
- 1.06

\_\_\_\_\_ ultraviolet
- 1.07

\_\_\_\_\_ sun
- 1.08

\_\_\_\_\_ transparent
- a.

Creator
- b.

gives heat to the earth
- c.

light shines through
- d.

sun’s rays
- e.

abbreviation for Celsius
- f.

height of 30 miles
- g.

no air
- h.

weather
- i.

atmosphere

Choose the correct word to complete each sentence (each answer, 3 points).

atmosphere	fog	rises	troposphere
cycle		pressure	second
radiation	third		expands

- 1.09

When air is warmed by the rays of the sun striking the earth, it \_\_\_\_\_ and becomes cooler.
- 1.010

Heat travels from the sun to earth by \_\_\_\_\_ .
- 1.011

The water \_\_\_\_\_ is God’s way of giving water to man, animals, and plants.
- 1.012

A cloud on or close to the ground is called \_\_\_\_\_ .
- 1.013

The layer of atmosphere that lies closest to the earth is called the \_\_\_\_\_ .
- 1.014

When something gets larger, it \_\_\_\_\_ .
- 1.015

Air has \_\_\_\_\_ .
- 1.016

God made air on the \_\_\_\_\_ day of Creation.
- 1.017

The air that surrounds the earth is the earth’s \_\_\_\_\_ .

**Write the correct letter and answer on the blank** (each answer, 3 points).

- 1.018** We live in an ocean of \_\_\_\_\_.  
a. water                                      b. fog                                      c. air
- 1.019** Large portions of our earth are kept green by means of the \_\_\_\_\_ cycle.  
a. decay                                      b. cloud                                      c. water
- 1.020** When water is heated, it changes into \_\_\_\_\_.  
a. a liquid                                      b. steam                                      c. lightning
- 1.021** Clouds that are heavy and dark usually have much water \_\_\_\_\_ in them.  
a. vapor                                      b. steam                                      c. pressure
- 1.022** A fog is a cloud close to the \_\_\_\_\_.  
a. ionosphere                                      b. desert                                      c. ground
- 1.023** Heat travels from the sun to earth, is taken in by the ground, and \_\_\_\_\_ again.  
a. rises                                      b. falls                                      c. disappears
- 1.024** The layer of ozone in the earth's atmosphere protects people against \_\_\_\_\_ rays from the sun.  
a. beneficial                                      b. ultraviolet                                      c. harmless
- 1.025** The layer of air nearest the earth is called the \_\_\_\_\_.  
a. troposphere                                      b. ionosphere                                      c. ozone
- 1.026** Height above sea level is called \_\_\_\_\_.  
a. latitude                                      b. altitude                                      c. ozone

**Answer true or false** (each answer, 2 points).

- 1.027** \_\_\_\_\_ As air reaches higher levels, it gets thinner.
- 1.028** \_\_\_\_\_ God created air on the sixth day.
- 1.029** \_\_\_\_\_ No atmosphere exists on the moon.
- 1.030** \_\_\_\_\_ When warm air goes up and cold air is pushed down, a movement of the air, called wind, occurs.

- 1.031** \_\_\_\_\_ The exosphere is the layer of air where jet planes fly at high speeds.
- 1.032** \_\_\_\_\_ When water evaporates, it changes from a gas to a liquid.
- 1.033** \_\_\_\_\_ God is very exact in what He does.
- 1.034** \_\_\_\_\_ You can see the air.
- 1.035** \_\_\_\_\_ The layer of gas in the upper part of the atmosphere is called ozone.

**Answer this question** (each answer, 1 point).

**1.036** What are four causes of changes in the weather?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_



**Teacher check:**

Score \_\_\_\_\_

Initials \_\_\_\_\_

Date \_\_\_\_\_

