

How Physical Activity Can Improve your Health and your Life!

UVic Elder Academy, October, 2017

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Regular moderate physical activity:

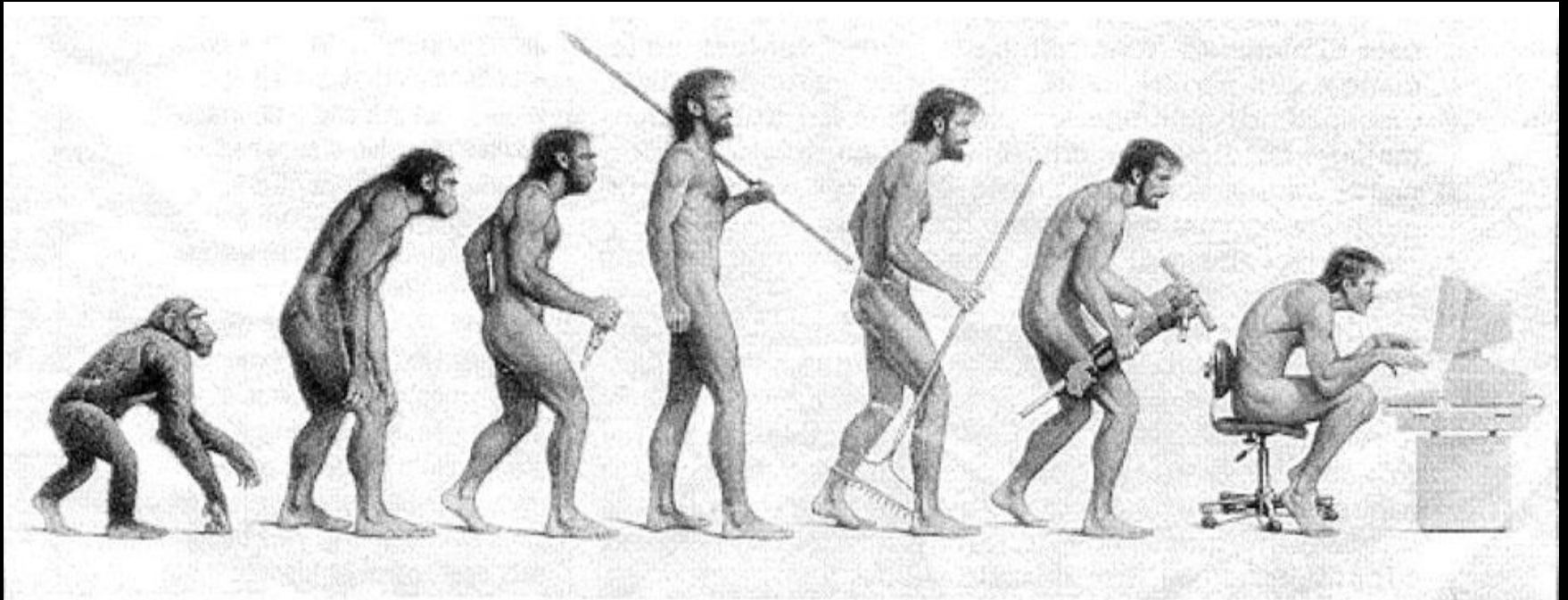
- Decreases the risk of CVD and CHD
- Decreases the risk of colon cancer
- Decreases the risk of developing non-insulin dependent diabetes (Type II)
- Prevents or delays development of high blood pressure → CKD!!
- Enhances the immune system
- *Relieves symptoms of depression and anxiety*

But research also tells us that being moderately physically active:

- maintains bone health (preventing or offsetting osteoporosis)
- prevents muscle loss (sarcopenia)
- decreases the risks of falls and associated health problems
- helps maintain functional activities for daily living (e.g. getting in and out of chairs, reaching for objects, going up and down stairs)
- Gives you more get up and go! (energy)
- **preserves cognitive function (preventing cognitive impairment and dementia)**

The human body was designed to be active.



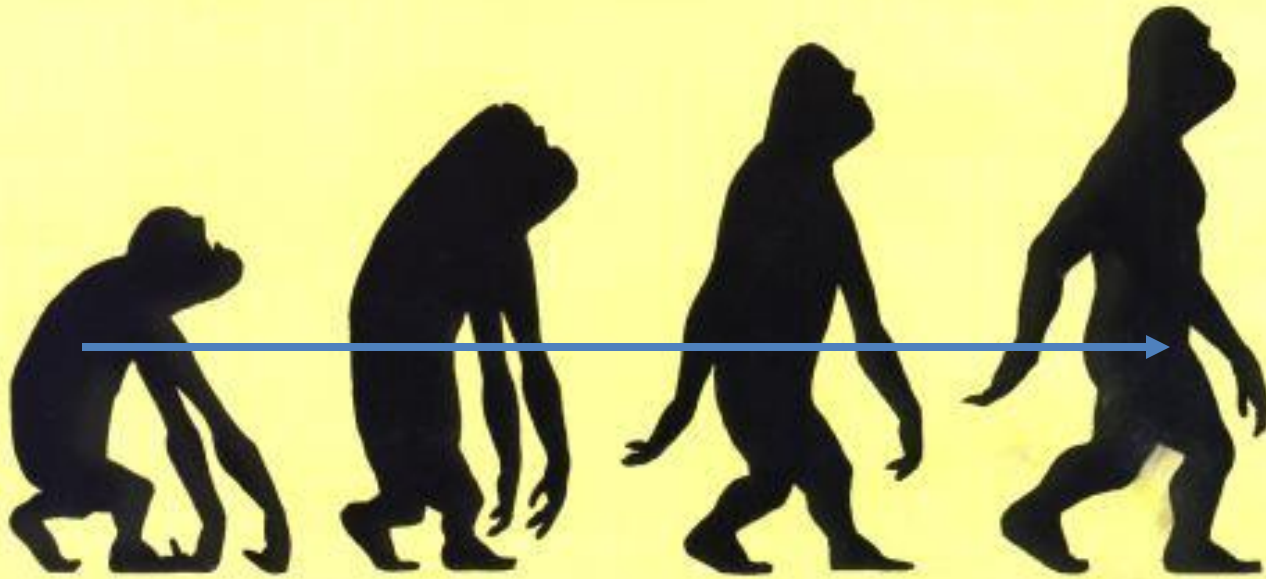


Increase in sedentary behaviour:

Leading to an increase in hypokinetic diseases (Kraus & Raab, 1961)

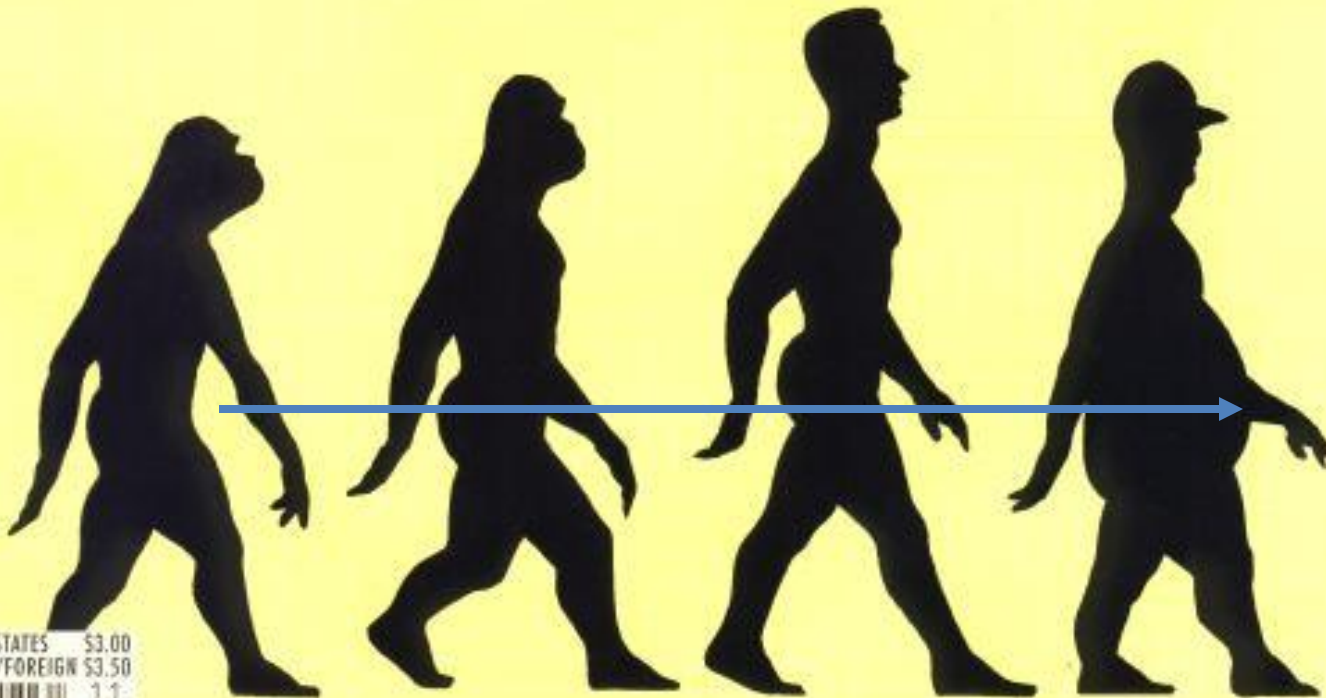
And the winner is...
A drive by funeral home!





The
evolution
of man!

Increase in
body mass
(fat!)



Times Colonist, Sat. Oct 15th, 2005

In fact:

*“.....exercise and (physical) activity are
the fountain of youth”*

(Colin Milner, CEO, International Council on Aging)

In fact:

Physical *inactivity* is a high risk factor and one of the strongest predictors of mortality

(equal to smoking!!!)

Surgeon General's Report, 1996

Putting physical activity back into our lives regardless of age!





Series of presentations.

1. The effects of physical activity on the cardiovascular system
2. The effects of physical activity on retaining memory and cognition
3. The effects of physical activity on strength
4. The effects of physical activity on balance/falls

Focus: The theory, rationale (research), and practices to achieve positive outcomes.

Series of presentations.

1. *The effects of physical activity on the cardiovascular system*
2. The effects of physical activity on retaining memory and cognition
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Focus: The theory, rationale (research), and practices to achieve positive outcomes.

1. The effects of physical activity on the cardiovascular system

- What is cardiovascular fitness/health?
- How does it relate to aerobic fitness/health
- How does physical activity affect cardiovascular/aerobic fitness/health.
- What are the ways/methods you can enhance cardiovascular health through physical activity?
- How much do you need to do?

Benefits of Regular Physical Activity (1)

- *Improvement in cardiovascular and respiratory function*
 - Decreased O₂ consumption at a given submax intensity
 - Decreased HR and BP at a given submax intensity
 - Decreased myocardial cost for a given submax intensity
 - Decreased minute ventilation at submax intensity
 - Longer duration at sub max intensity (<LT).
 - increased exercise threshold for onset of disease signs or symptoms (e.g. angina, claudication, ECG changes)

Benefits of Regular Physical Activity (2)

- *Reduction in cardiovascular disease risk factors*
 - Reduced resting systolic/diastolic pressure (BP)
 - Increased HDL and decreased TG
 - Reduced total body fat including intra-abdominal fat
 - Reduced insulin needs, improved glucose tolerance
 - Reduced platelet adhesiveness and aggregation
 - Reduced arterial inflammation
 - Secondary prevention re MI's

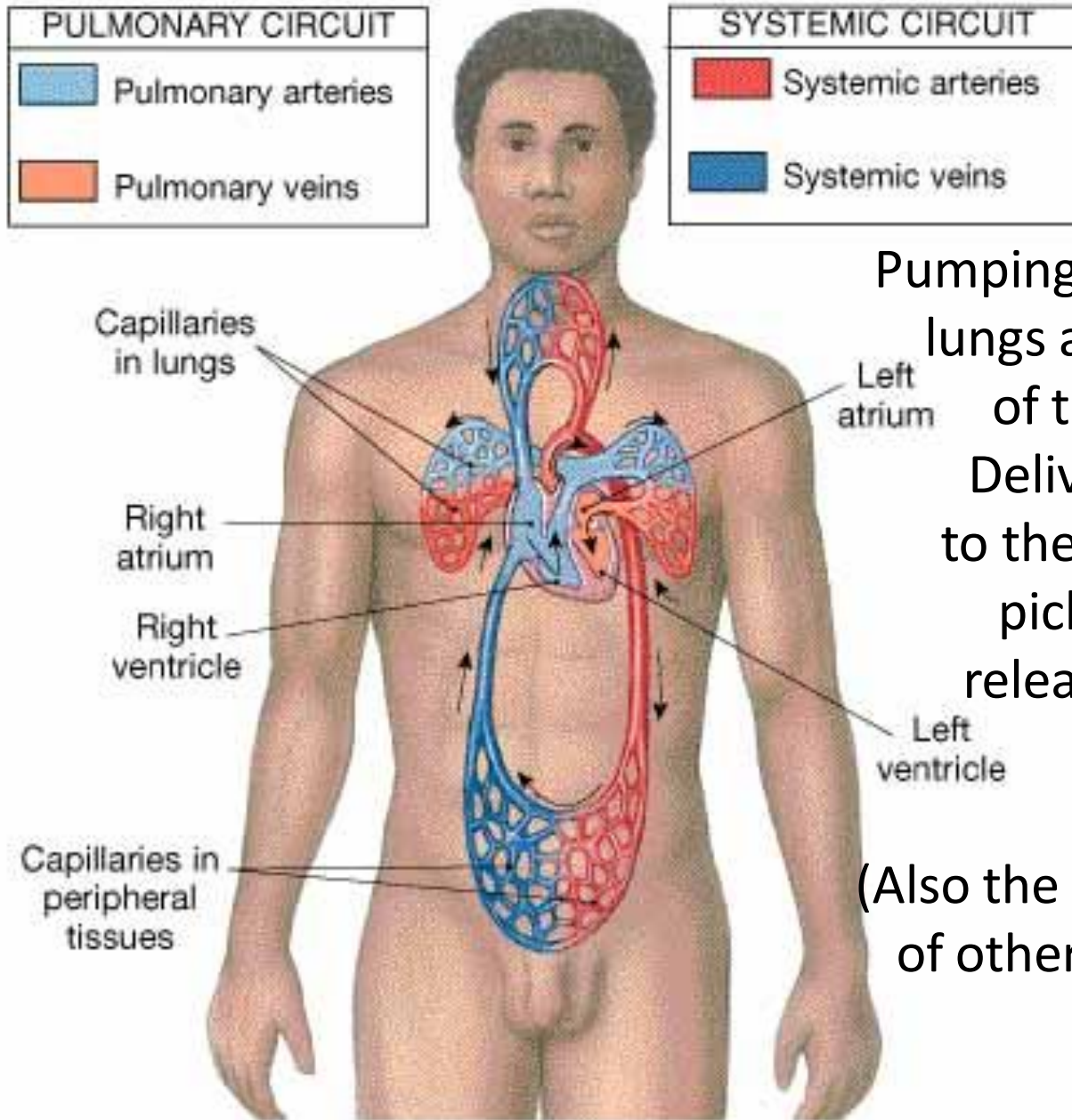
Relationship of cardiovascular, cardio respiratory, and aerobic fitness

- It really all has to do with our need to produce **energy** in order to function
- The only currency of energy is **ATP**
- We have three ways we produce ATP
 - Two of the ways do not require oxygen (anaerobic): are quick but little reserve
 - The most common way does require oxygen (aerobic): is slower but infinite reserve

Anatomy and function



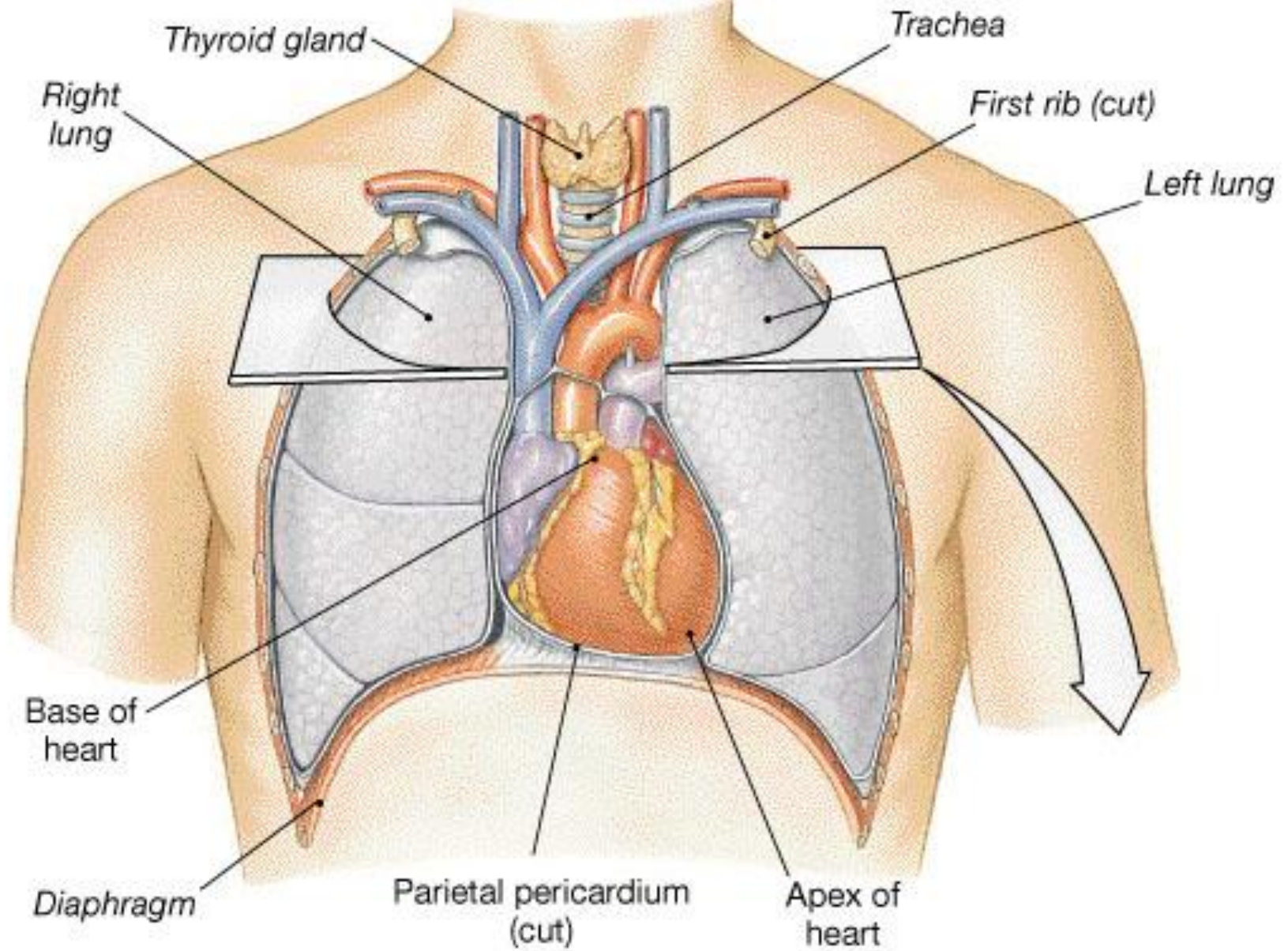
Pulmonary and systemic circuits



Pumping blood to the lungs and the rest of the body. Delivery of O_2 to the body and pick up and release of CO_2 .

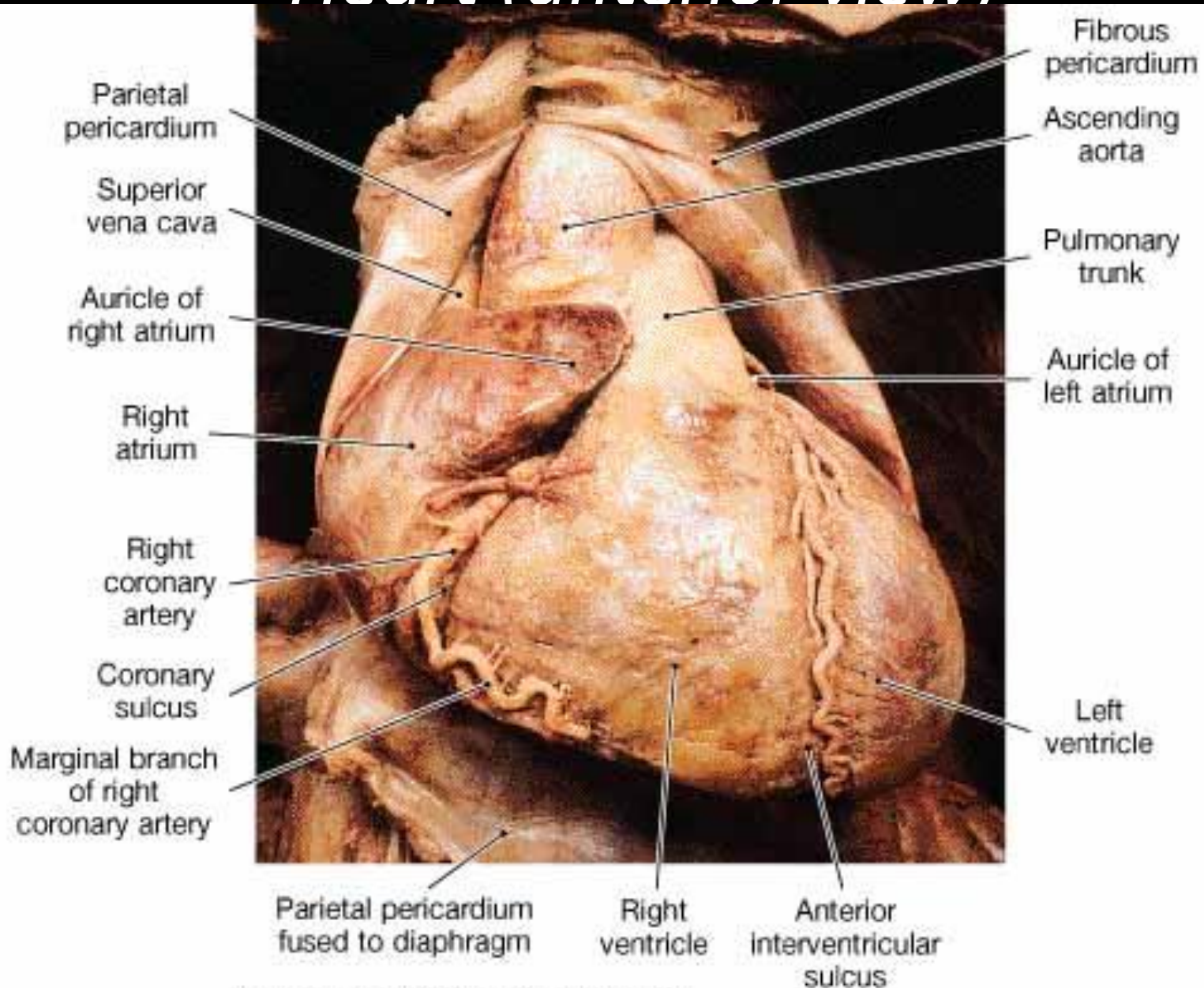
(Also the transportation of other substances)

Location of the heart (anterior view)



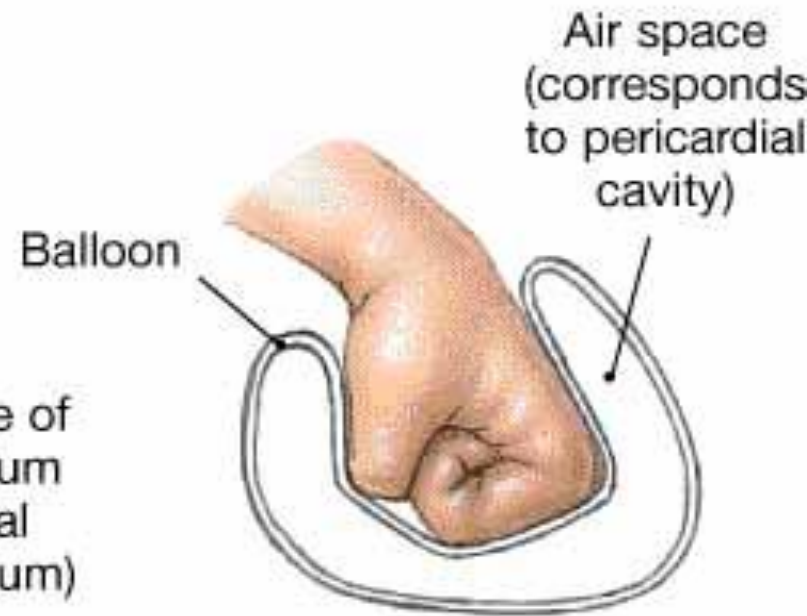
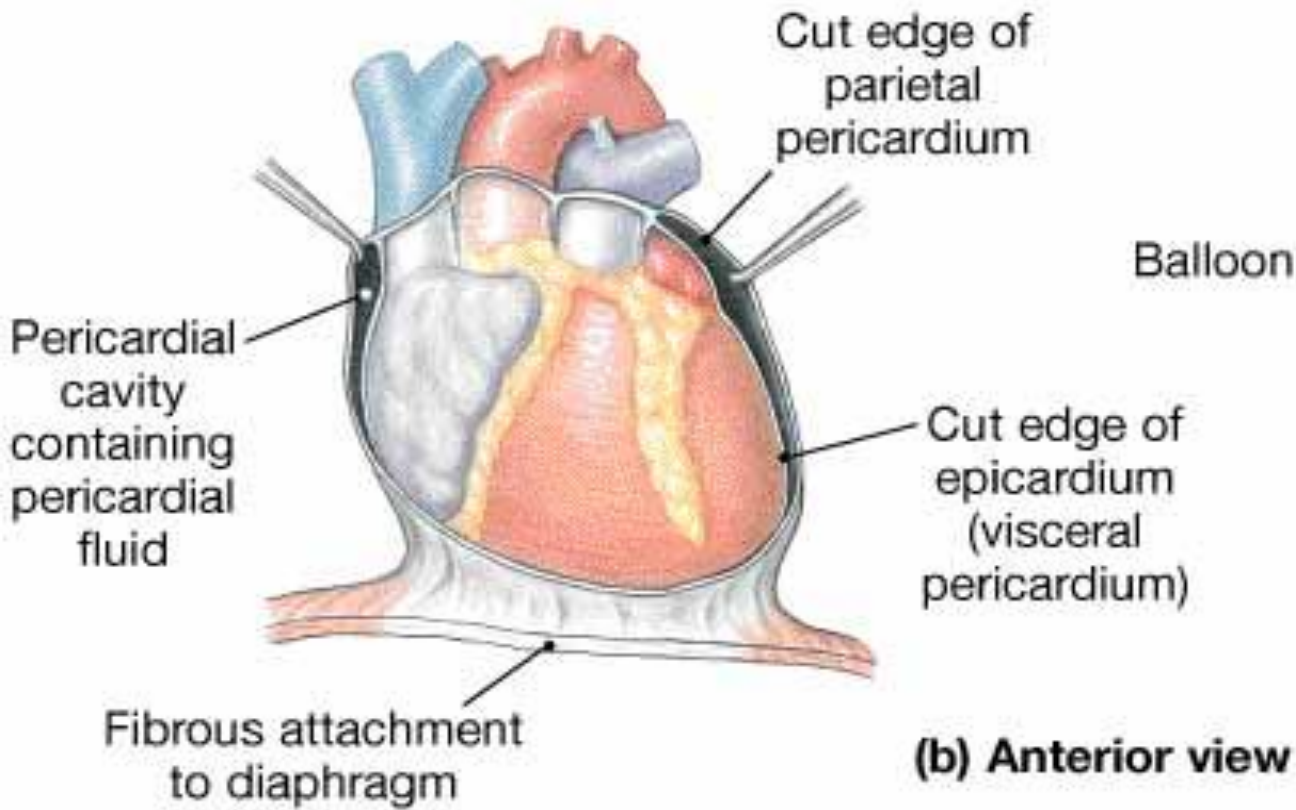
(a) Anterior view

Heart (anterior view)

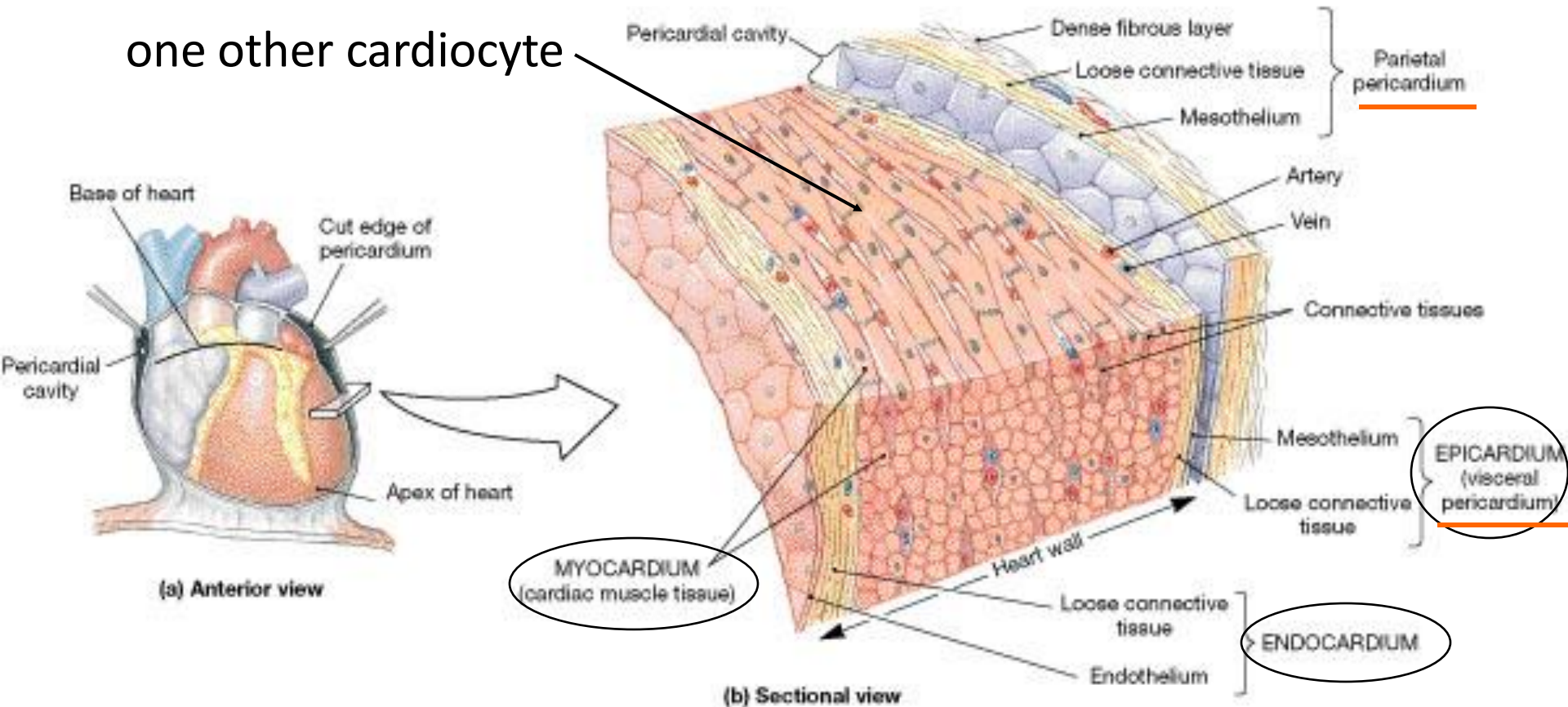


(a) Anterior (sternocostal) surface

The pericardium (anterior view)

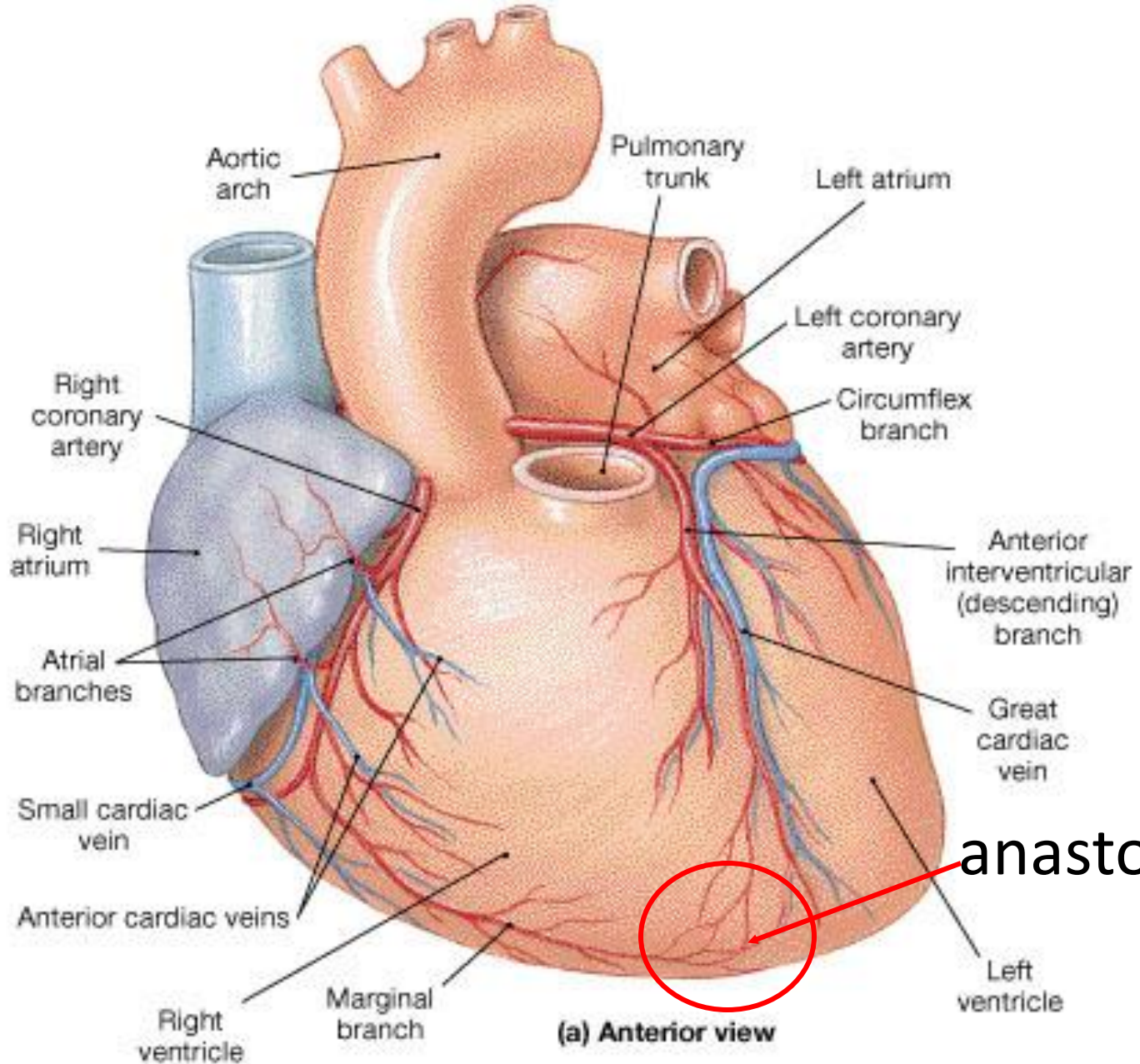


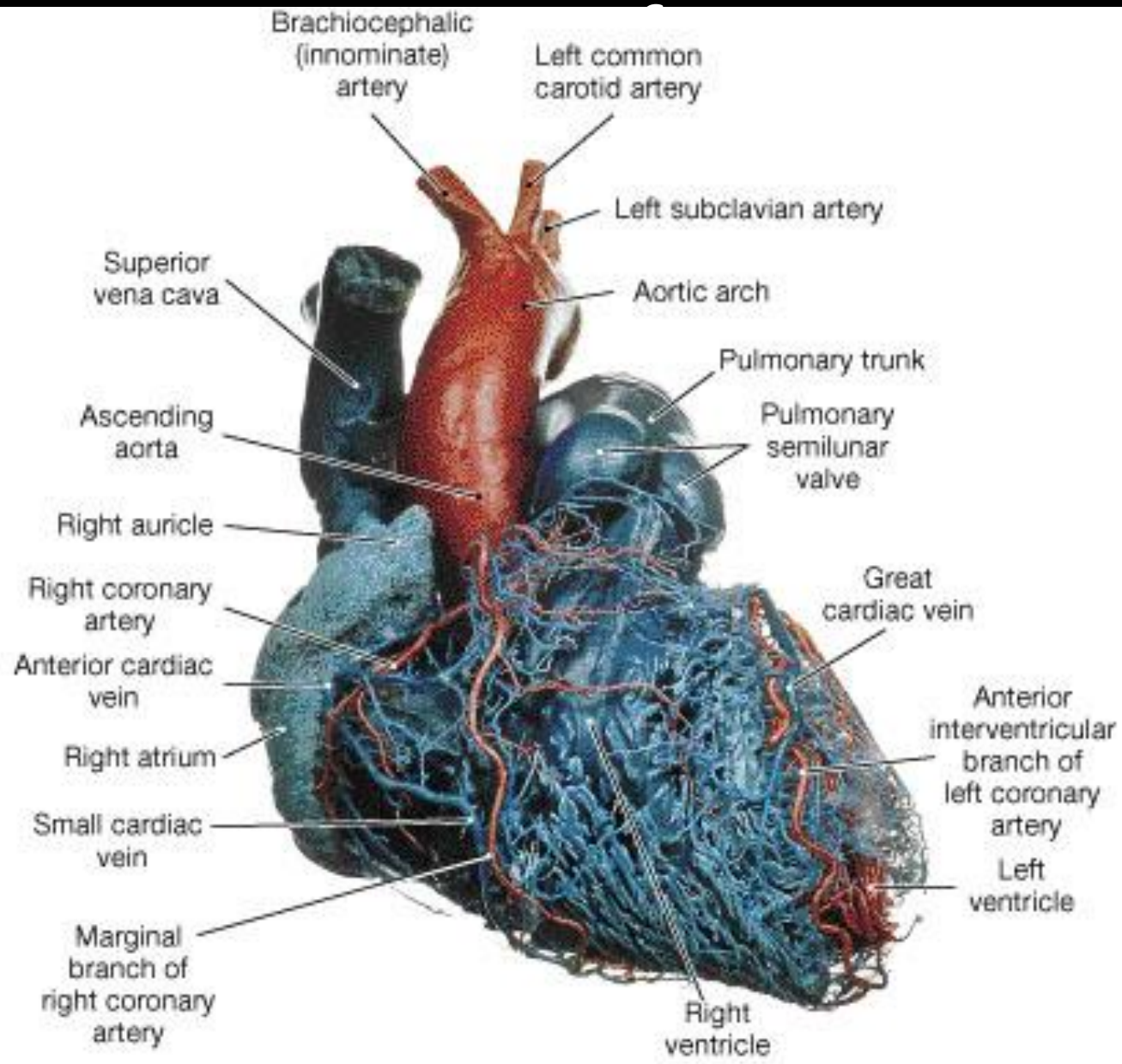
NB: a single cardiocyte connects with more than one other cardiocyte



NB: three layers of the heart (endocardium, myocardium, epicardium)

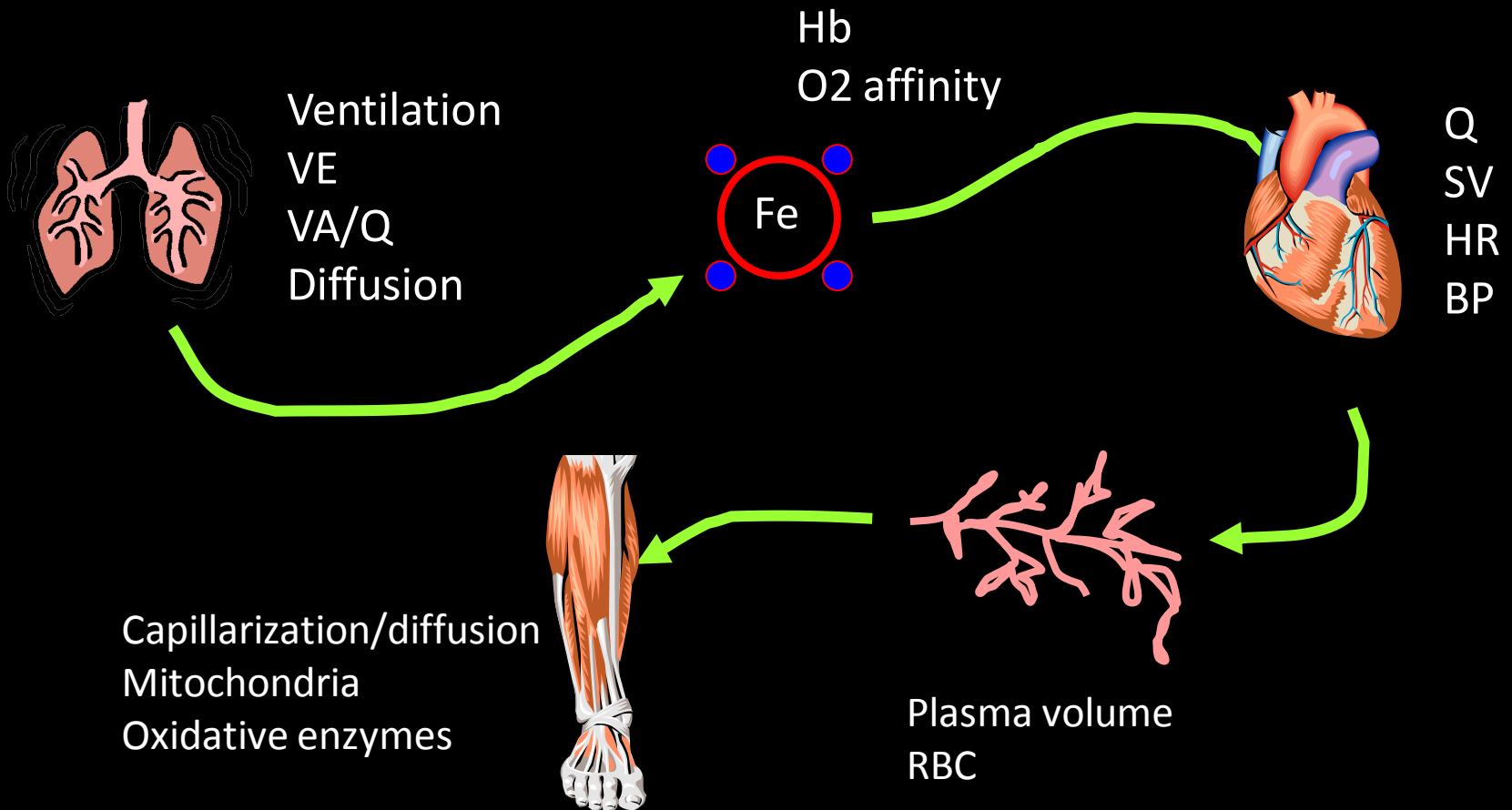
Coronary vessels (anterior view)



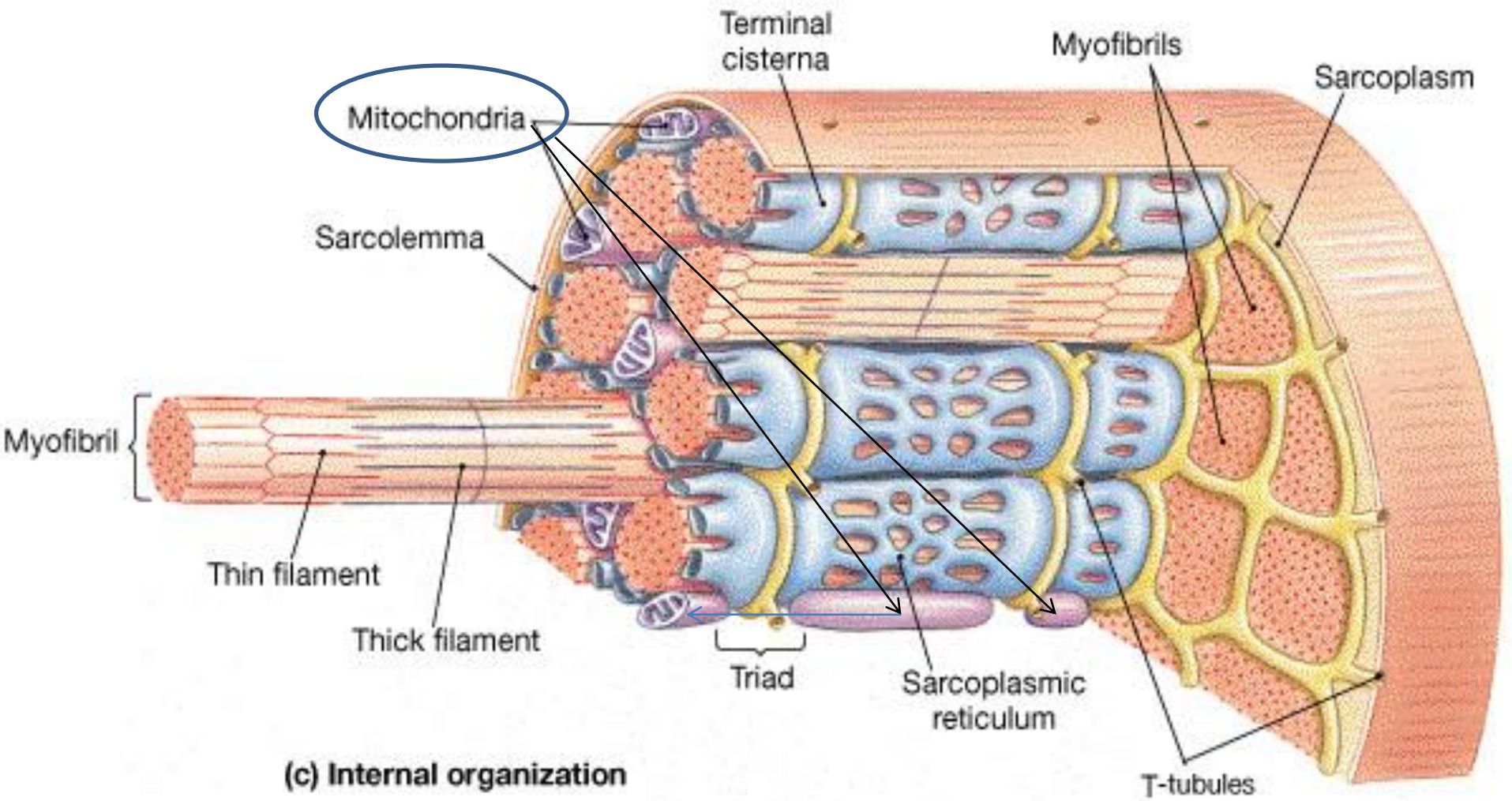


(c) Coronary circulation and great vessels, anterior view

Aerobic Fitness



Myofibril packaging (internal organization)



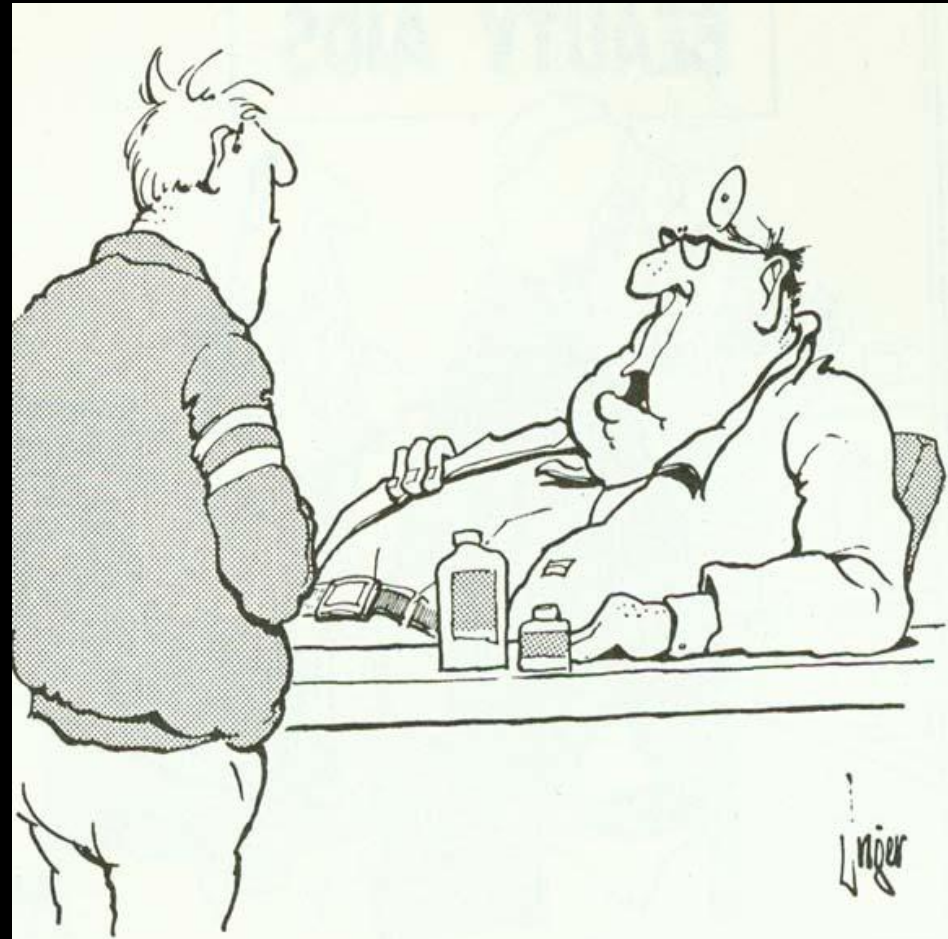
The goal !

- Expending 3-4 kcal per kg per day (for a 60 kg person this would mean 240 kcal)
- Expend at least **900-1000** calories per week by being **moderately physically active**

Surgeon General's Report, 1996; US Federal Physical Activity Guidelines Committee, 2008

Important questions?

- What is meant by moderate physical activity?
- How much do we need (what is 900 calories of physical activity)?
- How can we achieve it?
- What are the best ways of doing it?

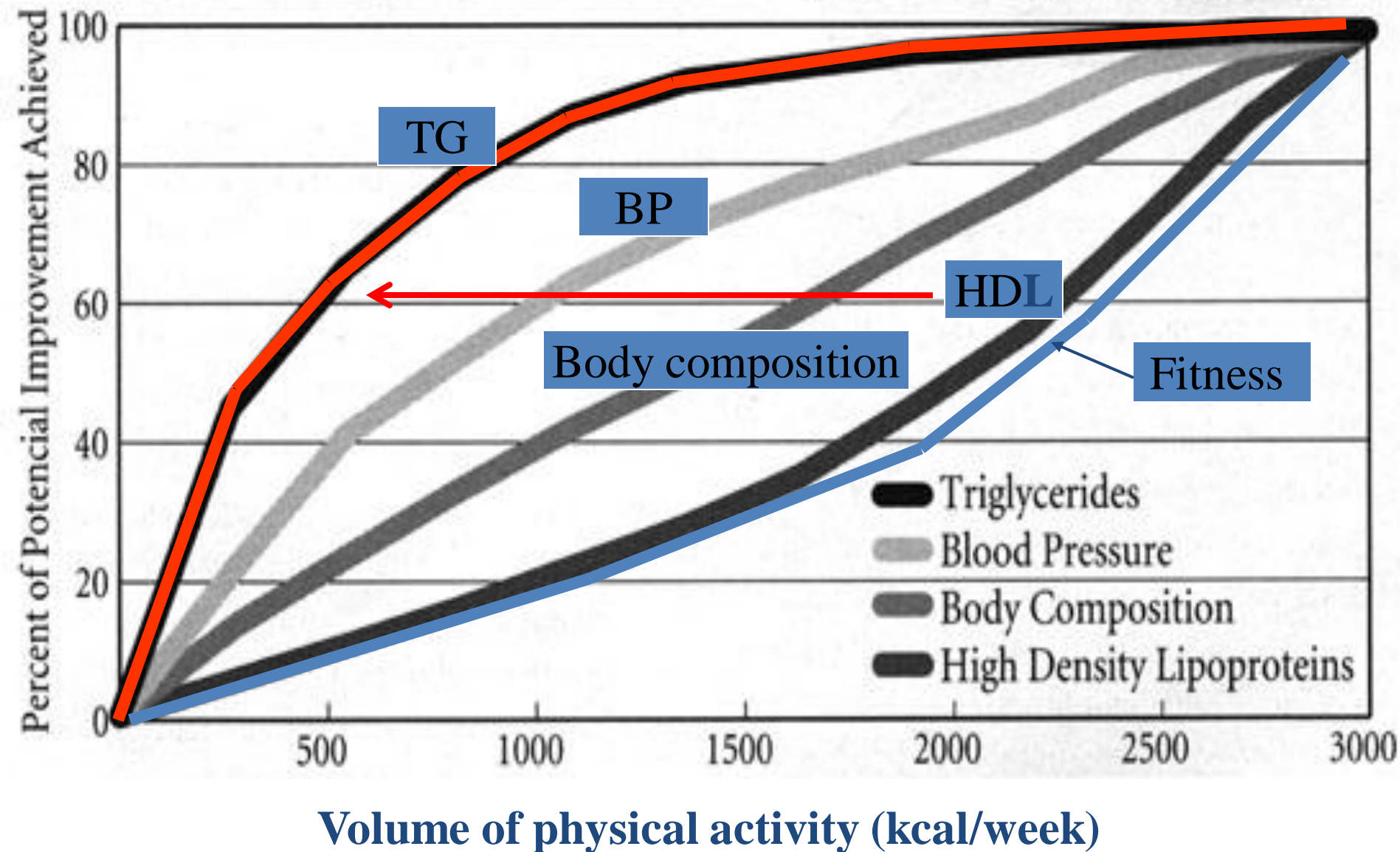


"Are you eating properly and getting plenty of exercise?"

FIGURE 1-3

DOSE-RESPONSE RELATIONSHIP

for Health Benefits and Volume of Physical Activity Participation



Prescription or guidelines for Physical Activity

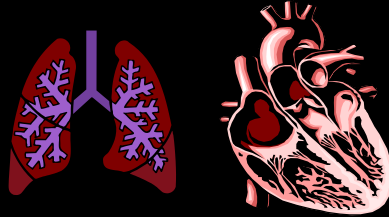
- American Heart Association
- American College of Sports Medicine
- World Health Organization
- Canadian Society of Exercise Physiology
- Heart and Stroke Foundation (Canada)
- British Medical Association

???????????

Physical Activity to Enhance Aerobic Energy System

Continuous

Interval



Guidelines: engage in

1. Continuous Physical Activity

- 30 min of moderate physical activity per day for 5-6 days per week
- 20 min of vigorous physical activity 3 days per week
- 10 min of moderate physical activity 3 times per day for 5-6 days per week
- 10,000 steps a day
- Continuous physical activity (training)



2. Aerobic interval training

- Interval training involves a period of high intensity effort (30s-3min) followed by an equal or greater time of active rest (30s-3min) repeated 5-10 times
- Suggested it targets the oxidative mechanisms in muscle by making the muscle hypoxic (increases oxidative enzymes and number of mitochondria). Also considered to offset some of the effects of aging (*from Cell Metabolism, 2017*)

Astrand, Rodahl, Dahl, & Stromme, 2003, Bell & Wenger, 1986. Gaiga & Docherty, 1995. Rhodas et al., 2000, MacDougall et al., 1998.

More recent approaches *(high intensity interval training:HIIT)*

- What is HITT?
- High intensity efforts with short recovery periods
 - 10 maximum efforts of 60s work with 60s active recovery (total time=20 min)
 - 4-6 maximum efforts of 30s work with 4 min active recovery (total time=20-27 min)
 - *8 maximum efforts of 20s work with 10s active recovery (total time=4 min!)
 - 3 maximum efforts of 20s work with 2 min active recovery (total time=2 min!)

- Used with many different populations including those with CHD and other chronic conditions (diabetes, obesity)
- Produces equal or better fitness and health outcomes compared to long duration endurance training (e.g. 30-60 min at lower intensity)

Little et al., 1985, Currie et al., 2013, Gibala & Jones, 2013, Gillan et al., 2013, Currie et al., 2012, Kessler et al., 2012

Mode of activity

- Cycling ergometer (stationary bike!)
- Running (treadmill or track)
- Whole body activity (e.g. burpees, jumping jacks, push ups etc.)
- Resistance exercise (e.g. body weight squats)

Tabata, 1996, Gillan, , Gabala, McCrae et al., 2012, Rozenek et al., 2007, and Kates, 2014

Intensity of effort:

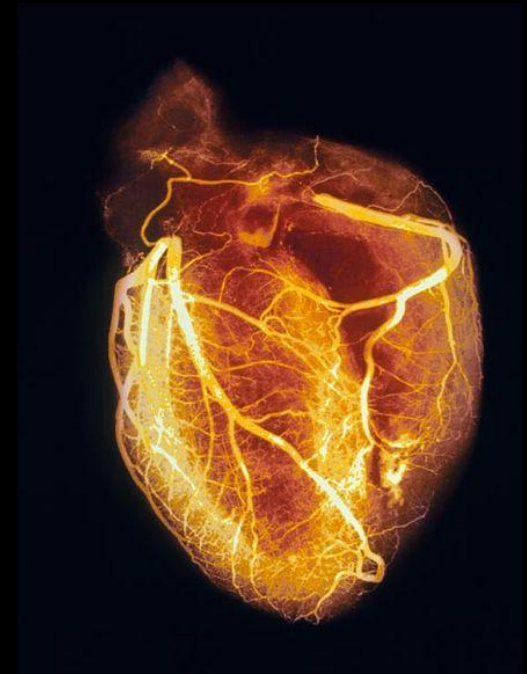
- Many studies 80-85% MHR
- 100% MPO
- 100% VO₂ max (MAP)
- 170% PO at MAP

Compared to 70% MAP with endurance studies.

McMaster Group, Tabata group.

ACSM Exercise Intensity Levels (per cent of maximal heart rate-%MHR)

- Light (35-54%MHR)
- Moderate (55-69%MHR)
- Moderately-intense (70-89%MHR)
- Very heavy/intense (90%+MHR)
- Maximal/very intense (100%MHR)



Rate of perceived Exertion (RPE)

RPE Scale

(Rate of Perceived Exertion)

1	Very Light Activity (anything other than complete rest)
2-3	Light activity (feels like you can maintain for hours, easy to breath and carry on a conversation)
4-5	Moderate Activity (feel like you can exercise for long periods of time, able to talk and hold short conversations)
6-7	Vigorous Activity (on the verge of becoming uncomfortable, short of breath, can speak a sentence)
8-9	Very Hard Activity (difficult to maintain exercise intensity, hard to speak more than a single word)
10	Max Effort (feels impossible to continue, completely out of breath, unable to talk)



"Two week's of jogging and so far he's made the front door."

Safety!

- HITT has been safely conducted with a variety of at-risk groups
- If you are contemplating doing it check with your doctor to find if it is appropriate and the safe limits in which you can exercise.

However.....

- Some activity is better than no activity!!

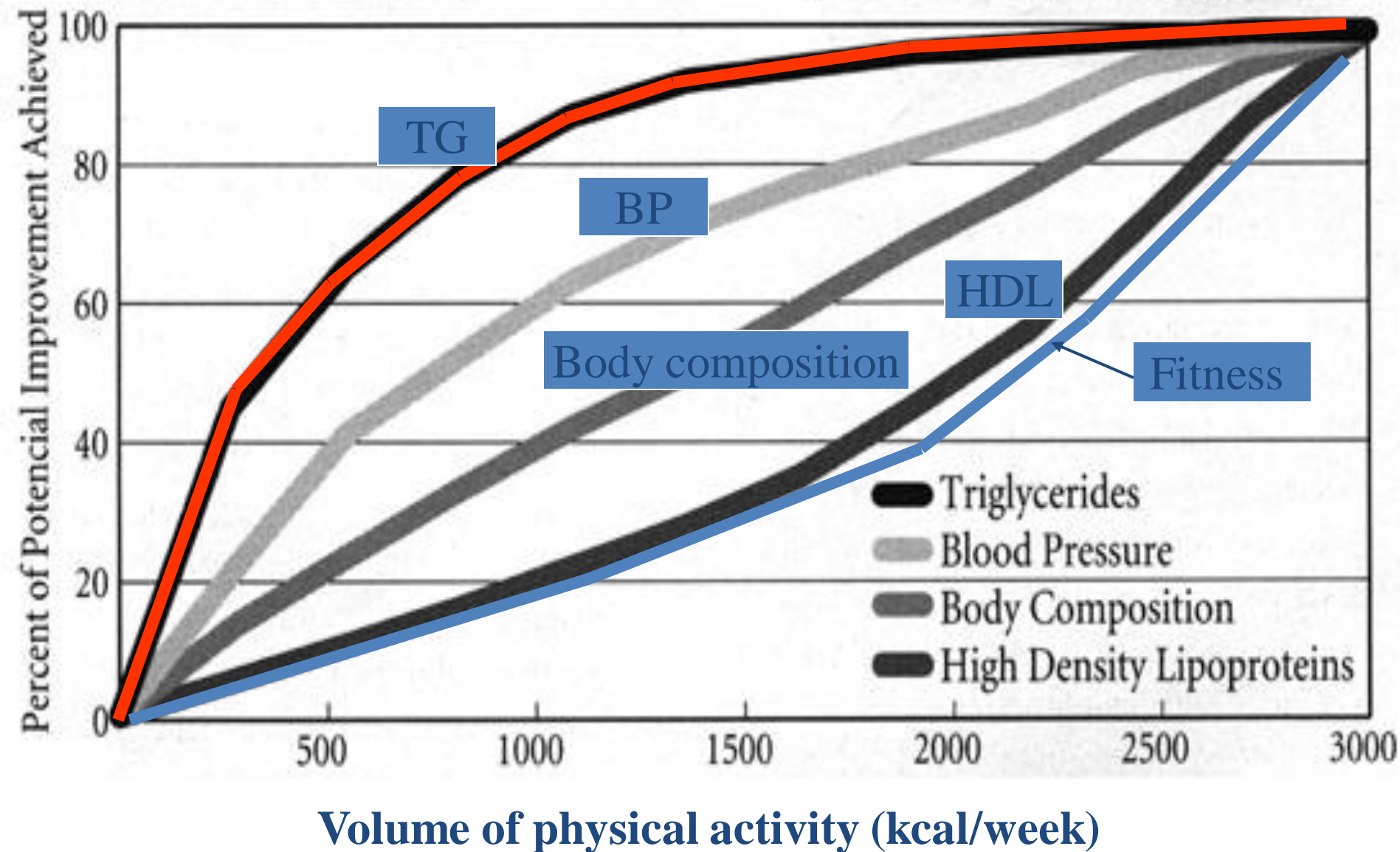


"ONE."

FIGURE 1-3

DOSE-RESPONSE RELATIONSHIP

for Health Benefits and Volume of Physical Activity Participation



Ways of increasing physical activity level to recommended levels

From this.....to.....this!



Work! Manual labour or a job with a lot of activity (e.g. postal deliverers, bus conductors!)



18,000 steps!

Building it into daily living (stairs, escalators, walking to work/activity, bike riding, house work, gardening



Recent article

- Studied 300,000 people in 17 different countries (30-70 years of age).
- Looked at amount of physical activity related to mortality and CVD over 7 years.
- Those engaging in physical activity (planned or job related) for 150 min/week had reduced risk of death by 28% and CHD by 20%.
- LISS (light intensity steady state) activity provides health benefits but probably requires more volume (750 min)!

Lear et al, et al... The Lancet, September 21, 2017)

Planned physical activity (walking groups, exercise classes, going to the gym)



"When we say 'parents invited' we usually mean to sit and watch."

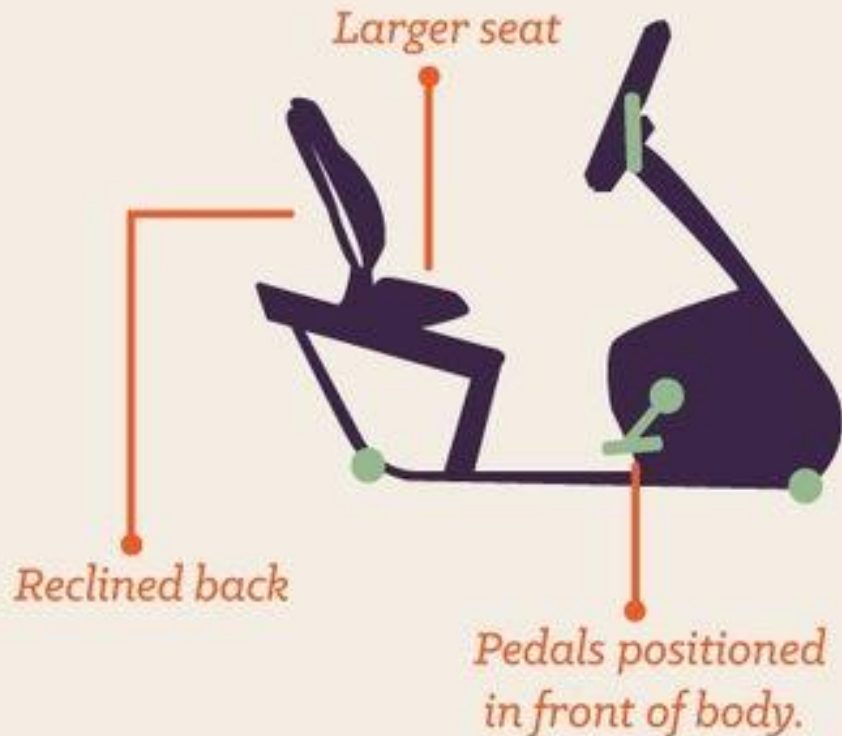


"Herman, don't go too far you'll miss Gunsmoke."

Best bike for you?

IDENTIFICATION

•RECUMBENT•



•UPRIGHT•



Benefits of recumbent bike

- Recumbent bikes are **easier on the lower back (lumbar spine)** due to the way that you sit in the bike. While an upright bike has you hunched over the handlebars, a recumbent bike encourages better spinal posture.
- Recumbent bikes are **gentle on all your joints**. Your lower back is supported by the bucket seat and your knees and ankles are protected from potential injurious impact.
- The fact that the **seat is larger** on a recumbent bike tends to be one of the most enticing features. An upright bike generally has a smaller seat and can be uncomfortable for many riders.

Further benefits.....

- Recumbent bikes are **generally safer** because you cannot stand up on the pedals. This eliminates many of the injuries that occur when using an upright bike.
- A recumbent bike is a **good choice for most people with neurological conditions** since the bike provides a workout for individuals of all ability levels. It is safe and provides a low impact total body workout.
- Due to the **low impact** the recumbent bike reduces the risk of pain and can build strength. If your back and hips are affected by rheumatoid arthritis, a recumbent bike may be easier to use due to the reclining position with your weight spread over your back and buttocks.

Exerpeutic 1000X



\$300: Walmart (4.5 stars)

Take home message



Recommendations:

- Do some form of moderate *aerobic activity* for 30 min, 5 days per week (it can be in increments of 10 min)

or

- Do some form of vigorous *aerobic activity* 3 days a week for 20 min continuous

or

- Some form of **HIIT** 3 days per week!

or

- combination





“Is that your idea of exercise — buying a book on jogging?”

Thank you

Questions?

85% of people believe physical activity is important for their health **but.....**

- The Canadian Health Measures Survey found only **15%** of Canadian **adults** achieve this minimal level of PA per week!
- And this **drops off after 65** years of age!

Colley et al., 2011.

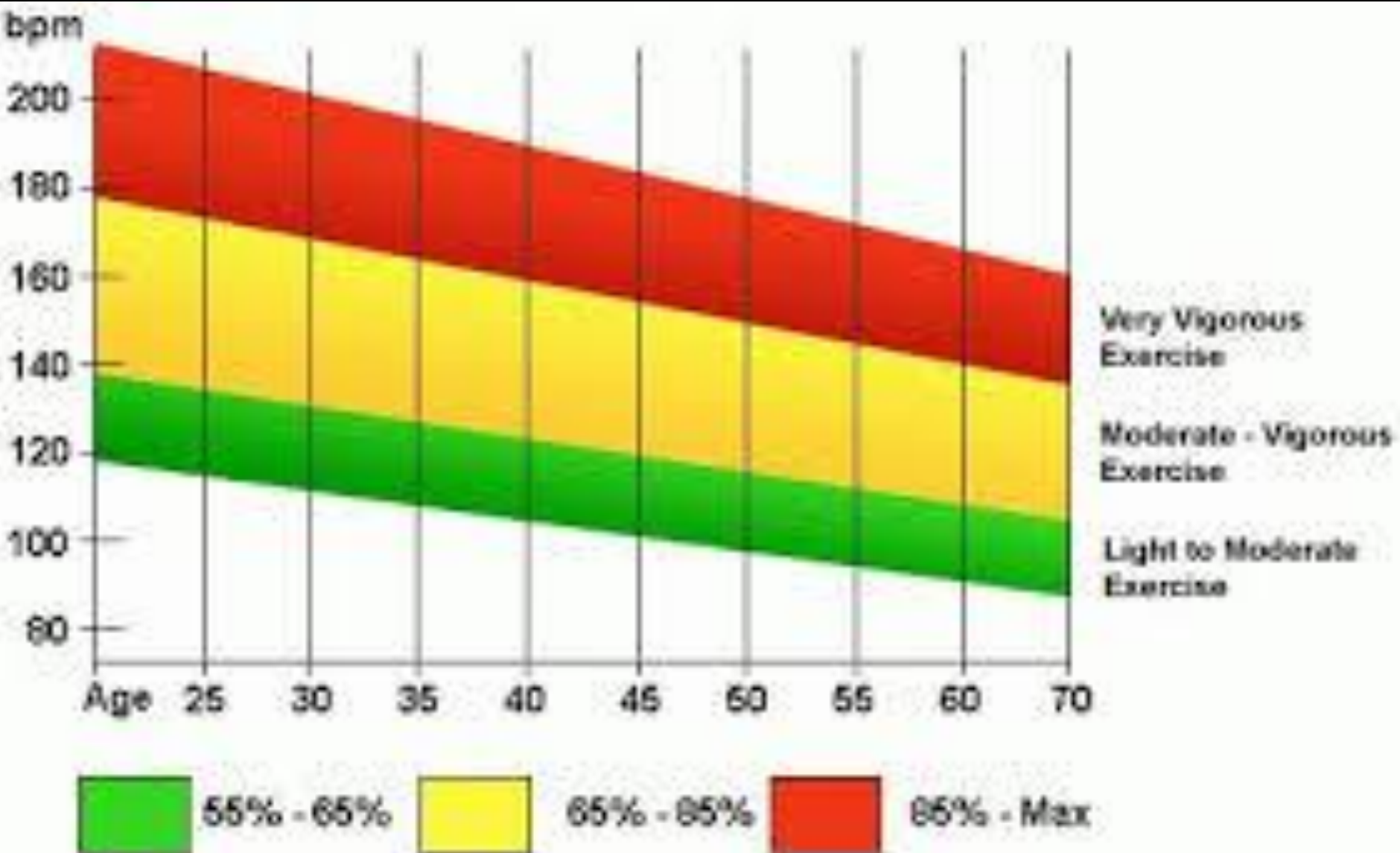
Reasons for not achieving minimal levels of PA

- Lack of facilities
- Lack of equipment
- Personal and social reasons **BUT**
- **Lack of time is consistently reported as the #1 barrier!!**

No time to be physically active?



Exercise intensity based on age



Exercise intensity (METs)

TABLE 1.2. CLASSIFICATION OF PHYSICAL ACTIVITY INTENSITY

INTENSITY	RELATIVE INTENSITY		ABSOLUTE INTENSITY RANGES (METs) ACROSS FITNESS LEVELS			
	VO ₂ R (%)	MAXIMAL HR (%)	12 MET VO _{2max}	10 MET VO _{2max}	8 MET VO _{2max}	6 MET VO _{2max}
	HRR (%)	HR (%)				
Very light	<20	<50	<3.2	<2.8	<2.4	<2.0
Light	20-39	50-63	3.2-5.3	2.8-4.5	2.4-3.7	2.0-3.0
Moderate	40-59	64-76	5.4-7.5	4.6-6.3	3.8-5.1	3.1-4.0
Hard (vigorous)	60-84	77-93	7.6-10.2	6.4-8.6	5.2-6.9	4.1-5.2
Very hard	≥85	≥94	≥10.3	≥8.7	≥7.0	≥5.3
Maximal	100	100	12	10	8	6

METs, metabolic equivalent units (1 MET = $3.5 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$); VO₂R, oxygen uptake reserve; HRR, heart rate reserve; HR, heart rate.

Adapted from U.S. Department of Health and Human Services. *Physical activity and health: a Report of the Surgeon General*. Washington (DC): Atlanta, GA: Center for Disease Control and Prevention; 1996. American College of Sports Medicine. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc.* 1998;30:575-81. Howley ET. Type of activity: resistance, aerobic and intermittent occupational physical activity. *Med Sci Sports Exerc.* 2001;33:5364-9.

Effects of high-intensity training on endurance performance

- Studies have been conducted that have used a variety of interval protocols with work intervals lasting from 15s to 4 min and rest periods from 10s to 4.5 min.
- They have all demonstrated improvements in MAP or distance performance.
- “More research is needed to establish the most effective form of interval training required to improve endurance performance”.

(Finn, 2001)



“Two week’s of jogging and so far he’s made the front door.”

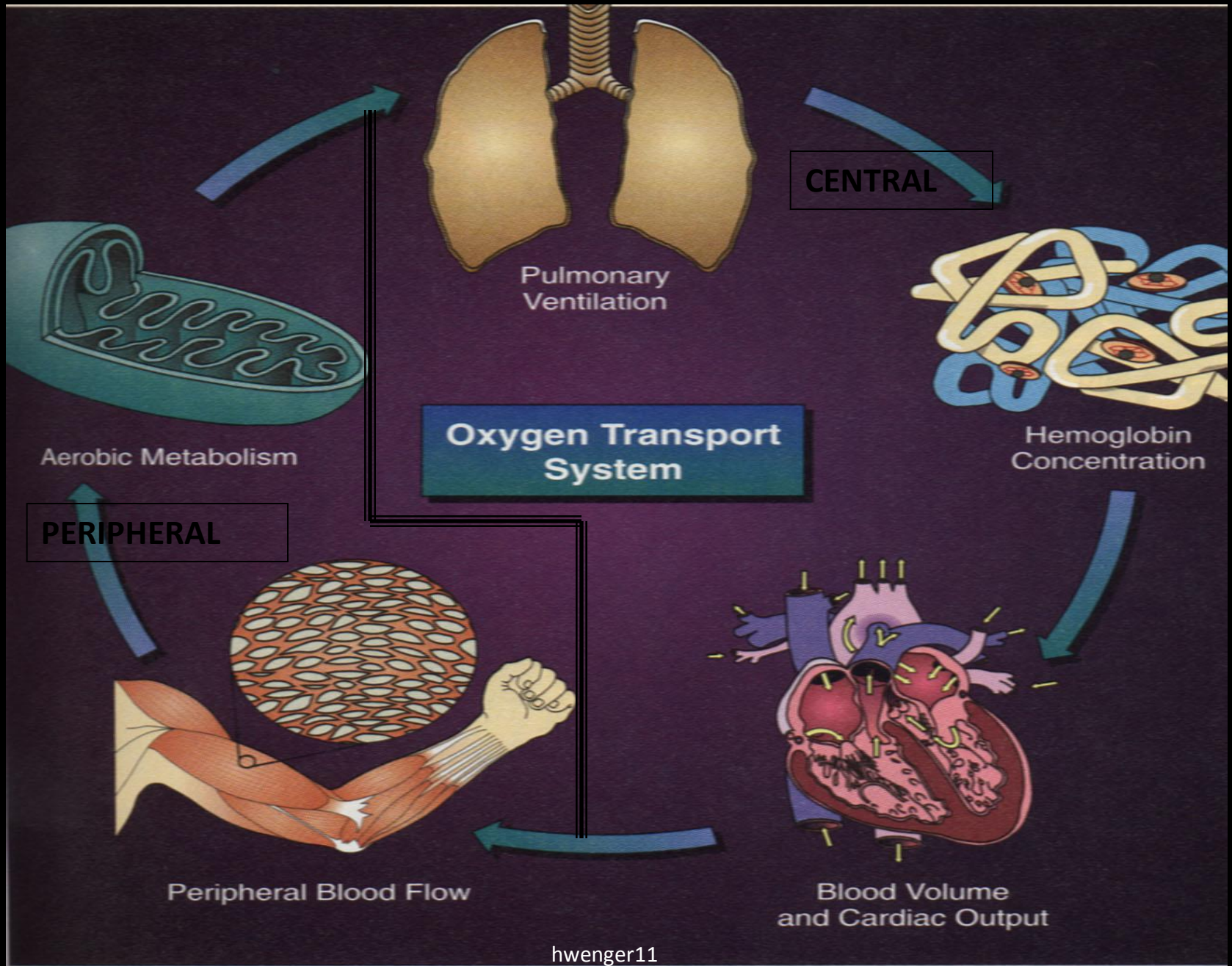
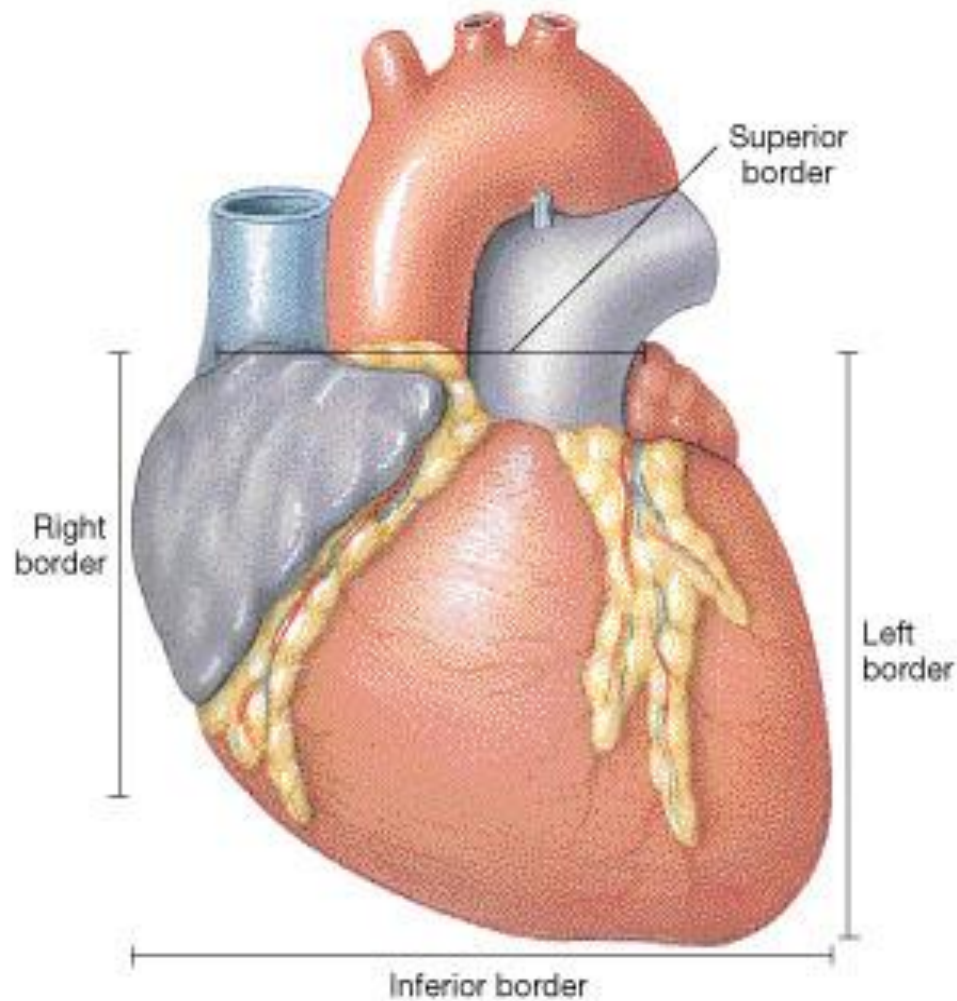
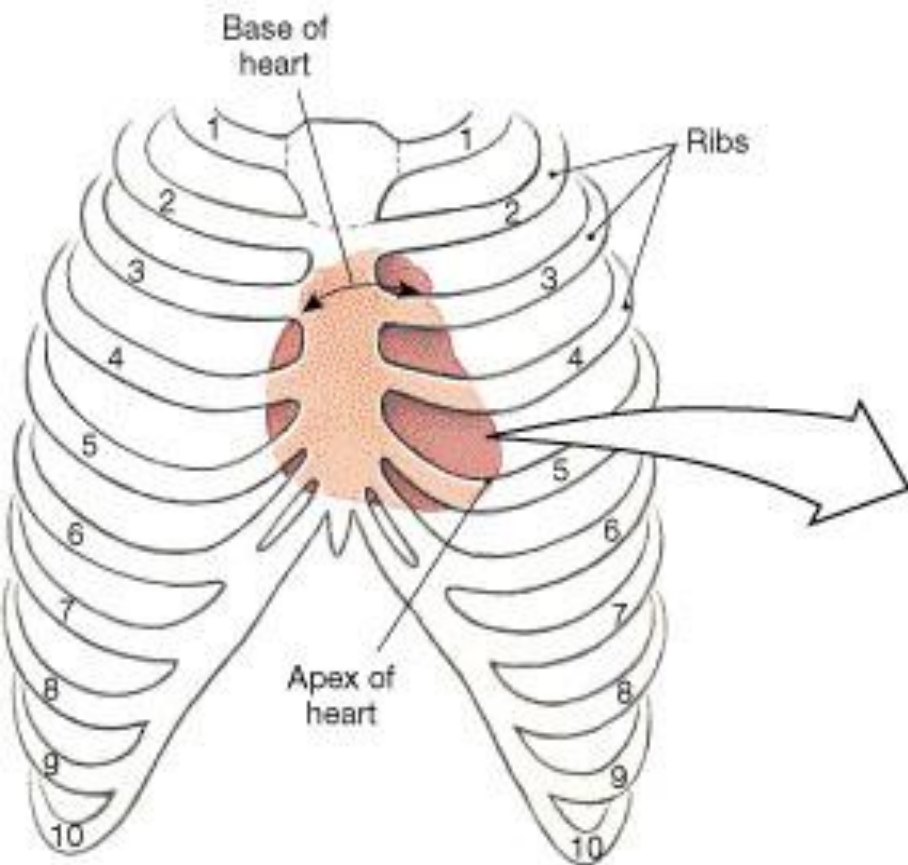
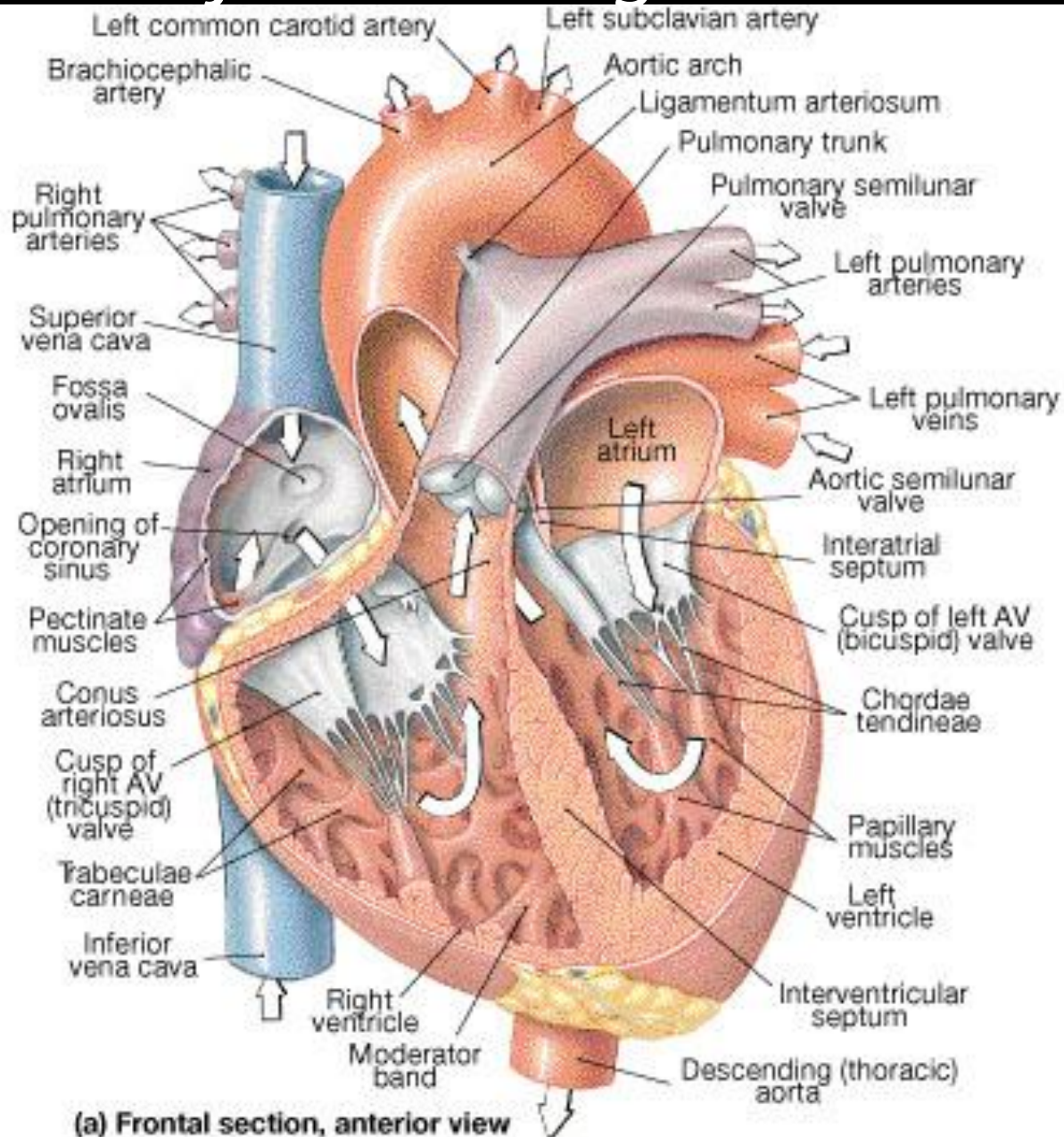


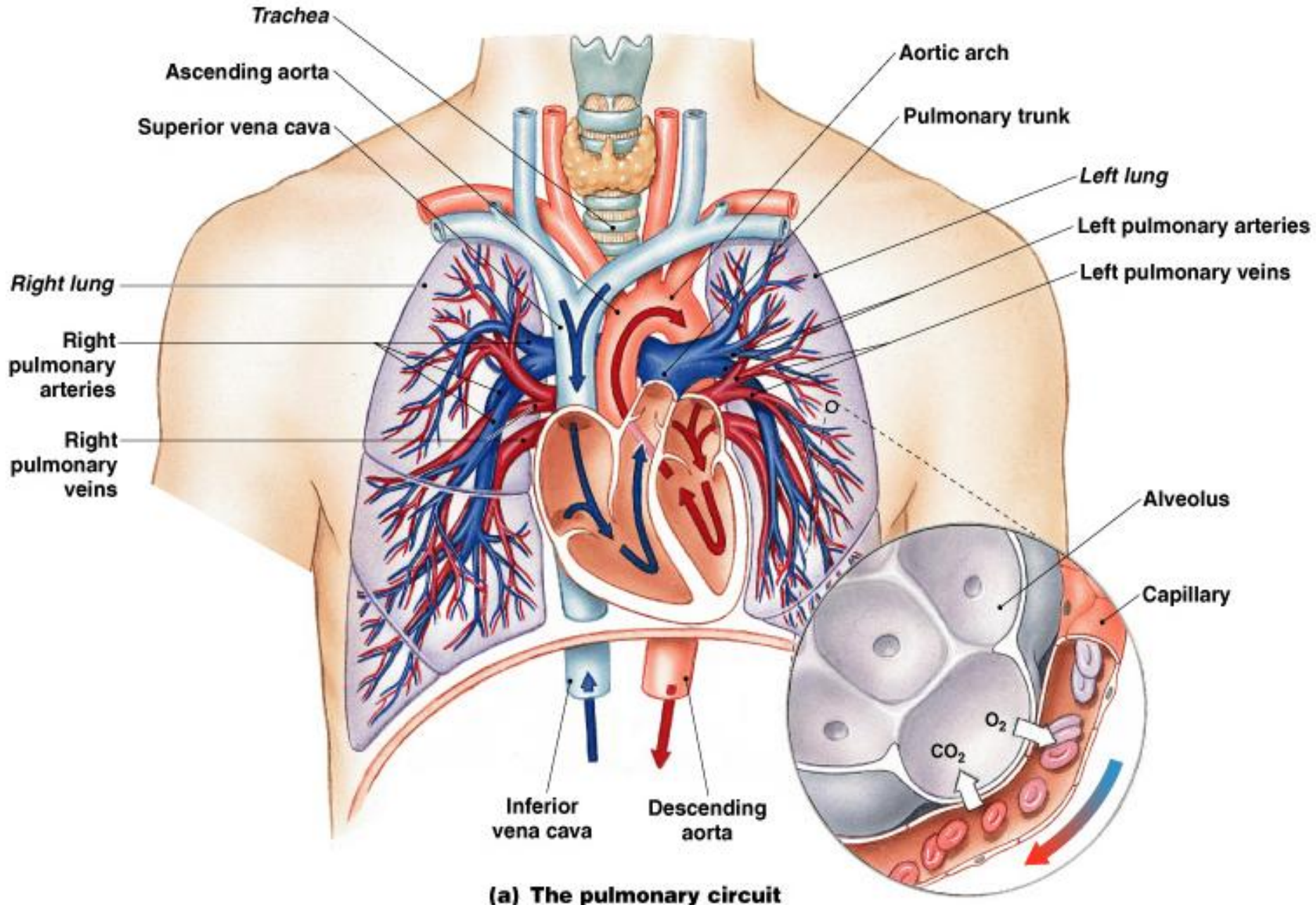
Figure 21-04: Position and orientation



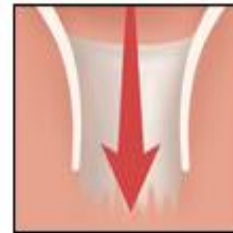
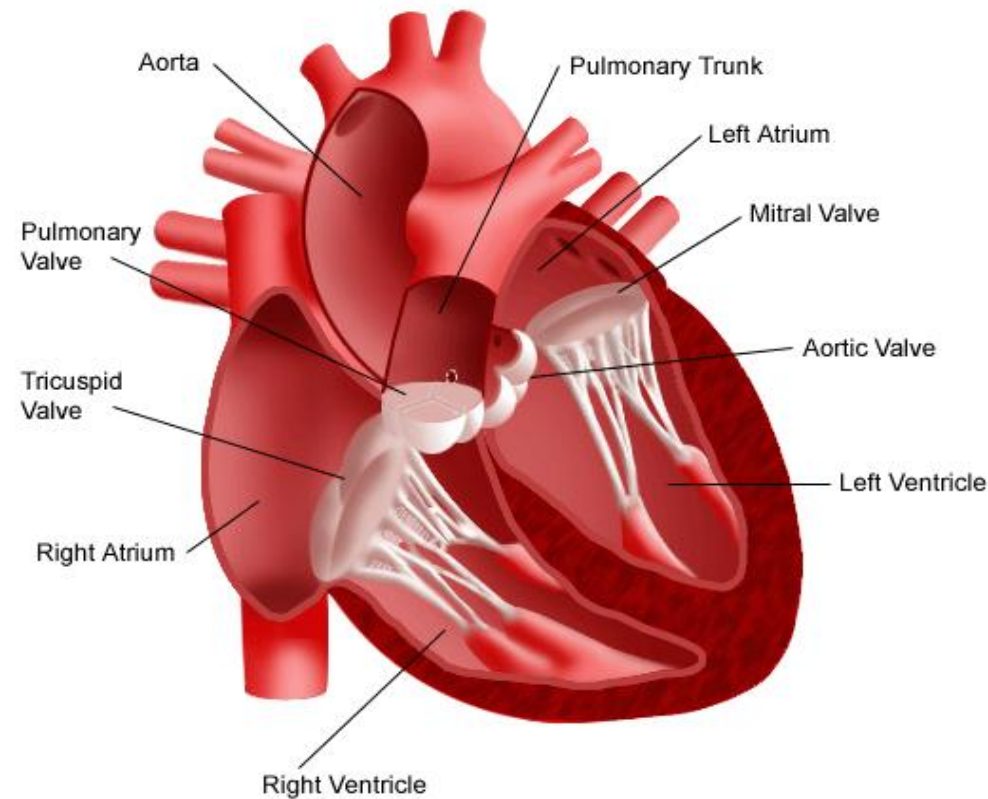
Blood flow through the heart



The Pulmonary Circuit



Valves of the Heart

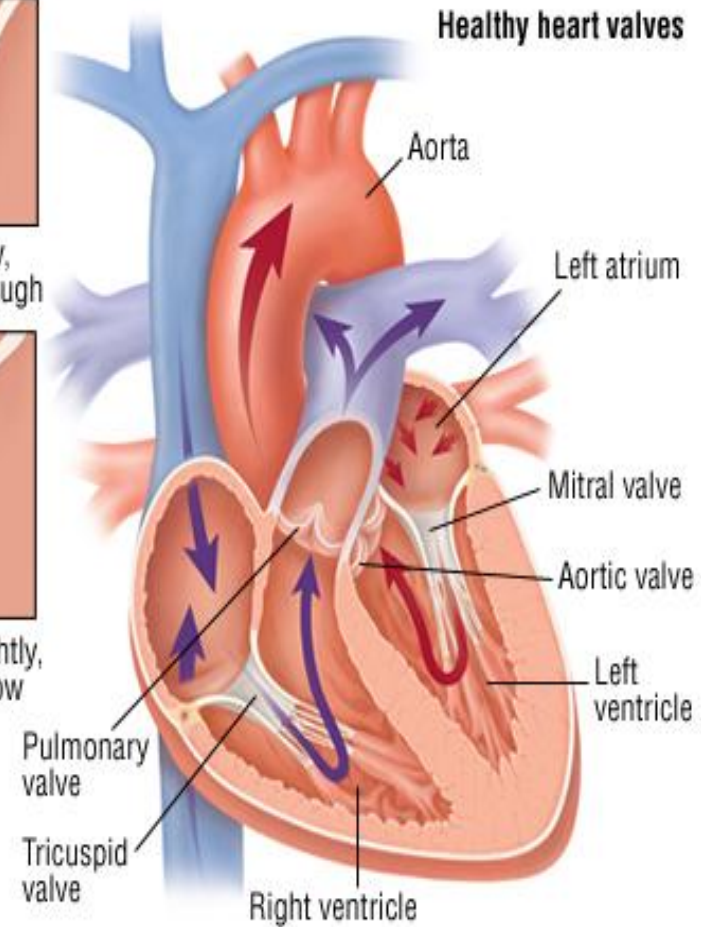


Valve opens fully,
blood flows through



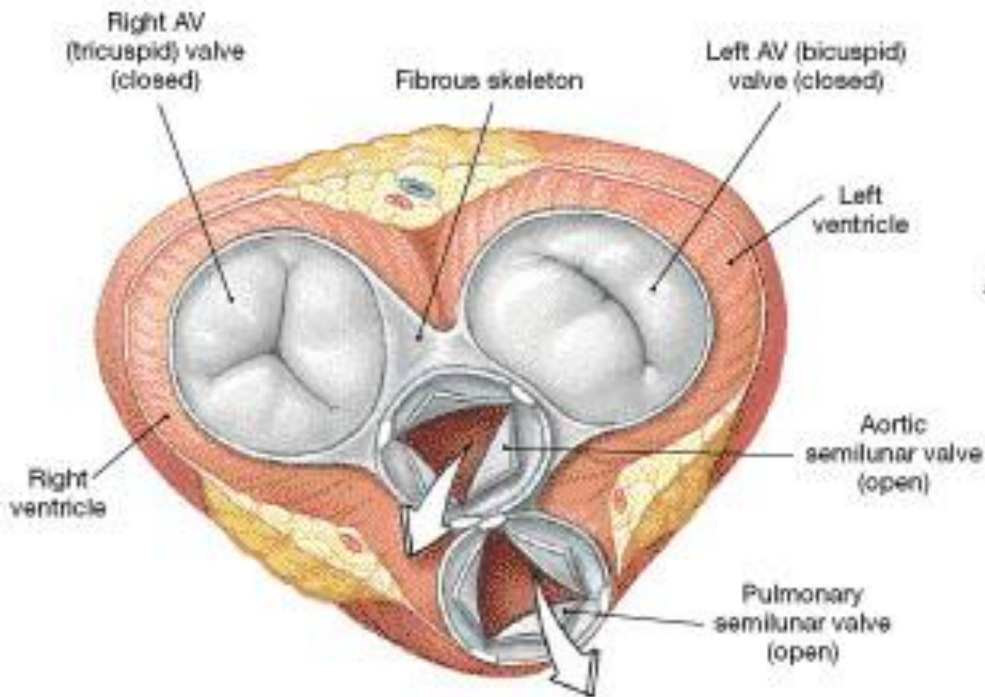
Valve closes tightly,
blood cannot flow
backwards

Healthy heart valves



Ventricular systole

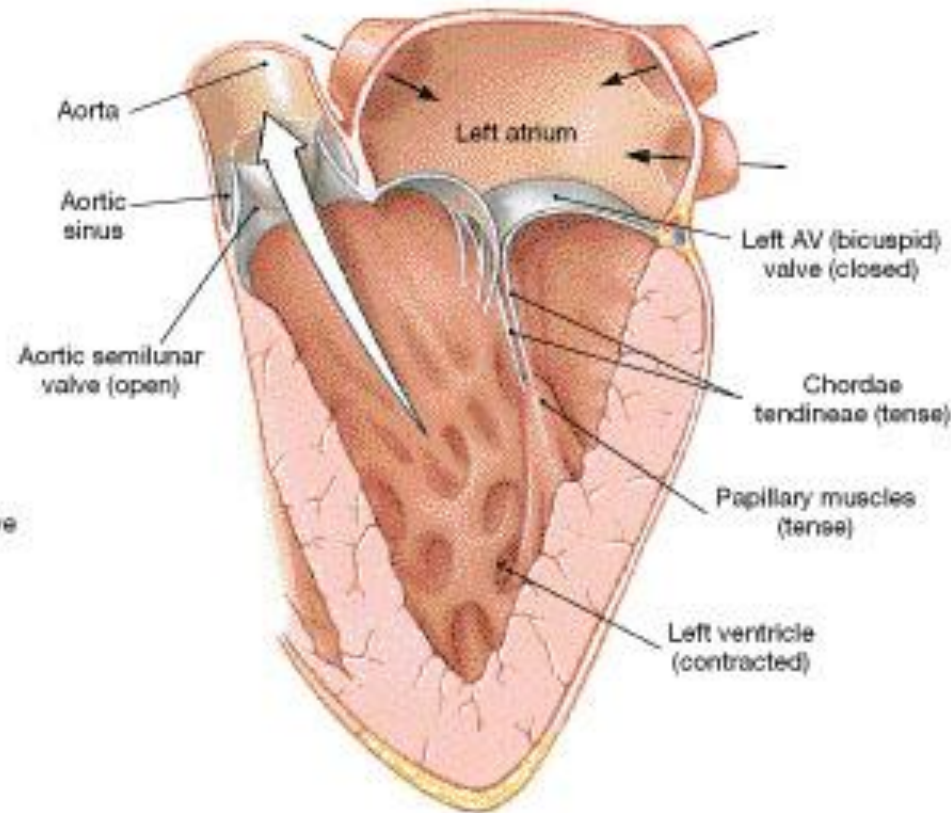
TRANSVERSE SECTION, SUPERIOR VIEW
(atria and great vessels removed)



TRANSVERSE SECTION

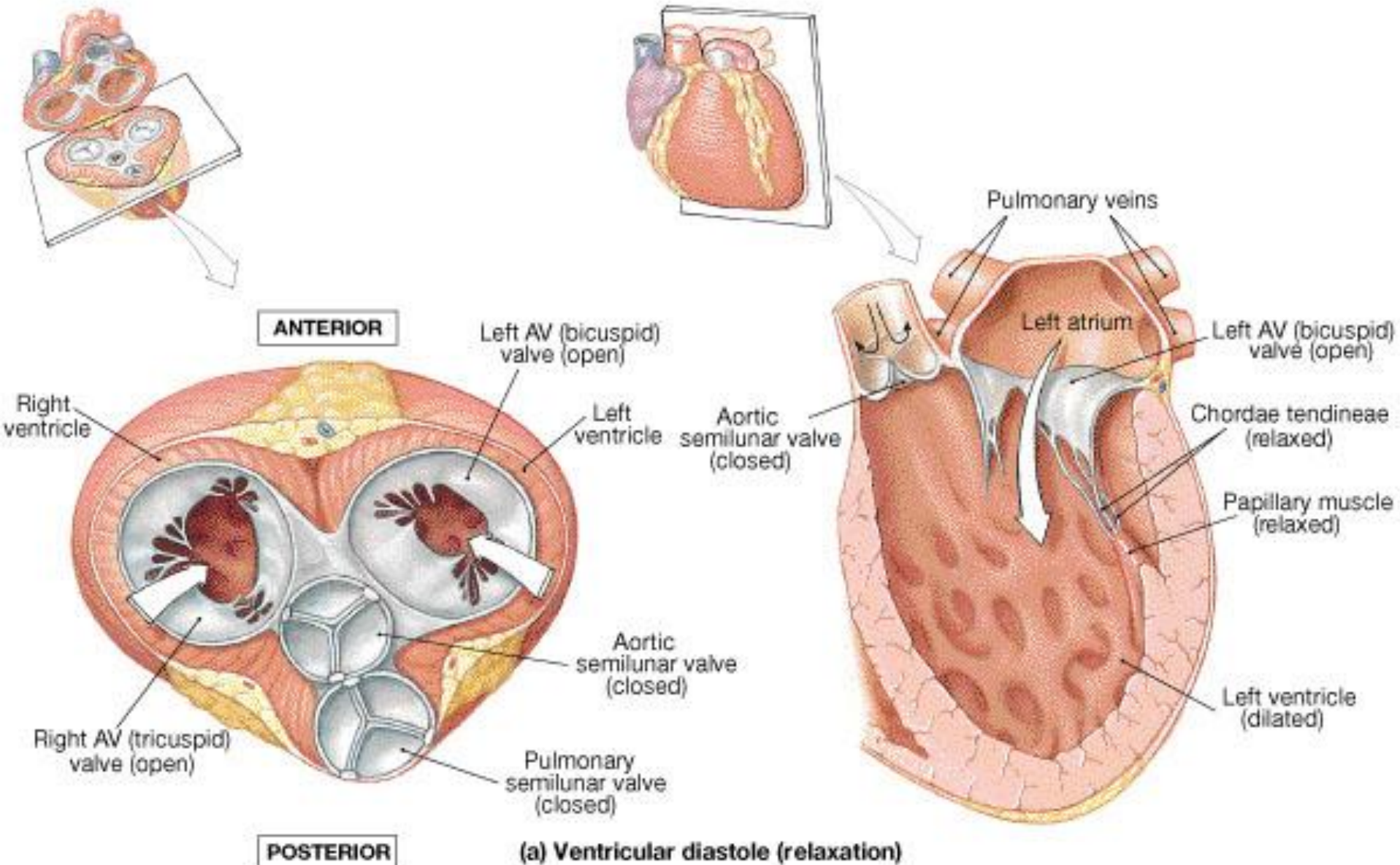
(b) Ventricular systole (contraction)

FRONTAL SECTION
(through left atrium and ventricle)

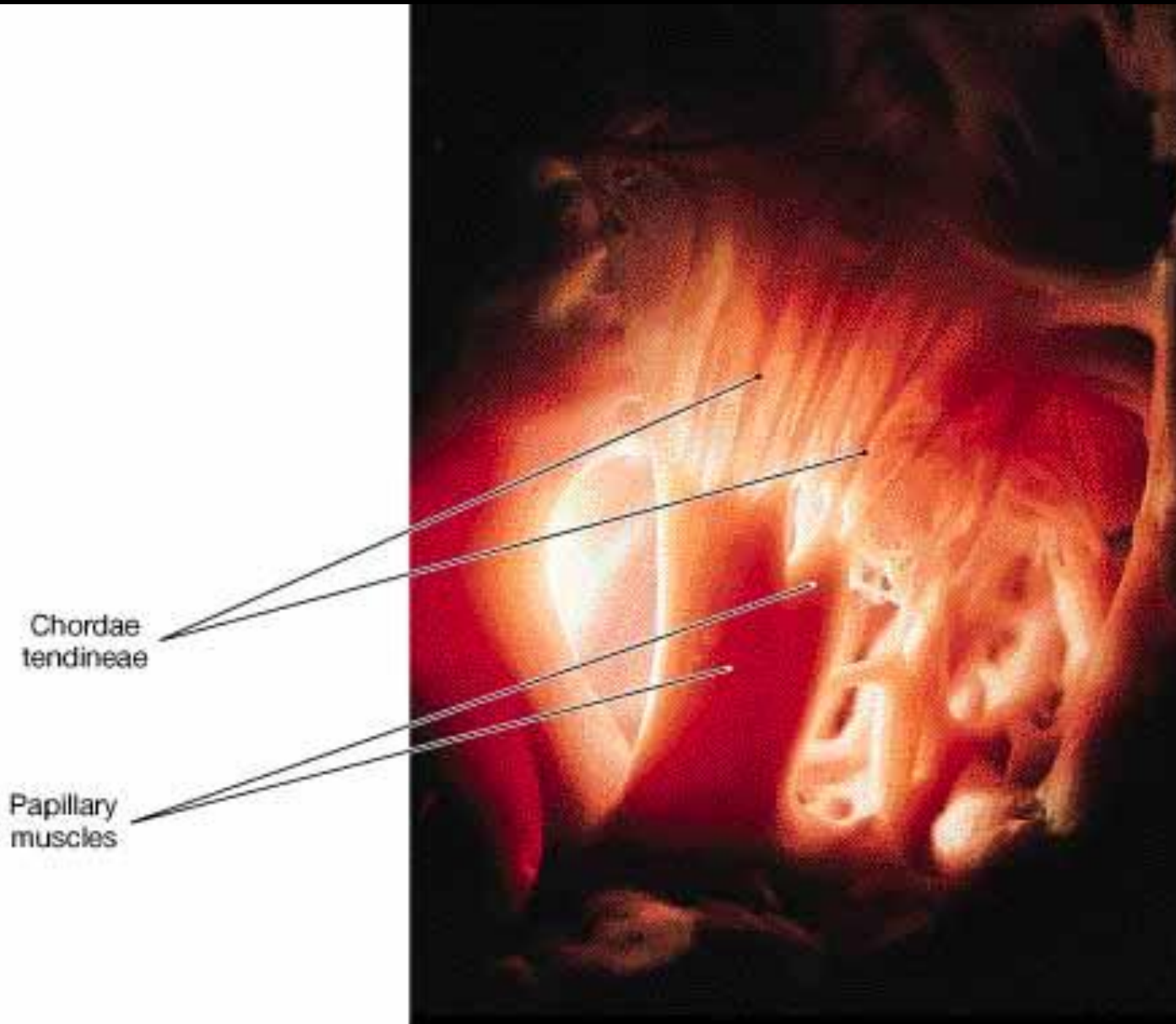


FRONTAL SECTION

Ventricular diastole (valve function)



Papillary muscle and chordae tendinae

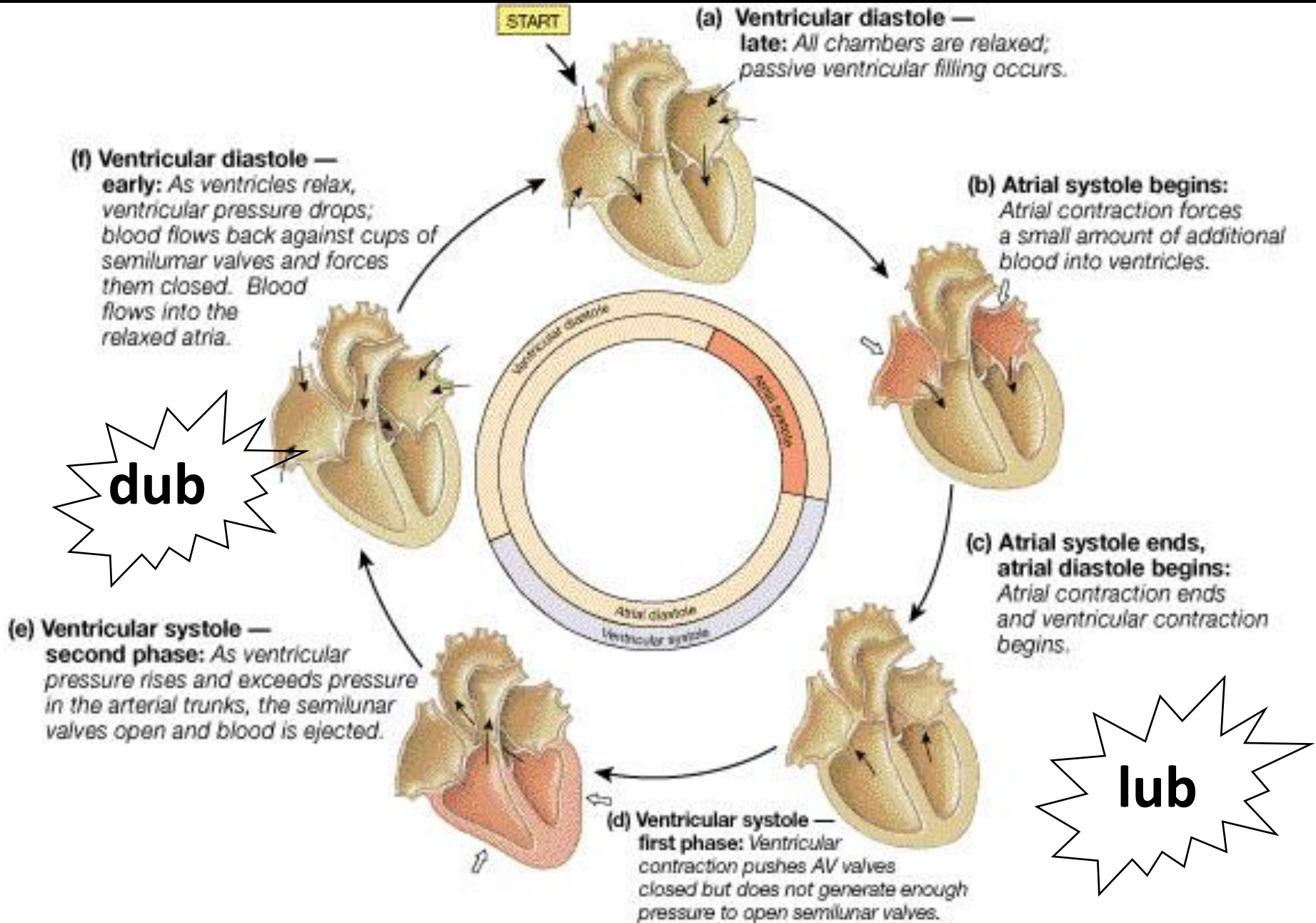


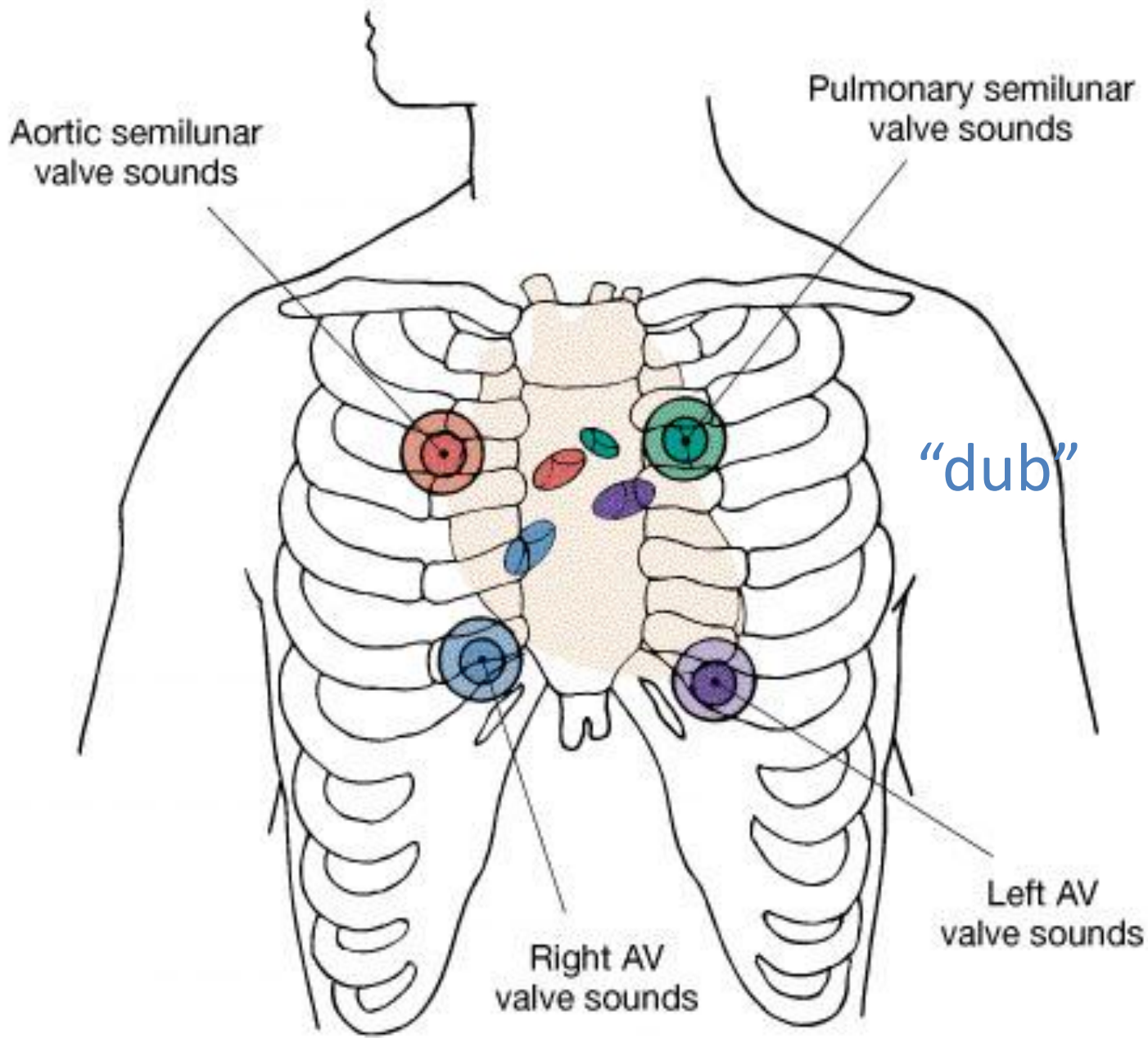
(b) Interior view, right ventricle

The Aortic Arch

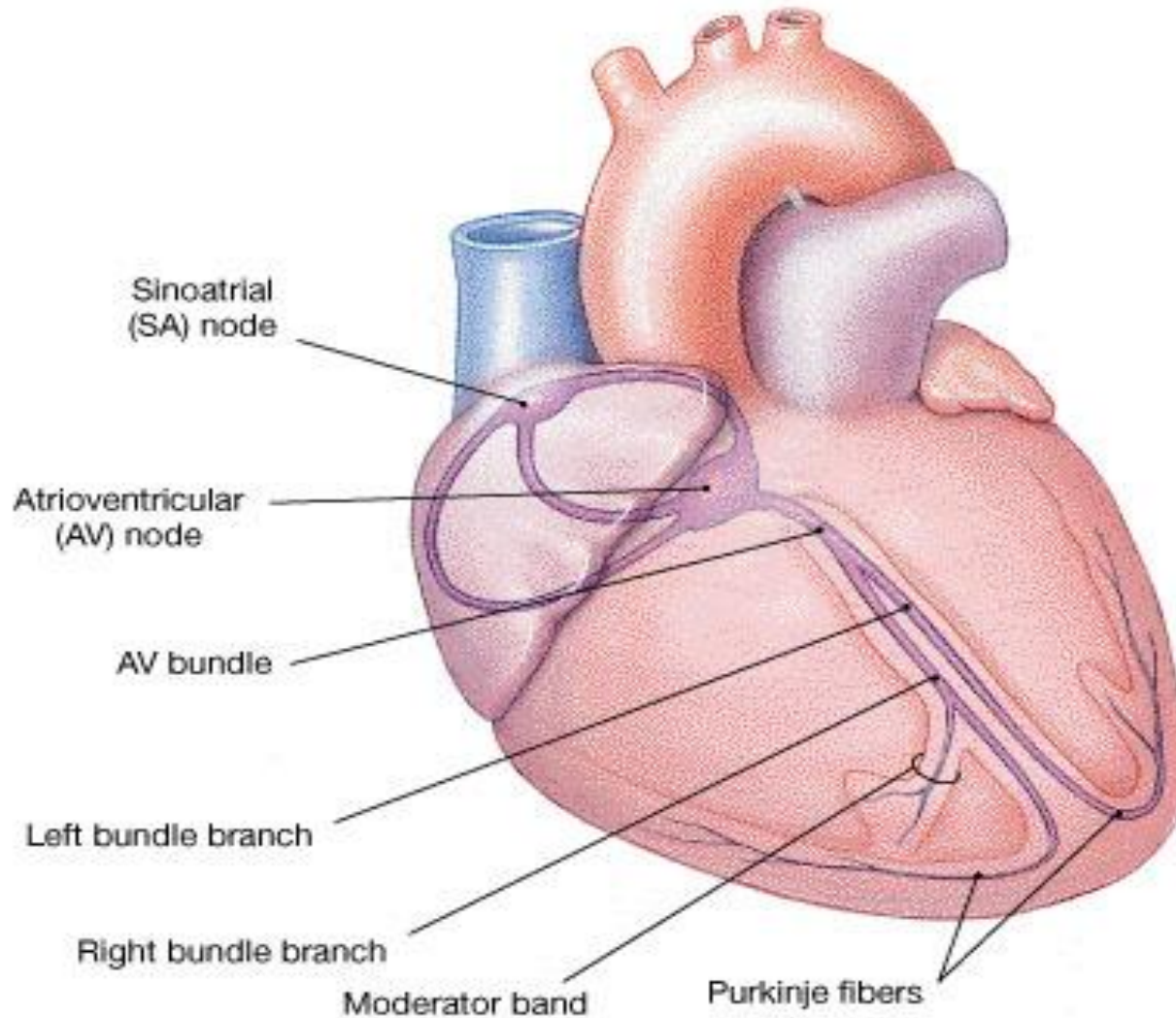


Cardiac cycle



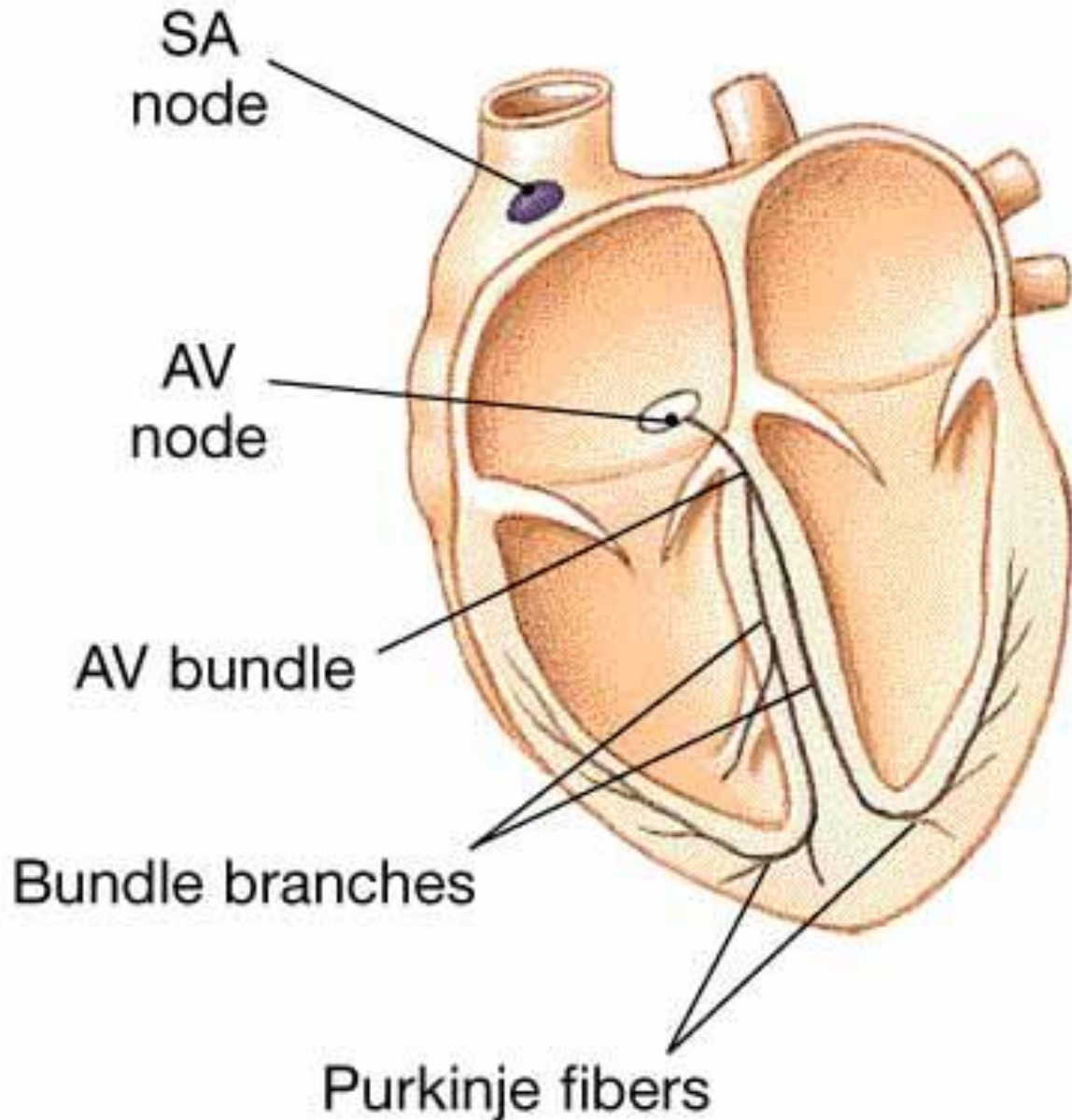


Control of Heart Rate: *Nodes and conducting fibers*



(a) Nodes and conducting fibers

Conducting system (step 1)

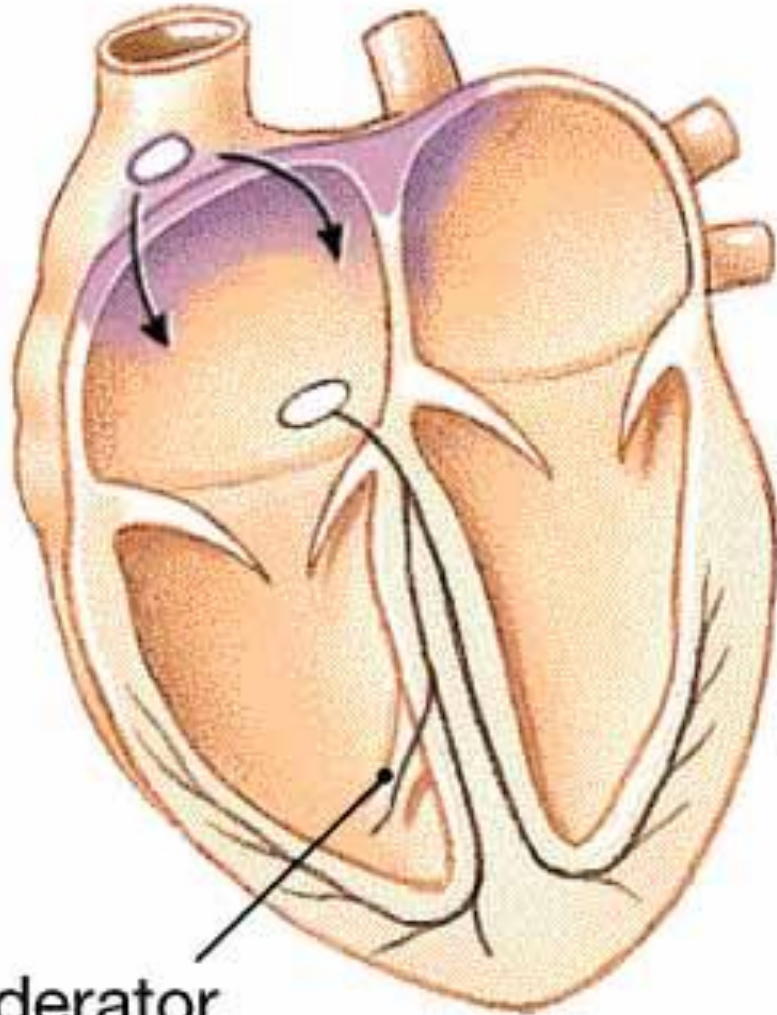


STEP 1:
SA node activity
and atrial
activation begin.

Time = 0



Conducting system (step 2)

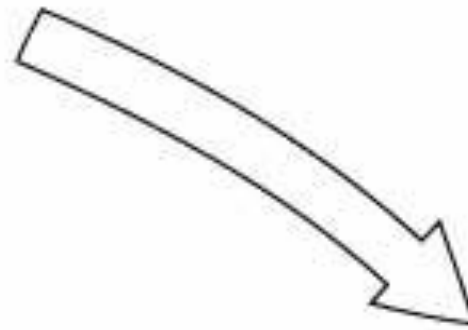


Moderator
band

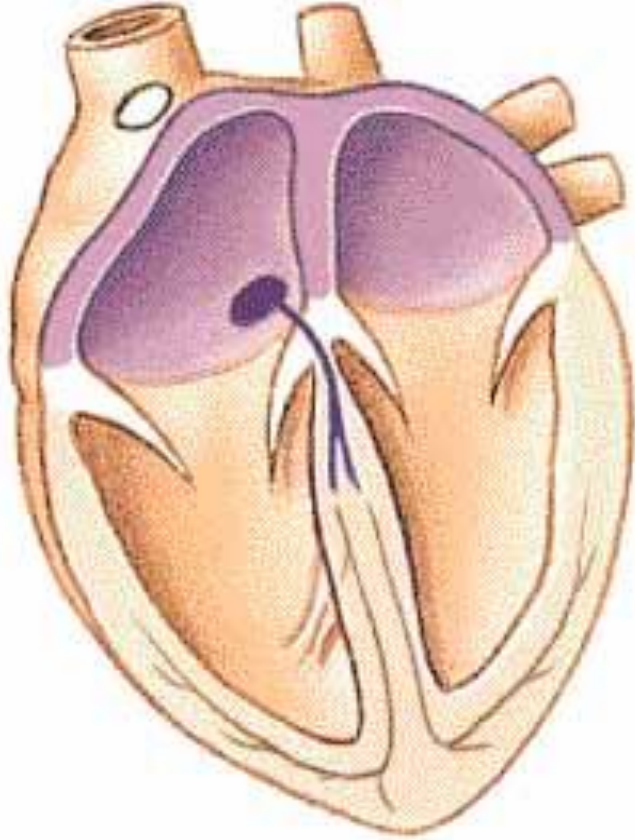
STEP 2:

Stimulus reaches
the AV node.

Elapsed time = 50 msec



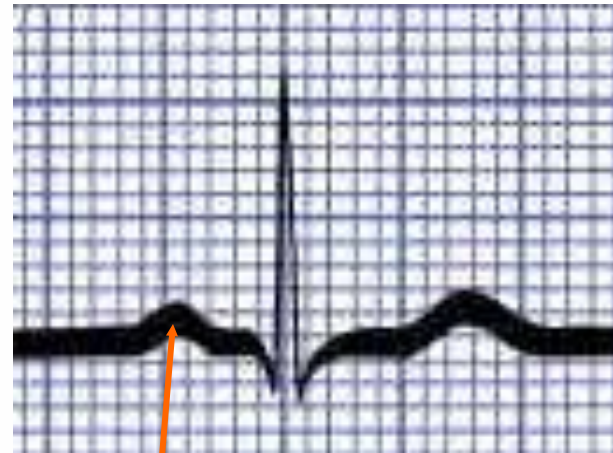
Conducting system (step 3)



STEP 3:

There is a 100 msec delay at the AV node. Atrial contraction begins.

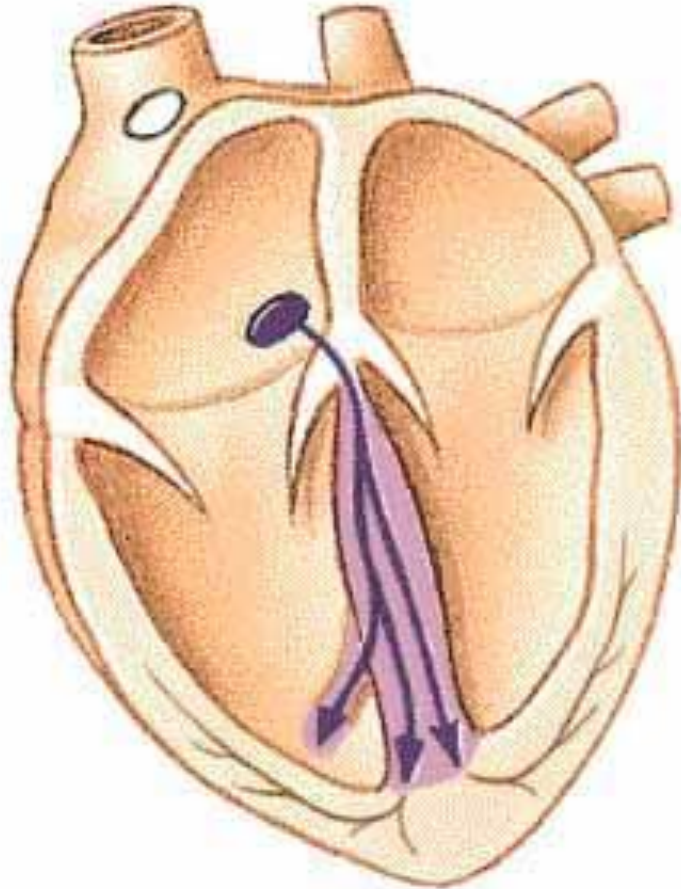
Elapsed time = 150 msec



'P' wave of EKG



Conducting system (step 4)



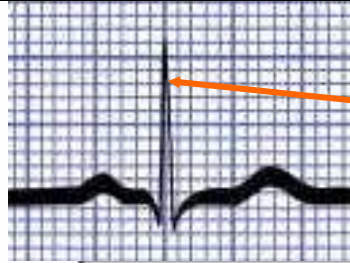
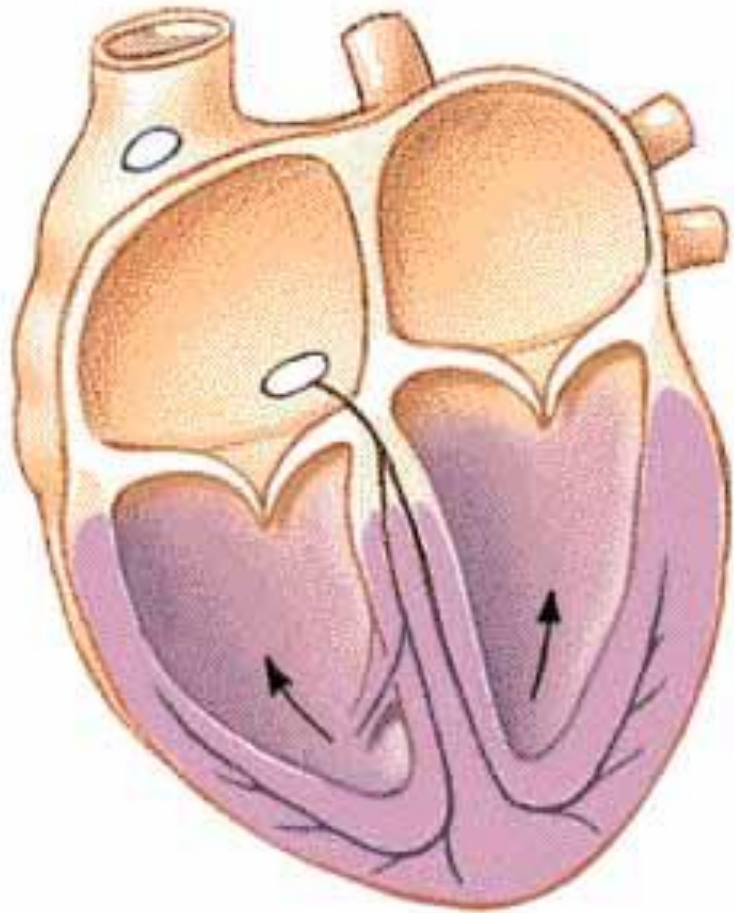
STEP 4:

The impulse travels along the interventricular septum via the AV bundle and the bundle branches, to the Purkinje fibers.

Elapsed time = 175 msec



Conducting system (step 5)



QRS complex of EKG

STEP 5:

The impulse is distributed by Purkinje fibers and relayed throughout the ventricular myocardium. Atrial contraction is completed, ventricular contraction begins.

Elapsed time = 225 msec

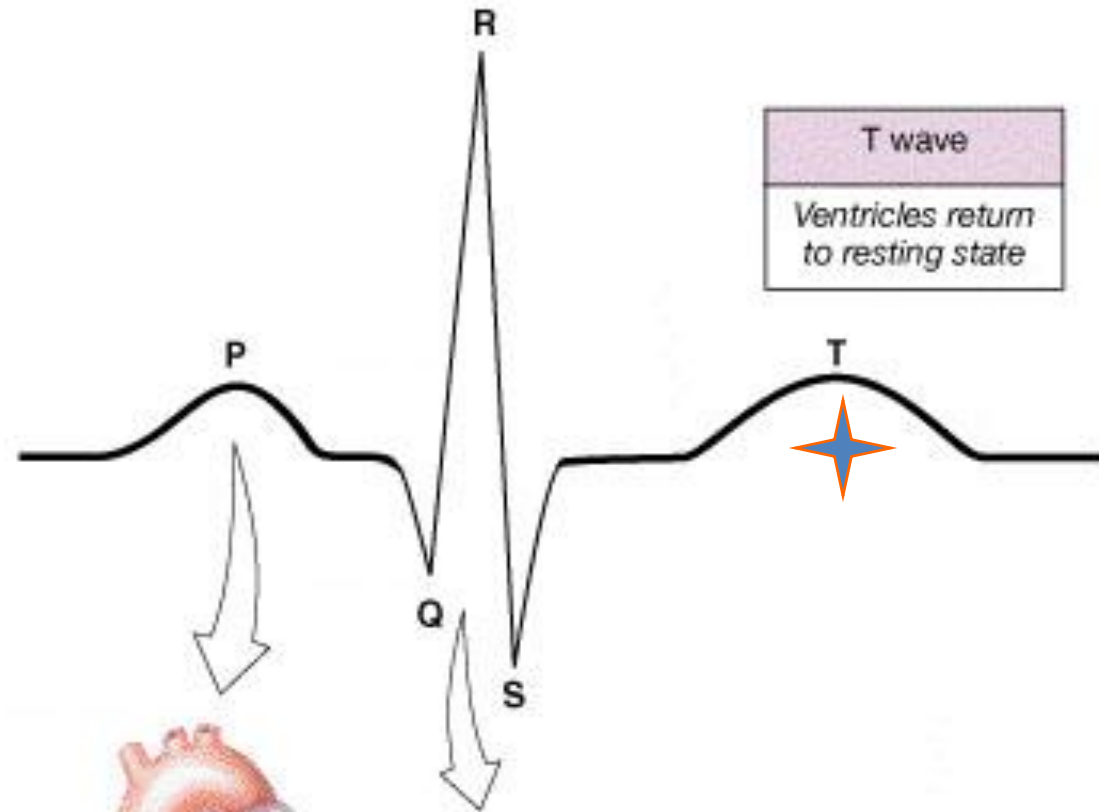
(b) Steps in distribution of stimulus

An electrocardiogram



EKG rhythm strip

The ECG wave related to conduction

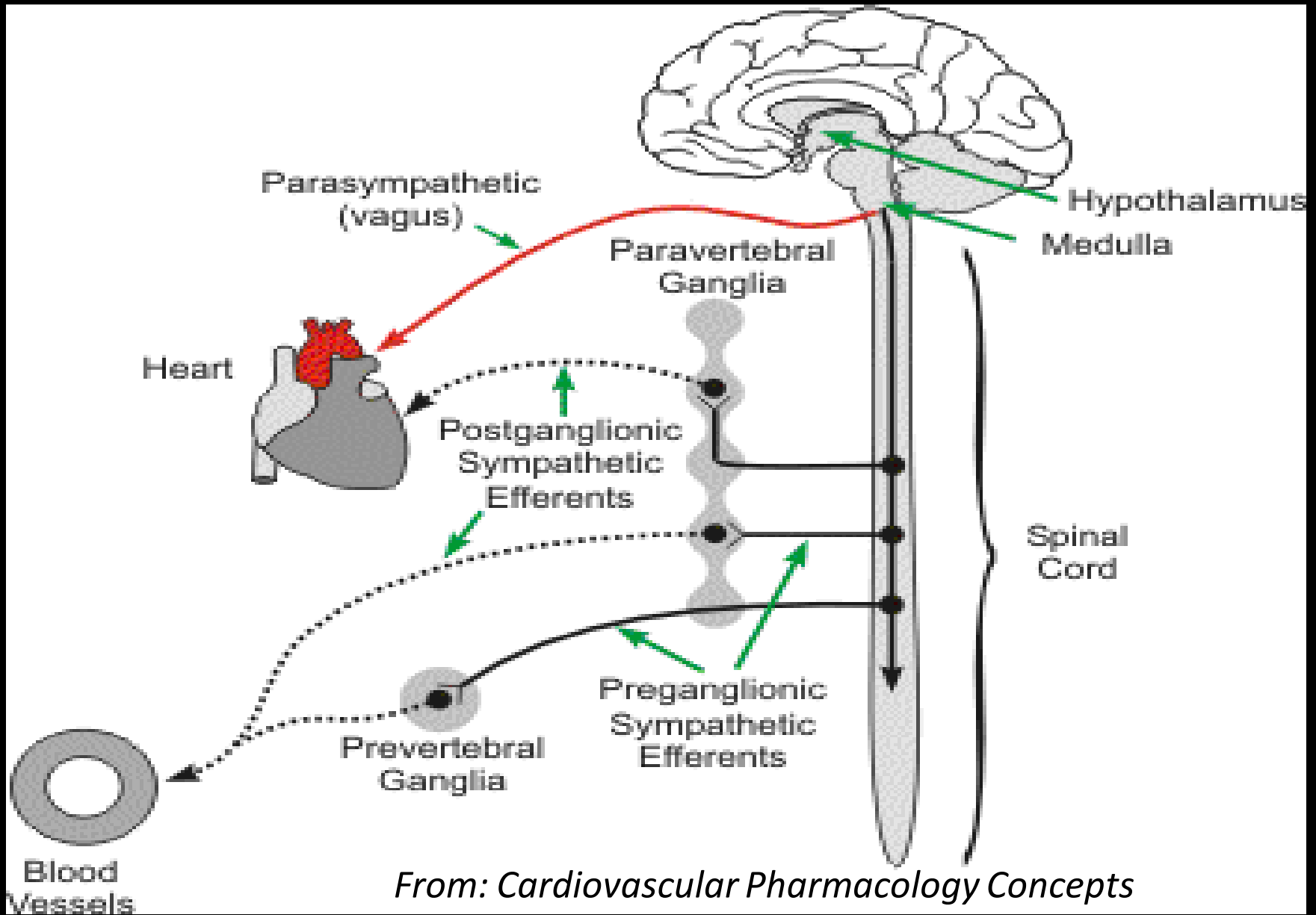


T wave
Ventricles return to resting state

P wave
Impulse spreads across atria, triggering atrial contractions

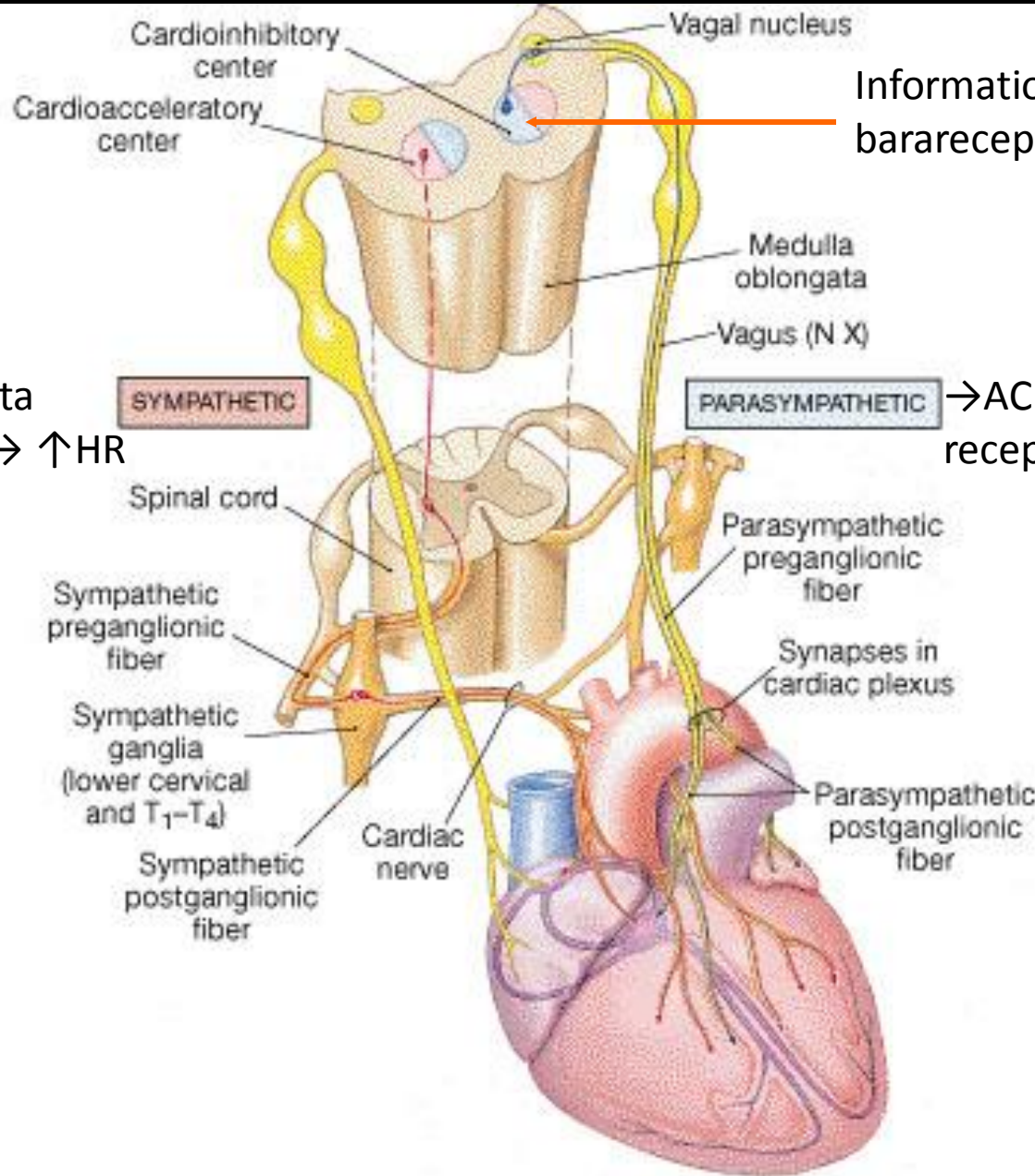
QRS complex
Impulse spreads to ventricles, triggering ventricular contractions

Autonomic Nervous System: Control of heart rate



From: Cardiovascular Pharmacology Concepts

Autonomic innervation of the heart



Information from hypothalamus, baroreceptors and chemoreceptors

→ NE → beta receptors → ↑HR

→ ACh → muscarinic receptors → ↓HR