

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

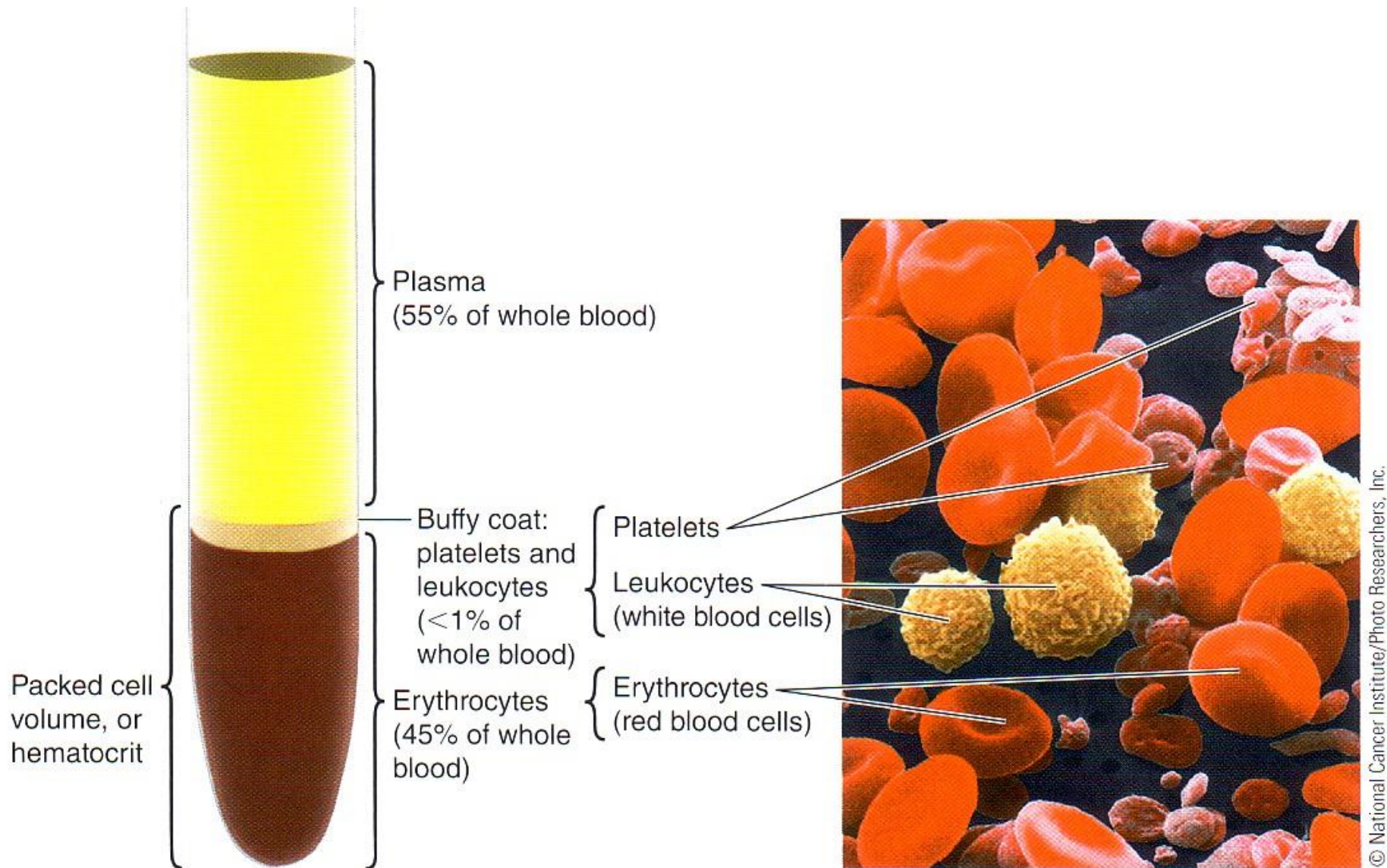


- I. Announcements:** No lab today! Break for exam week!  
Next R Blood Chemistry. Thanks sincerely for helping us optimize safety by reading  $\geq 2x$  Lab 5, LM pp 5-1 to 5-6.
- II. Blood Form & Function** LS ch 11, DC Module 5 pp 35-9
  - A. Formed vs Nonformed/cells vs plasma** fig+tab 11-1  
Cell origin - bone marrow. What's in plasma? p 316
  - B. Red blood cells/erythrocytes:** O<sub>2</sub> 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?



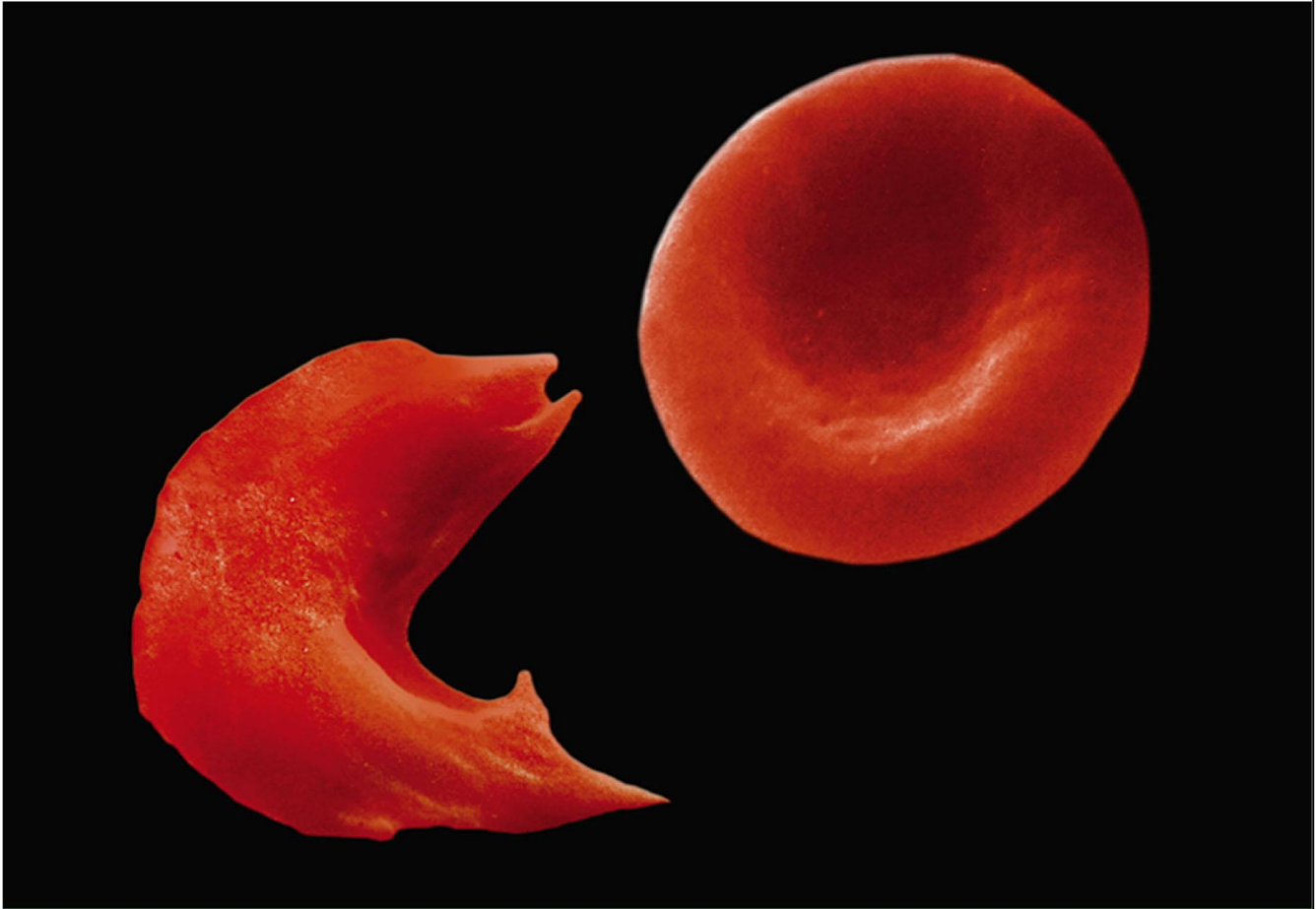
# What's in Blood? Plasma & Blood Cells



Sickle-shaped blood cells

Normal red blood cells

© Dr. Stanley Flegler/Visuals Unlimited



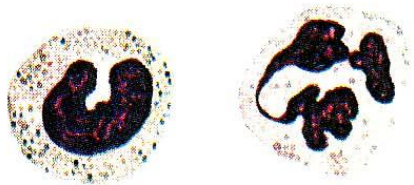
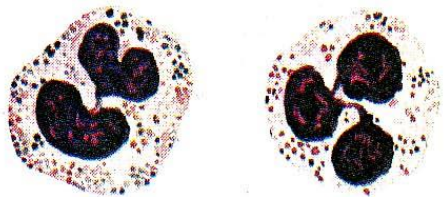
**What a difference one amino acid can make!**

Amino acid sequence of normal hemoglobin:

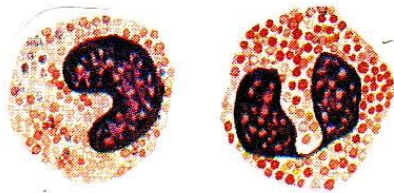
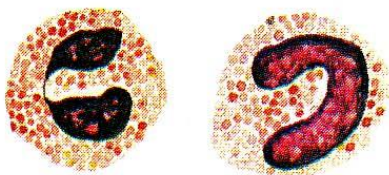


Amino acid sequence of sickle-cell hemoglobin:

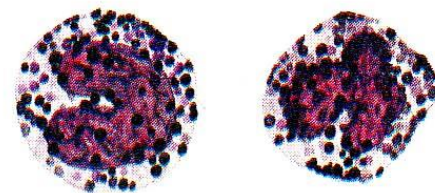
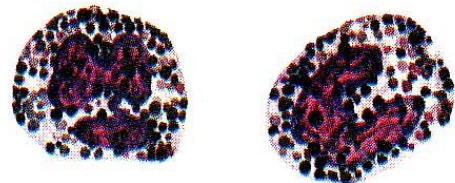




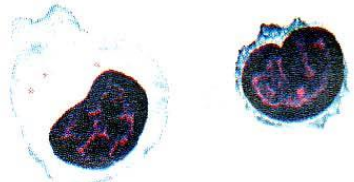
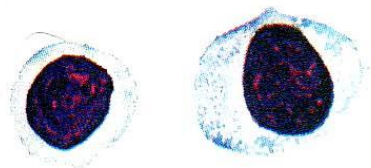
NEUTROPHILS



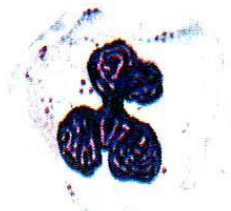
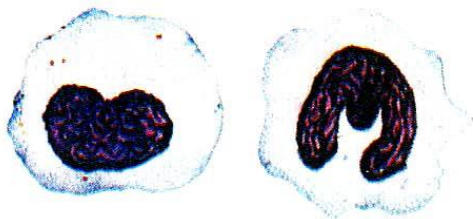
EOSINOPHILS



BASOPHILS



LYMPHOCYTES



MONOCYTES

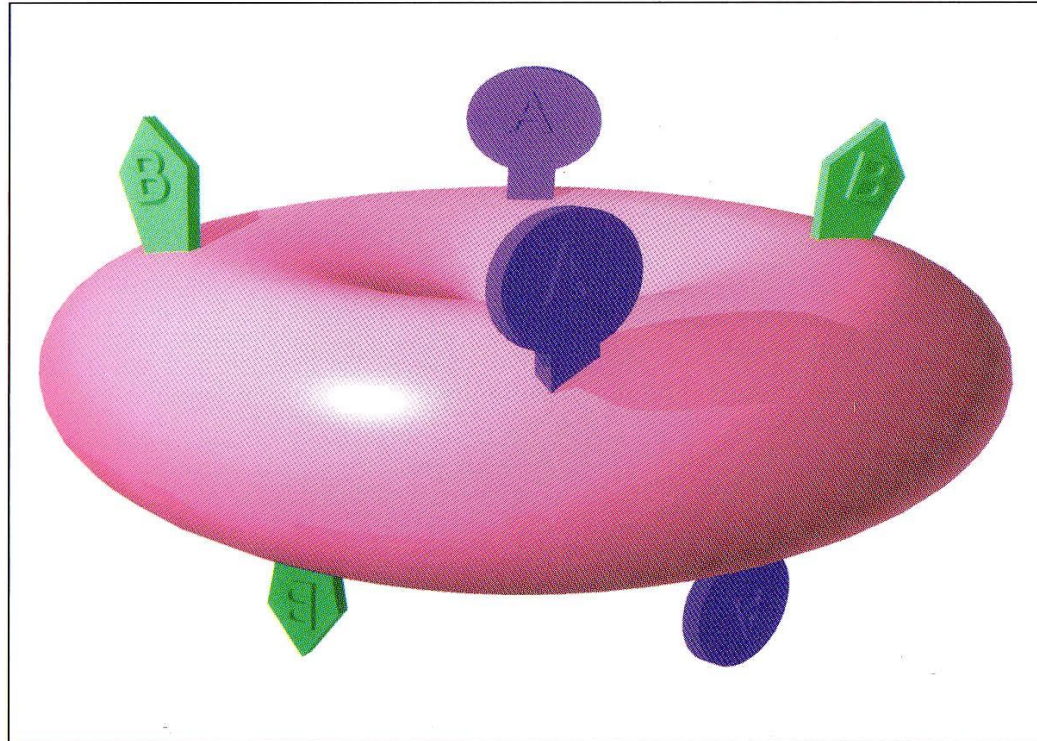


PLATELETS

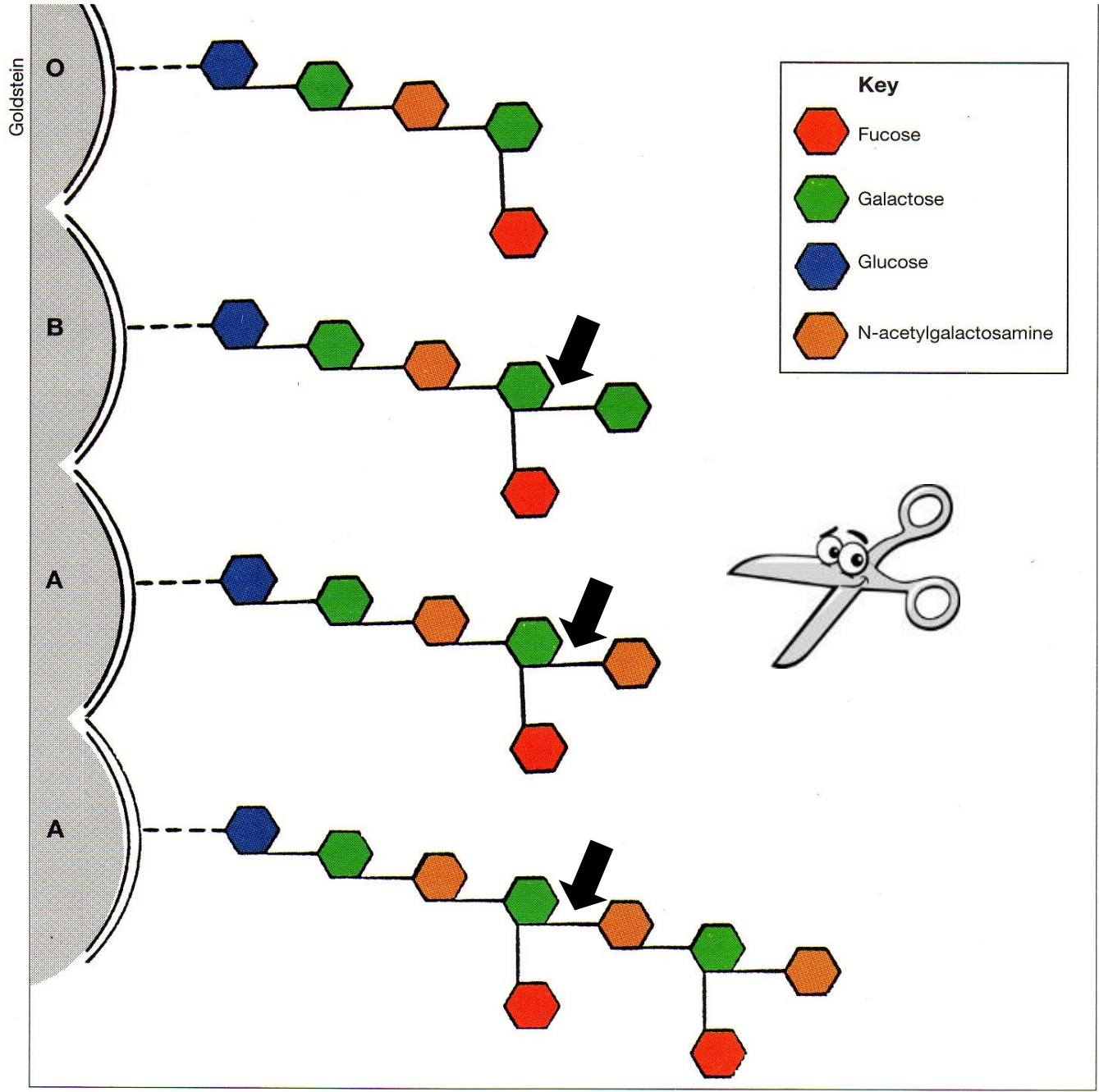


ERYTHROCYTES

# AB



A & B Antigens  
(Agglutinogens)



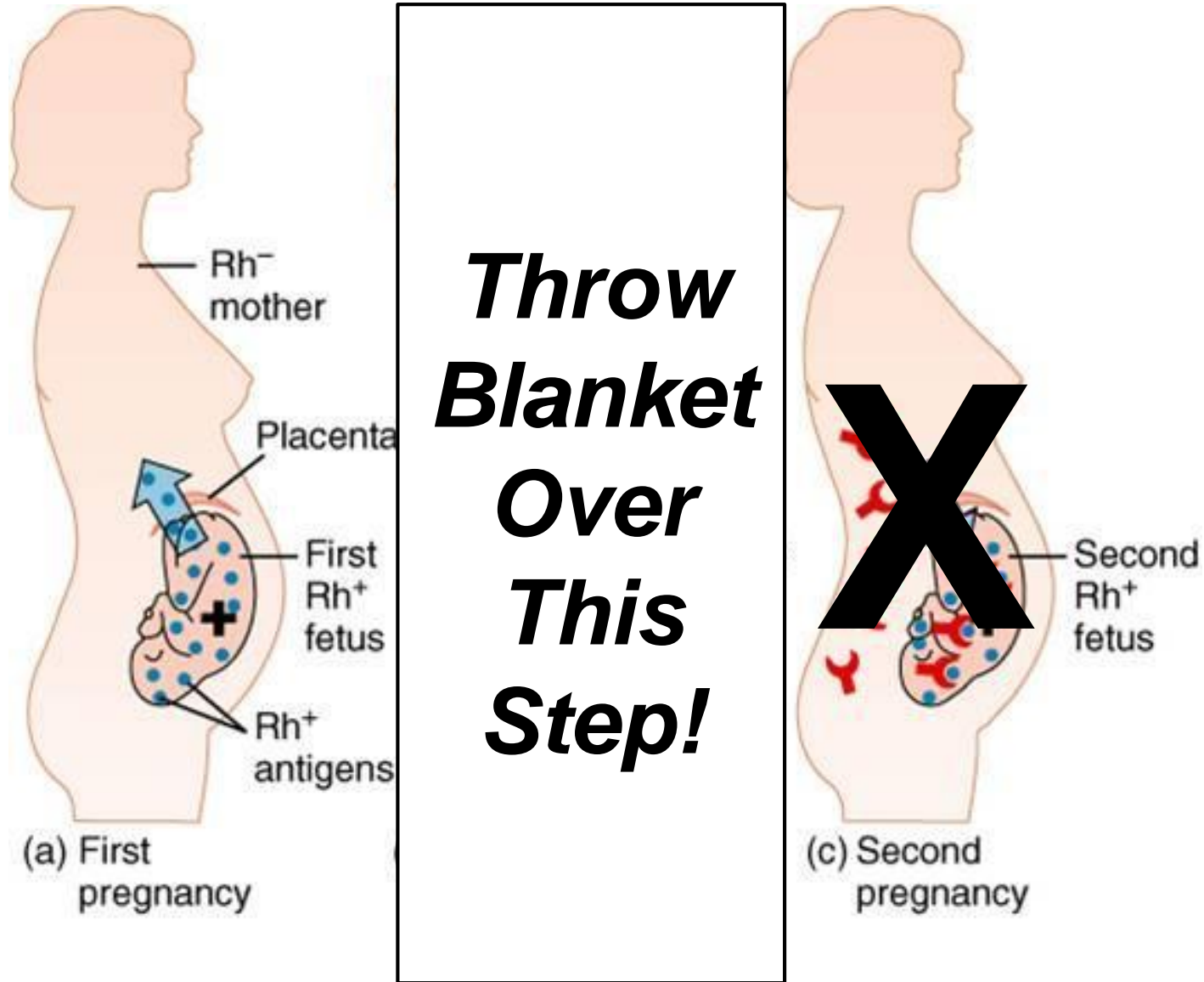
# BI 121 Lecture 10



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

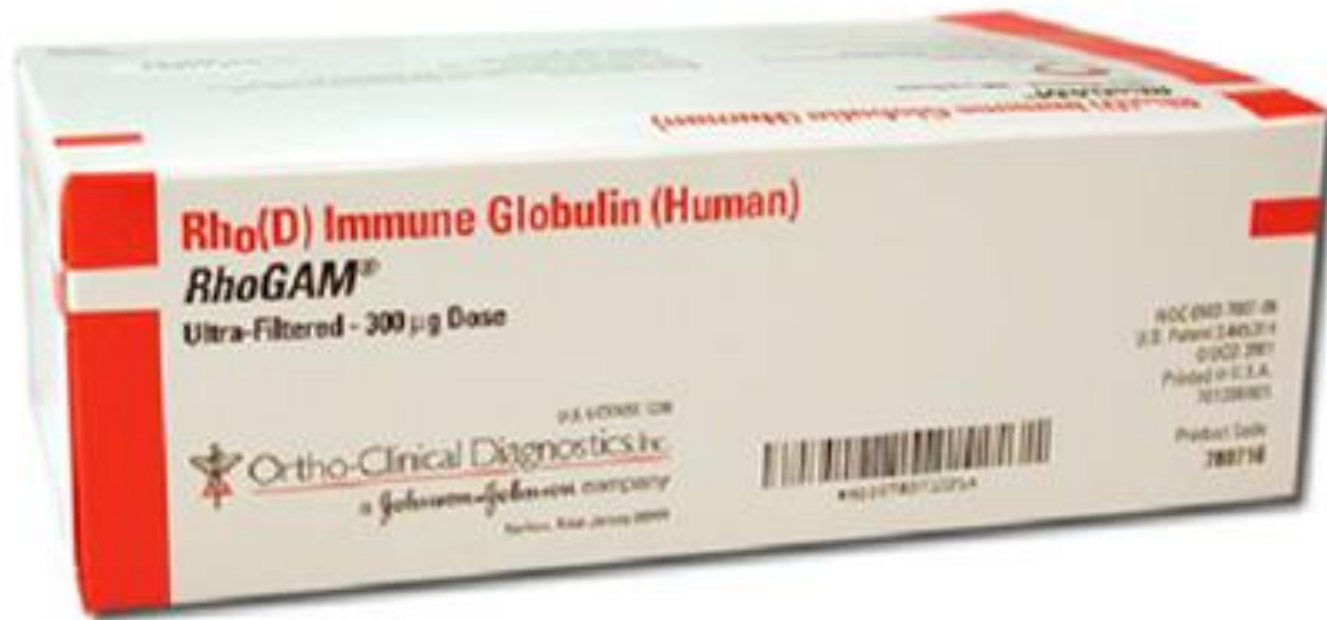
- I. Announcements** To make Lab 5 educational, fun & safe for all, **please read pp 5-1 thru 5-6 in LM twice before Thursday!** Remaining exams & notebooks returned > lecture. Key posted in glass box in Huestis near 120 HUE. Estimate grade? Q?
- II. Blood Chemistry Connections** LS ch 11 p 303, ch 17 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 or Hemolytic Disease of the Unborn/Newborn***



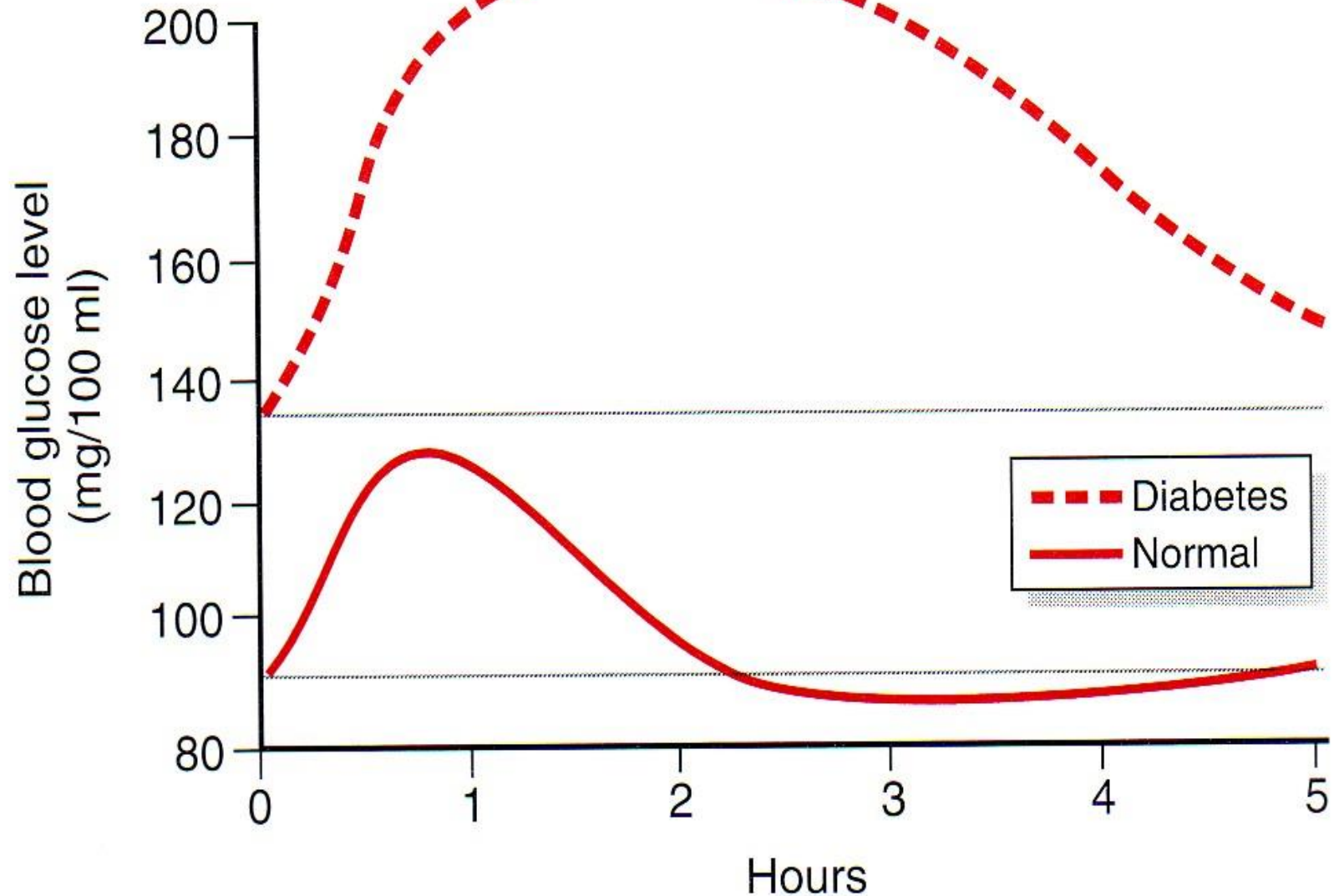


**Inject Mom with RhoGam  $\leq$  48-72 hr  
> each Rh+ Pregnancy**



**The Blanket is RhoGam → Masks  
the Mom's Immune System!**

# Diabetic & Normal Response to Glucose Load

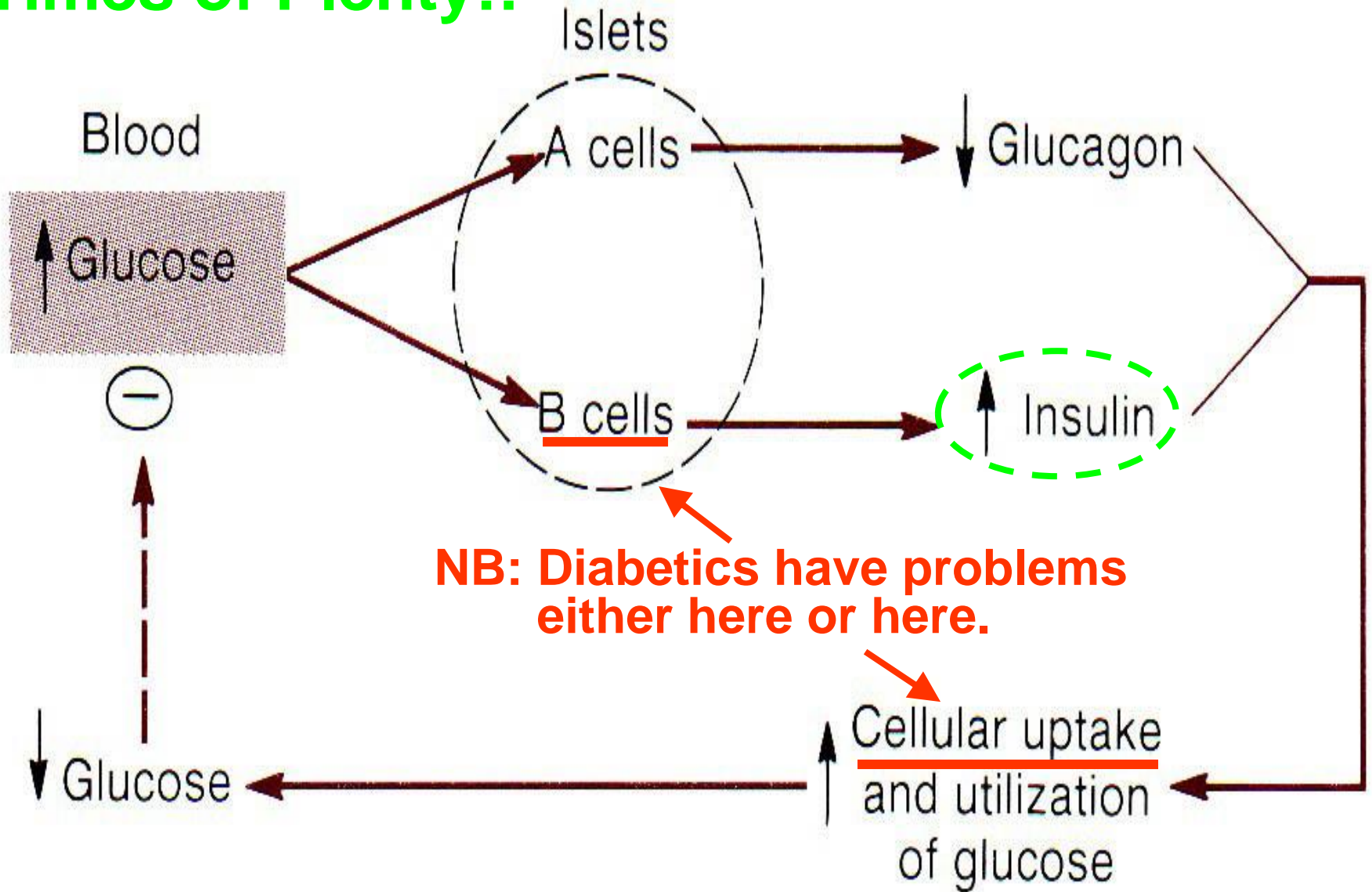


Glucose:  
Sugar in Blood



*Normal: 70-99*  
*Pre-Diabetes: 100-125*  
*Diabetes:  $\geq$  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!***

**Medication**



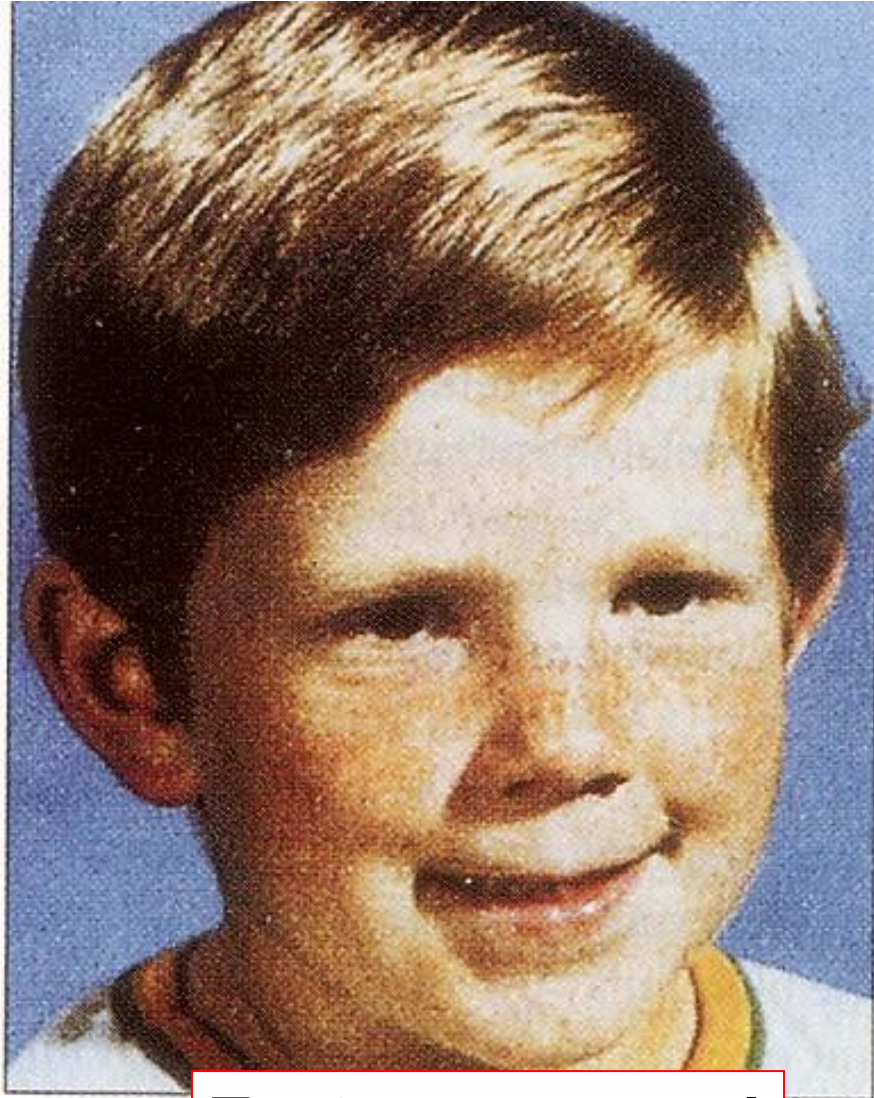
**Exercise**

**Diet**

***Exercise is a must based on  
its insulin-like effect!***



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



**T = 0, near normal**



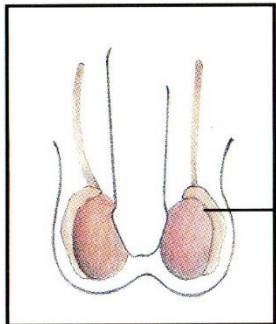
**T = 4 months later**



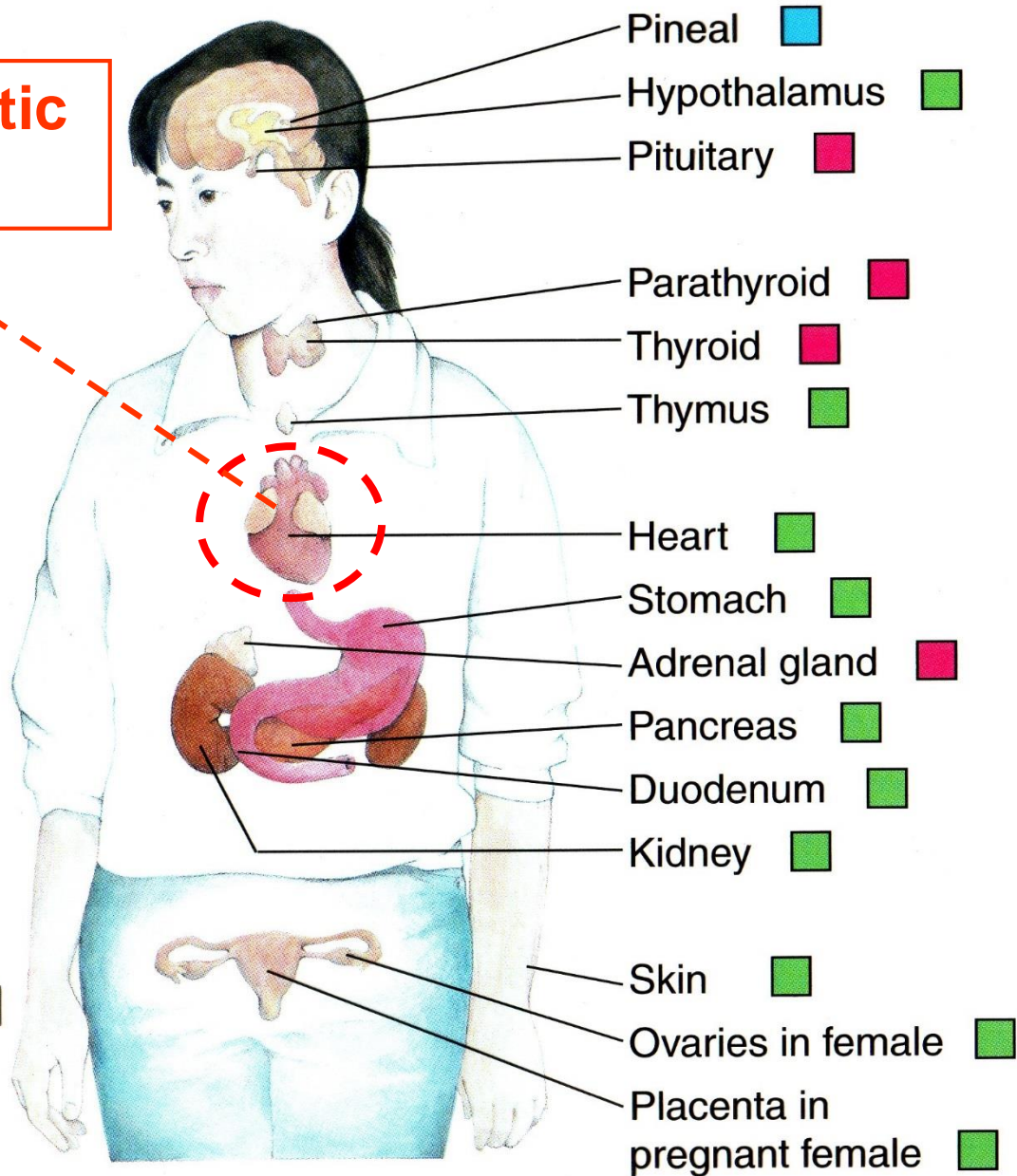
# Endocrine System

**ANP = Atrial Natriuretic Polypeptide**

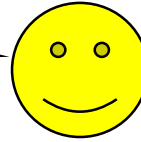
- Solely endocrine function
- Mixed function
- Complete function uncertain



Testes in male ■



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 & in e-mail. Thanks sincerely!  
Lab Manual & Exam I Remaining Returns. Q from last t?
- II. Safety & Techniques Review for Blood Chem Lab** Q?
- III. Endocrine Connections** LS ch 17, DC Module 13, SI Fox +...
  - A. Endocrine/hormone classes ~ LS pp 495 – 6
  - B. Hypothalamus (Master) – Pituitary (subcontroller)  
DC pp 104-6 + LS pp 499-506
  - C. Posterior pituitary+hormones DC p 108, LS fig 17-4 p 502
  - D. Anterior pituitary hormones DC pp 105-7, LS pp 502-6
  - E. Endocrine feedback + reflexes LS p 540 fig 17-7
  - F. GH: Body builder's dream? Fountain of youth?  
LS pp 506-10, fig 17-10, 17-11
  - G. Peripheral endocrine organs DC pp 109-13, LS pp 513-36
    1. Pancreas 2. Thyroid 3. Adrenals

***No food, drink or gum in lab today! Thanks sincerely!***



**...Healthy, tasty & fresh, but not in lab!!**



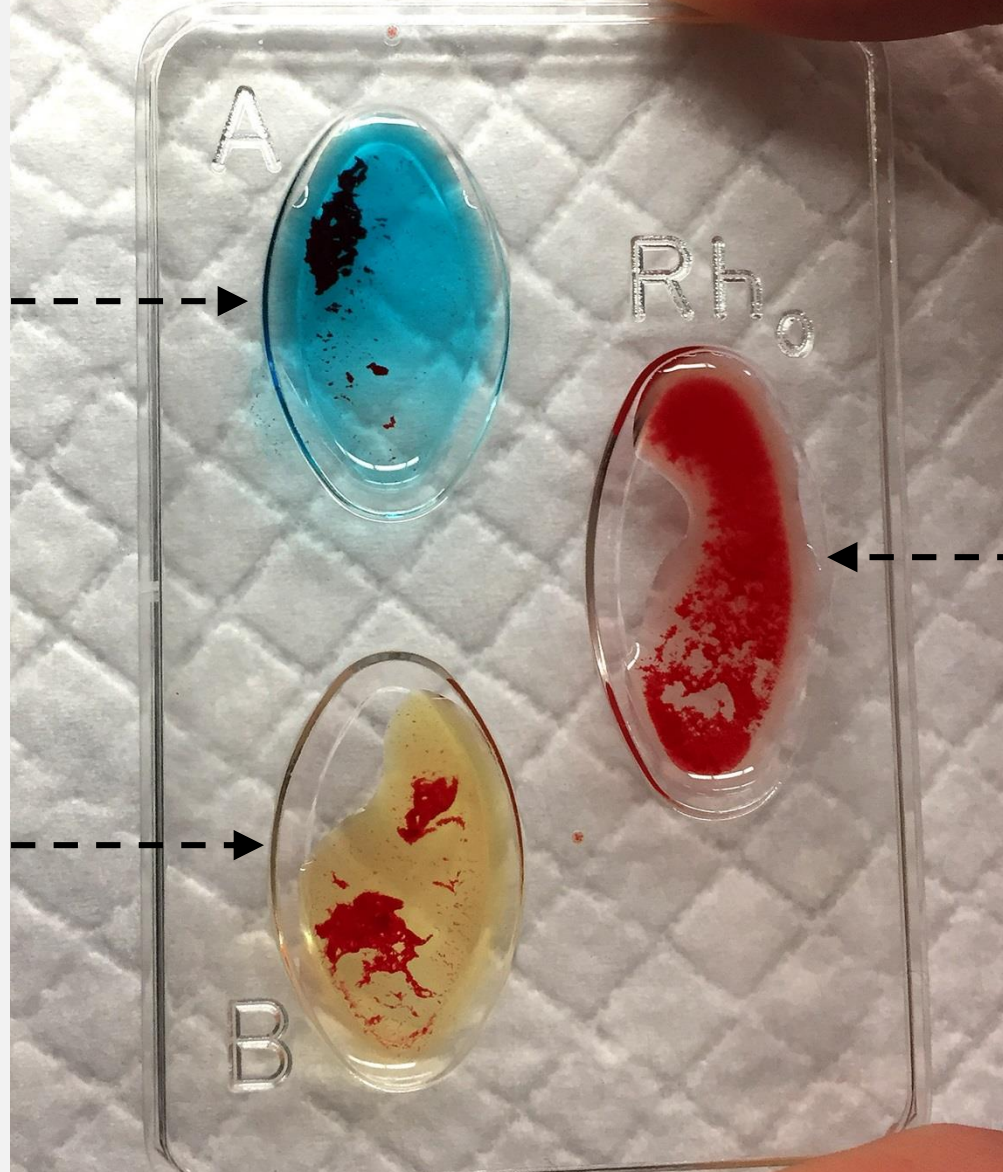
1<sup>o</sup> Q? Clumping in Any Wells?

Type AB+

Here?

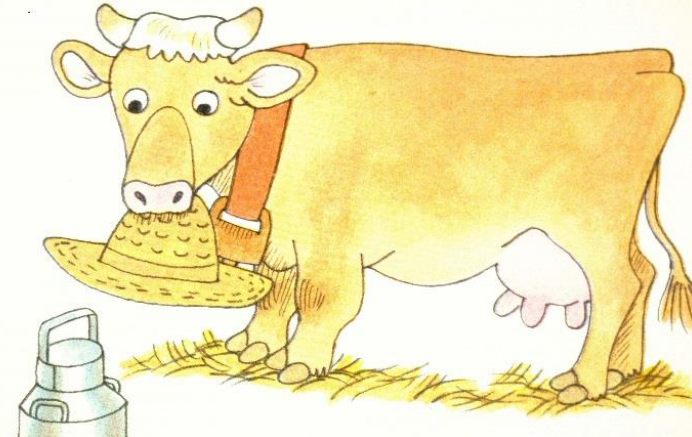
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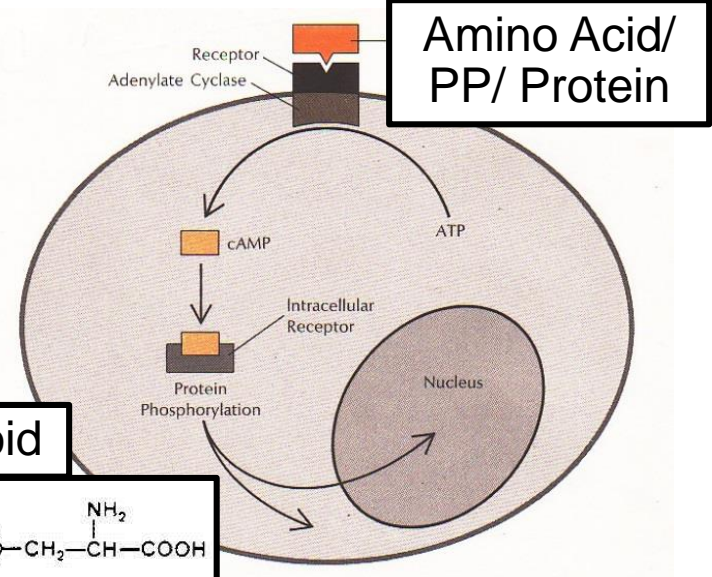


# Hormone/Endocrine Classifications?

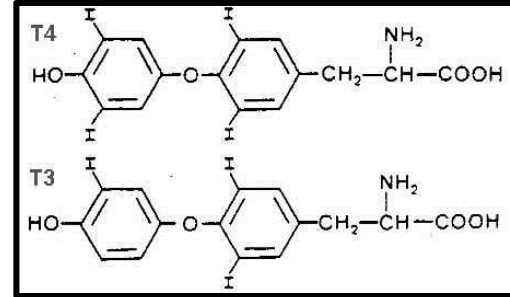
## Exogenous



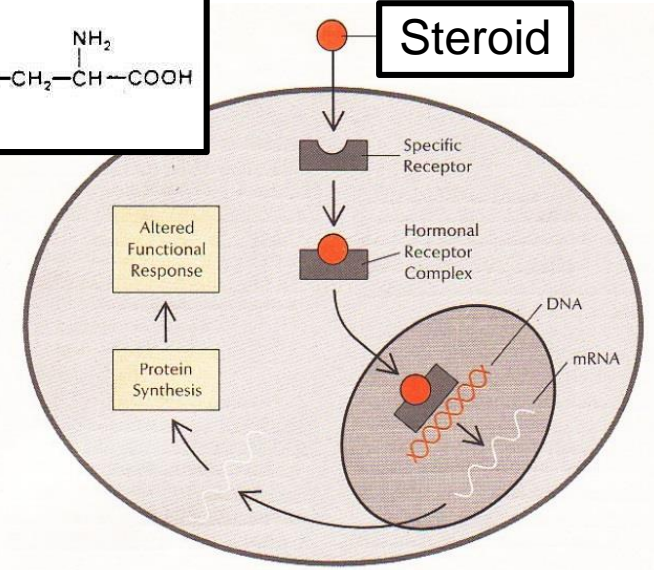
## Endogenous



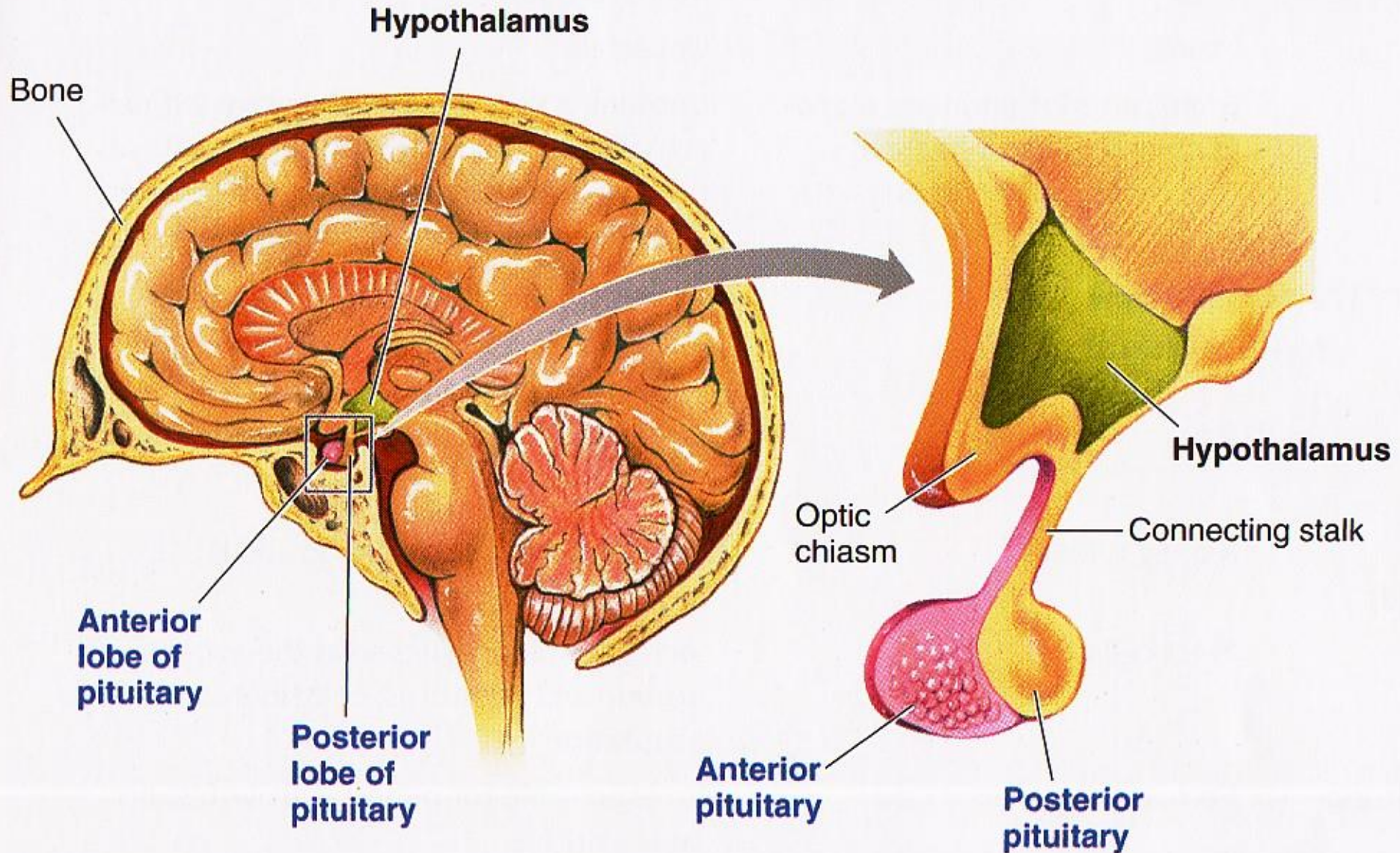
### Thyroid

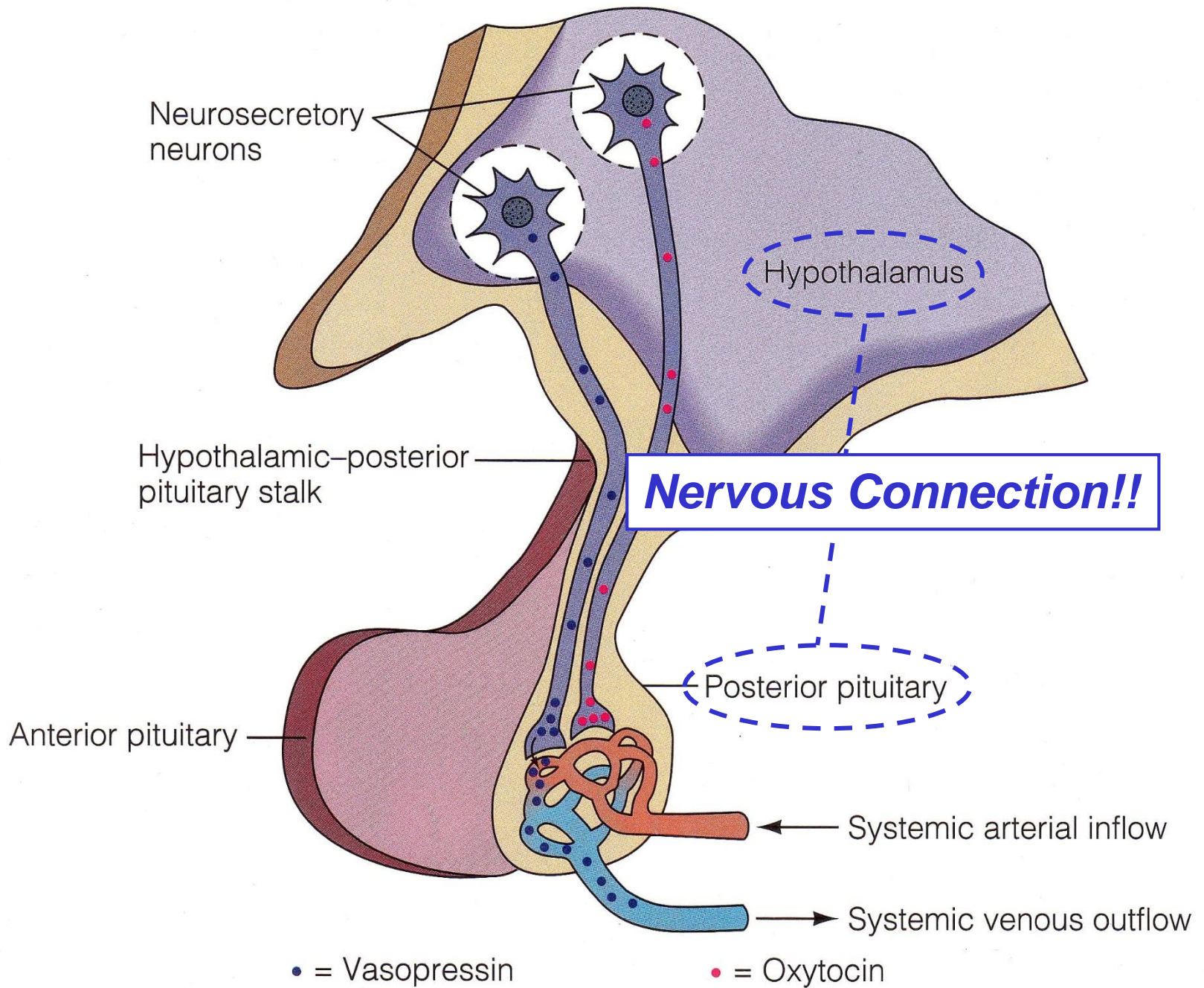


### Steroid

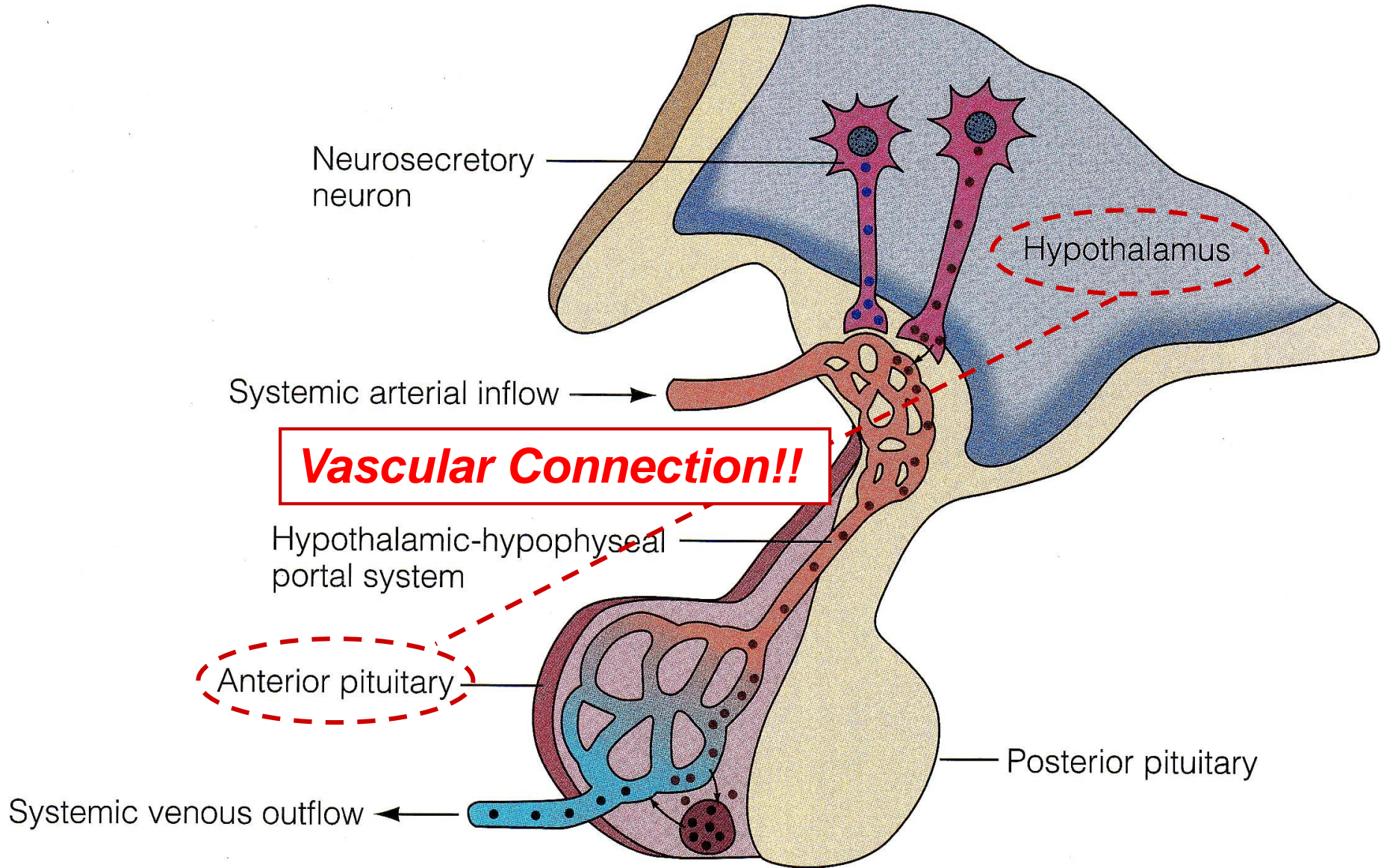


# Hypothalamus & Pituitary: Intimate Relationship





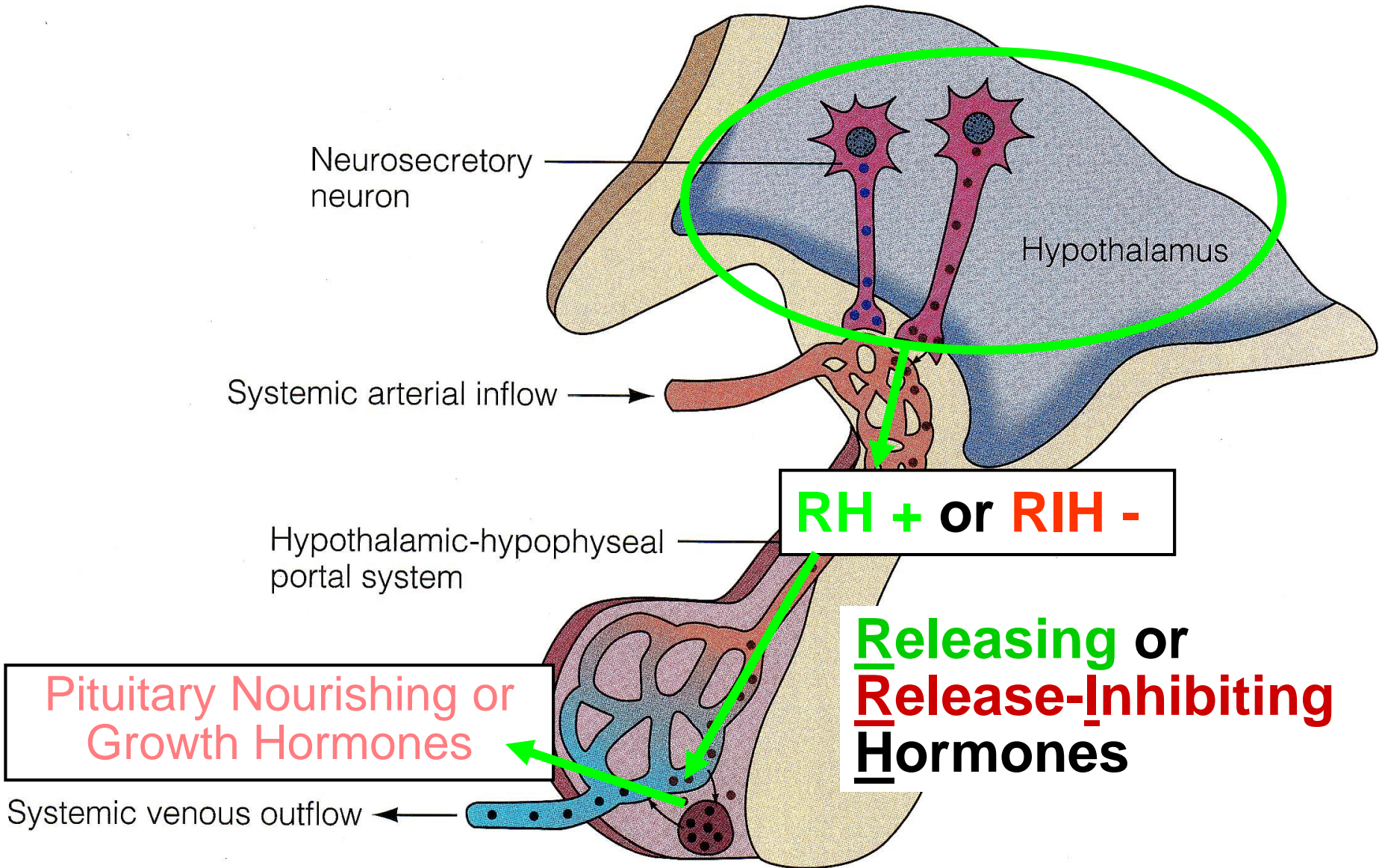
# Hypothalamus-Anterior Pituitary Vascular Connection!



• = Hypophysiotropic hormones

• = Anterior pituitary hormone





**RH + or RIH -**

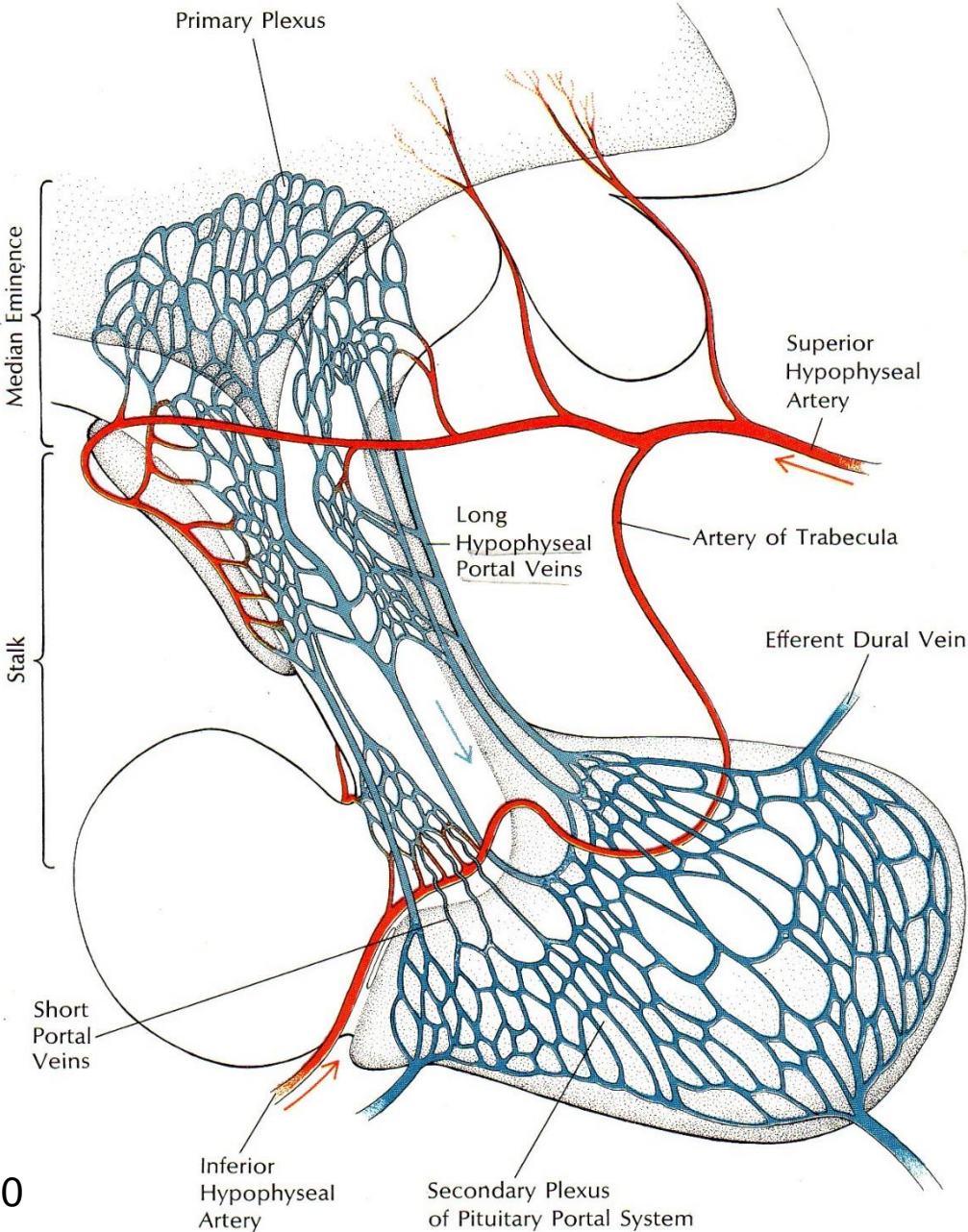
**Releasing or Release-Inhibiting Hormones**

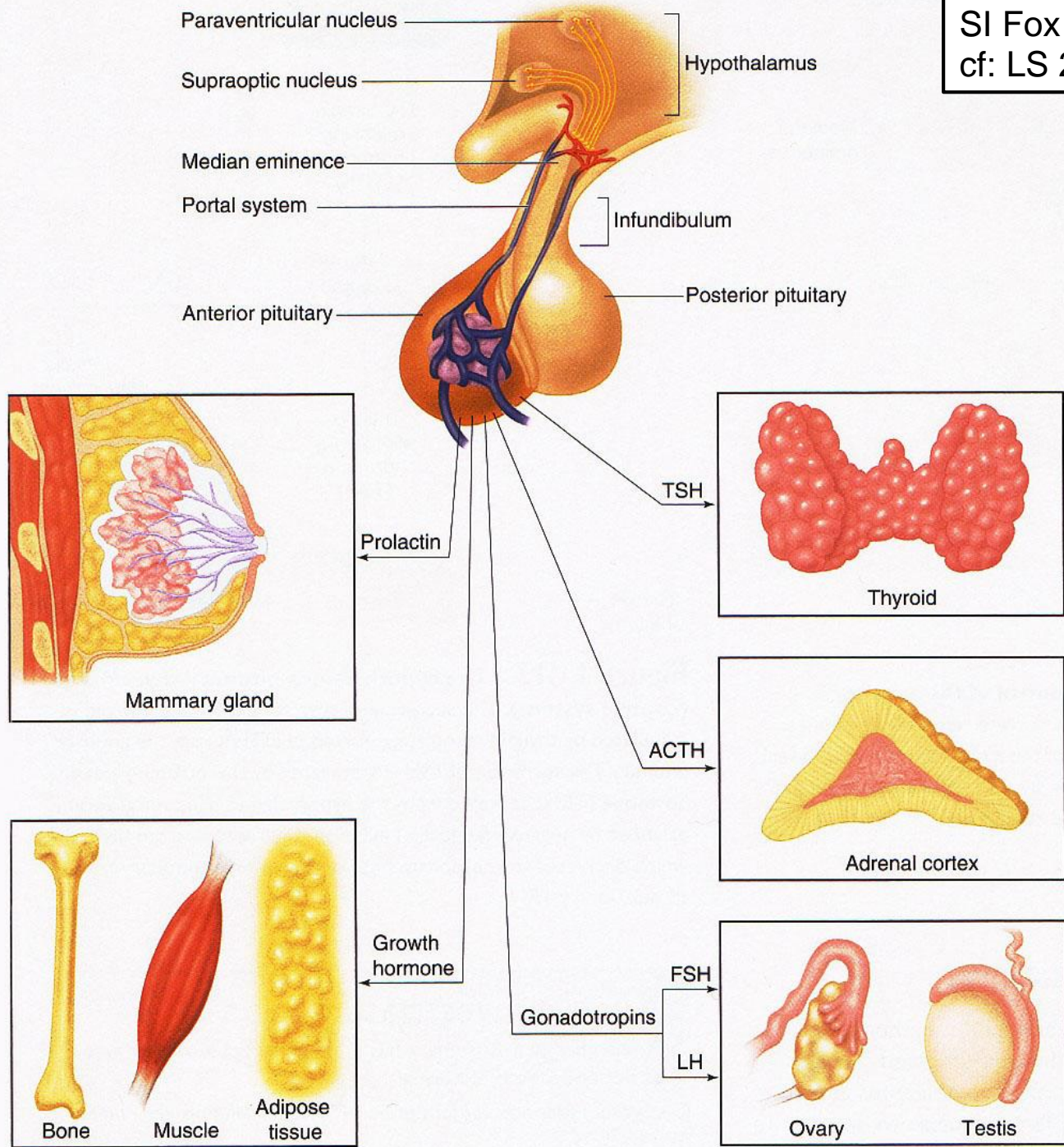
**Pituitary Nourishing or Growth Hormones**

- = Hypophysiotropic hormones
- = Anterior pituitary hormone

**Hypophysis ≡ Pituitary**

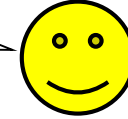
# Capillary-Venule-Capillary Intimate Circulation





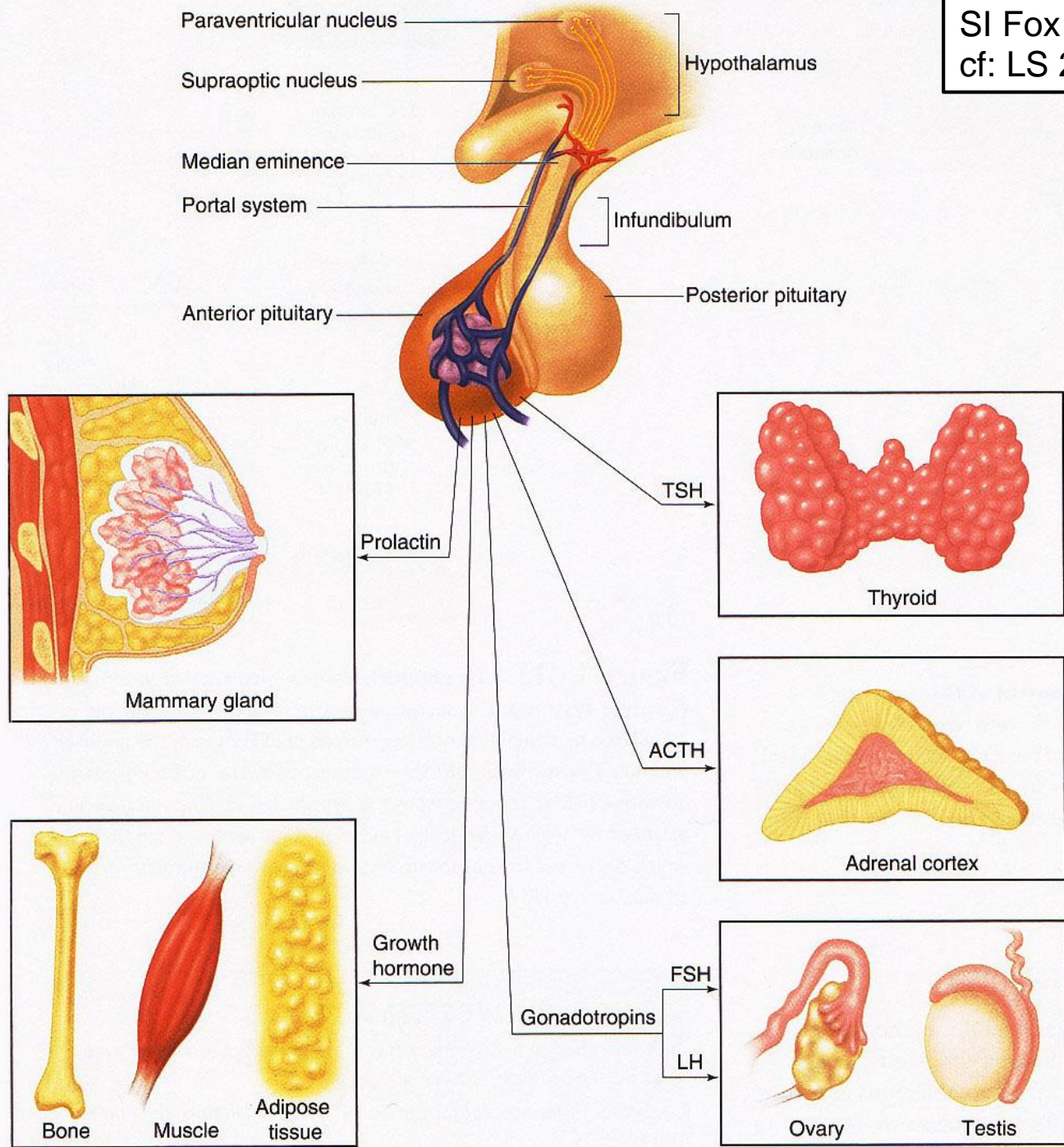
## BI 121 Lecture 12

Thanks to you, Holly, Hannah,  
& Erik!



For your effort  
& your  !!

- I. Announcements** Thanks for your help with blood lab! Great job! No lab this week. Study for Exam II, Dec 7, Wed, 8 am!
- II. Endocrine Connections** GH + Peripheral Endocrine Organs  
DC Module 13 p 104-113, LS pp 506-25 fig 17-18, 17-19 +...
- 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 2013 & 2014
- IV. Autonomic Nervous System** LS ch 7 pp 178-85+...
  - A. Sympathetic vs Parasympathetic branches LS fig 7-3
  - B. Neurotransmitters & receptors LS fig 7-1 & 7-2, tab 7-2
  - C. Actions LS tab 7-1
  - D. Fight-or-flight stories!



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

↑ Amino Acid uptake & Protein synthesis

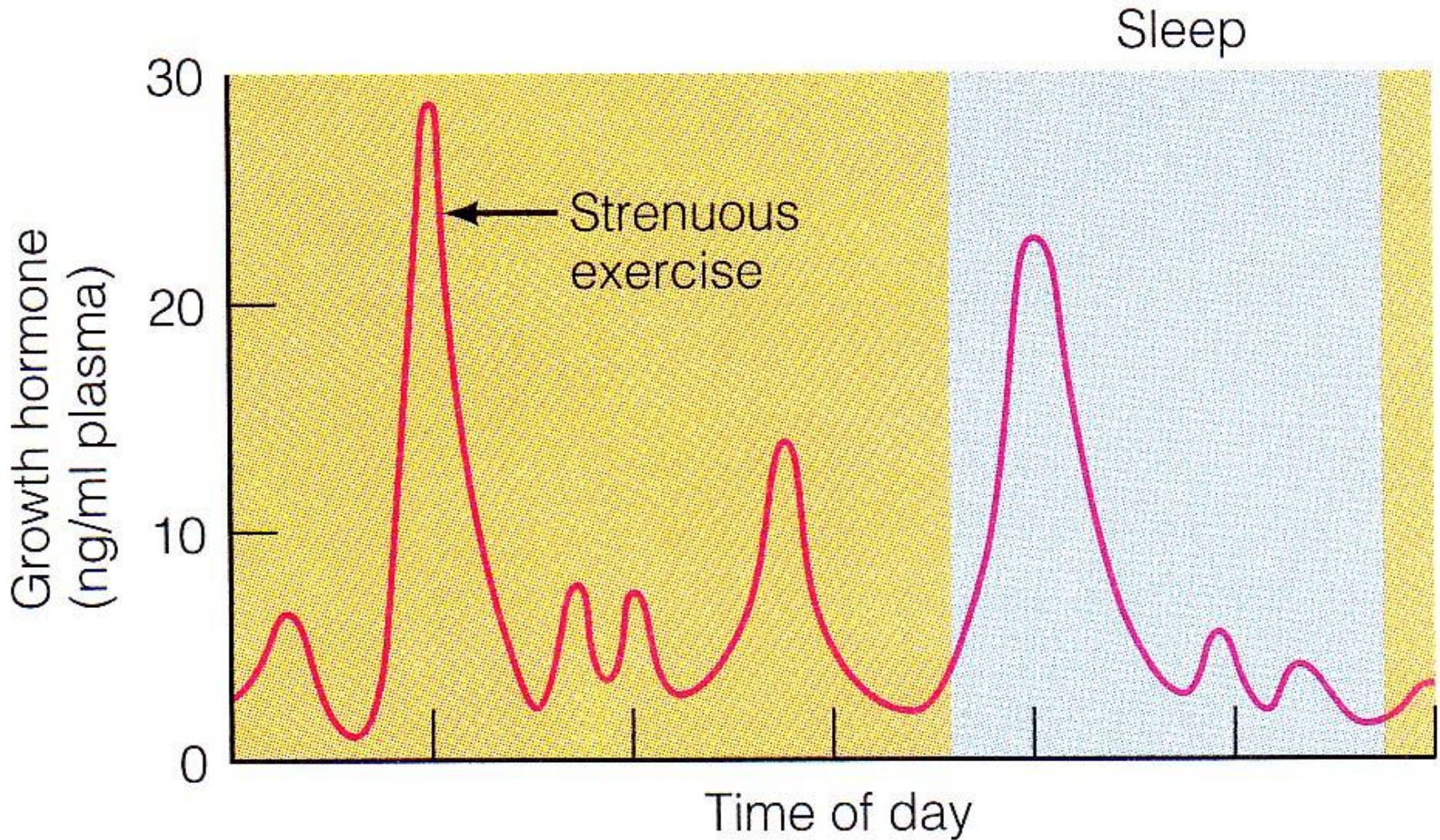
↑ Lipolysis & Fatty Acid mobilization

↓ Glucose uptake  
(skeletal muscle & adipocytes)

↑ Glucose production  
(liver glycogenolysis)

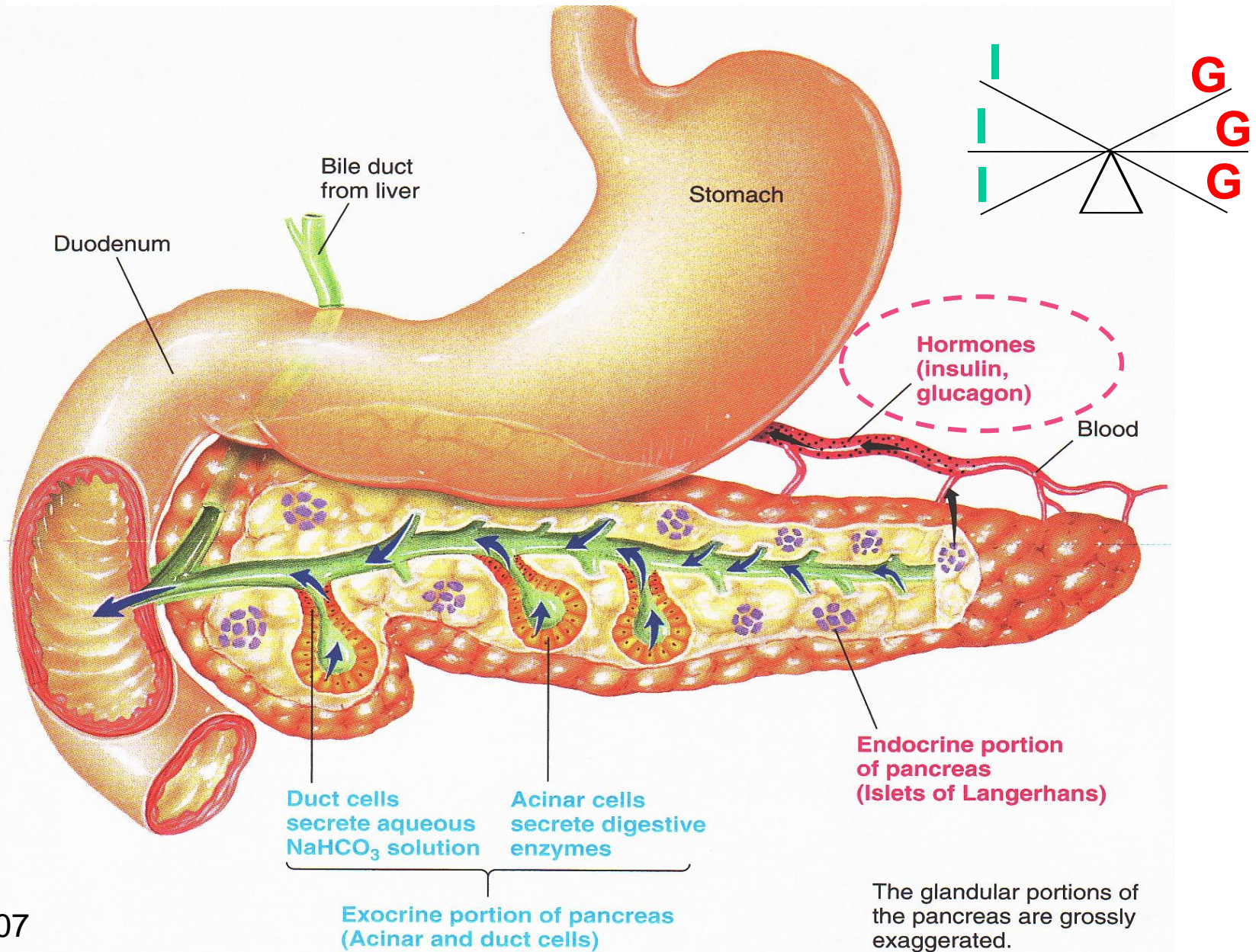
↑ Insulin secretion

# *Increase GH naturally with exercise & sleep!!*

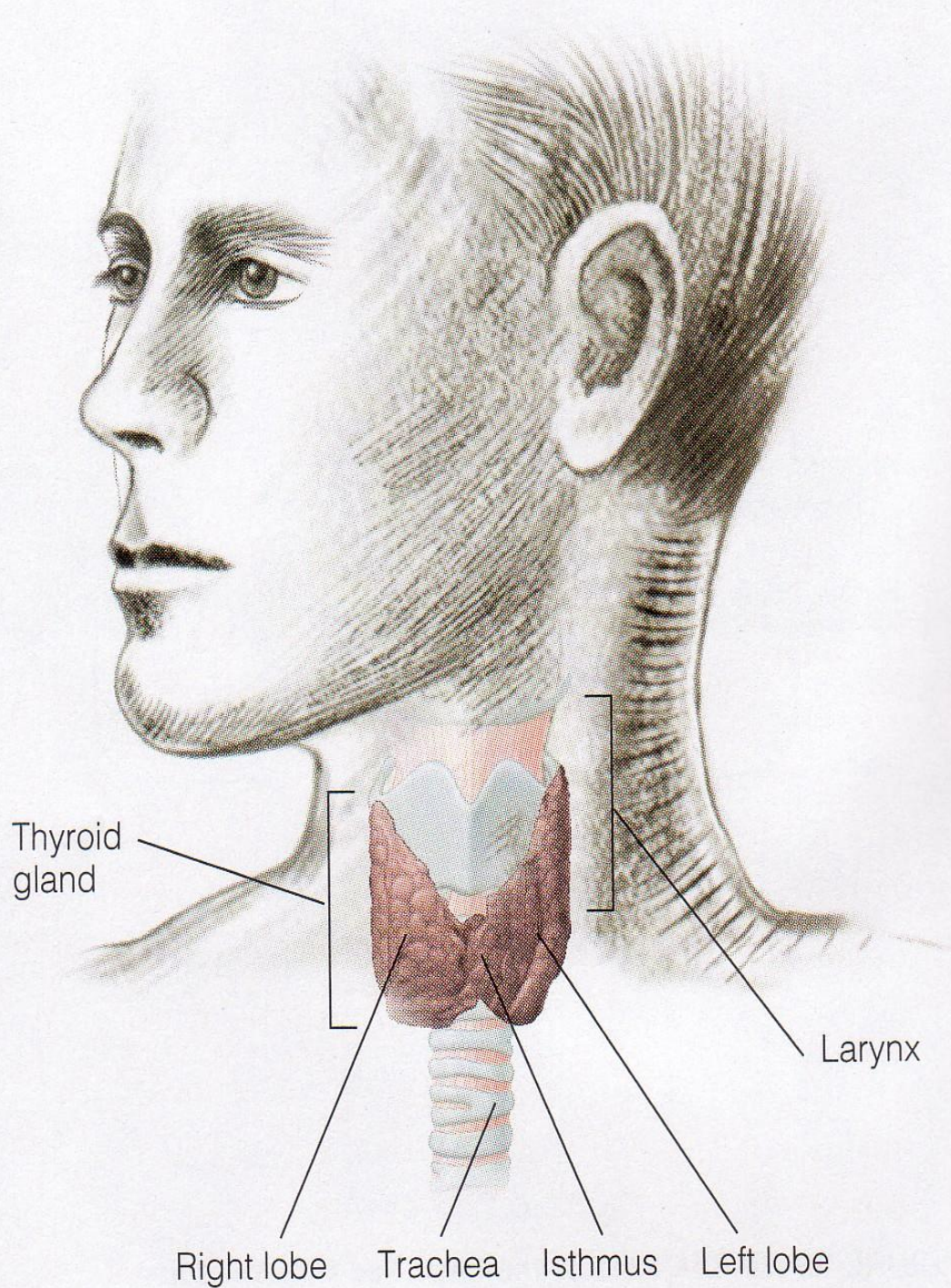


ng/ml = nanograms per milliliter

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







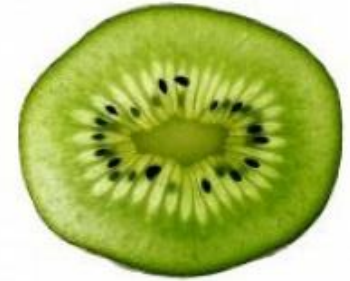
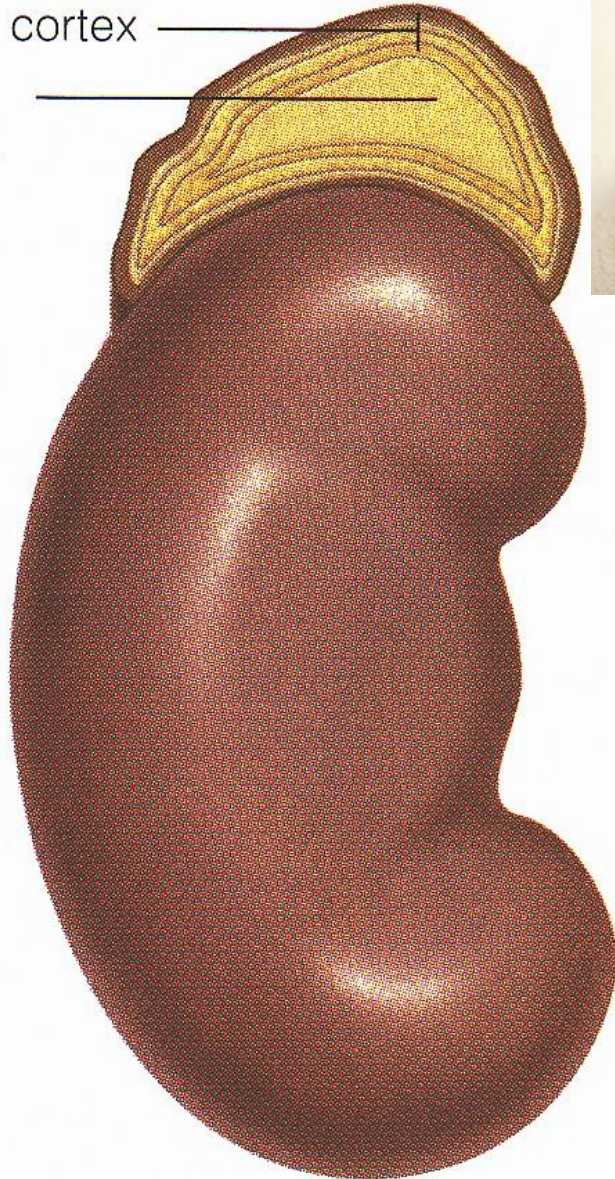


# Adrenal gland

Adrenal cortex

Adrenal medulla

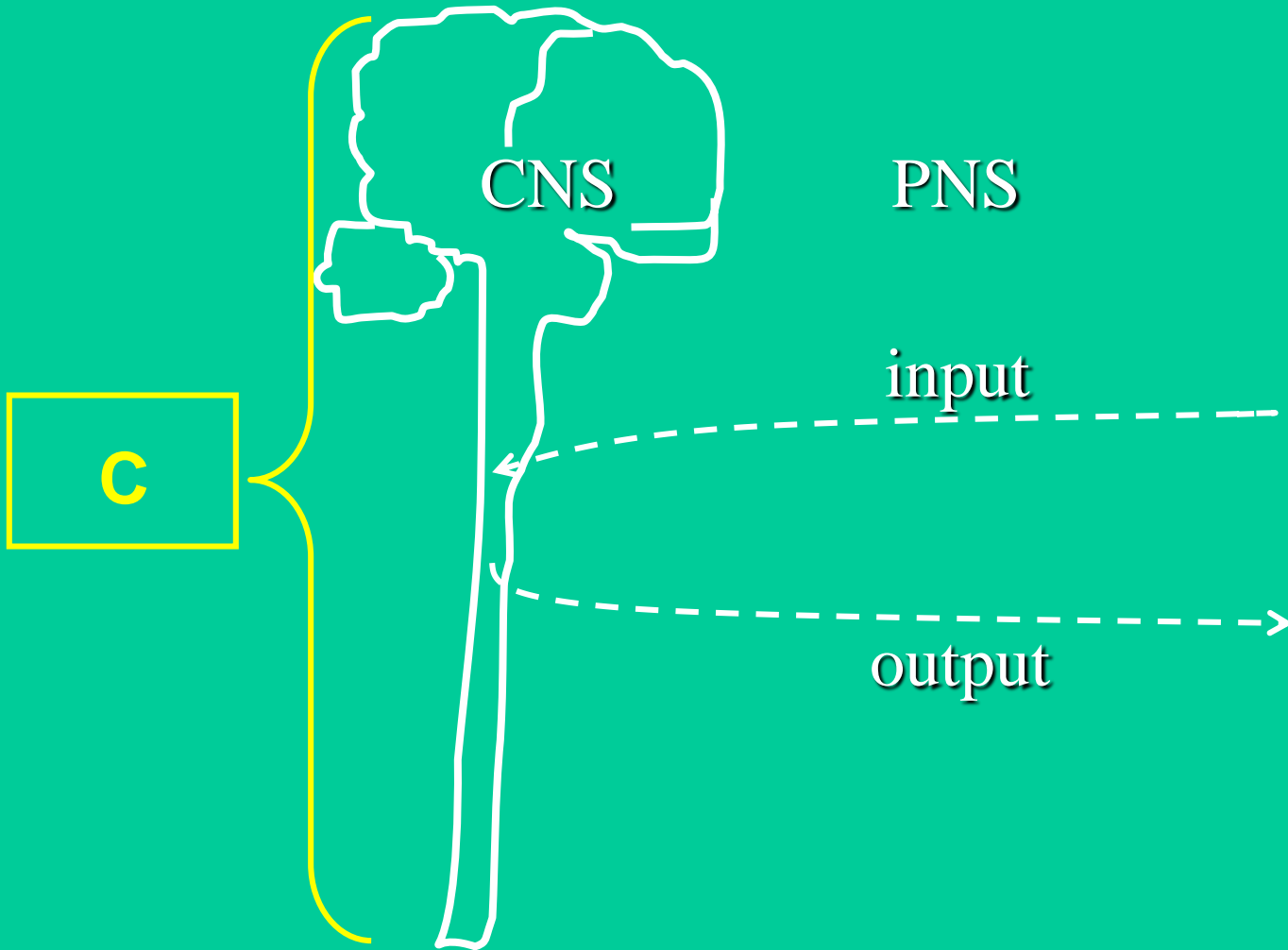
Kidney

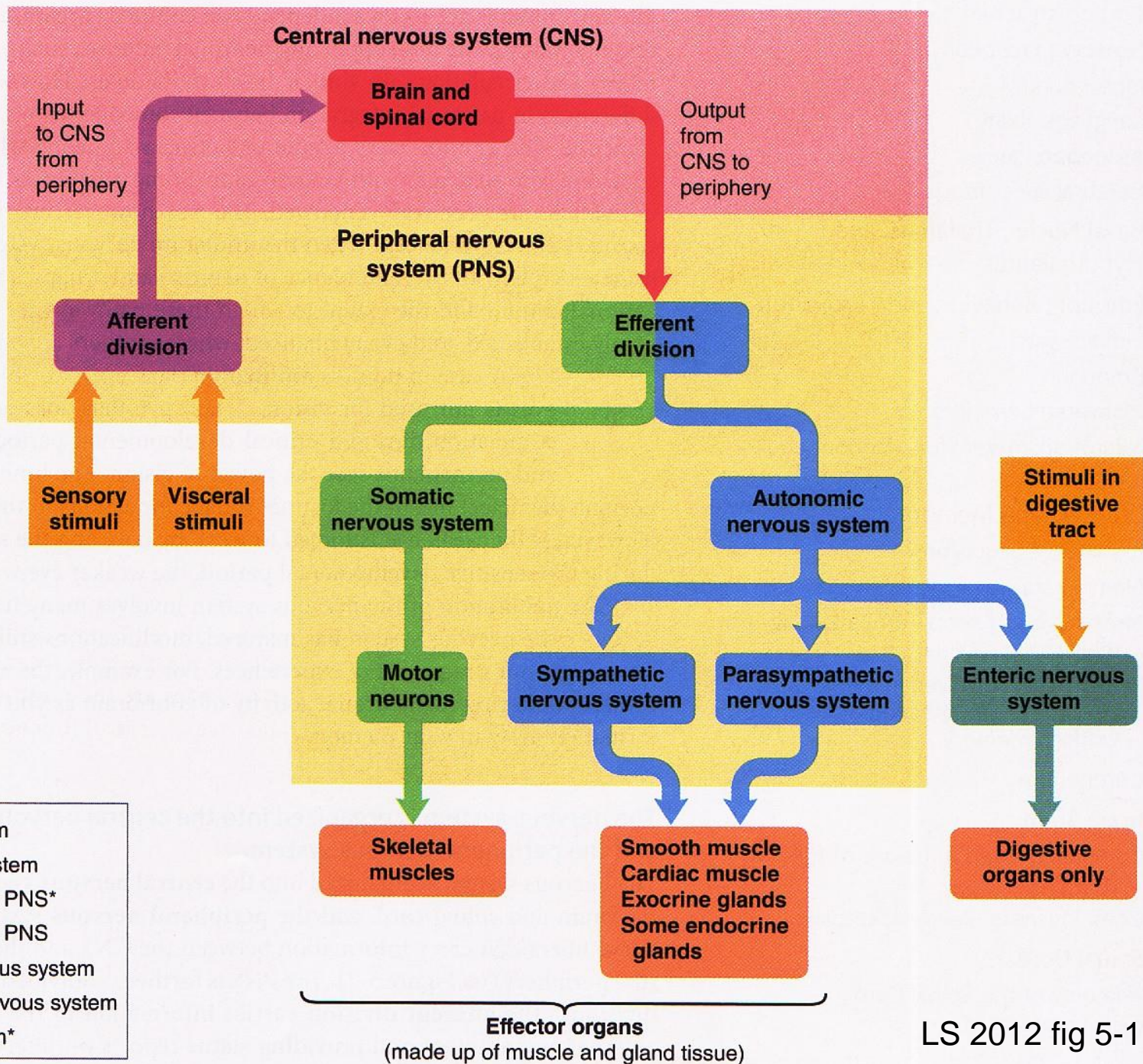
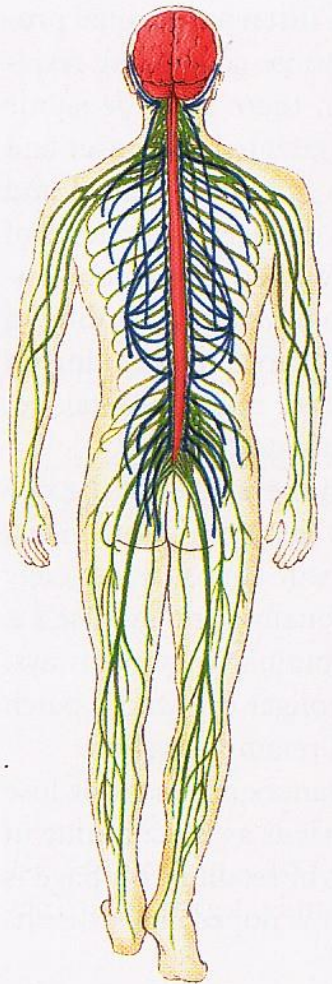


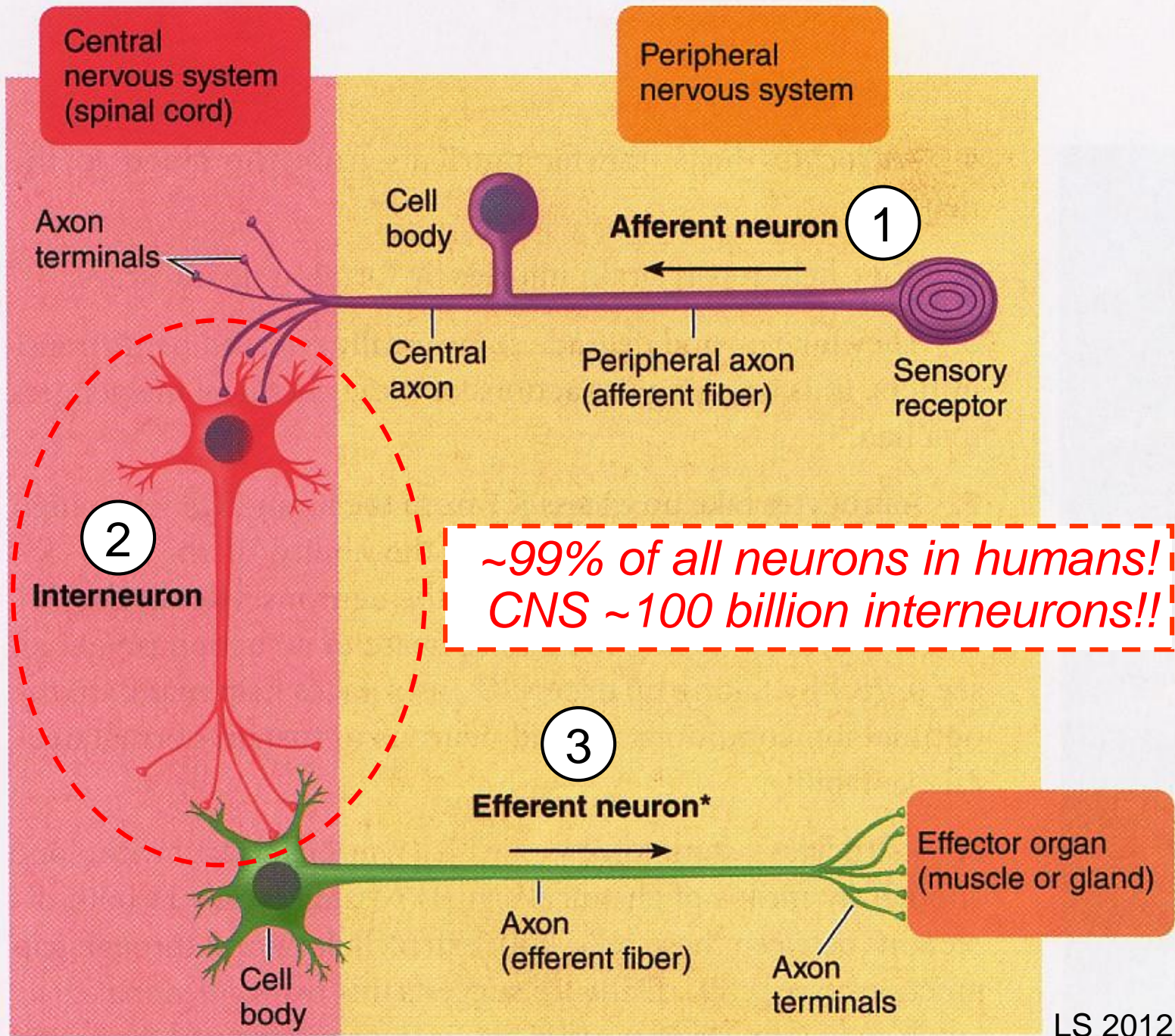
## FIGURE 13-12

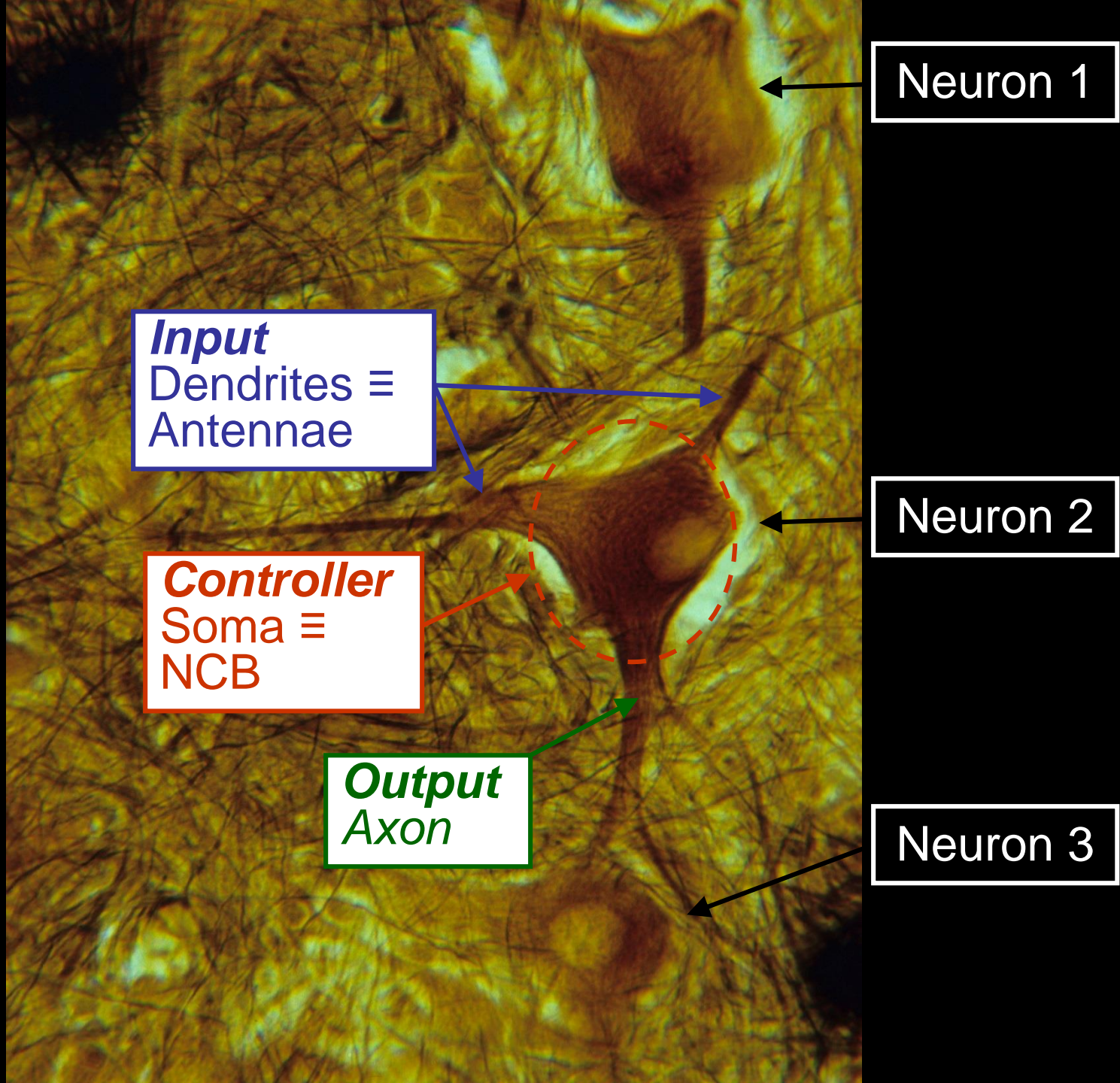
**Adrenal Gland** The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.

# Nervous System









Neuron 1

**Input**  
Dendrites ≡  
Antennae

Neuron 2

**Controller**  
Soma ≡  
NCB

**Output**  
Axon

Neuron 3



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?

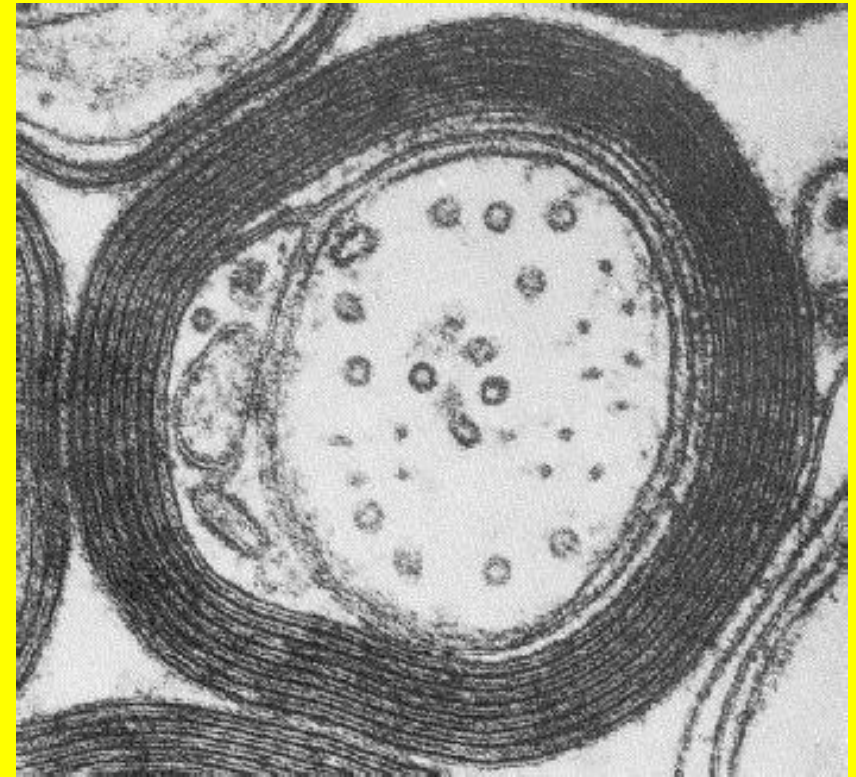
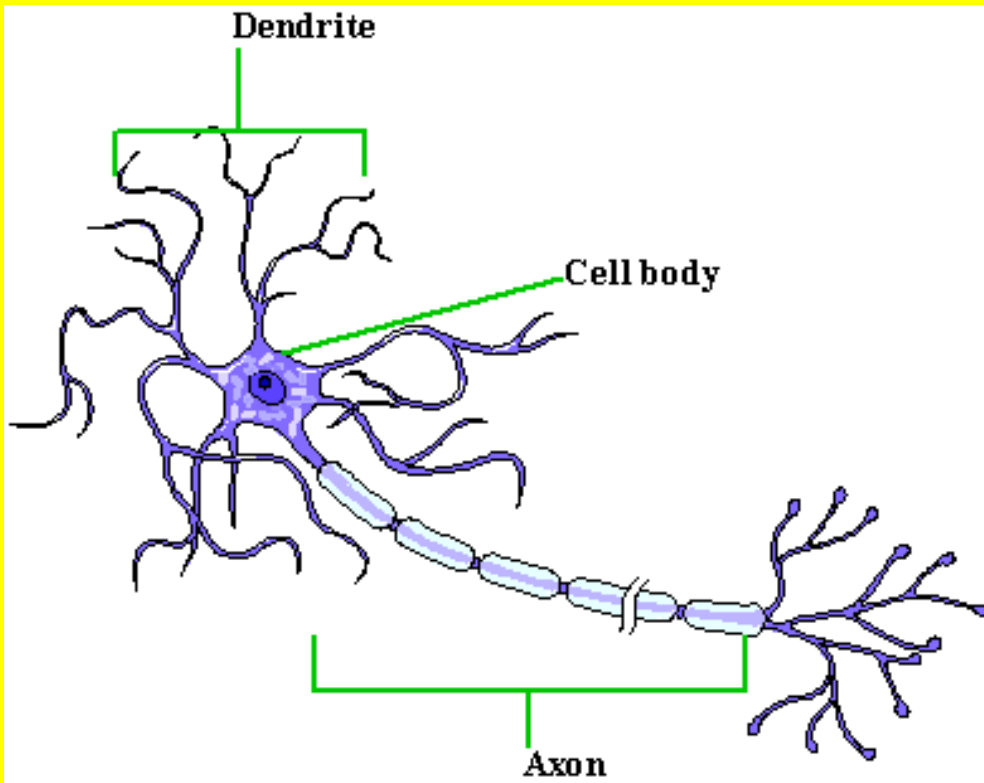
### II. CNS Connections Myelin, brain + spinal cord (CNS) **Protect your head with a helmet!** Bicycle head injury statistics *NHTSA & BHSI, 2014 data*

### 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. Ca<sup>2+</sup> bones!...but what else? p 190
  2. What do black widow spider venom, botulism, curare & nerve gas have in common? Botox pp 189-92

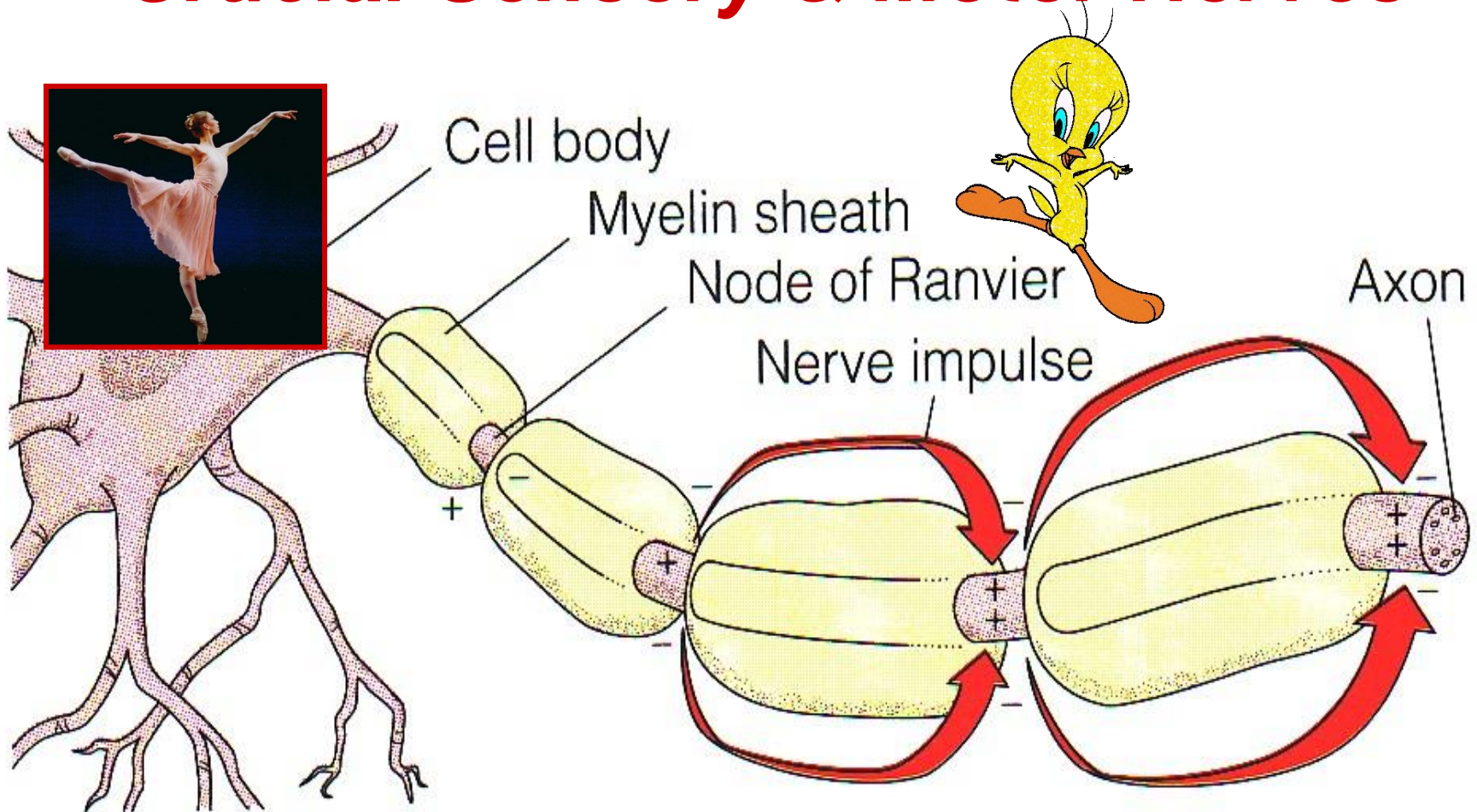


# *What is myelin? Why is it important?*



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

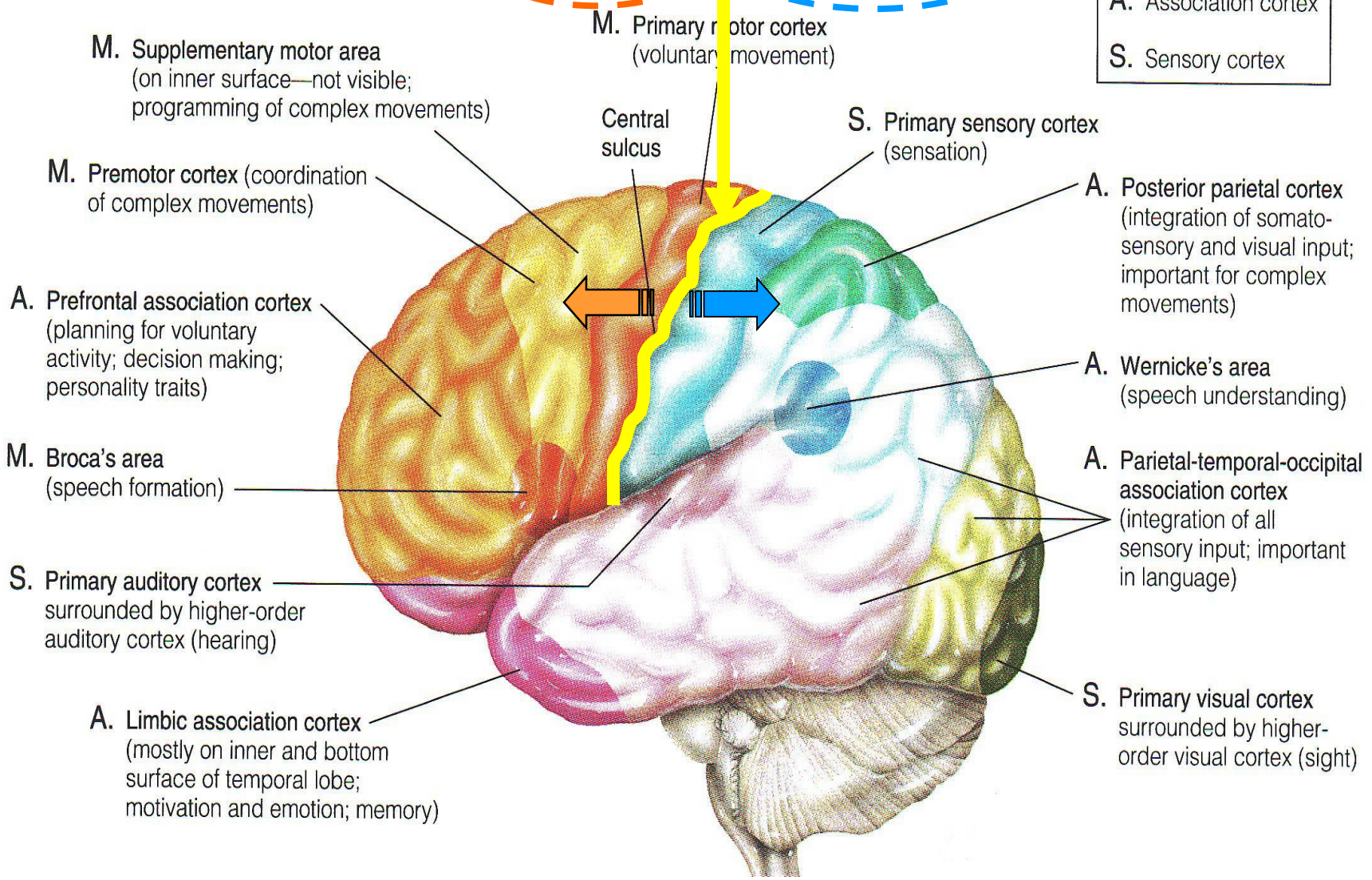
# Saltatory/Leaping Conduction! *Crucial Sensory & Motor Nerves*

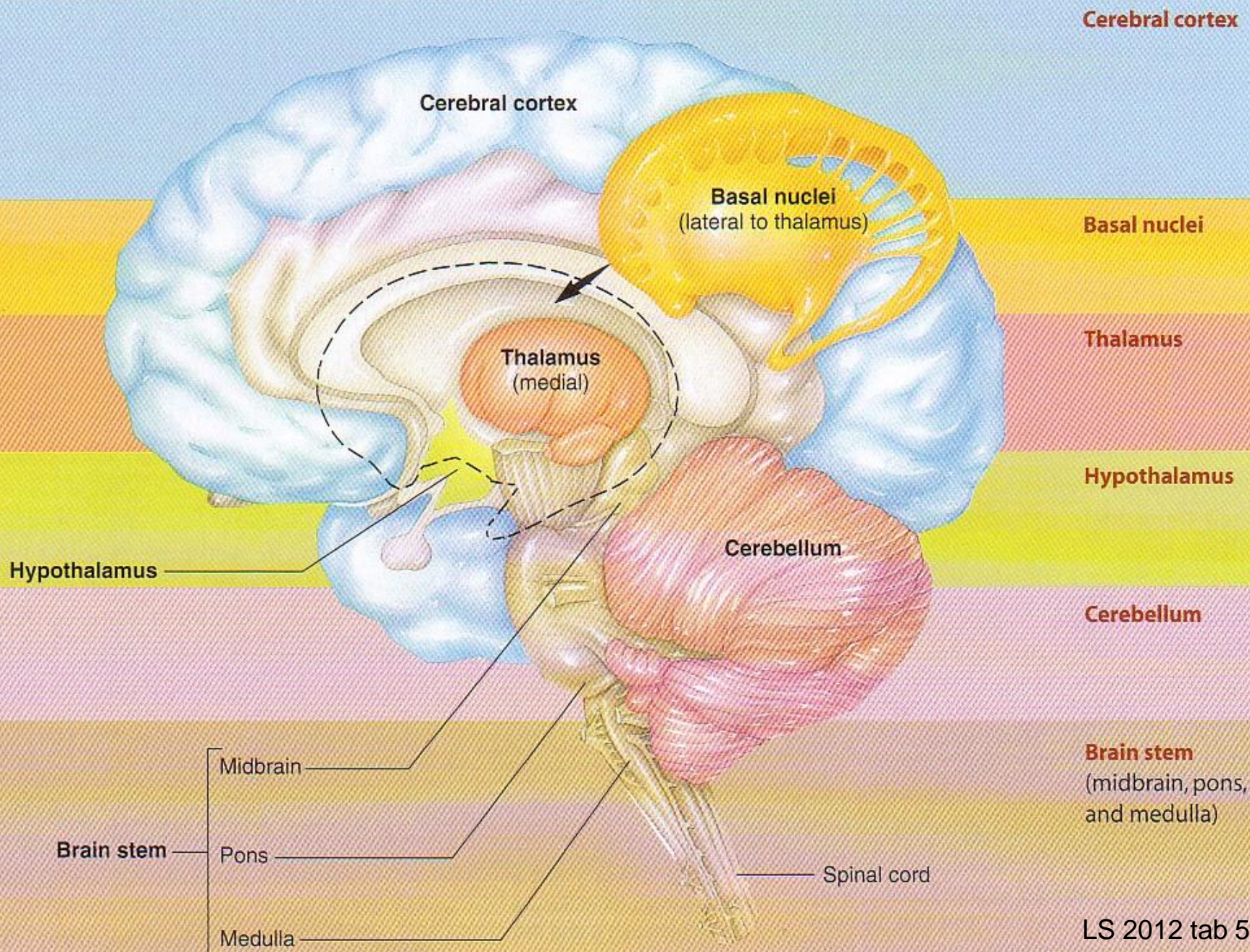


L. saltare to hop or leap! Fr. salt, sautier, sauté, leap, high air, vault



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







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



<http://www-nrd.nhtsa.dot.gov/Pubs/812018.pdf>  
<http://www.bhsi.org/stats.htm>

**~ 500,000 bicyclists/yr visit emergency rooms**

As of 2014, the population estimate of

State of Wyoming 584,153

Albany OR 51,980

Corvallis OR 54,953

Springfield OR 60,263



**~ 26,000 traumatic brain injuries**

**743 of ~900 cyclist deaths, 2013  $\equiv$  ~ 2% of all traffic fatalities**

**13% of deaths children  $\leq$  14 yr, 87%  $\sigma$**

**11% involved wrong-way riding!**

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

**Helmets may reduce head & brain injury risk by 85%!**

**~\$2.3 billion/yr = indirect injury costs from not using helmets!**

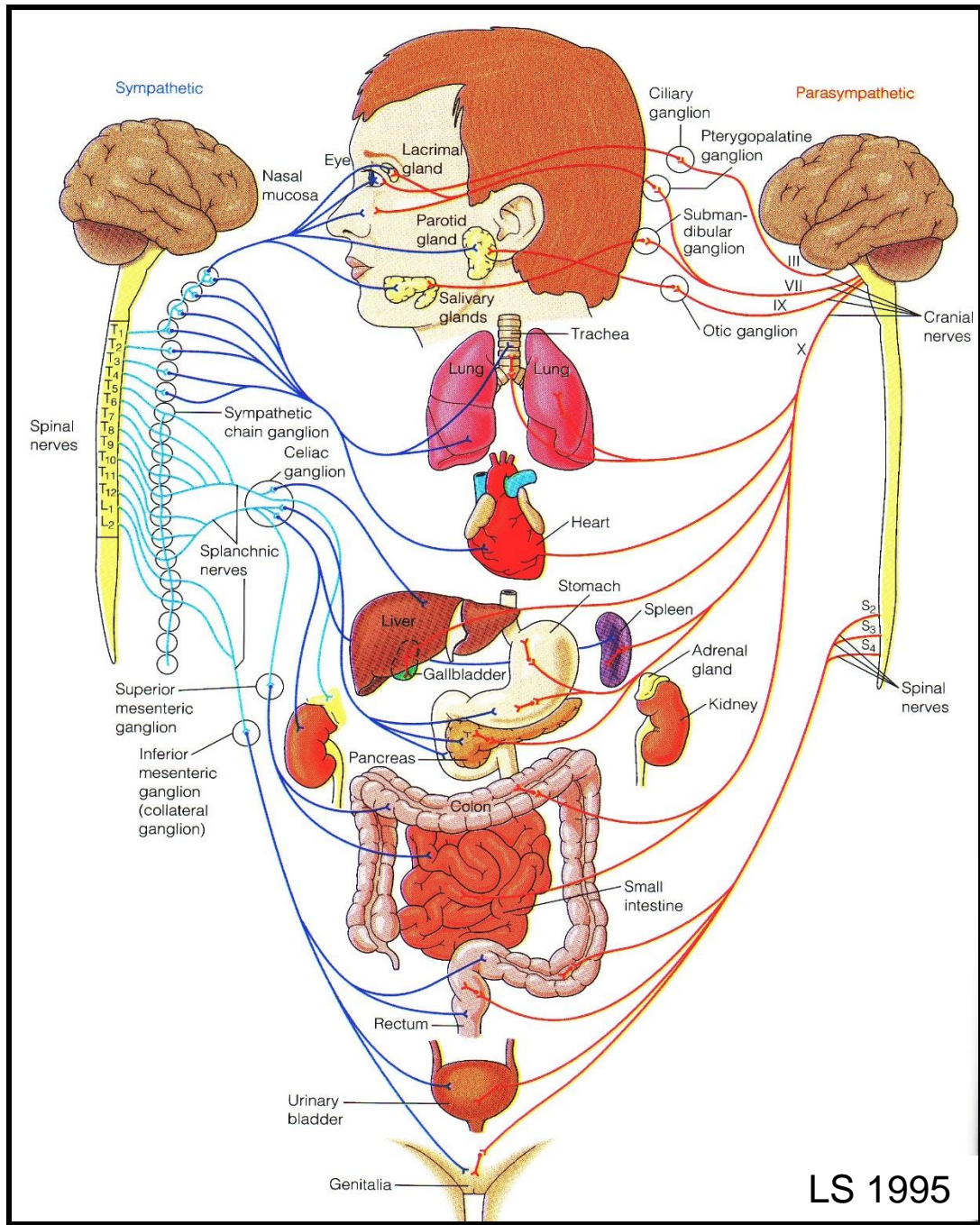
*Hey, I'm alive because I wore a helmet!!*



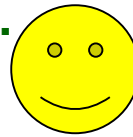
# Autonomic Nervous System

Why overlap or dual innervation?

*Fine-tune control & safety!*



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



BI 121 Exam II!

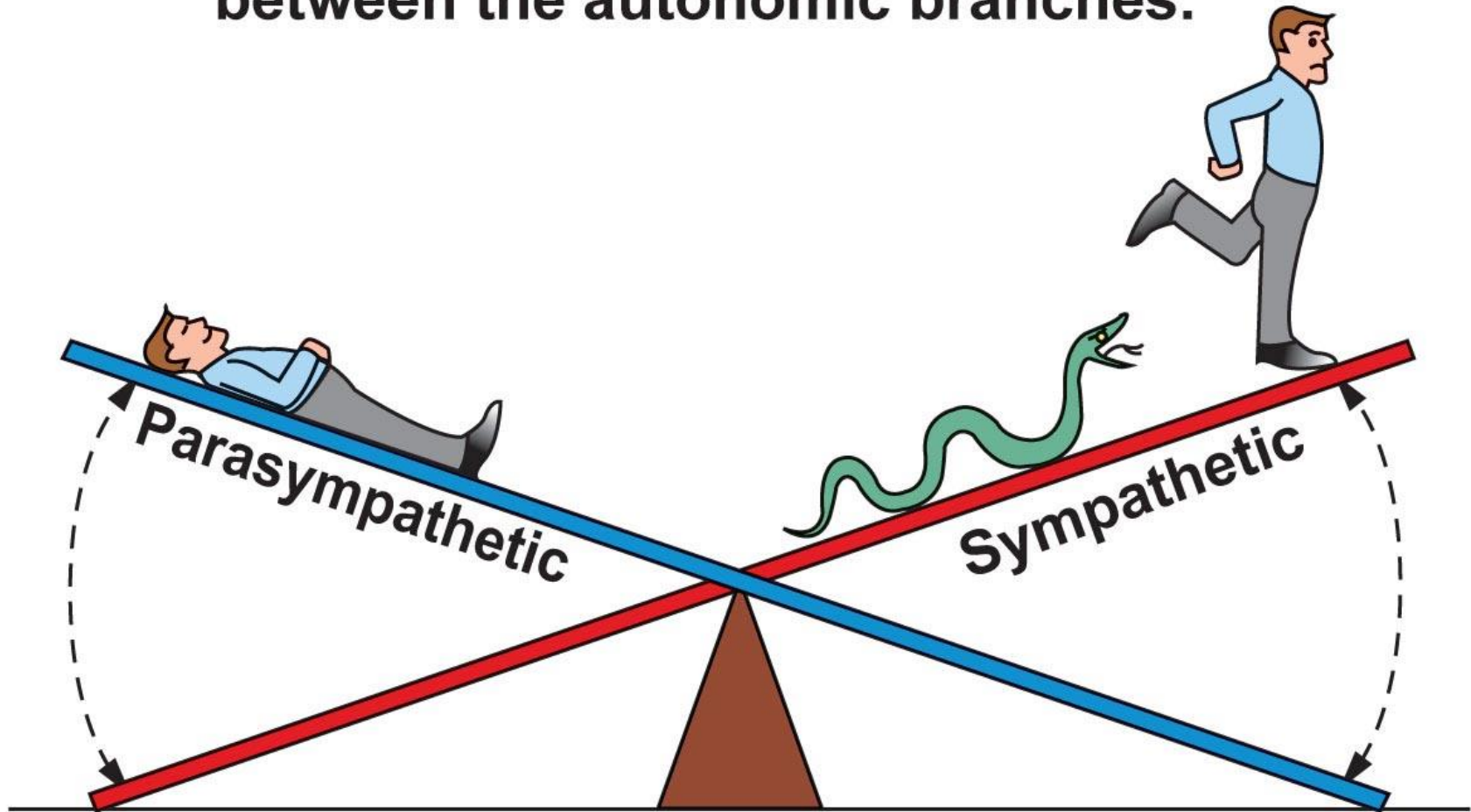


## BI 121 Lecture 14

- I. Announcements** Last Lab 6, Pulmonary Function Testing + optional notebook ✓ this Thurs. **Exam II Wed, Dec 7, 8 am Q?**
- II. Nervous System Connections** LS 7
  - A. Autonomic NS: Branches, neurotransmitters, receptors, actions, fight-or-flight stories ch 7 pp 179-85
  - B. Why are nerve & muscle unique? ch 4 p 71
  - C. How do excitable cells signal? ch 3 pp 62-7; ch 4 pp 74-83
  - D. How does the signal cross the nerve-muscle gap?  
ch 7 p 185-92 fig 7-5 p 190
  - E. What do black widow spider venom, botulism/Botox?, curare & nerve gas have in common? LS fig 7-5 p 190
- III. Muscle Structure-Function & Adaptation** LS ch 8 + DC Mod 12
  - A. Muscle types: cardiac, smooth, skeletal LS fig 8-1 pp 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. Thin filaments? Banding pattern LS fig 8-5, 8-3, 8-7
  - E. How do muscles contract? LS fig 8-6, 8-10
  - F. What's a cross-bridge cycle? LS fig 8-11 +...



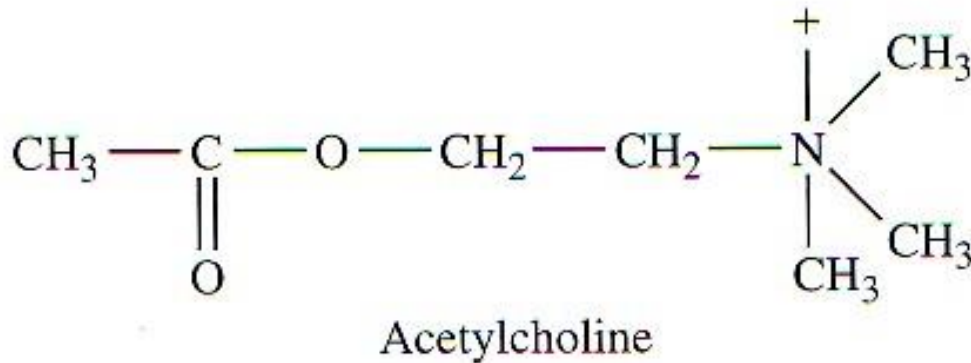
Homeostasis is a dynamic balance between the autonomic branches.



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

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

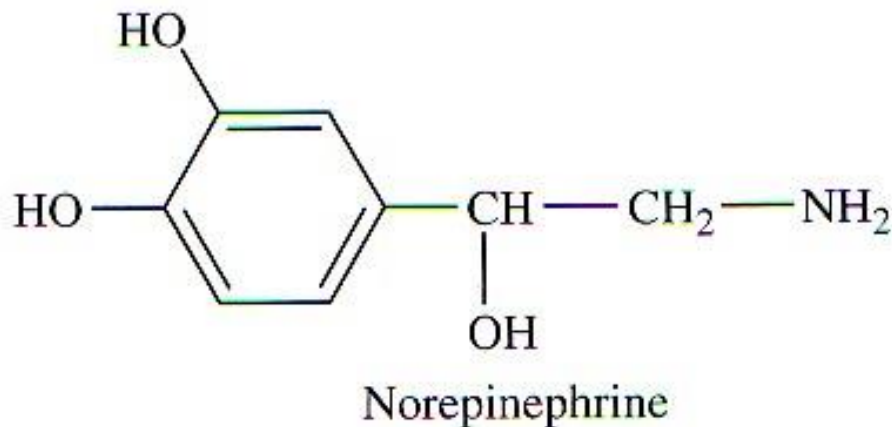
# Autonomic Neurotransmitters & Receptors



## Cholinergic

Nicotinic

Muscarinic

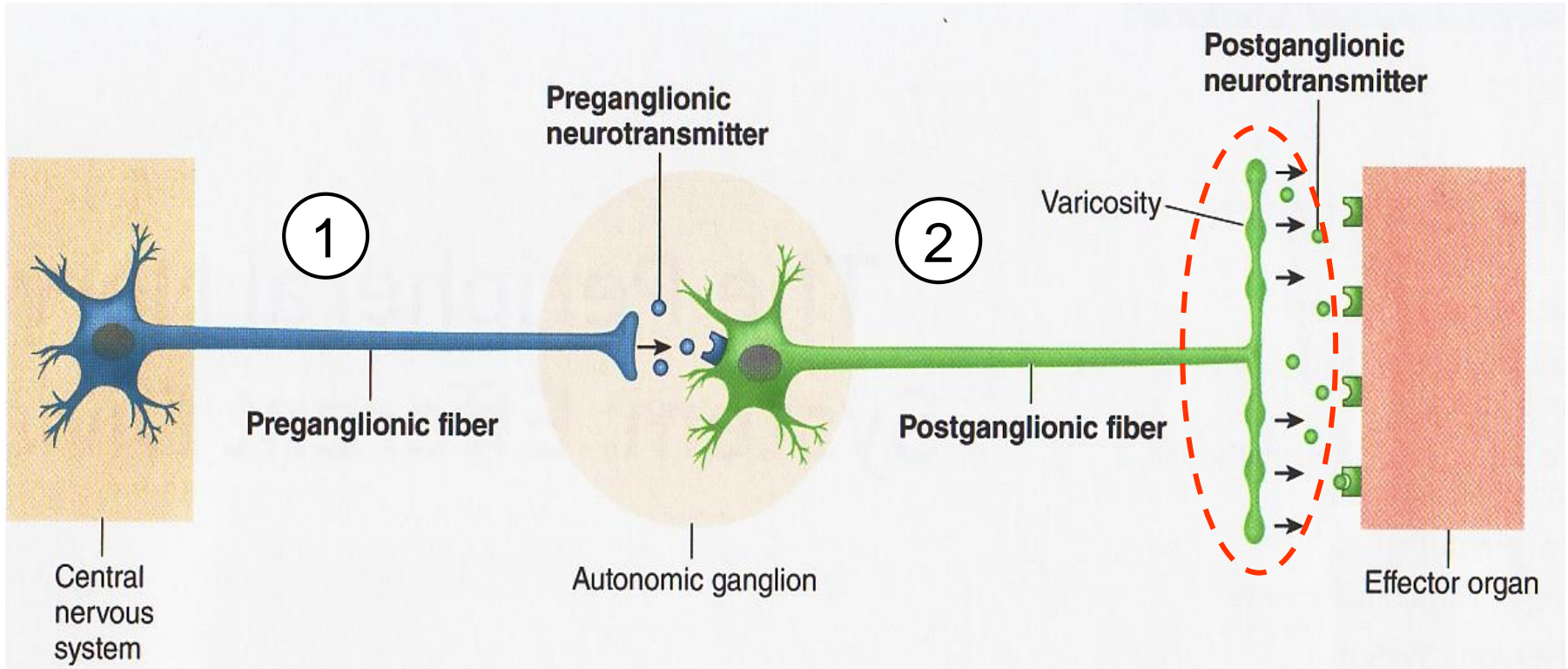


## Adrenergic

α = Alpha

β = Beta

# Autonomic Nerves: *Two Chain Pathway* with *Post-Ganglionic Varicosities*



**Nicotine activates both Sympathetic & Parasympathetic post-ganglionic neurons!**

**Problem?**



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

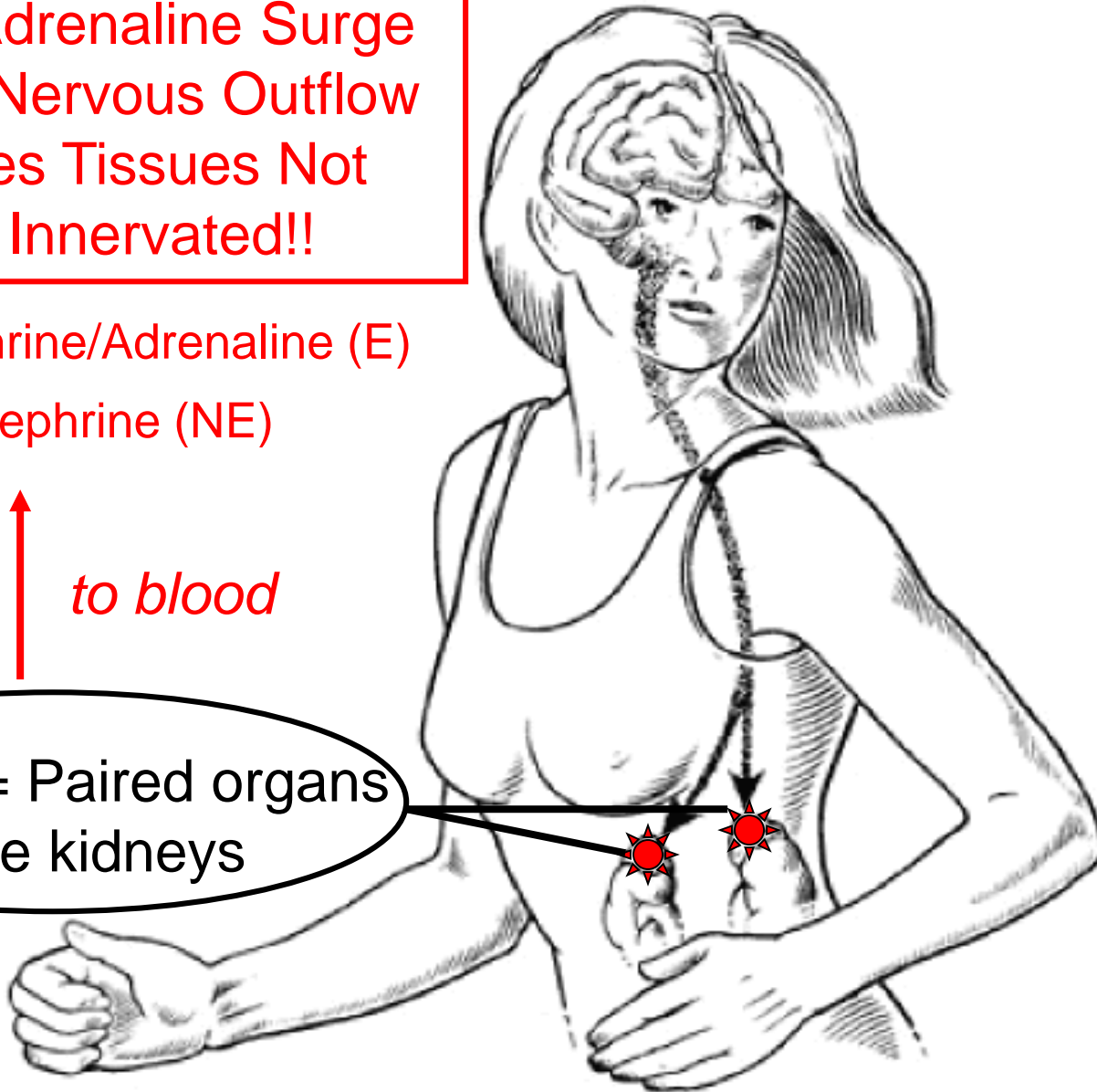


Hormonal Adrenaline Surge  
Reinforces Nervous Outflow  
& Accesses Tissues Not  
Directly Innervated!!

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

*Output* ↑ *to blood*

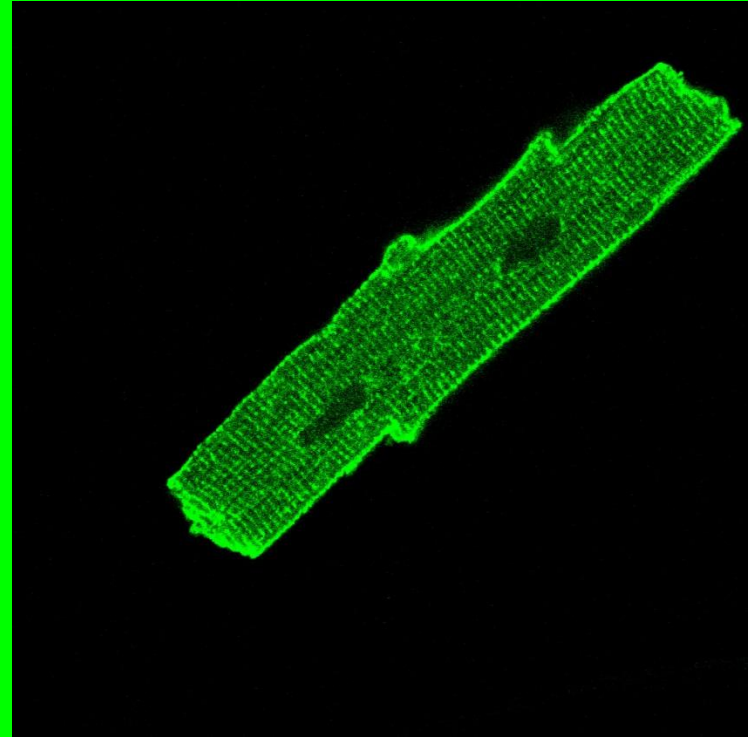
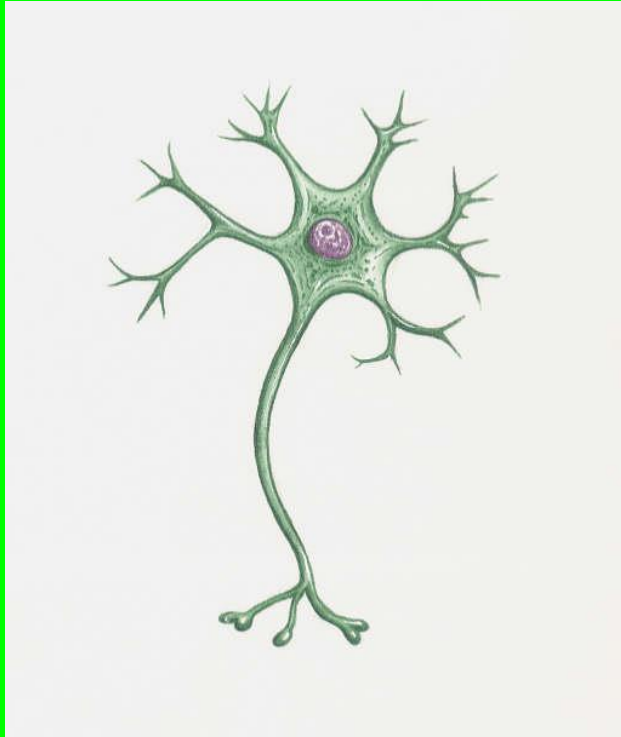
Adrenals = Paired organs  
above kidneys



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

Organ	Effect of Sympathetic Stimulation	Effect of Parasympathetic Stimulation
<b>Heart</b>	Increases heart rate and increases force of contraction of the whole heart	Decreases heart rate and decreases force of contraction of the atria only
<b>Blood Vessels</b>	Constricts	Dilates vessels supplying the penis and the clitoris only
<b>Lungs</b>	Dilates the bronchioles (airways)	Constricts the bronchioles
<b>Digestive Tract</b>	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
<b>Urinary Bladder</b>	Relaxes	Contracts (emptying)
<b>Eye</b>	Dilates the pupil Adjusts the eye for far vision	Constricts the pupil Adjusts the eye for near vision
<b>Liver (glycogen stores)</b>	Glycogenolysis (glucose is released)	None
<b>Adipose Cells (fat stores)</b>	Lipolysis (fatty acids are released)	None
<b>Exocrine Glands</b>		
<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
<b>Endocrine Glands</b>		
<i>Adrenal medulla</i>	Stimulates epinephrine and norepinephrine secretion	None
<i>Endocrine pancreas</i>	Inhibits insulin secretion	Stimulates insulin secretion
<b>Genitals</b>	Controls ejaculation (males) and orgasm contractions (both sexes)	Controls erection (penis in males and clitoris in females)
<b>Brain Activity</b>	Increases alertness	None

# *Why are nerve & muscle unique?*



*They are excitable!!*

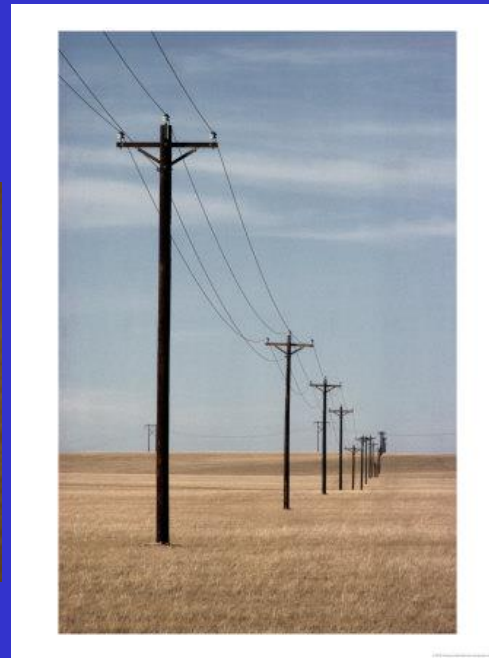
# **Action Potentials $\equiv$ Spikes $\equiv$ Impulses**

Ultra-short reversal of membrane potential

**Only in nerve and muscle cells**

Maintains strength over distance

**Primary way nerves & muscles communicate!**



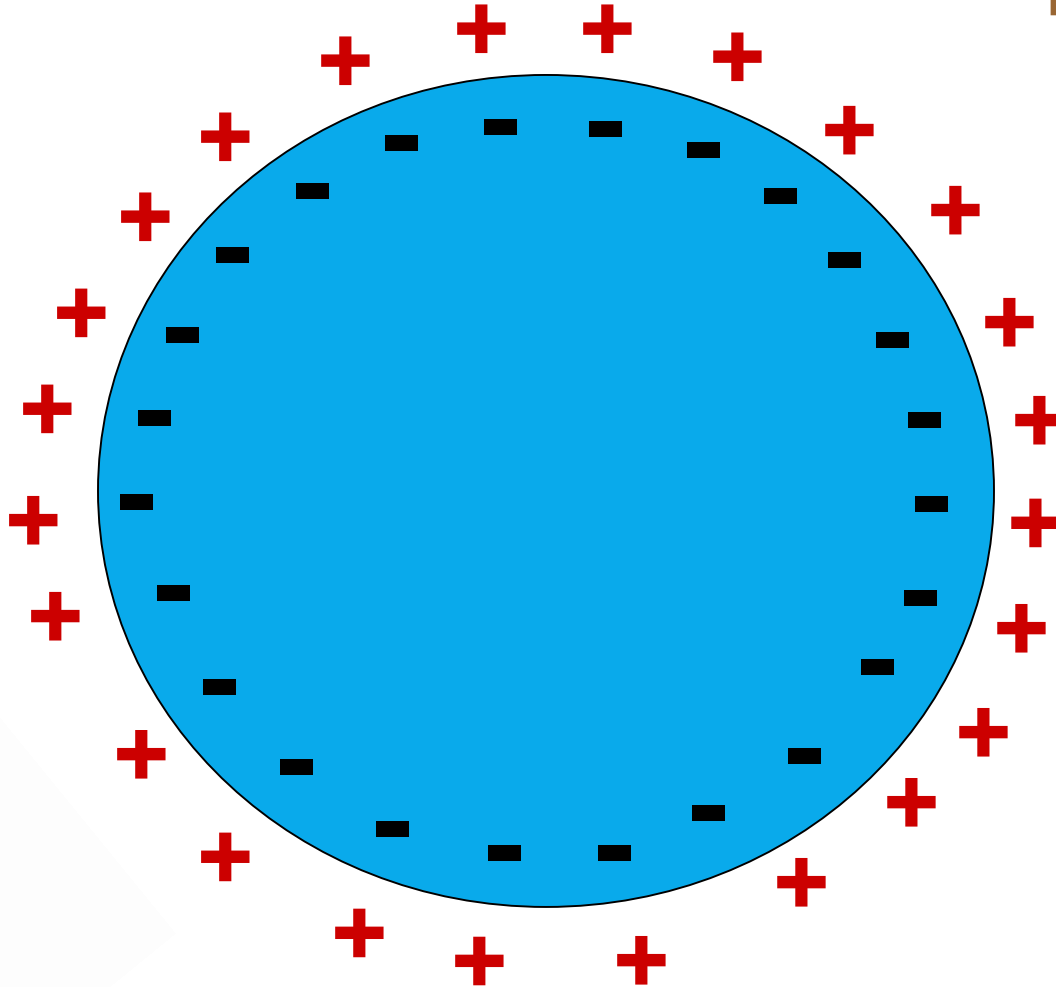
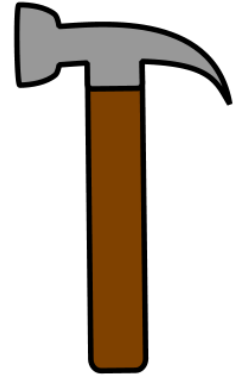


# Stimulate Cell @ Rest

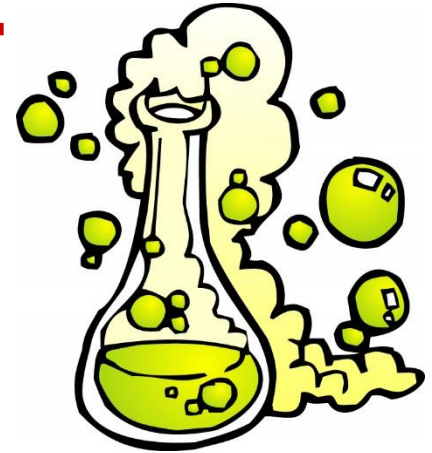
Thermal



Mechanical



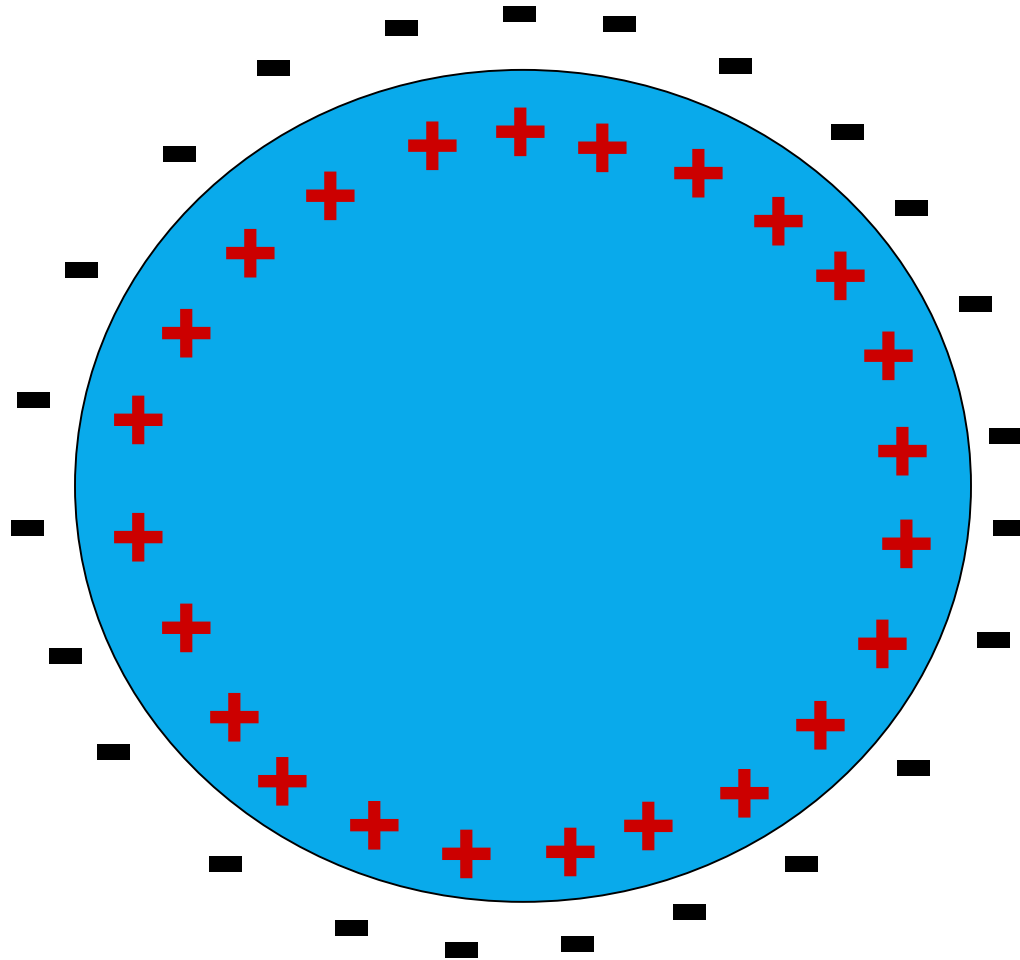
1



Electrical

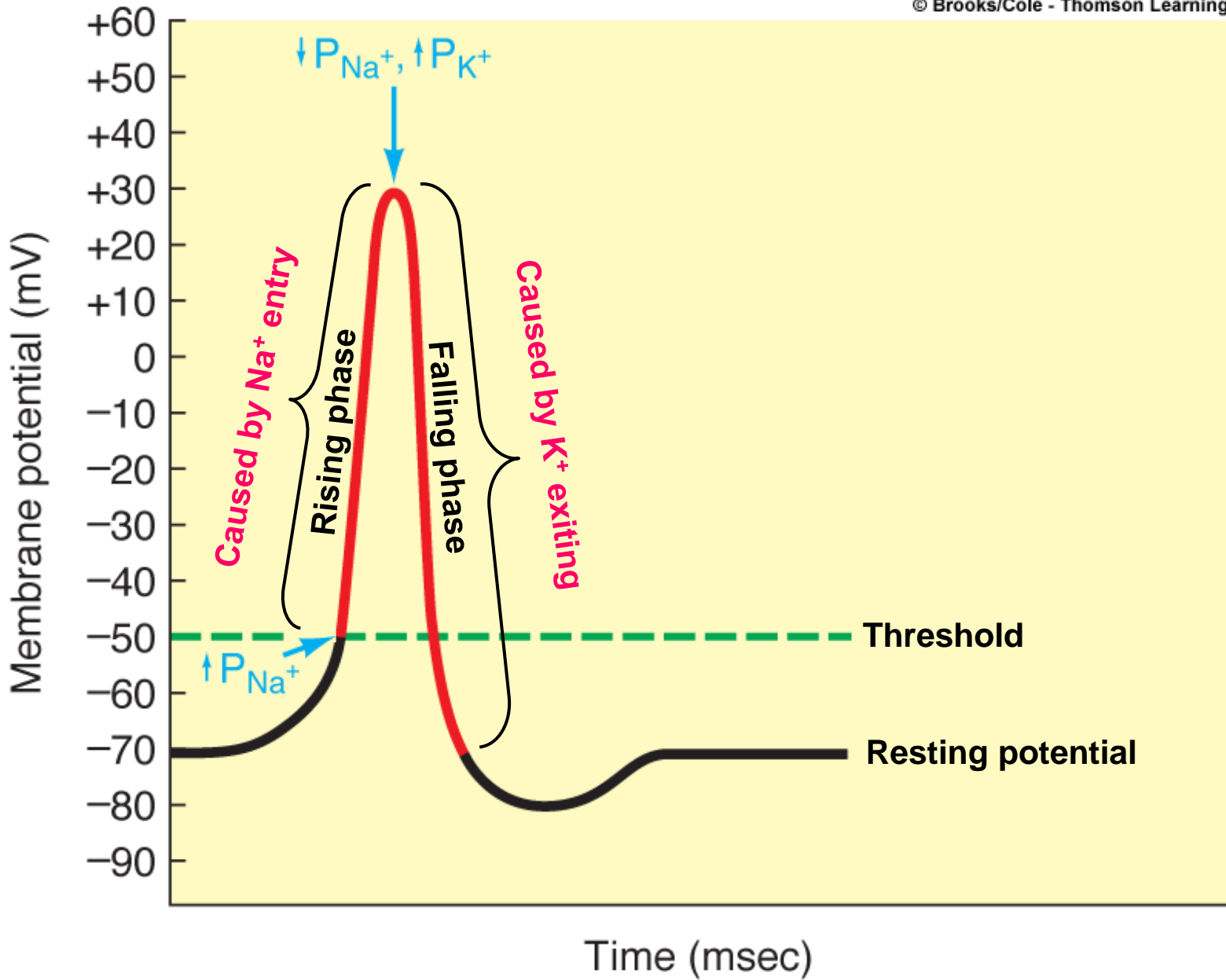
Chemical

***Action Potential has occurred!***



5

***Brief (1-2 ms) reversal to + inside cell!***

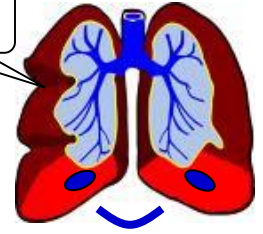


## BI 121 Lecture 15



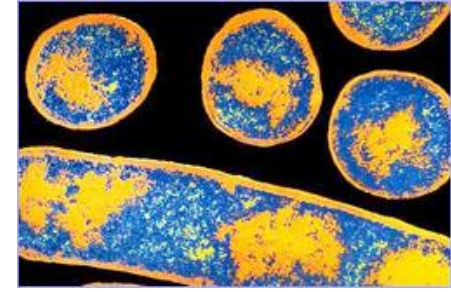
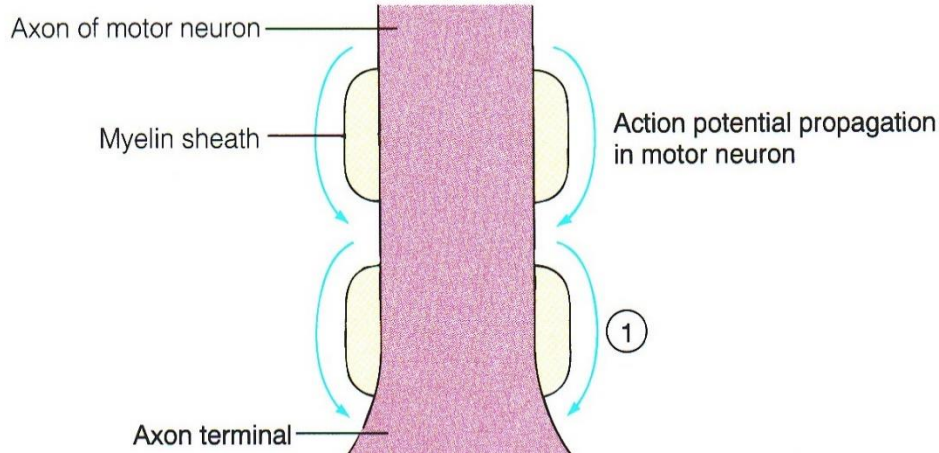
Fun lab with personal lifetime data!

Yes!!

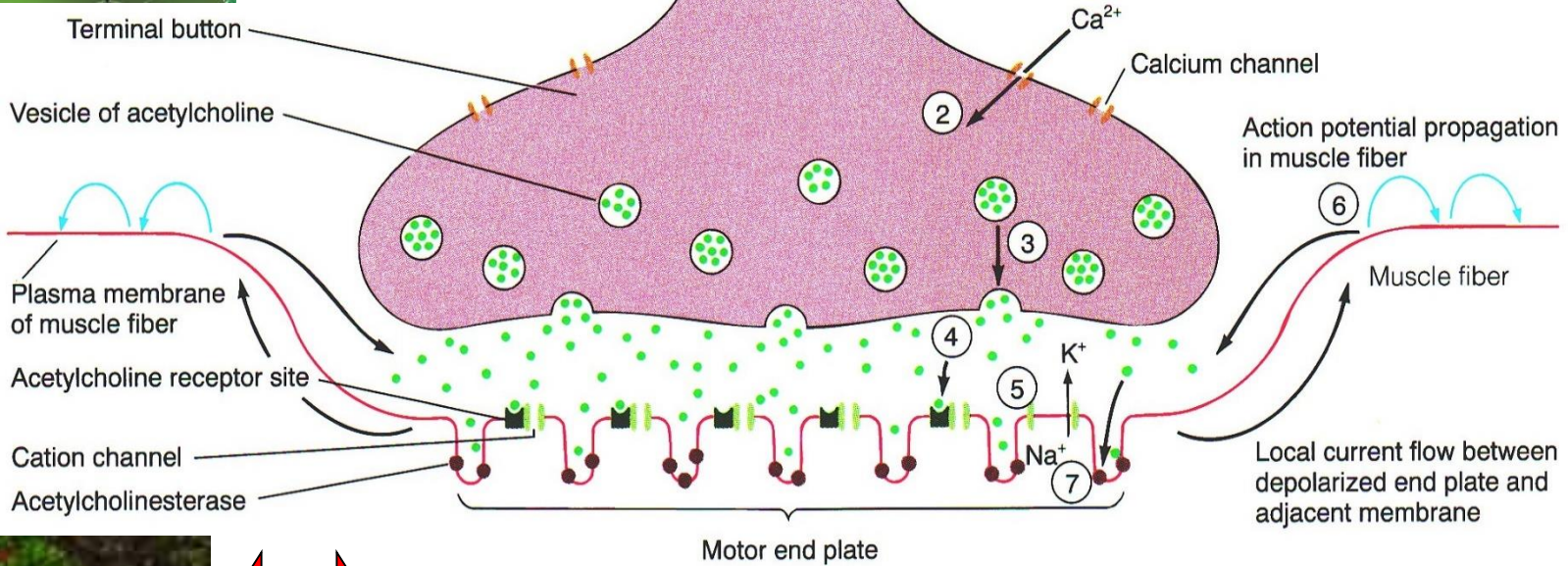


- I. Announcements** Lab 6, Pulmonary Function Testing (PFT) + optional notebook check today. Exam II Dec 7 Wed, 8 am!
- II. Introduction to PFT Lab 6** Pulmonary Function Testing
- III. Neuromuscular Junction Connections** LS fig 7-5 p 190
- IV. Muscle Contraction+Adaptation** DC Mod 12 + LS
  - A. Review of structure + banding pattern?** LS fig 8-1 thru 8-5
  - 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...

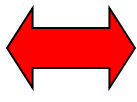
↑ 3



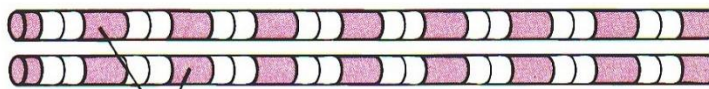
~~3~~



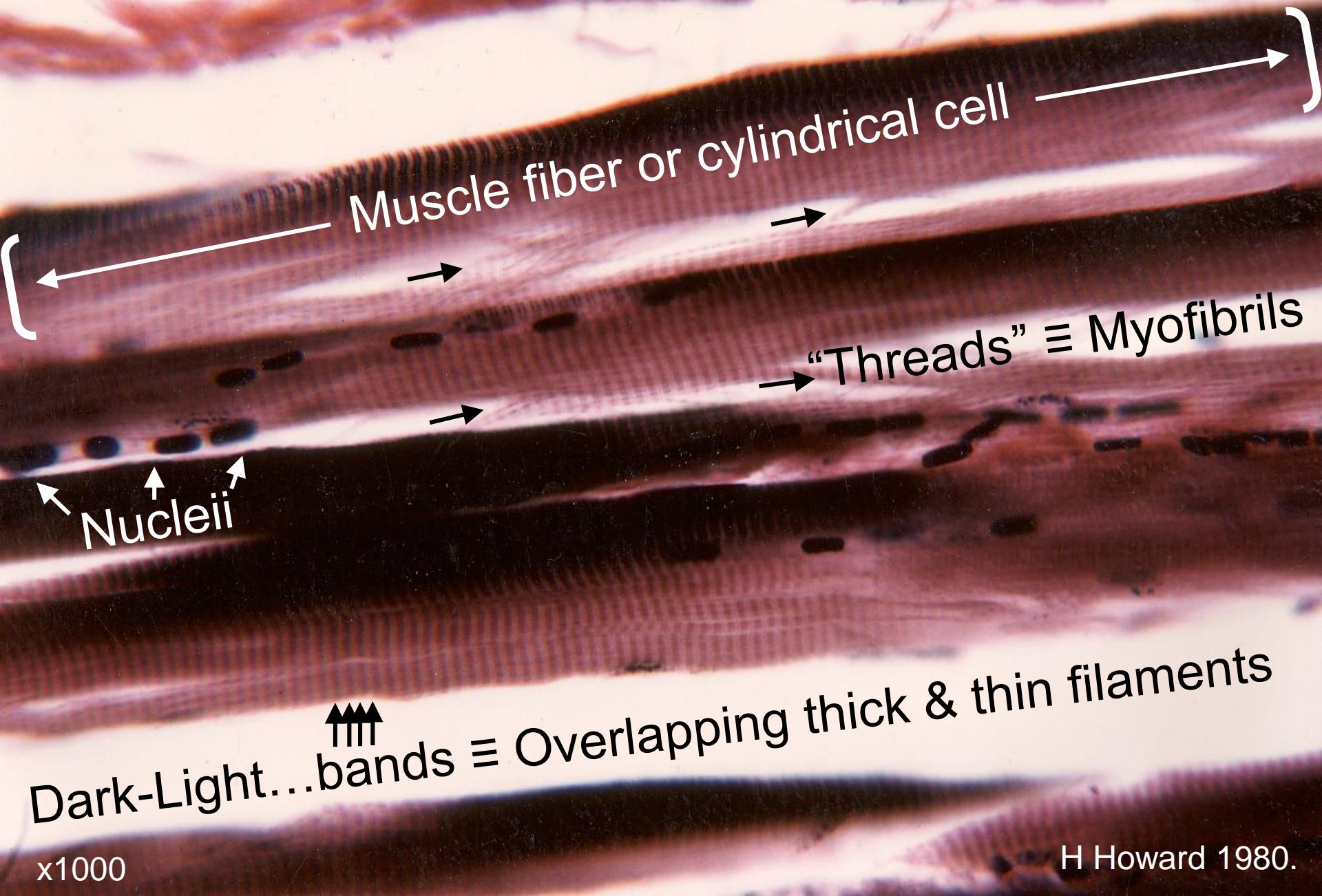
~~7~~



4



# Skeletal Muscle Histology: Microscopic Anatomy



Muscle fiber or cylindrical cell

Nucleii

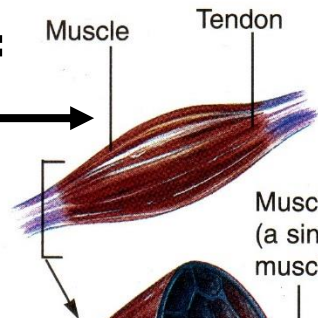
"Threads" ≡ Myofibrils

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

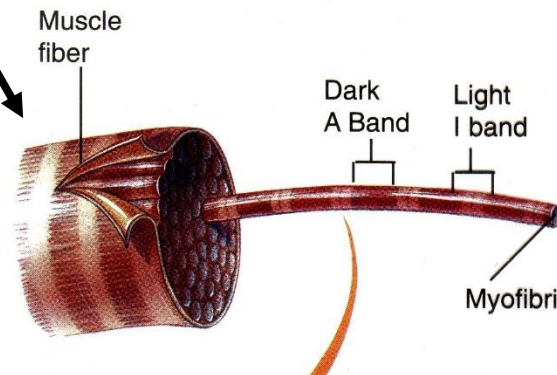
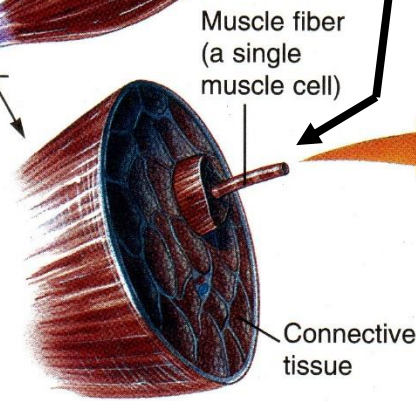
x1000

H Howard 1980.

**Organ =  
Muscle**

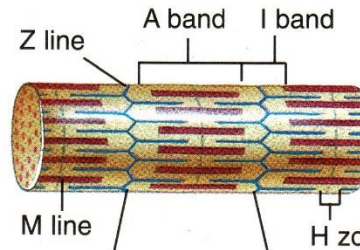


**Cell = Myocyte = Fiber**

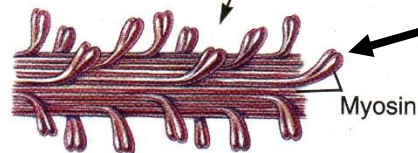
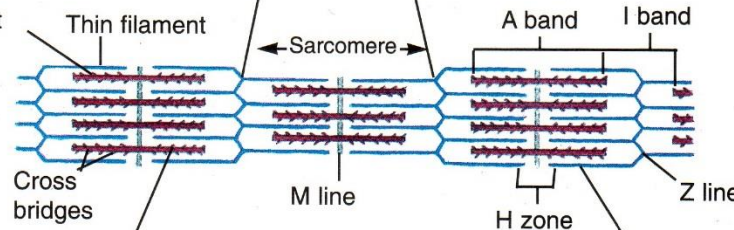


**Subcellular =  
Cytoskeleton**

Portion  
of myofibril



Thick filament

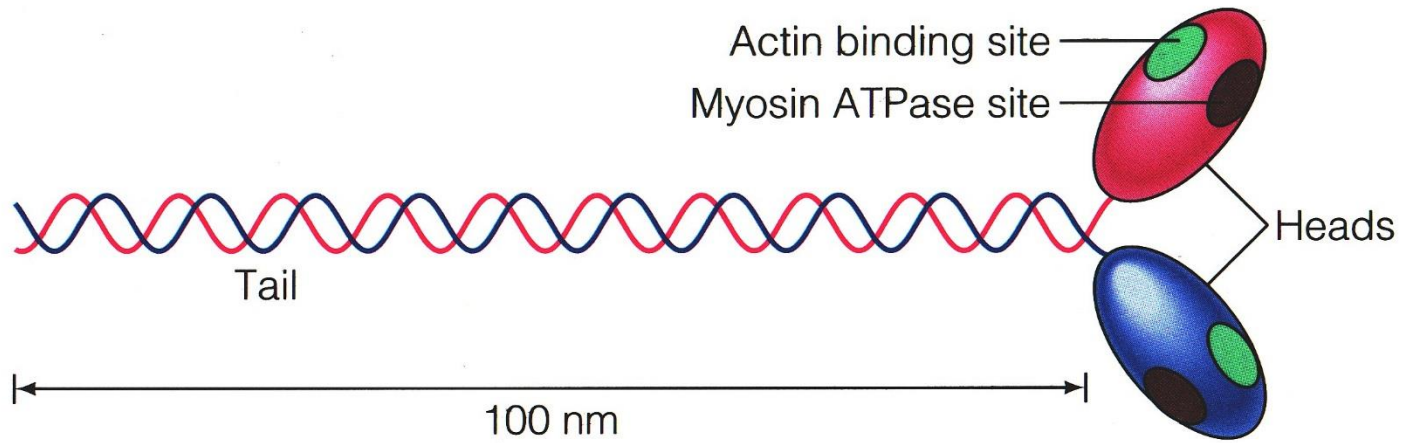


Thick filament



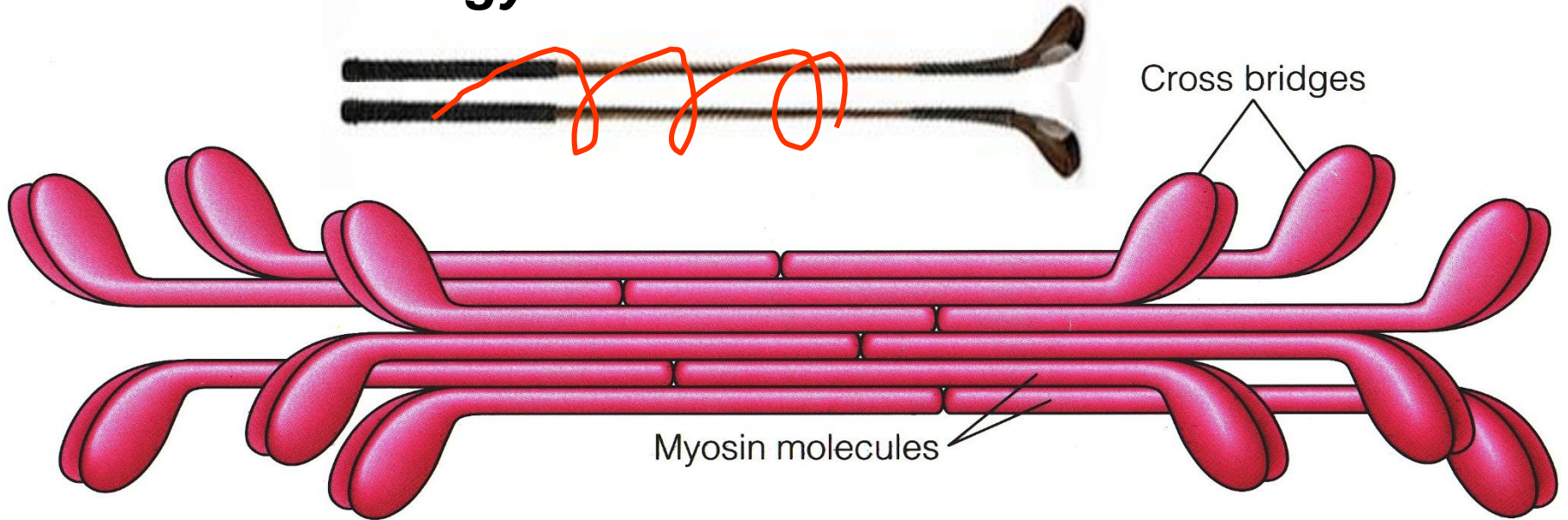
Thin filament

**Molecules =  
Actin & Myosin**



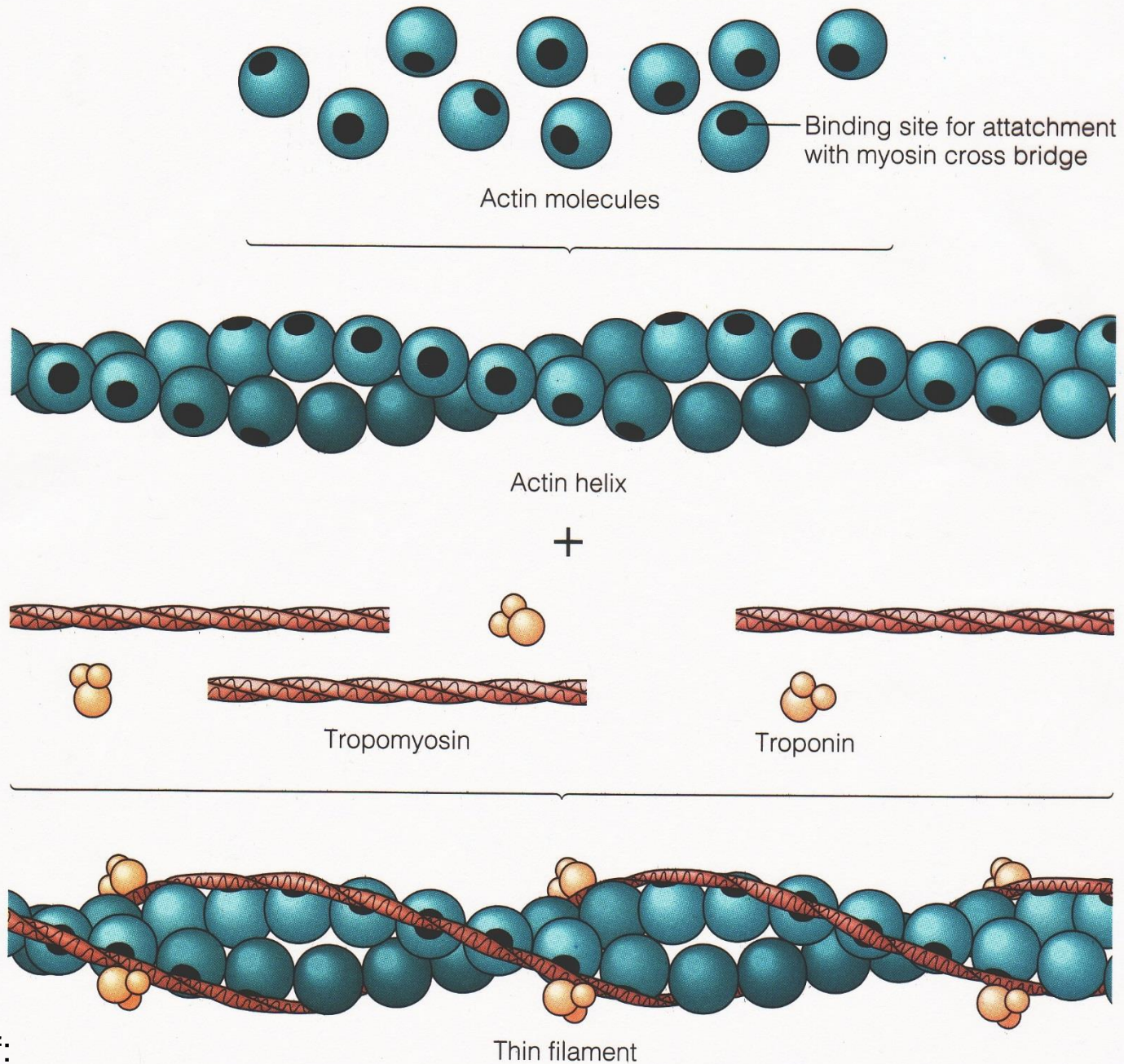
(a)

## ***Golf Club Analogy?***



(b)





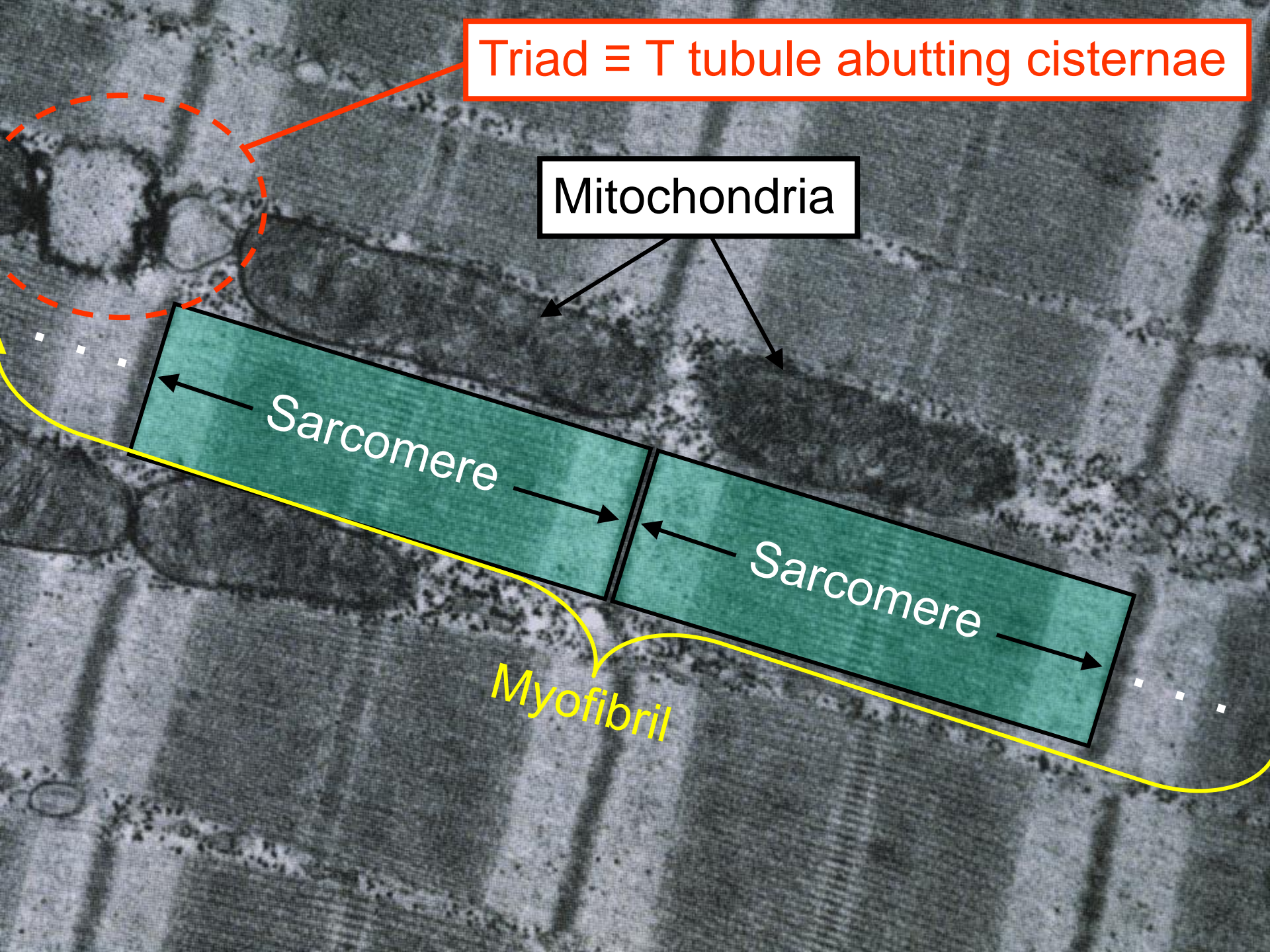
Triad  $\equiv$  T tubule abutting cisternae

Mitochondria

Sarcomere

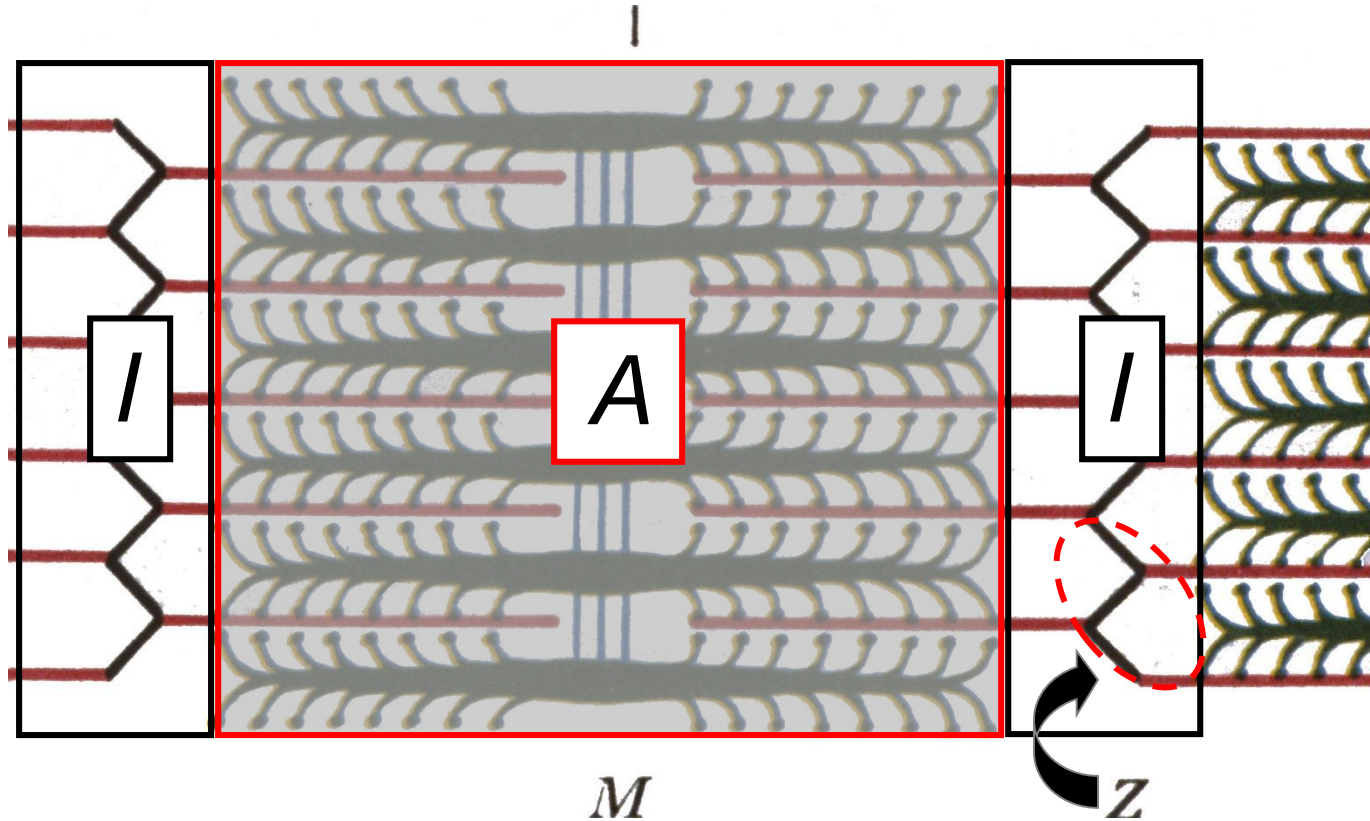
Sarcomere

Myofibril



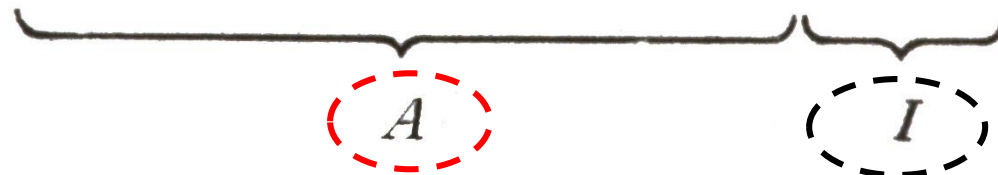
A Band = Dark Band

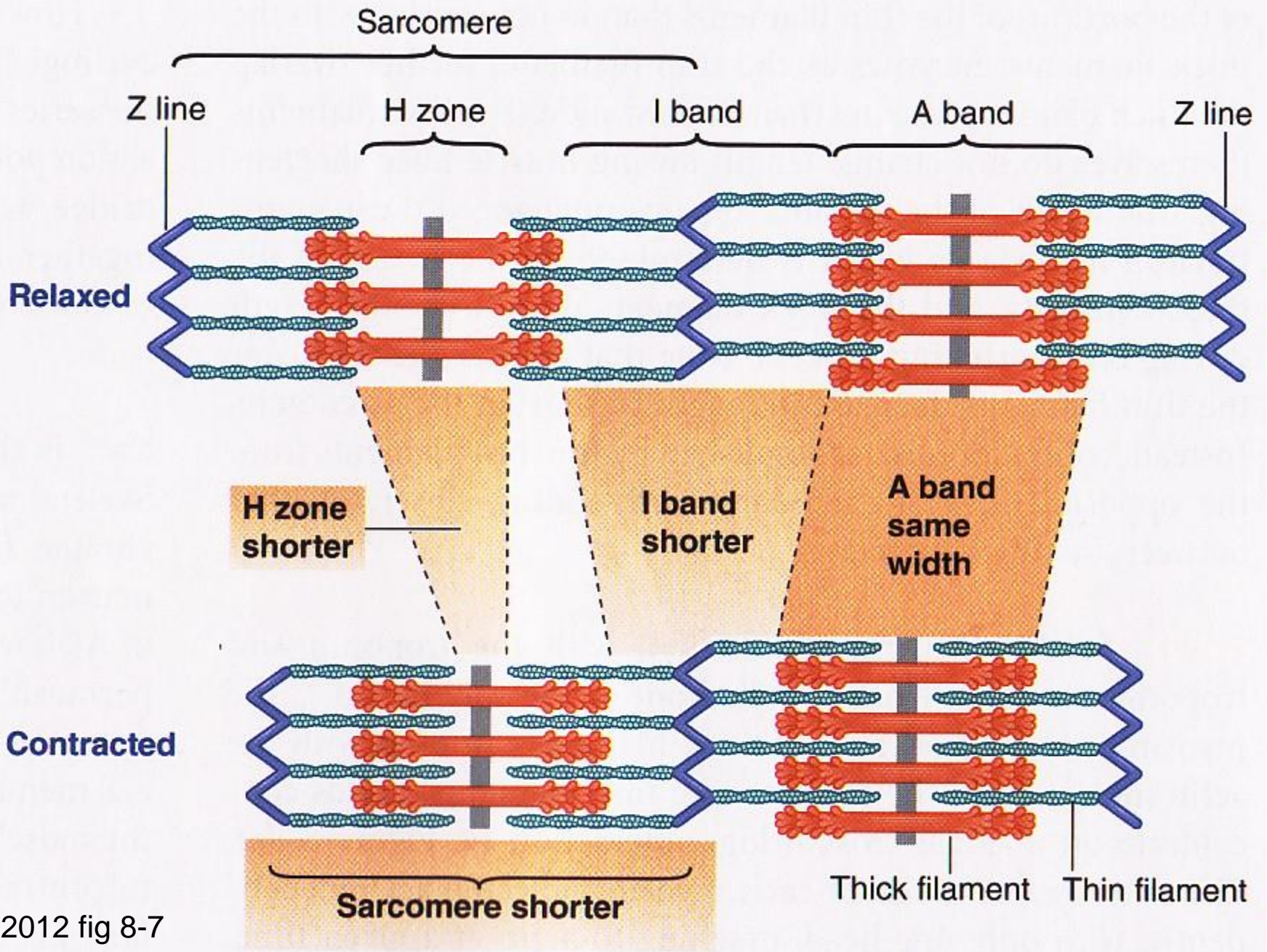
Anisotropic = Light Can't Shine Through



I Band = Light Band

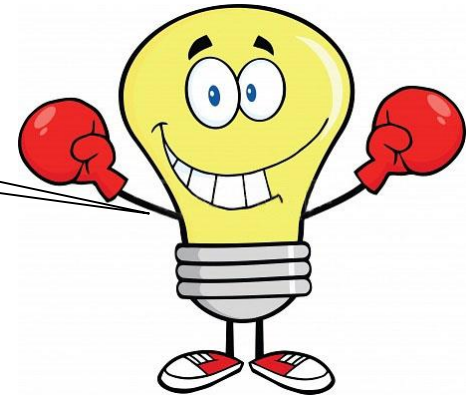
Isotropic = Light Can Shine Through





LS 2012 fig 8-7

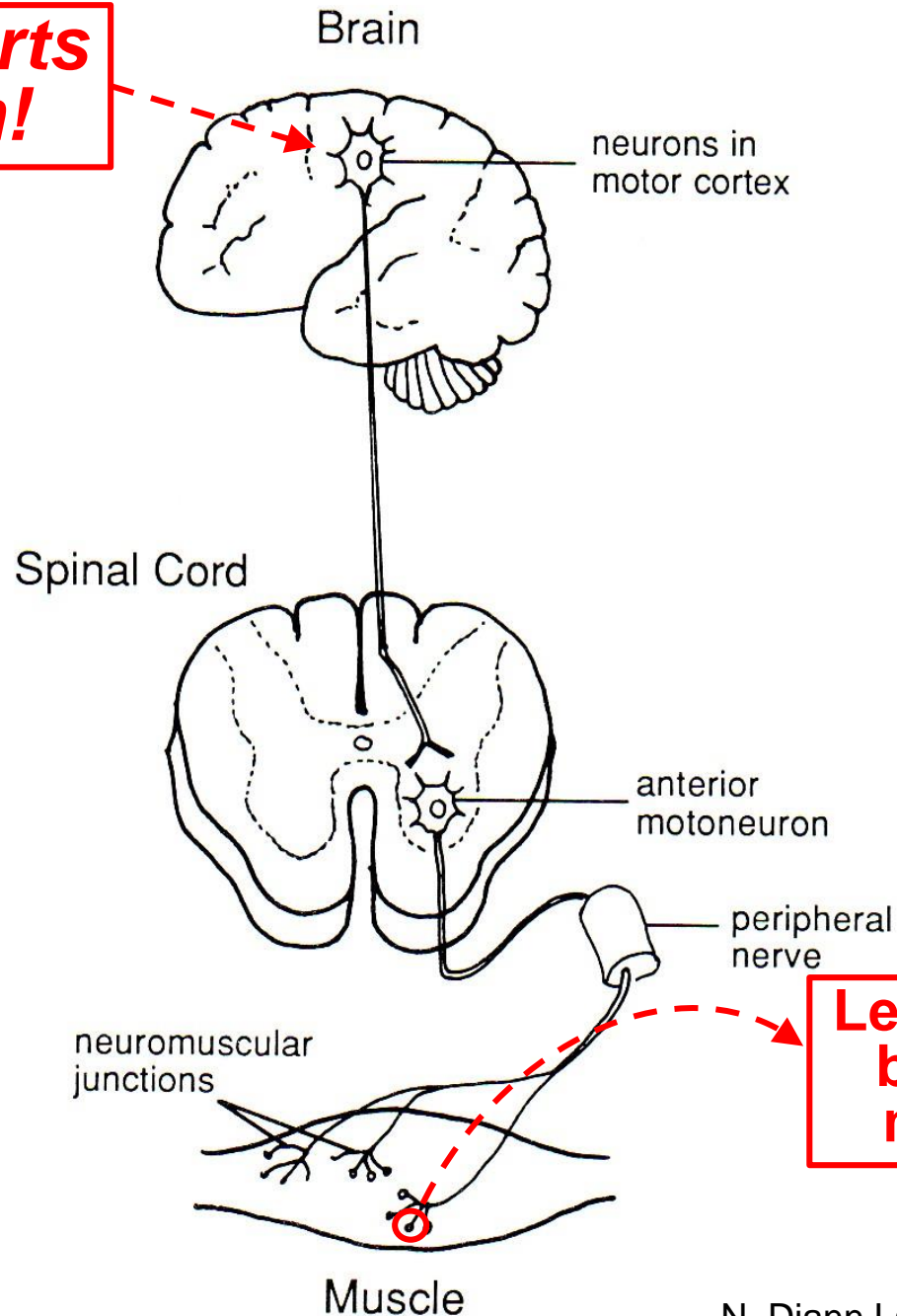
**We're on a roll! Bring on Exam II!**



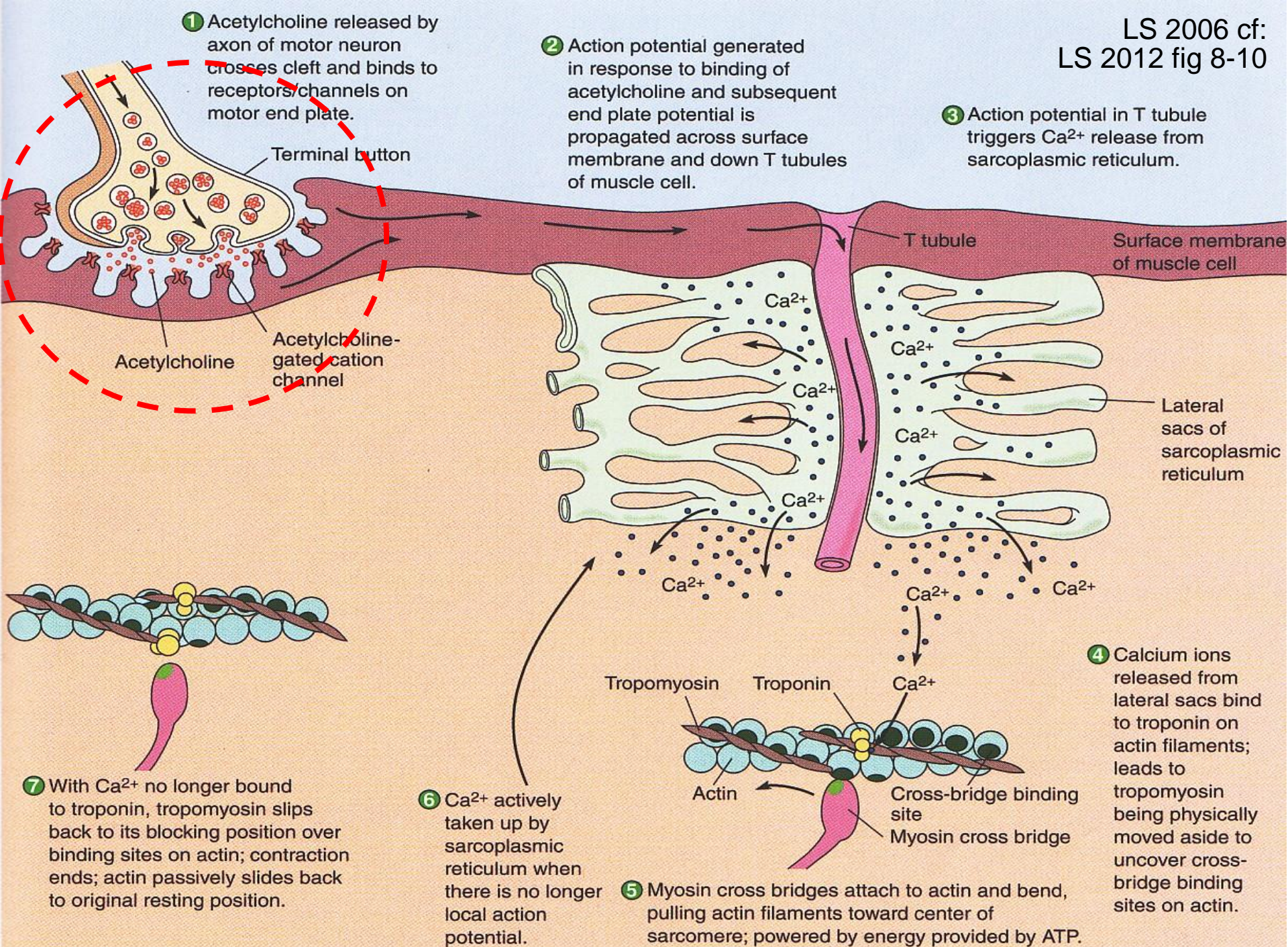
## **BI 121 Lecture 16**

- I. Announcements** Notebooks? **Exam II, Dec 7<sup>th</sup> Wed 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

**1<sup>st</sup> signal starts  
in the brain!**



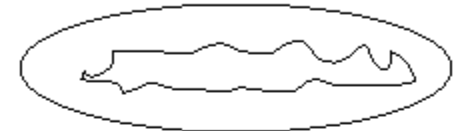
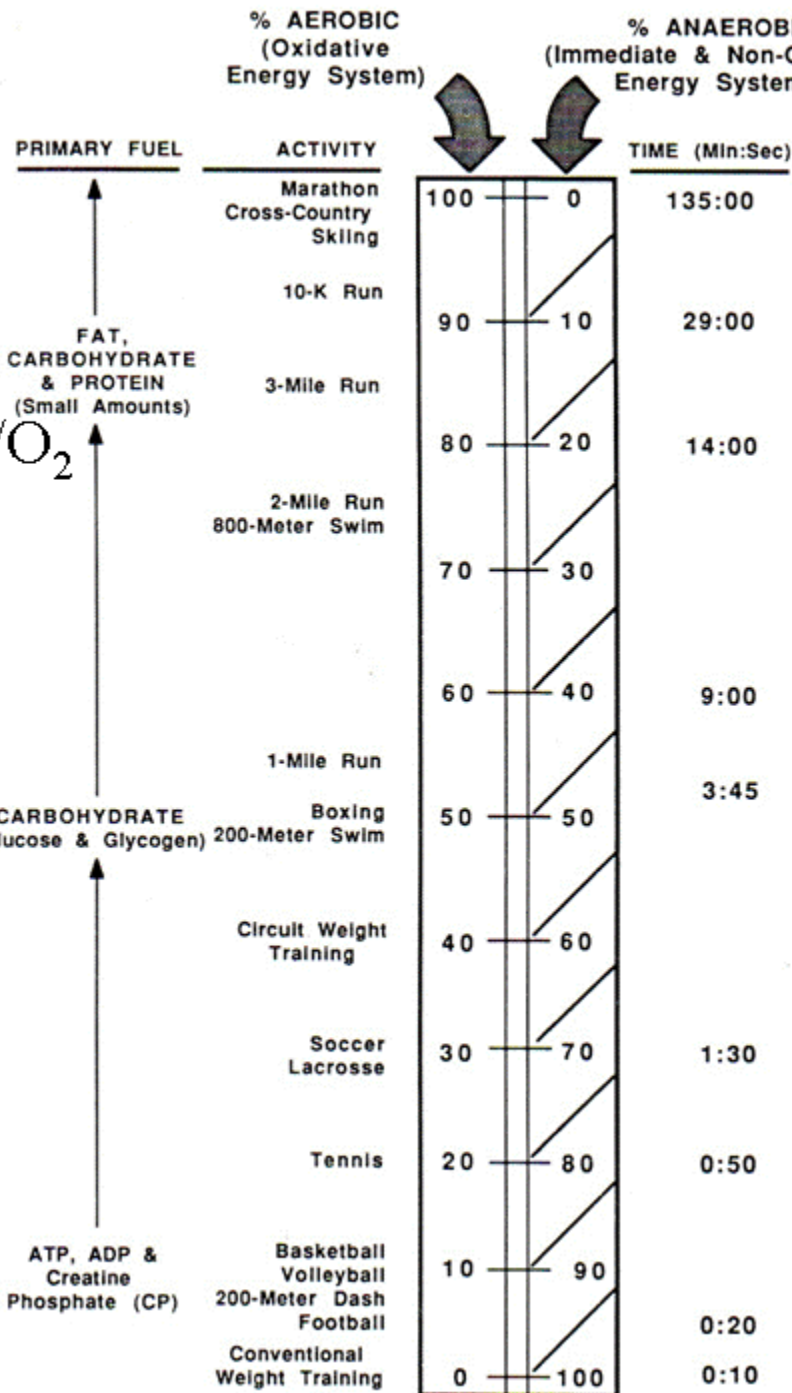
**Let's look @ one  
bouton & one  
muscle fiber!**





**AEROBIC**

w/O<sub>2</sub>



**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 Strength Training*

- ↑ Size of larger fast vs smaller slow fibers
- ↑ CP as well as creatine phosphokinase (CPK) which enhances short-term power output
- ↑ Key enzymes which help store and dissolve sugar including glycogen phosphorylase (GPP) & phosphofructokinase (PFK)
- ↓ Mitochondrial # relative to muscle tissue
- ↓ Vascularization relative to muscle tissue
- ↑ Splitting of fast fibers? Hyperplasia?  
With growth hormone (GH), androgenic-anabolic steroids (AAS)?

# ***Changes in Muscle Due to Endurance Training***

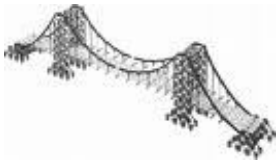
- ↑ Mitochondria, # & size
- ↑ Mitochondrial (aerobic) enzymes including those specific for fat burning
- ↑ Vascularization of muscles (better blood flow)
- ↑ Stores of fat in muscles accompanied by
- ↓ Triglycerides/fats in bloodstream
- ↑ Enzymes: activation, transport, breakdown ( $\beta$ -oxidation) of fatty acids
- ↑ Myoglobin (enhances O<sub>2</sub> 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!

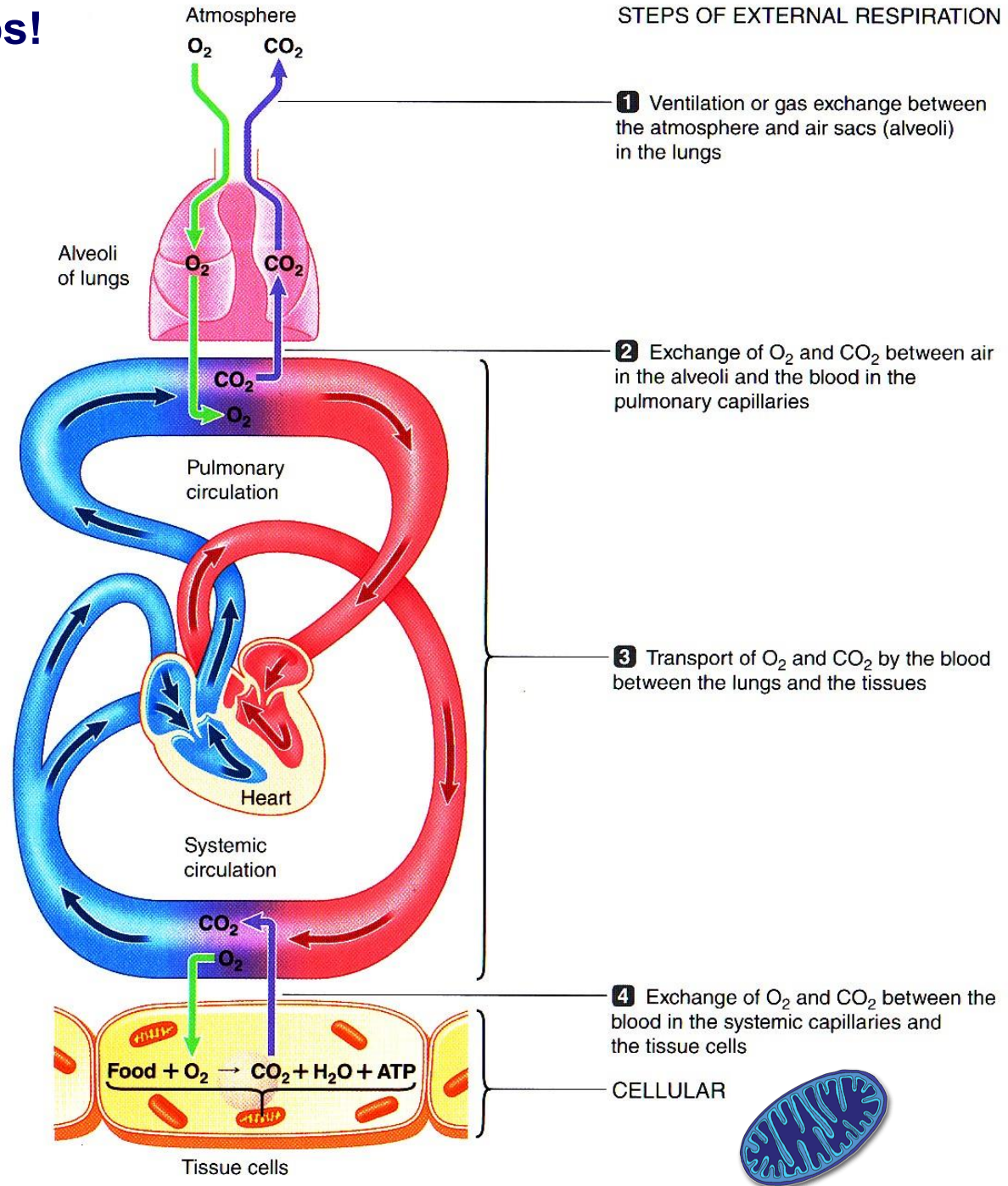
Go with the flow!



## 4 Cross membranes!

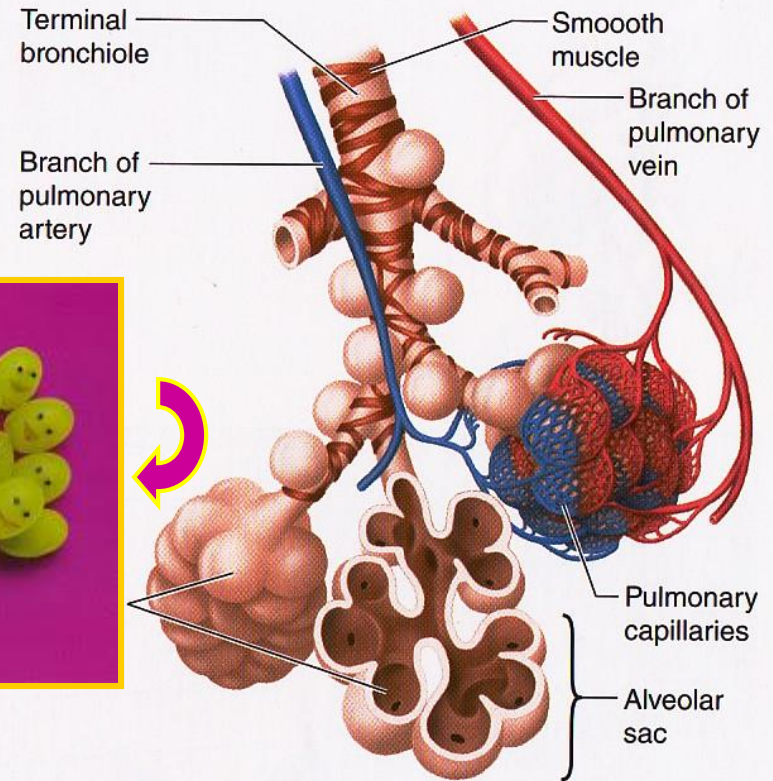
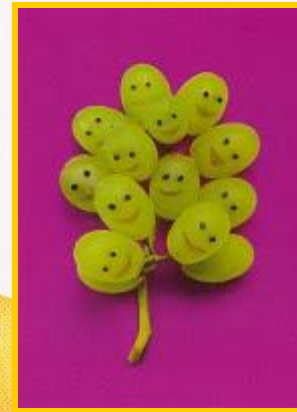
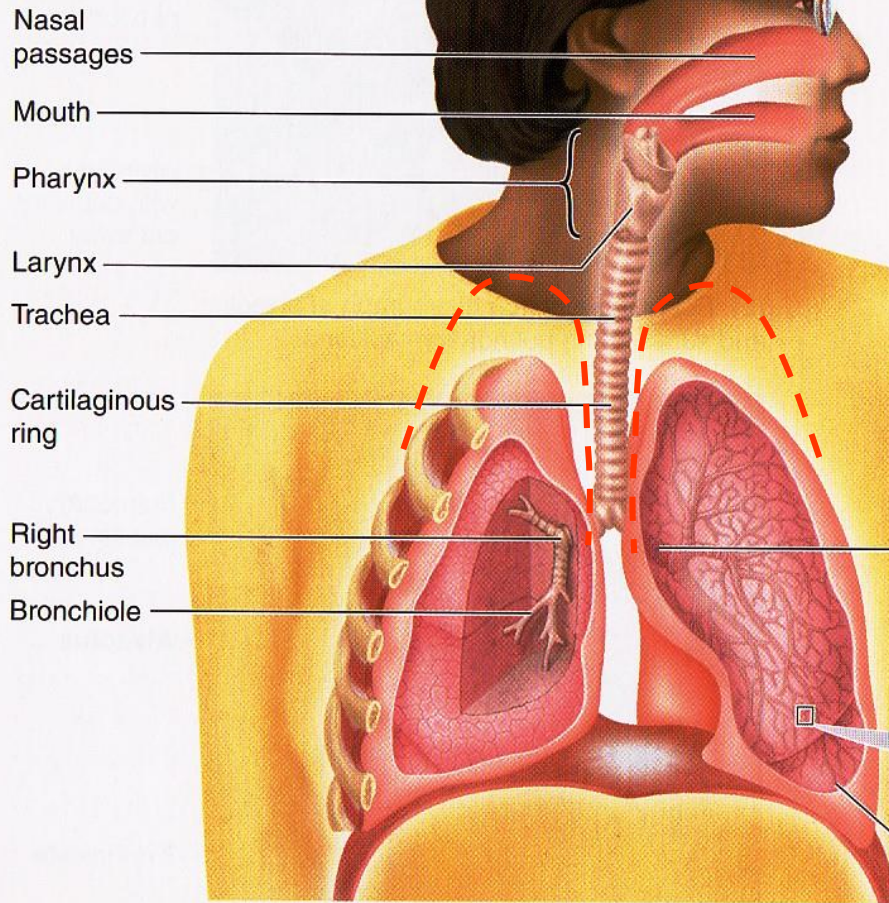


### STEPS OF EXTERNAL RESPIRATION

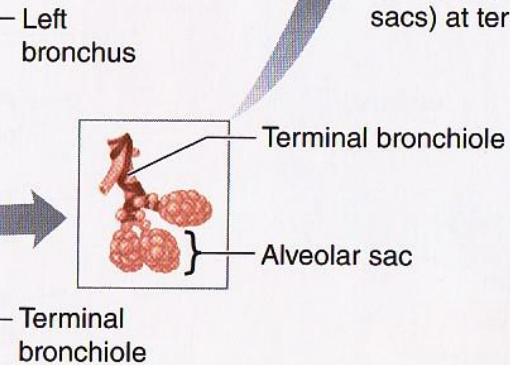


# Respiratory System Anatomy

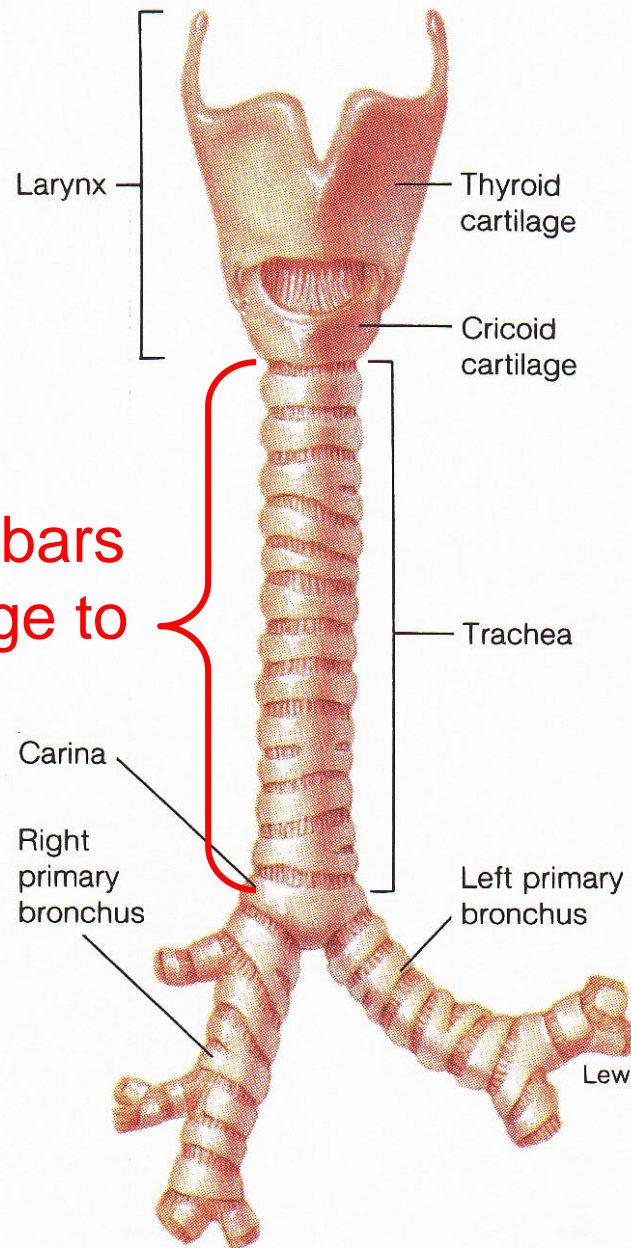
***NB: In vivo,***  
**Cupola or peak**  
**of each lung**  
**goes into neck**  
**> clavicle line!**

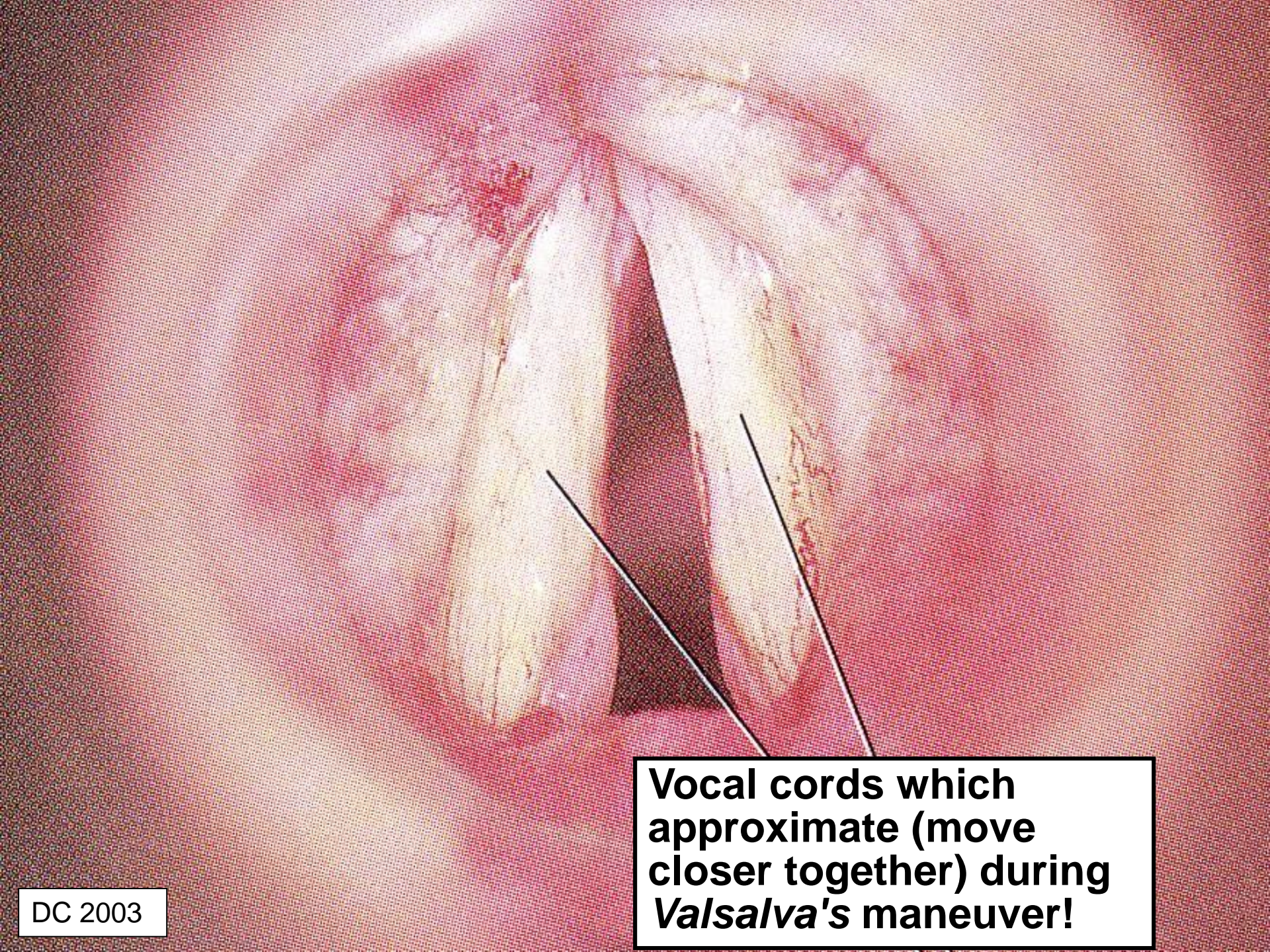


**(b)** Enlargement of alveoli (air sacs) at terminal ends of airways



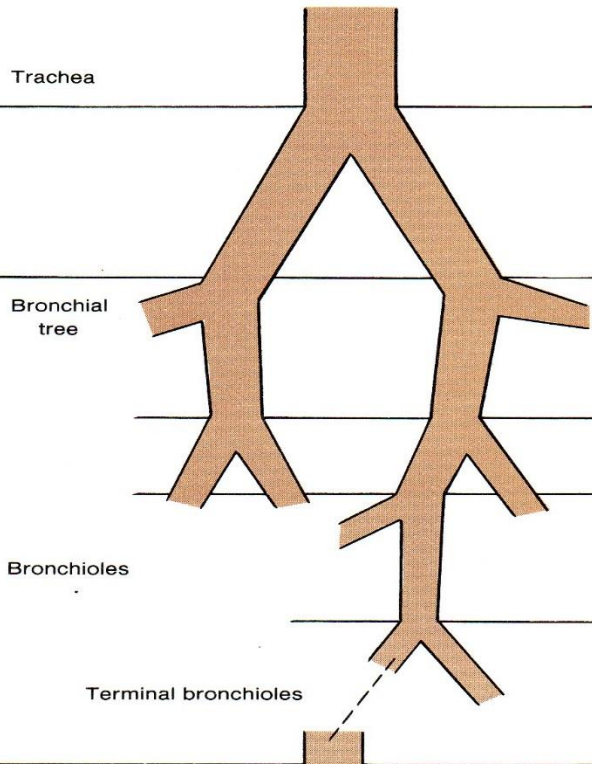
16-20 C-shaped bars  
of hyaline cartilage to  
prevent collapse





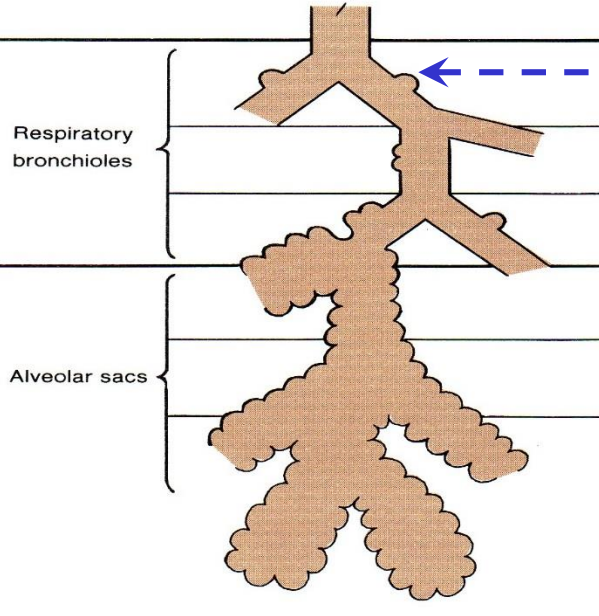
**Vocal cords which approximate (move closer together) during *Valsalva's* maneuver!**

**Conductive Zone**



**No Gas Exchange**

**Respiratory Zone**



-1<sup>st</sup> alveolar outpouching!

**Gas Exchange**



## BI 121 Lecture 17

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



**I. Announcements Exam II Wednesday Dec 7<sup>th</sup>  
@ 8:00 am! 10 am lab section report to 13 KLA,  
2 pm lab section 202 CAS. All others here!**

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

**II. Respiratory System Connections LS ch 12, DC Module 7+**

**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!**

# Muscles of Ventilation

**Accessory muscles of inspiration**  
(contract only during forceful inspiration)

Sternocleidomastoid

Scalenus

Internal intercostal muscles

Sternum

Ribs

External intercostal muscles

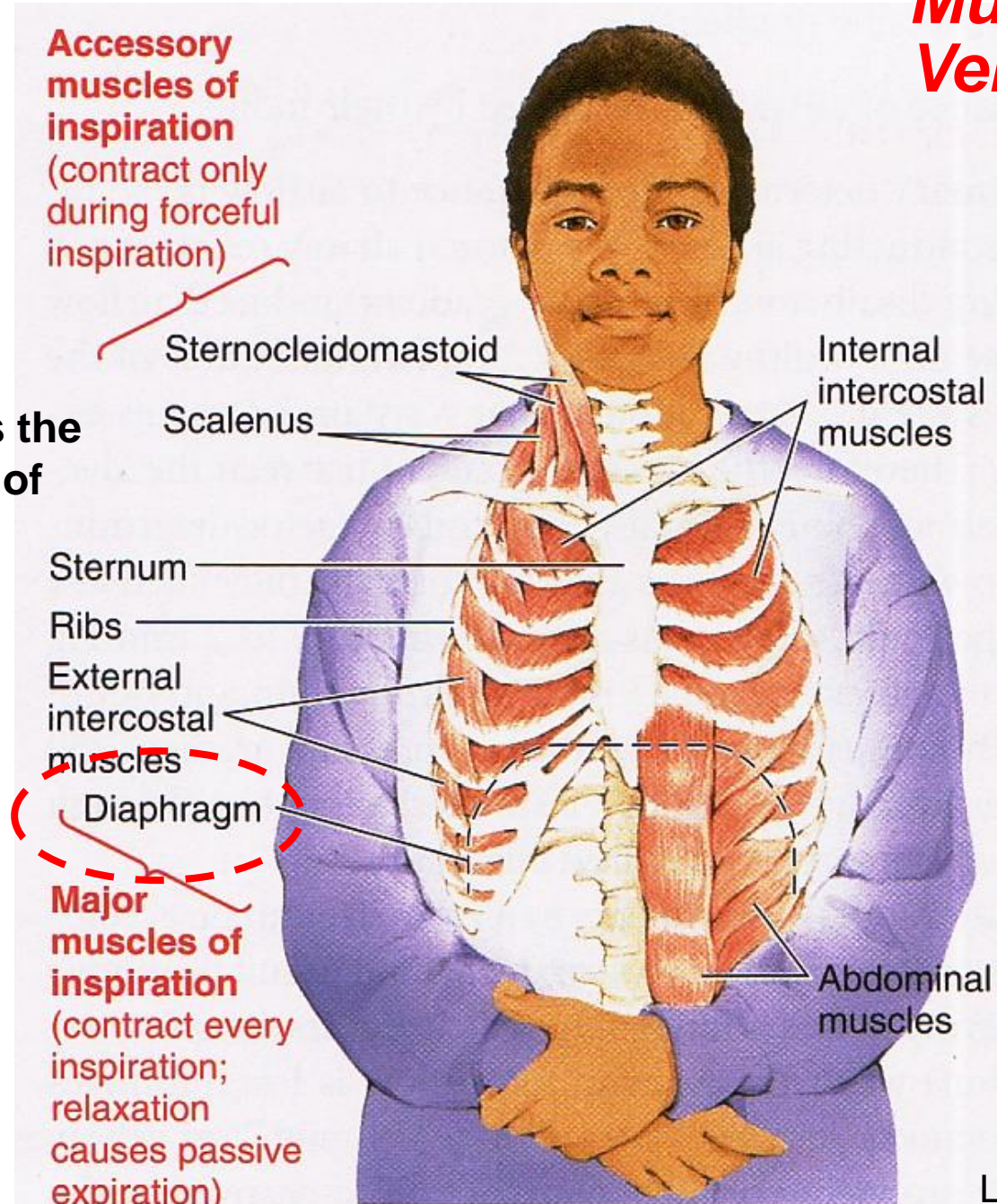
Diaphragm

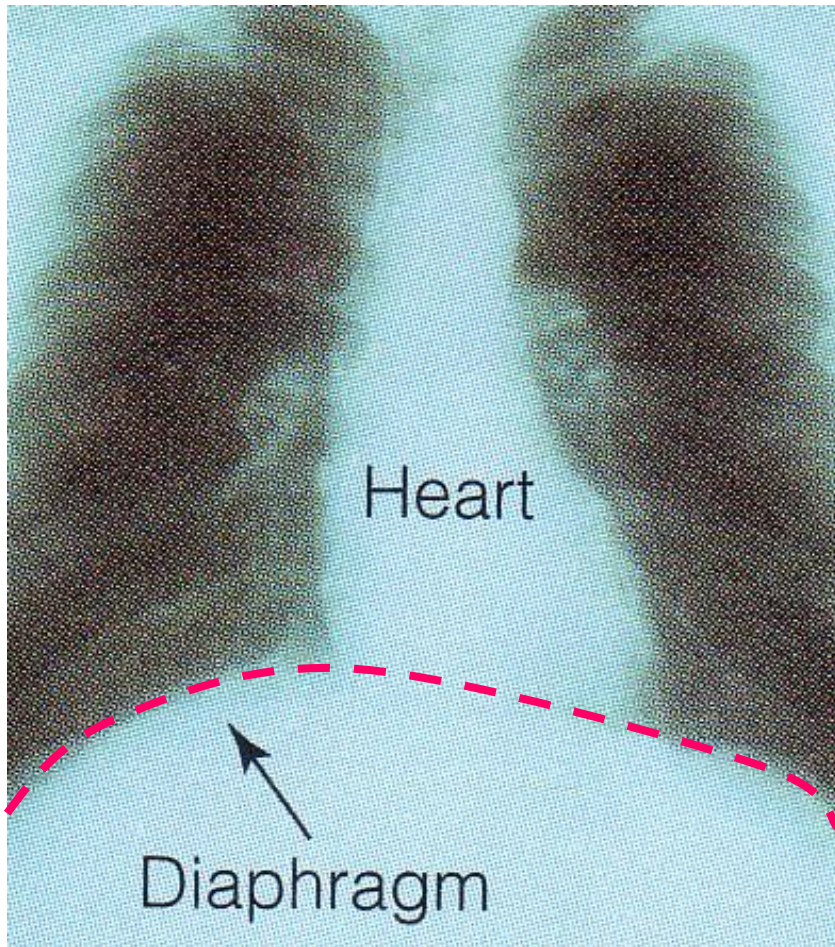
**Major muscles of inspiration**  
(contract every inspiration; relaxation causes passive expiration)

**Muscles of active expiration**  
(contract only during active expiration)

Abdominal muscles

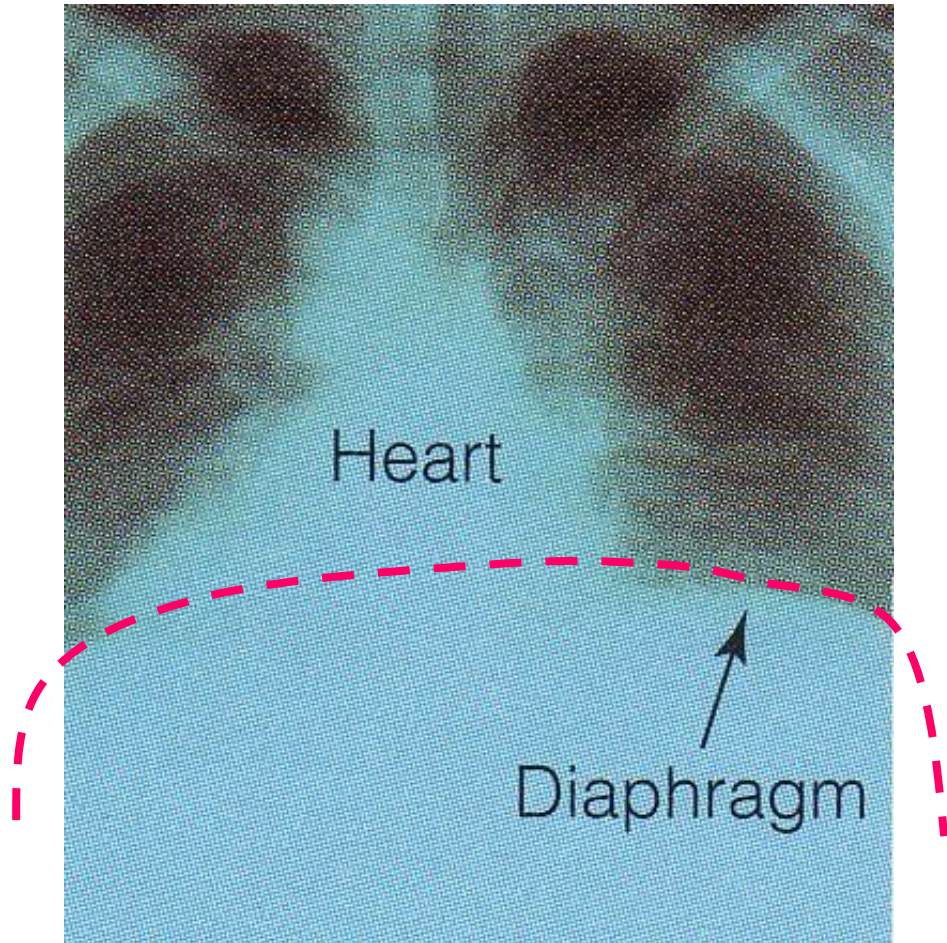
**NB: Diaphragm is the chief muscle of ventilation!**





*Inhale* (active)

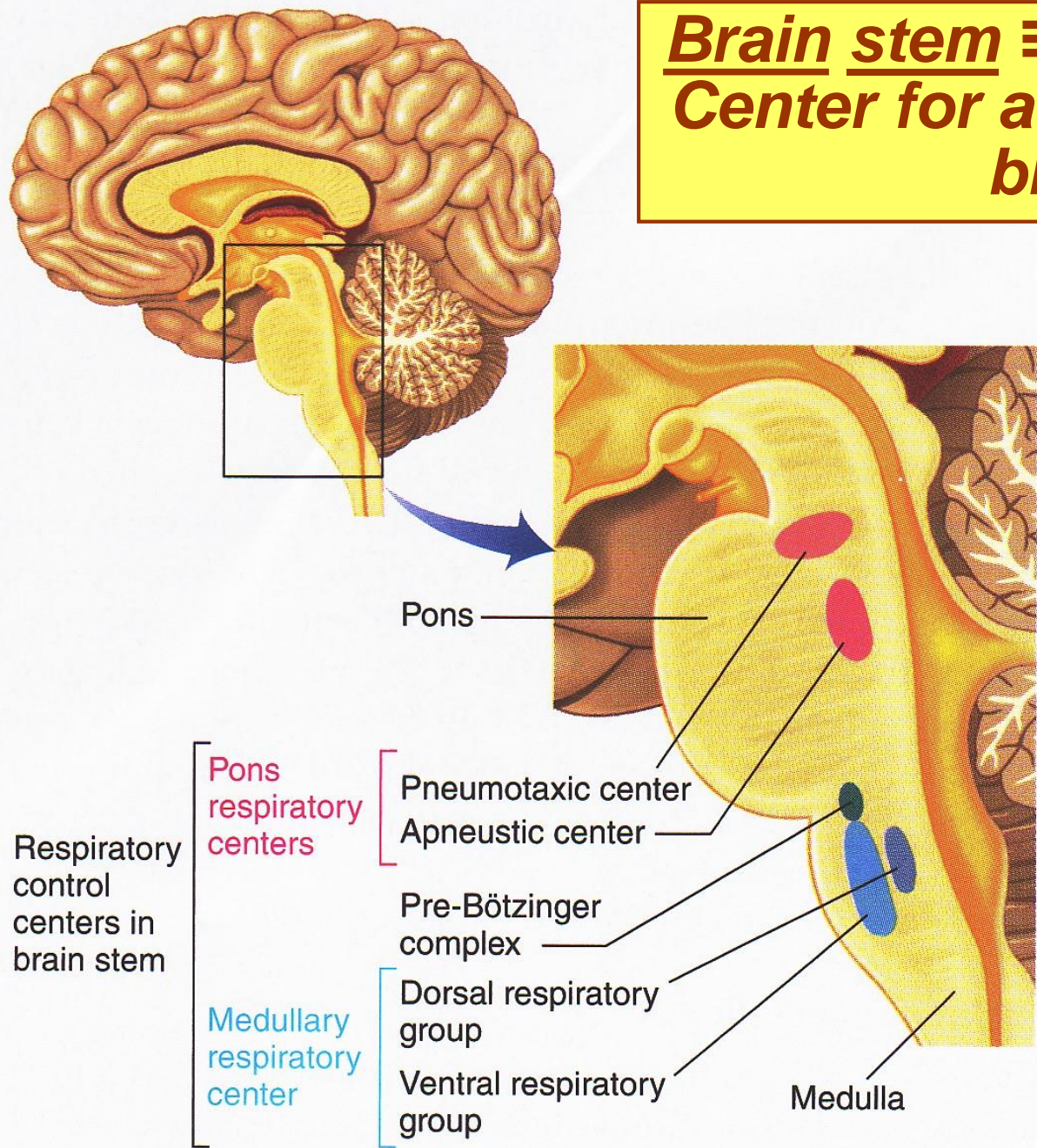
Contract & flatten diaphragm



*Exhale* (passive @ rest)

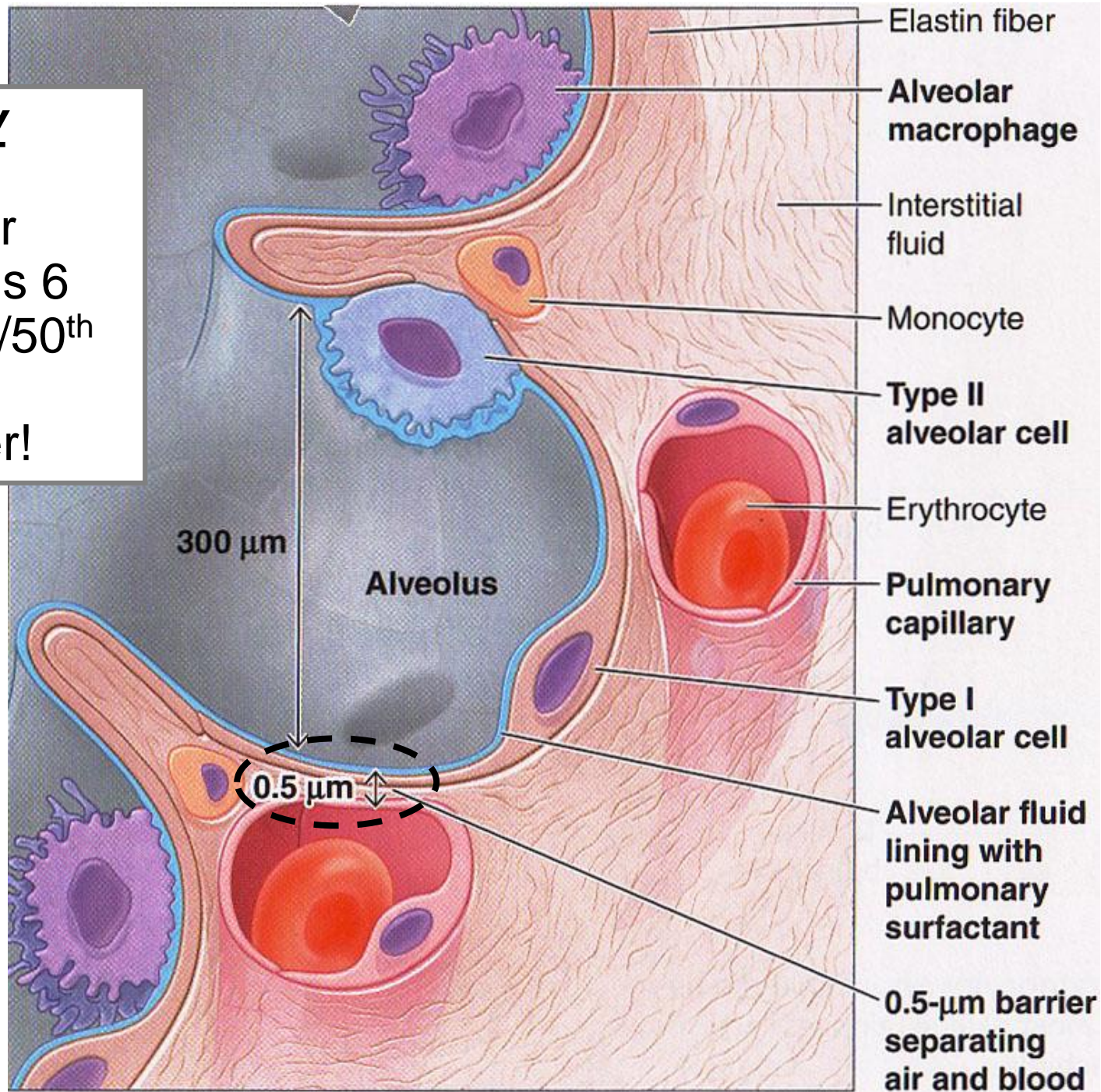
Relax & pouch up diaphragm!

**Brain stem ≡ Control Center for automatic breathing!**

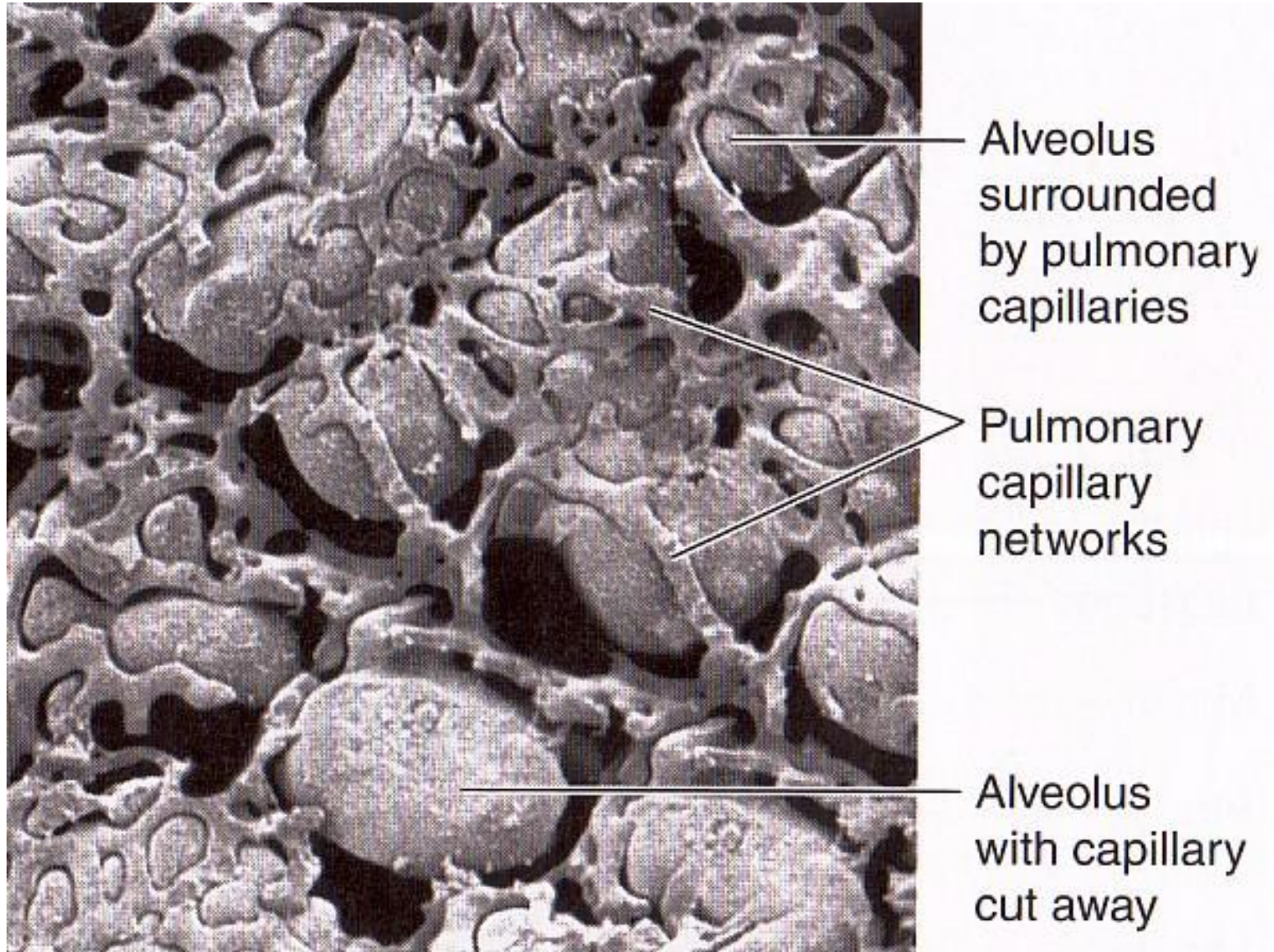


**Respiratory membrane**

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



*Alveoli are surrounded by jackets of capillaries!*



# Gas Exchange

CO<sub>2</sub> LOW

O<sub>2</sub> HIGH

**Across pulmonary capillaries:**

O<sub>2</sub> partial pressure gradient from alveoli to blood = 60 mm Hg (100 → 40)

CO<sub>2</sub> partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

**Across systemic capillaries:**

O<sub>2</sub> partial pressure gradient from blood to tissue cell = 60 mm Hg (100 → 40)

CO<sub>2</sub> partial pressure gradient from tissue cell to blood = 6 mm Hg (46 → 40)

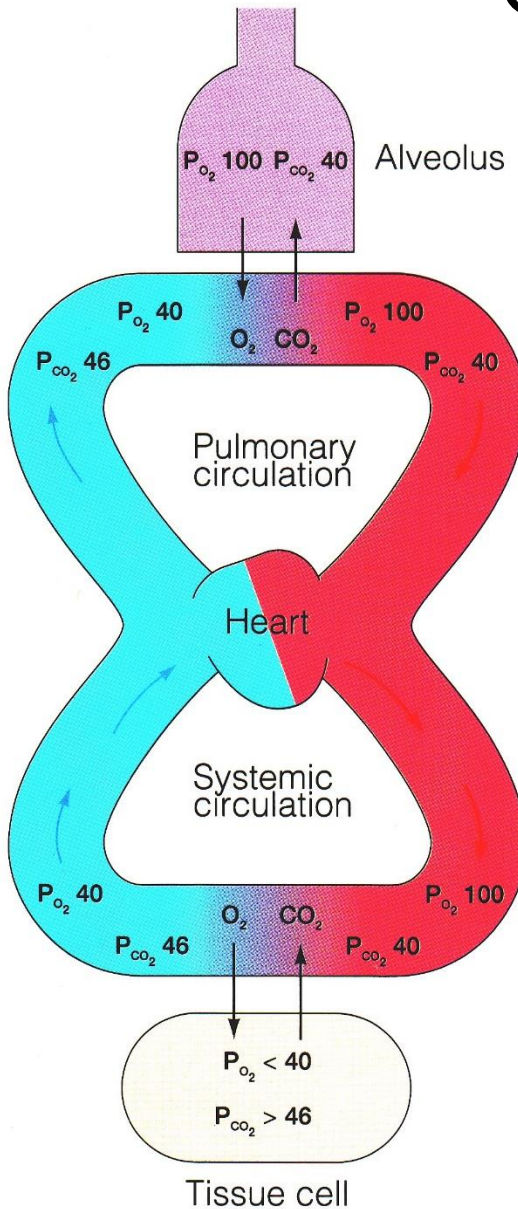
Numbers are mm Hg pressure.

Inspired air

P<sub>O<sub>2</sub></sub> 160

P<sub>CO<sub>2</sub></sub> 0.3

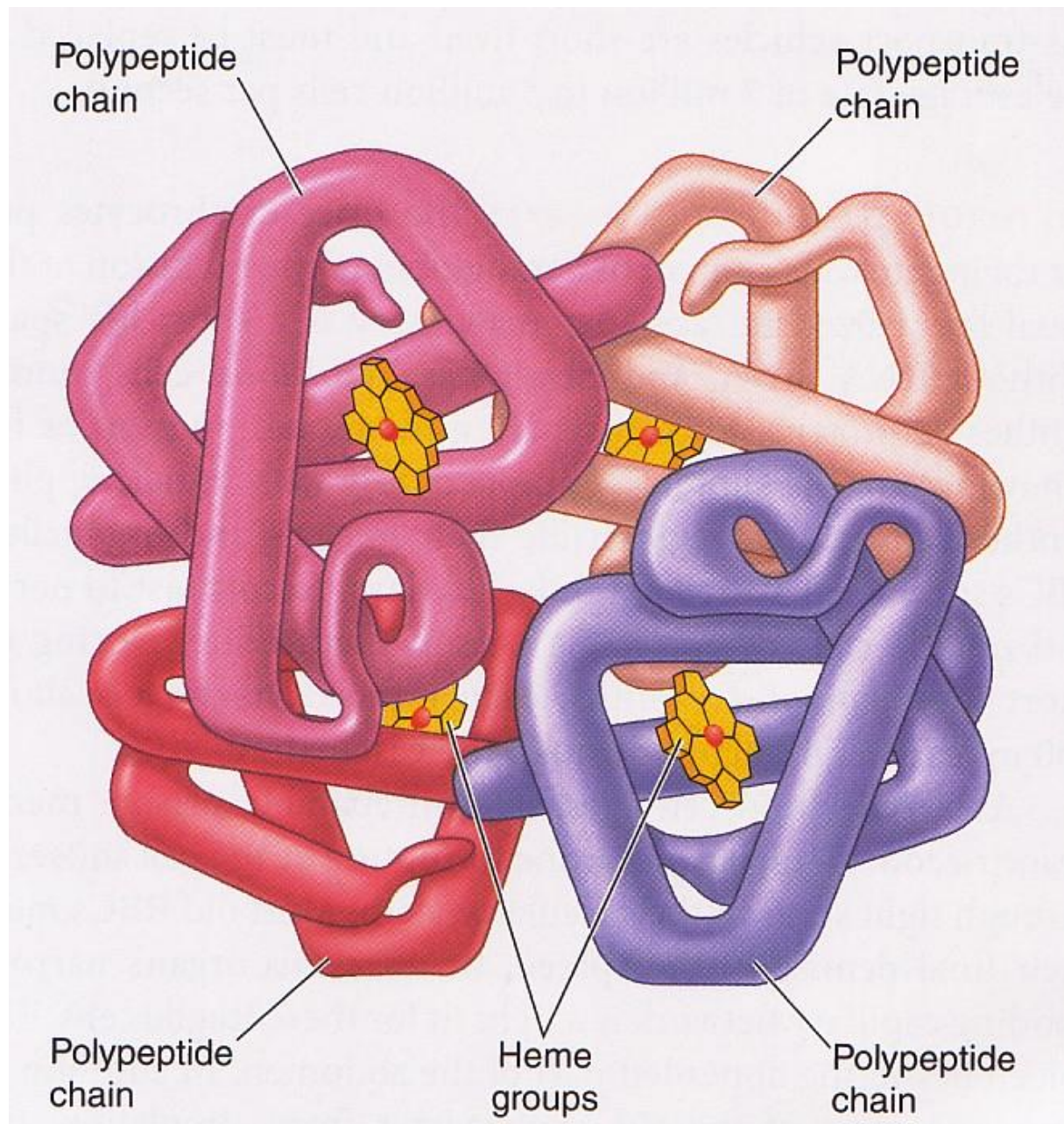
P<sub>O<sub>2</sub></sub> 100 P<sub>CO<sub>2</sub></sub> 40 Alveolus



CO<sub>2</sub> HIGH

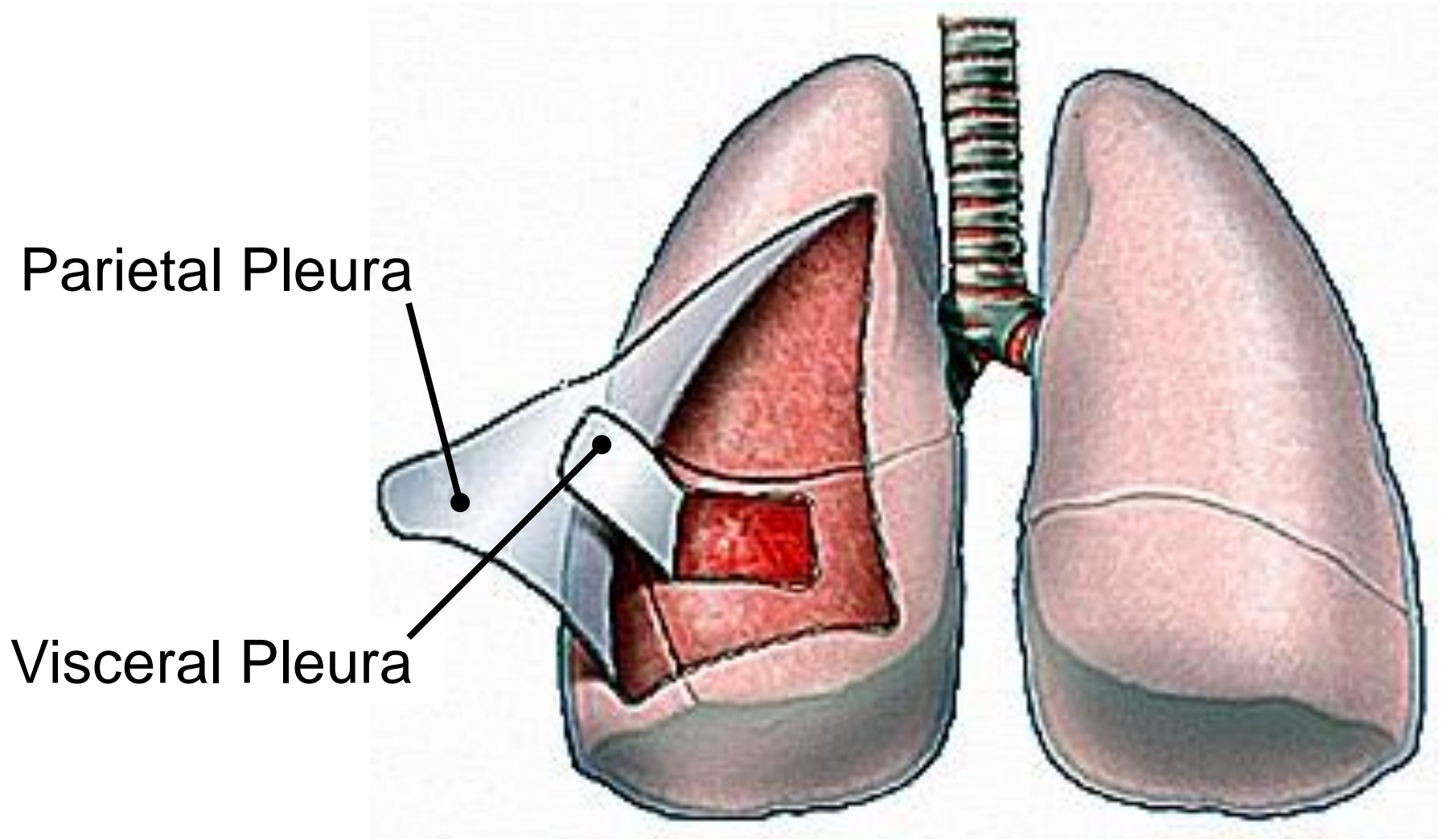
O<sub>2</sub> LOW

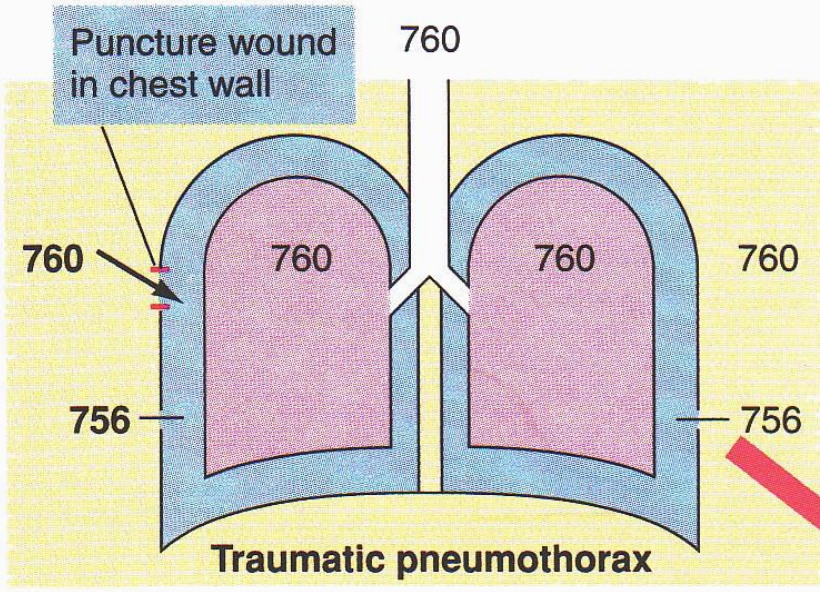
*O<sub>2</sub> is carried mainly by red blood cell hemoglobin!*



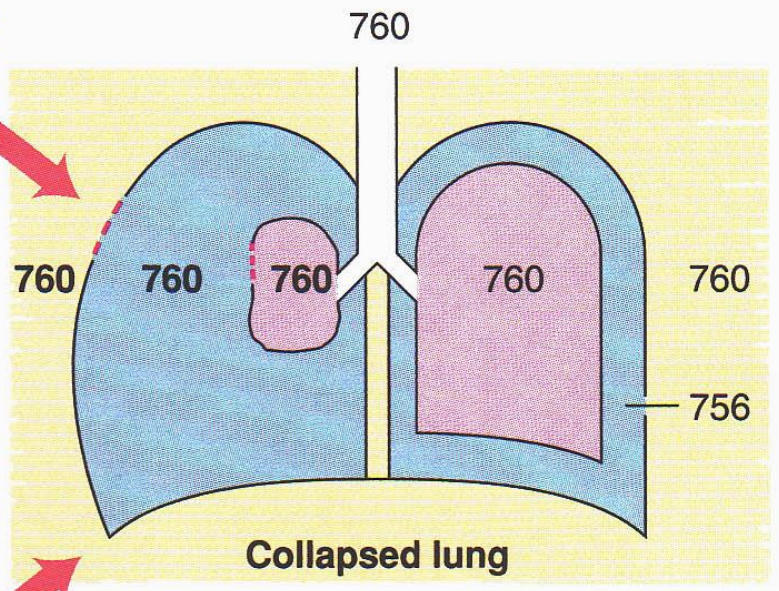


# *Pleura/Peritonea/Lung Membranes*

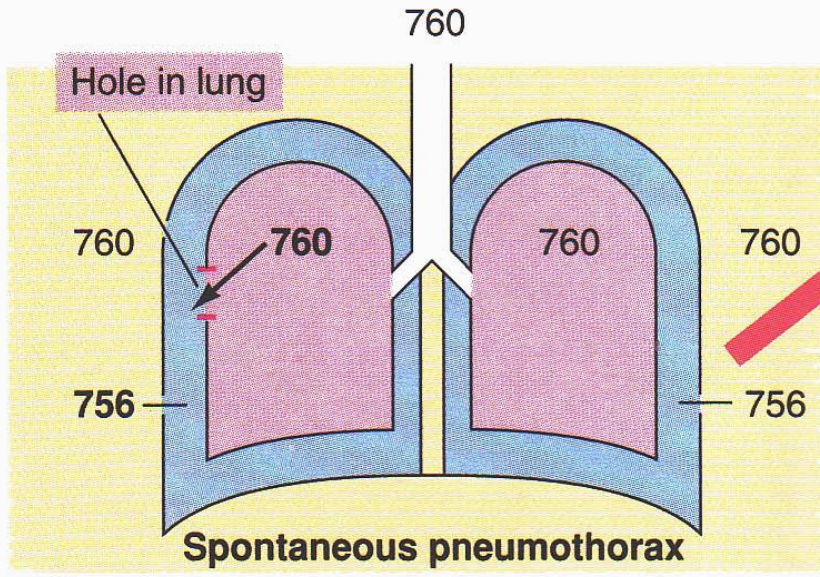




(a)



(b)



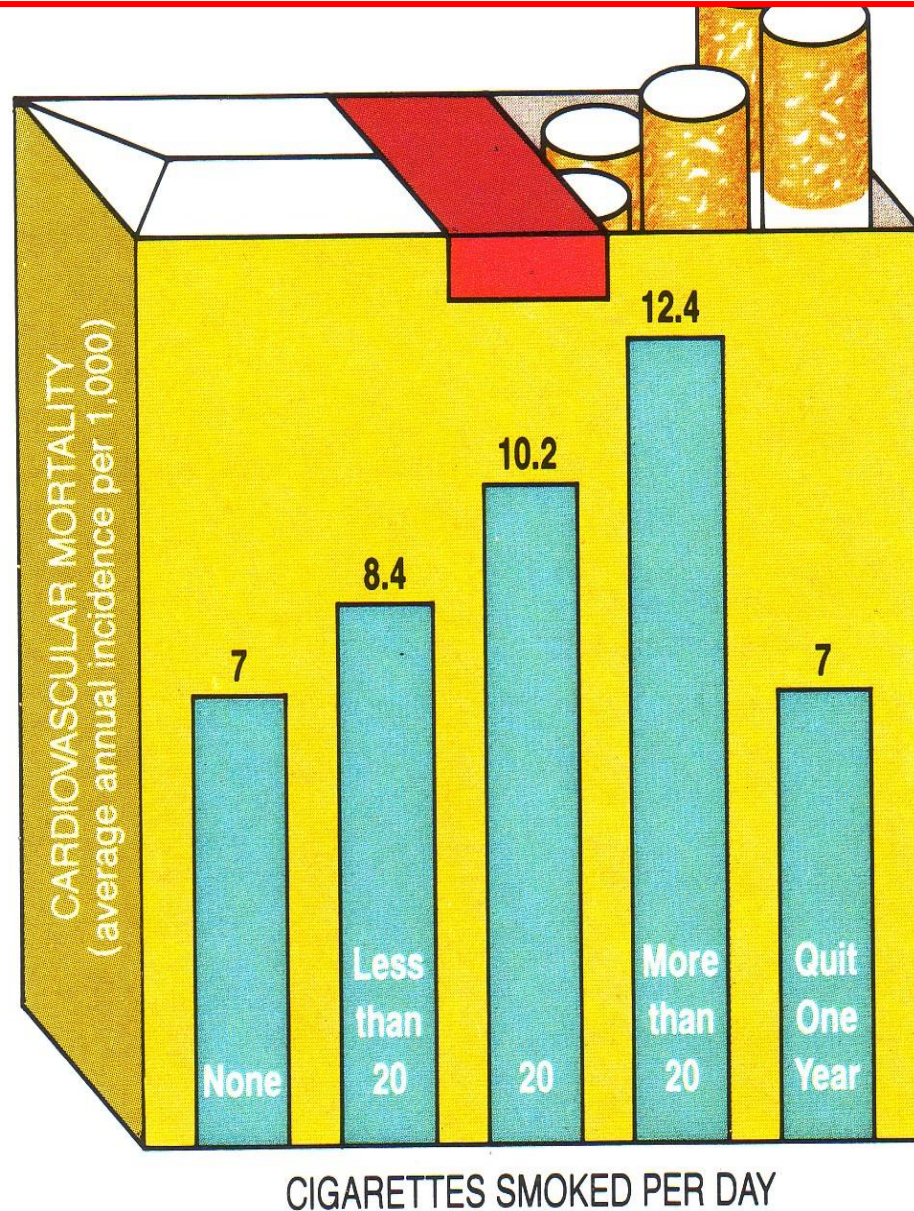
(c)

***American Cancer Society Great American Smoke Out!***

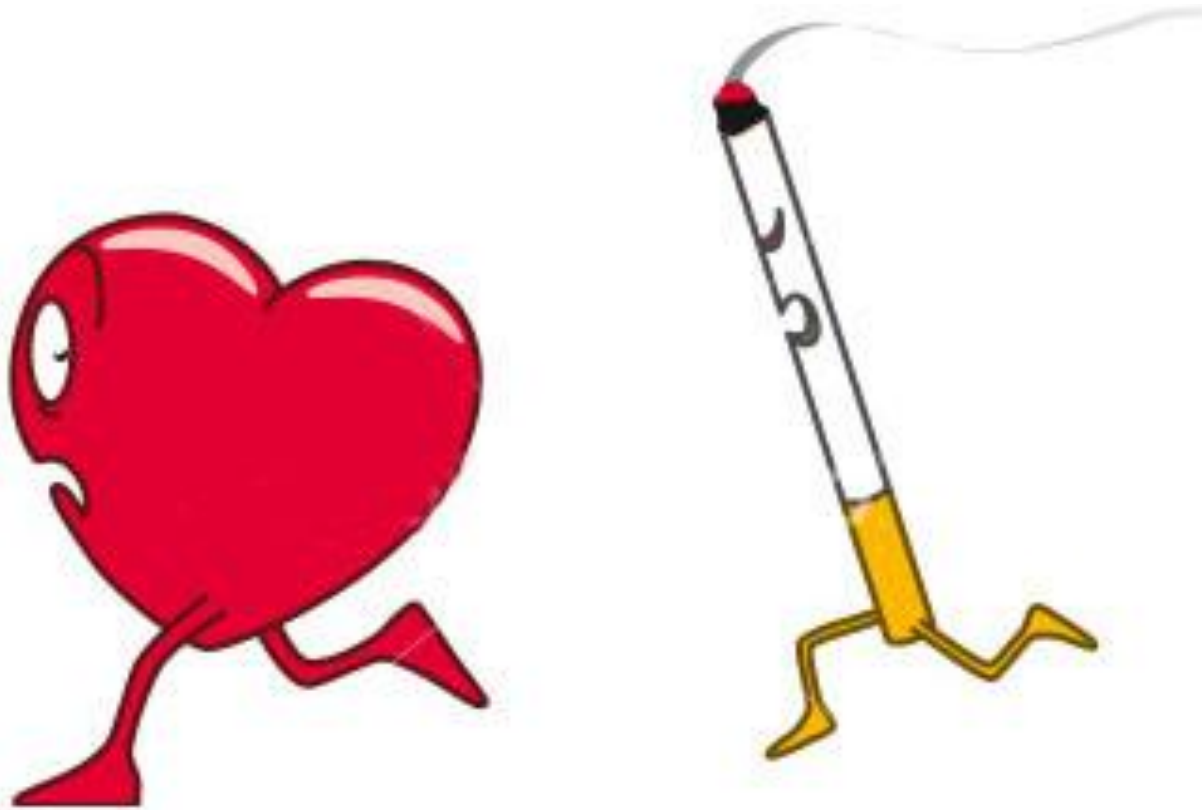


**[http://www.cancer.org/healthy/stayawayfromtobacco/  
greatamericansmokeout/](http://www.cancer.org/healthy/stayawayfromtobacco/greatamericansmokeout/)**

# 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!***

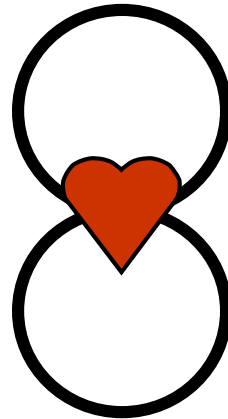
[http://www.cdc.gov/tobacco/data\\_statistics/sgr/  
50th-anniversary/index.htm#fact-sheets](http://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.htm#fact-sheets)

[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

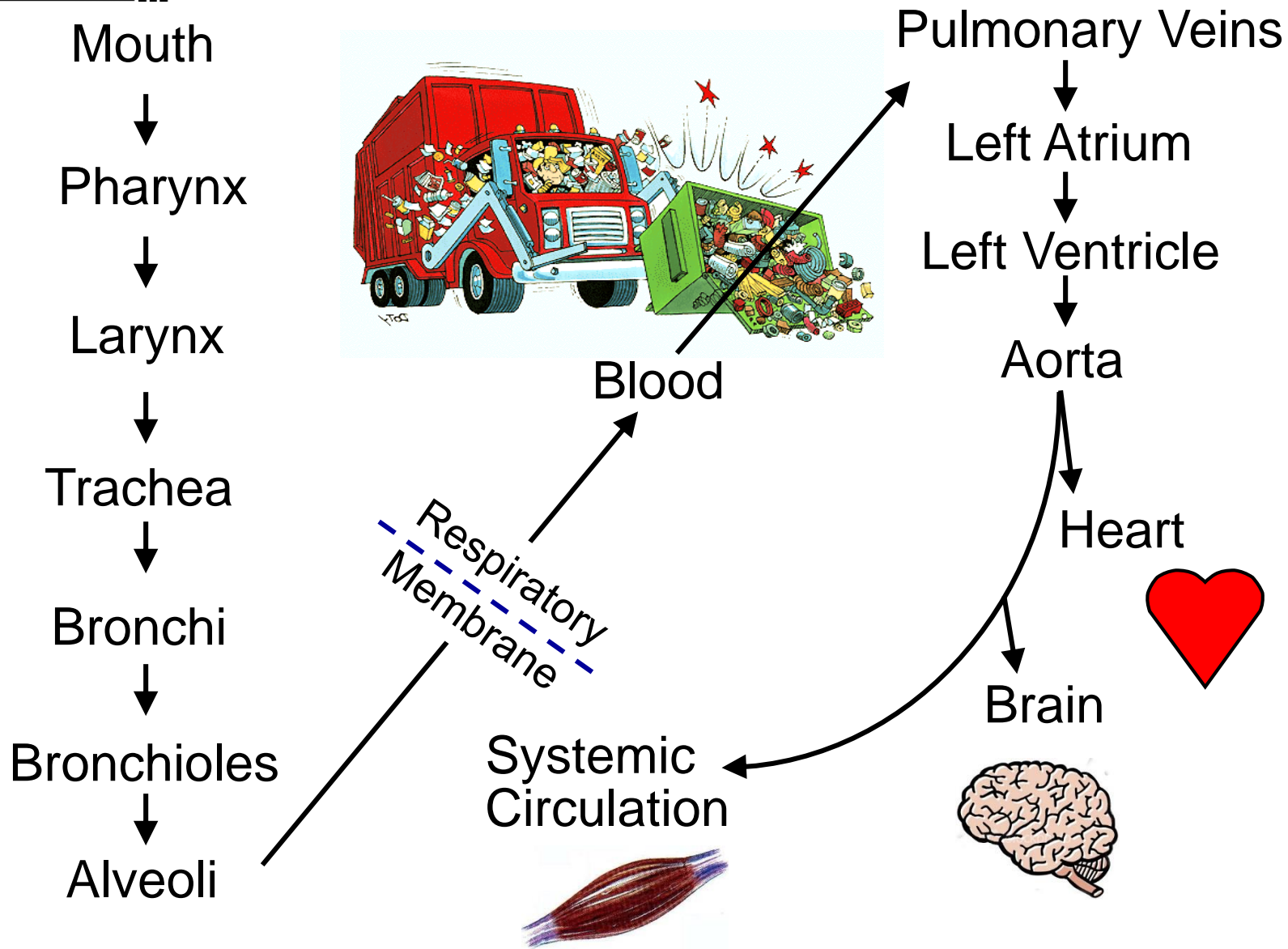


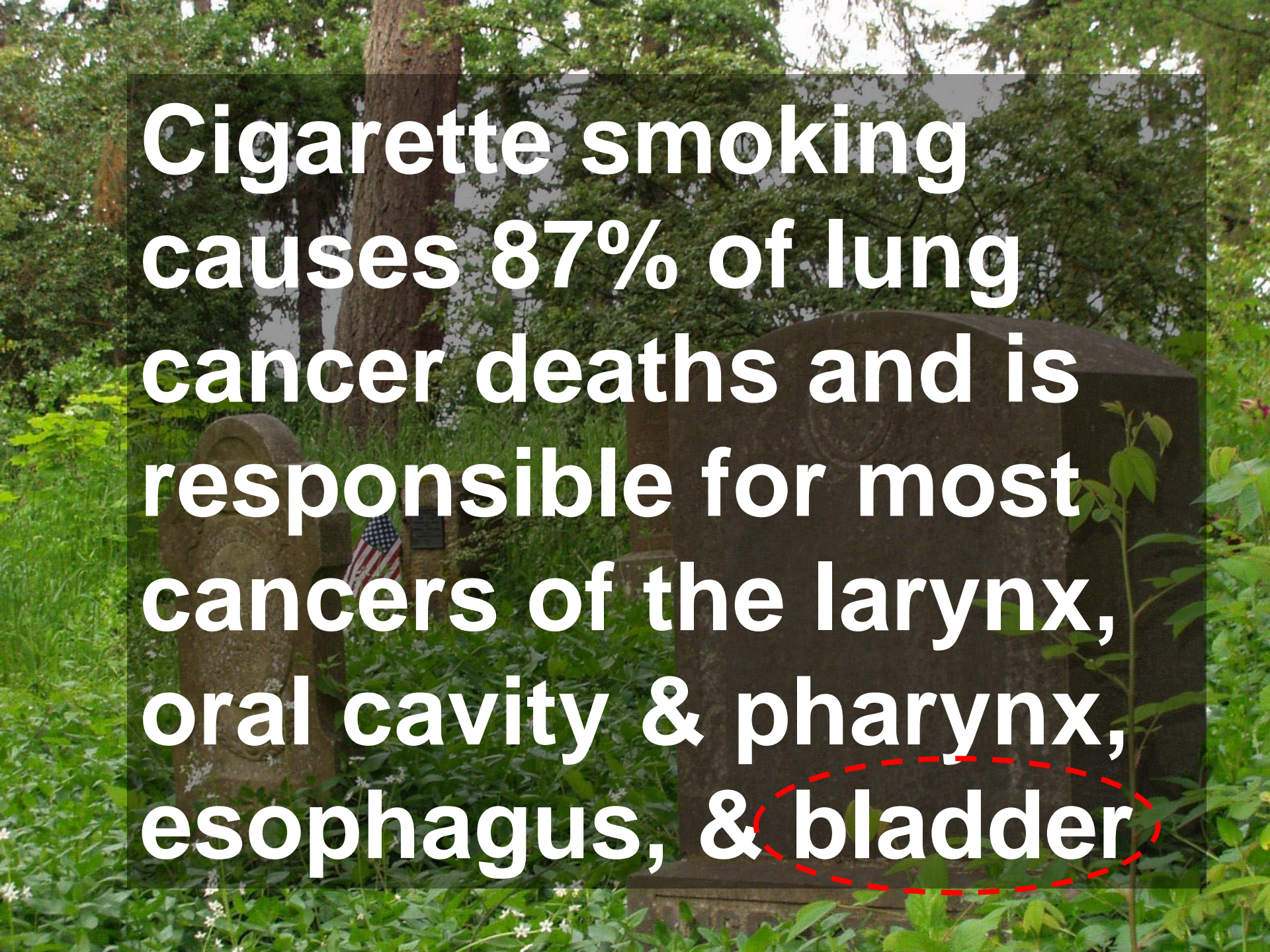
Systemic



# Tracing the Route of Cigarette Smoke

## Puff to Brain Time 5 to 8 seconds!!

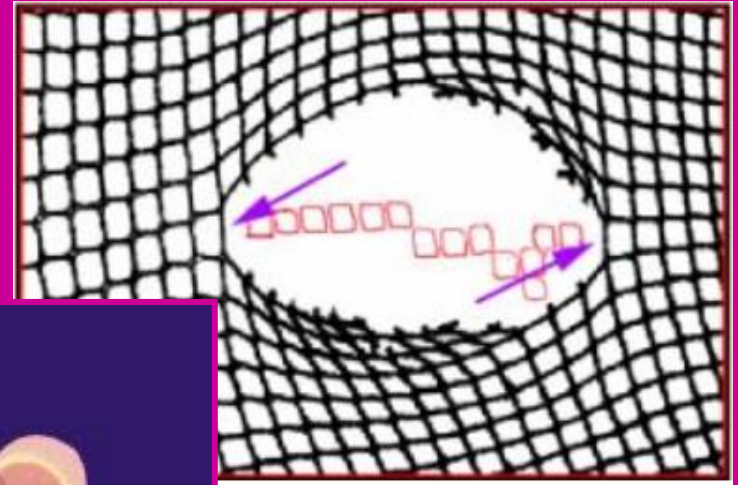
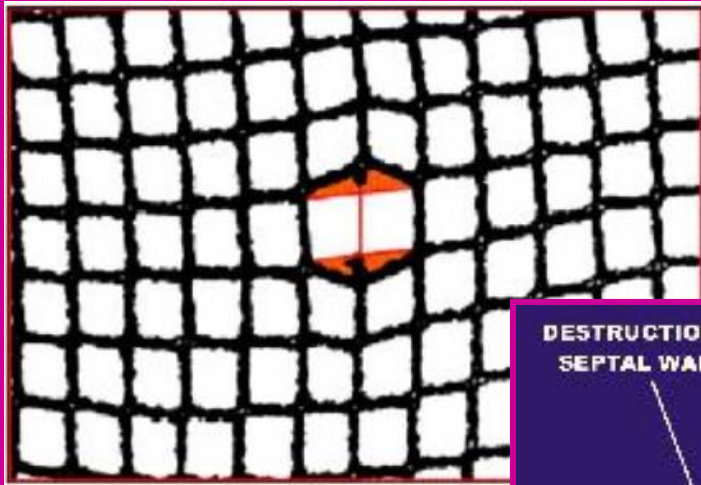


A photograph of a cemetery with several tombstones and lush green trees in the background. A semi-transparent grey text box is overlaid on the image, containing white text. The word 'bladder' in the text is circled with a red dashed line.

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



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



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



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](http://www.orthowomenshealth.com)



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

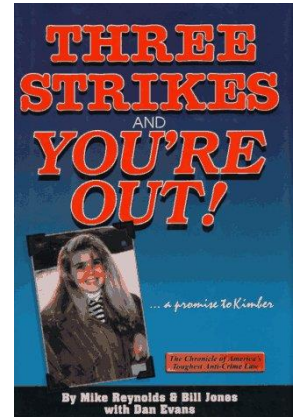
# On the Pill & Smoke?

## Increased Risk of:

1. Blood Clots

2. Heart Attack

3. Strokes!



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

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

A photograph of a man in a tuxedo with a cigarette in his mouth, looking at a woman. The text "Mind if I smoke?" is overlaid on the image.

"Mind if I smoke?"

*"Care if I die?"*

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

News: Health, Toxicology, Pollution

## Health risks of e-cigarettes emerge

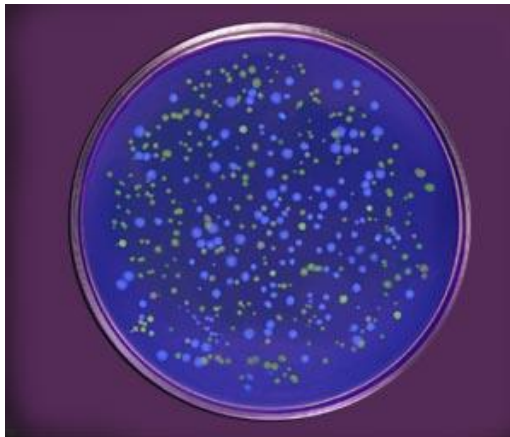
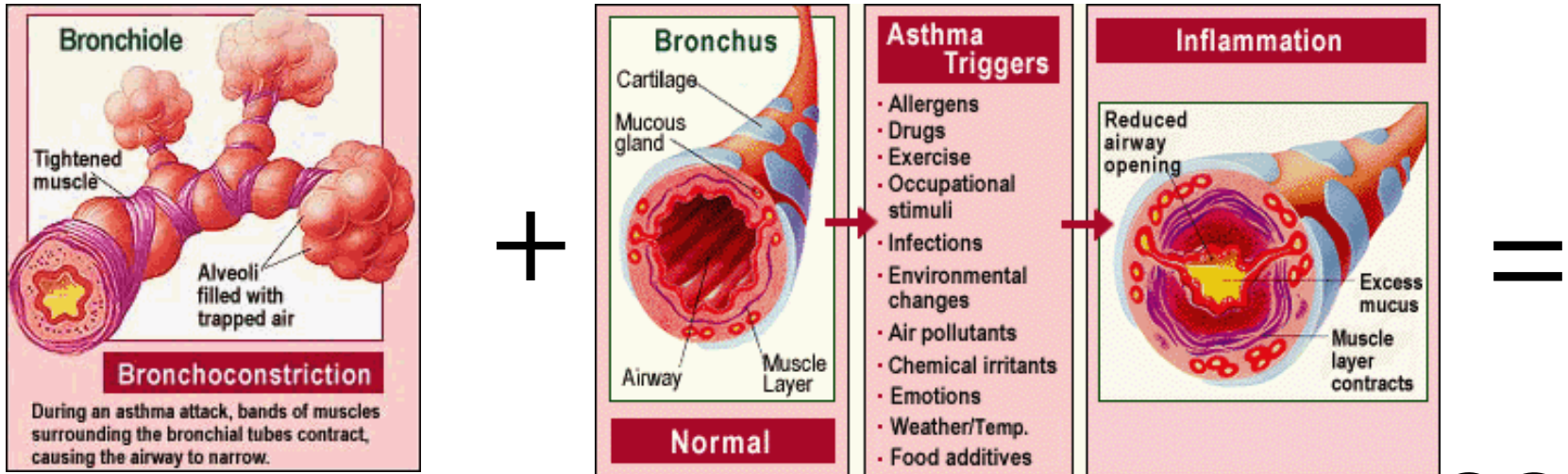
*Vaping pollutes lungs with toxic chemicals and may even make antibiotic-resistant bacteria harder to kill*

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

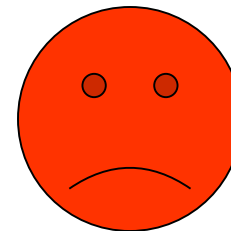


<https://www.sciencenews.org/article/health-risks-e-cigarettes-emerge>

# SMOKING ≡ ASTHMA?



**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

Sunflowers are planted along with our organic tobacco to attract beneficial insects to protect our organic crops...



To be buried with  
sunflowers?  
Compost?



**Cigarettes & 2<sup>nd</sup>-hand smoke!!**

...and to **avoid** the use of chemical pesticides.





## **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)

## **2<sup>nd</sup>-Hand Smoke or ETS & 3<sup>rd</sup>-Hand Smoke?**

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

## **2<sup>nd</sup>-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<br/>%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>