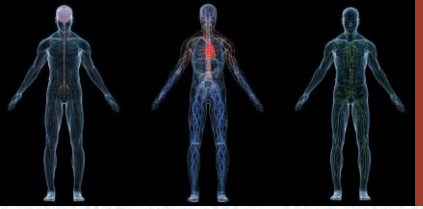

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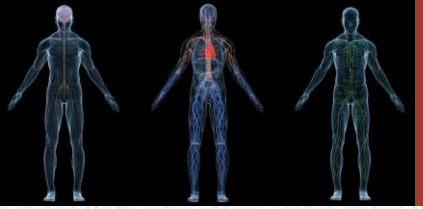
APPLIED PART OF RESPIRATORY PHYSIOLOGY

Dr.Charushila Rukadikar
Assistant Professor
Department of Physiology
ZMCH,Dahod

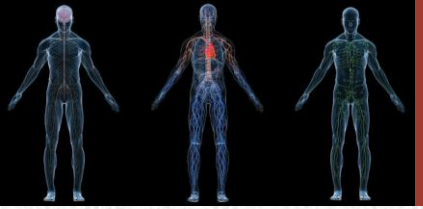


- **<u>Specific learning Objectives:</u>**

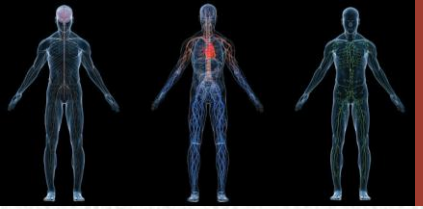
  High altitude physiology

  Aviation physiology

  Deep-Sea Diving physiology



HIGH ALTITUDE PHYSIOLOGY



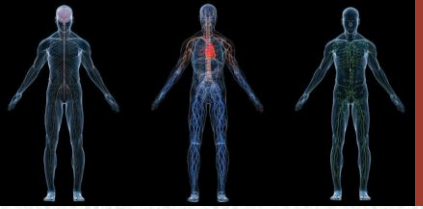
High Altitude

Altitude	Pressure	PO_2 (air)	PO_2 (alveoli)	Saturation
0	760	159	100	97
10,000	523	110	67	90
20,000	349	73	40	73
30,000	226	47	18	24

Oxygen , carbon dioxide, nitogen

Mount Everest is 29035 ft above sea level

Above 40,000- ozone layer starts.



Hypoxia stages

Stage of indifference – Po 2 above 60 mm of Hg

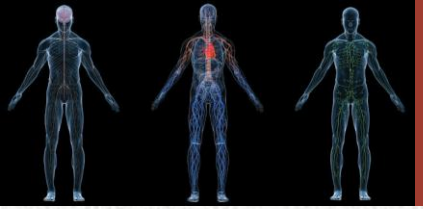
- mild hypoxia

Stage of reaction - Po 2 40 - 60 mm of Hg

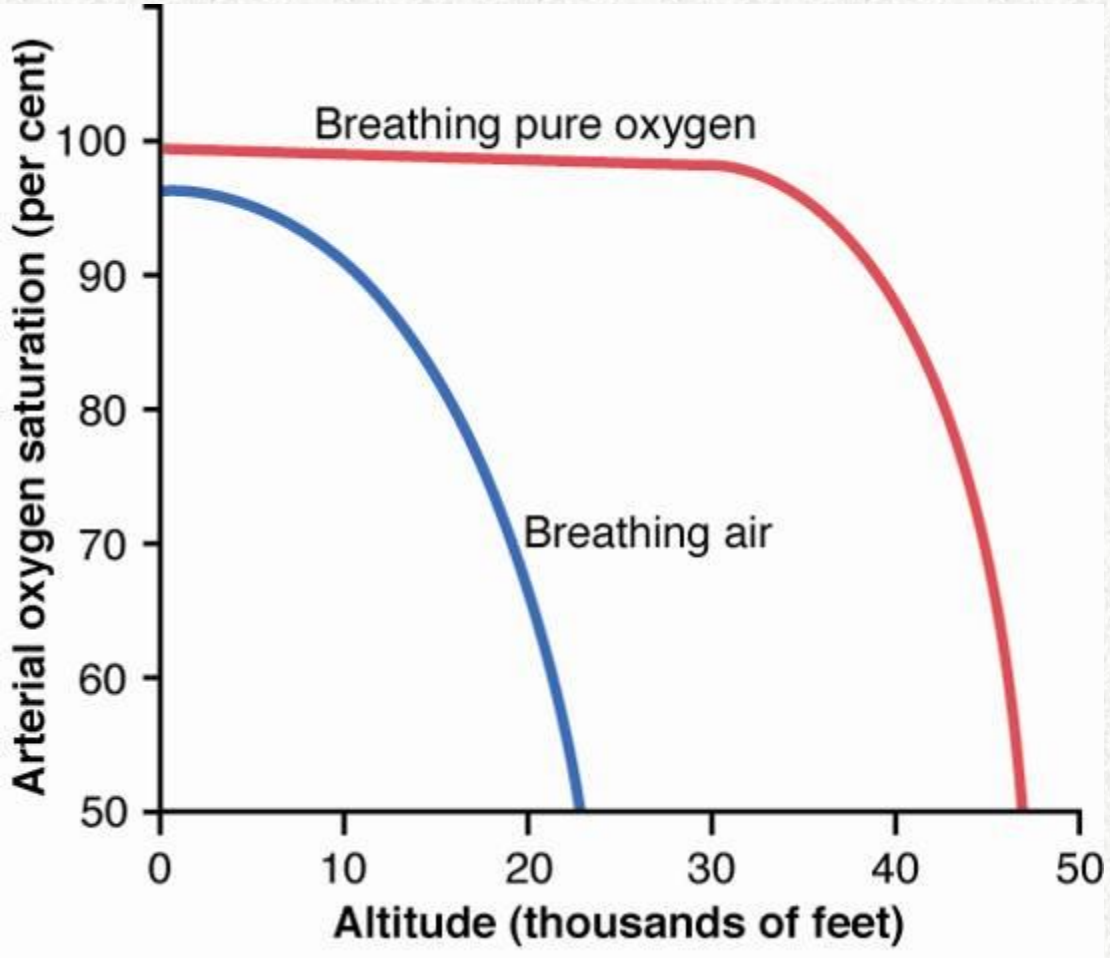
- moderate hypoxia, CVS, RS

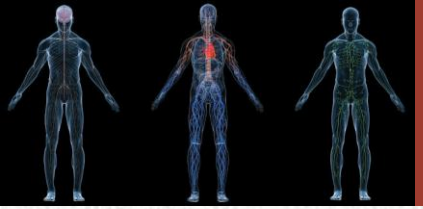
Stage of disturbance - Po 2 30 - 40 mm of Hg

- severe hypoxia, CNS



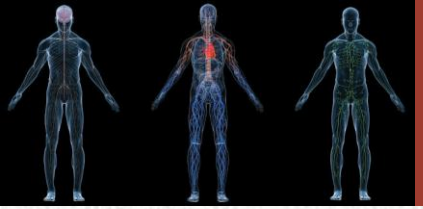
PO_2 Responses to High Altitude





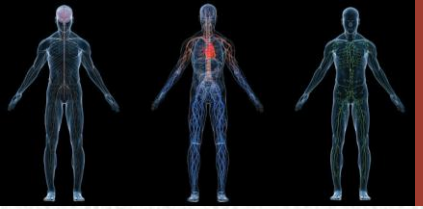
Acclimatization

1. RS – 1. Increased ventilation
   - due to decreased P_{O_2}
   - increase slowed by decreased P_{CO_2}



Low PO_2

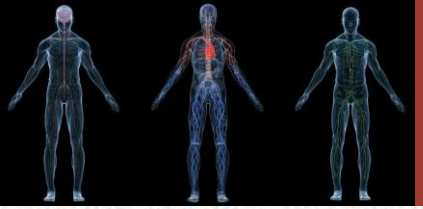
- 1- 2 day- Arterial chemoreceptor (Alveolar ventilation 1.65times)
- (2-5 days)- Blow off CO_2 –P_H increase- - inhibit brain stem respiratory center – oppose stimulation of respiration
- After 5 days--- reduction in HCO_3 ion in CSF, P_H decrease –stimulate respiratory center Pulmonary ventilation 5 times



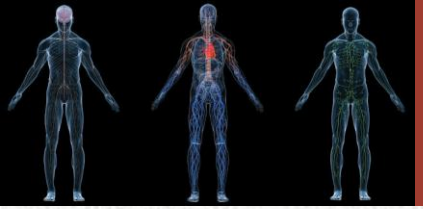
2. BLOOD -Increased hematocrit (content)-
    - Hb, PCV, 2,3 DPG
    - Blood Volume

1. RS – 2. Increased diffusing capacity
    - due to pulmonary capillary blood volume
    - Pulmonary arterial blood pressure
    - Lung air volume

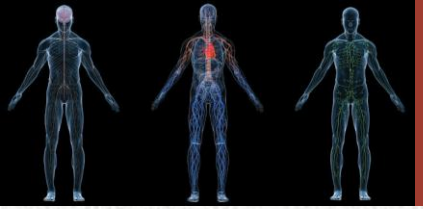
- 3. PULMONARY HTN



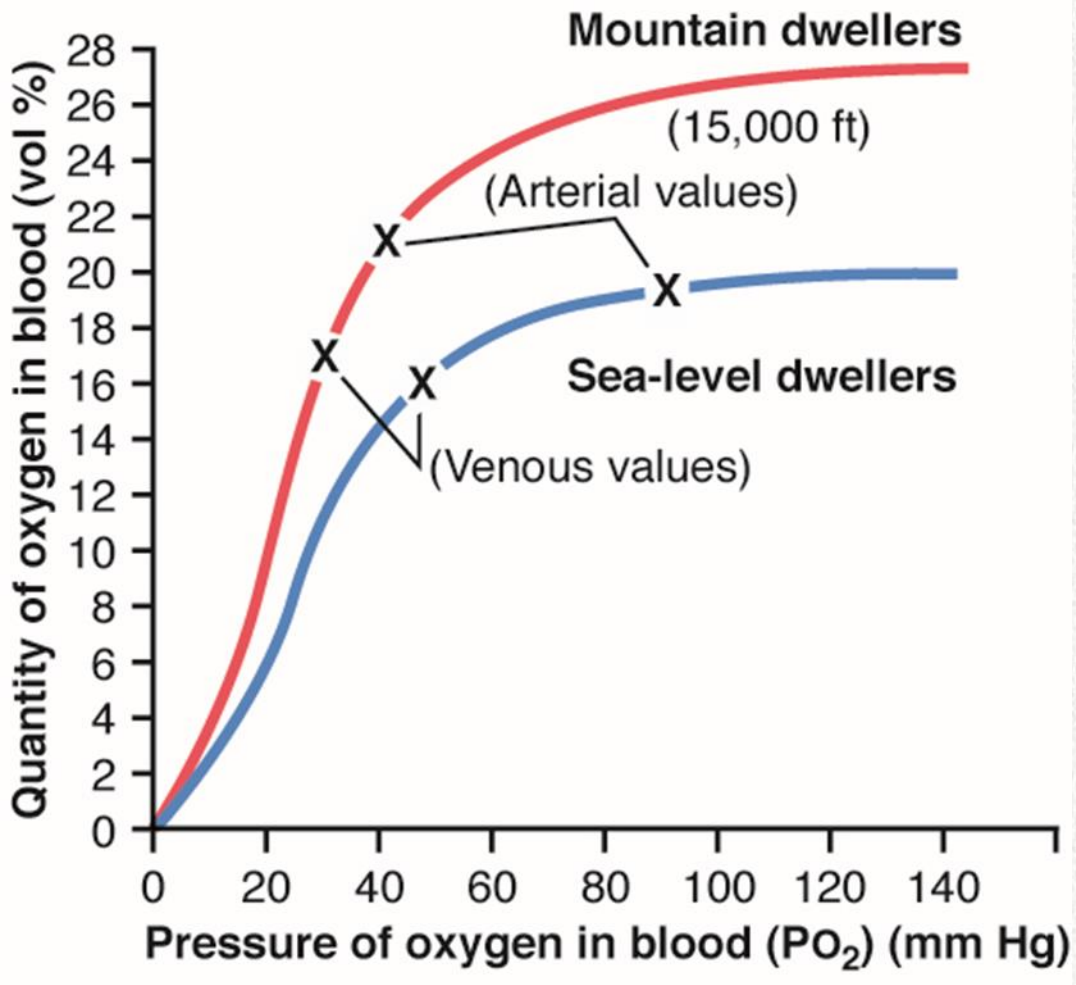
4. Increased capillarity- angiogenesis
5. Cellular level
6. CVS- CO, HR,FOC increase-Tachycardia
7. Work capacity

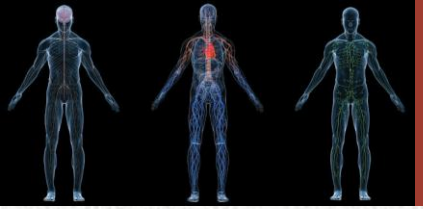


	Work capacity (per cent of normal)
Unacclimatized	50
Acclimatized for 2 months	68
Native living at 13,200 feet but working at 17,000 feet	87



Natures acclimatization





Mountain Sickness

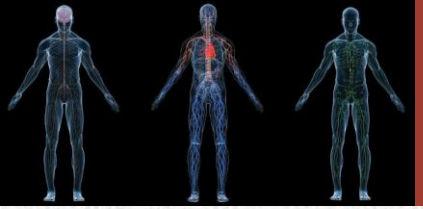
- Acute mountain sickness (1 -2 days)
  - Acute cerebral oedema

    local vasodilation of cerebral blood vessels, Autoregulation fails.

  - Acute pulmonary edema-

    1. Pulmonary arteriole constrict much in some area- force blood- increase pressure– oedema occurs
    2. Cold – vasoconstriction- increase PCHP – fluid outside- lung oedema

Rx- steroid



- Chronic mountain sickness

i. Increase in red cell mass - blood viscosity – tissue blood flow- oxygen supply

ii. GIT – Expansion of gases- nausea, vomitting

iii. Increase in pulmonary arterial pressure

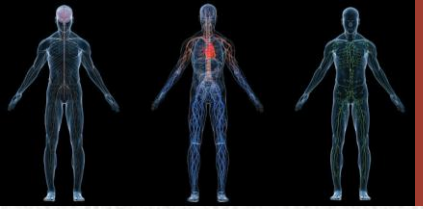
iv. Enlargement of right heart – HR, FOC

v. Peripheral arterial pressure fall

vi. CCF

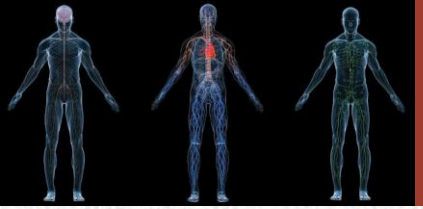
vii. Death

Rx – oxygen supply



- During acclimatization to high altitude all of the following take place except

a) Increase in minute ventilation
b) Increase in sensitivity of central chemoreceptor
c) Increase in sensitivity of carotid body
d) Decreased heart rate



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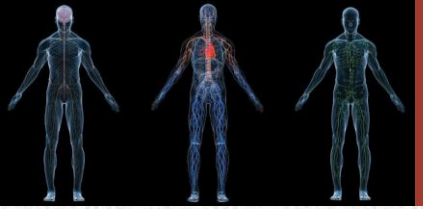


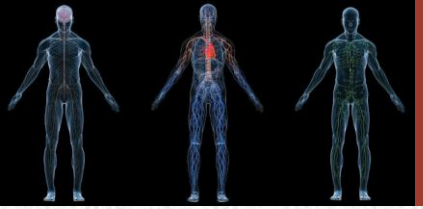
- A climber on high mountain reaches altitude of 5000 mt/ 16400 ft above sea level. What will happen to his arterial PCO_2 and pH?

a) Both will be more than normal

b) pH will rise and PCO_2 will fall

c) Both will higher than normal due to physical exertion

d) pH will fall and PCO_2 will rise



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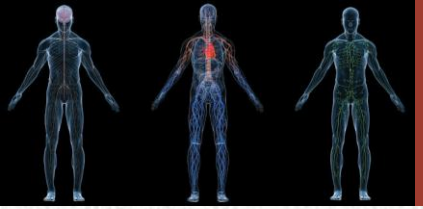
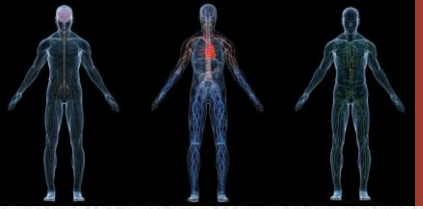
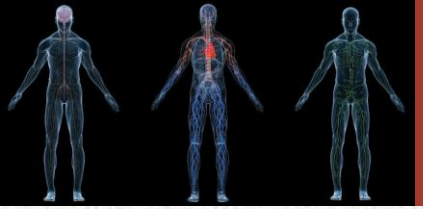


AVIATION PHYSIOLOGY

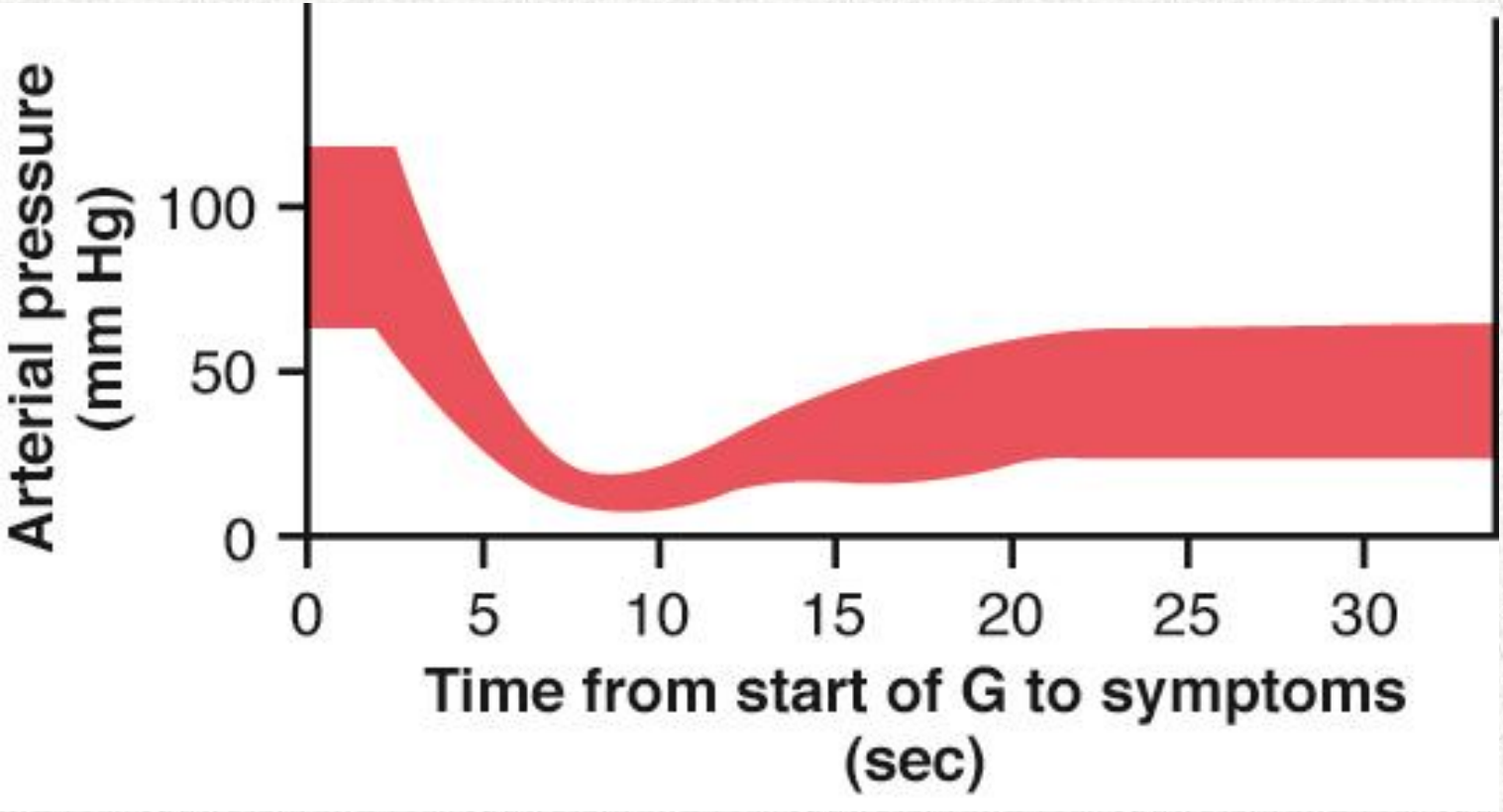


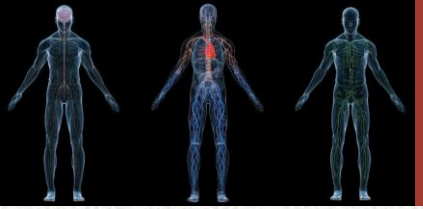
- Aviator is sitting in his seat, force with which he is pressing against seat results from pull of gravity and is equal to his weight. = +1 G
- Increase the speed – positive G

- If airplane goes through an outside loop so that person is held down by his seat belt, negative G is applied to his body = - 1 G.
- Decrease the speed – negative G



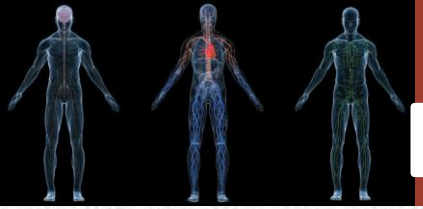
Blood Pressure Responses to G Forces





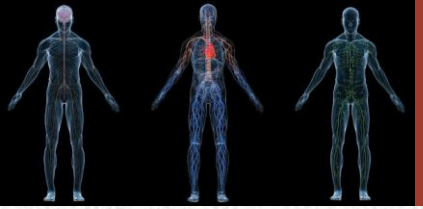
Effects of positive G

- Circulatory System– 5 G
- Blackout of vision-- 4 to 6 G
- Vertebrae– 20 G



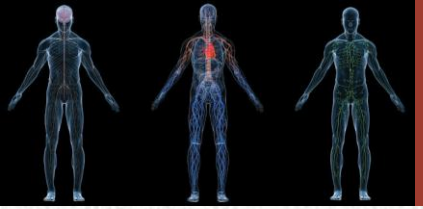
EFFECT OF NEGATIVE G

- Psychotic disturbance – (-4 TO -6 G)
- Cerebral BP – 300-400 mm of Hg
- Red out – eyes are not protected by cranium.



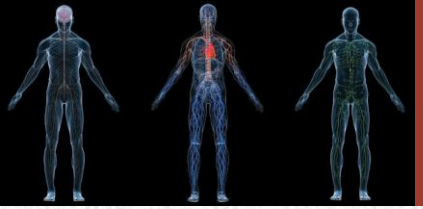
Prevention

- Anti G suits
- Abdominal belts



Weightlessness

- Gravity act both on spacecraft and person

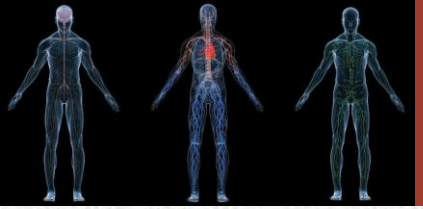


- Effects on Cardiovascular Systems and Kidneys

1. fluid shift.
2. No gravity, blood moves from lower part to upper part - enlargement of heart
3. accumulation of body fluids in upper part.

Compensatory mechanism -

- Excreting of fluid through kidneys.
- Along with water, kidneys excrete electrolytes
- osmolarity of body fluids is not altered,So thirst center is not stimulated , astronauts do not feel thirsty during space travel.

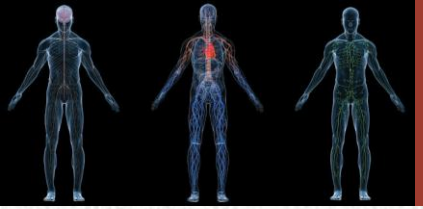


2. **Effects on Blood**

- Plasma volume decreases due to excretion of fluid through urine. RBC count decreases (space anemia)

3. **Effects on Musculoskeletal System**

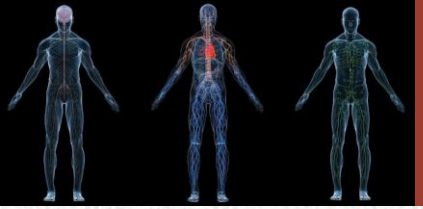
- Because of microgravity in space, muscles need not support the body against gravity. Astronauts move by floating instead of using their legs. This leads to decrease in muscle mass and muscle strength. Endurance decreases.
- Bones become weak-Osteoclastic activity increases during space travel.
- Calcium removed from bone is excreted



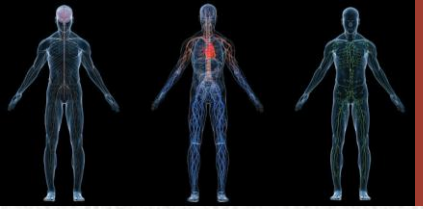
4. **Effects on Immune System** -suppression

5**. Space Motion Sickness**

- nausea, vomiting, headache and malaise (generalized feeling of discomfort or lack of wellbeing or illness that is associated with sensation of exhaustion).
- occurs due to abnormal stimulation of vestibular apparatus and fluid shift

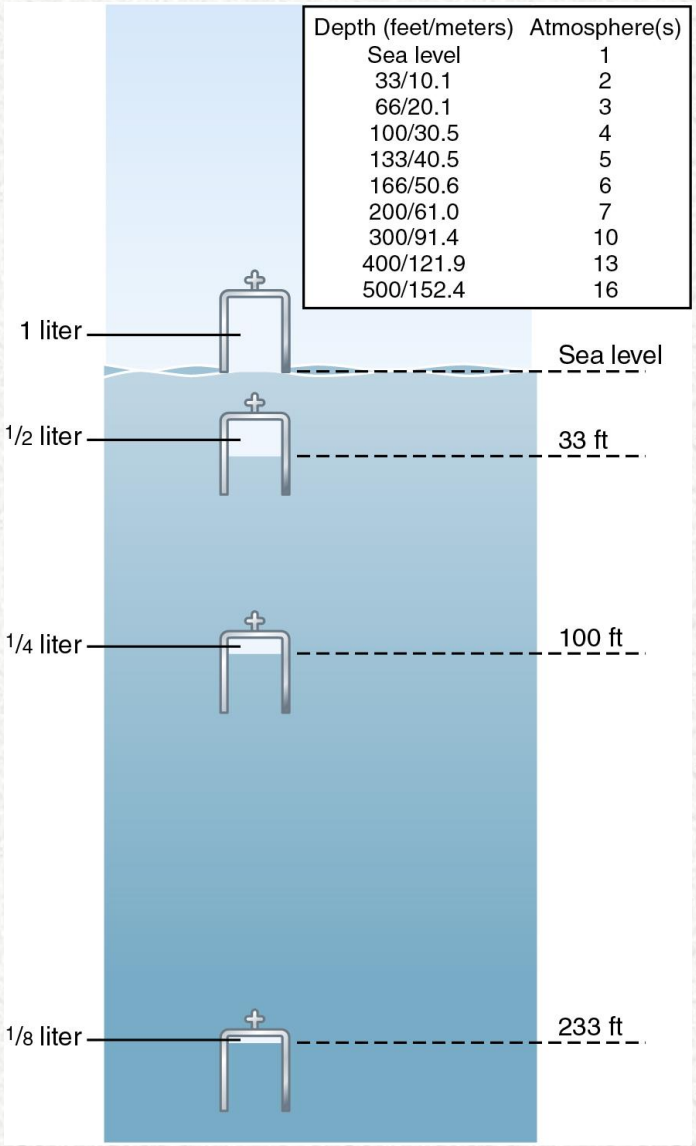


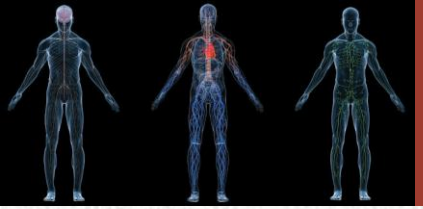
PHYSIOLOGY OF DEEP-SEA DIVING



Effect of Pressure on Volume Changes

Barometric Pressure and Volume Changes below Sea Level





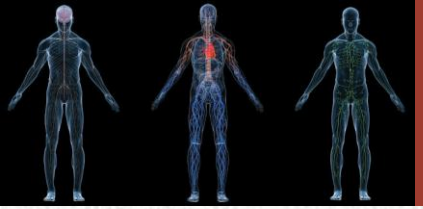
Deep Sea Diving

- 33 ft = 1 atm

Nitrogen

- 120 ft - confusion
- 150-200- drowsy
- 200- 250- weaning of strength
- Above 250- narcosis, repture of death
- Soluble in fat , as deep sea come nitogen dissolve in fat of various part of body. (neuronal membrane) like anesthetic agent.
- Reduces excitibility

TREATMENT - HELIUM

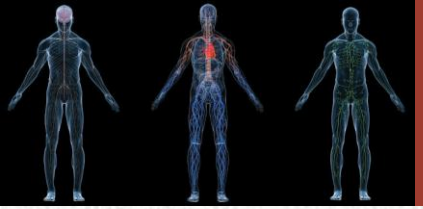


- **Oxygen –**

1. acute toxicity – free radicles, brain dysfunction, seizures, coma
2. chronic toxicity- lung congestion, pulmonary odema

- **Carbon Dioxide –**

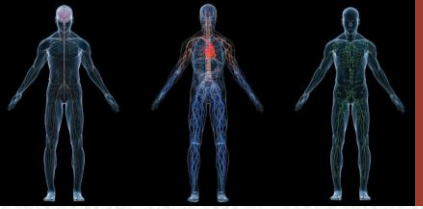
1. no toxicity
2. Co 2 production rate not increased, co 2 formed this is exhaled.



Decompression sickness (caissons (pressure chembers) disease)

- Mainly nitrogen

1. Bends –joint muscle pain, myline sheath
2. Numbness, tingling, itching
3. Divers palsy- paralysis of muscle motor nerve fiber
4. MI
5. Neurological symptom
6. Air embolism – Bubbles
7. Unconsciousness- death



Prevention

1. Use of breathing apparatus

   E.g. Self contained underwater breathing apparatus (SCUBA)

Air nesessory for inspiration enter the mask and
expired air exhaled out of mask

Disadvantage- short time stay
150 ft below only for few minutes

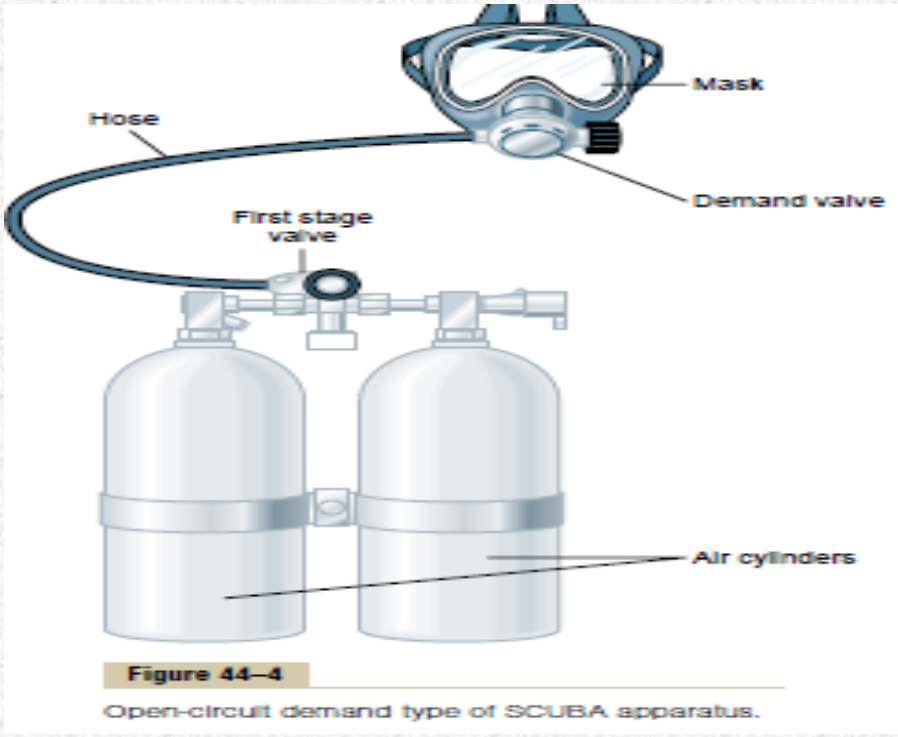
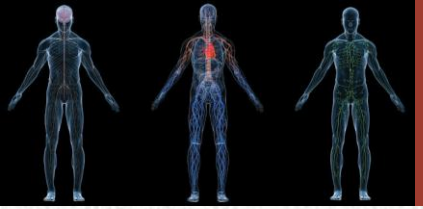
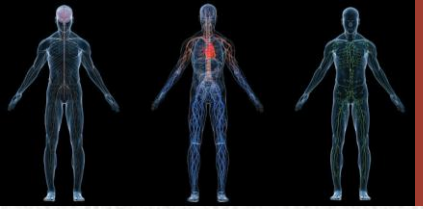


Figure 44–4
Open-circuit demand type of SCUBA apparatus.



2. Breathing mixtures (Helium and low oxygen)
3. Slow ascent
4. Decompression tank

HYPERBARIC Oxygen therapy

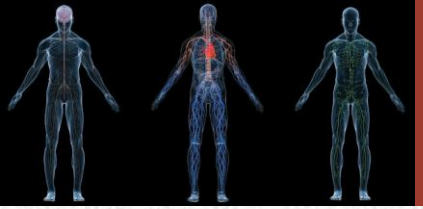


SUMMARY

- High altitude
- Acclimatization
- Mountain sickness

- Aviation
- Positive G & Negative G effect
- Weightlessness

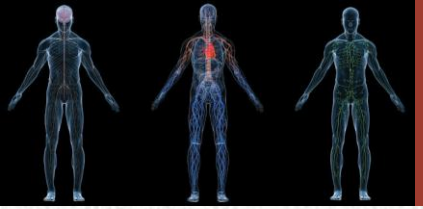
- Deep sea diving- decompression sickness



QUESTIONS….

SHORT NOTES:

1. Changes Occurred During Acclimatization
2. Chronic Motion Sickness
3. Effects Of Positive And Negative G
4. Oxygen toxicity



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Medical College and Hospital

DR.CHARUSHILA