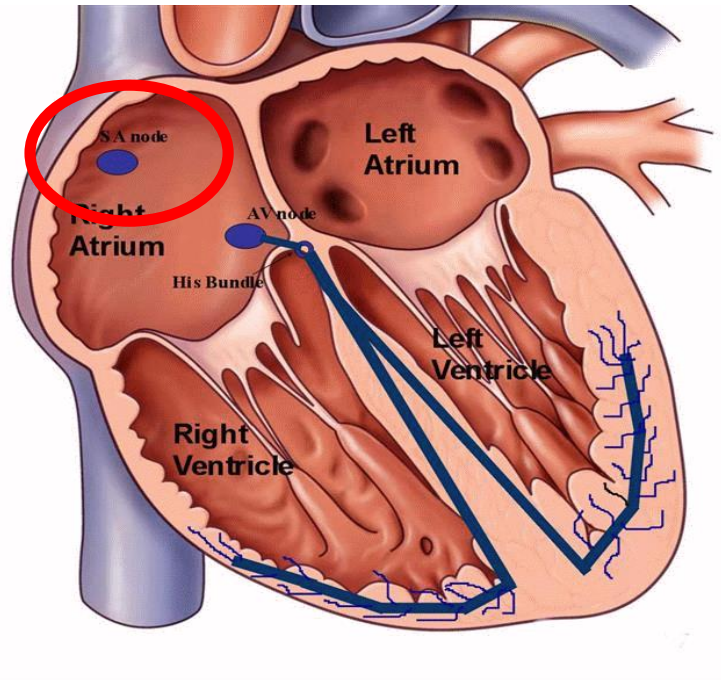
Monitoring the Circulatory System

Section 12.2

Contraction of the Heart

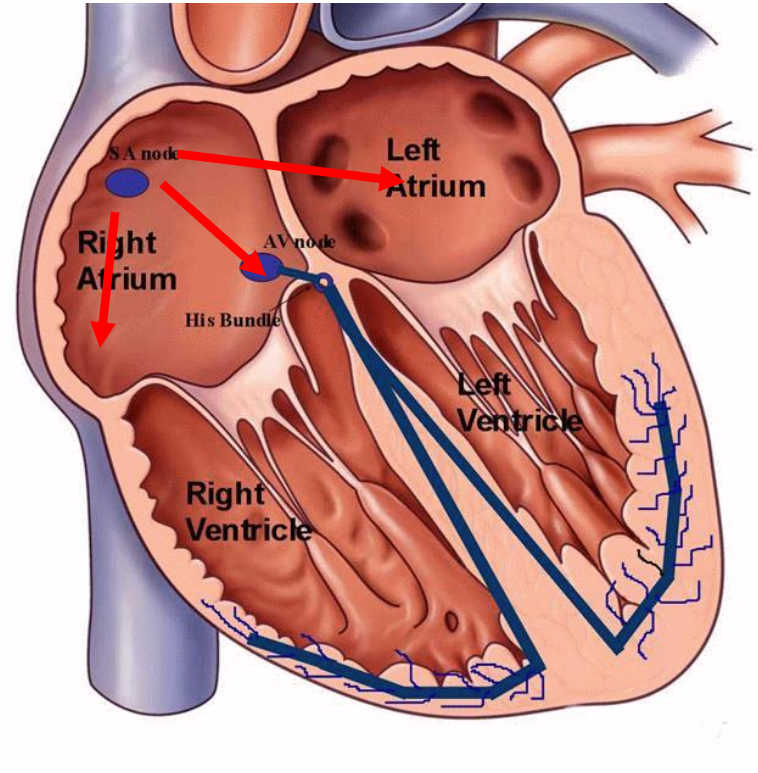
- Controlled by electrical impulses generated in the heart

- Electrical impulse is initiated by **sinoatrial (SA) node** (pacemaker)
  - bundle of specialised muscle tissue found in the wall of the **right atrium**

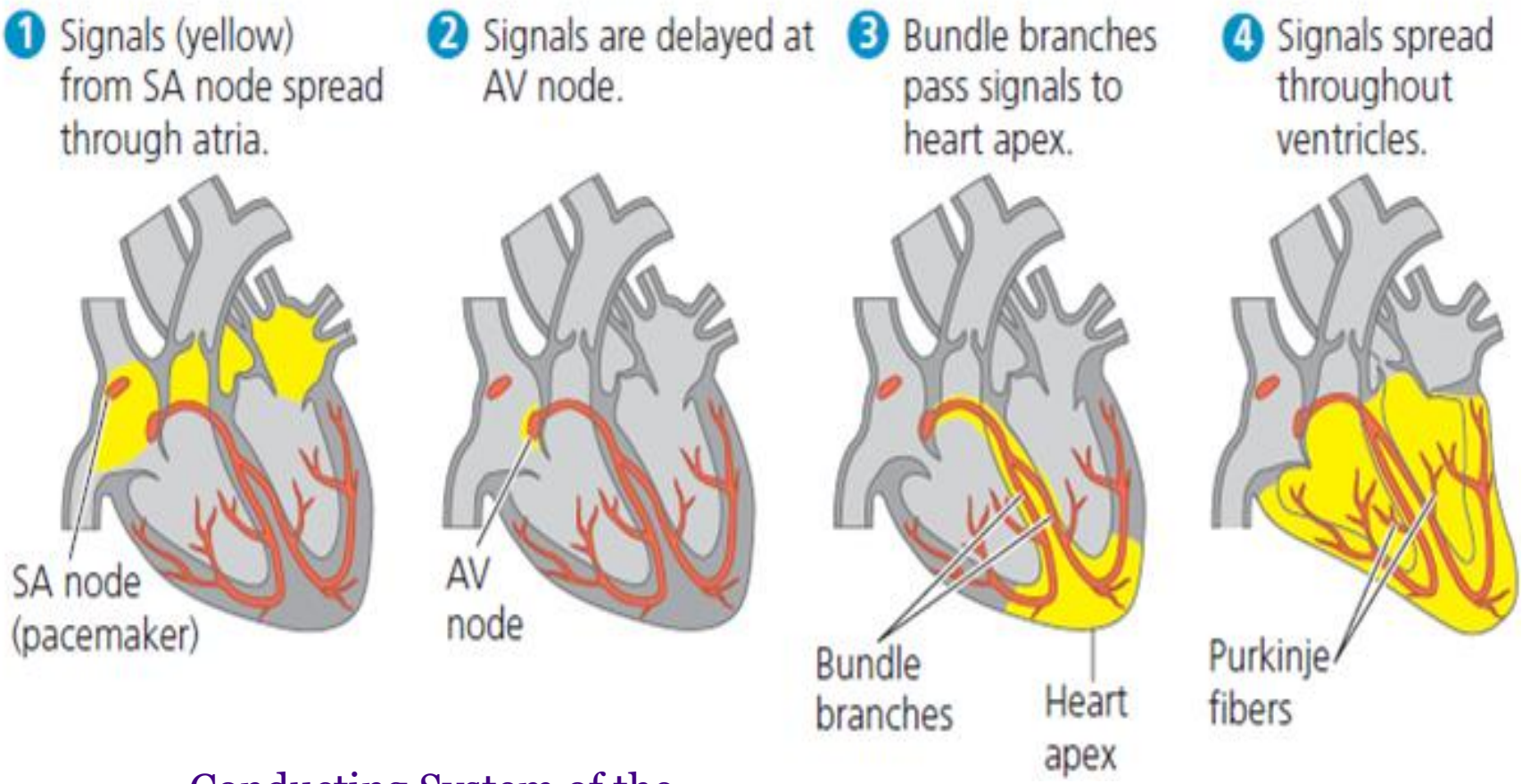


Contraction of the Heart

- Signal spreads over the two atria causing them to **contract**
- The impulse travels to the **atrioventricular (AV) node**, and a slight delay occurs
- The signal is then conducted via the ***Bundle of His*** (specialized fibres) to the ***Purkinje fibres*** (two branches of bundles that contract the cells in both ventricles)



Cardiac muscle has the property of *automaticity*

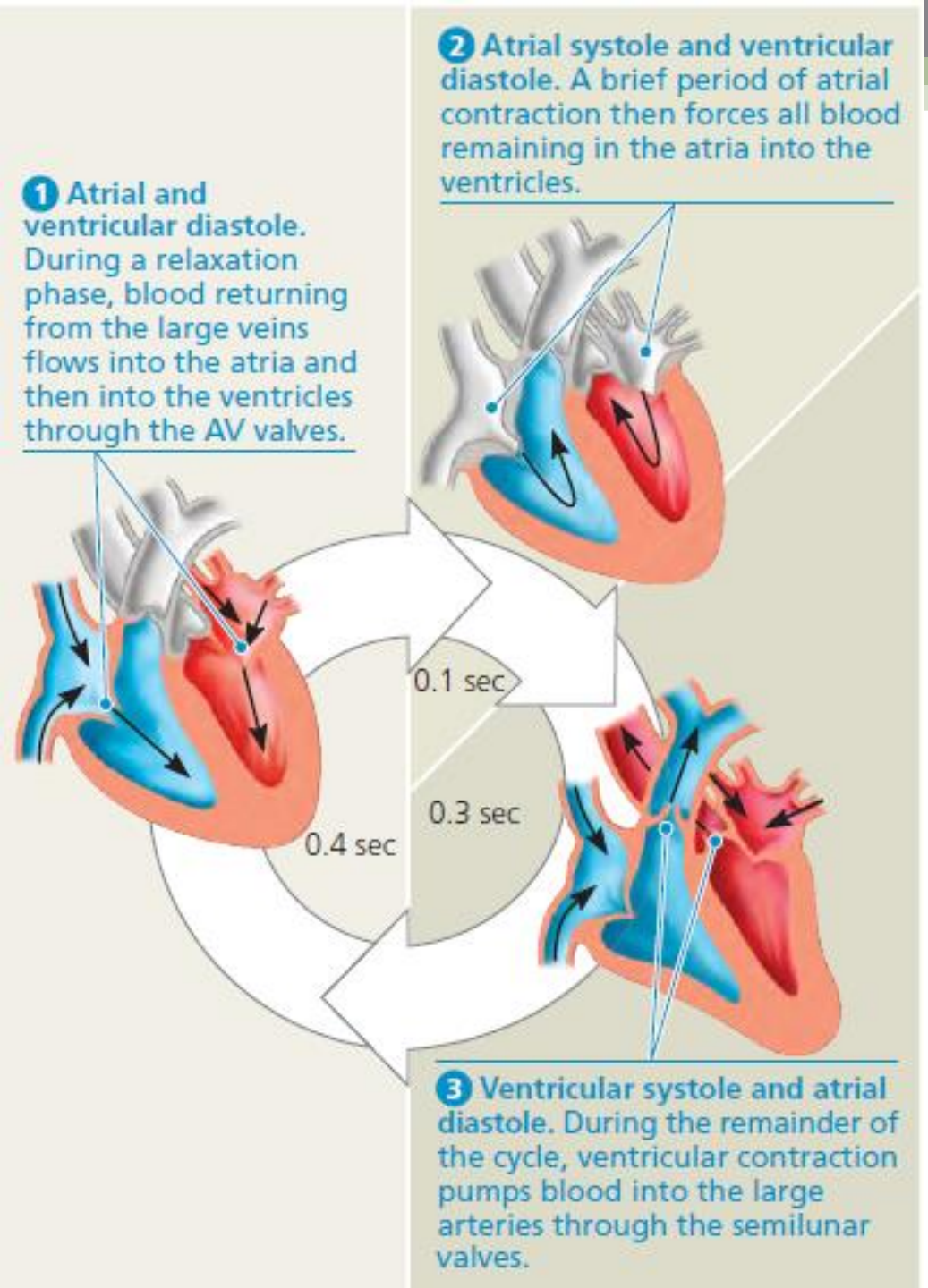


Conducting System of the Heart (Animation)

The Cardiac Cycle

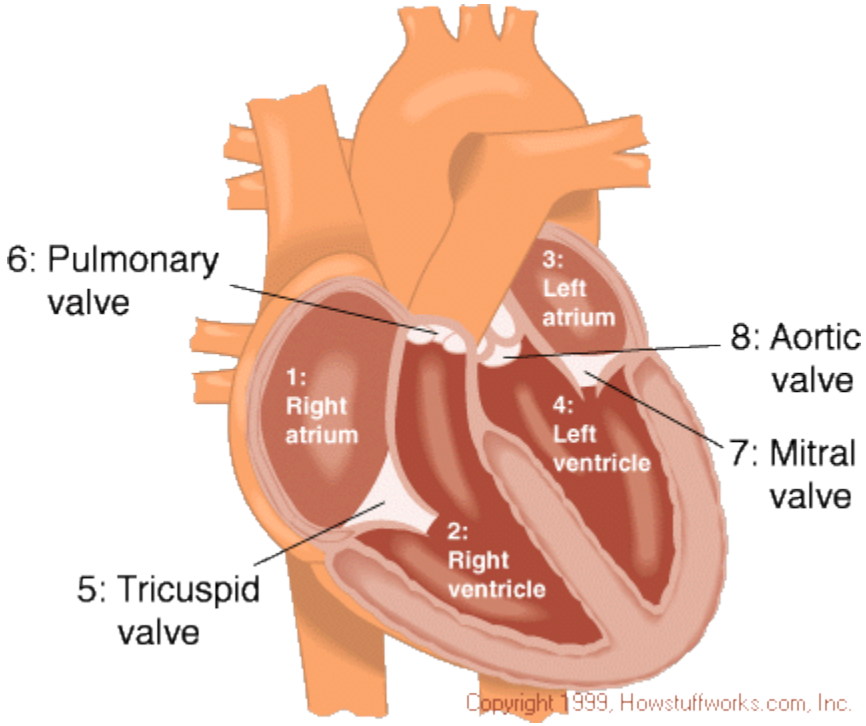
systole = contraction

diastole = relaxation



Heartbeat

- Detected by a **"stethoscope"** (listen to sounds inside body)
- characteristic "lub-DUB" sound (double beat)
- heartbeat is the sound of blood recoiling on the valves in the heart



“lub-DUB”

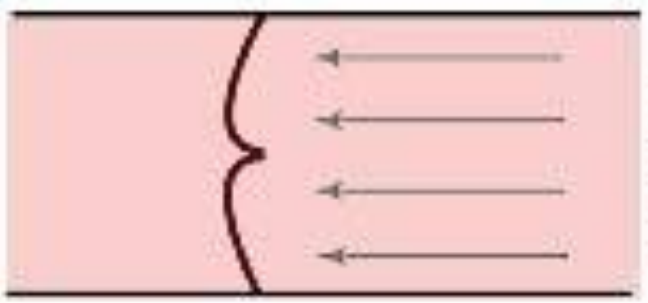
1. 1st sound: closing of the (AV) atrioventricular valves
   - blood is pumped from the atria INTO ventricles

1. 2nd sound: closing of the semilunar valves
   - blood is pumped from ventricles into arteries

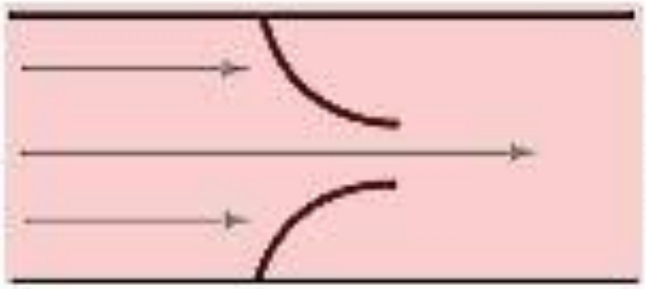
Heartbeat animation

Opening and closing of valves is a passive process

- controlled by differences in blood pressure



When pressure is greater in front of the valve, it closes

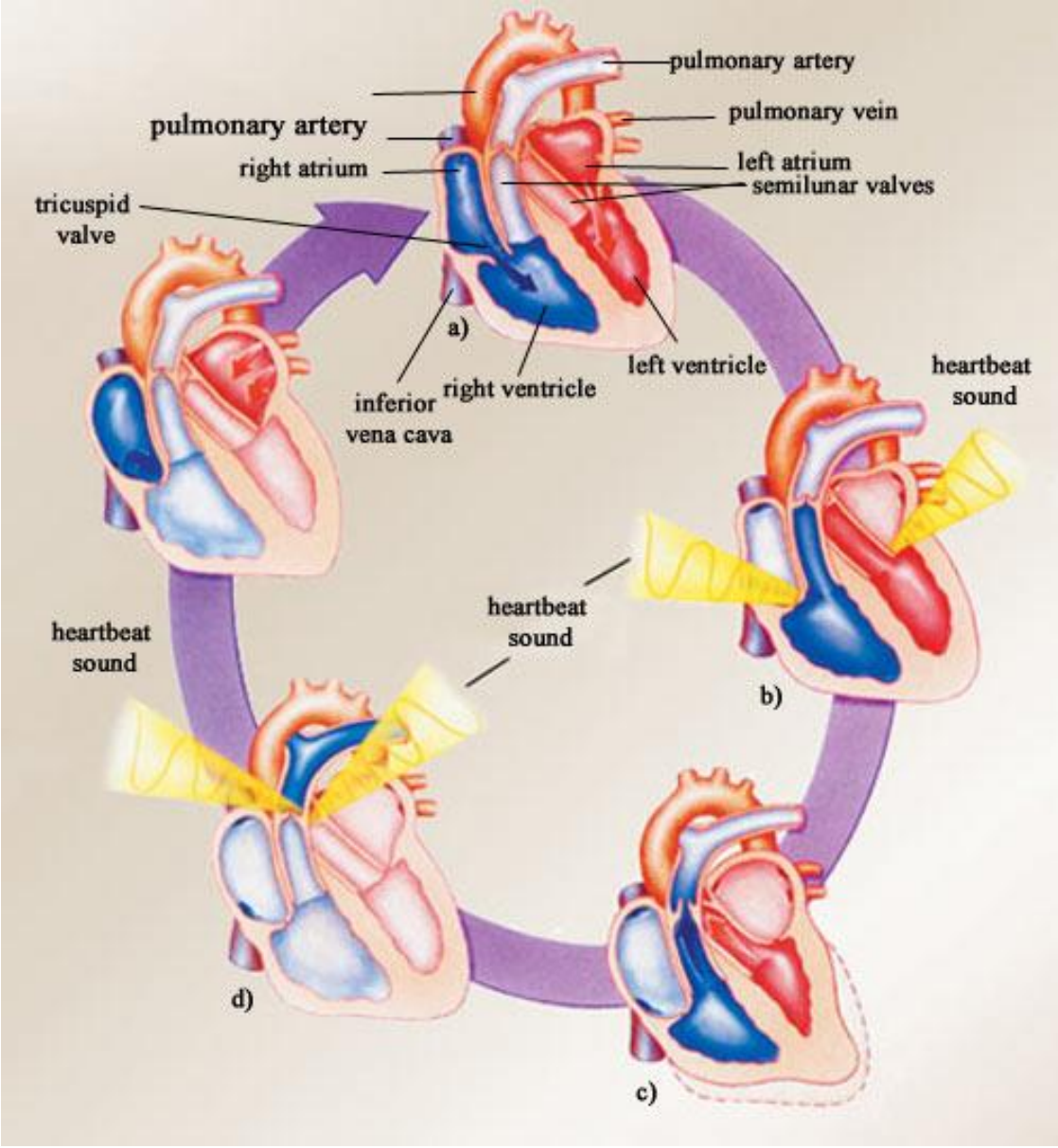


When pressure is greater behind the valve, it opens

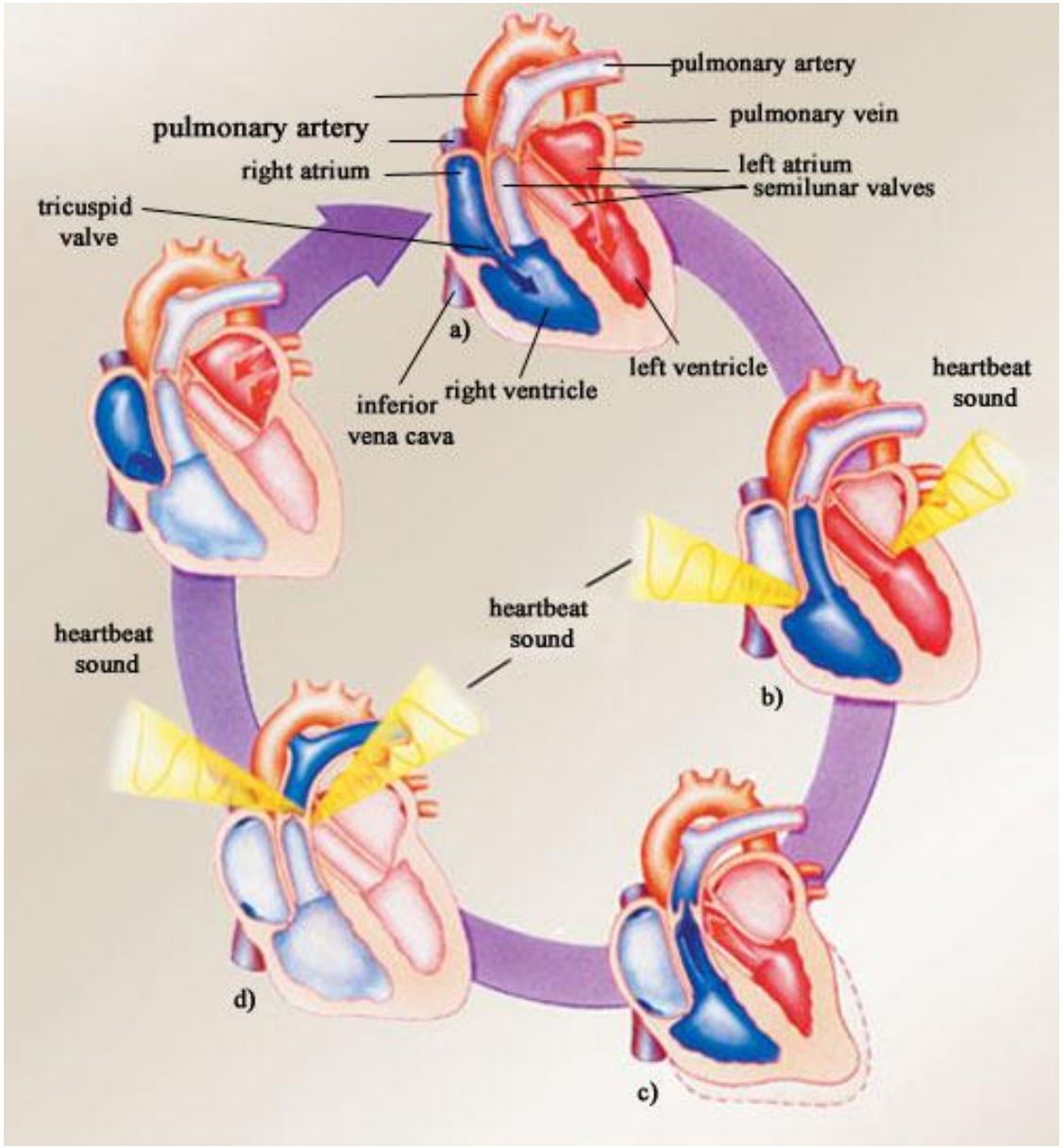
HEART VALVES DURING THE CARDIAC CYCLE

Ventricular Diastole:

- ventricles relax; pressure drops and
  SL valves close (“dub”)
- AV valves open
- blood flows from atria into ventricles



HEART VALVES DURING THE CARDIAC CYCLE



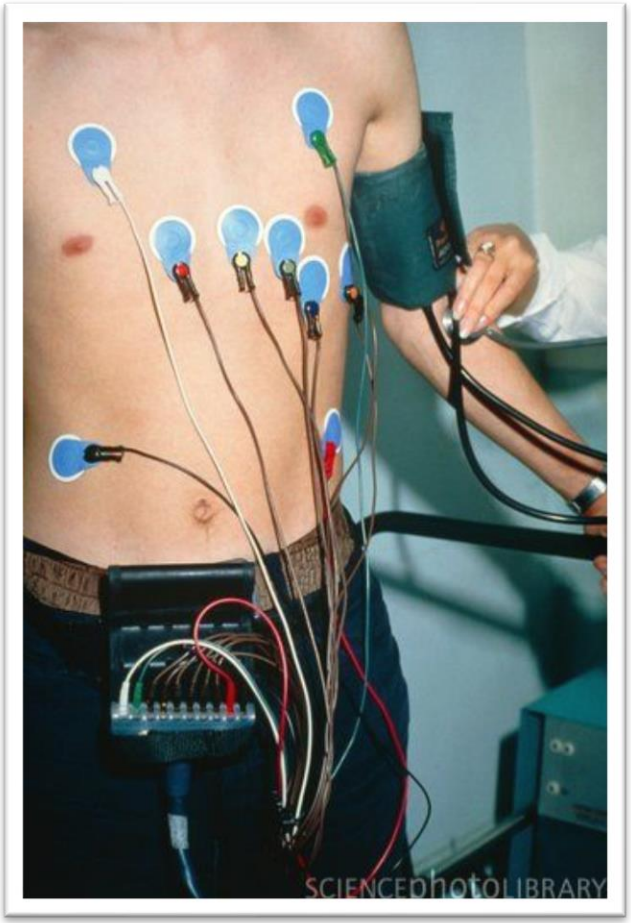
Ventricular Systole:

- ventricles contract; pressure rises
- AV valves close ("lub"), and SL valves open

Cardiac cycle and heartbeat

Electrocardiogram (ECG)

- electrical impulses create heartbeat
  - cause changes in the voltage of the heart muscle
- electrodes placed on the chest can measure these voltage changes
- **electrocardiogram** = plot of voltage measurements over time



Cardiac output

- ***Cardiac output:*** the amount of blood pumped by the heart, in mL/min

- Indicates the level of:
  - O2 delivered to the body
  - work the muscles can perform

cardiac output = **heart rate** × **stroke volume**

(mL/min) *(beats/min)* *(mL/beat)*

Cardiac output

- Average cardiac output, adult at rest:
  - 4900 mL (70 beats/min × 70 mL/beat)
    - *almost the entire volume of blood in the body (5 L) passes through the heart about once every minute*
  - males higher than females
  - increases during periods of exercise

cardiac output = **heart rate** × **stroke volume**

(mL/min) *(beats/min)* *(mL/beat)*

- controlled by SA node
- regulated by nervous system

<u>Factors that affect stroke volume</u>:

- Degree of ventricle filling (how easily the heart fills with blood)
  - *how efficiently does blood return in veins?*
  - *how stretchy are the ventricles?*
- How readily blood is emptied
  - *how strong is ventricular contraction?*
  - *how elastic are the arteries?*
  - *what pressure is exerted by the arterial walls?*

cardiac output = **heart rate** × **stroke volume**

(mL/min) *(beats/min)* *(mL/beat)*

Individual	Resting heart rate (beats/min)	Stroke volume (mL/beat)	Cardiac output (mL/min)
A	70	70	4900
B	98	50	4900
C	35	140	4900

Why do athletes tend to have higher stroke volumes?

- stronger cardiac muscles
- resting heart rate is correspondingly lower
- less work done by heart muscles but they deliver the same amount of O2 to the muscles

Blood pressure

- the pressure exerted by blood on the walls of the blood vessels

Systolic pressure – pressure generated when ventricles contract and push blood from heart.

- Phase is called “systole”

Diastolic pressure – pressure generated when ventricles fill with blood

- Phase is known as "diastole"

- Blood pressure is measured w/ a ***sphygmomanometer***
  - healthy blood pressure is 120/80 (systolic/diastolic) *"120 over 80"*

Systole/Diastole (Blood pressure readings)

Factors that affect blood pressure:

- Genetics
- Cardiac output/activity
- Stress
- Body temperature
- Diet
- Medications

Homework: pg. 491 #13, 15, 16 AND

pg. 493 # 2, 5-7, 9, 11, 13, 14