



SCIENCE

STUDENT BOOK

▶ **7th Grade | Unit 5**

SCIENCE 705

The Atmosphere

INTRODUCTION | 3

1. STRUCTURE OF THE ATMOSPHERE 5

GASES | 6

LAYERS | 8

SOLAR EFFECTS | 11

INFLUENCES ON LIFE | 16

CHANGES | 19

SELF TEST 1 | 21

2. NATURAL CYCLES 23

WATER CYCLE | 24

CARBON-OXYGEN CYCLE | 28

NITROGEN CYCLE | 31

SELF TEST 2 | 34

3. POLLUTION 37

TYPES OF POLLUTANTS | 38

EFFECTS ON LIFE | 40

OUR RESPONSIBILITY | 42

SELF TEST 3 | 46



LIFEPAC Test is located in the center of the booklet. Please remove before starting the unit.

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The Atmosphere

Introduction

Genesis tells how God created the heavens and the earth. The Bible does not give a detailed description of Creation. God has allowed man to investigate His creation to gain a better understanding of it. Through this understanding, man should see the power and divine nature of God (Romans 1:20). We can not fully appreciate God's creation unless we see God as He really is.

For study, the earth can be divided into the *lithosphere*, the *hydrosphere*, and the *atmosphere*. The solid part of the earth is called the *lithosphere*. Covering a large part of the lithosphere are oceans which make up the *hydrosphere*. Above the earth is an ocean of air called the *atmosphere*. We live at the boundary between the atmosphere and the lithosphere.

In this LIFEPAAC® you will study the structure of the atmosphere. You will also study the natural cycles which affect the composition of the atmosphere. Finally you will see how man's activities are upsetting the delicate balance of nature.

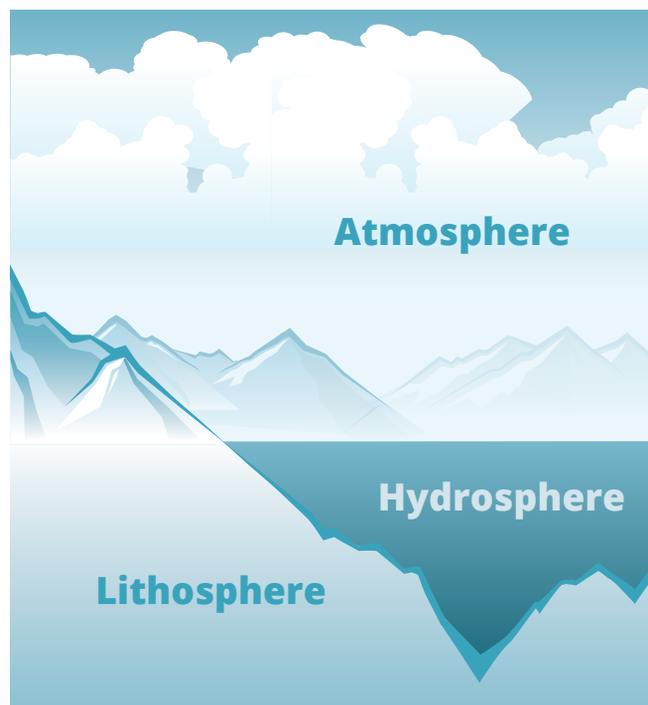
Objectives

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

1. Name the constant and variable gases and their percentages.
2. Name the layers of the atmosphere and some characteristics of each.
3. Describe the effects that the atmosphere has on solar radiation.
4. Tell how the atmosphere makes life possible.
5. Tell how the atmosphere has changed.
6. Describe the water cycle.
7. Describe the carbon-oxygen cycle.
8. Describe the nitrogen cycle.
9. Name the different air pollutants and their sources.
10. Describe some of the effects pollutants have on life.
11. State God's commands and explain how they should affect man's decisions about pollution.

1. STRUCTURE OF THE ATMOSPHERE

The atmosphere is important to every living thing. To understand why it is important, we must learn more about it. At first, all parts of the atmosphere appear to be the same. A closer look reveals that the atmosphere is a complex structure that has changed through time. Many inventions have been necessary to enable man to take this closer look. He had to build complicated instruments, airplanes, rockets, and satellites. The information he gathered slowly changed his view of the atmosphere. It no longer seemed the same from one part to another. As the data were put together, they revealed that the atmosphere was made up of many layers of different gases which affect the sunlight and life.



| Figure 1

SECTION OBJECTIVES

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

1. Name the constant and variable gases and their percentages.
2. Name the layers of the atmosphere and some characteristics of each.
3. Describe the effects that the atmosphere has on solar radiation.
4. Tell how the atmosphere makes life possible.
5. Tell how the atmosphere has changed.

VOCABULARY

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

aurora (ô rôr' u). Streamers or bands of light appearing in the sky at night, especially in polar regions.

greenhouse effect (gren hous u fekt). Process by which the atmosphere traps heat given off by the earth after having been heated by the sun.

ion (ĩ' on). An electrically charged atom.

ionosphere (i on' u sfir). The layer of atmosphere containing ions; above the stratosphere.

mesosphere (mes' u sfir). The layer of the atmosphere just above the stratosphere.

meteorite (mē´ tē u rīt). Mass of stone or metal that has passed through the atmosphere and has struck the earth’s surface.

meteoroid (mē´ tē u roid). Mass of stone or metal traveling through space.

ozone (ō´ zōn). A form of oxygen having three atoms of oxygen to a molecule.

ozonosphere (ō´ zon u sfir). A region in the upper stratosphere where ozone is concentrated.

photosynthesis (fō tu sin´ thu sis). The process by which green plants use chlorophyll and energy from sunlight to manufacture food from carbon dioxide.

pollution (pu lū´ shun). Waste substances added to the environment.

respiration (res pu rā´ shun). The process by which oxygen combines with food to release energy and carbon dioxide.

scattering (skāt´ ur ing). The bending of light rays in all directions by gas molecules.

spectrum (spek´ trum). A broad range of related waves.

stratosphere (strat´ u sfir). The layer of the atmosphere just above the troposphere where the temperature remains fairly constant.

thermosphere (thēr´ mu sfir). The layer of the atmosphere above the mesosphere where temperatures are the highest in the atmosphere.

troposphere (trō´ pu sfir). The layer of the atmosphere nearest the earth in which most weather changes occur.

Note: All vocabulary words in this LIFEPAC 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; /ul/ represents /al/ in about, /el/ in taken, /il/ in pencil, /ol/ in lemon, and /ul/ in circus.

GASES

The air of the earth’s atmosphere is a mixture of many gases. These gases are held in place by the earth’s gravity. The gases at the bottom of the atmosphere are compressed. Fifty percent of the total mass of the atmosphere lies within 5.6 kilometers of the earth’s surface. The remaining half of the atmosphere extends up for hundreds of kilometers but gets increasingly thinner. The atmosphere has a constant composition of some gases. Other gases are present in varying amounts.

Constant gases. If a sample of dried air is analyzed, we would find two main gases. Nitrogen would make up 78 percent of the sample; oxygen would make up 21 percent. Most of the remaining 1 percent would be argon and

carbon dioxide. Figure 2 lists other gases that are found in trace amounts.

Variable gases. Some gases not listed in Figure 2 are found in varying amounts. Water vapor is by far the most important variable gas in the atmosphere. Water vapor can account for as much as 3 percent of the total volume of very moist air. In very dry air, water vapor may take up as little as 0.1 percent.

Another variable gas is **ozone** (O₃). It is an uncommon form of oxygen (O₂), rarely found in the lower atmosphere. Between 30 and 60 km in the atmosphere, the percentage of ozone is relatively high; therefore, this region is called the **ozonosphere**. An ozone molecule has *three* oxygen atoms. An oxygen molecule consists

of only *two* atoms. Ultraviolet rays act upon oxygen molecules to form the ozone layer. The

ozone layer then acts as a shield to protect the earth from most of the sun's ultraviolet rays.

GAS	SYMBOL OR FORMULA	PERCENT BY VOLUME
Nitrogen	N ₂	78.084
Oxygen	O ₂	20.946
Argon	Ar	0.934
Carbon dioxide	CO ₂	0.033
Neon	Ne	0.00182
Helium	He	0.00053
Methane	CH ₄	0.00015
Krypton	Kr	0.00012
Xenon	Xe	0.00009
Hydrogen	H ₂	0.00005
Nitrous oxide	N ₂ O	0.00005

Figure 2 | Gases in Pure Dry Air



Answer these questions.

- 1.1 What percent of the atmosphere is above 5.6 kilometers? _____
- 1.2 What is the most abundant gas in the atmosphere? _____
- 1.3 What is the second most abundant gas in the atmosphere? _____
- 1.4 Which variable gas is most important? _____
- 1.5 What is the difference between oxygen and ozone? _____

- 1.6 Where is most of the ozone found? _____
- 1.7 What is the ozonosphere? _____

LAYERS

The atmosphere is divided into layers. The significant difference between the layers is the *temperature*. Except for the upper layers, the mixture of gases is relatively uniform.

The five layers are:

- **troposphere**,
- **stratosphere**,
- **mesosphere**,
- **thermosphere**, and
- **ionosphere**.

Troposphere. The layer closest to the earth is the troposphere. It extends from the earth's surface to an average height of ten kilometers (7 miles). The upper boundary of the troposphere, the tropopause, is higher above the equator than it is above the poles. The temperature within the troposphere decreases with height to about -55°C (-70°F).

The troposphere is warmed by the warm surface of the earth. Air near the bottom is the warmest. As warm air rises, cooler air sinks to replace it. This tendency to overturn gives the lower layer the name *troposphere*—*sphere of overturning*. (*Tropo* is Greek for *turn*.) Almost all weather and clouds occur in this layer.

Stratosphere. The second layer, the stratosphere, extends from the tropopause to a height of 50 kilometers (30 miles). In the lower part of the stratosphere, temperatures remain constant. Temperatures rise steadily in the upper part to about 70°C (150°F). The air is warmed directly by absorption of radiation in the ozonosphere, which is the upper part of the stratosphere.

The stratosphere is a stable layer. Little vertical air movement is possible because cold, heavy air is on the bottom. This layer is characterized by strong, steady winds and few sudden changes in weather.

Mesosphere. Above the stratosphere is a layer called the mesosphere. The upper boundary is at about the 80-kilometer (50-mile) level. Temperatures decrease steadily until they are the lowest anywhere in the atmosphere, -90°C (-130°F). Like the troposphere, the mesosphere is heated from below. The ozone layer provides the heat.

Thermosphere. The atmosphere above the mesosphere differs from the lower layers in two main ways. *First*, the gas mixture is replaced by layers of single gases. Gravity separates the gases so that the heaviest are at the bottom and the lightest are on top. The lowest layer is nitrogen molecules; the next, oxygen atoms; the next, helium atoms; and finally, the lightest gas, hydrogen atoms. A *second* difference is temperature. Within the thermosphere, temperatures increase with height and may exceed $2,000^{\circ}\text{C}$ ($3,600^{\circ}\text{F}$). Air in this layer is heated by direct radiation from the sun but is so thin that temperature as we know it is meaningless. Objects passing through the thermosphere are only slightly warmed.

Ionosphere. Cutting across all of the thermosphere is another layer, the ionosphere. It is not a separate region as the other layers. Powerful radiation from the sun is absorbed by

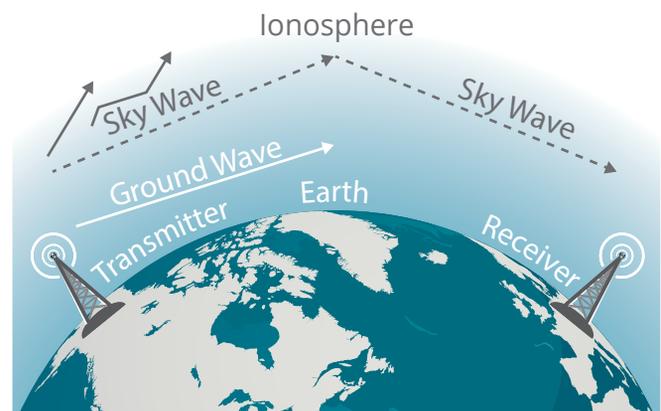


Figure 4 | Reflection of Radio Waves

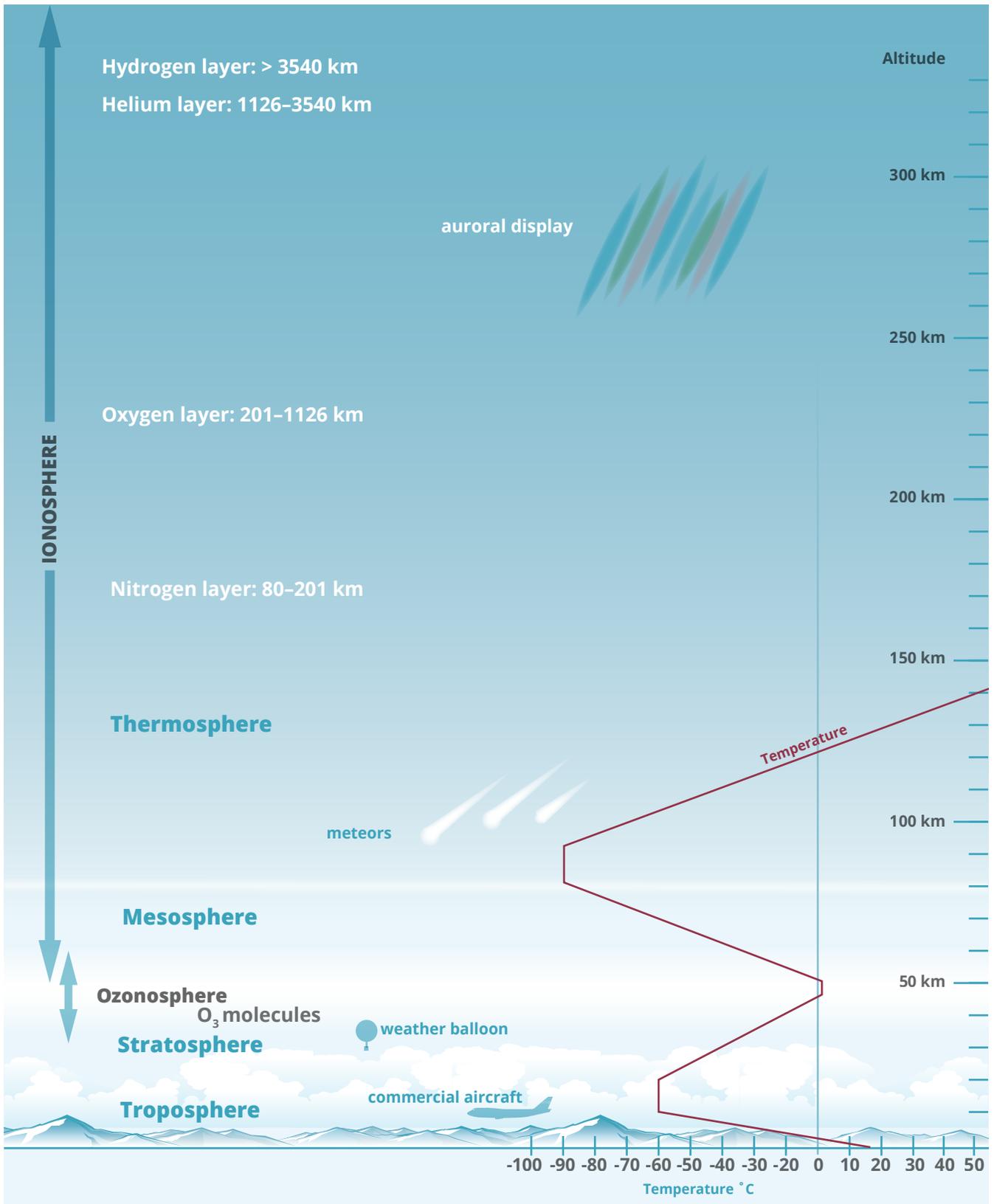


Figure 3 | The Atmosphere

nitrogen and oxygen. This action produces the high temperatures of the thermosphere and the **auroras** (northern and southern lights). In the process, electrons are given up by the molecules and atoms. Positively charged **ions** that are formed give this region an electrical charge.

This layer plays an important part in the transmission of radio waves. Radio waves traveling in straight lines would be lost to space if they were not reflected by the ionosphere. The curvature of the earth would limit reception from 80 to 100 kilometers.



Complete these activities.

- 1.8 The major factor that changes from one layer to another is _____ .
- 1.9 Most weather occurs in the _____ .
- 1.10 The ozonosphere is located in the upper part of the _____ .
- 1.11 The layer of the atmosphere that has the coldest temperatures is the _____ .
- 1.12 The hottest temperatures are found in the _____ .
- 1.13 The part of the atmosphere that includes all of the thermosphere is the _____ .

Match these items. Write the letter of the change that occurs in the temperature of each layer, from the bottom of the layer to the top.

- | | |
|-------------------------------|-------------------|
| 1.14 _____ troposphere | a. increases |
| 1.15 _____ lower stratosphere | b. decreases |
| 1.16 _____ upper stratosphere | c. stays the same |
| 1.17 _____ mesosphere | |
| 1.18 _____ thermosphere | |

Answer these questions.

- 1.19 What is the meaning of the word *troposphere*? _____
- 1.20 Which layer varies in thickness from the equator to the poles? _____
- 1.21 Why does air not move vertically in the stratosphere? _____

- 1.22 How is the arrangement of gases in the lower layers (troposphere, stratosphere, and mesosphere) different from the arrangement in the thermosphere? _____



Match these items. Write the letter indicating the way each of the layers is warmed.

- | | | |
|------|--------------------|--------------------------------------|
| 1.23 | _____ troposphere | a. by the earth |
| 1.24 | _____ stratosphere | b. by the ozonosphere |
| 1.25 | _____ mesosphere | c. by direct absorption of radiation |
| 1.26 | _____ thermosphere | |

Answer these questions.

- 1.27 In what way is the troposphere and mesosphere the same? _____

- 1.28 Why are the gases in the thermosphere arranged in particular order? _____

- 1.29 Why is the extremely high temperature of the thermosphere meaningless? _____

- 1.30 a. How is the ionosphere formed? _____

- b. Why is it important? _____

SOLAR EFFECTS

The sun is our most important source of heat. Only a small fraction of the energy released by the sun reaches the earth's atmosphere. The **spectrum** of solar radiation is shown in Figure 5. Visible light forms only a small part of the

entire spectrum. Incoming solar radiation is selectively absorbed and reflected to warm the earth and atmosphere and to maintain a temperature friendly to life.



Figure 5 | Solar Spectrum

SELF TEST 1

Match these items (each answer, 2 points). Some answers may be used more than once.

- | | | |
|-------------|---------------------------------|---------------------------------------|
| 1.01 | _____ 78% | a. reflects radio waves |
| 1.02 | _____ 21% | b. carbon dioxide |
| 1.03 | _____ ionosphere | c. oxygen |
| 1.04 | _____ 30% | d. amount of radiation reflected |
| 1.05 | _____ 70% | e. nitrogen |
| 1.06 | _____ needed for respiration | f. amount of solar radiation absorbed |
| 1.07 | _____ needed for photosynthesis | g. absorbs ultraviolet rays |
| 1.08 | _____ ozonosphere | |

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

- 1.09** The major difference between oxygen and ozone is _____ .
 a. the number of atoms in a molecule b. the kind of atoms they are made of
 c. the color of the gas d. one is a gas and the other is a liquid
- 1.010** *Sphere of overturning* is the meaning of _____ .
 a. thermosphere b. mesosphere c. troposphere d. ionosphere
- 1.011** The effect of the stratosphere being colder at the bottom than at the top is _____ .
 a. sudden weather changes b. no vertical air movement
 c. better radio reception d. the separation of gases into layers
- 1.012** The trapping of heat by carbon dioxide and water vapor is known as the _____ .
 a. radiation balance b. greenhouse effect
 c. radiant spectrum d. scattering
- 1.013** The waste products of respiration are water and _____ .
 a. food b. carbon dioxide c. oxygen d. sugar
- 1.014** The process by which plants make food is called _____ .
 a. photosynthesis b. respiration c. digestion d. transpiration
- 1.015** We are protected from falling meteors by the _____ .
 a. ozonosphere b. ionosphere c. atmosphere d. thermosphere
- 1.016** The burning of fossil fuels has caused _____ .
 a. more radiation to be reflected b. the carbon dioxide level to increase
 c. the climates to become cooler d. increased plant growth

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

1.017 _____ Exposure to radiation helps man to live longer.

Complete these sentences (each answer, 3 points).

1.018 The layer that is warmed from below by the ozonosphere is the _____

1.019 The hottest layer in the atmosphere is the _____ .

1.020 *Radiation balance* means that the amount of radiation gained by the atmosphere
_____ the amount of heat lost to space.

Answer these questions (each answer, 5 points).

1.021 What main factor varies from one layer to the next in the atmosphere?

1.022 Describe the arrangement of gases in the lower layers. _____

1.023 How does the ozonosphere protect us? _____

	SCORE _____	TEACHER _____	initials	date
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