THE DIFINITIVE GUIDE TO HUMAN ANATOMY & PHYSIOLOGY (HAP 2).

BLOOD

BLOOD COMPONENTS:

CELLULAR COMPONENTS → [LIVING CELLS] → FORMED ELEMENTS

LIQUID COMPONENTS → [NON-LIVING] → PLASMA

ALL FORMED ELEMENTS ARE CREATED IN THE RED BONE MARROW

FORMED ELEMENTS ARE FLOATING WITHIN THE PLASMA

FORMED ELEMENTS: 45%

ERYTHROCYTES

RBCS → CONTAIN HAEMOGLOBIN → A GAS TRANSPORTING PROTEIN → TRANSPORT O2 + CO2 → HAVE NO NUCLEUS.

LEUKOCYTES WBCS

→ BUFFY COAT

→ programmed to **RECOGNISE FOREIGN ANTIGENS** → **CAN LEAVE THE CARDIOVASCULAR SYSTEM** → **MOVE INTO CELLS + TISSUES.**

HAVE A NUCLEUS

PLATELETS

→ BUFFY COAT

→ **FRAGMENTS** OF LARGER CELLS CALLED **MEGAKARYOCYTES** → **CLOTTING FACTORS** → **HAVE NO NUCLEUS → DEGENERATE AFTER 10 DAYS**

BLOOD SAMPLE

44% **ERYTHROCYTES → HAEMATOCRIT → PACKED CELL VOLUME**

1% **(BUFFY COAT) → PLATELETS + LEUKOCYTES**

55% → PLASMA

45% → FORMED ELEMENTS [TOTAL]

CORONARY VESSELS:

CORONARY CIRCULATION:

The set of arteries and veins that service the heart muscle are referred to as coronary circulation.

THE BLOOD SUPPLY OF THE HEART ITSELF.

THE GREAT VESSELS:

AORTA

PULMONARY TRUNK

SUPERIOR VENA CAVA

INFERIOR VENA CAVA

LEFT CORONARY ARTERY and **RIGHT CORONARY ARTERY** → **BRANCH OFF THE AORTA** just above the aortic valve.

CORONARY SINUS: lies on the posterior side of the heart in the atrioventricular coronary sulcus; it is what the THREE cardiac veins of the heart drain in to.

THE CORONARY SINUS DRAINS INTO THE RIGHT ATRIUM.

VALVES OF THE HEART:

ATRIOVENTRICULAR VALVES

The atrioventricular valves are **INFLOW VALVES**.

The **ATRIOVENTRICULAR VALVES CLOSE** when the **VENTRICLES CONTRACT** → **STOPPING BLOOD FROM MOVING BACKWARDS WHEN THE VENTRICLES CONTRACT → FORCING BLOOD INTO THE GREAT VESSELS**.

TRICUSPID VALVE → RIGHT ATRIUM + RIGHT VENTRICLE

BICUSPID/MITRAL VALVE → LEFT ATRIUM + LEFT VENTRICLE

The **CLOSING** of the **AORTIC VALVES** is what we are hearing with the **S1 HEART SOUND**.

A RISE IN VENTRICULAR PRESSURE FORCES THE ATRIOVENTRICULAR VALVES CLOSED.

RESPIRATOIN PROCESS

RESPIRATORY SYSTEM

(1) **PULMONARY VENTILATION:** **(AIR OF THE LUNGS)**

- MOVEMENT OF **AIR** INTO THE **LUNGS**

- MOVEMENT OF **AIR** OUT OF THE **LUNGS**

THE MOVEMENT OF AIR IN AND OUT OF THE LUNGS.

BREATHING.

(2) **EXTERNAL RESPIRATION:**

(BLOOD OF THE LUNGS)

- **MOVEMENT** OF **OXYGEN** FROM: LUNGS **[ALVEOLI]** → BLOOD

- **MOVEMENT** OF **CARBON DIOXIDE** TO: BLOOD → LUNGS **[ALVEOLI]**

(AIR MOVES INTO CAPILLARIES GAS EXCHANGE)

THE MOVEMENT OF GASES BETWEEN THE LUNGS AND THE BLOOD.

GAS EXCHANGE BETWEEN THE AIR OF THE ALVEOLI AND THE BLOOD.

CARDIOVASCULAR SYSTEM

(3) TRANSPORT OF RESPIRATORY GASES:

- TRANSPORT OF OXYGEN TO: BLOOD → TISSUES

- TRANSPORT OF CARBON DIOXIDE FROM: TISSUES → BLOOD

(4) INTERNAL RESPIRATION:

- MOVEMENT OF OXYGEN FROM: BLOOD → TISSUE CELLS

- MOVEMENT OF CARBON DIOXIDE TO: TISSUE CELLS → BLOOD

THE MOVEMENT OF GASES BETWEEN THE BLOOD AND THE TISSUES.

9 LARYNX CARTILAGES:

(1) **Thyroid cartilage** (**SINGLE**):
midline of the **thyroid cartilage** is the **laryngeal prominence**, and is seen externally as the **Adam's apple**.

(2) **Epiglottis cartilage** (**SINGLE**):
During **swallowing**, the **epiglottis covers** the **glottis (vocal cords)**, **preventing** food or liquids from **entering** the **larynx** (larynx is sealed off).

(3) **Cricoid cartilage** (**SINGLE**):
Cartilage ring.

(4) **ARYTENOID cartilage** (**PAIRED**): triangular-shaped cartilage **involved** in **sound production**. They attach to and or **anchor** the **vocal folds**.

(5) **Corniculate cartilage** (**PAIRED**): sitting **atop** the **arytenoid cartilages** are the paired (one on each side) corniculate cartilages. They also aid in sound production.

(6) **Cuneiform cartilage** (**PAIRED**): found **in** the **lateral wall** of the **larynx**, where they help to **support** the **epiglottis**.

BRONCHIOLE TREE BRANCHES

PRIMARY [MAIN] BRONCHI/BRONCHUS

↓

SECONDARY [LOBAR] BRONCHI

↓

TERTIARY [SEGMENTAL] BRONCHI

↓

BRONCHIOLES

↓

TERMINAL BRONCHIOLES

↓

RESPIRATORY BRONCHIOLES

↓

ALVEOLAR SACS

↓

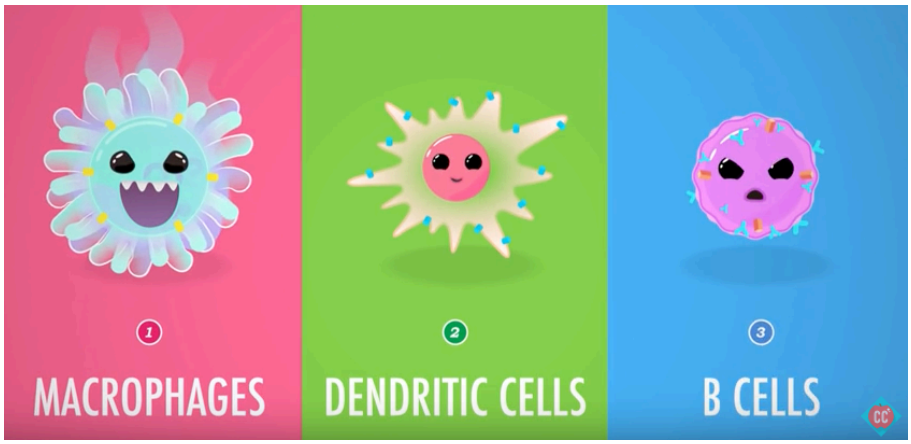
ALVEOLI

GAS EXCHANGE!!!

ANTIGEN-PRESENT CELLS

ANTIGEN-PRESENT CELLS: meaning that they **DISPLAY** a portion of the **PATHOGEN/ANTIGEN** that they have **INGESTED** on the **OUTSIDE** of their **CELL**/plasma **MEMBRANE**.

T CELLS of the adaptive immune response **RESPOND** to these **PRESENTED** cells, becoming activate if the T Cell has the specific make-up to destroy that **PATHOGEN/ANTIGEN.**



Dendritic cells:

- in connective tissues [tendons; ligaments; cartilage; parietal/serous membranes] and epidermis/skin.
- phagocytize pathogens, enter lymphatics to present antigens to T cells in lymph nodes.
- Most effective antigen presenter known.
- Key link between innate and adaptive immunity.

Macrophages:

- Macrophages **KILL MULTIPLE TIMES** before dying themselves.
- **FOUND IN THE TISSUES!**
- **FREE MACROPHAGES:** **WANDERING SCAVENGER CELLS**.
- **FIXED MACROPHAGES:** attached to fibres in specific organs **[LYMPHOID ORGANS]** devouring anything suspicious that passes by.

INTRAPERITONEAL ORGANS:

- LIVER
- STOMACH
- SPLEEN
- FIRST PART OF THE DUODENUM OF THE SMALL INTESTINE
- JEJUNUM OF THE SMALL INTESTINE
- ILEUM OF THE SMALL INTESTINE
- CAECUM OF THE LARGE INTESTINE
- TRANSVERSE COLON OF THE LARGE INTESTINE
- SIGMOID COLON OF THE LARGE INTESTINE

RETROPERITONEAL ORGANS:

- SECOND PART OF THE DUODENUM OF THE SMALL INTESTINE
- PANCREAS
- ASCENDING COLON OF THE LARGE INTESTINE
- DESCENDING COLON OF THE LARGE INTESTINE
- RECTUM

THE ARE THREE PERITONEAL FOLDS:

[1] MESENTRY: SUSPENDS THE SMALL INTESTINE

[2] MESOCOLON: SUSPENDS THE LARGE INTESTINE

[3] GREATER OMENTUM:

VESSEL SUPPLY:

ARTERIES [CARRYING OXYGEN-RICH, NUTRIENT-POOR BLOOD]

ARISE FROM THE **ABDOMINAL AORTA.**

CELIAC TRUNK

STOMACH, 1ST HALF OF DUODENUM, LIVER, SPLEEN AND PANCREAS.

SUPERIOR MESENTERIC ARTERY

2ND HALF OF DUODENUM, JEJUNUM, ILEUM, ASCENDING COLON, 1ST HALF OF TRANSVERSE COLON.

INFERIOR MESENTERIC ARTERY

SECOND HALF OF TRANSVERSE COLON, DESCENDING COLON, SIGMOID COLON AND RECTUM.

VEINS [CARRYING NUTRIENT-RICH, OXYGEN-POOR BLOOD]

DRAIN INTO SUPERIOR MESENTERIC VEINS →

HEPATIC PORTAL VEIN → LIVER.

Inferior Mesenteric Vein

The remainder of the large intestine.

Superior Mesenteric Vein

The remainder of the small intestine: jejunum, ileum.

Most of the large intestine.

Portal Vein

Liver Stomach Pancreas Duodenum

KIDNEY BLOOD SUPPLY:

- The kidneys receive **25%** of the **TOTAL CARDIAC OUTPUT!**

THE **RENAL ARTERIES** BRANCH OFF THE **ABDOMINAL AORTA**.

[1]RENAL ARTERY enters at the **HILUM**, branching into

[2]SEGMENTAL ARTERIES soon after entry.

As the **SEGMENTAL ARTERIES** branch, travelling along/through the **RENAL COLUMNS**, they become

[3]INTERLOBAR ARTERIES [each **RENAL PYRAMID** makes up its own **LOBE**]. When the **INTERLOBAR ARTERIES** reach the superior aspect of the **RENAL MEDULLAS**, bordering and **ARCHING AROUND** the **RENAL CORTEX**, they are known as the

[4]ARCUATE ARTERIES.

Extending laterally from the **ARCUATE ARTERIES**, toward the **RENAL CORTEX**, are the

[5]RADIATE ARTERIES INTERLOBULAR].

The **RADIATE ARTERIES** split, one branch continues to the **RENAL CORTEX**, and the other branch is the

[6]AFFERENT ARTERIOLE, which enters the

[7]GLOMERULUS. Exiting the **GLOMERULUS** is the

[8]EFFERENT ARTERIOLE.The **EFFERENT ARTERIOLE** feeds into a capillary bed known as the

[9]PERITUBULAR CAPILLARIES, which form a capillary network around the **RENAL TUBULE** of each **NEPHRON**.

The VASA RECTA are the capillaries that supply the **LOOP OF HENLE**. They arise from the **EFFERENT ARTERIOLES**, and **EMPTY** into the **RADIATE VEINS [INTERLOBULAR]**.

NOTE:

The **AFFERENT ARTERIOLE** enters the **GLOMERULUS** carrying **OXYGENATED**, UN-FILTERED BLOOD.

The **EFFERENT ARTERIOLE** exits the **GLOMERULUS** carrying **OXYGENATED**, **FILTERED BLOOD**.

The **[9]PERITUBULAR CAPILLARIES**, unlike the **GLOMERULAR CAPILLARY BEDS**, form traditional capillary beds, and therefore have a **VENOUS** end as well as and **ARTERIAL** end.

Leading out of the **PERITUBULAR CAPILLARY BEDS** are the **[10]RADIATE VEINS [INTERLOBULAR]**, which merge onto the **[11]ARCUATE VEINS** that arch around the lateral aspect of the **RENAL MEDULLA**, at the border of the **RENAL CORTEX**.

Once the **ARCUATE VEINS** return towards the **RENAL PELVIS** after circumferencing the **RENAL MEDULLA**, they join to form an **[12]INTERLOBAR VEIN**. This **INTERLOBAR VEIN** brings blood from the **RENAL MEDULLA** across the **RENAL PELVIS**, eventually merging to form the

[13]RENAL VEIN.

THE RENAL VEINS EXIT EACH KIDNEY AT THE **HILUM**, AND EMPTY INTO THE INFERIOR VENA CAVA.

There are **NO** **SEGMENTAL VEINS**.

SEMINIFEROUS TUBULES:

SITE OF SPERM PRODUCTION → SPERMATOGENESIS.

- **PRODUCE TESTICULAR FLUID** → **PROVIDES NUTRIENTS** for **SPERM CELLS**.
- **[SERTOLI CELLS]** form a **MUSCLE**-LIKE LAYER, which **SURROUNDS** the **OUTSIDE** BASEMENT MEMBRANE of the **SEMINIFEROUS TUBULES**.
- This muscle layer **CONTRACTS** to **PUSH SPERM** and **TESTICULAR FLUID THROUGH** the **TUBULES** and **OUT** of the **TESTES**.

[SECRETE ANDROGEN-BINDING PROTEIN (ABP)]

ANDROGEN-BINDING PROTEINS MAINTAIN A HIGH CONCENTRATION OF TESTOSTERONE AROUND THE SEMINIFEROUS TUBULES

→ SPERM PRODUCTION

- **LEYDIG CELLS** or INTERSTITIAL CELLS, as they are **LOCATED** in the **INTERSTITIAL SPCAE SURROUNDING** the SEMINFEROUS TUBULES.
- They **PRODUCE** and **SECRETE TESTOSTERONE** into the **INTERSTITIAL FLUID** around the SEMINIFEROUS TUBULES.

REMEMBER

Between ONE and FOUR SEMINIFEROUS TUBULES [SITE OF SPERM PRODUCTION], are LOCATED within each of the 250 LOBULES OF THE TESTICLE →

the SEMINIFEROUS TUBULES MERGE POSTERIORLY into a SINGLE STRAIGHT TUBULE from each LOBULE →

the STRAIGHT TUBULES JOIN FURTHER POSTERIORLY into the RETE TESTIS [NETWORK OF TUBULES], which moves SPERM from the TESTES through →

the EFFERENT DUCTULES into the DUCTUS EPIDIDYMIS of the EPIDIDYMIS →

the DUCTUS EPIDIDYMIS moves INFERIOR-POSTERIORLY around the TESTES,

the VAS/DUCTUS DEFERENS → the VAS DEFERENS ASCEND the SCROTUM INSIDE the SPERMATIC CORD, which ENTERS the PELVIS via the INGUINAL CANAL.

AT PUBERTY, THE PRESENCE OF OESTROGEN TRIGGERS THE → HYPOTHALAMUS TO SECRETE GONADOTROPIN RELEASING HORMONE:

THE RELEASE OF GONADOTROPIN RELEASING HORMONE STIMULATES THE ANTERIOR PITUITY GLAND TO SECRETE FOLLICLE-STIMULATING HORMONE + LUTENIZING HORMONE.

[OESTROGEN STIMULATES A DORMANT FOLLICLE TO MATURE INTO A VESTICULAR FOLLICLE].

THE PRESENCE OF THESE HORMONES [FSH + LT] TRIGGER FOLLICULAR DEVELOPMENT:

AS A PRIMARY FOLLICLE DEVELOPES INTO A SECONDARY FOLLICLE, AND THEN A VESTICULAR FOLLICULE → IT BEGINS TO PRODUCE OESTROGEN:

THE FURTHER THE FOLLICLE DEVELOPES, THE GREATER AMOUNT OF OESTROGEN IT PRODUCES.

IT IS THIS ↑ INCREASE IN OESTROGEN THAT HAS A POSITIVE FEEEBACK ON THE PITUITARY GLAND, CAUSING A SURGE OF FOLLICLE-STIMULATING HORMONE + LUTENIZING HORMONE TO BE RELEASED.

THIS SURGE IN HORMONES TRIGGERS THE FOLLICLE TO RUPTURE → RELEASING AN OVA FROM ITS CASING/SAC.

RUPTURE = OVULAION.

EXTRACELLULAR FLUID MOVEMENT

BLOOD PLASMA → INTERSTITIAL FLUID

THROUGH CAPILLARY WALLS

HYDROSTATIC PRESSURE → FLUID **LEAKS** FROM THE **ARTERIOLE END** OF **CAPALLIRIES**.

OSMOTIC PRESSURE → FLUID **REABSORBED** AT THE **VENULE END** OF **CAPILLARIES**.

LYMPHATICS → **RETURN** THE **REMAINING FLUID** TO THE **BLOOD**.

INTERSTITIAL FLUID → CELL CYTOSOL

MOVEMENT ACROSS CELL MEMBRANES!

OXYGEN: ← IN

NUTRIENTS: ← IN

WATER: ← BOTH →

CARBON DIOXIDE: → OUT

NITROGENOUS WASTES: → OUT

REGULATION OF WATER OUTPUT: ANTI-DIURETIC HORMONE

- Hormone of the PITUITARY GLAND.
- causes WATER RETENTION in the COLLECTING DUCTS.
- inserts AQUAPORONS into the KIDNEY'S TUBULES;
- ↑ INCREASES WATER REABSORPTION.
- REGULATED BY HYPOTHALAMIC OSMORECEPTORS.

The PRESENCE of ADH → WATER REABSORPTION → CONCENTRATED URINE.

A ↓ DECREASE of ADH → WATER LOSS → DILUTE URINE.

TRIGGERED BY:

- ↑ INCREASE IN PLASMA/EXTRACELLULAR CONCENTRATION/OSMOLALITY.
- ↓ DECREASE IN BLOOD PRESSURE + VOLUME.

AS SENSED BY THE BARORECEPTORS [STRETCH] IN THE ATRIA AND CAROTID ARTERIES.

INHIBITED BY:

- ↓ DECREASE IN PLASMA/EXTRACELLULAR CONCENTRATION/OSMOLALITY.
- ↑ INCREASE IN BLOOD PRESSURE + VOLUME.

AS SENSED BY THE BARORECEPTORS [STRETCH] IN THE ATRIA AND CAROTID ARTERIES.

ACID-BASE BALANCE

HYDROGEN = **ACIDIC**.

BICARBONATE = **ALKALINE**.

ACID:

any **SUBSTANCE** that **DONATES**/separates/**DISASSOCIATES**

its **HYDROGEN IONS** [when added to **WATER**].

BASE:

any **SUBSTANCE** that **ACCEPTS**/binds **HYDROGEN** ions

[when mixed together in **WATER**]. REDUCES ACIDITY.

STRONG ACIDS DISSOCIATE **COMPLETELY** IN WATER →

SIGNIFICANT IMPACT ON pH.

WEAK ACIDS ONLY **PARTIALLY** DISSOCIATES IN WATER **[STAYS BOUND]**

→ **MINIMAL IMPACT ON pH.**

STONG BASES QUICKLY BIND/ATTRACT/TIE-UP **HYDROGEN IONS** →

SIGNIFICANT IMPACT ON pH.

WEAK BASES SLOWLY BIND/ATTRACT/TIE-UP **HYDROGEN IONS** →

MINIMAL IMPACT ON pH.