

BI 121 Lecture 9

We survived the exam! Happy Halloween!!
Remember nutrient p & have safe fun!

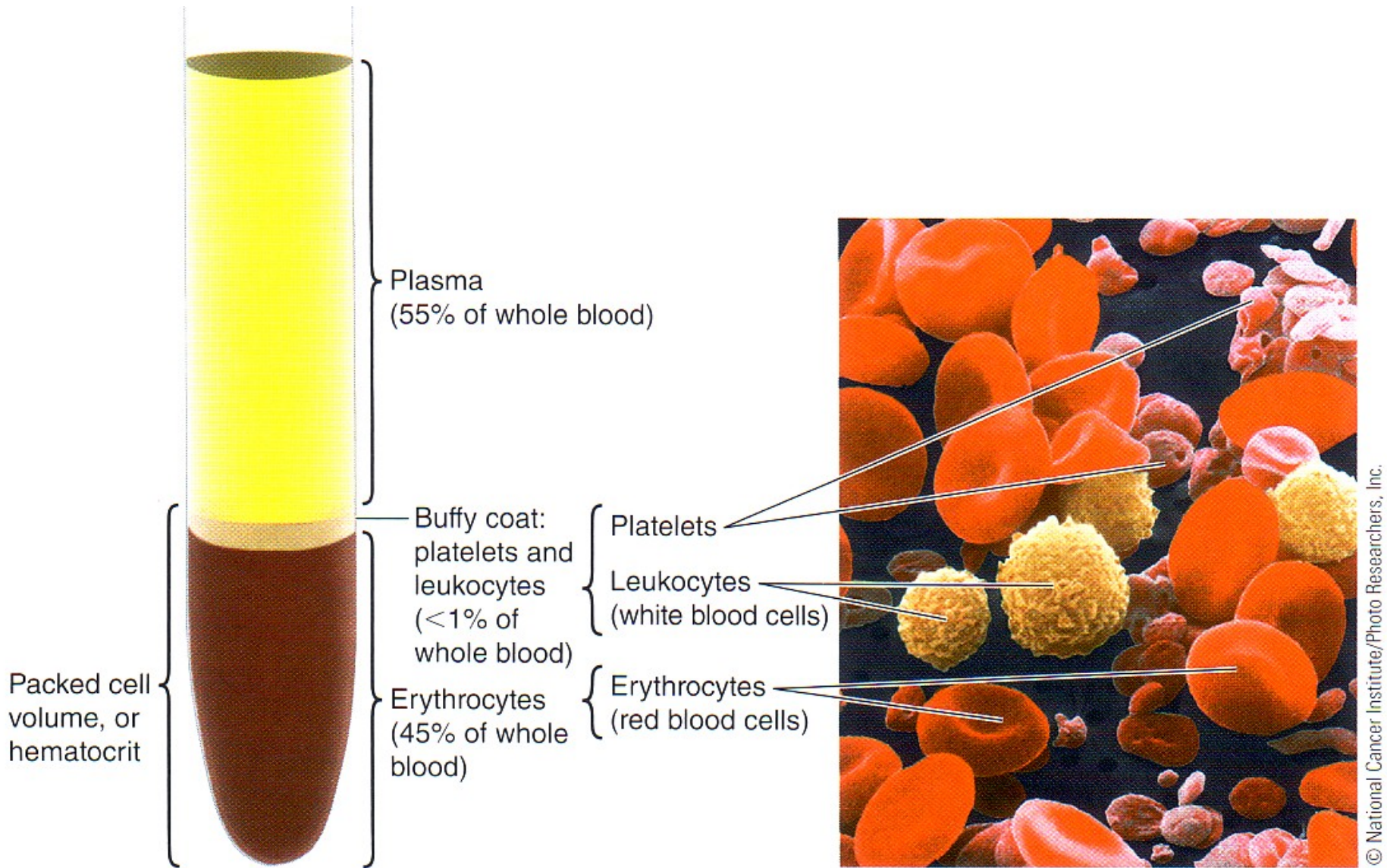


- I. Announcements:** No lab today! Break for exam week!
Next R Blood Chemistry. Thanks sincerely for helping us optimize safety by reading $\geq 2x$ Lab 5, LM pp 5-1 to 5-6.
- II. Blood Form & Function** LS ch 11, DC Module 5 pp 35-9
 - A. Formed vs Nonformed/cells vs plasma** fig+tab 11-1
Cell origin - bone marrow. What's in plasma? p 316
 - B. Red blood cells/erythrocytes: O₂ carrying** pp 317-8
Normal flexible vs fragile sickle cell fig 11-5 p 320
 - C. White blood cells/leukocytes: defense/immunity**
differential + general functions pp 326-30 fig 11-1
 - D. Platelets/thrombocytes: clotting** pp 321-2 fig 11-6
- III. Blood Chemistry Lab: Basics** LM + LS ch 11 & 17
 - A. What's blood typing? ABo System** ch 11 LS pp 341- 4
Rhesus factor? Erythroblastosis fetalis? LS p 343
 - B. Physiology in the News: Eat right for your type?**
 - C. What's blood glucose? Diabetes?** LS ch 17 pp 560- 73
 - D. Questions about blood chem lab?**
- IV. Exam Comments + Return**

Ghost, marshmallow
or white blood cell?

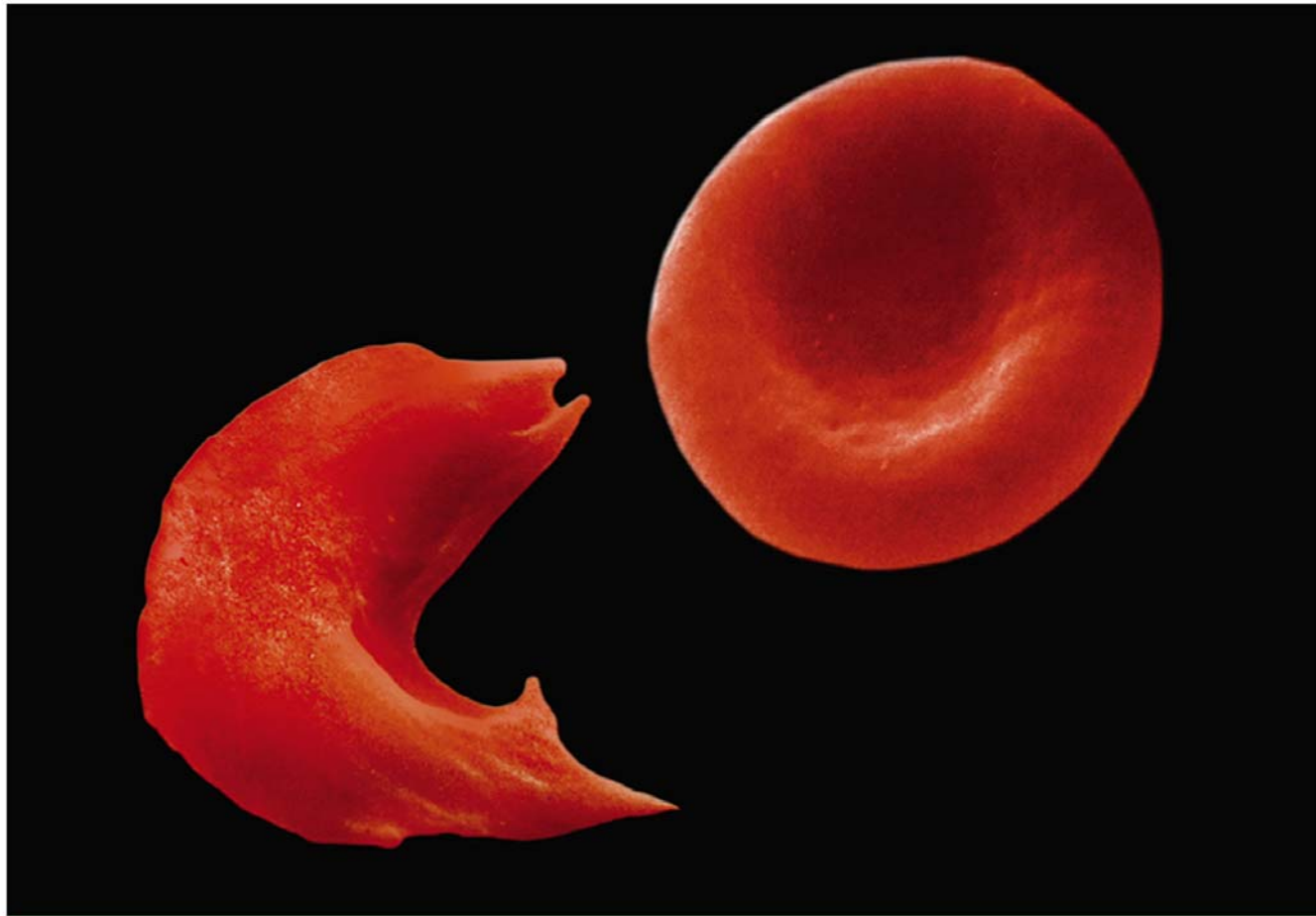


What's in Blood? Plasma & Blood Cells



Sickle-shaped blood cells

Normal red blood cells



© Dr. Stanley Flegler/Visuals Unlimited

What a difference one amino acid can make!

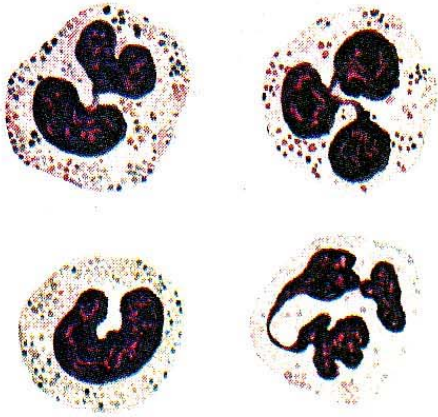
Amino acid sequence of normal hemoglobin:

Val — His — Leu — Thr — Pro — Glu — Glu

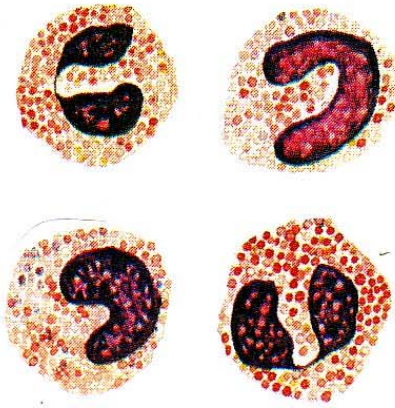
Amino acid sequence of sickle-cell hemoglobin:

Val — His — Leu — Thr — Pro — Val — Glu

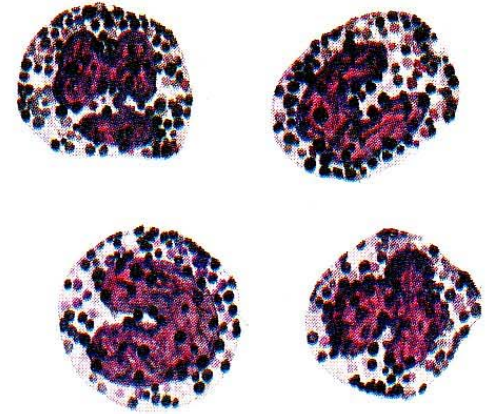
S&W 2011 fig 6-5 p 194



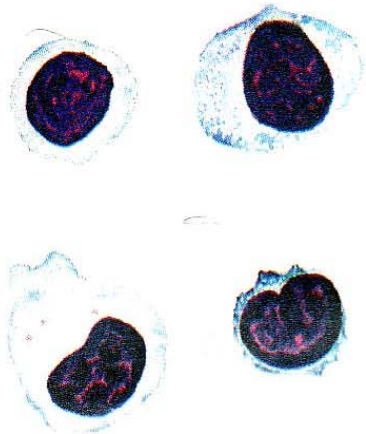
NEUTROPHILS



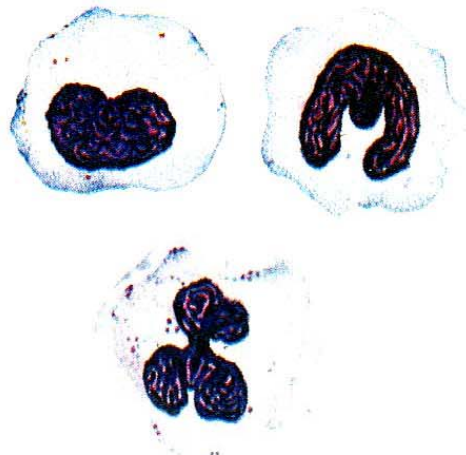
EOSINOPHILS



BASOPHILS



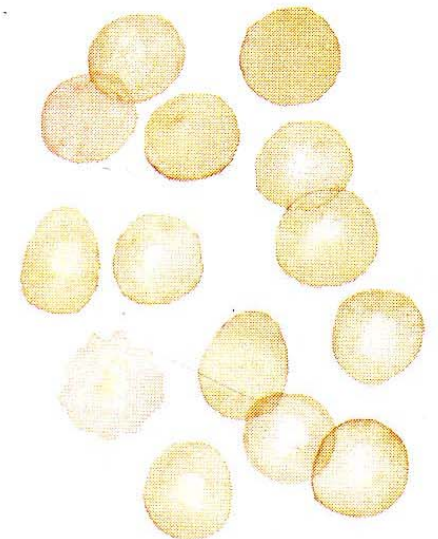
LYMPHOCYTES



MONOCYTES

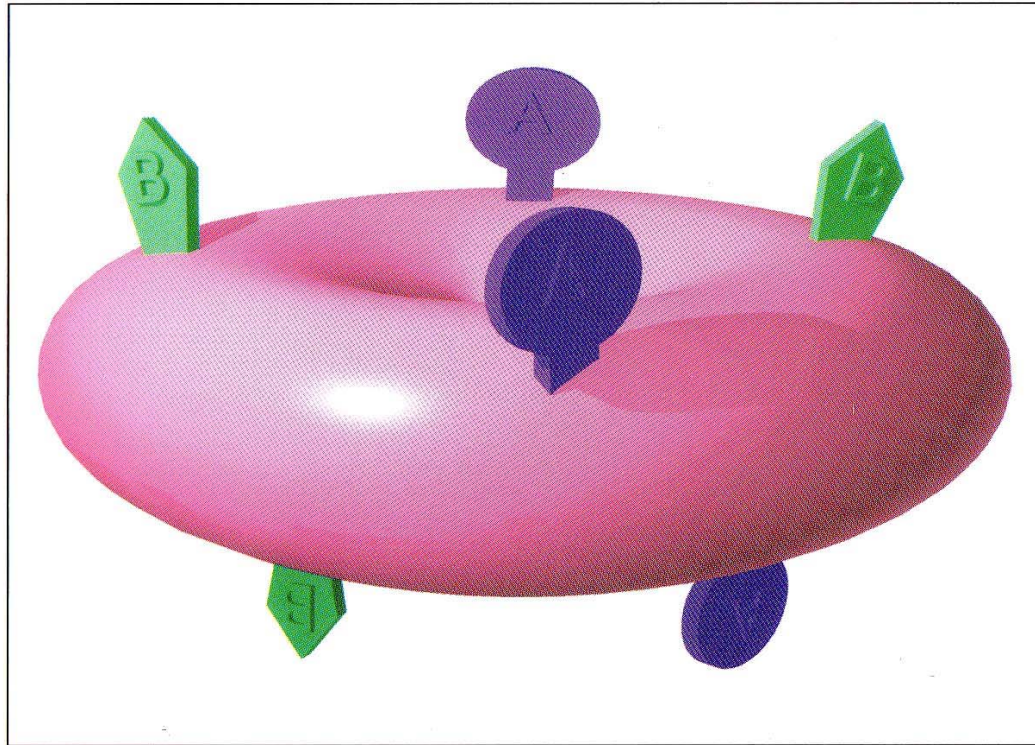


PLATELETS

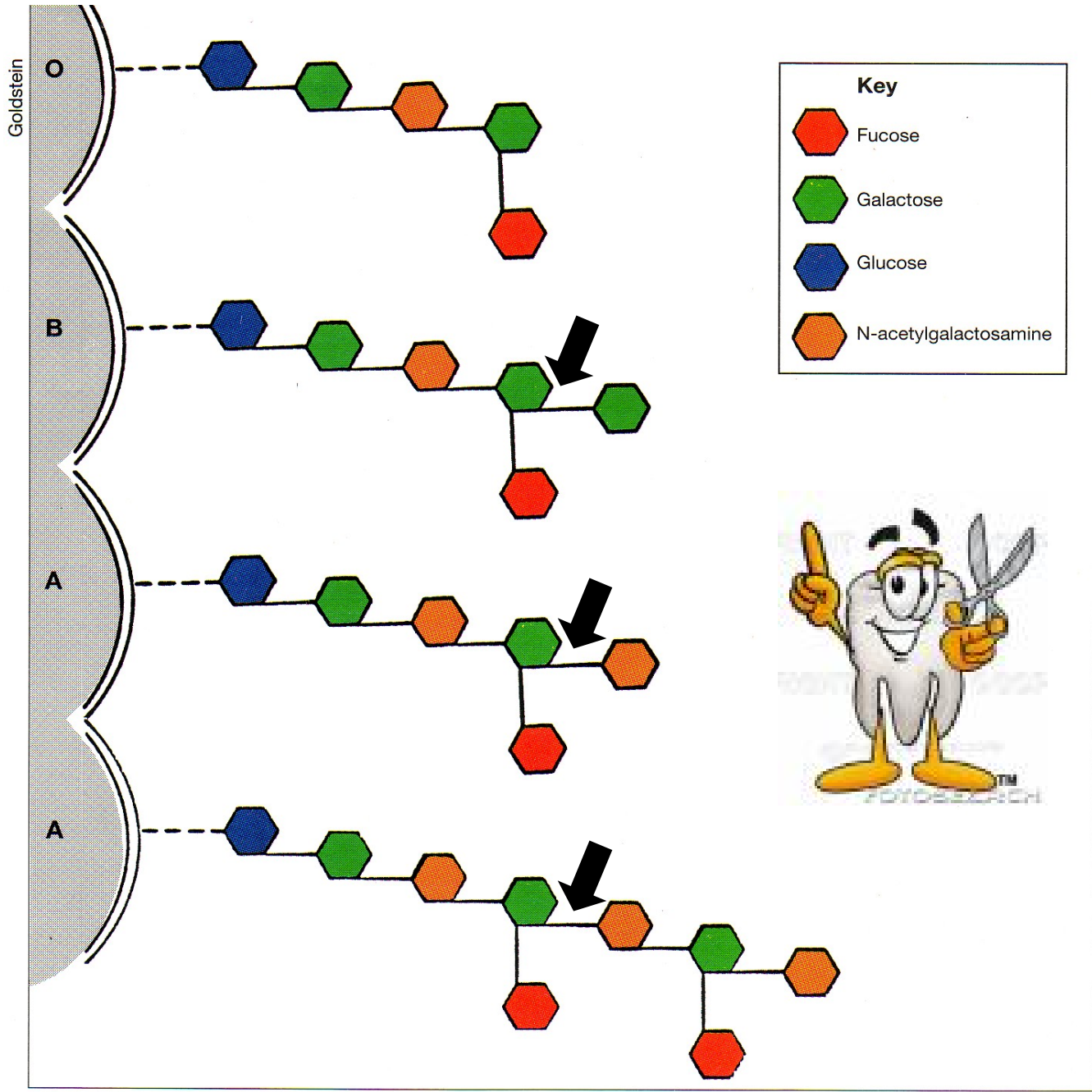


ERYTHROCYTES

AB

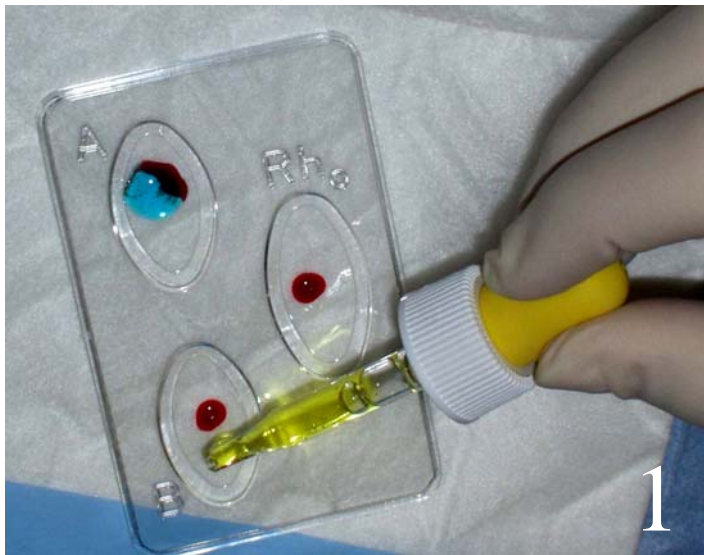


A & B Antigens
(Agglutinogens)

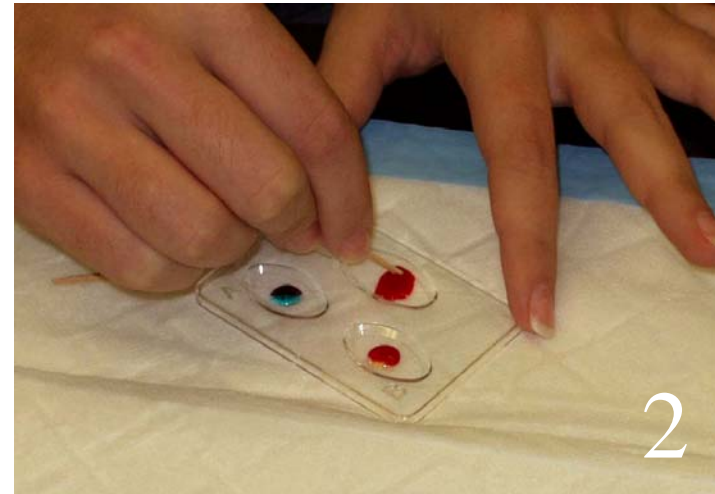


A cartoon character with a white body, yellow shoes, and a yellow hat, holding a pair of scissors and a pointer, representing the enzyme that removes the terminal sugar from the antigen.

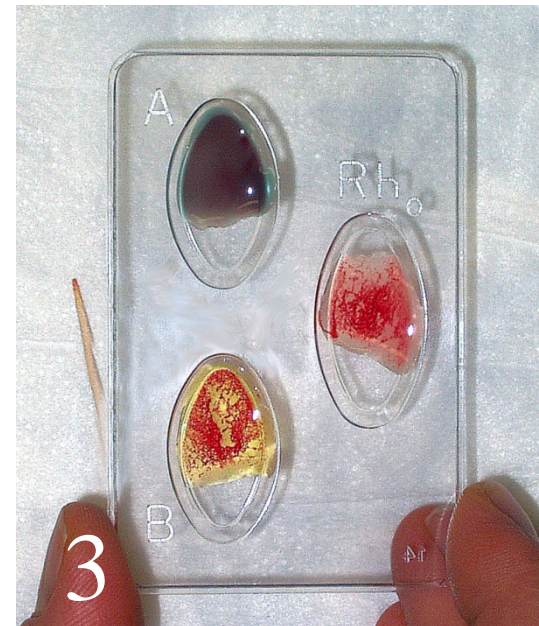
BLOOD TYPING



ADD ANTISERA



MIX W/TOOTHPICKS



READ & RECORD!!

BI 121 Lecture 10



...This Thursday more fun & data about me! Heck yeah!!

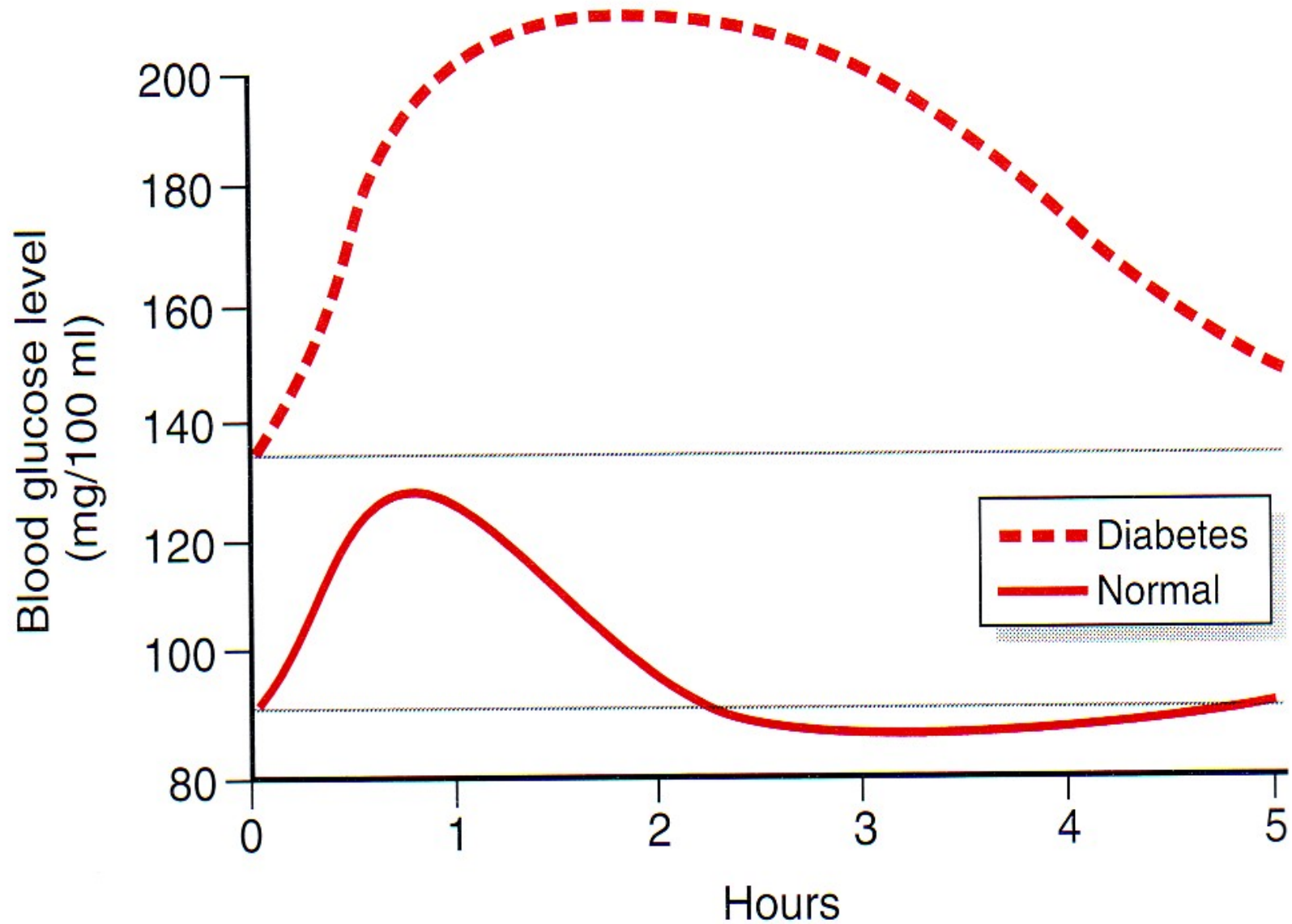
- I. Announcements** To make Lab 5 educational, fun & safe for all, **please read pp 5-1 thru 5-6 in LM twice before Thursday!** Remaining exams & notebooks returned > lecture. Key posted in glass box in Huestis near 120 HUE. Estimate grade? Q?
- II. Blood Chemistry Connections** LS ch 11 p 303, ch 17 pp 525-36
Erythroblastosis fetalis, diabetes, insulin, glucagon
- III. Endocrinology Overview** LS ch 17, DC Module 13, SI Fox+
 - A. Vignette: Cushing's syndrome LS fig 17-20 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 see-saw!) 2. Thyroid 3. Adrenals

Erythroblastosis Fetalis?

***e.g., Rh- mom
Rh+ baby***

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

Diabetic & Normal Response to Glucose Load



Glucose:
Sugar in Blood



Normal: 70-99

Pre-Diabetes: 100-125

Diabetes: ≥ 126 mg/dL

Times of Plenty!!

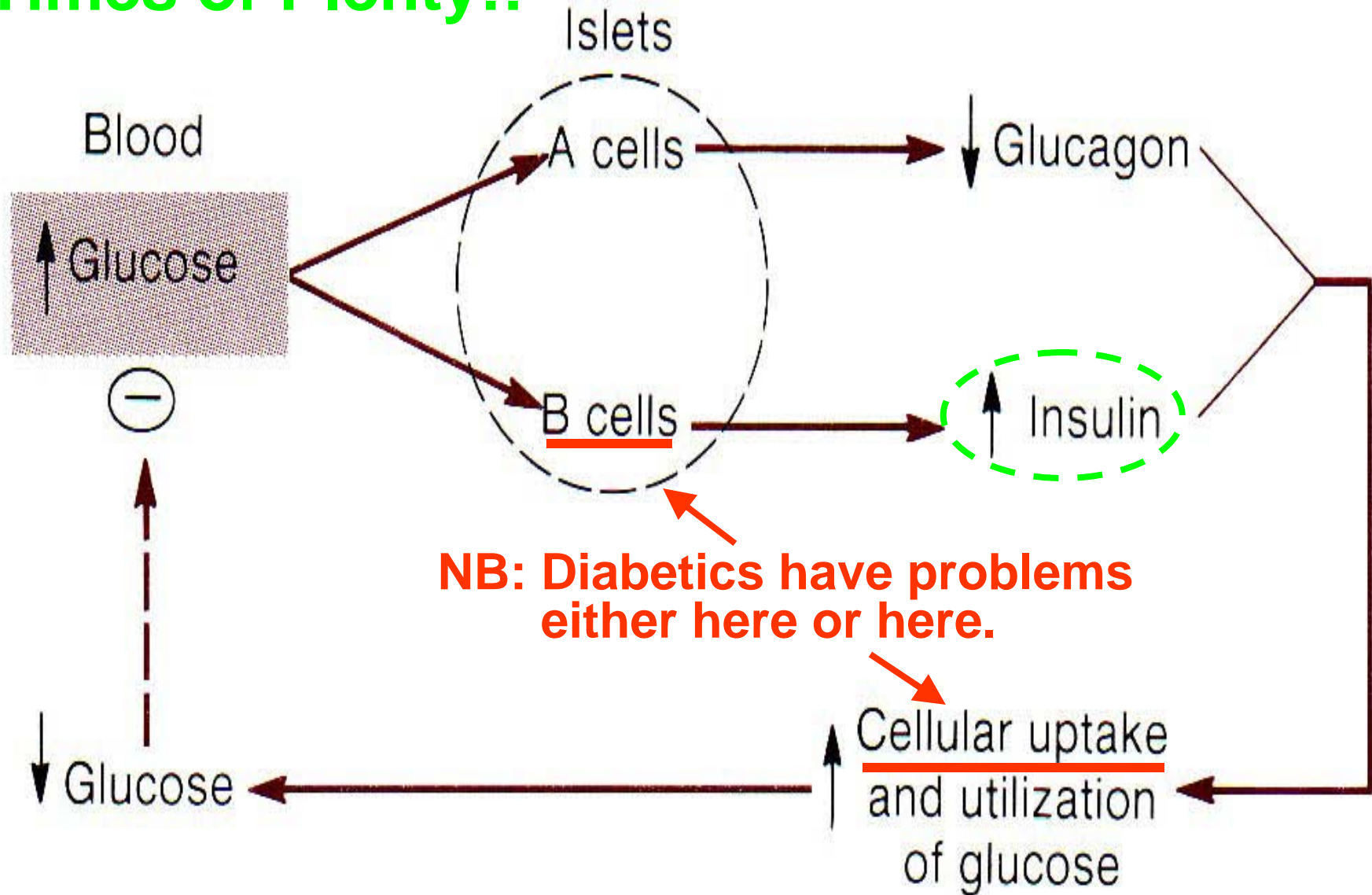


Table 4–9

Warning Signs of Diabetes

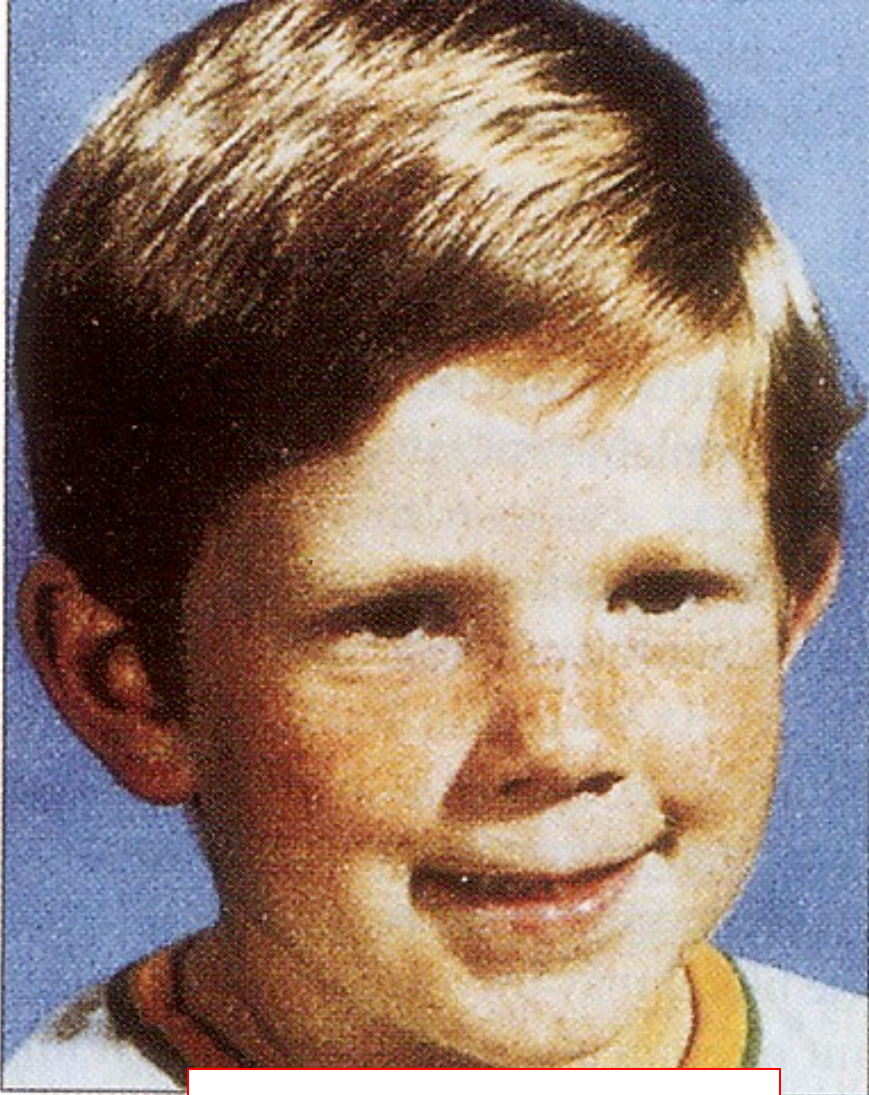
These signs appear reliably in type 1 diabetes and, often, in the later stages of type 2 diabetes.

- 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

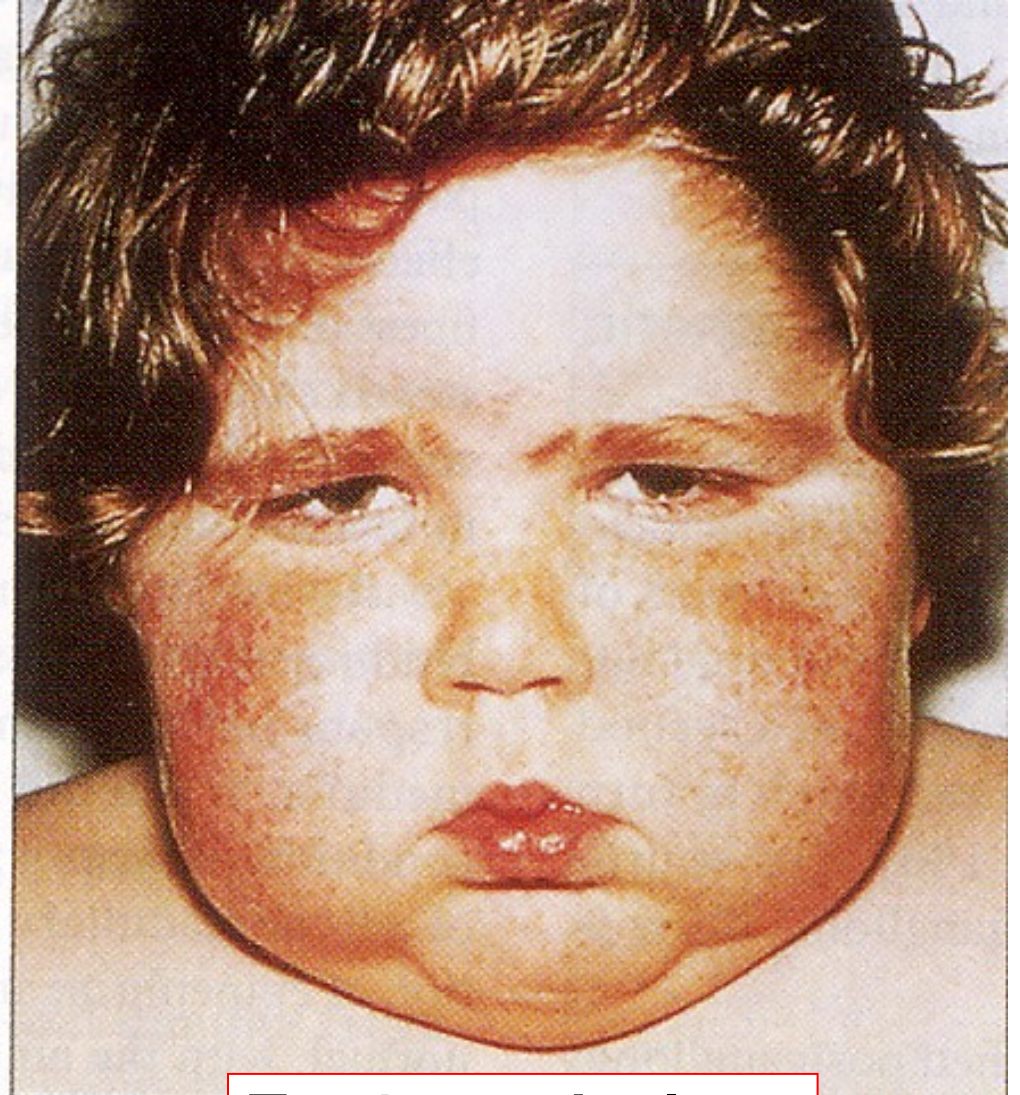
Diabetics must constantly juggle diet, exercise & medication to control blood glucose!



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



T = 0, near normal

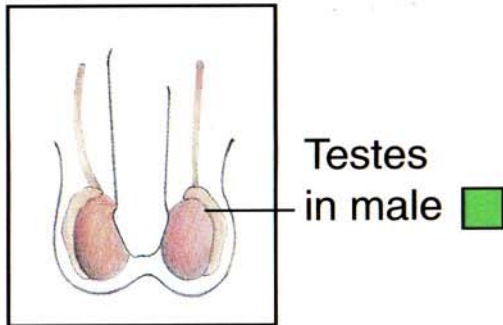
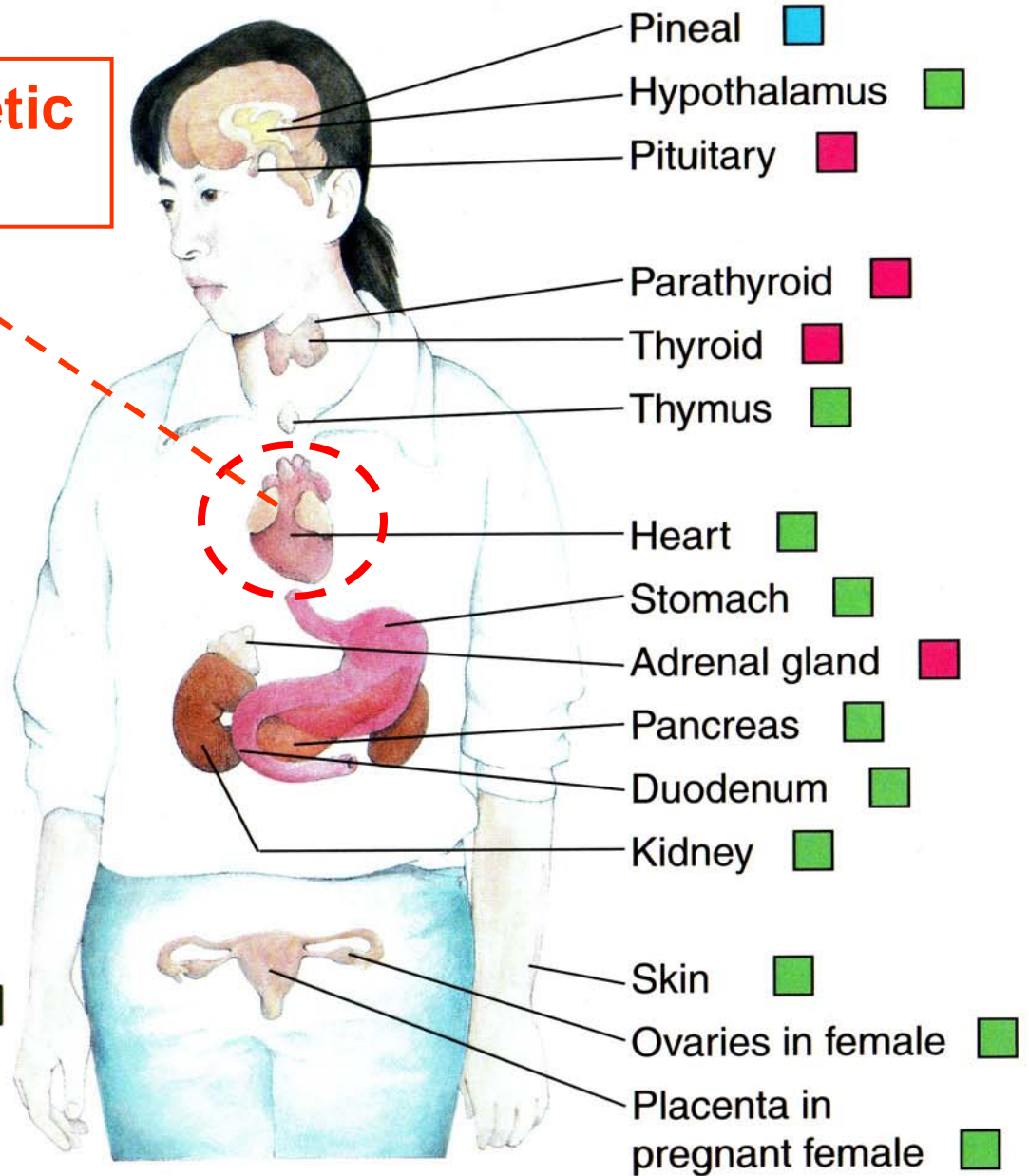


T = 4 months later

Endocrine System

ANP = Atrial Natriuretic Polypeptide

- Solely endocrine function
- Mixed function
- Complete function uncertain

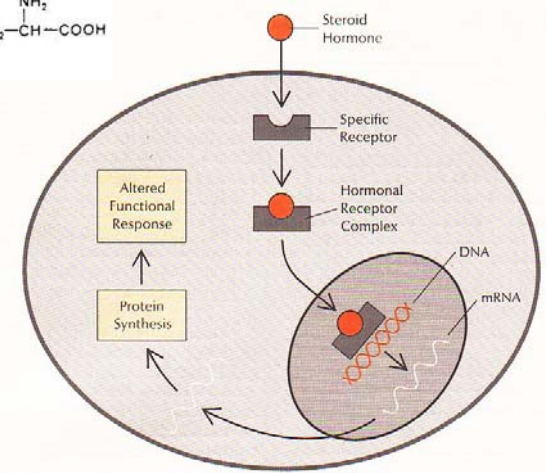
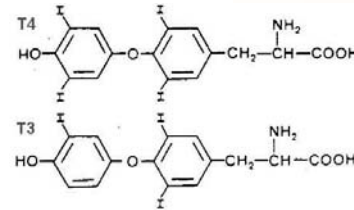
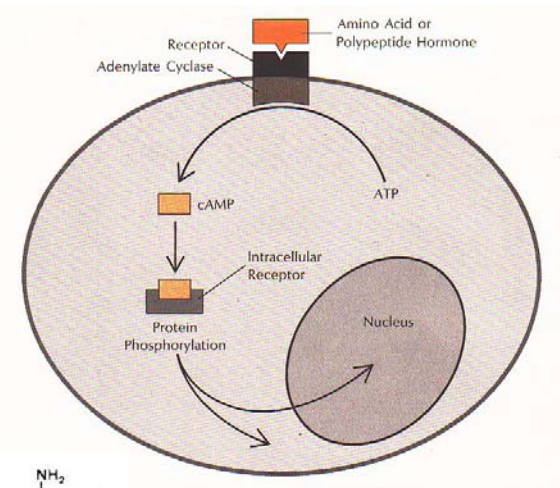


Hormone/Endocrine Classifications

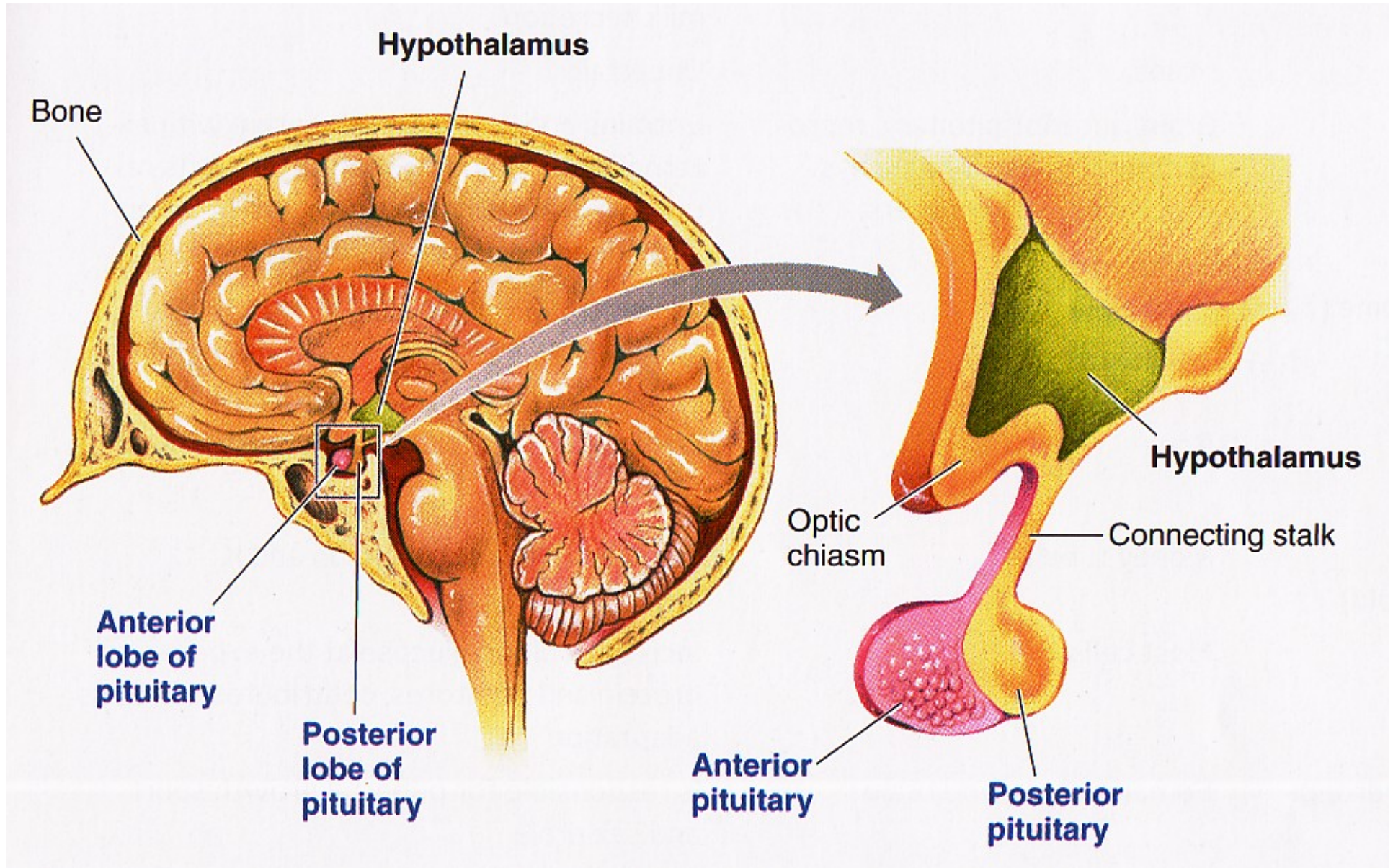
Exogenous



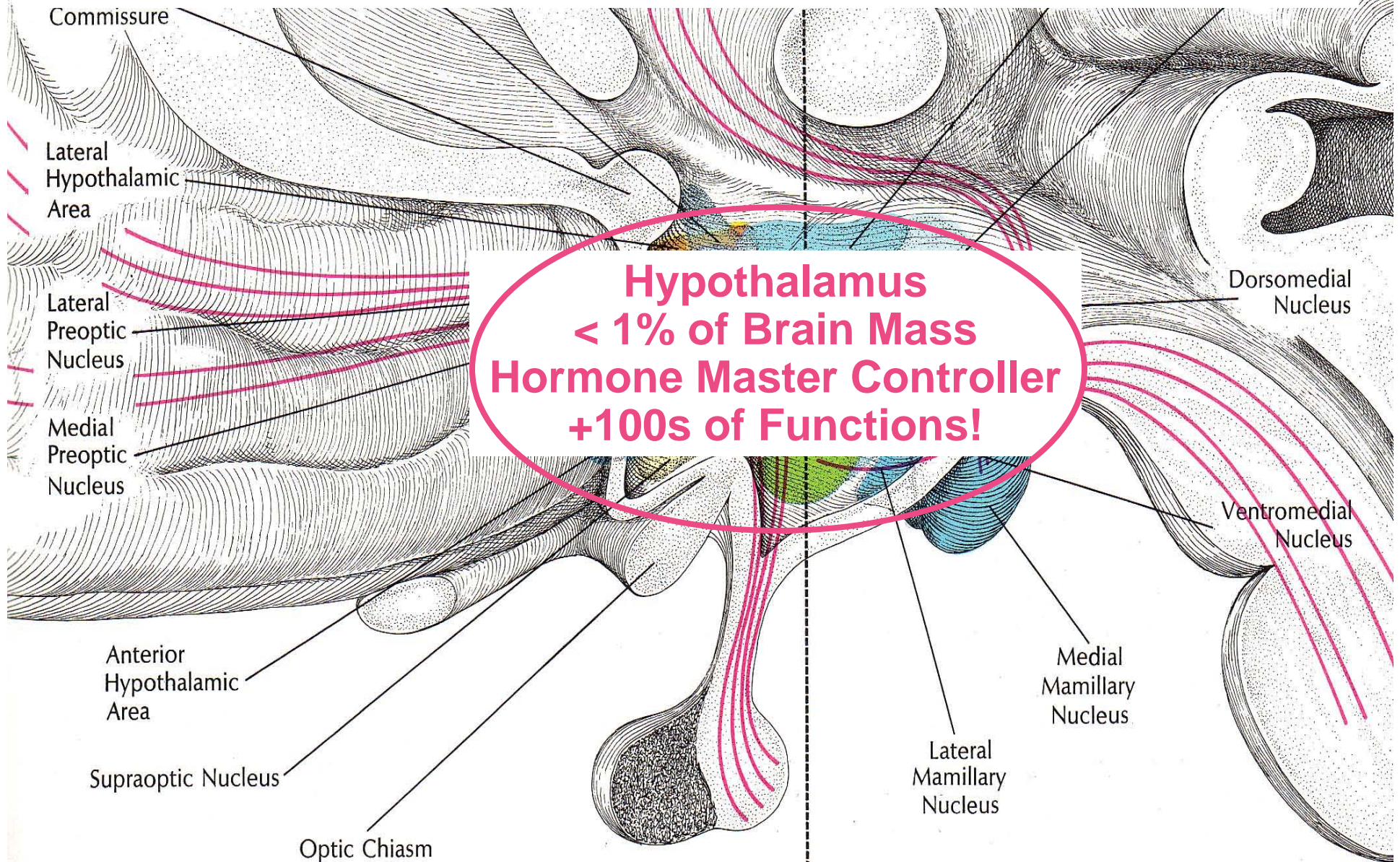
Endogenous



Hypothalamus & Pituitary: Intimate Relationship



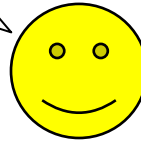
Good Things Come in Small Packages!



Kreiger & Hughes 1980

Personal data I can
use for a lifetime!!

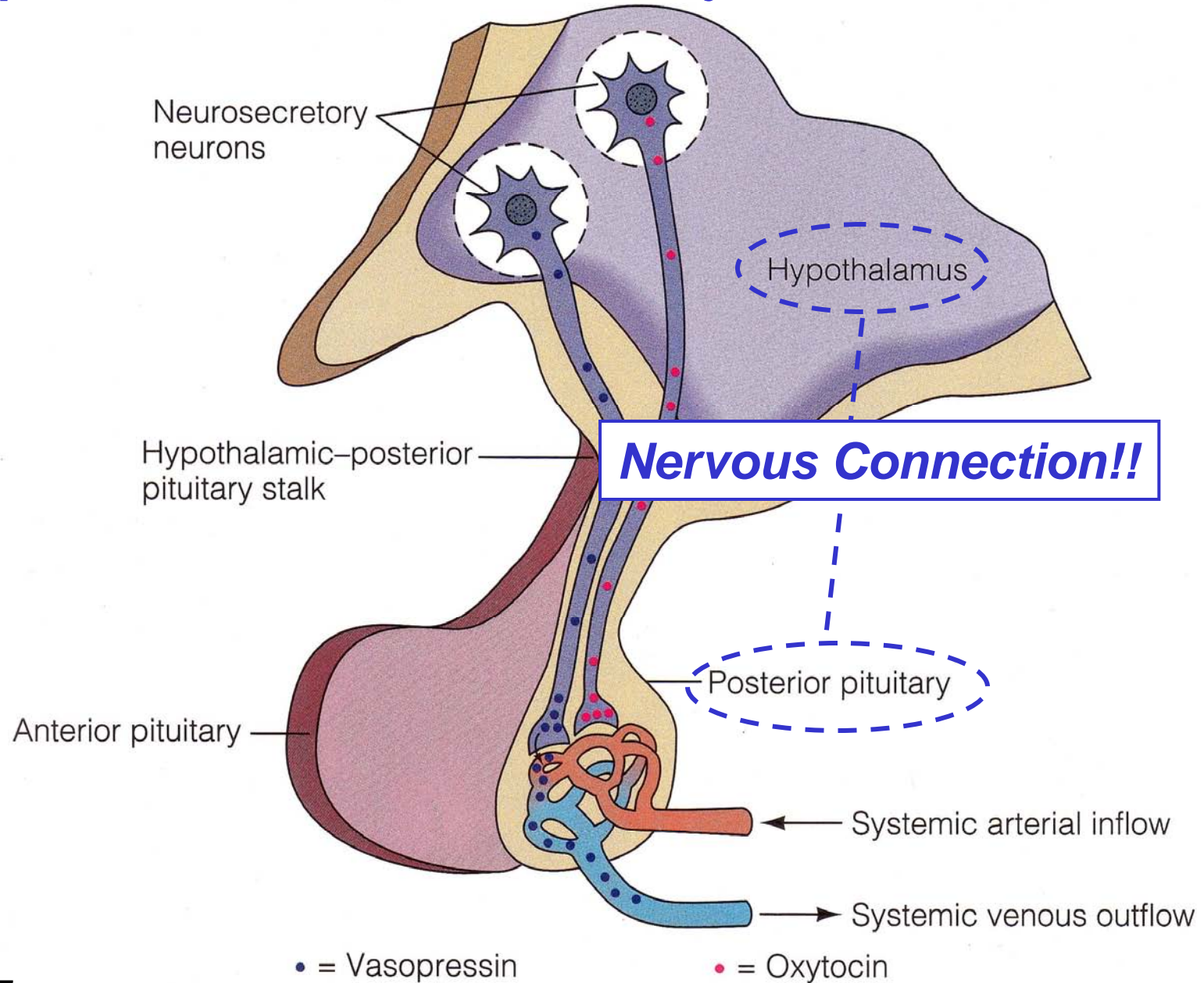
Heck yeah!



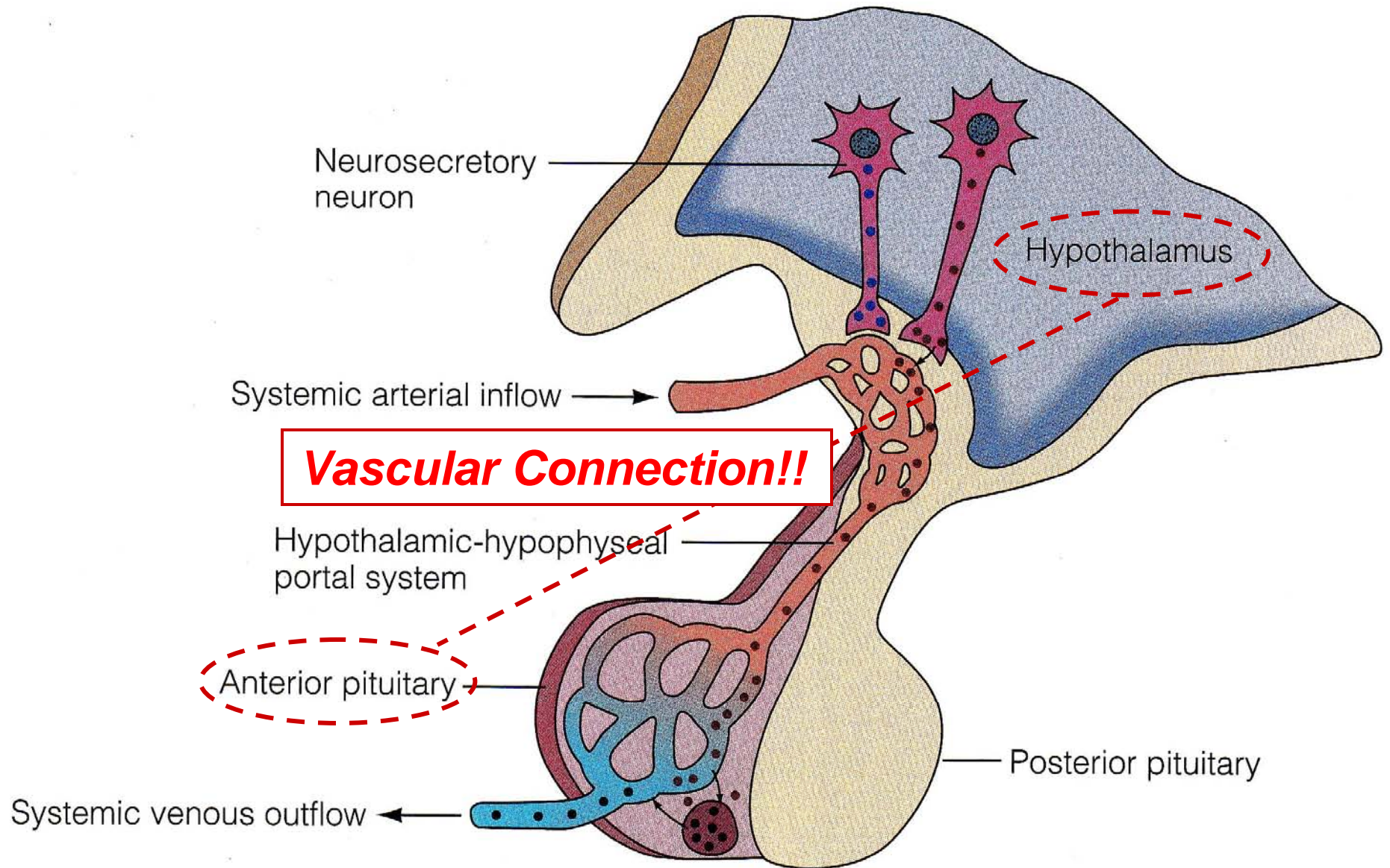
BI 121 Lecture 11

- I. **Announcements** Blood Chem Lab today! Fun day!!
Personal data!!! If you haven't already done so, please review Lab 5 in LM or on our website. Thanks sincerely!
Lab Manual & Exam I Remaining Returns. Q2 Exam I?
- II. **Safety & Techniques Review for Blood Chem Lab** Q?
- III. **Endocrine Connections** LS ch 17, DC Module 13, SI Fox +...
 - A. Posterior pituitary storage site DC p 108, LS fig 17-4 p 502
 - B. Anterior pituitary hormones DC pp 105-7, LS pp 502-6
 - C. Endocrine feedback + reflexes LS p 540 fig 17-7
 - D. GH: Body builder's dream? Fountain of youth?
LS pp 506-10, fig 17-10, 17-11
 - E. Peripheral endocrine organs DC pp 109-13, LS pp 513-36
 1. Pancreas (insulin – glucagon see-saw!)
 2. Thyroid
 3. Adrenals

Hypothalamus-Posterior Pituitary Nervous Connection!



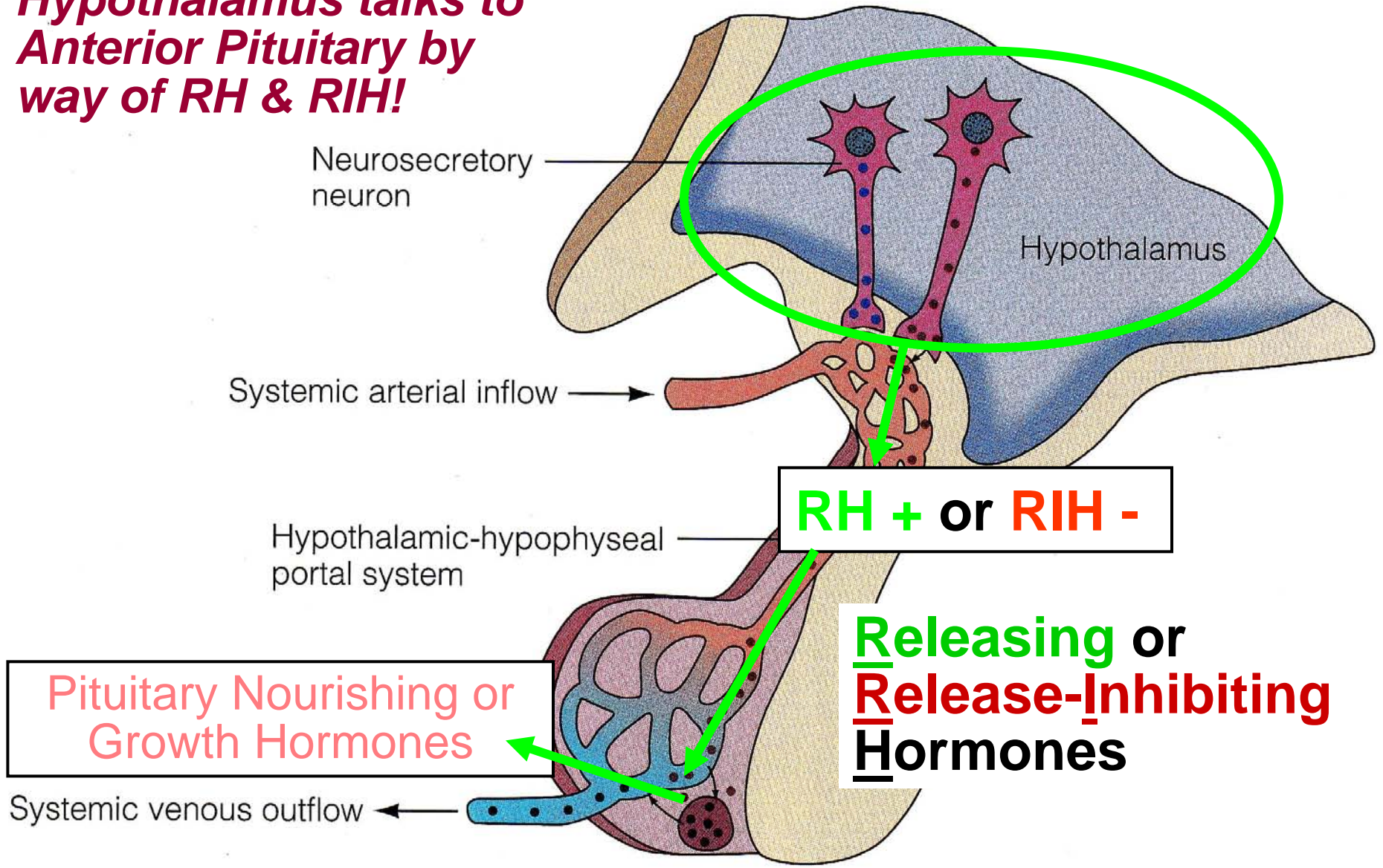
Hypothalamus-Anterior Pituitary Vascular Connection!



• = Hypophysiotropic hormones

• = Anterior pituitary hormone

Hypothalamus talks to Anterior Pituitary by way of RH & RIH!



RH + or RIH -

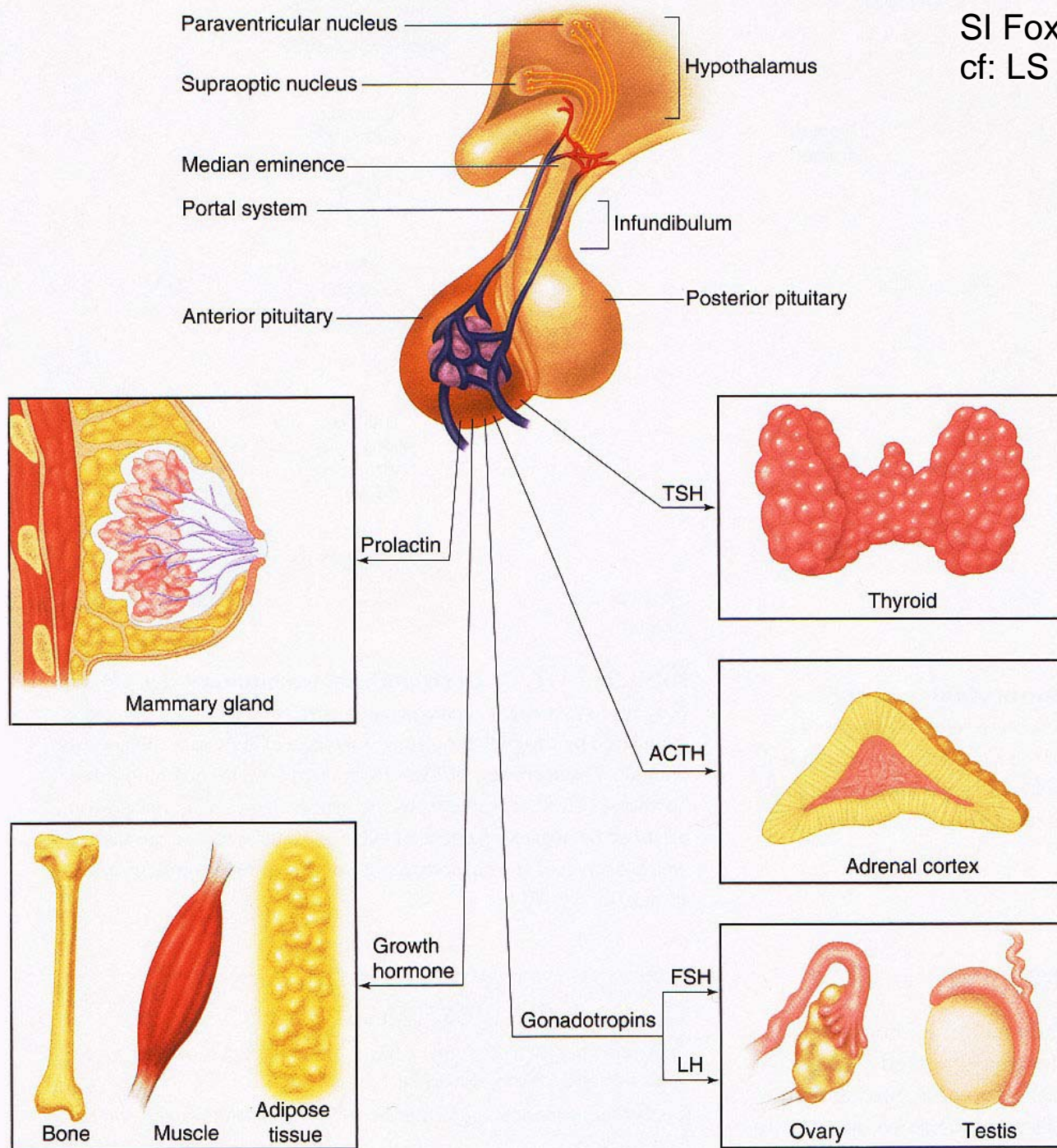
Releasing or Release-Inhibiting Hormones

Pituitary Nourishing or Growth Hormones

- = Hypophysiotropic hormones
- = Anterior pituitary hormone

Hypophysis ≡ Pituitary

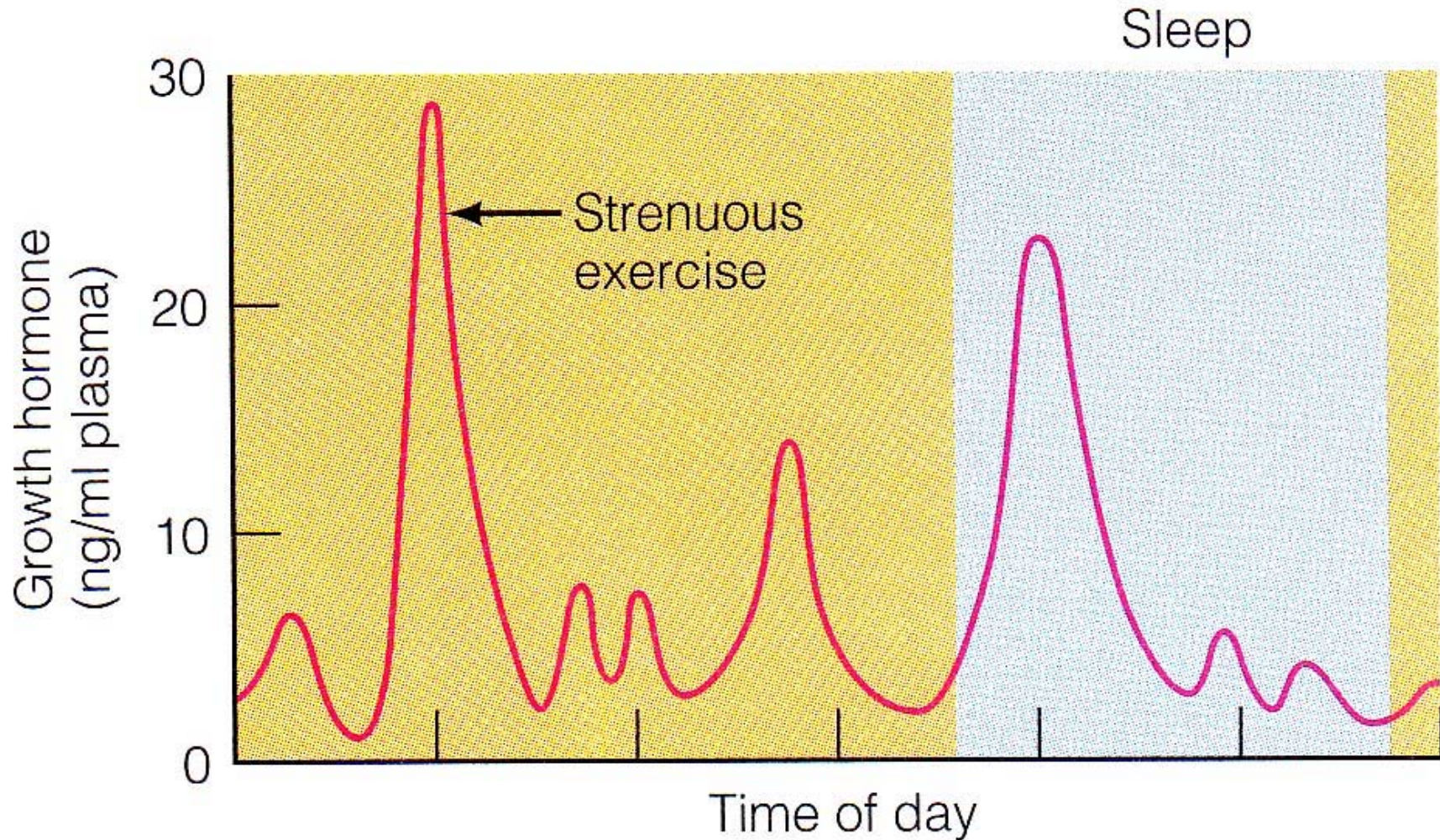
SI Fox 2008
cf: LS 2012 fig 17-5



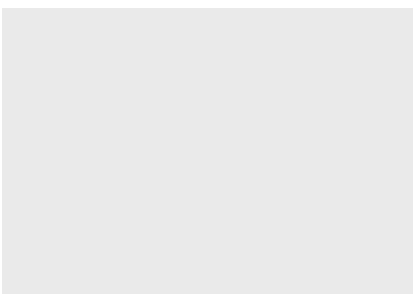
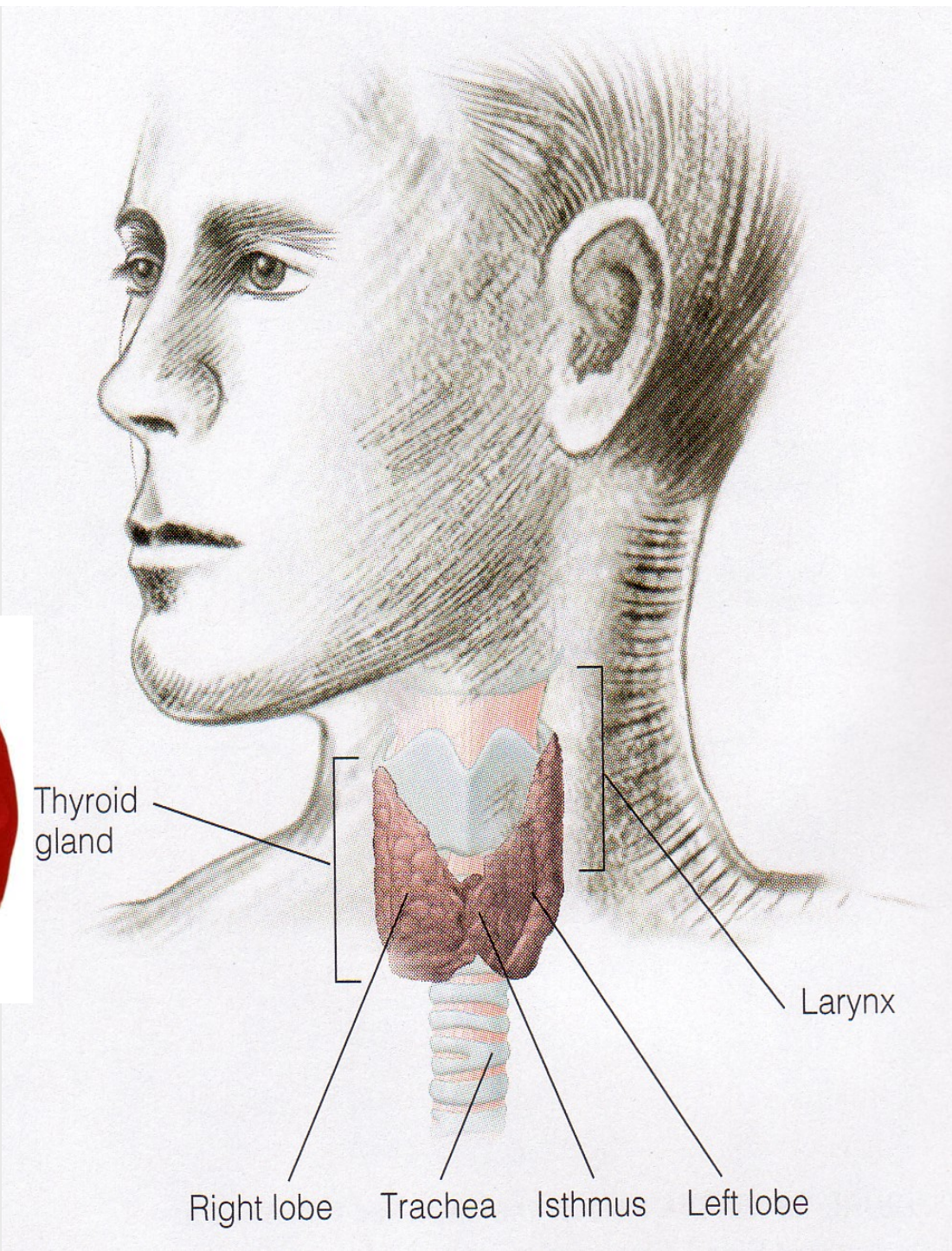
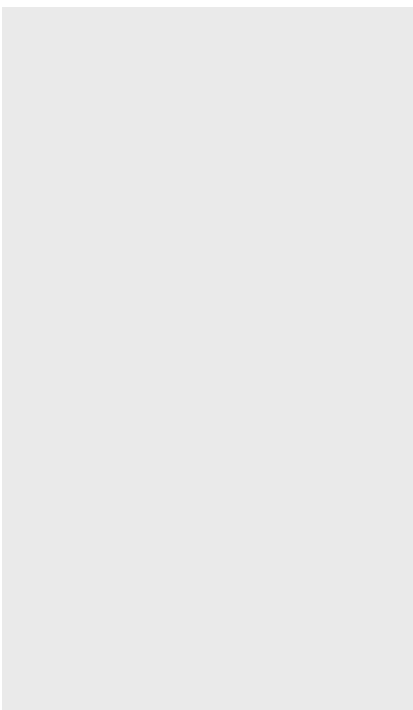
GH/STH Effects: Insulin Resistance/Type II Diabetes?

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

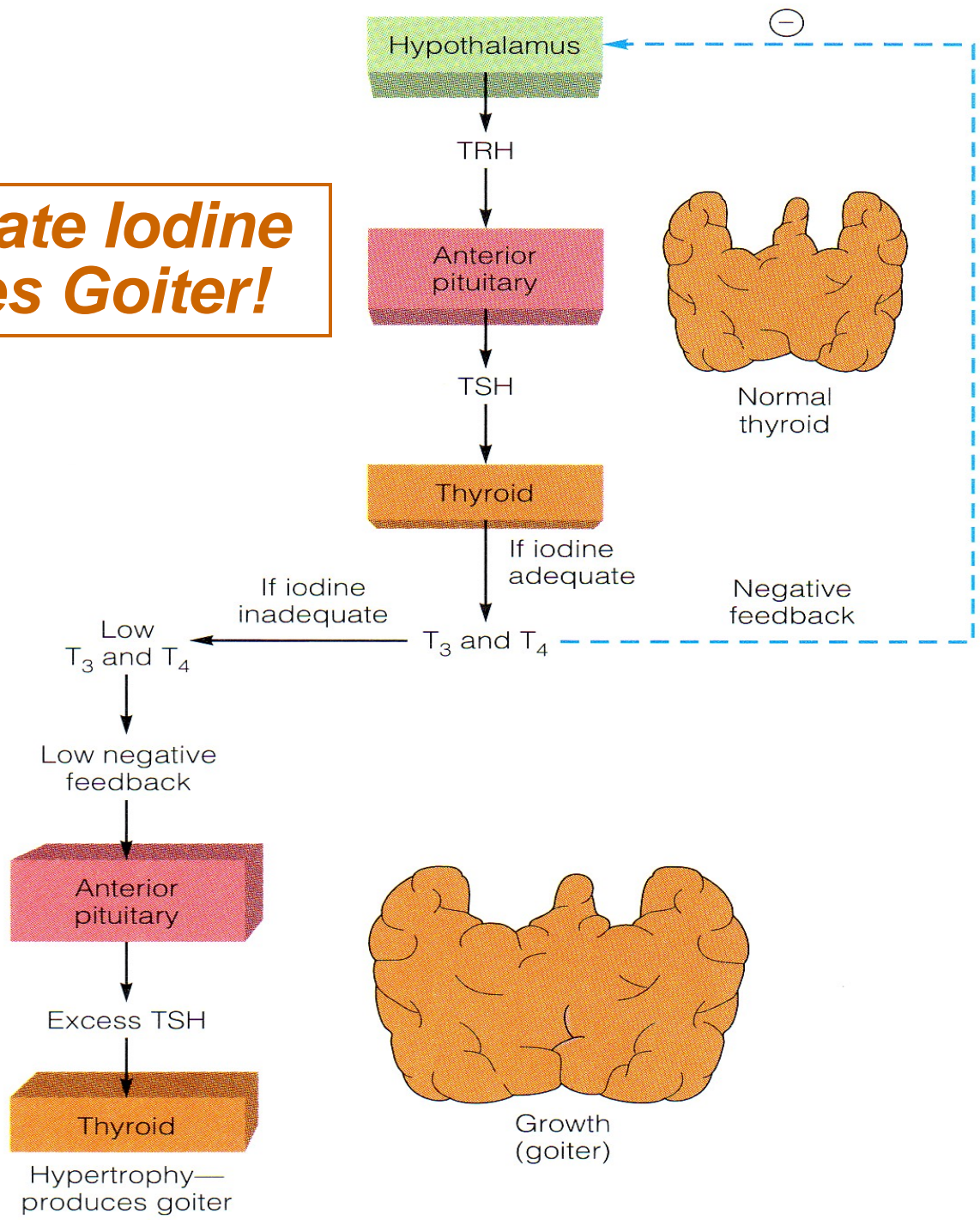
Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per milliliter

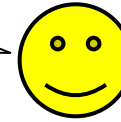


Inadequate Iodine Promotes Goiter!



BI 121 Lecture 12

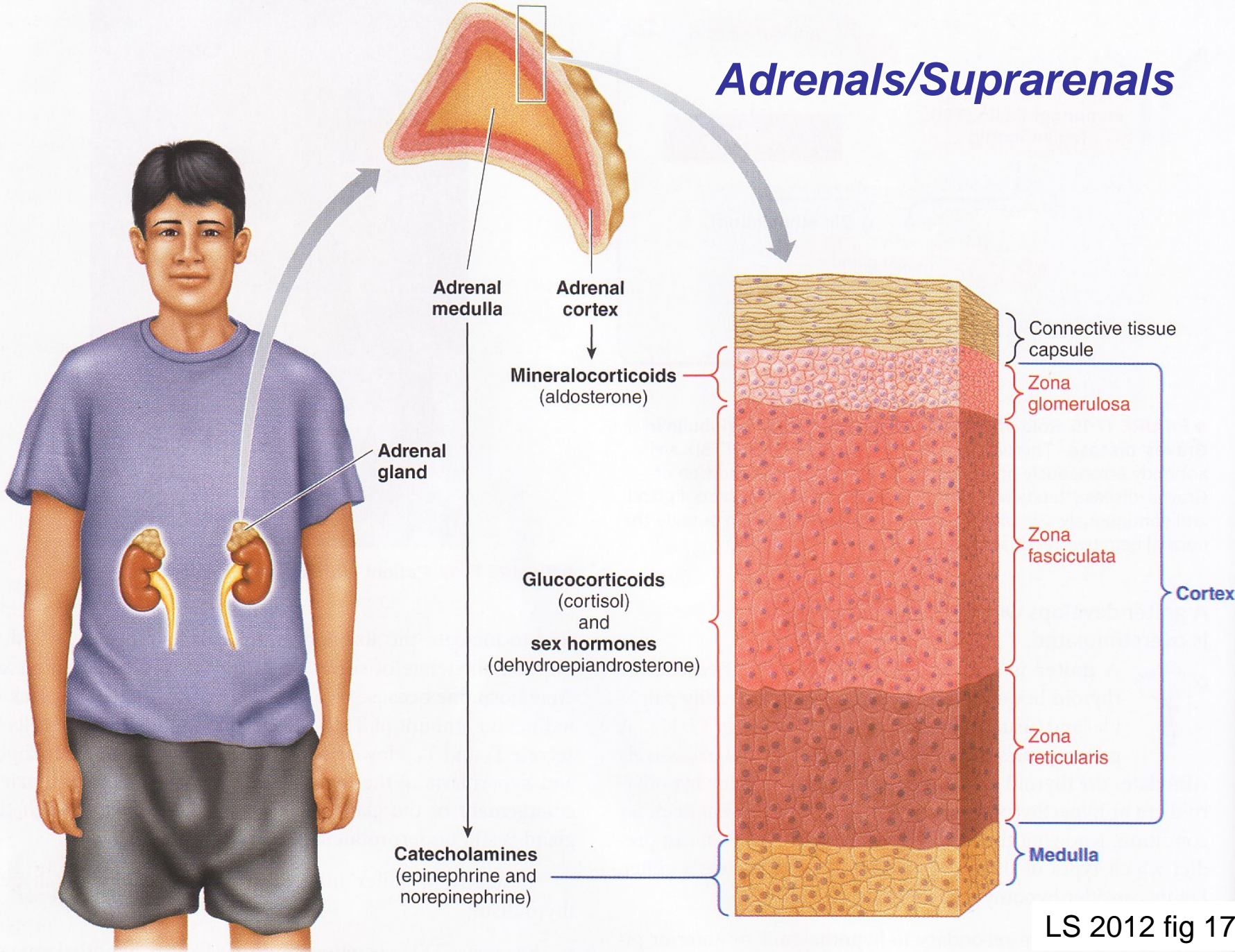
Thanks to you, Holly,
Precious, Sarah, & Andrew!



For your effort
& your 🩸 !!

- I. Announcements** Thanks for your help with blood lab!
Great job! No lab this week. Study for Exam II, Dec 8, Mon!
- II. Endocrine Connections** Adrenals/Suprarenals
LS pp 517-25 fig 17-18, 17-19; DC p 112 +...
- III. Introduction to the Nervous System** LS ch 5, DC Module 9
 - A. How is the nervous system organized? LS fig 5-1 DC p 67
 - B. Neurons? What kind? Classes? Velocity? LS fig 5-2, 5-4
 - C. What's myelin? How does it help? DC fig 9-3, LS pp 83-5
 - D. Brain structure & function DC fig 9-6 thru 9-10 pp 71-5 +...
 - E. **Protect your head with a helmet!** Bicycle head injury statistics, *NHTSA & BHSI* from 2011, the most recent yr
- IV. Autonomic Nervous System** LS ch 7 pp 178-85+...
 - A. Sympathetic vs Parasympathetic branches fig 7-3
 - B. Neurotransmitters & receptors fig 7-1 & 7-2, tab 7-2
 - C. Actions tab 7-1
 - D. Fight-or-flight stories!

Adrenals/Suprarenals



LS 2012 fig 17-18

BI 121!!



**Epinephrine
80%
Norepinephrine
20%**



Guyton & Hall 2000

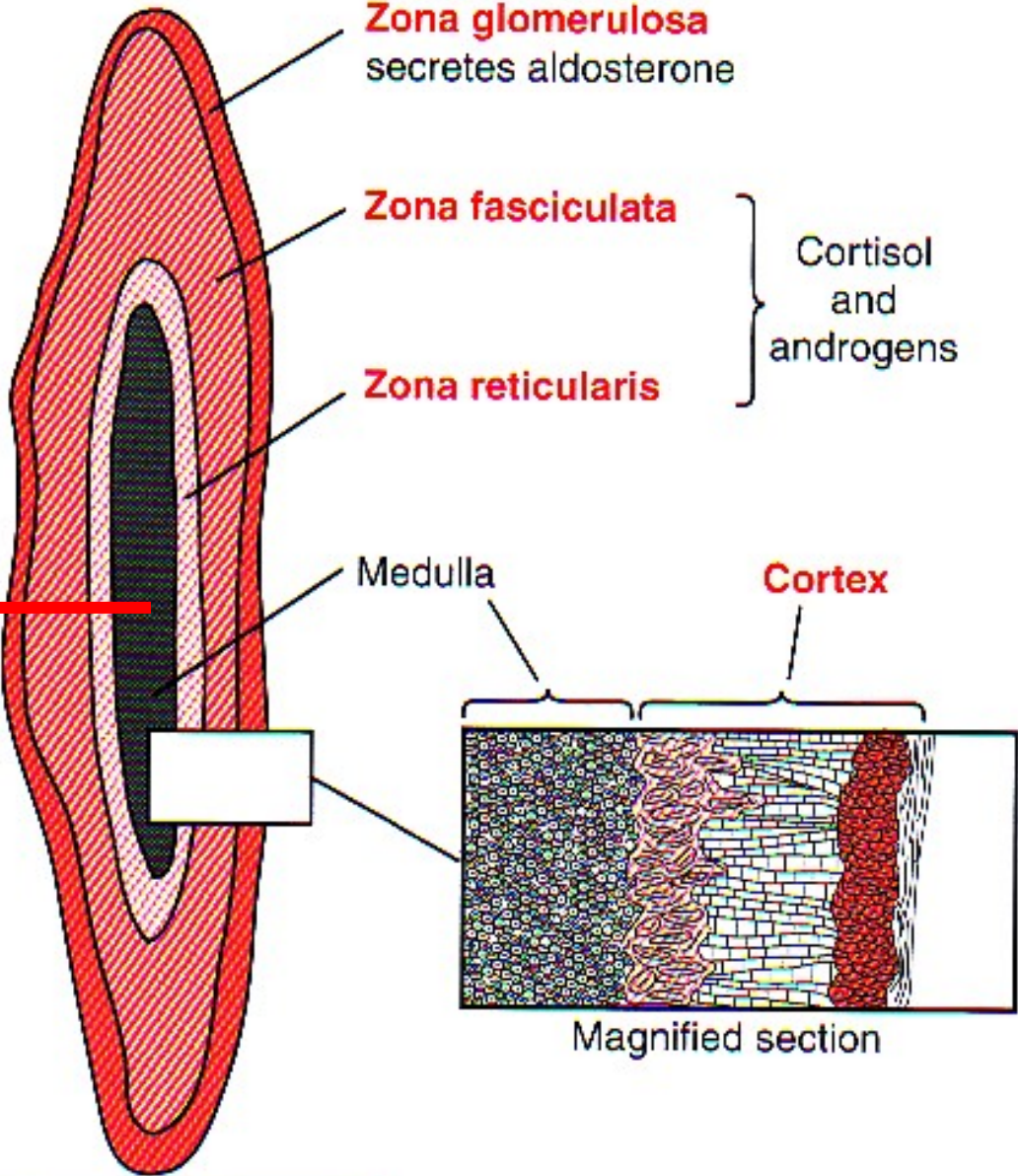
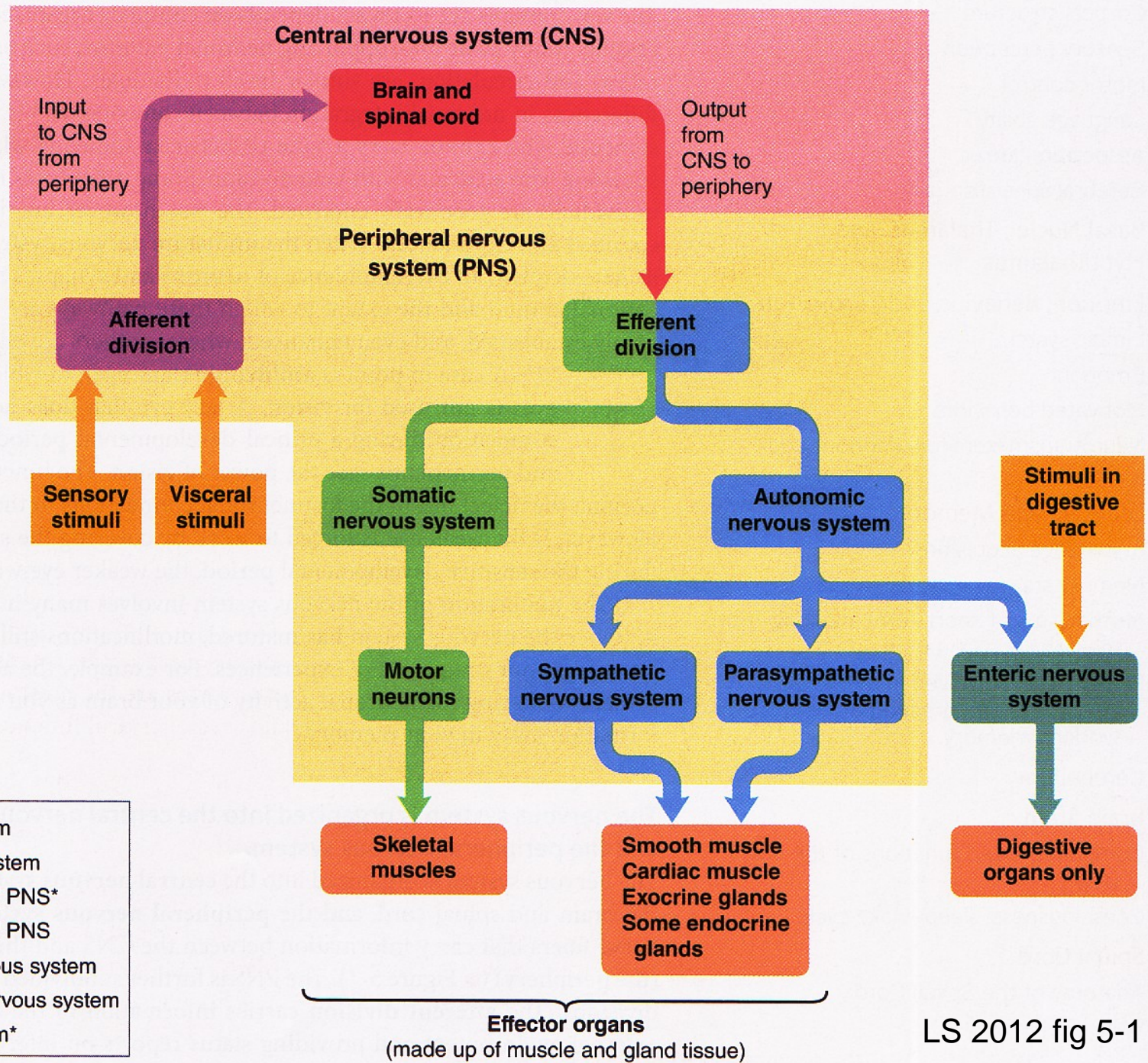
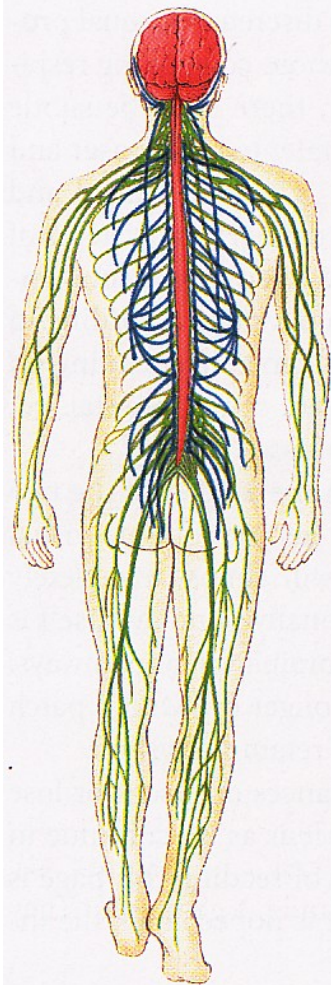
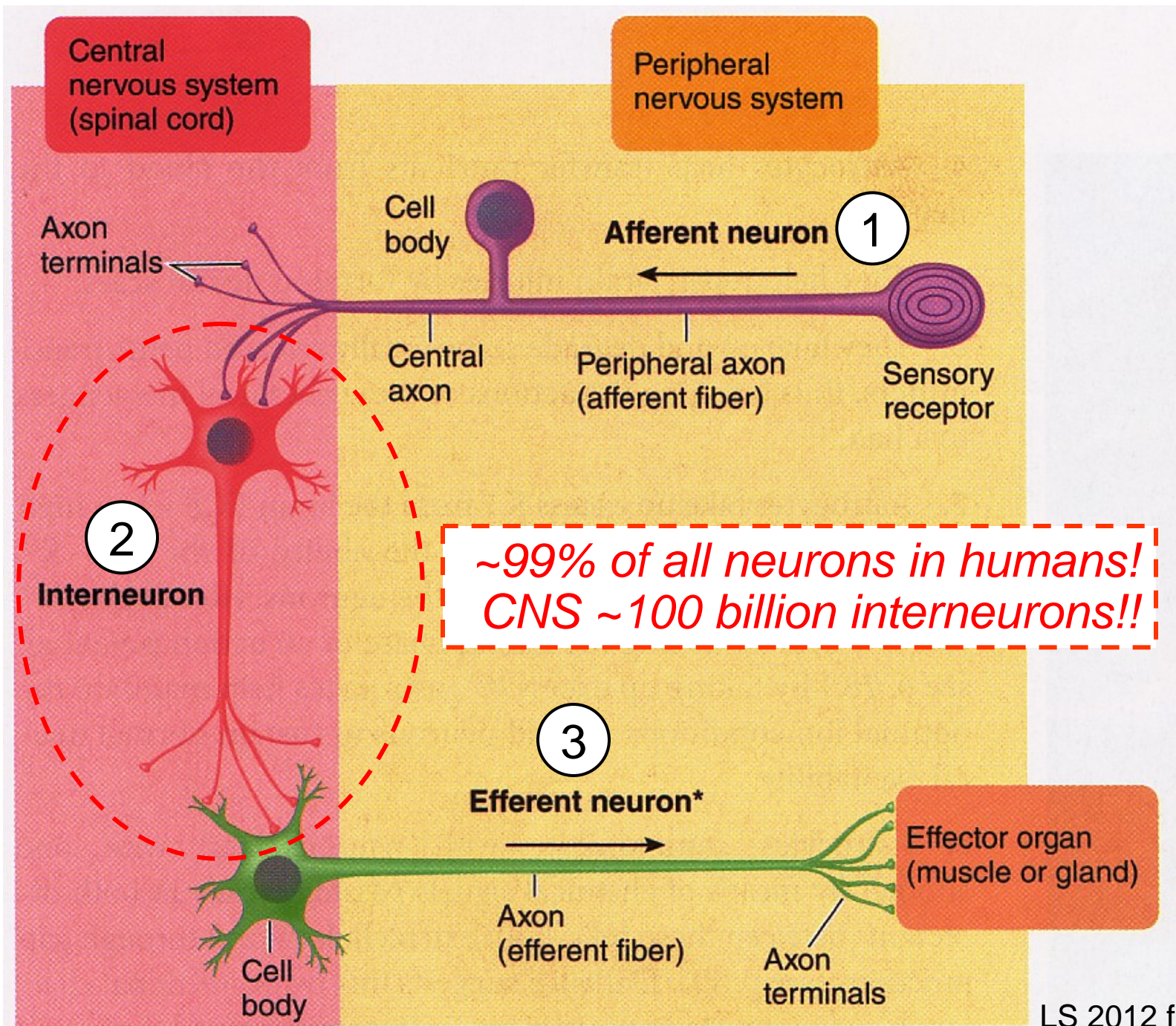


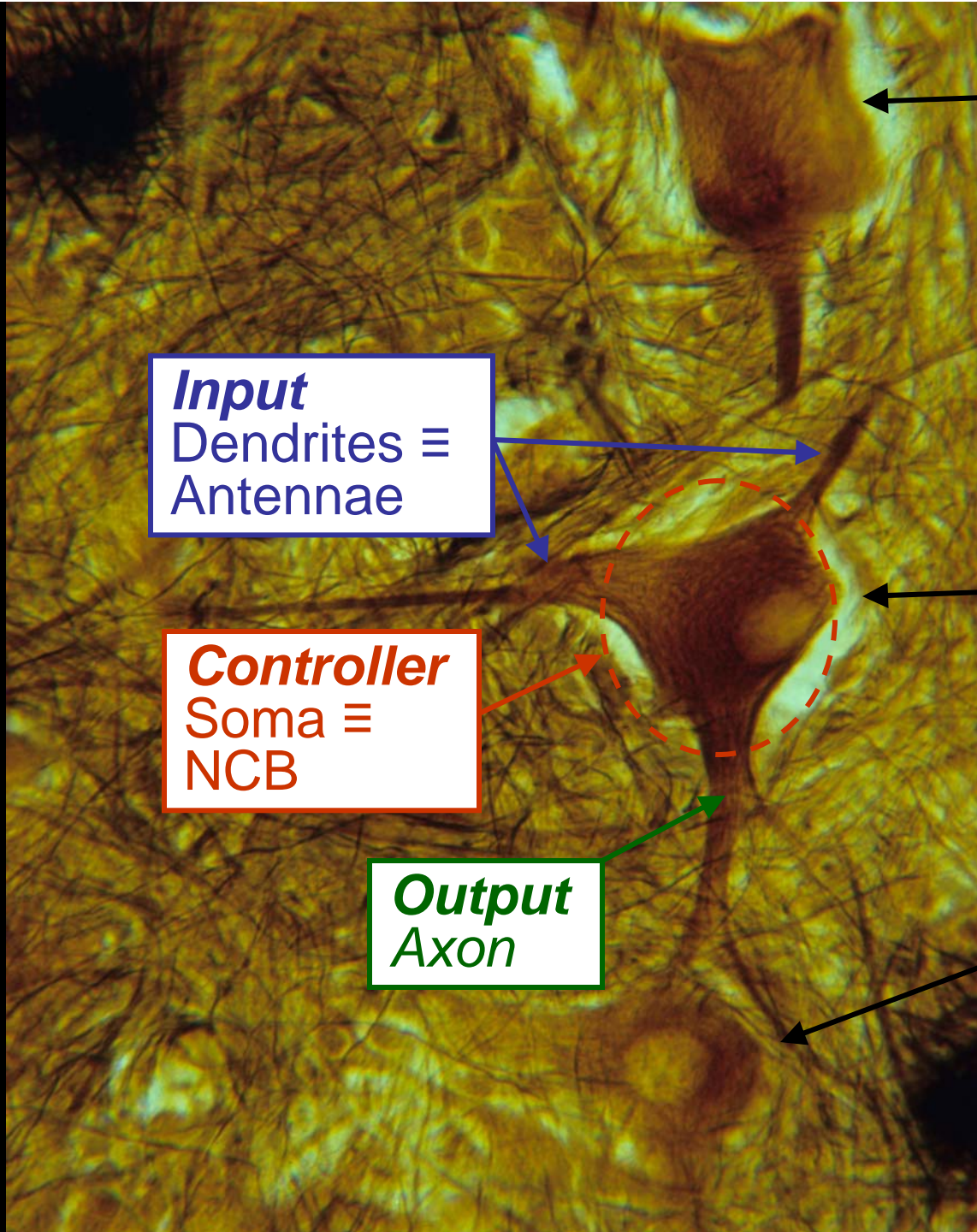
FIGURE 77 - 1

Secretion of adrenocortical hormones by the different zones of the adrenal cortex.





LS 2012 fig 5-2



Neuron 1

Input
Dendrites ≡
Antennae

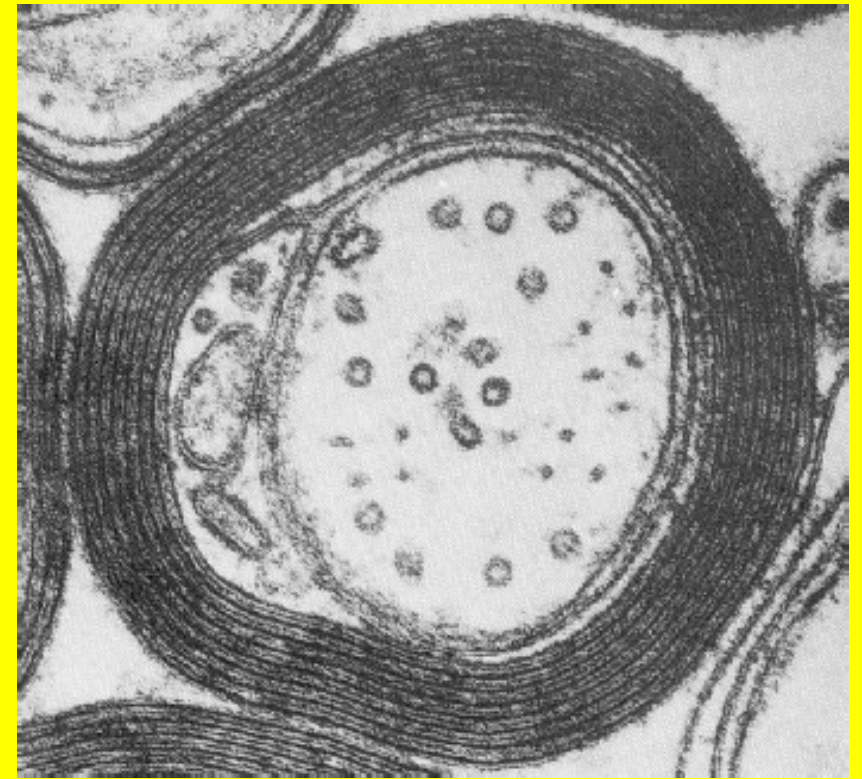
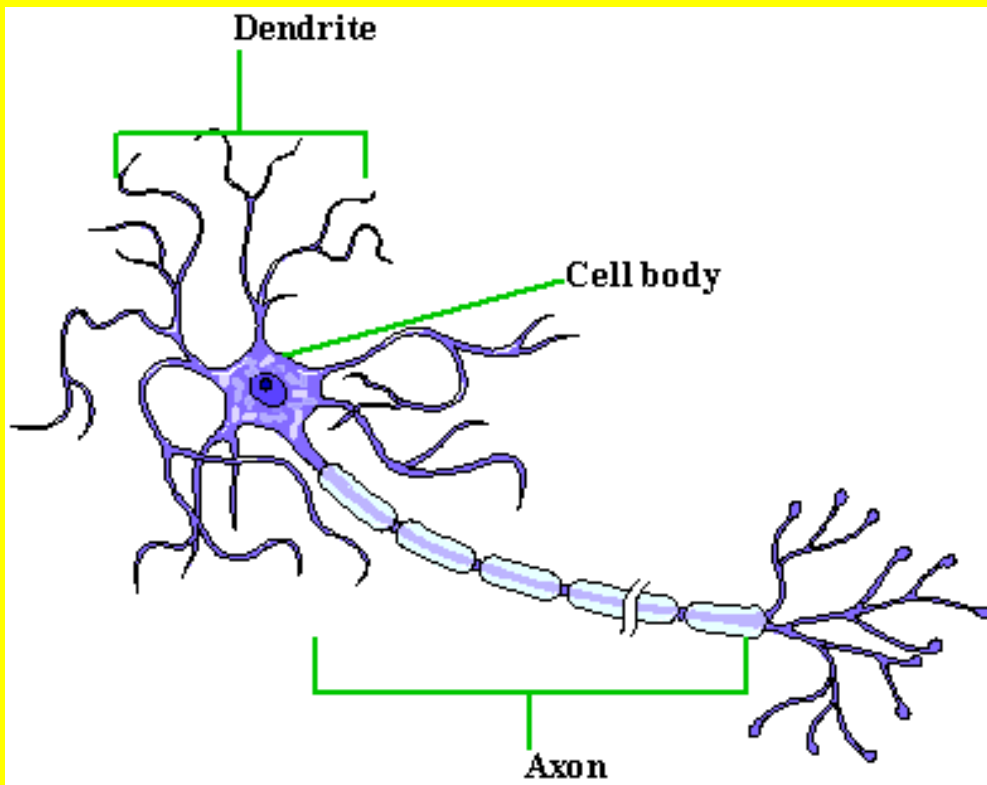
Neuron 2

Controller
Soma ≡
NCB

Output
Axon

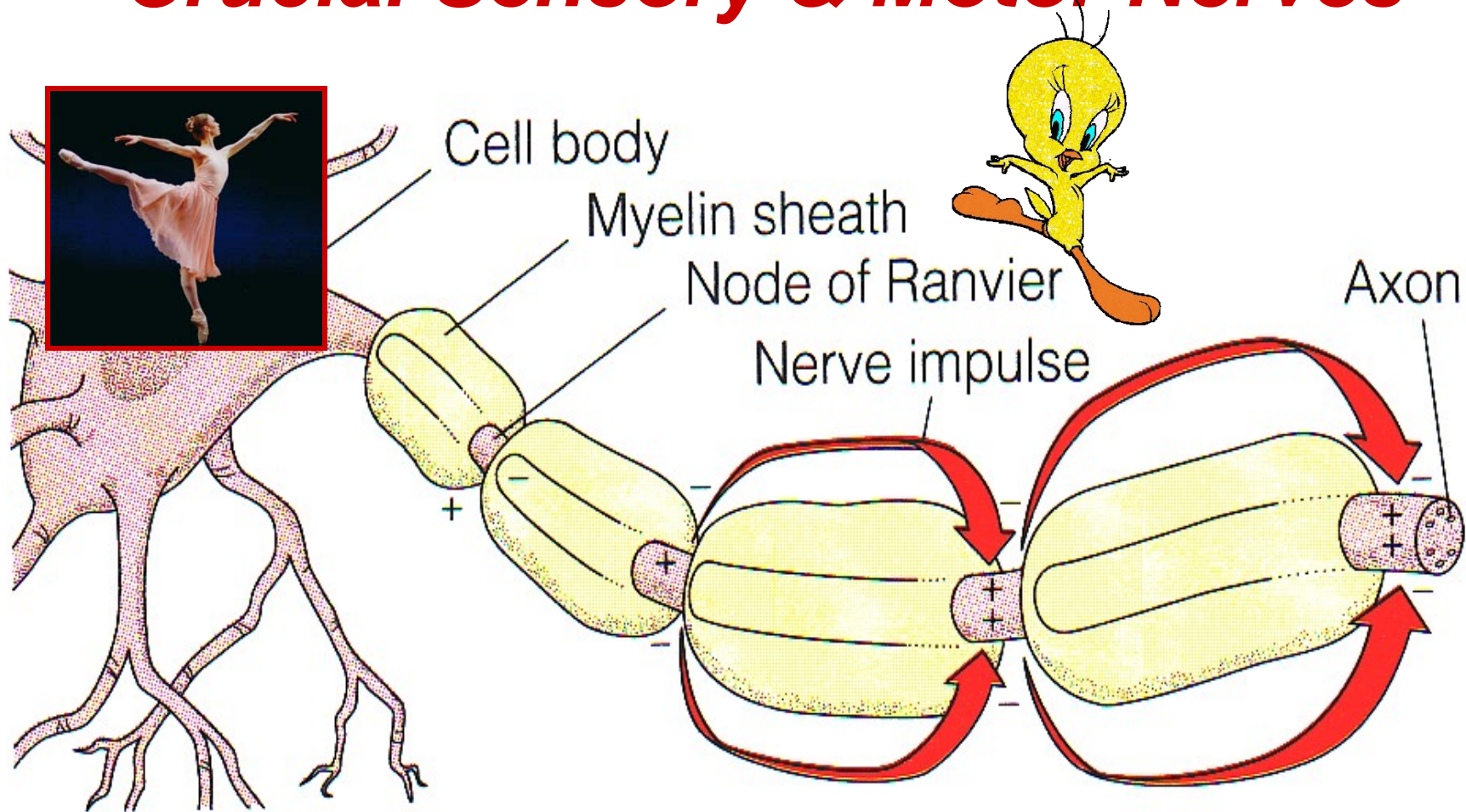
Neuron 3

What is myelin? Why is it important?

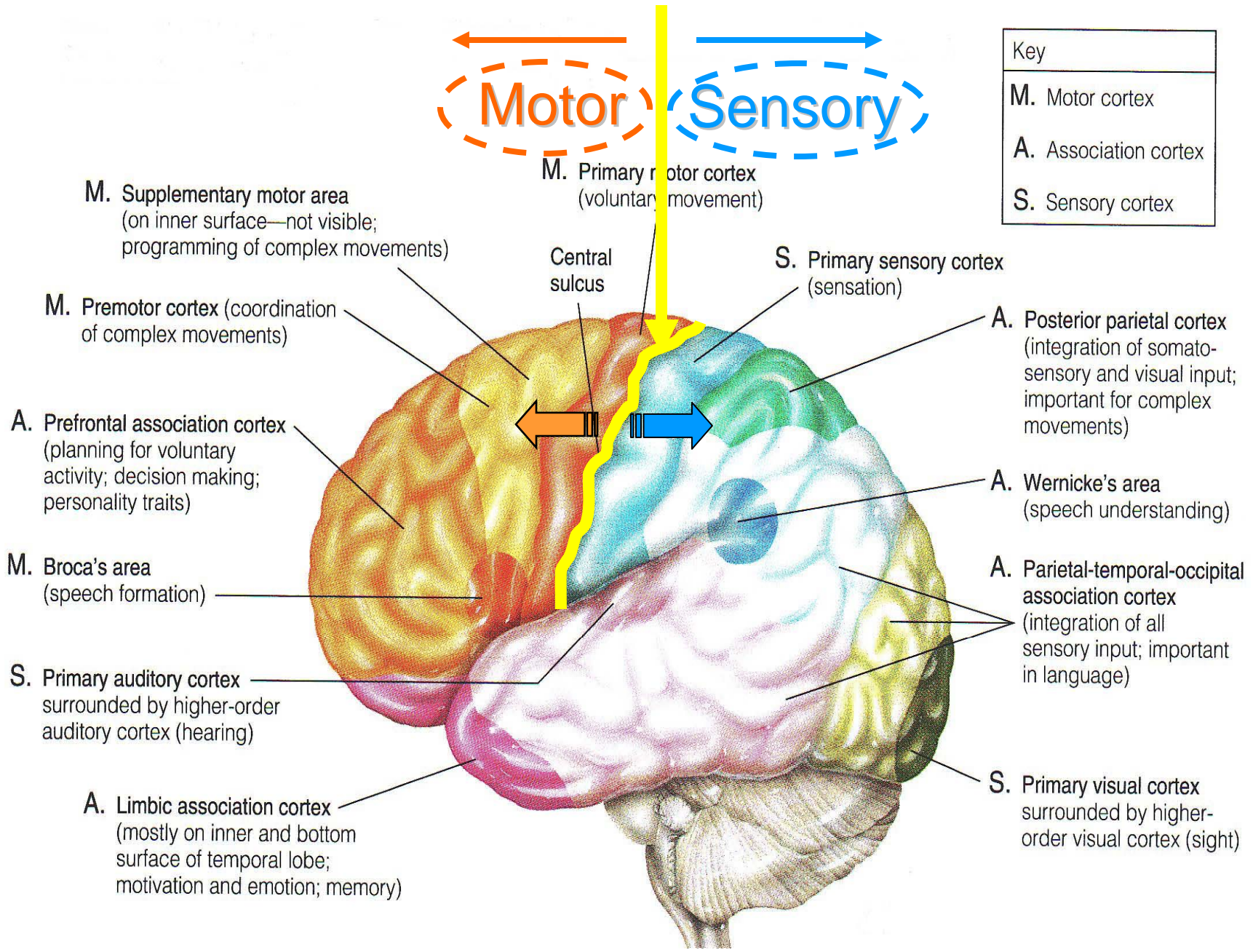


*Lipid insulative coat
↑ \vec{v} , conserves ions & ATP*

Saltatory/Leaping Conduction! Crucial Sensory & Motor Nerves



L. saltare to hop or leap! Fr. salt, sautier, sauté, leap, high air, vault



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



I'm gonna smash Exam II because
— I'm dedicated & I ♥ physiology!



BI 121 Lecture 13

I. Announcements No lab today – Study for Exam II!!

Optional Lab notebook check after last Lab 6, Mac pulmonary function testing (PFT) next Thursday. Q?

II. CNS Connections Protect your head with a helmet!

Bicycle head injury statistics, *NHTSA* & *BHSI*, 2011 data

III. Peripheral Nervous System LS sections of ch 3, 4, & 7

- A. Autonomic NS: Branches, neurotransmitters, receptors, actions, fight-or-flight stories ch 7 pp179-85
- B. Why are nerve & muscle unique? ch 4 p 71
- C. How do excitable cells signal? ch 3 pp62-7; ch 4 pp74-83
- D. How does the signal cross the nerve-muscle gap?
ch 7 p 185-92 fig 7-5 p 190
 1. Ca²⁺ bones!...but what else? p 190
 2. What do black widow spider venom, botulism, curare & nerve gas have in common? Botox pp 189-92



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



<http://www-nrd.nhtsa.dot.gov/Pubs/811743.pdf>

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

~540,000 bicyclists/yr visit emergency rooms

67,000 head injuries, 1 in 8 brain injuries

677 cyclists died in 2011 \equiv 2% of all traffic fatalities

9% of deaths children \leq 14 yr, 69% σ

> 54,000 cyclists have died since 1932

As of 2012, the population of

Albany, OR 51,322

Corvallis, OR 54,998

Springfield, OR 59,869



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

Helmets may reduce head & brain injury risk by 66-88%!

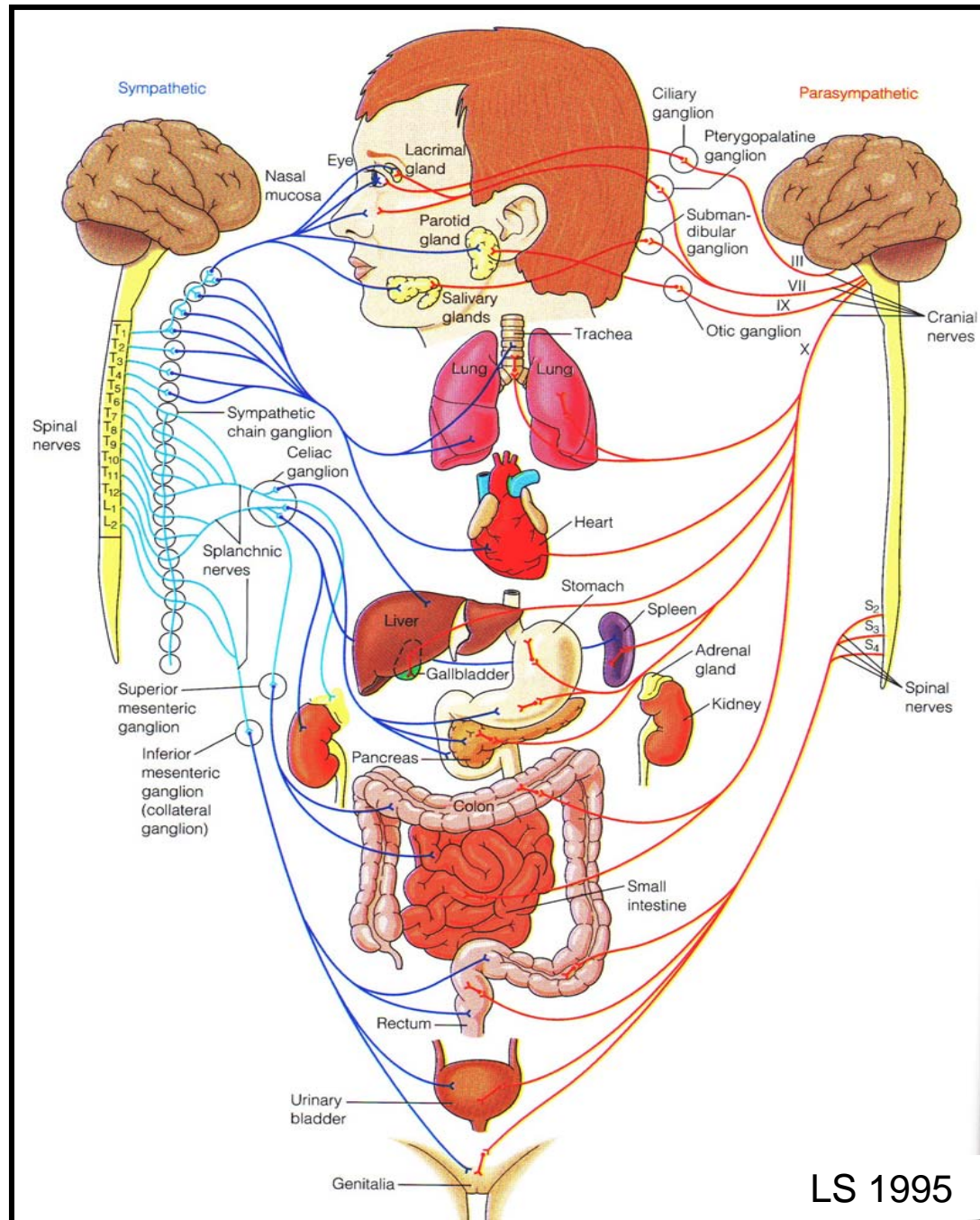
~\$81 million/yr = direct injury costs from not using helmets!

Autonomic Nervous System

Why overlap or dual innervation?

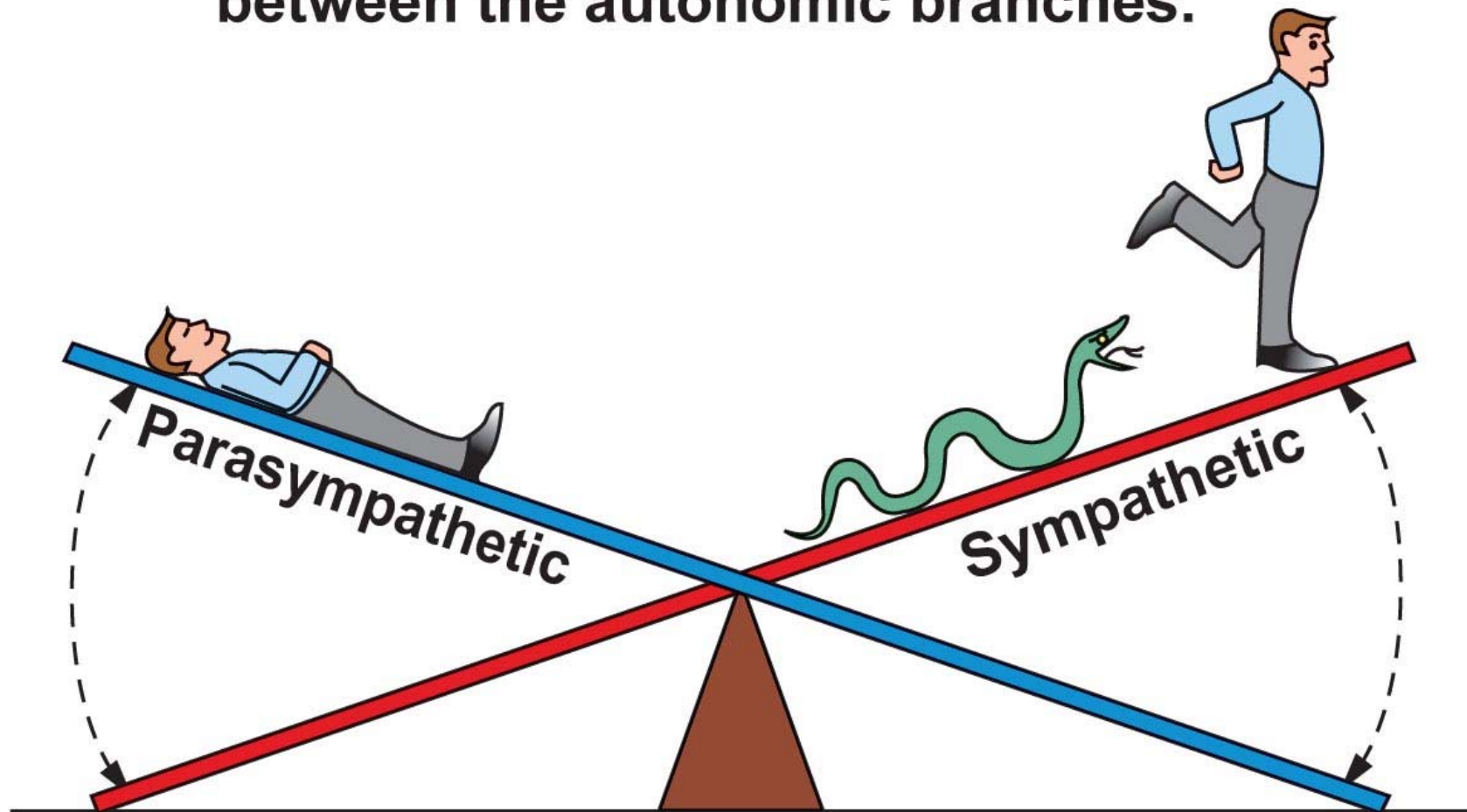
Fine-tune control & safety!

cf: LS 2012 fig 7-3



LS 1995

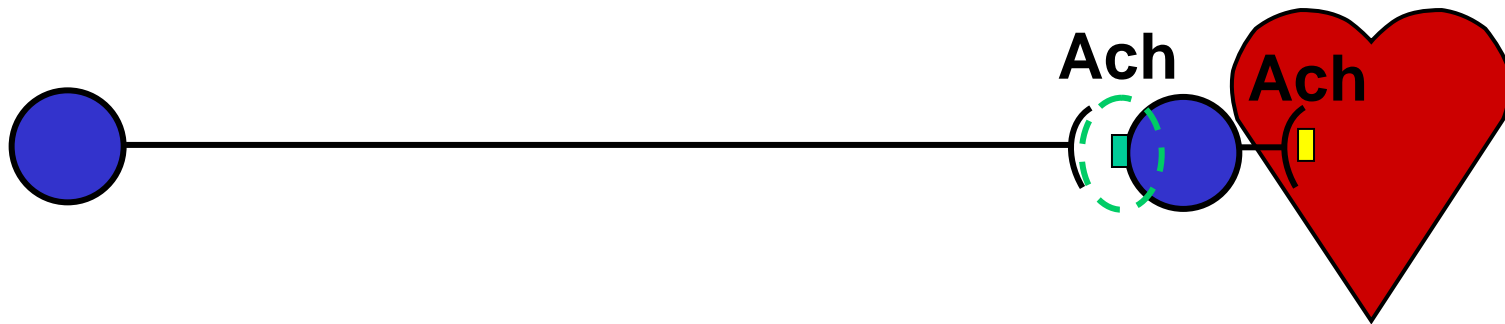
Homeostasis is a dynamic balance between the autonomic branches.



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

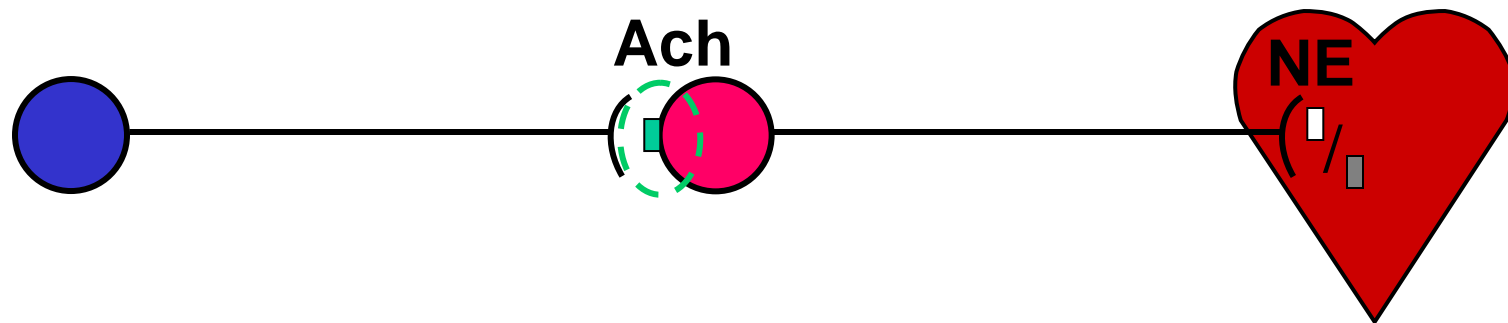
**Fight-or-flight:
Sympathetic activity
dominates.**

Parasympathetic



Ach = Acetylcholine
■ = Nicotinic Receptor
■ = Muscarinic Receptor

Sympathetic



NE = Norepinephrine
□ = α Receptor (α_1 , α_2)
■ = β Receptor (β_1 , β_2)

Nicotine activates both Sympathetic & Parasympathetic post-ganglionic neurons!

Problem?



Like hammering the gas pedal & brake at the same time!!

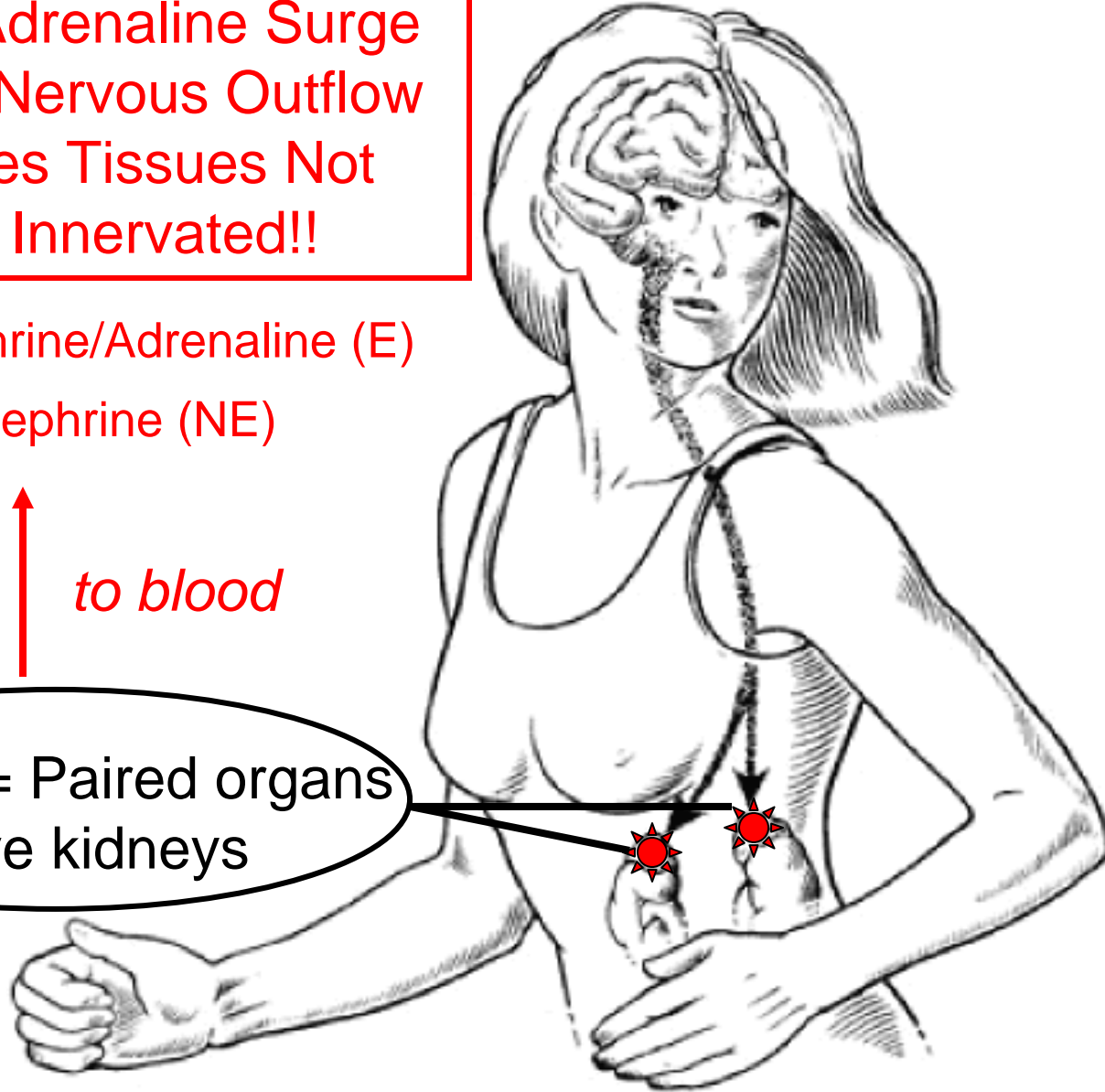


Hormonal Adrenaline Surge
Reinforces Nervous Outflow
& Accesses Tissues Not
Directly Innervated!!

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

Output ↑ *to blood*

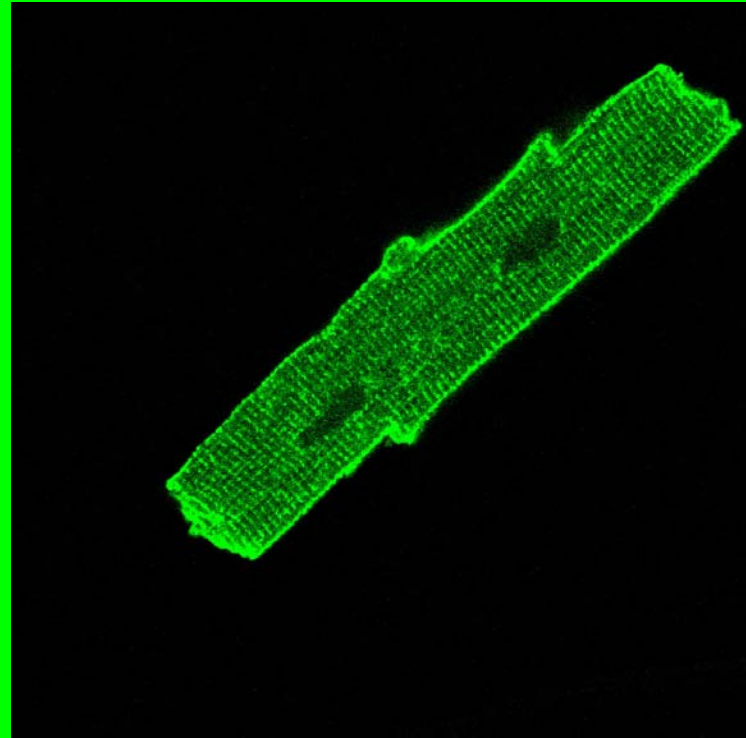
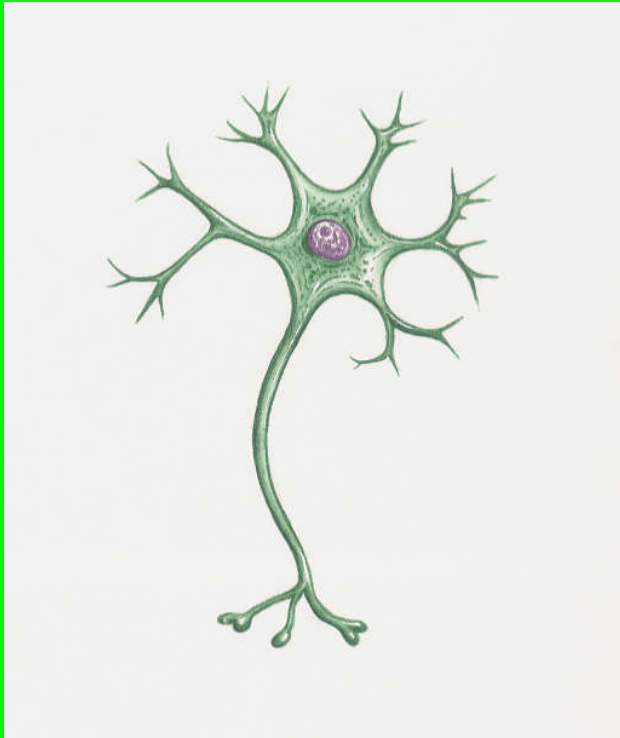
Adrenals = Paired organs
above kidneys



▲ **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

Why are nerve & muscle unique?



They are excitable!!

Action Potentials \equiv Spikes \equiv Impulses

Ultra-short reversal of membrane potential

Only in nerve and muscle cells

Maintains strength over distance

Primary way nerves & muscles communicate!

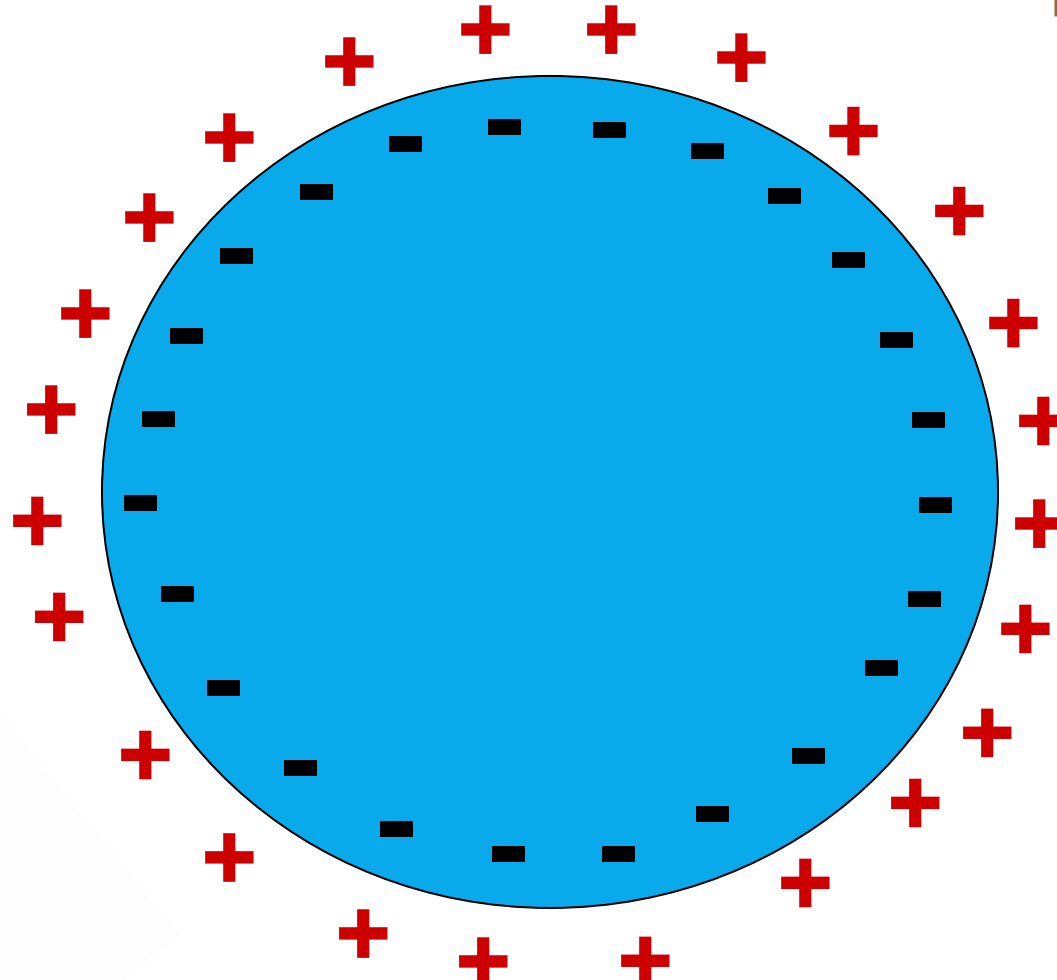
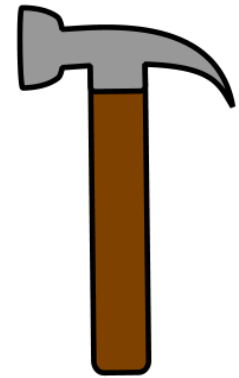


Stimulate Cell @ Rest

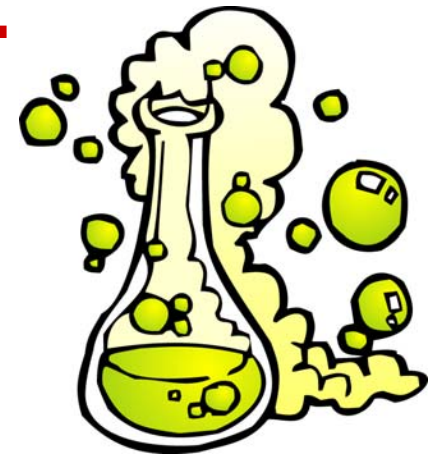
Thermal



Mechanical



1

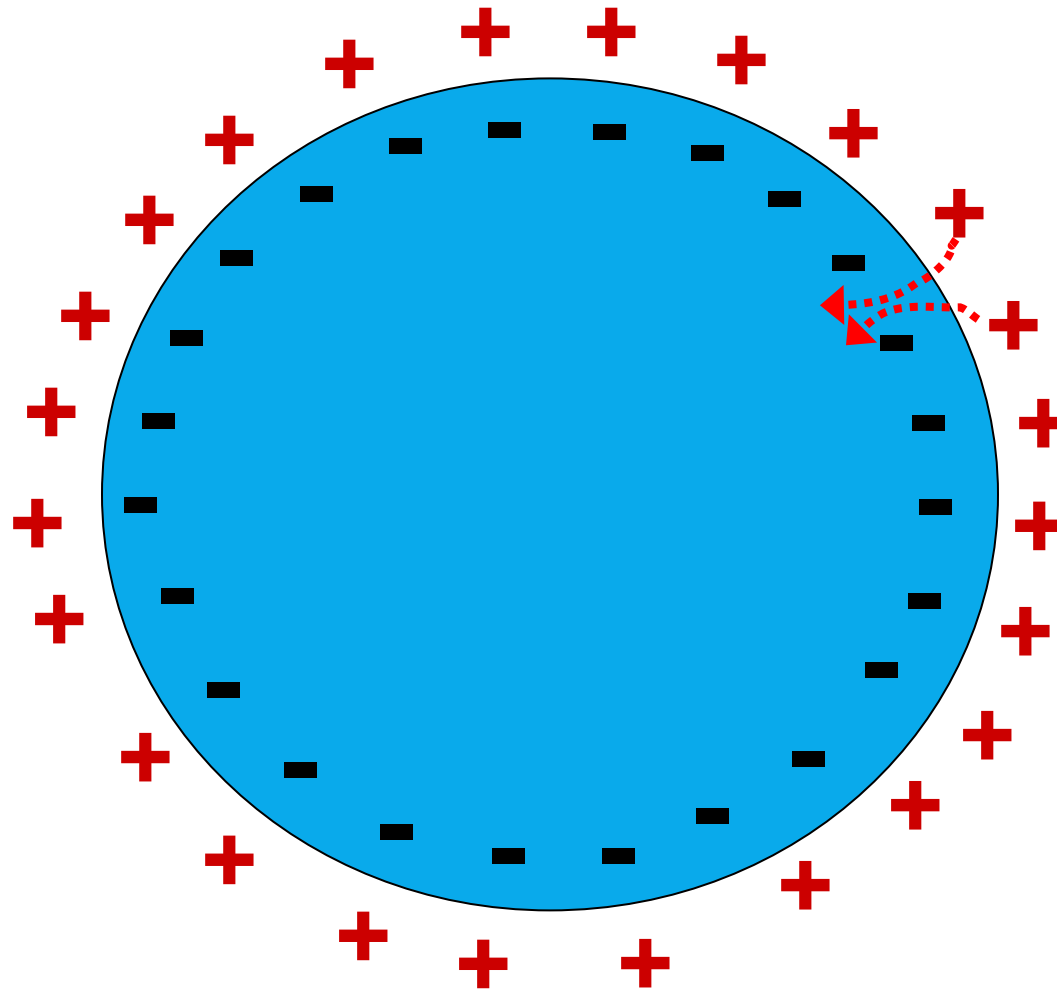


Electrical



Chemical

Changes Cell Membrane Permeability to Sodium/Na⁺!



3

+ Charges/Na⁺ Rushes In!

Exam II is coming! I'll be ready!!...

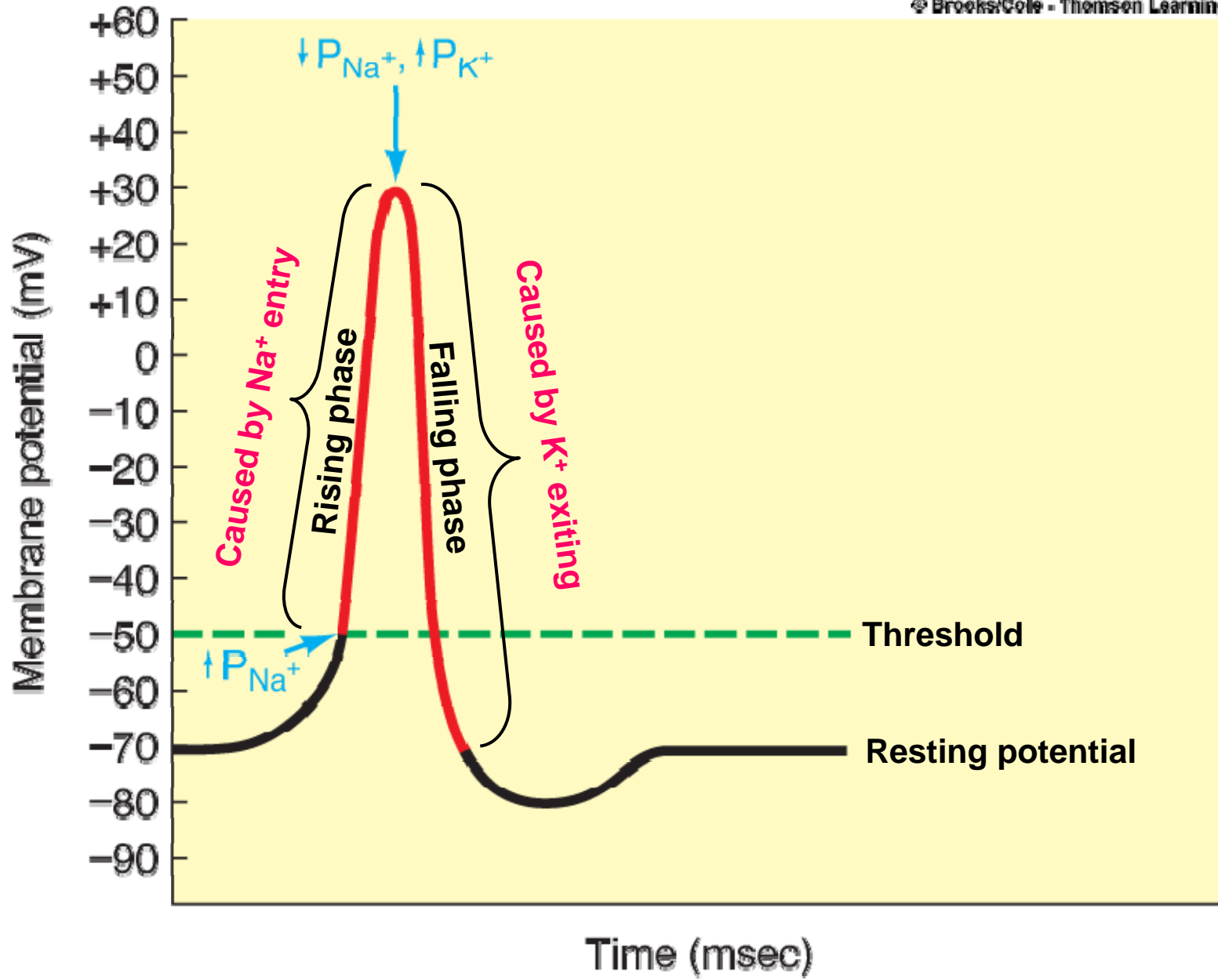
BI 121 Exam II!

BI 121 Lecture 14

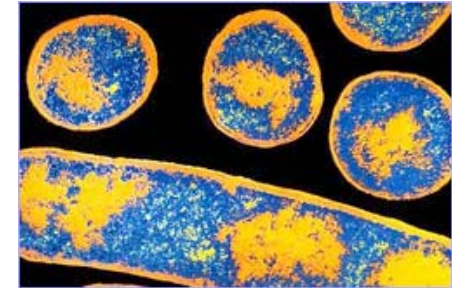
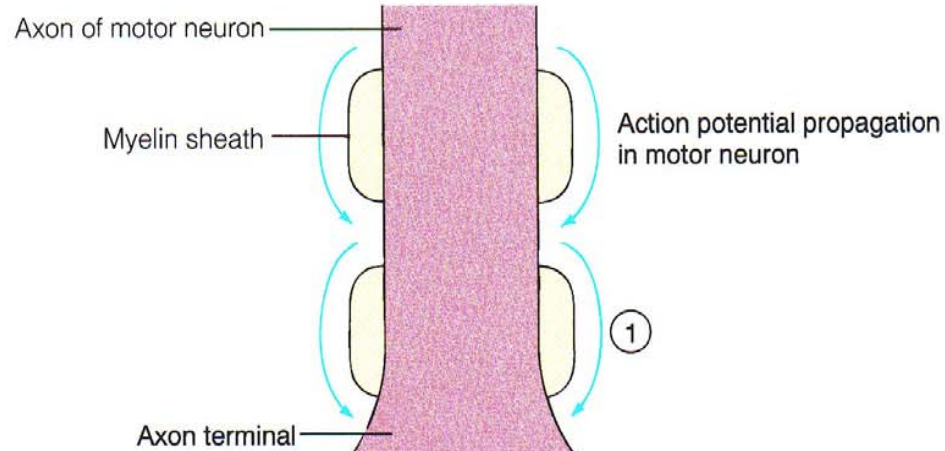


- I. **Announcements** Last Lab 6, Pulmonary Function Testing + optional notebook ✓ this Thurs. **Exam II Mon, Dec 8, 8 am Q?**
- II. **Action Potential + Neuromuscular Junction Connections** LS 7
What's an AP? What do black widow spider venom, botulism, curare & nerve gas have in common? LS fig 7-5 p190 Botox?
- III. **Muscle Structure-Function & Adaptation** LS ch 8 + DC Mod 12
 - A. Muscle types: cardiac, smooth, skeletal LS fig 8-1 pp194-6
 - 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. 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 & environment?**
 - J. Endurance vs. strength training continuum? fiber types...

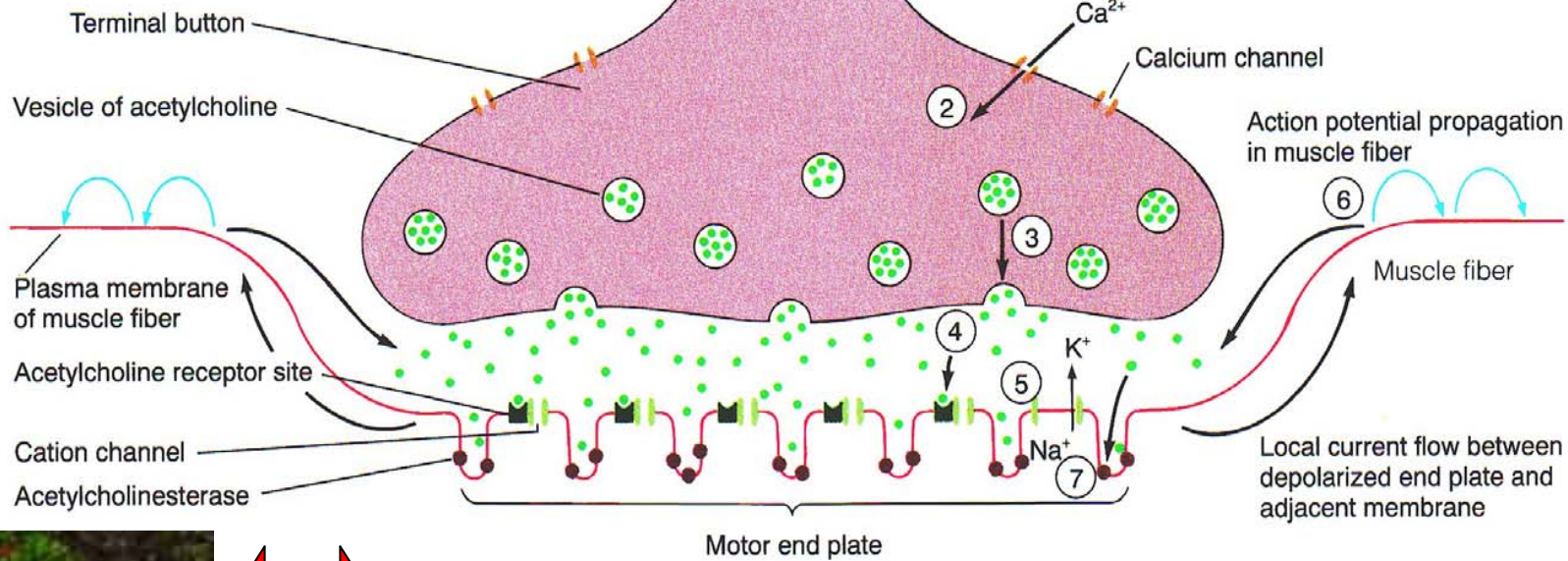




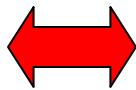
↑ 3



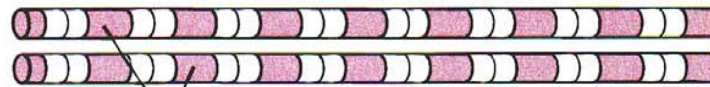
~~3~~



~~7~~



4



Contractile elements within muscle fiber



Skeletal Muscles

Homeostasis

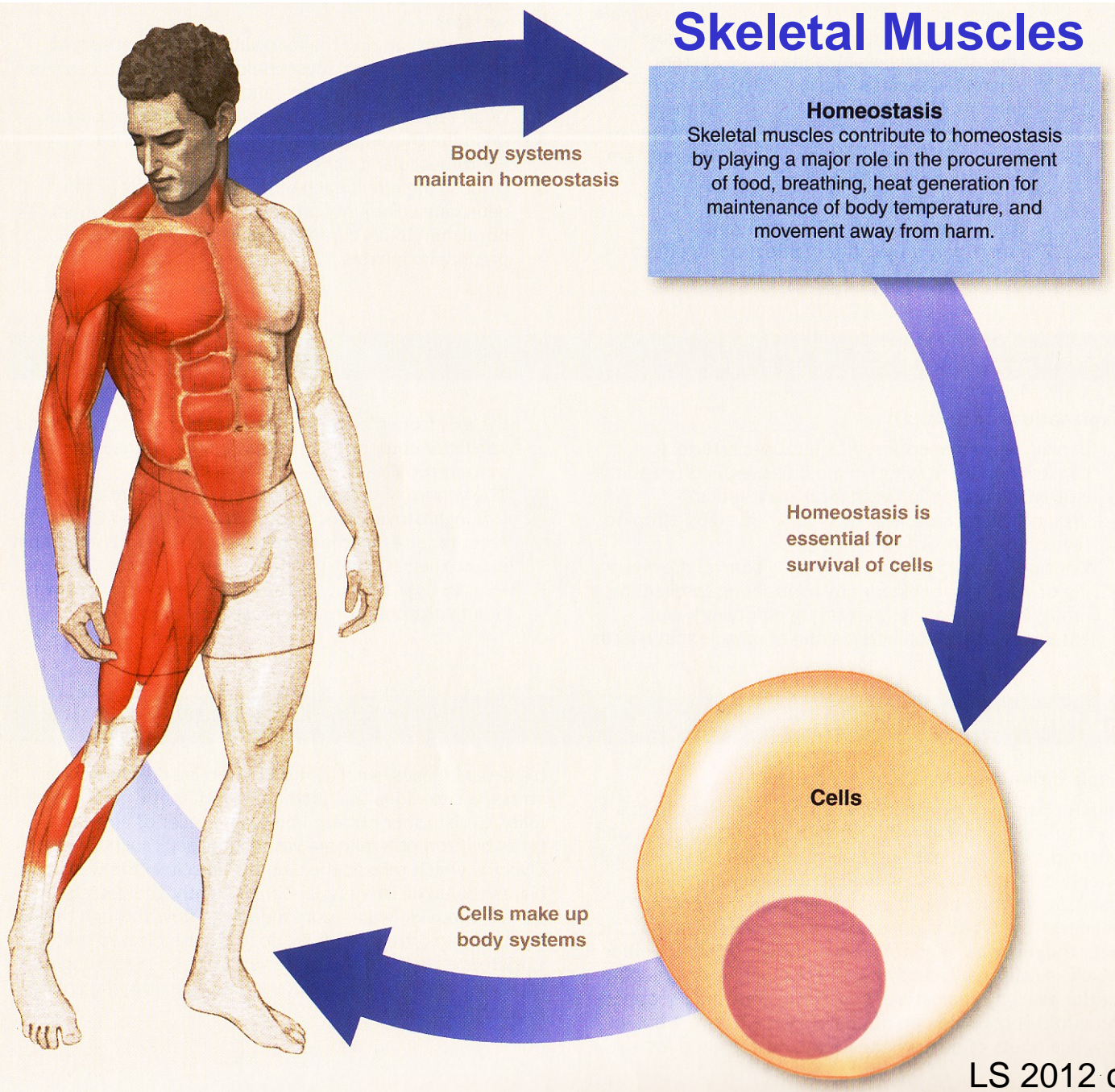
Skeletal muscles contribute to homeostasis by playing a major role in the procurement of food, breathing, heat generation for maintenance of body temperature, and movement away from harm.

Body systems
maintain homeostasis

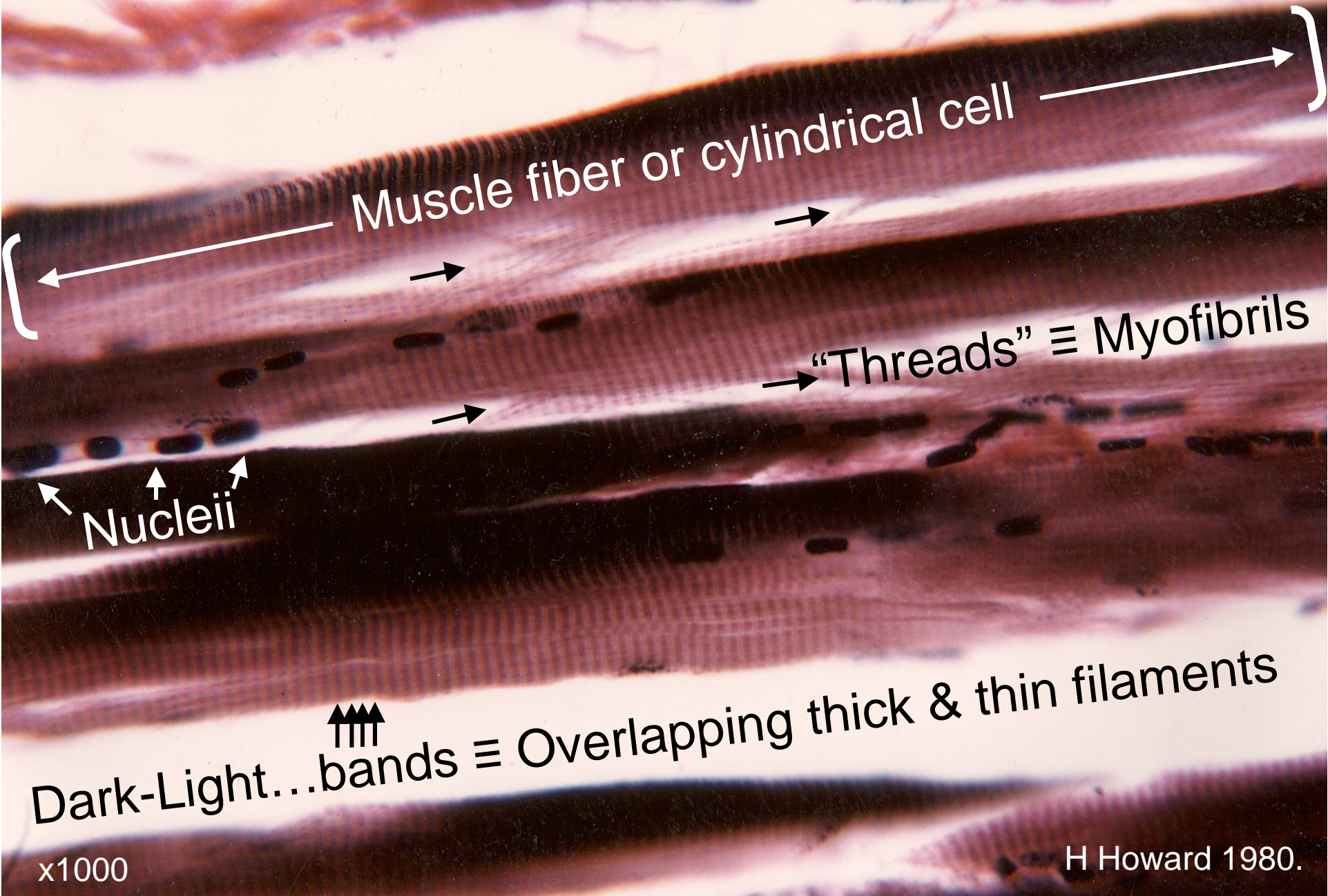
Homeostasis is
essential for
survival of cells

Cells

Cells make up
body systems



Skeletal Muscle Histology: Microscopic Anatomy



Muscle fiber or cylindrical cell

Nucleii

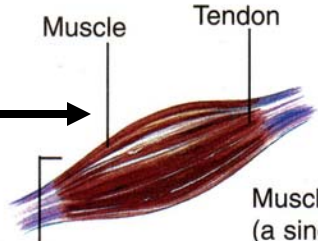
"Threads" ≡ Myofibrils

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

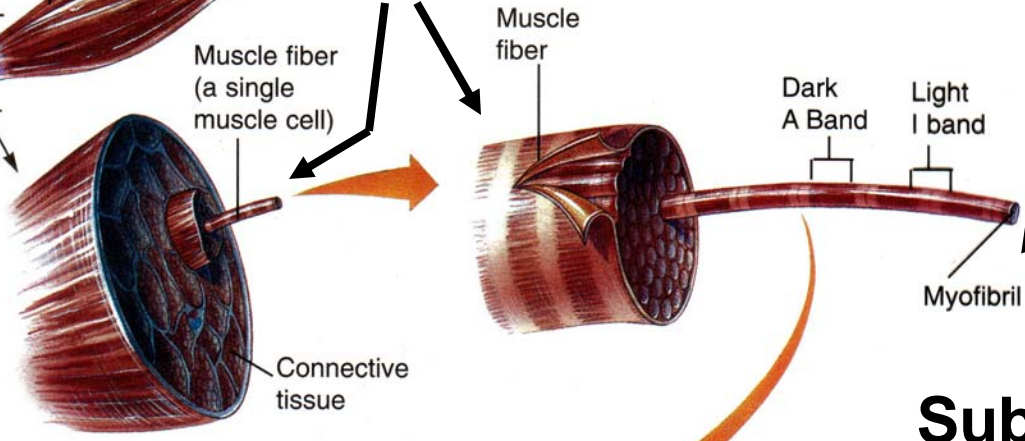
x1000

H Howard 1980.

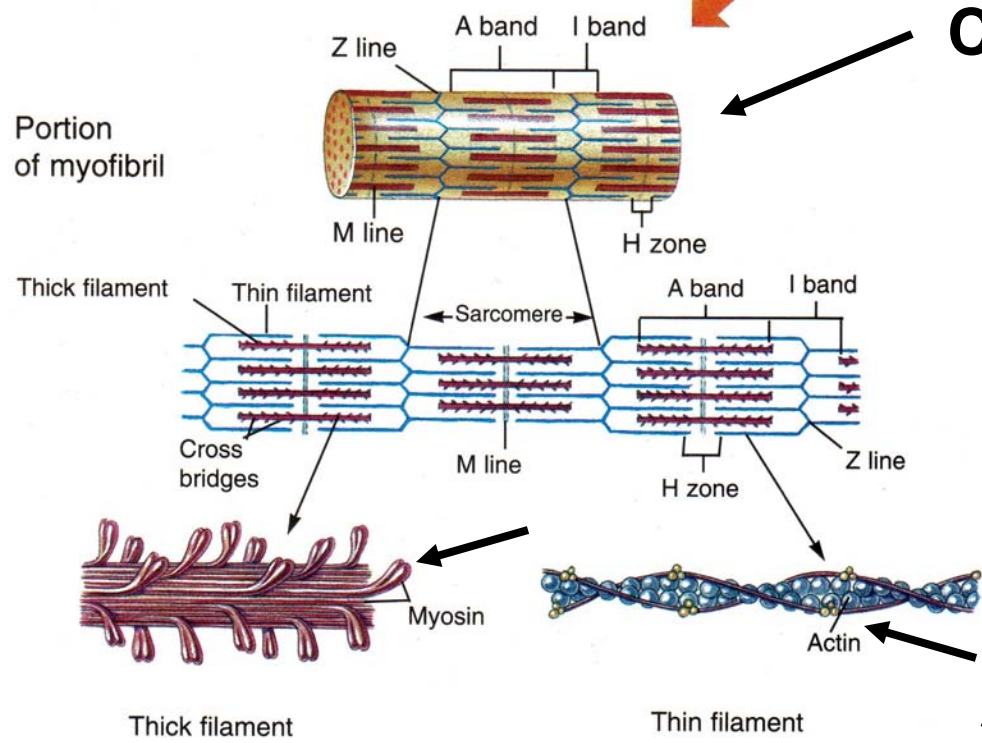
**Organ =
Muscle**



Cell = Myocyte = Fiber

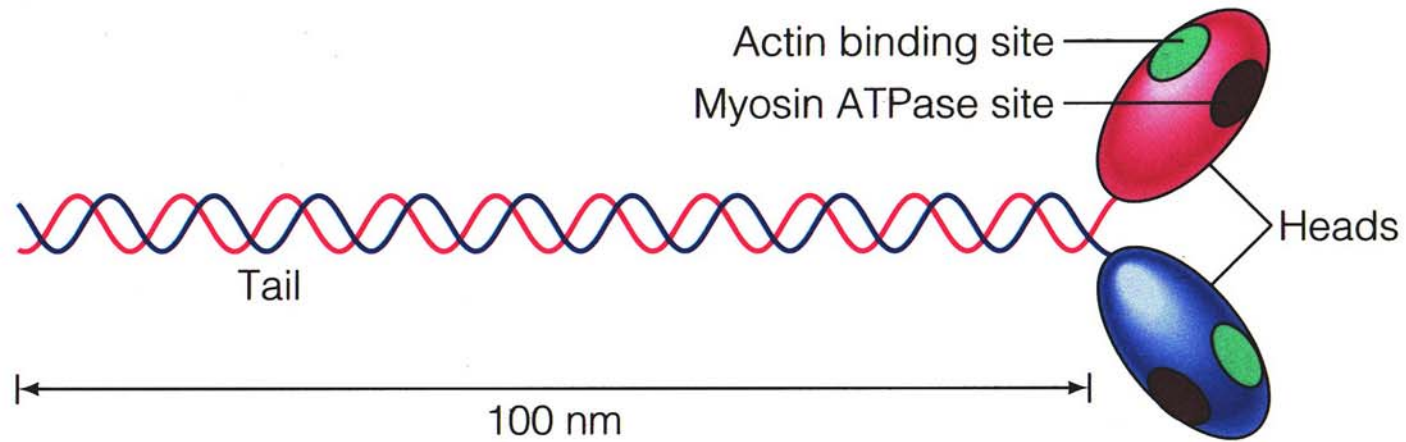


**Subcellular =
Cytoskeleton**



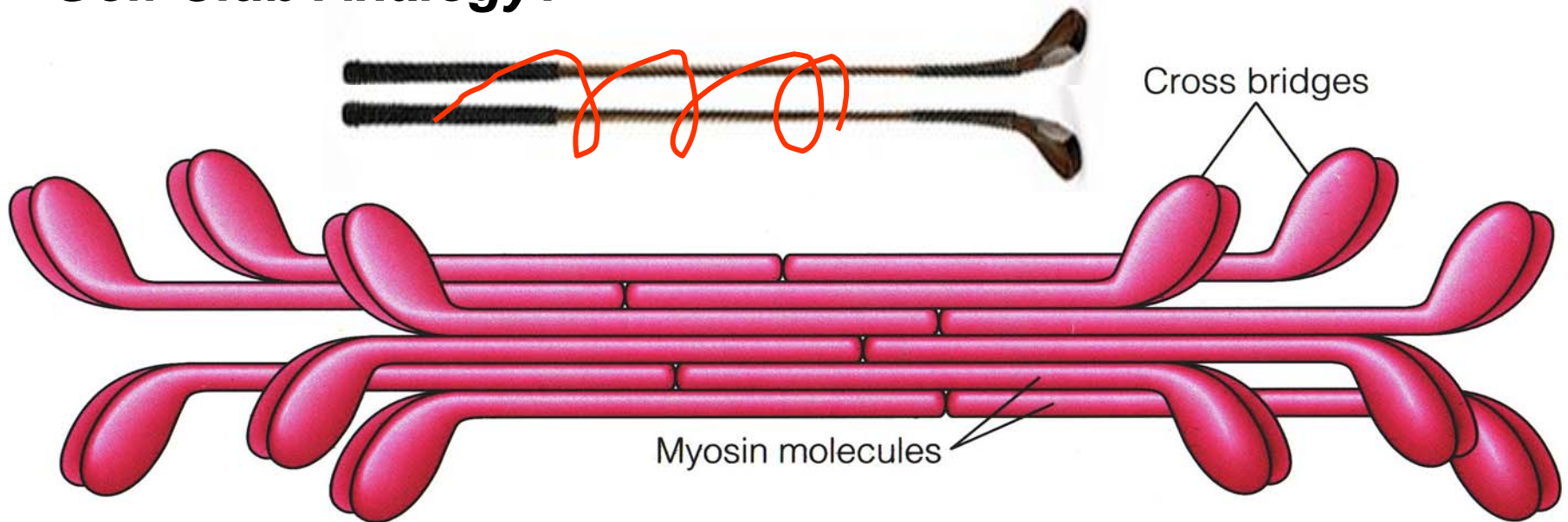
**Molecules =
Actin & Myosin**

LS 2006, cf:
LS 2012 fig 8-2
DC 2013 fig 12-3



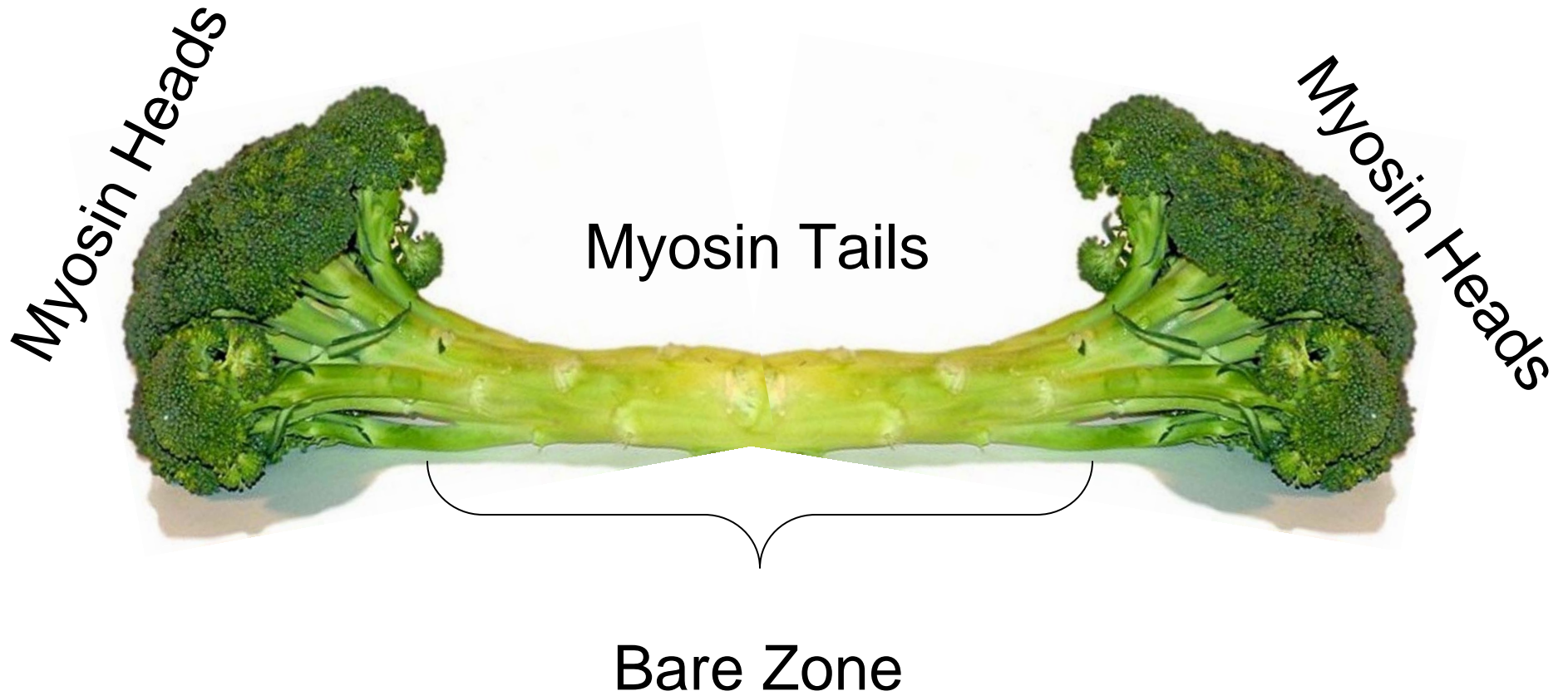
(a)

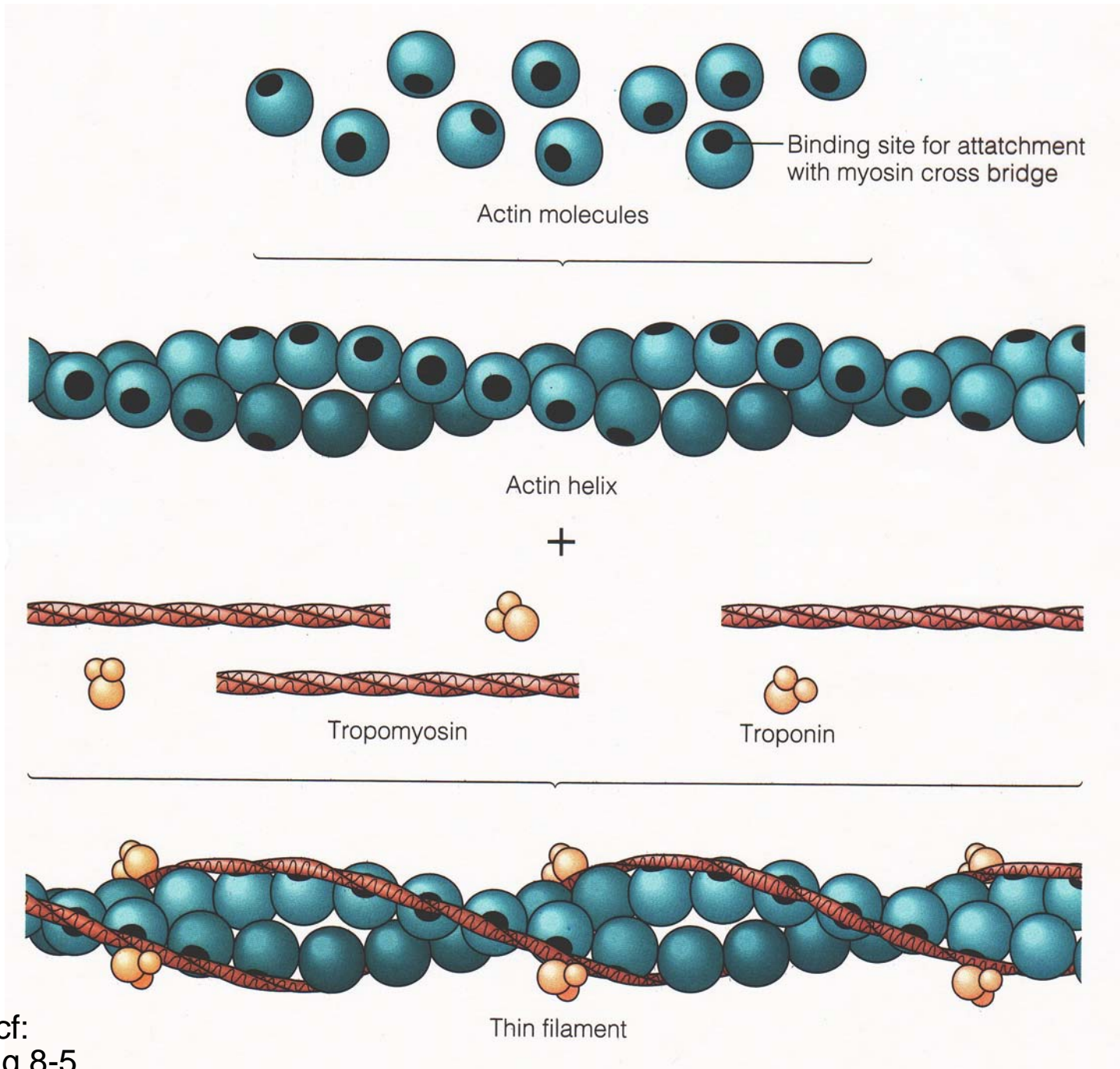
Golf Club Analogy?



(b)

Broccoli Analogy?





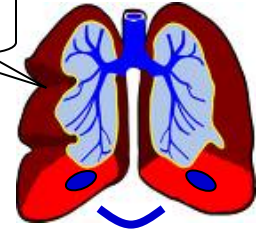
LS 2006, cf:
 LS 2012 fig 8-5

BI 121 Lecture 15



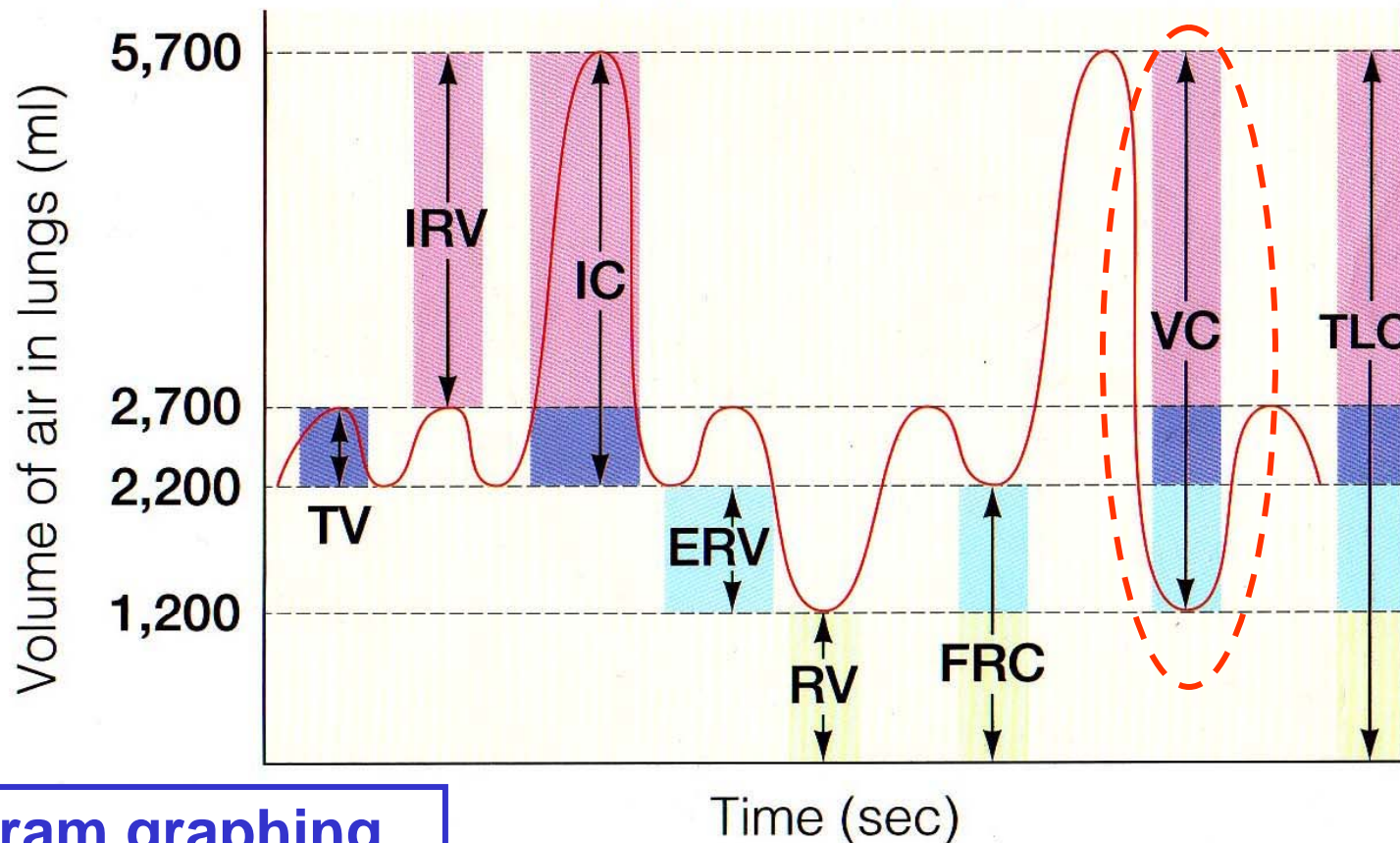
Fun lab with personal lifetime data!

Yes!!



- I. Announcements** Lab 6, Pulmonary Function Testing (PFT) + optional notebook check today. Exam II Dec 8 Monday, 8 am!
- II. Introduction to PFT Lab 6** Pulmonary Function Testing
- III. Connections: Muscle Contraction+Adaptation** DC Mod 12+
 - A.** Review of structure + banding pattern? LS fig 8-3, fig 8-7
 - B.** How do muscles contract? LS fig 8-6, 8-10, 8-11 +...
 - C.** Summary of skeletal muscle contraction with videos
Courtesy David Bolinsky, *XVIVO* & Malcolm Campbell, Department of Biology, Davidson College, NC +...
 - D.** Exercise adaptation variables LS ch 8 pp 210-214
mode, intensity, duration, frequency, distribution of training sessions, individual & environmental factors
 - E.** *Endurance vs. Strength* training continuum? fiber types...

Normal Spirogram of Healthy Young Adult Male

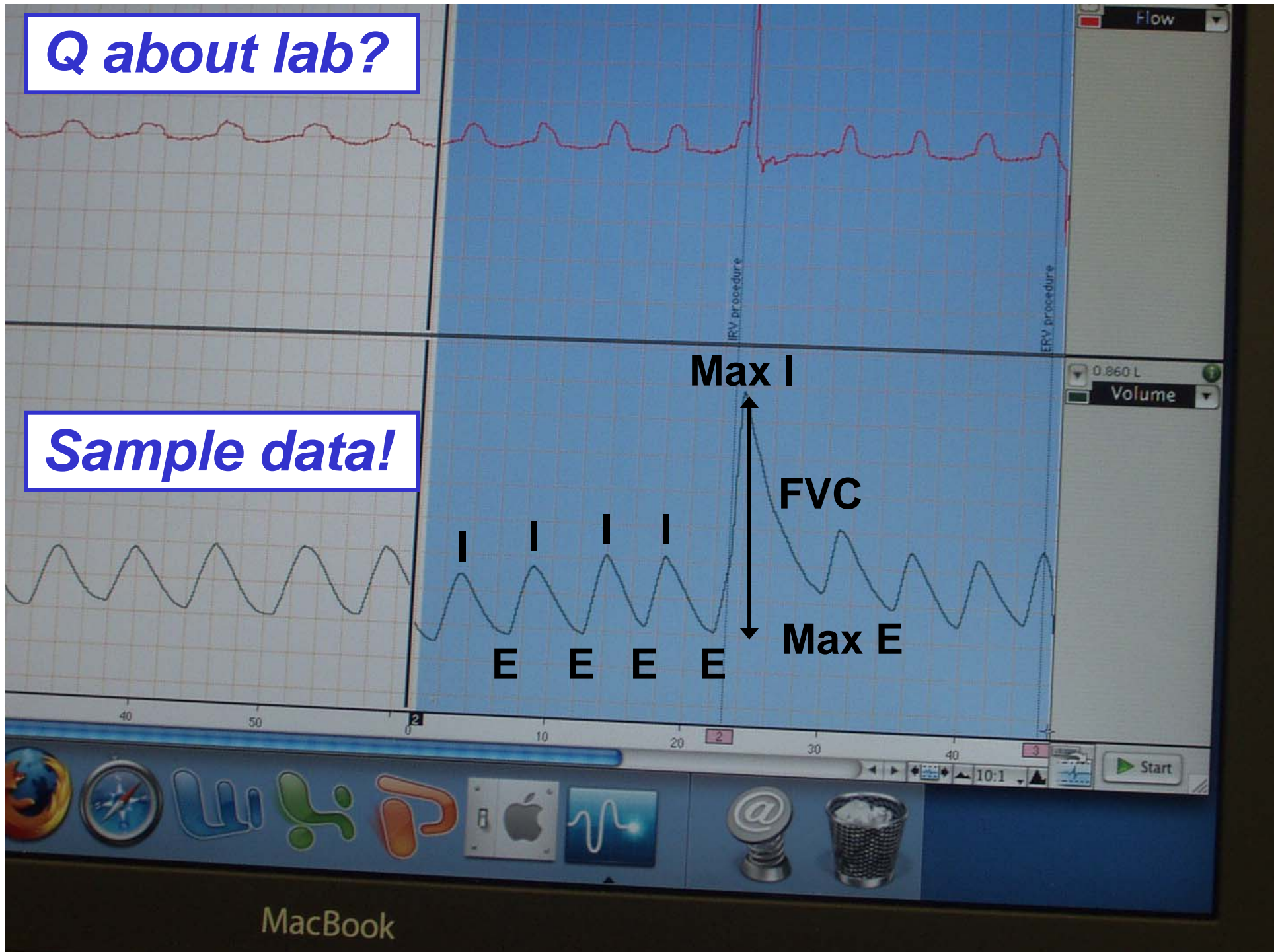


**Spirogram graphing
complete *PFT* from
computer simulation.**

- 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)

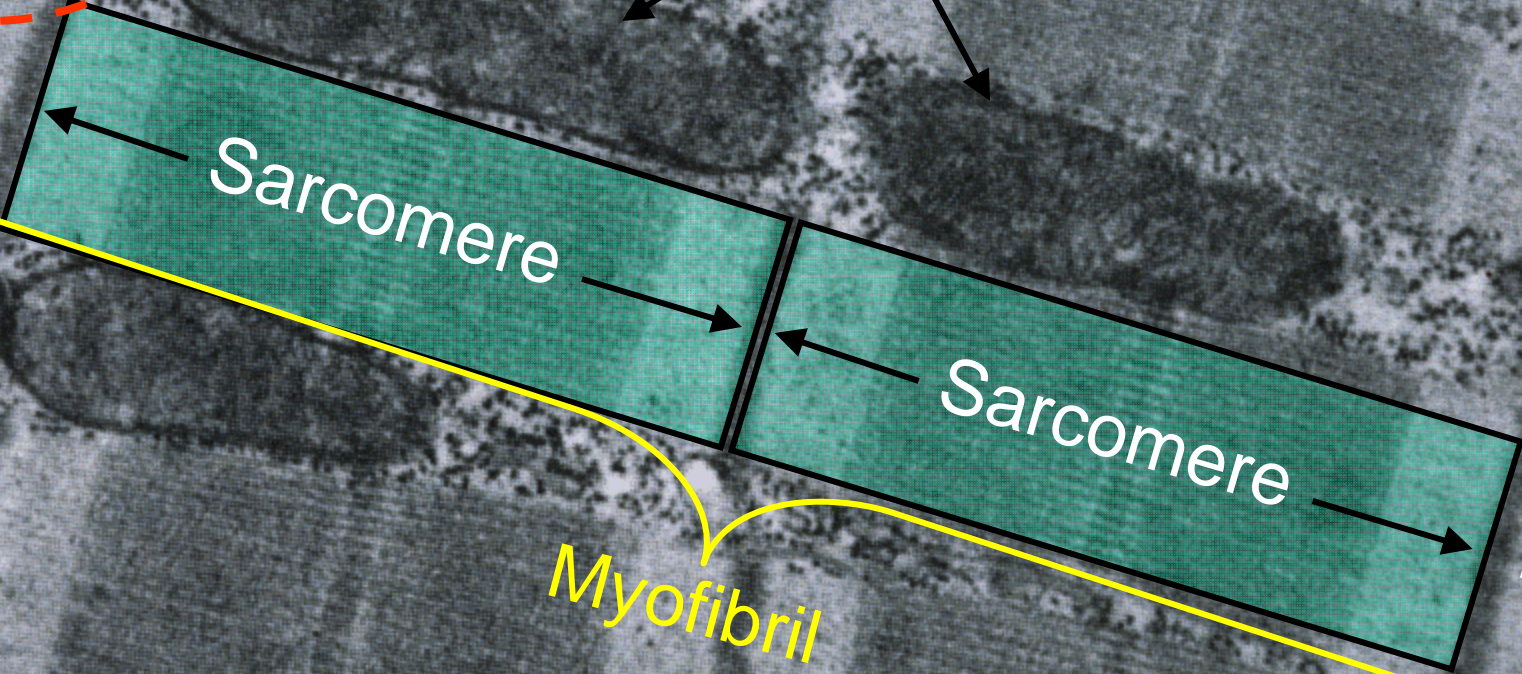
Q about lab?

Sample data!

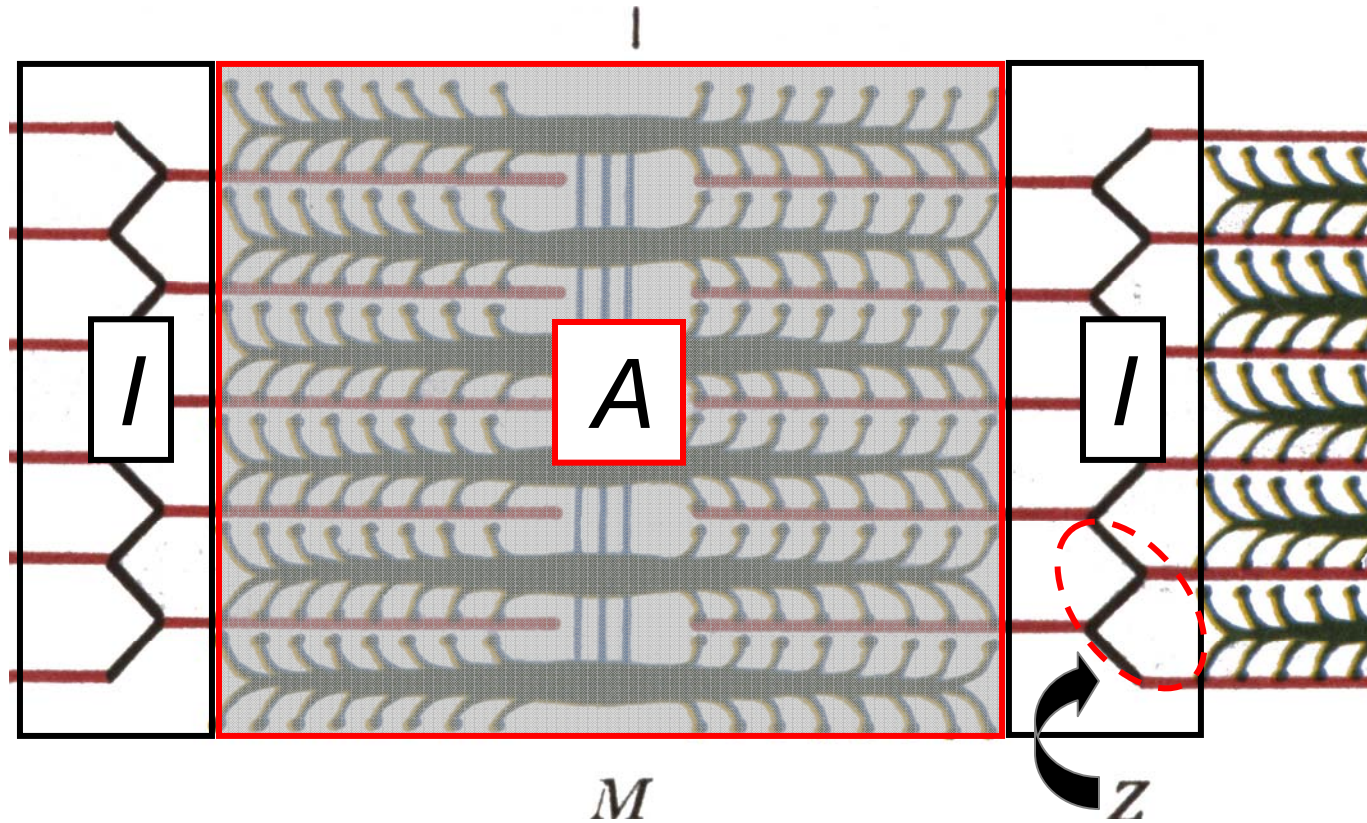


Triad \equiv T tubule abutting cisternae

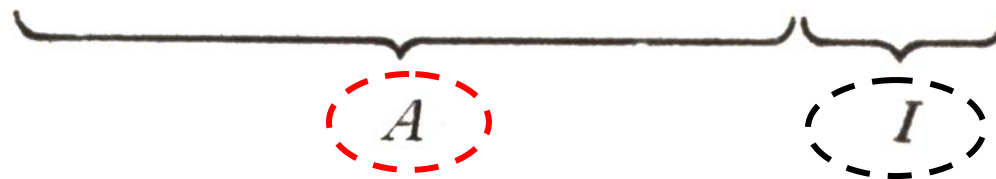
Mitochondria

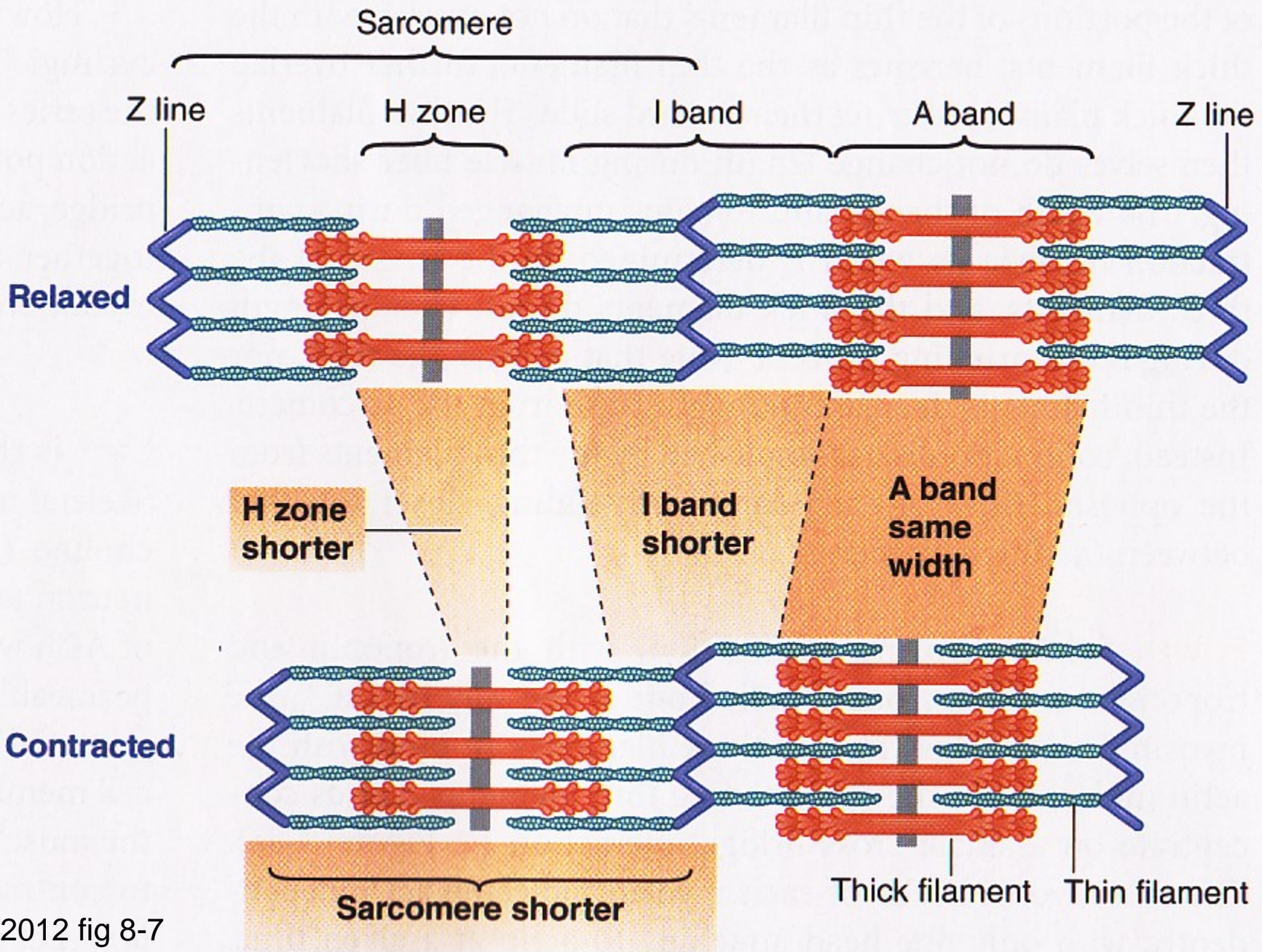


A Band = Dark Band
Anisotropic = Light Can't Shine Through



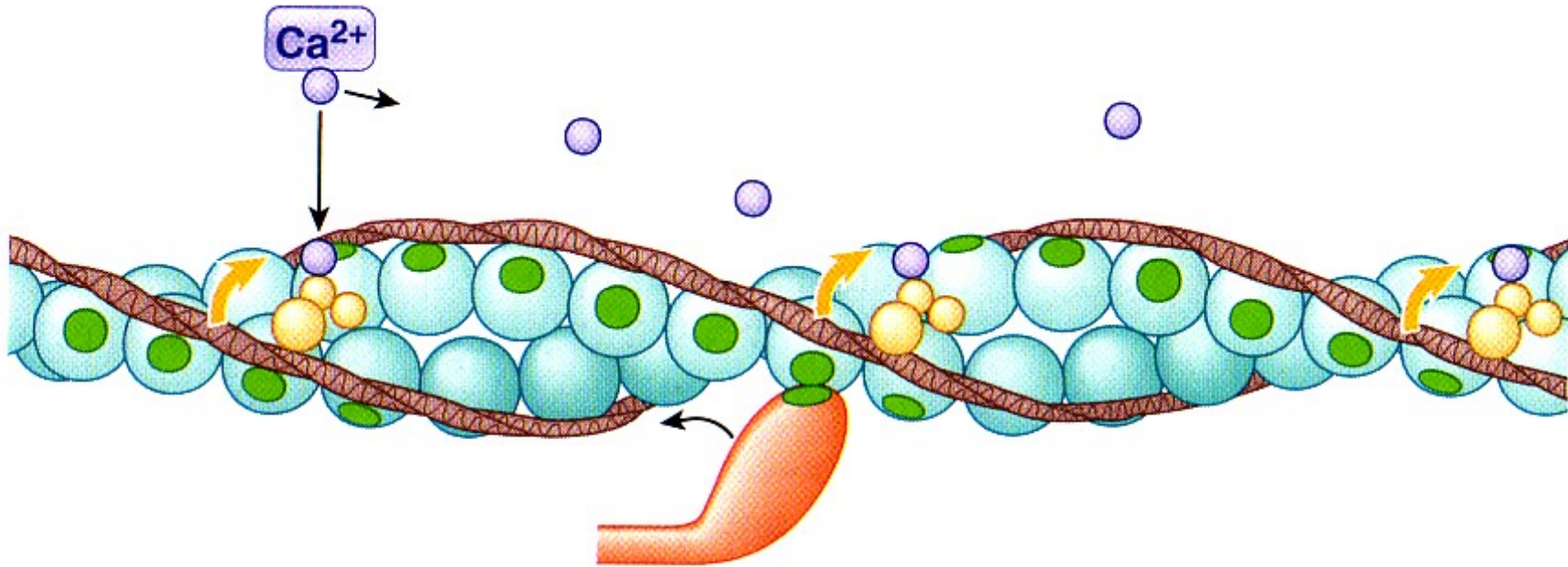
I Band = Light Band
Isotropic = Light Can Shine Through





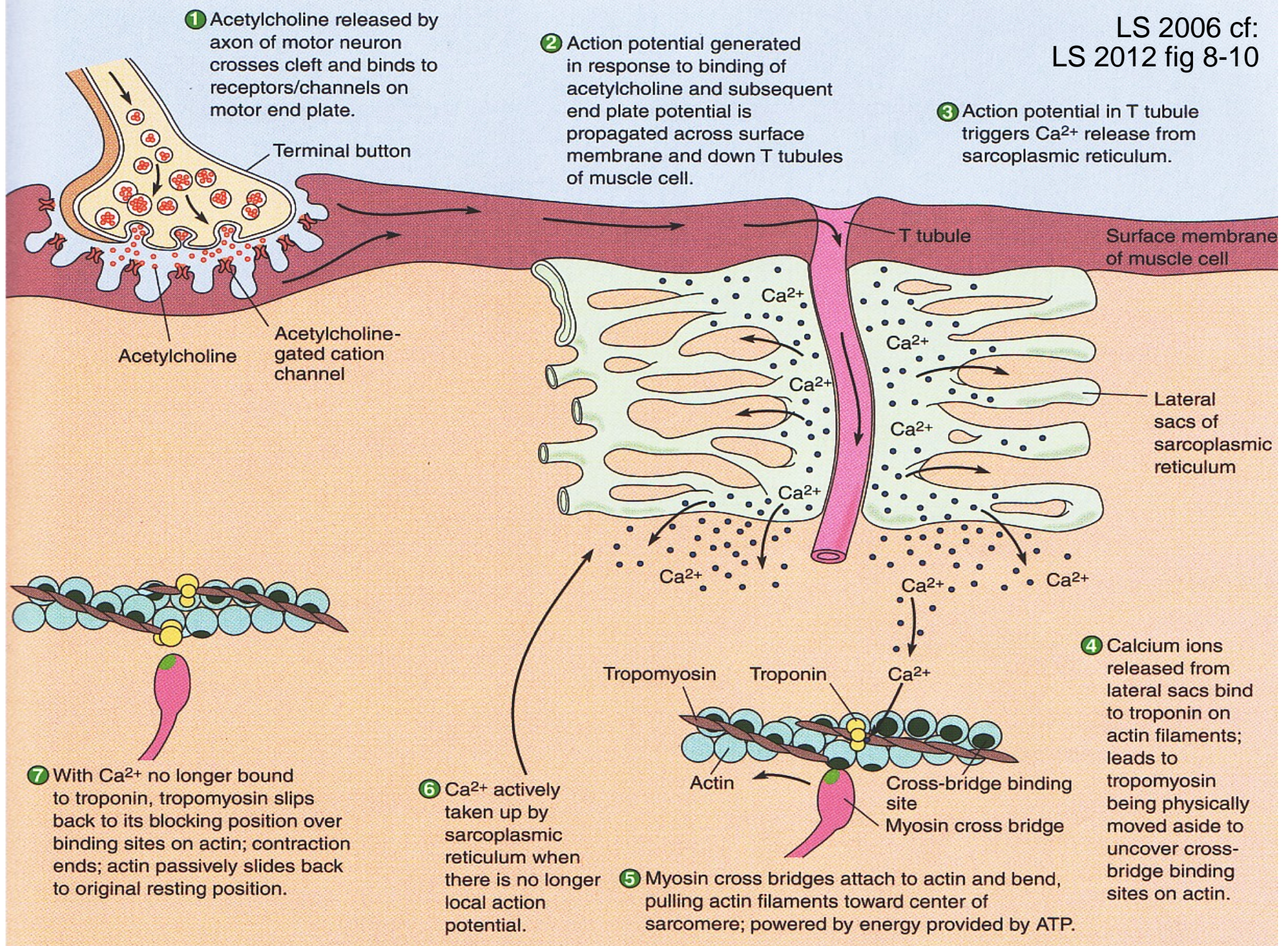
LS 2012 fig 8-7

Excited: Calcium Triggers Cross-Bridge Binding



(b) Excited

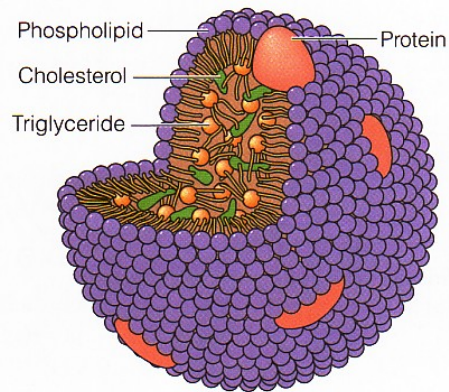
- 1** Muscle fiber is excited and Ca^{2+} is released.
- 2** Released Ca^{2+} binds with troponin, pulling troponin–tropomyosin complex aside to expose cross-bridge binding site.
- 3** Cross-bridge binding occurs.
- 4** Binding of actin and myosin cross bridge triggers power stroke that pulls thin filament inward during contraction.



Adaptations to Exercise?

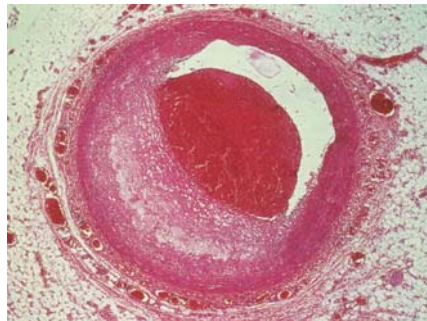
Body Levels of Organization?

Which Body System?

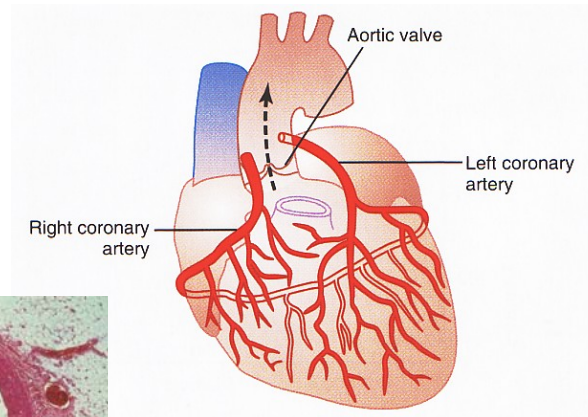


A typical lipoprotein

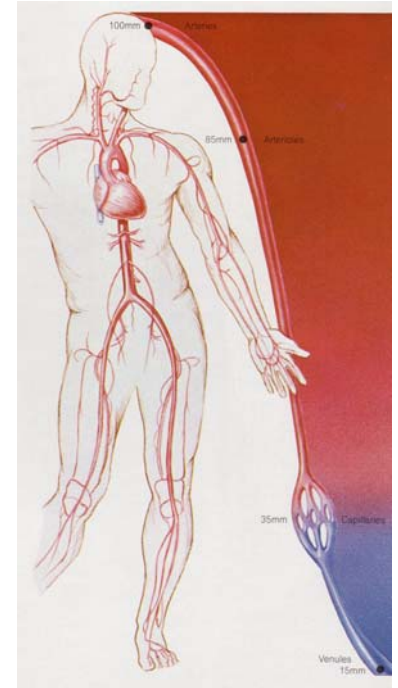
Molecular



Cell/Tissue

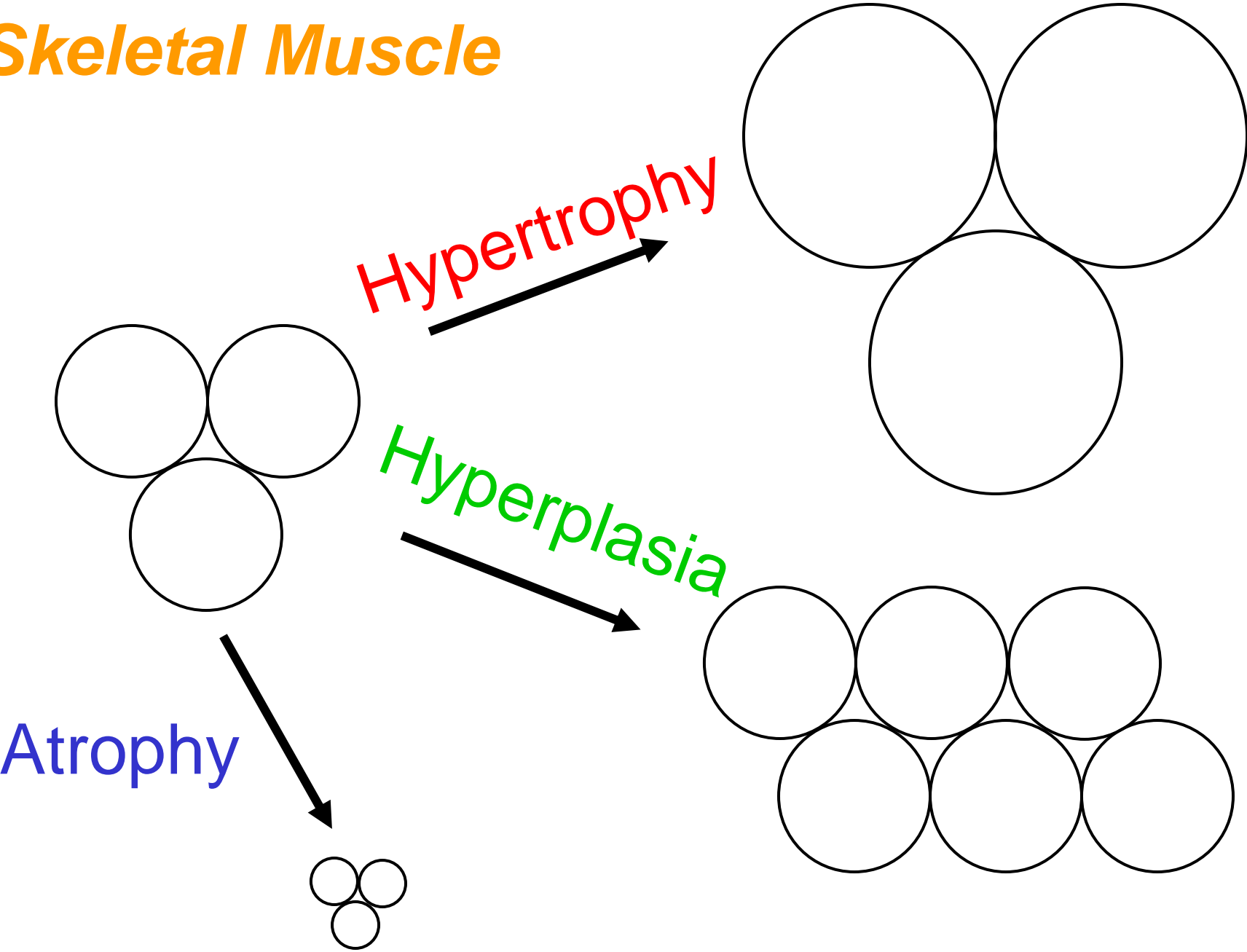


Organ



Body System

Skeletal Muscle



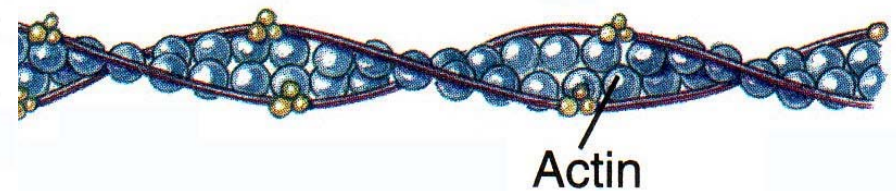
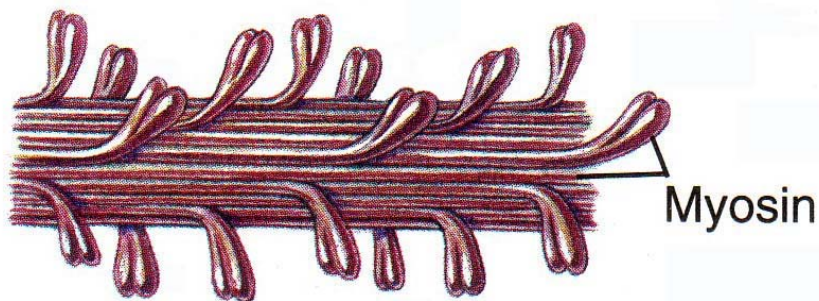
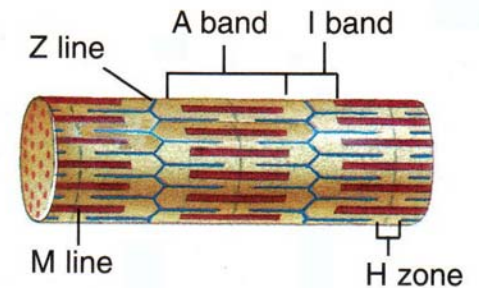


Hypertrophy: *Increased*

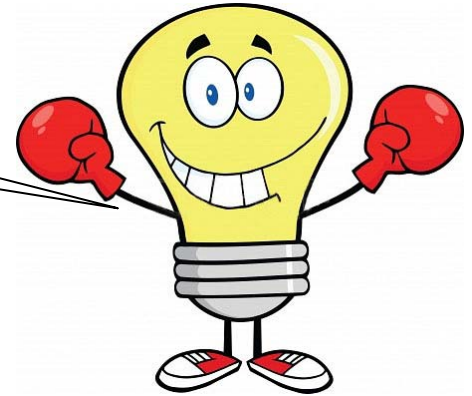
Number of Myofibrils

Thick & Thin Filaments

Myosin & Actin Molecules



We're on a roll! Bring on Exam II!



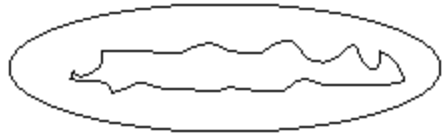
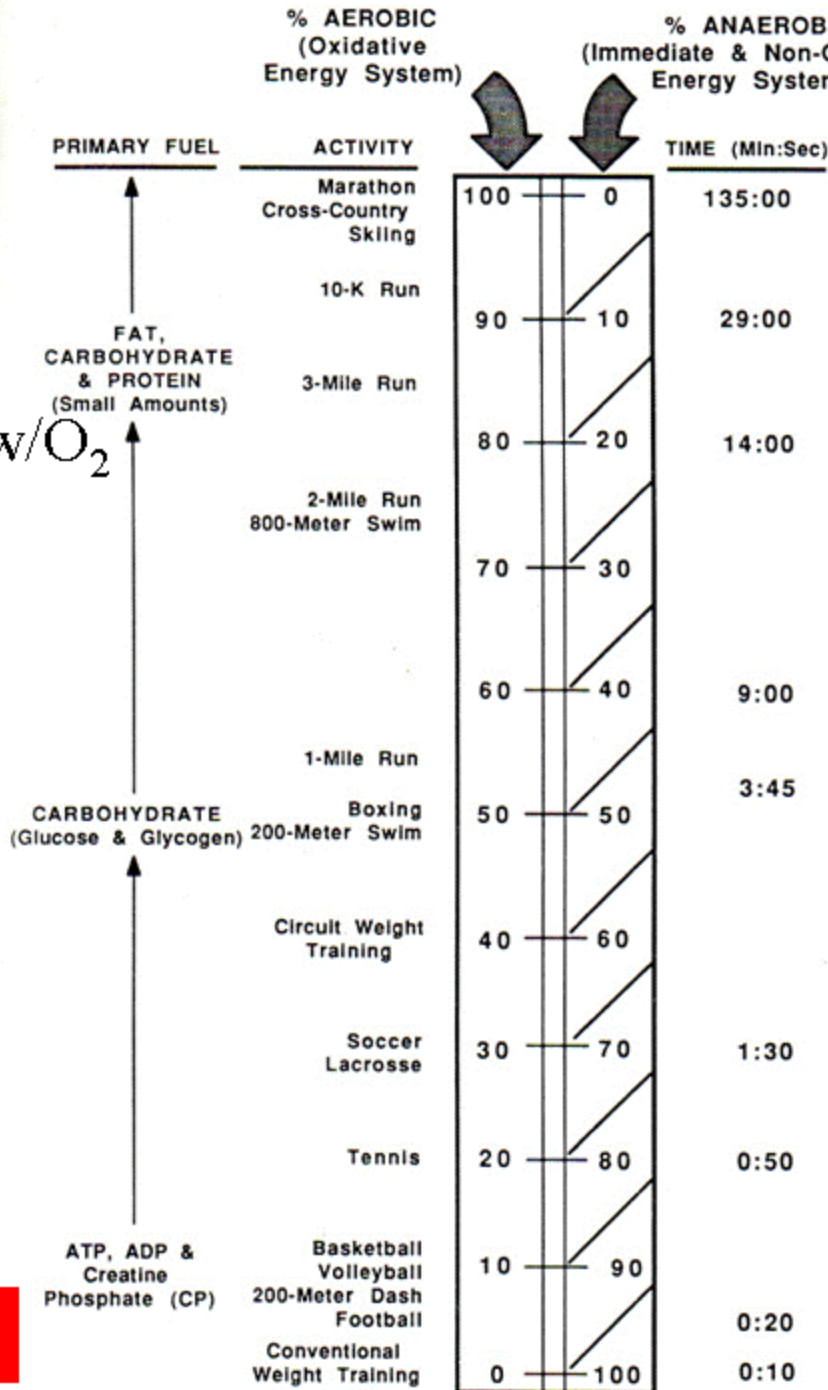
BI 121 Lecture 16

- I. Announcements Notebooks? **Exam II, December 8th Monday 8 am.** Review session in class next Thursday. Q?
- II. Muscle Adaptation Connections LS ch 8, DC Module 12
- III. Respiratory System LS ch 12, DC Module 7, Fox +...
 - A. Steps of respiration? External vs. cellular/internal?
LS fig 12-1 pp 345-347
 - B. Respiratory anatomy LS fig 12-2 p 347, DC, Fox +...
 - C. Histology LS fig 12- 4 pp 347-349, DC
 - D. How do we breathe? LS fig 12-12, fig 12-25 pp 349-356,
pp 373-378
 - E. Gas exchange LS fig 12-19 pp 362-5
 - F. Gas transport LS tab 12-3 pp 365-70



AEROBIC

w/O₂



MITOCHONDRIA

CYTOSOL

Glycolysis



Immediate/ATP-PC



ANAEROBIC

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

Changes in Muscle Due to Endurance Training

- ↑ Mitochondria, # & size
- ↑ Mitochondrial (aerobic) enzymes including those specific for fat burning
- ↑ Vascularization of muscles (better blood flow)
- ↑ Stores of fat in muscles accompanied by
- ↓ Triglycerides/fats in bloodstream
- ↑ Enzymes: activation, transport, breakdown (β -oxidation) of fatty acids
- ↑ Myoglobin (enhances O_2 transport)
- ↑ Resting energy levels which inhibit sugar breakdown
- ↑ Aerobic capacity of all three fiber types.

Lombo's simplified steps!

1 Breathe in & out!



2 Cross membranes!



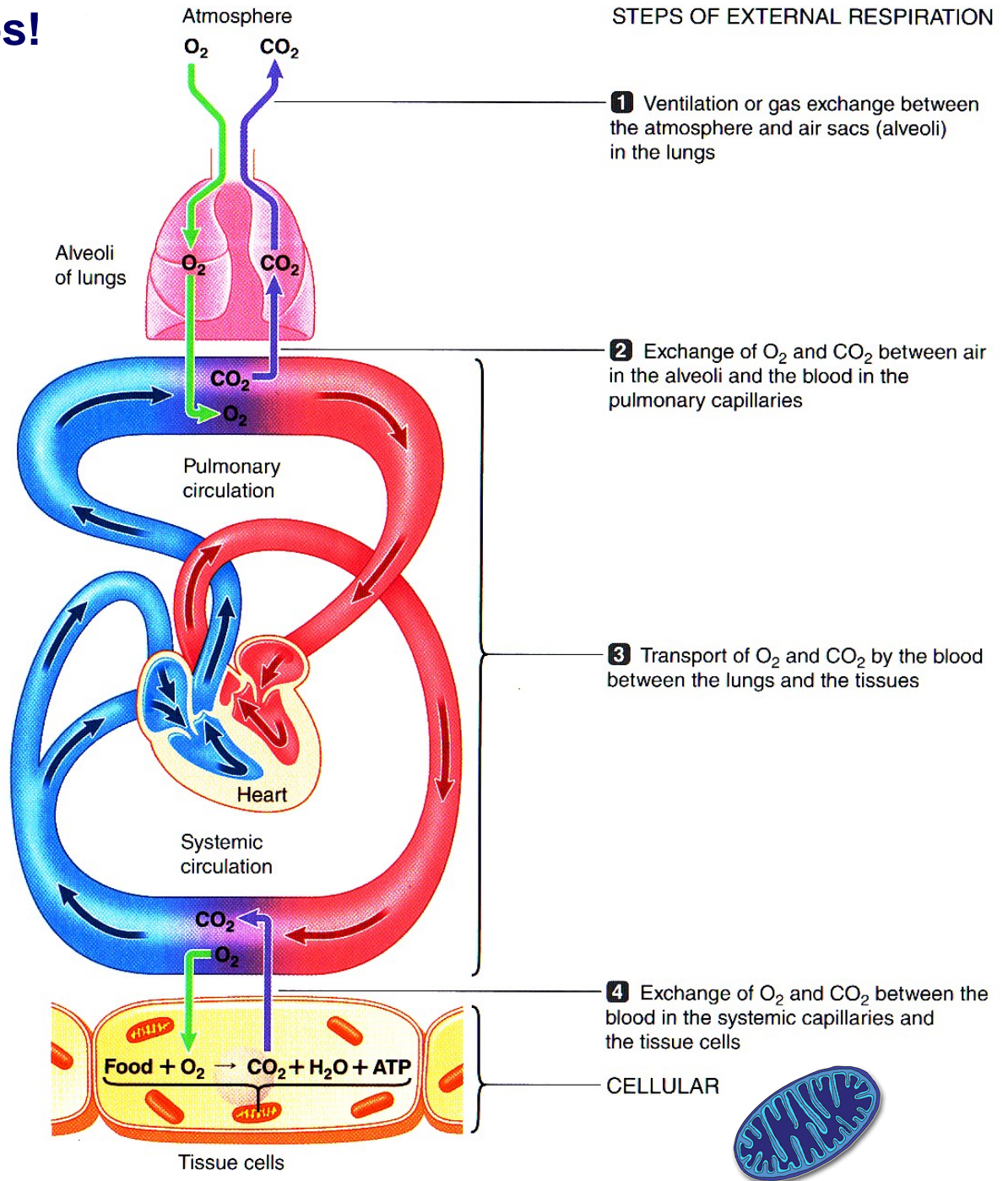
3 Move with blood!



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

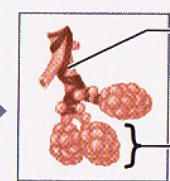
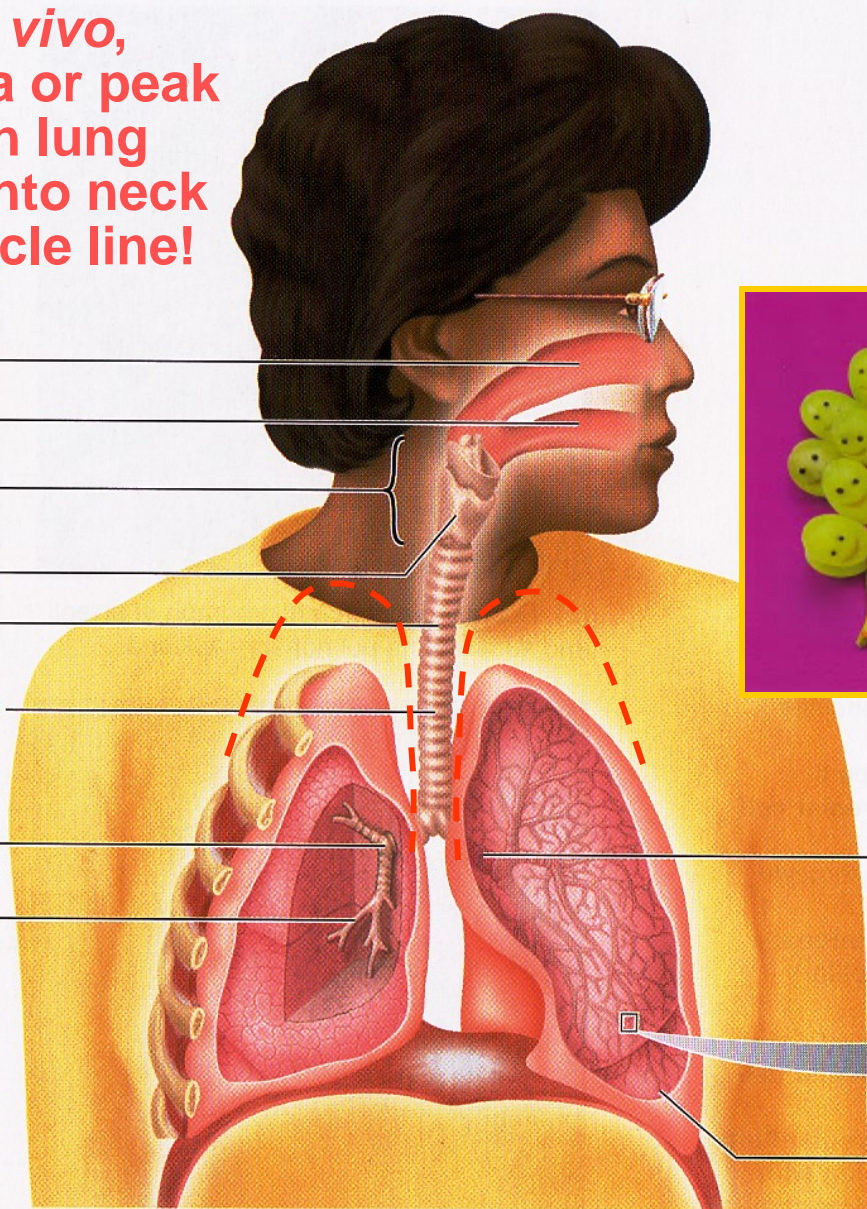
(b) Enlargement of alveoli (air sacs) at terminal ends of airways

Left bronchus

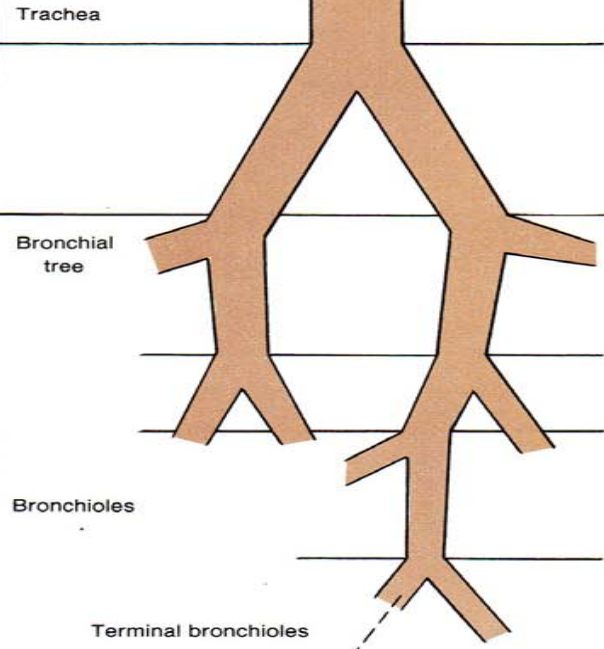
Terminal bronchiole

Alveolar sac

Terminal bronchiole

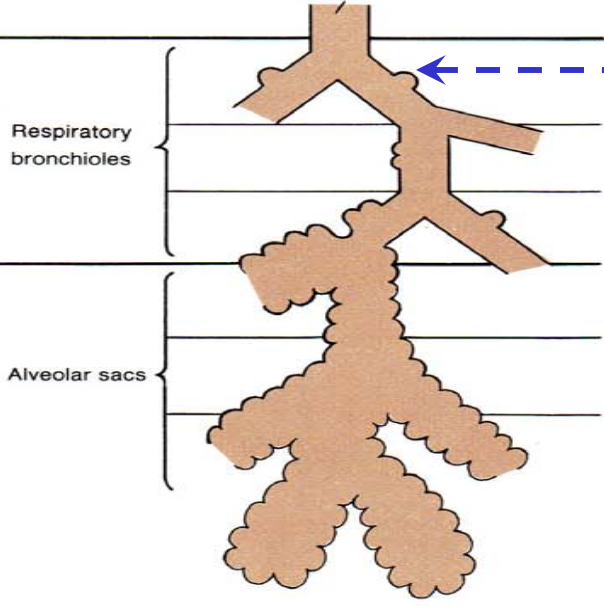


Conductive Zone



No Gas Exchange

Respiratory Zone

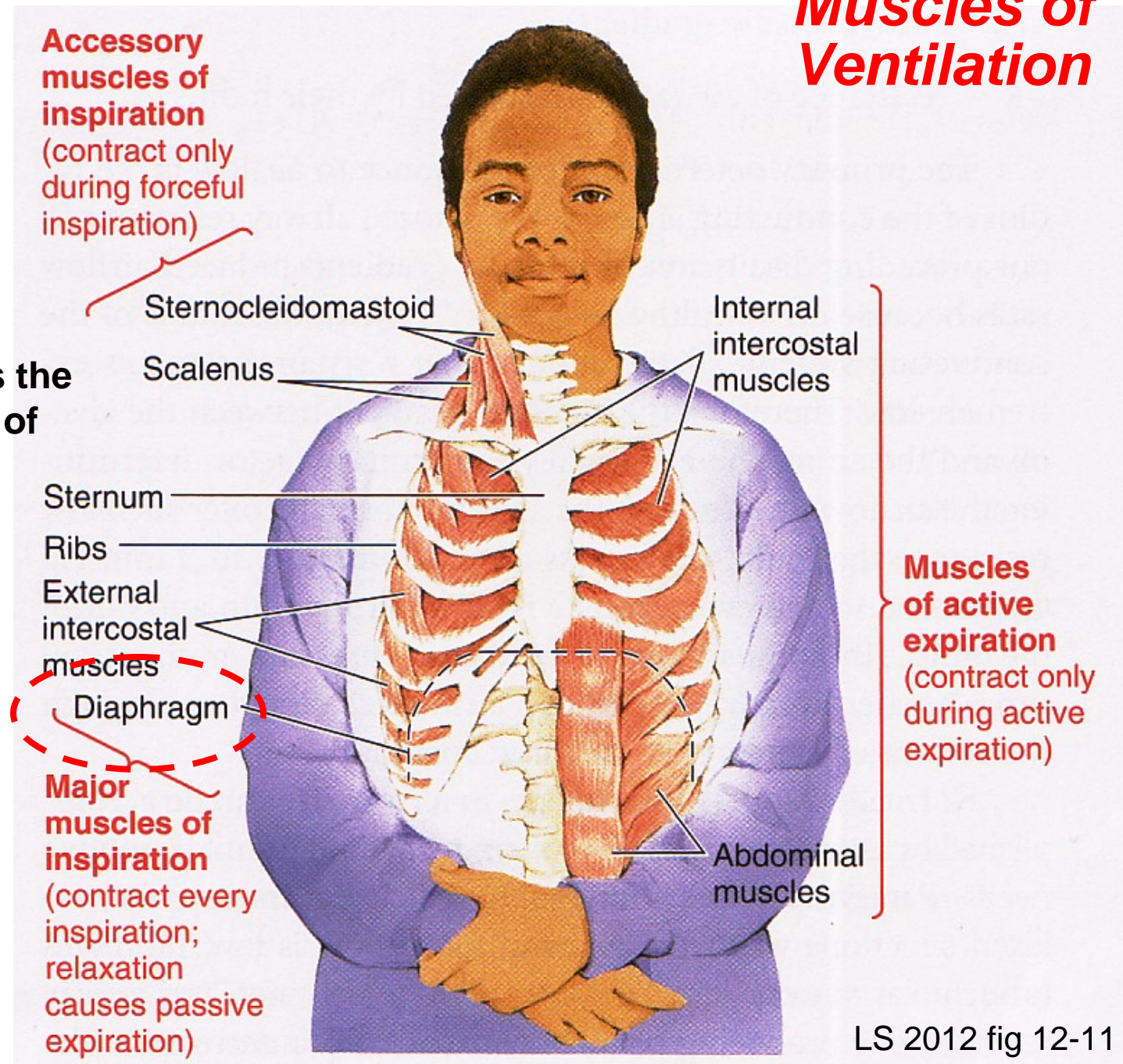


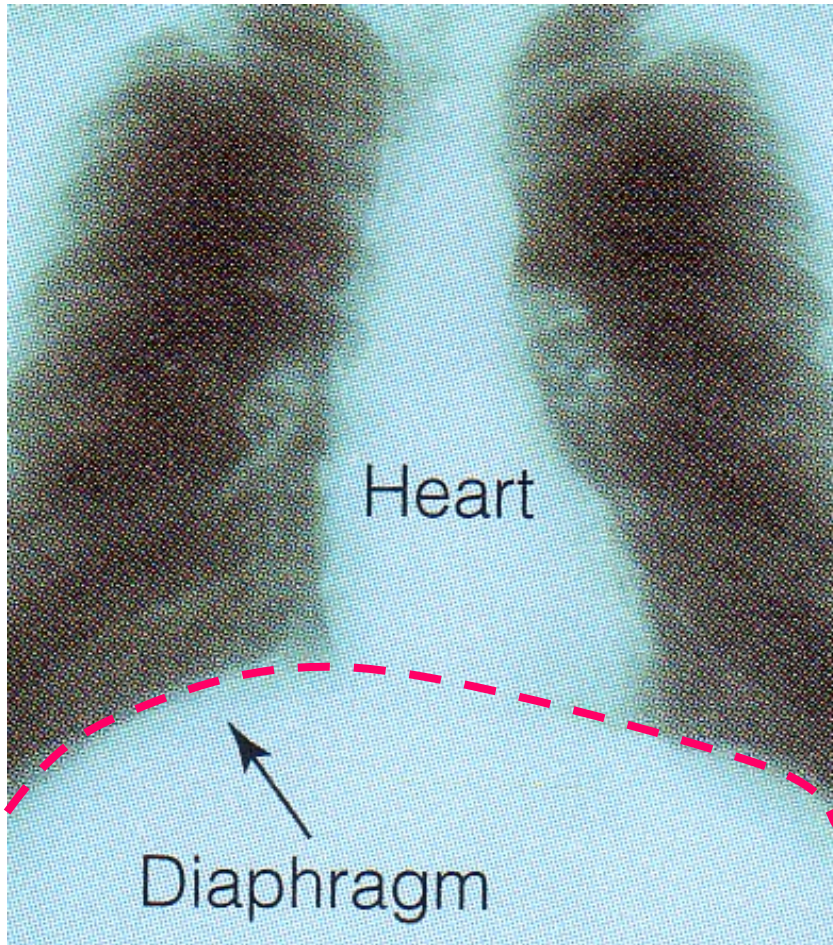
1st alveolar outpouching!

Gas Exchange

Muscles of Ventilation

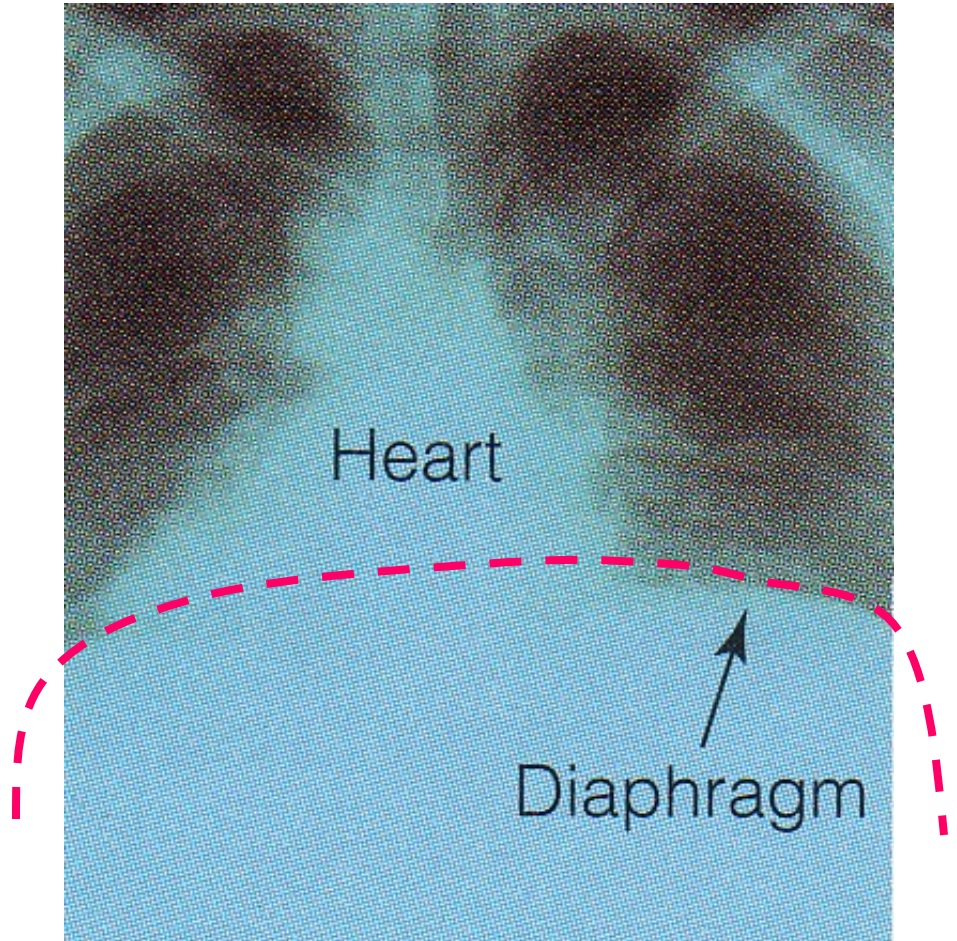
NB: Diaphragm is the chief muscle of ventilation!





Inhale (active)

Contract & flatten diaphragm



Exhale (passive @ rest)

Relax & pouch up diaphragm!

BI 121 Lecture 17

*We're so close. Let's
shine on the exam!*



**I. Announcements Exam II Monday Dec 8th
@ 8:00 am! 12 n lab section report to 129 HUE,
1 pm lab section 130 HUE. All others here!**

Discussion-Review, this Thursday, here in 100 WIL!

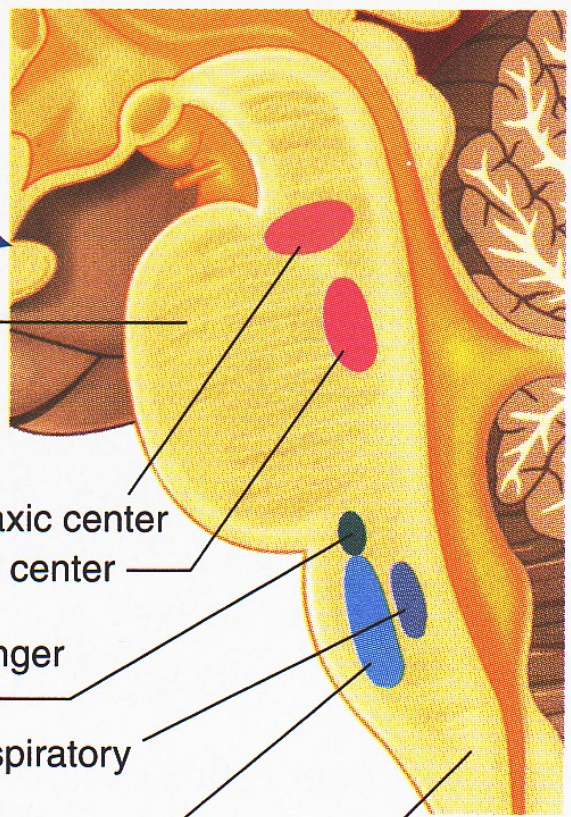
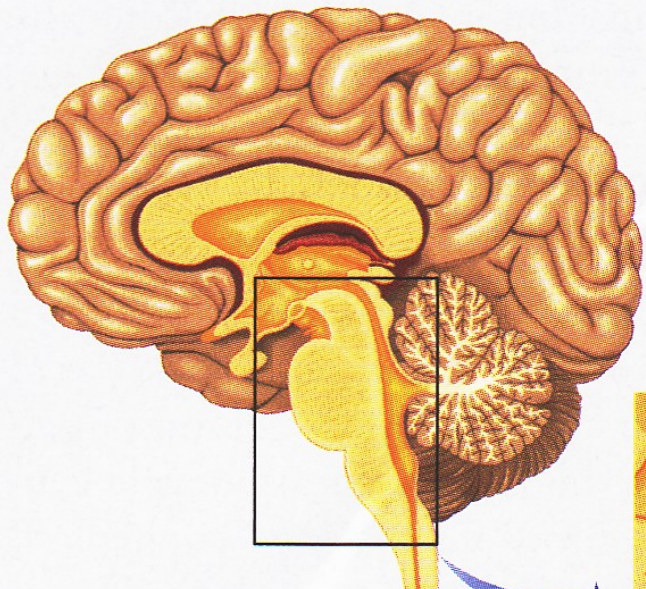
II. Respiratory Physiology Connections LS ch 12, DC m7+

- A. How do we breathe? LS fig 12-12, fig 12-25 pp 349-356,
pp 373-378**
- B. Gas exchange LS fig 12-4, fig 12-19 pp 362-5**
- C. Gas transport LS fig 11-2 p 299, tab 12-3 pp 365-70**
- D. What happens in a gunshot wound or impalement
injury? Pulmonary membranes? Pneumothorax?
LS fig 12-5, 12-6, 12-8, 12-9, pp 349-52**

III. Physiology of Cigarette Smoking LS + DC + ACS +...

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

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

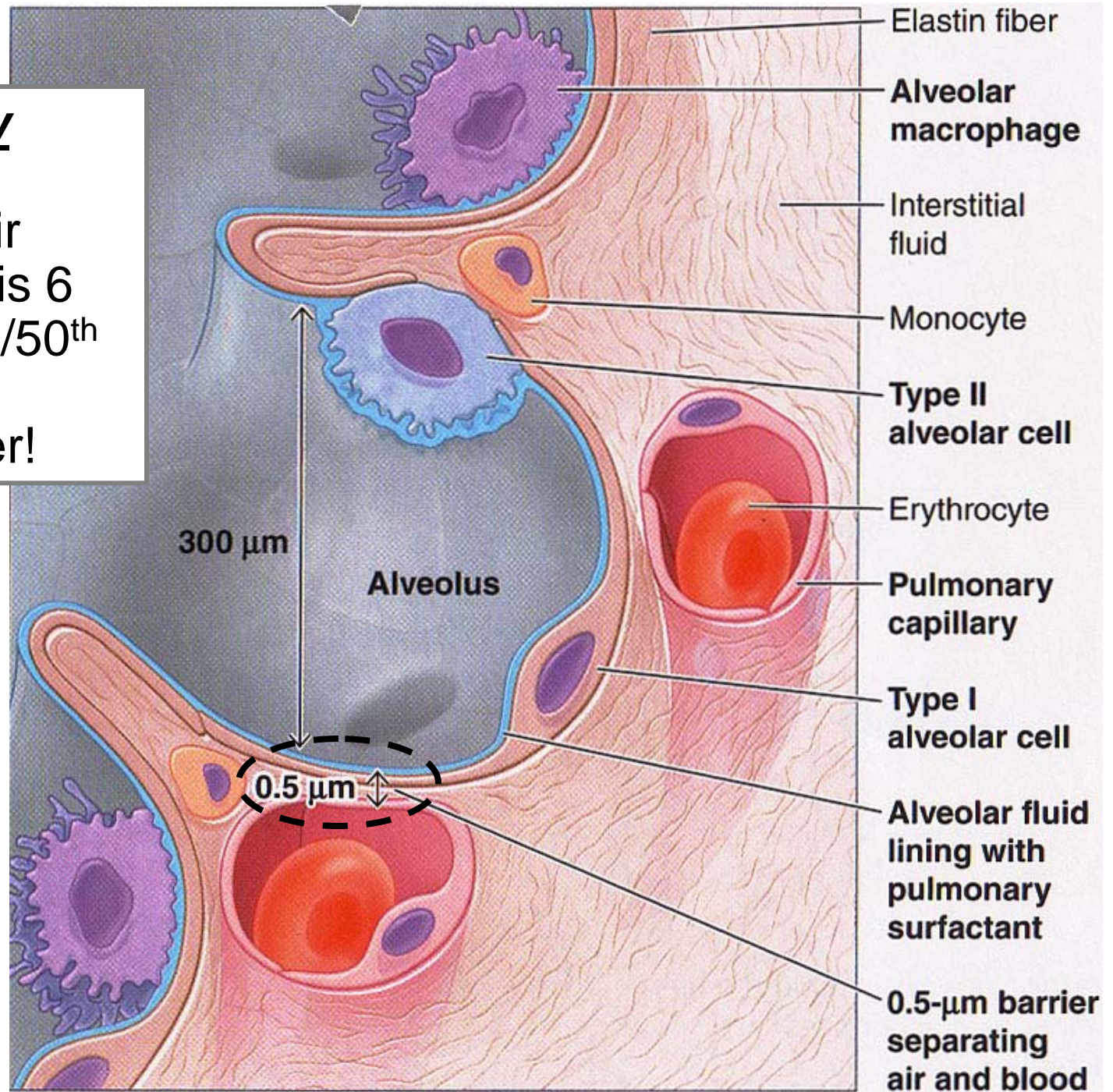
Dorsal respiratory group

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)

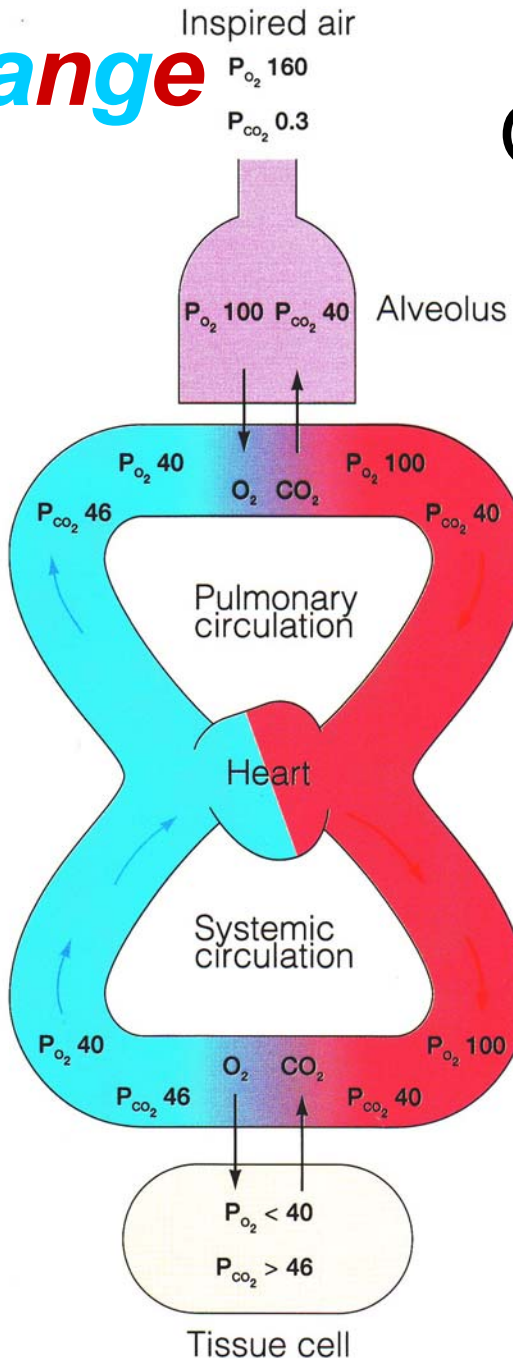
CO₂ partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

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)

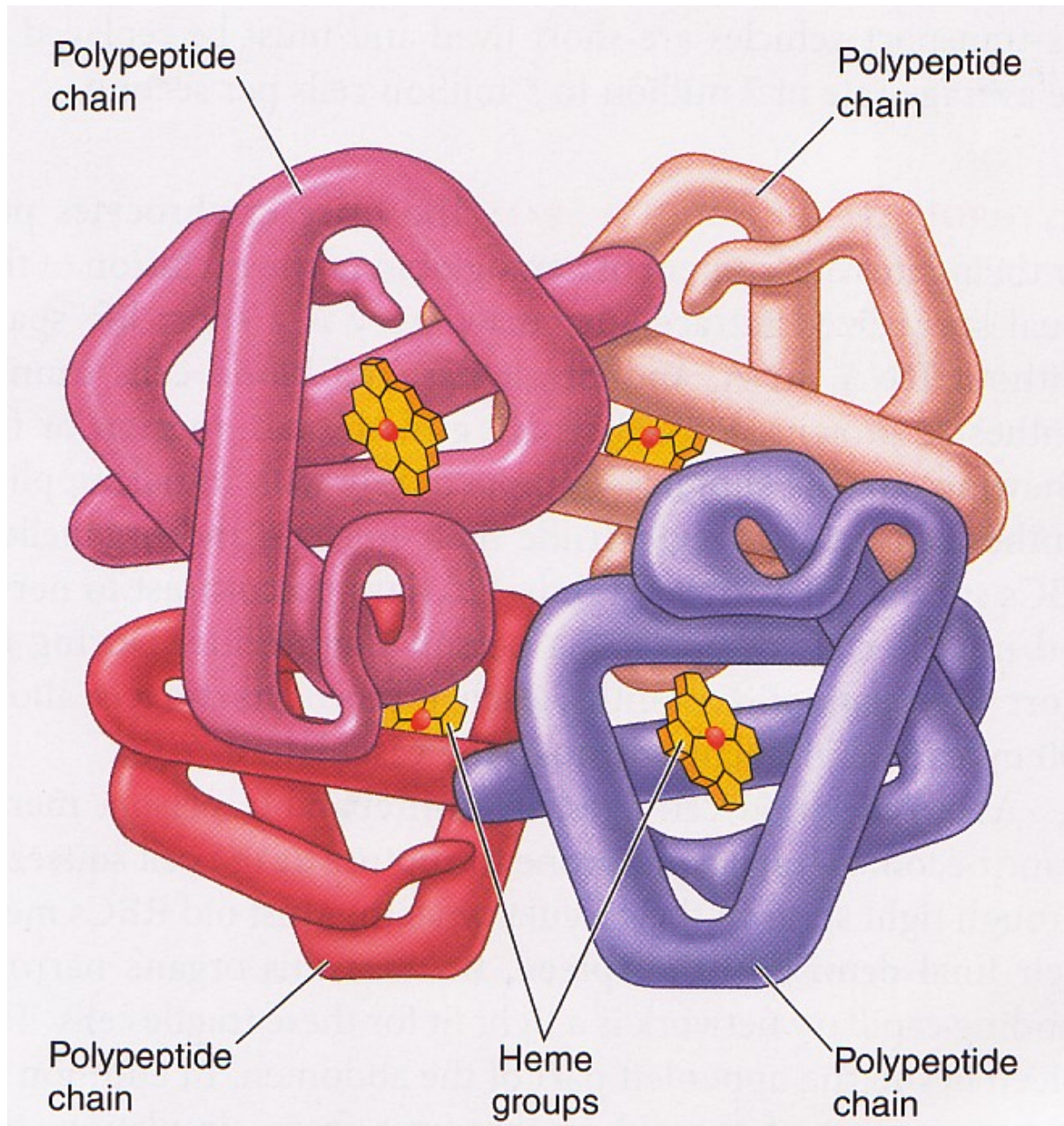
Numbers are mm Hg pressure.



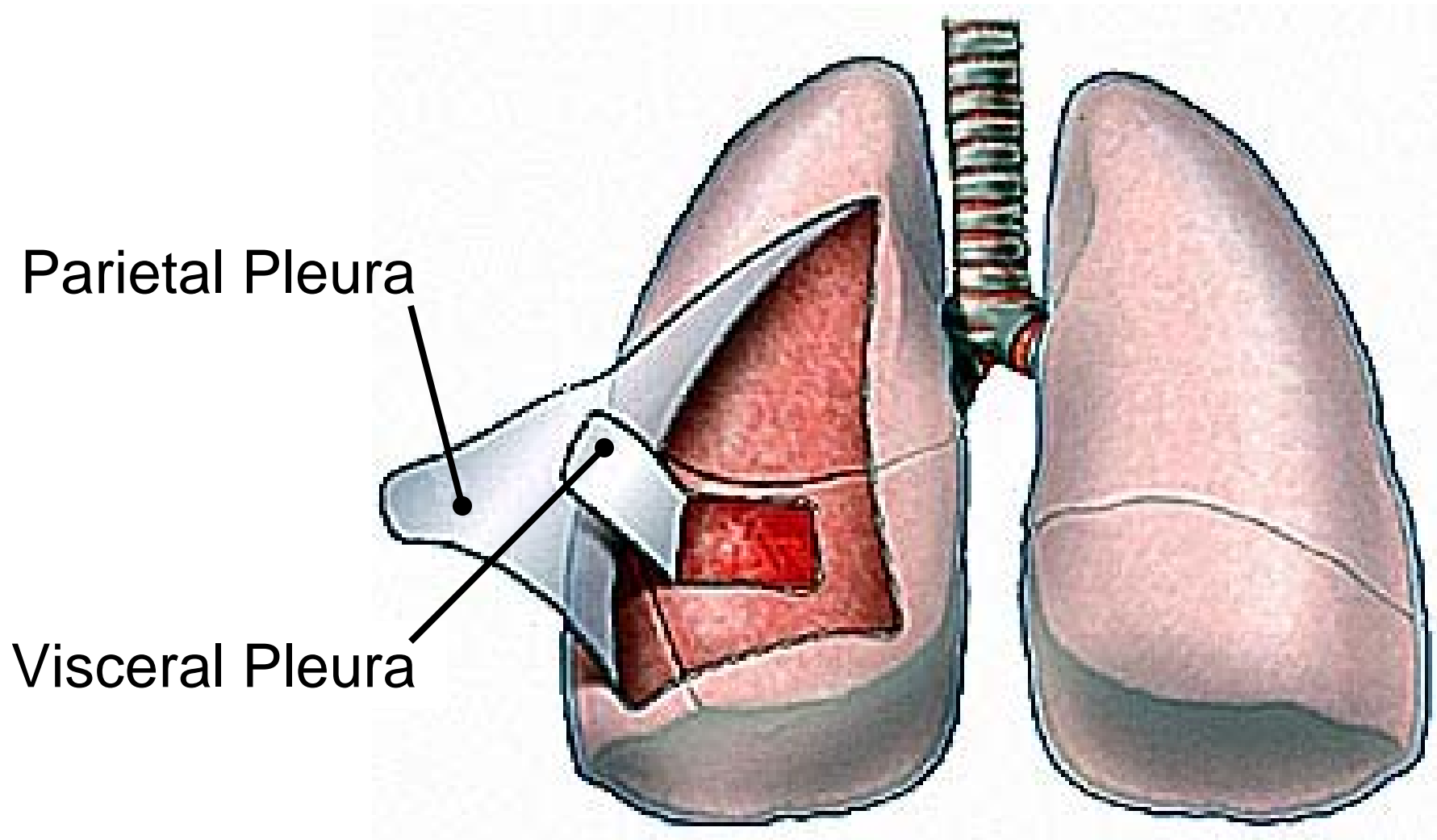
CO₂ HIGH

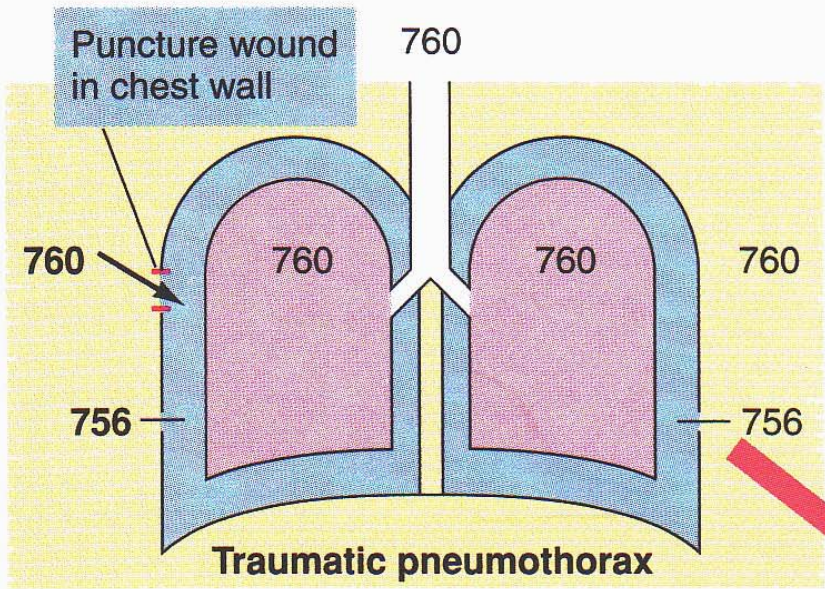
O₂ LOW

O₂ is carried mainly by red blood cell hemoglobin!

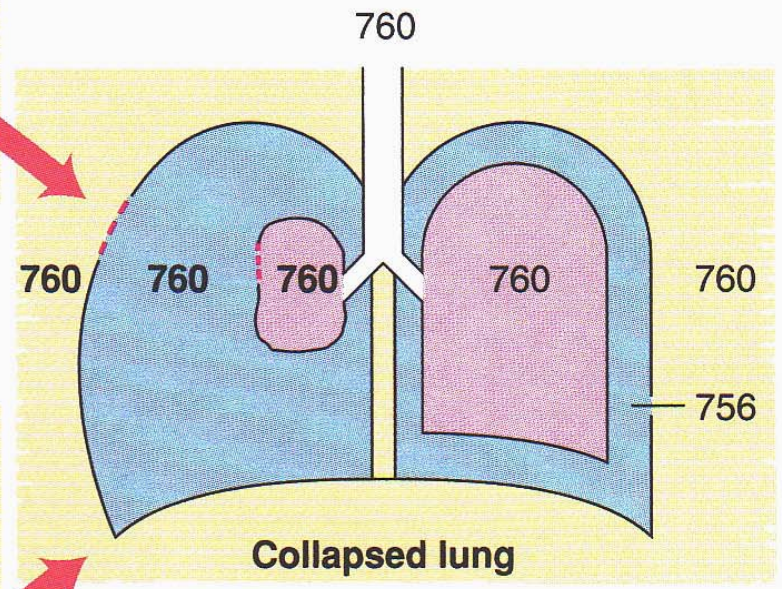


Pleura/Peritonea/Lung Membranes

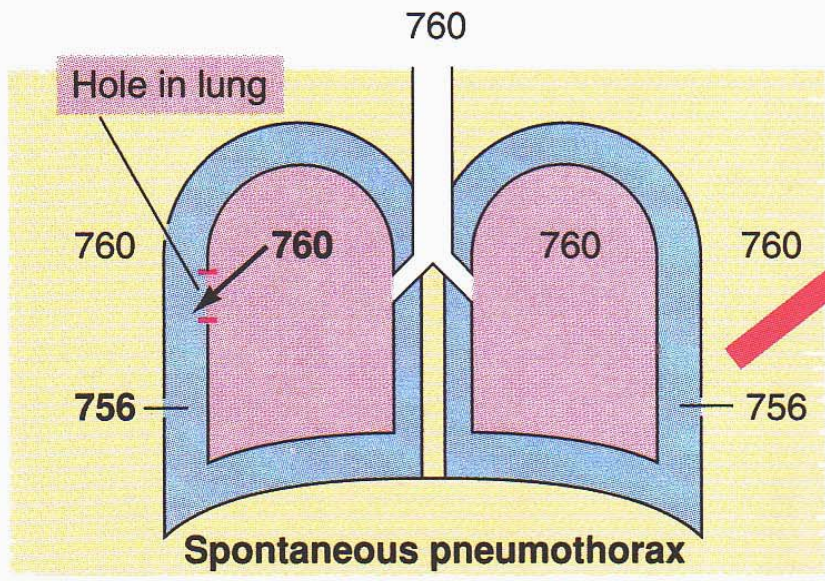




(a)



(b)



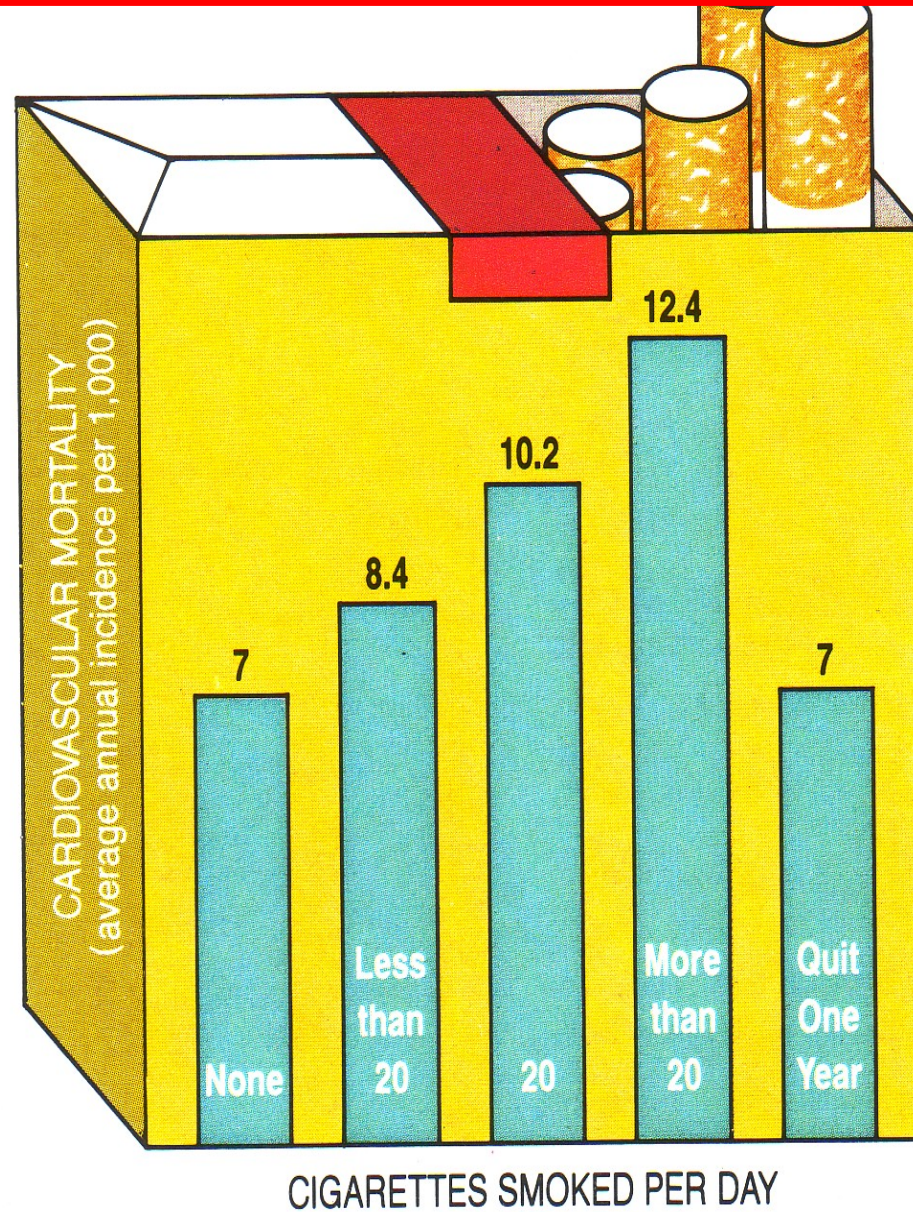
(c)

American Cancer Society Great American Smoke Out!

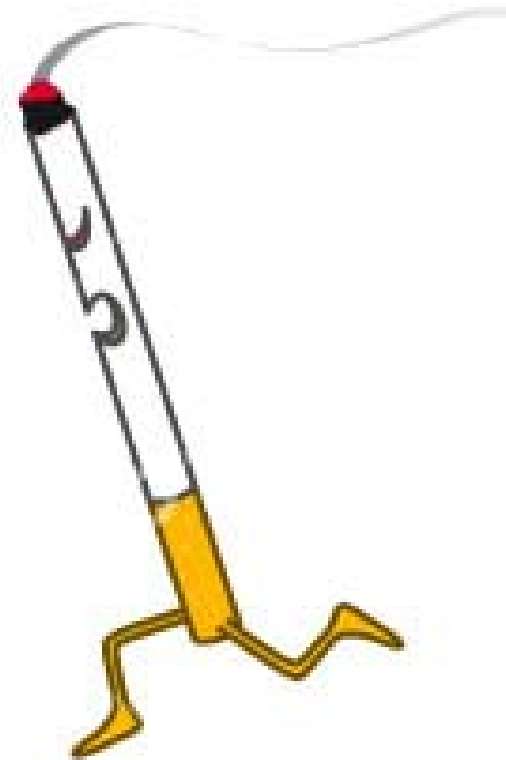
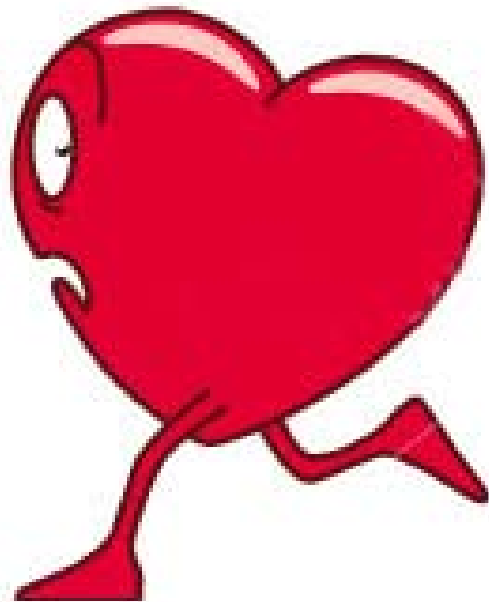


**[http://www.cancer.org/healthy/stayawayfromtobacco/
greatamericansmokeout/](http://www.cancer.org/healthy/stayawayfromtobacco/greatamericansmokeout/)**

Cigarette Smoking: #1 Preventable Cause of Premature Death in the US



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



Tobacco smoke = Deadly mix of > 7000 chemicals!

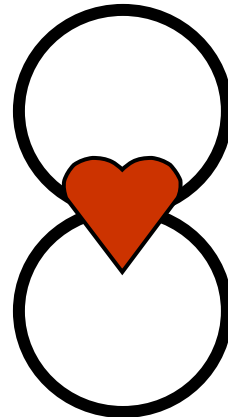
**[http://www.cdc.gov/tobacco/data_statistics/sgr/
50th-anniversary/index.htm#fact-sheets](http://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.htm#fact-sheets)**

**[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/)**

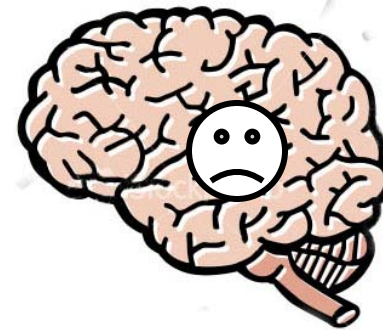
***Cigarettes ≡ Patient-Assisted Drug-Delivery System
Inhaling Bypasses the Systemic Circulation
& Is Powerfully Reinforcing!***



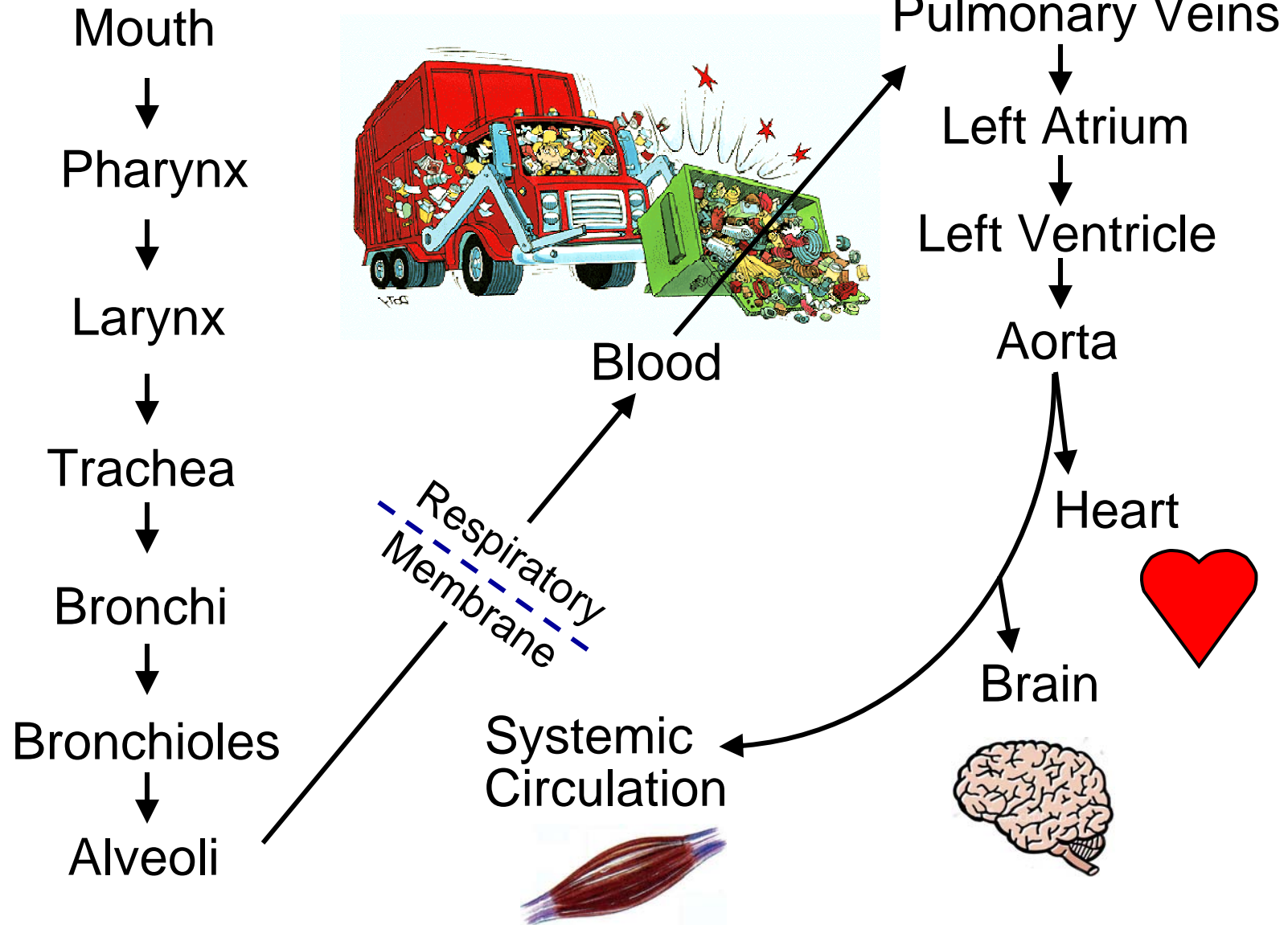
Pulmonary



Systemic



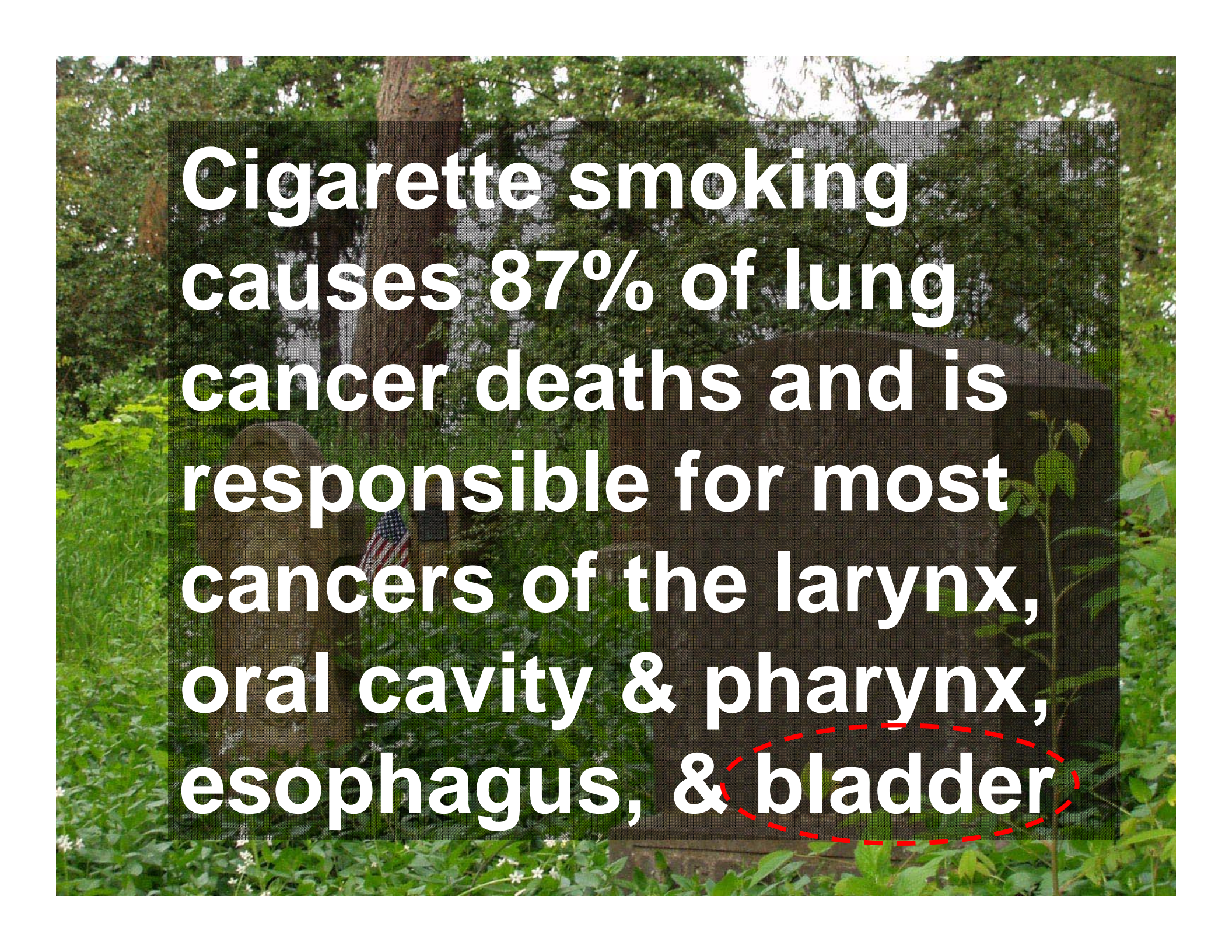
Tracing the Route of Cigarette Smoke Puff to Brain Time 5 to 8 seconds!!



Keep it Basic?

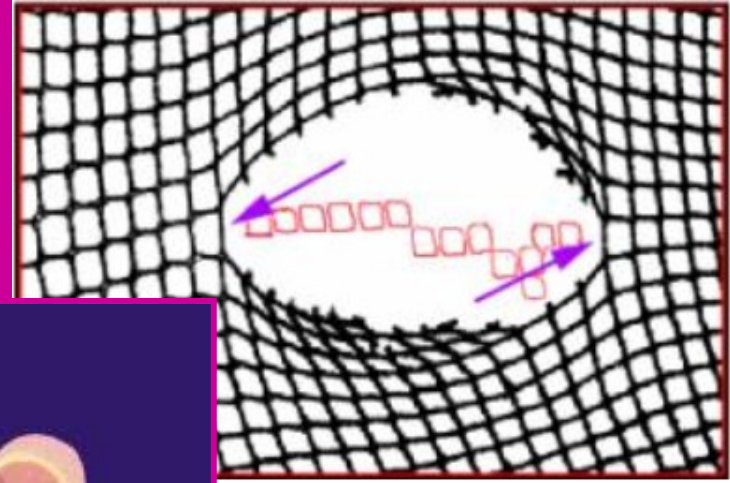
Cigarette smoking is the most important preventable cause of premature death in the U.S. accounting for 443,000 annual deaths.

http://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/tobacco_related_mortality/#cigs



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

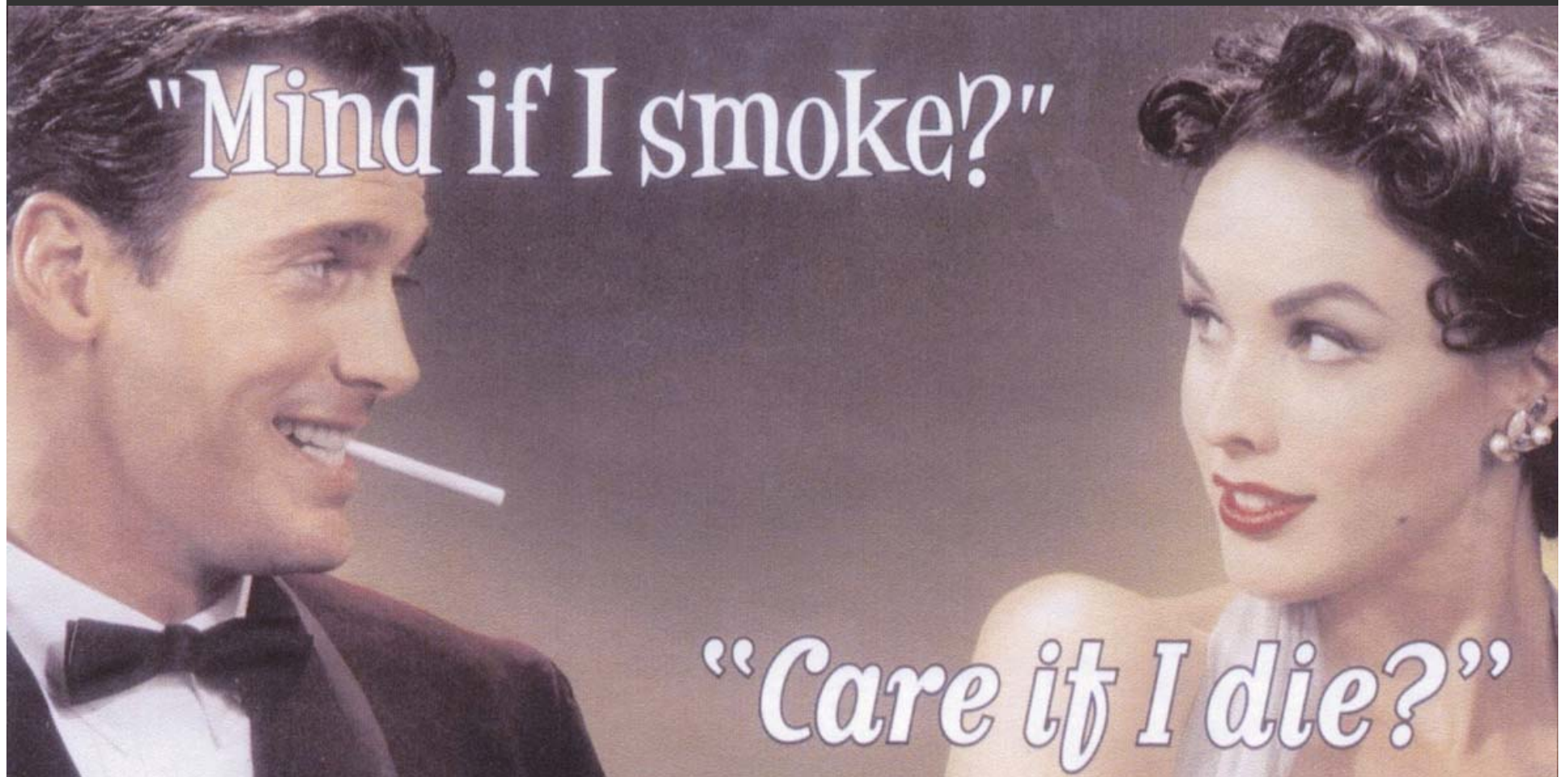
Emphysema ≡ Corrosion of Alveolar Walls with ↓ SA & Labored Breathing



*Internet Journal of Pathology
Mayo Clinic Health*

**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**

2nd-hand smoke is the 3rd leading preventable cause of death in the US!



Each year ~45,000 Americans die due to 2nd-hand smoke exposure!

News: Health, Toxicology, Pollution

Health risks of e-cigarettes emerge

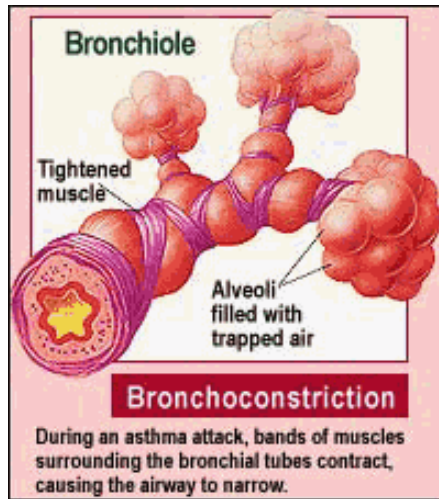
Vaping pollutes lungs with toxic chemicals and may even make antibiotic-resistant bacteria harder to kill

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

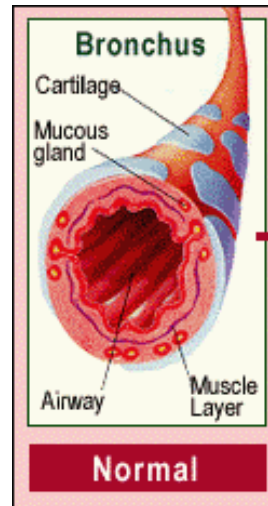


<https://www.sciencenews.org/article/health-risks-e-cigarettes-emerge>

SMOKING ≡ ASTHMA?



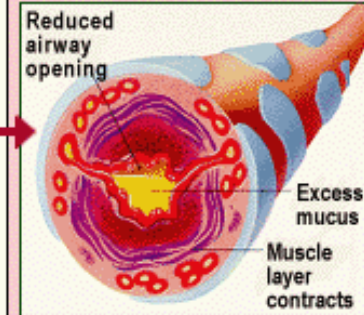
+



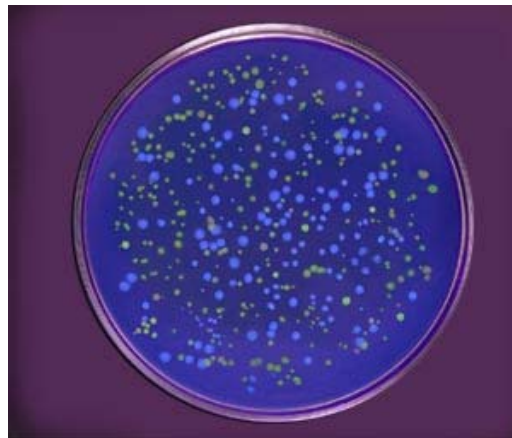
Asthma Triggers

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

Inflammation

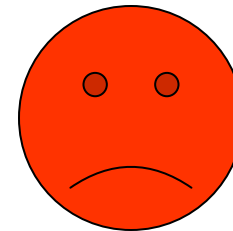


=



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?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>