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Introduction to Physiology notes

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INTRODUCTION TO PHYSIOLOGY

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I RESPIRATORY + CIRCULATORY SYSTEM (JD)

RESPIRATORY SYSTEM:

- O_2 FROM ATMOSPHERE → MITOCHONDRIA
- CO_2 EXCRETION

CIRCULATORY SYSTEM:

- DISTRIBUTION OF GASES & NUTRIENTS

$\dot{V}_{O_2} \approx 250 mL/min \Rightarrow$ CONSUMPTION OF O_2 AT REST } STEADY STATE
$\dot{V}_{CO_2} \approx 200 mL/min \Rightarrow$ PRODUCTION OF CO_2 AT REST }

IN ATMOSPHERE:

$F_{O_2} \approx 0.21$

$F_{N_2} \approx 0.79$

$F_{CO_2} \approx \phi$

WHAT CONSUMES ALL THE CO_2? PLANTS → PRODUCE O_2 FROM CO_2

* CATELY WE HAVE BEEN PRODUCING MORE CO_2 THAN IT CAN BE CONSUMED

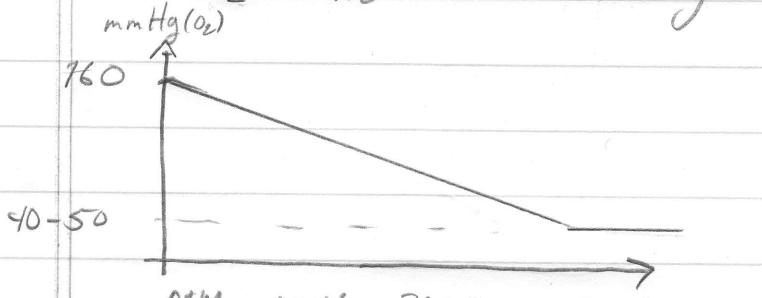
0.0003 INCREASED TO 0.00045 ⇒ BIG RELATIVE CHANGE BUT SMALL ABSOLUTE Δ

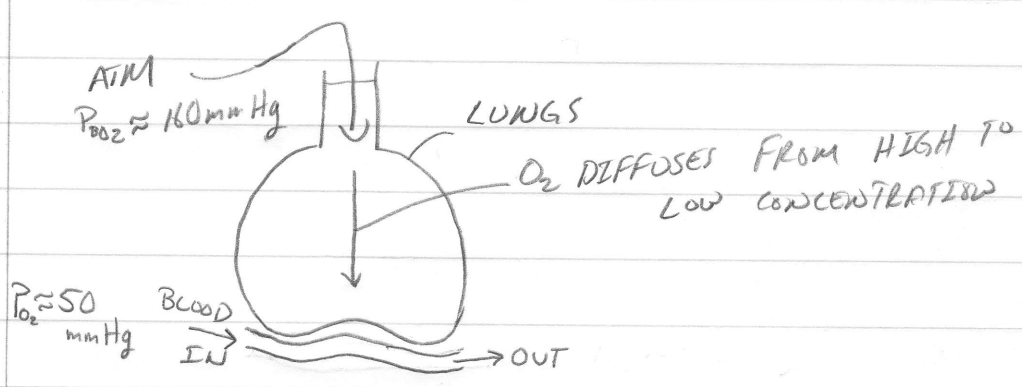
BAROMETRIC PRESSURE: $P_B \approx 760 mm Hg \pm 20_{mm\ Hg}$

$P_x = F_x \cdot P_B$

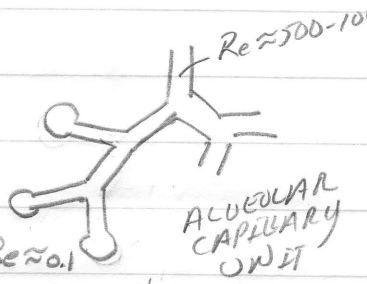
FOR O_2: $P_{BO_2} = 0.21 \cdot 760\,mm\,Hg = 160\,mm\,Hg$

N_2: $P_{N_2} = 0.79 \times 760\,mm\,Hg = 600\,mm\,Hg$





FOR AIR TO DIFFUSE TO A $\Delta P_{O_2} \approx 100\,mm\,Hg$ IT WILL REQUIRE AN AREA OF ABOUT A TENNIS COURT!!



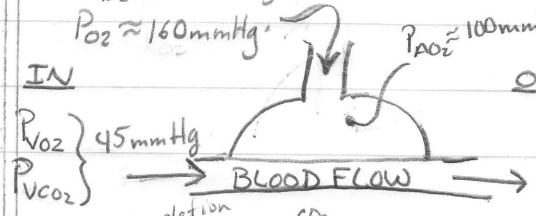
* BY BRANCHING HUNDREDS OF TIMES, THE LUNG ACHIEVES A VERY LARGE SURFACE AREA.

$P_{N_2} \approx 600\,mm\,Hg$

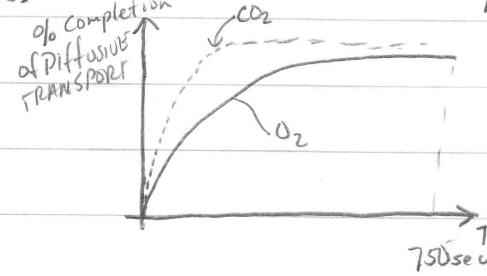
$P_{O_2} \approx 160\,mm\,Hg$

$P_{AO_2} \approx 100\,mm\,Hg$

P_a = ARTERIAL PARTIAL PRESSURE

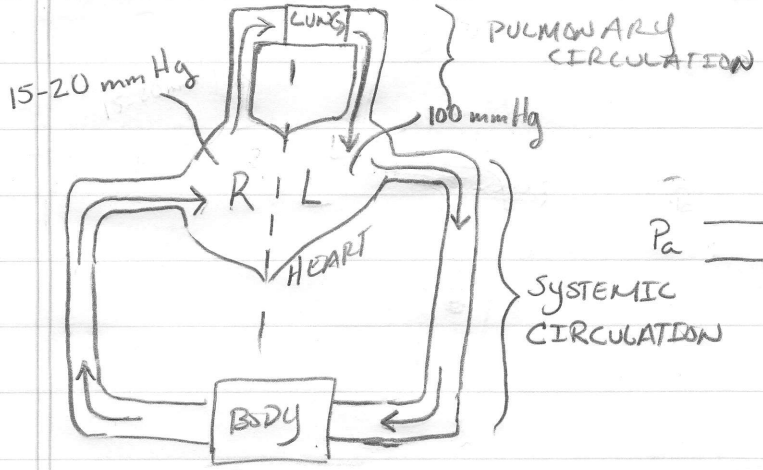


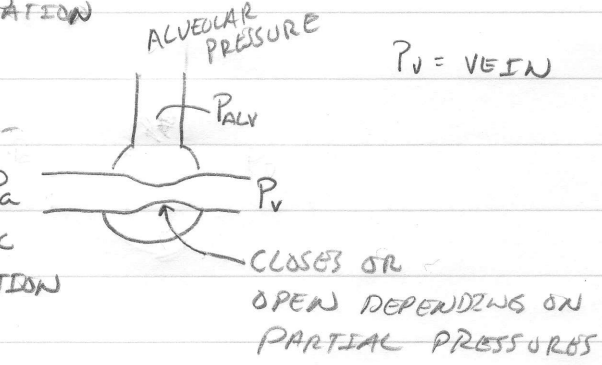
	NO VENT	VENTILATION LIKE MAD!!	NORMAL
P_aO_2	45	160	100
P_aCO_2	45	ϕ	40



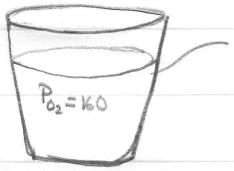
DURING REST, WE ONLY USE ABOUT 1/3 OF LUNG CAPACITY

AT HIGH ALTITUDE P_{O_2} IS LOWER BUT THE BODY MAKES MORE RED BLOOD CELLS SO MORE O_2 CAN BE CARRIED.





CAPACITY TO CARRY O_2



100mL OF H_2O

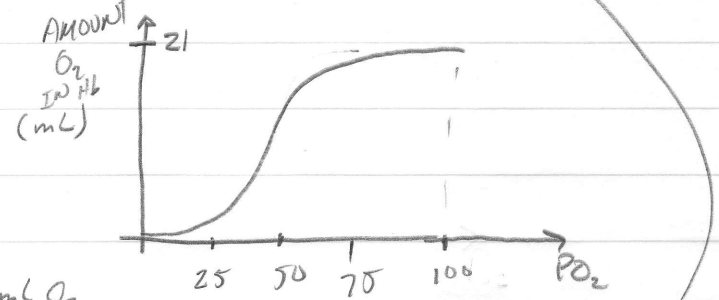
AMOUNT = SOL. OF O_2 × P_{O_2}

$= 0.003 \frac{mL}{mmHg} \times 160 mmHg = 0.48 mL\ O_2$

IN BLOOD ⇒ HEMOGLOBIN TRAPS O_2, DEPENDS ON:

① AMOUNT OF Hb

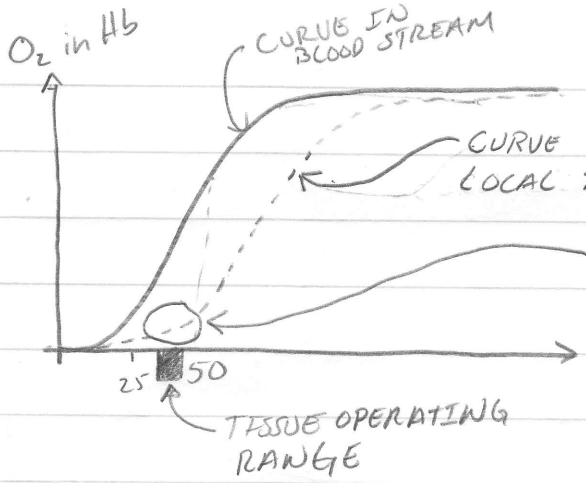
② P_{O_2}



100mL OF BLOOD ≈ 15g Hb → 21mL O_2

COMPARE WITH 0.48mL O_2 IN 100mL OF H_2O!!!

BLOOD IS MUCH MORE EFFICIENT ON CARRYING O_2



SINCE TISSUE OPERATES IN THE RANGE OF 35-45 mmHg, O_2 IS RELEASED FROM Hb WHEN IT REACHES THE TISSUE

CONGESTIVE HEART FAILURE ⇒ ACCOMULATION OF FLUID (EDEMA) DUE TO REDUCED FUNCTION OF EITHER SIDE OF HEART

ASTHMA ⇒ MUSCLE CONTRICTS LUMEN ADDING RESISTANCE TO AIR FLOW

EMPHYSEMA ⇒ DESTRUCTION OF ELASTIC COMPONENTS OF LUNG, DIFFICULT TO EXHALE.

II PHYSICAL PRINCIPLES IN ABDOMINAL PHYSIOLOGY (M2)

- HOMEOSTASIS ⇒ INTERACTION WITH ENVIRONMENT, BALANCE

EPITHELIAL CELLS ⇒ LINED UP ALONG SURFACE OF MANY ORGANS

ANATOMY: STOMACH, GI TRACT, LIVER, KIDNEY, ETC

- STOMACH: pH ~ 2, DEGRADATION OF FOOD
- GI TRACT: ABSORB NUTRIENTS
- LIVER: FOOD IS PROCESSED
- KIDNEY: REMOVE POISON TO BE EXCRETED (N_2)

EPITHELIAL CELLS (POLARIZED) ⇒ APICAL SURFACE ⇒ EXPOSED TO CAVITY, LUMEN

BASOLATERAL SURFACE ⇒ ATTACHED TO SURFACE, BLOOD SIDE

ANATOMY OF STOMACH, LIVER, KIDNEY

THE EPITHELIAL TISSUE KEEPS THE BODY IN BALANCE BY CHECKING ION CONCENTRATION, pH, OSMOLALITY, ETC.

URINE: pH ~5, ALSO EXCRETES ACIDS

PHYSICO-CHEMICAL PROCESSES

(A) PASSIVE DIFFUSION: ALLOW REGULATION

H_2O, UREA, NH_3, H^+, CO_2

AQUOPORINS ⇒ ALLOW H_2O TRANSPORT ACROSS MEMBRANES

ION CHANNELS ⇒ " ION " "

(B) ACTIVE TRANSPORT ⇒ USE ATP TO MOVE AGAINST GRADIENT

Na^+, K^+ ATPase

PROTON ATPase

(C) SECONDARY ACTIVE TRANSPORT (USE GRADIENTS FORMED IN ACTIVE TRANS)

Na^+, GLUCOSE

SEE SLIDES FOR PROXIMAL TUBE: TRANSPORT FUNCTIONS

TRANSPORTERS:

NA/K-ATPase ⇒ BASOLATERAL SIDE OF EPITHELIUM

mTAL ⇒ BUMETANIDE-SENSITIVE CO-TRANSPORTER, ABSORB SALT

SEE SLIDES FOR OTHER EXAMPLES

HORMONES CAN REGULATE H_2O ABSORPTION (ANTI-DIURETIC HORMONE)

THERE ARE REDUNDANT SYSTEMS TO KEEP THE BODY IN BALANCE