

DATE: 07/02/26.

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Q# 01 :

Describe the structure and function of Blood capillaries?

Blood Capillaries:

Definition:

" Blood capillaries are microscopic, thin-walled blood vessels that connects arterioles to venules and forms an extensive network within tissues. "

They are the main site of exchange between blood and body cells.

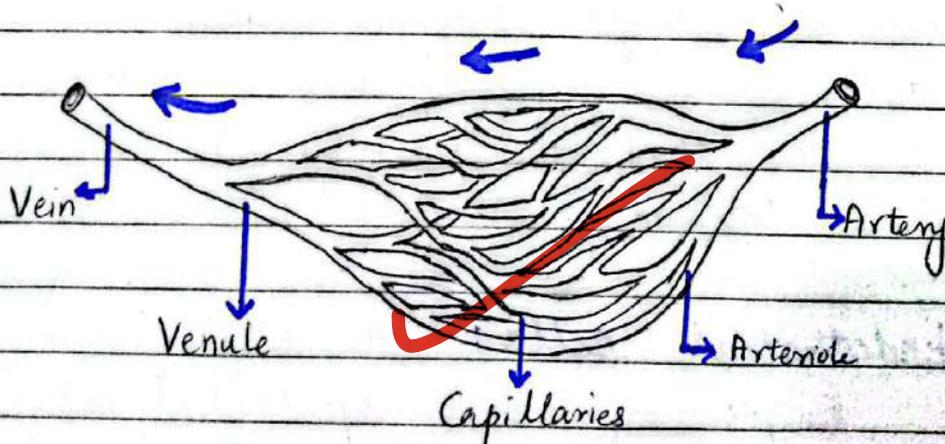


Fig. Blood Capillaries:

Explanation:

A capillary is a small

Q2)

DATE 07/01/26.

blood vessel, from 5 to 10 μm in diameter and is part of microcirculation system -

Capillary comes from Latin word, means "capillaris" meaning of "resembling hair".

Marcello Malpighi was the first to observe and describe capillaries correctly.

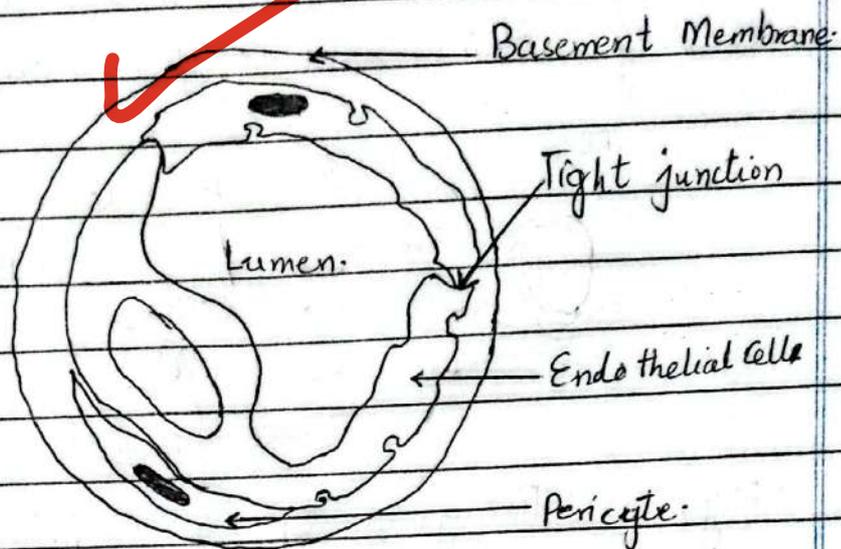
August Krogh discovered how capillaries provide nutrients to animal tissues. For his work, he was awarded Nobel Prize 1920 he estimated that the total length of capillaries in a human body is as long as 100,000 km.

Structure of Blood Capillaries:

A capillary wall is approximately 0.5 to 1.0 micrometers thick, which is roughly $1/100^{\text{th}}$ width of a human hair. Because they lack thick muscular layers (tunica media) and outer elastic layers of larger vessels, they are composed of only the tunica intima.

Endothelial cells: A single layer of simple squamous epithelial cells. These cells are flat and elongated, forming a smooth tube. The primary job is to act as a semi-permeable barrier.

Basement Membrane: Basal lamina, a thin, fibrous extracellular layer that surrounds the endothelium. It provides structural support and acts as a physical filter for larger proteins.



Intracellular Clefts: Small gaps or channels between adjacent endothelial cells. These are the 'doorways' through which water and small water-soluble solutes (Glucose and ions) pass.

Pericytes: Contractile "mural" cells that wrap around the exterior of the capillary. They help regulate blood flow by constricting the vessel. They are vital for maintaining the blood-brain barrier.

Narrow Lumen:

They do not have any valves, the narrow lumen helps them to hold blood longer.

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DATE: 07/1/26

to complete the nutrient / gaseous exchange process

Absence of Muscle and Elastic Tissue: Capillaries lack smooth muscle and elastic fibers. This makes them extremely thin and permeable.

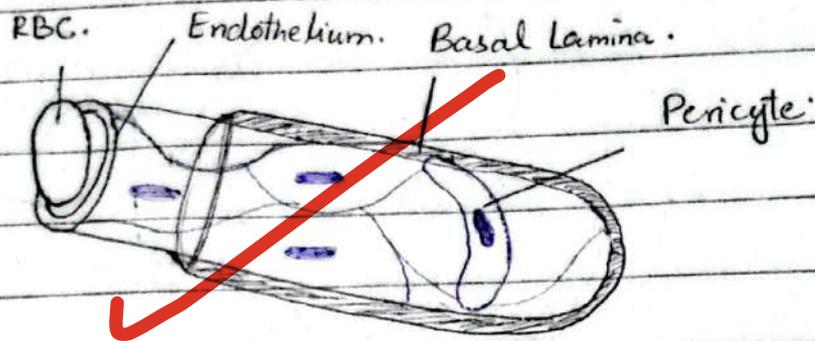


Fig. Diagram of a capillary.

Function Of Blood Capillary:

Following are the major functions of blood capillaries:

- (i) Gaseous Exchange.
- (ii) Nutrient Delivery.
- (iii) Waste Removal.
- (iv) Thermoregulation.
- (v) Fluid Balance.
- (vi) Immune Response.
- (vii) Hormone Transport.
- (viii) Mechanism of Flow.

Gaseous Exchange:

The primary function of capillaries is the exchange of gases (O_2 and CO_2). Capillaries facilitate the critical swap of Oxygen and Carbon dioxide.

In Body Tissues: Oxygen moves out of the blood into cells for cellular respiration, while carbon dioxide (a waste product) moves from cell into the blood.

Oxygen Delivery: Moves from blood → Interstitial Cells → Fluid

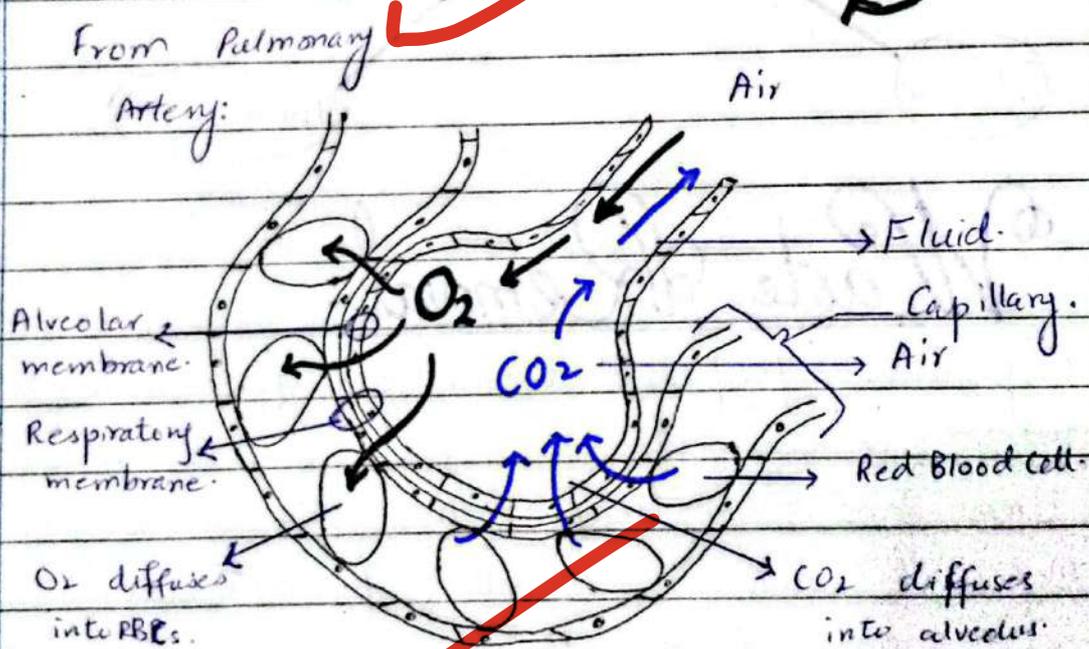


Fig. Gaseous Exchange at Alveoli.

In the Lungs: This process is reversed in pulmonary capillaries. CO_2 is dropped off to be exhaled and fresh O_2 is picked up.

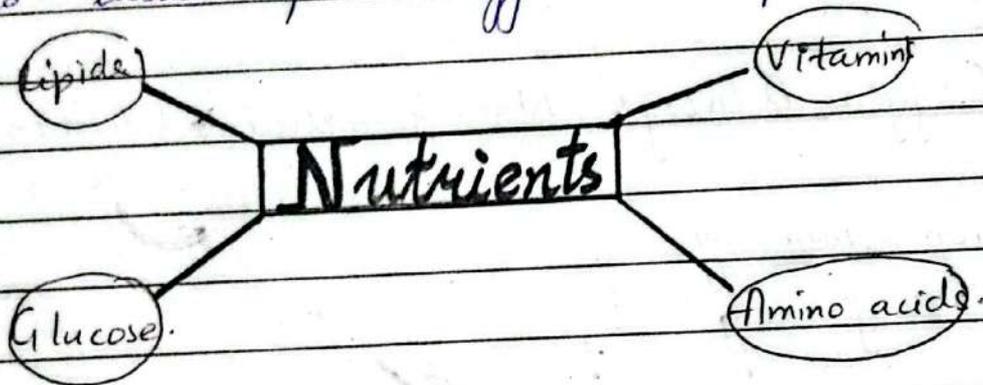
CO_2 Removal: Moved from cells → Blood (Lungs).

Nutrient Delivery:

As their walls are one cell thick, capillaries allow essential molecules to pass through easily:

Glucose and Amino acids: They are transported from the digestive system to all living cells.

Lipids and Vitamins: These are delivered to tissues for energy and repair.



Waste Removal:

Capillaries perform excretory function i.e. waste management.

Urea and Creatinine: Also known as metabolic waste is collected from tissue, and delivered to the kidneys for filtration.

Lactic Acid: Transported from liver muscles to the liver for processing.

Thermoregulation:

Capillaries play a vital role in keeping

your body at a steady 37°C.

Vasodilation: When you are hot, capillaries near the surface of the skin widen (dilate). This brings warm blood closer to the skin, allowing heat to radiate away into environment.

High Temperature → Capillaries → Dilate (Vasodilation)

Vasoconstriction: When you are cold, these capillaries narrow (constrict) to keep blood and its heat closer to the core organs.

Low Temperature → Capillaries → Constrict (Vasoconstriction)

Fluid Balance:

Capillaries manage the movement of fluid between the blood and the surrounding tissues by using Hydrostatic pressure and Osmotic pressure.

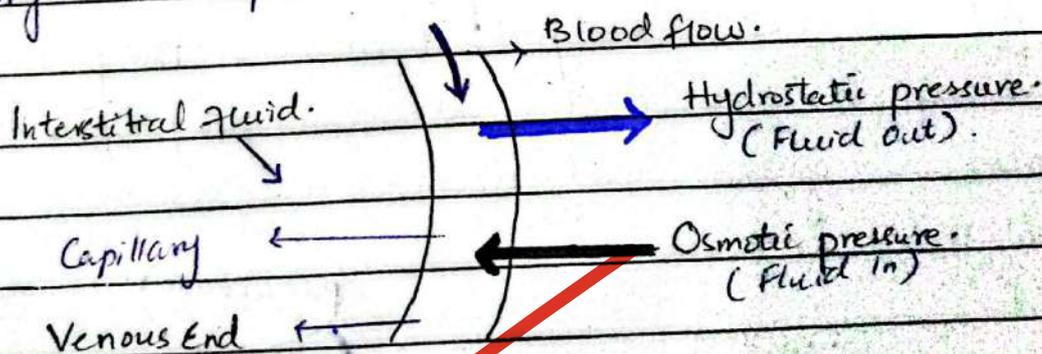


Fig. Capillary Microcirculation

Filteration: High pressure at the start of the capillary pushes fluid out into the tissues.

Reabsorption: Osmotic pressure at the end of the capillary pulls most of the fluid back in. This

ensures tissues stay hydrated without swelling (edema) -

Immune Response:

Capillaries are involved in Immune Surveillance. Walls can become "leaky" during an infection, allowing WBCs (leukocytes) to squeeze out of the blood and enter the tissue to fight the pathogens.

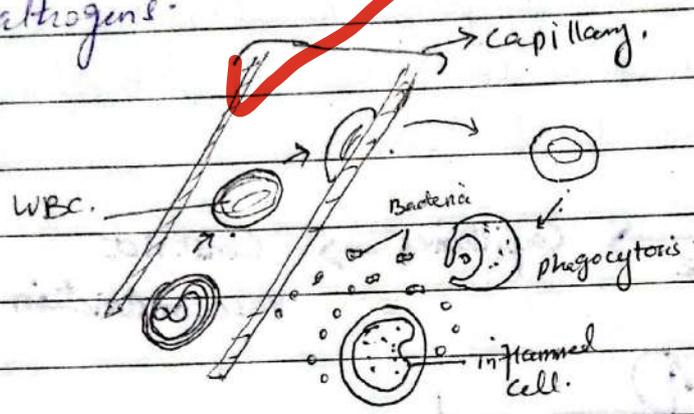


Fig. Immune Surveillance by Capillary.

Hormone Transport:

Capillaries also transport hormones, they pick up hormones (chemical messengers) from endocrine glands and deliver them to their targeted organs.

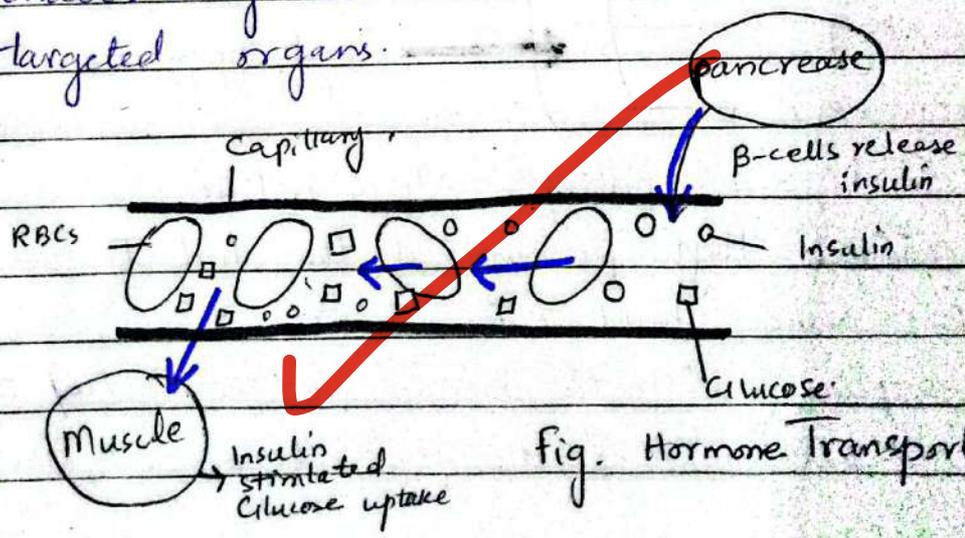
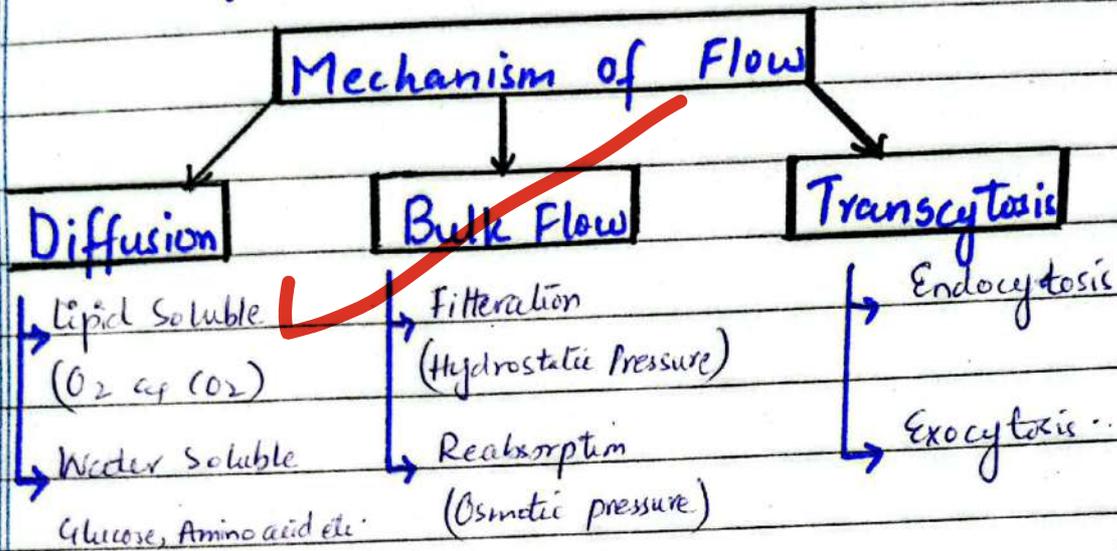


Fig. Hormone Transport

Mechanism Of Flow:

The mechanism of flow by capillaries is driven by three main processes.



- a) Diffusion: Movement of gases and small molecules.
- b) Bulk Flow: Movement of large volumes of fluid based on pressure.
- c) Transcytosis: Using vesicles to move large proteins across the cell wall.

very good.....

but the answer is very lengthy and will badly affect your time management. 2-3 sides of a page are enough for a 5 marks answer.

In short, blood capillaries are the smallest blood vessels with very thin - one cell - thick walls, they form dense networks between arterioles and venules their thin and permeable structure allows efficient exchange of gases, nutrients and wastes - Capillaries, thus play a key role in tissue nourishment and waste removal.