

BI 121 Lecture 8



... *Welcome back – let's get to work!!*

I. Announcements Tomorrow HR & BP Lab 4 + **Required Notebook Check**. Turn in today? Thurs Blood Chemistry Lab 5. Please read Lab 5 twice prior to Thursday. Thanks!

II. Cardiovascular System LS 2012 ch 9, Torstar Books 1984, DC 2003 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

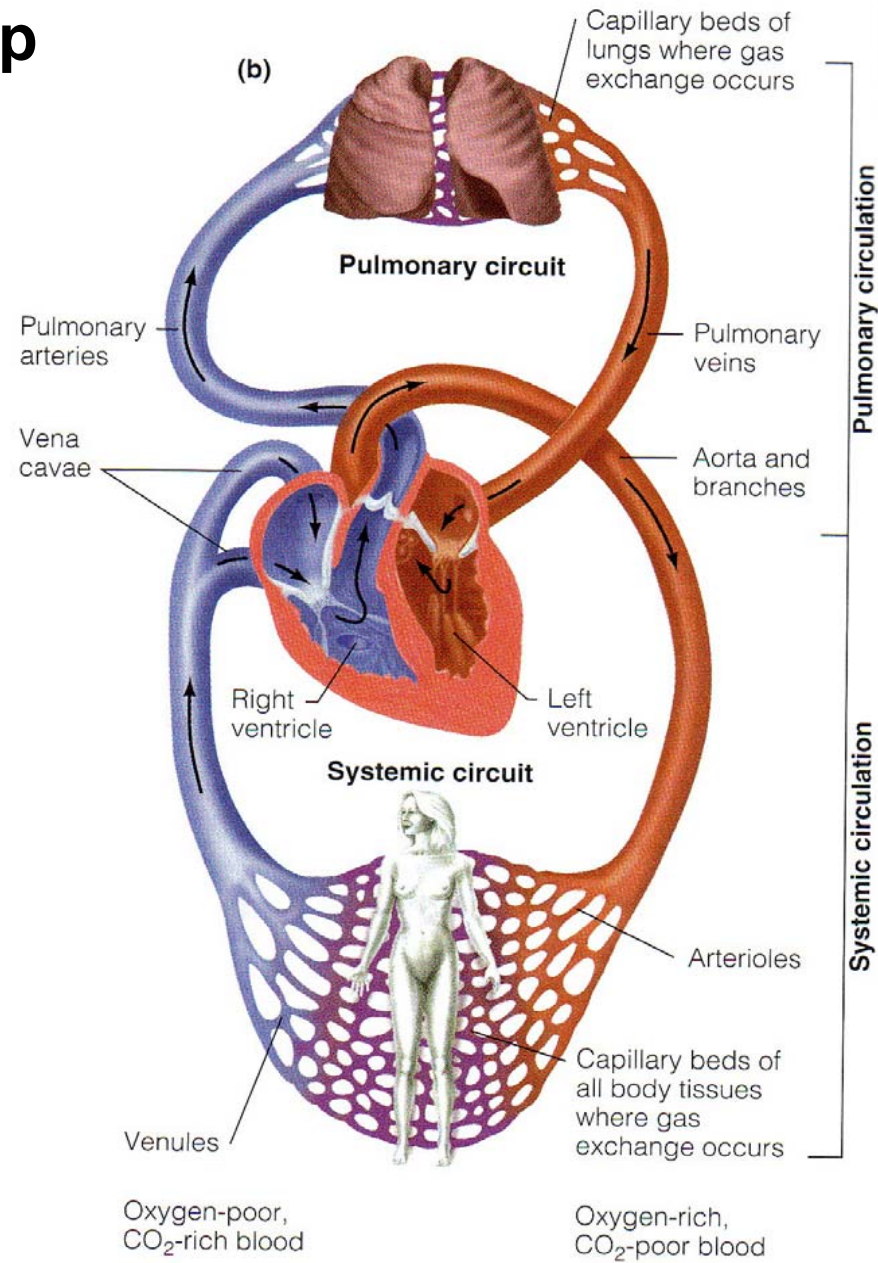
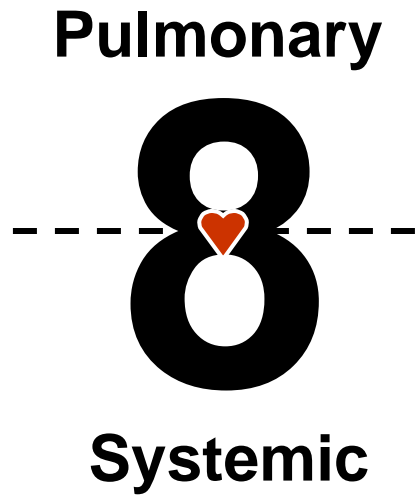
E. ♥ layers, box, chambers, valves, inlets, outlets
LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6

F. Normal vs abnormal blood flow thru ♥ & CV system
Billy has a hole in his ♥ SI Fox 2009 fig 13.16, 13.17

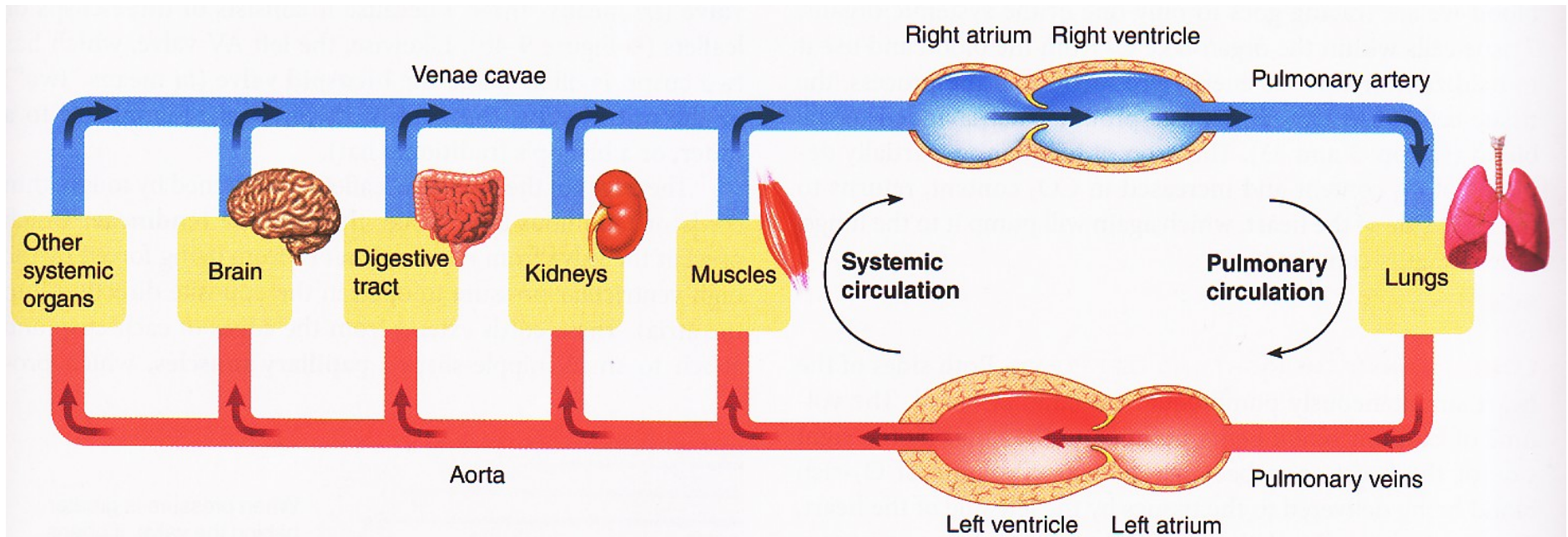


III. Comments on Midterm & Tests Returned

NB: Figure-8 loop



Dual Pump Action & Parallel Circulation

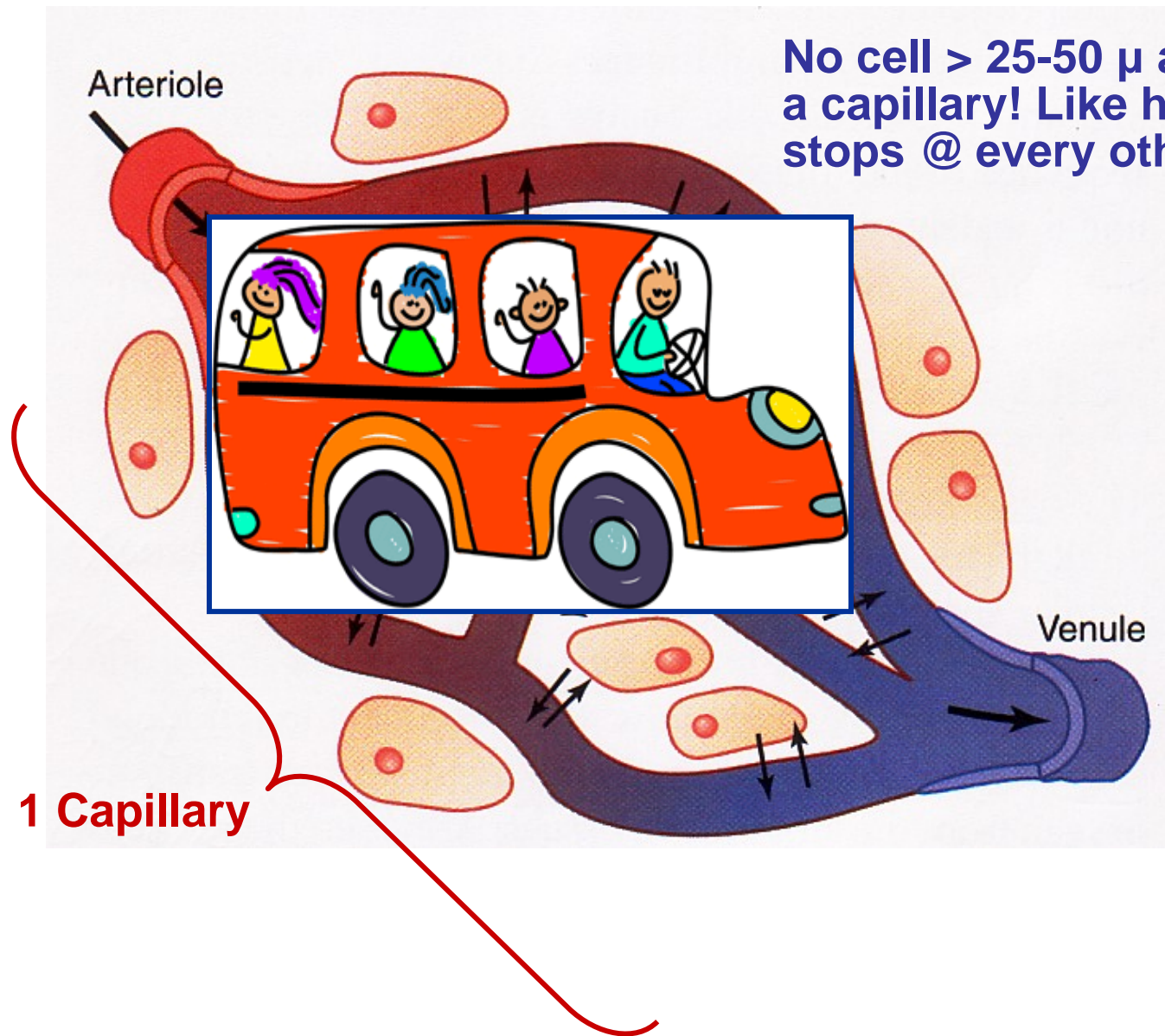


Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm

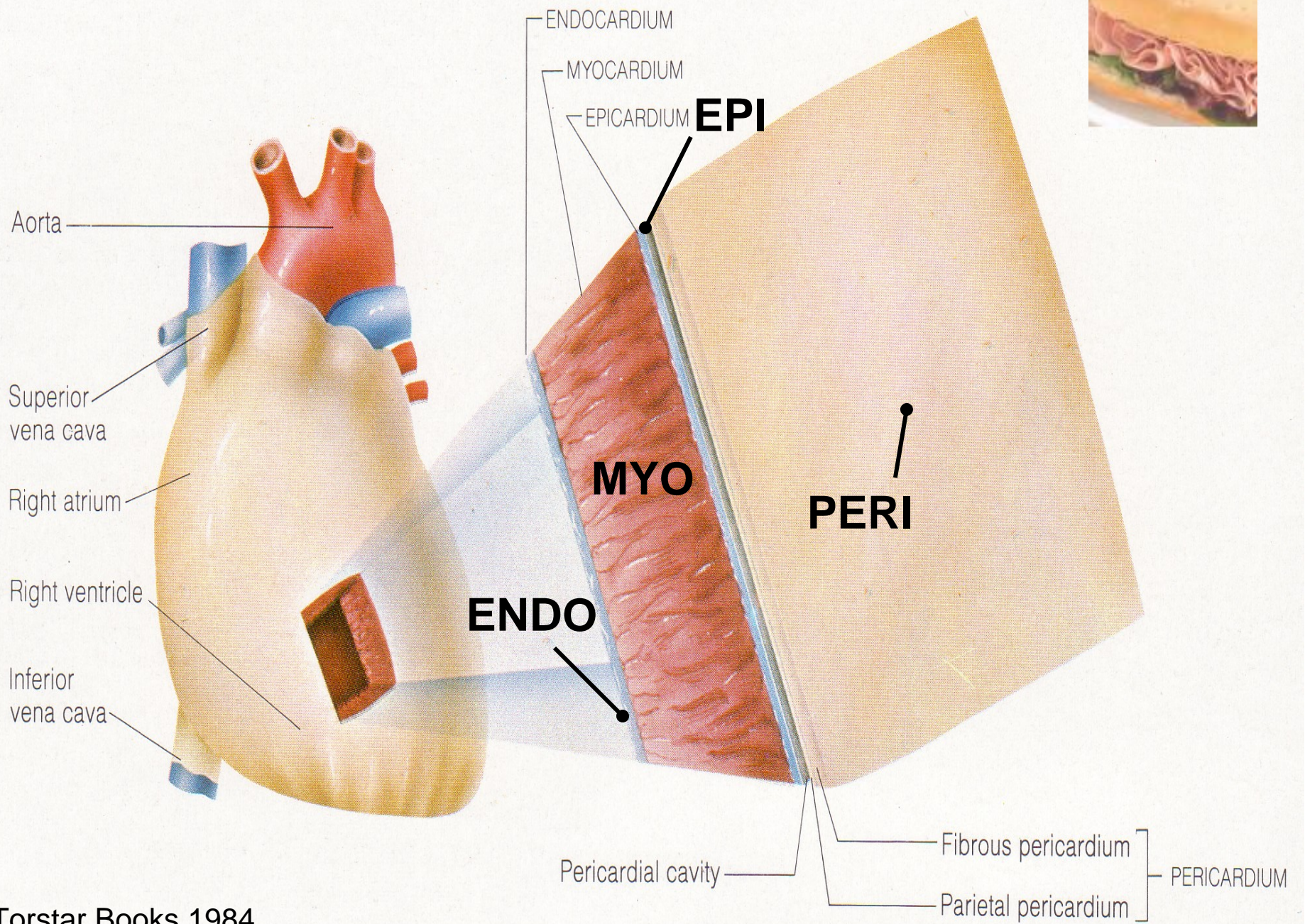


Fred Marsik/Visuals Unlimited

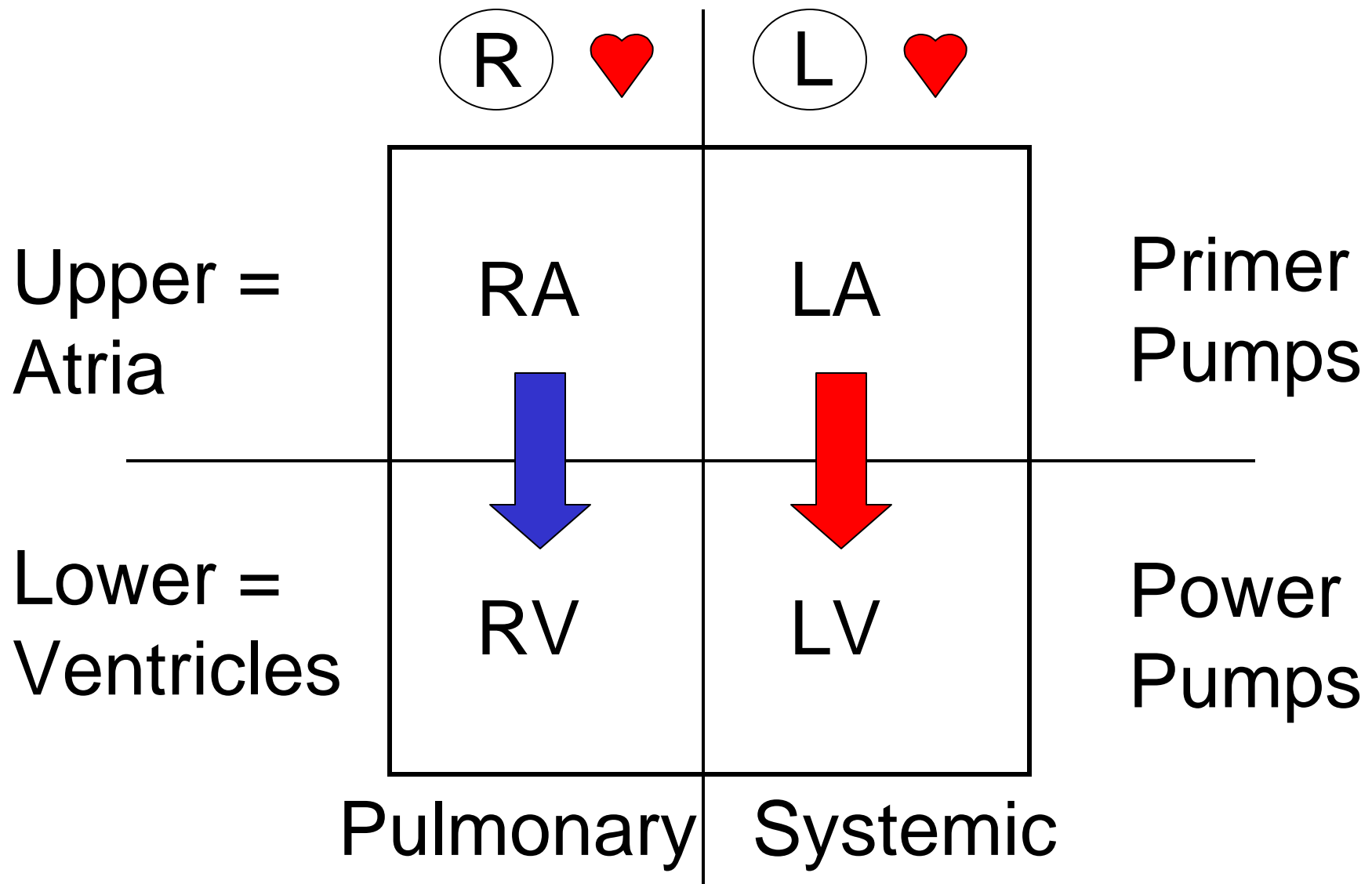
Microcirculation Exchange: 10 Billion Capillaries!



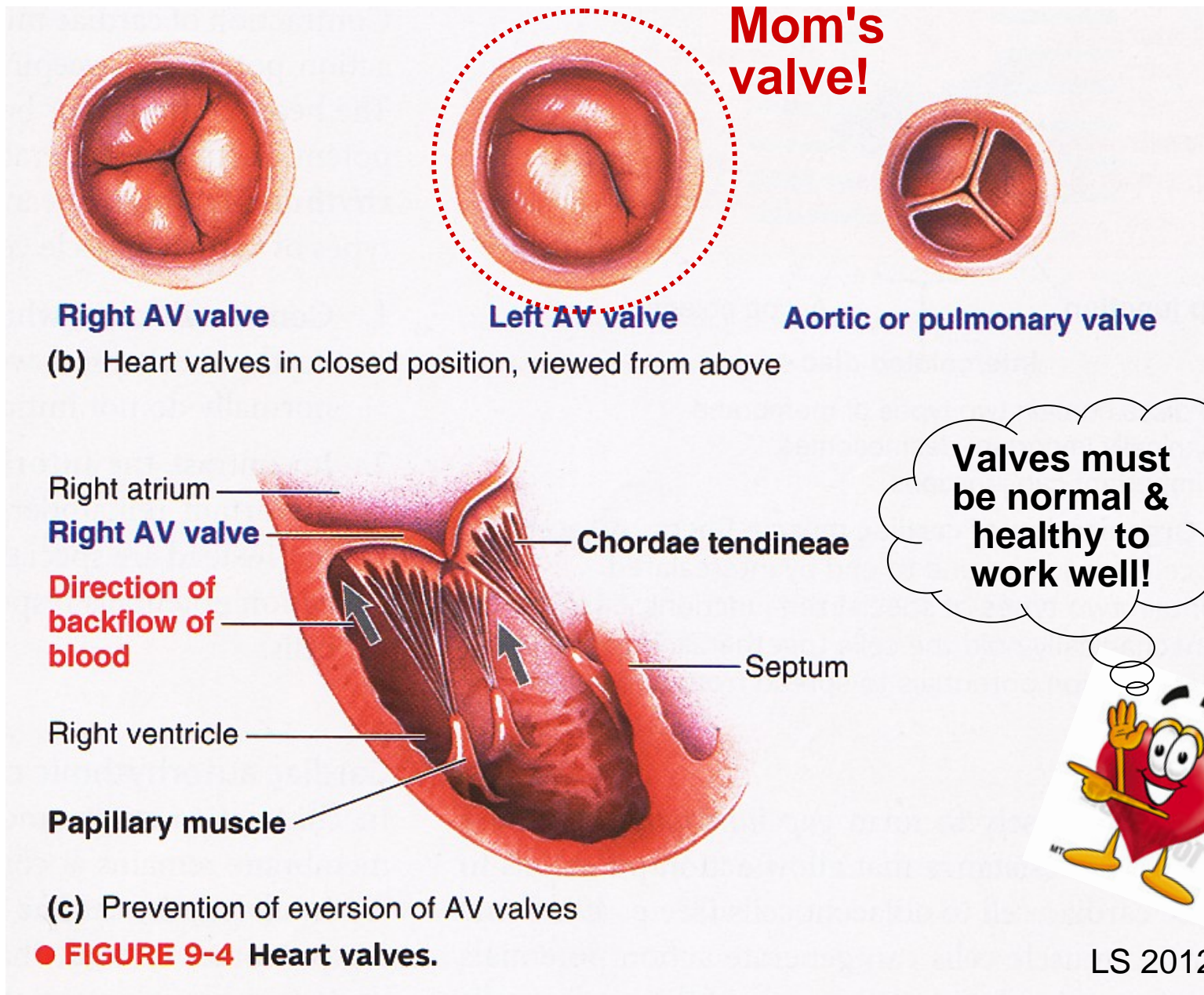
No cell > 25-50 μ away from a capillary! Like having bus stops @ every other block!



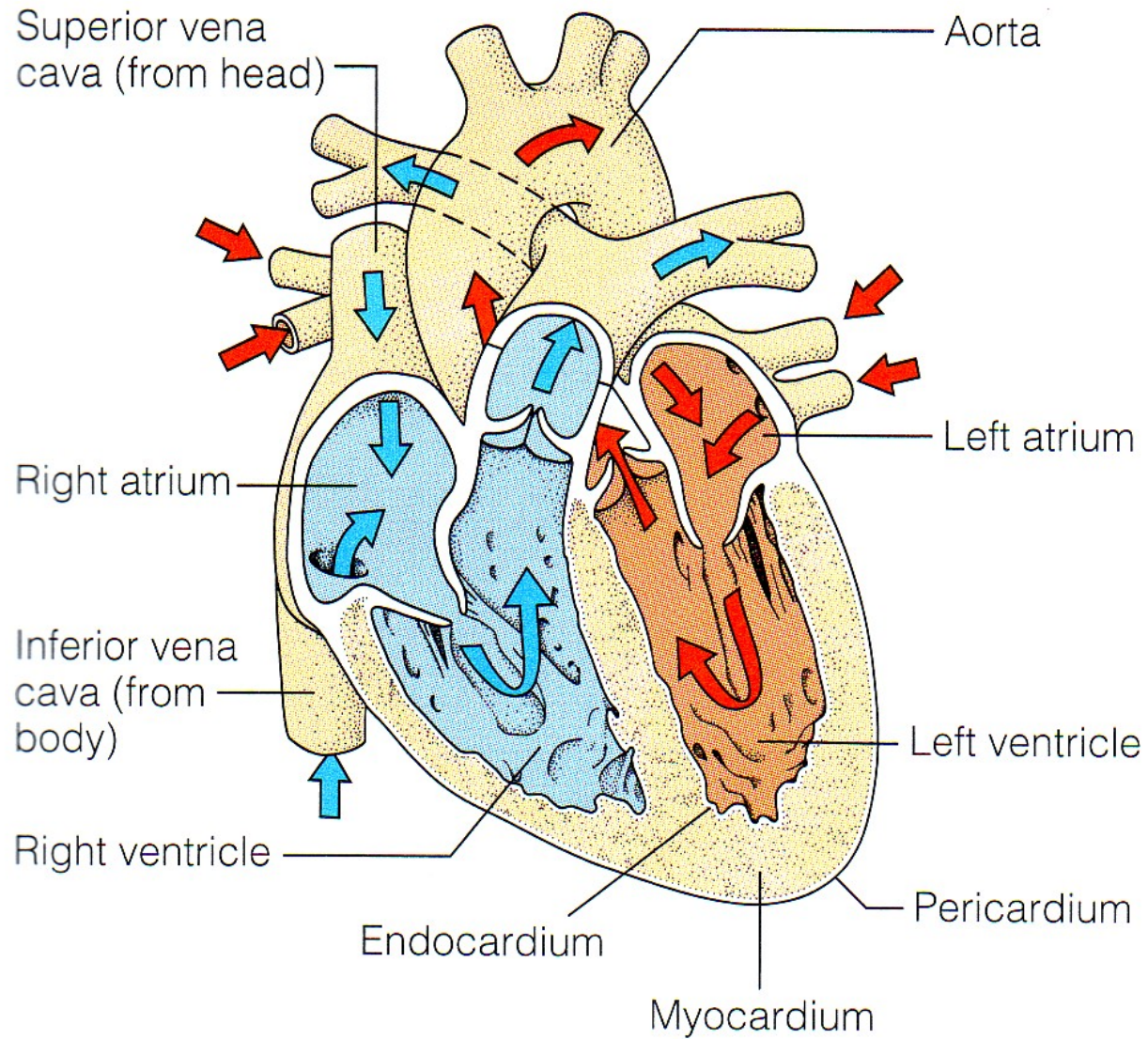
Human  = 4-chambered box?
2 separate pumps?



Heart Valves Ensure Unidirectional Blood Flow!



Veins → Atria → Ventricles → Arteries



BI 121 Lecture 9

- I. Announcements** Lab notebook due today! Lab 4 HR & BP.
Thursday, Lab 5 Blood Chemistry. Read pp 5-1 thru 5-6 x2. Q?
- II. Overview of Labs** HR & BP. Blood chem lab review
- III. Cardiovascular Connections** LS 2012 ch 9

- A. Cardiac cycle? Contract-relax!
B. ♥'s electrical highway + Pacemaker activity
LS fig 9-7 p 235, tab 9-1 p 236, fig 9-8 p 237
C. NHLBI & AHA websites



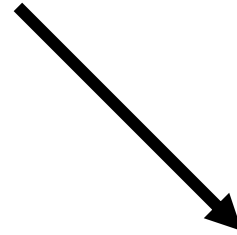
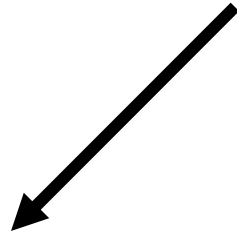
- IV. CV Physiology in the News** NHLBI & AHA websites
Exercise & Nic? Exercise guidelines: ACSM, AHA, CDC

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

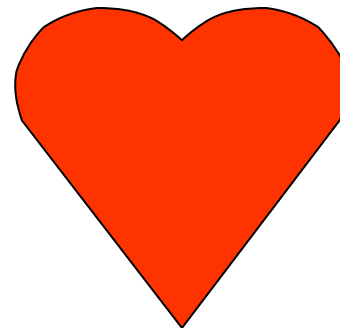
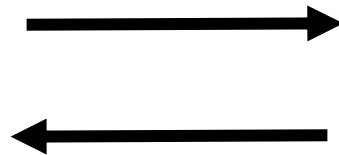
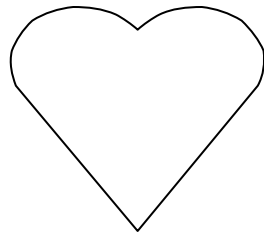


Systole

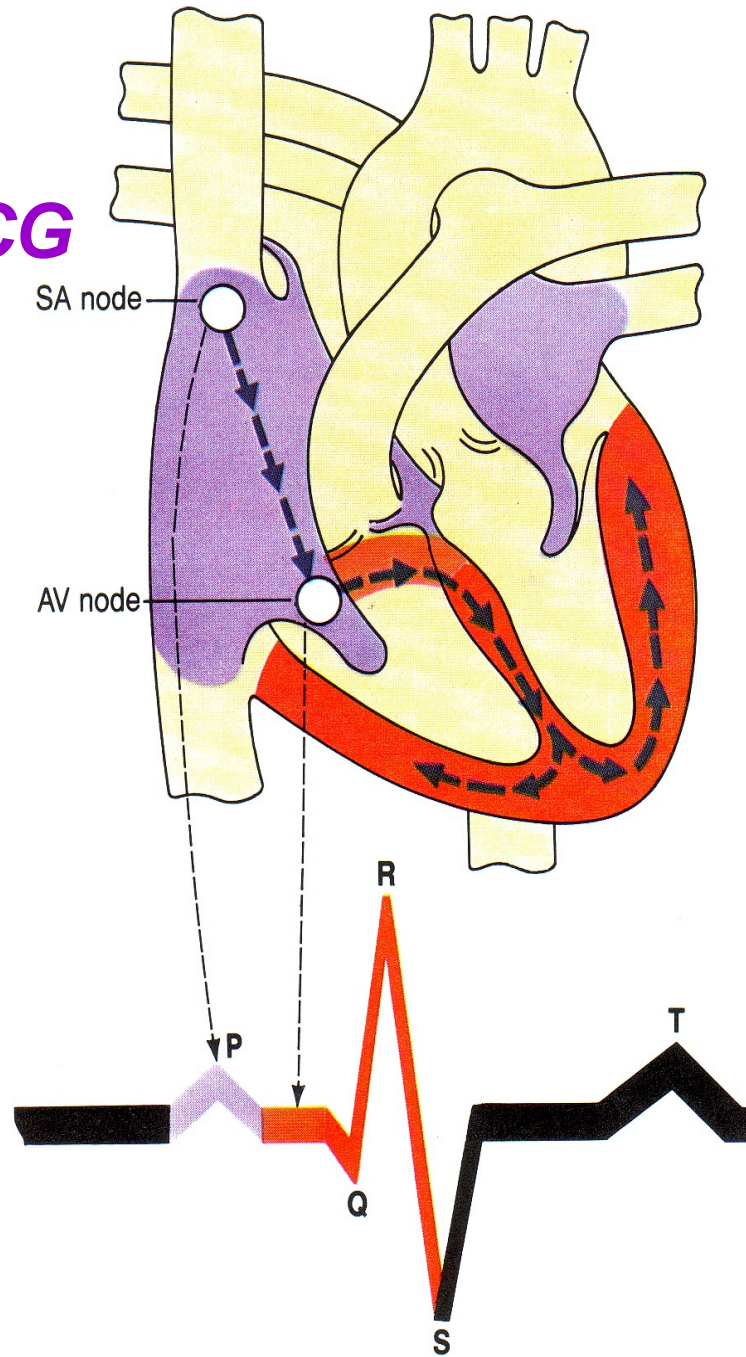
Contract
& Empty

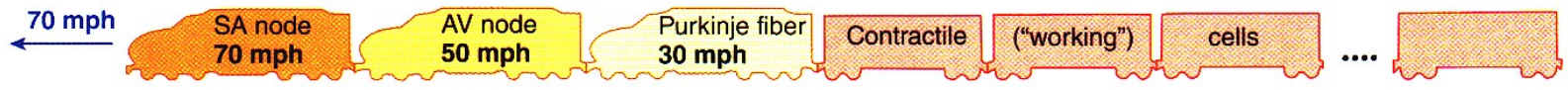
Diastole

Relax
& Fill

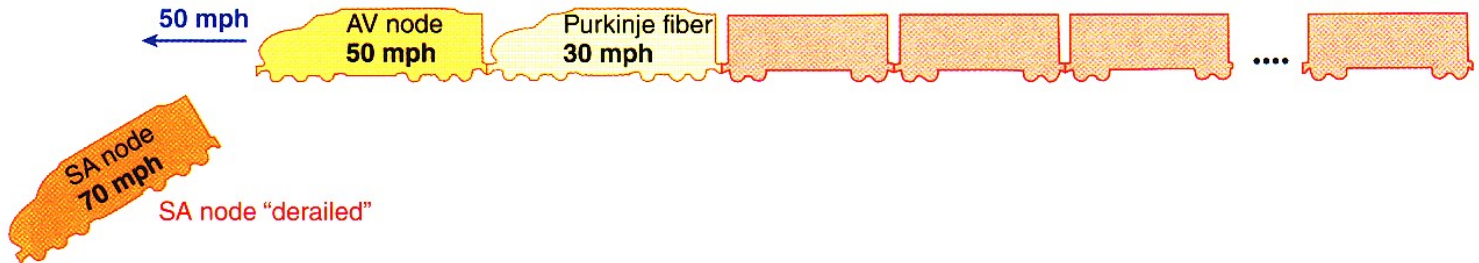


**EKG/ECG
Origin**

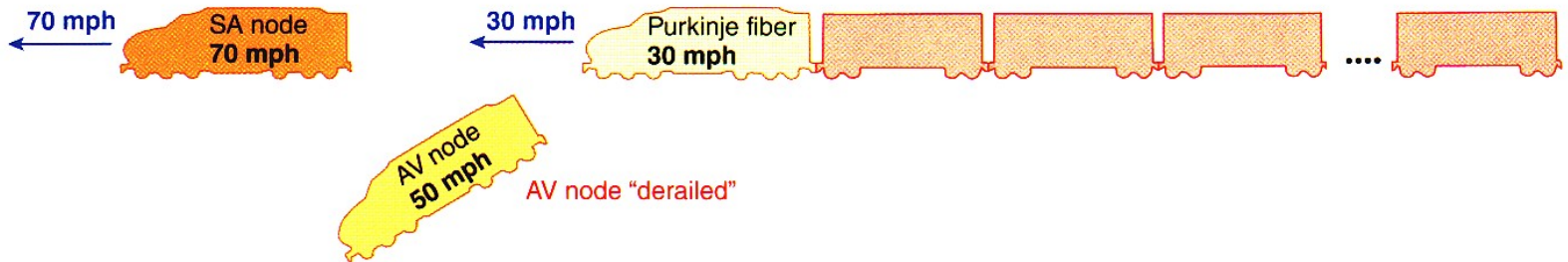




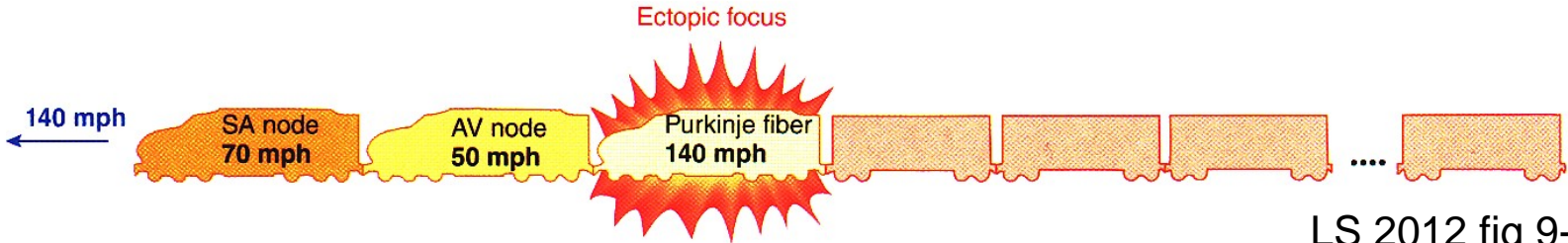
(a) Normal pacemaker activity: Whole train will go **70 mph** (heart rate set by SA node, the fastest autorhythmic tissue).



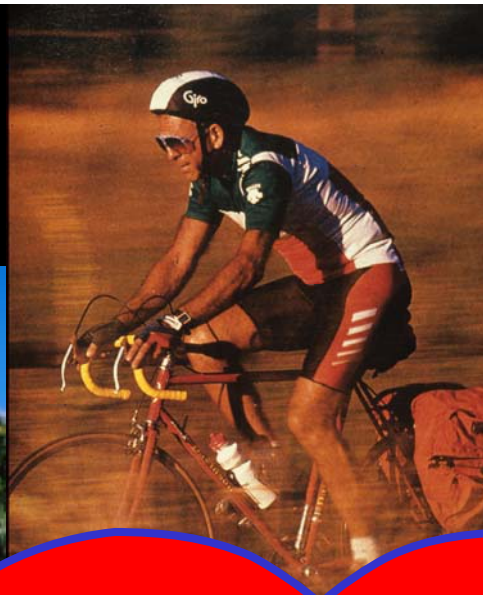
(b) Takeover of pacemaker activity by AV node when the SA node is nonfunctional: Train will go **50 mph** (the next fastest autorhythmic tissue, the AV node, will set the heart rate).



(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).



How much aerobic?



Continuous exercise
≥ 50% muscle mass
≥ Conversational pace
≥ 20-30 min/day
≥ 10 min/session
3-5 days/wk



http://journals.lww.com/acsm-msse/Fulltext/2011/07000/Quantity_and_Quality_of_Exercise_for_Developing.26.aspx
<http://www.acsm.org/access-public-information/brochures-fact-sheets/fact-sheets>

CVDs

AMI

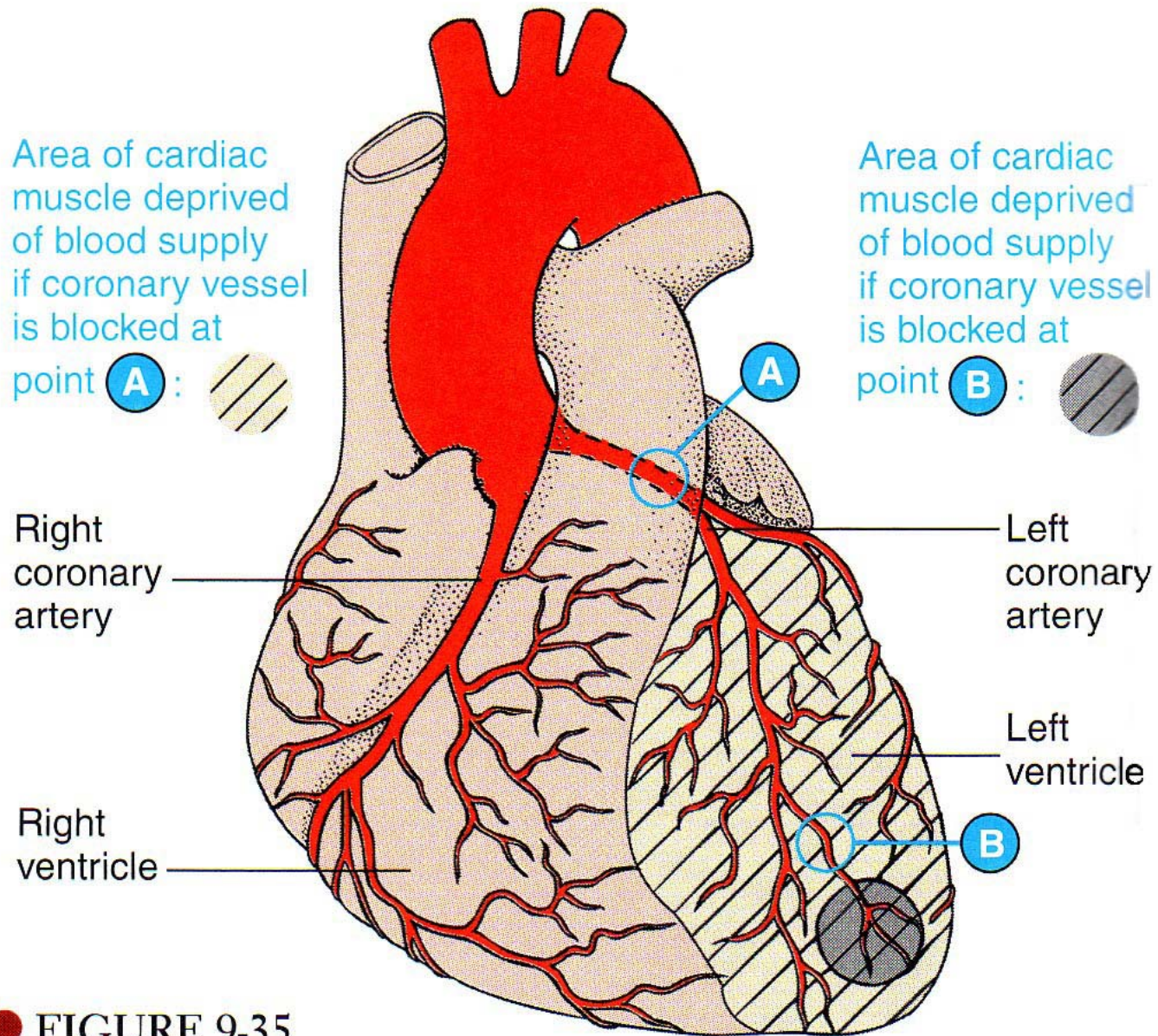
CVA



TIA

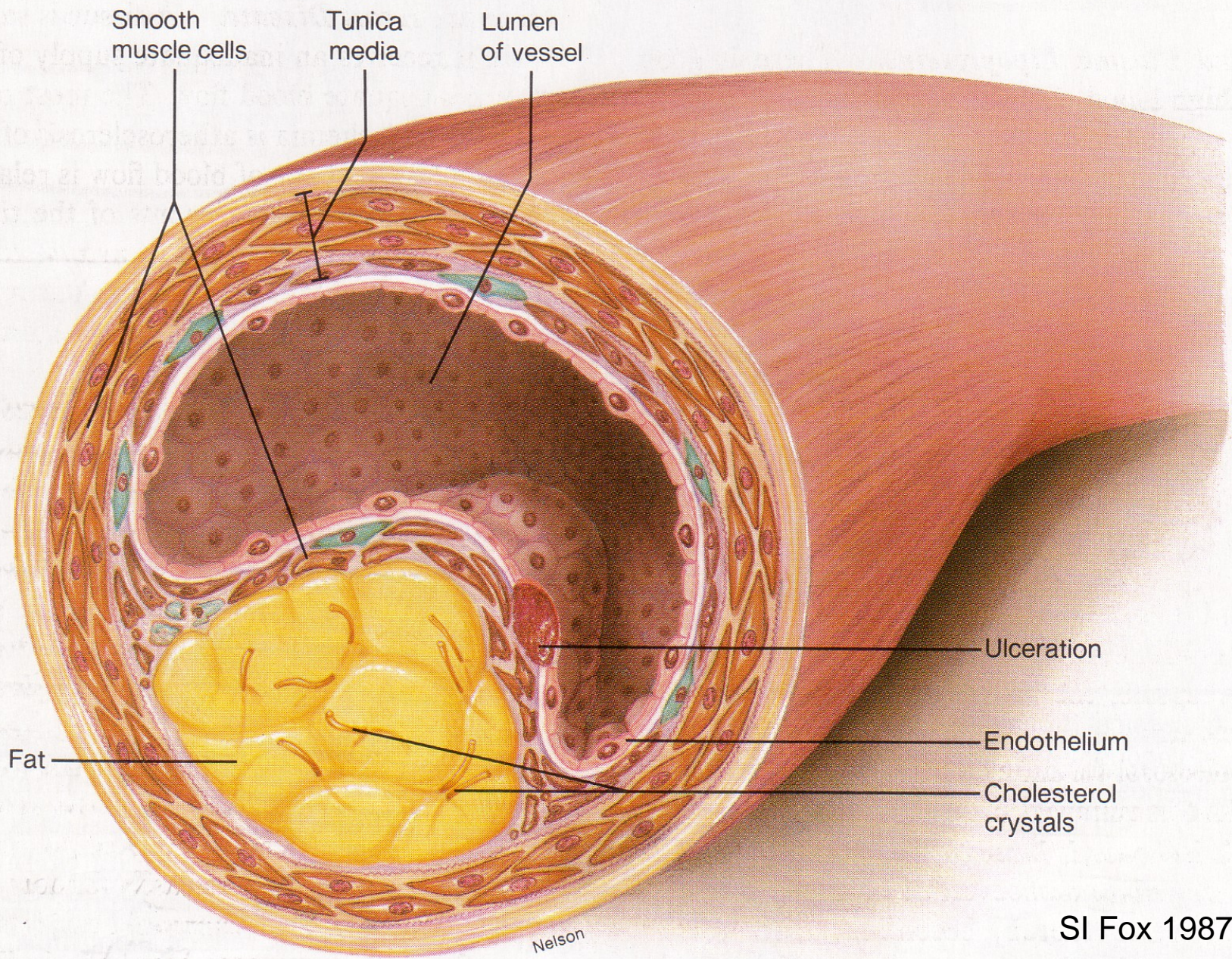
HTN

PVD



● FIGURE 9-35

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

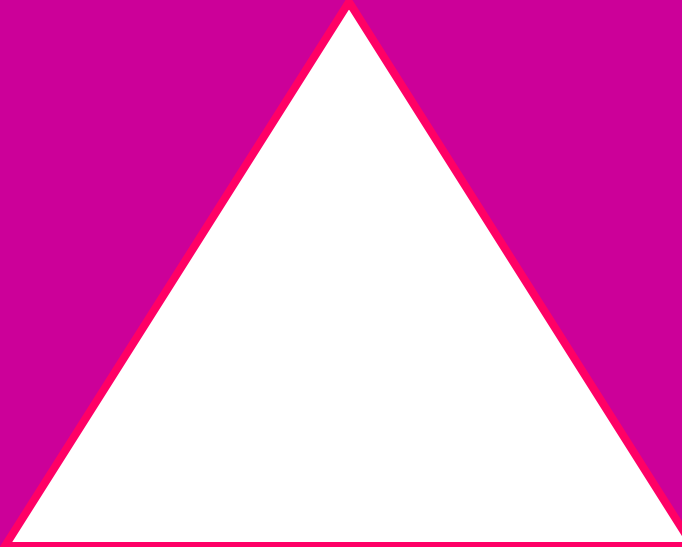


Treatment Triad

NB: Last blasted resort!!



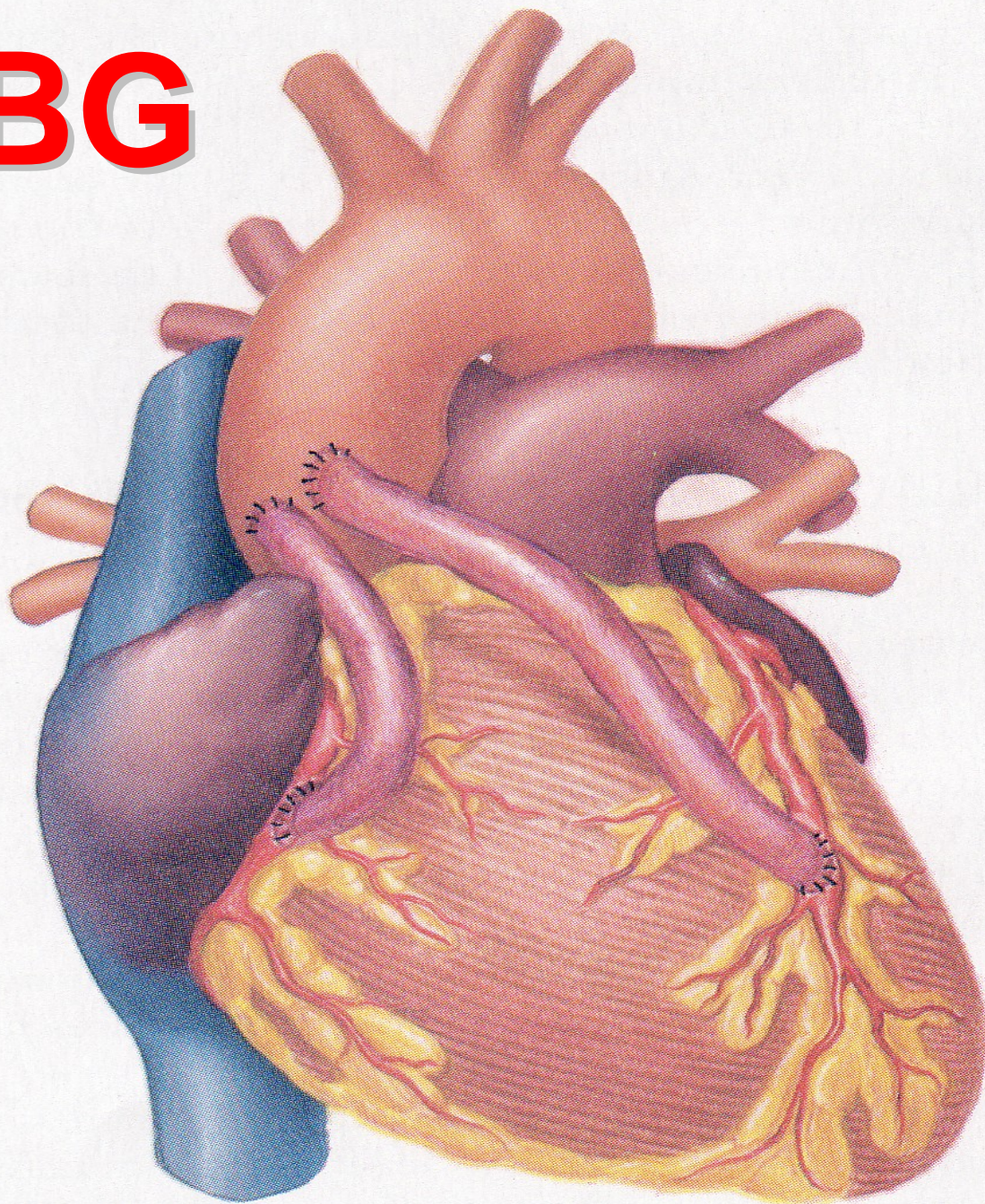
Drugs/Surgery



Exercise

***Dietary
Modification***

CABG





Healthy Oils to Minimize Atherosclerosis HAPOC?

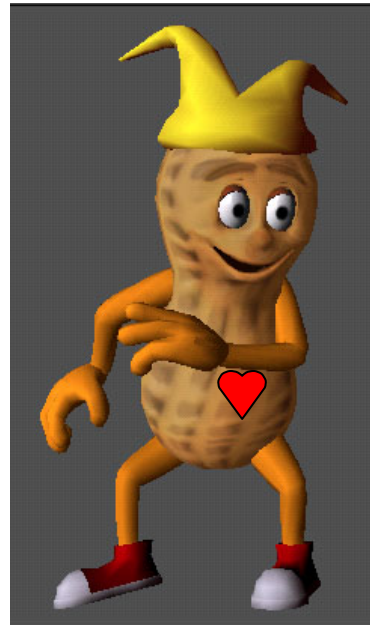
H



A



P



O



C



BI 121 Lecture 11



Fun lab today! Data for a lifetime!
Thanks for being prepared!

I. Lab 5 Review: Safety & Techniques Q?

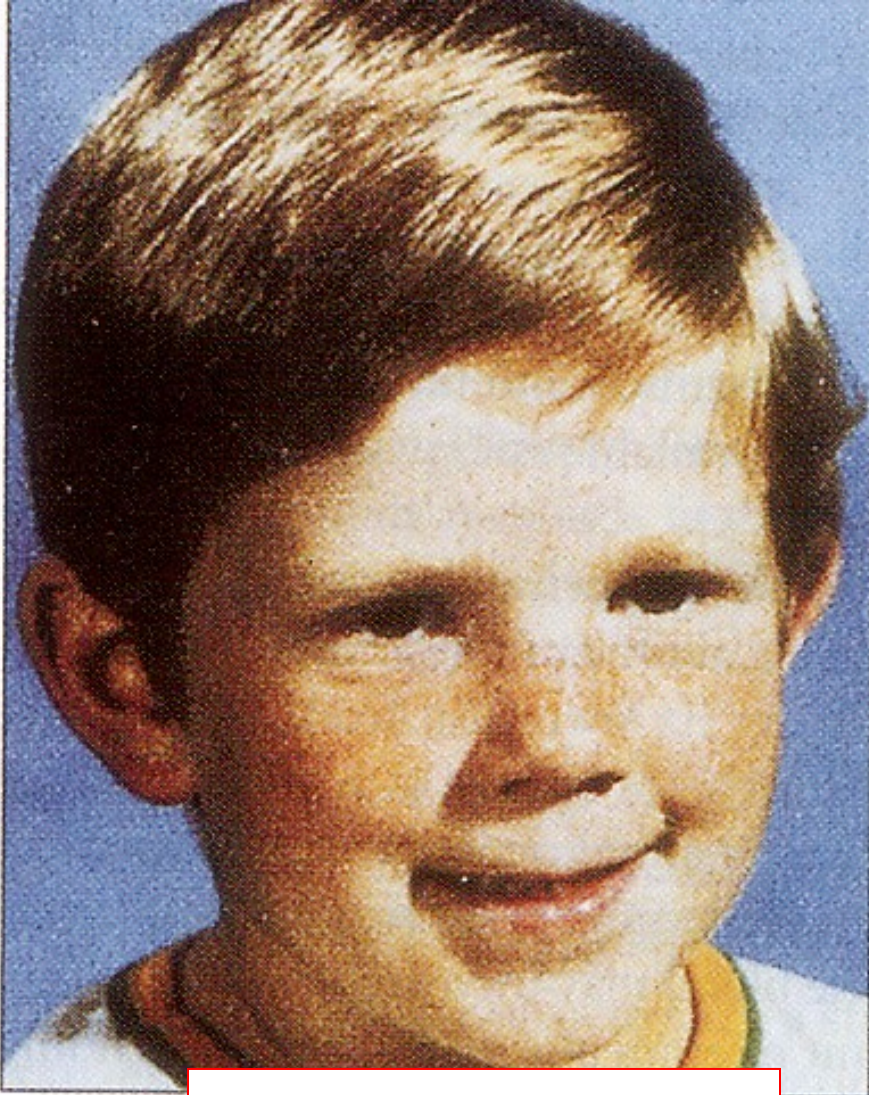
II. Introduction to Endocrinology LS ch 17, DC Module 13, SI Fox+

- 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

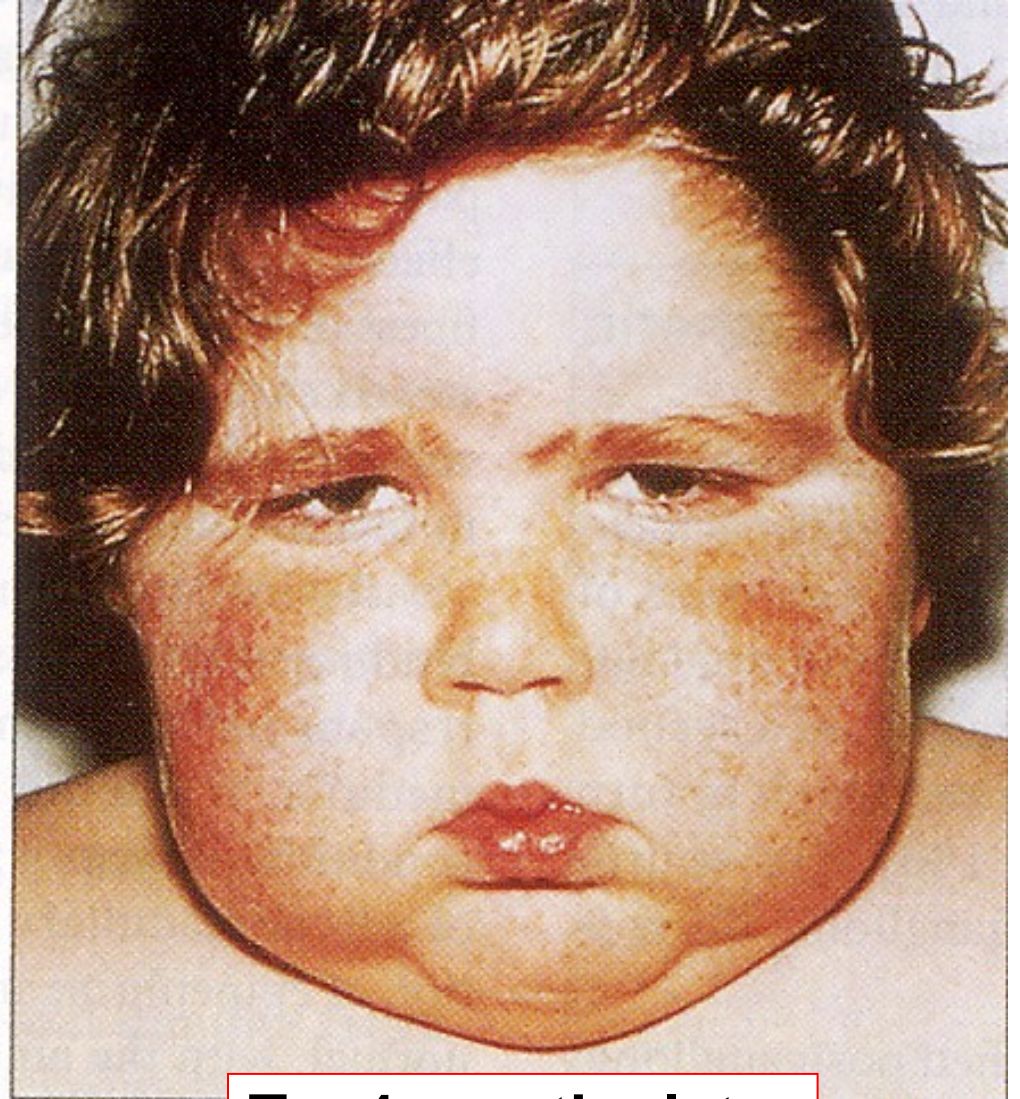
III. Nervous System & Excitable Cell Connections LS ch 5, 4, 7

- 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*
- E. Autonomic nervous system overview LS pp 178 – 85

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



T = 0, near normal

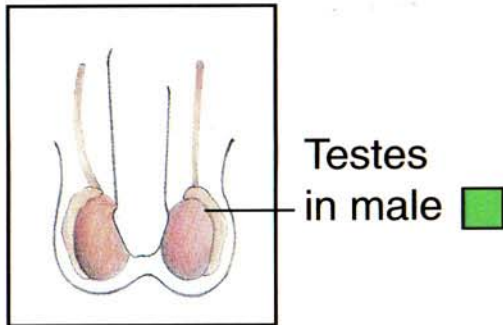
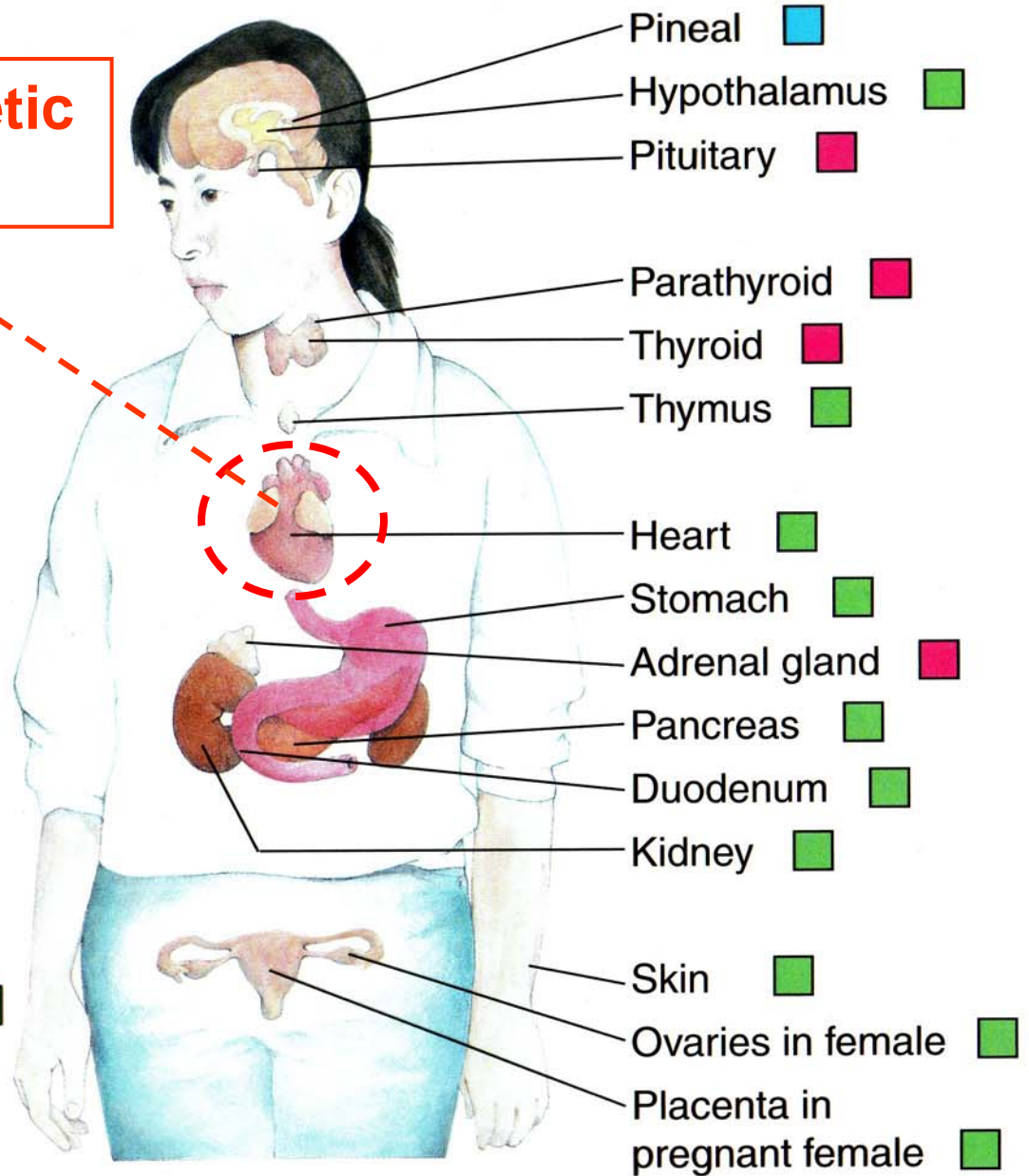


T = 4 months later

Endocrine System

ANP = Atrial Natriuretic Polypeptide

- Solely endocrine function
- Mixed function
- Complete function uncertain

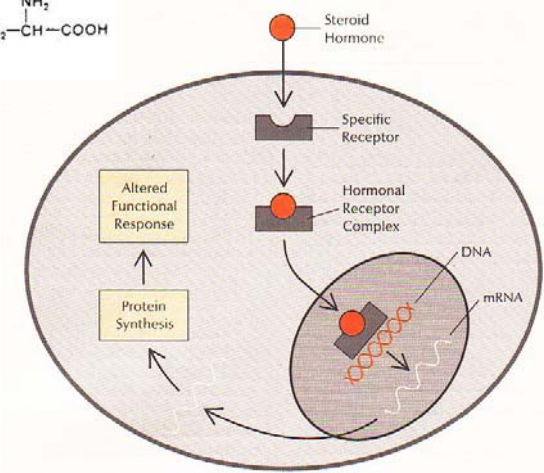
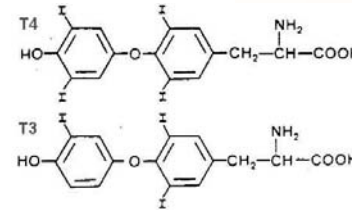
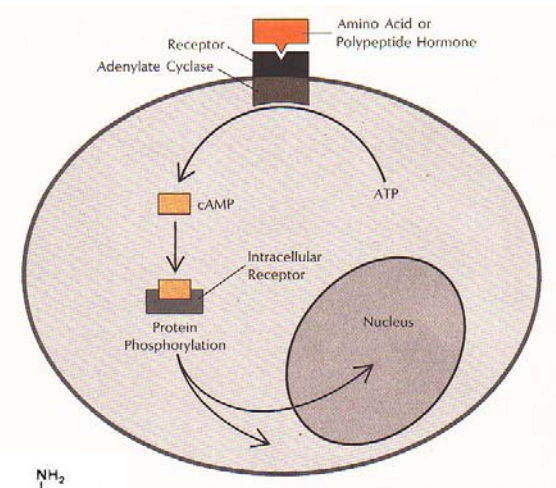


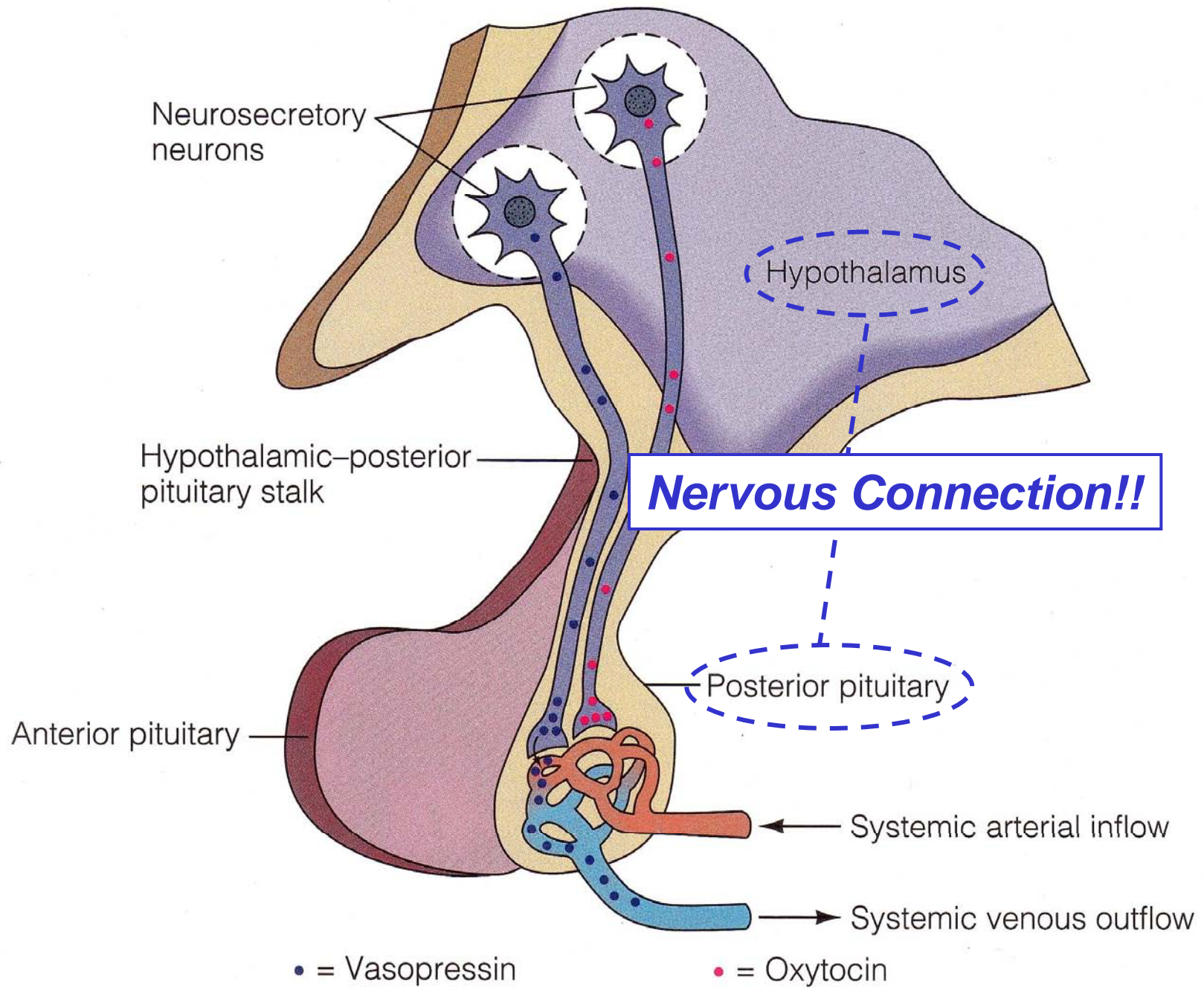
Hormone/Endocrine Classifications

Exogenous

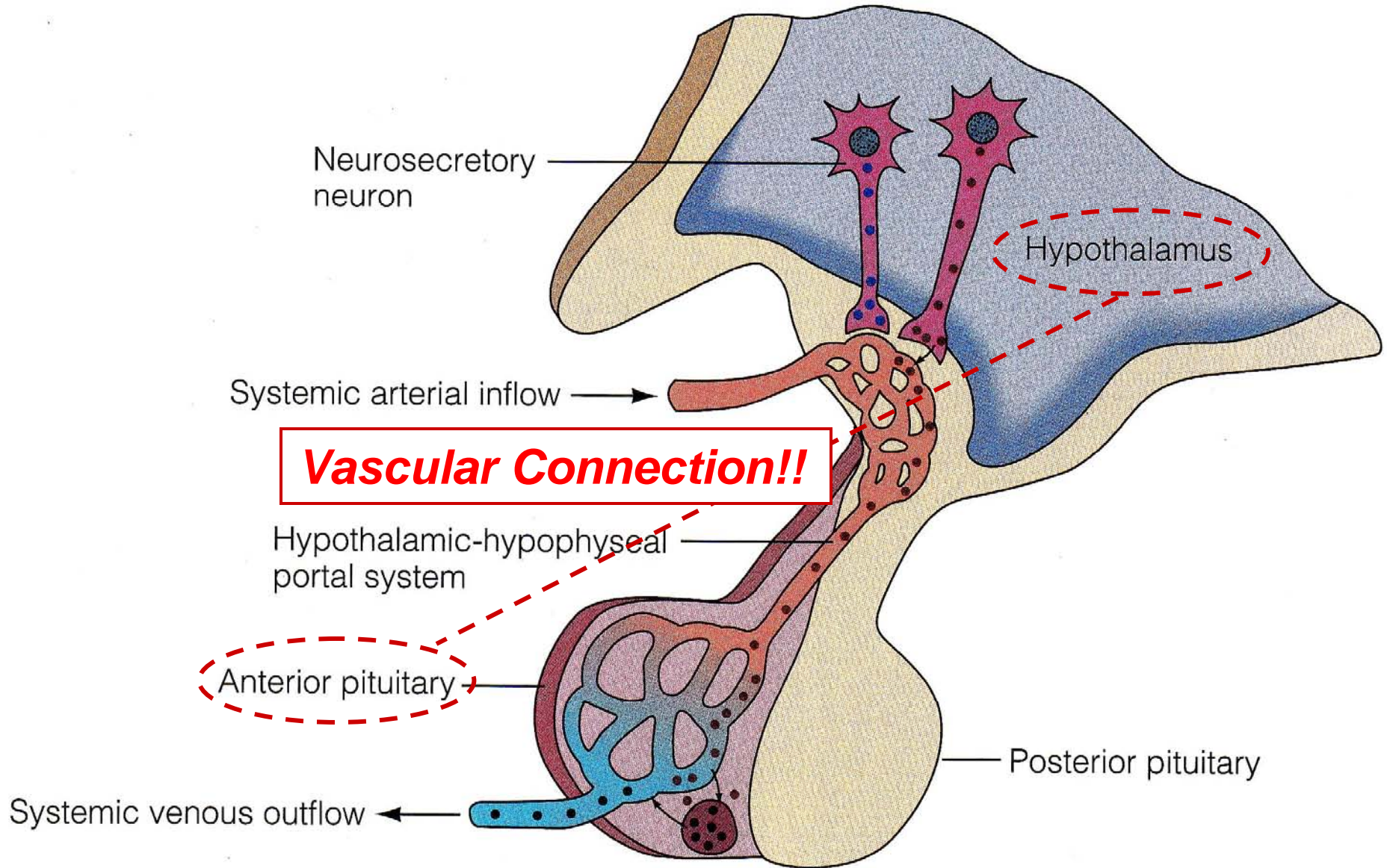


Endogenous



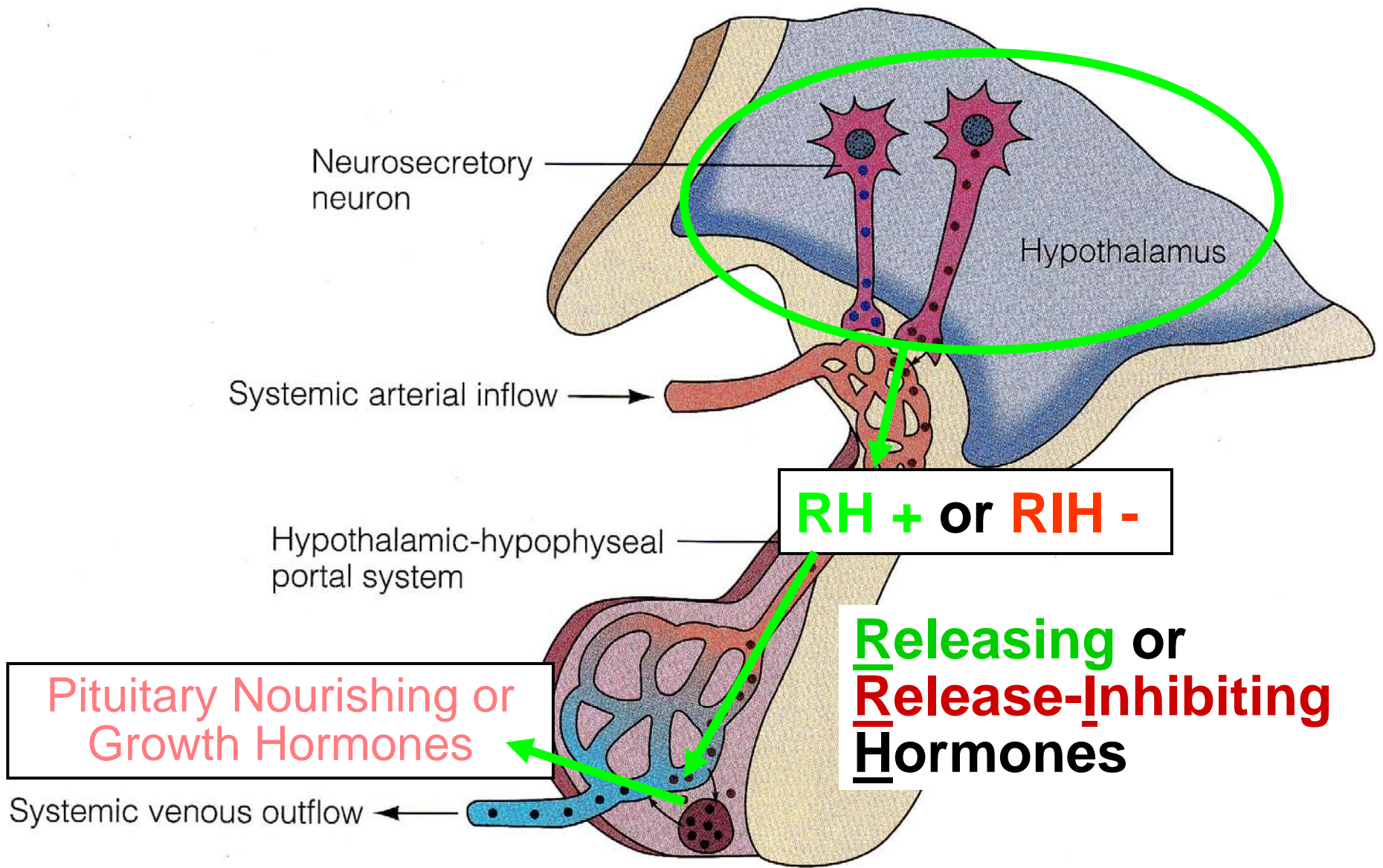


Hypothalamus-Anterior Pituitary Vascular Connection!



• = Hypophysiotropic hormones

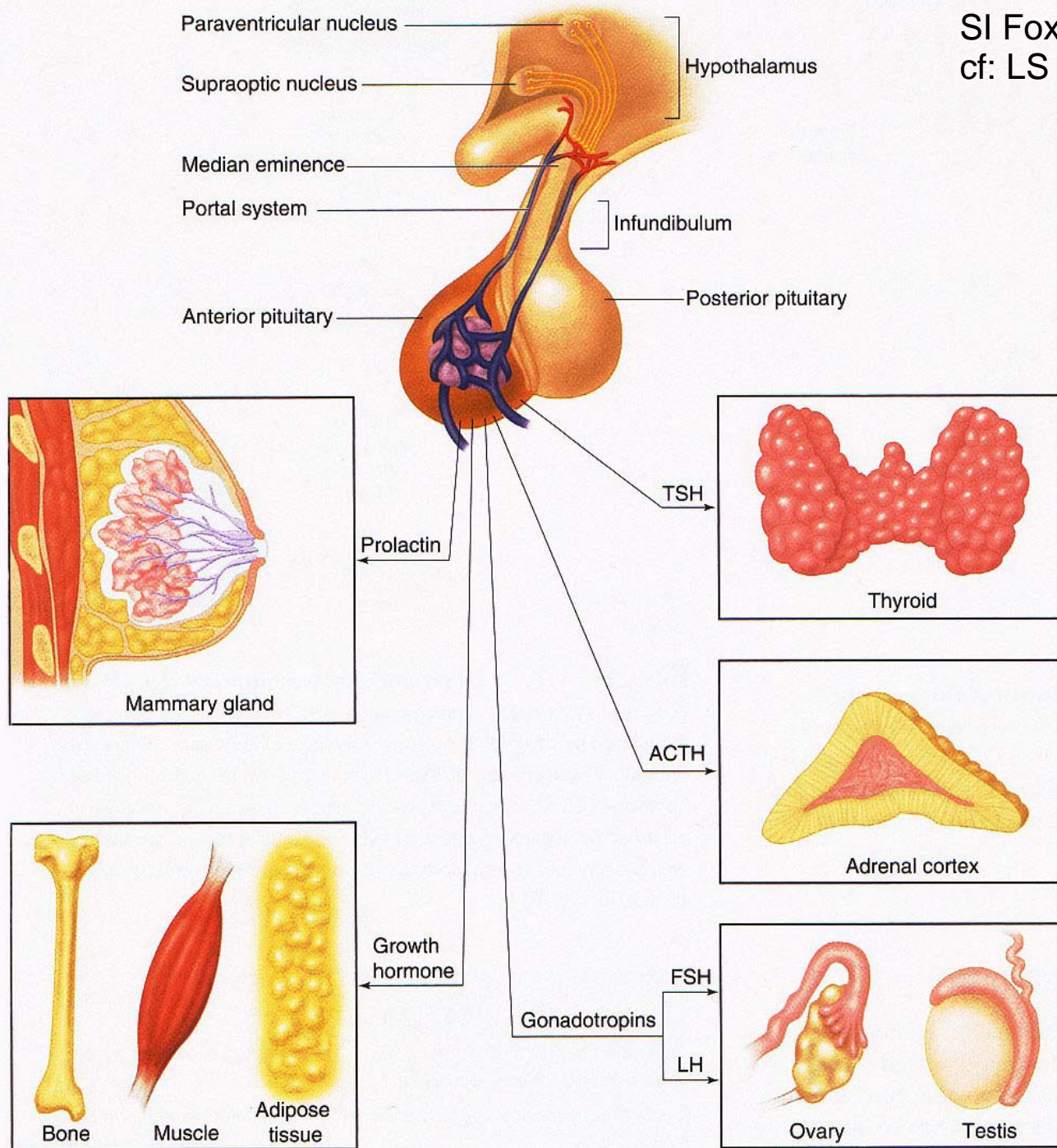
• = Anterior pituitary hormone



- = Hypophysiotropic hormones
- = Anterior pituitary hormone

Hypophysis ≡ Pituitary

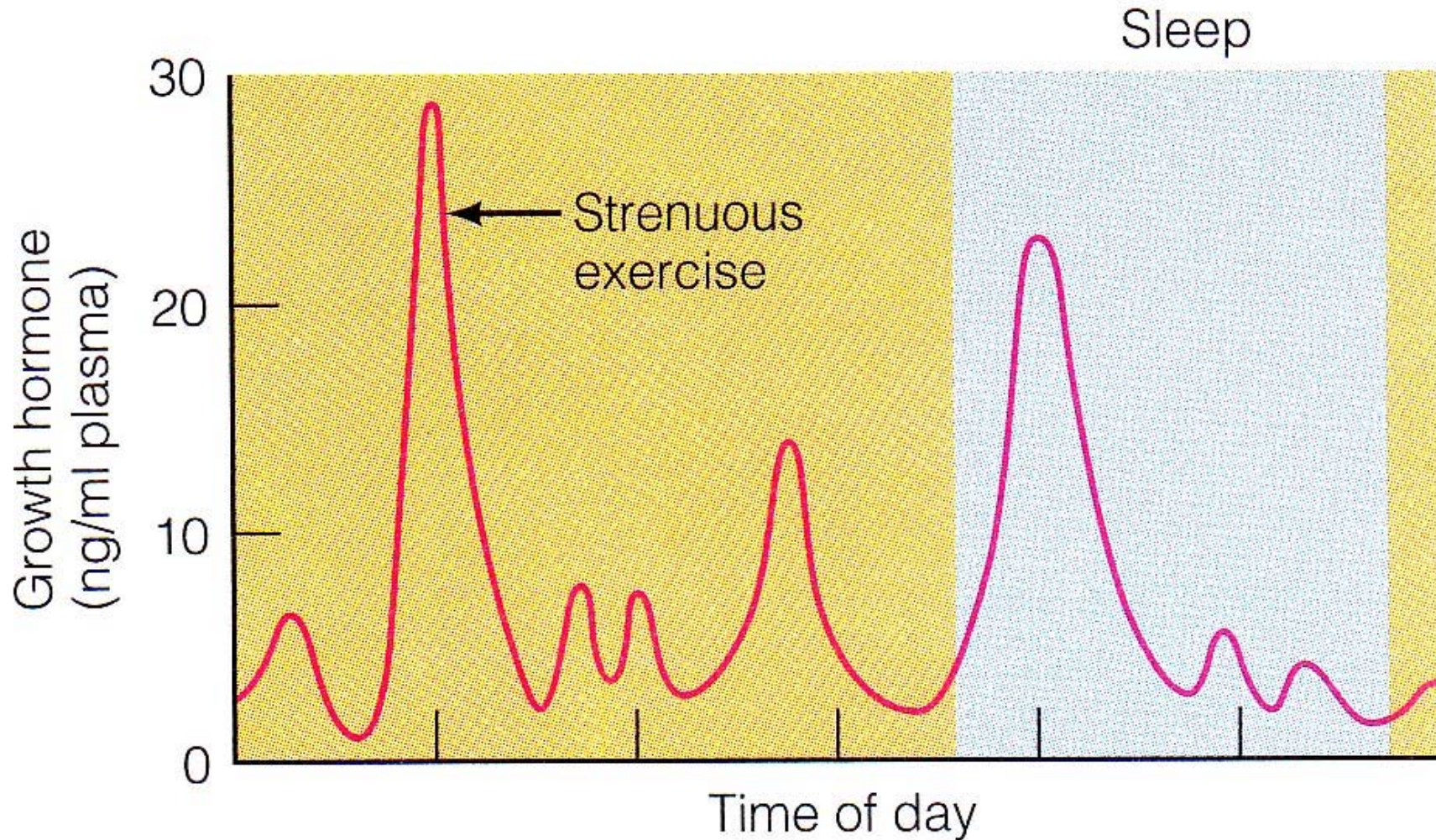
SI Fox 2008
cf: LS 2012 fig 17-5



GH/STH Effects: Insulin Resistance/Type II Diabetes?

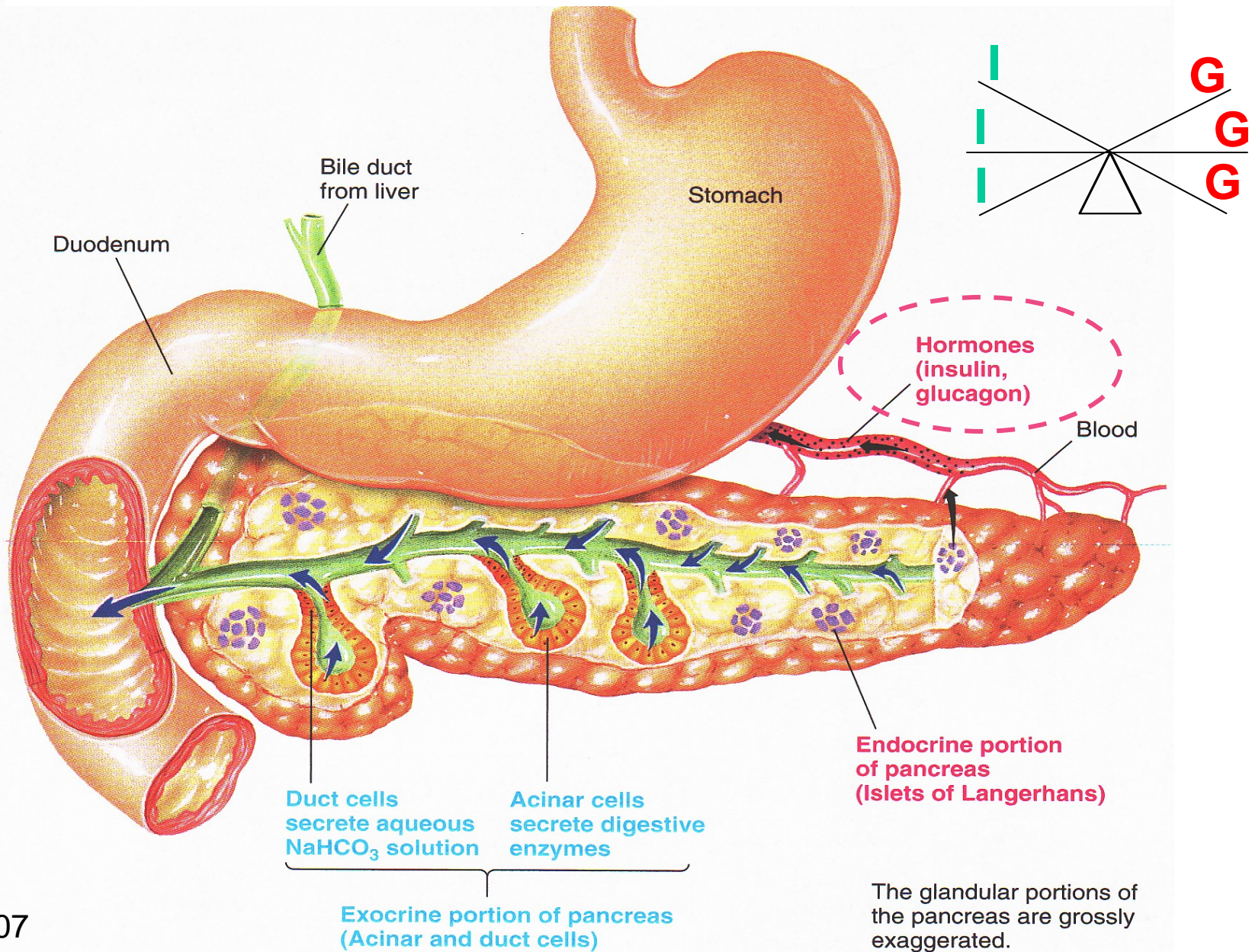
- ↑ Amino Acid uptake & Protein synthesis
- ↑ Lipolysis & Fatty Acid mobilization
- ↓ Glucose uptake
(skeletal muscle & adipocytes)
- ↑ Glucose production
(liver glycogenolysis)
- ↑ Insulin secretion

Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per milliliter

Endocrine Pancreas: Insulin (I) & Glucagon (G) See-Saw Hormones in Regulating Blood Glucose



The glandular portions of the pancreas are grossly exaggerated.

Glucose:
Sugar in Blood



Normal: 70-99

Pre-Diabetes: 100-125

Diabetes: ≥ 126 mg/dL

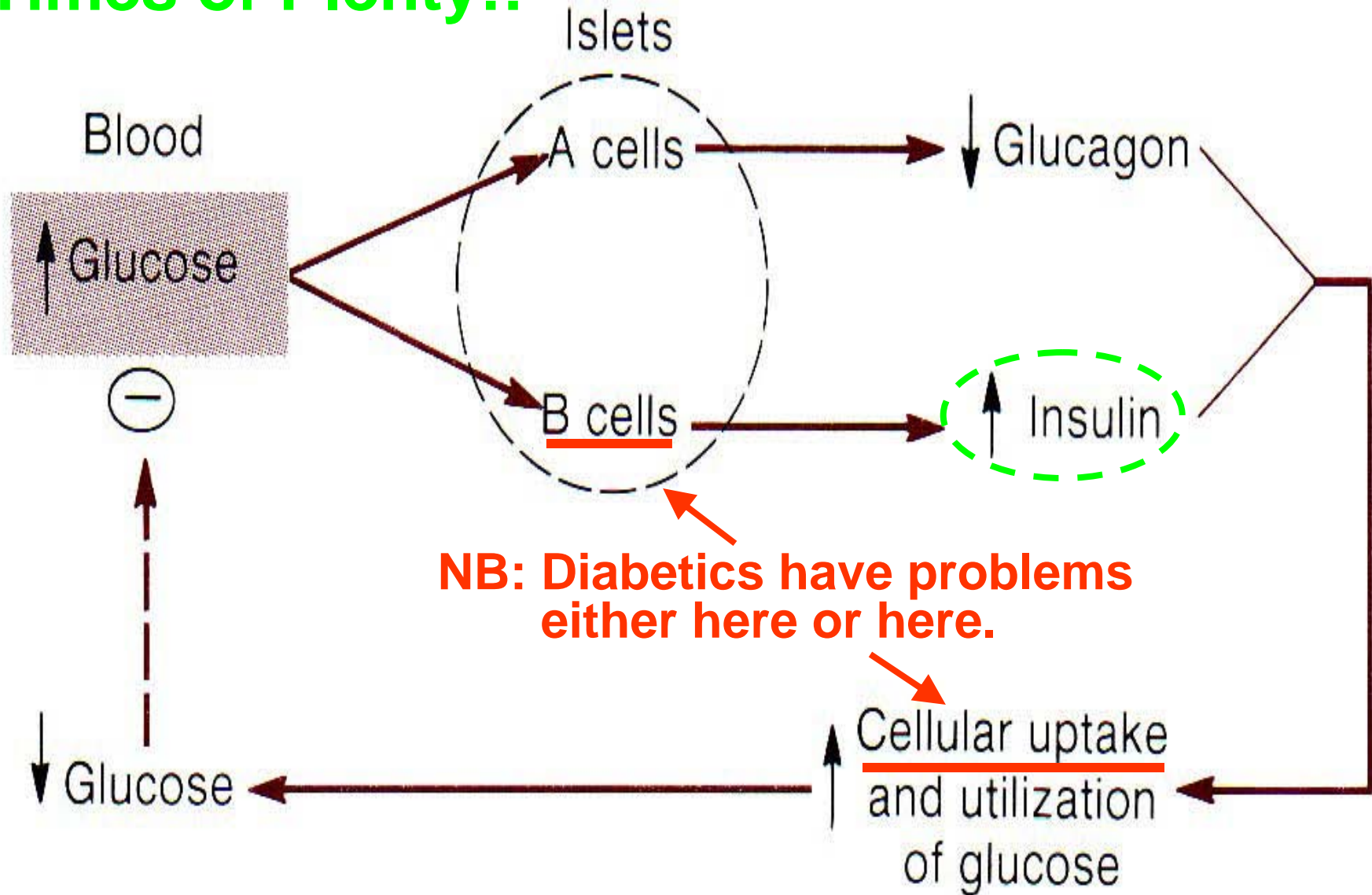
TABLE
4-7

Warning Signs of Diabetes

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

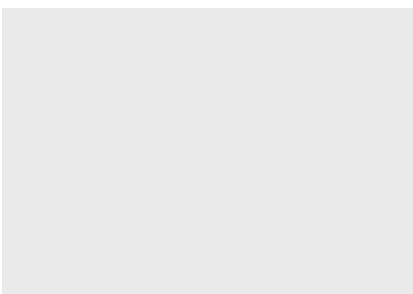
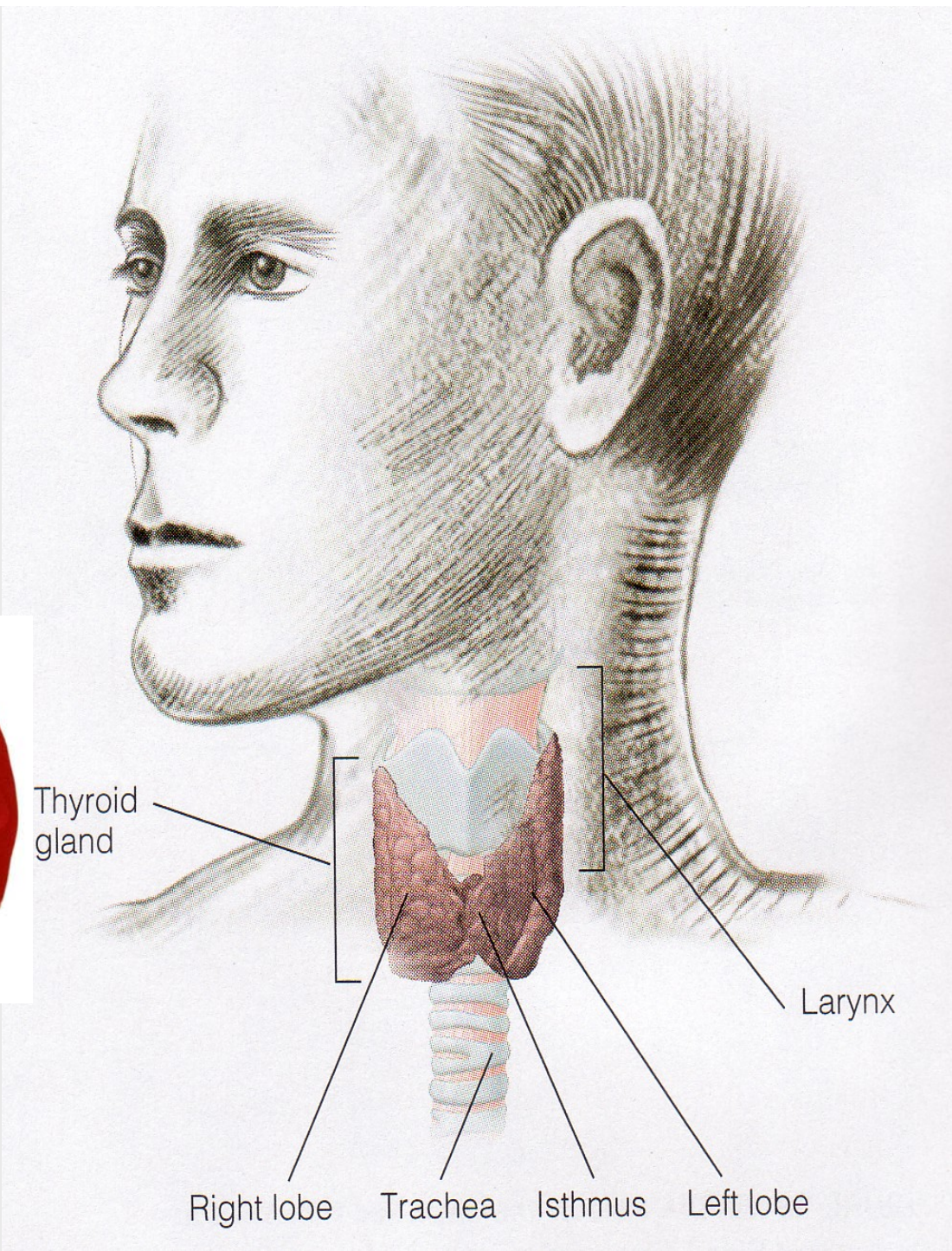
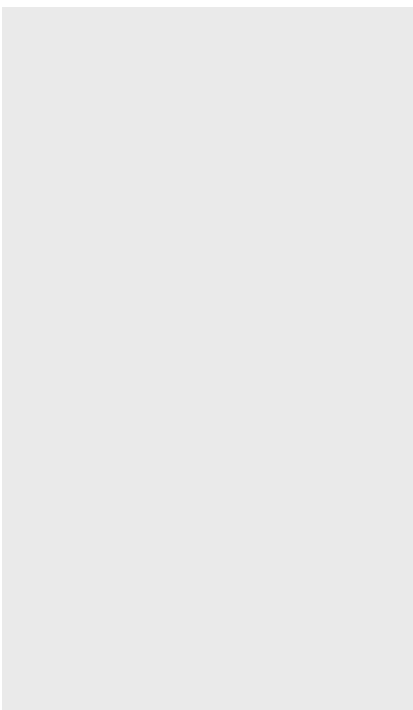
- Excessive urination and thirst
- Glucose in the urine
- Weight loss with nausea, easy tiring, weakness, or irritability
- Cravings for food, especially for sweets
- Frequent infections of the skin, gums, vagina, or urinary tract
- Vision disturbances; blurred vision
- Pain in the legs, feet, or fingers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

Times of Plenty!!

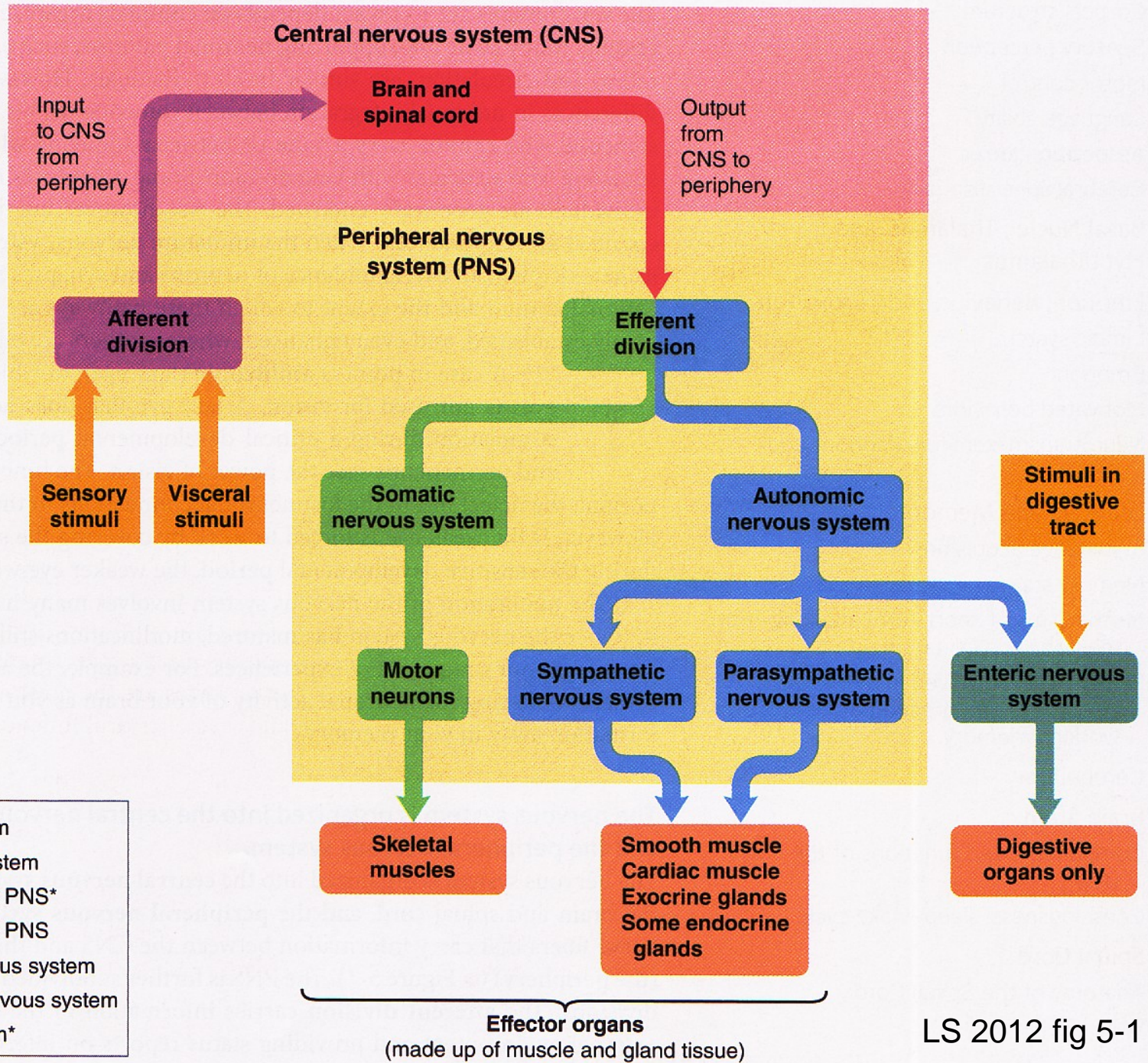
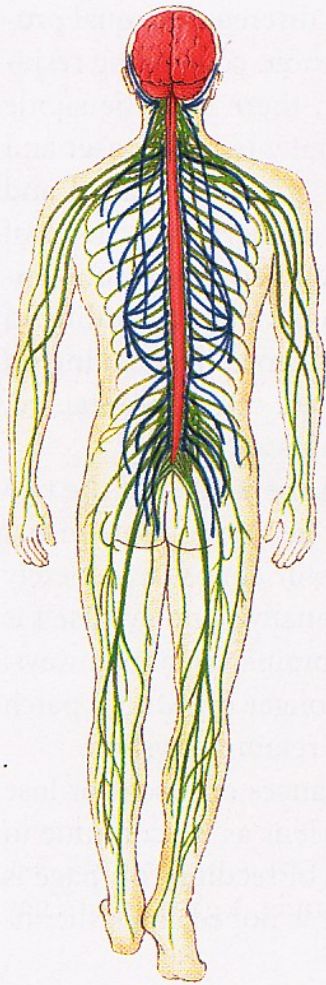


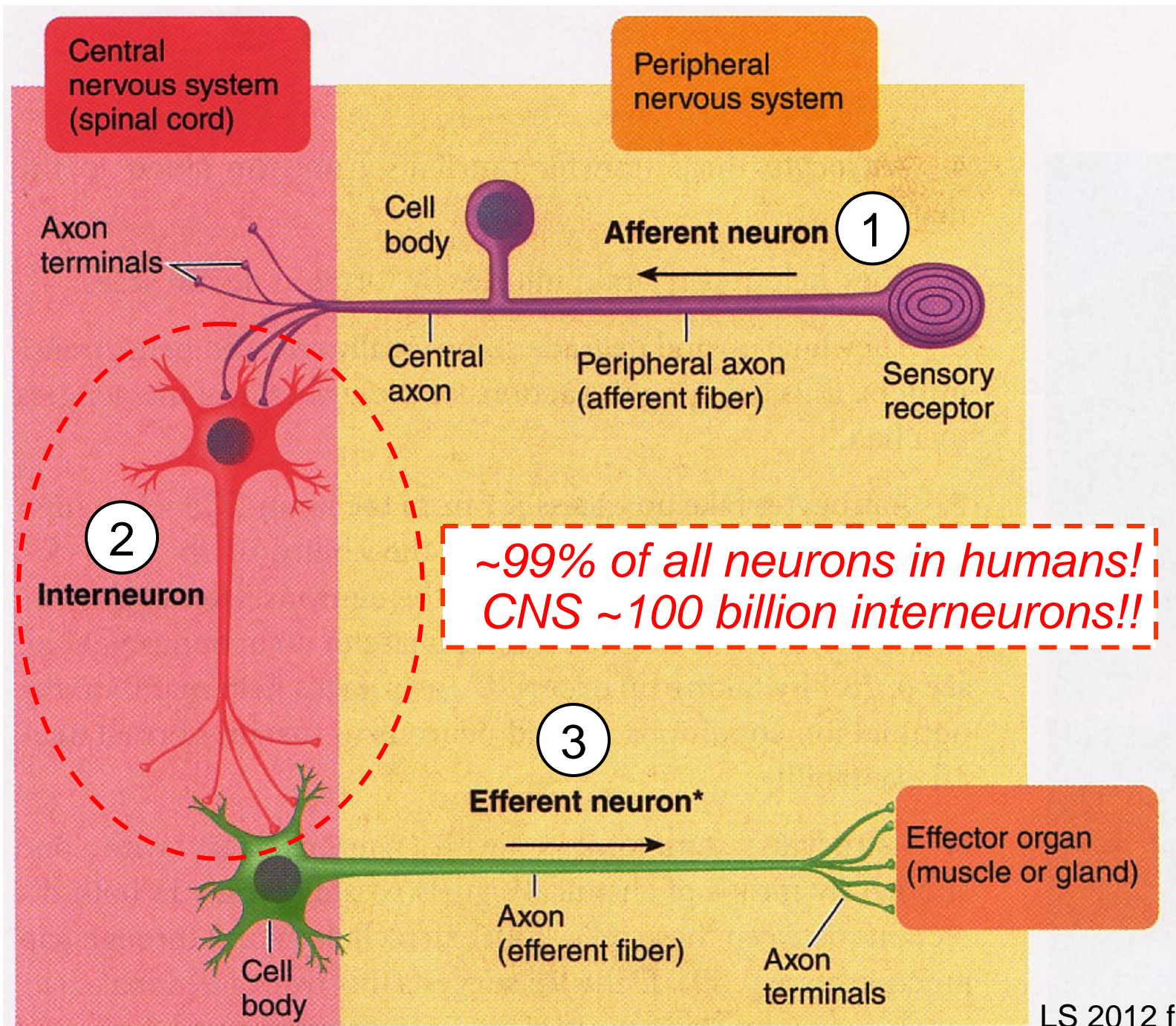
Like others, diabetics benefit from whole grains, vegetables, fruits, legumes & non-/low-fat milk products!



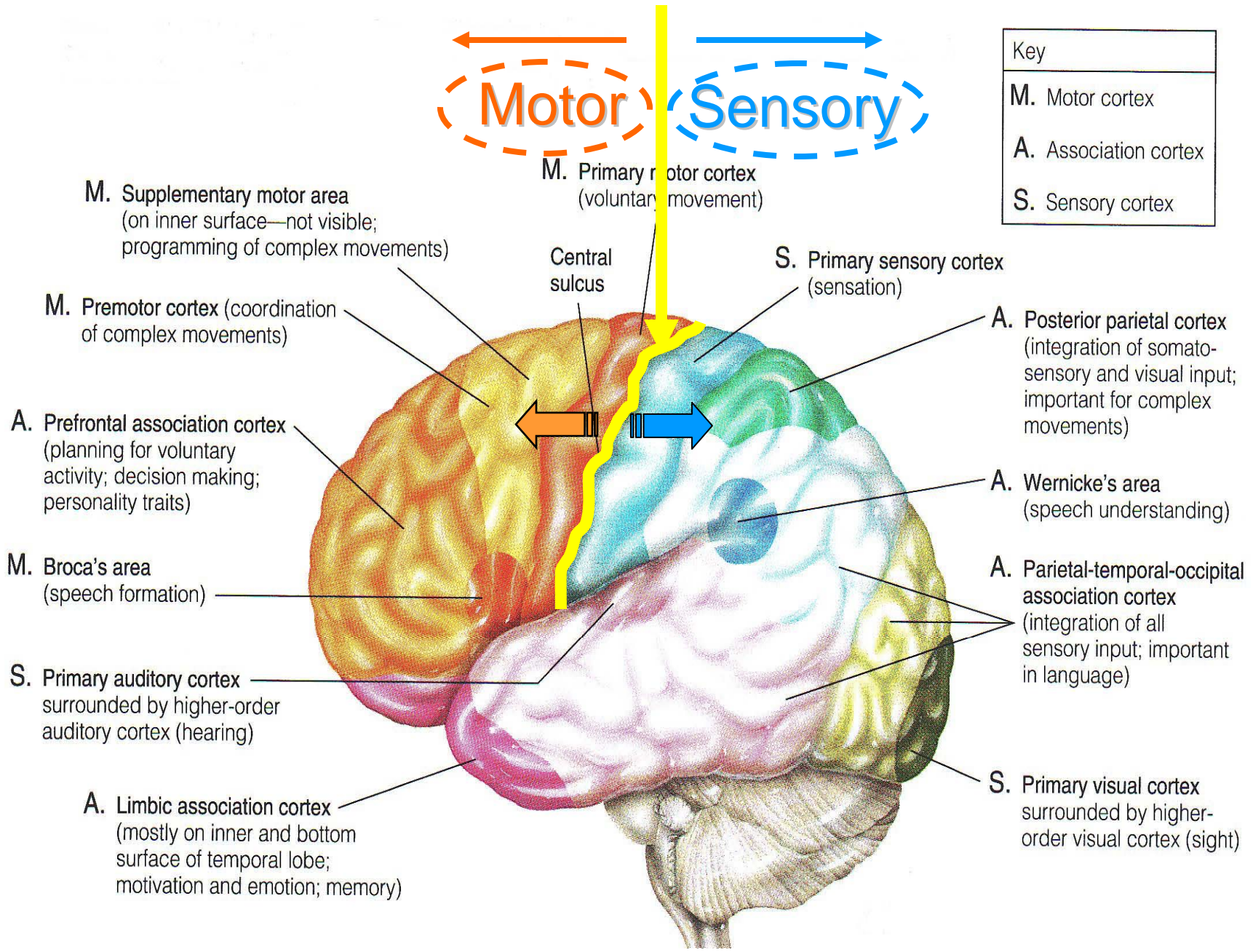








LS 2012 fig 5-2



LS 2006, cf: LS 2012 fig 5-8a



Helmets Cheap, Brains Expensive!! Use Your Head, Get a Helmet!!



<http://www-nrd.nhtsa.dot.gov/pubs/811156.pdf>

<http://www.bhsi.org/stats.htm>

~540,000 bicyclists/yr visit emergency rooms

67,000 head injuries, 1 in 8 brain injuries

716 cyclists died in 2008 \equiv 2% of all traffic fatalities

1/2 of deaths children < 15 yr

53,000 cyclists have died since 1932

that's more than the population of

Springfield, OR 52,864

Bend, OR 52,029

Corvallis, OR 49,322



Bicycle crashes & injuries are under reported,
since majority not serious enough for ER visits.

Helmets may prevent 45-88% of brain injuries!

~\$81 million/yr = direct injury costs from not using helmets!

BI 121 Lecture 12 **Thanks for your help with the blood chemistry lab!...** 

- I. Announcements Optional notebook check + Lab 6 tomorrow. Pulmonary Function Testing. Final exam > your Q on Wed. Q?
- II. Autonomic Nervous System Overview LS pp 178 – 85
LS Table 7-1 p 183 + stories to remember **fight-or-flight!**
- III. 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? Ca^{2+} 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
- IV. 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...

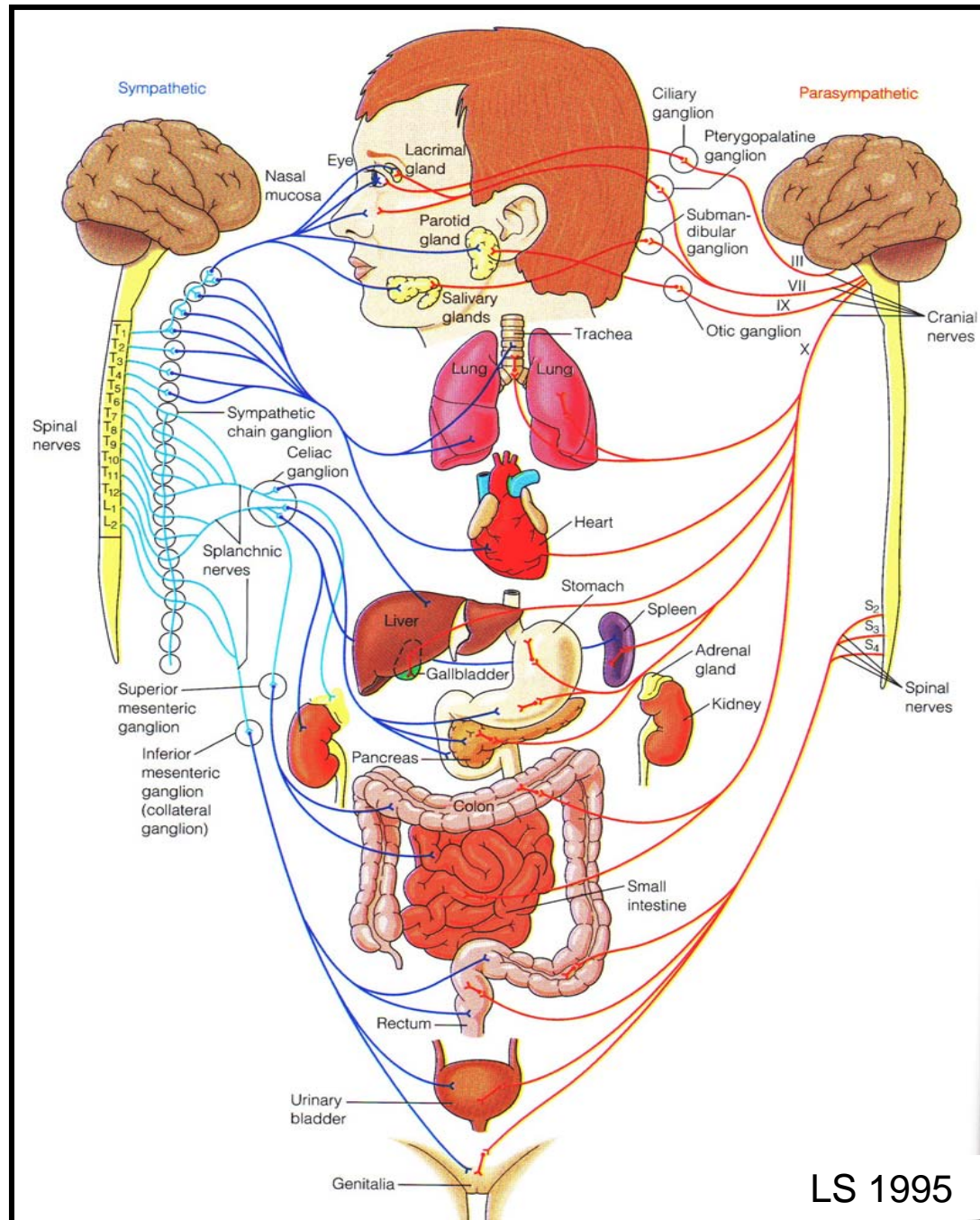


Autonomic Nervous System

Why overlap or dual innervation?

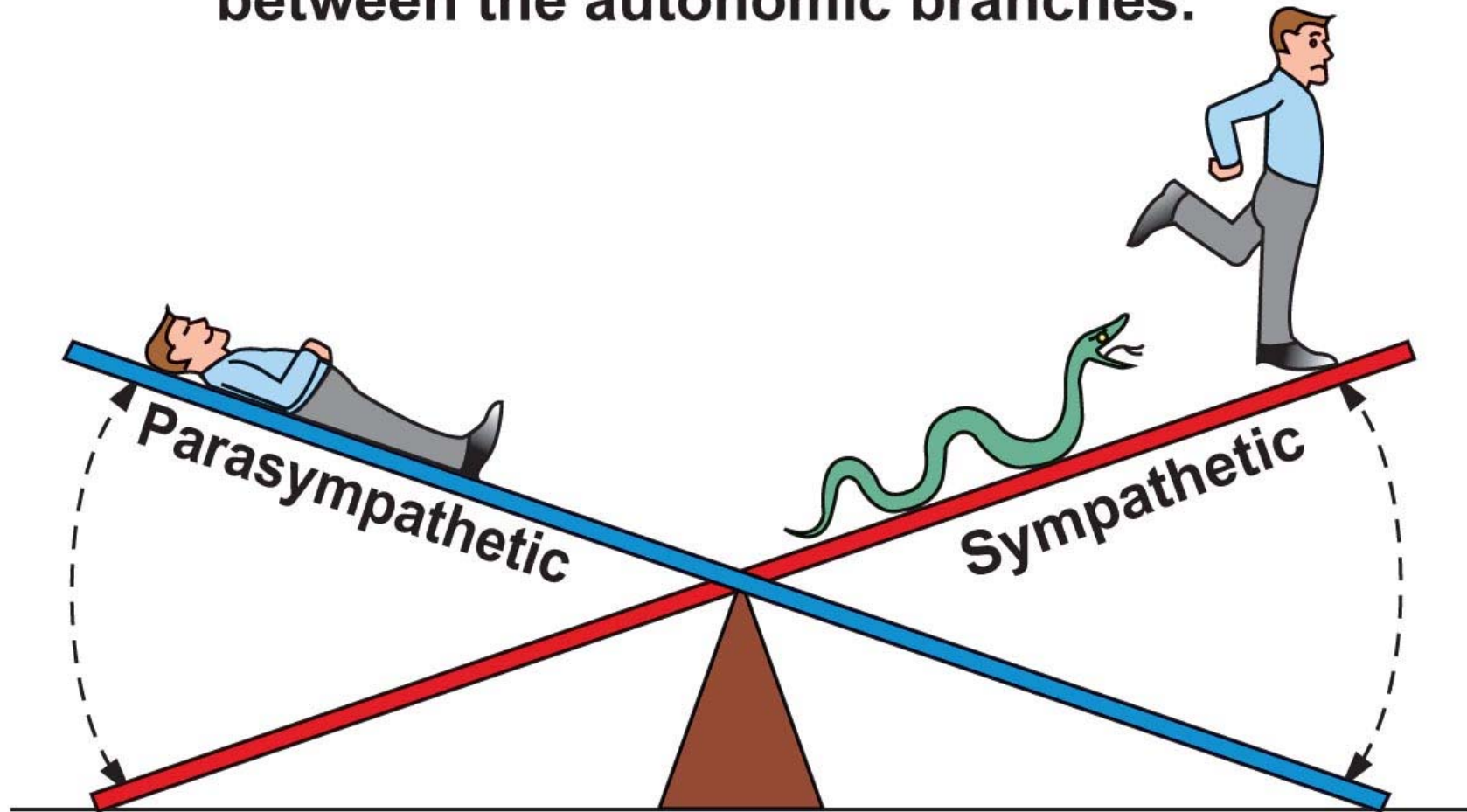
Fine-tune control & safety!

cf: LS 2012 fig 7-3



LS 1995

Homeostasis is a dynamic balance between the autonomic branches.



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

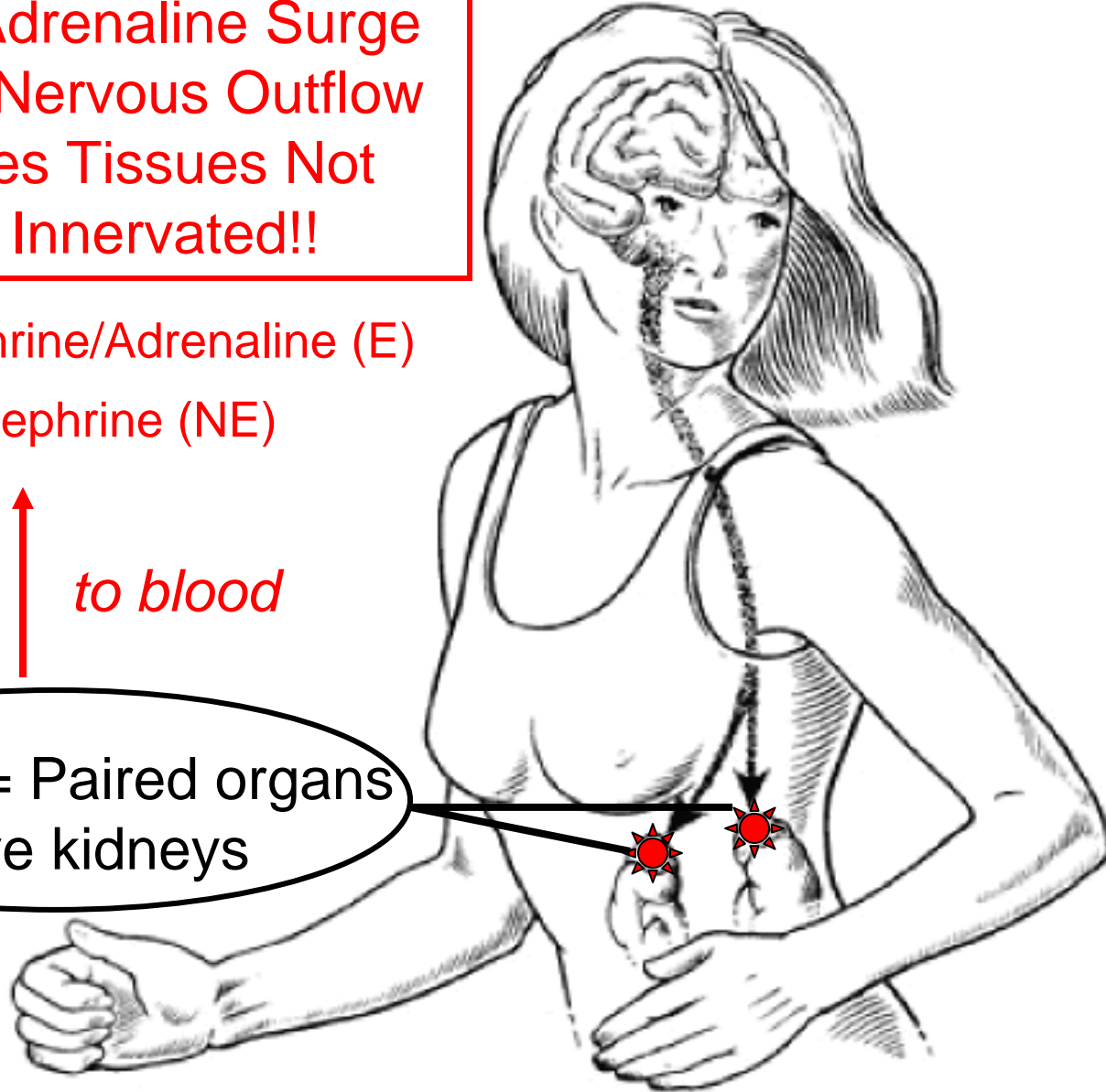
**Fight-or-flight:
Sympathetic activity
dominates.**

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

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

Output ↑ *to blood*

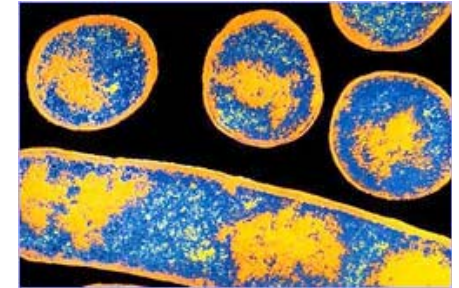
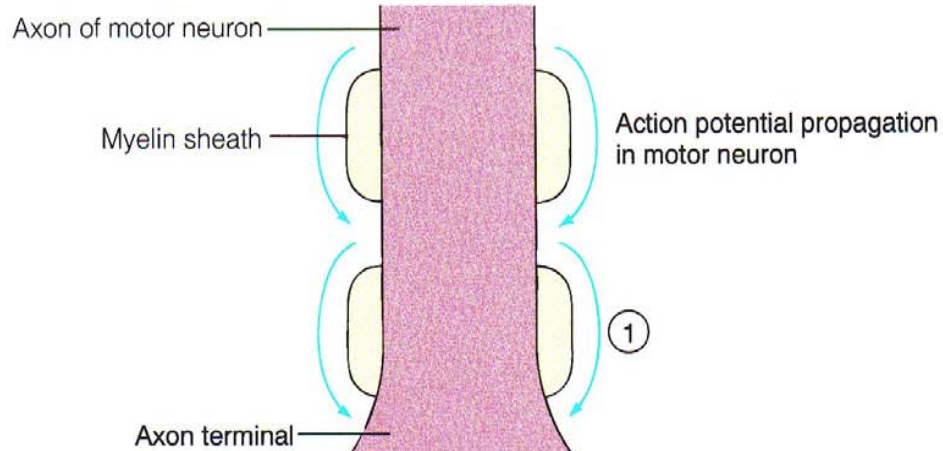
Adrenals = Paired organs
above kidneys



▲ **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

↑ 3



~~3~~



Terminal button

Axon terminal

Ca²⁺

Calcium channel

Vesicle of acetylcholine

Action potential propagation in muscle fiber

Plasma membrane of muscle fiber

Acetylcholine receptor site

Cation channel

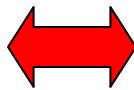
Acetylcholinesterase

Muscle fiber

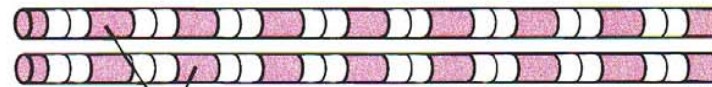
Local current flow between depolarized end plate and adjacent membrane

Motor end plate

~~7~~



4

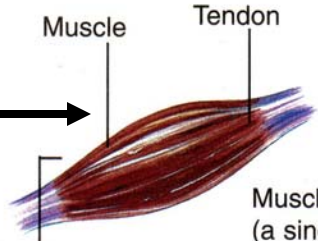


Contractile elements within muscle fiber

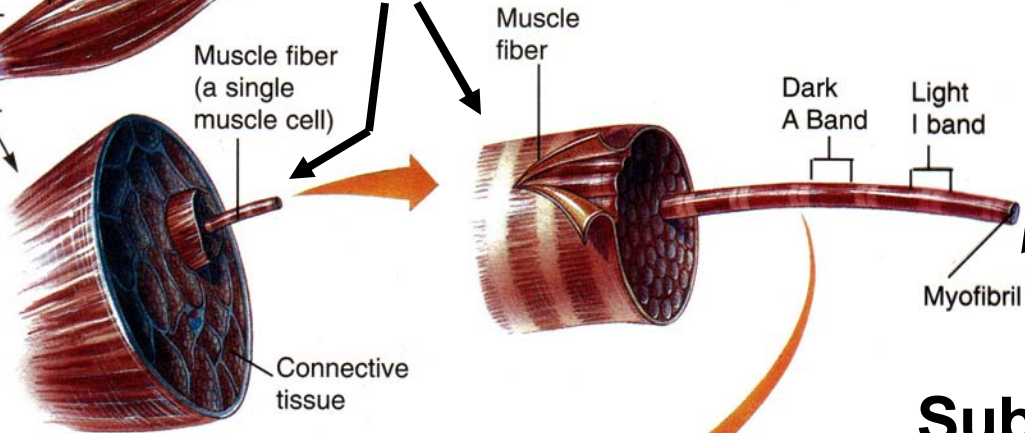


Dept. of Defense/Helene C. ...

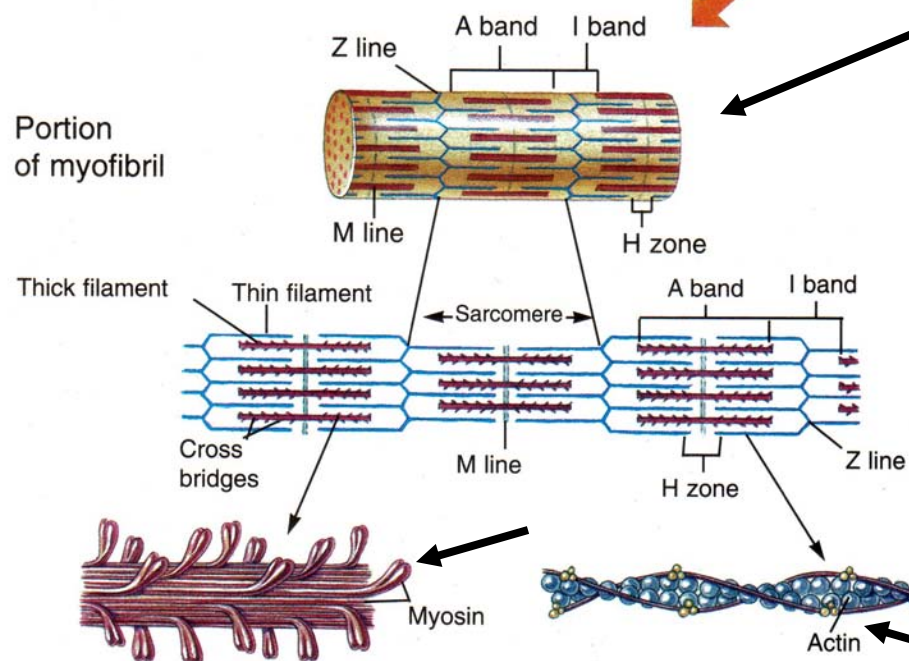
**Organ =
Muscle**



Cell = Myocyte = Fiber

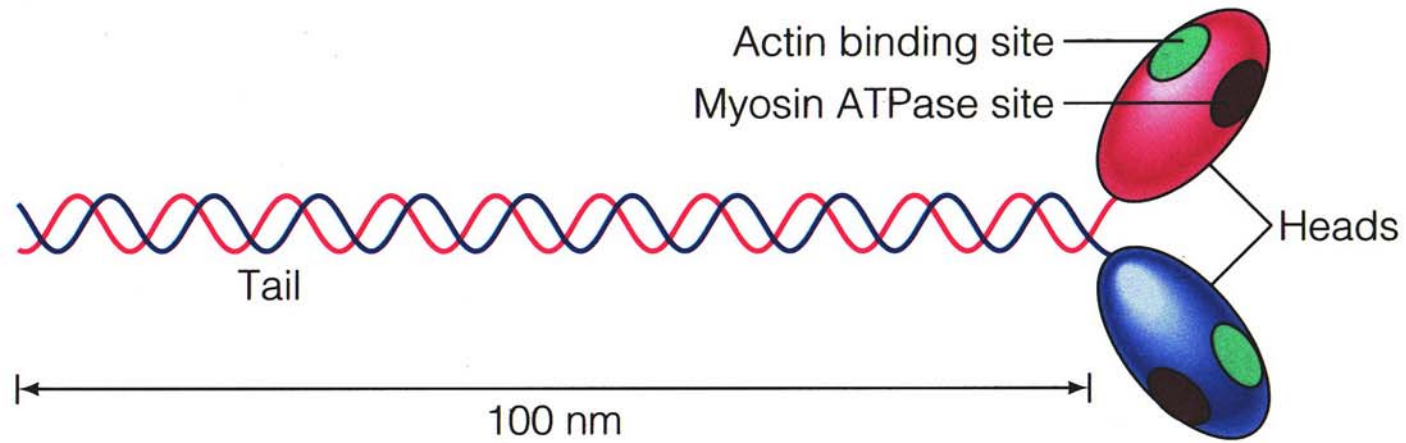


**Subcellular =
Cytoskeleton**



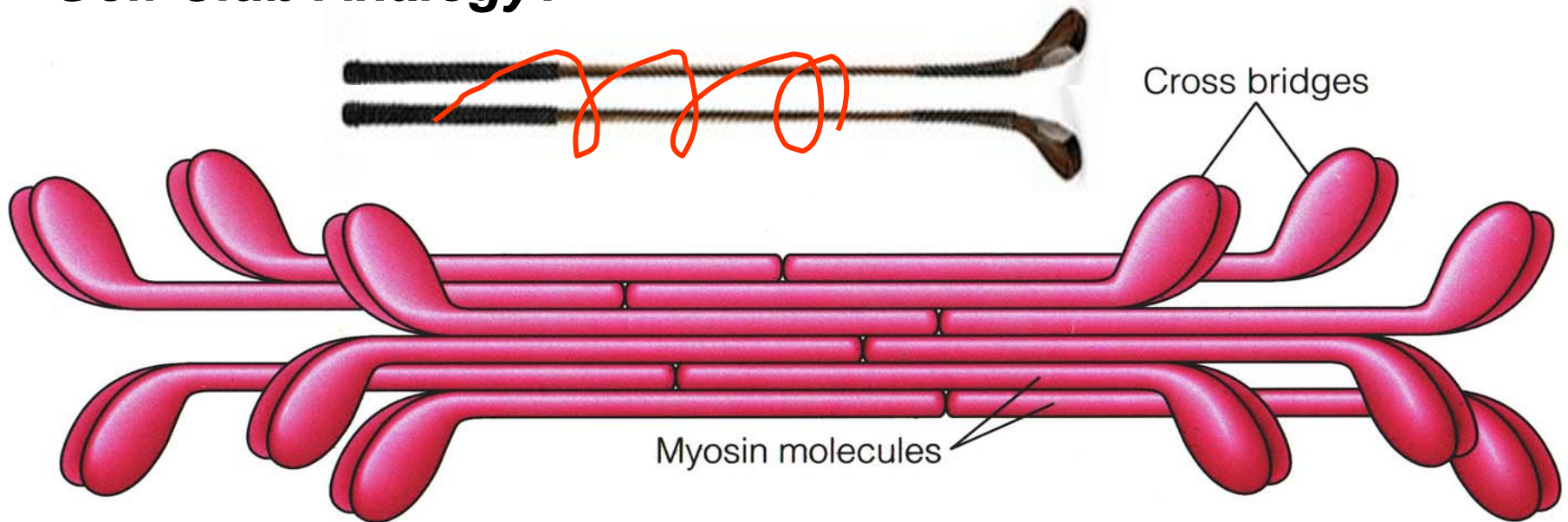
**Molecules =
Actin & Myosin**

LS 2006, cf:
LS 2012 fig 8-2

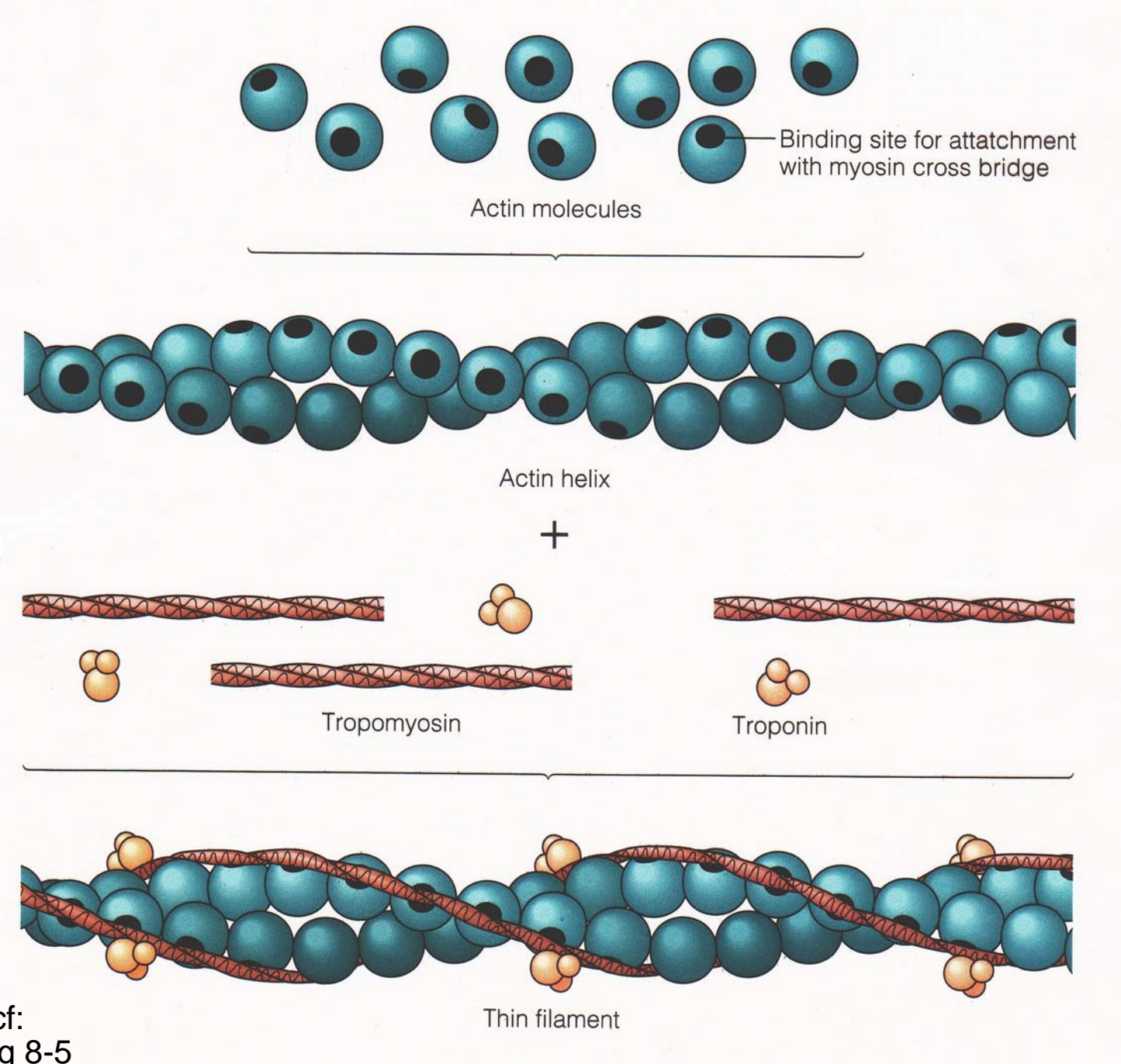


(a)

Golf Club Analogy?



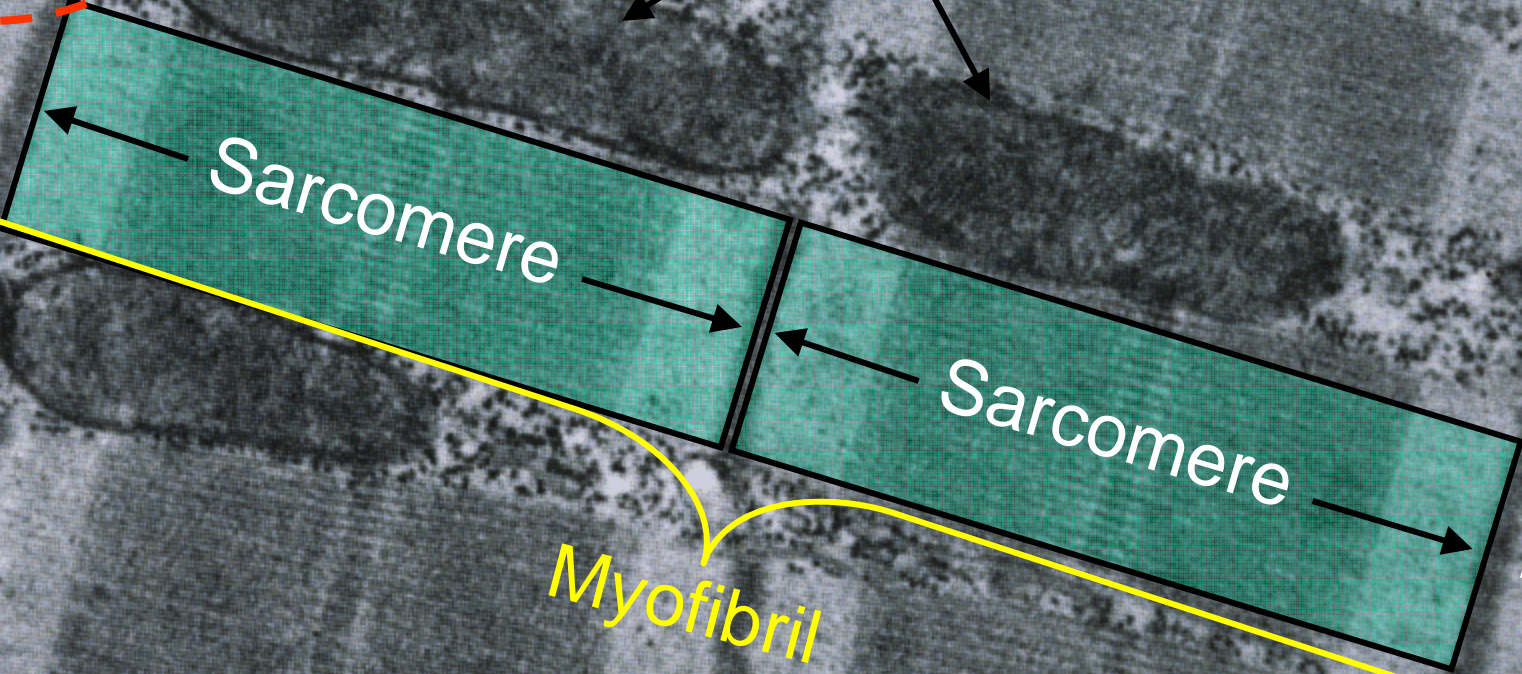
(b)

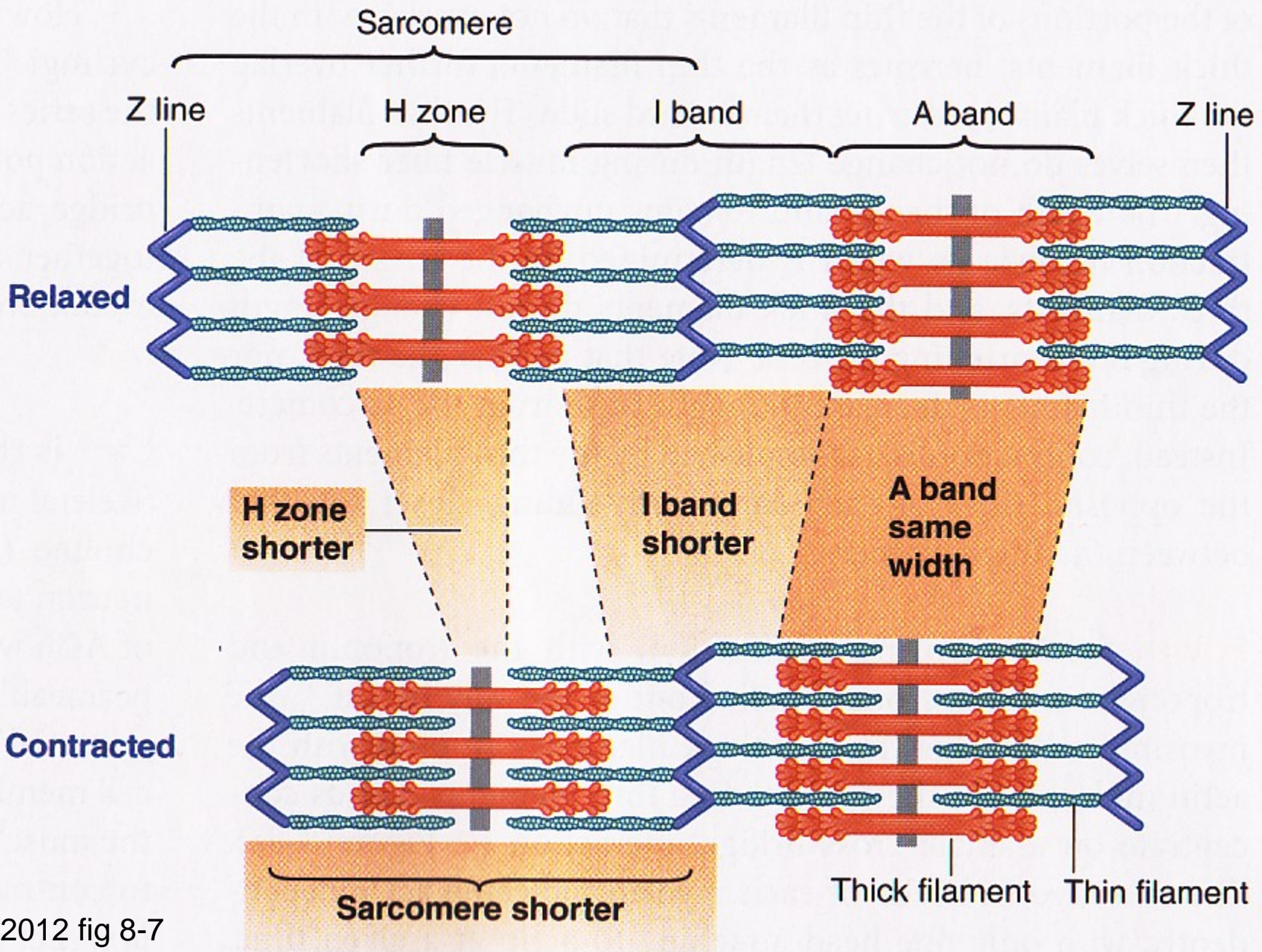


LS 2006, cf:
LS 2012 fig 8-5

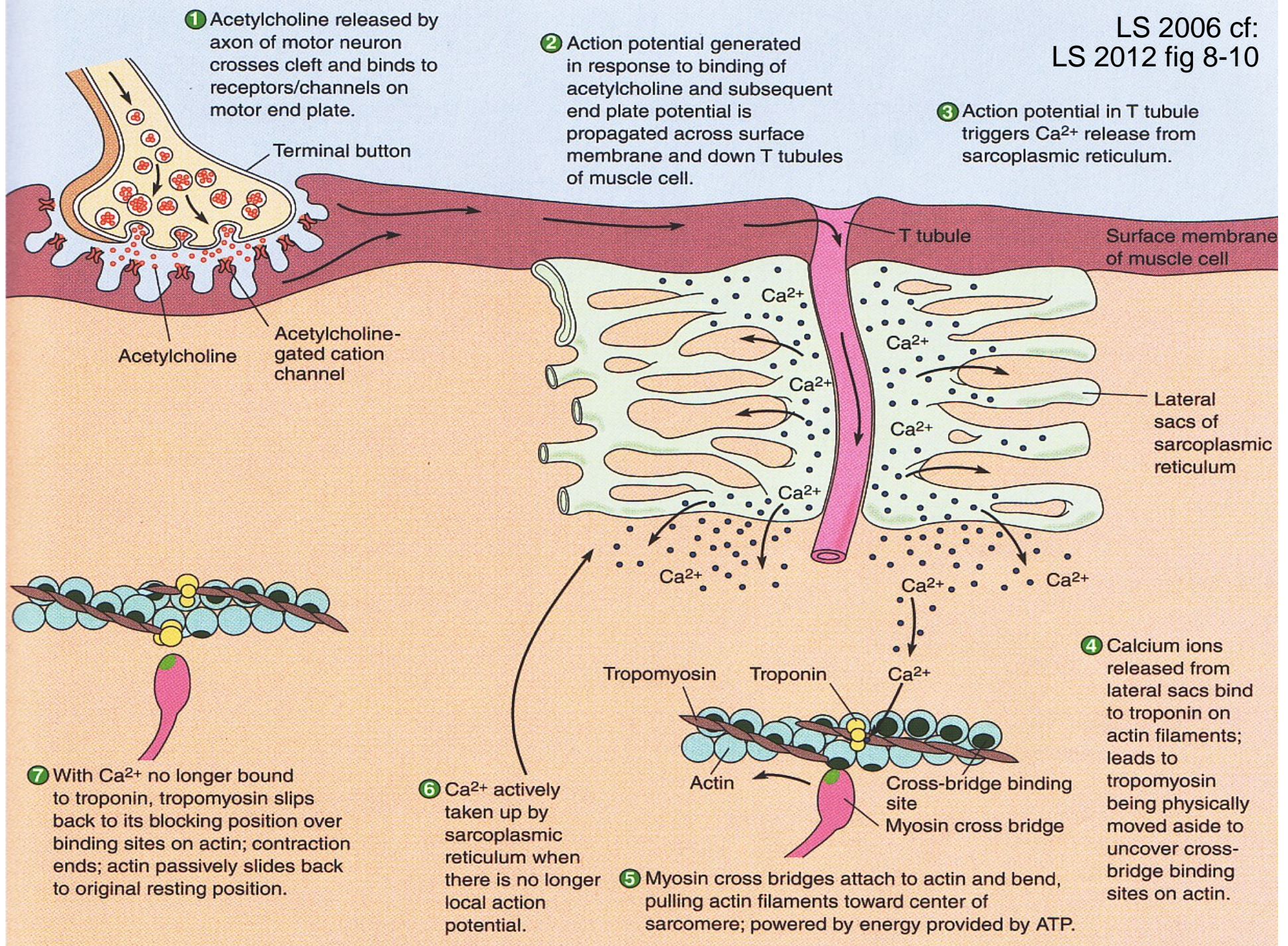
Triad \equiv T tubule abutting cisternae

Mitochondria



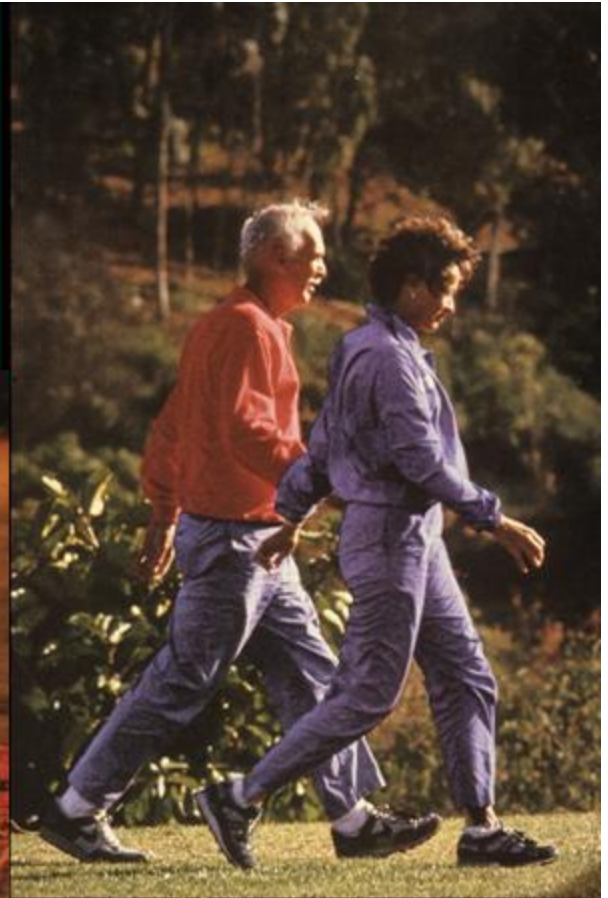
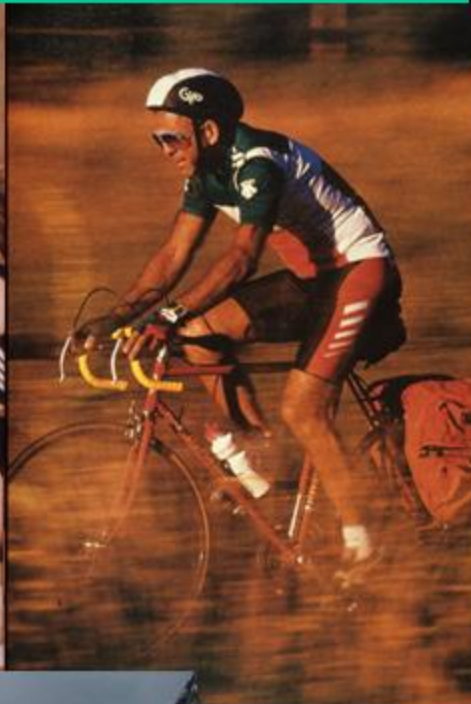


LS 2012 fig 8-7

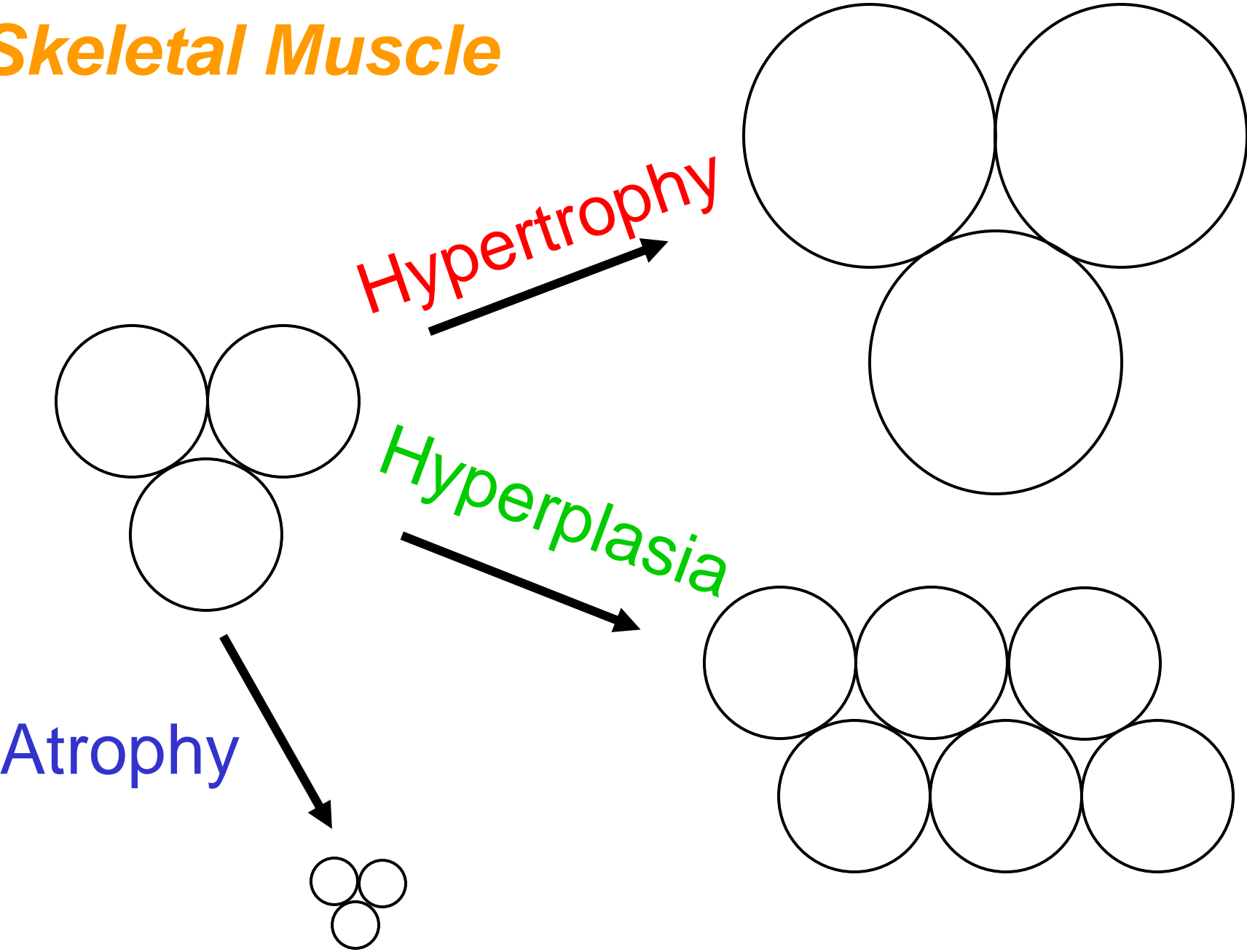


Adaptations to Exercise?

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

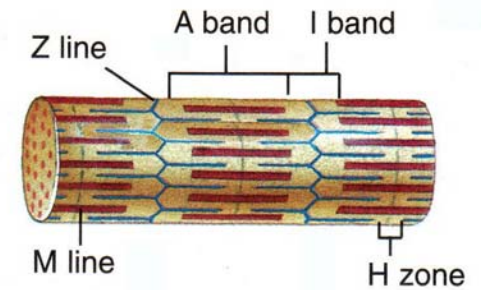


Skeletal Muscle

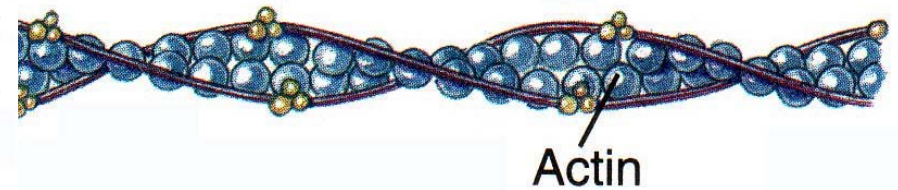
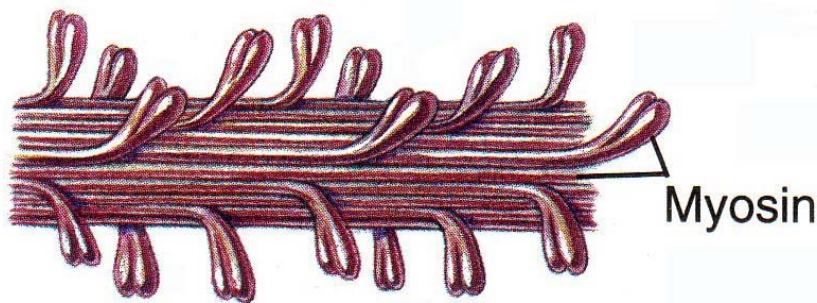




***Hypertrophy: Increased
Number of Myofibrils
Thick & Thin Filaments***

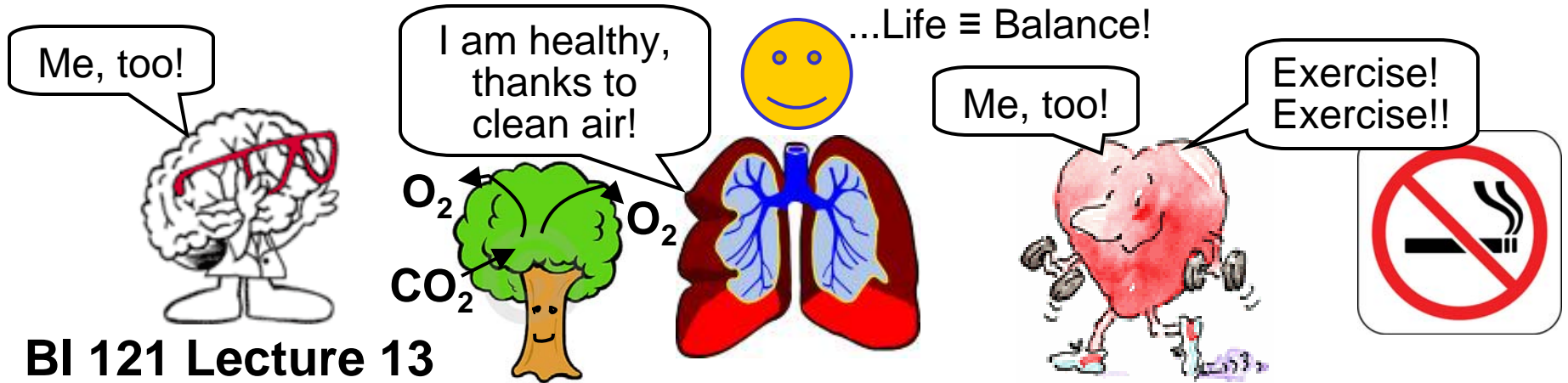


Myosin & Actin Molecules



Characteristics of Skeletal Muscle Fibers

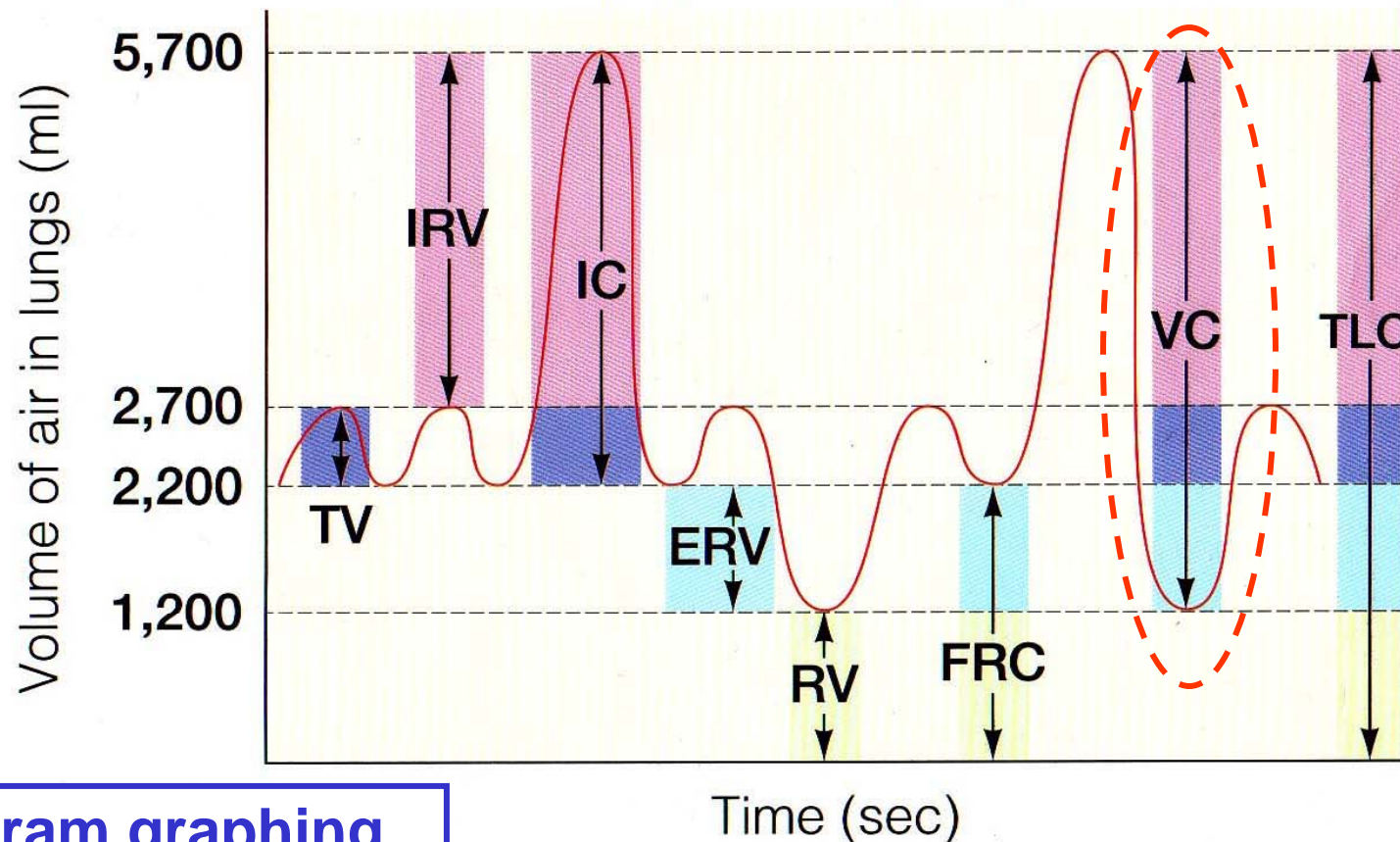
Characteristic	TYPE OF FIBER		
	Slow Oxidative (Type I)	Fast Oxidative (Type IIa)	Fast Glycolytic (Type IIb)
Myosin-ATPase Activity	Low	High	High
Speed of Contraction	Slow	Fast	Fast
Resistance to Fatigue	High	Intermediate	Low
Aerobic Capacity	High	High	Low
Anaerobic Capacity	Low	Intermediate	High
Mitochondria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



BI 121 Lecture 13

- I. Announcements Optional notebook check today. Short t for Q followed by final exam tomorrow. Q?
- II. Introduction to PFT Lab 6 Pulmonary Function Testing
- III. 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
- IV. 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!

Normal Spirogram of Healthy Young Adult Male



**Spirogram graphing
complete *PFT* from
computer simulation.**

- TV = Tidal volume (500 ml)
- IRV = Inspiratory reserve volume (3,000 ml)
- IC = Inspiratory capacity (3,500 ml)
- ERV = Expiratory reserve volume (1,000 ml)
- RV = Residual volume (1,200 ml)
- FRC = Functional residual capacity (2,200 ml)
- VC = Vital capacity (4,500 ml)
- TLC = Total lung capacity (5,700 ml)

Lombo's simplified steps!

1 Breathe in & out!



2 Cross membranes!



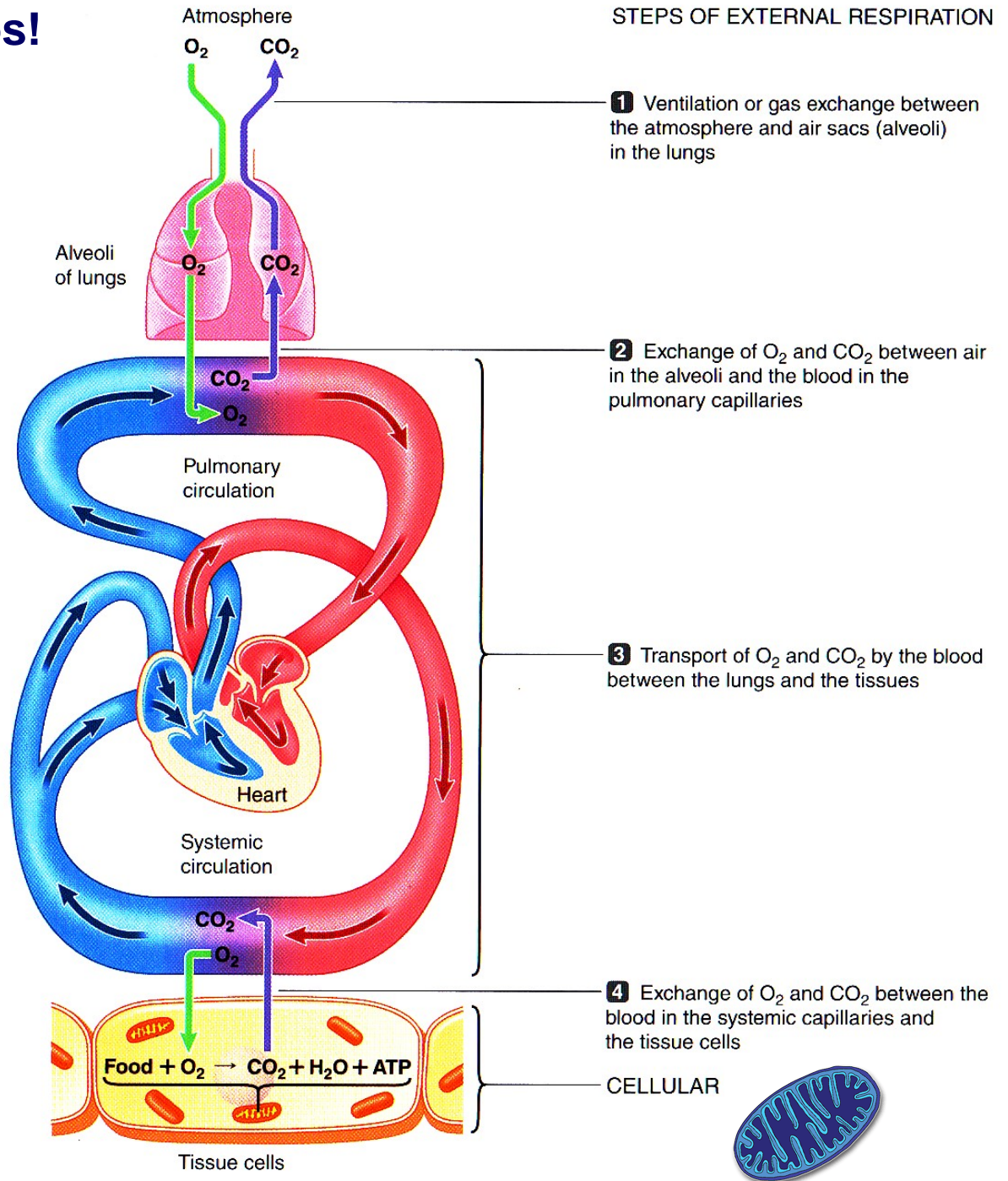
3 Move with blood!



4 Cross membranes!



STEPS OF EXTERNAL RESPIRATION



Respiratory System Anatomy

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

Nasal passages

Mouth

Pharynx

Larynx

Trachea

Cartilaginous ring

Right bronchus

Bronchiole

Terminal bronchiole

Branch of pulmonary artery

Smooth muscle

Branch of pulmonary vein



Pulmonary capillaries

Alveolar sac

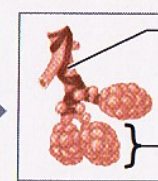
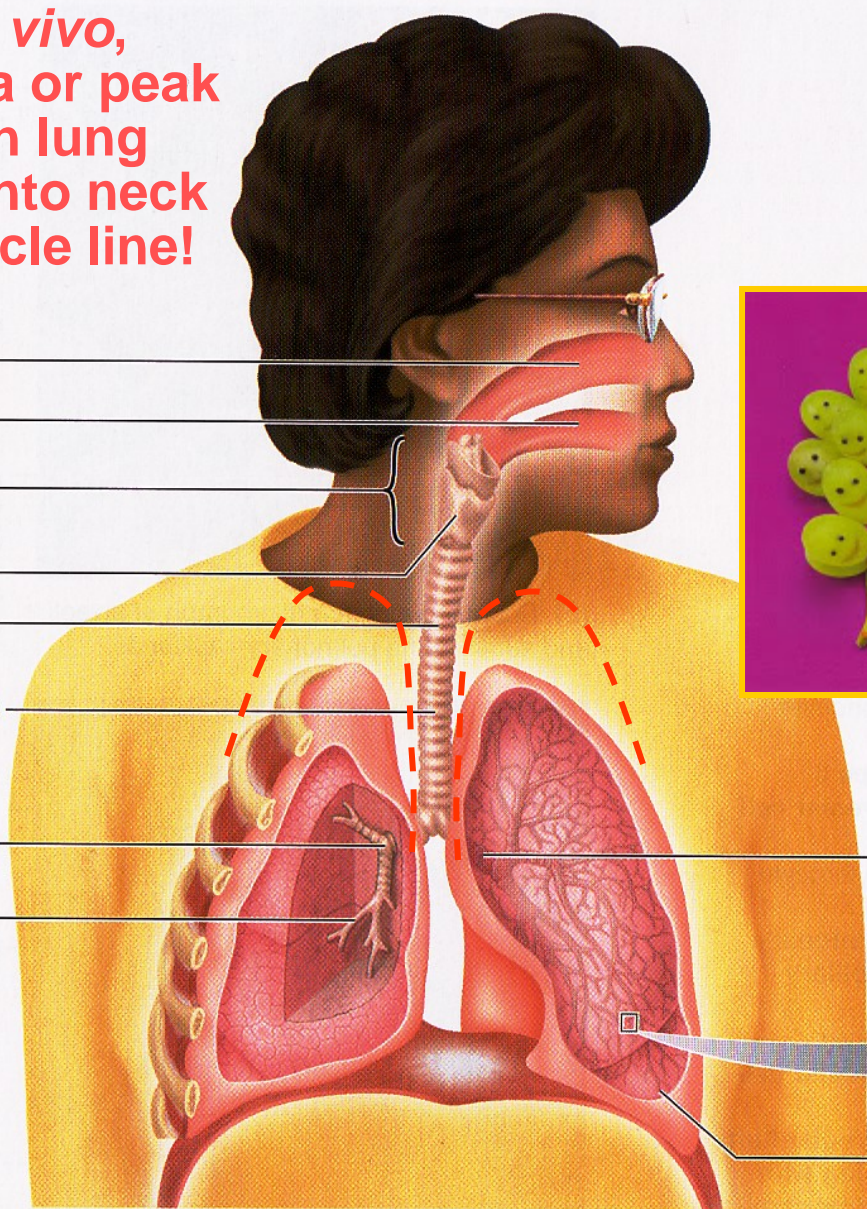
(b) Enlargement of alveoli (air sacs) at terminal ends of airways

Left bronchus

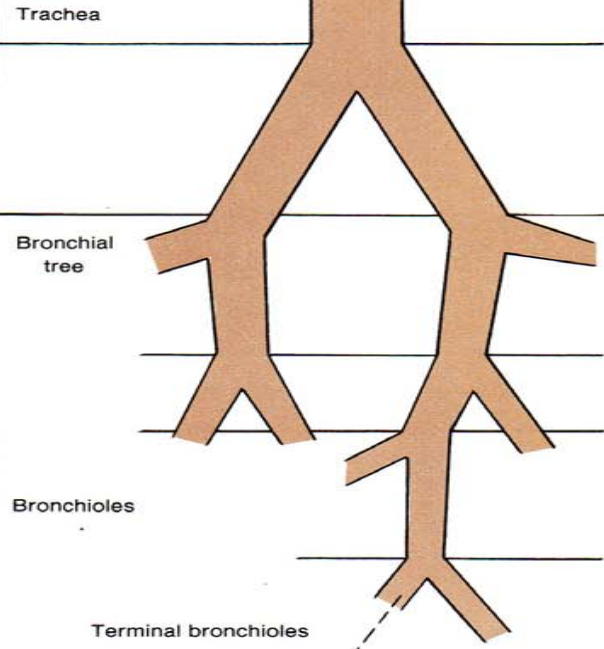
Terminal bronchiole

Alveolar sac

Terminal bronchiole

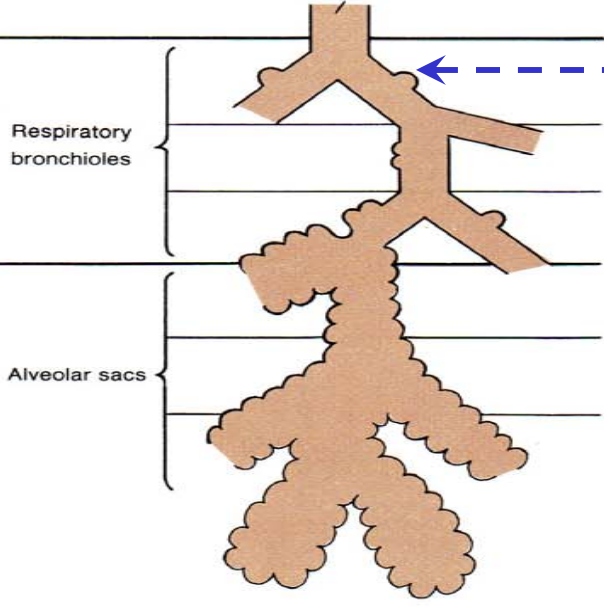


Conductive Zone



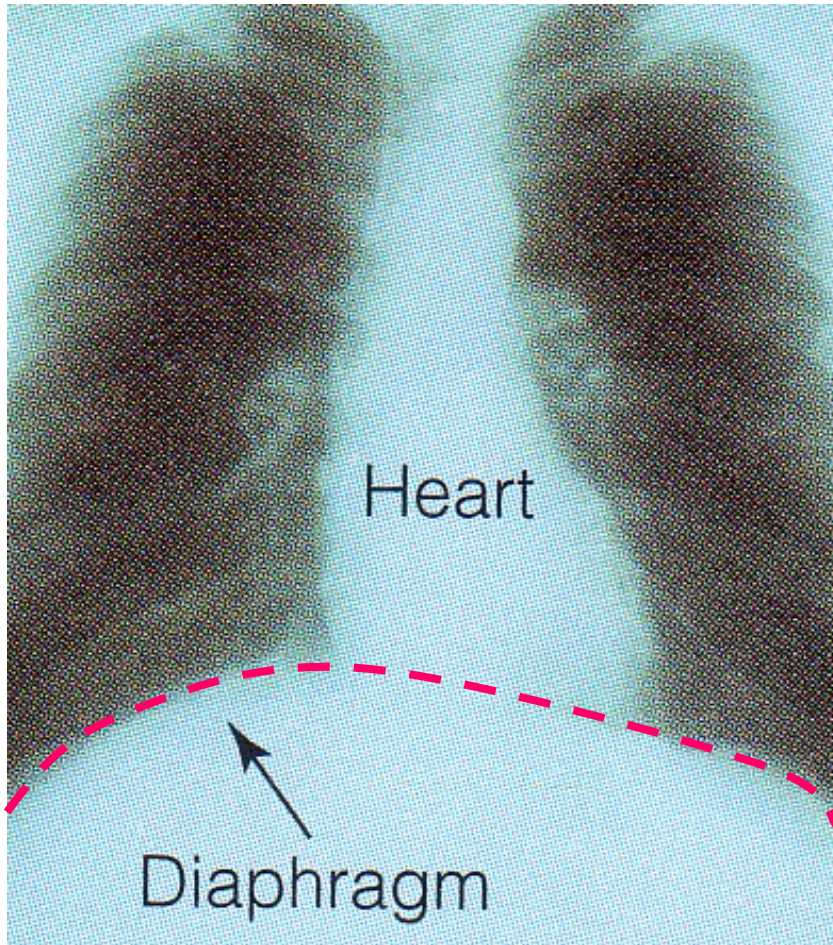
No Gas Exchange

Respiratory Zone



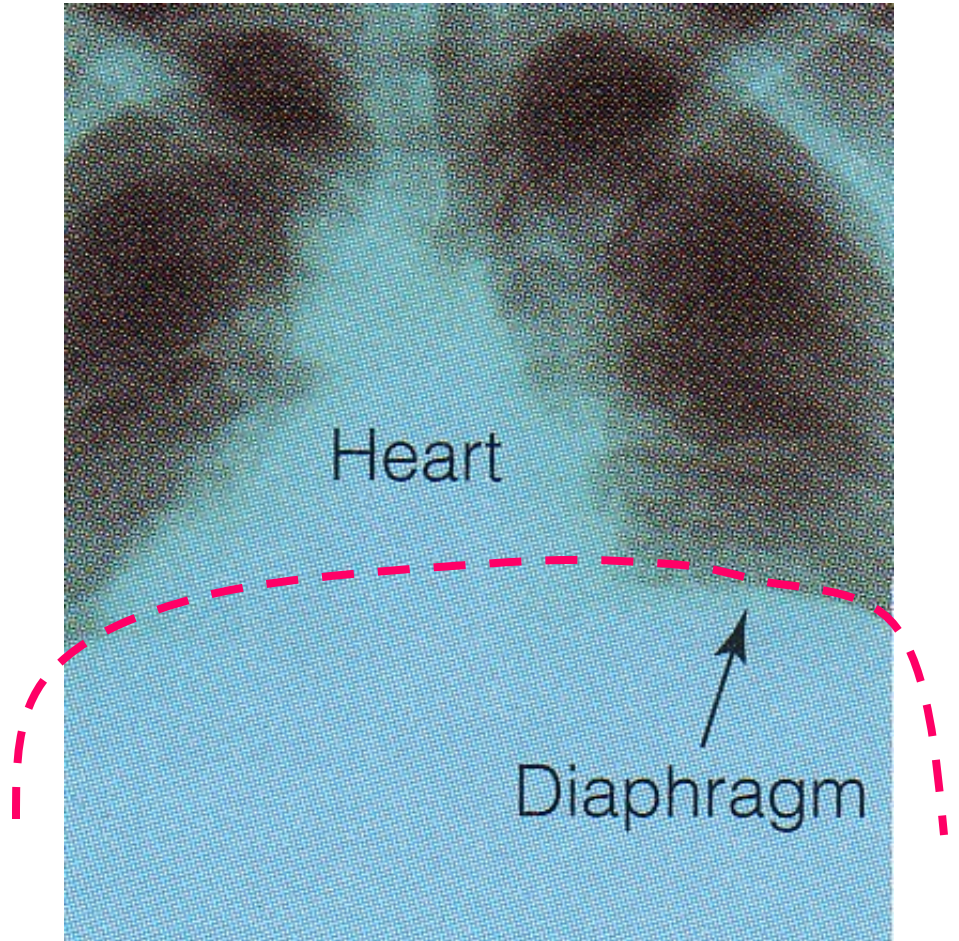
1st alveolar outpouching!

Gas Exchange



Inhale (active)

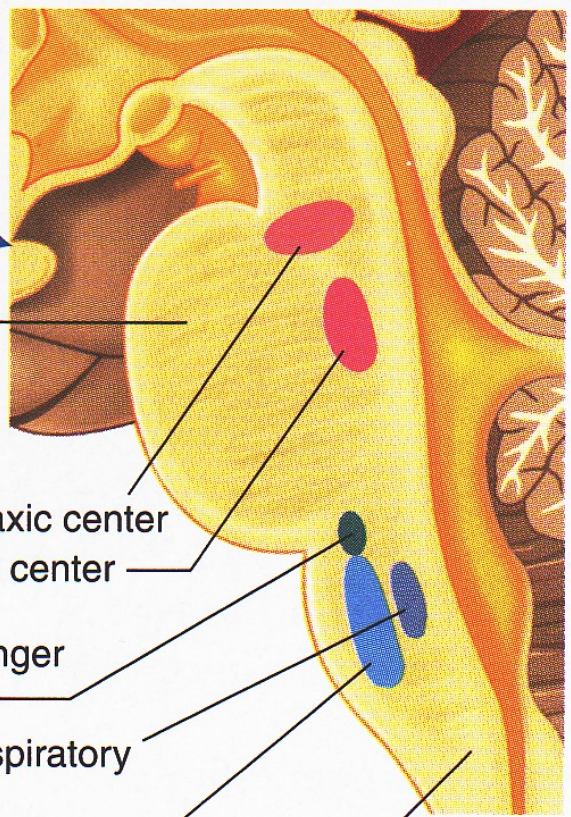
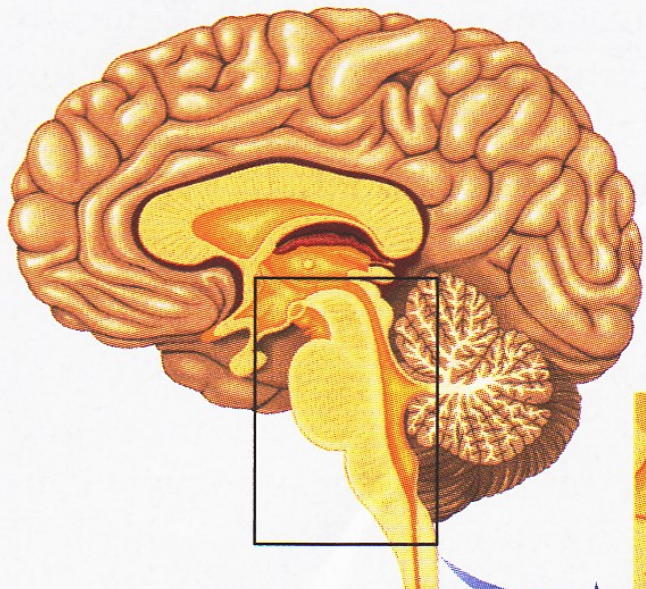
Contract & flatten diaphragm



Exhale (passive @ rest)

Relax & pouch up diaphragm!

Brain stem ≡ Control Center for automatic breathing!



Respiratory control centers in brain stem

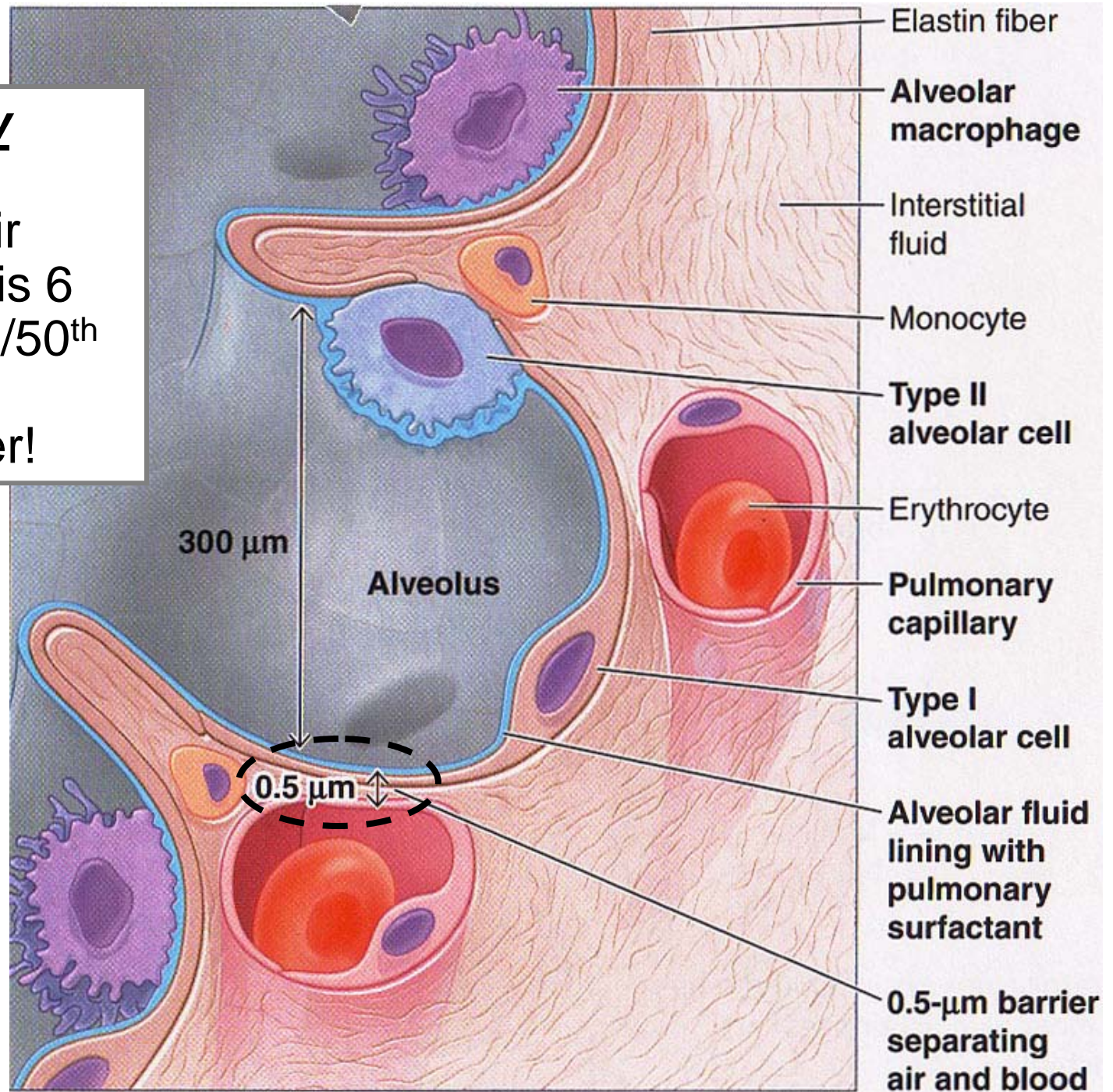
- Pons respiratory centers
- Medullary respiratory center

- Pneumotaxic center
- Apneustic center
- Pre-Bötzinger complex
- Dorsal respiratory group
- Ventral respiratory group

Medulla

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)

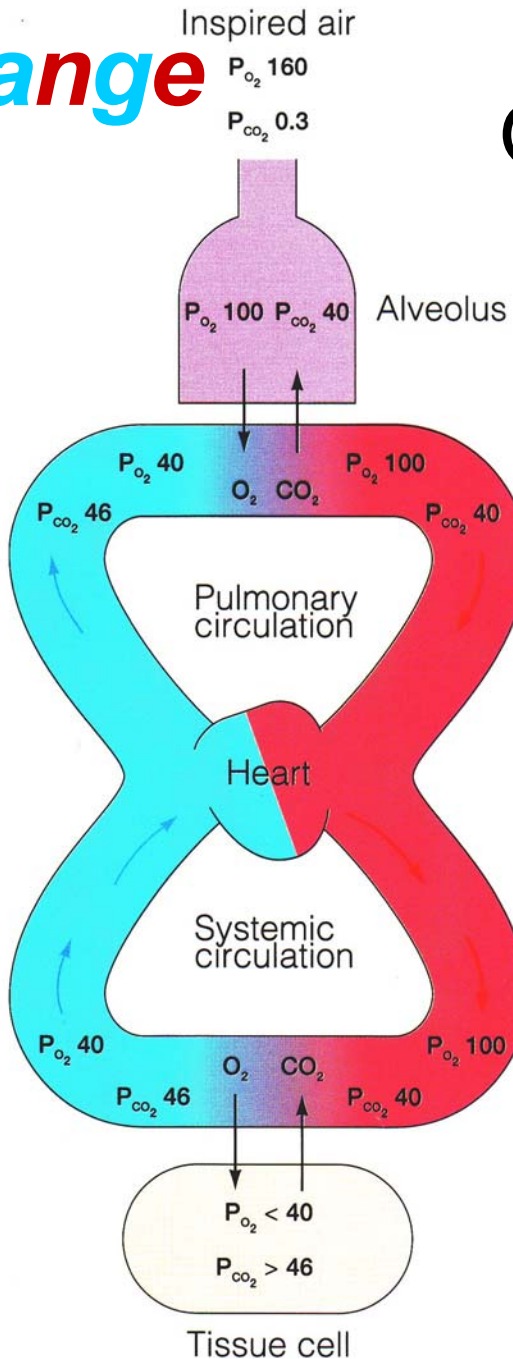
CO₂ partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

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)

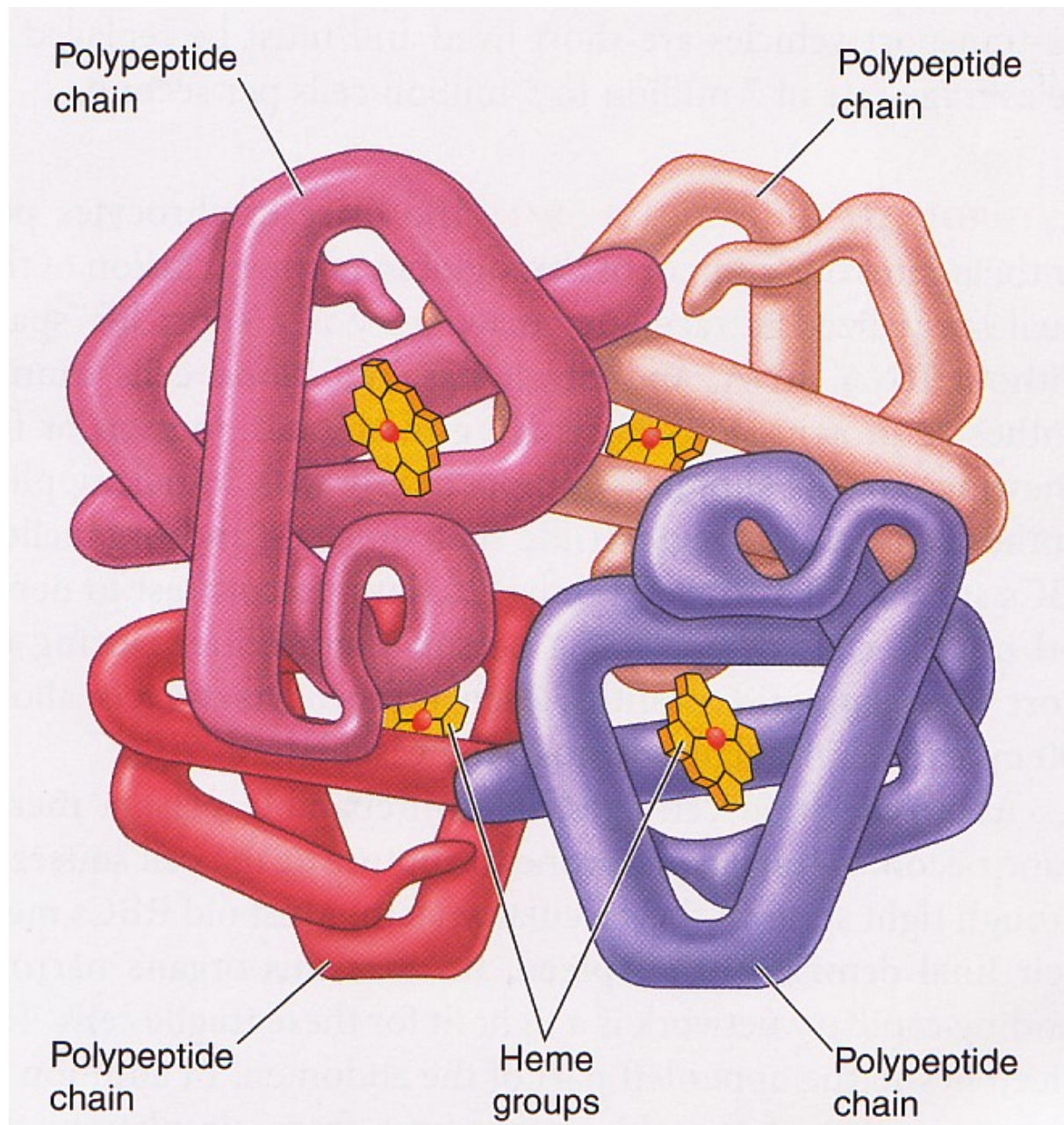
Numbers are mm Hg pressure.



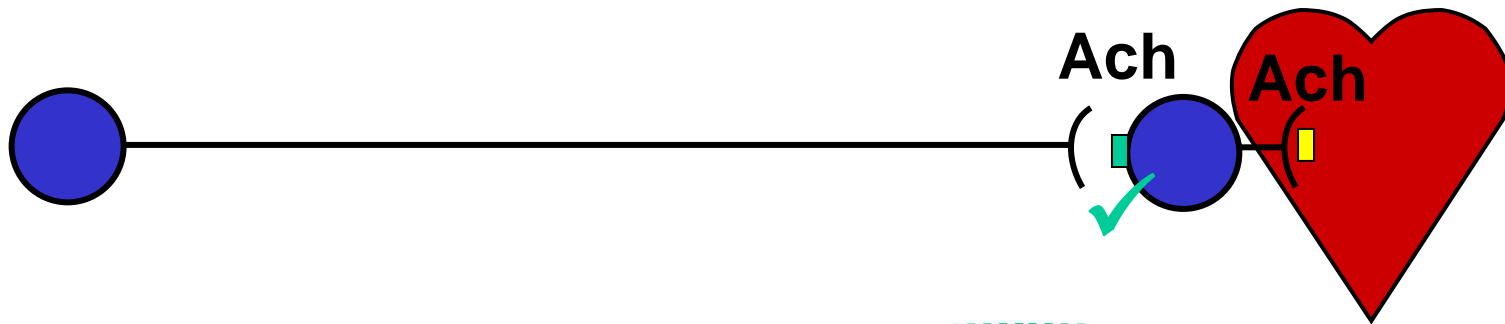
CO₂ HIGH

O₂ LOW

O₂ is carried mainly by red blood cell hemoglobin!



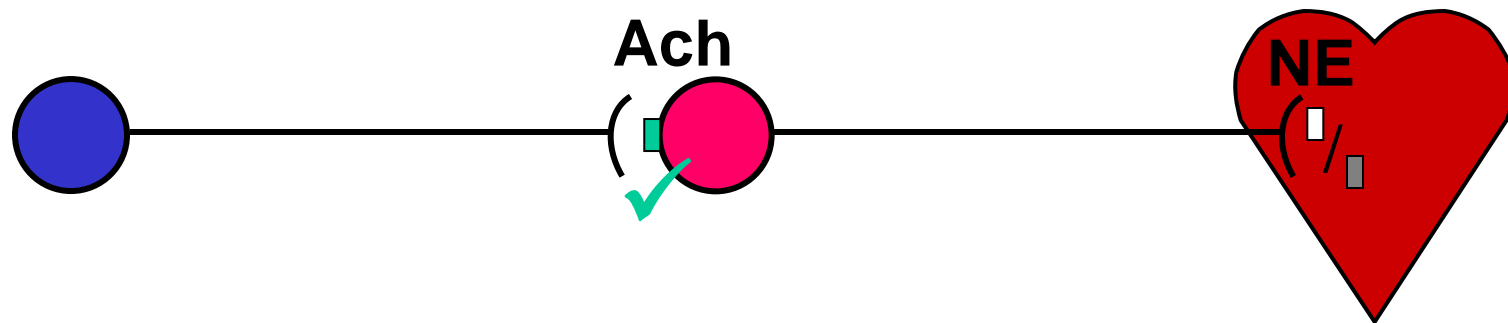
Parasympathetic



Ach = Acetylcholine

- = Nicotinic Receptor
- = Muscarinic Receptor

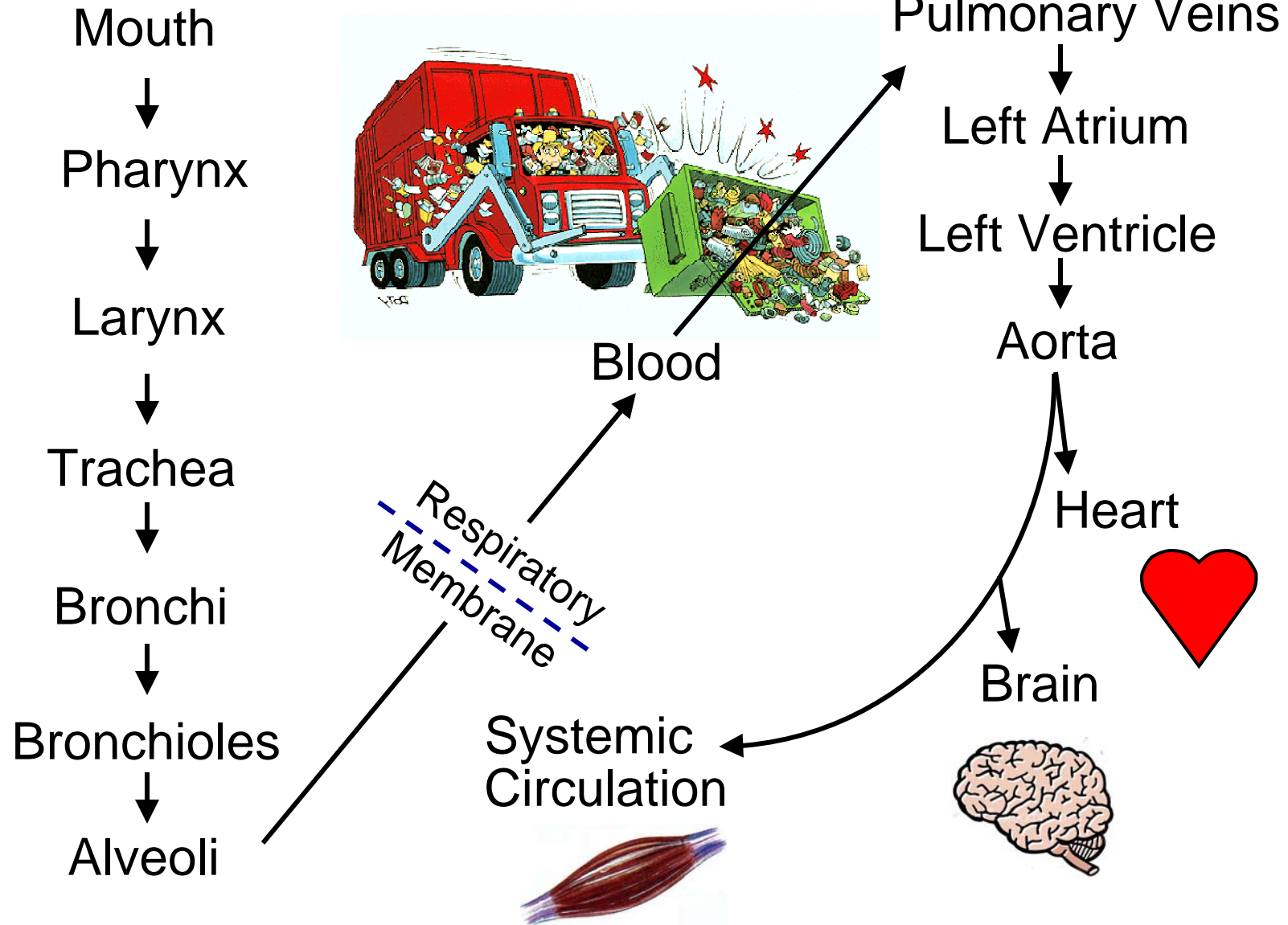
Sympathetic



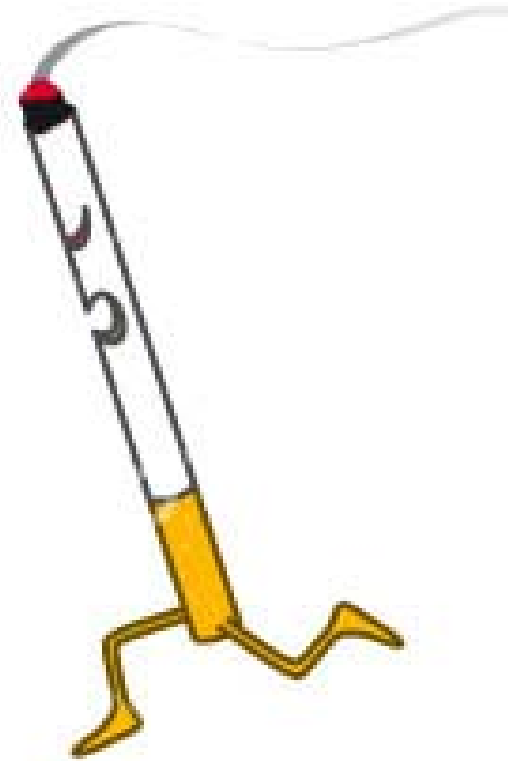
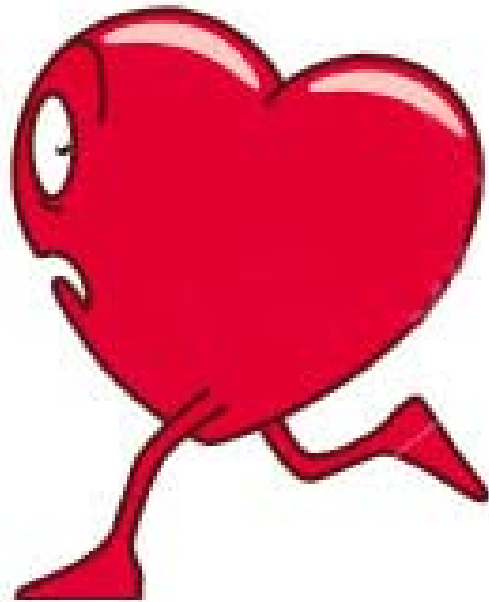
NE = Norepinephrine

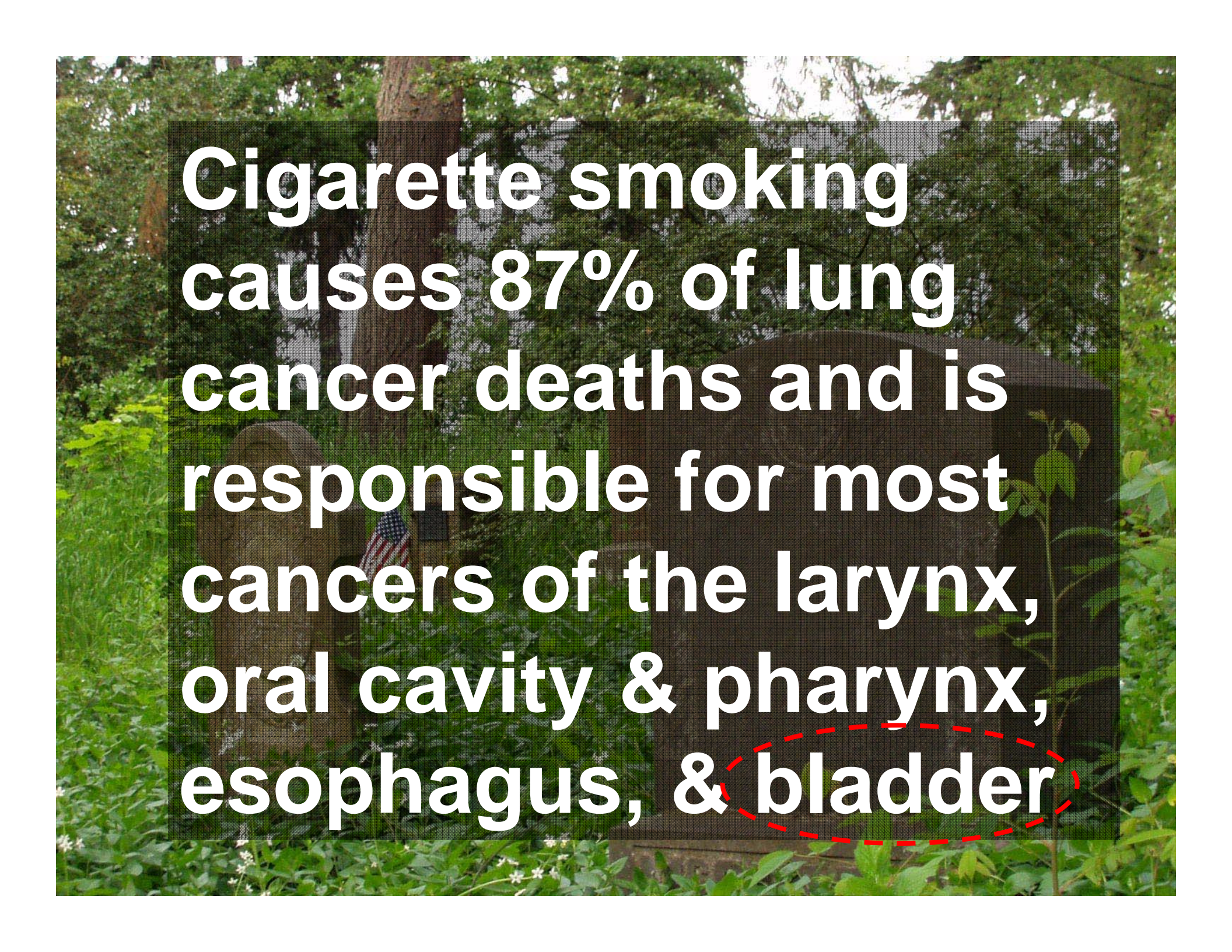
- = α Receptor (α_1 , α_2)
- = β Receptor (β_1 , β_2)

Tracing the Route of Cigarette Smoke Puff to Brain Time 5 to 8 seconds!!



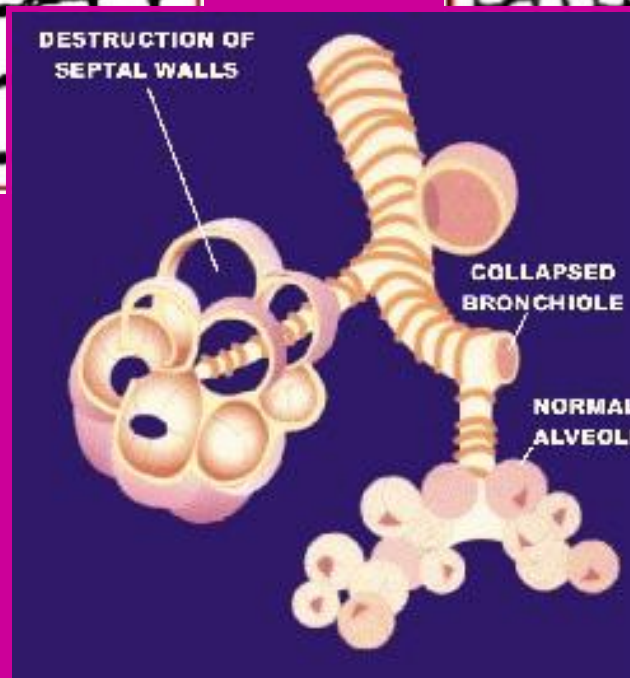
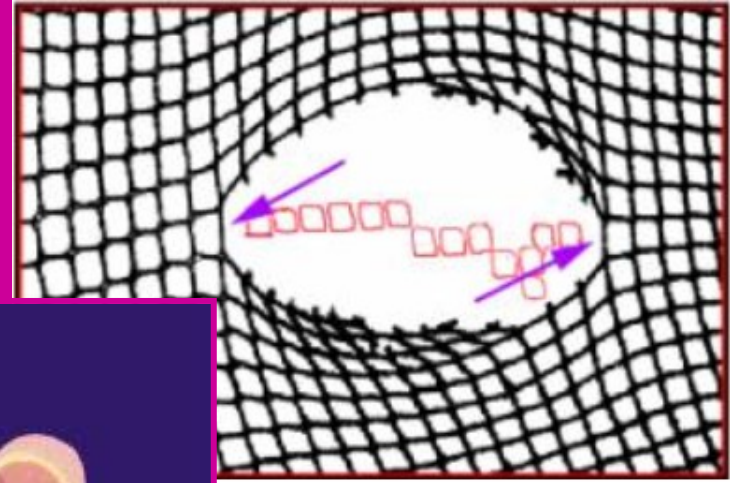
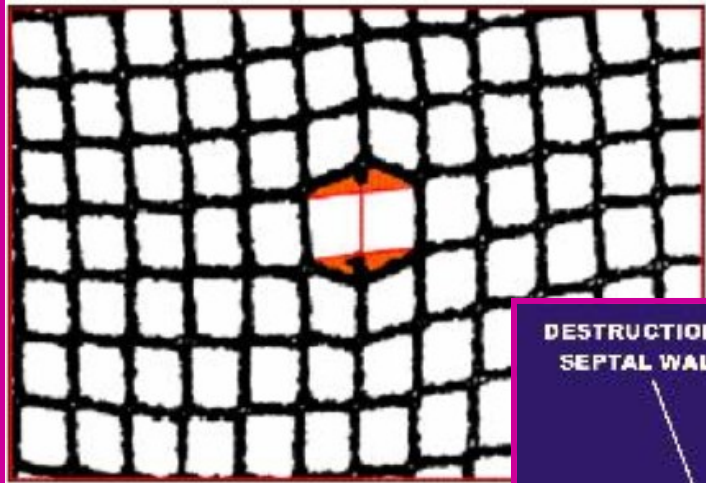
***Not only the Brain, but the Heart & 100s of Other
Tissues and Organs are Adversely Affected!***





**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



*Internet Journal of Pathology
Mayo Clinic Health*

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

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.

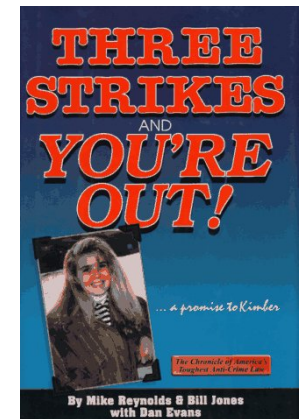
On the Pill & Smoke?

Increased Risk of:

1. Blood Clots

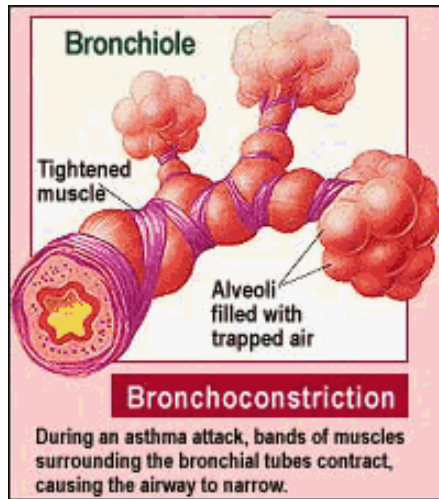
2. Heart Attack

3. Strokes!

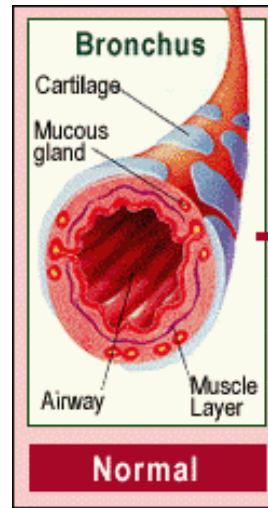


**Breathing 2nd-hand
smoke for as little as
1/2 hr activates
platelets almost as
much as if you were a
pack-a-day smoker**

SMOKING ≡ ASTHMA?



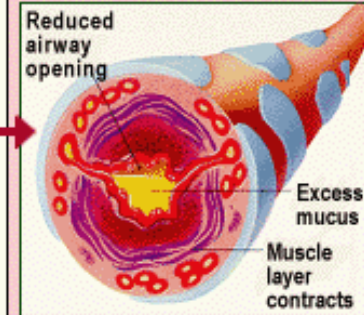
+



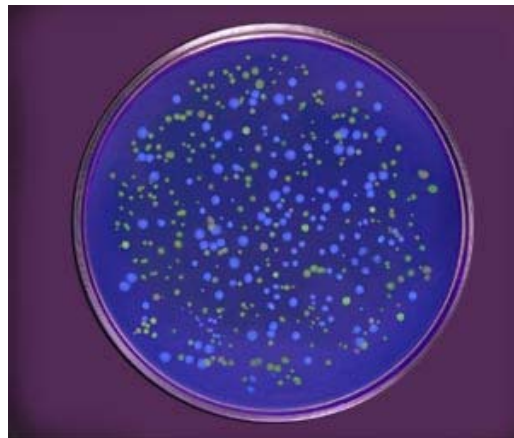
Asthma Triggers

- Allergens
- Drugs
- Exercise
- Occupational stimuli
- Infections
- Environmental changes
- Air pollutants
- Chemical irritants
- Emotions
- Weather/Temp.
- Food additives

Inflammation



=



Petri-dish Effect



Ugh!!
Cough!
Cough!!



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/20211642>

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

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