

# Cardiovascular System



<b>Arteries</b>	<b>Veins</b>
Arteries carry oxygenated blood, away from the heart except pulmonary artery	Veins carry deoxygenated blood, towards the heart except pulmonary veins
These are mostly deeply situated in the body	These are superficial and deep in location
These are thick-walled, highly muscular except arteries of cranium and vertebral column	These are thin-walled
These possess narrow lumen	These possess wide lumen
Valves are absent	Valves are present which provide unidirectional flow of blood
These are reddish in color	These are bluish in color
These show spurty movement of blood giving pulse	These show sluggish movement of blood

## Arteries

## Veins

Blood in arteries moves with pressure

Blood in veins moves under very low pressure

Arteries empty up at the time of death

Veins get filled up at time of death

If arterial wall is injured, the blood comes out like a 'fountain' in a large area all around the artery

If venous wall is injured, blood comes out, collects in a pool in a small area around vein

# ARTERIOLES

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
<ol style="list-style-type: none"><li>1. Endothelium present</li><li>2. Sub endothelial layer absent</li><li>3. Internal elastic lamina absent</li></ol>	<ol style="list-style-type: none"><li>1. 1-2 layers of circularly arranged smooth muscle cells with collagen &amp; elastic fibers.</li><li>2. External elastic lamina is absent</li></ol>	<ol style="list-style-type: none"><li>1. Longitudinally running collagen fibers and fibroblasts.</li></ol>

# SMALL ARTERIES

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
<ol style="list-style-type: none"><li>1. Endothelium present</li><li>2. Sub endothelial layer present</li><li>3. Internal elastic lamina may or may not be present</li></ol>	<ol style="list-style-type: none"><li>1. 3-5 layers of circularly arranged smooth muscle cells with collagen &amp; elastic fibers.</li><li>2. External elastic lamina is +/- present</li></ol>	<ol style="list-style-type: none"><li>1. Longitudinally running collagen &amp; elastic fibers and fibroblasts.</li></ol>

# MEDIUM SIZED/MUSCULAR/DISTRIBUTING ARTERIES

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
<ol style="list-style-type: none"><li>1. Endothelium present</li><li>2. Sub endothelial layer present</li><li>3. Internal elastic lamina is present in the form of fenestrated membranes, thrown into folds.</li></ol>	<ol style="list-style-type: none"><li>1. 25-40 layers of circularly arranged smooth muscle cells with collagen &amp; elastic fibers.</li><li>2. External elastic lamina is present</li></ol>	<ol style="list-style-type: none"><li>1. Longitudinally running collagen &amp; elastic fibers and fibroblasts.</li></ol>

# LARGE SIZED /ELASTIC/CONDUCTING ARTERIES

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
<ol style="list-style-type: none"><li>1. Endothelium present</li><li>2. Sub endothelial layer present</li><li>3. Internal elastic lamina is present in the form of fenestrated membranes.</li></ol>	<ol style="list-style-type: none"><li>1. 40-60 lamellae of elastic fibers in the form of fenestrated tubes with smooth muscle cells In between .</li><li>2. External elastic lamina of elastic fiber is present</li></ol>	<ol style="list-style-type: none"><li>1. collagen , elastic &amp;smooth muscles fibers spirally arranged .</li></ol>

# VENULES

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
1. Endothelium present	1. ABSENT	1. collagen fibrils & few fibroblasts



## SMALL VEINS

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
<ol style="list-style-type: none"><li>1. Endothelium present</li><li>2. sub endothelium is absent.</li><li>3. Internal elastic lamina is absent</li></ol>	<ol style="list-style-type: none"><li>1. 1-3 layers of circularly arranged smooth muscles with few connective tissue fibers.</li><li>2. External elastic lamina is absent.</li></ol>	<ol style="list-style-type: none"><li>1. A thick layer of longitudinally disposed collagen &amp; elastic fibers.</li></ol>

## MEDIUM SIZED VEINS

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
<ol style="list-style-type: none"><li>1. Endothelium present</li><li>2. sub endothelium is PRESENT.</li><li>3. Internal elastic lamina is present</li></ol>	<ol style="list-style-type: none"><li>1. layers of circularly arranged smooth muscles with collagen and elastic fibers.</li><li>2. External elastic lamina is ill-defined.</li></ol>	<ol style="list-style-type: none"><li>1. Well developed</li><li>2. Consists of spirally arranged collagen &amp; elastic fibers and few bundles of longitudinally disposed smooth muscles.</li></ol>

# LARGE SIZED VEINS

<b>INTIMA</b>	<b>MEDIA</b>	<b>ADVENTITIA</b>
<ol style="list-style-type: none"><li>1. Endothelium present</li><li>2. sub endothelium is present.</li><li>3. Internal elastic lamina is present</li></ol>	<ol style="list-style-type: none"><li>1. Is thin consists of layers of circularly arranged smooth muscles with numerous collagen and few elastic fibers.</li></ol>	<ol style="list-style-type: none"><li>1. <b><u>Inner zone</u></b> consists of dense collagen fibers spirally arranged.</li><li>2. <b><u>Middle zone</u></b> consists of smooth muscles fibers longitudinally disposed.</li><li>3. <b><u>Outer zone</u></b> consists of collagen &amp; elastic fibers.</li></ol>

# Comparison between capillaries & sinusoids

<b>PARAMETERS</b>	<b>CAPILLARIES</b>	<b>SINUSOIDS</b>
SITES	All over the body	Liver, spleen, bone marrow.
Lumen	Narrow regular lumen	Wide irregular lumen
Cell & basement membrane	Simple squamous epithelium with absence of pores resting on a continuous basement membranes	Simple squamous epithelium with presence of pores resting on a incomplete basement membrane.
Pores in their walls	Absent except in kidney & endocrine glands	Present
Cells around adventitia	Undifferentiated pericytes	Phagocytes macrophage littoral cells

## Comparisons between medium sized artery and vein

<b>Parameters</b>	<b>Muscular artery</b>	<b>Medium sized vein</b>
Shape of lumen	Narrow and rounded	Wide but collapsed
Contents in lumen	No blood	Blood present
Wall	Thick	Thin
Valves	Absent	Often present
Tunica intima	Thick, folded and well developed internal elastic lamina	Thin, not folded and has no internal elastic lamina
Tunica media	Thick, many elastic fibers	Thin, few elastic fibers
External elastic lamina	Present	Absent
Tunica adventitia	Thin, some elastic fibers	Thick, rich collagen fibers
Lymphatic capillaries	Absent in adventitia	May be present.

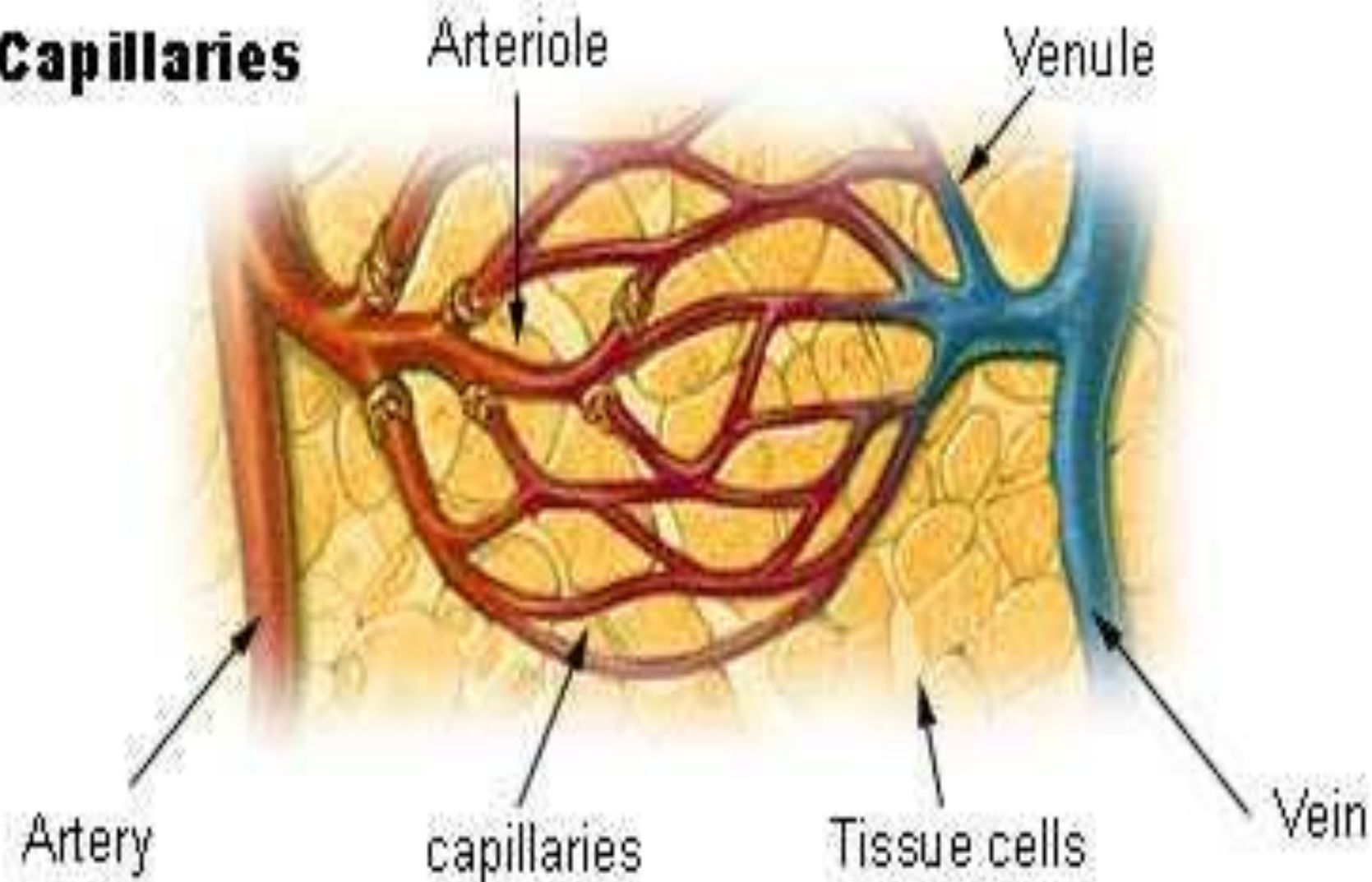
## COMPARISON BETWEEN ELASTIC & MUSCULAR ARTERY

<b>Parameters</b>	<b>Elastic artery</b>	<b>Muscular artery</b>
Type	Conducting vessel	Distributing vessels
Size	More	Less
Wall & lumen	Thick wall & wide lumen	Thin wall & narrow lumen
Tunica intima	<ul style="list-style-type: none"> <li>•Thick, endothelium &amp; sub endothelium</li> </ul>	<ul style="list-style-type: none"> <li>•Thin only endothelium</li> </ul>
Internal elastic lamina	<ul style="list-style-type: none"> <li>•Not clear</li> </ul>	Prominent & corrugated
Tunica media <ul style="list-style-type: none"> <li>•Thickness</li> <li>•Type of tissue</li> <li>•External elastic lamina</li> </ul>	<ul style="list-style-type: none"> <li>•Thick</li> <li>•Elastic tissue&gt;muscular tissue</li> <li>•Absent</li> </ul>	<ul style="list-style-type: none"> <li>•Thicker</li> <li>•muscular tissue&gt;elastic tissue</li> <li>•Visible</li> </ul>
Tunica adventitia	More thin	Less thin.

# Capillaries

- Capillaries (**capillus = hair**) are networks of microscopic endothelial tubes interposed between the metarterioles and venules.
- The true capillaries (without any smooth muscle cell) begin after a transition zone of 50-100 micron beyond the precapillary sphincters.

# Capillaries





# Size of capillaries:

- The average diameter of a capillary is **6—8 micron**, just sufficient to permit the red blood cells to pass through in 'single file'.
- It is smallest in the brain and intestines, and largest in the skin and bone marrow.

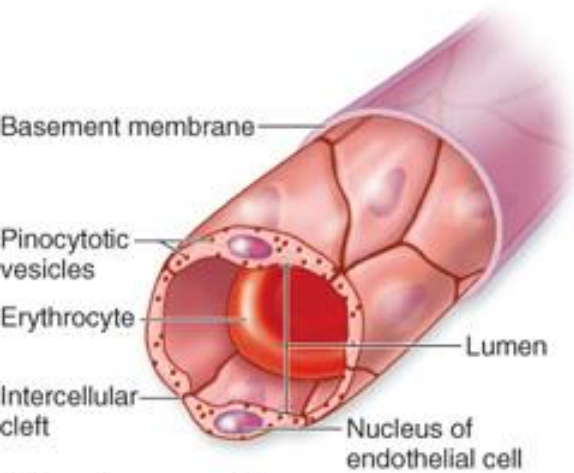
# Types and Structure of capillaries:

## Continuous capillaries:

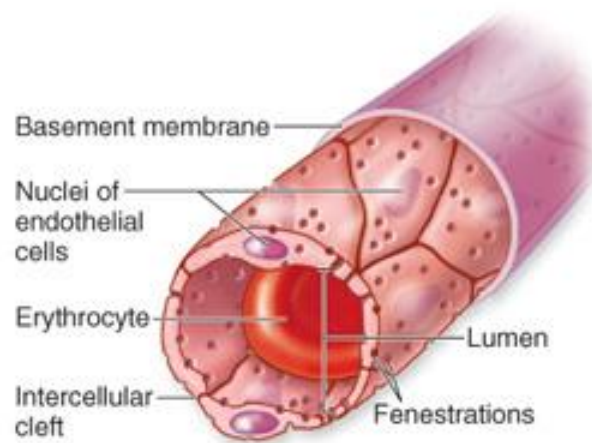
- Continuous capillaries are found in the skin, connective tissue, skeletal and smooth muscles, lung and brain. These allow the small molecules to pass across their walls.

## Fenestrated capillaries:

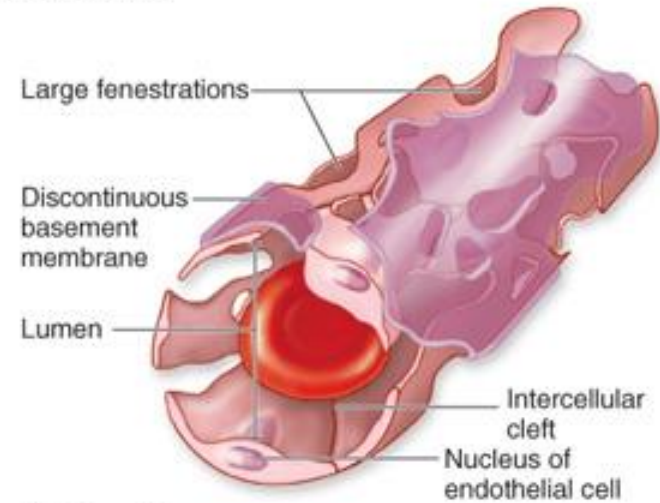
- Fenestrated capillaries are found in the renal glomeruli, intestinal mucosa, endocrine glands and pancreas. These allow passage across their walls of larger molecules.



(a) Continuous capillary



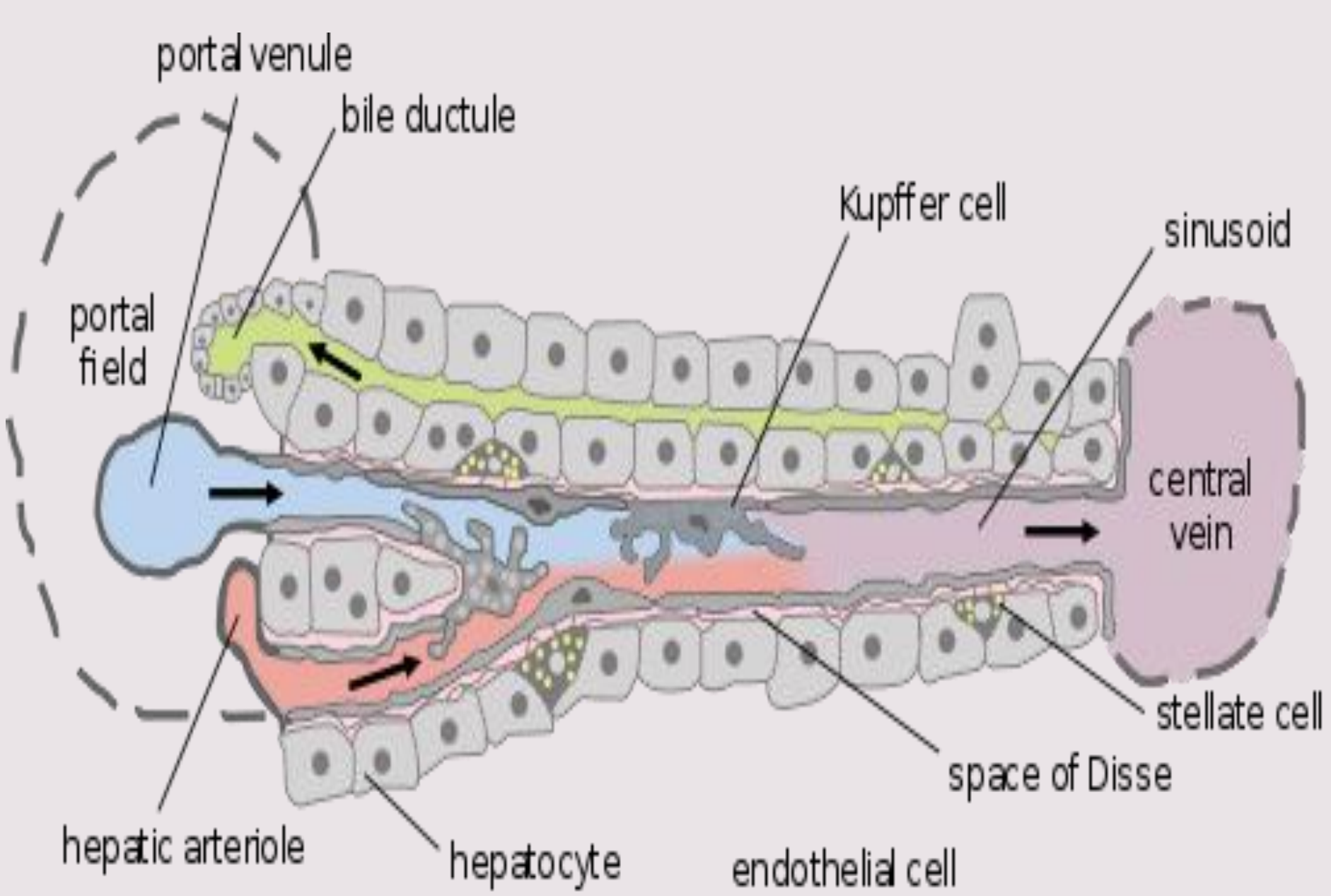
(b) Fenestrated capillary



(c) Sinusoid

# Sinusoids

- are small, irregular, vascular spaces which are closely surrounded by the parenchyma of the organ.
- They replace capillaries in certain organs, like liver, spleen, bone marrow, suprarenal glands, parathyroid glands, carotid body, etc.



# Characteristic Features of sinusoids:

These differ from capillaries in the following respects;

- Their lumen is wider (up to 30 micron) and irregular.
- Their walls are thinner and may be incomplete. They are lined by endothelium in which the phagocytic cells (macrophages) are often distributed.
- The adventitial support is absent.
- These may connect arteriole with venule (spleen, bone marrow), or venule with venule (liver).