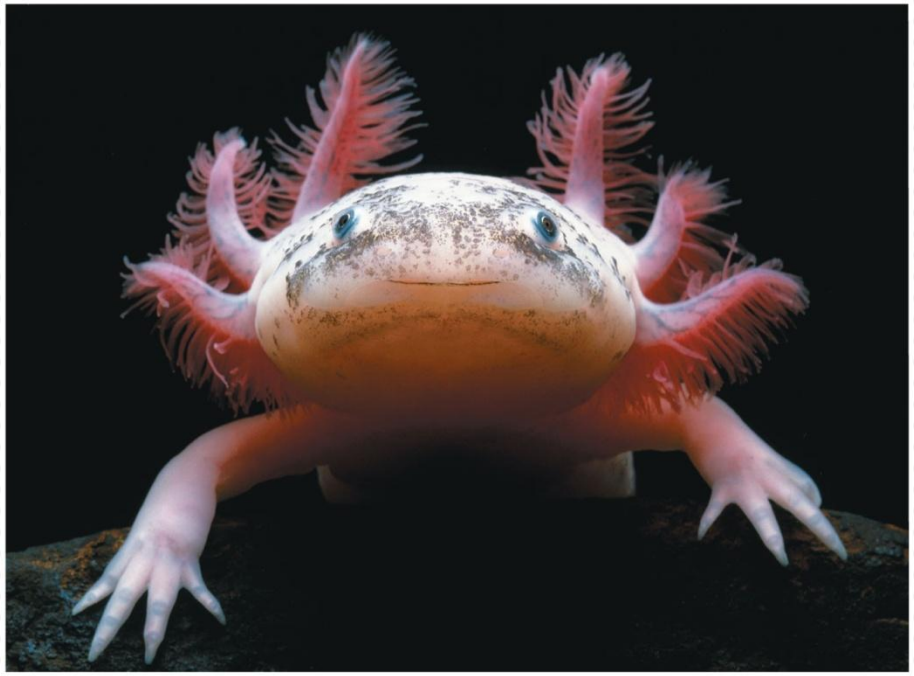
Warm-Up

1. (Ch. 41) List the locations where each of the 4 macromolecules are chemically digested.
2. (Ch. 41) Where do vertebrates store excess calories?
3. (Ch. 42) Draw and label the structure of a human heart.
4. (Ch. 42) List the pathway of a single red blood cell through the heart.

Circulation

Chapter 42 – Part I



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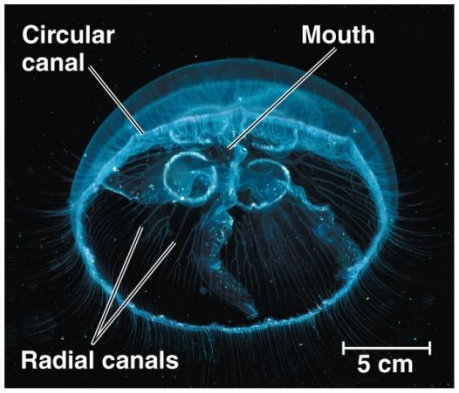
What you need to know:

- Circulatory vessels, heart chambers, route of mammalian circulation
- Evolution of the heart from 2□4 chambers
- How RBC's demonstrate structure/function
- Blood pressure
- Cardiovascular disease (Roles of diet, BP, genetics)

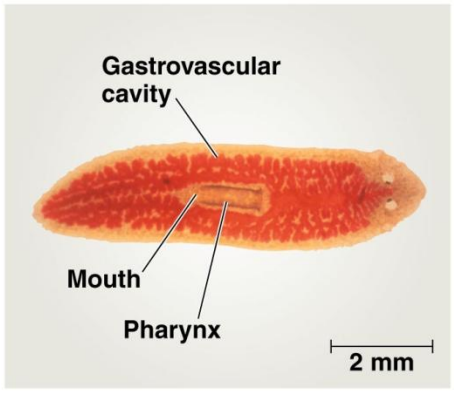
Transport systems (circulation) linked with gas exchange (respiration)

- Diffusion of gases only rapid across small distances

Basic:	Gastrovascular Cavity:	Circulatory System:
Cells in direct contact with environment	For digestion & distribute substances	Moves fluid to tissues & cells for exchange
Ex. sponges	Ex. jellies, flatworms	Ex. larger animals



(a) The moon jelly *Aurelia*, a cnidarian



(b) The planarian *Dugesia*, a flatworm

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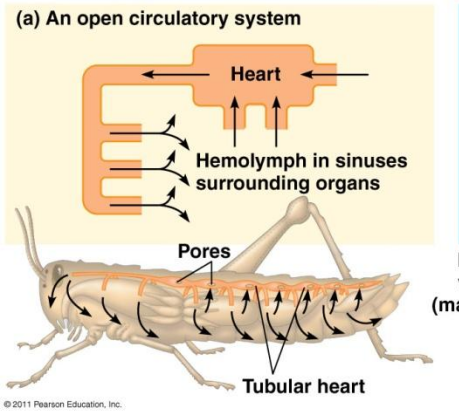

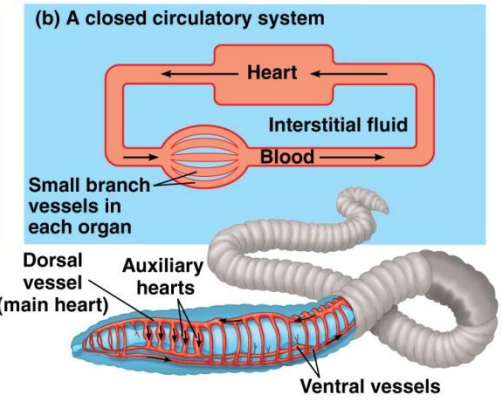

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Circulatory System = Blood + Vessels + Heart

Open circulatory system:
blood bathes organs directly
- Blood + lymph = hemolymph
- Heart pumps hemolymph into sinuses
- Ex. arthropods, mollusks

Closed circulatory system:
blood contained in vessels & pumped around body
- Blood and fluid separate
- Ex. annelids, cephalopods, vertebrates

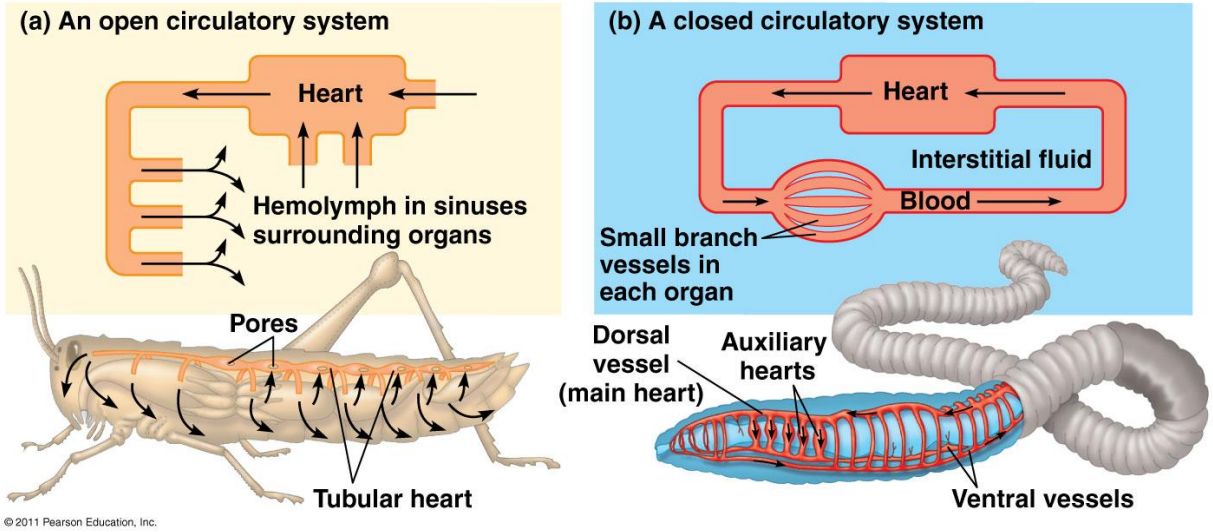

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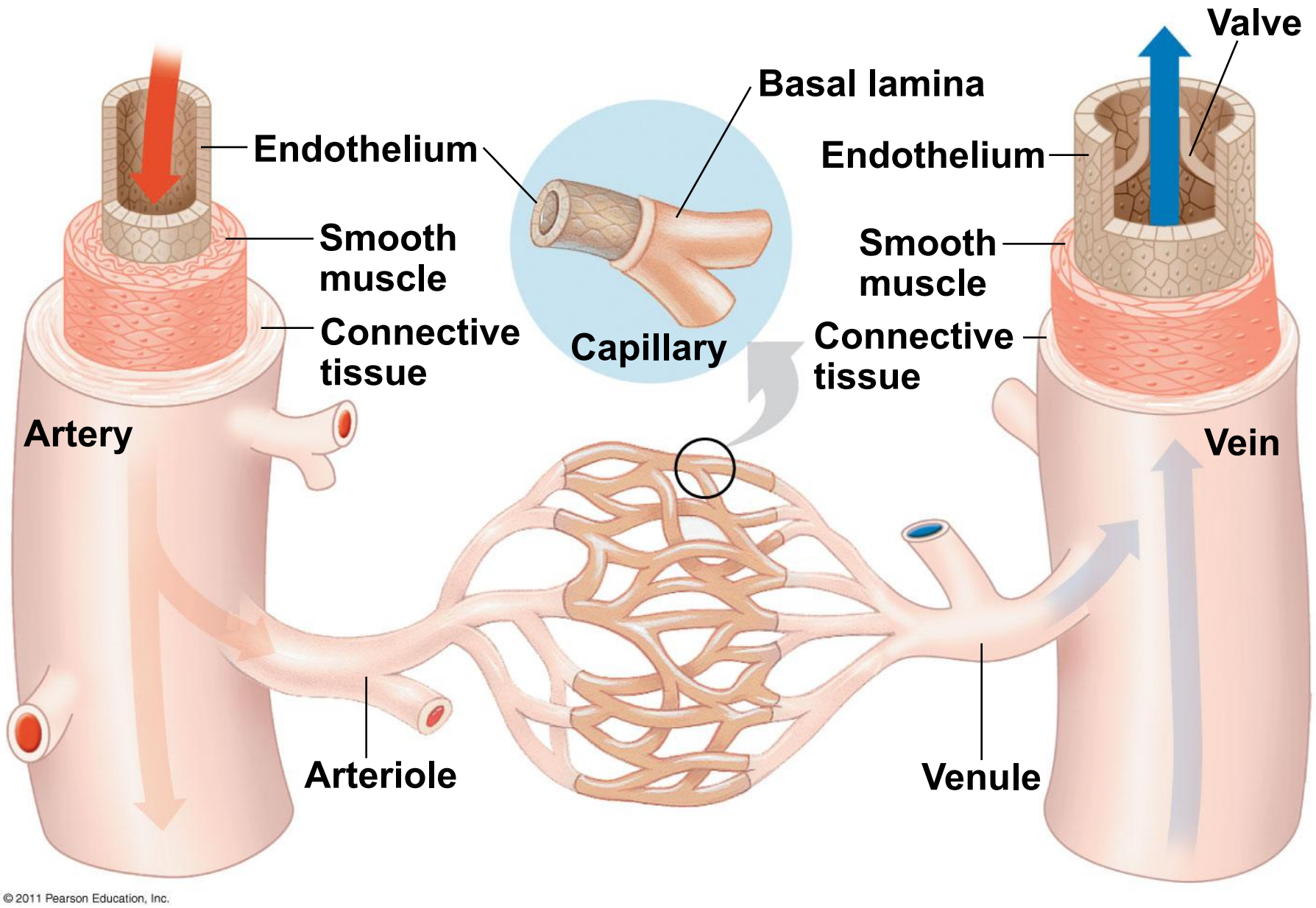
Figure 42.10a



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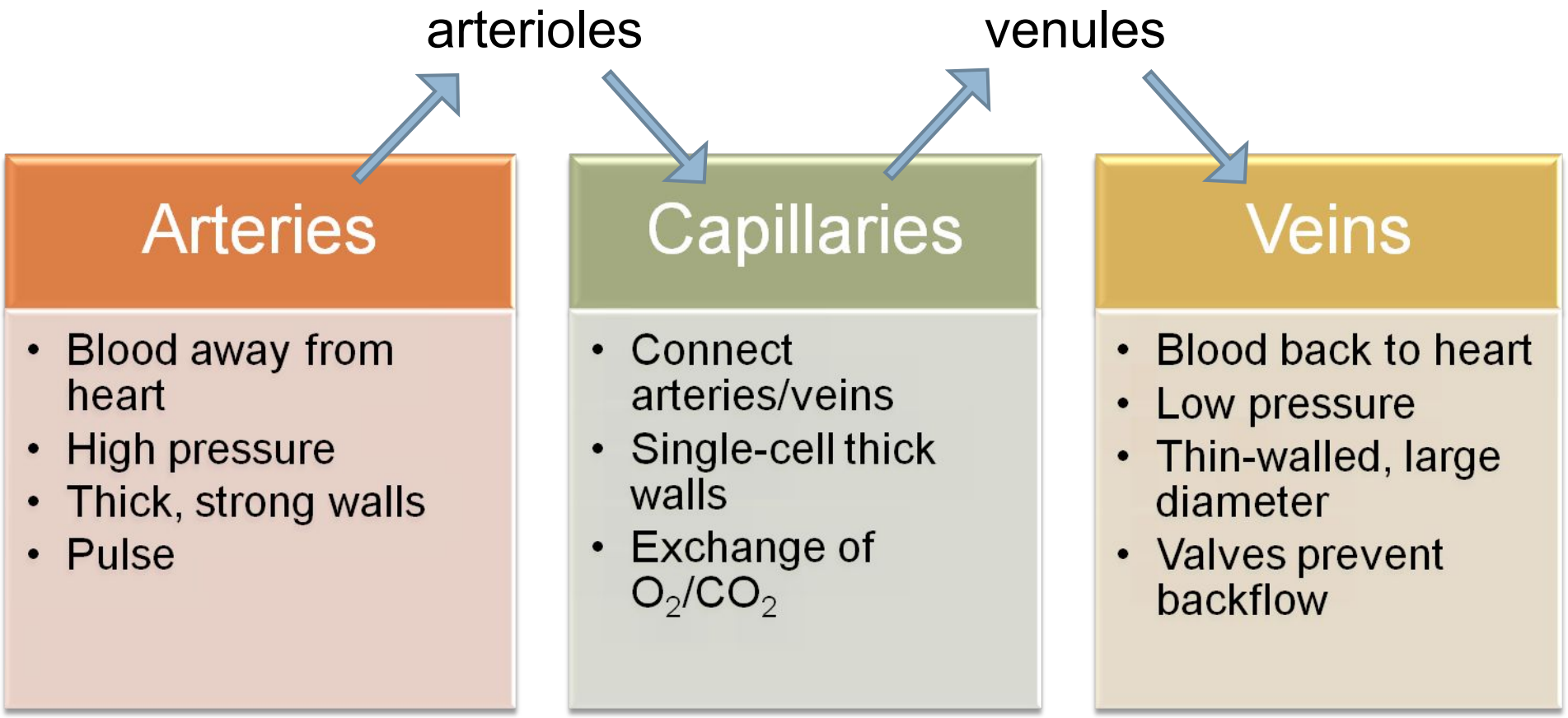
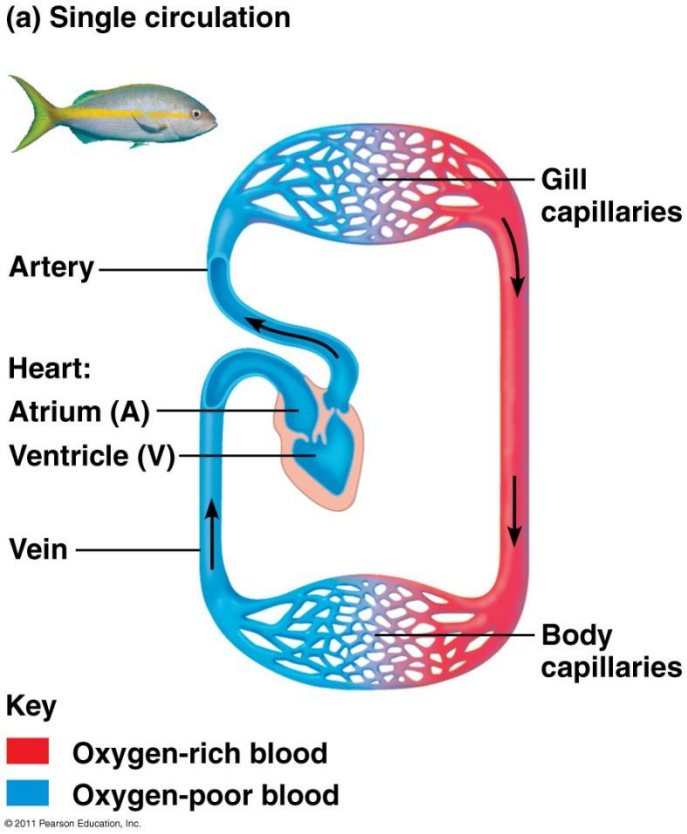
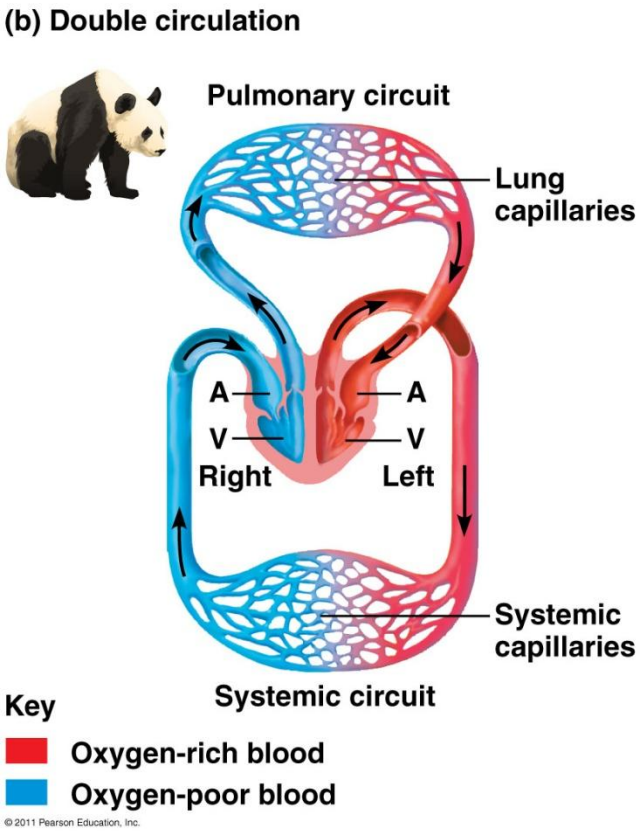
Types of Blood Vessels



- Blood enters through an **atrium** and is pumped out through a **ventricle**
- Fish = single circulation pathway, 2 chambers
- Double circulation: amphibians, reptiles, mammals





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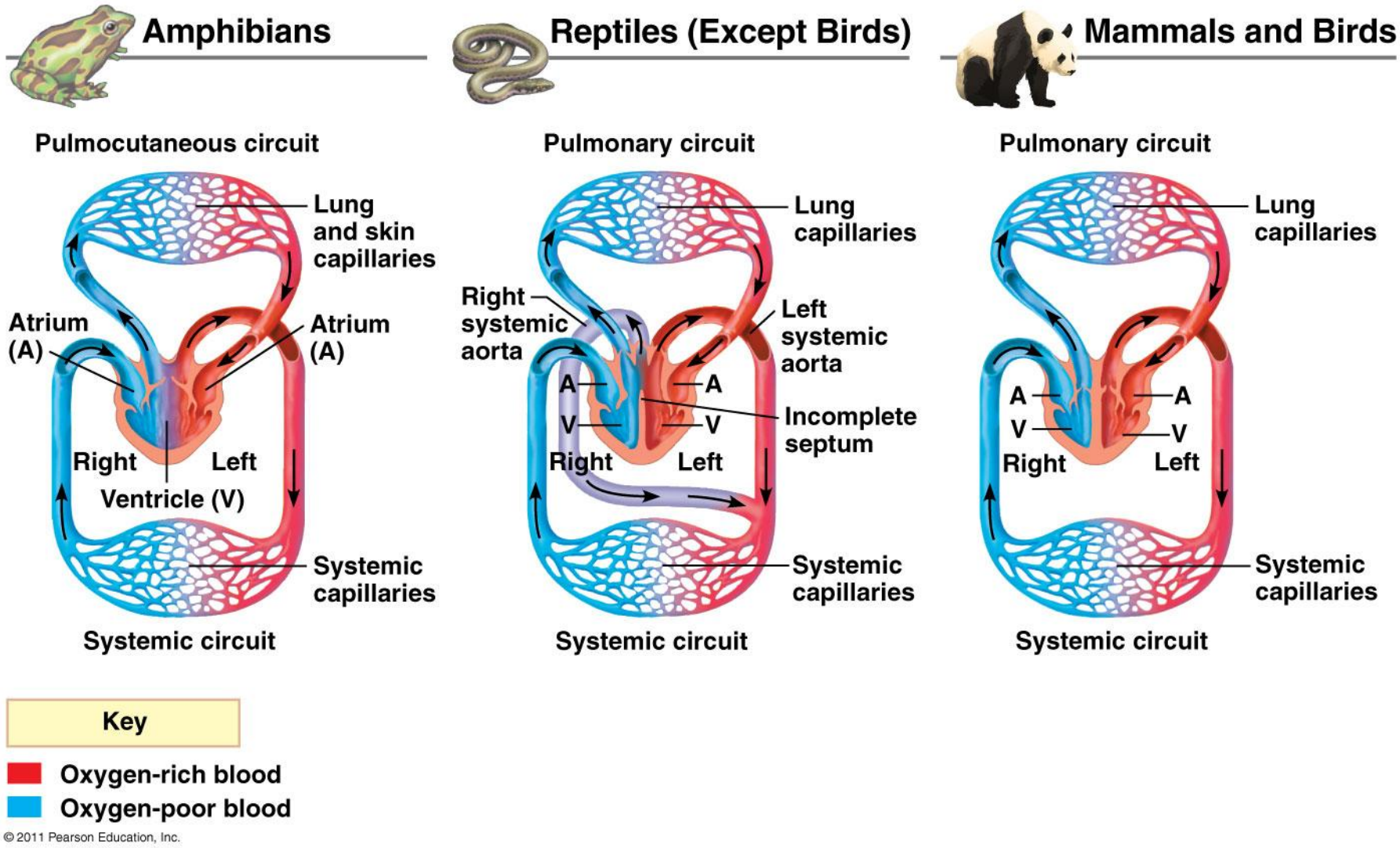
Double circulation pathways in vertebrates



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Pathway of blood through heart

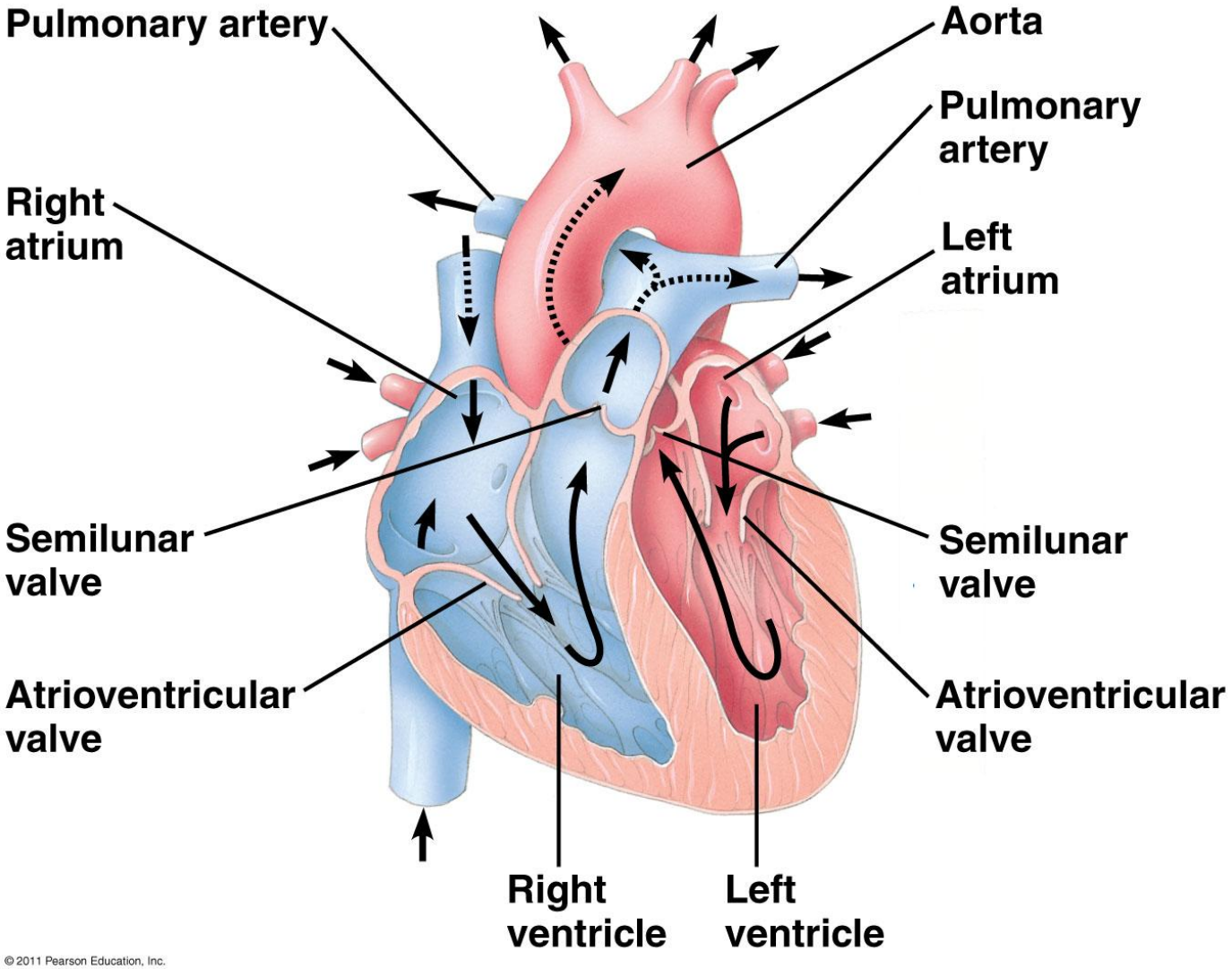

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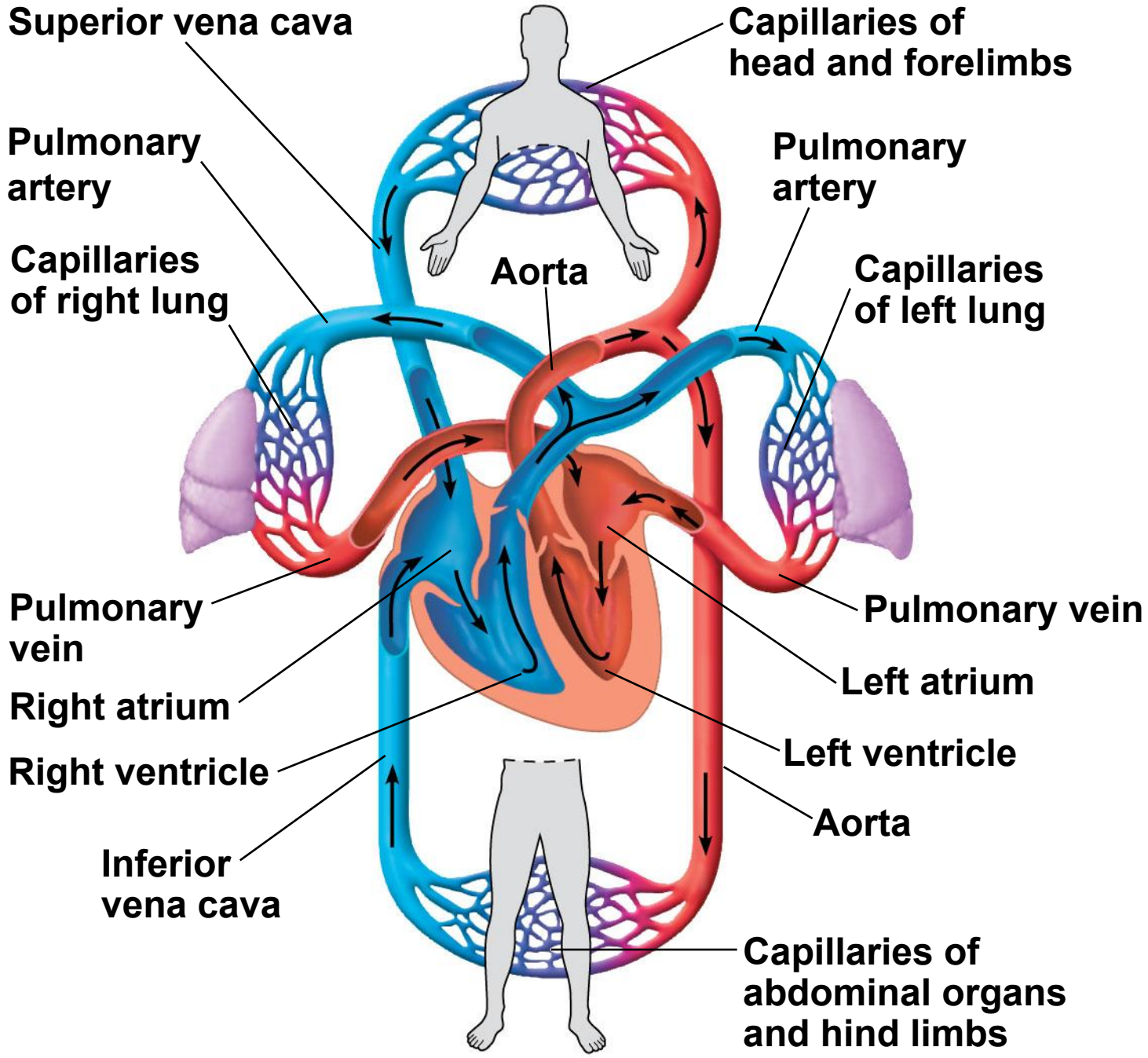
Figure 42.6



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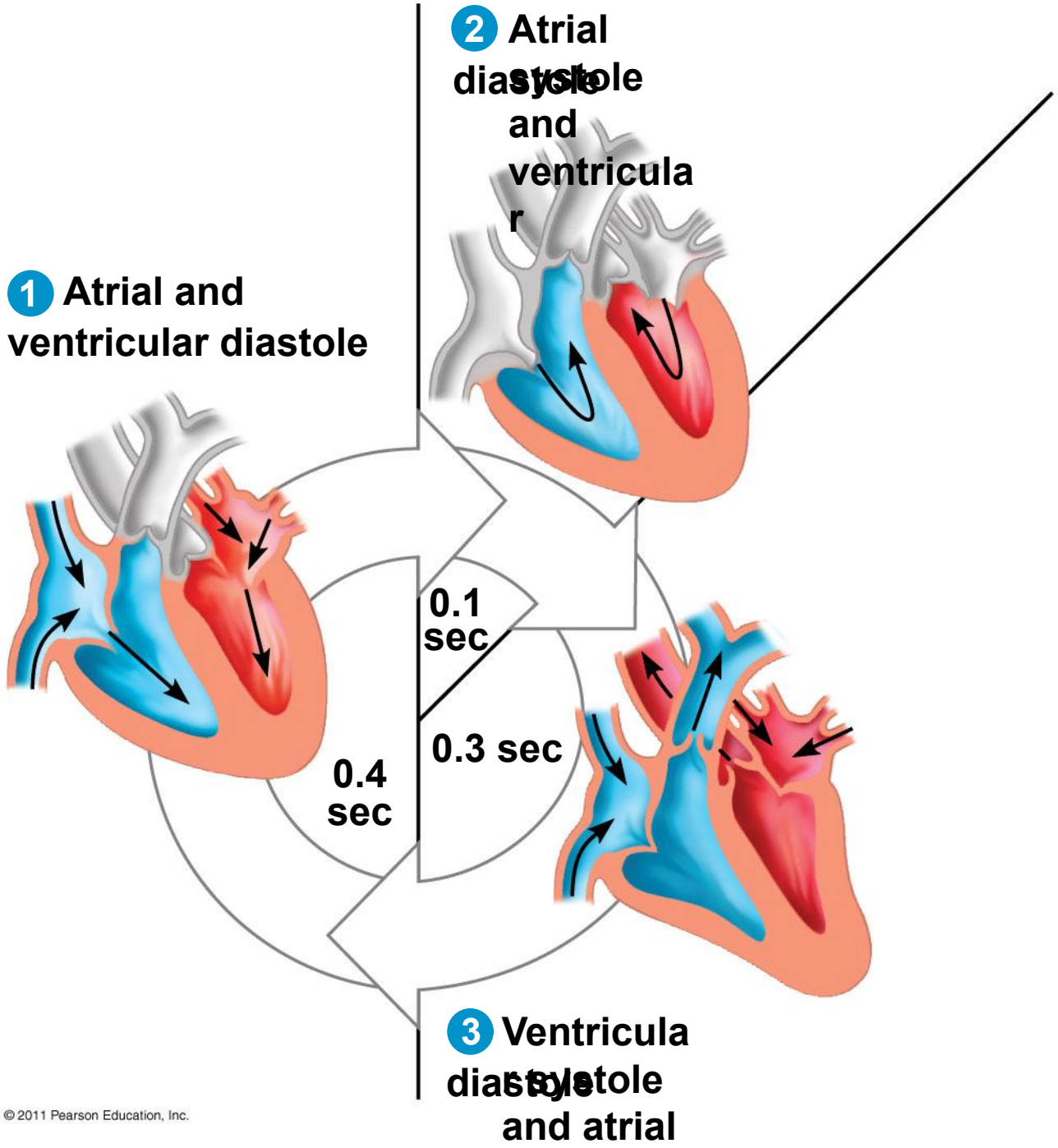
Cardiac cycle

- Systole: contraction or pumping phase
- Diastole: relaxation or filling phase

- Heart rate: # beats/minute (72 bpm resting)
- Stroke volume: amount of blood pumped by L. ventricle during contraction (~70 ml)

Figure 42.8-3


1 Atrial and ventricular diastole
2 Atrial systole and ventricular
0.1 sec
0.3 sec
0.4 sec
3 Ventricular systole and atrial
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Valves: prevent backflow of blood

- The **atrioventricular (AV) valves** (tricuspid, bicuspid) separate each atrium and ventricle
- The **semilunar valves** control blood flow to the aorta and the pulmonary artery
- "Lub-dup" sound = blood against closed AV valves (lub) / the semilunar (dup) valves
- **Heart murmur**: backflow of blood through a defective valve

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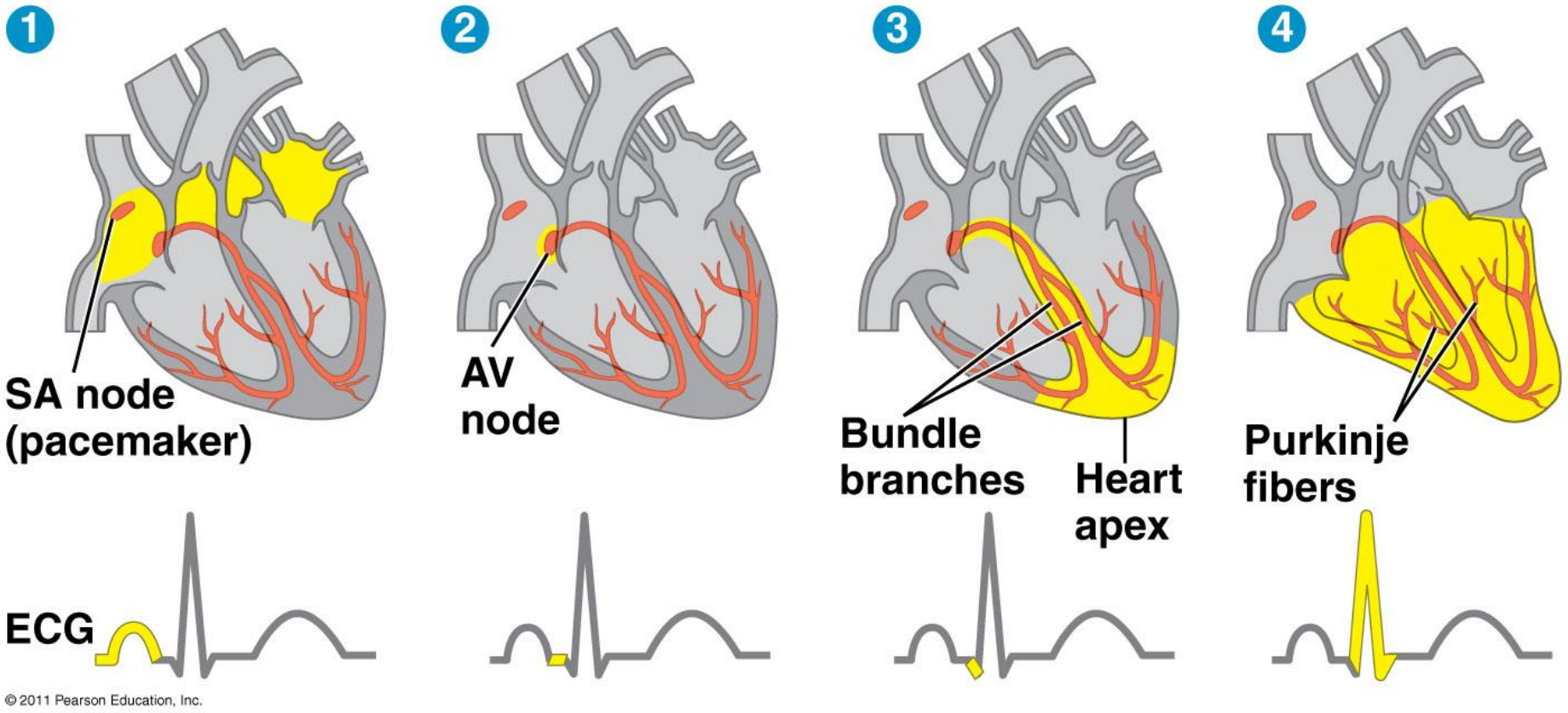
Sinoatrial (SA) node: pacemaker of heart, in right atrium



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- The pacemaker is regulated by two portions of the nervous system: the sympathetic and parasympathetic divisions
- The sympathetic division speeds up the pacemaker
- The parasympathetic division slows down the pacemaker
- The pacemaker is also regulated by hormones (epinephrine) and temperature

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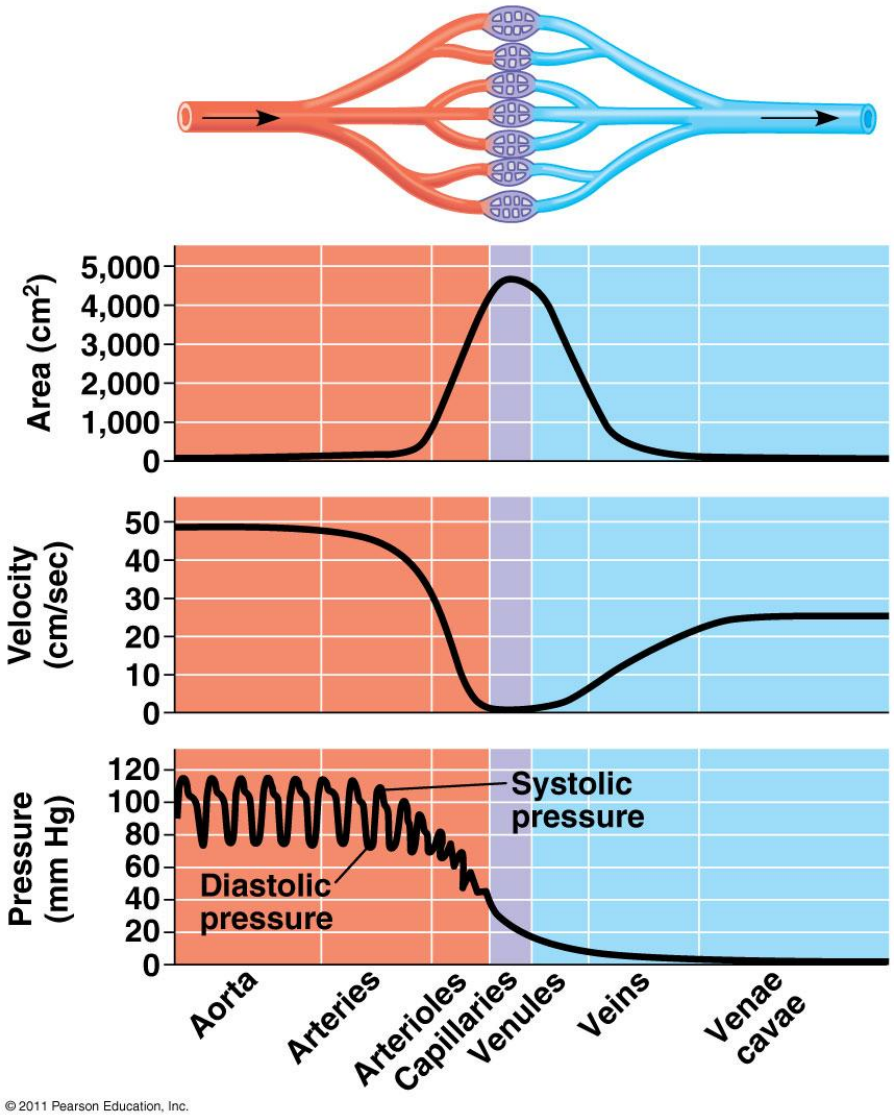
Blood Pressure

- **BP** = systolic/diastolic pressure
  - Systolic: heart contracts
  - Diastolic: heart relaxed
  - Normal: 120/70

- **Pulse**: rhythmic bulging of artery walls with each heartbeat



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Using a Sphygmomanometer

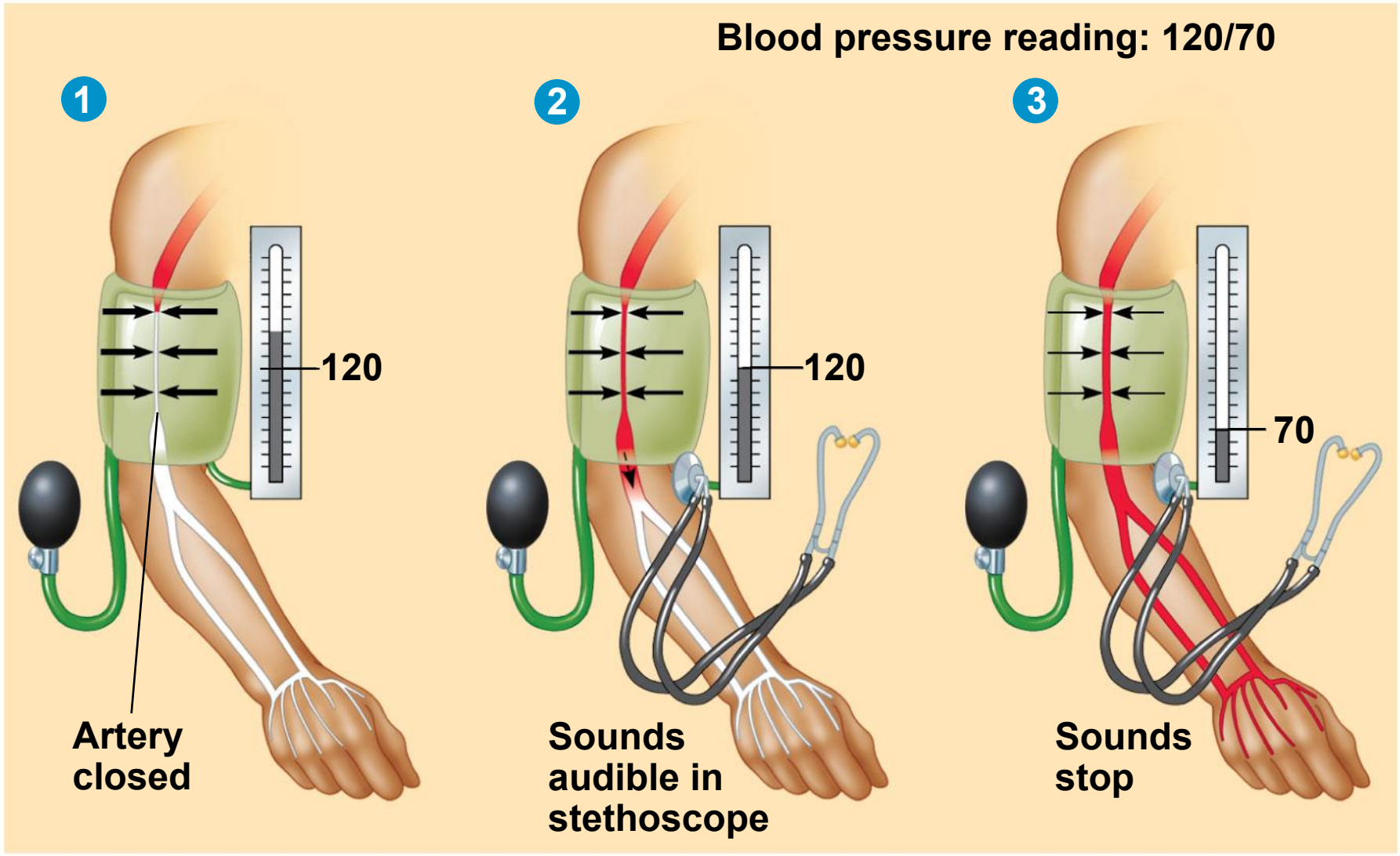

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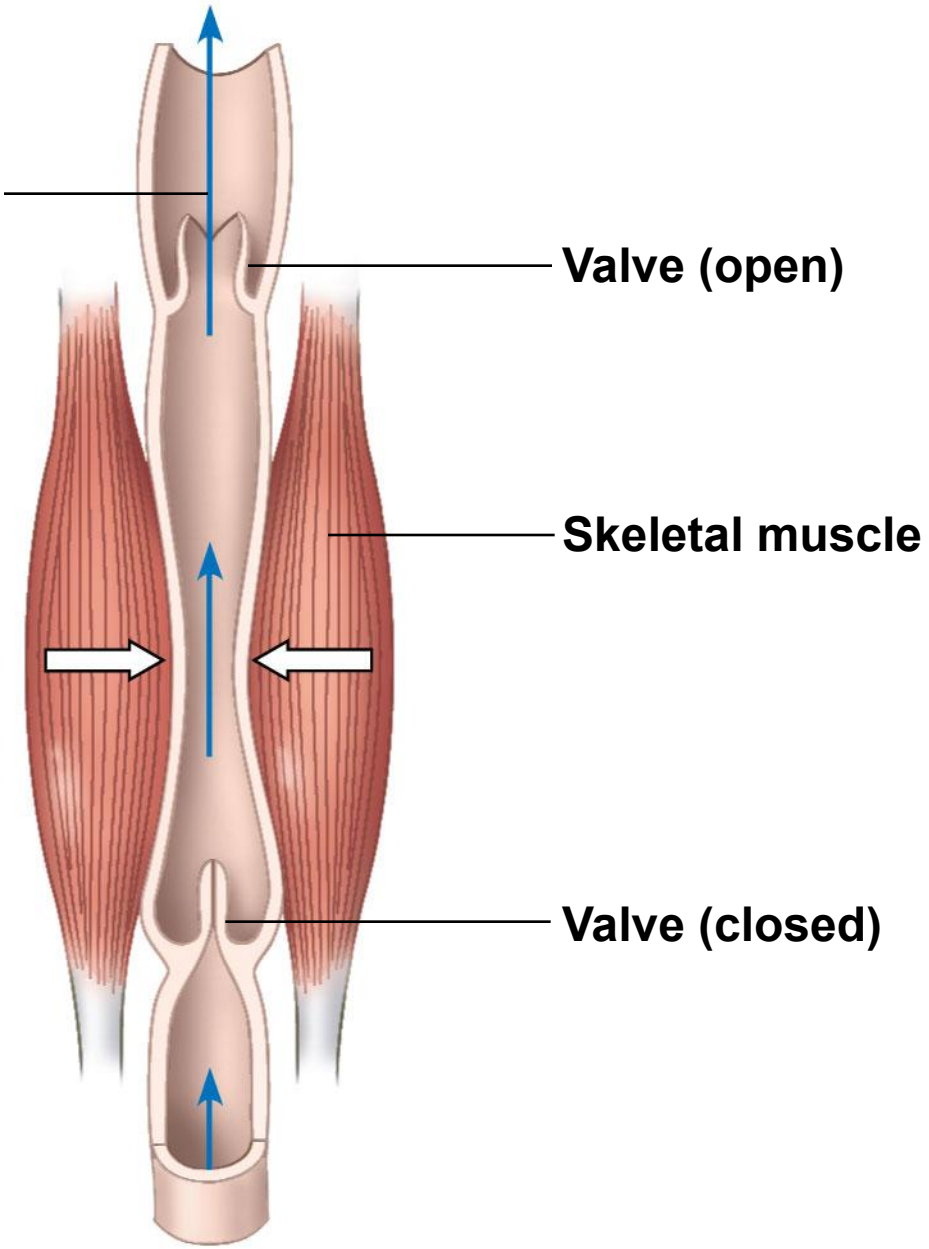
Figure 42.13



Blood returning to heart through veins and venules

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Lymphatic System: returns lost fluid and proteins to blood as lymph

- **Lymph Nodes:** filter lymph, house WBC's
- Immune system role

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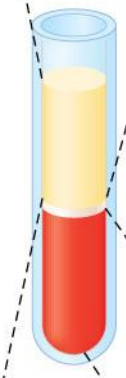
Blood

- Plasma (55%) – water, ions, proteins, gases, nutrients, wastes, hormones
- Cells (45%) – RBC, WBC, platelets
  - Develop from stem cells in bone marrow
  - Red blood cells (erythrocytes): O_2 transport via **hemoglobin**
  - White blood cells (leukocytes): fight infection
  - Platelets (cell fragments): blood clotting

Figure 42.17

Plasma 55%	
Constituent	**Major functions**
Water	Solvent for carrying other substances
Ions (blood electrolytes) Sodium Potassium Calcium Magnesium Chloride Bicarbonate	Osmotic balance, pH buffering, and regulation of membrane permeablity
Plasma proteins	
Albumin	Osmotic balance, pH buffering
Fibrinogen	Clotting
Immunoglobulins (antibodies)	Defense
Substances transported by blood Nutrients Waste products Respiratory gases Hormones	



Separated blood elements

Cellular elements 45%		
Cell type	**Number per µL (mm^3) of blood**	**Functions**
Leukocytes (white blood cells) Basophils Lymphocytes Eosinophils Neutrophils Monocytes	5,000–10,000	Defense and immunity
Platelets	250,000–400,000	Blood clotting
Erythrocytes (red blood cells)	5–6 million	Transport of O_2 and some CO_2

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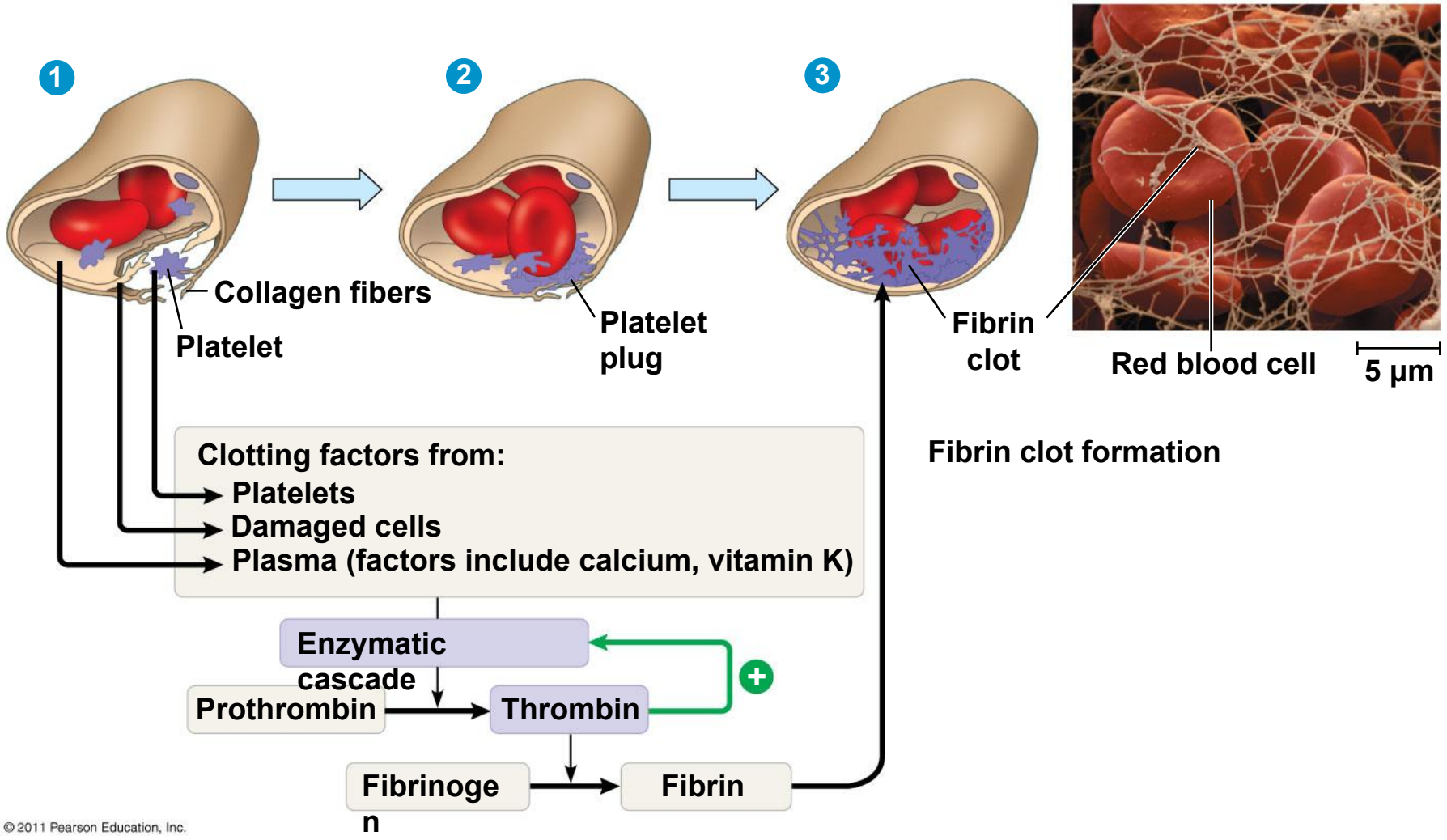
Figure 42.18


1
2
3
Collagen fibers
Platelet
Platelet plug
Fibrin clot
Red blood cell
5 µm
Clotting factors from:
Platelets
Damaged cells
Plasma (factors include calcium, vitamin K)
Enzymatic cascade
Prothrombin
Thrombin
+
Fibrinogen
Fibrin
Fibrin clot formation
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Cardiovascular Disease

- **Atherosclerosis**: buildup of plaque deposits within arteries
- **Heart attack** (myocardial infarction): blockage of one or more coronary arteries
- **Stroke**: rupture or blockage of arteries in the head
- **Hypertension**: high blood pressure; promotes atherosclerosis and increases the risk of heart attack and stroke

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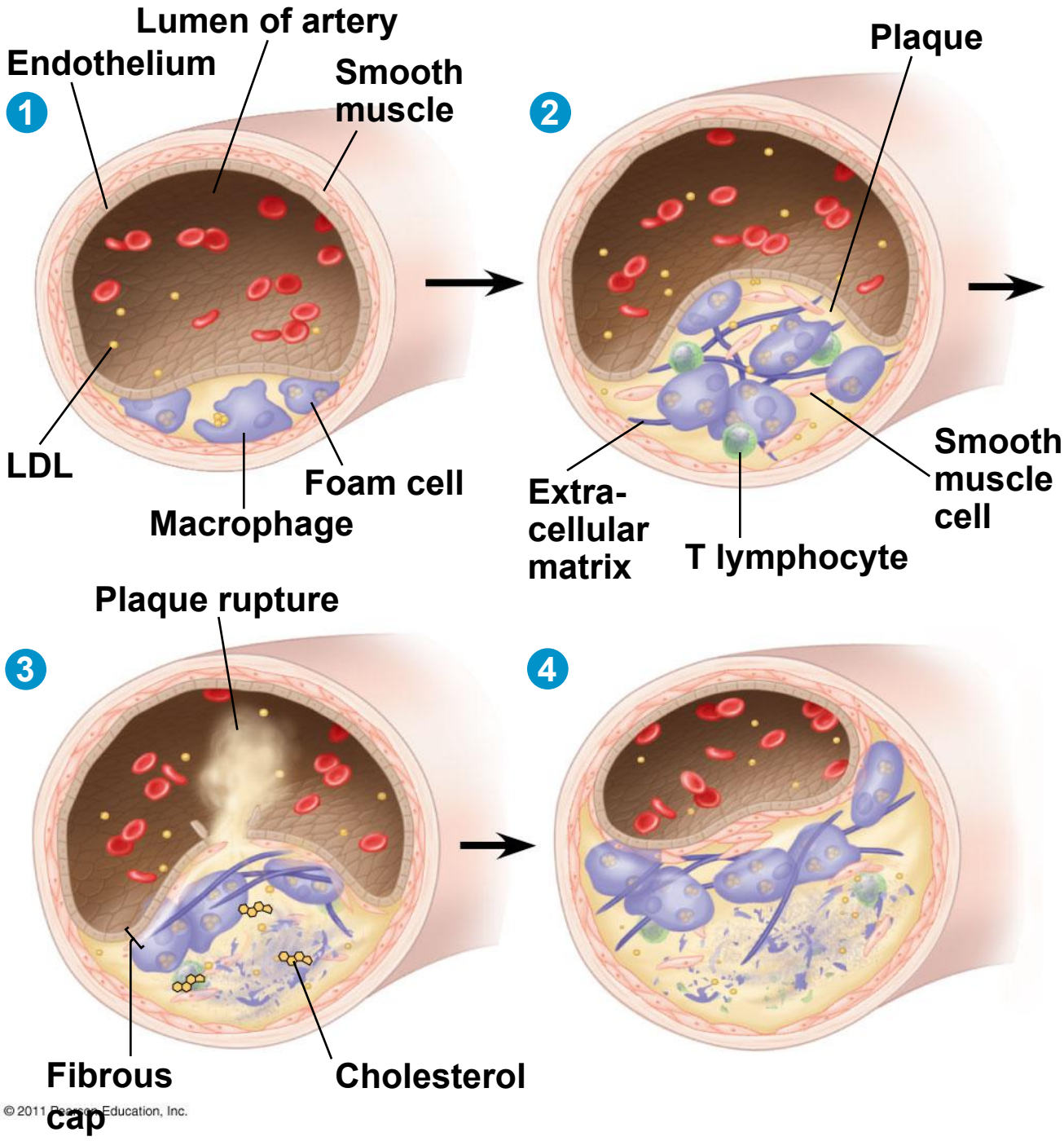
Figure 42.20



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