

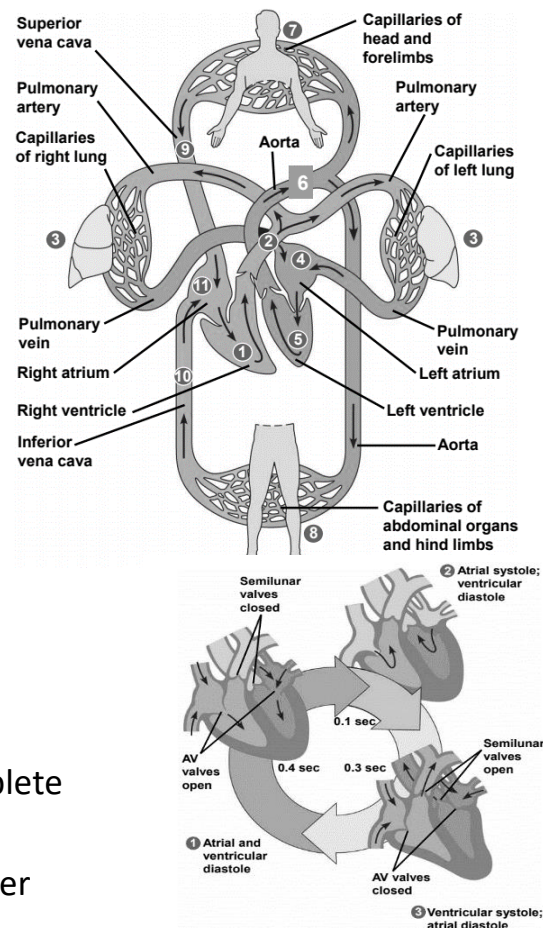
Chapter 42 summary BIO

- Exchanges ultimately occur at the cellular level.
- In unicellular organisms, these exchanges occur directly with the environment.
- For most cells making up multicellular organisms, direct exchange with the environment is not possible.
- Gills: are specialized exchange system in animals
- Internal transport and gas exchange are functionally related in most animals.
- **Circulatory systems:**
 - ✓ In most animals, transport systems connect the organs of exchange with the body cells.
 - ✓ complex animals have either open or closed circulatory systems.
 - ✓ Both systems have three basic components:
 - circulatory fluid (blood or hemolymph)
 - set of tubes (blood vessels)
 - muscular pump (the heart)
 - ✓ In insects, other arthropods, and most molluscs, blood **bathes** the organs directly in an open circulatory system
 - ✓ In an open circulatory system, there is no distinction between blood and interstitial fluid this and, general body fluid is more correctly called **hemolymph**.
 - ✓ In a closed circulatory system, blood is **confined** to vessels and is distinct from the interstitial fluid.
 - ✓ Closed systems are more efficient at transporting circulatory fluids to tissues and cells.
 - ✓ Humans and other vertebrates have a closed circulatory system, often called the cardiovascular system.
 - ✓ The three main types of blood vessels are: Arteries, Veins and Capillaries:
 - *Arteries branch into arterioles and carry blood to capillaries.
 - *Networks of capillaries called **capillary beds** are the sites of chemical exchange between the blood and interstitial fluid.
 - *Venules converge into veins and return blood from capillaries to the heart.
 - ✓ Vertebrate hearts contain two or more chambers.
 - ✓ Blood enters through an atrium and is pumped out through a ventricle.
 - ✓ Single Circulation:
 - * Bony fishes, rays, and sharks have single circulation with a two-chambered heart.
 - * single circulation, blood leaving heart passes through **two** capillary beds before returning.
 - ✓ Double Circulation:
 - * Amphibian, reptiles, and mammals have double circulation.
 - * Oxygen-poor and oxygen-rich blood are pumped separately from the right and left sides of the heart.

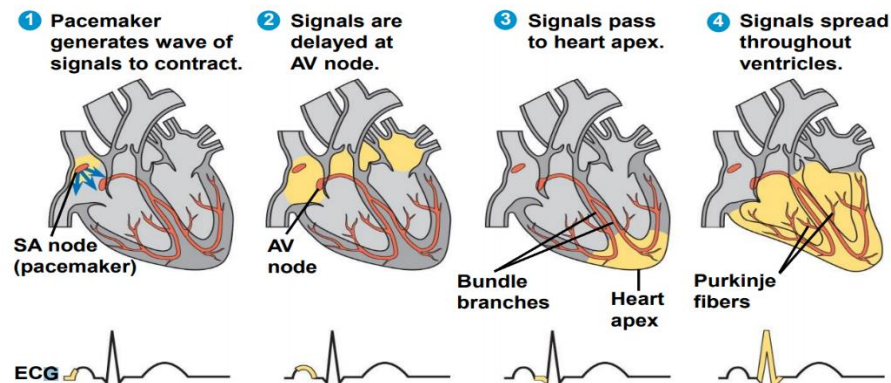
- * In reptiles and mammals, oxygen-poor blood flows through the pulmonary circuit to pick up oxygen through the lungs.
- * Oxygen-rich blood delivers oxygen through the systemic circuit.
- * Double circulation maintains higher blood pressure in the organs than does single circulation.

✓ Mammalian Circulation:

- ♣ Blood begins its flow with the right ventricle pumping blood to the lungs. In the lungs, the blood loads O_2 and unloads CO_2 .
- ♣ Oxygen-rich blood from the lungs enters the heart at the left atrium and is pumped through the aorta to the body tissues by the left ventricle.
- ♣ The aorta provides blood to the heart through the coronary arteries.
- ♣ Blood returns to heart through superior vena cava (blood from head, neck, and forelimbs) and inferior vena cava (blood from trunk and hind limbs), flow into right atrium.
- ♣ The heart contracts and relaxes in rhythmic cycle called cardiac cycle.
- ♣ The contraction, or pumping, phase is called **systole**.
- ♣ The relaxation, or filling, phase is called **diastole**.
- ♣ For an adult human, the heart rate is 72 beats/min; one complete cardiac cycle takes 0.8s
- ♣ The heart rate, also called the **pulse**, is the number of beats per minute.
- ♣ The stroke volume is the amount of blood pumped in a single contraction.
- ♣ The cardiac output is the volume of blood pumped into the systemic circulation per minute and depends on both the heart rate and stroke volume.
- ♣ Four valves prevent backflow of blood in the heart.
- ♣ The atrioventricular (AV) valves separate each atrium and ventricle.
- ♣ The semilunar valves control blood flow to the aorta and the pulmonary artery.
- ♣ The “lub-dup” sound of a heartbeat is caused by the **recoil** of blood against the AV valves (**lub**) then against the semilunar (**dub**) valves.
- ♣ Backflow of blood through a defective valve causes a heart murmur.
- ♣ Some cardiac muscle cells are self-excitable, meaning they contract without any signal from the nervous system.
- ♣ The sinoatrial (SA) node or pacemaker sets the rate and timing at which cardiac muscle cells contract.



- ♣ Impulses from the SA node travel to the atrioventricular (AV) node.
- ♣ At the AV node, the impulses are delayed and then travel to the Purkinje fibres that make the ventricles contract.
- ♣ Impulses that travel during cardiac cycle can be recorded as electrocardiogram (ECG or EKG)



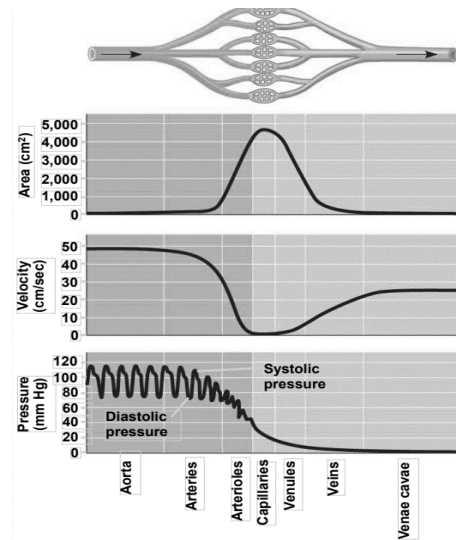
- ♣ The pacemaker is **influenced** by nerves, hormones (epinephrine), body temperature, and exercise.
- ♣ An increase of body temperature by **1°C**, increases heart rate by **10 beats /min**.
- ✓ Blood Vessel Structure and Function:
- ♣ The epithelial layer that lines blood vessels is called the **endothelium**.
- ♣ Capillaries have thin walls, the endothelium plus its basement membrane, to facilitate the exchange of materials.
- ♣ Arteries and veins have an endothelium, smooth muscle, and connective tissue.
- ♣ Arteries have thicker walls than veins to accommodate the high pressure of blood pumped from the heart.
- ♣ In the thinner-walled veins, blood flows back to the heart mainly because of muscle action.
- ✓ Blood Flow Velocity:
- ♣ Velocity of blood flow is slowest in the capillary beds, because of the high resistance and large total cross-sectional area.
- ♣ Blood flow in capillaries is necessarily slow for exchange of materials.

The interrelationship of:

-cross-sectional area of blood vessels:

-velocity:

-pressure:



✓ Changes in Blood Pressure During the Cardiac Cycle:

♣ Blood pressure: is the hydrostatic pressure that blood exerts against the wall of a vessel.

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)	DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	LESS THAN 80
ELEVATED	120-129	LESS THAN 80
HIGH BLOOD PRESSURE STAGE1	130-139	80-89
HIGH BLOOD PRESSURE STAGE2	140 OR HIGHER	90 OR HIGHER
HYPERTENSIVE	HIGHER THAN 180	HIGHER THAN 120

♣ Systolic pressure is the pressure in the arteries during ventricular systole; it is the highest pressure in the arteries.

♣ Diastolic pressure is the pressure in the arteries during diastole.

♣ A pulse is the rhythmic bulging of artery walls with each heartbeat.

♣ Blood pressure is determined by cardiac output and peripheral resistance due to constriction of arterioles.

♣ Vasoconstriction is contraction of smooth muscle in arteriole walls; it increases blood pressure.

♣ Vasodilation is the relaxation of smooth muscles in the arteriole walls; it causes blood pressure to fall.

♣ Blood pressure is generally measured for artery in the arm at the same height as the heart.

✓ Capillary Function:

♣ Capillaries in major organs are usually filled to capacity.

♣ 2 mechanisms regulate distribution of blood in capillary bed:
– Contraction of the smooth muscle layer in the wall of an arteriole constricts the vessel.

– Precapillary sphincters control flow of blood between arterioles and venules.

♣ The exchange of substances between the blood and interstitial fluid takes place across the thin endothelial walls of the capillaries.

✓ The lymphatic system:

♣ returns fluid that leaks out in the capillary beds.

♣ This system aids in body defence.

♣ Fluid, called lymph, re-enters the circulation directly at the venous end of the capillary bed.

♣ The lymphatic system drains into veins in the neck.

♣ Lymph nodes are organs that filter lymph and play an important role in the body's defence.

♣ Edema is swelling caused by disruptions in the flow of lymph.

