Human Physiology (Cardiovascular System): Heart and Blood Vessels

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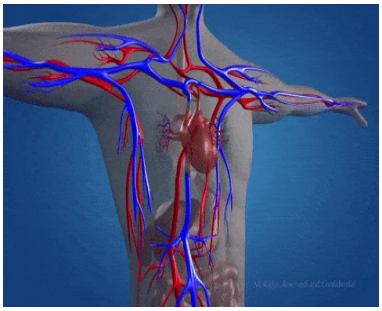

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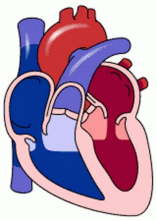
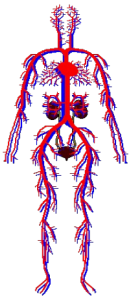
Contents:

- **The Heart:**
  - Heart Chambers
  - Heart Septa
  - Heart Wall Layers
  - Heart Valves
  - Actions of the Hear
- **Types of Blood Vessels**
- **Divisions of Circulation**





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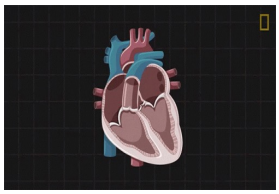
Objectives:

By the end of this lecture, you will be able to:

- **Describe the:**
  - Heart Chambers
  - Heart Septa
  - Heart Wall Layers
  - Heart Valves
  - Actions of the Heart



- **Know the types of blood vessels.**
- **Differentiate between the types of Circulation.**

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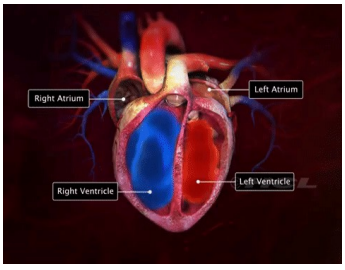
Cardiovascular system: Heart:

- **Heart:**
  - a muscular organ situated in between two lungs
  - pumps blood throughout the circulatory system.
- **Made up of four chambers:**
  - **Two atria**

✓ Smaller than ventricles
✓ Musculature is thin

  - **Two ventricles**

✓ Larger than atria
✓ The musculature is thick



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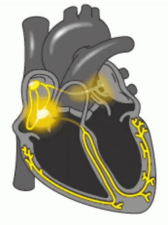
Cardiovascular system: Heart:

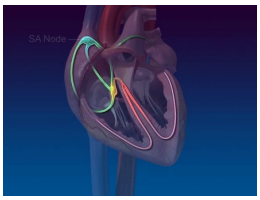
- **Right side of the heart has 2 chambers:**
- **Right atrium (RA):**
- **Right ventricle (RV):**



- RA is a thin walled and low pressure chamber.
- RA has got the pacemaker known as:

✓ **Sinoatrial (SA) node:**

- produces cardiac impulses.



✓ **Atrioventricular (AV) node:**

- conducts the impulses to the ventricles.

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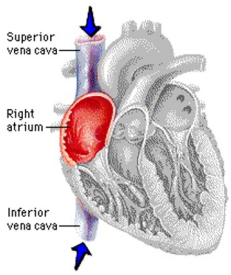
Right side of the Heart:

- **Right atrium** receives venous (**deoxygenated**) blood via two large veins:

1. **Superior vena cava:** blood from upper parts of the body.
2. **Inferior vena cava:** blood from lower parts of the body.



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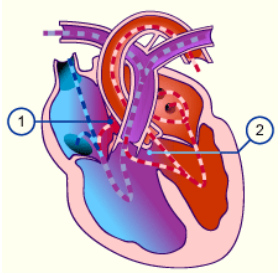
Right side of the Heart:

- RA communicates with RV through **tricuspid valve**.
- Wall of RV is thick.
- Venous blood from the RA enters the RV through this valve.
- From the RV, pulmonary artery arises.
- Pulmonary artery carries the venous blood from RV to lungs.
- In the lungs, the **deoxygenated blood** is **oxygenated**.



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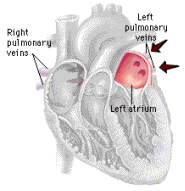
Left side of the Heart:

- **Left side of the heart has two chambers:**
- **Left atrium (LA):**
- **Left ventricle (LV):**
- LA is a thin walled and low pressure chamber.
- LA receives oxygenated blood from the lungs through **pulmonary veins**.

*** This is the only exception in the body, where an:**

✓ An artery carries venous (deoxygenated) blood

✓ A vein carries the arterial (oxygenated) blood.



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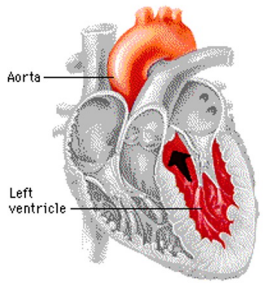
Left side of the Heart:

- Blood from LA enters the LV through **mitral valve (bicuspid valve)**.
- Wall of the LV is very thick. LV pumps the arterial blood to different parts of the body through **systemic aorta**.



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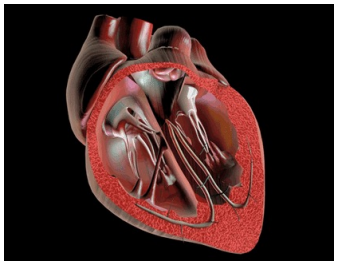
Septa of the Heart:

- Right and left atria are separated from one another by a fibrous septum called **interatrial septum**.
- Right and left ventricles are separated from one another by **interventricular septum**.



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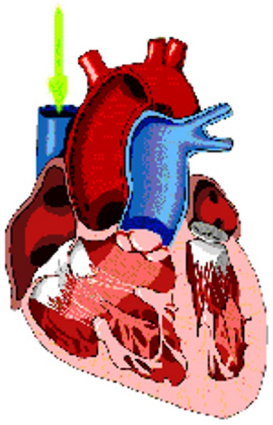
Structure of the heart



- Right Atrium
- Tricuspid Valve
- Right Ventricle
- Pulmonic Valve
- Pulmonary Arteries
- Pulmonic Veins
- Left Atrium
- Mitral Valve
- Left Ventricle
- Aortic Valve
- Aorta

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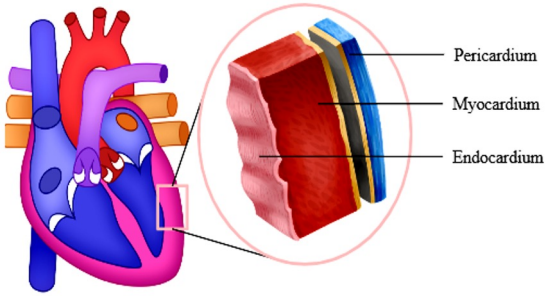
Layers of Wall of the Heart:

- **Heart is made up of three layers of tissues:**

1. Outer layer "Pericardium"
2. Middle layer "Myocardium"
3. Inner layer "Endocardium"



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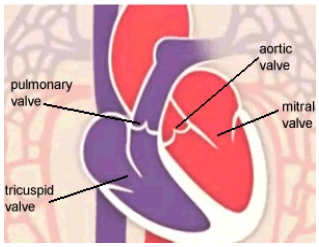
Valves of the Heart:

- There are four valves in human heart:

- **Two atrioventricular (AV) valves:**

✓ **Left AV valve (mitral or bicuspid valve).**

✓ **Right AV valve (Tricuspid valve).**



- **Two Semilunar (SL) valves:**

✓ **Aortic SL valve**:
- at the openings of systemic aorta

✓ **Pulmonary SL valve**:
- at the openings of pulmonary artery

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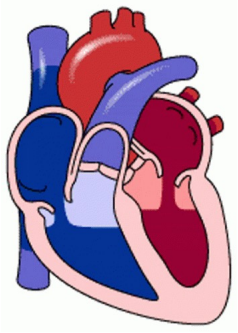
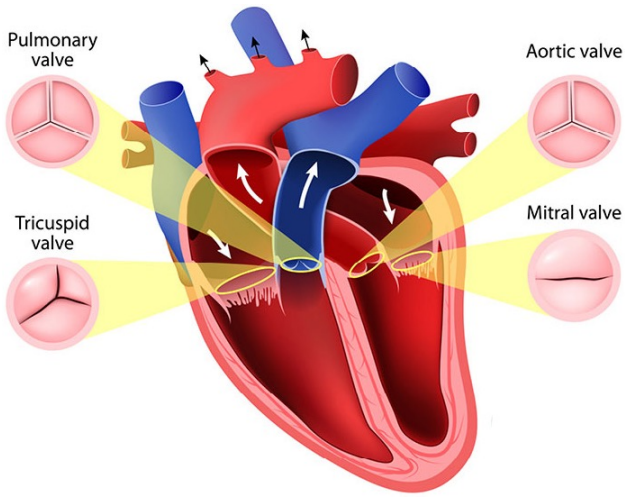
Valves of the Heart:





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Actions of the Heart:

1. Chronotropic action:

- The frequency of heartbeat: **Tachycardia & Bradycardia**

2. Inotropic action:

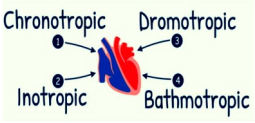
- The force of contraction of heart: **Positive and Negative**

3. Dromotropic action:

- The conduction of impulse through heart: **Positive and Negative**

4. Bathmotropic action:

- The excitability of cardiac muscle: **Positive and Negative**



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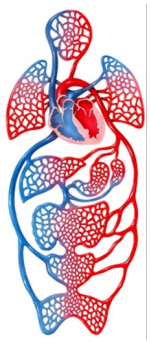
Human Physiology (Cardiovascular System): Blood Vessels



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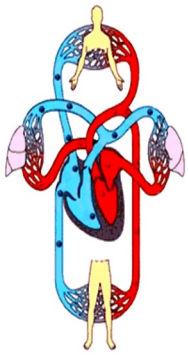

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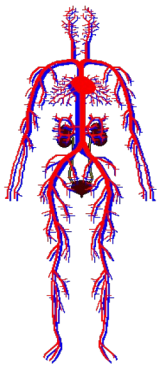
Contents:

- **Types of Blood Vessels.**
  - **Arteries** (and their subtypes):
  - **Veins** (and their subtypes):
  - **Capillaries**
- **Divisions of Circulation:**
  - Systemic (greater) circulation.
  - Pulmonary (lesser) circulation.



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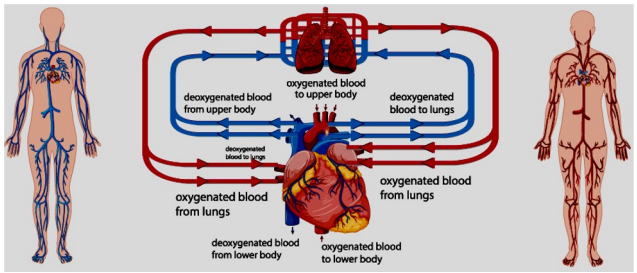
Objectives:

By the end of this lecture, you will be able to:

- Describe different types of Blood Vessels.
- Differentiate between the divisions of circulatory system.



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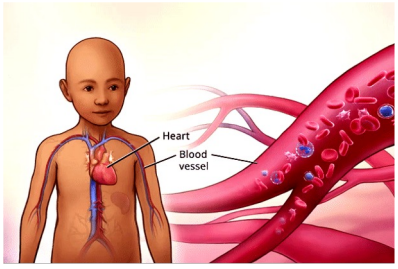
Blood Vessels:

Blood vessels contribute to homeostasis by:

1. Transporting and distributing blood throughout the body.
2. Providing the structures for the flow of blood **(»heart»)**
3. The exchange of nutrients and wastes (**in tissues**)
4. adjusting the velocity and volume of blood flow.



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Blood Vessels:

The blood vessels form a closed system of tubes that:

- Carries blood away from the heart (**Arteries**)
- Transports blood to the tissues (**Capillaries**)
- Returns blood to the heart (**Veins**)

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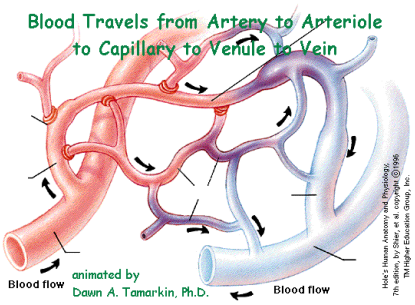
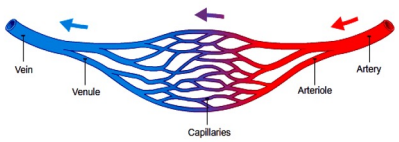
Types of Blood Vessels:

There are 5 main types of blood vessels:

- Arteries
- Arterioles
- Capillaries
- Venules
- Veins





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Types of Blood Vessels:

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- Arteries
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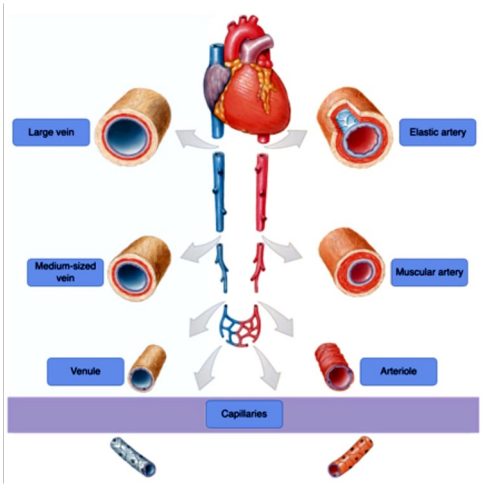

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Types of Blood Vessels:

Arteries:

- Carry blood away from the heart to other organs.
- The outer & middle layers of large arteries are quite thick.
- Have a **high compliance**:
  - walls **stretch easily or expand** without tearing in response to a small increase in pressure.

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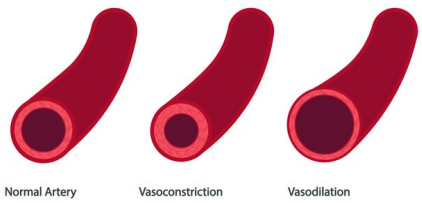
Types of Blood Vessels:

Arteries:

- The SMC enables arteries to **constrict** or **dilate** (that is regulated by the sympathetic fibers of the ANS).

⬆ Sympathetic stimulation **contract**

⬇ Sympathetic stimulation, stimulates the SMC to **relaxes**.



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Types of Arteries:

Elastic Arteries (conducting arteries):

- **Conducting arteries**:
  - conduct blood from the heart to medium-sized arteries).
- **The largest arteries** (aorta and pulmonary trunk).
- **Rich in elastic fibers.**
  - **Stretch** (store mechanical energy).
  - **Recoil** and convert stored energy in the vessel into kinetic energy of the blood.
- **Pressure reservoirs**
  - help propel blood onward while the ventricles are relaxing.

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Types of Arteries:

Muscular Arteries (distributing arteries):

- **Distributing arteries**
  - They are medium-sized arteries.
  - Continue to branch and distribute blood to various organs.
- Have **thick smooth muscle** wall.
- **Vascular tone:**
  - adjust the rate of blood flow (**Vasoconstriction** & **Vasodilatation**)
  - Is a state of **partial contraction that stiffens the vessel wall**.
  - It is important in maintaining vessel pressure and efficient blood flow.

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Types of Arteries:

Arterioles: (resistance vessels):

- Small arteries (abundant microscopic vessels)
- **Resistance vessels (??):**
  - Regulate resistance (TPR) (**flow of blood into the capillaries**)
  - **Regulate blood pressure (BP):**
    - ⬆ BP (Vasoconstriction of arterioles).
    - ⬇ BP (Vasodilatation of arterioles).
- **Metarteriole** is the terminal end of the arteriole.

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Types of Blood Vessels:

Capillaries:

- The **Smallest of blood vessels**.
- Connect **arterioles** and **venules**.
- **Exchange vessels (??)**

  In capillaries, nutrients, gases, and wastes are exchanged between the blood and interstitial fluid.
- **Microcirculation:**

  Metarteriole → Capillaries → Postcapillary venule

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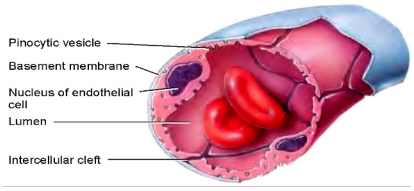
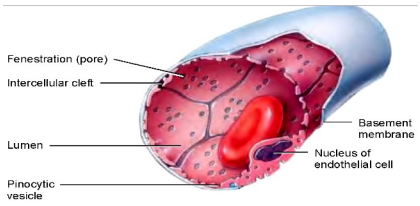
Types of Capillaries :

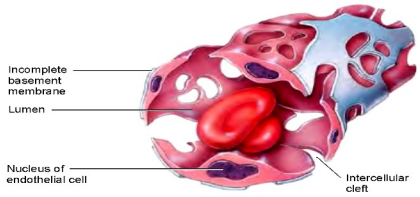
① Continuous capillaries:



②Fenestrated capillaries:



③ Sinusoids:



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Types of Blood Vessels:

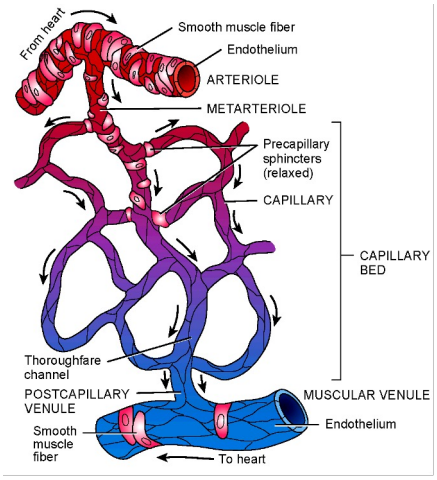
Venules: divided into:

Postcapillary venules:

- Receive blood from capillaries.

Muscular venules:

- Have **thicker walls** across which exchanges with the interstitial fluid can no longer occur.



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Types of Blood Vessels:

Veins:

- **Volume reservoirs**; the most distensible elements of the vascular system.
- Have **high capacitance (??)**
- **The blood moves from veins back to heart by:**
  - The pumping action of the heart.
  - Contraction of the skeletal muscles in legs.
  - Some contains valves.

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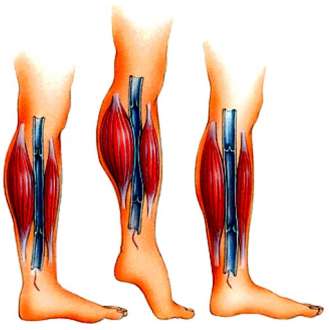
Types of Blood Vessels:

Veins:

- **Venous valves** are most numerous in veins of the legs, where blood must often return to the heart **against the force of gravity**.

Q.

Aside from cardiac contractions, what mechanisms act as pumps to boost venous return?



Answer:

The skeletal muscle pump and respiratory pump also aid venous return

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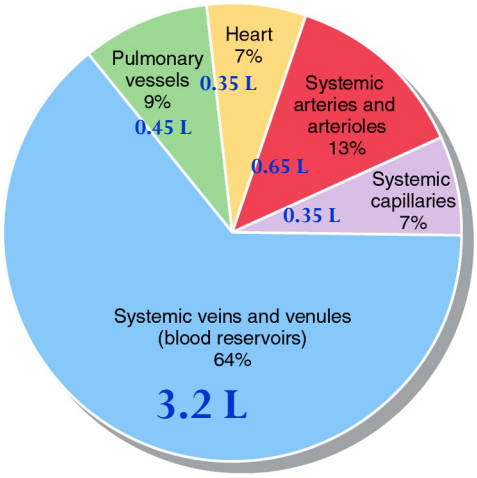
Blood distribution in the cardiovascular system at rest:

- If your total blood volume is 5 L, what volume is in your:
  - **Venules and Veins?**
  - **Capillaries?**



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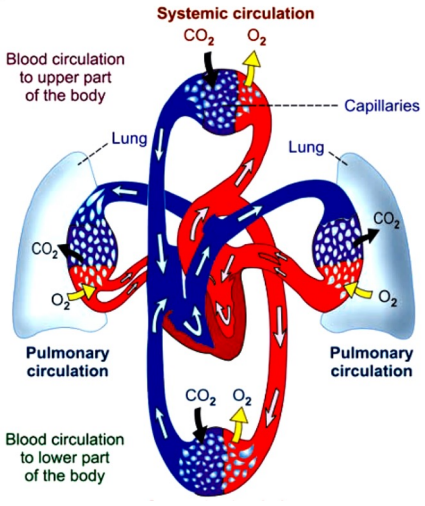
Divisions of Circulation:

- **Blood flows through two divisions of circulatory system:**

1. Systemic circulation: (**greater circulation**)
2. Pulmonary circulation (**lesser circulation**)



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Divisions of Circulation:

1. Systemic (or greater) circulation:

- ✓ Blood pumped from **LV** passes through a series of blood vessels, arterial system and reaches the tissues.
- ✓ Exchange of various substances between blood and the tissues occurs at the capillaries.
- ✓ After exchange of materials, blood enters the venous system and returns to **RA** of the heart.
- ✓ From **RA**, blood enters the **RV**.
- ✓ Thus, through systemic circulation, **oxygenated blood** is supplied from heart to the tissues and venous blood returns to the heart from tissues.

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Divisions of Circulation:

2. Pulmonary (or lesser) circulation:

- ✓ Blood is pumped from RV to lungs through pulmonary artery.
- ✓ Exchange of gases occurs between blood and alveoli of the lungs at pulmonary capillaries.
- ✓ **Oxygenated blood** returns to **LA** through the pulmonary veins.

Thus:

- ✓ Lt. side of the heart contains **oxygenated (arterial) blood**.
- ✓ Rt. side of the heart contains **deoxygenated (venous) blood**.

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Questions/Comments

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