## What's Blood Made of

| | |
|---|---|
| Plasma (Liquid) | 55% |
| White Blood Cells & Platelets | Less than 1% |
| Red Blood Cells | 45% |
| **Plasma Portion** | |
| 91% Water | |
| | Maintains blood volume |
| | Transports molecules |
| 7% Proteins | |
| | Clotting proteins |
| | Albumin |
| | Immunoglobulins (Antibodies) |
| 2% Things carried around body | |
| | Salts |
| | Gases (02, CO2) |
| | Nutrients |
| | Wastes |
| | Hormones |
| | Vitamins and Minerals |
| Blood is 95% Formed Elements(Solid) | |
| **The solid portion of blood is** | |
| Red Blood Cells | Erythrocytes/Corpuscles |
| White Blood Cells | Leukocytes |
| Platelets | Thrombocytes |

## Antigens, Antibodies & Blood type

| | |
|---|---|
| **Antigen** | Identification protein on a RBC |
| Glycoprotein on RBC membrane | |
| There are two kinds of antigens on humans RBC's: A and or B | |
| Therefore, there are 4 possible blood types: | |
| Antigen A ---> | Type A blood |
| Antigen B ---> | Type B blood |
| Antigen A & B ---> | Type AB blood |
| No Antigens ---> | Type O blood |

## Antigens, Antibodies & Blood type (cont)

| | |
|---|---|
| **AntiBody** | A protein designed to combat any foreign protein |
| Made by WBC cells in the body | |
| | Will bind to foreign proteins with foreign antigens |
| | This causes agglatination (Clumping) |
| | WBC's will then destroy the agglutinated cells |
| *Foreign Antigen + Your antibodies attack --->* | *AGGLUTINIZATION* |
| Opposite to the antigens we have on our RBC's | (So we wont attack our own blood) |
| *Because of that* | Blood transfusions are tricky.Foreign antigens lead to death |
| *Blood Type* | Blood Donor |
| A | A & A = Yes A & B = Clumps A & AB = Clumps A & O = Yes |
| B | B & A = Clumps B & B = Yes B & AB = Clumps B & O = Yes |
| C | AB & A = Yes AB & B = Yes AB & AB = Yes AB & O = Yes |
| O | O Clumps with everything except O & O = Yes |

## Types of Blood Vessels

Arteries

Arterioles

Capillaries

Venules

Veins

## Capillary Fluid Exchange (Arteriole & Venule Side)

**CFE(Arteriole Side)**

Blood pressure = 40mmHg

Osmotic pressure = 25 mmHg

Net blood pressure (15mm Hg) forces water out of the blood into the interstitial fluid

Water carries with it the CO2 and metabolic wastes

Because there is more O2 and nutrients in interstitial fluid it

The large things (Ie:RBC, WBC, platelets, blood proteins) stay in the capillary because they are too big to leave

Because most of the water has left, the blood becomes very hyperosmotic (Concentrated)

The venule side of the capillary is therefore under great osmotic pressure to draw water back into the blood

**CFE(Venule Side)**

Osmotic pressure = 25 mmHg

blood pressure = 10 mmHg

Blood very concentrated (little water)

Net osmotic pressure forces water back into the blood

Water carries with is CO2 and metabolic wastes (urea)

These are carried to the kidneys and other excretory organs to be removed

## Aorta & Coronary Arteries and Veins

**Aorta**

Biggest artery

Carries O2 rich blood from left ventricle to body systems

Loops over top of heart creating aortic arch

Goes down inside the backbone = Dorsal Aorta

Smaller arteries branch off to "feed" the body cells

**Coronary Arteries and Veins**

Very first branch off the aortic arch

## Aorta & Coronary Arteries and Veins (cont)

Smaller arteries branch off to feed the body cells

**Carotid Arteries**

Branch off the aortic arch to take the blood to the head

Supply blood to brain = highly specialized

1)Chemoreceptores detect oxygen content

2)Pressure receptors detect changes in blood pressure

Reasonably close to the surface, pulse can be found in neck

## Jugular Veins & Subclavien Arteries/Veins

**Jugular Veins**

Take blood out of head region to the anterior vena cava

These veins do not contain any valves

Blood flows down them because of gravity only

**Subclavien arteries Veins**

Arteries branch off of aorta and travel under the clavicle

Branch off to feed chest wall/arms (Via brachial arteries)

Note for later :Lymphatic ducts join circulatory system right before the subclavian veins meet up with the anterior vena cava

## Red Blood Cells

**Red Blood Cells**

Facts about RBC

No Nuclei

Transport CO2 and O2 (Acts like a Butter)

Bioconcave discs look like donuts without complete holes!

Live for - 120 days (4 months)

Dark purple to bright red

Contains: hemogloben molecules, carbonic anhydrase, and antigens

THere are - 800 million oxygen molecules in each RBC

## Red Blood Cells (cont)

Made in the red bone marrow

**Transports**

Transports oxygen as oxyhemoglobin (Bright Red)

Hb + O2 ---> HbO2

Transports carbon dioxide as carboxhemoglobin

Hb + CO2 ---> HbCO2

Transports hydrogen ions as reduced hemoglobin (thus acting as a buffer)

Hb + $H^+$ ---> HHb

## Erythroblastosis

**Erythroblastosis**

Rh factor is another antigen that may be present on the RBC

Presence of this antigen plays a role in childbirth

| | |
|---|---|
| If you are Rh+ you have the antigen you don't have the D antibodies | (85% of Caucasions are Rh+) |

You don't normally have the "D" antibodies but can make them if you are exposed to Rh antigens

**Why Else is this Important**

If an Rh- mother can have an Rh+ baby, complication can occure with a second pregnancy

Normally, the mother/ fetal blood does not mic or cross the placents.

**How Can this be prevented**

| | |
|---|---|
| | When first Rh+ baby born, doctors can destroy the Rh+ blood cells (in mothers plasma) before mother has time to make Rh Antibodies |
| | Rh immune globulin injection (RhoGAM) does this |

## Blood Vessels

**Arteries**

Function

Transport blood away from heart

Structure

Thick, elastic walls

Location

Usually deep, along bones

This protects them from injury and temperature loss

Notes

Walls can expand

Arteries have very high blood pressure

Expansion is the "Pulse" we feel

**Arterioles**

Function

Control blood flow to capilaries

Structure

Smaller in diameter than arteries, thinner walls

Have pre capillary sphincters

Notes

Blood Pressure > Osmotic Pressure

Regulate blood pressure with pre-capillary sphincter muscles (Can dilate or constrict to increase or decrease blood flow to a particular capillary)

**Capillaries**

Function

Connect arteries to veins

Site capillary-fluid exchange

Structures

Very thin walls

Location

Found everywhere within a few cells of each other

**Venules**

Function

Drain blood from capillaries

Structure

## Blood Vessels (cont)

Thinner walls than veins

Location

Often near the surface

Notes

Join to form veins

Osmotic pressure greater than the blood pressure

The end result is no change in blood volume (No volume lost in exchange)

**Veins**

Function

Transport blood towards the heart

Structure

Inelastic walls, contain one-way valves

Location

Often near the surface

Notes

Blood pressure & velocity is much lower than in arteries

Valves prevent blood from flowing backwards

Surrounded by skeletal muscle, "Squeezes" blood along

**How does it all fit together**

Arteries

Carry blood away from the heart

Elastic

Cappillaries

Very thin tubes

Connect arteries to veins

Can close down or open up to regulate blood flow

Gas exchange

Veins

Bring blood towards the heart

Have valves to stop blood from moving backwards

## Mesenteric arteries & Hepatic Portal Vein

**Mesenteric Arteries**

Branch off from the dorsal aorta

Go to the intestines

Branch into capillaries of the intestinal villi

Pick up the newly digested nutreints (glucose, amino acids, and nucleotides)

**Hepatic Portal Vein**

Hepatic = Liver; Portal = capillary bed on either end

This vein transports blood rich in nuctrients directly from the intestines to the liver

**Significant functions related to the circulatory system**

Regulation of Blood [Glucose]

Destroys old RBC's

Detoxification of blood

## White Blood Cells (WBC) & Platelets

**WBC**

| | |
|---|---|
| Make histamines antibodies and hunter killer cels | *Antibodies attach to foreign invaders & the hunter killer cells destroy them* |

Fight infection

WBC's can squeeze out of blood vesells to attack invaders

Strangely shaped nuclei

Made of red bone marrow

**Platelets**

150,000-300,000 / $mm^3$ blood

Fragments of cell no nuclei

Humans produce 200 billion a day

Made in bone marrow

Aid in blood clotting

recognize micro tears in blood vessels & bined together to form a blood clot

**Steps**

| | |
|---|---|
| A Vessel and Platelets become Damaged some way | Step 1 |

## White Blood Cells (WBC) & Platelets (cont)

| | |
|---|---|
| Platelets release a protein called thromboglastie | Step 2 |
| Thromboplastin changes prothrombin (a blood protein produced by the liver) into thrombin (requires calcium) | Step 3 |
| Thrombin changes fibrinogen into fibrin (insoluble) | Step 4 |

## Circulatory system two parts

**Systemic Circulation**

System of blood vessels that delivers exygenated blood to body systems

**Pulmonary Circulation**

System of blood vessels that delivers deoxygenated blood to the lungs to be replenished with oxygen

The systemic arteries carry oxygenated blood

Pulmonary arteries carry deoxygenated blood

## Hepatic Veins, Renal & Iliac Arteries/Veins

**Hepatic Veins**

Carries the blood from liver to posterior vena cava

**Renal Arteries/Veins**

Renal arteries branch off dorsal aorta and bring blood to kidneys

Renal veins take blood from kidneys to posterior vena cava

**Iliac Arteries/Veins**

Dorsal aorta branches into two iliac arteries in the pelvic area

One iliac artery goes down each leg

Femoral artery branches off iliac artery to large quadricep muscle

Iliac veins return blood to posterior

**Pulmonary Arteries/Veins**

## Hepatic Veins, Renal & Iliac Arteries/Veins (cont)

de02 blood collected from the body is pumped into the pulmonary artery from the right ventricle

Pulmonary artery brings de02 blood to lungs

blood picks up O2 in the alveoli of lungs

Pulmonary vein takes high O2 blood back to heart

## Fetal Circulation

A fetus does not use its lungs

The fetus receives its O2 blood from the Placenta, not its lungs

To do this, ther are four features in the fetus not presents in the adult

**Foramen Ovale**

This is an opening between the left and right atria

It is covered by a flup that acts as a valve

It allows the blood to bypass the lungs

it reroutes most of the blood from the right atrium into the left atrium

**Ductus Arteriosus (Arterial Duct)**

This is small arterial connection, like a shunt

Between the pulmonaryartery and the aonta

It further allows blood to bypass the lungs

**Umbilical Cord**

Has three blood vessels traveling through it

The largest one is the umbilical vein which transports blood with oxygen and nutrients into the fetus

The other two are the umbilical arteries which branch off of the iliac arteries in the fetus and take spent (wastes and CO2) blood back into the mother via the placenta

**Ductus Venosus (Venous Duct)**

The blood vessel connects to the vena cava

The O2 blood from the umbilical vein mixes with deO2 blood in the vena cava

## Fetal Circulation (cont)

The ductus veaosus bypasses the l8iver and this blood is sent directly to the heart

Blood will go to the liver eventually but not until it has reached the hepatic portal vein

This is why the fetus is so susceptible to toxins in blood

**Changes at Birth**

| | |
|---|---|
| The First Breath | The lungs are filled with air instead of fluid and higher oxygen levels of the blood and alveoli results in an increase in pulmonary blood flow |
| Anatomical Changes | The placenta is removed from circulation |
| | The foramen ovale, ductus venosus, and ductus arteriosus close |

## Lymphatic System

**Functions**

Take up excessive tissue fluids

Transport fatty acids and glycerol (From intestines to subclavian vein)

Fight infection (Lymphocytes)

Trap and remove cellular debris

**Structures**

*Lymph Ducts and Capillaries*

Drain and collect excess fluids from tissues

Take fluids to nodes to be cleaned

Cleansed lymph travels through lymph ducts to the subclavian vein where they are dumbped into the anterior vena cava

*Lymph Nodes*

Remove debris from lymph = Cleanse lymph

Contain Phagocytic Lymphocytes

White Blood Cells make antibodies and attack invaders

*Lactaels*

## Lymphatic System (cont)

Absorb/Transport fatty acids & glycerol in the villi of the small intestine

*Other lymphoid Organs*

Tonsils, Appendix, Spleen, and Thymus Gland