

## LAYERS OF THE ATMOSPHERE

### **BACKGROUND**

THE ENVELOPE OF GASES SURROUNDING THE EARTH IS THE ATMOSPHERE. FIVE DISTINCT LAYERS ARE CLASSIFIED BY TEMPERATURE CHANGES. IN ADDITION, CHEMICAL COMPOSITION, MOVEMENT, AND DENSITY ARE USED TO CHARACTERIZE THE 5 LAYERS. EACH LAYER IS BOUNDED BY PAUSES WHERE CESSATION OCCURS.

### **I. TROPOSPHERE**

THE TROPOSPHERE BEGINS AT THE EARTH'S SURFACE AND EXTENDS 15 Km ABOVE EARTH. THIS IS THE LAYER OF THE ATMOSPHERE IN WHICH WE LIVE. THE TROPOSPHERE HOLDS ~ 80% OF THE ATMOSPHERE'S GASSES. ALMOST ALL WEATHER OCCURS IN THIS REGION.

AS THE DENSITY OF THE GASES IN THE TROPOSPHERE DECREASE WITH HEIGHT, THE AIR BECOMES THINNER. THE TEMPERATURE IN THE TROPOSPHERE DECREASES WITH HEIGHT. IN THE TROPOSPHERE, THE TEMPERATURE DROPS FROM (17°C) TO (-51°C).

THE TRANSITION BOUNDARY BETWEEN THE TROPOSPHERE AND THE LAYER ABOVE IS CALLED THE TROPOPAUSE. THE TROPOPAUSE IS A COLD TRAP FOR RISING WATER VAPOR.

### **II. STRATOSPHERE**

THE STRATOSPHERE EXTENDS FROM THE TOP OF THE TROPOSPHERE TO 50 Km ABOVE EARTH. THIS LAYER HOLDS ~19% OF THE ATMOSPHERE'S GASES AND VERY LITTLE WATER VAPOR. THE TROPOSPHERE IS WHERE JETS FLY.

THE TEMPERATURE INCREASES WITH HEIGHT IN THE STRATOSPHERE. HEAT IS PRODUCED DURING THE FORMATION OF OZONE. OZONE IS A PRODUCT OF THE REACTION BETWEEN THE SUN'S ENERGY AND OXYGEN RESULTING IN AN INCREASE IN THE TEMPERATURE FROM (-51°C) TO (-15°C).

THE TRANSITION BOUNDARY WHICH SEPARATES THE STRATOSPHERE FROM THE LAYER ABOVE IS CALLED THE STRATOPAUSE.

### **III. MESOSPHERE**

THE MESOSPHERE EXTENDS FROM THE TOP OF THE STRATOSPHERE TO 90 Km ABOVE EARTH. AS A RESULT OF THE RARIFIED AIR (ESPECIALLY THIN), TEMPERATURE DECREASES FROM (-15°C) TO (-120°C).

HOWEVER, THE GASES IN THE MESOSPHERE ARE STILL THICK ENOUGH TO PROTECT THE EARTH FROM METEORS HURLING INTO THE ATMOSPHERE. THE METEORS BURN UP LEAVING FIERY TRAILS IN THE NIGHT SKY.

THE TRANSITION BOUNDARY WHICH SEPARATES THE MESOSPHERE FROM THE LAYER ABOVE IS CALLED THE MESOPAUSE.

### **IV. THERMOSPHERE**

THE THERMOSPHERE EXTENDS UP TO 600 Km ABOVE EARTH. THIS IS THE LAYER WHERE THE SPACE SHUTTLE AND SPACE STATION ORBITS.

THE GASES OF THE THERMOSPHERE BECOME INCREASINGLY THINNER. THE TEMPERATURE INCREASES WITH HEIGHT AND CAN REACH AS HIGH AS 2,000°C NEAR THE TOP BECAUSE OF THE ABSORPTION OF THE SUN'S ENERGY. DESPITE THE HIGH TEMPERATURE, THIS LAYER OF THE ATMOSPHERE WOULD FEEL VERY COLD BECAUSE OF THE EXTREMELY THIN AIR. THE TOTAL AMOUNT OF ENERGY FROM THE VERY FEW MOLECULES IS NOT ENOUGH TO BURN.

#### **A. THE IONOSPHERE**

A SUBLAYER OF THE THERMOSPHERE IS THE IONOSPHERE. THE IONOSPHERE IS MADE OF ELECTRICALLY CHARGED GAS PARTICLES (IONIZED) BY THE ABSORPTION OF RADIATION. THE IONOSPHERE EXTENDS FROM 60-300 Km ABOVE THE EARTH. THE IONOSPHERE IS DIVIDED INTO 3 LAYERS: THE F-LAYER, E-LAYER, AND D-LAYER. DURING THE DAYTIME THE F-LAYER SPLITS INTO 2 LAYERS THEN RECOMBINES AT NIGHT.

THE E-LAYER WAS DISCOVERED FIRST. IN 1901, GUGLIELMO MARCONI TRANSMITTED A SIGNAL BETWEEN EUROPE AND NORTH AMERICA AND SHOWED THAT IT HAD TO BOUNCE OFF AN ELECTRICALLY CONDUCTING LAYER ABOUT 100 Km ALTITUDE. IN 1927, SIR EDWARD APPLETON NAMED THAT CONDUCTING LAYER THE (E)LECTRICAL-LAYER. ADDITIONAL CONDUCTING LAYERS DISCOVERED LATER WERE SIMPLY CALLED THE D-LAYER AND F-LAYER.

SINCE THE IONOSPHERE'S EXISTENCE IS DUE TO RADIATION FROM THE SUN STRIKING THE ATMOSPHERE, IT CHANGES IN DENSITY FROM DAYTIME TO NIGHTTIME. ALL 3 LAYERS ARE MORE DENSE DURING THE DAYTIME. AT NIGHT, ALL LAYERS DECREASE IN DENSITY WITH THE D-LAYER UNDERGOING THE GREATEST CHANGE. AT NIGHT THE D-LAYER ESSENTIALLY DISAPPEARS.

AS SEEN AROUND THE 1900'S, THE IONOSPHERE HAS THE IMPORTANT QUALITY OF BOUNCING RADIO SIGNALS TRANSMITTED FROM THE EARTH. THE IONOSPHERE'S EXISTENCE IS WHY PLACES ALL OVER THE WORLD CAN BE REACHED VIA RADIO.

AS THE RADIO SIGNAL IS TRANSMITTED, SOME OF THE SIGNAL WILL ESCAPE THE EARTH THROUGH THE IONOSPHERE. THE GROUND WAVE IS THE DIRECT SIGNAL WE HEAR. GROUND WAVES WEAKEN QUICKLY AND IS HEARD AS A FADING SIGNAL.

THE REMAINING WAVES ARE CALLED SKYWAVES. SKYWAVE WAVES BOUNCE OFF THE IONOSPHERE AND CAN BOUNCE FOR MANY 1000'S OF Km DEPENDING UPON THE ATMOSPHERIC CONDITIONS.

#### **B. MAGNETOSPHERE**

ANOTHER SUBLAYER OF THE IS THE MAGNETOSPHERE. THE EARTH'S MAGNETIC FIELD CREATES THE MAGNETOSPHERE. THE SHAPE OF THE MAGNETOSPHERE IS A RESULT OF BEING BLASTED BY THE SUN'S SOLAR WIND. THE MAGNETOSPHERE PREVENTS THE SUN'S PARTICLES FROM HITTING THE EARTH AND PROTECTING LIFE.

### **V. EXOSPHERE**

THE EXOSPHERE IS THE OUTERMOST LAYER OF THE ATMOSPHERE. IT EXTENDS FROM THE TOP OF THE THERMOSPHERE TO 10,000 Km ABOVE EARTH. IN THIS LAYER, SATELLITES ORBIT AND ATOMS AND MOLECULES ESCAPE INTO SPACE.

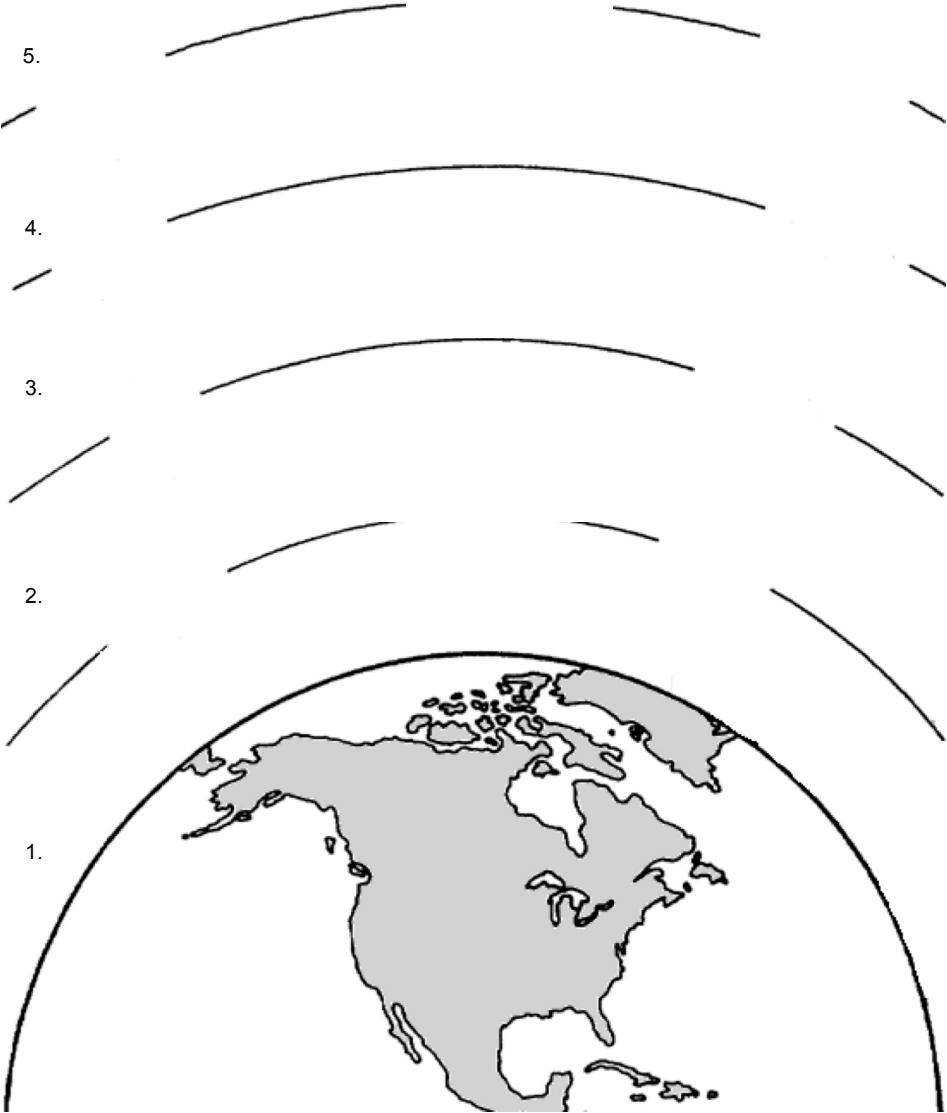
**ANSWER QUESTIONS**

- |   |  |
|---|--|
| 1. WHAT IS THE ATMOSPHERE?                          | 8. WHERE IS THE AURORA BOREALIS?                         |
| 2. DESCRIBE THE COMPONENTS OF THE ATMOSPHERE.       | 9. WHERE IS THE AURORA AUSTRALIS?                        |
| 3. HOW ARE THE LAYERS OF THE ATMOSPHERE CLASSIFIED? | 10. WHICH LAYER DO SATELLITES ORBIT?                     |
| 4. WHAT DOES OZONE DO?                              | 11. WHICH LAYER DOES THE TEMPERATURE REACH 2000 °C?      |
| 5. DESCRIBE THE IONOSPHERE.                         | 12. WHICH LAYER CONTAINS RARIFIED AIR (ESPECIALLY THIN)? |
| 6. DESCRIBE THE MAGNETO SPHERE.                     | 13. WHICH LAYER CONTAINS THE OZONE LAYER?                |
| 7. DESCRIBE AURORA.                                 | 14. WHICH LAYER IS WHERE WEATHER OCCURS?                 |

**PROCEDURE**

- COLOR THE EARTH'S WATER AND LAND ANY 2 DIFFERENT COLORS
- IN THE FIRST COLUMN LABEL EACH LAYER OF THE ATMOSPHERE
- IN THE FIRST COLUMN LABEL THE HEIGHT OF EACH LAYER OF THE ATMOSPHERE
- IN THE FIRST COLUMN LABEL THE TEMPERATURE OF EACH LAYER OF THE ATMOSPHERE
- IN THE SECOND COLUMN RECORD INFORMATION ABOUT EACH LAYER
- COLOR THE LAYERS:  
TROPOSPHERE = GREEN, STRATOSPHERE = BLUE, MESOSPHERE = YELLOW, THERMOSPHERE = RED, EXOSPHERE = GREY

HEIGHT	TEMPERATURE	
5.		5.
4.		4.
3.		3.
2.		2.
1.		1.



The diagram shows a cross-section of the Earth's atmosphere. The Earth is at the bottom, with a grey landmass and white water. Five horizontal lines represent the boundaries between the five layers of the atmosphere. To the left of the diagram, a vertical axis is labeled 'HEIGHT' with five numbered boxes (1-5) corresponding to the boundaries. To the right, a vertical axis is labeled 'TEMPERATURE' with five numbered boxes (1-5) corresponding to the boundaries. The atmosphere is divided into five layers by these lines.