PENANG SANGAM HIGH SCHOOL
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LESSON NOTES

Year/Level: 12C/D week 24 **Subject:** Biology

Strand	1 structure & life processes
Sub Strand	1.4 comparative form and function in plants and animals
Content Learning Outcome	describe the different methods of transport in vertebrates (birds and mammals)

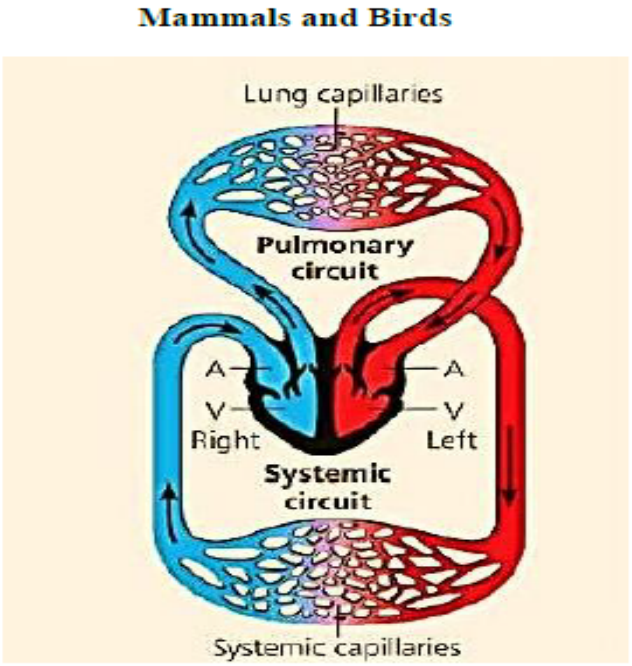
Transport in Mammals and Birds - Closed, double-loop circulation

- Mammals and birds have four-chambered hearts – two auricles and two ventricles.
- Their blood circulates in two loops.
- One loop is between the heart and the lungs.
- The other is between the heart and the rest of the body.

✓ Blood circulates in two loops:

i. Pulmonary circulation: between heart and lungs
   - ✓ deoxygenated blood is pumped from the heart to the lungs
   - ✓ oxygenated blood returns to the heart from the lungs

ii. Systematic circulation: between heart and body cells –
   - ✓ Oxygenated blood is pumped from the heart around the body



Adaptive Value

- Mammals and birds have the most efficient transport system of all organisms.
- Their deoxygenated and oxygenated blood is completely separated into the right and left sides of the heart.
- The heart pumps blood to the body forcefully since blood returns to the heart for a second push after it passes through the lungs.
- Mammals and birds need efficient transport for:

1) They are warm blooded.
2) They are very active.
3) Flight in particular consumes energy very quickly.

❖ Some mammals, such as whales and elephants, are very large. Without an efficient transport system, they would not be able to supply their cells with enough oxygen to survive.

❖ Bird and mammal brains have a more developed cerebrum than most animals. The cerebrum consumes large amount of oxygen and nutrients.

Warm – blooded versus Cold – blooded

- Mammals and birds are warm-blooded.
- They keep their body temperatures constant regardless of environmental temperature.
- For e.g., humans keep their body temperature at 37°C, regardless of the temperature of the environment they are in.
- Normally air temperature is lower than the body temperature of birds and mammals.
- Therefore, these animals constantly lose heat to the air.
- Keeping the body warm in spite of constant heat loss requires plenty of energy.
- This is why warm-blooded animals need a very efficient oxygen and nutrient supply.
- All other animals, including fish, amphibians and reptiles, are cold-blooded.
- Their body temperatures vary with the environmental temperature.
- Cold- blooded animals consume less energy than warm- blooded animals.
- However, when the air is cold they cannot be very active because their metabolic reactions are too slow (the rates of virtually all reactions increases as temperature increases).

Blood Types

✓ Blood is typed according to the **antigen** present on red blood cells
✓ Blood plasma contains **antibodies** against antigens **not** present on RBC

➢ **Antibodies** – proteins in the blood that fight germs/foreign bodies
  ➢ Proteins produced by the immune system that recognize and attach to antigens so that the antigen can be destroyed

➢ **Antigens** – foreign bodies in blood e.g. virus and bacteria
  ➢ Is a protein that is recognized and labeled by antibody

Blood Group	Antigen	Antibody	Cannot Receive	Can Receive Blood
A	A	Anti-B	B	A or O
B	B	Anti-A	A	B or O
AB	AB	None	-	A,B,AB,O
O	None	Anti-A Anti-B	A or B	O

Another blood protein is the Rhesus factor:

- People with this protein are Rh positive
- While those without are Rh negative

Transport Method	*Organism*	*Adaptive Value*
Direct Diffusion	- bacteria - fungi - protists - cnidarians	no separate transport system, materials diffuse directly to and from cells; supplies enough materials and carries wastes away fast enough to support small or sessile organisms
Open Circulation	- arthropods - molluscs	blood is pumped by a heartbeat into an open body cavity, it is not contained in vessels; sufficient for small organisms which have a separate system that provides cells with oxygen
Closed Circulation	- annelids - vertebrates	blood does not directly touch cells, it is contained in vessels; needed in active, larger organisms to adjust blood flow to different body parts and to supply materials and remove wastes quickly.
Single – loop Circulation	- fish	blood passes through the heart only once (blood from the gills does not return for a second push before going to the rest of the body cells.); blood can make it through the gills and the rest of the body because being under water reduces the effect of gravity.
Partial double-loop Circulation	- reptiles - amphibians	blood passes through the heart twice but mixes in the single ventricle; blood gets the extra push it needs to flow against gravity in land animals
Double loop Circulation	- birds - mammals	blood passes through the heart twice, oxygenated and deoxygenated blood do not mix; this is the most efficient transport system of all.

Closed systems	Open systems
Usually high-pressure systems	Usually low-pressure systems
High pressure requires high peripheral resistance	
High pressure sustained between heartbeats, requires elastic walls	Sustained pressure possible
Blood conveyed directly to organs	Similar to closed systems
Distribution to different organs well regulated	Distribution of blood less readily regulated
Blood return to heart rapid	Blood return to heart often slow

1. What is the difference between single-loop and double loop circulation? Is circulation in these loops closed or open?

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2. State how many chambers the heart of each of the following animals has: a frog, a mynah, a dog, a fish.

3. Define the words cold-blooded and warm-blooded and give example of an animal with each.

4. State one advantage and one disadvantage of being cold-blooded.

5. Which is more efficient, a three-chambered or four-chambered heart? Why?

6. Why must birds sit on their eggs while other egg-laying animals, such as fish and mosquitoes, do not?