

Lecture 10: Blood Pressure

1. Basics of Blood Pressure
2. Non-invasive Blood Pressure Measurement
3. Auscultatory Method

★ Student presentations (Mar 10+12)

→ Teams of 2-3 students

→ 20 min powerpoint

- Disease or medical condition
- Electronic instrumentation

← e.g. ablation catheter

- PreLab due at lab session

- Lab 3 report due Fri (Feb 14)
(Template on course website)

- Exam #1 problems due next Mon (Feb 17)

→ Counts as HW

→ Re-do all 4 problems

- Ellis Hospital Tour ← Mar 10²
(still working on this...)

0. Review EEG (Electroencephalography)

Alpha 8-13 Hz
Awake, resting state



Beta 14-30 Hz

Beta I: similar to alpha



Beta II: Agitation

Theta 4-7 Hz
Frustration

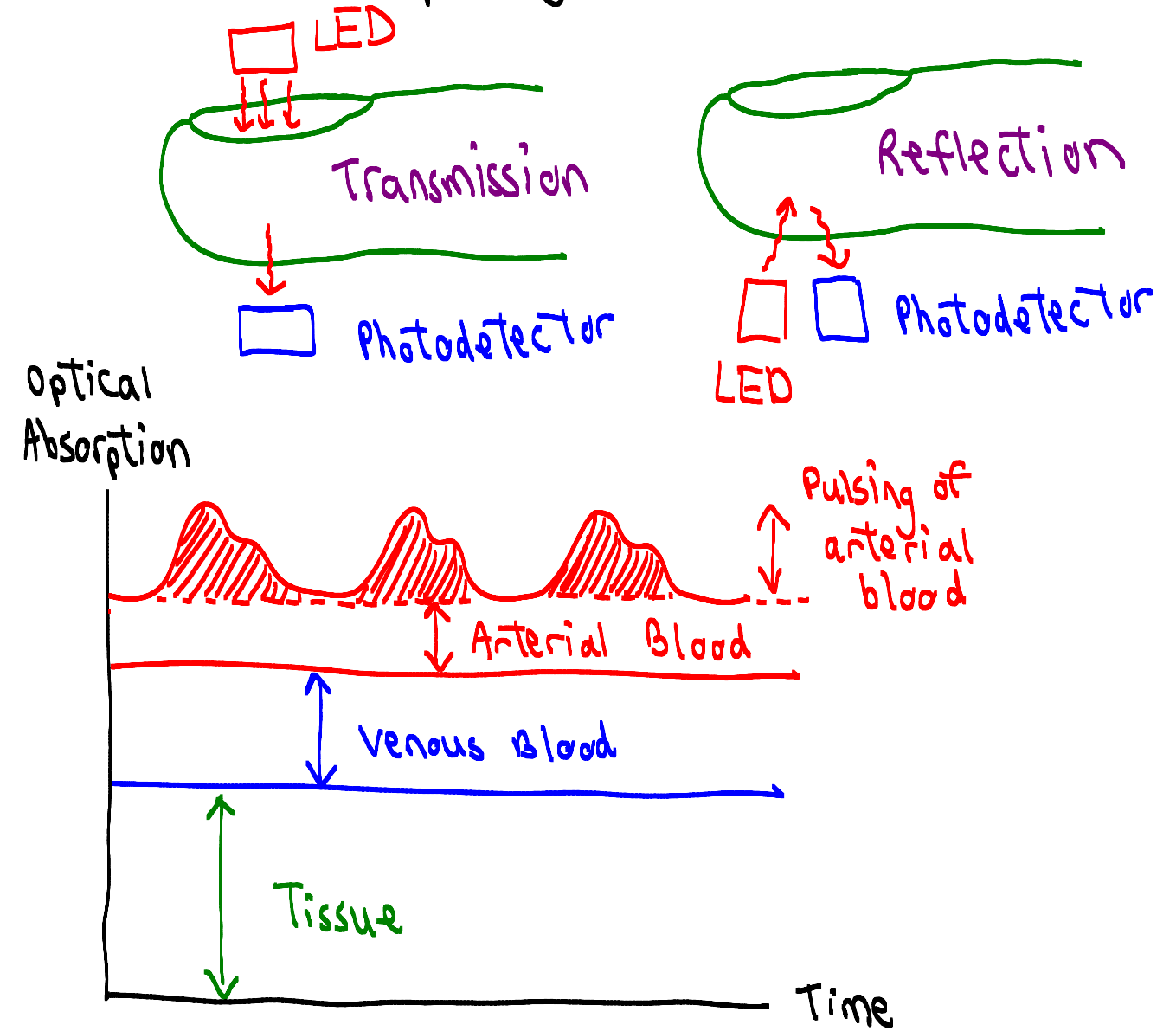


Delta below 3.5 Hz
Deep sleep...



Photoplethysmography (PPG)

(10.0)

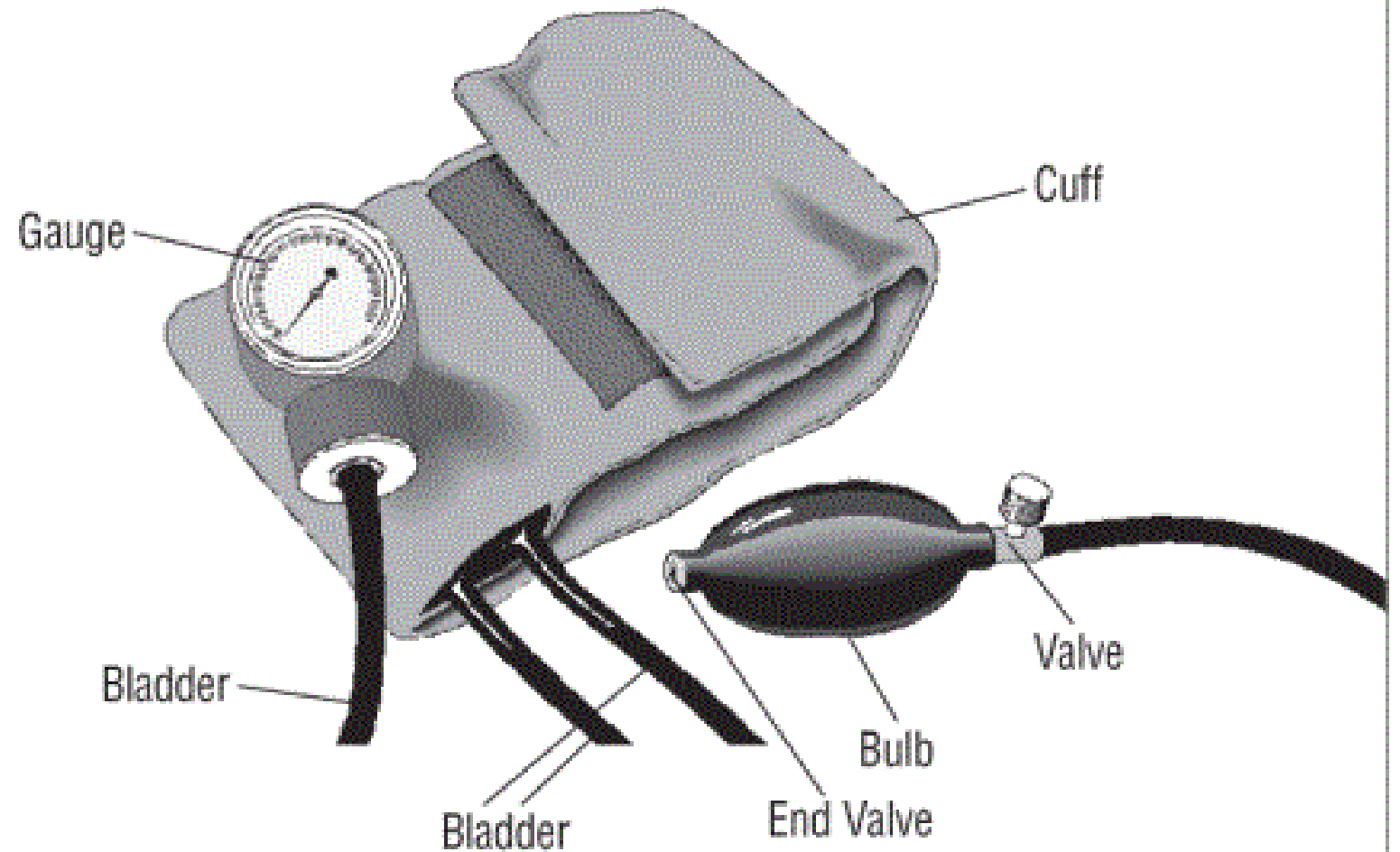


Moving on from heart rate to ...

1. Basics of Blood Pressure ← Arterial blood pressure

A. Clinical Significance

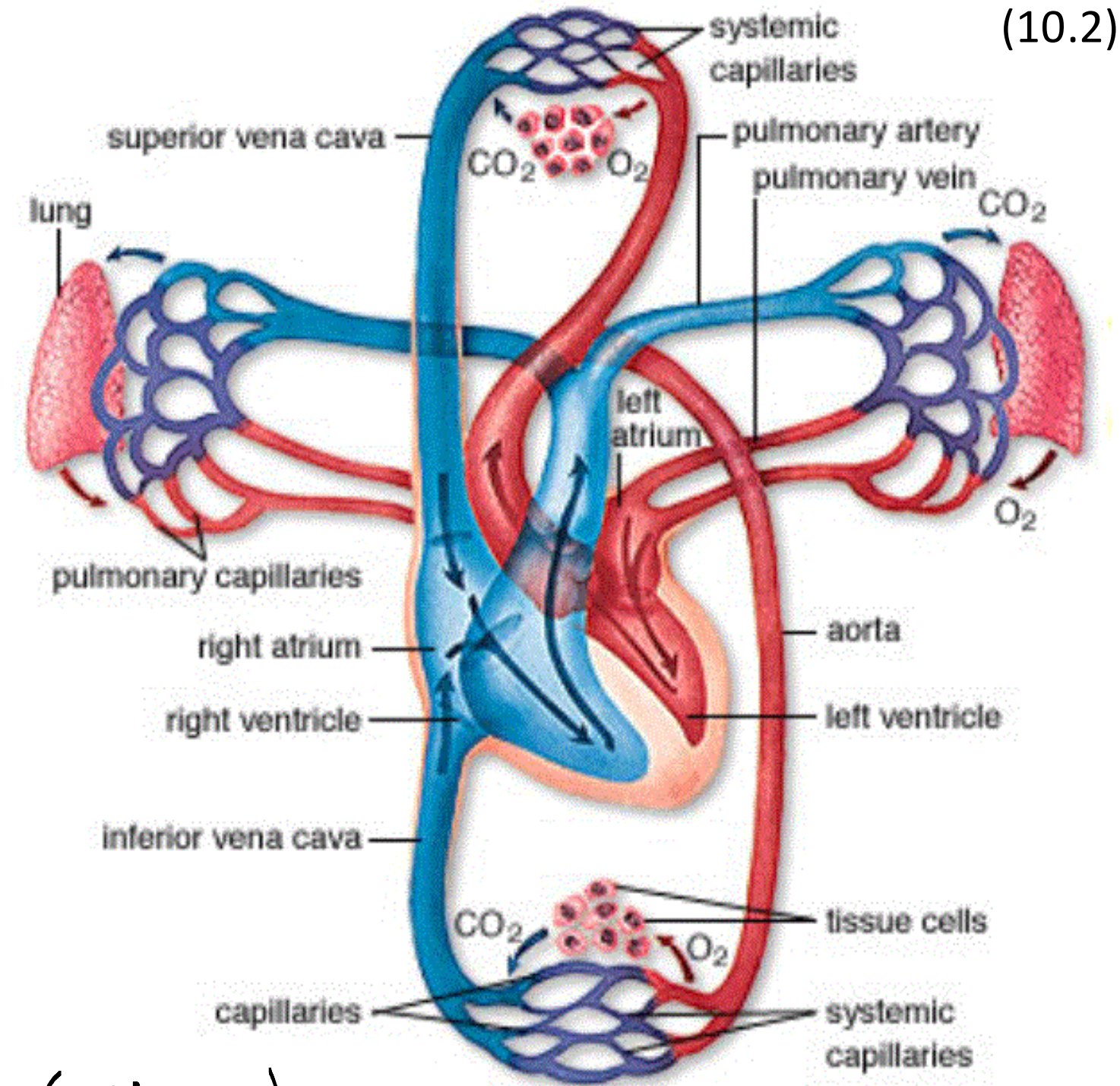
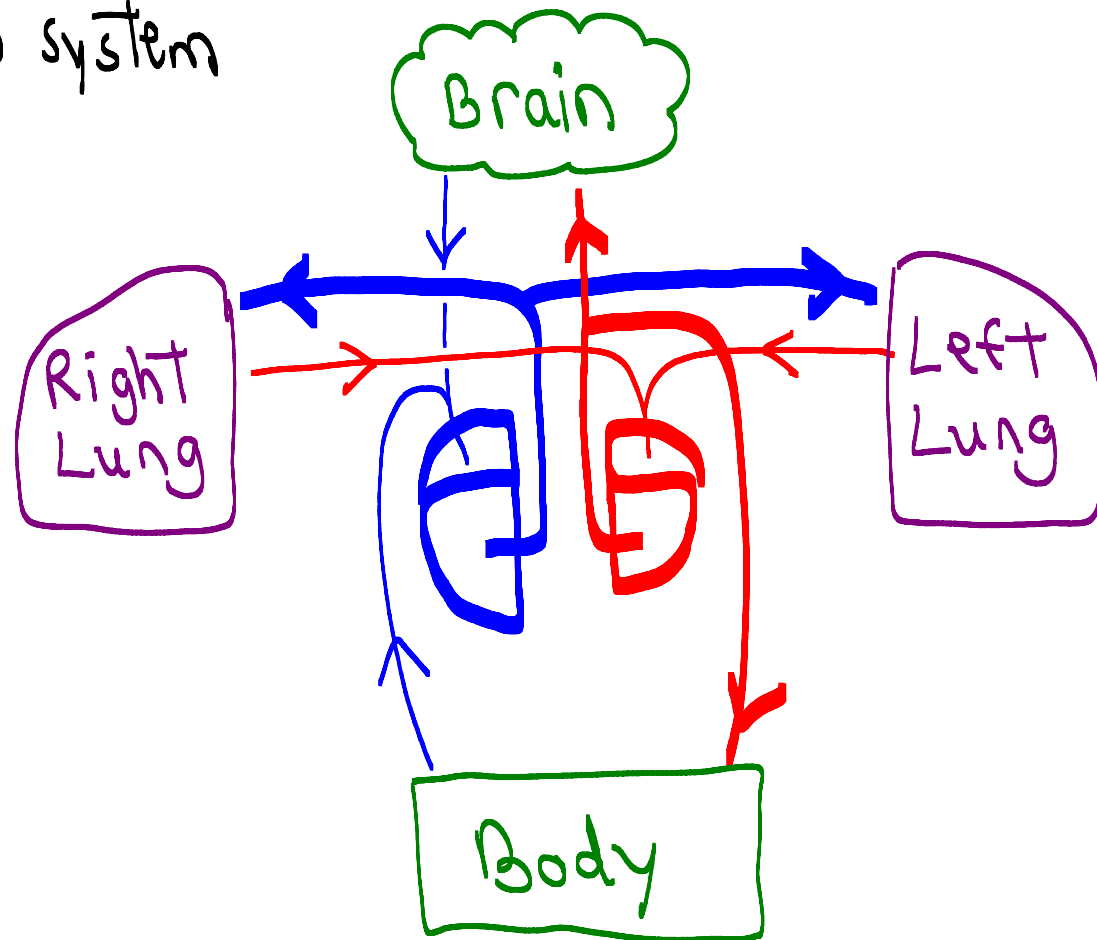
- HIGH blood pressure (Hypertension):
 - undesirable
 - Risk factor for stroke, heart attack, heart failure, arterial aneurysm, kidney disease ... ☹️
- LOW blood pressure (Hypotension):
 - often a good thing 😊
 - Can lead to dizziness, Light-headedness, fainting... ☹️



B. Circulatory System

★ Heart must pump blood to lungs and rest of body

★ Closed loop system

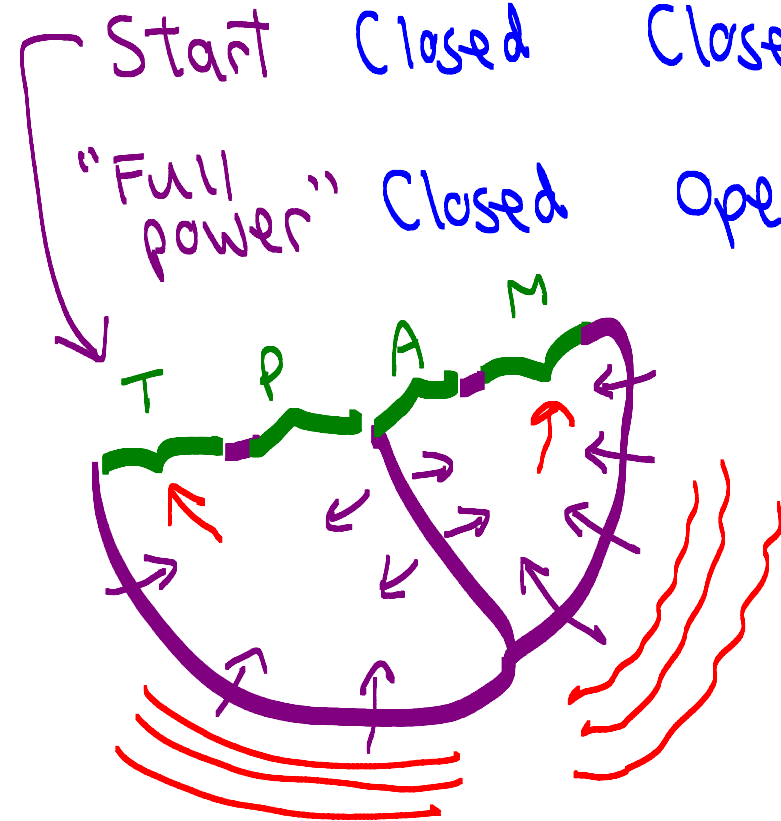


(mhhe.com)

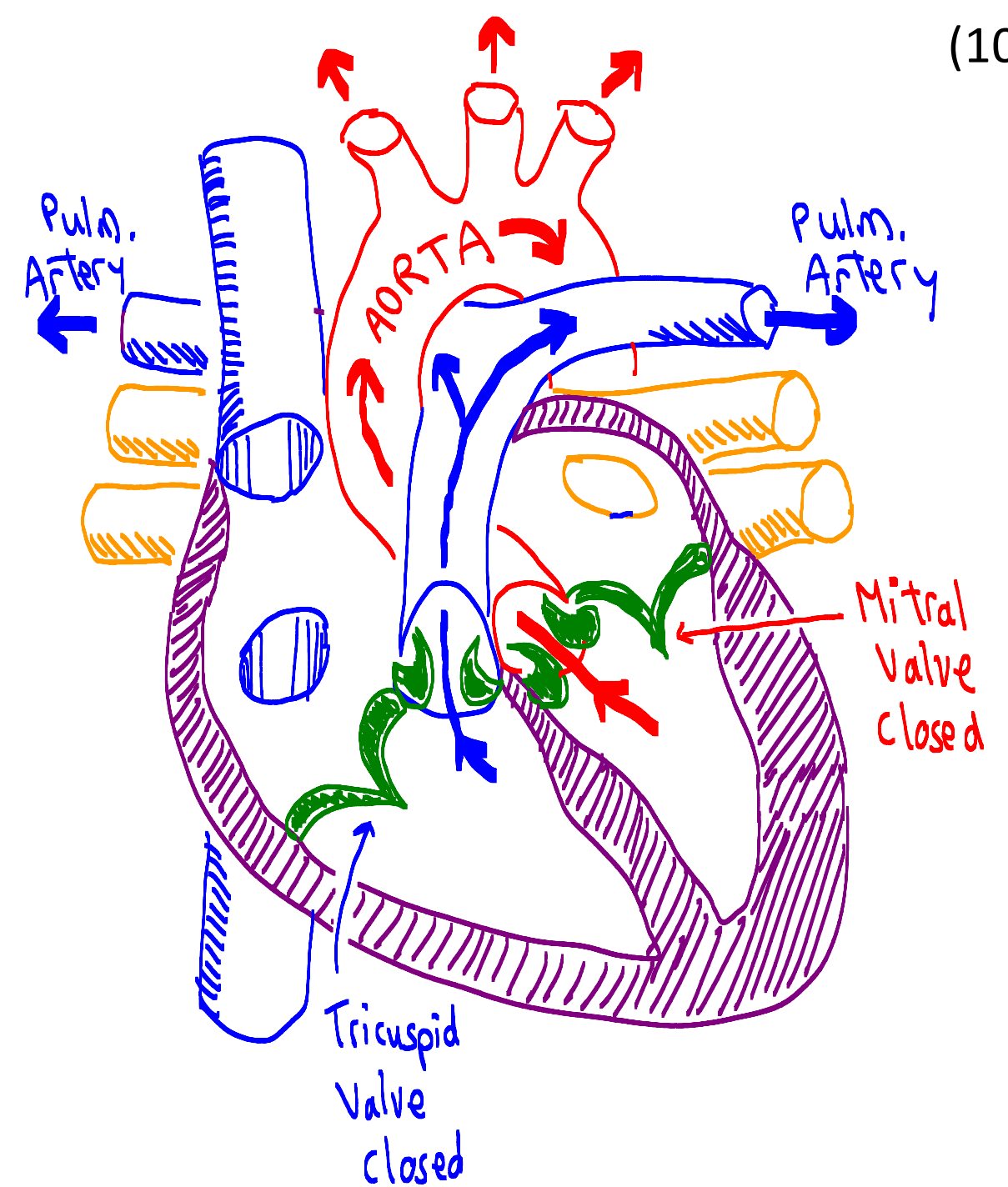
Systole "Pumping Phase" ← Blood leaves ventricles

- Ventricles contract
- Valves open/close to direct blood flow

	Right Ventricle		Left Ventricle	
Pumping	Tricuspid	Pulmonary	Aortic	Mitral
Start	Closed	Closed	Closed	Closed
"Full power"	Closed	Opens	Opens	Closed



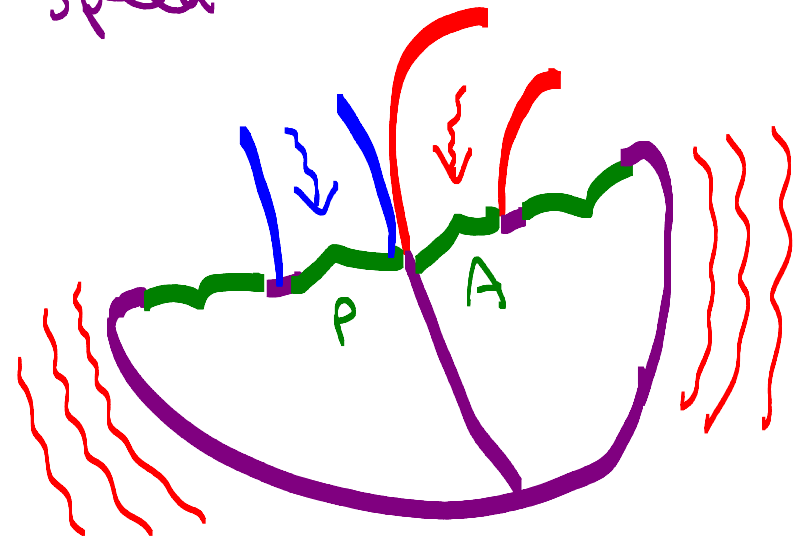
Heart Sound #1 "Lub"
is reverb due to blockage
of reverse blood flow!



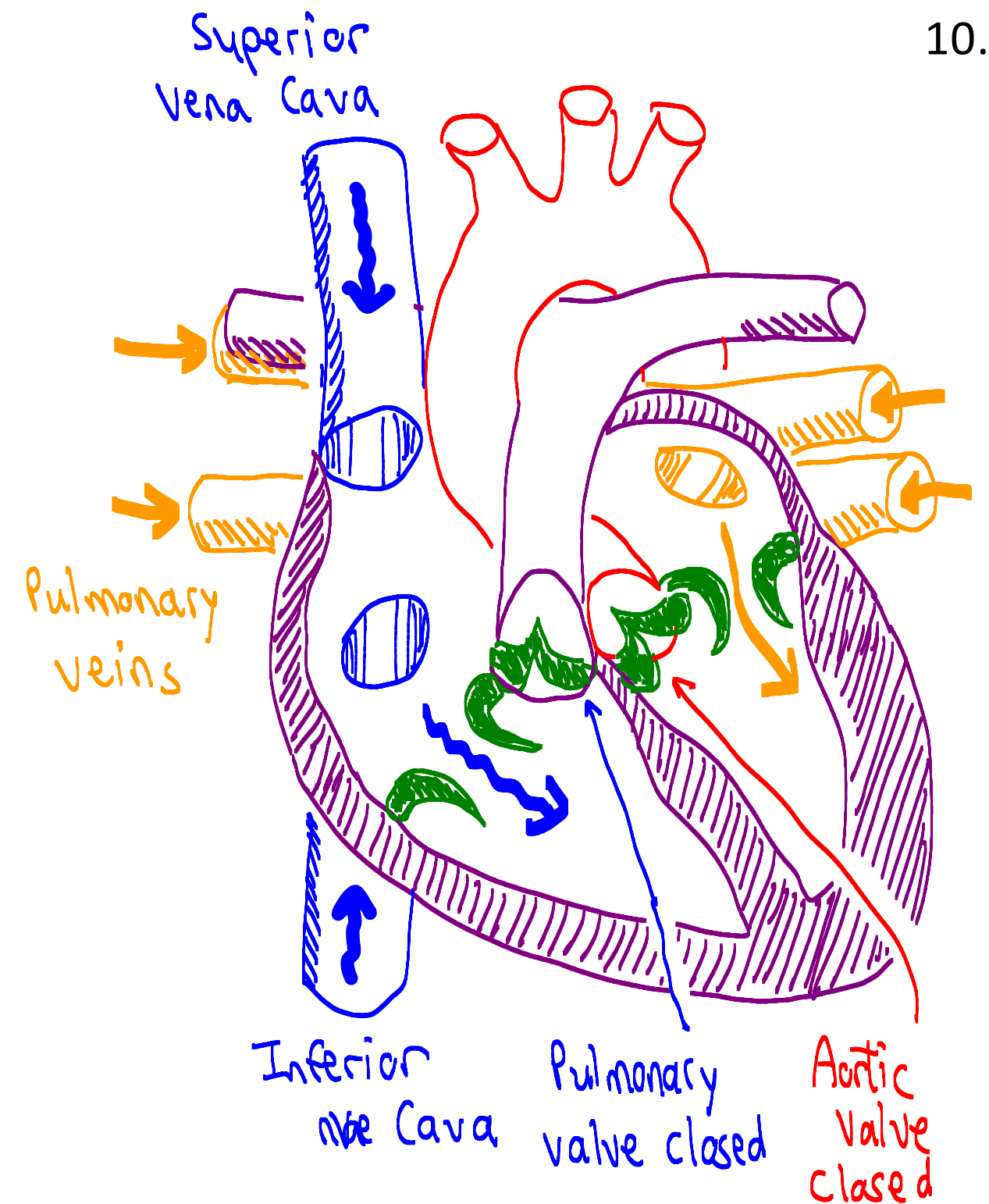
Diastole "Resting Phase" ← Refill ventricles

- Atria contract
- Valves open/close to direct blood flow

	Right Ventricle		Left Ventricle	
Refill	Tricuspid	Pulmonary	Aortic	Mitral
Start	Closed	Closed	Closed	Closed
"Full" speed	Opens	Closed	Closed	Opens

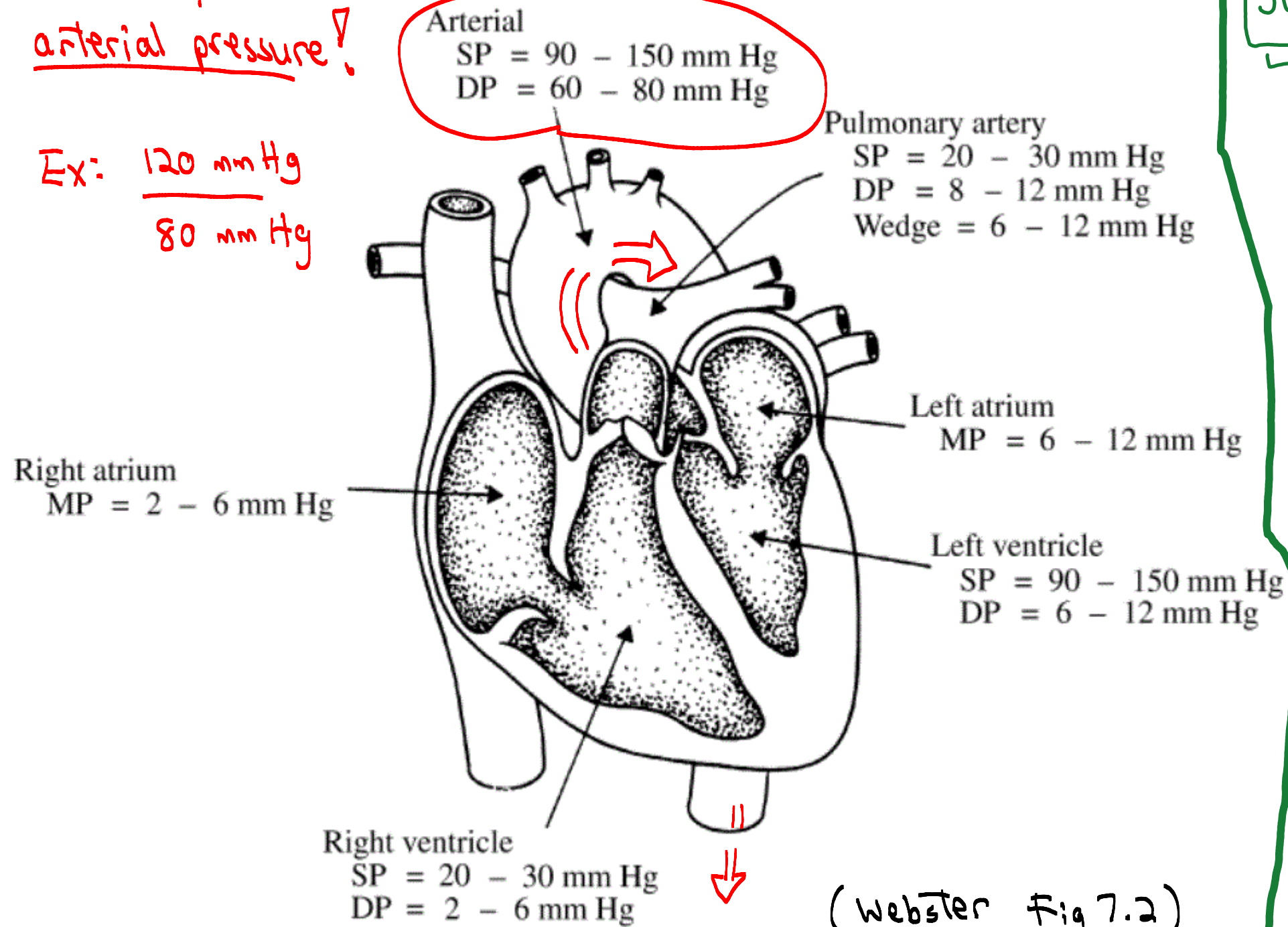


Heart Sound #2 "Dub" is reverb due to blockage of reverse blood flow!



★ we usually measure arterial pressure!

Ex: 120 mmHg
80 mmHg



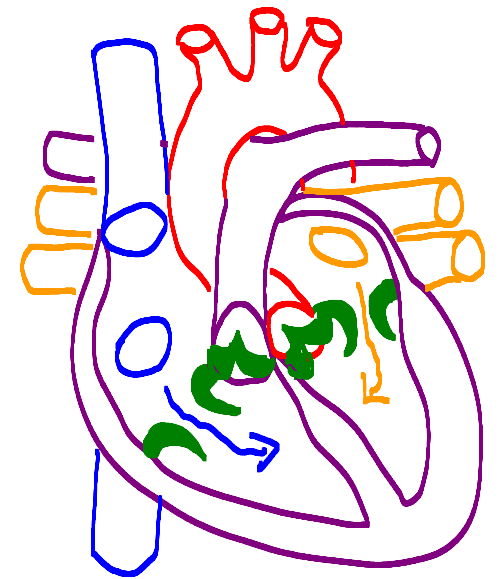
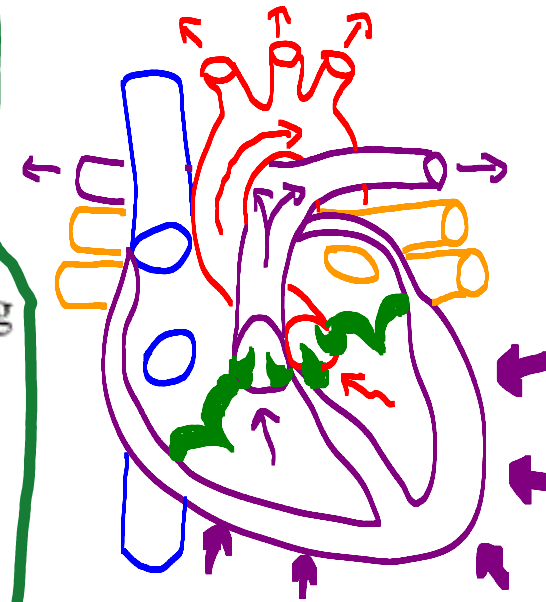
Summary

"Pumping Phase"
"LUB"

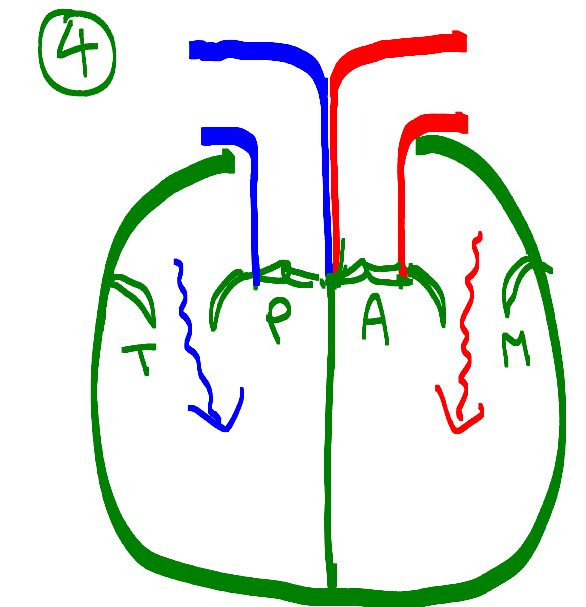
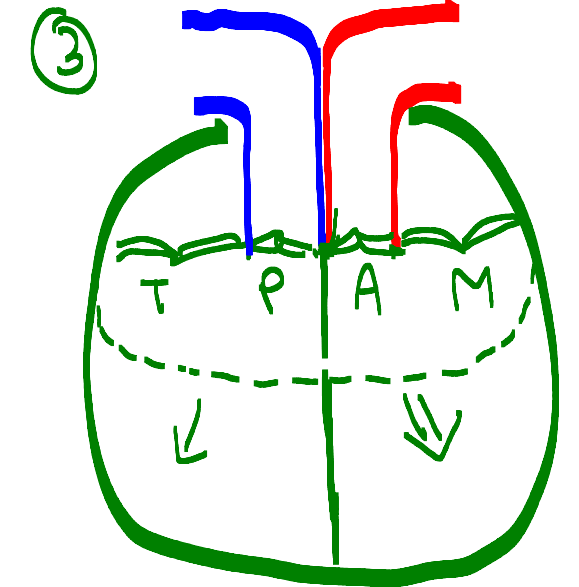
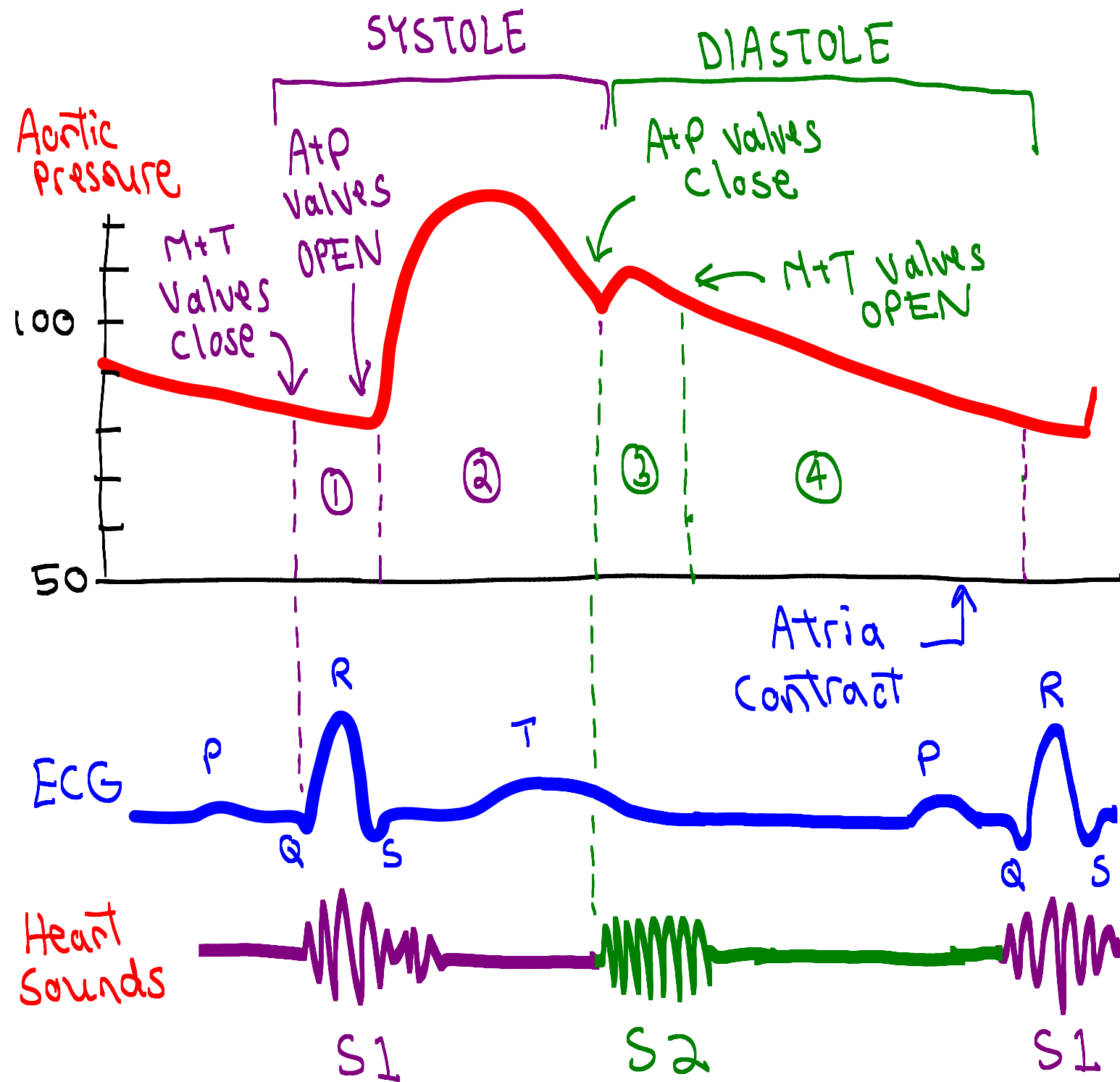
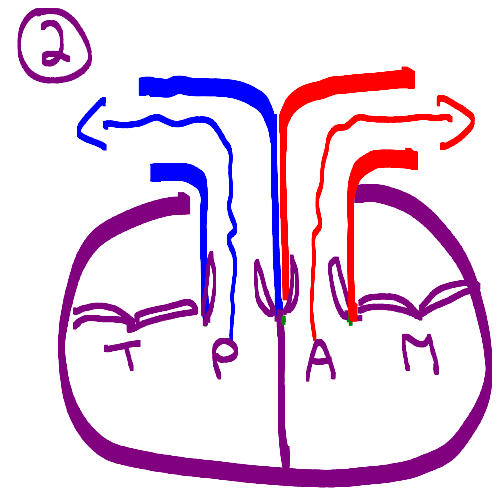
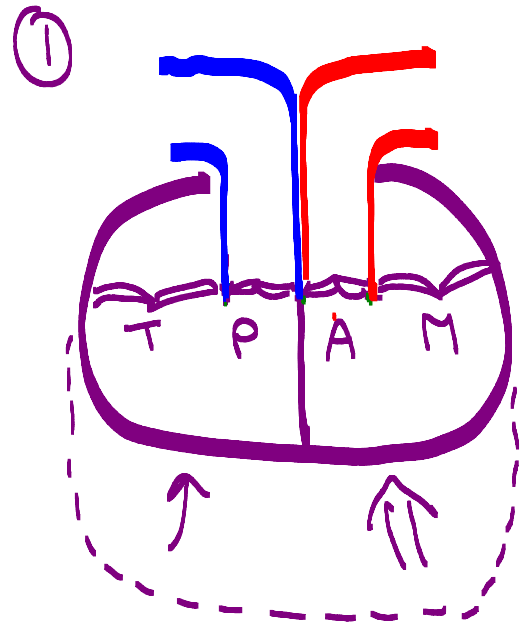
SYSTOLE

"Resting Phase"
"DUB"

DIASTOLE



C. Relation to ECG



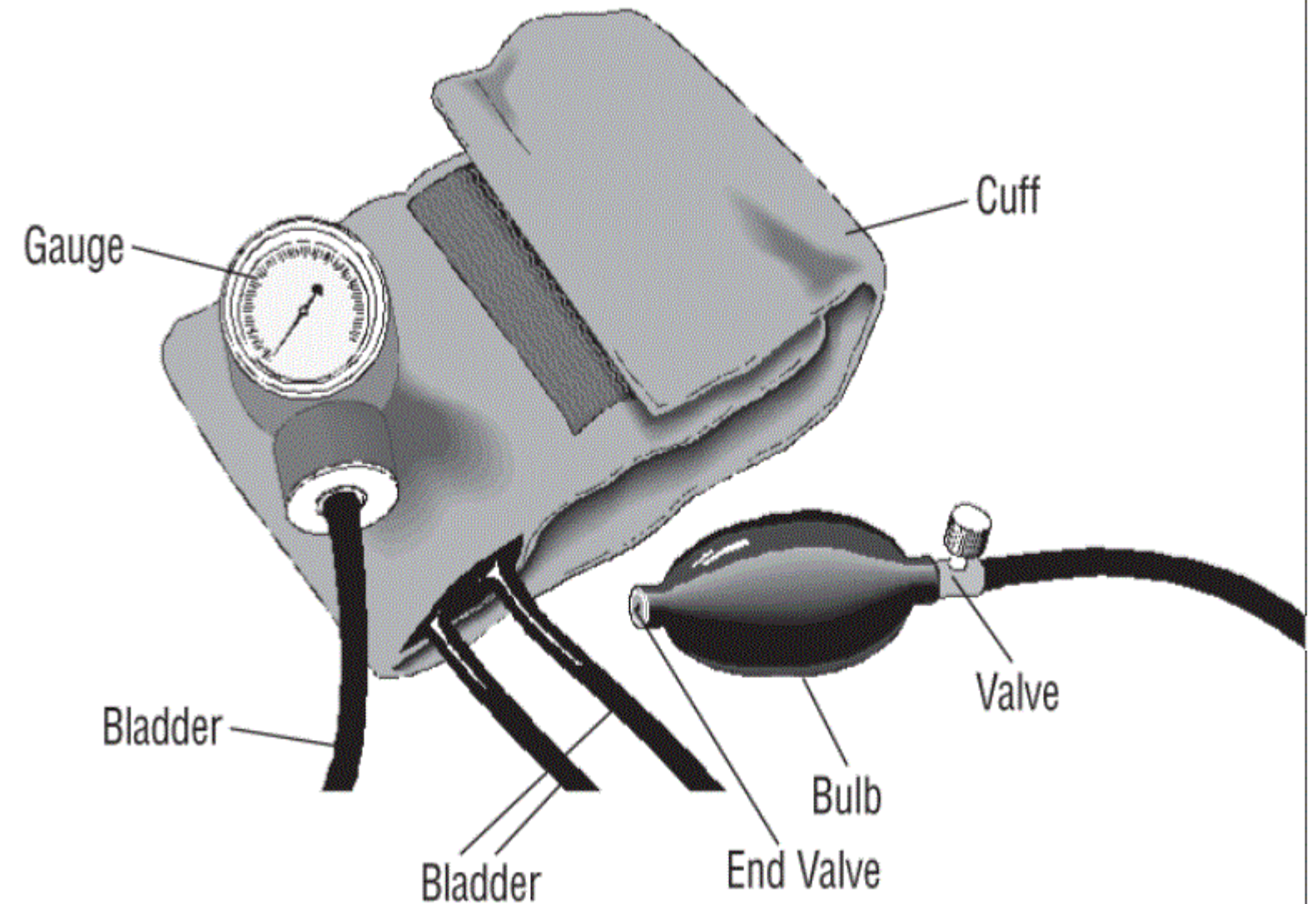
2. Non-invasive Measurement of Arterial Pressure

Sphygmomanometer = Inflatable cuff + Pressure Measurement Unit

→ usually used
on upper arm

Basic idea:

- ① Inflate cuff so that blood flow (in arm) stops ($P_{\text{cuff}} > P_{\text{sys}}$)
- ② slowly release the cuff pressure
- ③ Record pressure when blood flow resumes ← systole
- ④ Record pressure when blood flow is unimpeded by cuff ← diastole



mountainside-medical.com

3. Auscultatory Method

Sphygmomanometer

+ Stethoscope

Listen for arterial sounds
(Korotkoff)

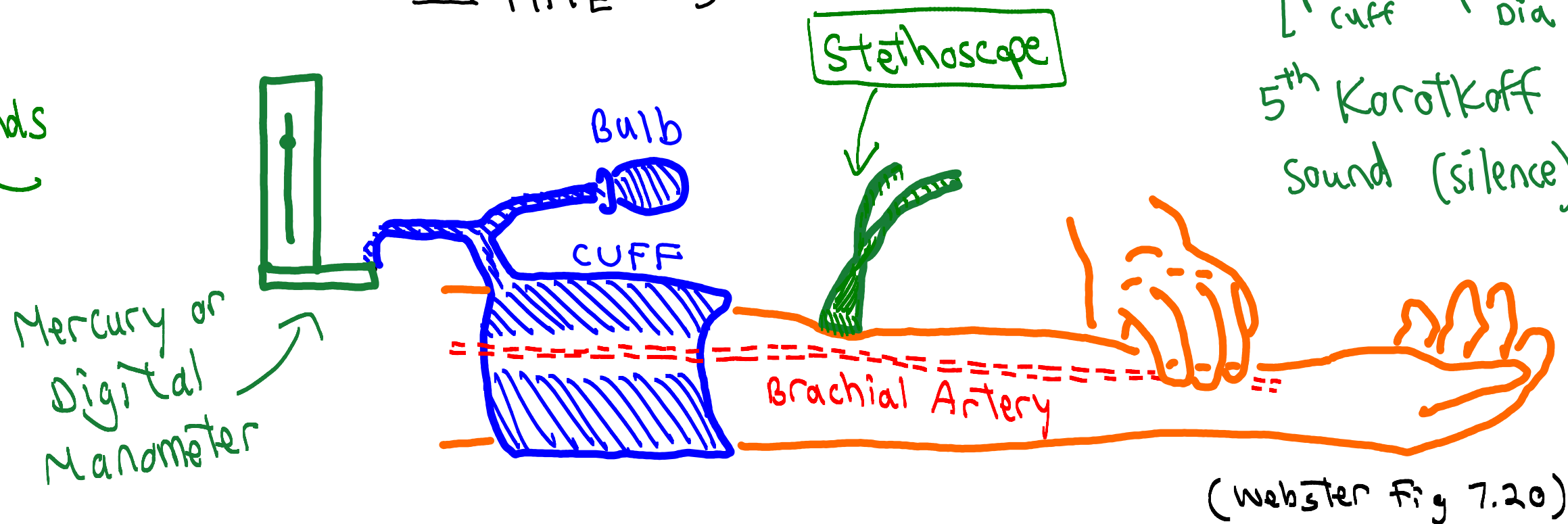
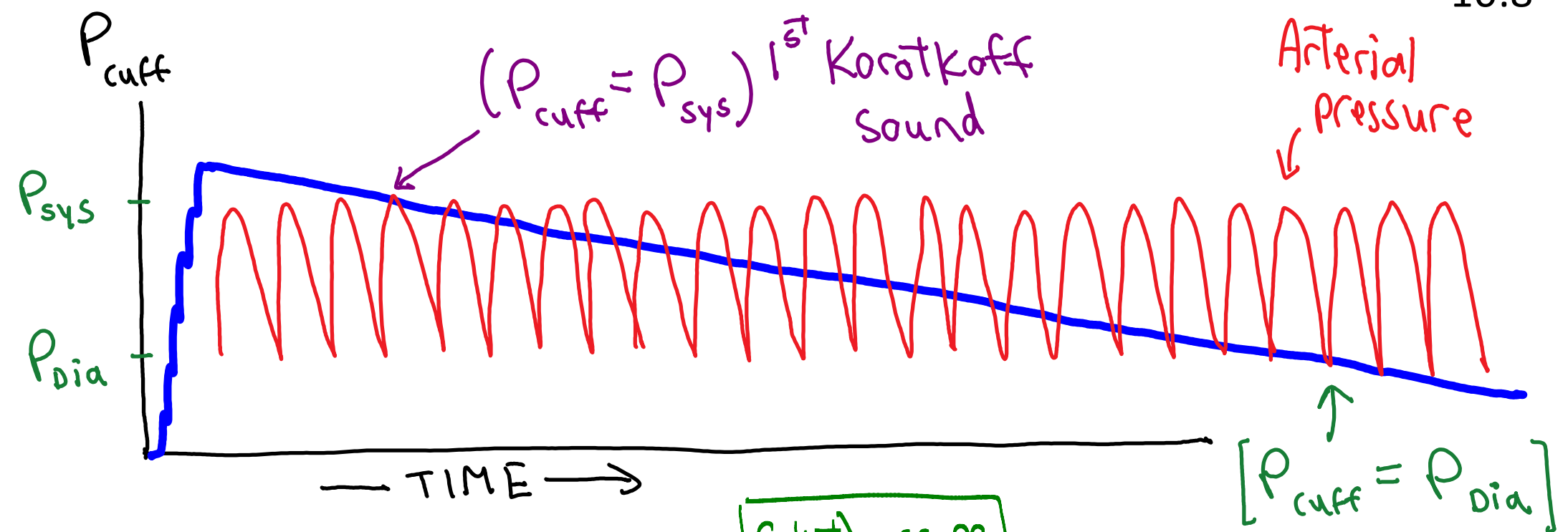
downstream from cuff!

NOTE:

Korotkoff Sounds $\neq$ Heart Sounds

Arteries in
the arm

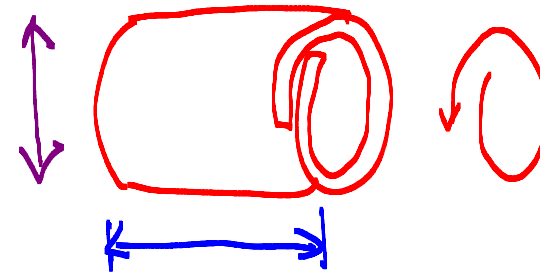
Heart



Issues:

(10.9)

- should take a few measurements
- Poor accuracy for infants + hypotensive patients
 - Proper size of occlusive cuff
 - Cuff should be placed at heart level
 - Cuff reliability ← mechanical failure of bulb, bladder, tubes, etc.



- Cannot be used in noisy environment
- User must have good hearing at low freq (20-300 Hz)
- Automated versions {
 - cuff inflation + deflation
 - Microphone or pressure sensor
 - Signal processing