

BI 121 Lecture 8



...We're back & rarin' to go for last 2 weeks!

I. Announcements HR & BP Lab 4 tomorrow + **Required Notebook Check**. Turn in today or tomorrow? Q about LM? Please read Blood Chemistry Lab 5 twice < Thurs. Thanks!

II. Cardiovascular System LS 2012 ch 9, Torstar Books 1984, DC 2013 Module 4, Guyton & Hall (G&H) 2011 +...

A. Circulatory vs Cardiovascular (CV)? cf + parts

LS pp 229, CV vs Lymphatic, DC pp 23, 31

B. CV Pulmonary & Systemic circuits

DC fig 4-1 p 24, LS fig 9-2b p 231

C. Arteries, capillaries, veins G&H +Torstar

D. Varicose veins? Phlebitis? DC

E. ♥ layers, box, chambers, valves, inlets, outlets

LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6

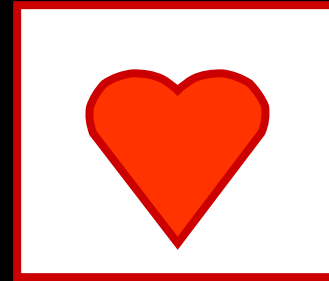
F. Normal vs abnormal blood flow thru ♥ & CV system

Billy has a hole in his ♥ SI Fox 2009 fig 13.16, 13.17

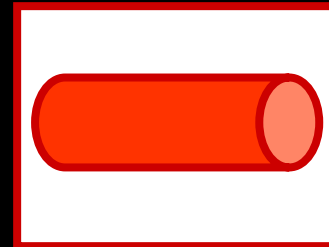


III. Comments on Midterm & Tests Returned

Cardiovascular (CV) = Heart + Vessels + Blood!



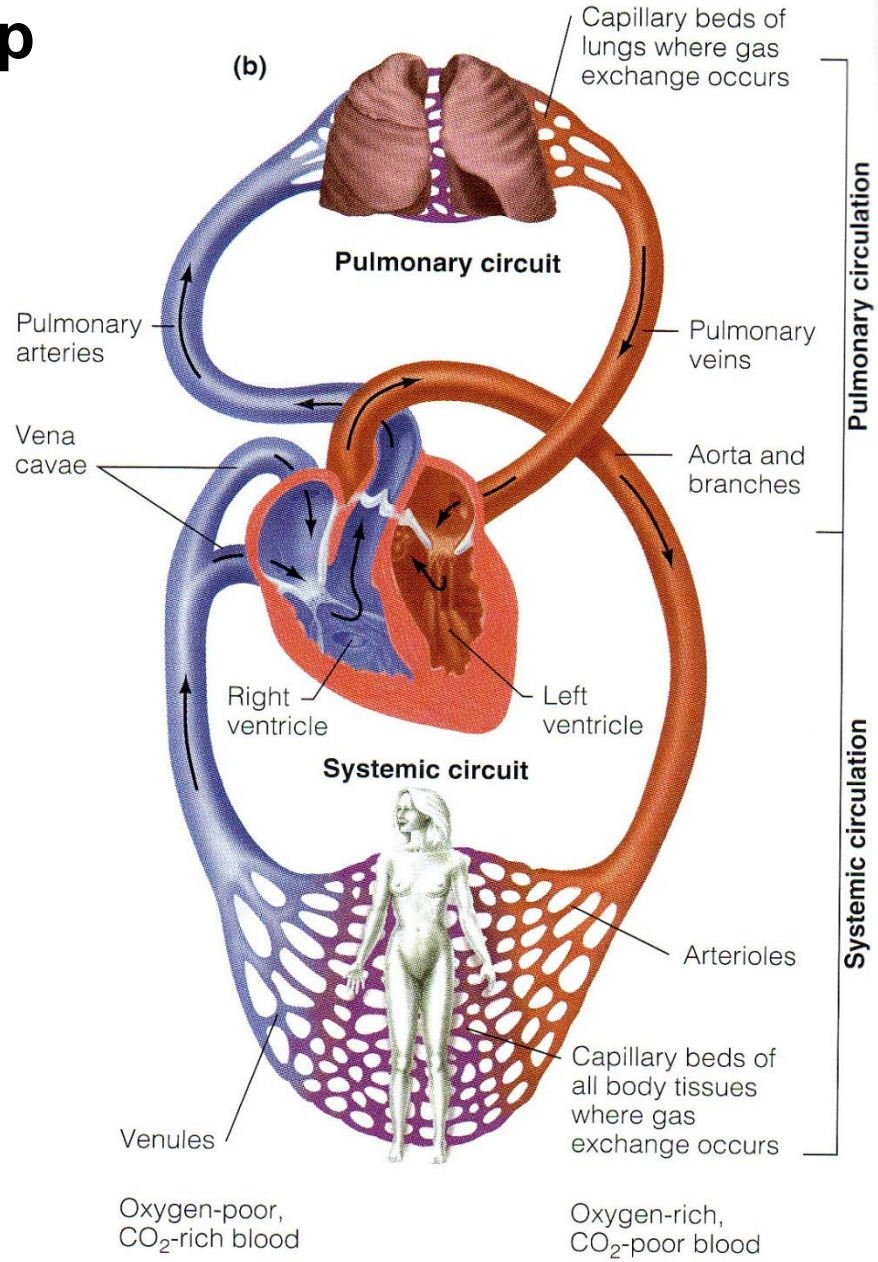
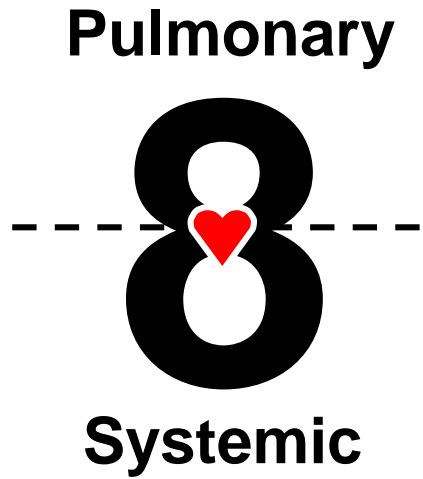
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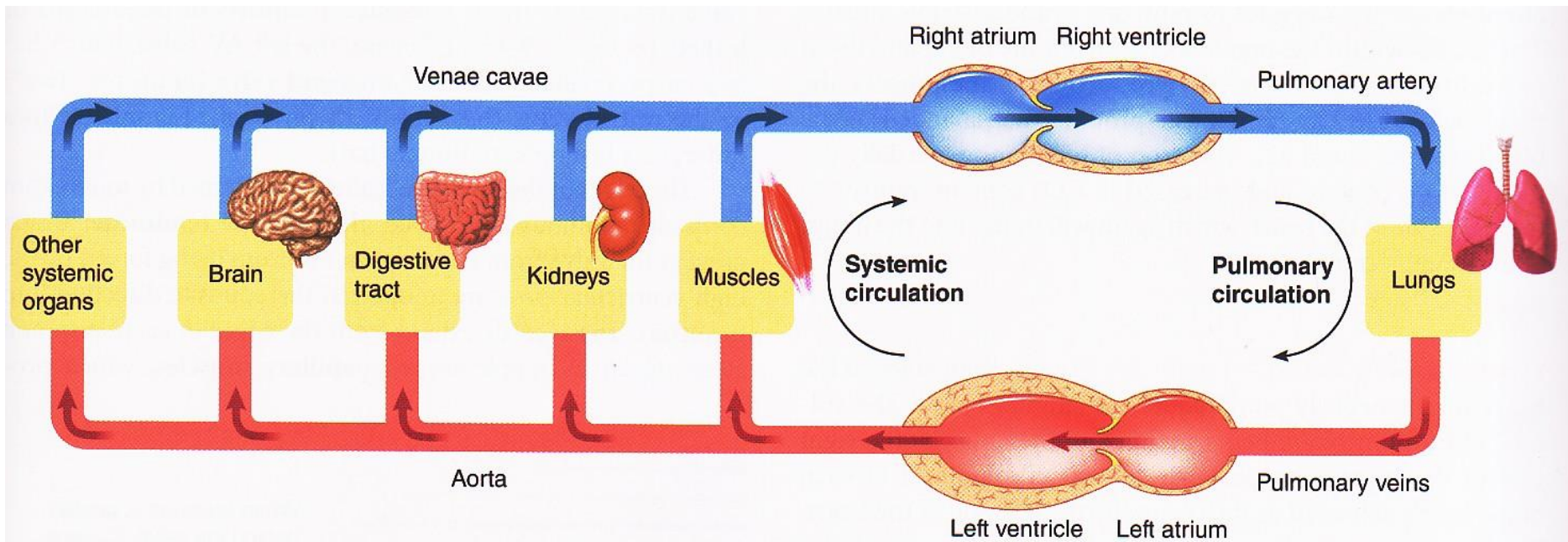
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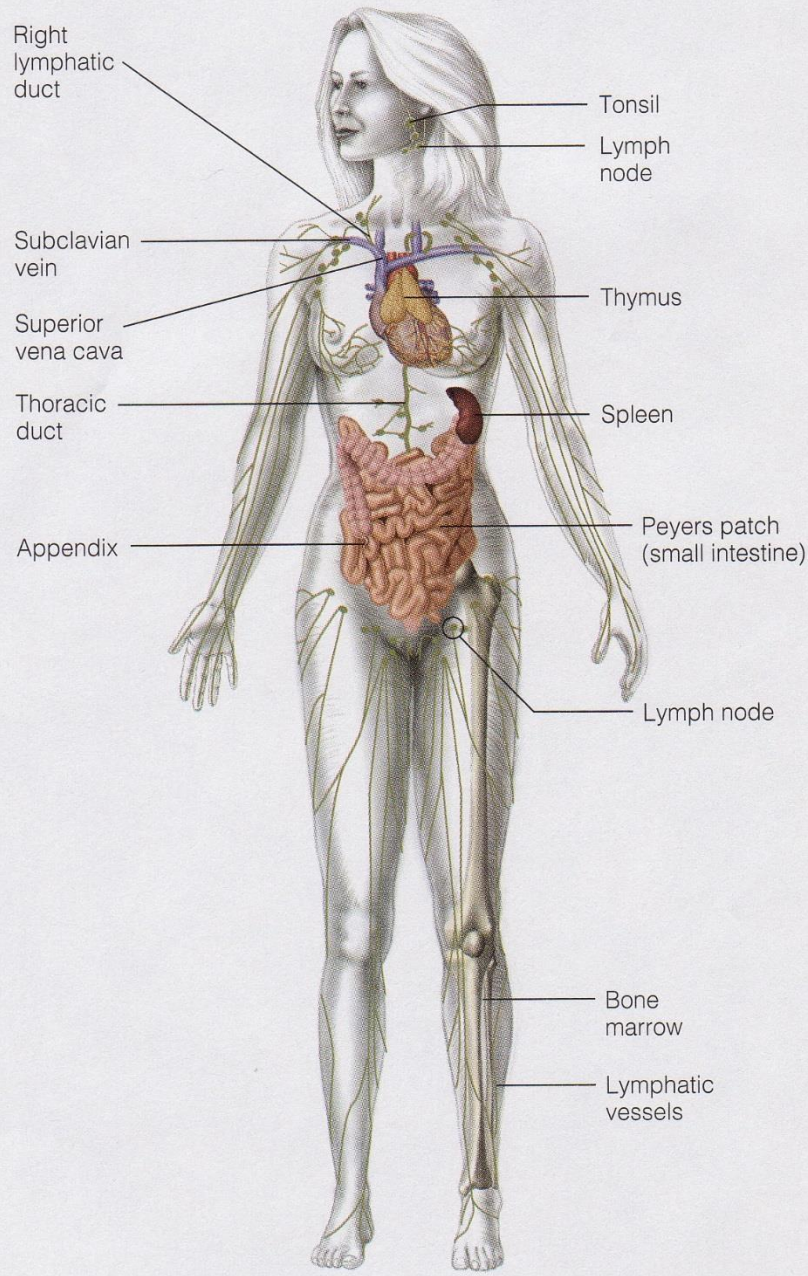


NB: Figure-8 loop



Dual Pump Action & Parallel Circulation



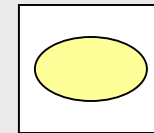


Lymphatic System

1. Lymph Nodes

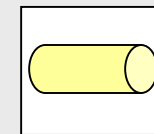
2. Vessels

3. Lymph

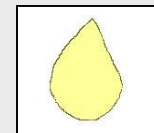


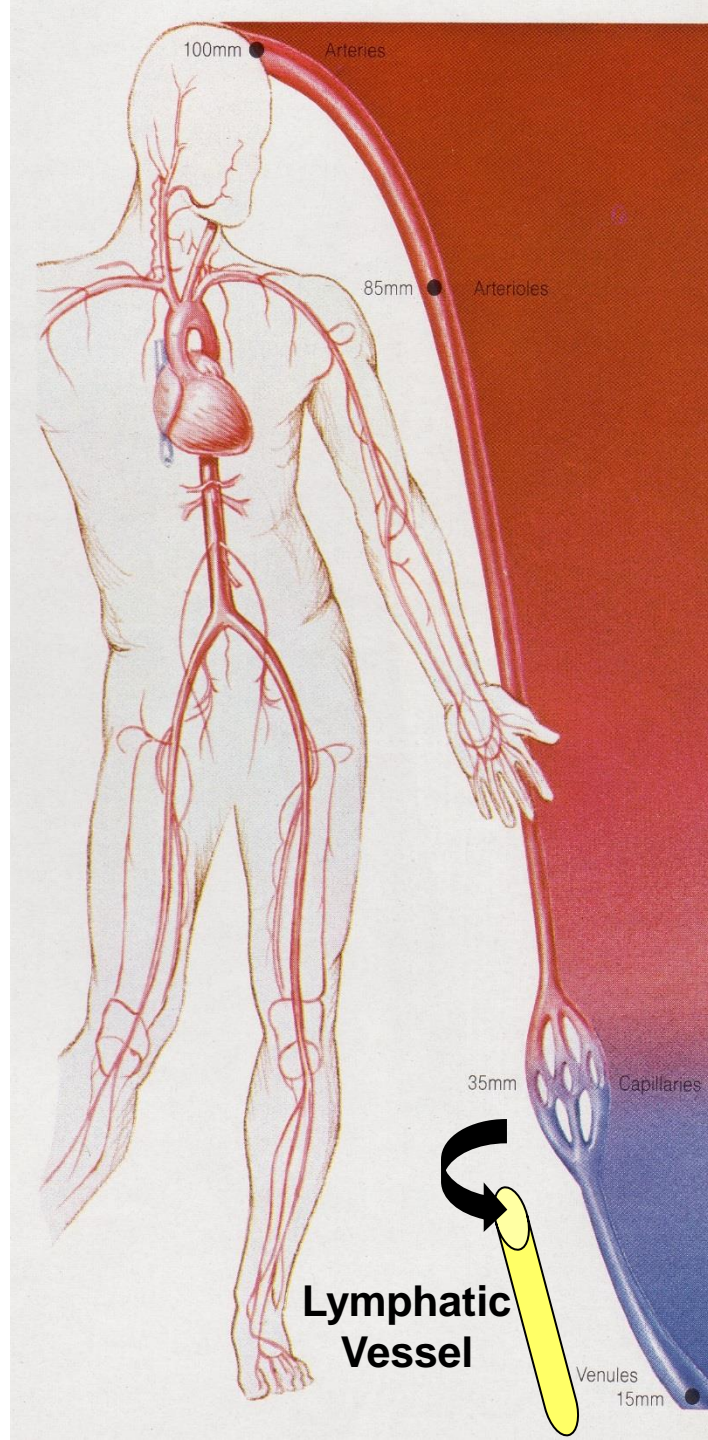
No pump!

+



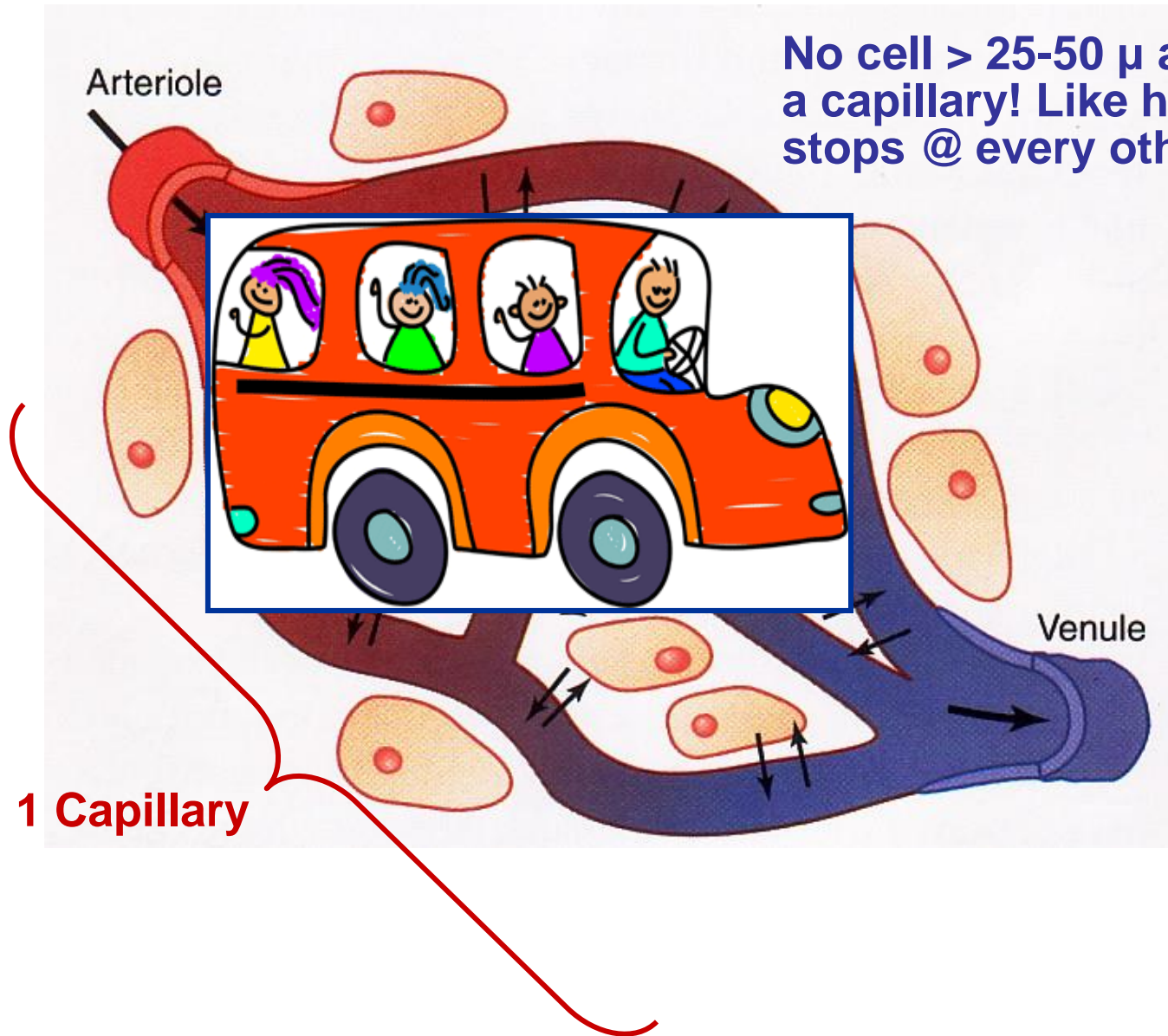
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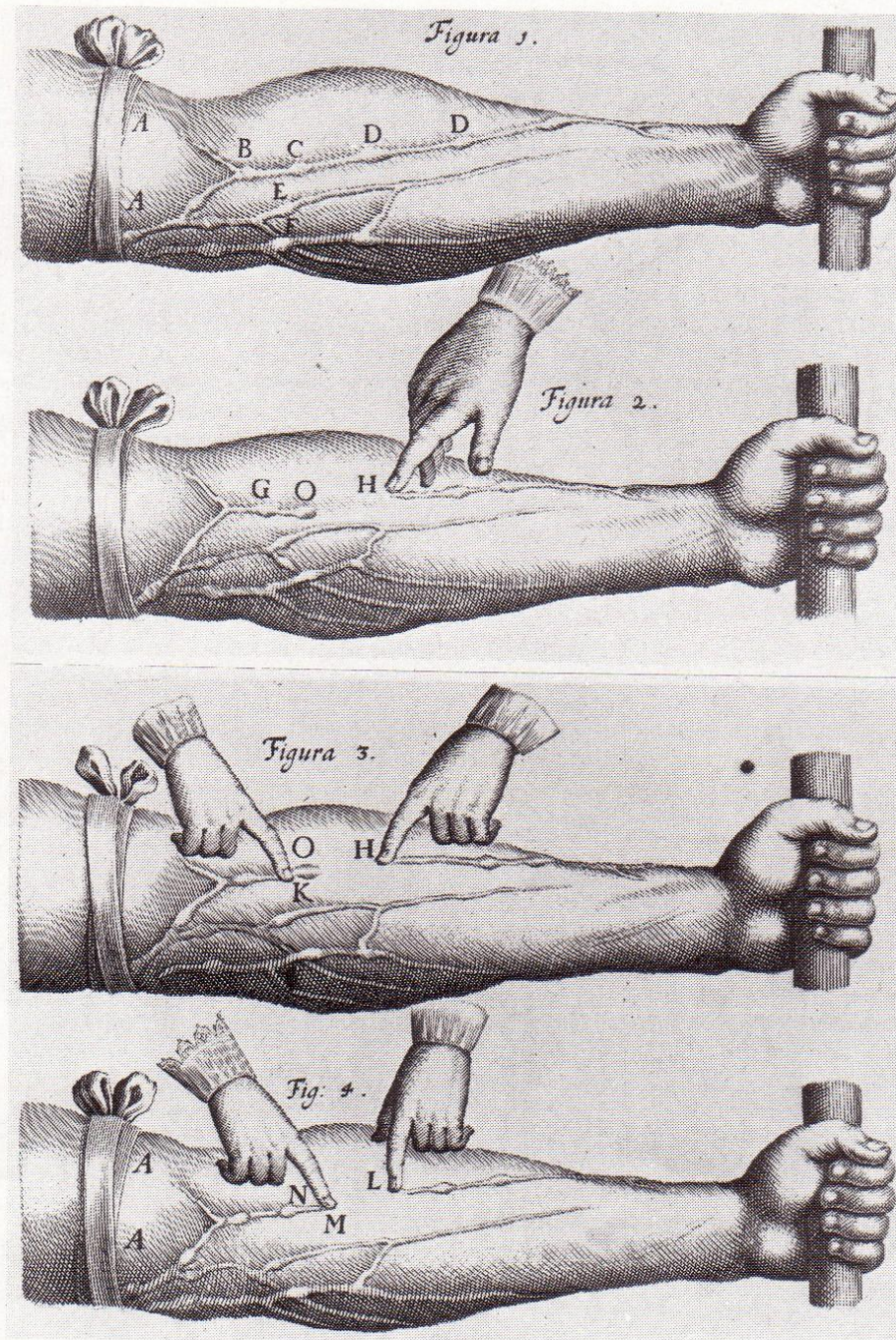


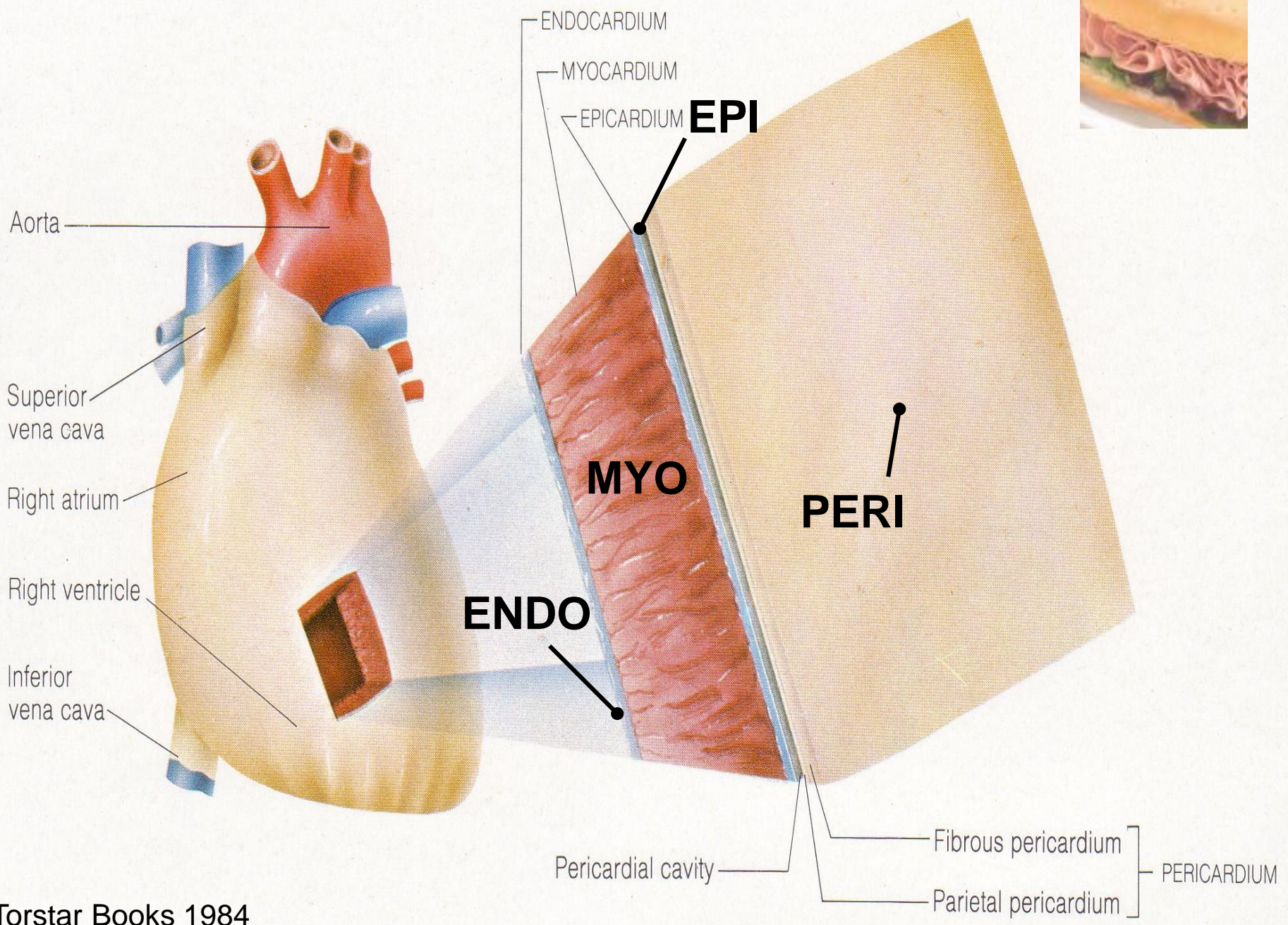
Lymphatics collect run-off & are parallel to venules/small veins!

Microcirculation Exchange: 10 Billion Capillaries!

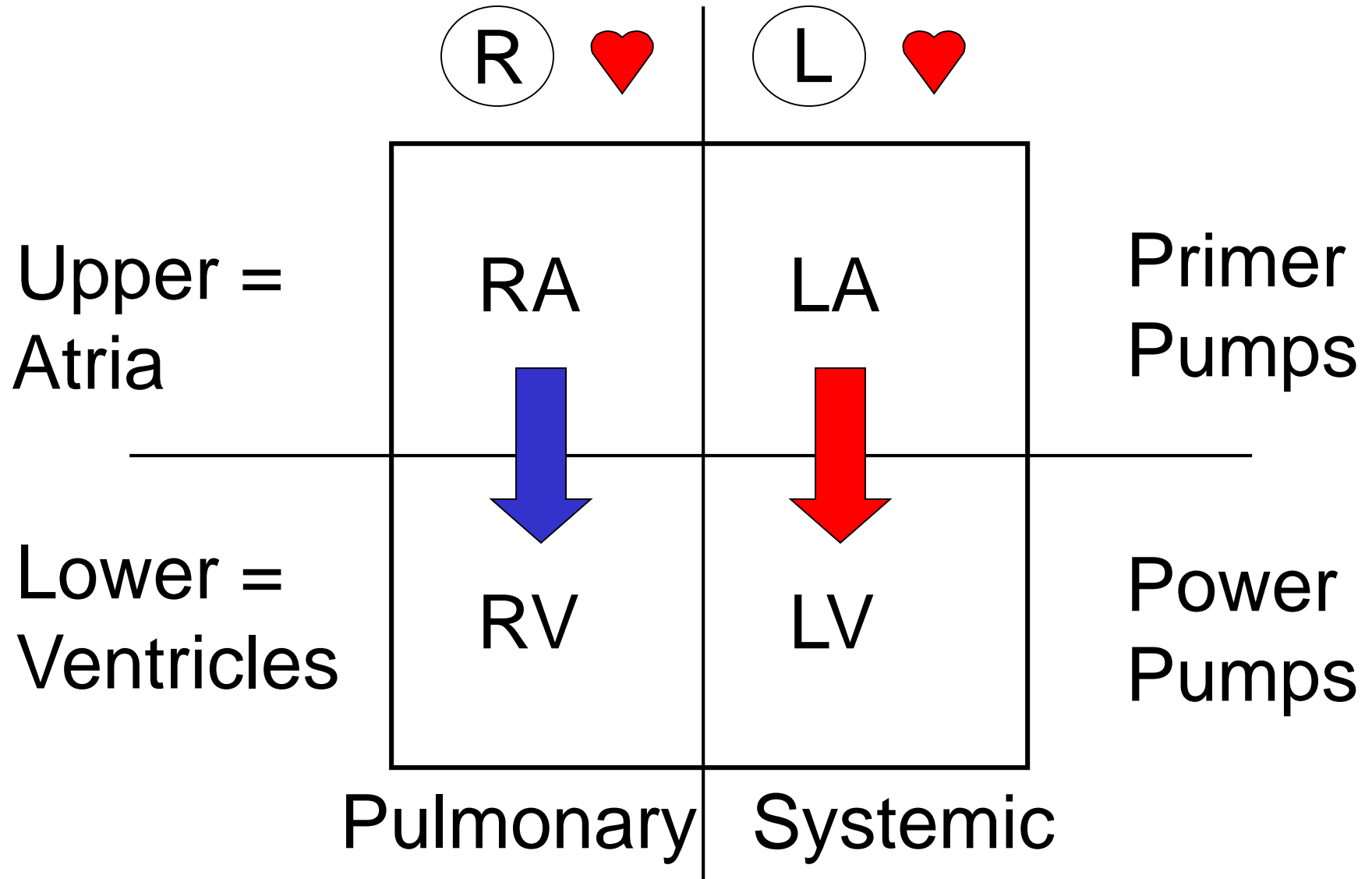


**Harvey
Experiments:
1-way system
of venous
valves!**





Human  = 4-chambered box?
2 separate pumps?



Heart Valves Ensure Unidirectional Blood Flow!



Right AV valve



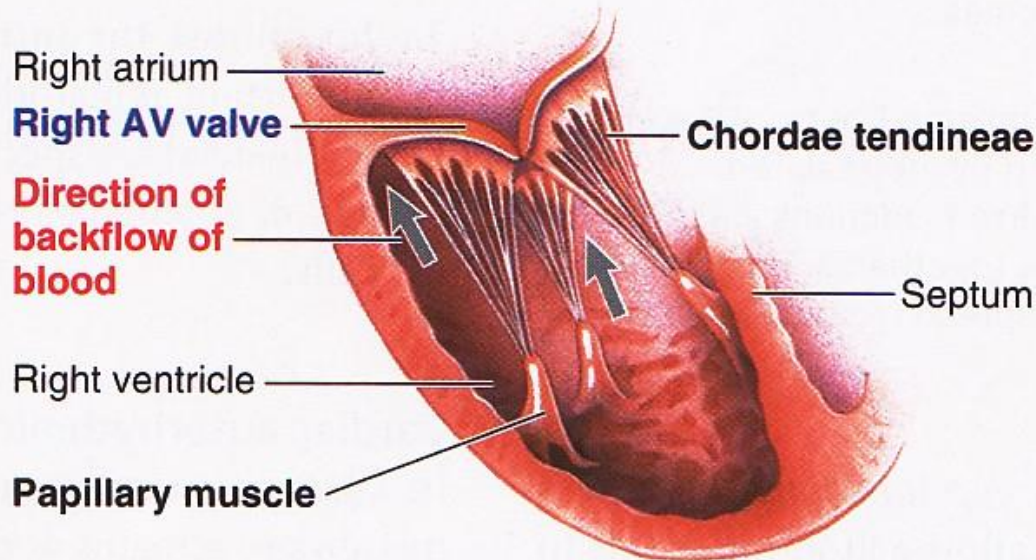
Left AV valve

Mom's
valve!



Aortic or pulmonary valve

(b) Heart valves in closed position, viewed from above



Right atrium

Right AV valve

Direction of
backflow of
blood

Right ventricle

Papillary muscle

Chordae tendineae

Septum

(c) Prevention of eversion of AV valves

● **FIGURE 9-4** Heart valves.

Valves must
be normal &
healthy to
work well!



Human ♥ = 4 unique valves?
2 valve sets?

Semilunar = Half-moon shaped

More rigid

1. Pulmonic/Pulmonary
2. Aortic



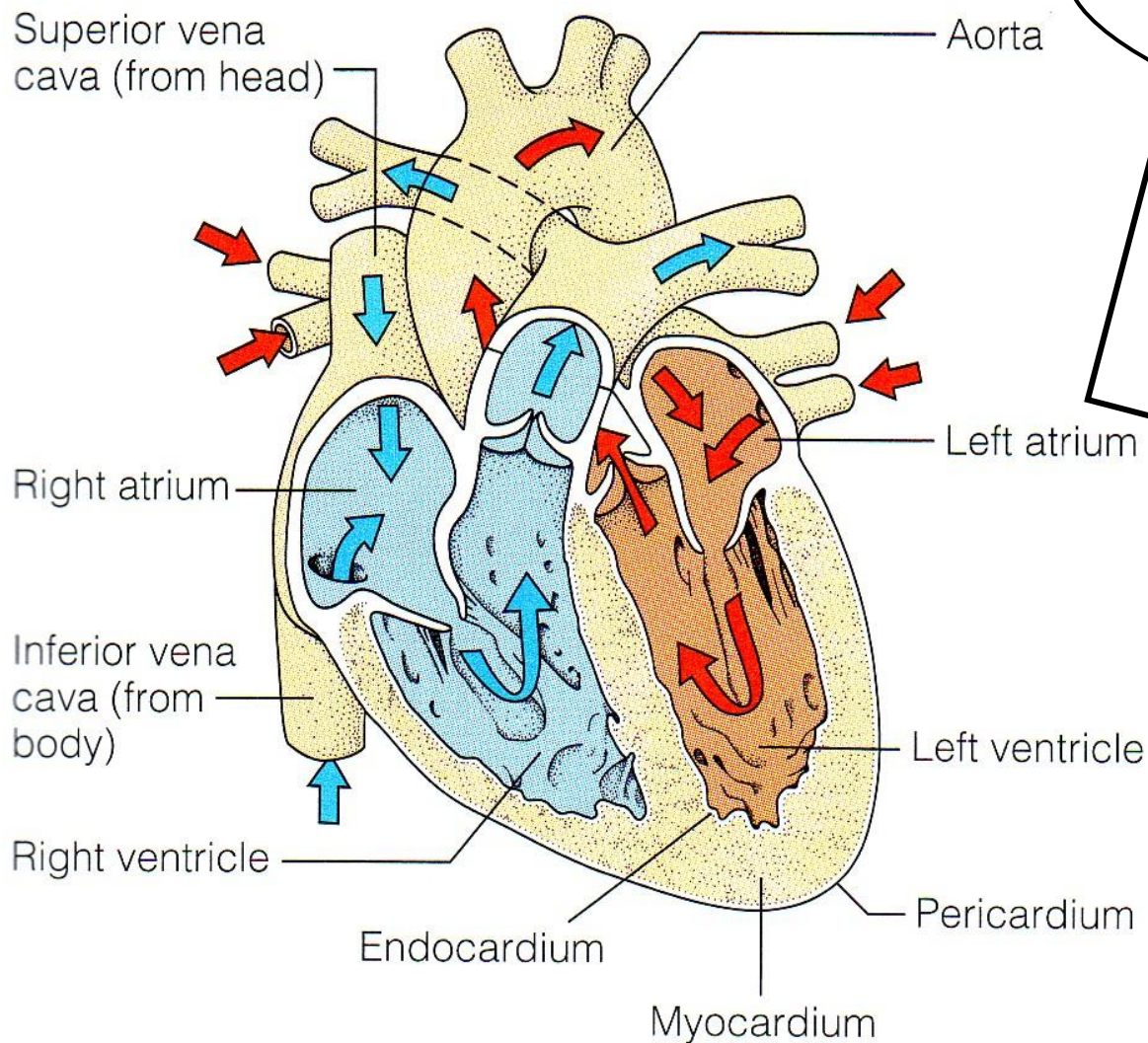
AV = Atrioventricular

More flimsy

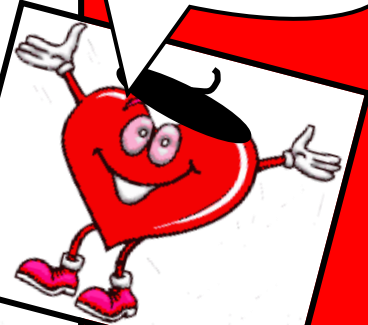
3. (R) AV = Tricuspid
4. (L) AV = Mitral/Bicuspid



Veins → Atria → Ventricles → Arteries



VAVA!



<http://www.nhlbi.nih.gov/health/health-topics/topics/hhw/contraction.html>

BI 121 Lecture 9

I. Announcements Lab notebook due today! Lab 4 HR & BP. Thursday, Lab 5 Blood Chemistry. Read 2x pp 5-1 thru 5-6. Q?

II. Overview of Labs HR & BP. ♥ Cycle. Blood chem lab review

III. Cardiovascular Connections LS 2012 ch 9

A. Normal vs abnormal blood flow! Q?

B. ♥'s electrical highway + Pacemaker activity
LS fig 9-7 p 235, tab 9-1 p 236, fig 9-8 p 237



IV. CV Physiology in the News Randy Foye, NBA player with *Situs Inversus*? 1:10,000! NHLBI & AHA websites

Nicole Kidman & exercise? ACSM, AHA, CDC guidelines

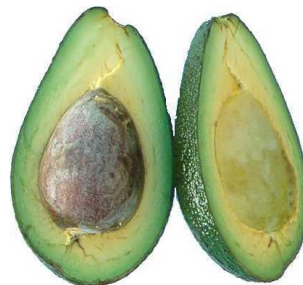
V. CV Pathophysiology & Risk Reduction LS ch 9, 10 +...

A. AMI, CVA, CVD, PVD, TIA, HTN? + surgical treatments

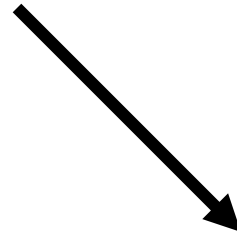
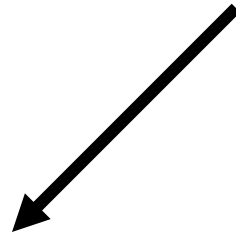
B. Atherosclerosis? LS fig 9-27, 9-25, 9-26 pp 266-8

C. How to minimize risk of CVDs? Treatment triad:
Exercise, Diet, Drugs + Surgery

D. Food choices make a difference?
What's HAPOC?



Cardiac Cycle

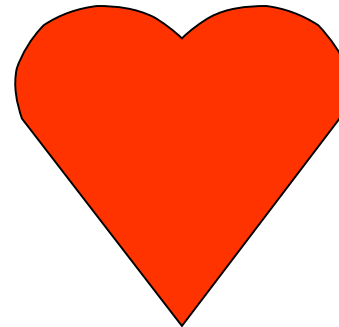
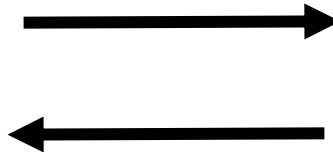
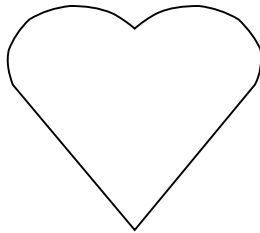


Systole

Contract
& Empty

Diastole

Relax
& Fill

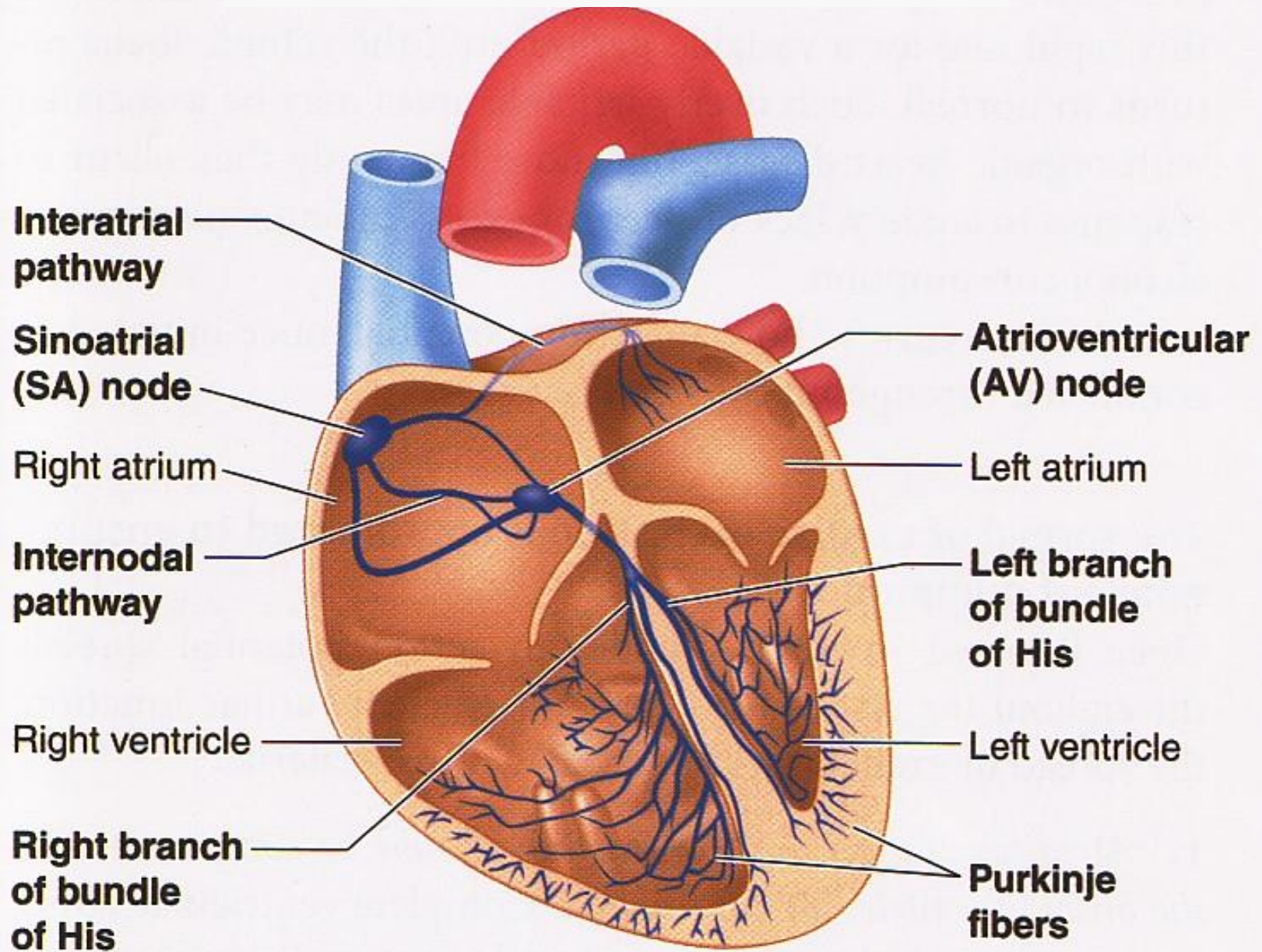


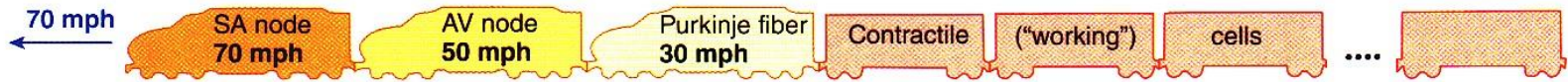
Blood Chemistry on Thursday! No food, drink or gum in lab!



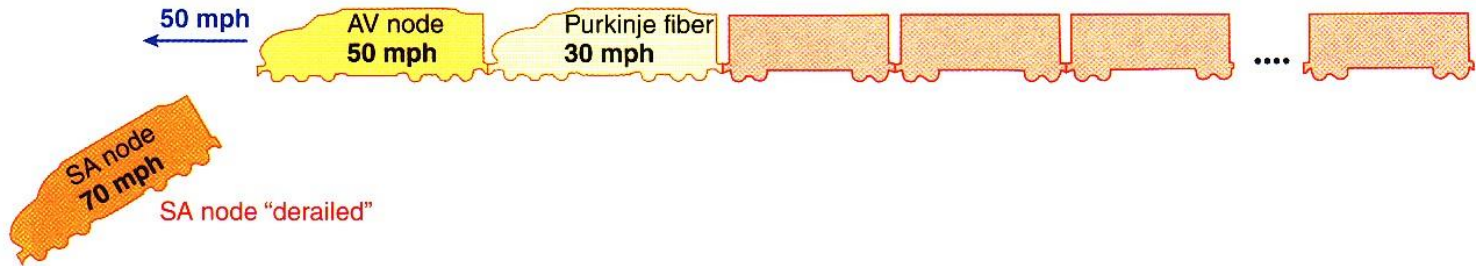
Thanks sincerely!

Heart's Electrical Highway!

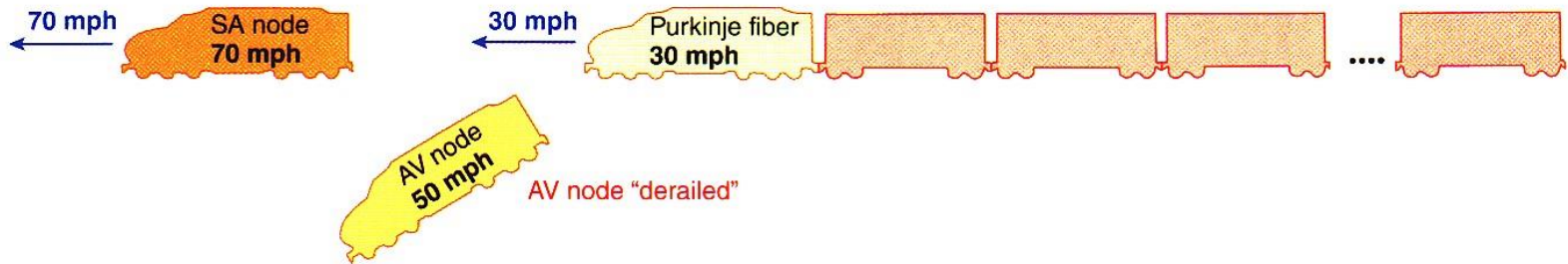




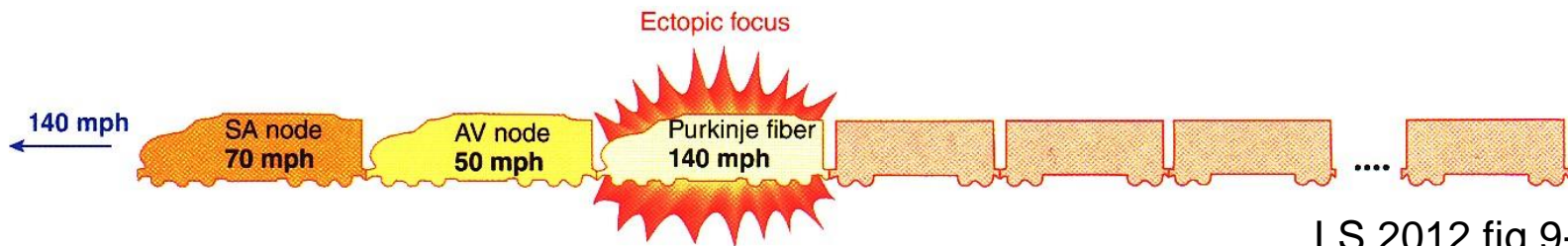
(a) Normal pacemaker activity: Whole train will go **70 mph** (heart rate set by SA node, the fastest autorhythmic tissue).



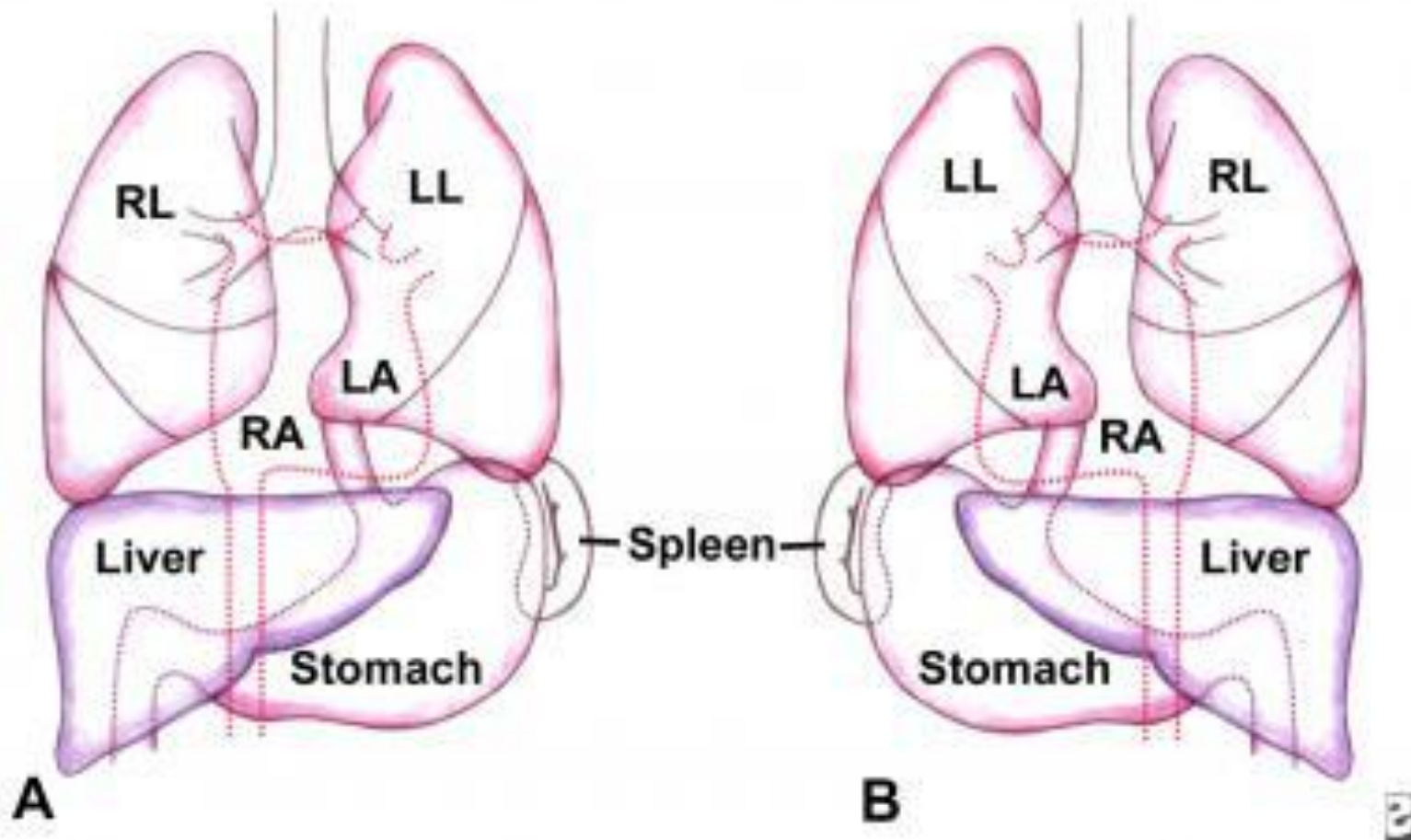
(b) Takeover of pacemaker activity by AV node when the SA node is nonfunctional: Train will go **50 mph** (the next fastest autorhythmic tissue, the AV node, will set the heart rate).



(c) Takeover of ventricular rate by the slower ventricular autorhythmic tissue in complete heart block: First part of train will go **70 mph**; last part will go **30 mph** (atria will be driven by SA node; ventricles will assume own, much slower rhythm).

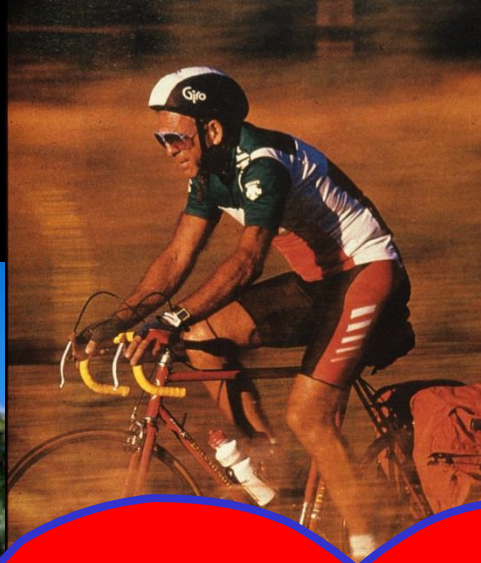


Normal (A) vs *Situs Inversus* (B): 1:10,000 live births!

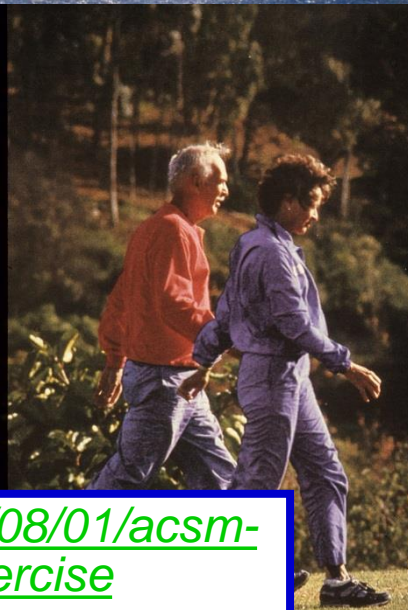
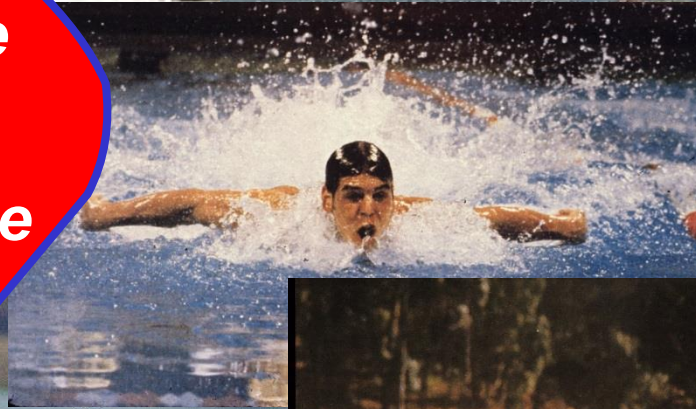


SOURCE: Medscape <http://emedicine.medscape.com/article/413679-overview>

How much aerobic?



Continuous exercise
≥ 50% muscle mass
≥ Conversational pace
20-60 min/session
3-5 days/wk



<http://www.acsm.org/about-acsm/media-room/news-releases/2011/08/01/acsm-issues-new-recommendations-on-quantity-and-quality-of-exercise>



AMERICAN COLLEGE
of **SPORTS MEDICINE**

Guidelines: Healthy Adults < 65 yr

American Heart
Association® 
Learn and Live™

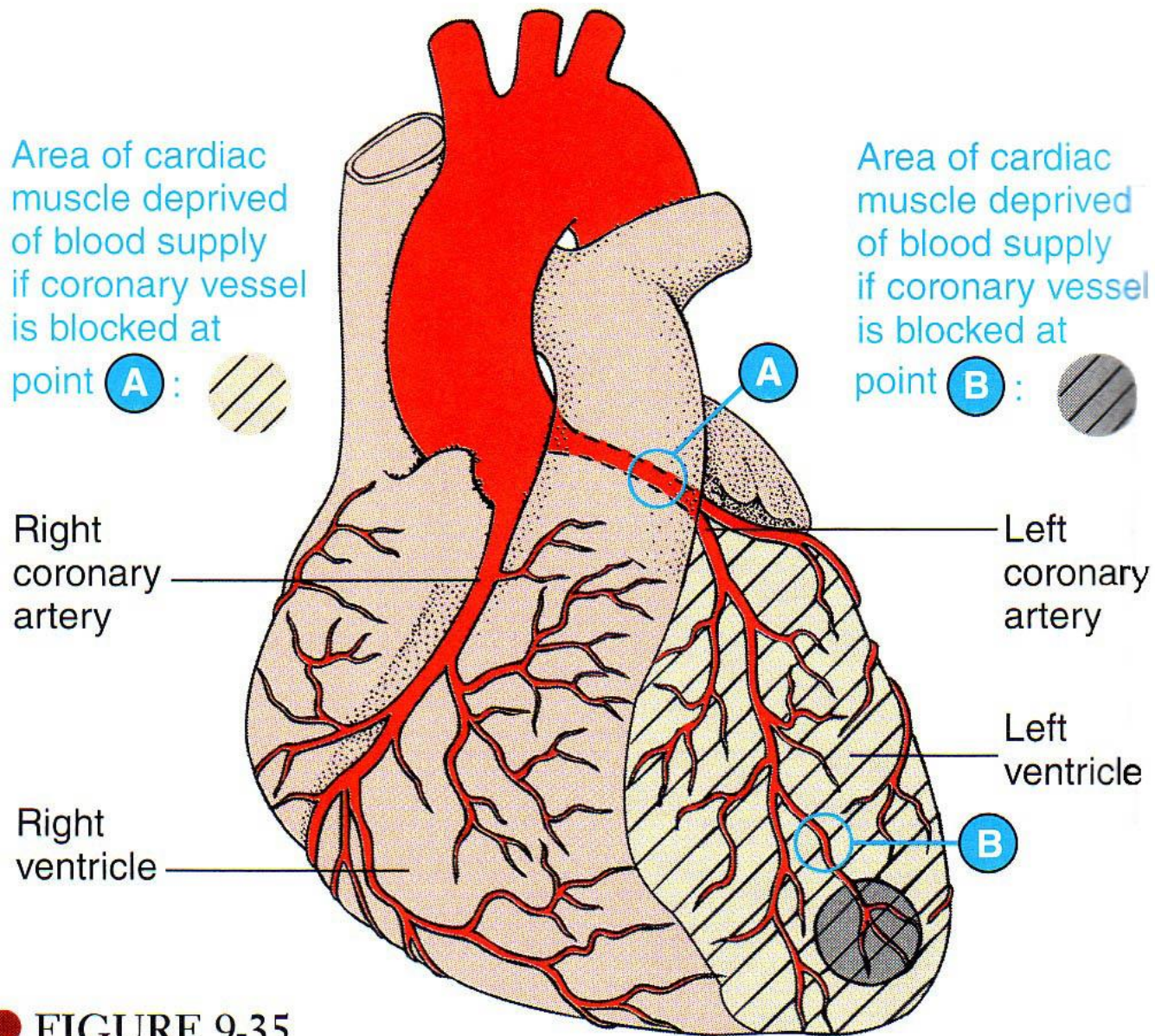
**Do moderately intense aerobic exercise
30 min/d, 5 d/wk**

OR

**Do vigorously intense aerobic exercise
20 min/d, 3 d/wk**

AND

**Do 8-10 strength-training exercises
8-12 repetitions/each exercise, 2 d/wk**



● FIGURE 9-35

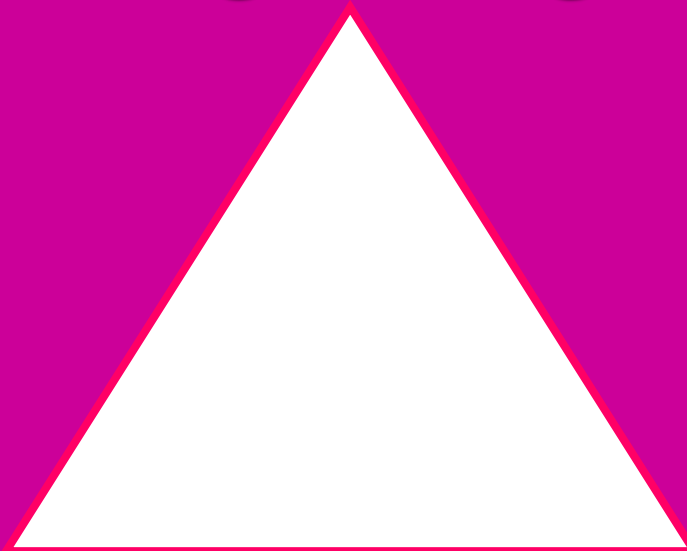
Extent of myocardial damage as a function of the size of the occluded vessel

Treatment Triad

NB: Last blasted resort!!



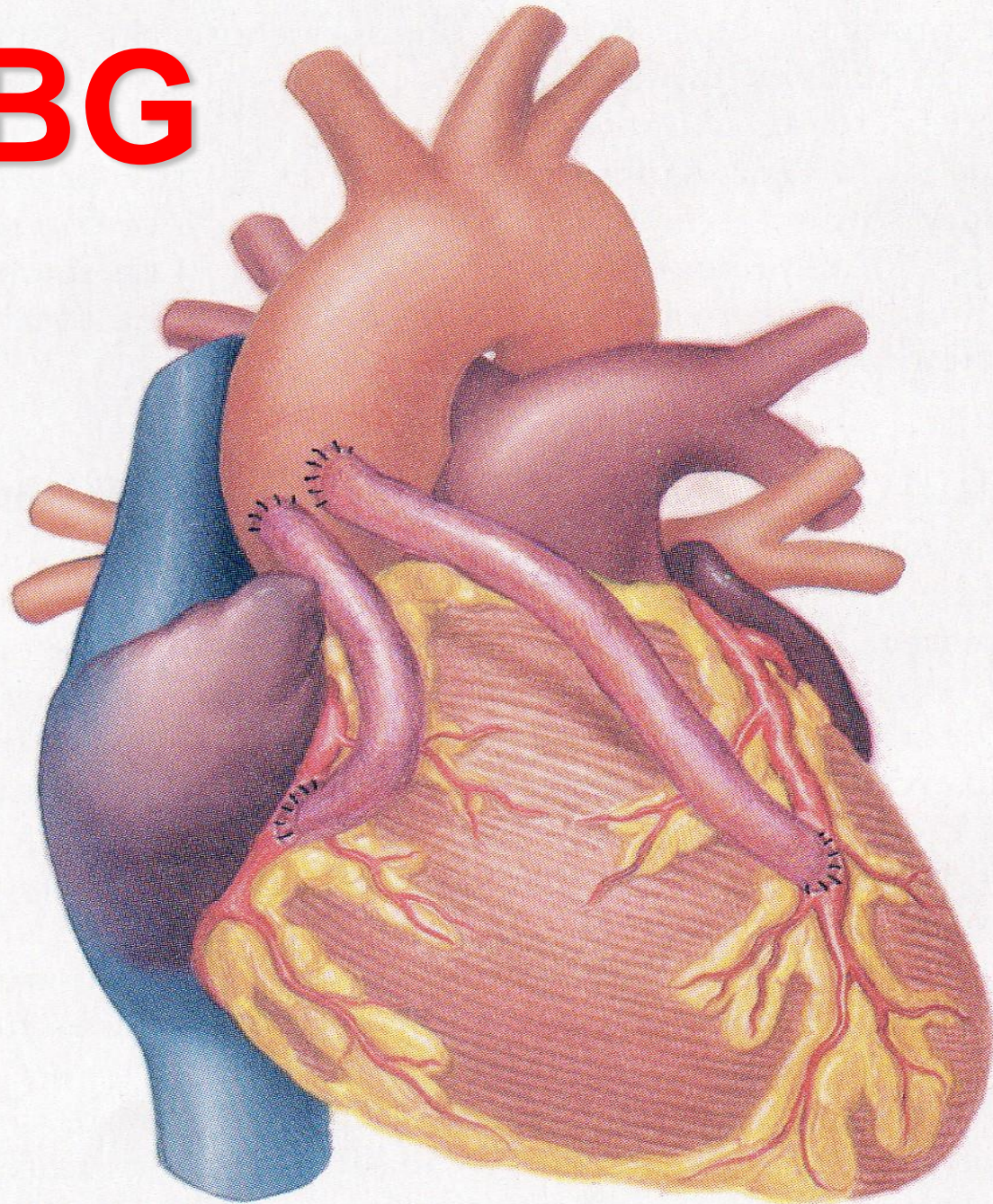
Drugs/Surgery

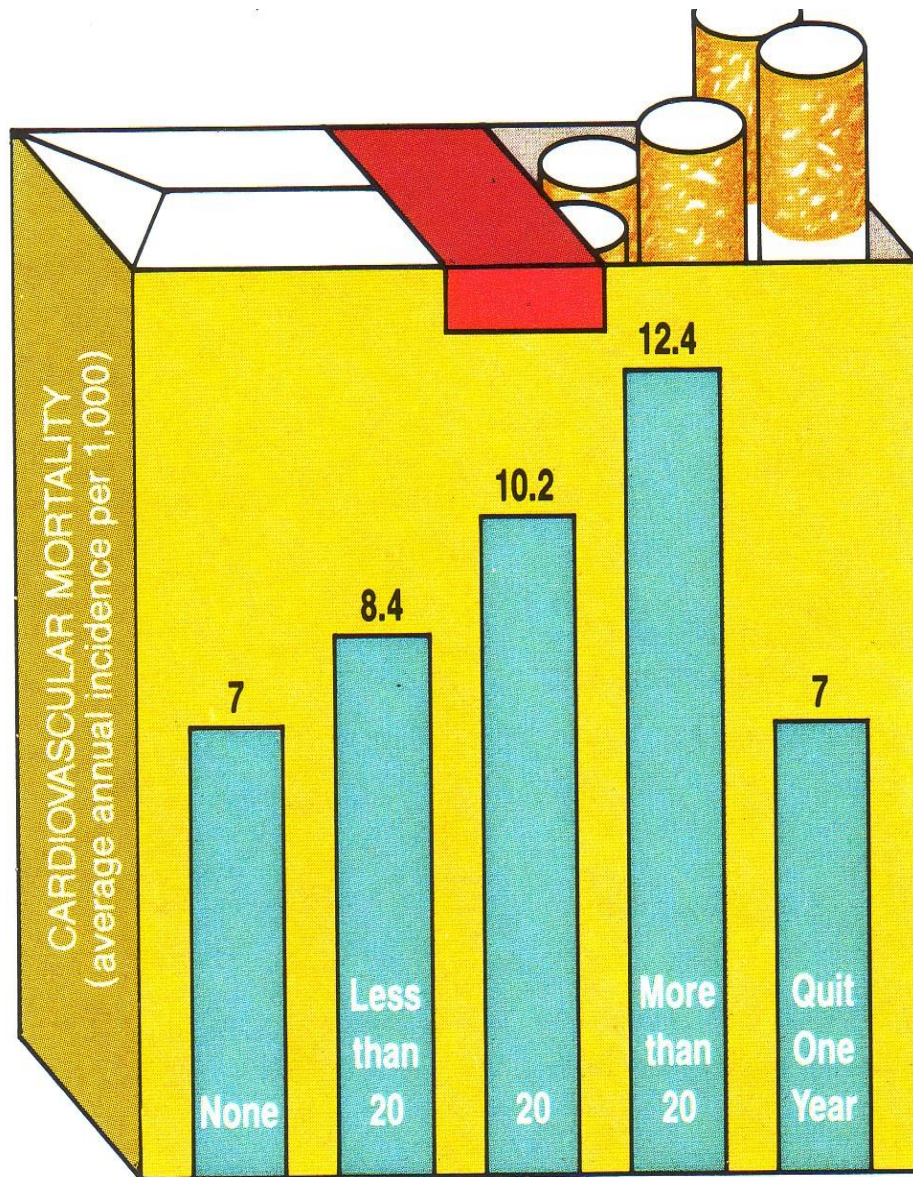


Exercise

*Dietary
Modification*

CABG





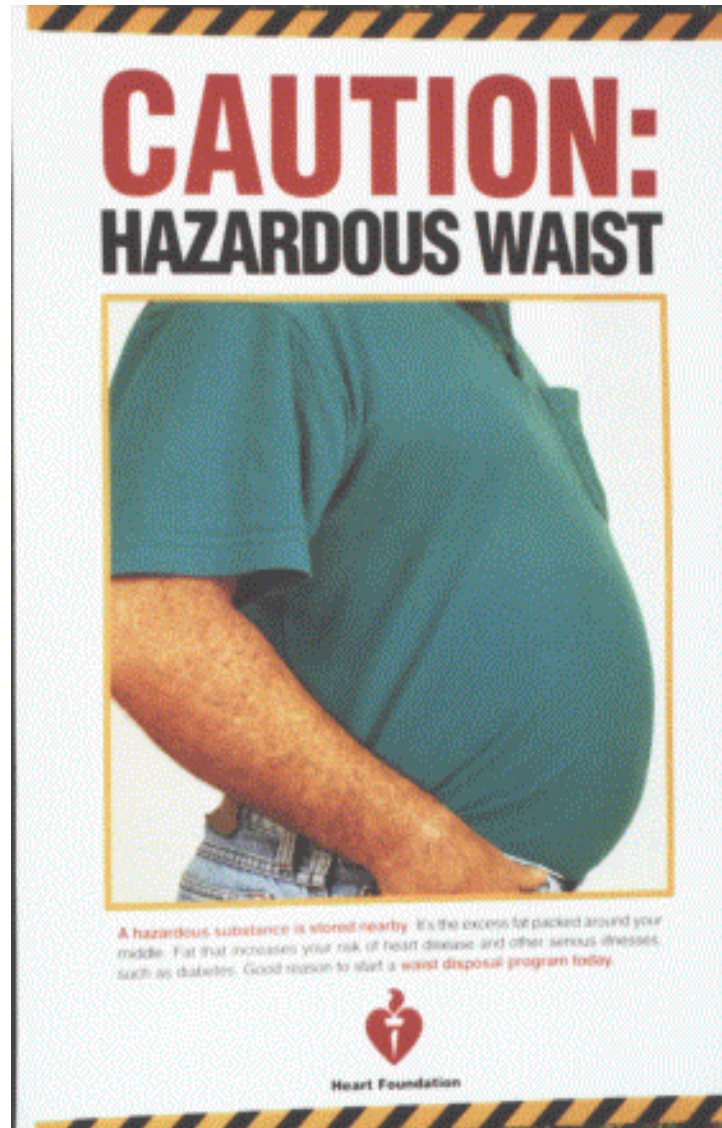
CIGARETTES SMOKED PER DAY

Apple type of obesity predisposed to CVD!

Pear type of fat pattern...



implies lower disease risk!



Eat more apples...



to help prevent the apple type of obesity!



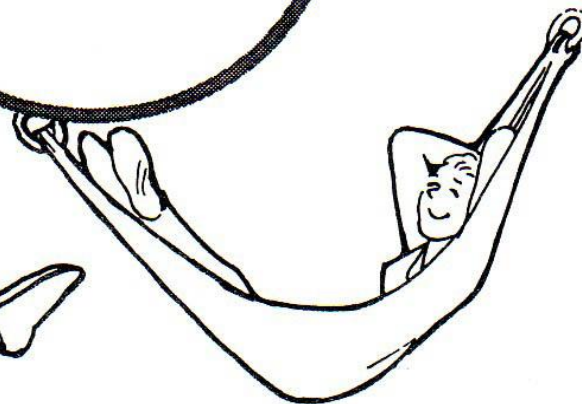
**Cardiorespiratory
Endurance**



**Muscular
Strength/Endurance**



Flexibility



Neuromuscular Relaxation



Healthy Oils to Minimize Atherosclerosis HAPOC?

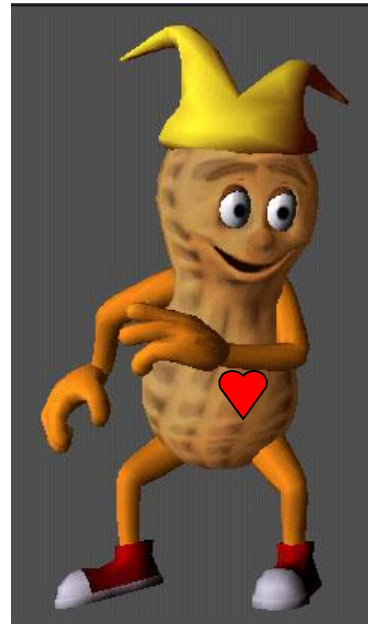
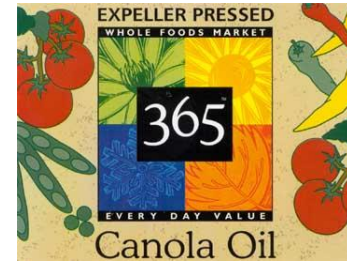
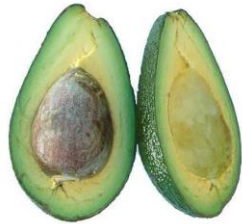
H

A

P

O

C



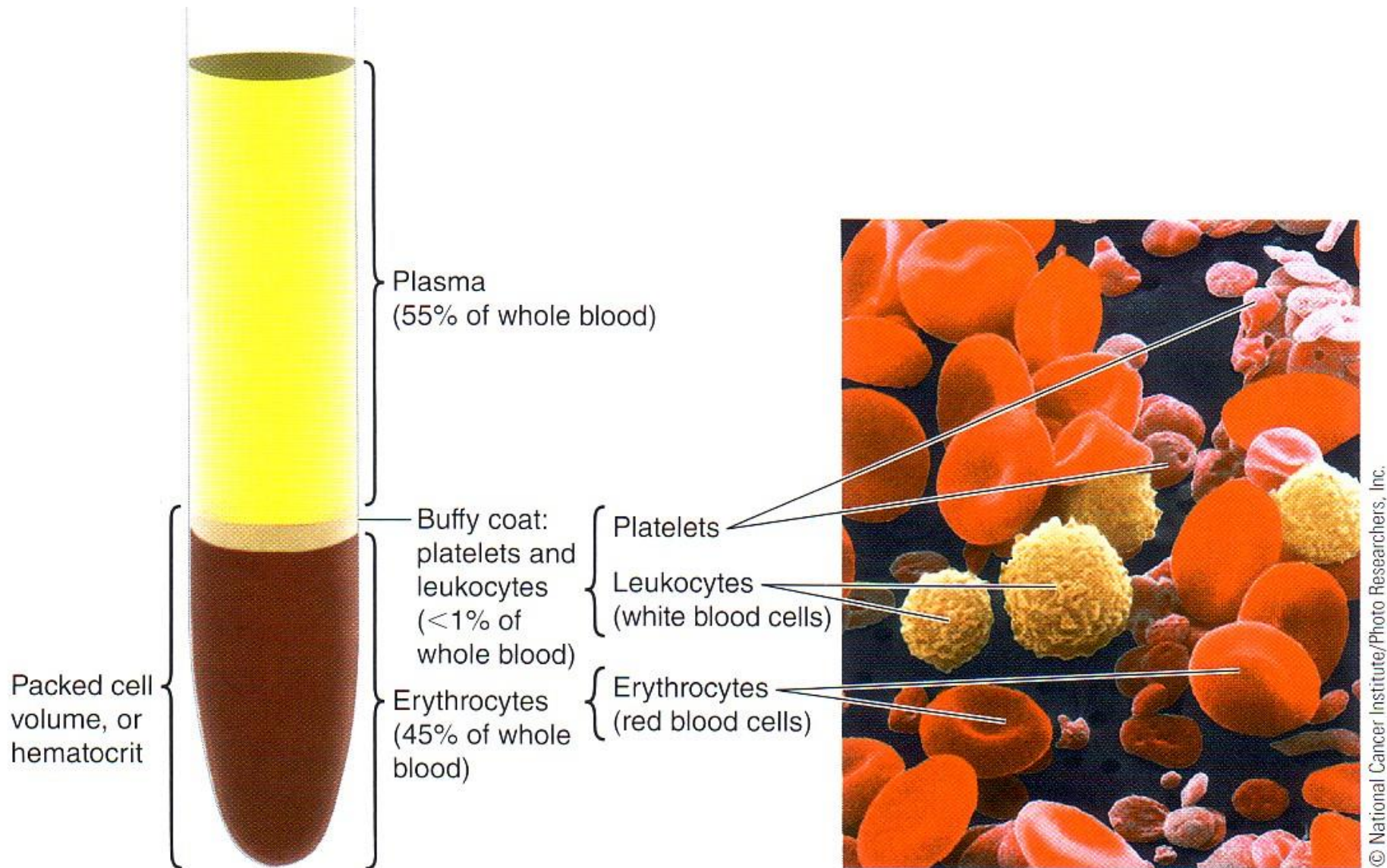


...Fun lab week with much personal data!

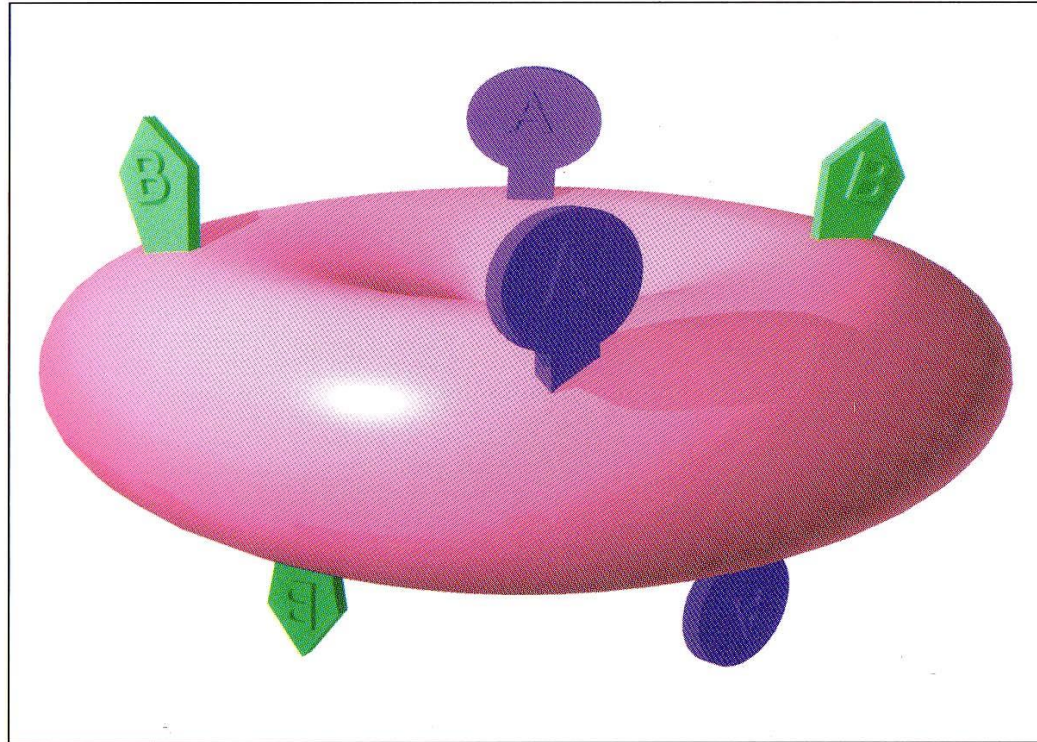
BI 121 Lecture 10

- I. Announcements** Remember to read Lab 5 before Thursday. Thanks for helping us be well-prepared. Q from last time? Calculating grade from estimated final. Keys to success? Q?
- II. CVDs Prevention & Treatment** Exercise, dietary modifications anti-inflammatory oils? PTCA, CABG, ... Torstar, S&W ch 5+...
- III. Blood Form & Function** LS ch 11 pp 296-304, 309-12
DC Module 5 + SI Fox + *National Geographic* Lennart Nilsson
 - A. Formed vs. nonformed/cells vs. plasma fig+tab 11-1
 - B. Red blood cells/erythrocytes: O₂-carrying
sickle cells, ABO blood typing, Rh factor pp 299-304.
 - C. White blood cells/leukocytes: Defense/immunity
differential + general functions pp 309-12
 - D. Platelets/thrombocytes: Initial clotting p 304
- IV. Blood Glucose & Diabetes Mellitus** LS ch 17, DC Module 13

What's in Blood? Plasma & Blood Cells



AB



A & B Antigens
(Agglutinogens)

Erythroblastosis Fetalis?

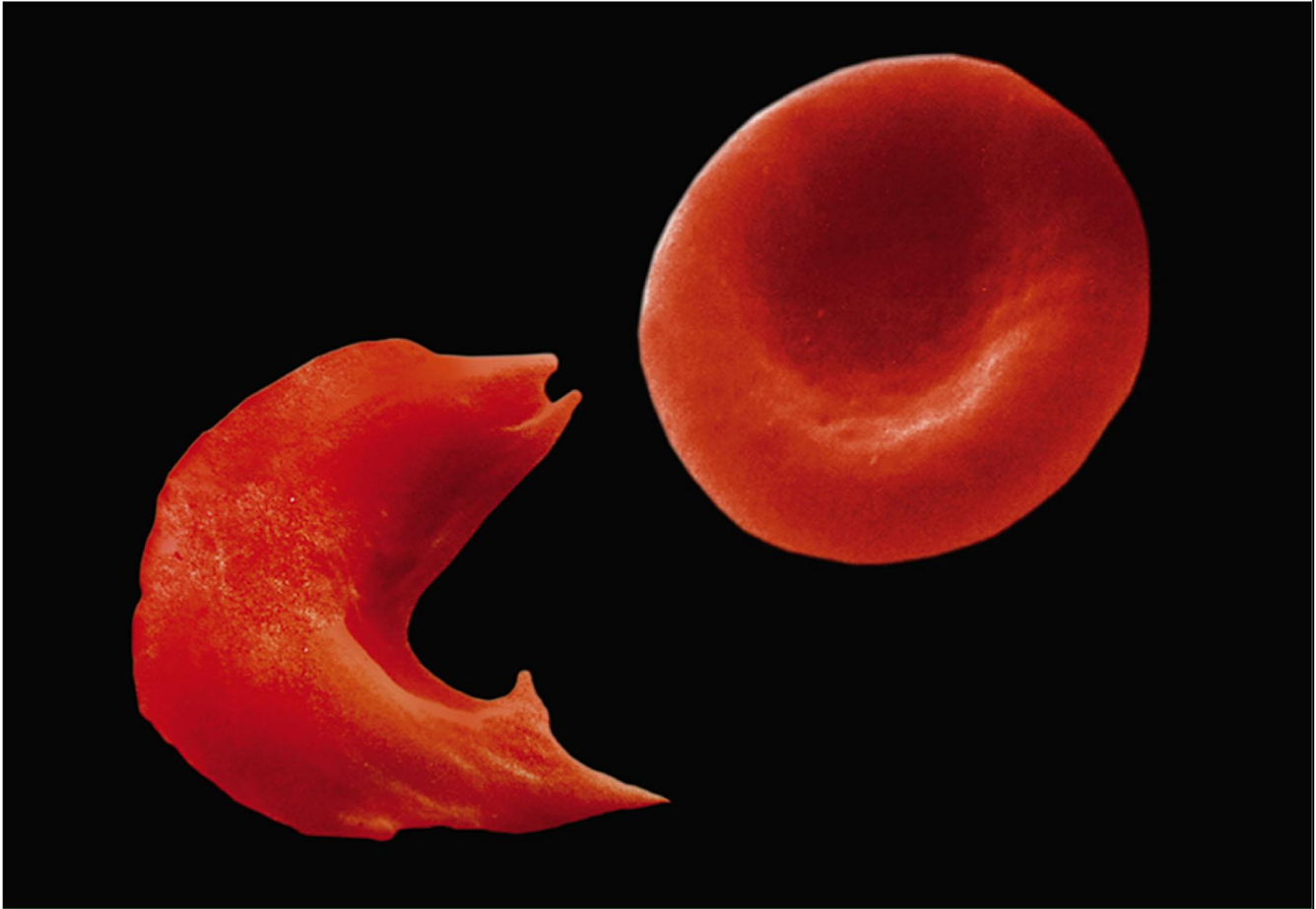
**eg, Rh- mom
Rh+ baby**

<http://www.nlm.nih.gov/MEDLINEPLUS/ency/article/001298.htm#Alternative%20Names>

Sickle-shaped blood cells

Normal red blood cells

© Dr. Stanley Flegler/Visuals Unlimited



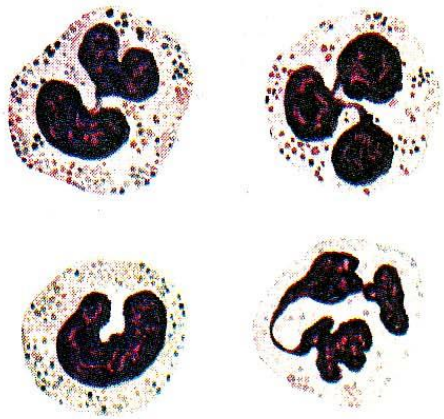
What a difference one amino acid can make!

Amino acid sequence of normal hemoglobin:

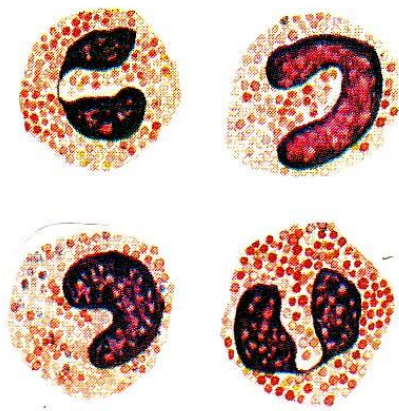


Amino acid sequence of sickle-cell hemoglobin:

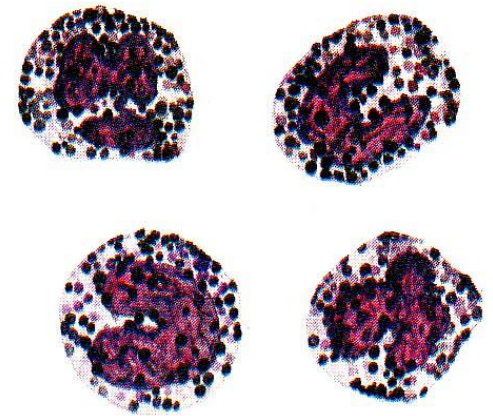




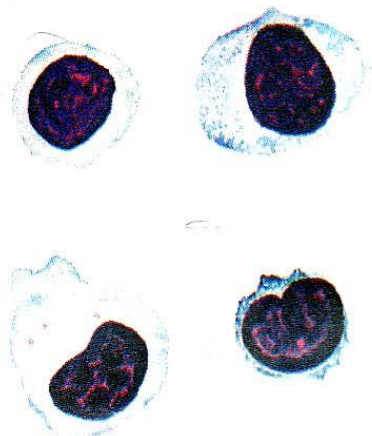
NEUTROPHILS



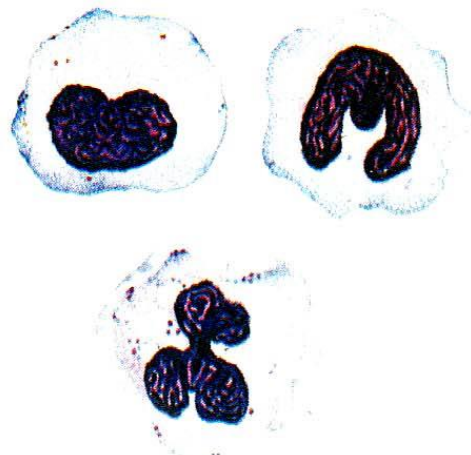
EOSINOPHILS



BASOPHILS



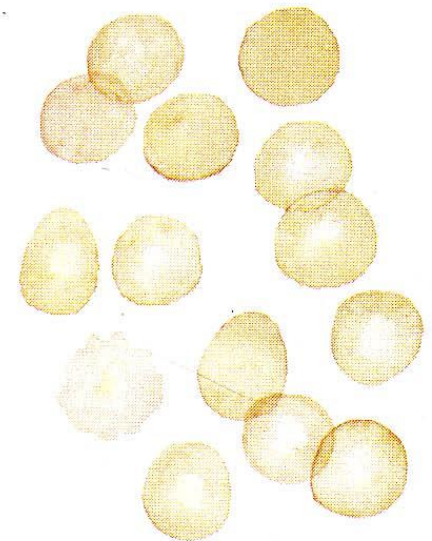
LYMPHOCYTES



MONOCYTES



PLATELETS



ERYTHROCYTES

Glucose:
Sugar in Blood

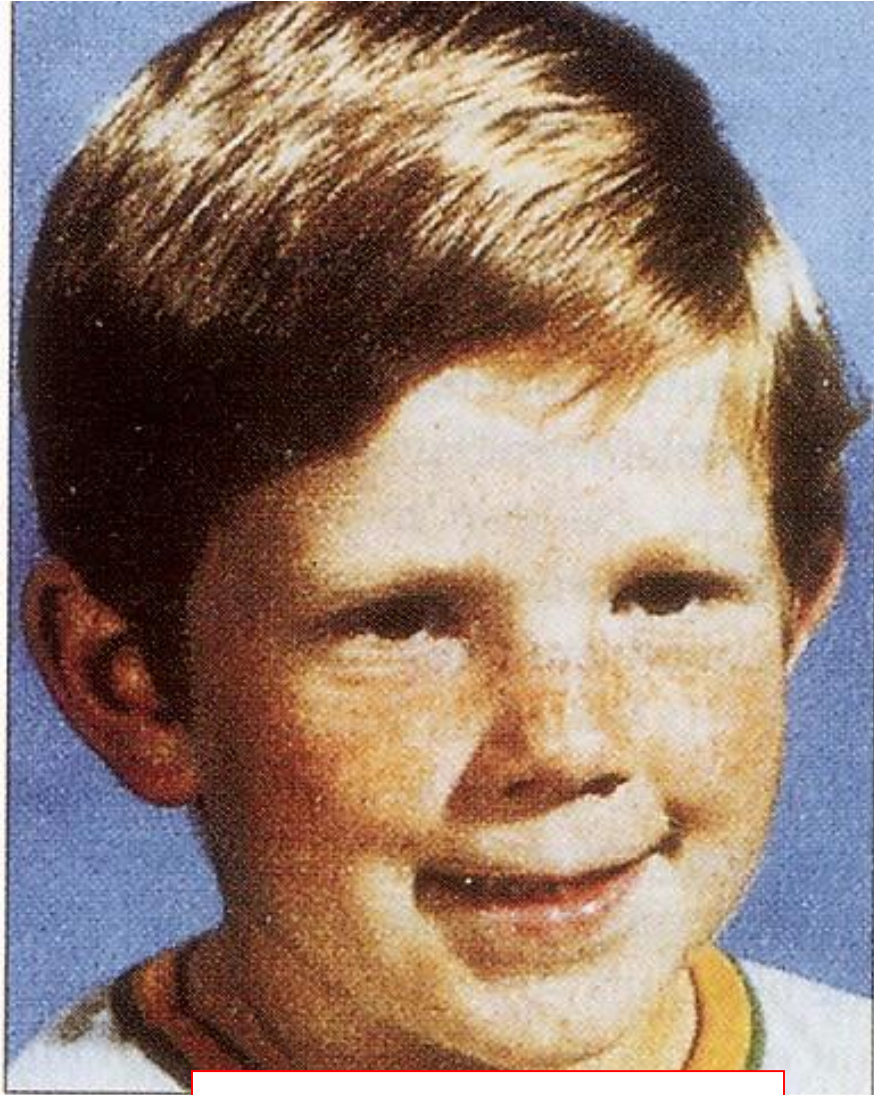


Normal: 70-99
Pre-Diabetes: 100-125
Diabetes: ≥ 126 mg/dL

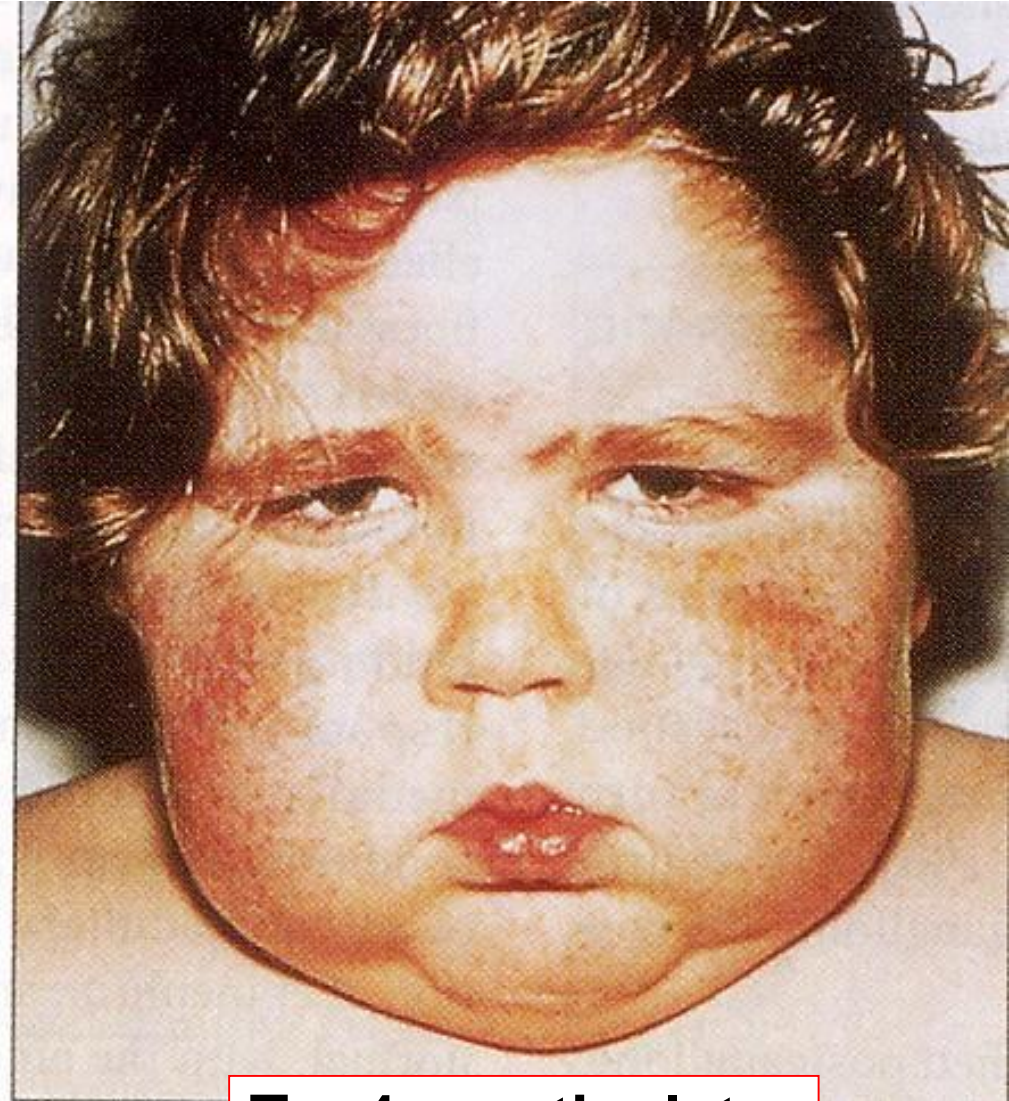


- I. Lab 5 Review: Safety & Techniques + Connections Q?**
- II. Introduction to Endocrinology** LS ch 17, DC Module 13, SI Fox+
 - A. Endocrine vignette: Cushing's syndrome** LS fig17-20 p 521-2
 - B. Endocrine system** DC p 103 fig 13-1, LS fig 17-1, tab 17-1
 - C. What's an endocrine? + classes** ~ LS pp 495 – 6
 - D. Hypothalamus (Master) – Pituitary (subcontroller)**
DC pp 104-6 + LS pp 499-506
 - E. Posterior pituitary + hormones** DC p 108, LS fig 17-4 p 502
 - F. Anterior pituitary + hormones** DC pp 105-7, LS pp 502-6
 - G. GH: Body builder's dream? Fountain of youth?** LS pp 506-11
 - H. Peripheral endocrine organs** DC pp 109-13, LS pp 513-36
 - 1. Pancreas (insulin, glucagon, diabetes) 2. Thyroid 3. Adrenals
- III. Nervous System & Excitable Cell Connections** LS ch 5, 4, 7
 - A. How is the nervous system organized?** fig 5-1 p 108
 - B. Neurons? What kind?** fig 5-2 p 109
 - C. Brain structure & function** fig 5-7, 5-8 pp 116 - 7
 - D. Protect your head with a helmet!** Bicycle head injury statistics, *NHTSA & BHSI*

***Cushing's Syndrome = Hypersecretion
of Cortisol: Hypothalamic (CRH),
Pituitary (ACTH), or Adrenal (Cortisol)***



T = 0, near normal

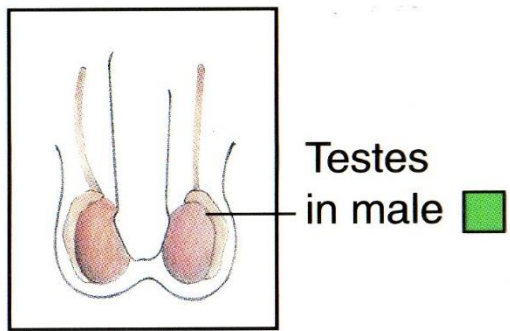
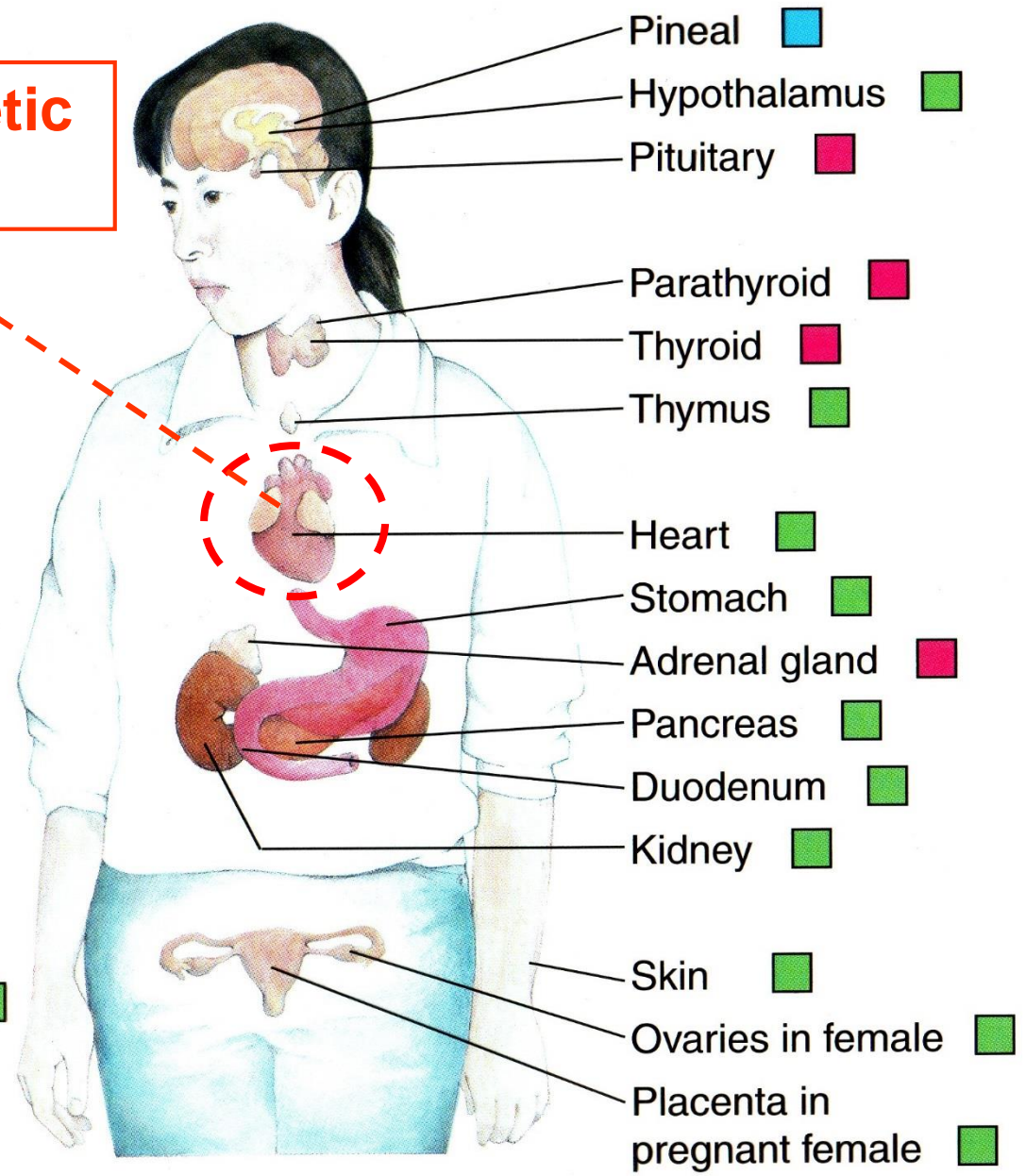


T = 4 months later

Endocrine System

ANP = Atrial Natriuretic Polypeptide

- Solely endocrine function
- Mixed function
- Complete function uncertain

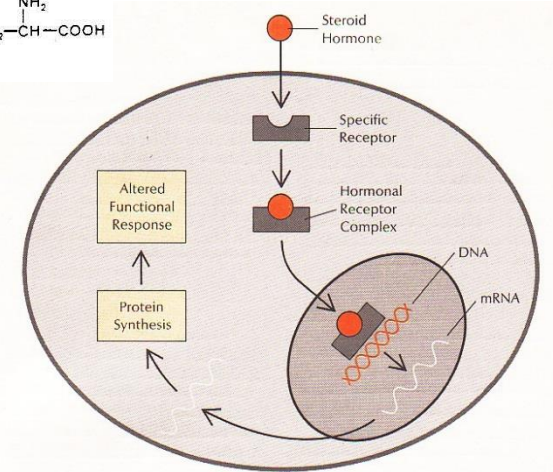
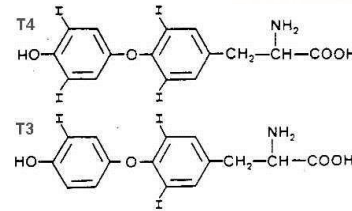
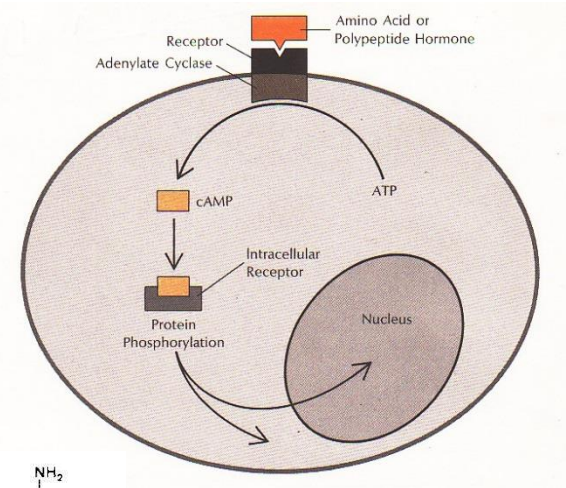


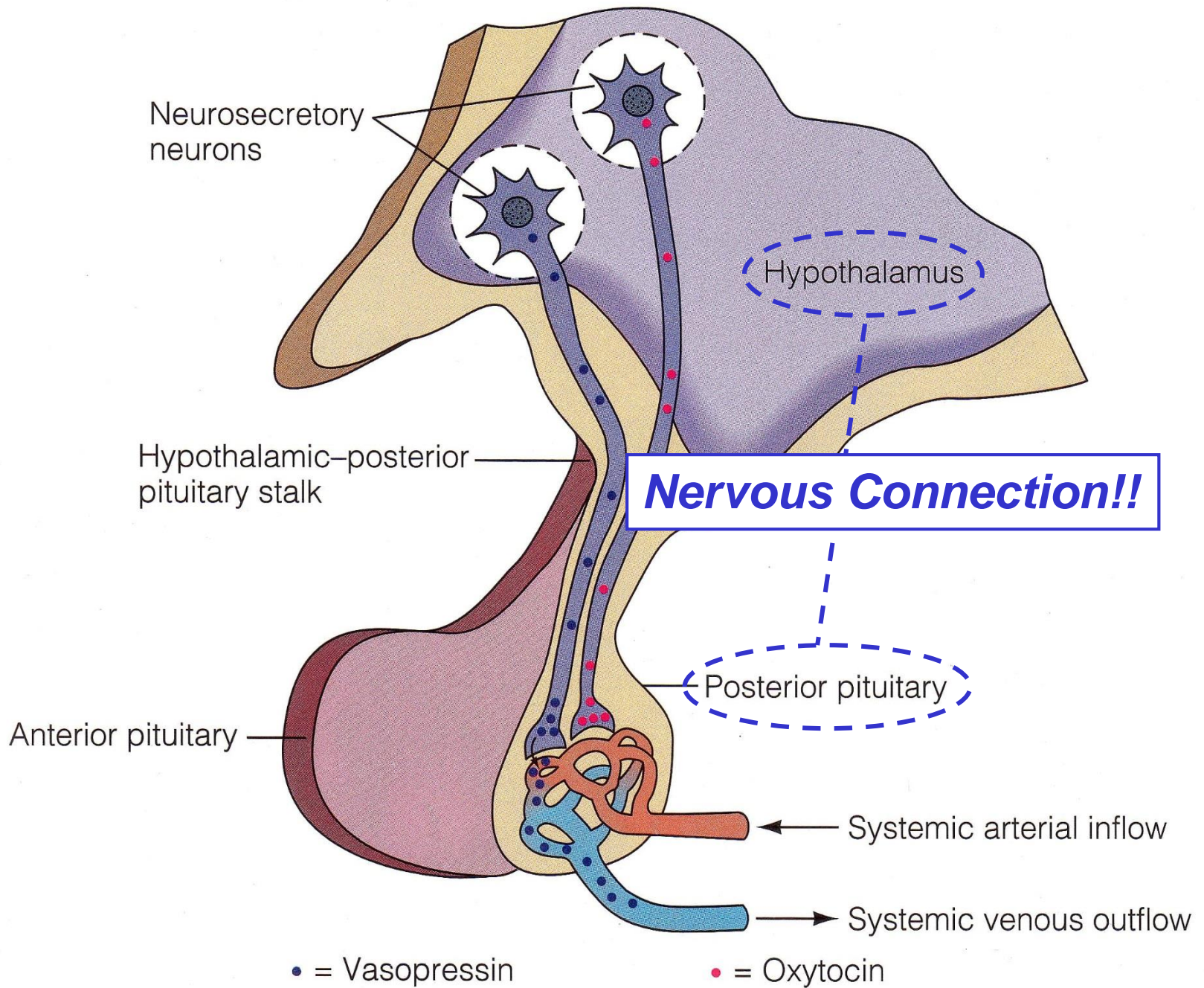
Hormone/Endocrine Classifications

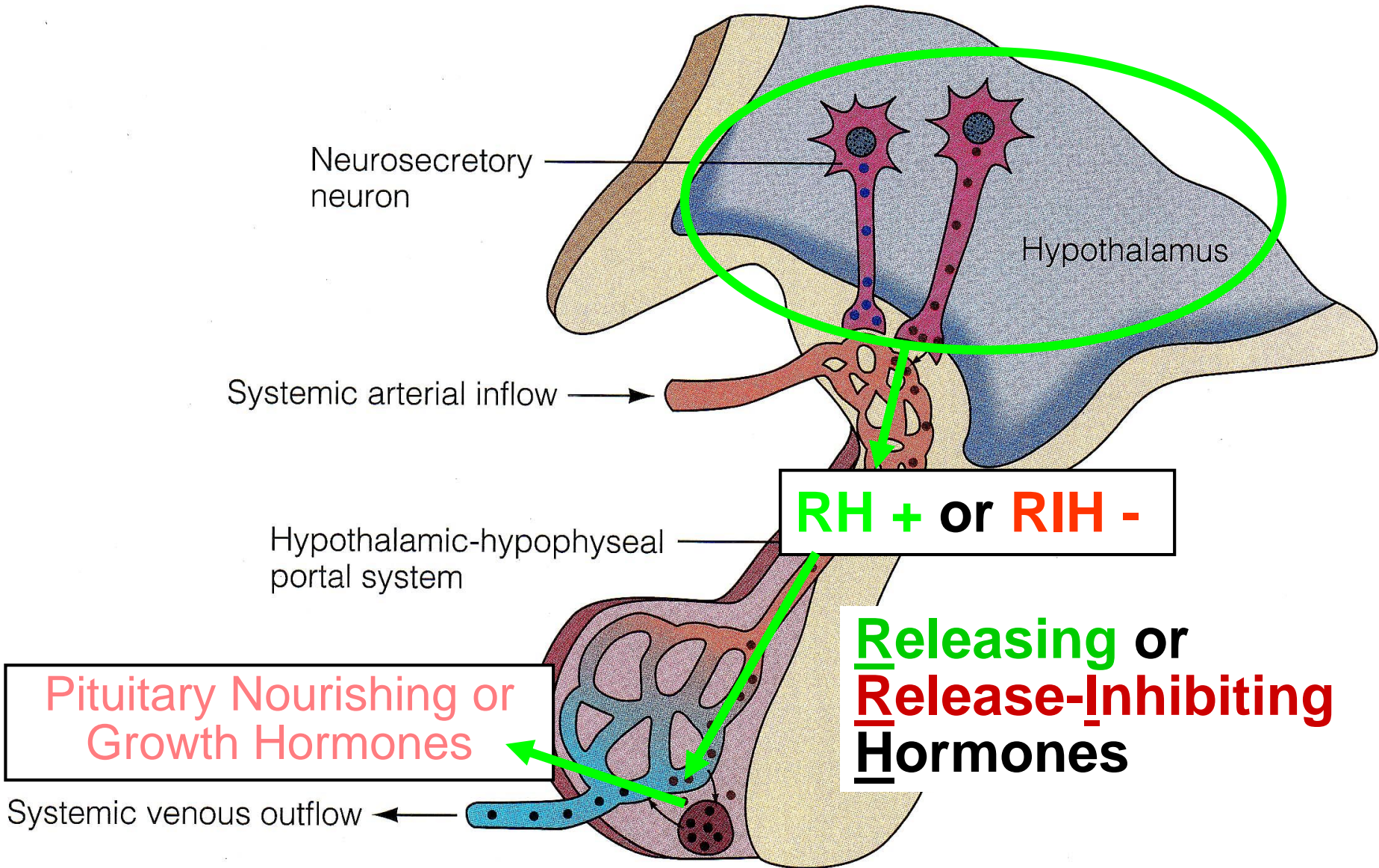
Exogenous



Endogenous



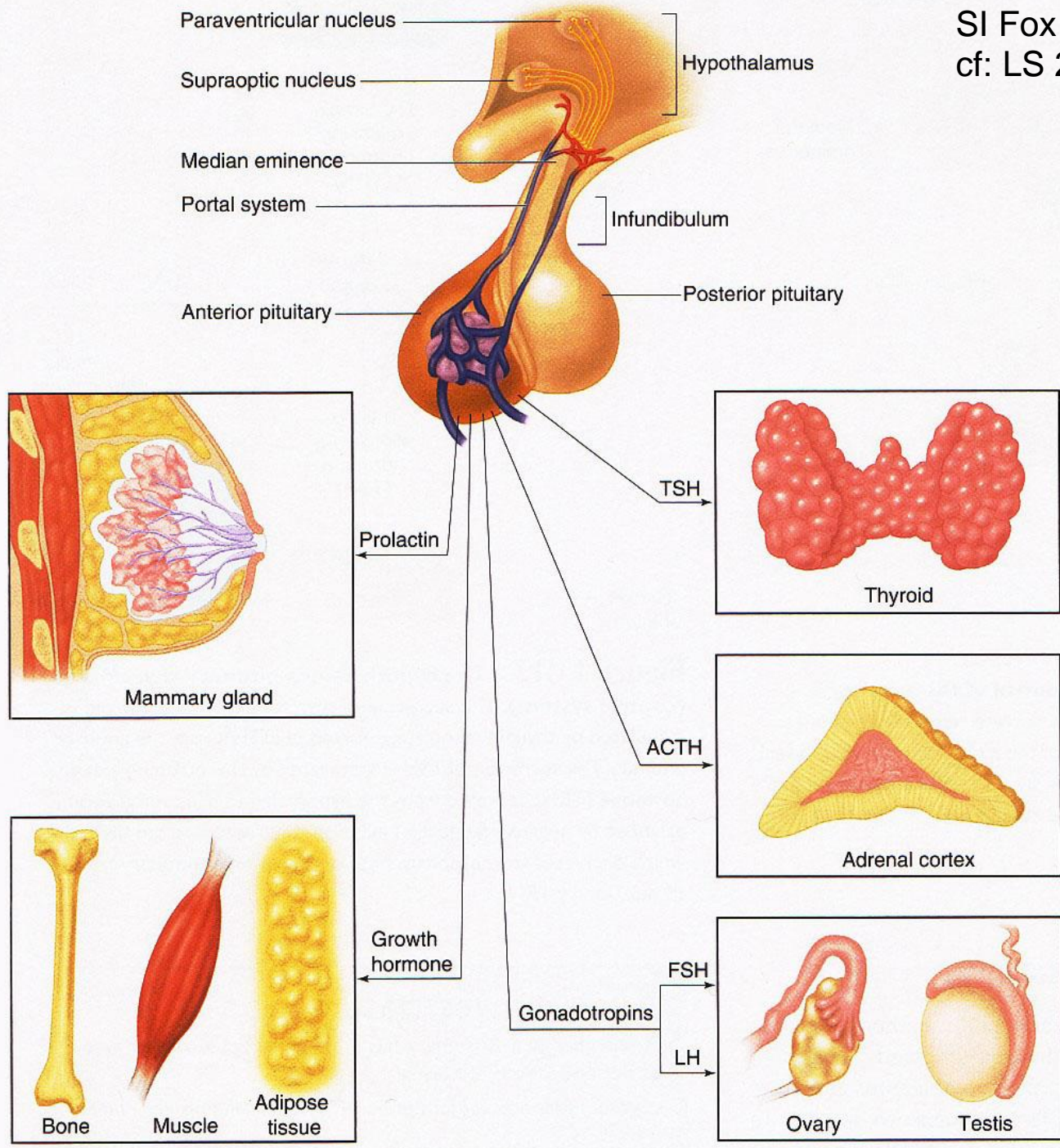




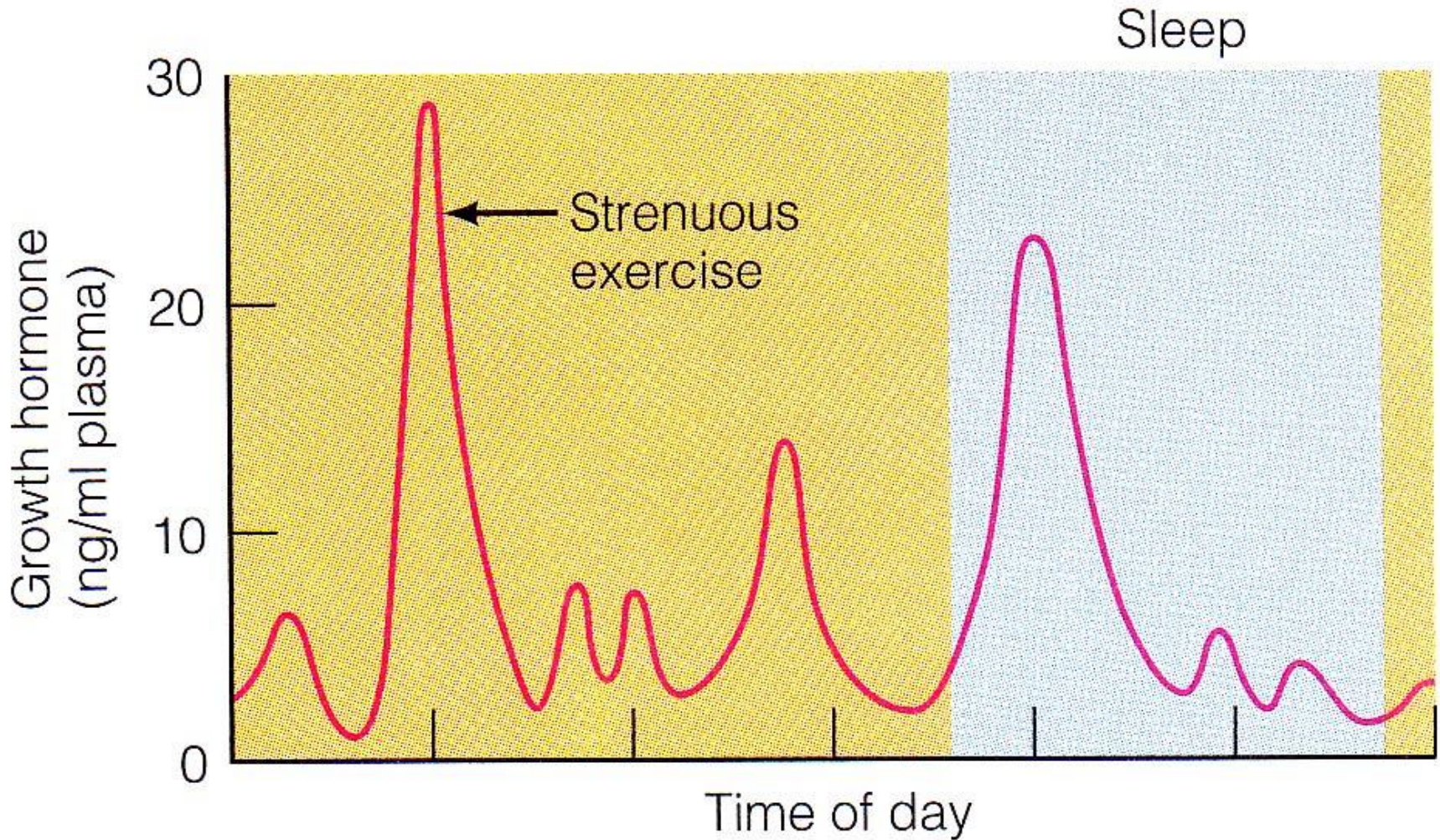
• • = Hypophysiotropic hormones

• = Anterior pituitary hormone

Hypophysis ≡ Pituitary



Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per milliliter



- I. *Announcements*** Optional notebook check + Lab 6 tomorrow. Pulmonary Function Testing. Final exam > your Q on Thurs. Q?
- II. *Endocrine Connections*** Peripheral endocrine organs
 - A. Pancreas (insulin, glucagon, diabetes) B. Thyroid C. AdrenalsDC Module 13 pp 109-13, LS pp 513-36
- III. *Nervous System & Excitable Cells*** DC Module 9, LS ch 5, 4, 7
 - A. How is the nervous system organized? fig 5-1 p 108
 - B. Neurons? What kind? fig 5-2 p 109
 - C. Brain structure & function fig 5-7, 5-8 pp 116 – 7
 - D. Protect your head with a helmet!
Bicycle head injury statistics, NHTSA & BHSI
- IV. *Brain + Autonomic Nervous System Overview*** DC pp 71-77, LS pp 178 – 85, tab 7-1 p 183 + stories to remember *fight-or-flight!*
- V. *Neuromuscular Connections*** LS ch 7 pp 186-92, DC pp 69-71
How does the signal cross the nerve-muscle gap? LS fig 7-5
 - A. Normal function? Ca²⁺ for bones!...but what else? LS p 190
 - B. What do black widow spider venom, botulism, curare & nerve gas have in common? Botox? LS p 189-91
- VI. *Muscle Structure, Function & Adaptation*** LS ch 8, DC Module 12
 - A. Muscle types: cardiac, smooth, skeletal LS fig 8-1 p 194-6
 - B. How is skeletal muscle organized? LS fig 8-2, DC fig 12-2

Times of Plenty!!

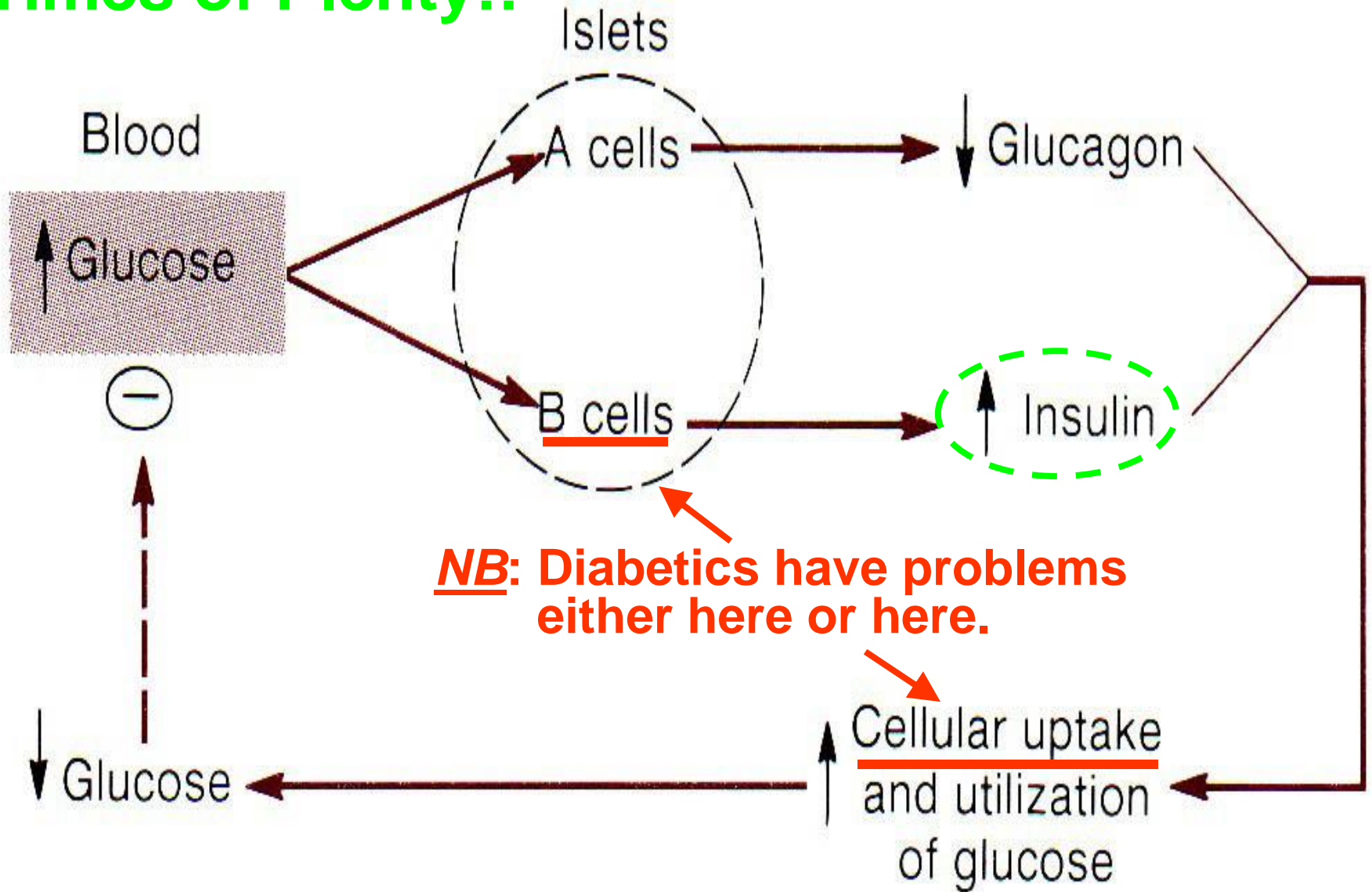
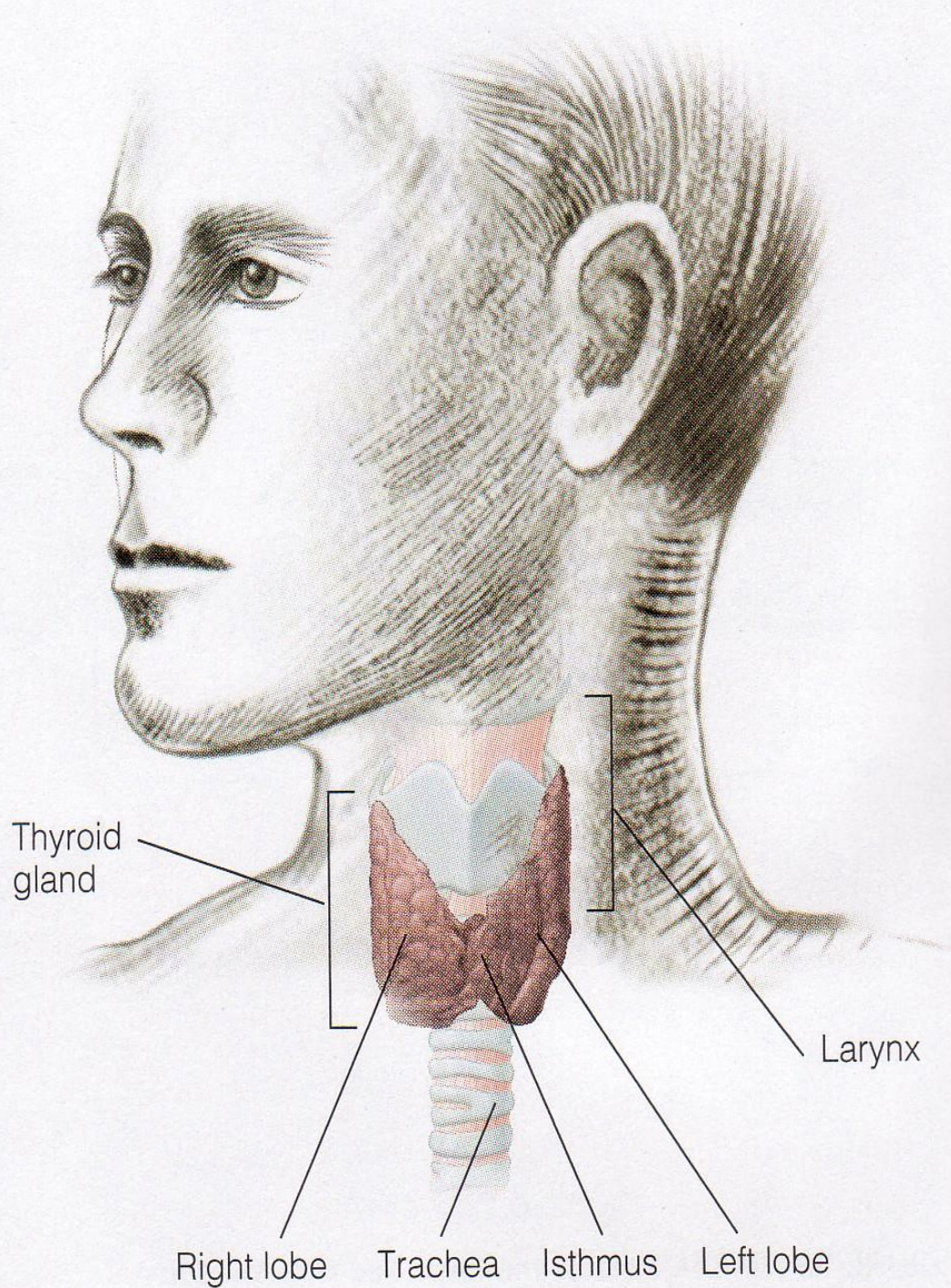


TABLE
4-7

Warning Signs of Diabetes

These signs appear reliably in type 1 diabetes and, often, in the later stages of type 2 diabetes.

- Excessive urination and thirst
- Glucose in the urine
- Weight loss with nausea, easy tiring, weakness, or irritability
- Cravings for food, especially for sweets
- Frequent infections of the skin, gums, vagina, or urinary tract
- Vision disturbances; blurred vision
- Pain in the legs, feet, or fingers
- Slow healing of cuts and bruises
- Itching
- Drowsiness
- Abnormally high glucose in the blood







Adrenal gland

Adrenal cortex

Adrenal medulla

Kidney

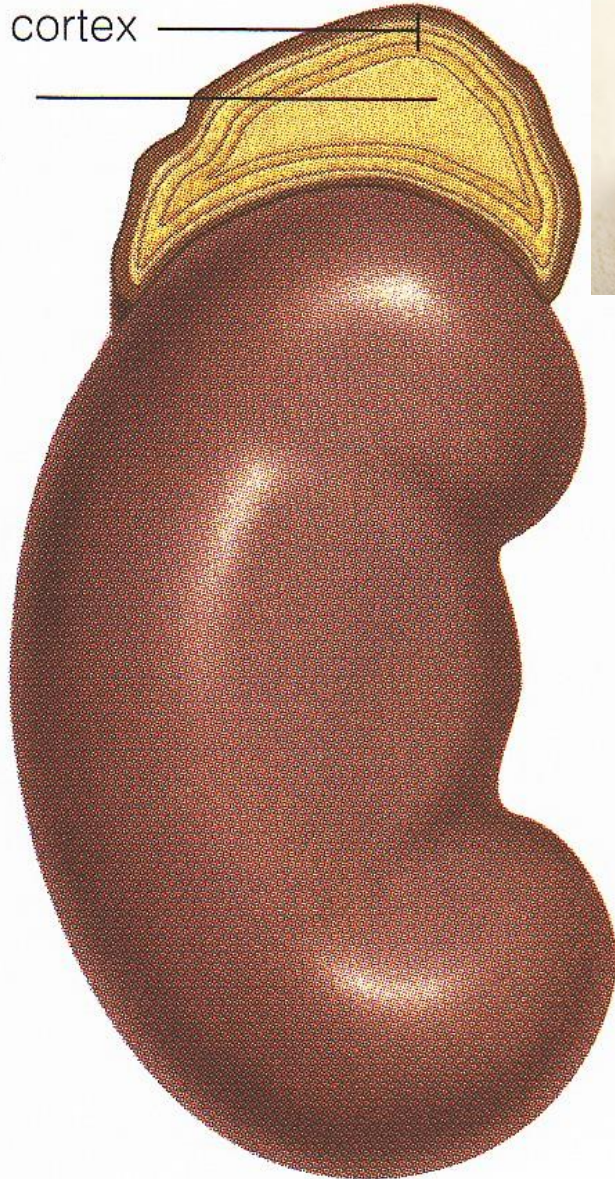
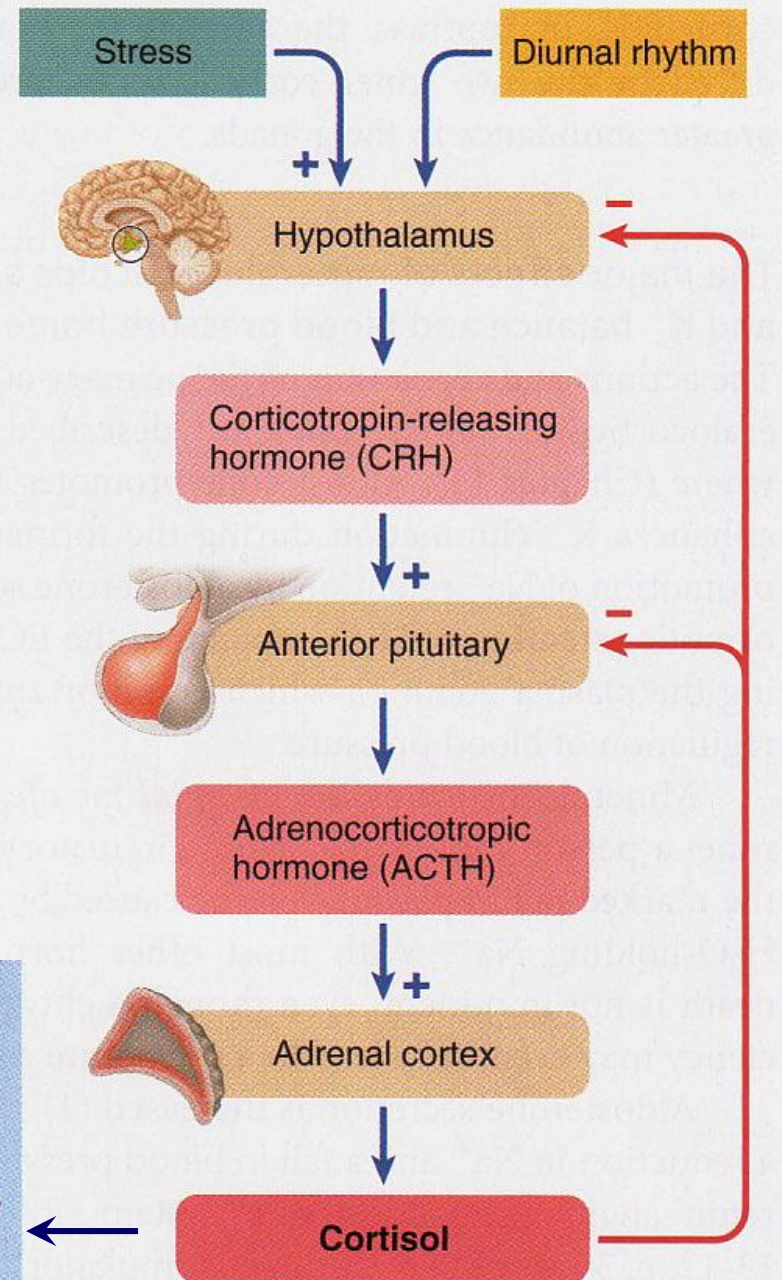


FIGURE 13-12

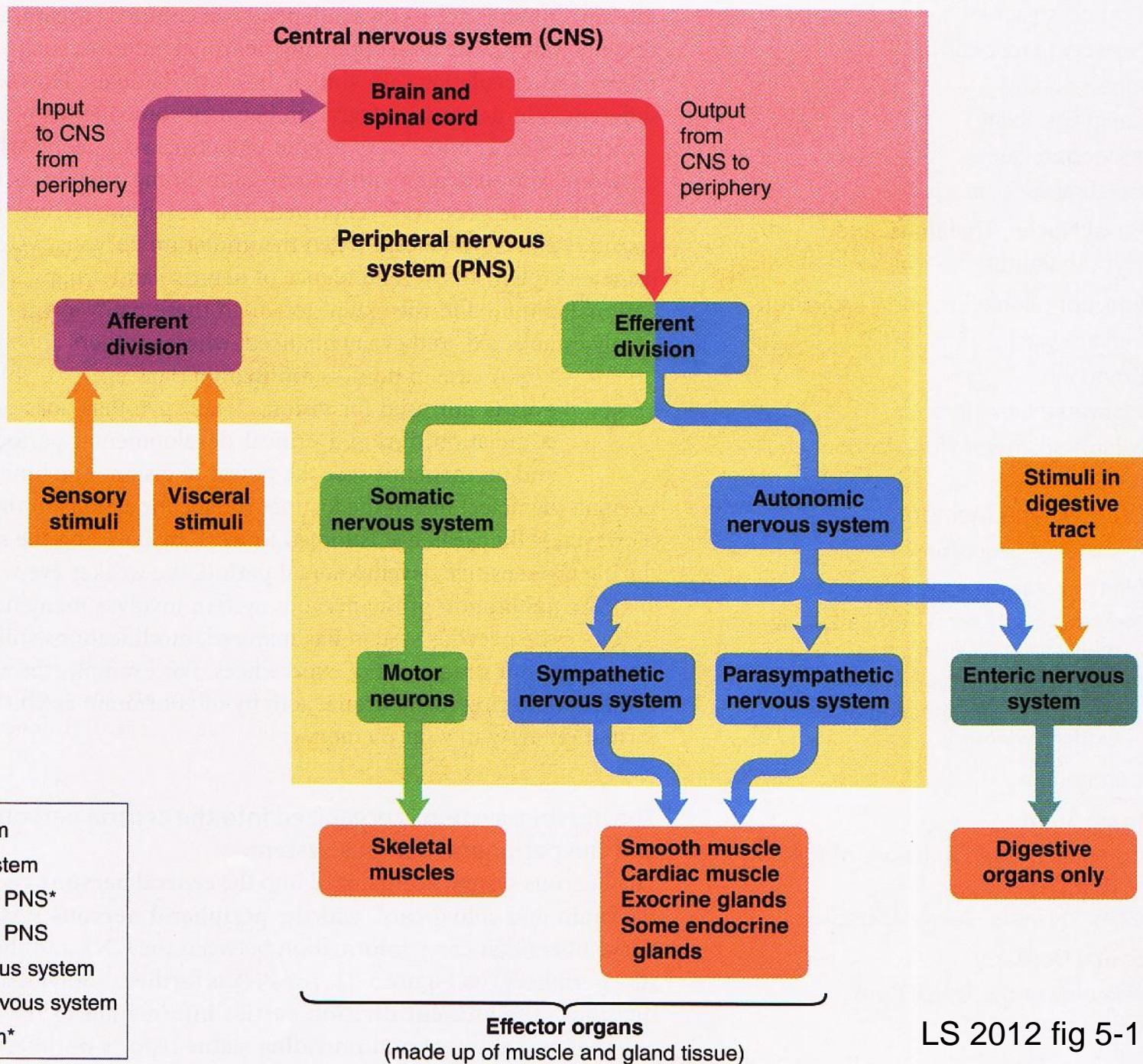
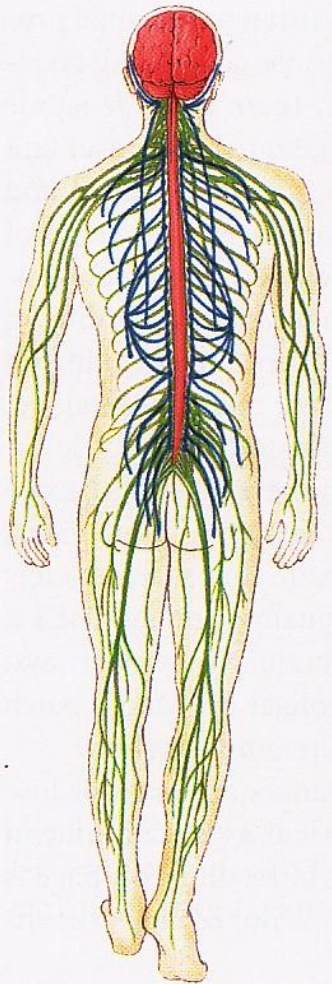
Adrenal Gland The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.

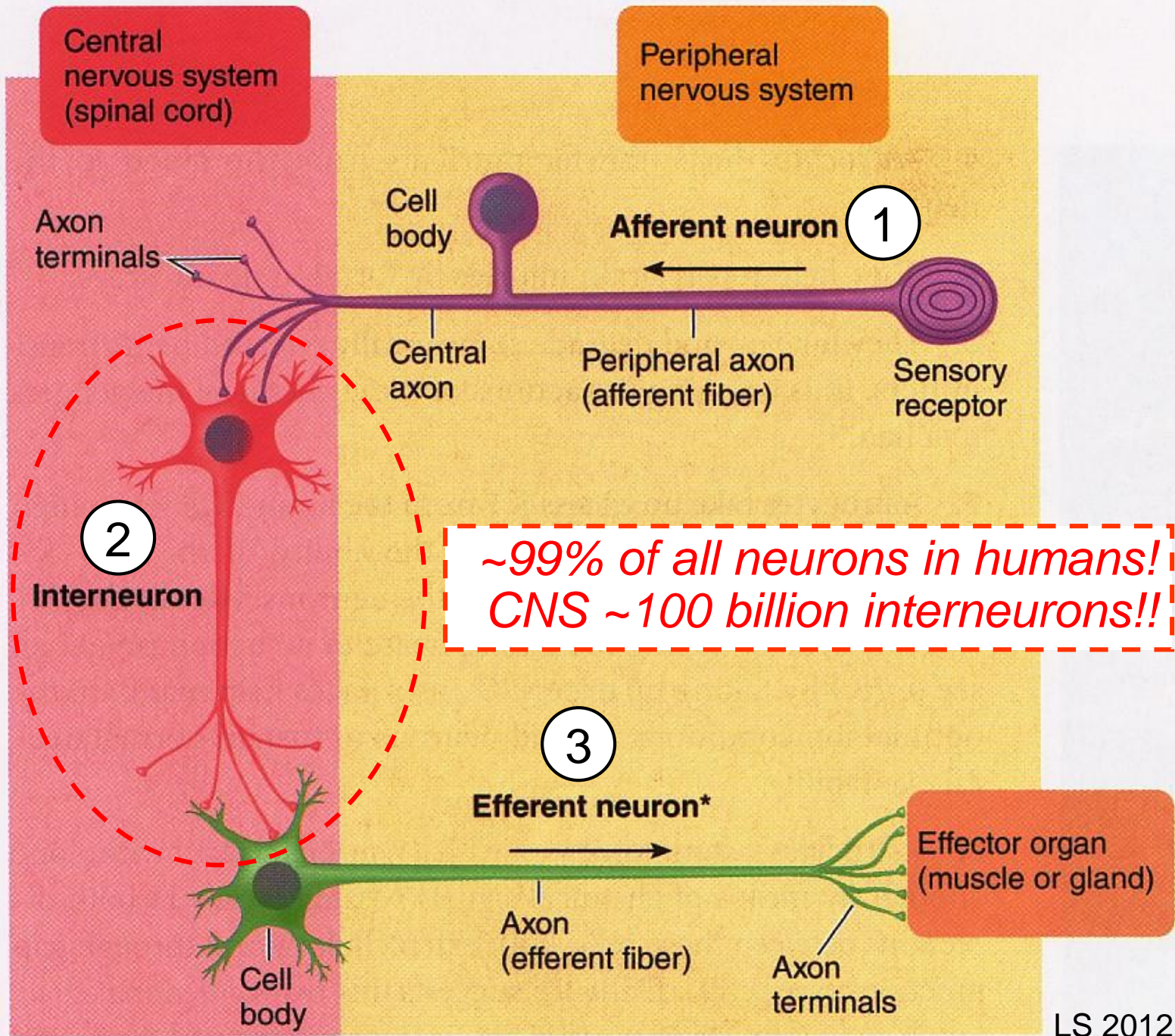
Stress Promotes Cortisol Secretion



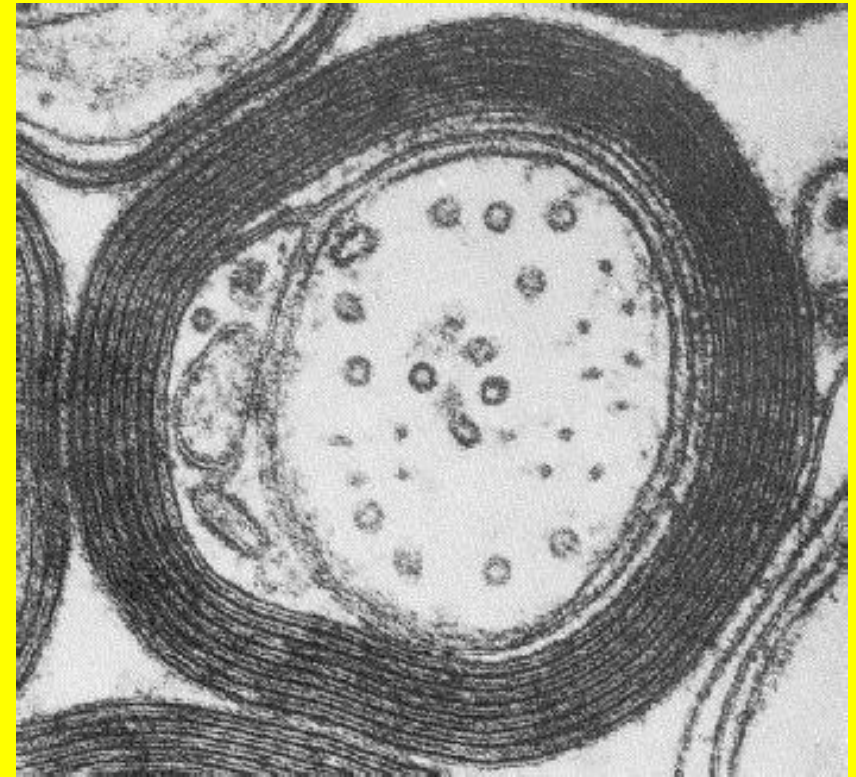
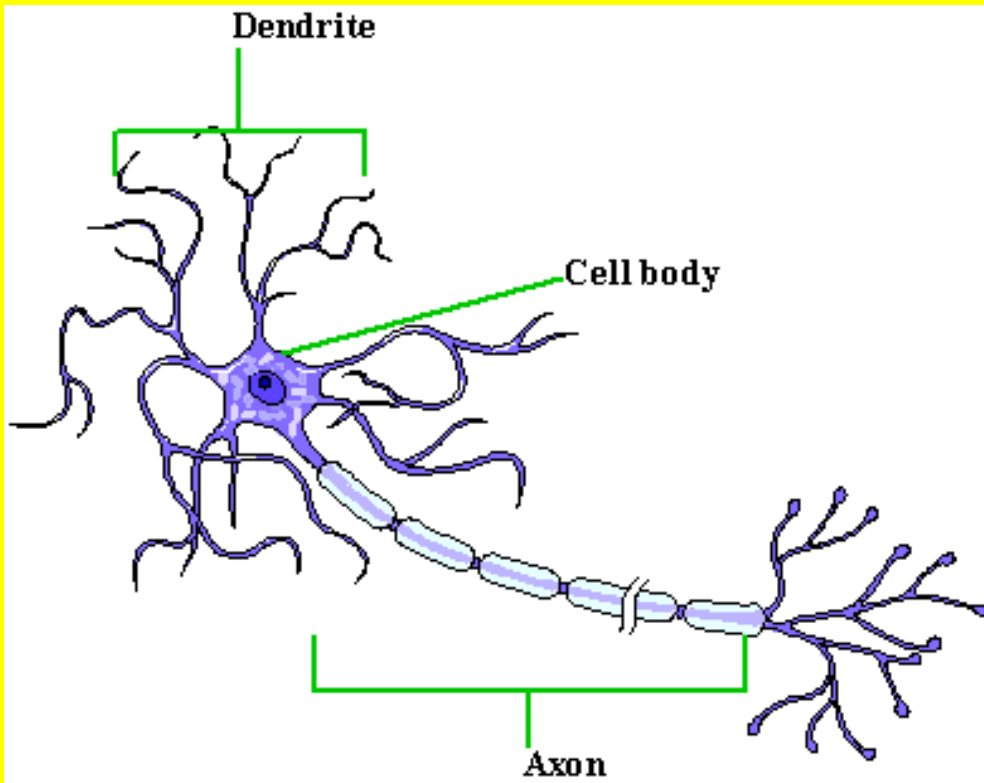
Metabolic fuels and building blocks available to help resist stress

- ↑ Blood glucose (by stimulating gluconeogenesis and inhibiting glucose uptake)
- ↑ Blood amino acids (by stimulating protein degradation)
- ↑ Blood fatty acids (by stimulating lipolysis)





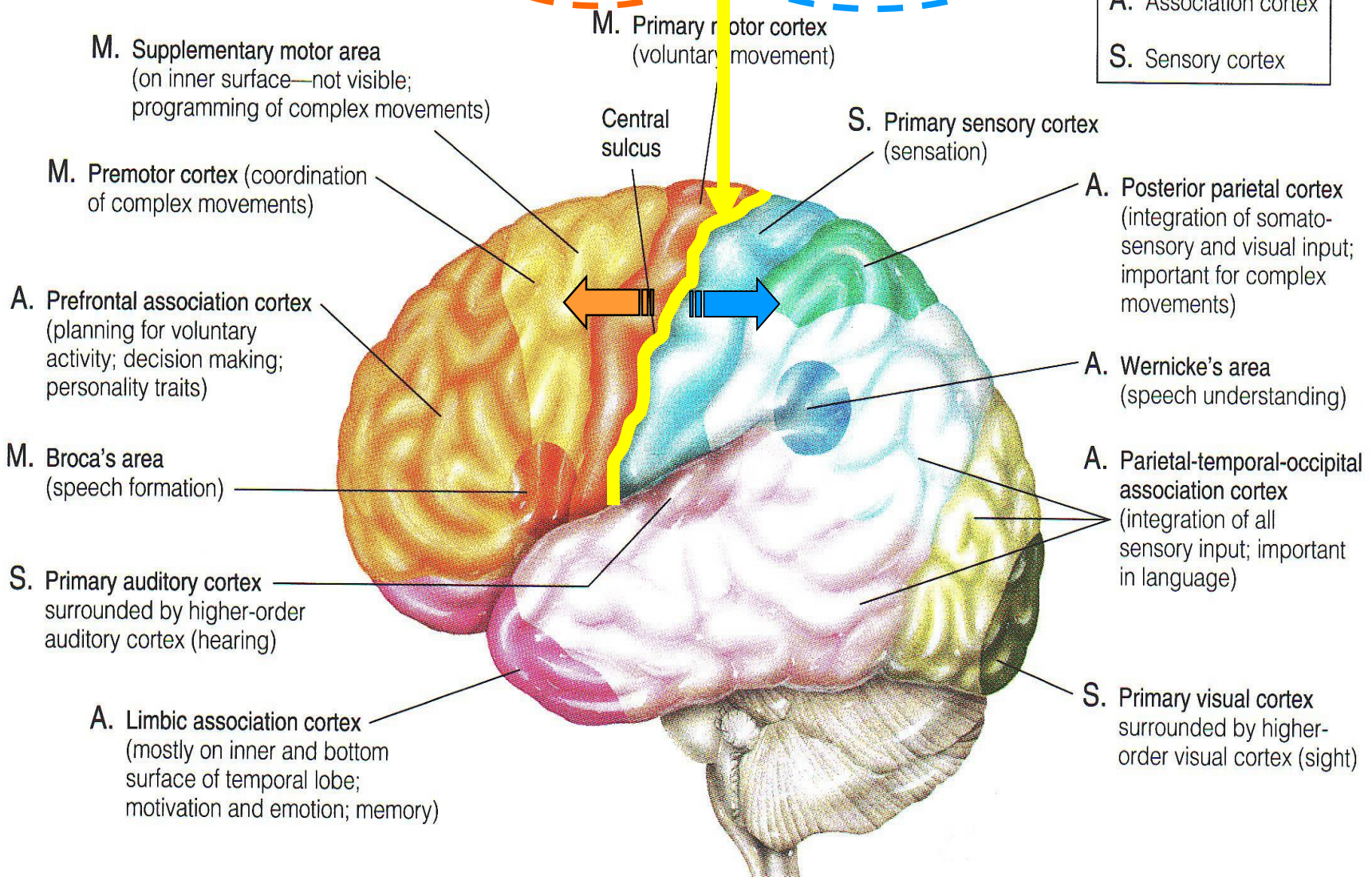
What is myelin? Why is it important?

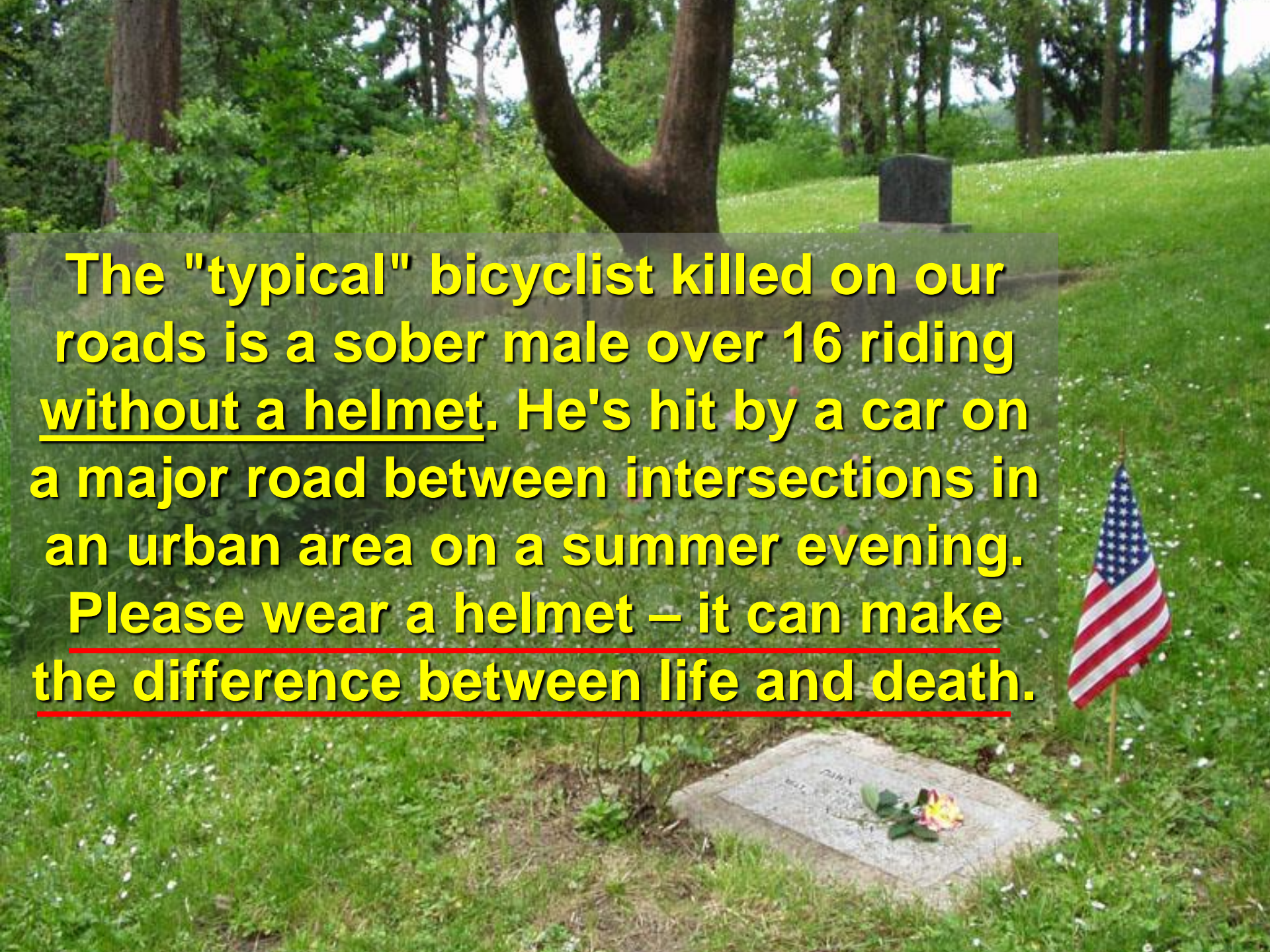


Lipid insulative coat
 $\uparrow \vec{v}$, *conserves ions & ATP*



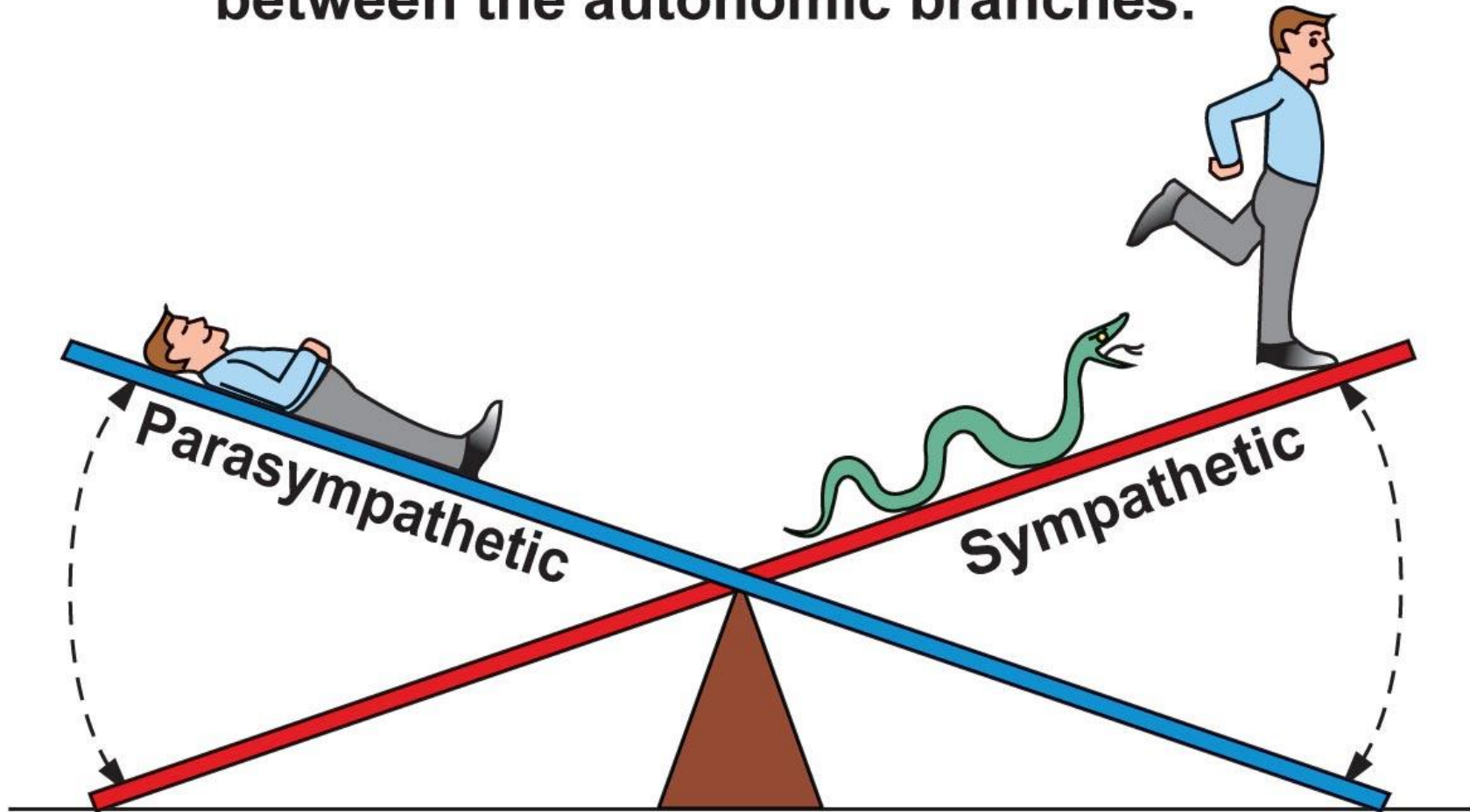
Key	
M.	Motor cortex
A.	Association cortex
S.	Sensory cortex



A photograph of a cemetery. In the foreground, a large, dark tree trunk is visible on the left. To the right, a small, dark, rectangular gravestone stands on a grassy slope. In the lower right foreground, a small American flag is planted in the ground next to a flat, rectangular gravestone. A single rose lies on the flat gravestone. The background is filled with green grass and more trees under a bright sky.

The "typical" bicyclist killed on our roads is a sober male over 16 riding without a helmet. He's hit by a car on a major road between intersections in an urban area on a summer evening. Please wear a helmet – it can make the difference between life and death.

Homeostasis is a dynamic balance between the autonomic branches.



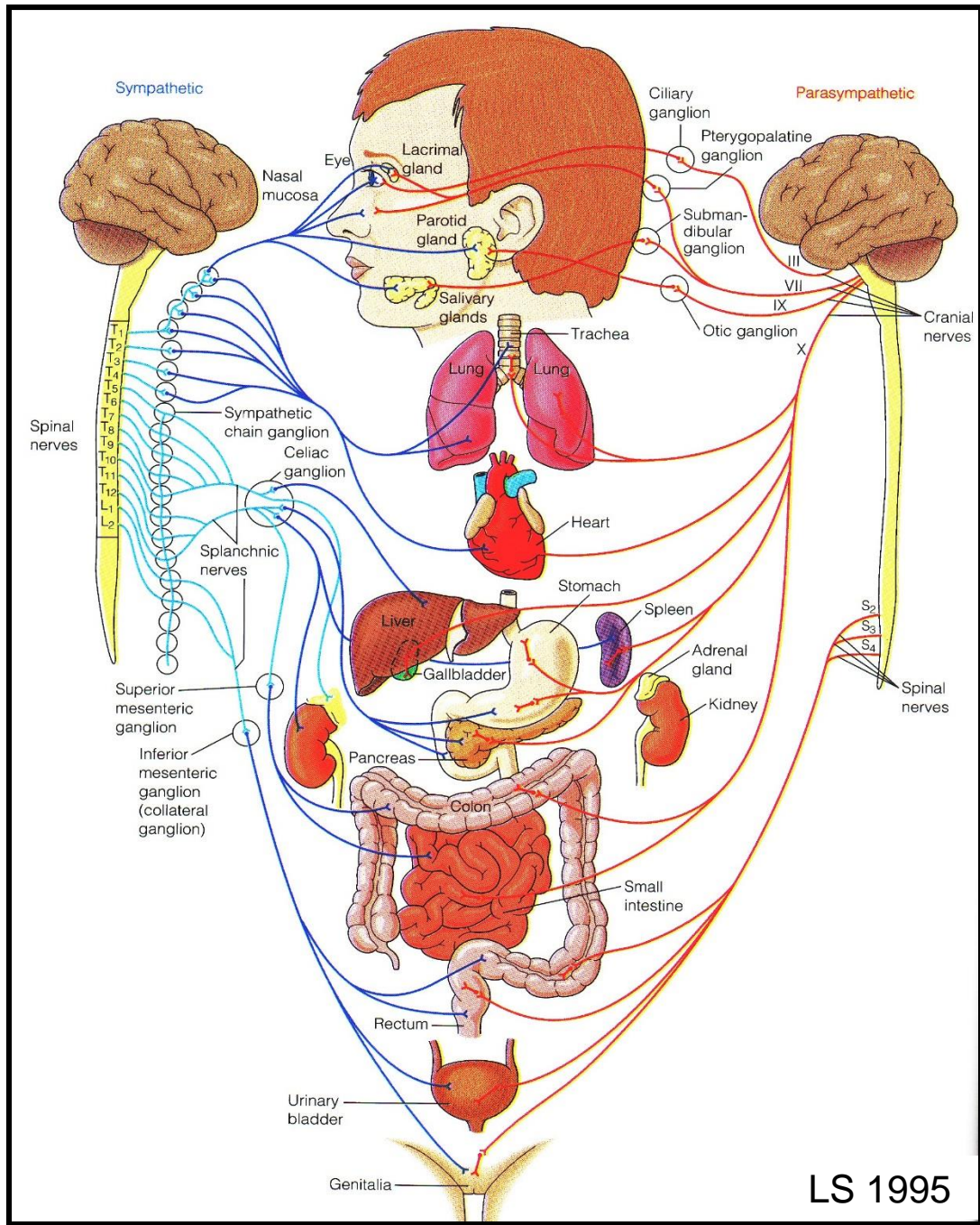
**Rest-and-digest:
Parasympathetic
activity dominates.**

**Fight-or-flight:
Sympathetic activity
dominates.**

Autonomic Nervous System

Why overlap or dual innervation?

Fine-tune control & safety!

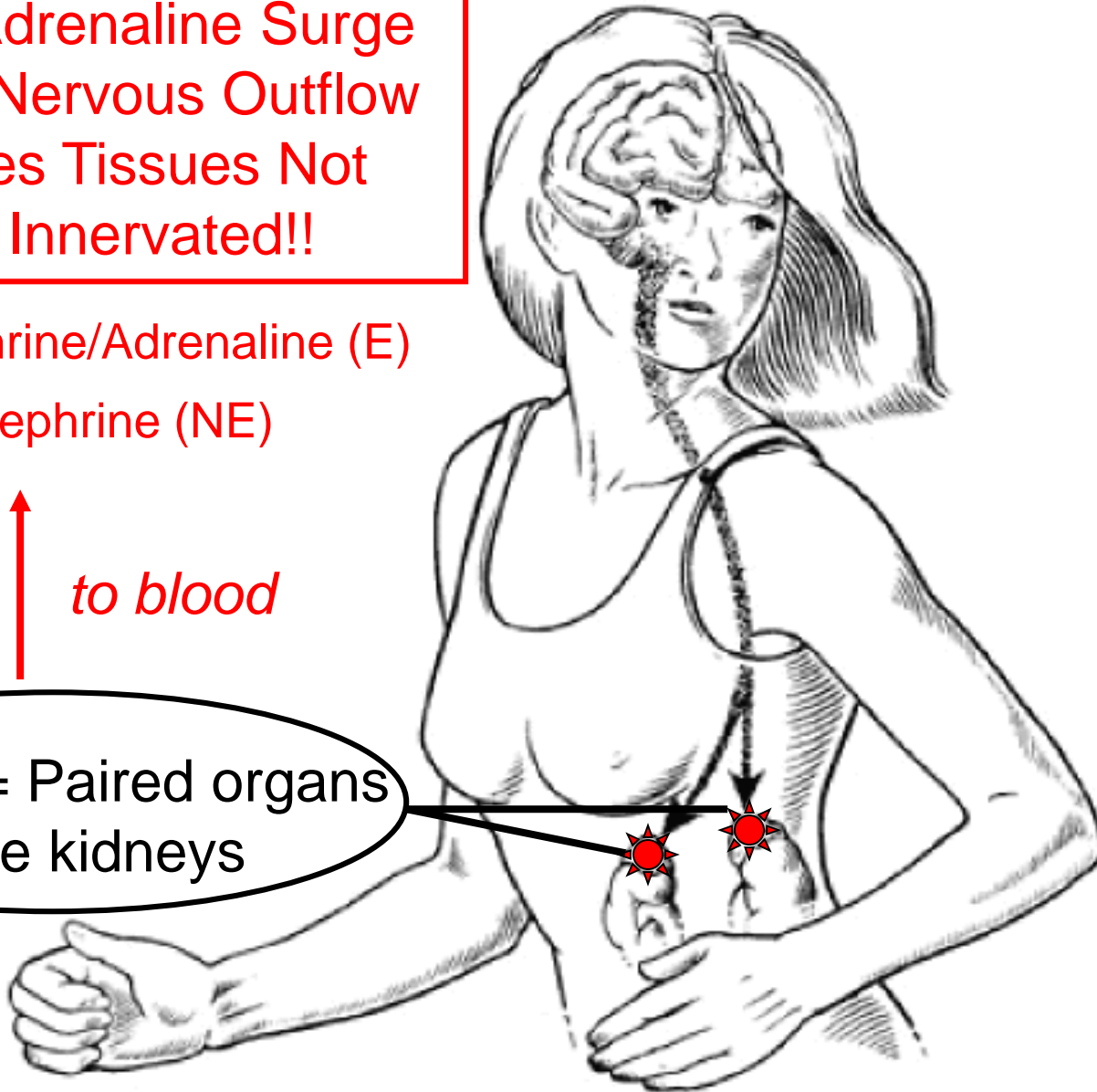


Hormonal Adrenaline Surge
Reinforces Nervous Outflow
& Accesses Tissues Not
Directly Innervated!!

80% Epinephrine/Adrenaline (E)
20% Norepinephrine (NE)

Output ↑ *to blood*

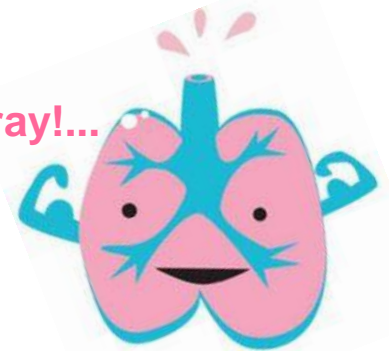
Adrenals = Paired organs
above kidneys



▲ Table 7-1 Effects of Autonomic Nervous System on Various Organs

Organ	Effect of Sympathetic Stimulation	Effect of Parasympathetic Stimulation
Heart	Increases heart rate and increases force of contraction of the whole heart	Decreases heart rate and decreases force of contraction of the atria only
Blood Vessels	Constricts	Dilates vessels supplying the penis and the clitoris only
Lungs	Dilates the bronchioles (airways)	Constricts the bronchioles
Digestive Tract	Decreases motility (movement) Contracts sphincters (to prevent forward movement of tract contents) Inhibits digestive secretions	Increases motility Relaxes sphincters (to permit forward movement of tract contents) Stimulates digestive secretions
Urinary Bladder	Relaxes	Contracts (emptying)
Eye	Dilates the pupil Adjusts the eye for far vision	Constricts the pupil Adjusts the eye for near vision
Liver (glycogen stores)	Glycogenolysis (glucose is released)	None
Adipose Cells (fat stores)	Lipolysis (fatty acids are released)	None
Exocrine Glands		
<i>Exocrine pancreas</i>	Inhibits pancreatic exocrine secretion	Stimulates pancreatic exocrine secretion (important for digestion)
<i>Sweat glands</i>	Stimulates secretion by sweat glands important in cooling the body	Stimulates secretion by specialized sweat glands in the armpits and genital area
<i>Salivary glands</i>	Stimulates a small volume of thick saliva rich in mucus	Stimulates a large volume of watery saliva rich in enzymes
Endocrine Glands		
<i>Adrenal medulla</i>	Stimulates epinephrine and norepinephrine secretion	None
<i>Endocrine pancreas</i>	Inhibits insulin secretion	Stimulates insulin secretion
Genitals	Controls ejaculation (males) and orgasm contractions (both sexes)	Controls erection (penis in males and clitoris in females)
Brain Activity	Increases alertness	None

Pulmonary Function Testing today! Hooray!...



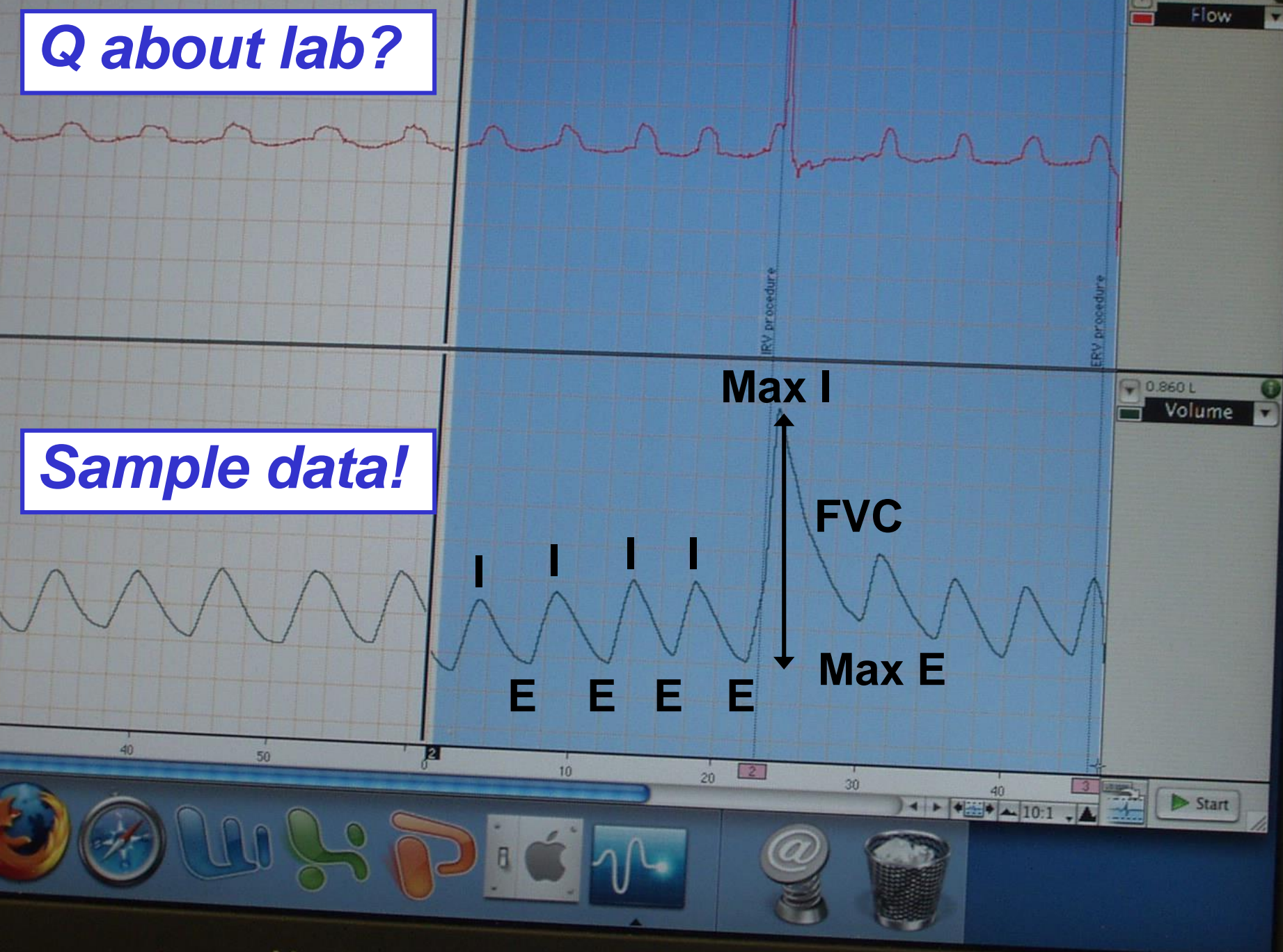
BI 121 Lecture 13

- I. Announcements Optional notebook check + Lab 6 today.
Pulmonary Function Testing. Final exam > your Q on Wed. Q?
- II. Pulmonary Function Lab Overview
- III. Muscle Structure, Function & Adaptation LS ch 8, DC Module 12
 - A. Muscle types: cardiac, smooth, skeletal LS fig 8-1 p 194-6
 - B. How is skeletal muscle organized? LS fig 8-2, DC fig 12-2
 - C. What do thick filaments look like? LS fig 8-4, DC fig 12-4
 - D. How about thin filaments? LS fig 8-5
 - E. Banding pattern? LS fig 8-3, fig 8-7
 - F. How do muscles contract? LS fig 8-6, 8-10
 - G. What's a cross-bridge cycle? LS fig 8-11 +...
 - H. Summary of skeletal muscle contraction
 - I. Exercise adaptation variables: *mode, intensity, duration, frequency, distribution, individual & environmental char...?*
 - J. Endurance vs. strength training continuum? fiber types...



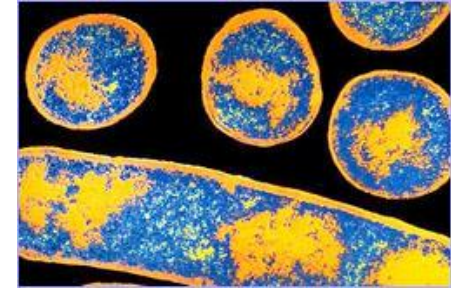
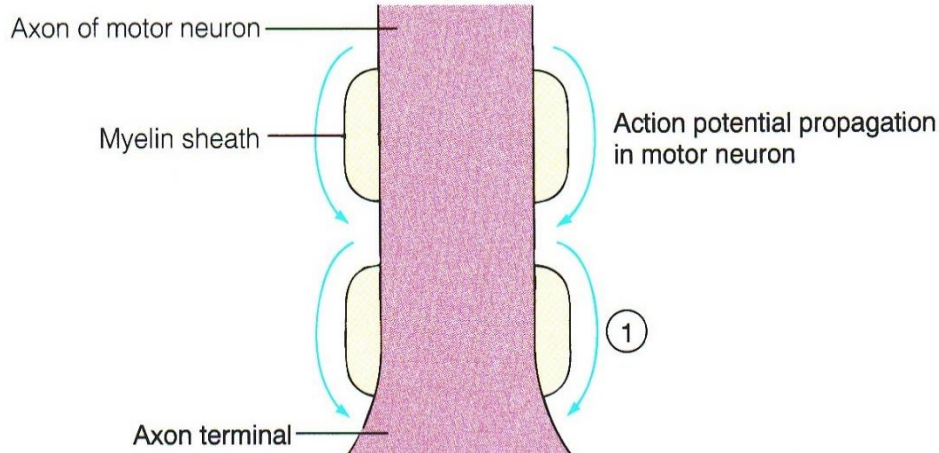
Q about lab?

Sample data!

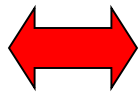
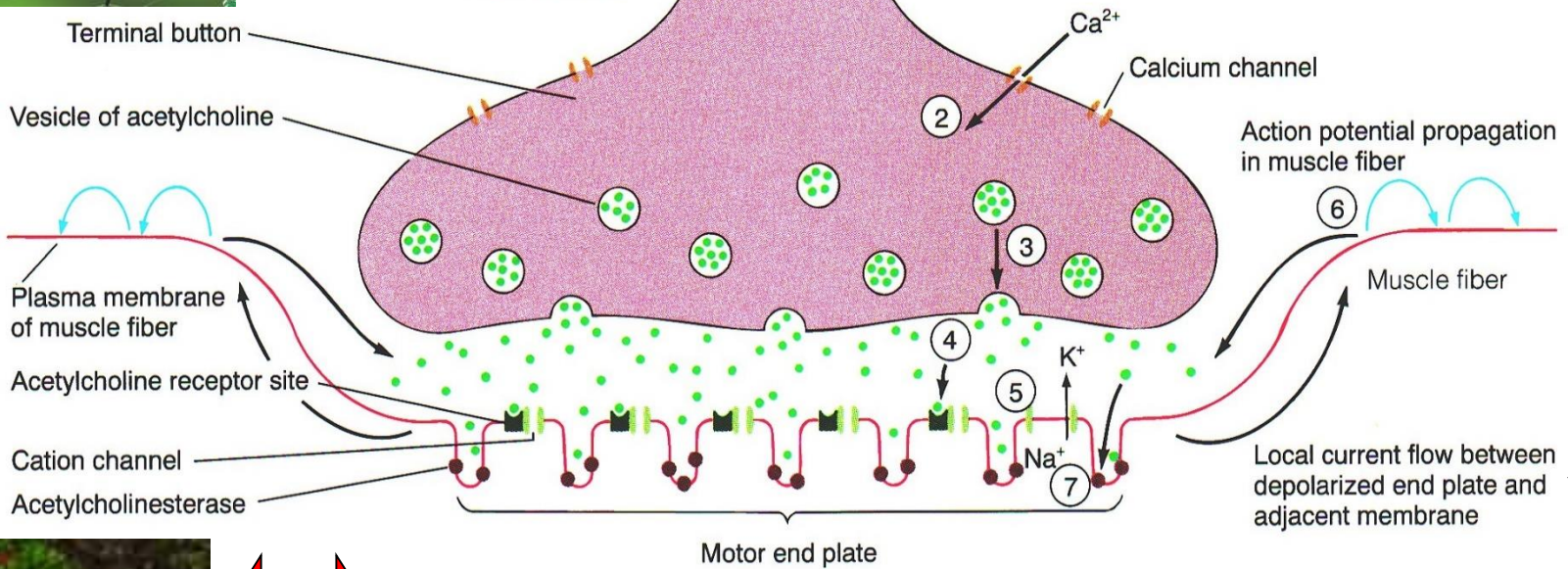


MacBook

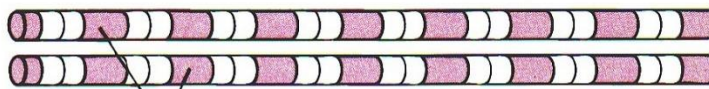
↑ 3



~~3~~



4

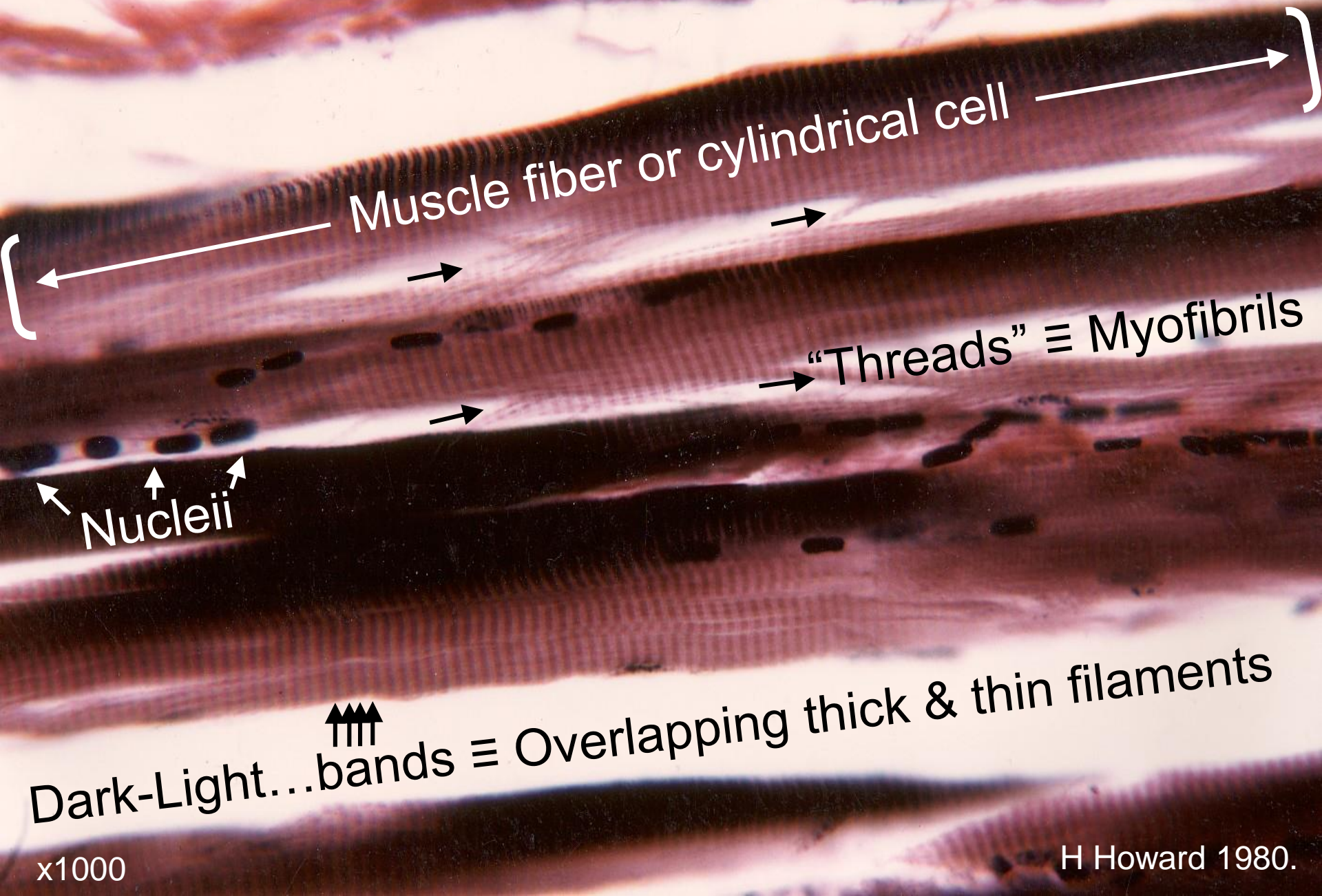


Contractile elements within muscle fiber

~~7~~



Skeletal Muscle Histology: Microscopic Anatomy



Muscle fiber or cylindrical cell

Nucleii

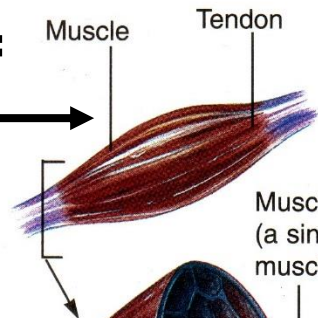
"Threads" ≡ Myofibrils

Dark-Light...bands ≡ Overlapping thick & thin filaments

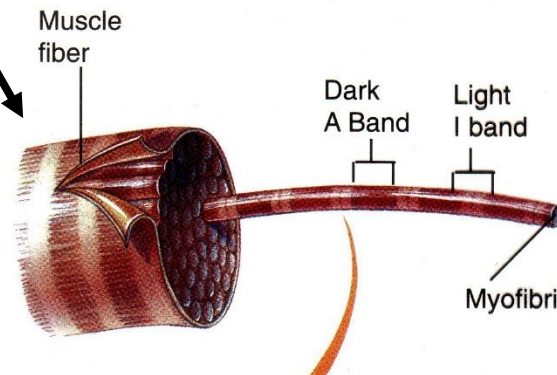
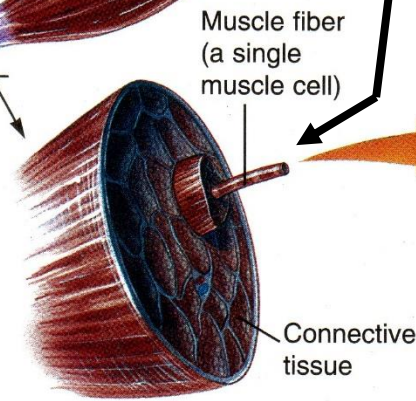
x1000

H Howard 1980.

**Organ =
Muscle**

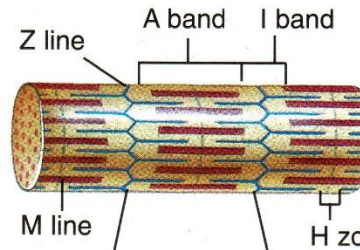


Cell = Myocyte = Fiber

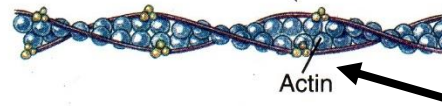
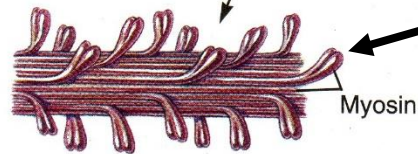
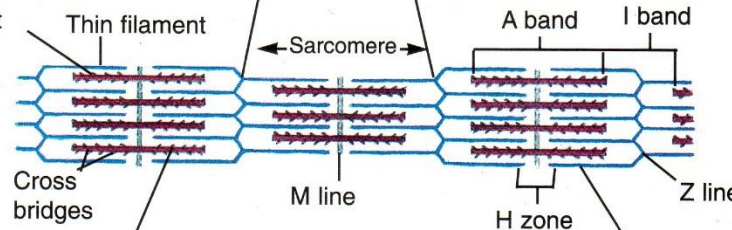


**Subcellular =
Cytoskeleton**

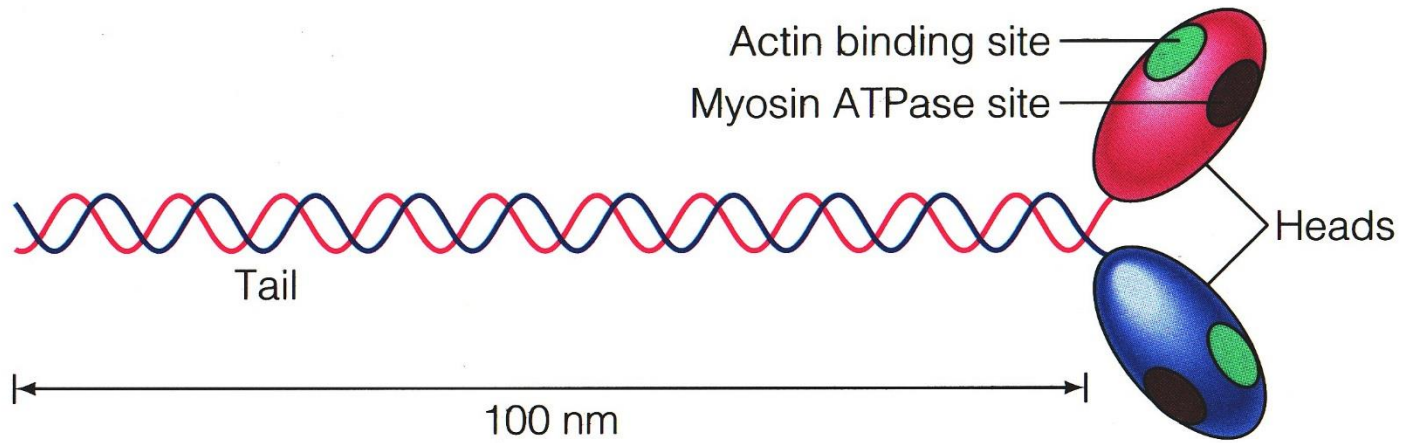
Portion
of myofibril



Thick filament

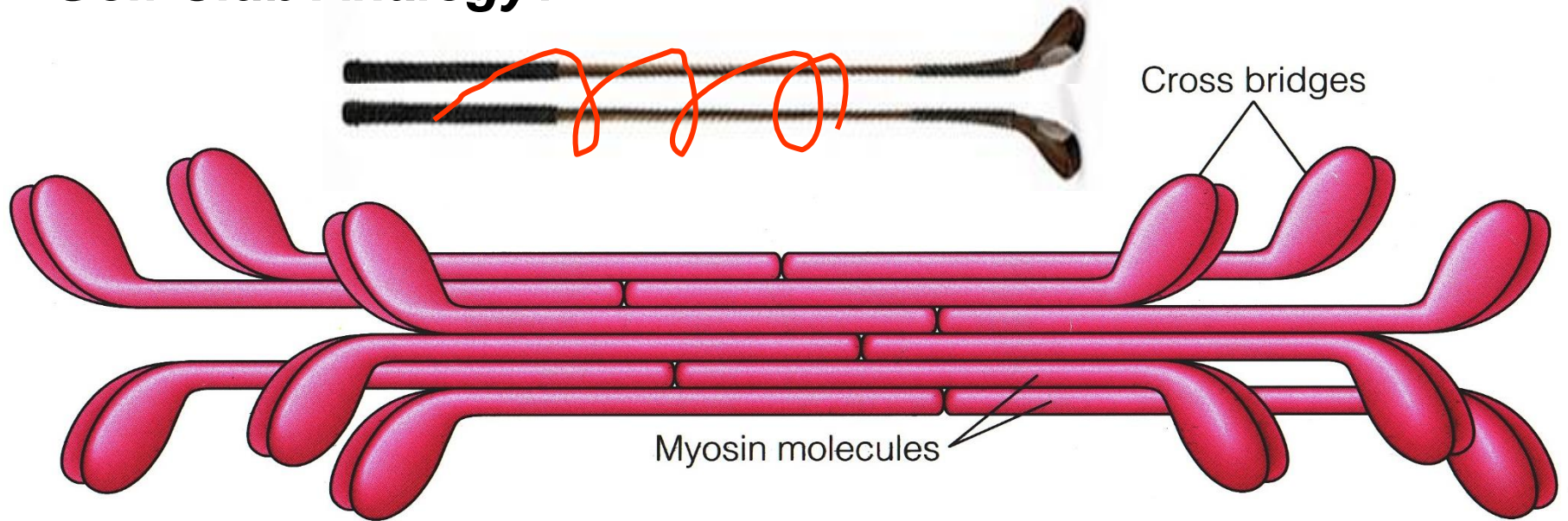


**Molecules =
Actin & Myosin**

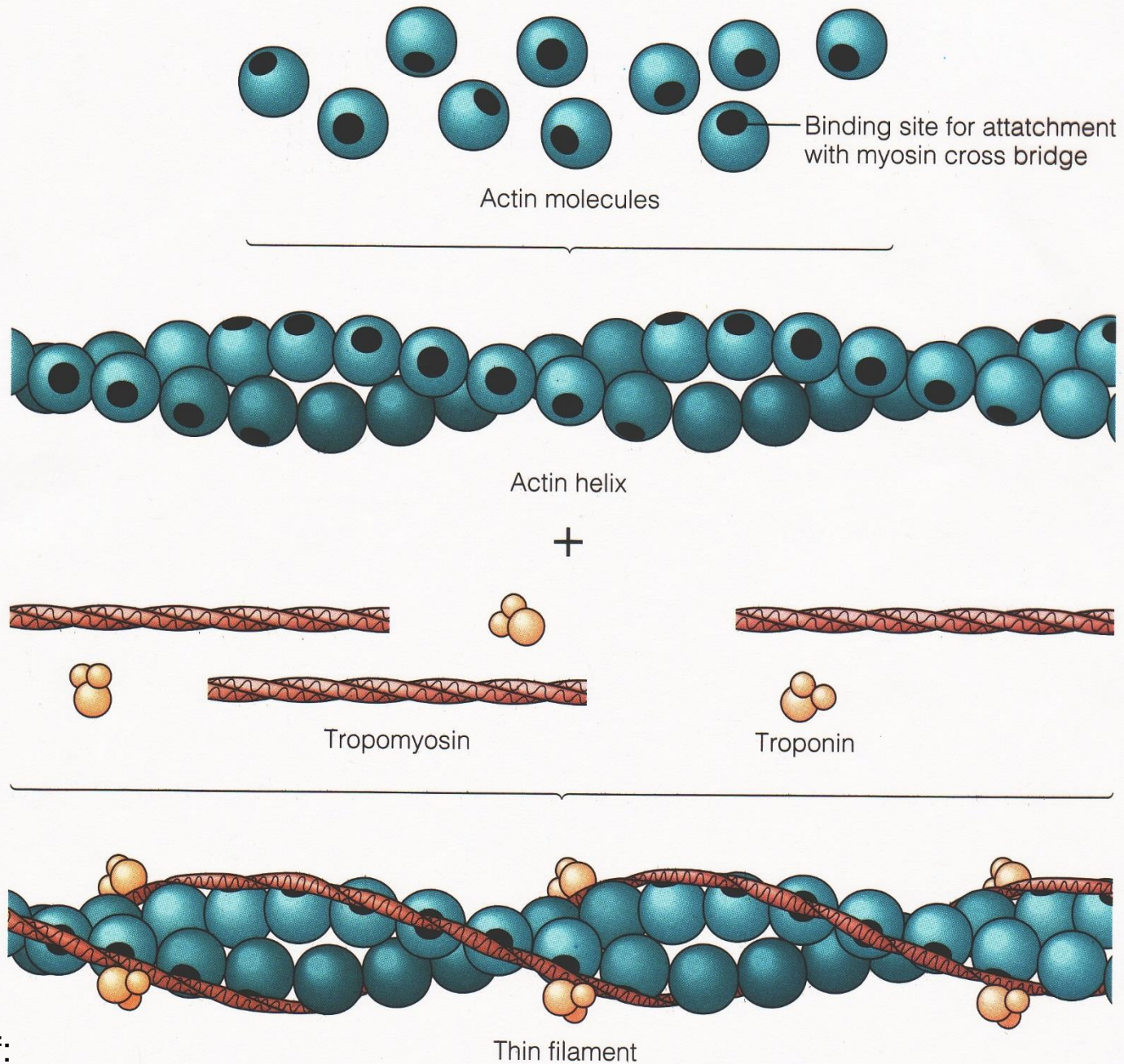


(a)

Golf Club Analogy?

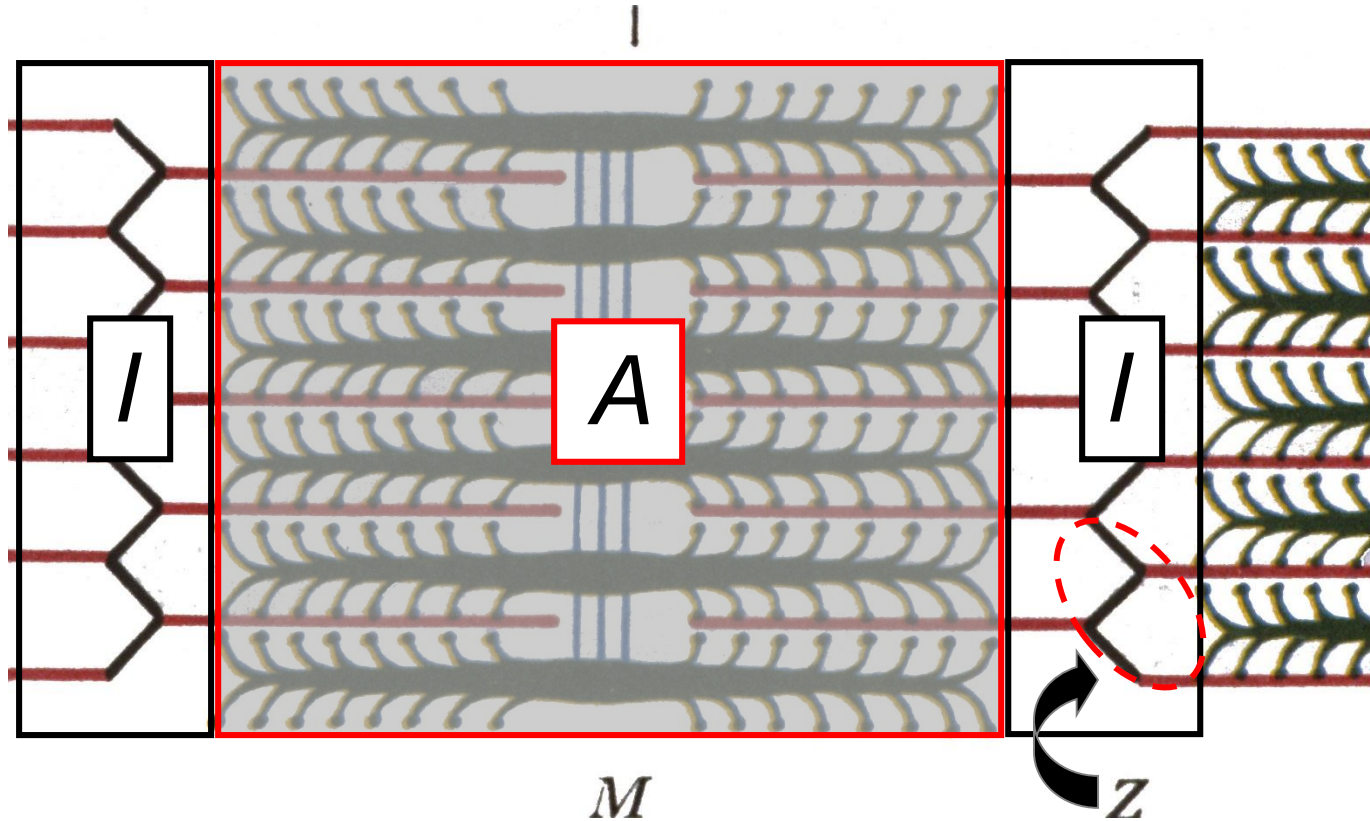


(b)



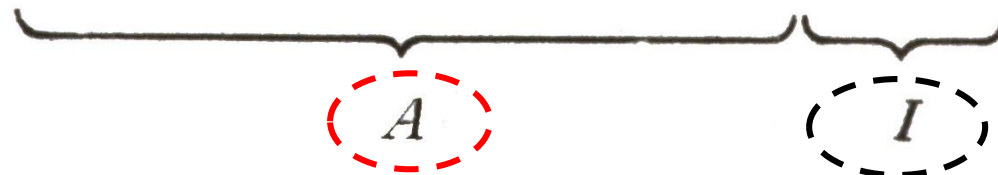
A Band = Dark Band

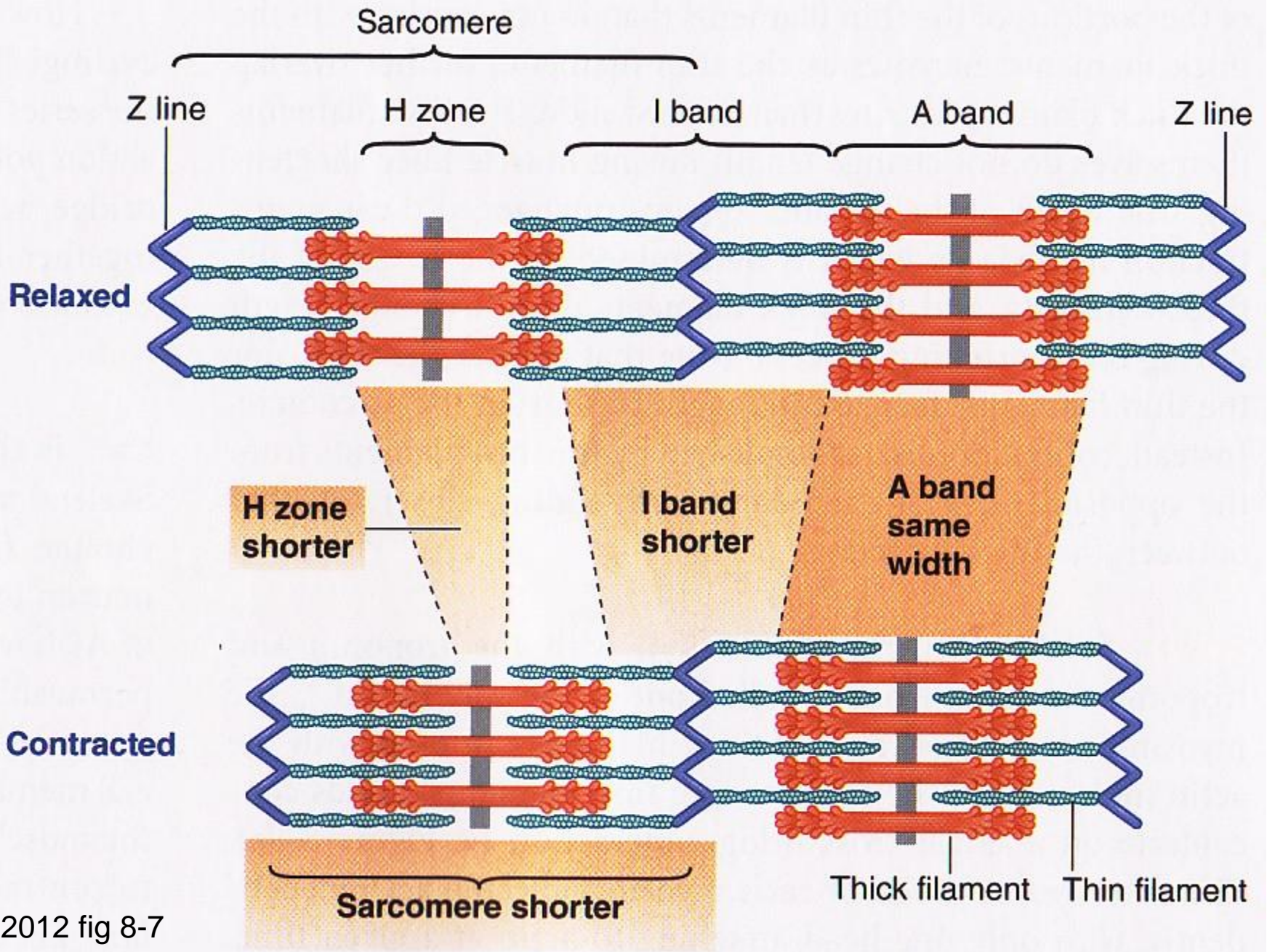
Anisotropic = Light Can't Shine Through



I Band = Light Band

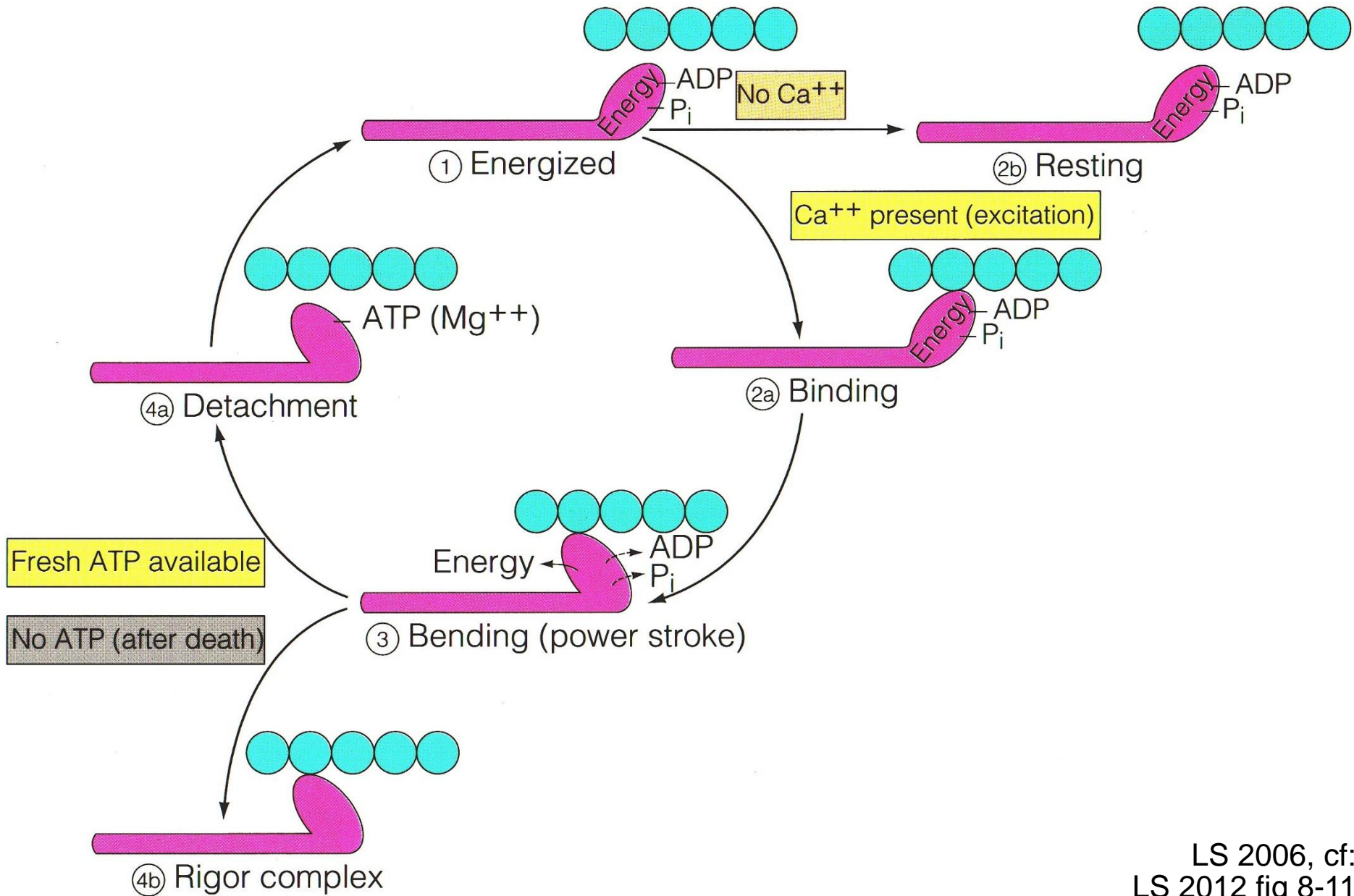
Isotropic = Light Can Shine Through

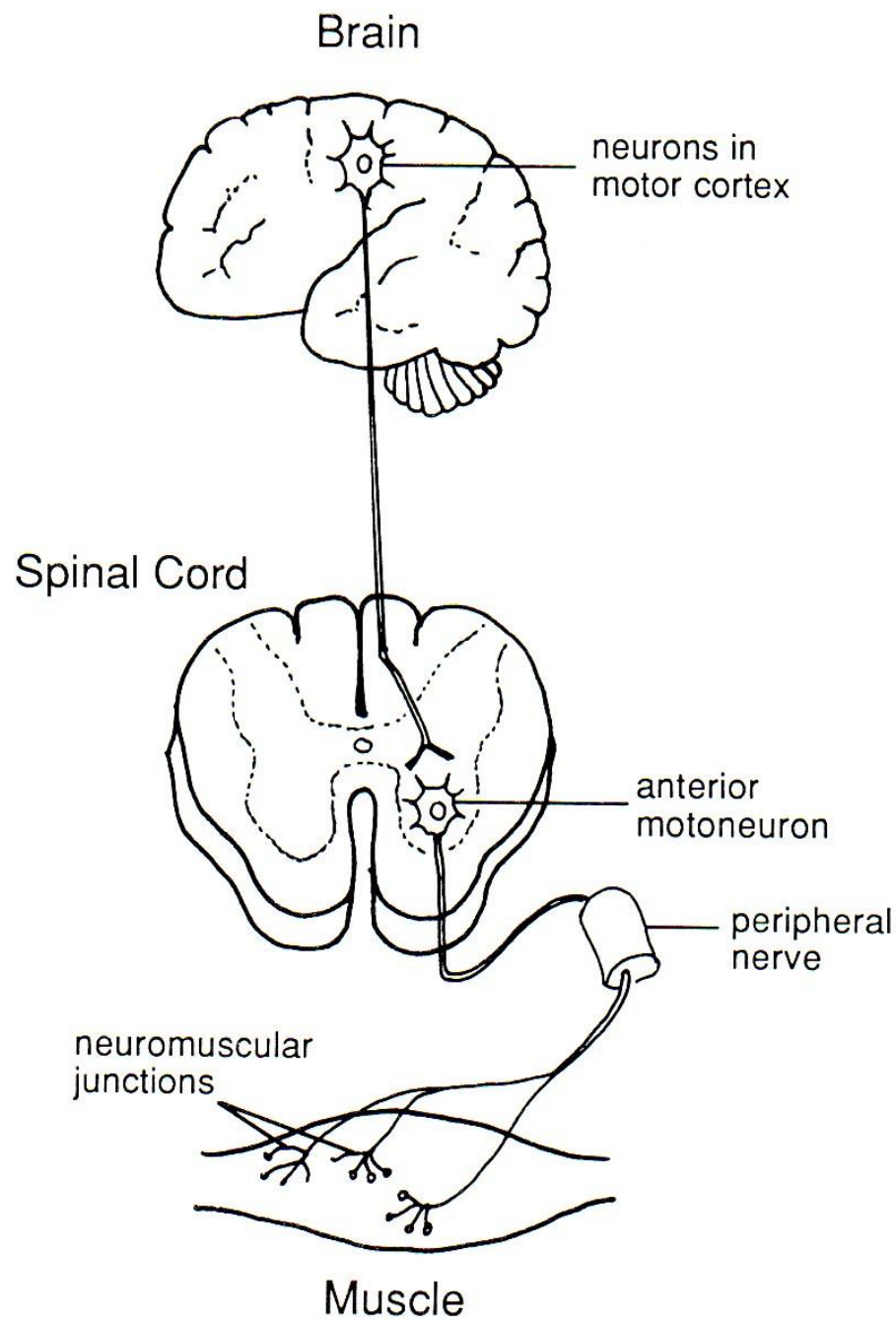




LS 2012 fig 8-7

Cross-Bridge Cycle

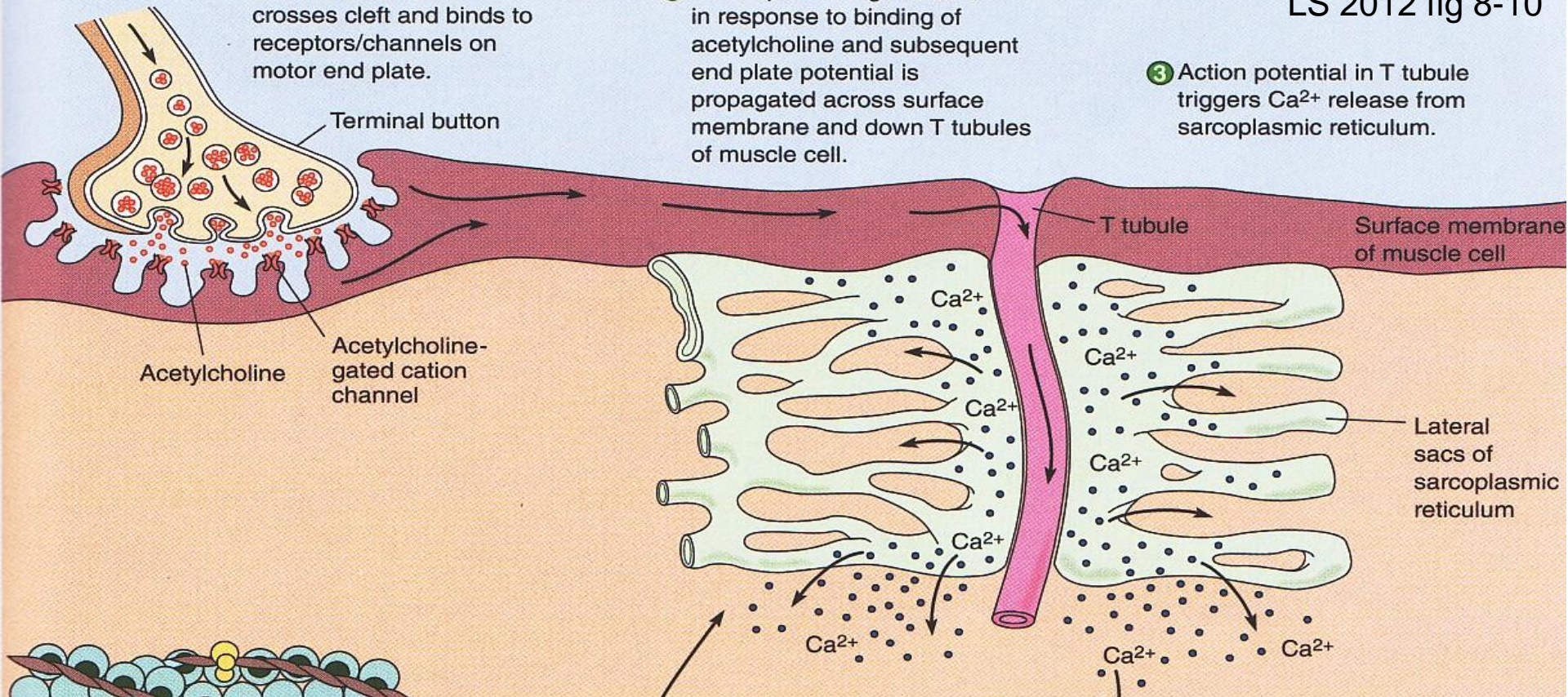




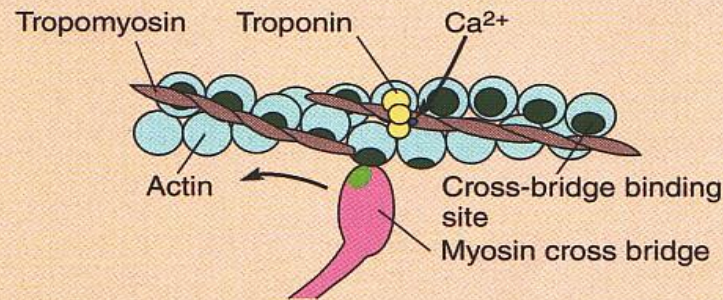
① Acetylcholine released by axon of motor neuron crosses cleft and binds to receptors/channels on motor end plate.

② Action potential generated in response to binding of acetylcholine and subsequent end plate potential is propagated across surface membrane and down T tubules of muscle cell.

③ Action potential in T tubule triggers Ca^{2+} release from sarcoplasmic reticulum.



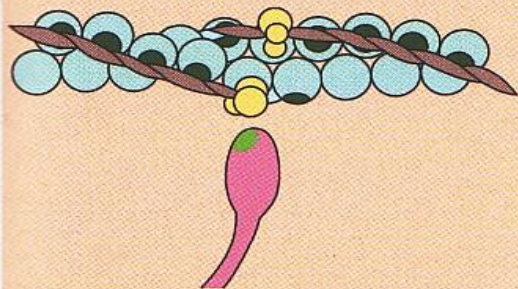
④ Calcium ions released from lateral sacs bind to troponin on actin filaments; leads to tropomyosin being physically moved aside to uncover cross-bridge binding sites on actin.



⑤ Myosin cross bridges attach to actin and bend, pulling actin filaments toward center of sarcomere; powered by energy provided by ATP.

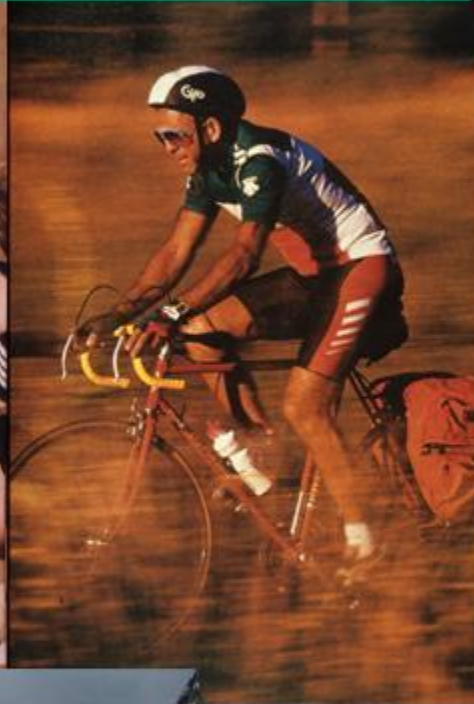
⑥ Ca^{2+} actively taken up by sarcoplasmic reticulum when there is no longer local action potential.

⑦ With Ca^{2+} no longer bound to troponin, tropomyosin slips back to its blocking position over binding sites on actin; contraction ends; actin passively slides back to original resting position.

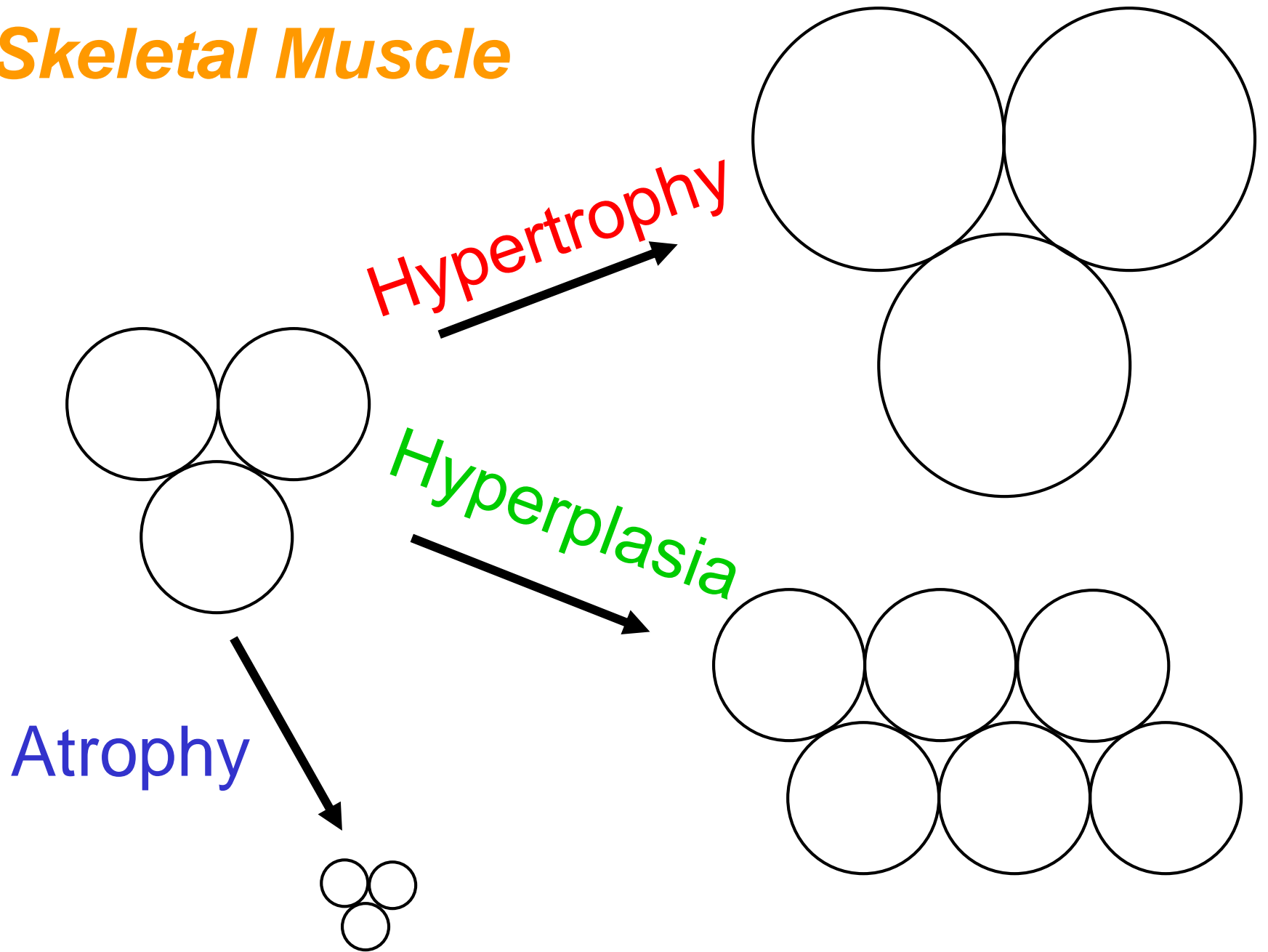


Adaptations to Exercise?

Mode, Intensity, Duration, Frequency,
Distribution of Training Sessions?
Conditions of Environment? Individual?



Skeletal Muscle





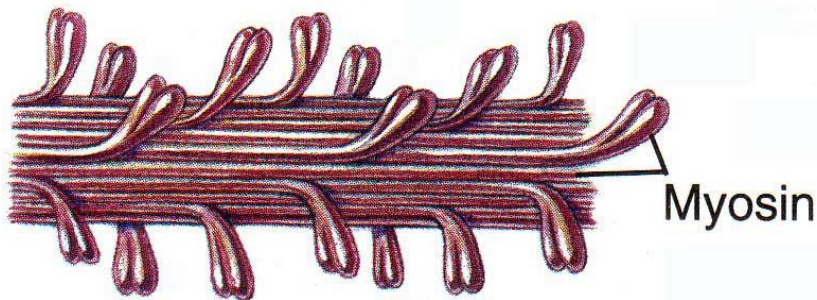
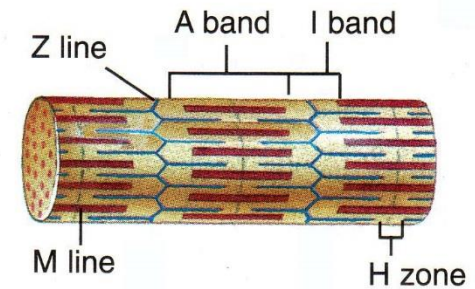
Myofibril

Hypertrophy: *Increased*

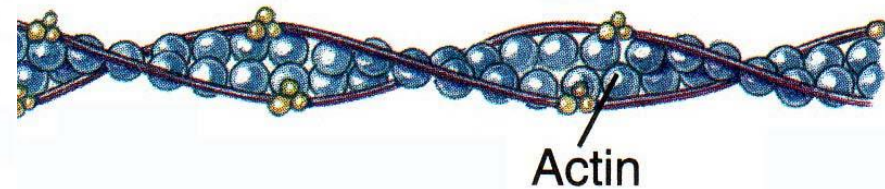
Number of Myofibrils

Thick & Thin Filaments

Myosin & Actin Molecules



Myosin



Actin

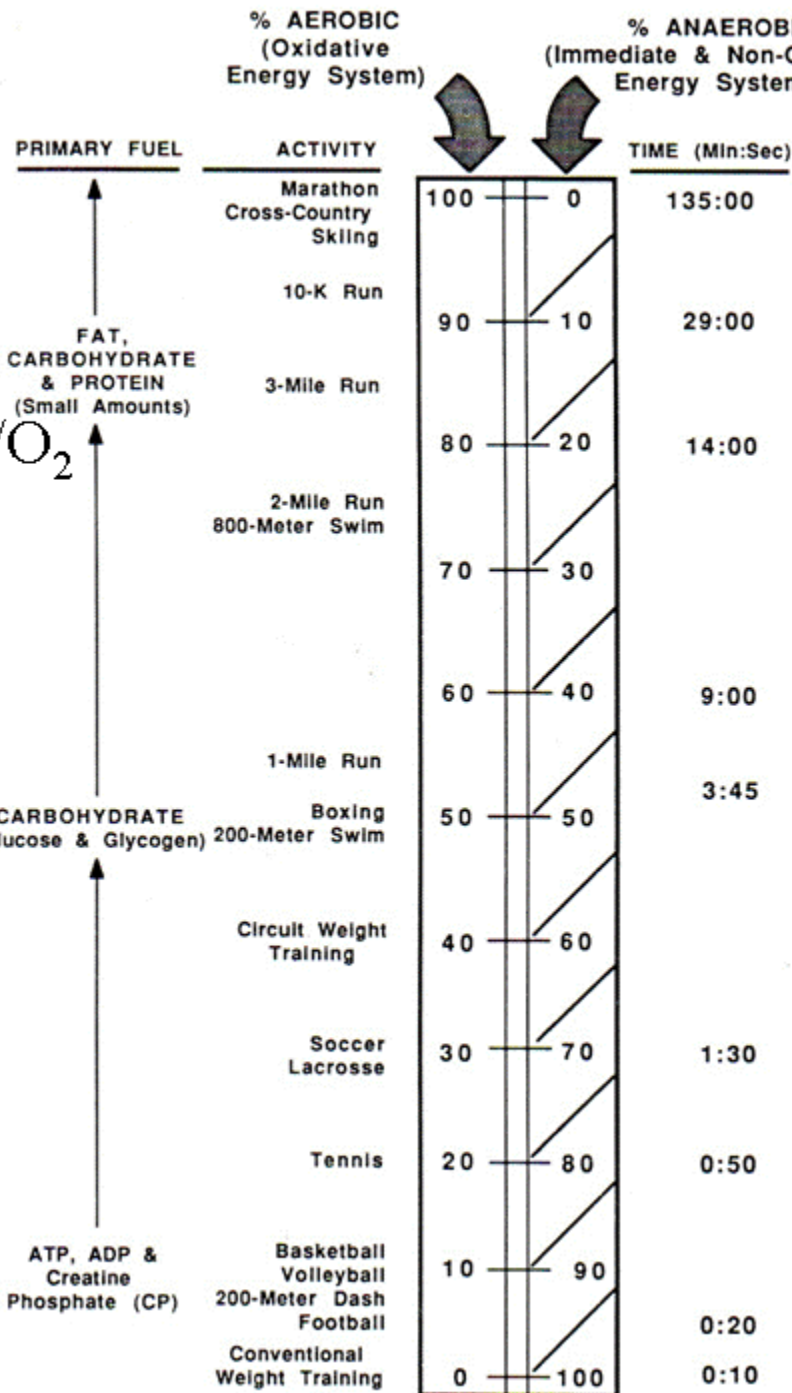
Characteristics of Skeletal Muscle Fibers

Characteristic	TYPE OF FIBER		
	Slow Oxidative (Type I)	Fast Oxidative (Type IIa)	Fast Glycolytic (Type IIb)
Myosin-ATPase Activity	Low	High	High
Speed of Contraction	Slow	Fast	Fast
Resistance to Fatigue	High	Intermediate	Low
Aerobic Capacity	High	High	Low
Anaerobic Capacity	Low	Intermediate	High
Mitochondria	Many	Many	Few
Capillaries	Many	Many	Few
Myoglobin Content	High	High	Low
Color of Fibers	Red	Red	White
Glycogen Content	Low	Intermediate	High



AEROBIC

w/O₂



MITOCHONDRIA

CYTOSOL

Glycolysis



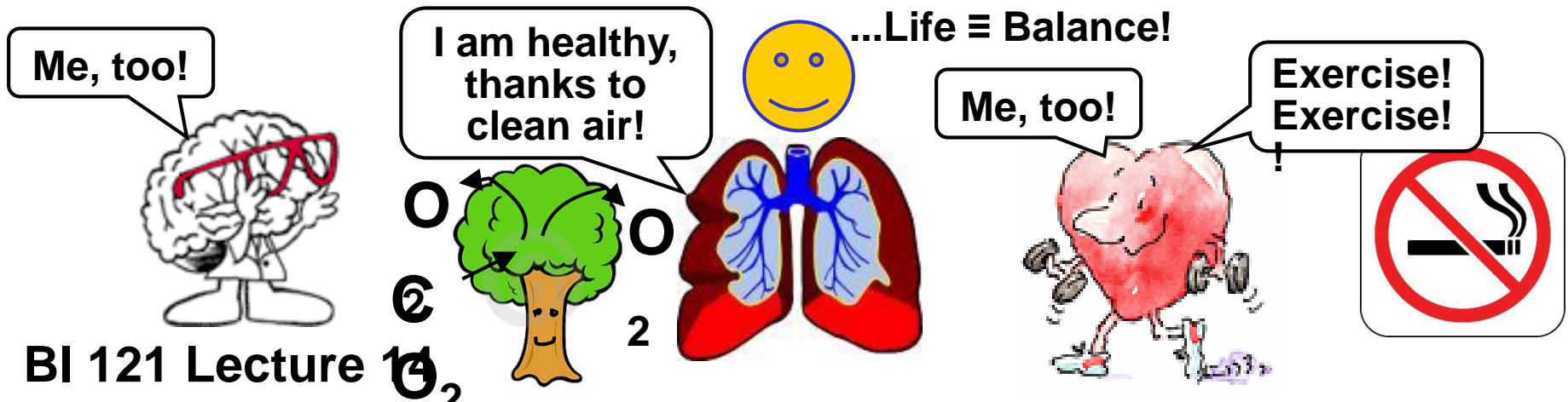
Immediate/ATP-PC



ANAEROBIC

Extremes of the energy continuum!





BI 121 Lecture 14

I. Announcements Optional notebook check today. Discussion-Review followed by final exam tomorrow. Q?

II. Respiratory System LS ch 12, DC Module 7, SI Fox +...

- A. Steps of respiration? External vs. cellular/internal?
LS fig 12-1 pp 345-7
- B. Respiratory system anatomy LS fig 12-2 p347, DC, SI Fox +...
- C. Histology LS fig 12-4 pp 347-9, DC
- D. How do we breathe? LS fig12-12, fig12-25 pp 349-56, 373-8
- E. Gas exchange LS fig 12-19 pp 362-5
- F. Gas transport LS tab 12-3 pp 365-70

III. Physiology of Cigarette Smoking

- A. ANS, autonomic nerves & nicotine? Route of chemicals,...
- B. Emphysema? 2nd-hand smoke?... p 356, 365
- C. UO Smoke-Free since Fall 2012! Help is available!

Lombo's simplified steps!

1 Breathe in & out!



2 Cross membranes!



3 Move with blood!

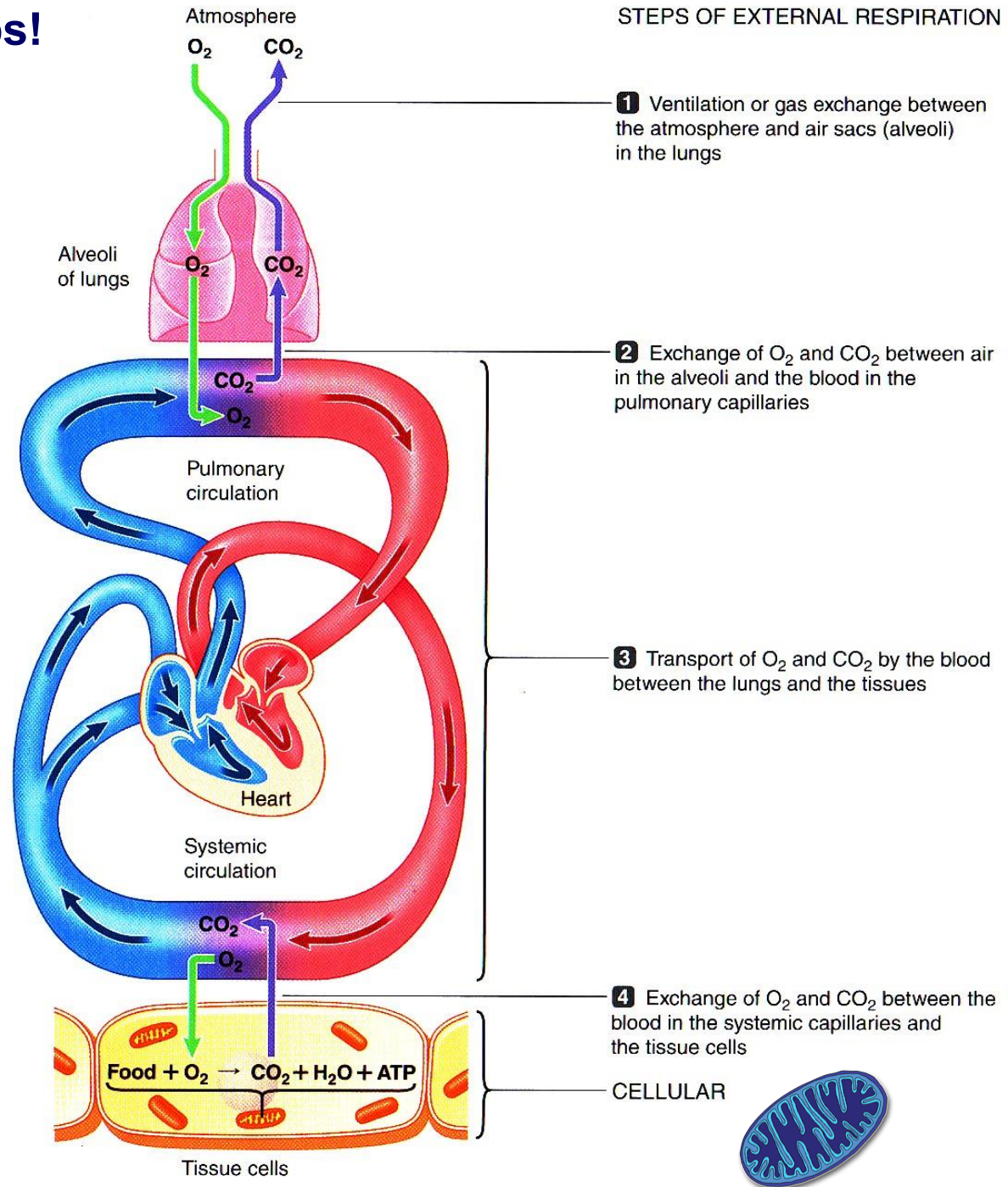
Go with the flow!



4 Cross membranes!

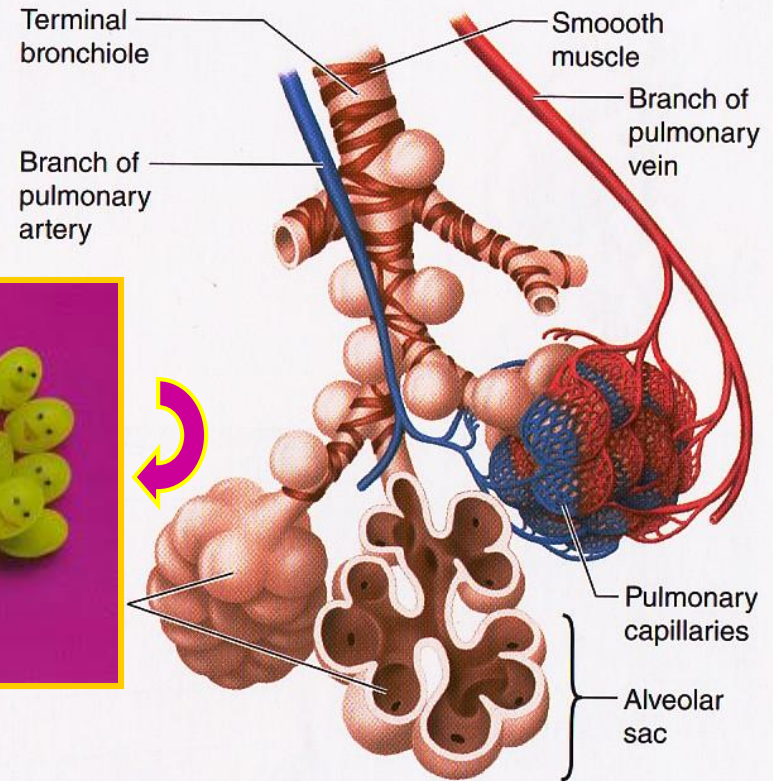
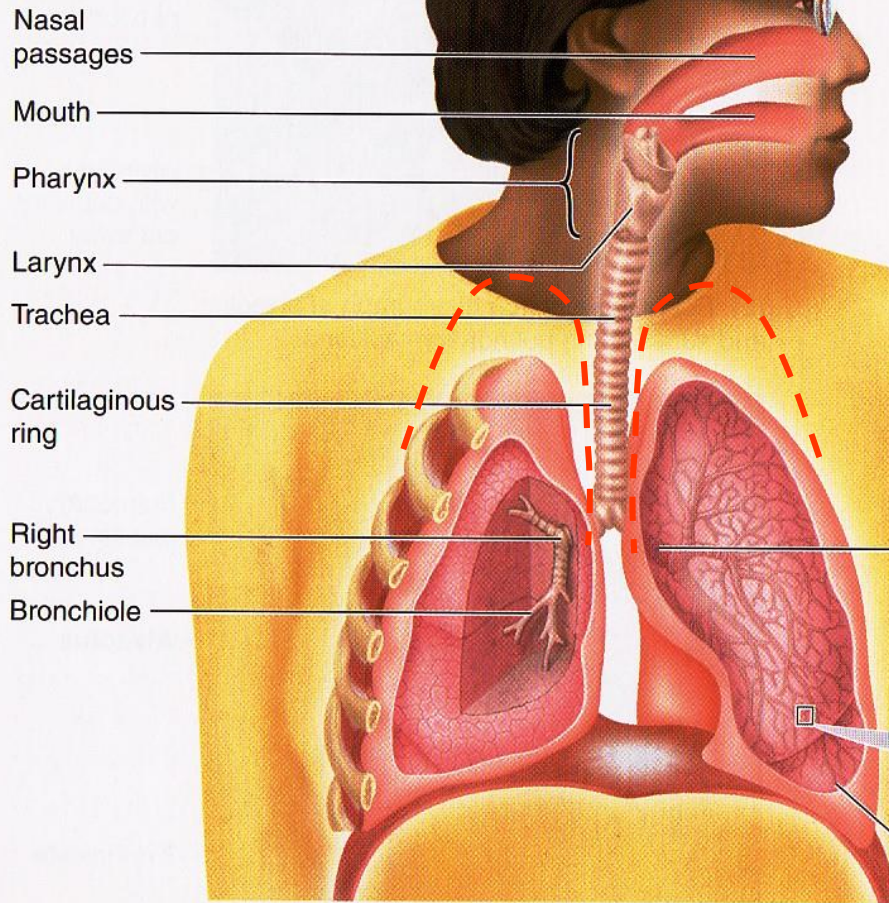


STEPS OF EXTERNAL RESPIRATION

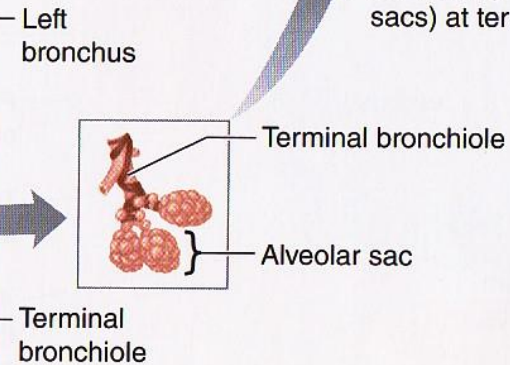


Respiratory System Anatomy

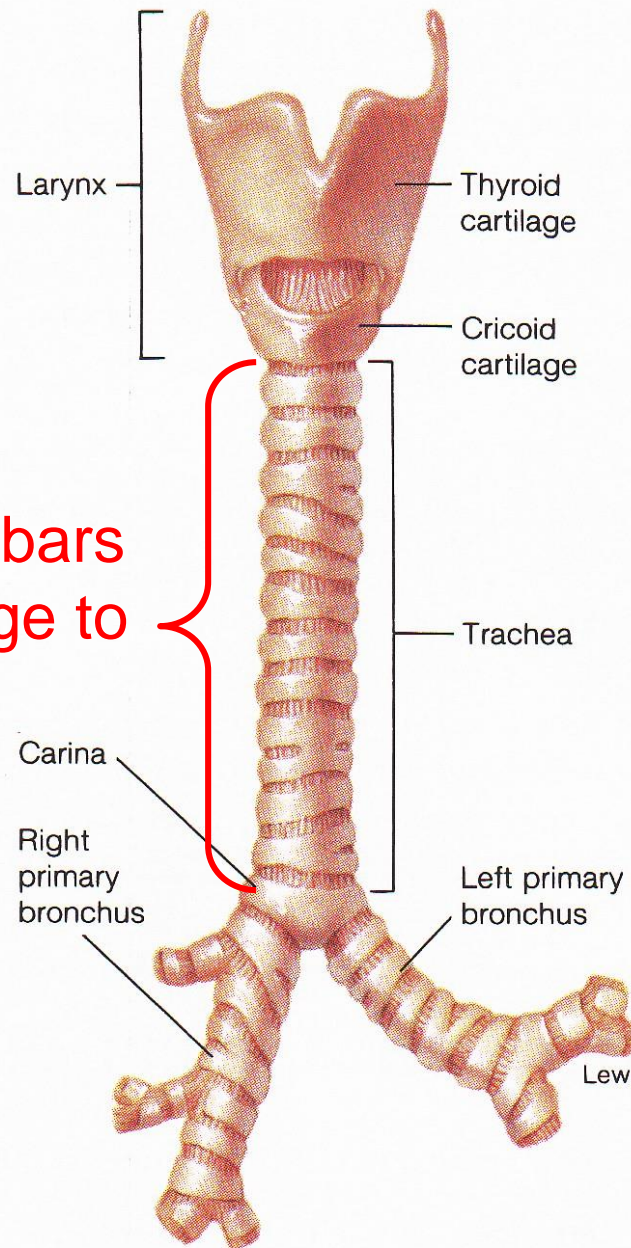
NB: In vivo,
Cupola or peak
of each lung
goes into neck
> clavicle line!

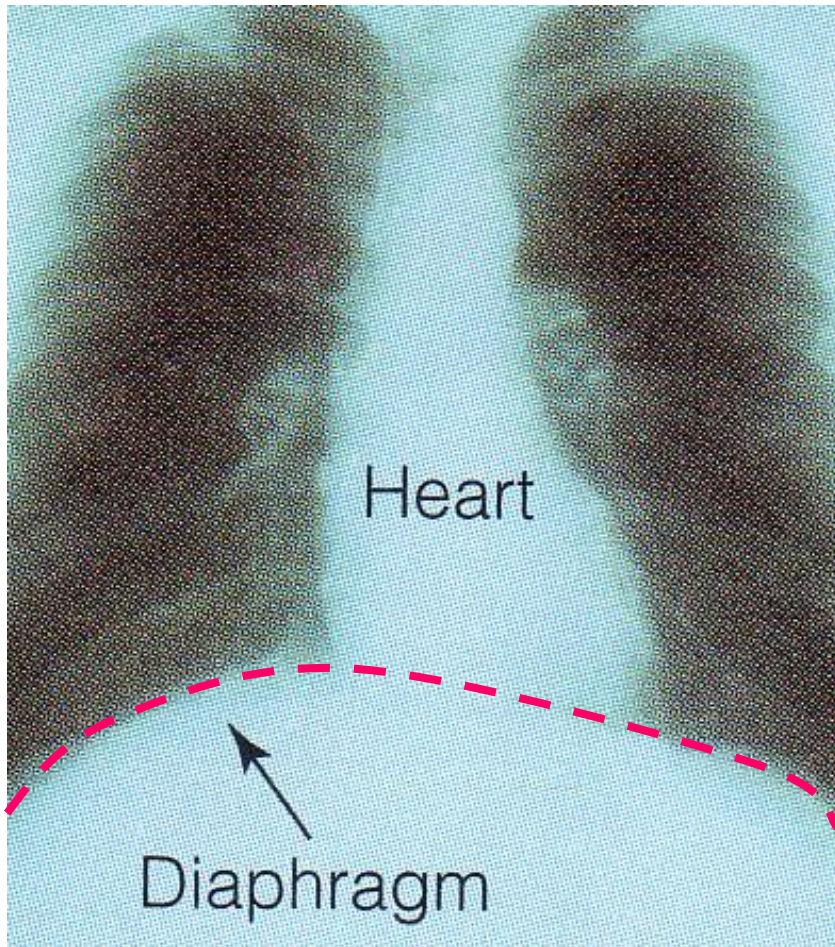


(b) Enlargement of alveoli (air sacs) at terminal ends of airways



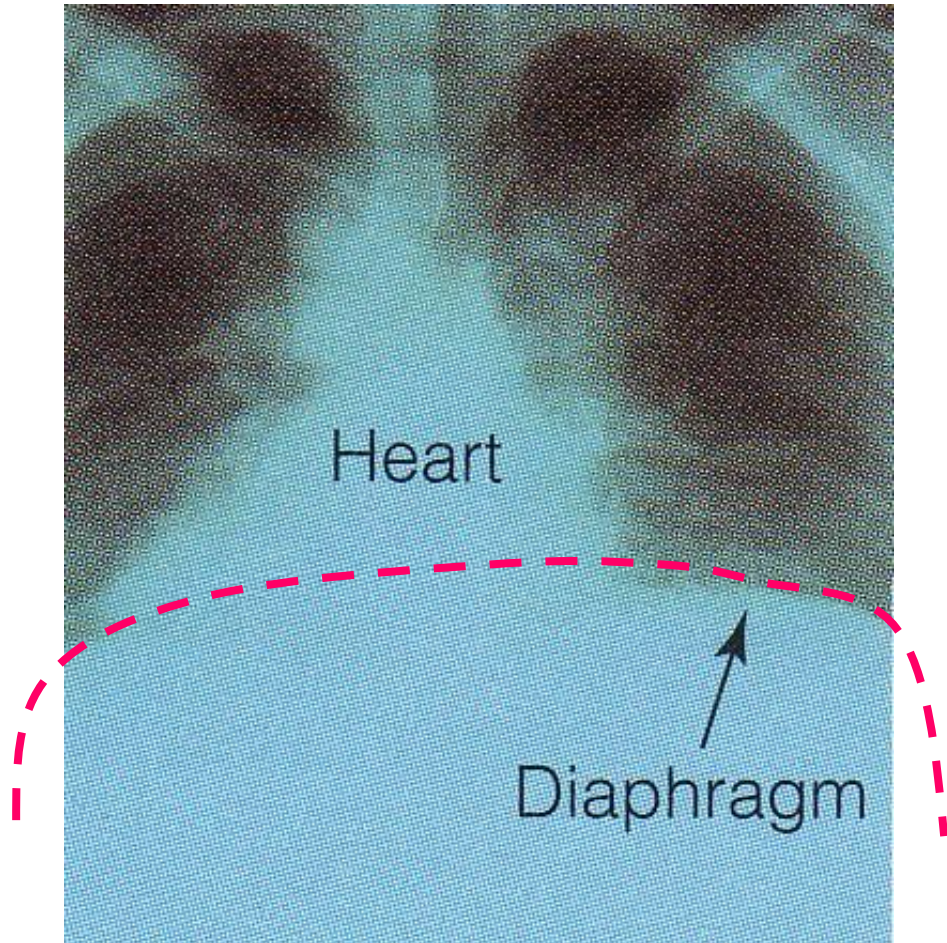
16-20 C-shaped bars
of hyaline cartilage to
prevent collapse





Inhale (active)

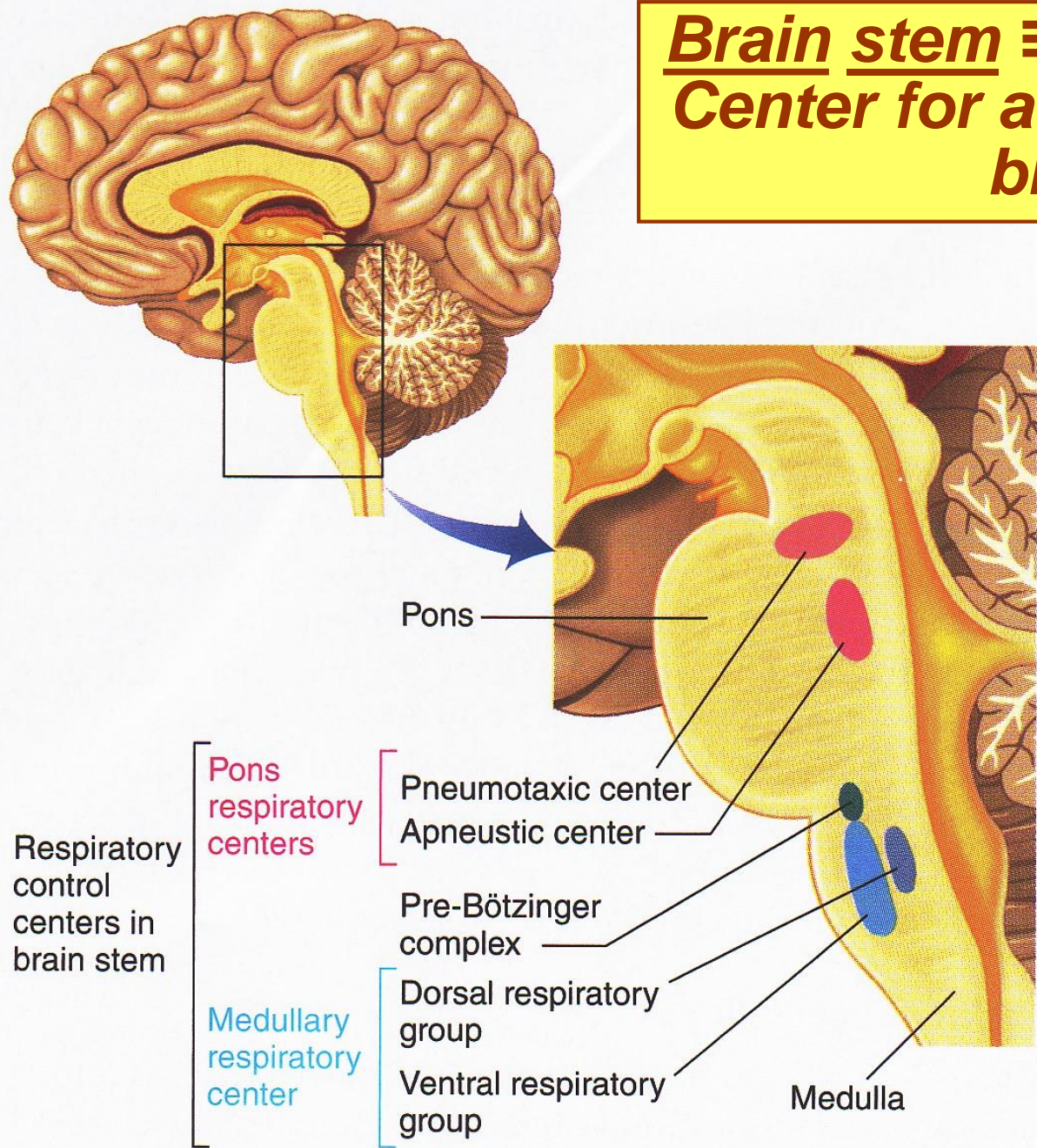
Contract & flatten diaphragm



Exhale (passive @ rest)

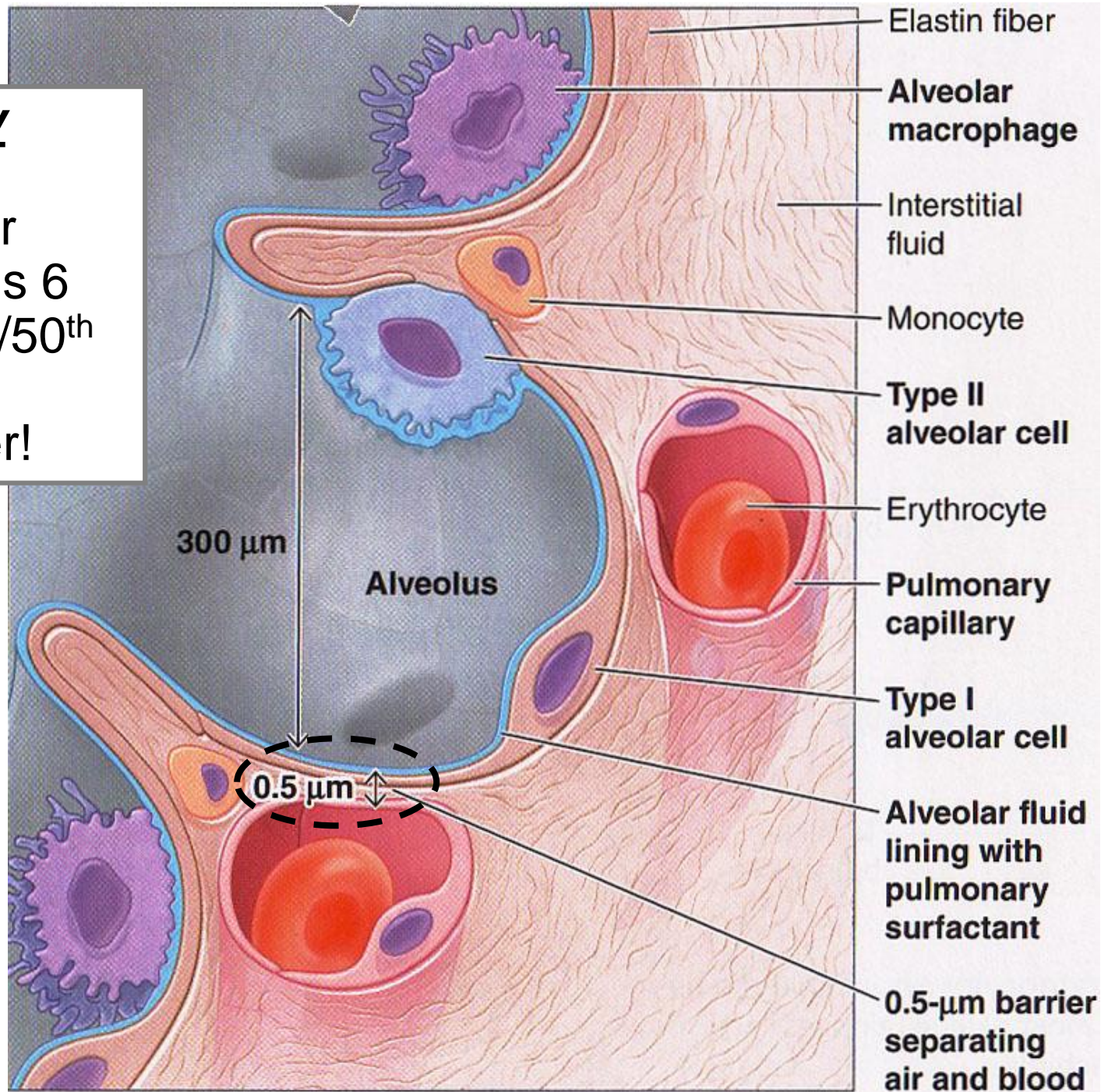
Relax & pouch up diaphragm!

Brain stem ≡ Control Center for automatic breathing!



Respiratory membrane

separates air from blood, is 6 layers, yet 1/50th thickness of tracing paper!



Gas Exchange

CO₂ LOW

O₂ HIGH

Across pulmonary capillaries:

O₂ partial pressure gradient from alveoli to blood = 60 mm Hg (100 → 40)

CO₂ partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

Across systemic capillaries:

O₂ partial pressure gradient from blood to tissue cell = 60 mm Hg (100 → 40)

CO₂ partial pressure gradient from tissue cell to blood = 6 mm Hg (46 → 40)

Numbers are mm Hg pressure.

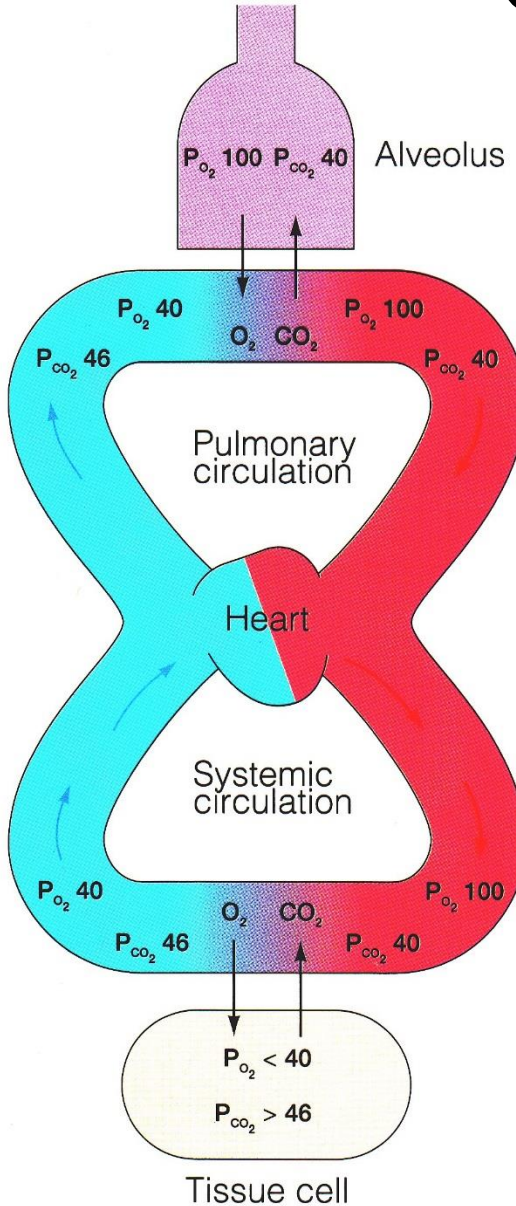
Inspired air

P_{O₂} 160

P_{CO₂} 0.3

P_{O₂} 100 P_{CO₂} 40

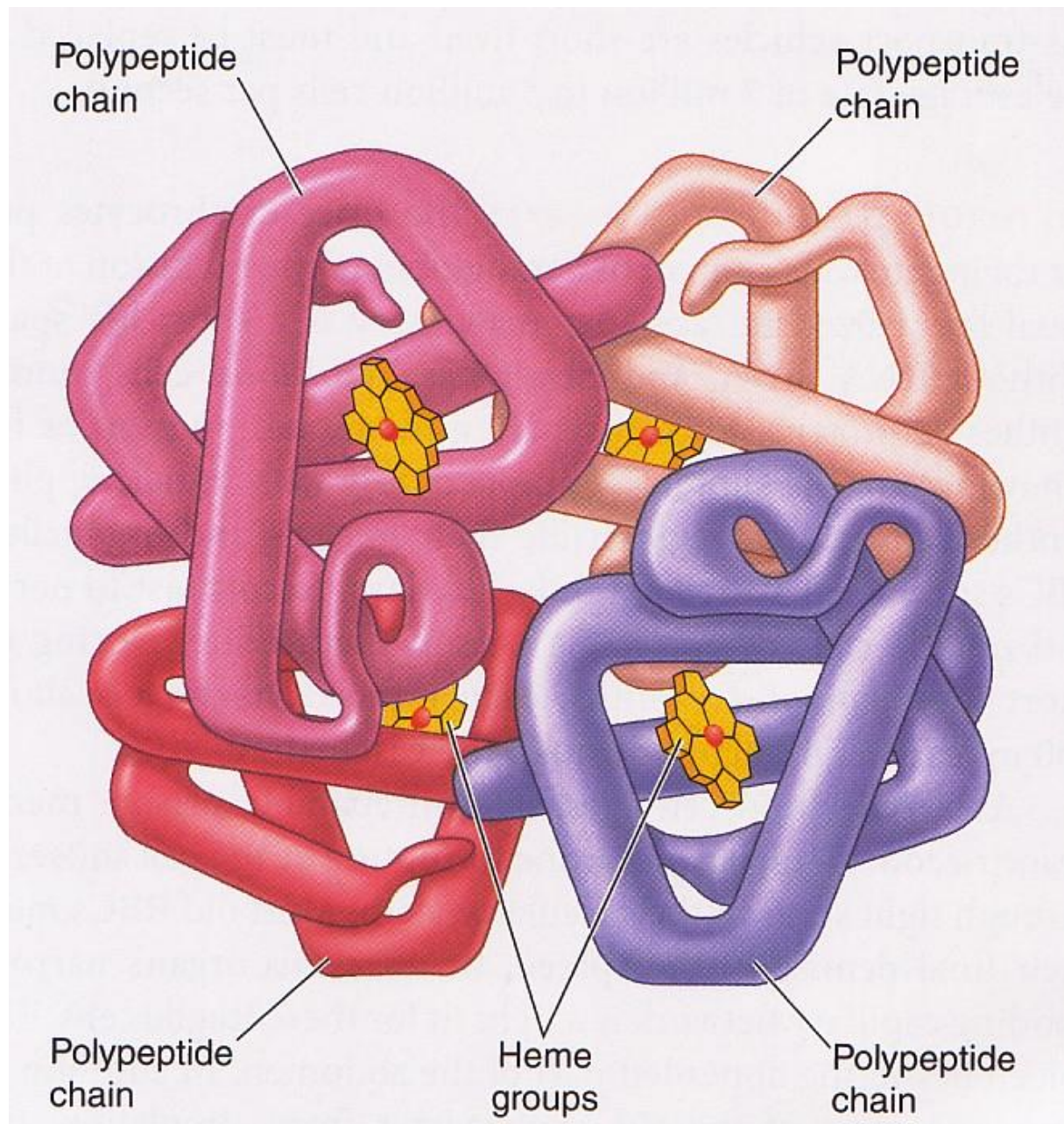
Alveolus



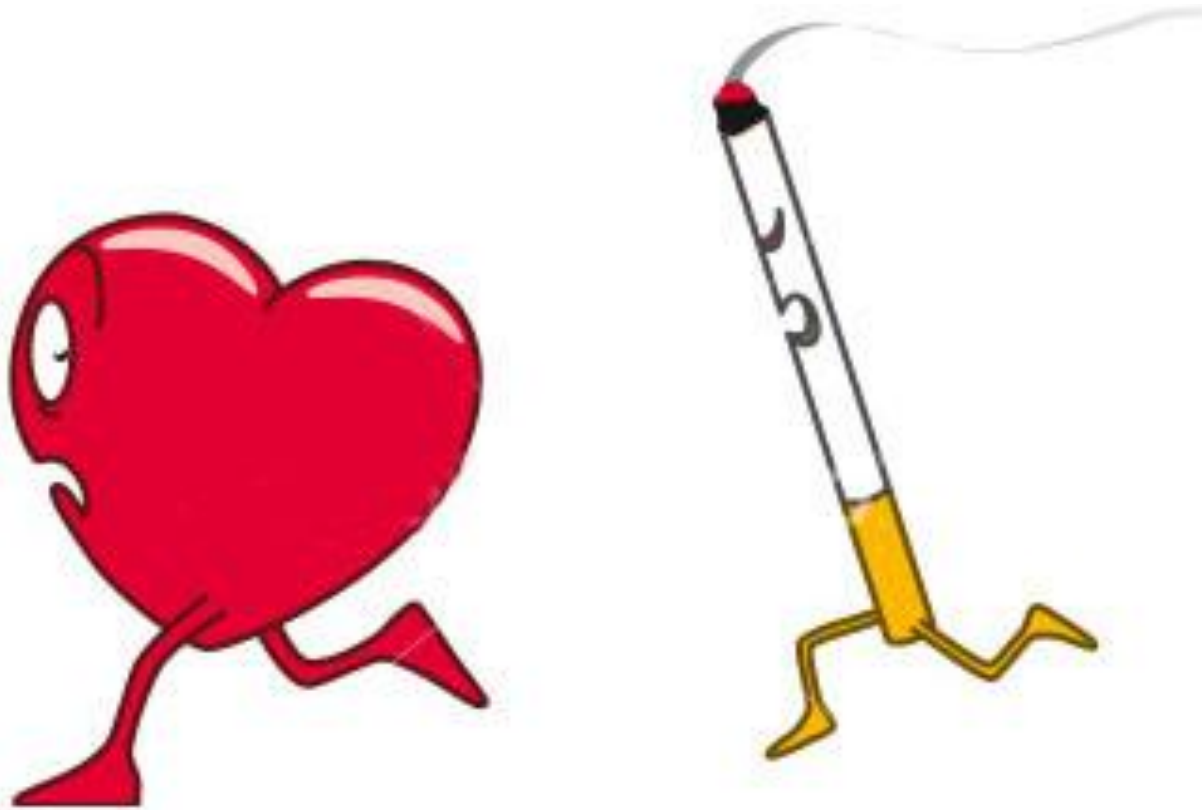
CO₂ HIGH

O₂ LOW

O_2 is carried mainly by red blood cell hemoglobin!



***Not only the Lungs, but the Heart, Brain & 100s
of Other Tissues & Organs Adversely Affected!***

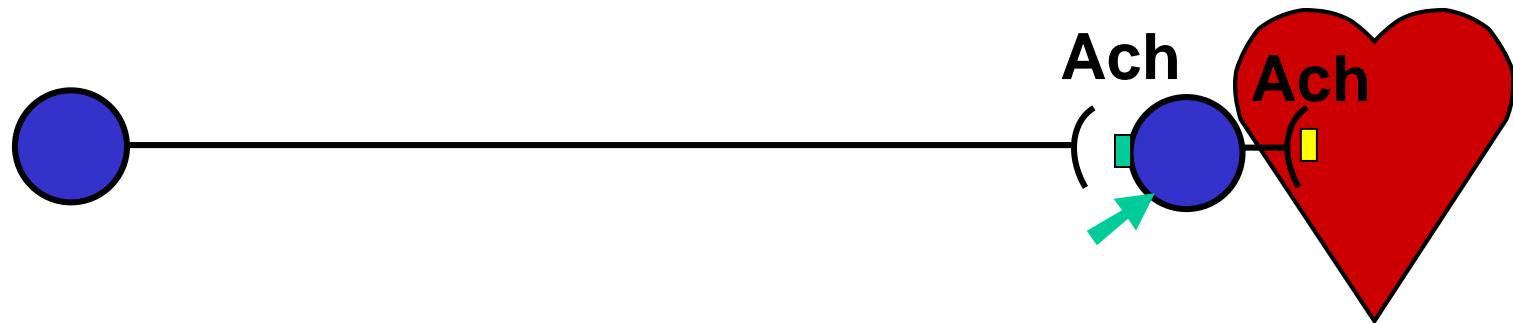


Tobacco smoke = Deadly mix of > 7000 chemicals!

**[http://www.cdc.gov/tobacco/data_statistics/sgr/
50th-anniversary/index.htm#fact-sheets](http://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.htm#fact-sheets)**

**[http://www.cdc.gov/tobacco/data_statistics/sgr/
2010/consumer_booklet/chemicals_smoke/](http://www.cdc.gov/tobacco/data_statistics/sgr/2010/consumer_booklet/chemicals_smoke/)**

Parasympathetic

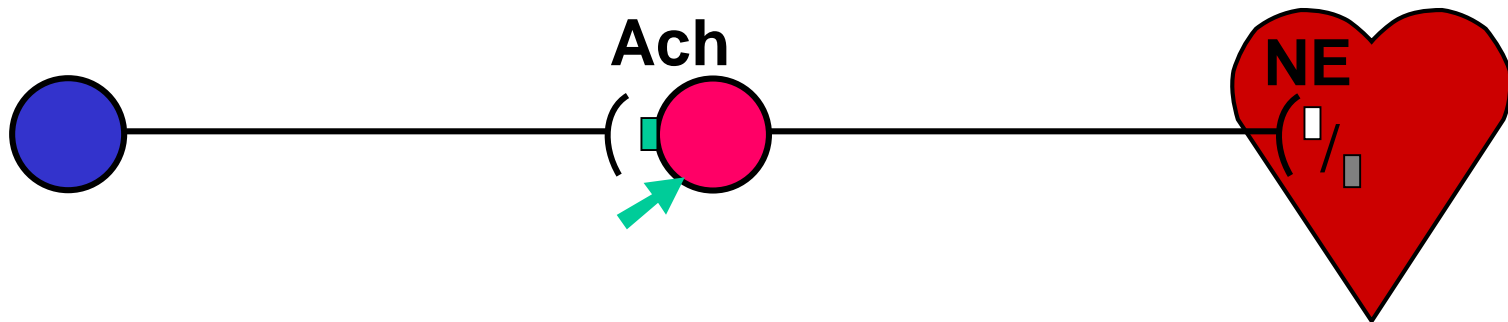


Ach = Acetylcholine

■ = Nicotinic Receptor

■ = Muscarinic Receptor

Sympathetic



NE = Norepinephrine

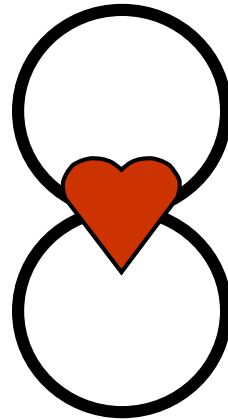
□ = α Receptor (α_1 , α_2)

■ = β Receptor (β_1 , β_2)

Cigarettes ≡ Patient-Assisted Drug-Delivery System Inhaling Bypasses the Systemic Circulation & Is Powerfully Reinforcing!



Pulmonary

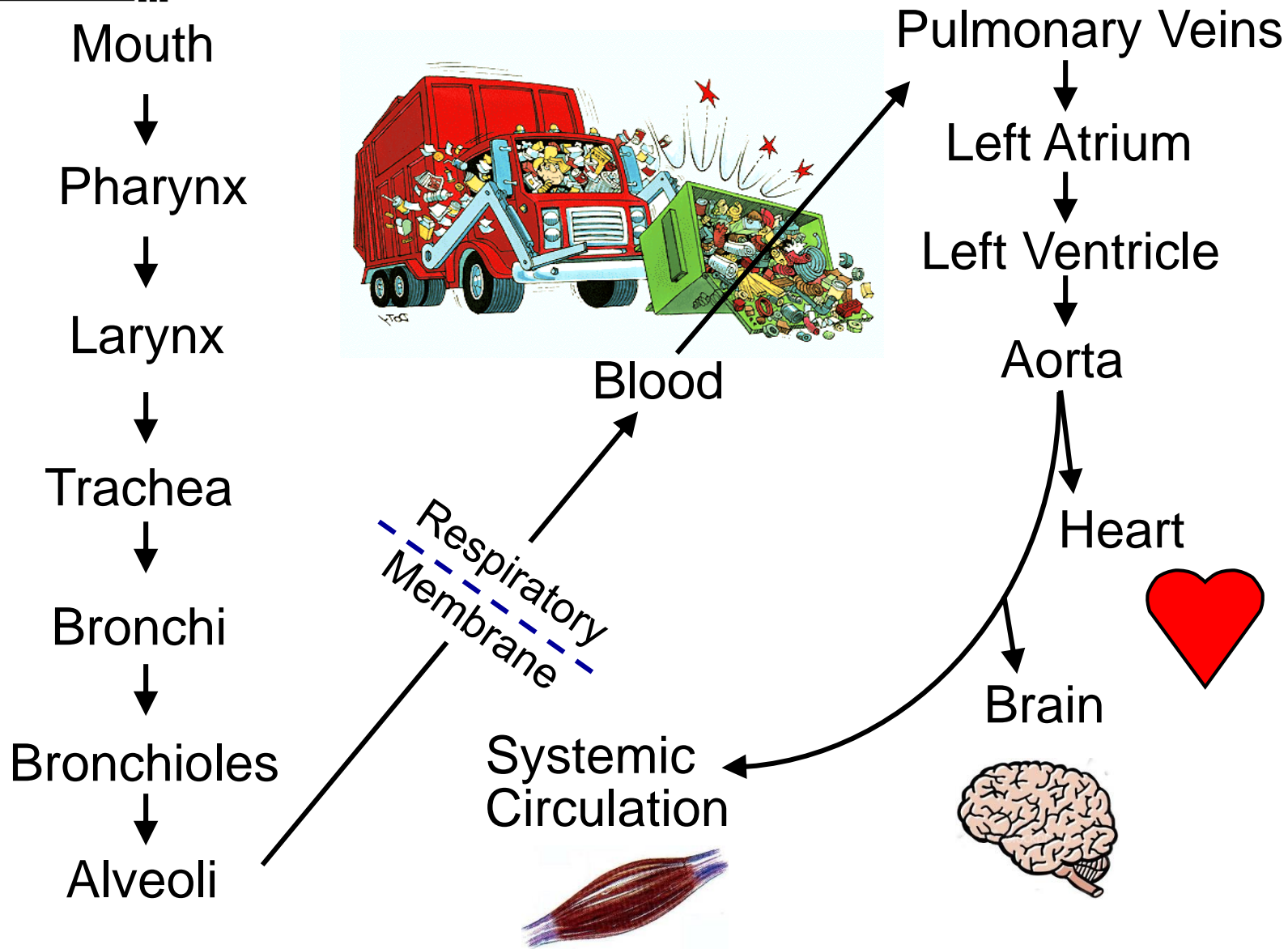


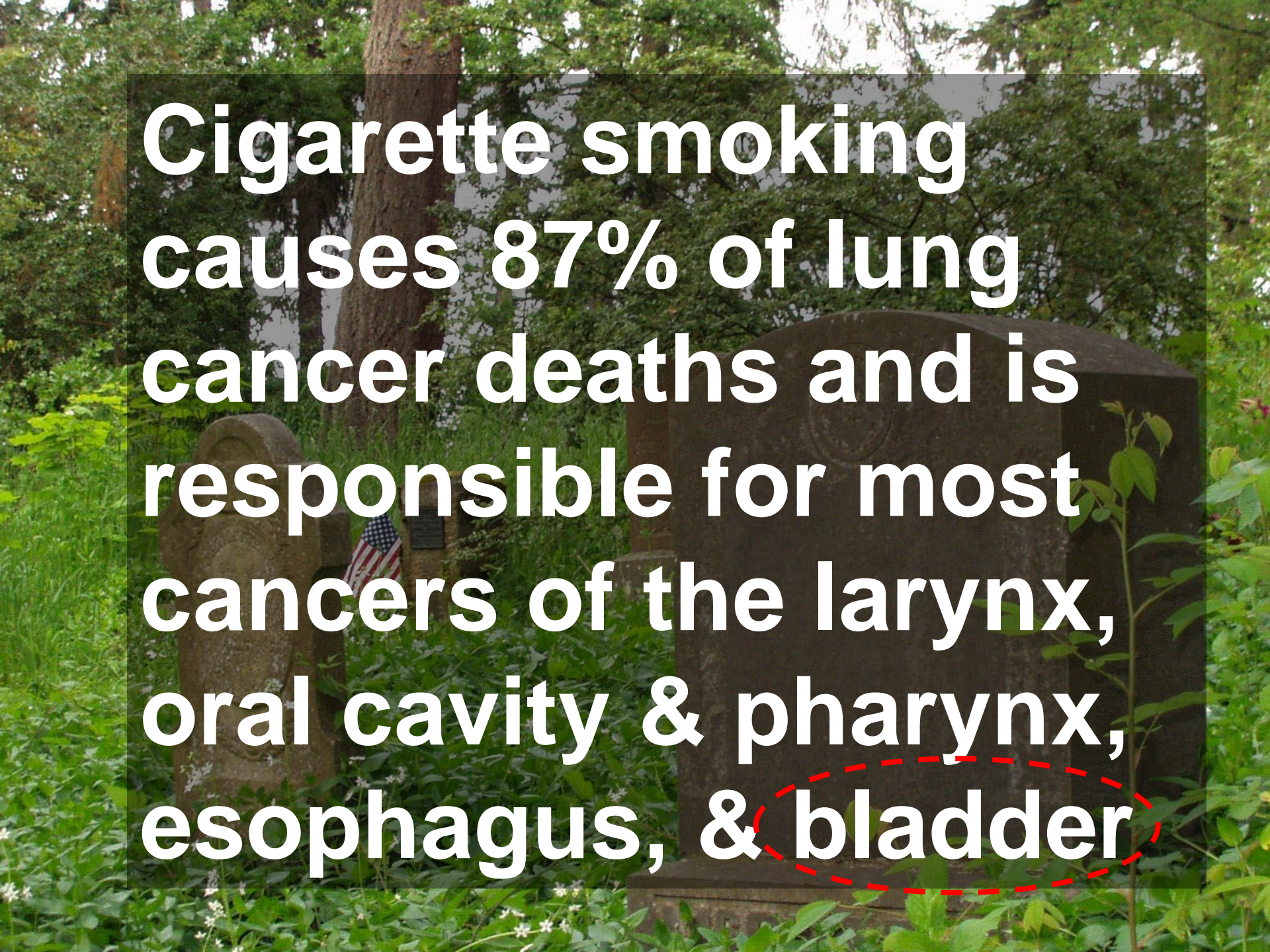
Systemic



Tracing the Route of Cigarette Smoke

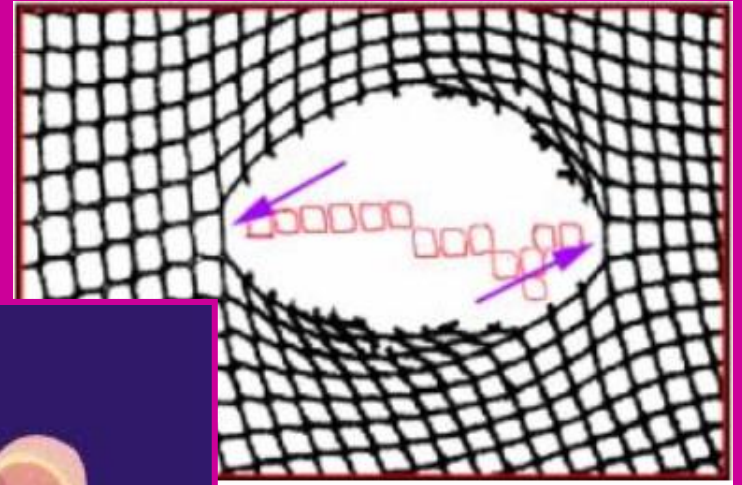
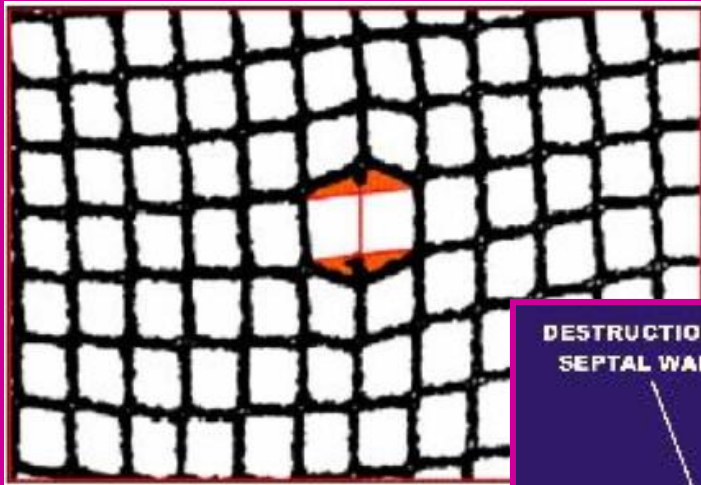
Puff to Brain Time 5 to 8 seconds!!



A photograph of a cemetery with several tombstones and lush green trees in the background. A semi-transparent grey text box is overlaid on the image, containing white text. The word 'bladder' in the text is circled with a red dashed line.

Cigarette smoking causes 87% of lung cancer deaths and is responsible for most cancers of the larynx, oral cavity & pharynx, esophagus, & bladder

Emphysema ≡ Corrosion of Alveolar Walls with ↓ SA & Labored Breathing



Why you have to tell your gynecologist you smoke. Even if it's only at parties.

©AMP 2008 03/11/08

You figure an occasional cigarette can't hurt, and you really don't want to listen to the "stop smoking" lecture from your doctor. But if you want any type of hormonal birth control, smoking is a vitally important issue.

Hormonal birth control is a prescription drug, and while the risks are rare, they can be serious, and smoking, even a little, increases the risks, especially if you're over 35.

Risks include blood clots, stroke, and heart attack. If you have a history of these conditions or certain cancers, you shouldn't use hormonal birth control.

Of course, you should tell your healthcare professional if you could be pregnant, and because hormonal birth control doesn't protect against HIV or sexually transmitted diseases, learn how to stay safe and healthy.

Hormonal birth control has been used safely by millions of women for 45 years, and is 99% effective when used correctly.

It could be a good choice for you. To find out, talk to your healthcare professional. And to help you get started, there's a list of questions to ask at: www.orthowomenshealth.com



Be smart about your body.
Be smart about your birth control.

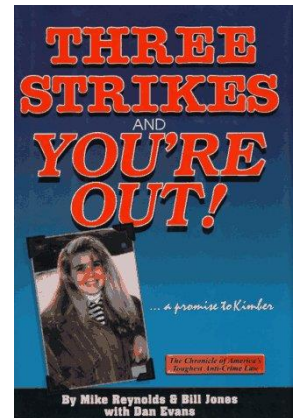
On the Pill & Smoke?

Increased Risk of:

1. Blood Clots

2. Heart Attack

3. Strokes!



**Breathing 2nd-hand
smoke for as little as
1/2 hr activates
platelets almost as
much as if you were a
pack-a-day smoker**

News: Health, Toxicology, Pollution

Health risks of e-cigarettes emerge

Vaping pollutes lungs with toxic chemicals and may even make antibiotic-resistant bacteria harder to kill

By JANET RALOFF 4:31PM, JUNE 3, 2014



<https://www.sciencenews.org/article/health-risks-e-cigarettes-emerge>



freebase nicotine!!

Ammonia converts nicotine, the addictive agent in tobacco, into a more volatile form, Pan-kow said. "Ammonia is the thing that helps tobacco companies hook the smoker by providing a means of delivering the nicotine."

Last October a former tobacco industry employee revealed that secret industry documents indicated that ammonia was added to tobacco to double the impact of nicotine. The Oregon Graduate Institute study confirms the contention that

Nicotine Addiction & Help Quitting Smoking

[http://www.cancer.org/healthy/stayawayfromtobacco/guide
toquittingsmoking/guide-to- quitting-smoking-help-phys-nrt](http://www.cancer.org/healthy/stayawayfromtobacco/guide-toquittingsmoking/guide-to- quitting-smoking-help-phys-nrt)

2nd-Hand Smoke or ETS & 3rd-Hand Smoke?

[http://www.cancer.org/cancer/cancercauses/tobaccocancer/
secondhand-smoke](http://www.cancer.org/cancer/cancercauses/tobaccocancer/secondhand-smoke)

2nd-Hand Smoke Addictive?

[http://www.ncbi.nlm.nih.gov/pubmed?term=2nd%20hand
%20smoke%20addictive](http://www.ncbi.nlm.nih.gov/pubmed?term=2nd%20hand
%20smoke%20addictive)

<http://www.ncbi.nlm.nih.gov/pubmed/20211642>

<http://www.ncbi.nlm.nih.gov/pubmed/19936715>

<http://www.ncbi.nlm.nih.gov/pubmed/21840504>