A PRESENTATION BY NANA YANNICK

CIRCULATORY AND RESPIRATORY ADJUSTMENTS TO LOW ATMOSPHERIC PRESSURE

ADAPTATION TO HIGH HYDROSTATIC PRESSURE

- Atmospheric pressure:the pressure exerted by the atmosphere
- An individual at high altitude exerts the following physiological changes:

- **Hypoxia:** Results to lack of oxygen in the tissues.
- There are two types: environmental and medical hypoxia

Effects of altitude and partial pressure of gases

Partial pressure (PP):This is when rate of diffusion of a gas is directly proportional to the pressure caused by that gas alone.

- At high altitudes individuals become **dehydrated**
- High altitude also leads to low **ambient temperature**

- **Ambient temperature**: Here water vapour contents of the ambient air is reduced.
- Any animal with body temperature above ambient temperature will loose water quickly in its warm saturated area e.g. montane tenebrids have **cryptonephridia**: an excretory adaptation to minimise water loss

Circulatory and respiratory adjustments to low atmospheric pressure

- These adjustments can be tested by subjecting a person to an atmosphere where there is low partial pressure of oxygen (PPO_2)
- How does a person adjusts to such conditions?
- Depends on how high the altitude is and how quickly he gets there

- A mountaineer at about 4000m above sea level begins to develop signs of hypoxia.
- This results to increase blood oxygen carrying capacity
- At the same time, total number of red blood cells (RBC) and Hb count of the body increases
- In addition, increase in production of RBC by bone marrow

- There is also increase in gaseous exchange by the action of 2,3 diphosphoglycerate (2,3 DPG)
- Ventilation rate increases when mountaineers and mammals are exposed to environmental hypoxia due to reduction in PPO_2
- Increase ventilation rate reduce $PPCO_2$, leading to alkalosis.
- After few days, kidney removes bicarbonate ions and blood P^H is returned to normal

Response of other vertebrates to low atmospheric pressure

- Birds can tolerate lower values of oxygen tension in the inspired air than mammals
- At high altitude, there is no change in the concentration of Inositol hexaphosphate (IHP)
- IHP is the major organic phosphate in avian RBC
- Avian eggs have a particular respiratory problem at high altitudes: because shells compensate for reduced rate of gaseous exchange and therefore incurring rapid evporative water loss

ADAPTATION TO HIGH HYDROSTATIC PRESSURE (DIVING ANIMALS)

- Lung fish when subjected to aerated water, blood flow to the gills is high and blood flow to the lungs is low.
- During lung ventilation, situation is reversed
- Diving birds and mammals are unable to exchange gases with the aquatic environment

- Such animals show a number of adaptations to their aquatic environment, hence blood volume and oxygen carrying capacity are higher than in their terrestrial relatives
- They tend to reduce blood flow to somatic and splanchnic muscles, consequently nearly all oxygen contained in the blood is made available to the CNS and heart
- If heart, blood pressure and other variables in diving animals is recorded, the cardiac frequency will decrease drastically

- This causes reserved oxygen deprived from its Hb and myoglobin being sent to organs like the heart and brain

BUOYANCY

- This is another adaptation to high hydrostatic pressure where the density of diving animals is less dense than water
- By avoiding the effect of variable pressure, combination and physiology, buoyancy can be achieved by:

- Removing heavy material
- Adding very light materials
- Increasing floatation by increasing surface area to volume ratio.

THANKS FOR LISTENING