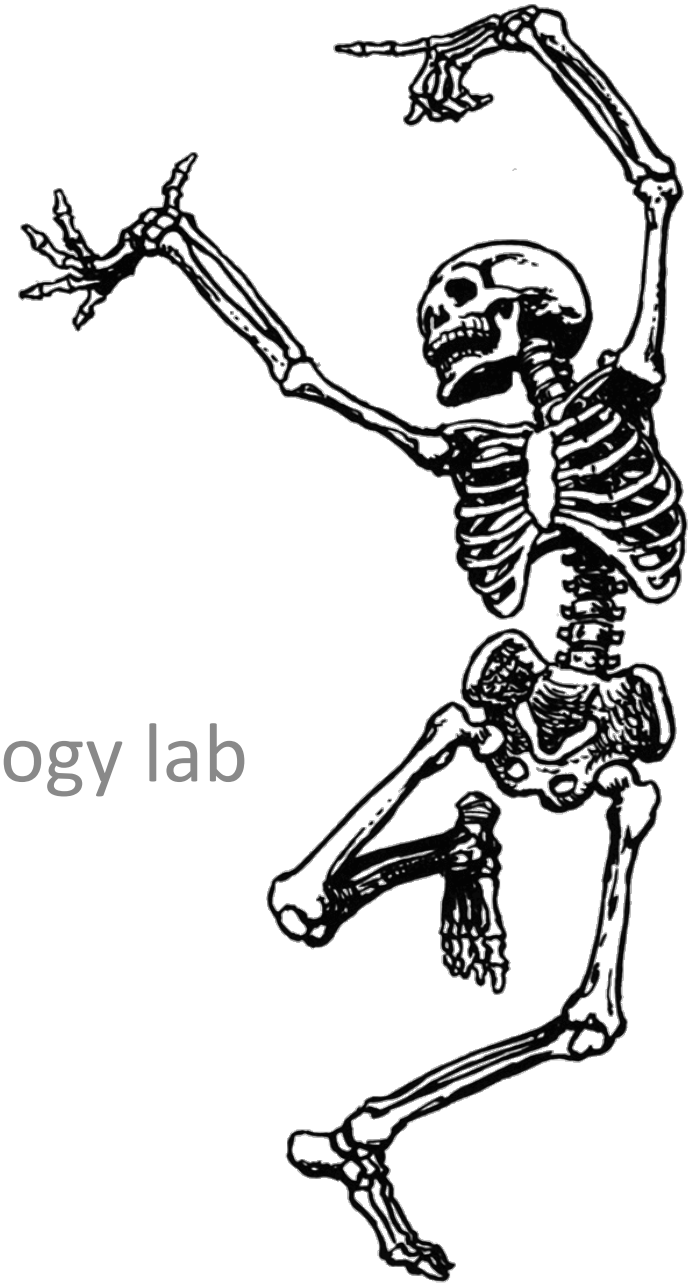
Z142L

Cardiovascular Physiology lab



To Accomplish Today

- CV Physiology – two exercises in the lab manual
  1. Exercise 31: Conduction system of the heart
     - EKG – AliveCor
  2. Exercise 33: BP and pulse determinations
- Supplemental experiments

- Experiments
  - Effects of age, sex, exercise and body position on EKG, BP and HR.
- Prepare to write your 1st Z142L lab report.
  - Due 6 March 2017 (along with the notebook and on the same day as the 1st lab practical!)

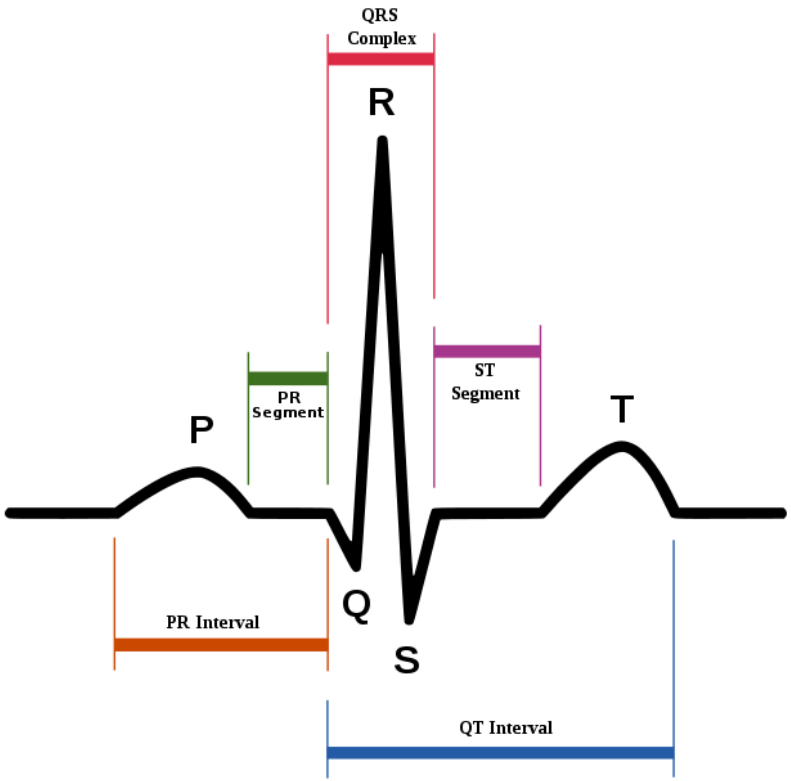
HUMAN CV PHYSIO: Conduction

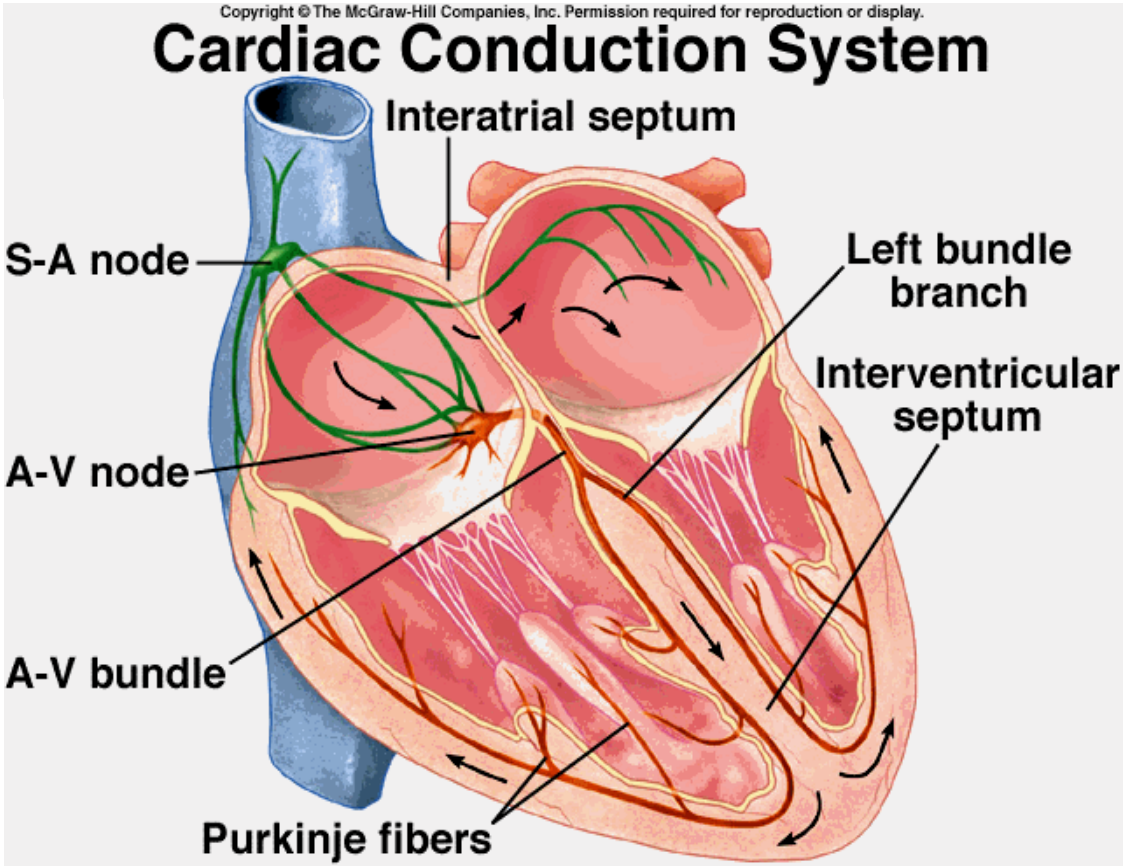
- State the function of the intrinsic conduction system of the heart.
- List the elements of the intrinsic conduction system of the heart and describe how impulses are initiated and conducted.
- Identify and interpret ECG waves in terms of depolarization and repolarization events.
- Calculate heart rate and wave intervals from ECGs recorded during lab period.
- Evaluate the effects of exercise and body position on ECG waves.

Master the objectives for the Human CV Physiology: Conduction System of the Heart and ECG.

HUMAN CV PHYSIO: Conduction

- Intrinsic conduction system.
  - Examine models and figures





HUMAN CV PHYSIO: Conduction

- Recording ECG using the AliveCor iPhone device and App.
  - All students get a 20-30 second base line reading
- Record BP using a sphygmomanometer (blood pressure cuff).

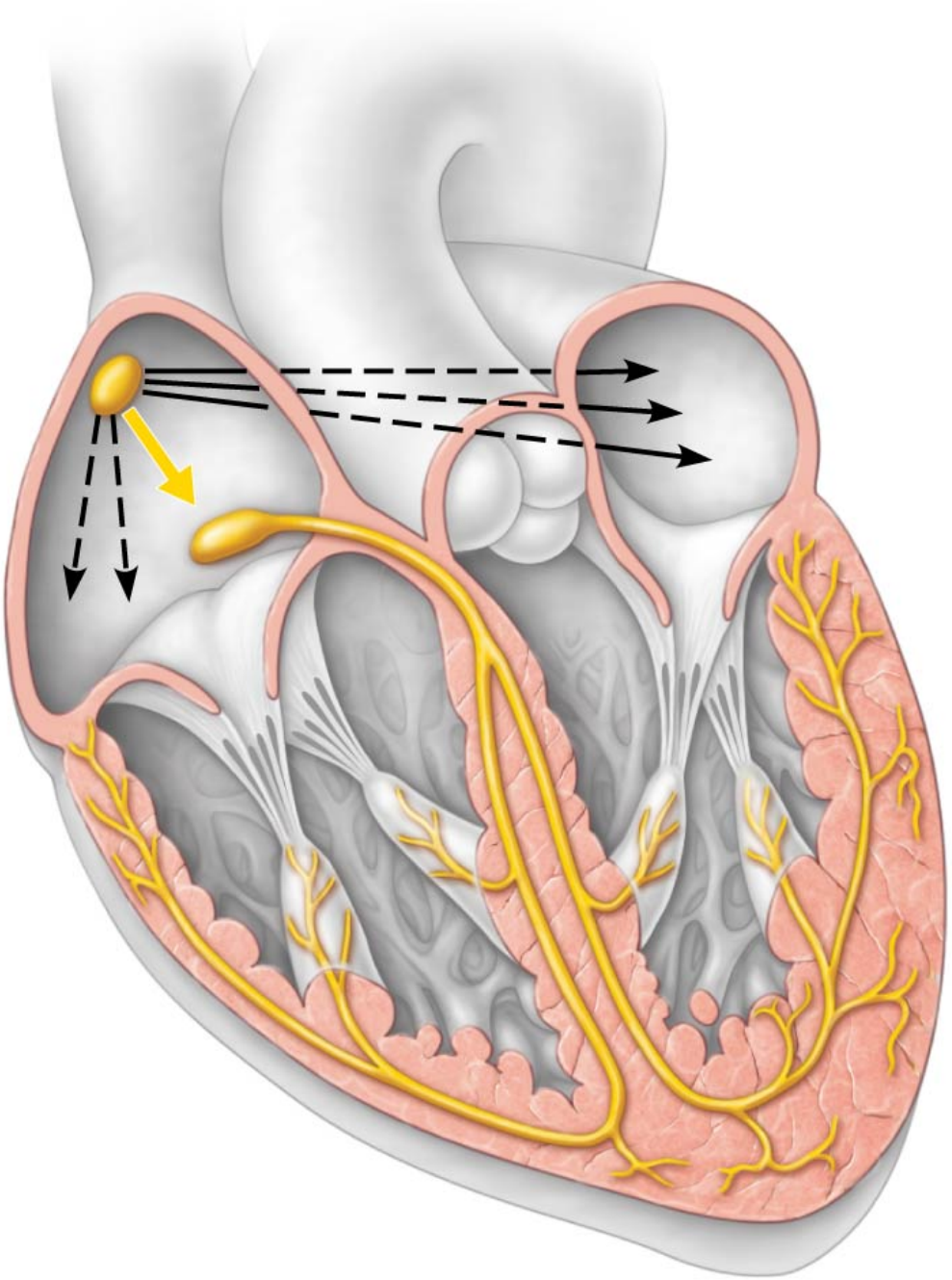
Intrinsic Conduction Supplemental Questions

Question	Answer
Describe the physiological basis of the intrinsic heart beat and auto-rhythmicity.	
What are the extrinsic and intrinsic control centers for heart rate?	

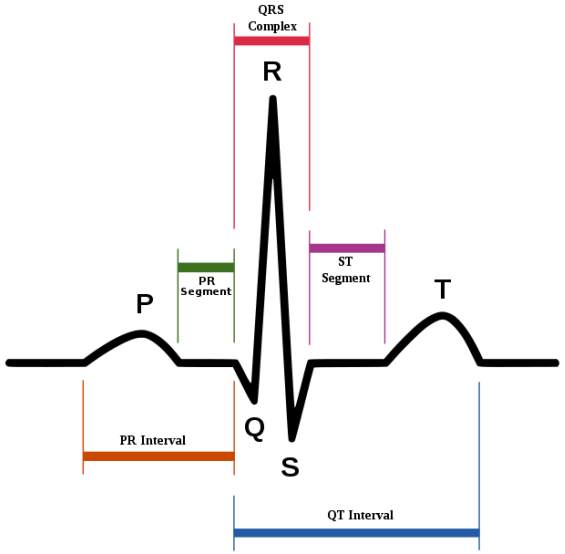
List the components of the intrinsic conduction system in sequence starting with the SA node. You may need to add or subtract arrows.

Definitions

Term	Definition
Tachycardia	
Bradycardia	
Fibrillation	
Systole	
Diastole	
Cardiac cycle	
Pulse	
Pulse pressure	
Pulse deficit	
Blood pressure	
Sounds of Korotkoff	
MAP	



Objective 2: List and identify the elements of the intrinsic conduction system, and describe how impulses are initiated and conducted through this system and the myocardium.



Recording ECGs using the AliveCor device

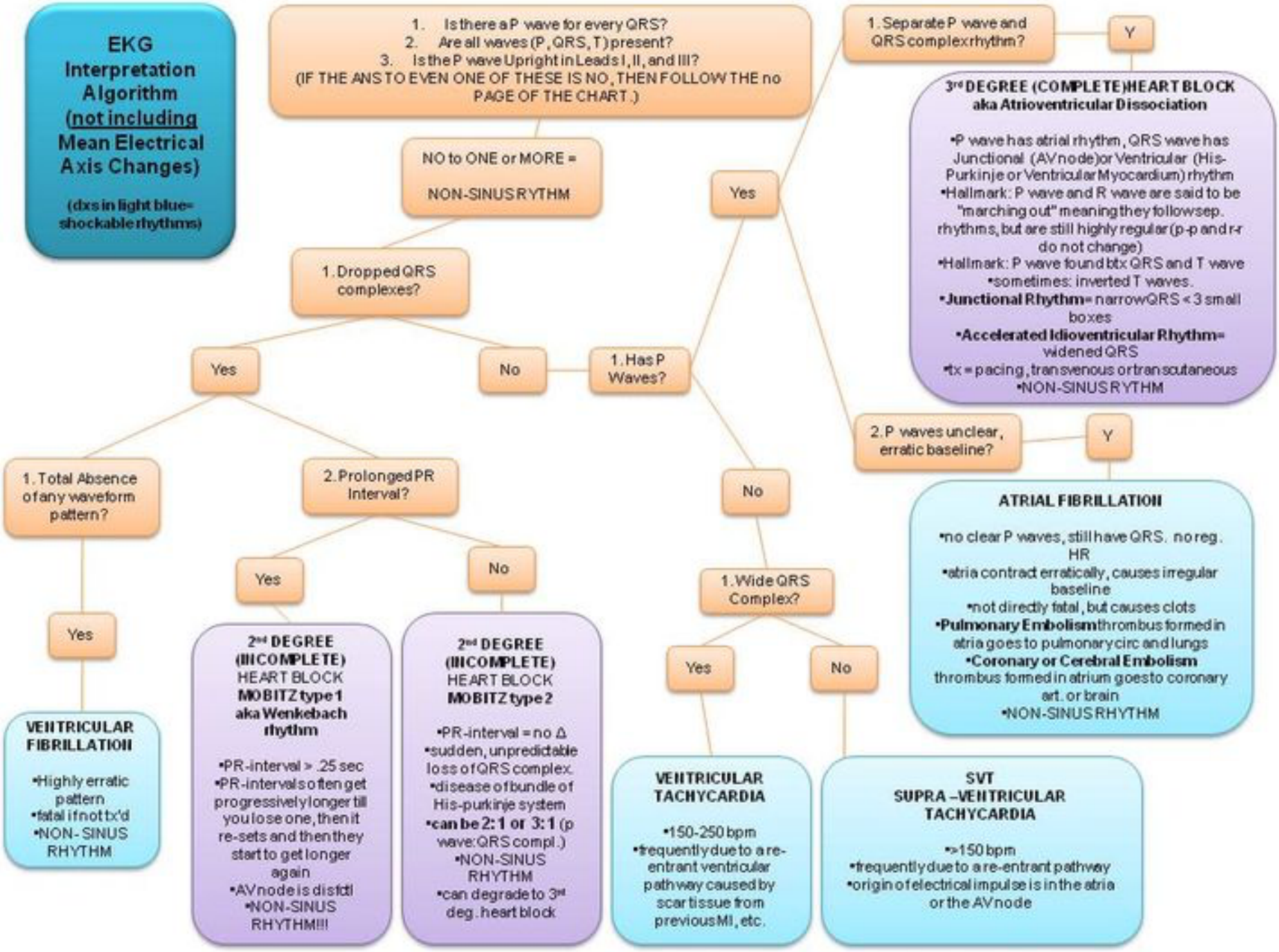
You should have a photo of yourself for the methods section of both your notebook and the CV paper.

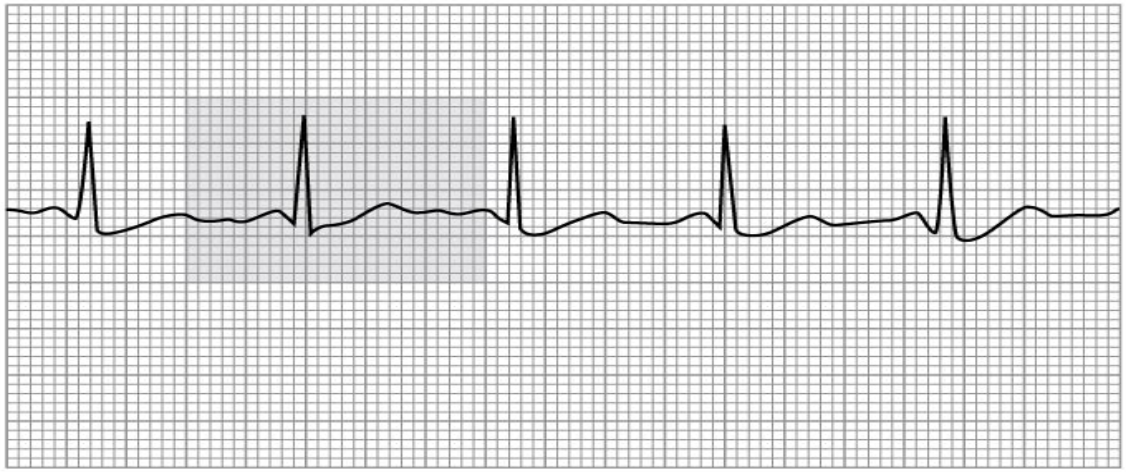
We will record 30 seconds of activity and you will get an email of your results.

Hypothesis Statements - Effects of body position and exercise on ECG waves and BP

Variable	Hypothesis
Laying down	
Sitting up after laying down	
Breath holding for 20 seconds	
Exercising for 5 minutes	

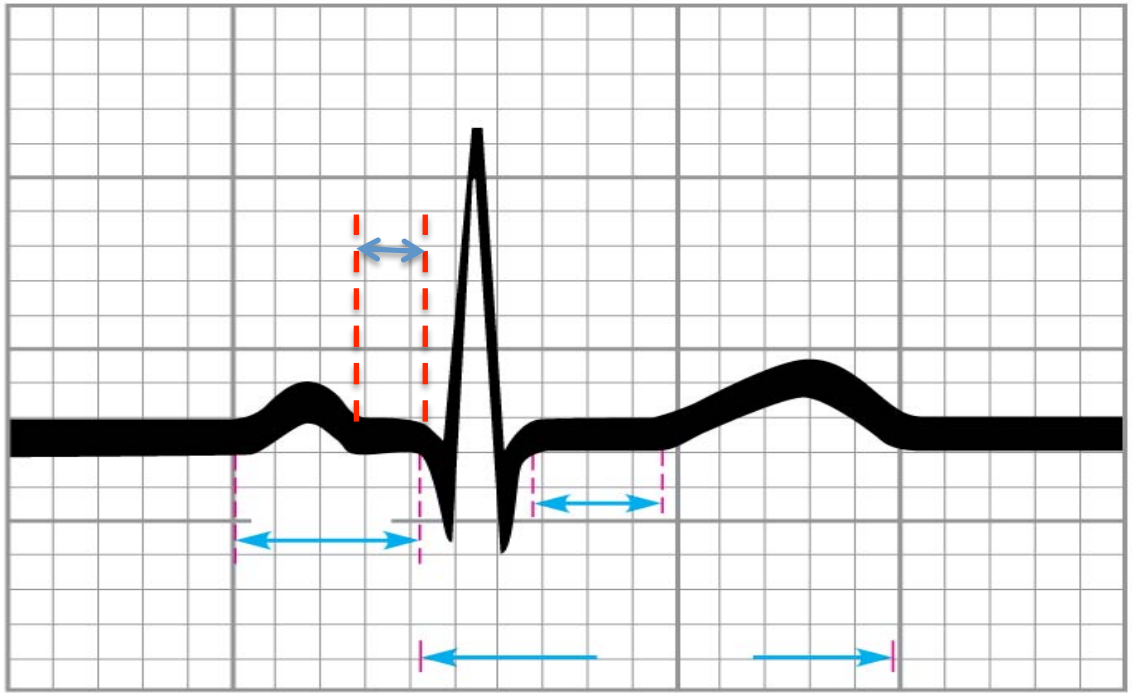
Your hypothesis statements are placed in the introduction of your paper and discussed (were you right or wrong and why) in the discussion section.


EKG Interpretation Algorithm (not including Mean Electrical Axis Changes)
(dxs in light blue= shockable rhythms)
1. Is there a P wave for every QRS?
2. Are all waves (P, QRS, T) present?
3. Is the P wave Upright in Leads I, II, and III?
(IF THE ANS TO EVEN ONE OF THESE IS NO, THEN FOLLOW THE no PAGE OF THE CHART.)
NO to ONE or MORE = NON-SINUS RYTHM
1. Dropped QRS complexes?
Yes
No
1. Has P Waves?
Yes
1. Total Absence of any waveform pattern?
Yes
VENTRICULAR FIBRILLATION
•Highly erratic pattern
•fatal if not tx'd
•NON- SINUS RHYTHM
2. Prolonged PR Interval?
Yes
2nd DEGREE (INCOMPLETE) HEART BLOCK MOBITZ type 1 aka Wenkebach rhythm
•PR-interval > .25 sec
•PR-interval often get progressively longer till you lose one, then it re-sets and then they start to get longer again
•AV node is dist'd
•NON-SINUS RHYTHM!!!
No
2nd DEGREE (INCOMPLETE) HEART BLOCK MOBITZ type 2
•PR-interval = no Δ
•sudden, unpredictable loss of QRS complex.
•disease of bundle of His-purkinje system
•can be 2:1 or 3:1 (p wave:QRS compl.)
•NON-SINUS RHYTHM
•can degrade to 3rd deg. heart block
No
1. Wide QRS Complex?
Yes
VENTRICULAR TACHYCARDIA
•150-250 bpm
•frequently due to a re-entrant ventricular pathway caused by scar tissue from previous MI, etc.
No
SVT SUPRA –VENTRICULAR TACHYCARDIA
•>150 bpm
•frequently due to a re-entrant pathway
•origin of electrical impulse is in the atria or the AV node
1. Separate P wave and QRS complex rhythm?
Y
3rd DEGREE (COMPLETE) HEART BLOCK aka Atrioventricular Dissociation
•P wave has atrial rhythm, QRS wave has Junctional (AV node) or Ventricular (His-Purkinje or Ventricular Myocardium) rhythm
•Hallmark: P wave and R wave are said to be "marching out" meaning they follow sep. rhythms, but are still highly regular (p-p and r-r do not change)
•Hallmark: P wave found btx QRS and T wave
•sometimes: inverted T waves.
•Junctional Rhythm= narrow QRS < 3 small boxes
•Accelerated Idioventricular Rhythm= widened QRS
•tx = pacing, transvenous or transcutaneous
•NON-SINUS RYTHM
2. P waves unclear, erratic baseline?
Y
ATRIAL FIBRILLATION
•no clear P waves, still have QRS. no reg. HR
•atria contract erratically, causes irregular baseline
•not directly fatal, but causes clots
•Pulmonary Embolism thrombus formed in atria goes to pulmonary circ and lungs
•Coronary or Cerebral Embolism thrombus formed in atrium goes to coronary art. or brain
•NON-SINUS RHYTHM



(a)

Indicate the normal length of the cardiac cycle.



(b)

You will label the three waves that make up the normal ECG as well as the intervals and segments.

You will then calculate the average duration of all major waves and segments. See the lab book for instructions, but use three ECGs.

Go to http://en.my-ekg.com/basic-principles/intervals-segments-ekg.html to read about the waves, segments and intervals.

Table 31.1 Boundaries of Each ECG Component

Feature	Boundaries
P wave	Start of P deflection to return to isoelectric line
P-R interval	Start of P deflection to start of Q deflection
QRS complex	Start of Q deflection to S return to isoelectric line
S-T segment	End of S deflection to start of T wave
Q-T interval	Start of Q deflection to end of T wave
T wave	Start of T deflection to return to isoelectric line
T-P segment	End of T wave to start of next P wave
R-R interval	Peak of R wave to peak of next R wave

Average duration of ECG waves

Wave	Normal (seconds)	Measured duration (seconds)	Average of measurements (seconds)
P	0.06-0.11	1.	
		2.	
		3.	
QRS complex	0.08 - 0.12	1.	
		2.	
		3.	
T	0.16	1.	
		2.	
		3.	

Average duration of ECG segments.

Segment	Normal (Miliseconds)	Measured duration (seconds)	Average duration (seconds)
P-R Interval	120-200	1. 2. 3.	
P-R Segment	80	1. 2. 3.	
S-T Segment	120	1. 2. 3.	
Q-T Interval	310-450 (460 in kids and 470 in women)	1. 2. 3.	
T-P Segment	Variable	1. 2. 3.	
QRS – QRS Interval	60 - 100	1. 2. 3.	Estimated HR: _____

More questions

Question	Answer
Compare your results to clinical norms. Are your values “normal?”	
What does a prolonged P-R segment indicate clinically?	
What does a prolonged T-R interval indicate clinically?	
Compare “segment” to “interval” on an ECG.	

Effects of exercise and body position on ECG intervals

Subject/Sex/ Age/Fitness	Activity	HR	P	PR	RR	QRS	ST	QT	T	T (HT)	TR
1	Laying (baseline)										
	Sitting up										
	Breath hold (20 sec)										
	Exercising (5 min)										
2	Laying (baseline)										
	Sitting up										
	Breath hold (20 sec)										
	Exercising (5 min)										
3	Laying (baseline)										
	Sitting up										
	Breath hold (20 sec)										
	Exercising (5 min)										

Effects of exercise and body position on ECG intervals

Subject/Sex/ Age/Fitness	Activity	HR	P	PR	RR	QRS	ST	QT	T	T (HT)	TR
4	Laying (baseline)										
	Sitting up										
	Breath hold (20 sec)										
	Exercising (5 min)										
5	Laying (baseline)										
	Sitting up										
	Breath hold (20 sec)										
	Exercising (5 min)										
6	Laying (baseline)										
	Sitting up										
	Breath hold (20 sec)										
	Exercising (5 min)										

Effects of exercise and body position on ECG intervals

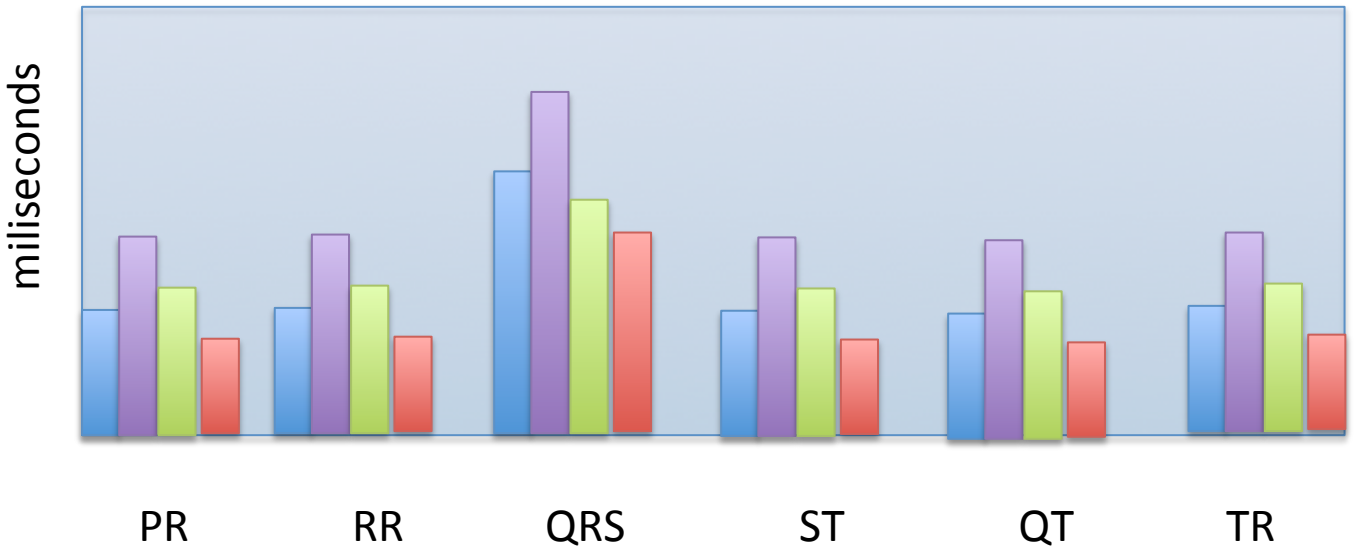
Average	Activity	HR	P	PR	RR	QRS	ST	QT	T	T (HT)	TR
	Laying (baseline)										
	Sitting up										
	Breath hold (20 sec)										
	Exercising (5 min)										

Produce a bar graph comparing each activity using the averages of pooled data.

Add appropriate scale

Key:
Baseline
Sitting
Breath holding
Exercising

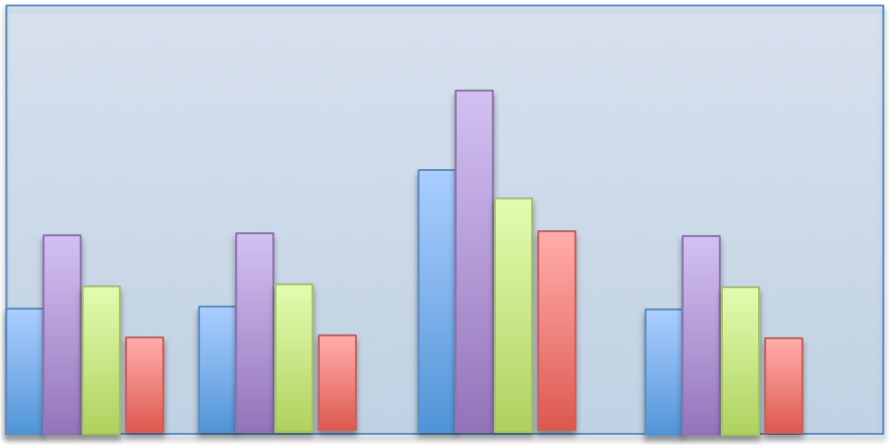
#, Title, Description



Produce a bar graph comparing each activity using the averages of pooled data. Make sure to correctly label the "Y" axis with Beats per minute for HR and millimeters (mm) for the wave heights. You can use both the left and right sides of the box as "Y" axes. Put the appropriate scale along with the axes heading.

#, Title, Description

Key:
Baseline
Sitting
Breath holding
Exercising



Add appropriate scale

BPM

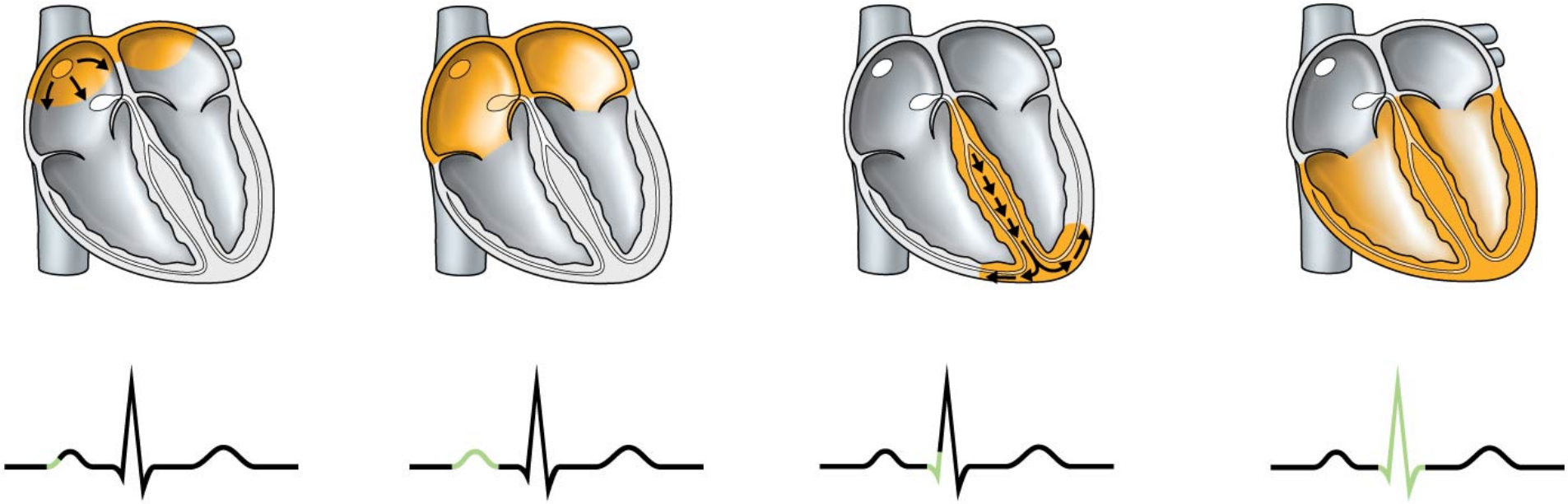
Add appropriate scale

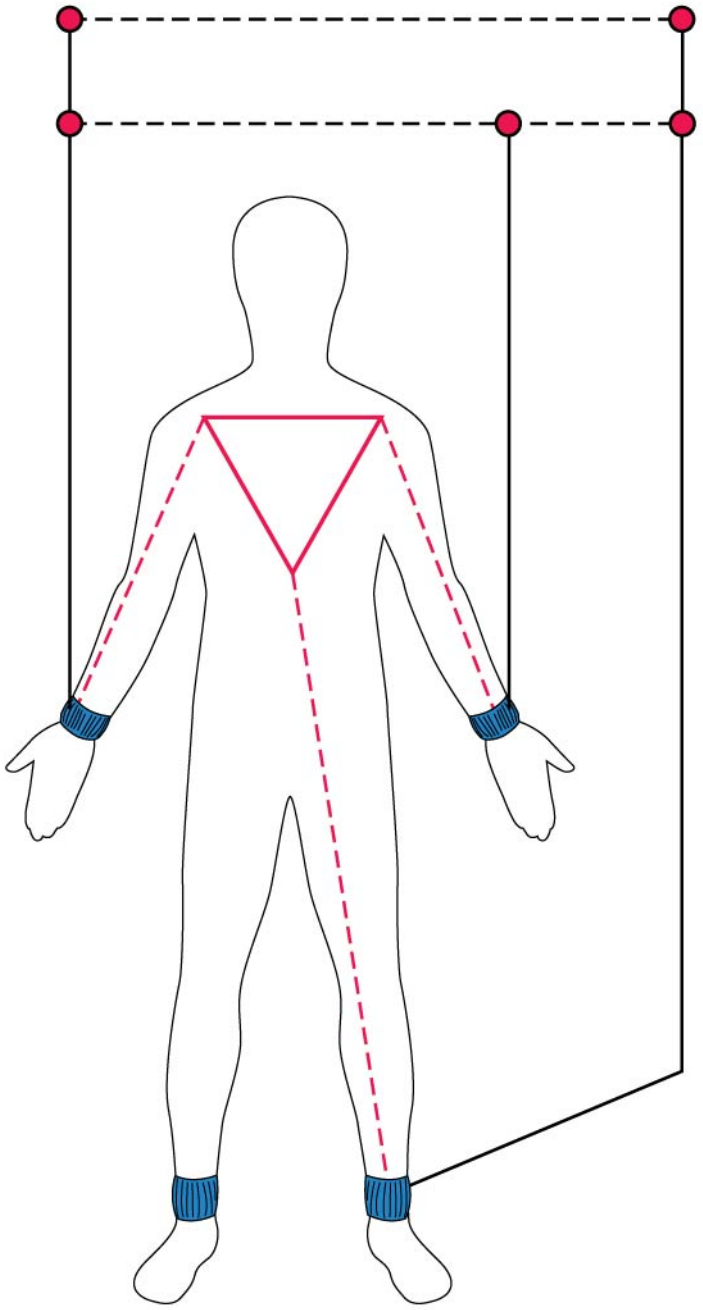
MM

HR P QRS T

In your paper, you will need to discuss the findings you represent in these graphs. Talk about normal and what it means when these numbers are too high or too low. Do not discuss the results in the results section. The results section contains your graphs, not data tables or discussion. Data tables are for the lab notebook.

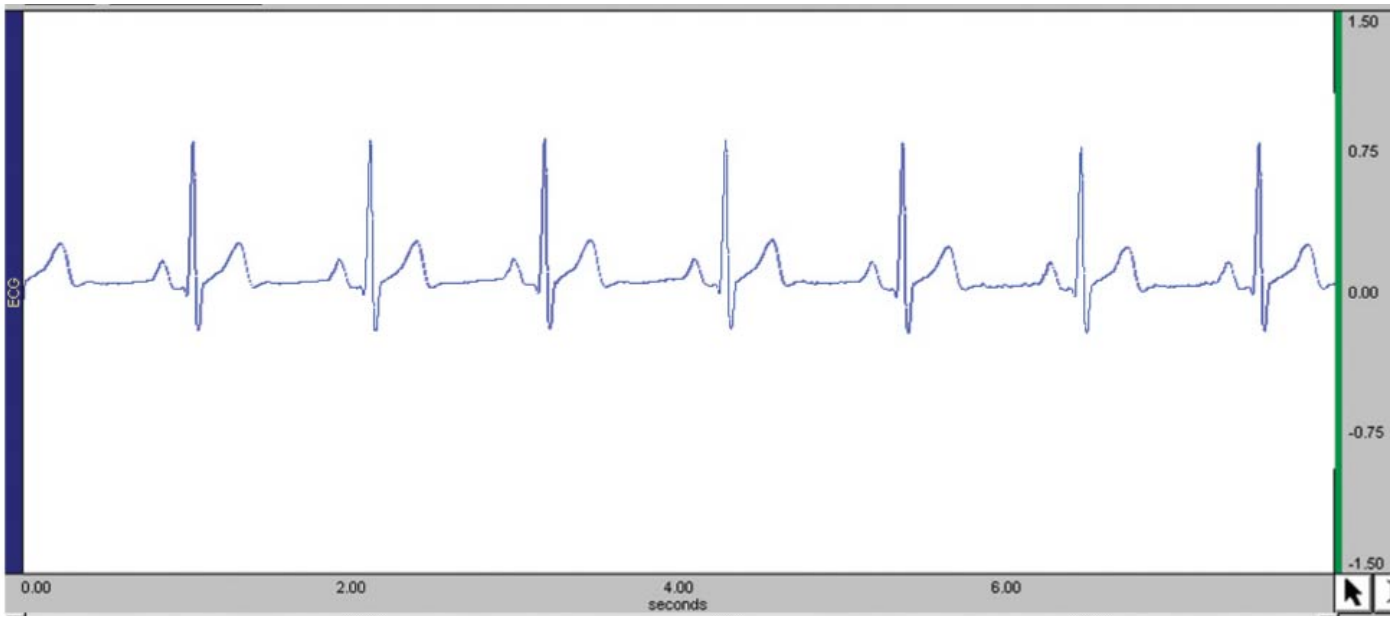
You need to be able to diagram and describe the events that are occurring in the heart at the time of each of the wave deflections.



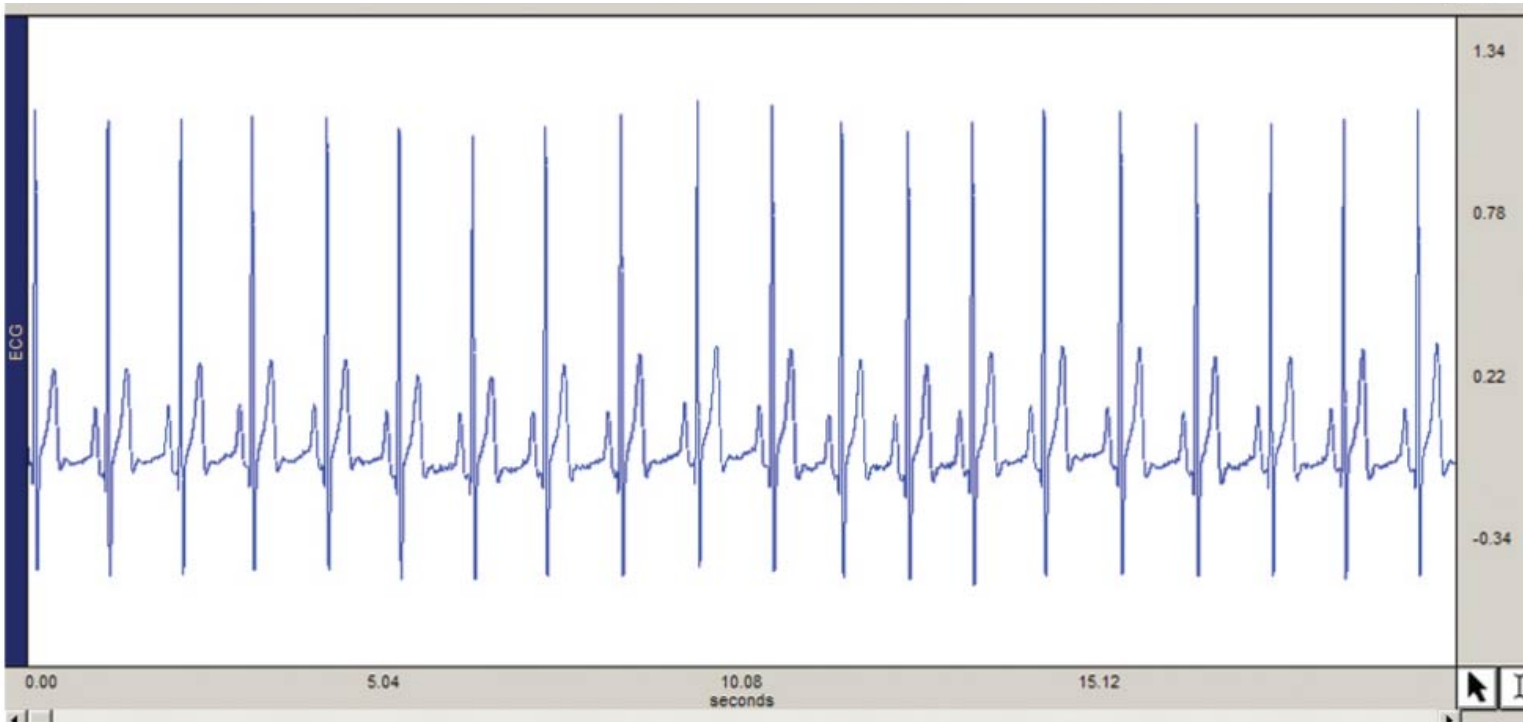


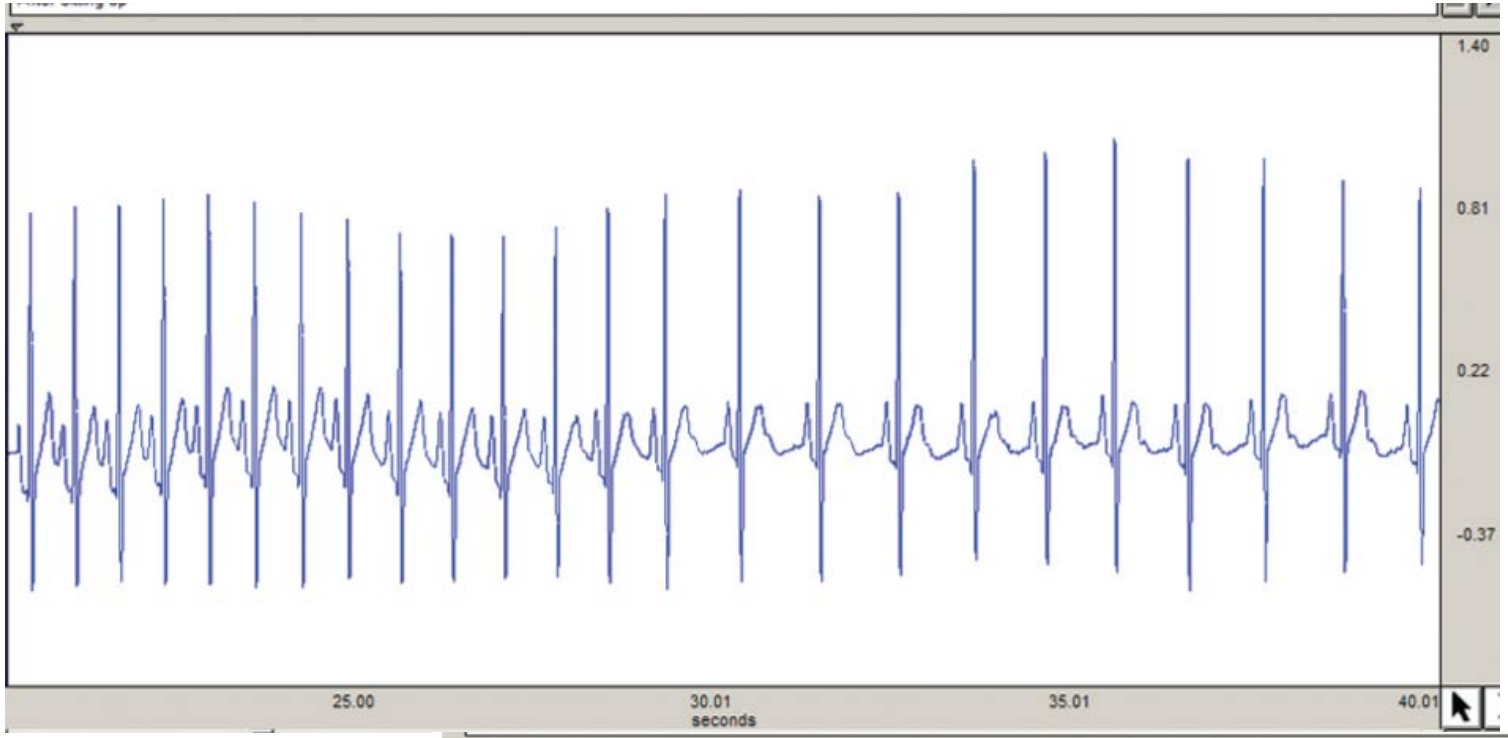
This diagram illustrates a three-lead hook up to take an ECG. We are doing a one-lead.

Explain how a one-lead ECG works and compare it to a three-lead and the normal 12-lead ECG.

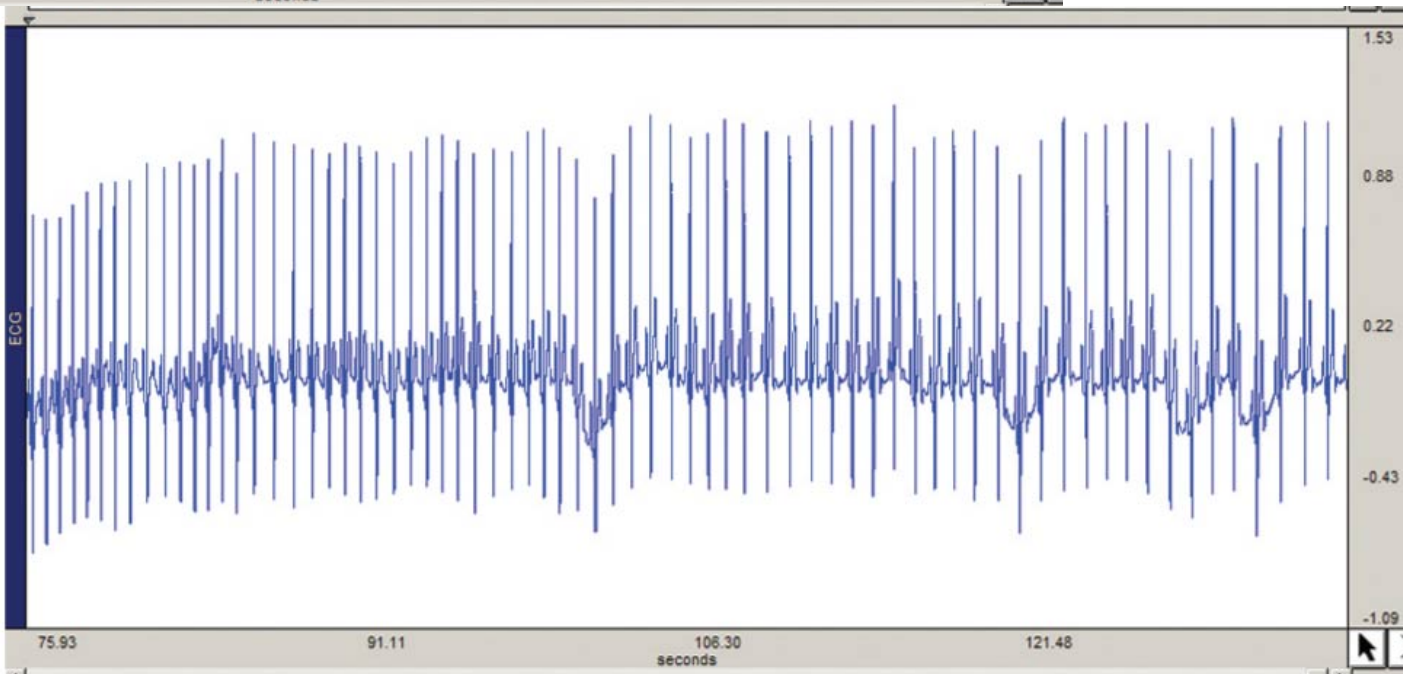


Label each of these tracings and explain what is shown.





Label each of these tracings and explain what is shown.



CV BP and Pulse

Activity 1. Use a stethoscope to auscultate heart sounds.

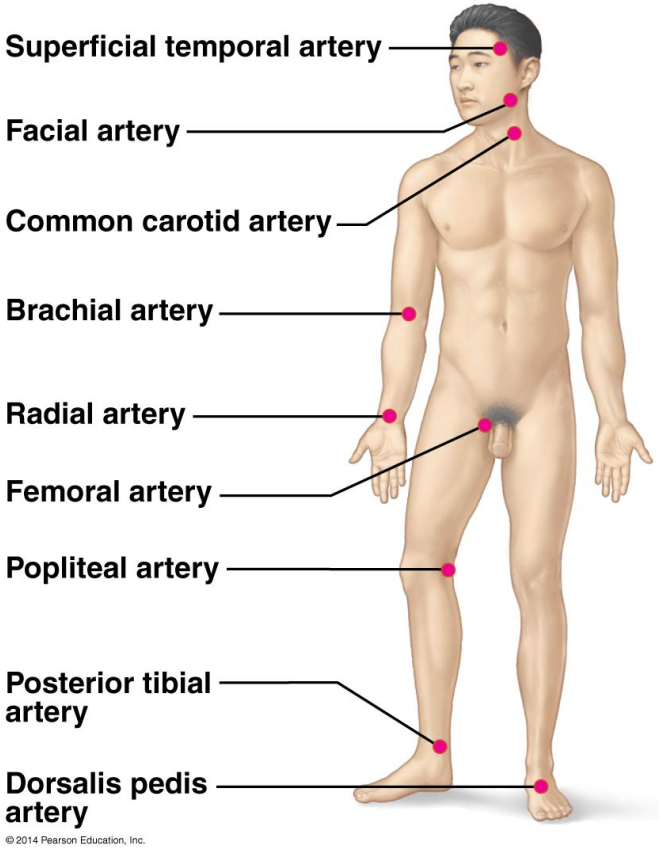
Activity 2. Palpate major pulse points.

Activity 4. Apical pulse

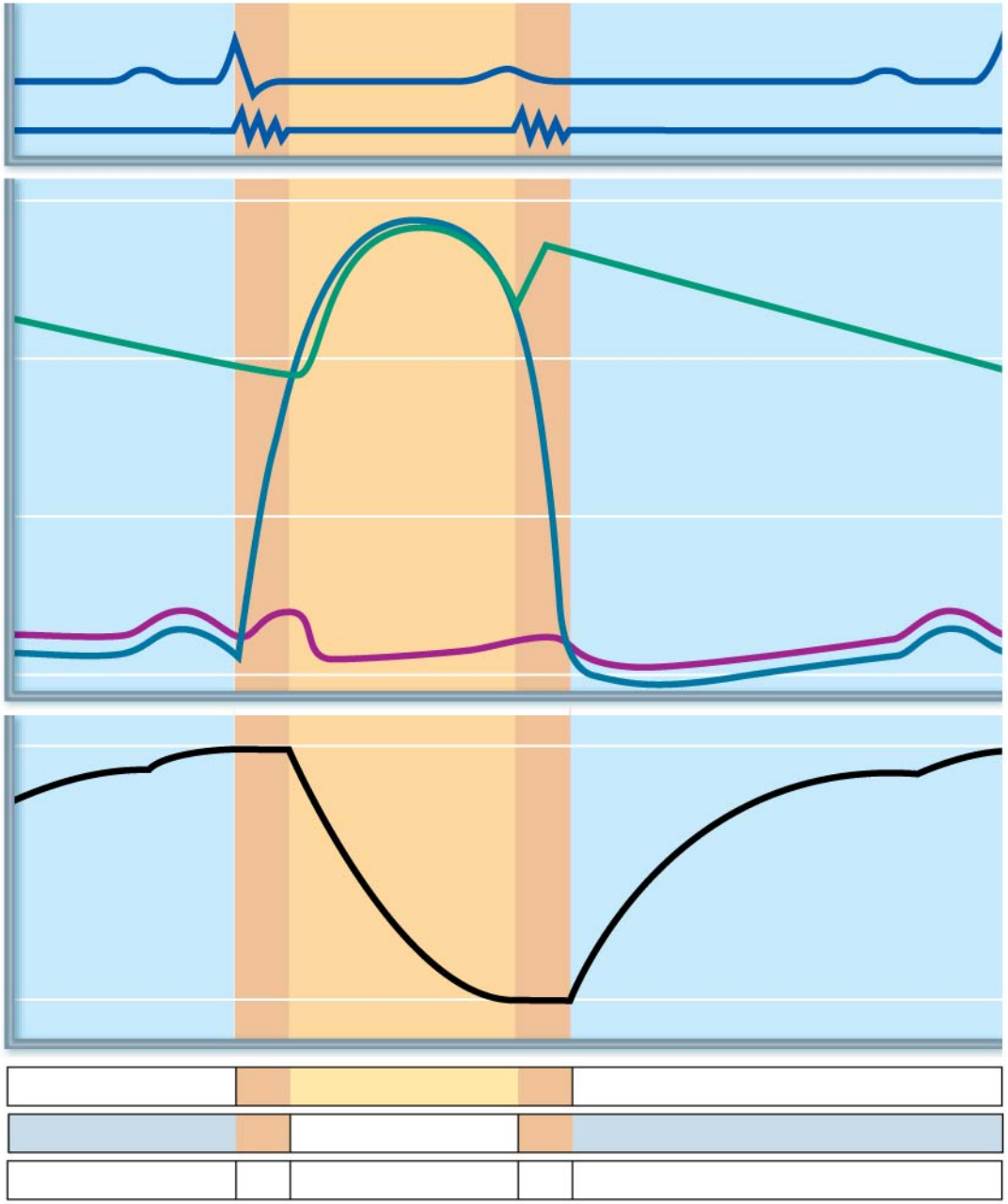
Activity 5. Use a manual sphygmomanometer to measure blood pressure.

- Measure or calculate pulse, pulse pressure, mean arterial pressure and stroke volume.

- ❑ Define systole, diastole, and cardiac cycle.

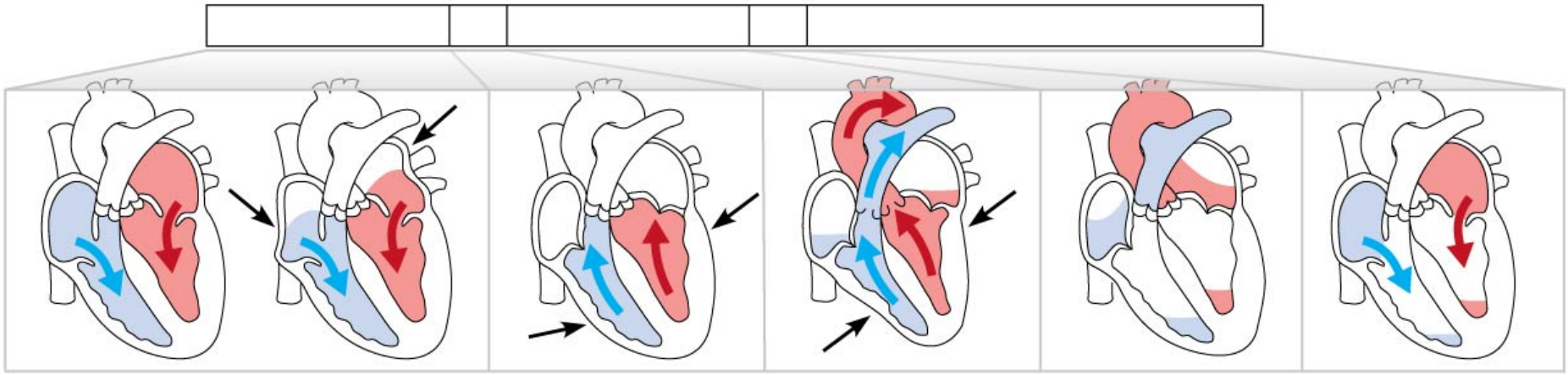


Label the Wiggins diagram.



(a)

You should be able to label a figure like this and relate it to the conduction aspects of the cardiac cycle. Describe what is occurring in each panel of this diagram. Be able to label all the parts of the heart and associated blood vessels.



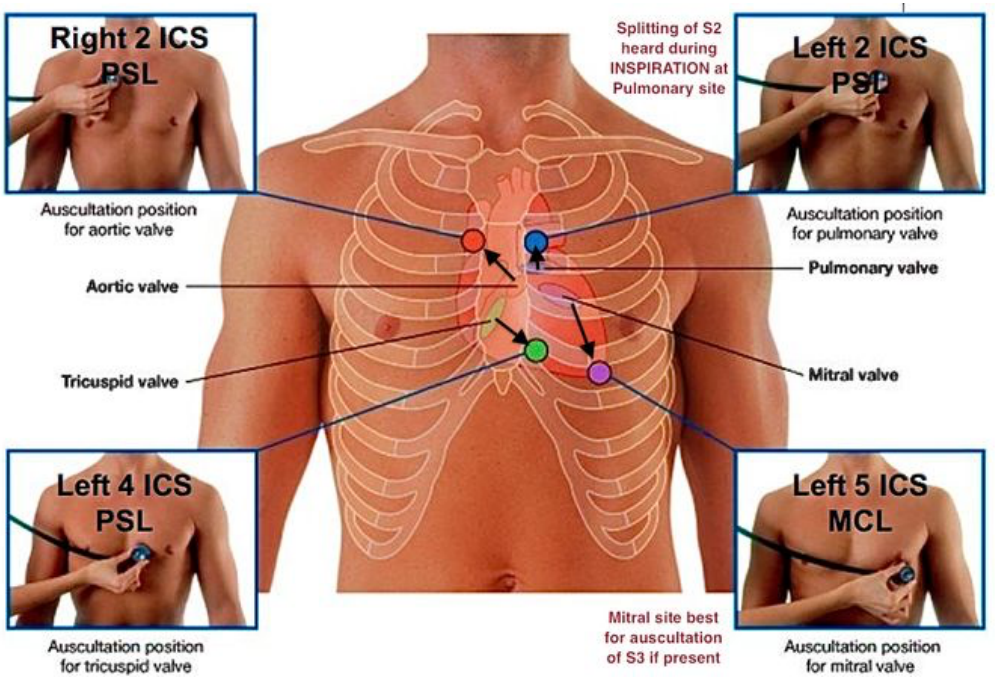
Objective 2 BP & Pulse: Indicate the normal length of the cardiac cycle, the relative pressure changes occurring within the atria and ventricles, the timing of valve closure, and the volume changes occurring in the ventricles during the cycle.

Objective 3: Correlate the events of the ECG with the events of the cardiac cycle.

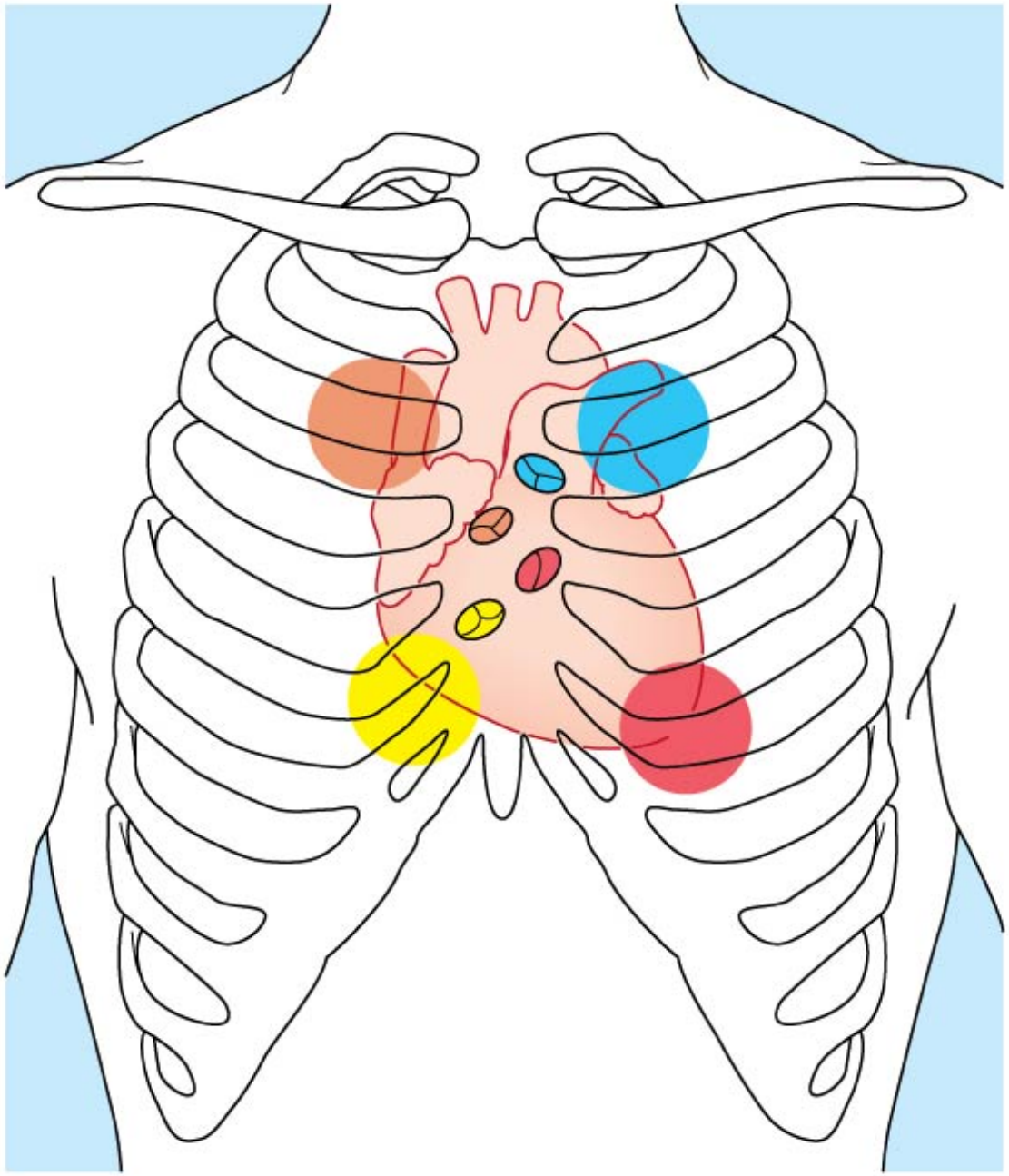
CV BP and Pulse

Use a stethoscope to listen to heart sounds (S1 and S2) in each of the following locations (see Figure 33a.2 on p 494). (BE SURE TO CLEAN EAR PIECES BEFORE USE)

- 2nd intercostal space right of sternal margin
- 2nd intercostal space left of sternal margin
- 5th intercostal space left of sternum
- 5th intercostal space right of sternum



Obj 4: Use the stethoscope to auscultate heart sounds, relate heart sounds to cardiac cycle events and describe the clinical significance of heart murmurs.

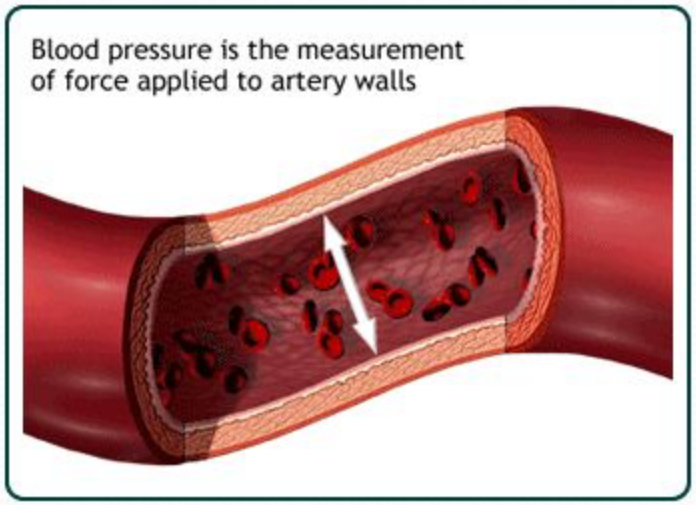


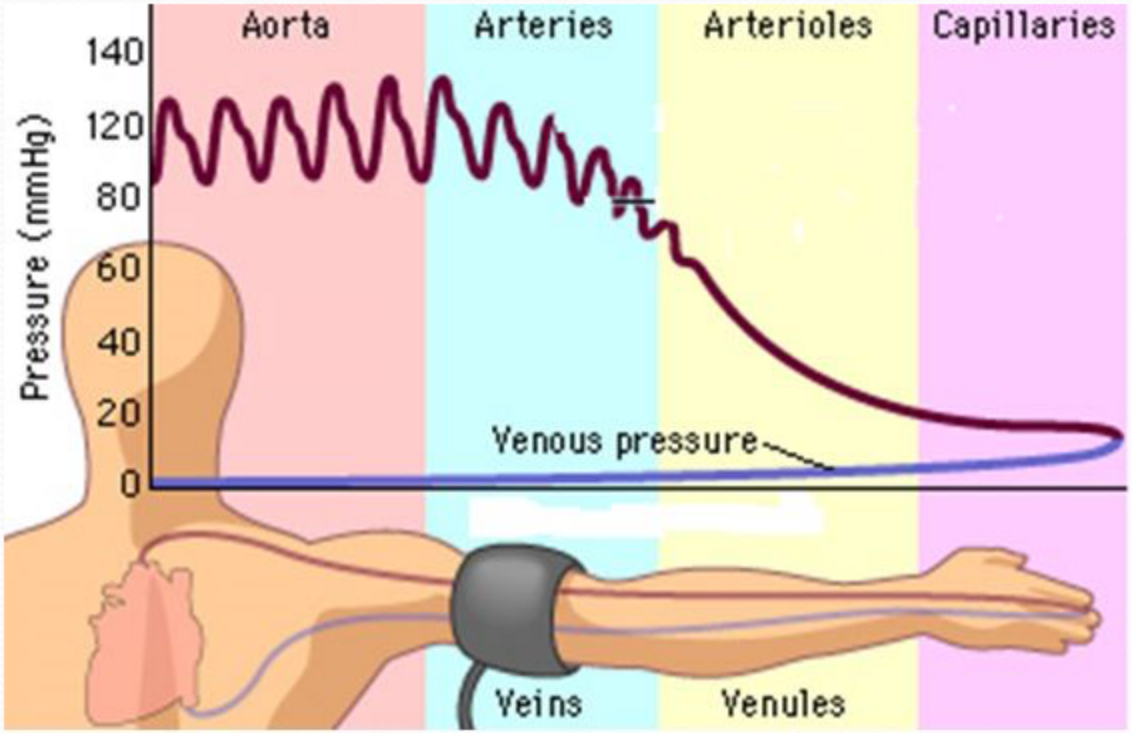
Notice how your text has slightly different reference points. They place the auscultation point for the pulmonary (tricuspid) valve on the RIGHT lateral edge of the body of the sternum at rib 5.

Objective 5: Demonstrate thoracic locations where the 1st and 2nd heart sounds are most accurately auscultated.

Blood Pressure

- Blood pressure is the pressure the blood exerts against the inner walls of the blood vessels.
- Usually, we refer to the pressure of the arteries.

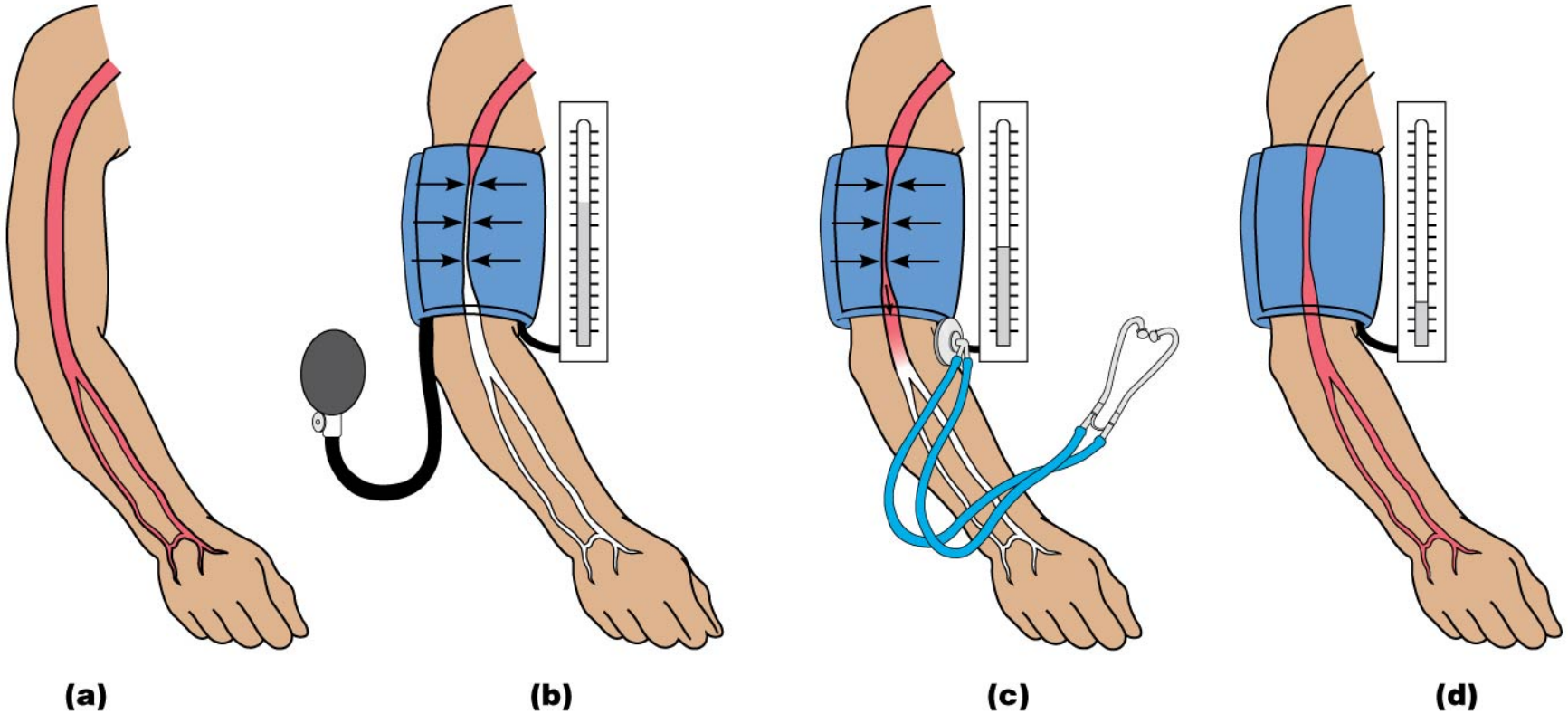




Be able to explain how a blood pressure cuff works.

Objective 8. Determine a subject's blood pressure with a sphygmomanometer, and relate systolic and diastolic pressures to events of the cardiac cycle.

Objective 9. Compare the value of venous pressure to systemic blood pressure, and describe how venous pressure is measured.



CV BP and Pulse

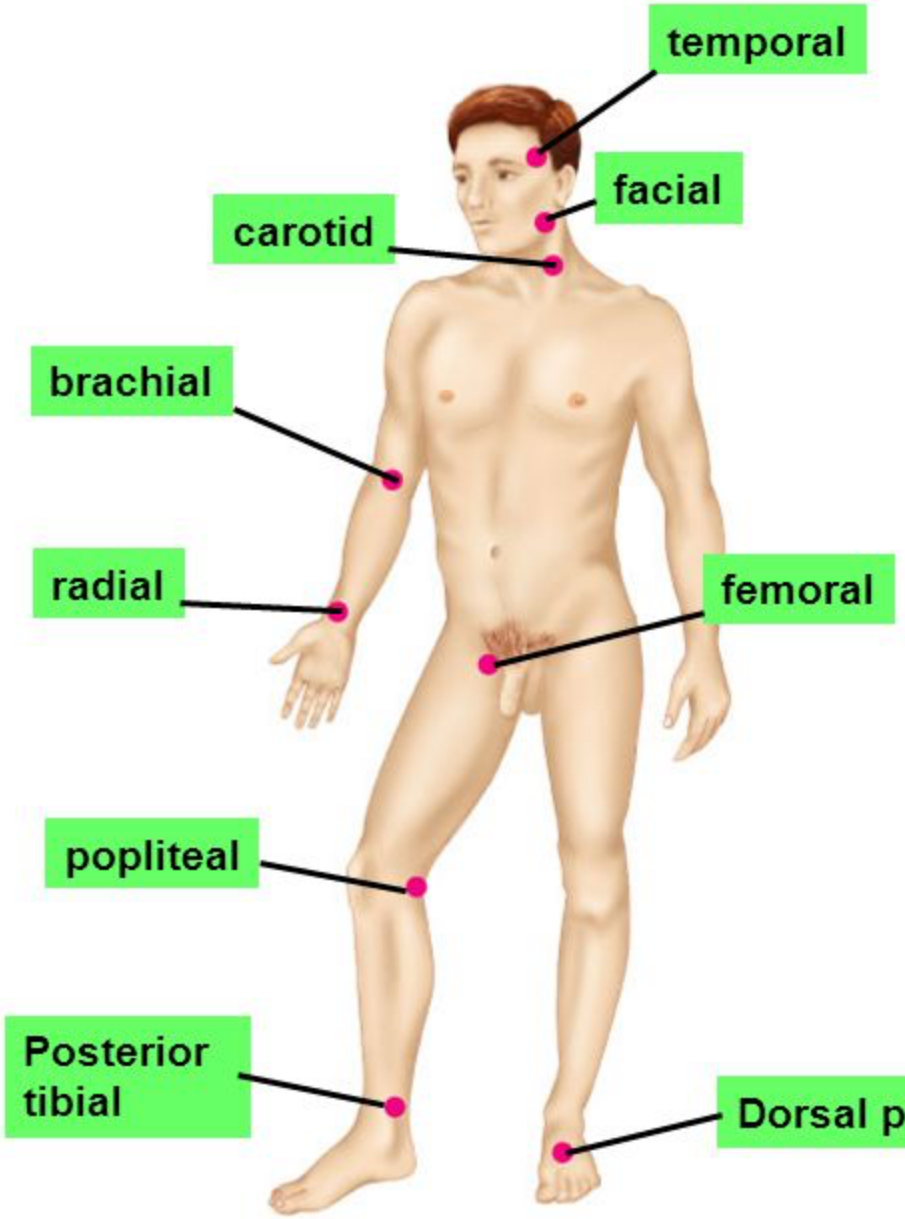
- Palpate superficial pulse points.
  - Common carotid artery
  - Brachial artery
  - Radial artery
  - Posterior tibial artery

- ❑ Palpate each location (photograph or diagram).
- ❑ Estimate HR.
- ❑ Answer question in the supplemental handout

Objective 7: Determine a subject's apical and radial pulse.

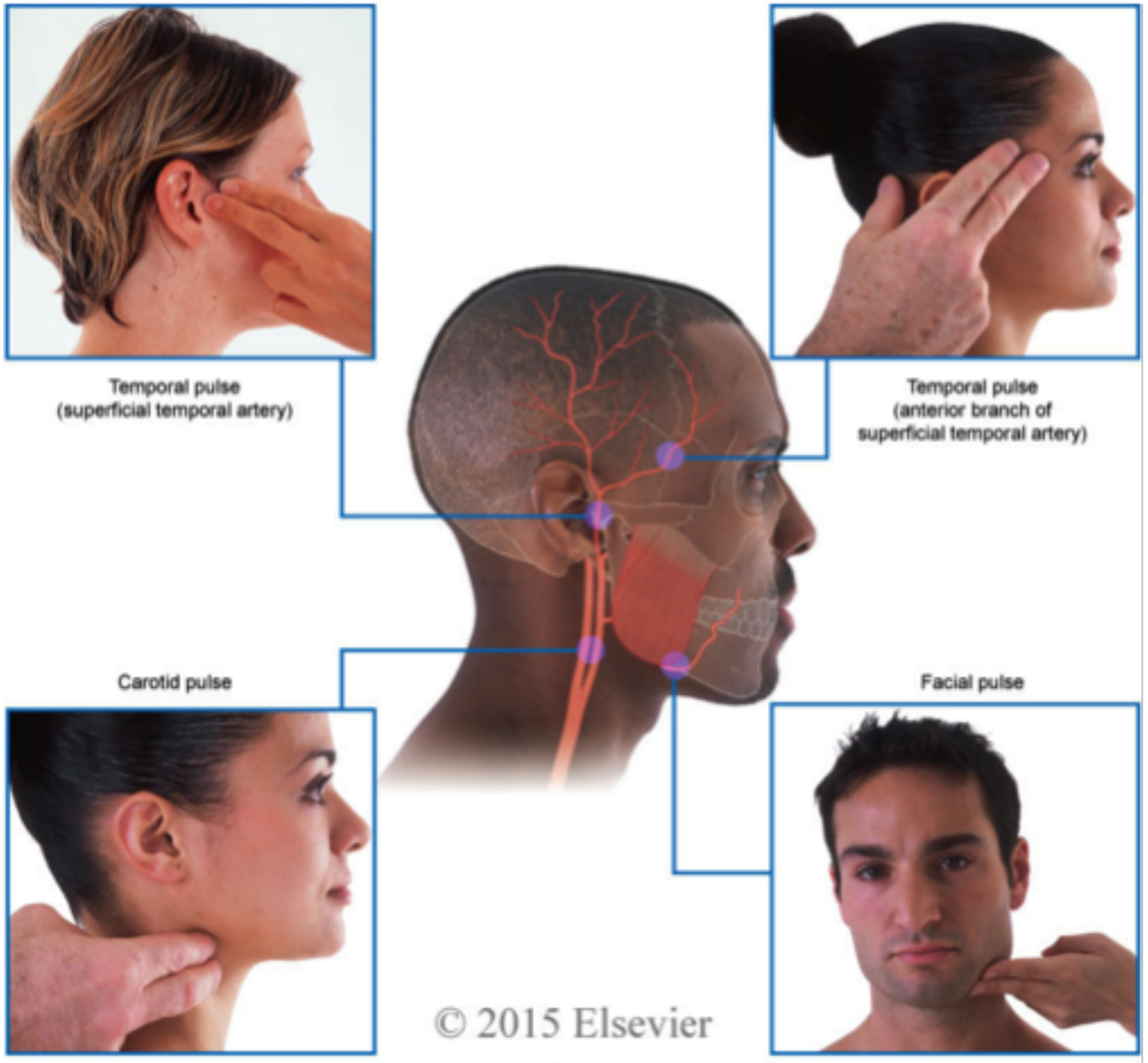
Objective 11: Indicate factors affecting blood flow and skin color.

Superficial Pulse Points- arteries, not veins



60 beats/minute

- Temporal artery
- Facial artery
- Common carotid artery
- Brachial artery
- Radial artery
- Femoral artery
- Popliteal artery
- Posterior tibial artery
- Dorsal pedis artery



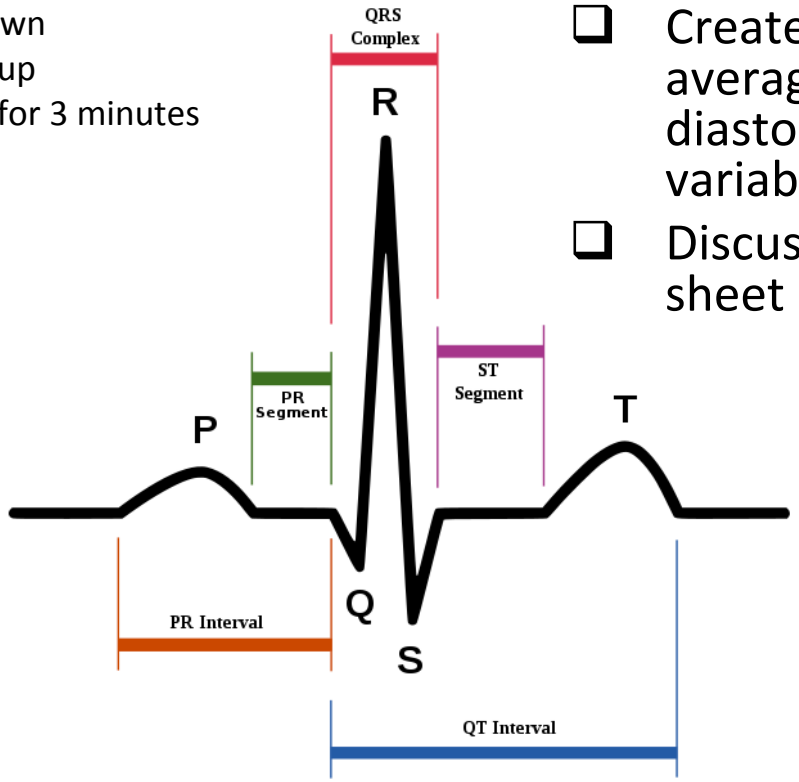
Pulse Points in Upper Limb

Pulse Points in Lower Limb

HUMAN CV PHYSIO: BP & pulse

Effects of body position on BP and pulse.

- Record ECG using the AliveCor iPhone device and App. Record BP using a sphygmomanometer.
  - 1 student from each lab group
    1. Sitting
    2. Laying down
    3. Standing up
    4. Standing for 3 minutes



- ❑ Hypothesis for each variable
- ❑ Complete subject info table
- ❑ Complete BP table & calculations
- ❑ Estimate HR from ECG
- ❑ Pool data for all groups on table
- ❑ Create bar graph comparing average systolic and average diastolic BP and CO for each variable
- ❑ Discussion per supplemental sheet

Hypothesis Statements - Effects of body position and exercise on BP and pulse

Variable	Hypothesis
Sitting (baseline)	
Laying down	
Standing (immediately)	
Standing after 3 minutes	

Your hypothesis statements are placed in the introduction of your paper and discussed (were you right or wrong and why) in the discussion section.

Effects of body position on HR & BP

Subject/ Sex/Age/Wt	Activity	HR	Systolic BP	Diastolic BP	Pulse pressure	MAP	CO
1	Sitting (baseline)						
	Laying down						
	Standing (immediate)						
	Standing (post 3 min)						
2	Sitting (baseline)						
	Laying down						
	Standing (immediate)						
	Standing (post 3 min)						
3	Sitting (baseline)						
	Laying down						
	Standing (immediate)						
	Standing (post 3 min)						

Effects of body position on HR & BP

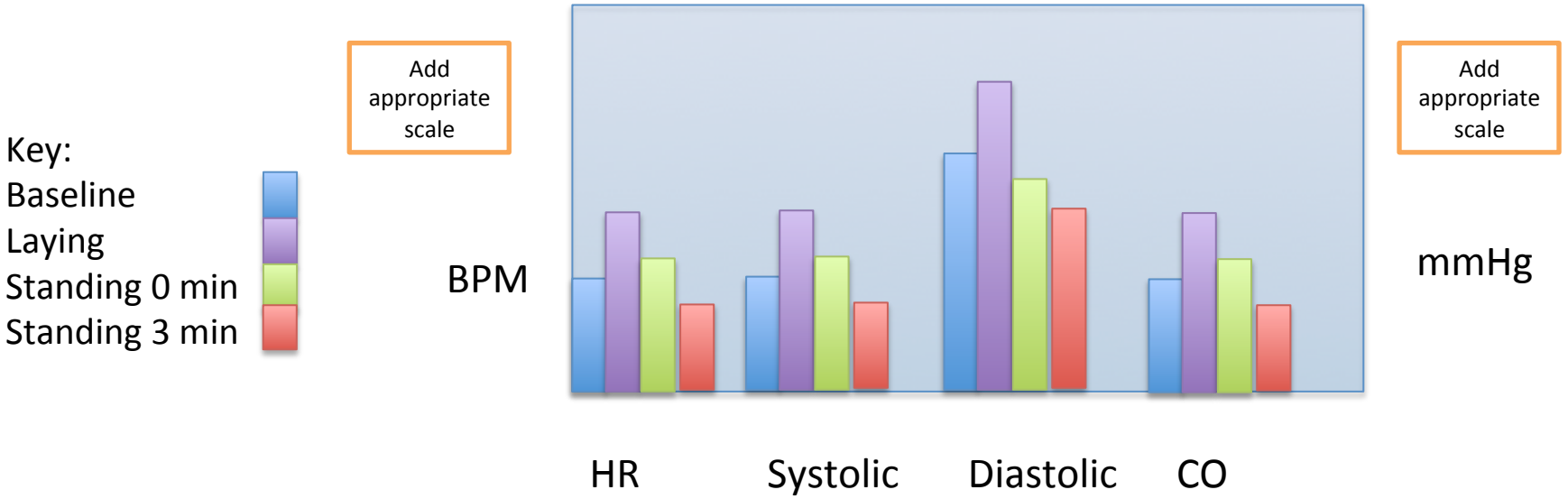
Subject/ Sex/Age/Wt	Activity	HR	Systolic BP	Diastolic BP	Pulse pressure	MAP	CO
4	Sitting (baseline)						
	Laying down						
	Standing (immediate)						
	Standing (post 3 min)						
5	Sitting (baseline)						
	Laying down						
	Standing (immediate)						
	Standing (post 3 min)						
6	Sitting (baseline)						
	Laying down						
	Standing (immediate)						
	Standing (post 3 min)						

Effects of body position on HR & BP

Subject/ Sex/Age/Wt	Activity	HR	Systolic BP	Diastolic BP	Pulse pressure	MAP	CO
AVERAGE of at least 6 readings	Sitting (baseline)						
	Laying down						
	Standing (immediate)						
	Standing (post 3 min)						

Produce a bar graph comparing the effects of each activity using the averages of pooled data. Make sure to correctly label the "Y" axis with Beats per minute for HR and millimeters mercury (mmHg) for the blood pressure readings. You can use both the left and right sides of the box as "Y" axes. Put the appropriate scale along with the axes heading. You need to add a heading and units for Cardiac Output.

#, Title, Description



In your paper, you will need to discuss the findings you represent in these graphs. Talk about normal and what it means when these numbers are too high or too low. Do not discuss the results in the results section. The results section contains your graphs, not data tables or discussion. Data tables are for the lab notebook.

Writing an A&P paper

- Title page
  - Title of paper
  - Names of partners
  - Course
  - Date
- Introduction
  - 1-2 paragraphs
  - Hypothesis statements
  - Overview of what we did and why it is important
  - Summary of most important findings and how their relevance.
- Methods and materials
  - 1-2 pages
  - Describe methods
  - Photos of set up and procedures work really well
  - All photos, figures, graphs, charts, illustrations, diagrams…. Must be sequentially numbered, have a title and brief description. You must also refer to the figure in the text.

Writing an A&P paper

- Results
  - The analyzed data: graphs, NOT tables!!
  - Each experimental procedure should be represented.
    - Conduction
    - Auscultation
    - Pulse points
    - BP and pulse
  - All photos, figures, graphs, charts, illustrations, diagrams…. Must be sequentially numbered, have a title and brief description. You must also refer to the figure in the text.
- Discussion
  - Address whether or not your hypothesis statements were supported by the research.
    - If not, why not… look for sources of error and explain them
    - If yes, what is a next research step?
  - Explain your results in the context of cardiac conduction, the cardiac cycle, blood pressure and pulse.
  - Use the objectives to create an outline, but don't just respond to the objectives, create a narrative.
  - Address how the experiments illustrate clinical procedures and how they differ.
  - Address how the clinical ramifications and any diagnostic potential…

Writing an A&P paper

- References
  - At least three
    - One is the text
    - Two must be primary sources
      - Use Google Scholar and search by key words
      - Find papers dealing with some aspect of our experiments
      - Cite the paper in context
- Style
  - 1” margins
  - 1.5-2 spacing
  - Pitch = 12 for body, 14 for headings
  - Font = Arial or Times (Times New Roman is fine)
  - Use MLA style guide https://style.mla.org or similar, just be consistent.

For additional details, see “How to Write an A&P paper” by Dr. Langston.