Man in Flight

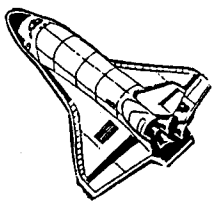
The further man travels upward in the earth's atmosphere towards space the more he must protect himself from an increasingly hostile environment. We are accustomed to the weight or pressure of air at the lower altitudes. It can easily compressed further and the application of aerodynamic forces allows aircraft to fly.

This chart identifies some of the factors to be considered as man travels upward.

Above this altitude man is in biological space and must have a completely self-contained environment to survive

70,000

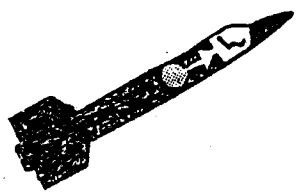
In the unprotected body blood and other fluids would boil....man's survival would be less than 12 seconds



An independent environment is important for life support.

Ozone poisoning a problem if outside air is used for pressurization

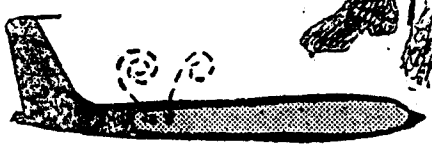
60,000



Atmospheric pressure is only 1/4 of that at sea level....oxygen must be forced into the lungs..reversed breathing.

50,000

High flying pilots wear a tight fitting pressure suit to protect their bodies in the thin atmosphere

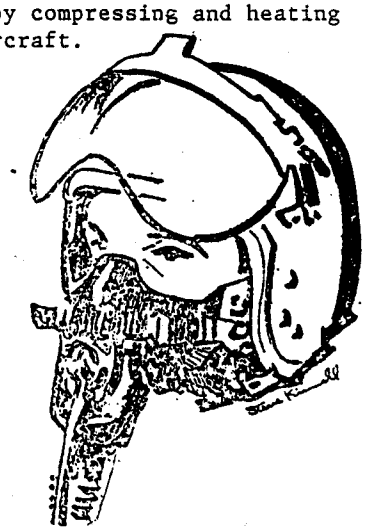


Most all of the earth's weather is below

Without pressurization 100 % oxygen is necessary

30,000

This is the realm of jet aircraft.....their cabins are pressurized by compressing and heating air from outside the aircraft.

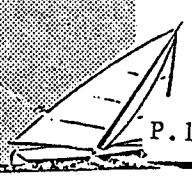


Military pilots use an oxygen mask to provide supplemental oxygen

18,000

Loss of efficiency, night vision impaired Most private aircraft fly below this altitude

12,000



Mankind has adapted well to the atmosphere near the earth's surface where air pressure and oxygen are ideal.

Sea level

Effects of High Altitude on Human Respiration and Circulation

Effects of Altitude

a. On the average, air tends to become colder at the rate of _____ degrees per _____ feet of increased altitude.

b. The stratosphere is a region of the atmosphere that begins at a height of about _____.

c. The base of the stratosphere is coldest over the _____. Why?

d. Air pressure (increases, decreases) with altitude. Air pressure at sea level is _____ pounds per square inch.

e. State Dalton's Law:

f. Define normal respiration.

g. What happens when the partial pressure of oxygen falls, as it does at high altitudes?

h. Give the two reasons why we breathe.

i. Summarize briefly the mechanics of breathing.

j. The chief factor in breathing is _____.

k. Why is it hard to hold your breath very long?

l. What is one of the dangers of high altitude flight?

Altitude Sickness

a. How high did Tissandier go before he became unconscious?

b. Tissandier suffered from what is now known as _____.

c. This condition is called _____.

d. What do they call the aid that is used in altitude research?

e. State the real cause of anoxia.

f. The two factors regulating breathing, oxygen and carbon dioxide, _____ each other at high altitudes.

g. The first evidence of oxygen lack usually appears at about _____ feet.

h. The rate of breathing (increases, decreases) slightly; the pulse rate and blood pressure (increase, decrease, remain constant).

i. List the reactions that usually occur at 15,000 feet.

j. List and describe briefly how various people react at high altitudes.

k. Does the victim recognize his reactions as abnormal?

l. Make a comparison between altitude sickness and alcoholic intoxication.

m. List the effects of high altitude on man.

n. Does forward speed have any biological effect on man?

o. Explain how the rate of vertical ascent affects the human body.

p. Is it possible for man to become acclimatized to high altitude of, say, 10,000 feet? _____ 20,000 feet? _____ Where has this occurred?

q. List the factors that may modify altitude sickness.

r. In general, what elevation is considered safe for long flights when no supplemental oxygen supply is available?

s. An absence of oxygen for about _____ minutes may completely destroy brain cells.

t. How can altitude sickness be prevented?

u. How is altitude sickness treated?

v. What will happen if you drop liquid oxygen on your skin?

w. How high is it possible to fly when oxygen is available?

What are the effects of high altitude on human respiration and circulation?

Suggested learning activities

1. Review the organs of human respiration and circulation. Using charts, diagrams, and tables of air pressure and temperature, review the characteristics of the earth's atmosphere at various altitudes.

Discuss the following questions:

What is anoxia?
What are the effects of a lack of oxygen on the human mind and body?
What is aeroembolism? What causes it?
What is airsickness? What causes it?
How has man overcome the limitations of his body at high altitudes?

3. Have a local physician (or the school nurse) discuss the problem with the class.

4. Have an experienced pilot talk to the class about high altitude flight.

5. Assign oral reports on such topics as the following:

Aviation medicine
Anoxia
Aeroneurosis
Airsickness

6. Have the students search out the answers to the questions in the work guide outline which follows.

Reproducible Activity

Activity 14

The Apollo spacesuit had to provide the astronauts with protection. It had to protect them from temperatures ranging from −157 to +121 degrees Celsius (−250 to +250 degrees Fahrenheit). Not only did the Moon explorers' spacesuits have to offer protection from jagged rocks and the searing heat of the lunar day, but the suit also had to be flexible enough to permit stooping and bending as the crew gathered samples from the Moon.

A backpack portable life-support system provided breathing oxygen, suit cooling, and pressurization for moonwalks lasting up to eight hours.

From the body outward, the Apollo spacesuit began with a liquid-cooling garment similar to a pair of long underwear with a network of spaghetti-like tubing sewn into the fabric. Cool water, circulated through the tubing, transferred the body heat from the astronaut's body to the backpack, and then to space. The suit had a total of 21 layers of material.

The Apollo helmet was formed from high-strength Lexan plastic, and was attached to the spacesuit by a pressure-sealing neckring. While walking on the Moon, Apollo astronauts wore an outer visor over the bubble helmet to shield against eye-damaging ultraviolet radiation.

(See spacesuit on reverse side)

Spacesuit