THE CIRCULATORY SYSTEM

The TRANSPORT or CIRCULATORY system connects all other systems. This system performs four (4) principal functions:

- Transportation of oxygen and carbon dioxide
- Distribution of nutrients and transportation of wastes
- Maintenance of body temperature
- Circulation of hormones

Structure of circulatory system

Three general components:
- FLUID (blood) in which materials are transported
- System of BLOOD VESSELS in which the fluid moves in
- PUMP – (heart) that pushes fluid throughout system

The cardiovascular system = heart + blood vessels + blood

BODY STATS:
- HEART: 300 grams (size of fist)
- BLOOD: body contains five liters (5L)
- RATE: beats 72 per minute

CIRCULATORY SYSTEM: two systems in one

a) Pulmonary circuit: blood from RIGHT side (low OXYGEN) pumped to LUNGS to pick up oxygen (release CO₂)
b) Systemic circuit: blood from LEFT side (high OXYGEN) pumped through body
Heart Structure

HEART: a double pump

a) RIGHT: pulmonary circuit
b) LEFT: systemic circuit

A large MUSCLE called the SEPTUM separates both sides.

The heart is divided into four (4) chambers:

- **ATRIA:** top two chambers, thin walls, RECEIVE blood
- **VENTRICLES:** bottom two chambers, thick walls, PUMP blood

VALVES: these are found between atria and ventricles and where ventricles empty into arteries that leave the heart

ex. Atrioventricular valves: a) bicuspid valve- between RA and RV
     b) tricuspid valve- between LA and LV

Semilunar valves: found between ventricles and arteries

Function of Valves: to ensure blood flows in ONE DIRECTION only
- prevents blood from going the wrong way

HEART RHYTHMS, SOUNDS, AND PRESSURES

PACEMAKER: SA (sinoatrial) node
- bundle of nerves controlling heart beat (72)

AV (atrophicventricular) node
- passes the nerve impulses to the ventricles so they contract in unison

Human heartbeats originate in a small cluster of specialized tissue called the sinoatrial node (SA node) near the right atrium. Modified muscle cells in this area contract, sending a signal to other muscle cells in the atria to contract. This causes the atria to push the blood into the ventricles. The signal spreads from the SA node to the atrioventricular node (AV node). The signals from the AV node are slightly delayed—about 0.07 s—to allow the atria to complete their contraction. The signals are carried through a bundle of fibres, called the bundle of His, to the Purkinje fibres and cause the ventricles to contract simultaneously.
Heart Sounds:

LUBB-DUBB sound: made when heart valves CLOSE
  a) LUBB -- when atrioventricular valves close
  b) DUBB – when semilunar valves close

Pressures in the heart

a) DIASTOLE – the atria RELAX and fill with blood (low pressure)
   - produces diastolic pressure

c) SYSTOLE – the ventricles CONTRACT pushing blood into arteries
   - produces systolic pressure (high pressure)

BLOOD PRESSURE:

- measured with an instrument called a sphygmomanometer
- units: mm of Hg (mercury)

Two pressures: a) systolic 120
              b) diastolic 80 mm Hg

HYPERTENSION: high blood pressure
  - dangerous
  - destruction of blood vessels (fatal = aneurysm)

LOW blood pressure:
  - poor transport of important materials throughout body

BLOOD VESSELS
There are THREE main types of blood vessels:

1. ARTERIES:
   - carry blood AWAY from the heart
   - THICK walls (extra muscle)
   - blood under high pressure
   - largest called the AORTA
   - most have HIGH amounts of OXYGEN except pulmonary artery (low $O_2$ – goes to lungs)

   - ARTERIOLES: small arteries

2. CAPILLARIES:
   - smallest blood vessels
   - where exchange of materials between blood and cells occurs
   - one cell thick

3. VEINS:
   - carry blood BACK to the heart
   - THIN walls (less muscle)
   - blood under LOW pressure
   - contain VALVES to keep blood moving in one direction

   - VENULES: small veins

Blood flow through vessels:

Heart $\rightarrow$ arteries $\rightarrow$ arterioles $\rightarrow$ capillaries $\rightarrow$ EXCHANGE $\rightarrow$ venules $\rightarrow$ veins $\rightarrow$ heart
BLOOD COMPONENTS

Normal adult contains about five liters (5L) of blood.

Blood:  
55 % liquid - called PLASMA
45 % cells - 1 % WBC (white), rest are RBC (red)

- PLASMA: functions – carries dissolved nutrients, hormones, wastes, and antibodies

BLOOD CELLS:

- WBC: - white
  - many types, called LEUKOCYTES
  - function: protect the body from invading microorganisms and toxins
  - cells have a nucleus

- RBC: - red
  - contain hemoglobin: an iron-containing protein which helps blood carry OXYGEN and CARBON DIOXIDE
  - with oxygen the blood is bright red
  - with carbon dioxide blood is dark red
  - cells do NOT have a nucleus

- PLATELETS: - small cell fragments (not really true cells)
  - job: help blood CLOT by working with SERUM proteins