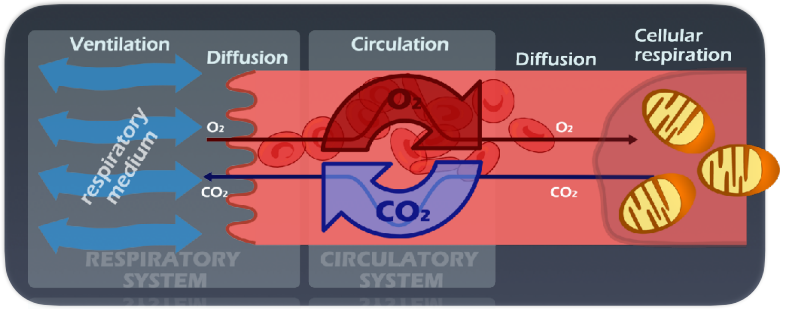
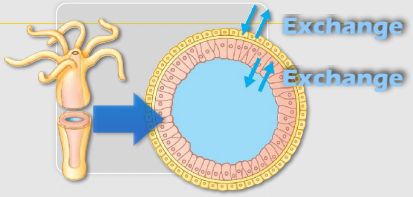
circ./gas ex.
chapter 42

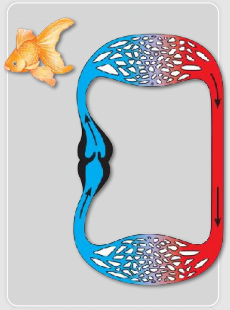
distributing gases

- **organismal gas exchange**
  - ventilation - diffusion
  - circulation - diffusion
  - cellular respiration



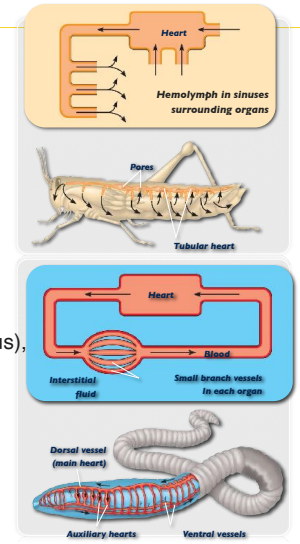
- **simpler organisms**
  - gastrovascular cavity
    - e.g. cnidarians, flatworms
  - acoelomate
- **pseudocoelomate**
  - pseudocoelom
- **eucoelomate**
  - hemal system
  - basic circulatory setup
    - circulatory fluid
    - a set of tubes
    - muscular pump





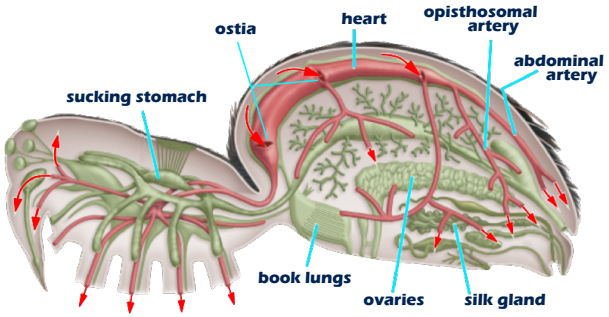
open vs. closed

- **open circulatory systems**
  - hemolymph
    - hemocytes
  - exchange -> hemolymph and cells
  - e.g. arthropods, mollusks (most)
- **closed circulatory systems**
  - separate blood, lymph
  - exchange -> capillaries and interstitial fluid
  - e.g. vertebrates, cephalopods (squid and octopus),



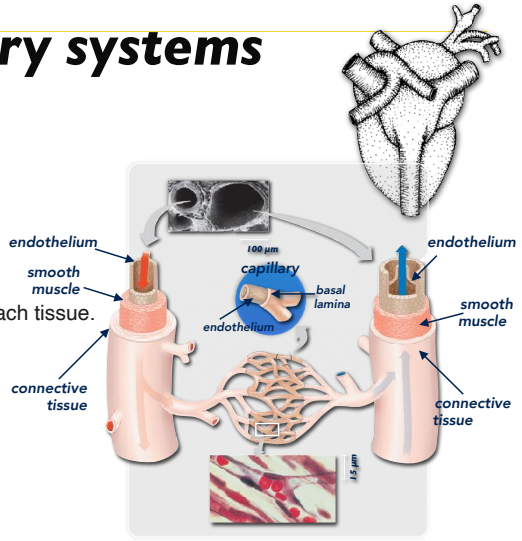
open circulatory systems

- **hemocoel (lacunae)**
- **heart**
- **arteries/veins**
- **hemolymph pathway**
  - heart —> arteries —> tissues —> lacunae —> book lungs —> heart
- **tracheal systems?**
- **no system for shunting**



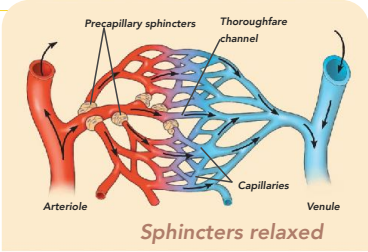
closed circulatory systems

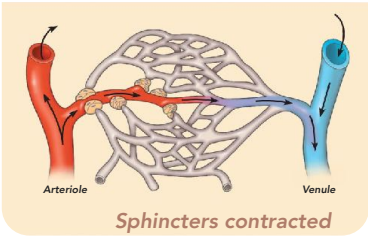
- **cardiovascular system**
  - heart
    - 1-2 atria
    - 1-2 ventricles
  - three main kinds of blood vessels.
    - Arteries
    - capillaries
      - networks of capillaries infiltrate each tissue.
    - Veins



capillaries

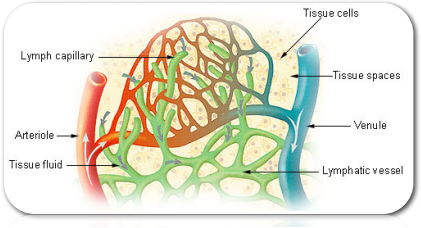
- **shunting:**
  - smooth muscle layer constricts
  - pre-capillary sphincters
- **exchange**
  - endocytosis on one side, exocytosis on the other
  - diffusion

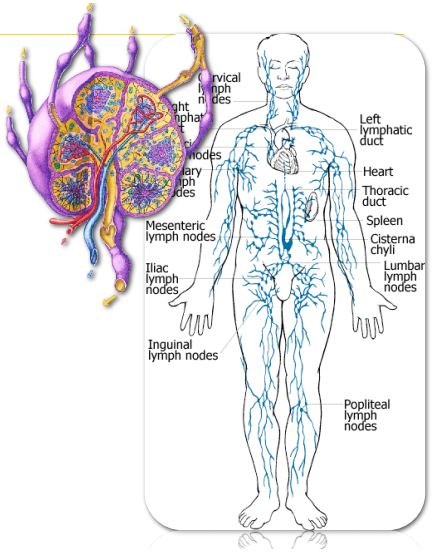




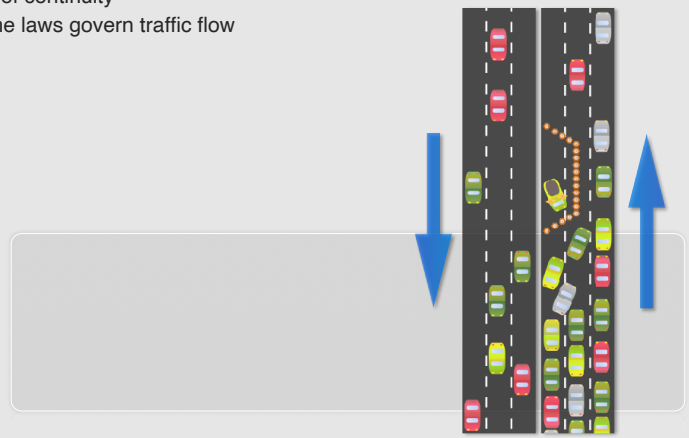
lymphatic system

- **lymphatic vessels**
  - Fluid diffuses into lymph capillaries
  - drains into circulatory system at vena cavae.
- **lymph nodes**
  - filter lymph
  - provide place to attack viruses and bacteria

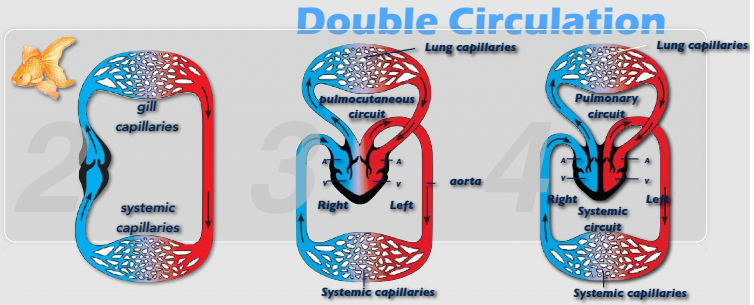




- **Physical laws governing the movement of fluids**
  - law of continuity
  - same laws govern traffic flow

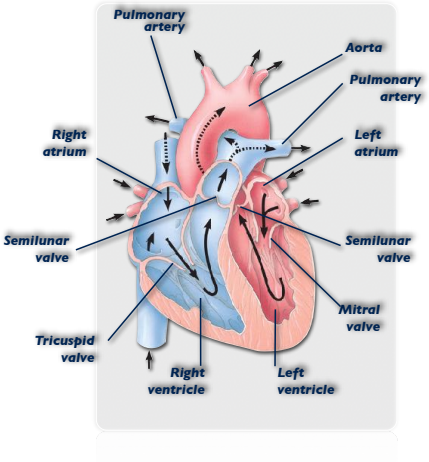


- **fish heart (2 chambered heart)**
  - two capillary beds inline - the gill and systemic capillaries.
- **3-chambered (amphibians, most reptiles)**
  - two atria
- **4-chambered heart (crocodilians, birds, and mammals)**
  - important adaptation for endotherms (need 10X O2)



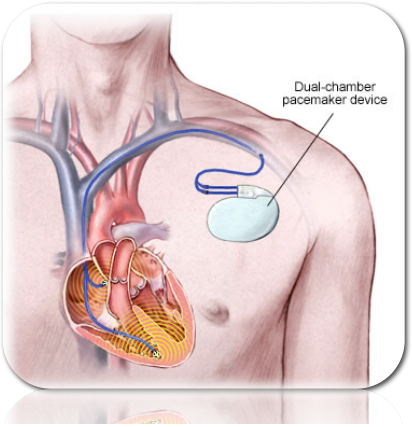
heart

- **heart anatomy**
  - two atria -- (auricles)
  - two ventricles --
  - Four valves in the heart
  - two atrioventricular (AV) valves
    - (left=mitral; right=tricuspid)
  - Two sets of semilunar valves



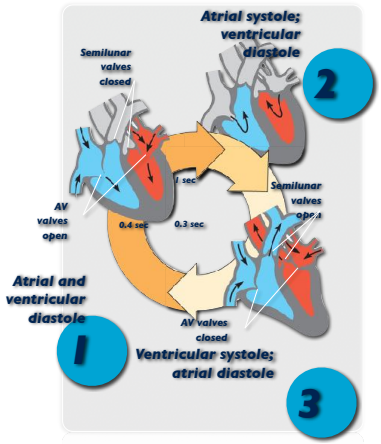
rhythm

- **continuity and control of the heartbeat**
  - cells self-excitable
    - individual intrinsic contraction rhythm
  - sinoatrial (SA) node, or pacemaker
    - AV node
    - sinus rhythm
  - arrhythmia



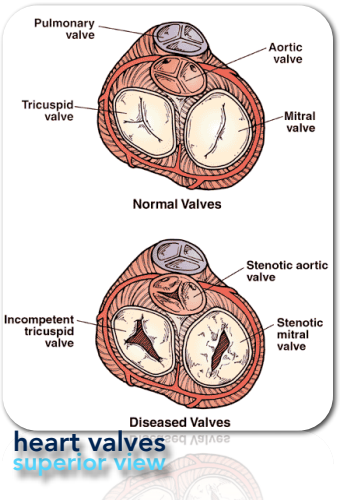
heartbeat

- **cardiac cycle**
  - contraction phase = systole
  - relaxation = diastole
- **normal resting pulse = 75 bpm**
- **Cardiac output depends on 2 factors:**
  - heart rate
    - pulse (indirect measure)
  - stroke volume
  - resting cardiac output



heart valves

- **heart sounds**
  - closing of valves
- **heart murmur**
  - some congenital
  - due to damage
  - stenosis
  - incompetent



measuring pressure

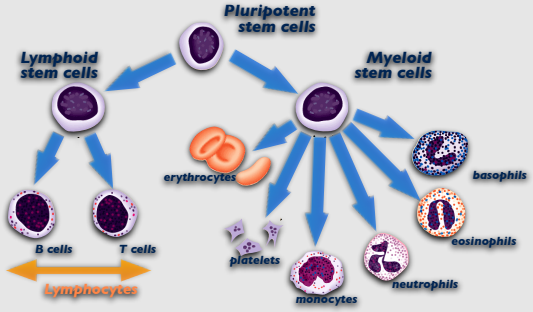
- **Blood pressure**
  - ventricular systole = systolic pressure
  - ventricular diastole = diastolic pressure
- **sphygmomanometer**
  - 120 mm Hg / 80 mm Hg
  - high blood pressure (hypertension)
    - kidney problems, stroke, other problems...
    - cardiac output, peripheral resistance

blood components

- **plasma (about 90% water)**
  - water
  - nutrients, waste products
  - respiratory gases
  - hormones
  - electrolytes
  - plasma proteins
- **cellular elements**

cell type	number (per mm³ of blood)	functions
erythrocytes	5-6 million	transport O_2 and CO_2
leukocytes	5000-10000	defense and immunity
platelets	250,000-400,000	blood clotting

- **cellular elements are replaced constantly**
  - erythrocytes -- (3 to 4 months)
  - pluripotent stem cells in bone marrow
    - mainly flat bones
    - also blood stream



control

- **erythrocyte production**
  - negative-feedback mechanism
    - kidneys - erythropoietin
    - cycle takes about 3 weeks

problems

- **Cardiovascular diseases**
  - >50% the deaths in the U.S.
- **heart attack**
- **stroke**
  - ischemic
    - embolus
  - hemorrhagic stroke