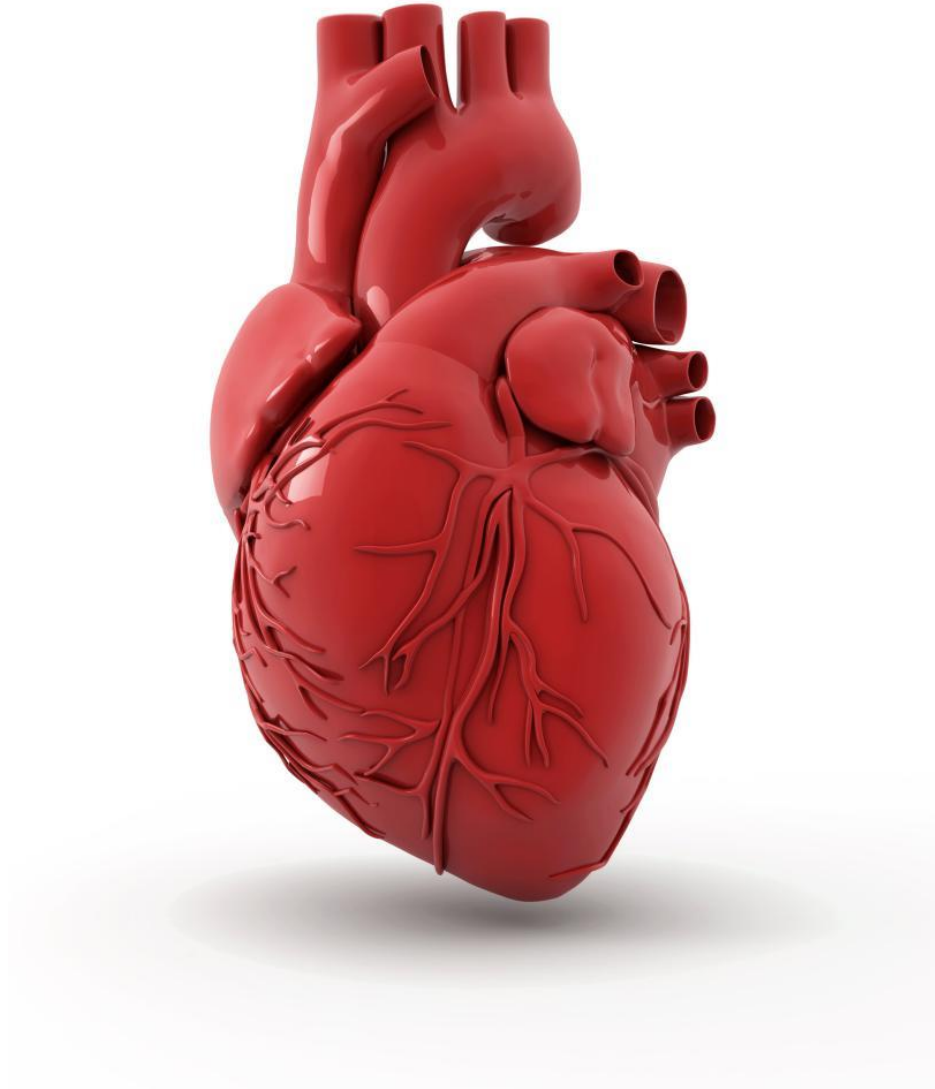
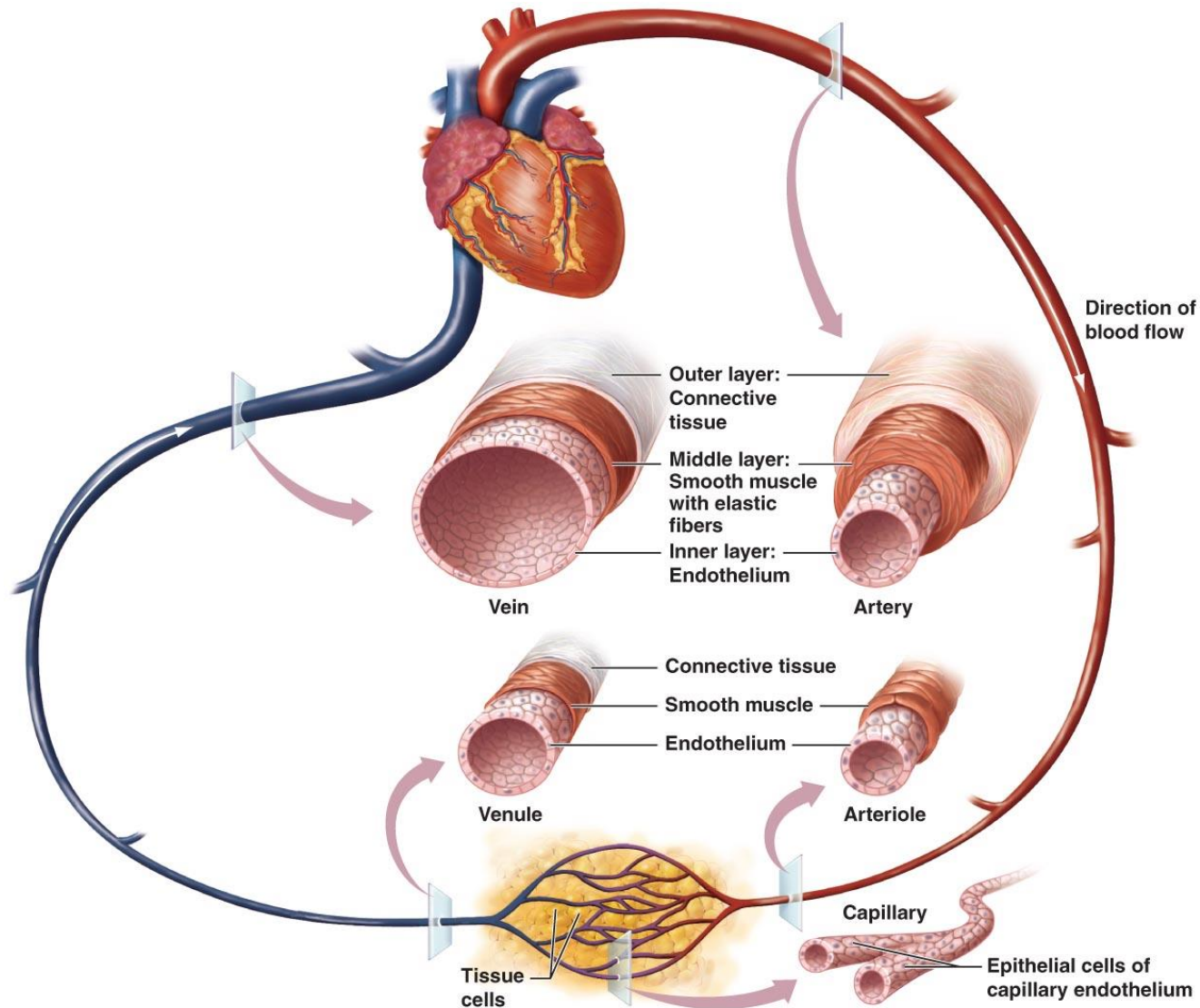


# Heart and Blood Vessels



# Blood Vessels Transport Blood



# Three Types of Blood Vessels Transport Blood

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- Arteries
  - Carry blood away from the heart
  - Transport blood under high pressure
- Capillaries
  - Exchange solutes and water with cells of the body
- Veins
  - Return blood to the heart

# Arteries

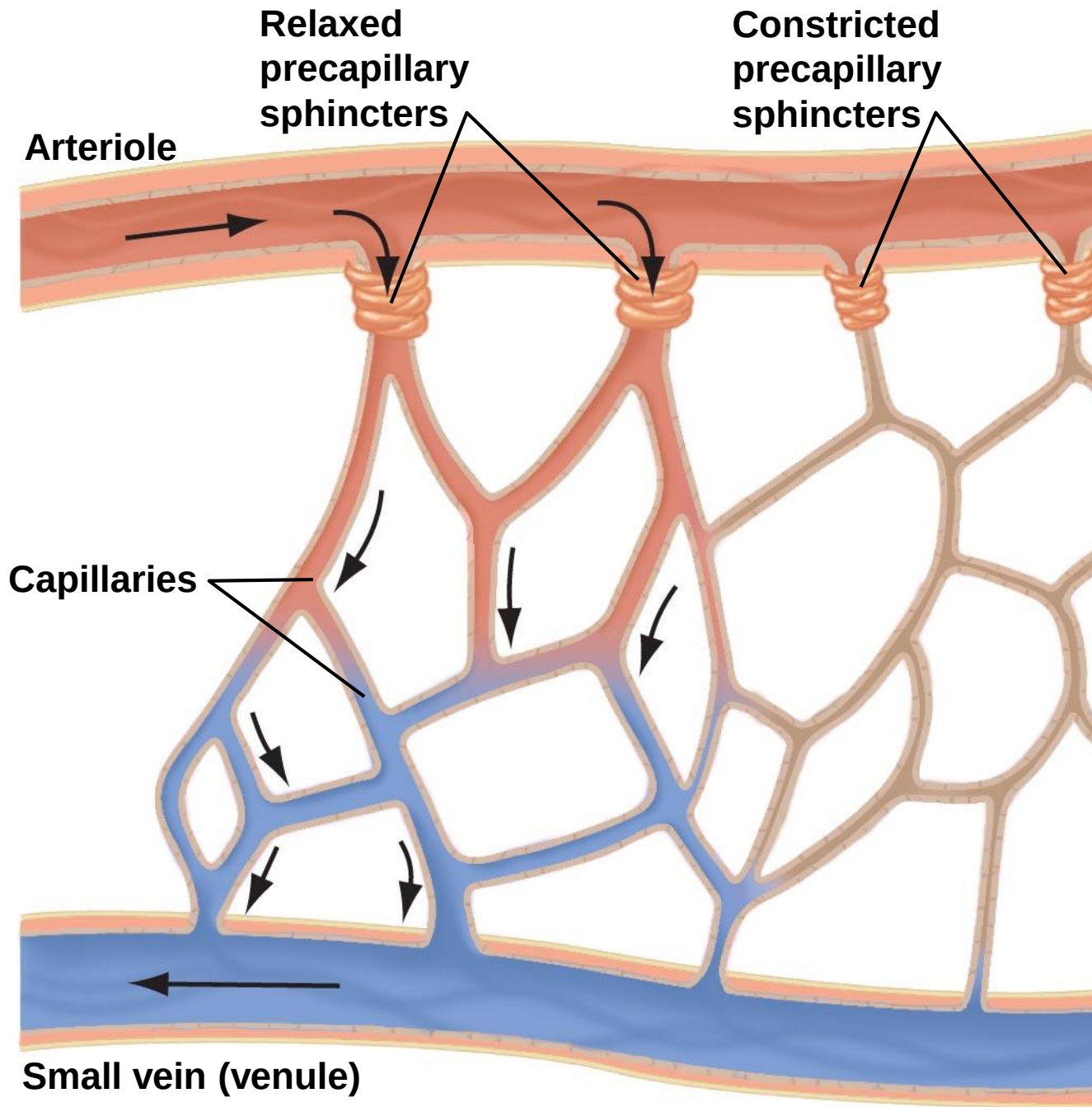
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- Structure
  - Thick-walled, three layers
    - Innermost layer: endothelium
    - Middle layer: smooth muscle
    - Outer layer: connective tissue
- Function
  - Arteries carry blood away from heart
  - Carry blood under pressure
  - Usually (NOT always) oxygen rich

# Arterioles and Precapillary Sphincters

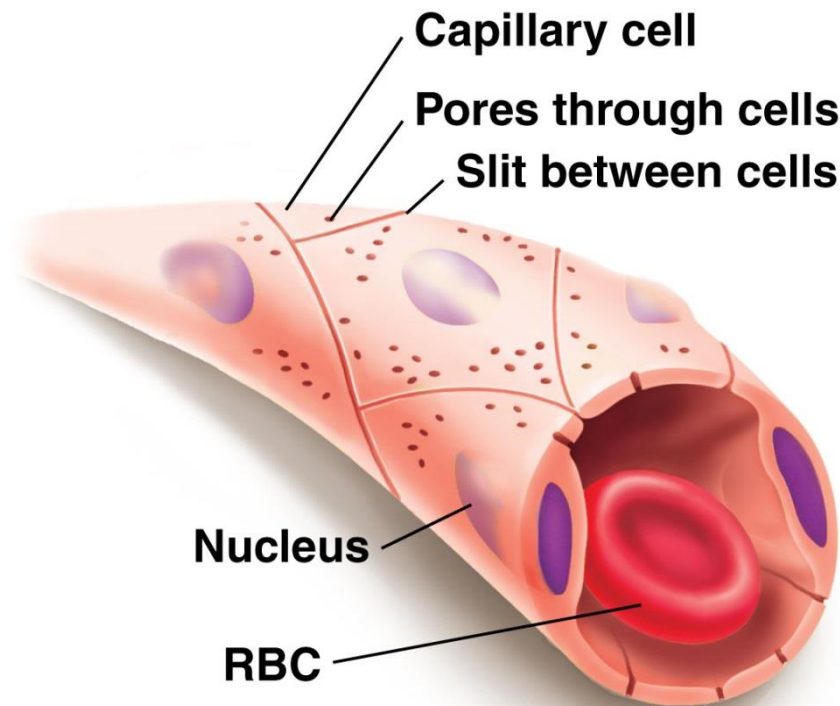
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- Arterioles: smallest arteries
- Precapillary sphincters: control blood flow into capillaries
  - **Vasodilation:** increases blood flow to capillaries
  - **Vasoconstriction:** decreases blood flow to capillaries



# Capillaries

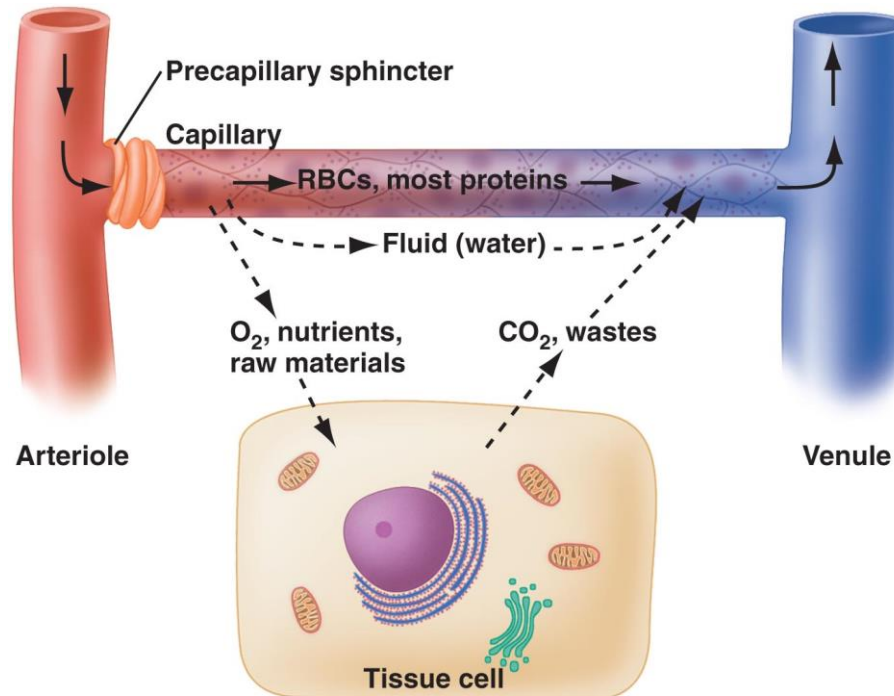
- Structure
  - Smallest blood vessels
  - Thin-walled: one cell-layer thick
  - Porous



**c) The structure of a capillary.**

# Capillaries

- Capillary beds
  - extensive networks of capillaries
- Function
  - selective exchange of substances with the interstitial fluid (fluid around cells)



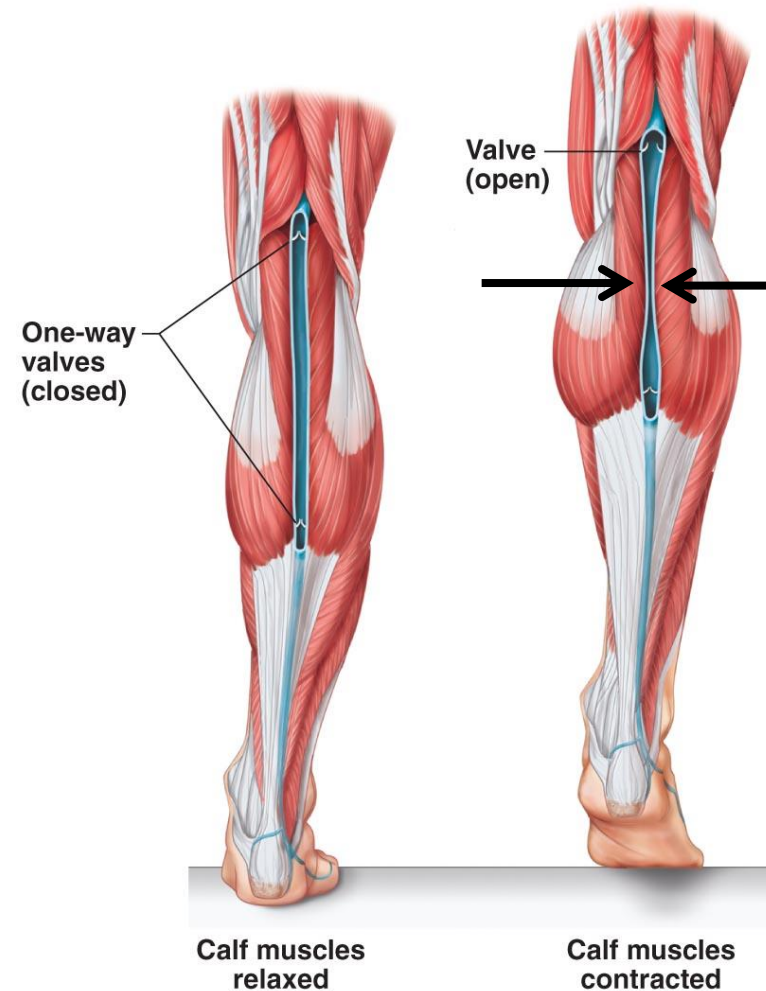
# Veins

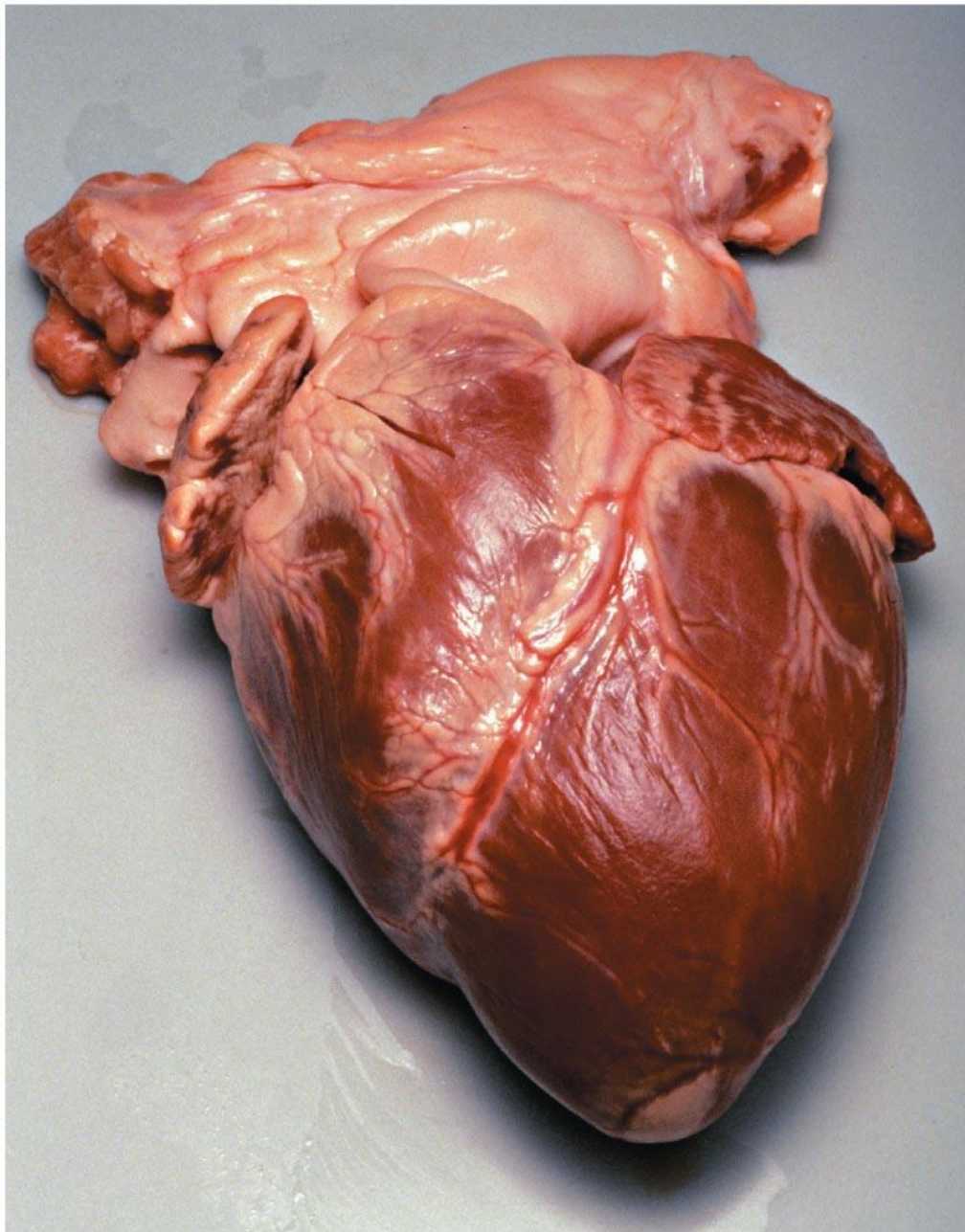
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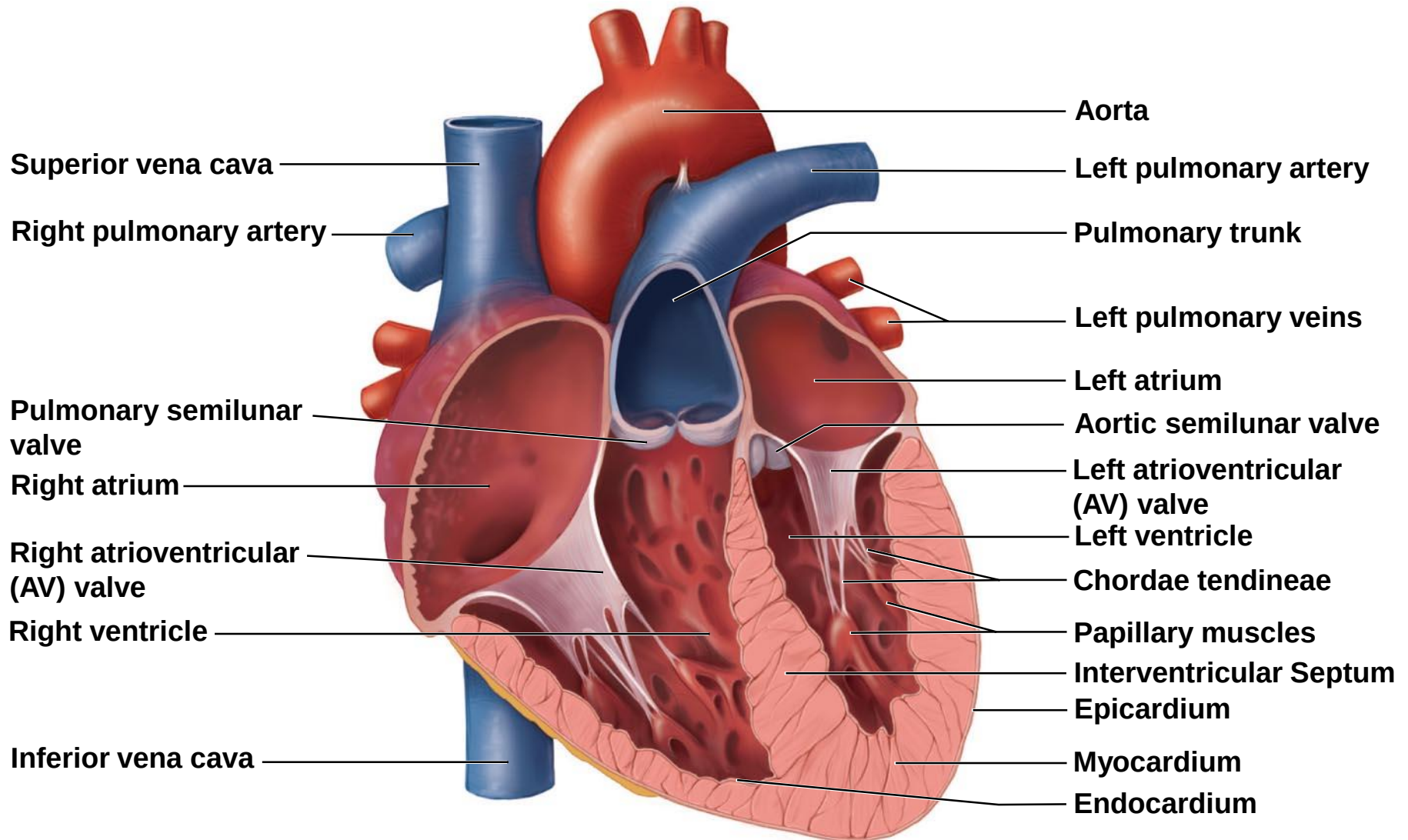
- Structure
  - Three layers, thin-walled
  - Larger lumen than arteries
  - High distensibility (stretch)
- Functions
  - Carry blood toward the heart
  - Serve as blood volume reservoir

# Three Mechanisms Assist Venous Return to the Heart

- Mechanisms in blood return
  - Contraction of skeletal muscles
  - One-way valves
  - Pressure changes associated with breathing







# The Heart - Layers

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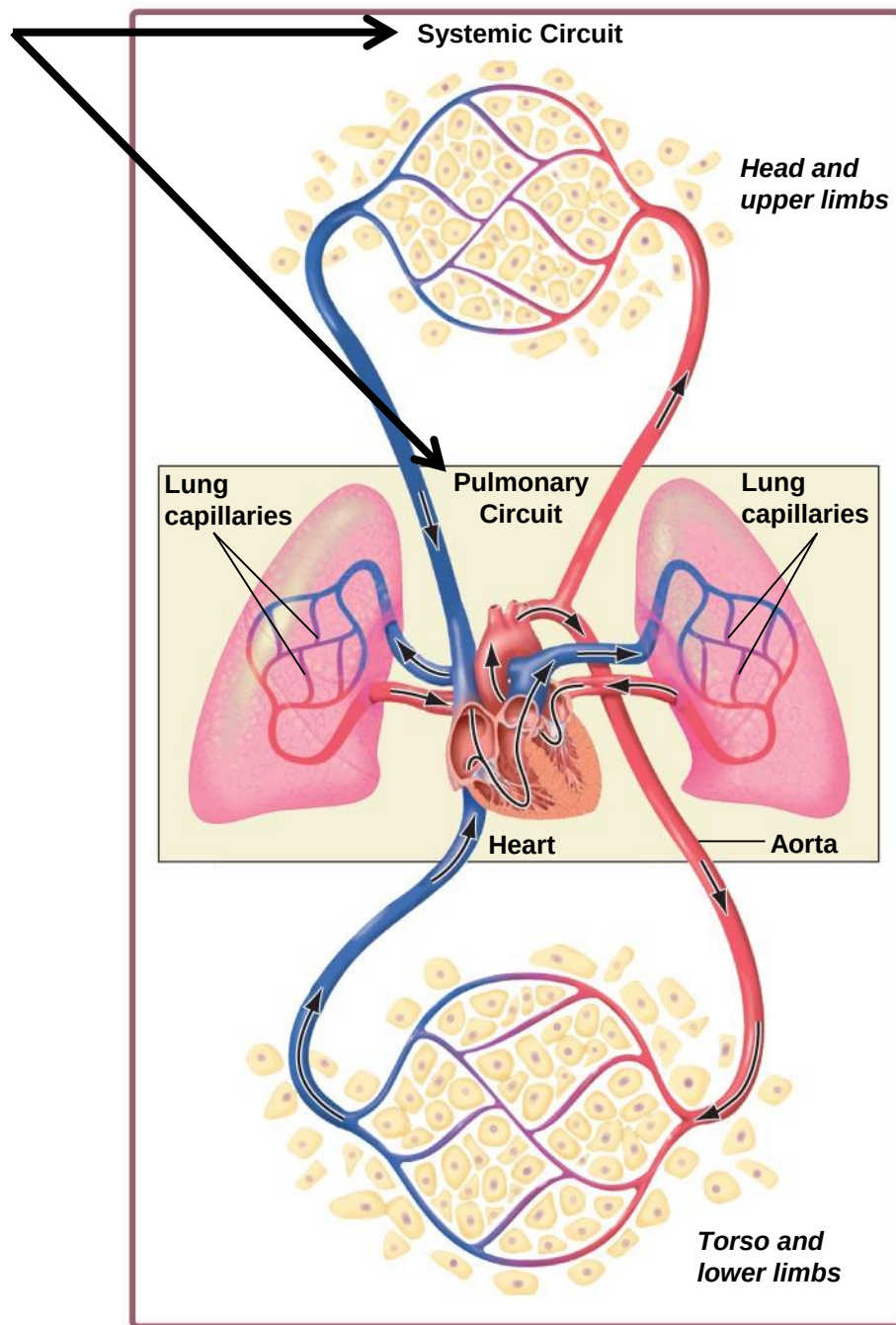
- Surrounded by fibrous sac
  - **pericardium**
- Layers of the heart
  - **Epicardium**
    - thin layer of epithelial and connective tissue
  - **Myocardium**
    - thick layer of cardiac muscle
  - **Endocardium**
    - thin layer of endothelial tissue

# The Heart – Chambers and Valves

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- Four chambers
  - Two atria
  - Two ventricles
- Valves – prevent backflow
  - Two atrioventricular valves
    - Tricuspid valve
    - Bicuspid (mitral) valve
  - Two semilunar valves
    - Pulmonary valve
    - Aortic valve

# Two Circuits



# Pulmonary Circuit – Oxygenation of Blood

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1. Deoxygenated blood from the body travels through the vena cava to the right atrium
2. Through the right atrioventricular valve to the right ventricle
3. Through the pulmonary semilunar valve to the pulmonary trunk and the lungs
4. Blood is oxygenated within pulmonary capillaries
5. Oxygenated blood travels through the pulmonary veins to the left atrium
6. Through the left atrioventricular valve to the left ventricle

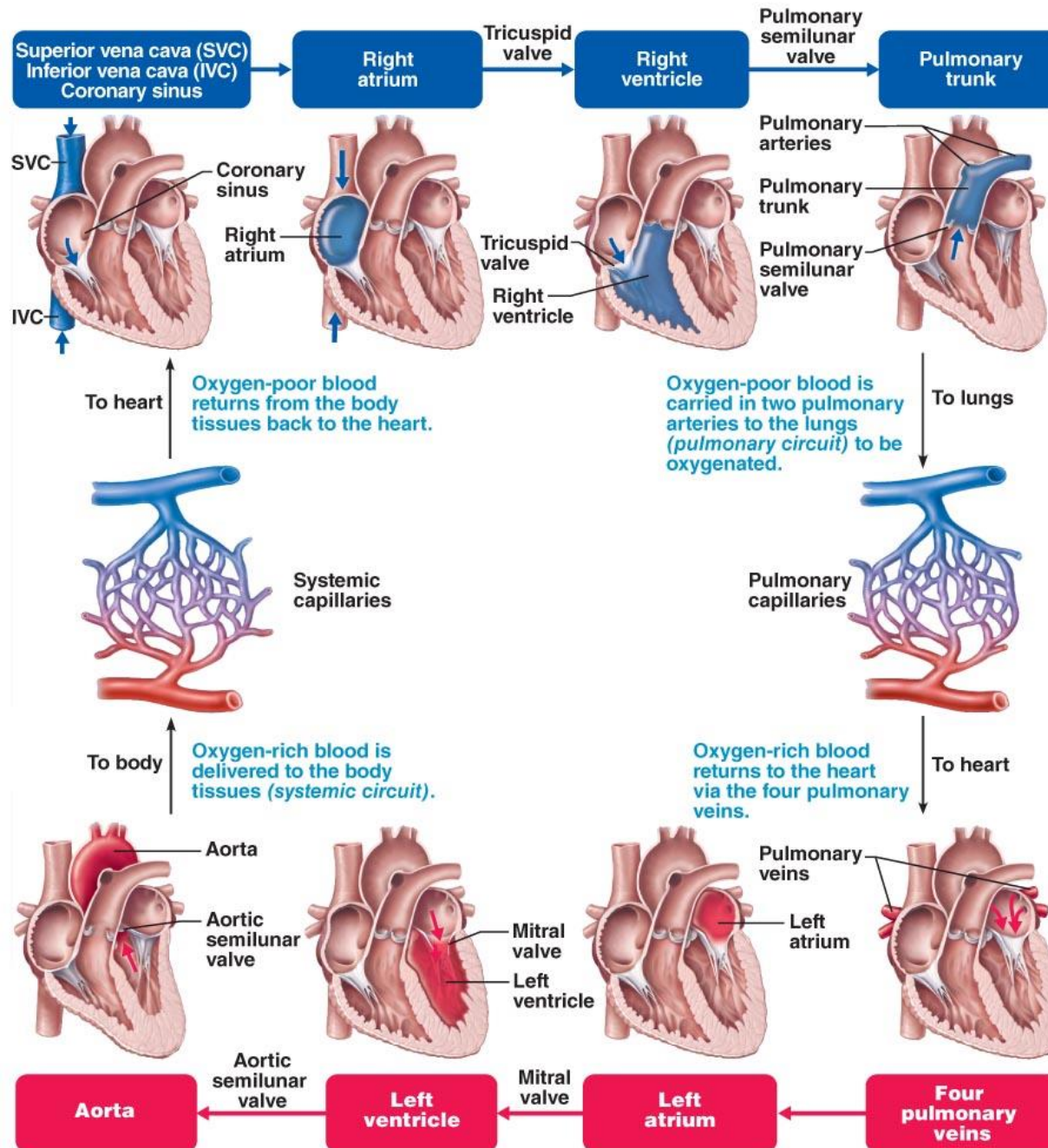
# Systemic Circuit – Delivery of Oxygenated Blood to Tissues

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1. Oxygenated blood travels from the left ventricle through the aortic semilunar valve to the aorta
2. Through branching arteries and arterioles to tissues
3. Through the arterioles to capillaries
4. From capillaries into venules and veins
5. To the vena cava and into the right atrium

Both sides of the heart pump at the same time, but let's follow one spurt of blood all the way through the system.

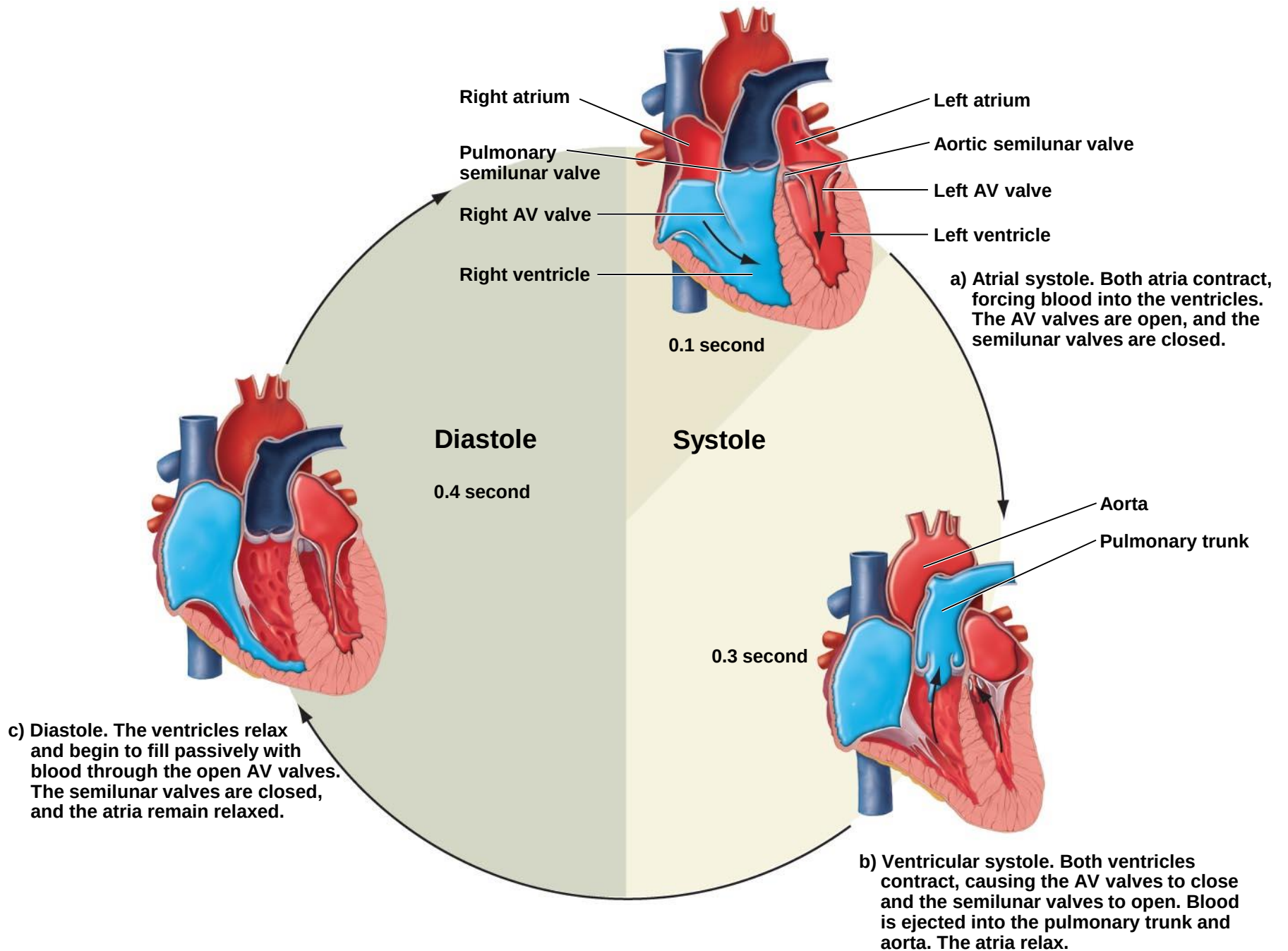
■ Oxygen-poor blood  
■ Oxygen-rich blood



# Cardiac Cycle – The heart contracts and relaxes

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- Atrial systole
  - Both atria contract
  - AV valves open, semilunar valves are closed
  - Ventricles fill
- Ventricular systole
  - Both ventricles contract
  - AV valves close, semilunar valves open
- Diastole
  - Both atria and ventricles relax
  - Semilunar valves close



# Heart Sounds and Heart Valves

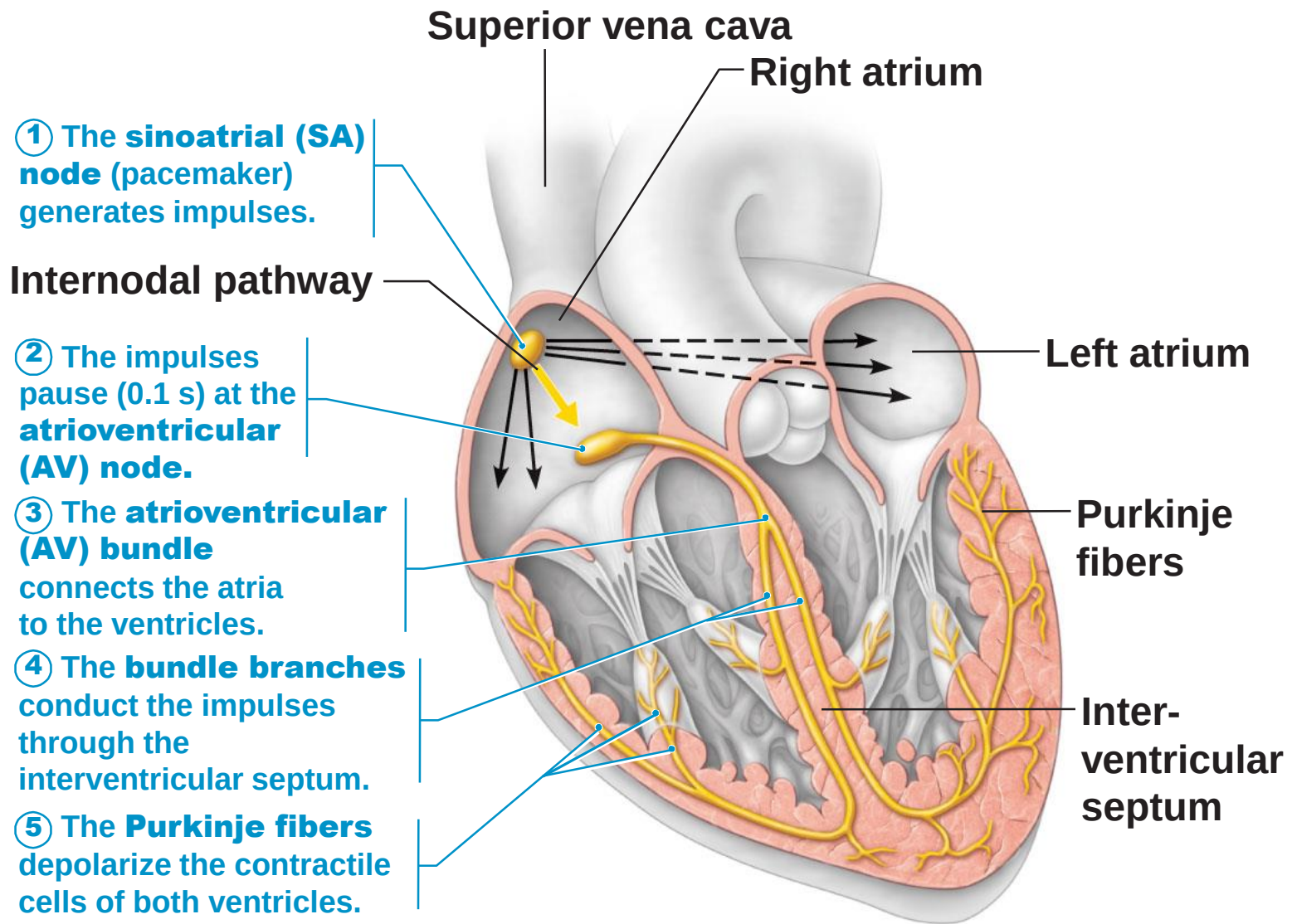
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- Lub-dub heart sound
  - Lub: closing of both AV valves during ventricular systole
  - Dub: closing of both semilunar valves during ventricular diastole
- Heart murmurs
  - Caused when blood flow is disturbed
  - May be a sign of a defective valve

# Cardiac Conduction System Coordinates Contraction

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- SA node
  - Cardiac pacemaker
  - Initiates the heartbeat
  - Pace can be modified by nervous system
- AV node
  - Relays impulse
- AV bundle and Purkinje fibers
  - Carry impulse to ventricles



**Anatomy of the intrinsic conduction system showing the sequence of electrical excitation**

# Electrocardiogram (EKG/ECG)

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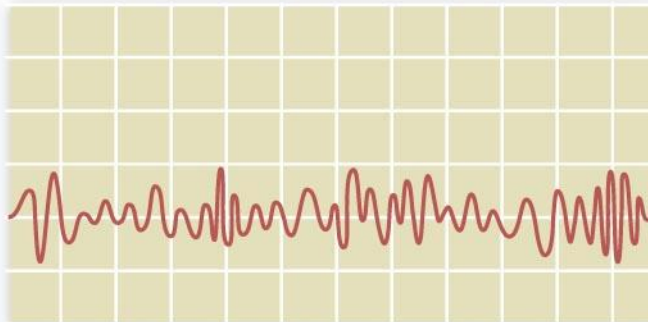
- Tracks the electrical activity of the heart
- A healthy heart produces a characteristic pattern
- Three formations
  - **P wave**: impulse across atria
  - **QRS complex**: spread of impulse down septum, around ventricles in Purkinje fibers
  - **T wave**: end of electrical activity in ventricles
- EKGs can detect
  - Arrhythmias
  - Ventricular fibrillation



**a) An ECG being recorded.**



**b) A normal ECG recording.**



**c) Ventricular fibrillation.**

# Blood Pressure

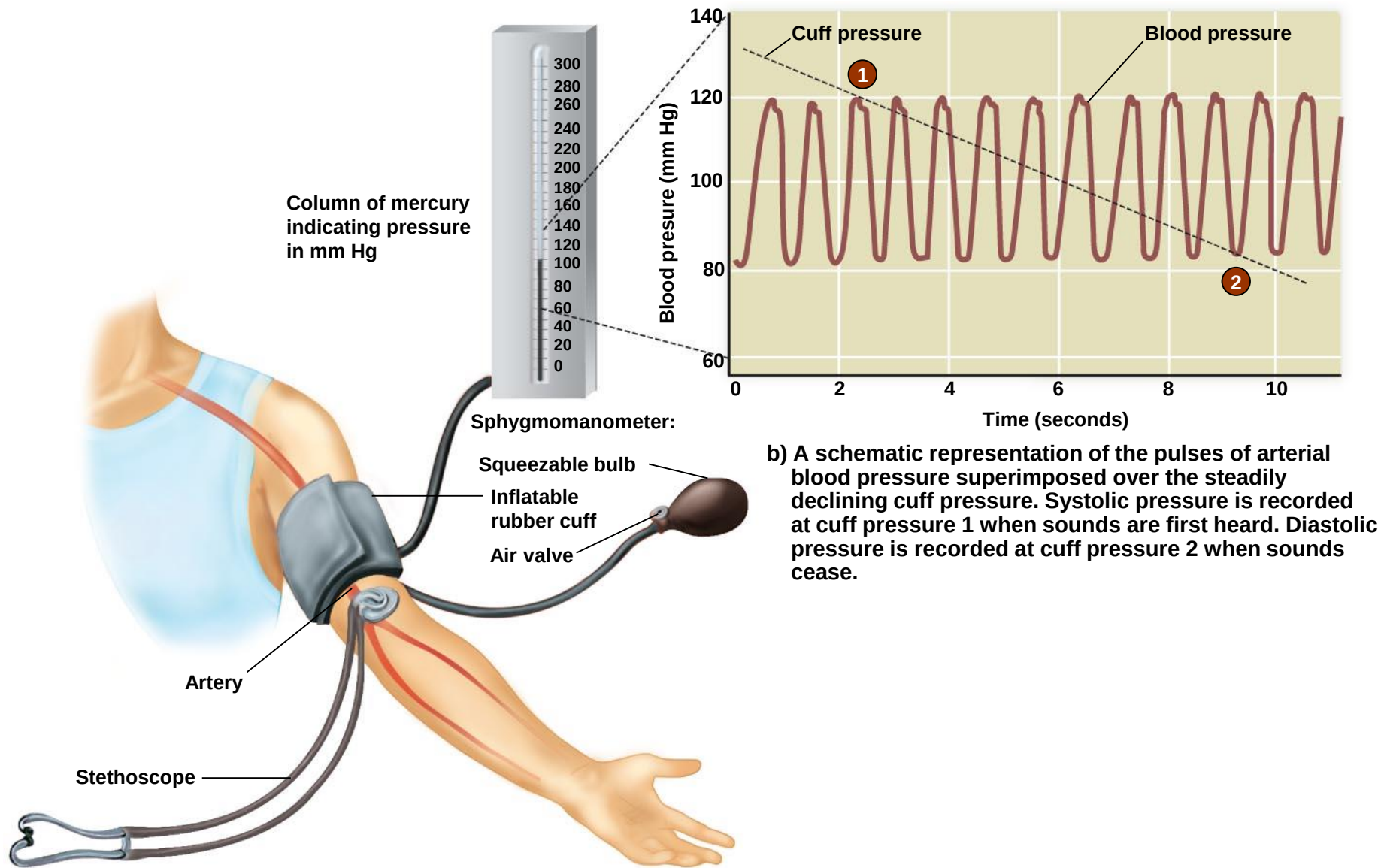
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- The force that the blood exerts on the wall of the blood vessels
  - **Systolic pressure** – highest pressure, as blood is ejected during ventricular systole
  - **Diastolic pressure** – lowest pressure, during ventricular diastole
- Measurement
  - Sphygmomanometer – measures pressure
  - “Normal” readings
    - Systolic pressure <120 mmHg
    - Diastolic pressure <80 mmHg

# Blood Pressure (cont.)

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- **Hypertension:** high blood pressure
  - The silent killer
- **Hypotension:** blood pressure too low
  - Clinical signs – dizziness, fainting
  - Causes of hypotension – orthostatic, severe burns, blood loss



a) A clinician inflates the cuff with air and then allows the pressure in the cuff to fall gradually while using a stethoscope to listen for the sounds of blood movement through the artery.

b) A schematic representation of the pulses of arterial blood pressure superimposed over the steadily declining cuff pressure. Systolic pressure is recorded at cuff pressure 1 when sounds are first heard. Diastolic pressure is recorded at cuff pressure 2 when sounds cease.

# Cardiovascular Disorders

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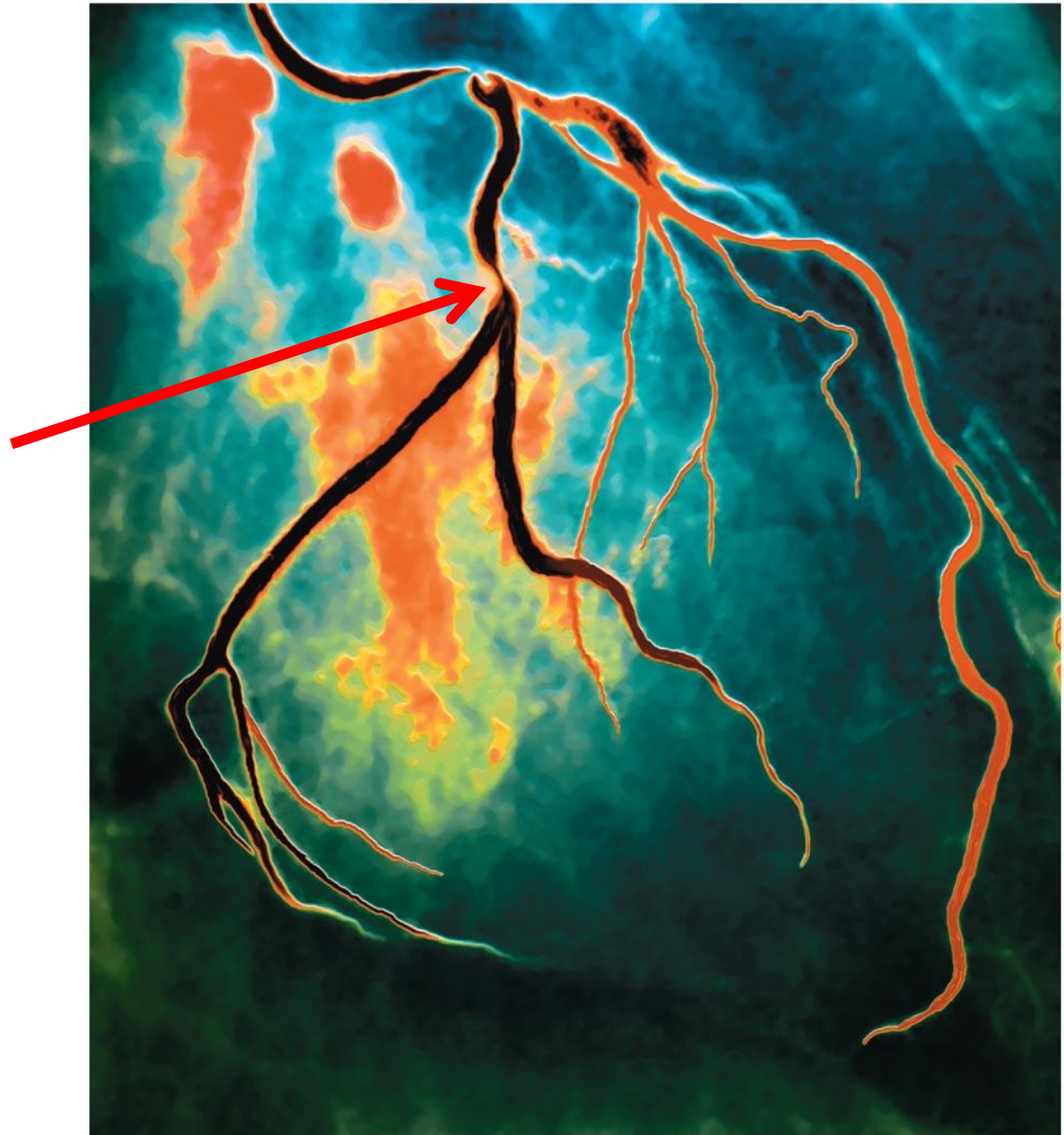
- **Angina pectoris**
  - narrowed coronary arteries impair blood flow
- **Congestive heart failure**
  - decrease in pumping efficiency
- **Embolism**
  - blockage of blood vessels
- **Stroke**
  - impaired blood flow to the brain

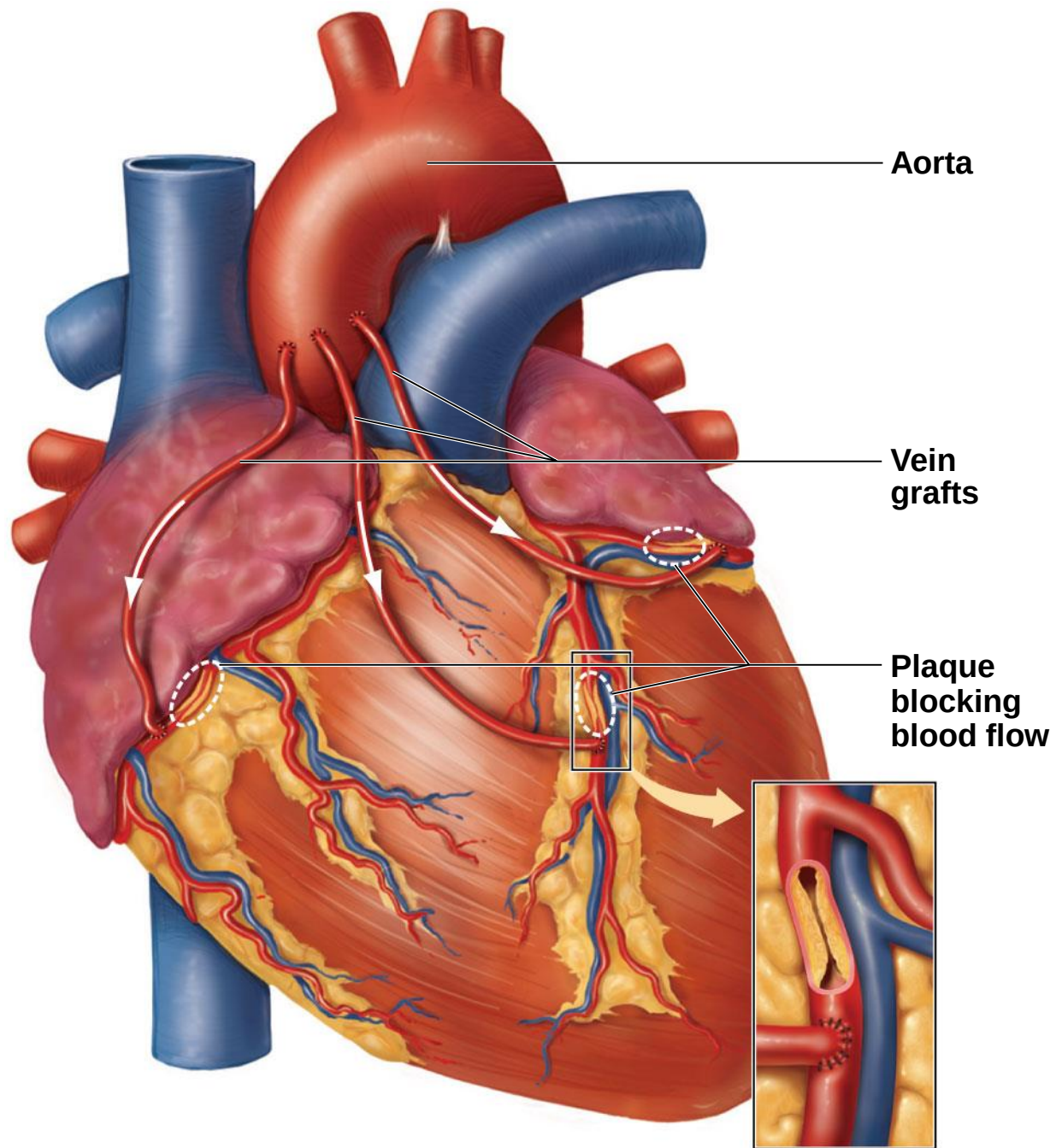
# Heart Attack

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- Also known as **myocardial infarction**
  - Permanent damage to myocardium
- Symptoms
  - Intense chest pain, nausea, heaviness in the chest, difficulty breathing, pain radiating to left arm, jaw, back, upper abdomen
- Diagnosis
  - EKG
  - Blood test for cardiac enzymes
- Prevention/Treatment
  - Clot-busting medications
  - CABG

# Coronary Angiogram





# Reducing the Risk of Cardiovascular Disease

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- Smoking – don't (see link in learning module)
- Blood lipids – monitor cholesterol levels
- Exercise – regular and moderate
- Blood pressure – treat hypertension

# Reducing the Risk of Cardiovascular Disease

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- Weight – being overweight increases risk of heart attack and stroke
- Control of diabetes mellitus – early diagnosis and treatment delays onset of related problems
- Stress – avoid chronic stress