



Exam II Review Slides



Exam II!
Whee!



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

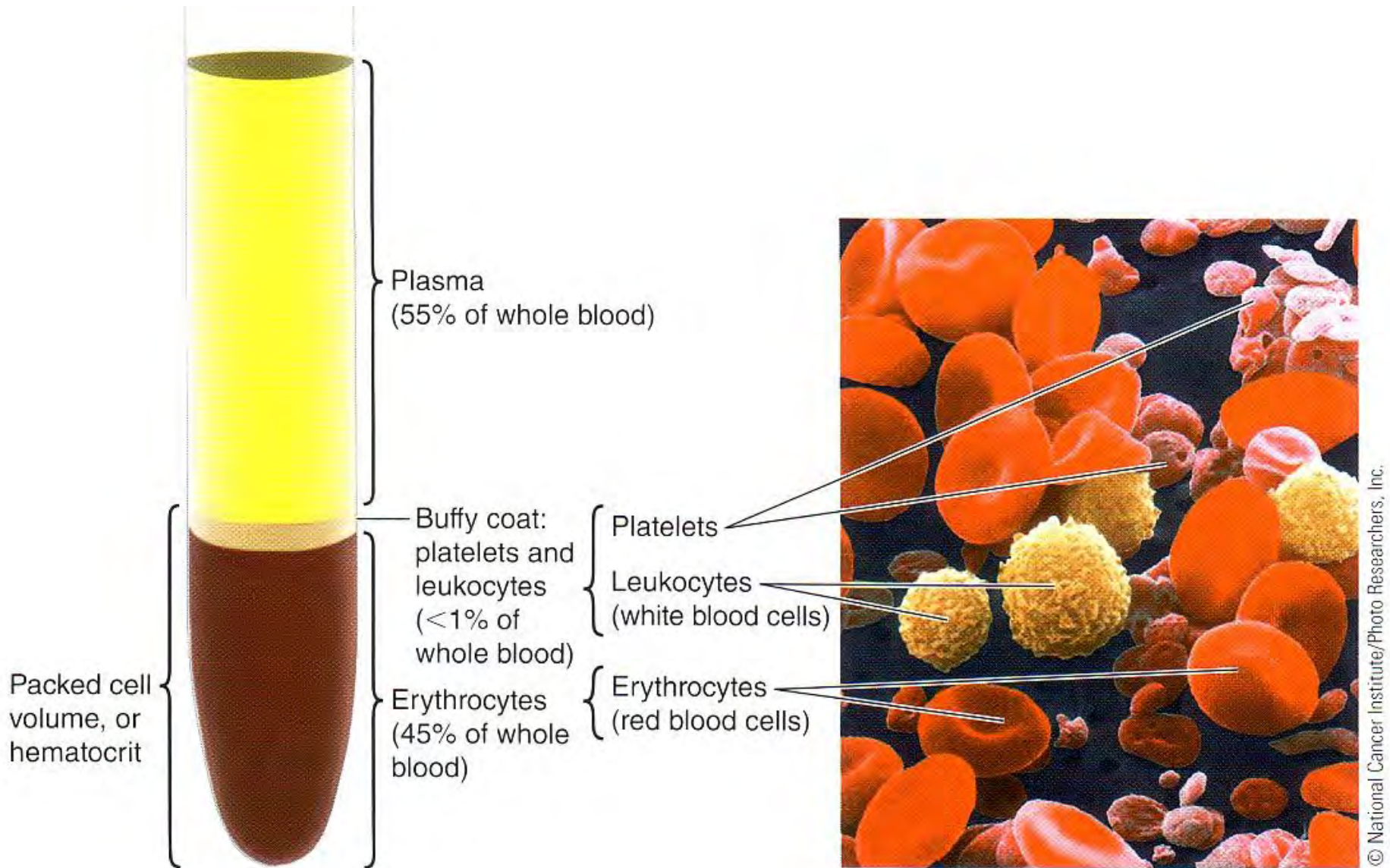


- I. Announcements** No lab today! Break for exam week!
Next R Blood Chemistry. Thanks sincerely for helping us optimize safety by reading $\geq 2x$ Lab 5, LM pp 5-1 to 5-6.
- II. Blood Form & Function** LS ch 11, DC Module 5 pp 35-9
- A. Formed vs Nonformed/cells vs plasma LS fig + tab 11-1
Cell origin - bone marrow. What's in plasma? LS p 297
 - B. Red blood cells/erythrocytes: O_2 carrying LS p 299
Normal flexible vs fragile sickle cell LS p 301
 - C. White blood cells/leukocytes: defense/immunity
differential + general functions LS pp 298, 309-12
 - D. Platelets/thrombocytes: clotting LS pp 304-6 fig 11-6+7
- III. Blood Chemistry Lab: Basics** LM + LS ch 11 & 17
- A. What's blood typing? ABo System LS pp 302- 4
Rhesus factor? Erythroblastosis fetalis? LS p 303-4
 - B. What's blood glucose? Clinically healthy range?
 - C. Diabetes + Treatment LS ch 17 pp 532-5
- IV. Exam Comments & Return**

Ghost, marshmallow
or white blood cell?



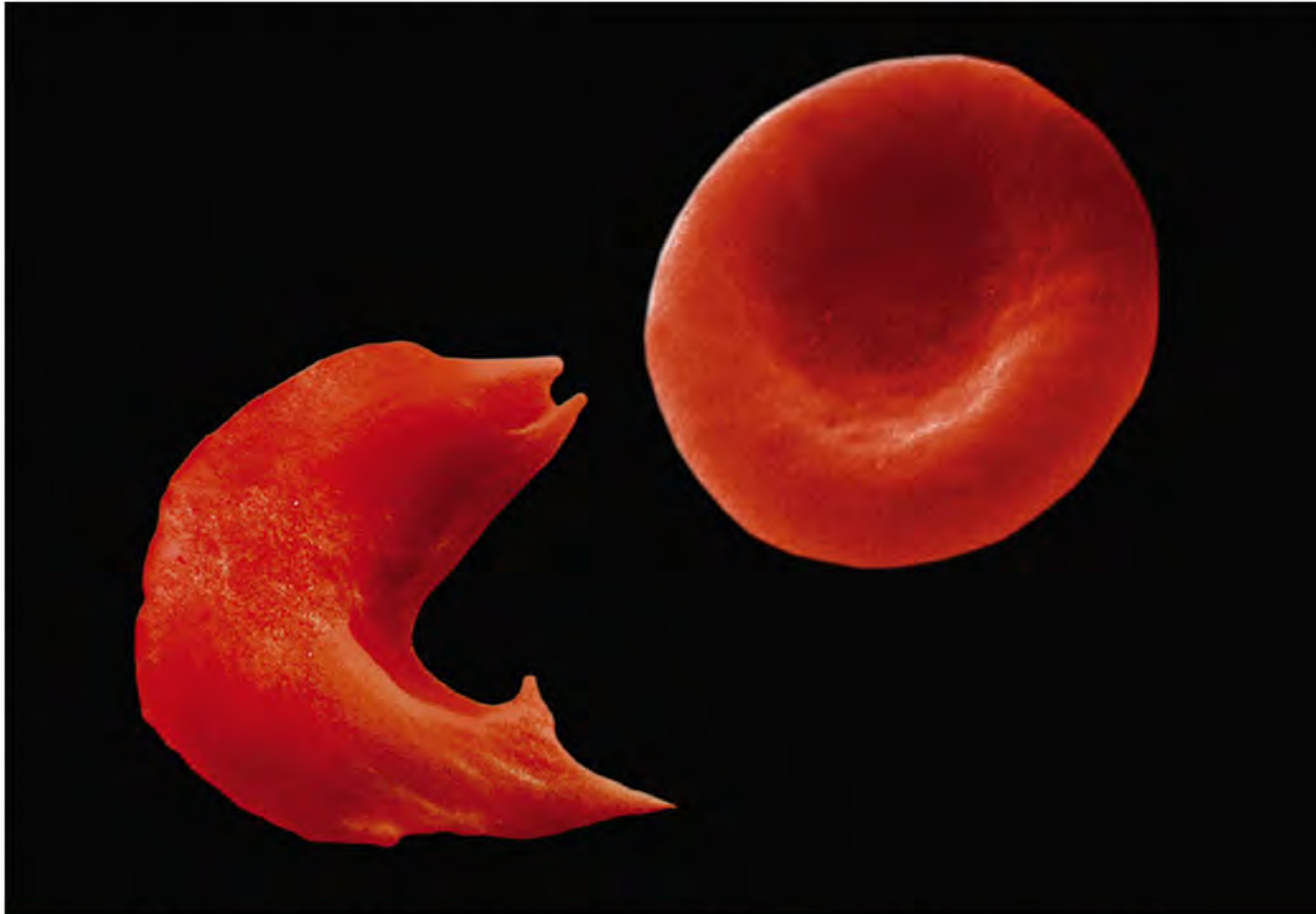
What's in Blood? Plasma & Blood Cells



Sickle-shaped blood cells

Normal red blood cells

© Dr. Stanley Flegler/Visuals Unlimited



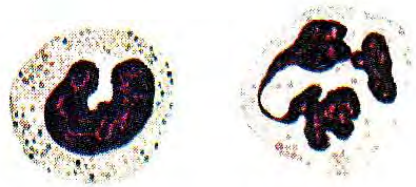
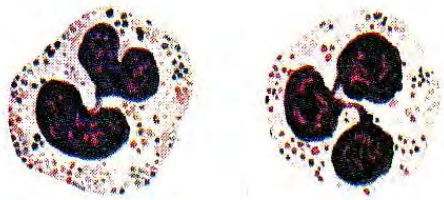
What a difference one amino acid can make!

Amino acid sequence of normal hemoglobin:

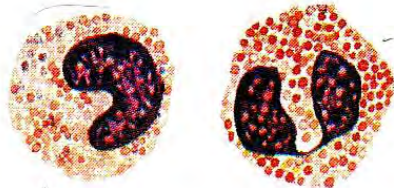
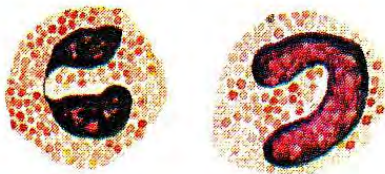
Val — His — Leu — Thr — Pro — Glu — Glu

Amino acid sequence of sickle-cell hemoglobin:

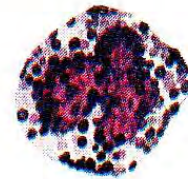
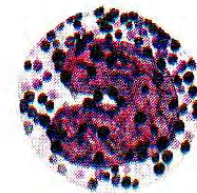
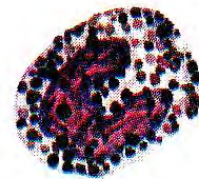
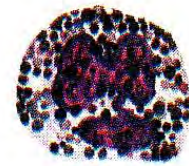
Val — His — Leu — Thr — Pro — Val — Glu



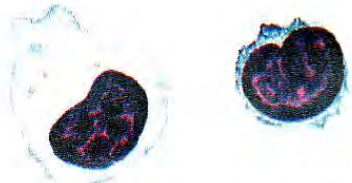
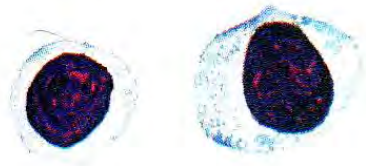
NEUTROPHILS



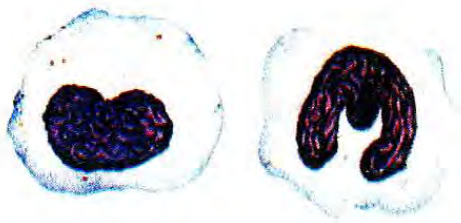
EOSINOPHILS



BASOPHILS



LYMPHOCYTES



MONOCYTES



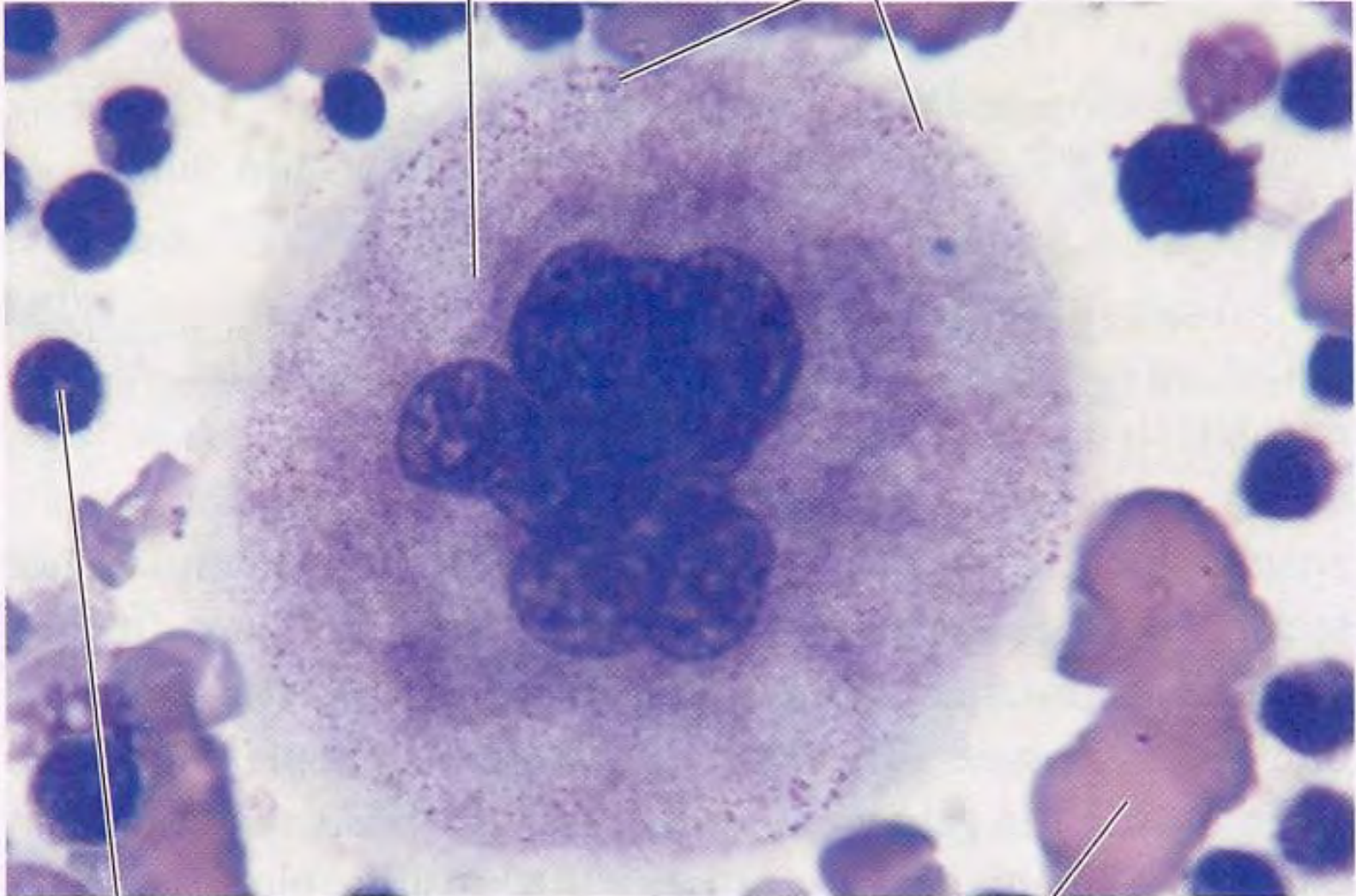
PLATELETS



ERYTHROCYTES

Megakaryocyte

Clusters of platelets
about to shed off



Carolina Biological/Visuals Unlimited

Developing
leukocyte

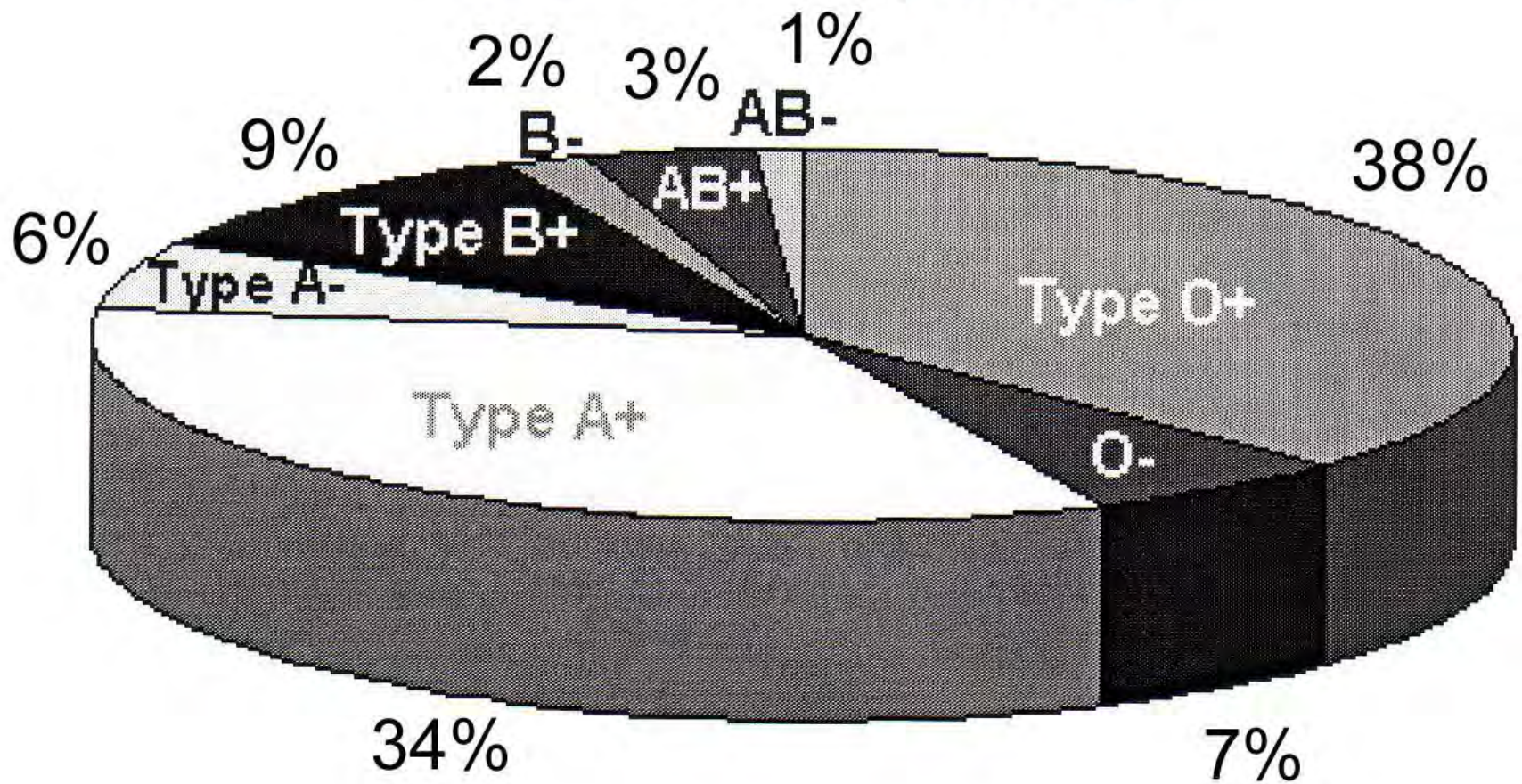
Cluster of developing
erythrocytes

AB



A & B Antigens
(Agglutinogens)

Blood Type Distribution, General Population



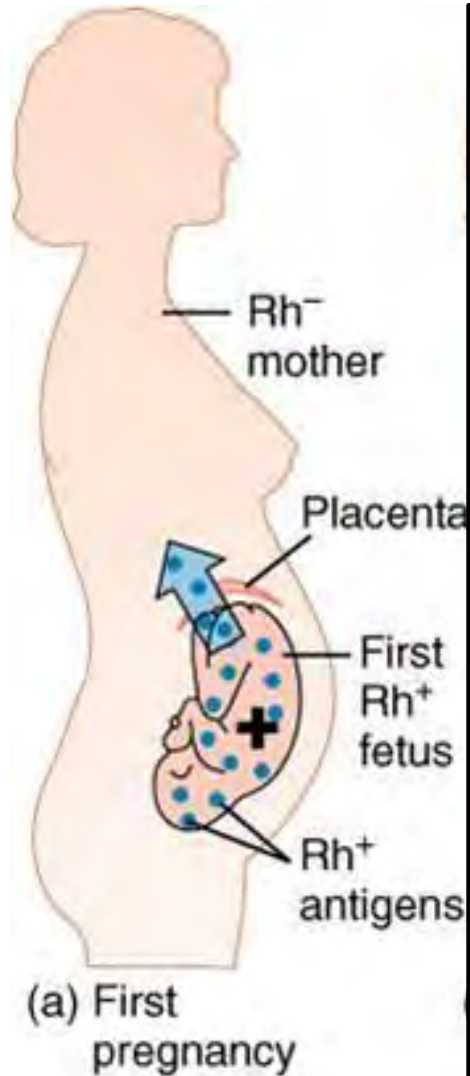
Erythroblastosis Fetalis?

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

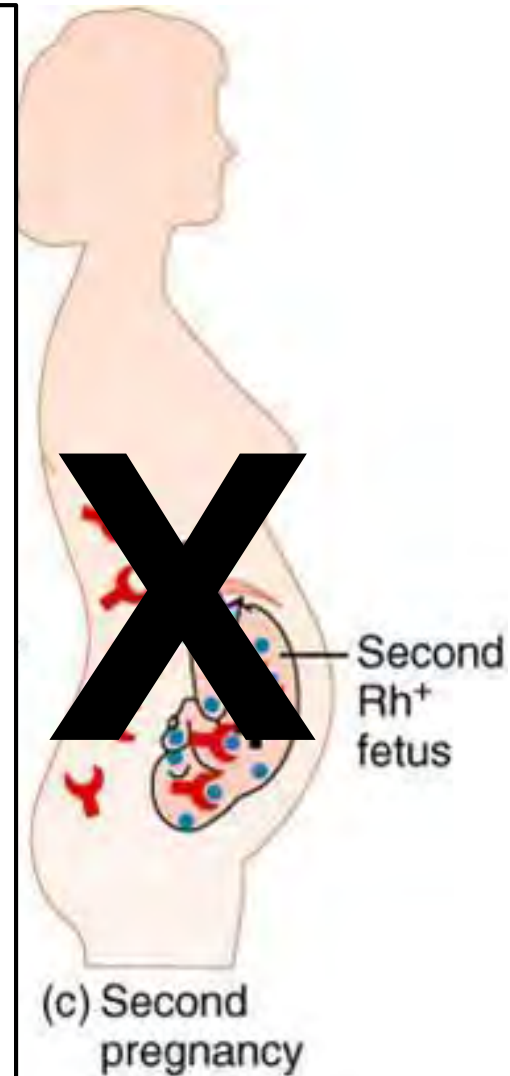
<https://www.nlm.nih.gov/medlineplus/rhincompatibility.html>

[http://www.nlm.nih.gov/MEDLINEPLUS/ency/article/001298
.htm#Alternative%20Names](http://www.nlm.nih.gov/MEDLINEPLUS/ency/article/001298.htm#Alternative%20Names)

Erythroblastosis Fetalis or Hemolytic Disease of the Unborn/Newborn



***Throw
Blanket
Over
This
Step!***



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



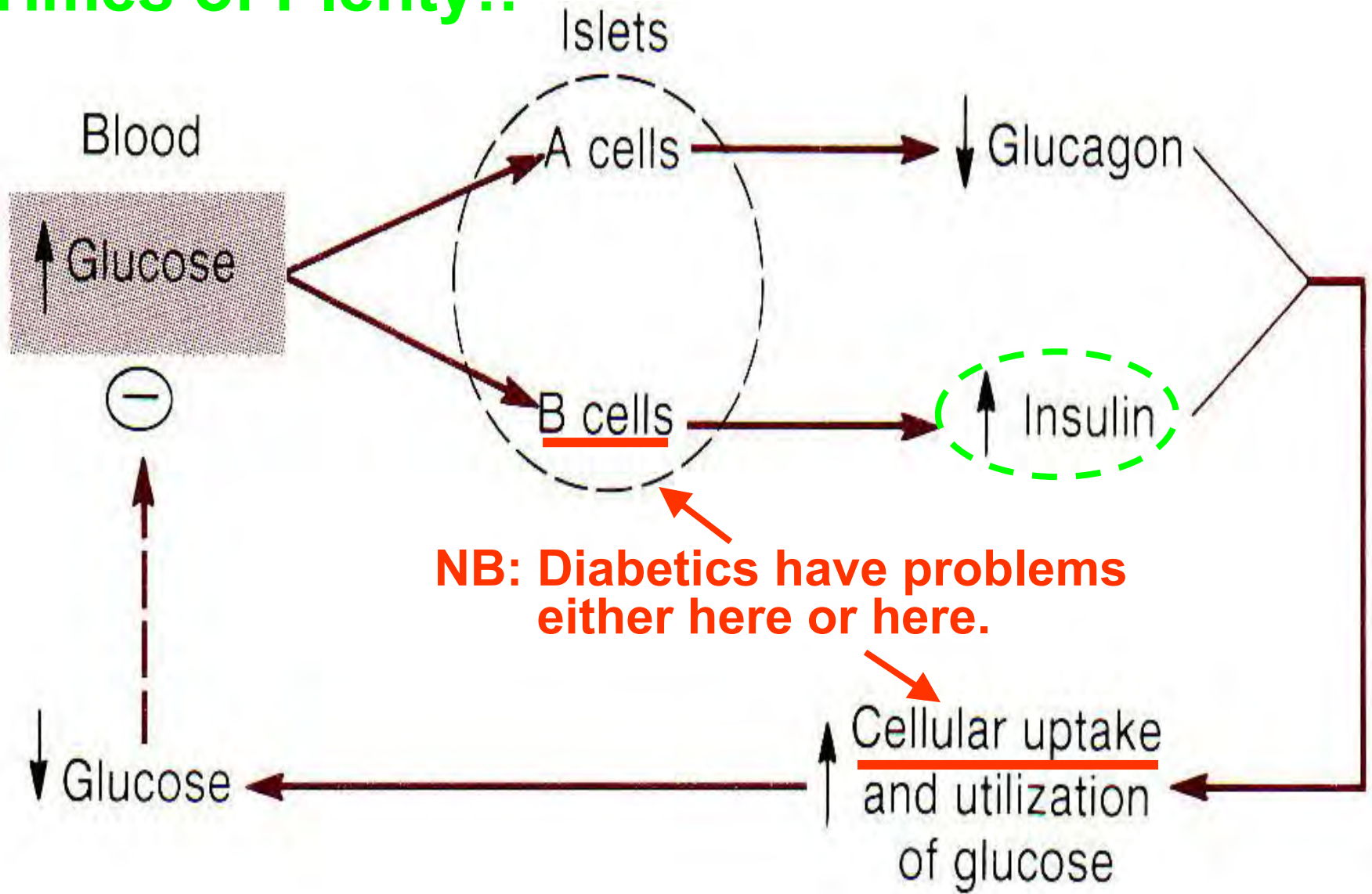
**The Blanket is RhoGam → Masks
the Mom's Immune System!**

Glucose:
Sugar in Blood



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

Times of Plenty!!



NB: Diabetics have problems either here or here.

Type 1 and Type 2 Diabetes Compared

| | Type 1 | Type 2 |
|----------------------------|---|--|
| Percentage of cases | 5–10% | 90–95% |
| Age of onset | <30 years | >40 years ^a |
| Associated characteristics | Autoimmune diseases, viral infections, inherited factors | Obesity, aging, inherited factors |
| Primary problems | Destruction of pancreatic beta cells; insulin deficiency | Insulin resistance, insulin deficiency (relative to needs) |
| Insulin secretion | Little or none | Varies; may be normal, increased, or decreased |
| Requires insulin | Always | Sometimes |
| Older names | Juvenile-onset diabetes Insulin-dependent diabetes mellitus (IDDM) | Adult-onset diabetes Noninsulin-dependent diabetes mellitus (NIDDM) |

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

BI 121 Lecture 10

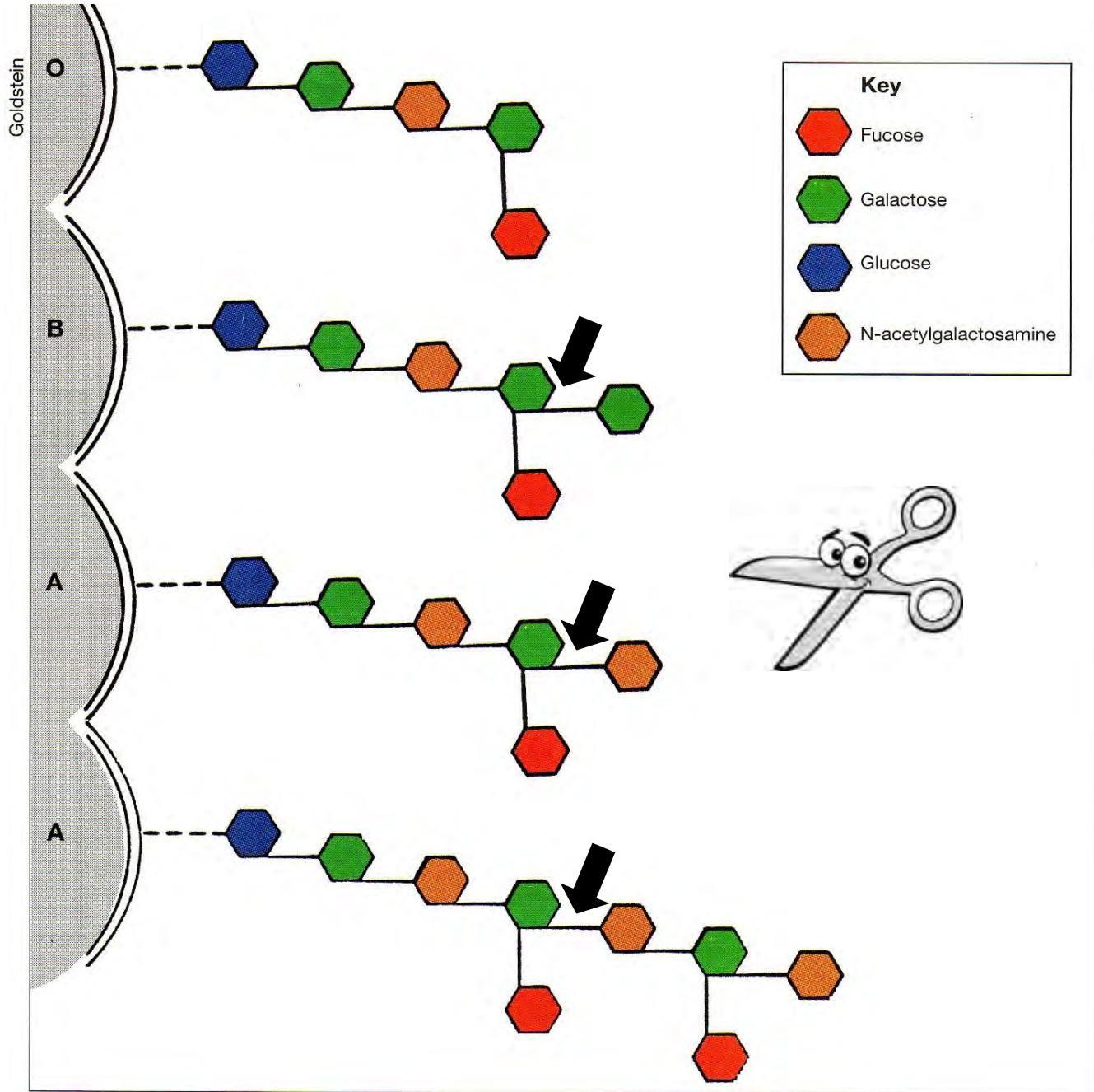


...This Thursday more fun & data about me! Heck yeah!!

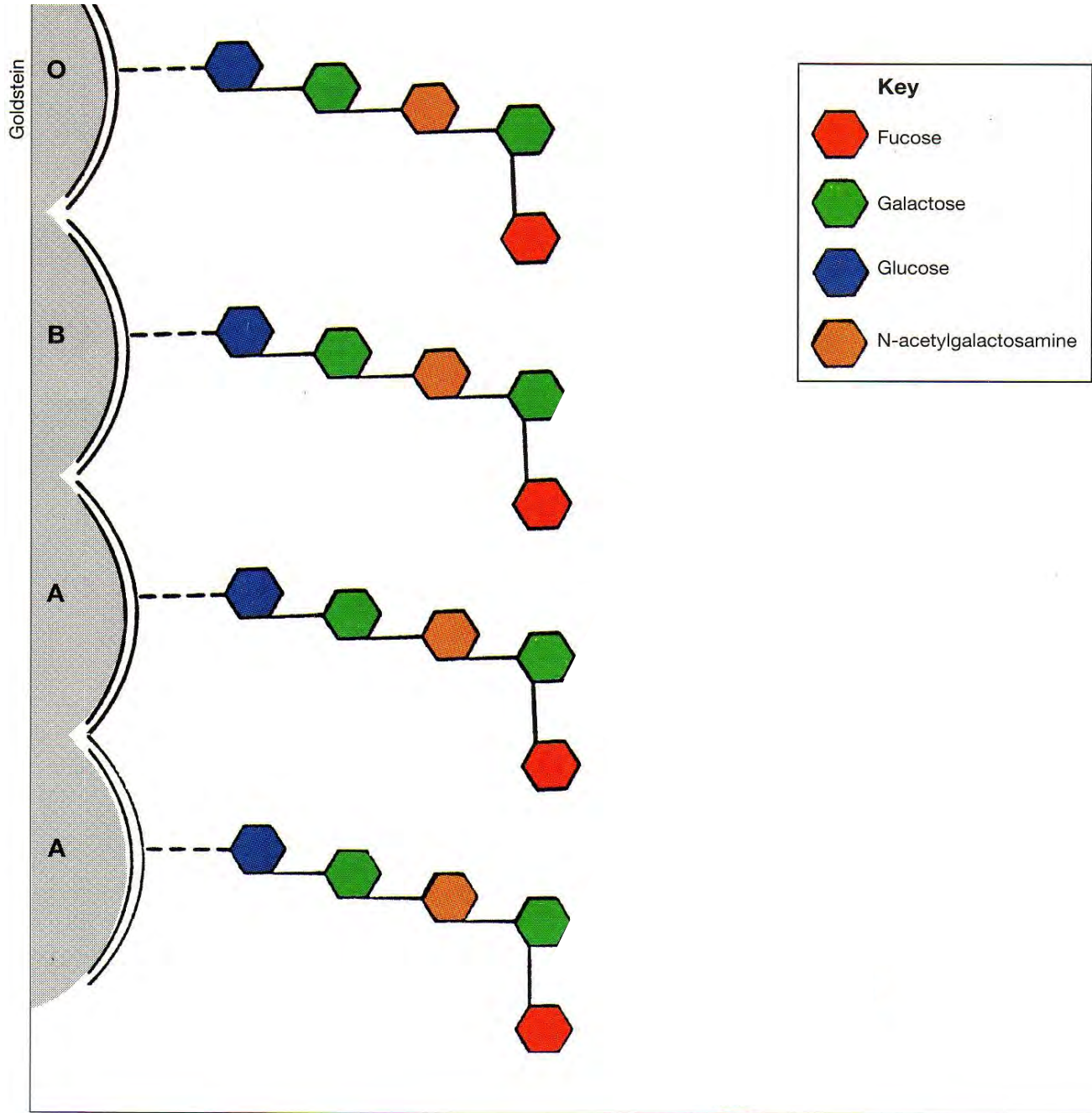
- I. Announcements** To make Lab 5 educational, fun & safe for all, **please read pp 5-1 thru 5-6 in LM twice before Thursday!** Remaining exams & notebooks returned > lecture. Key posted in glass box in Huestis near 120 HUE. Estimate grade? Q?
- II. Blood Chemistry Review** LS ch 11 + 17, DC Module 5, Q?
- 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**

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





All like Type O!



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



T = 0, near normal

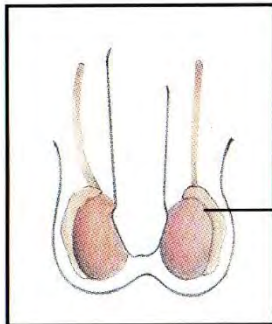


T = 4 months later

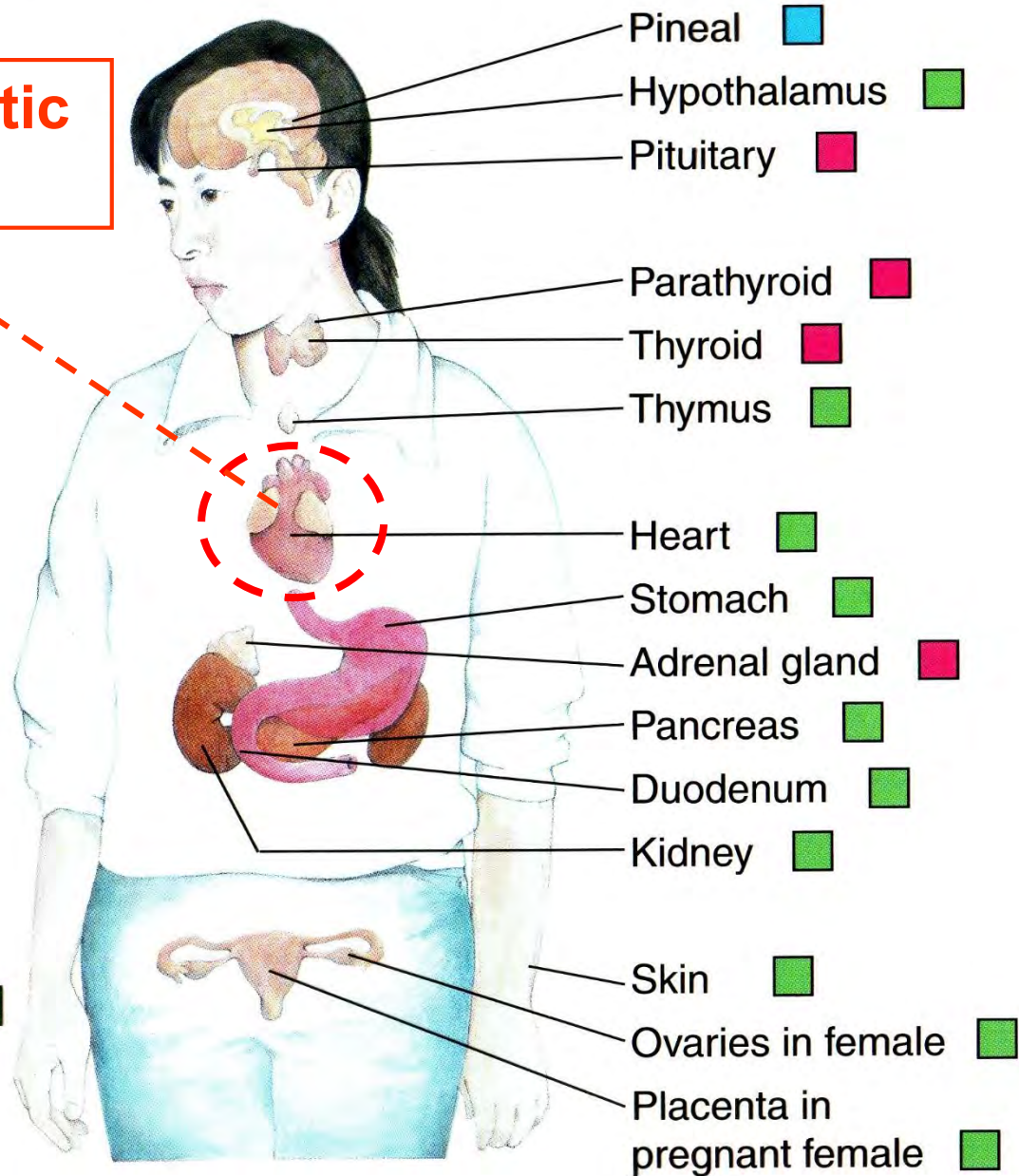
Endocrine System

ANP = Atrial Natriuretic Polypeptide

- Solely endocrine function
- Mixed function
- Complete function uncertain



Testes in male



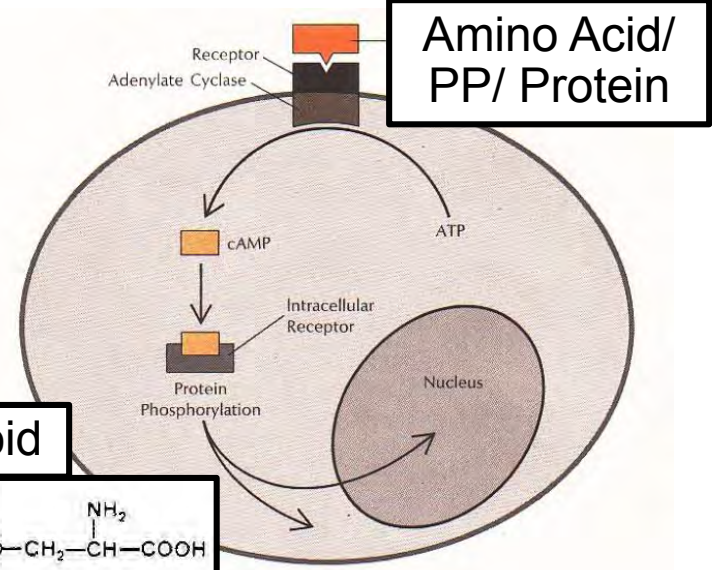
- Pineal ■
- Hypothalamus ■
- Pituitary ■
- Parathyroid ■
- Thyroid ■
- Thymus ■
- Heart ■
- Stomach ■
- Adrenal gland ■
- Pancreas ■
- Duodenum ■
- Kidney ■
- Skin ■
- Ovaries in female ■
- Placenta in pregnant female ■

Hormone/Endocrine Classifications?

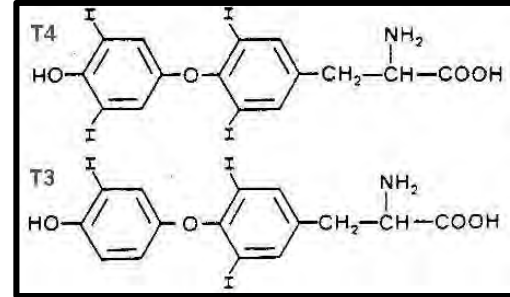
Exogenous



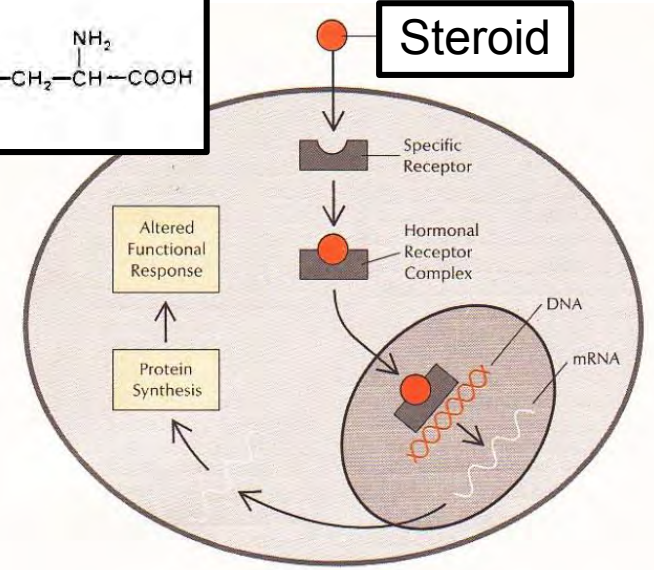
Endogenous



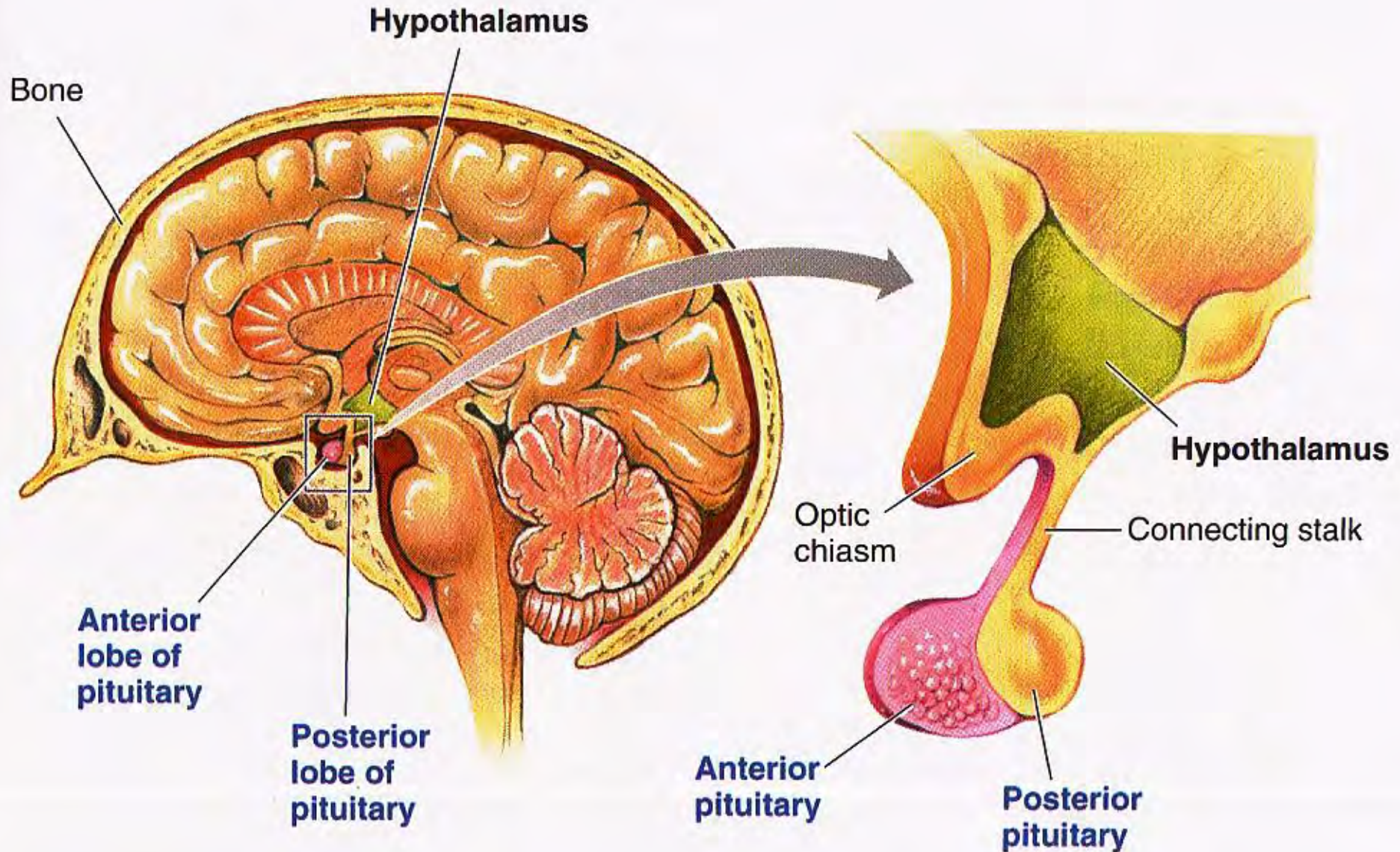
Thyroid



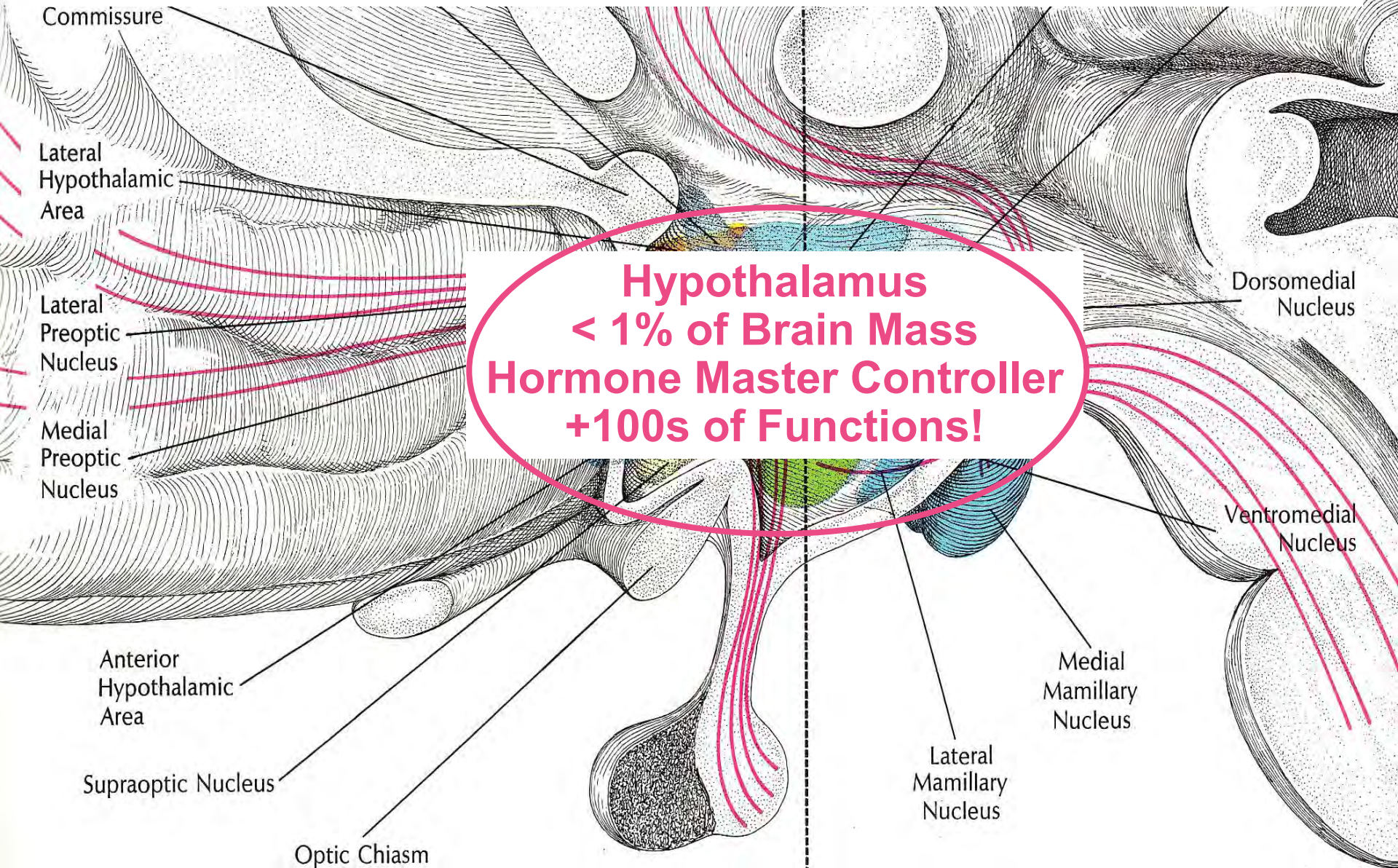
Steroid

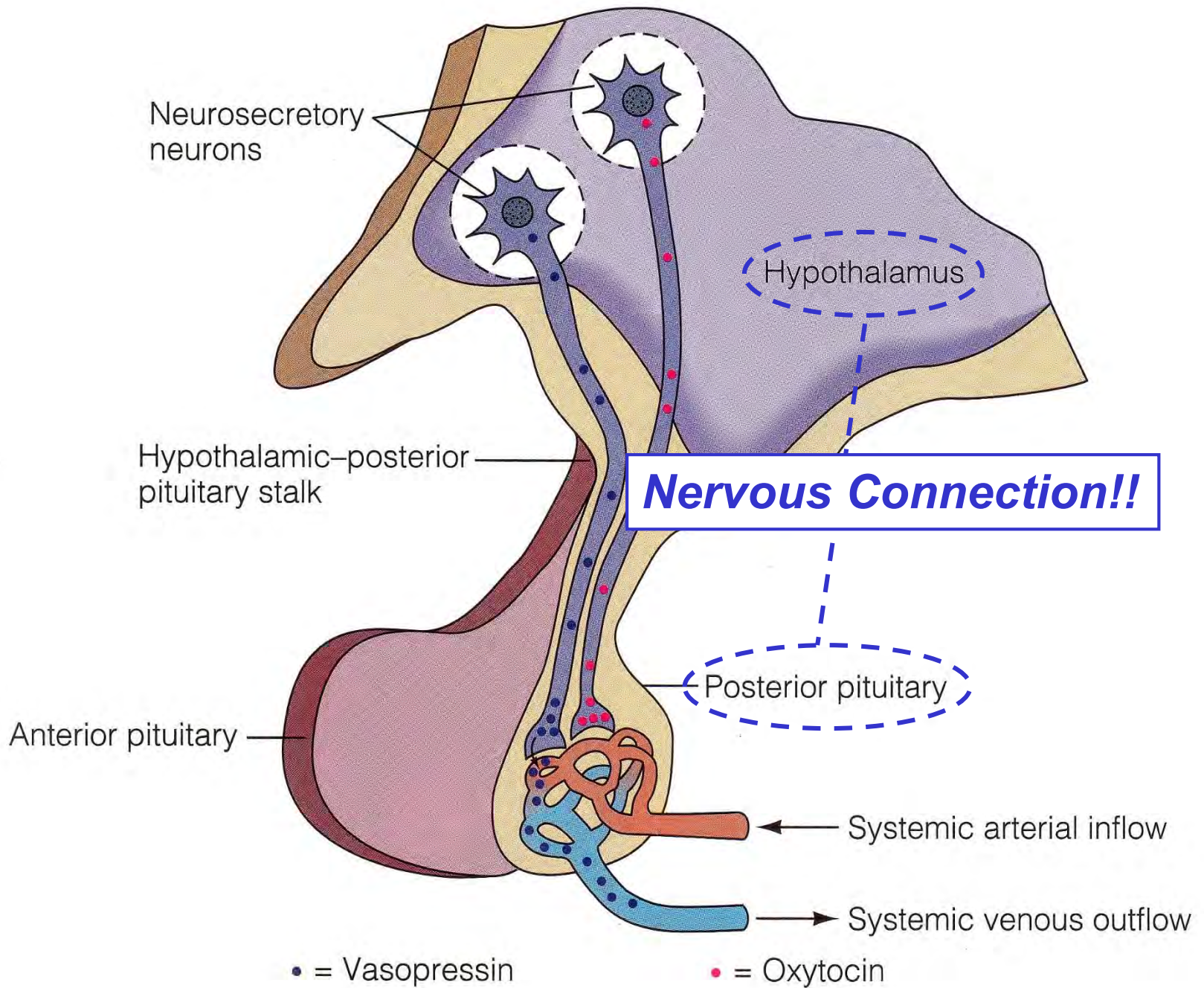


Hypothalamus & Pituitary: Intimate Relationship

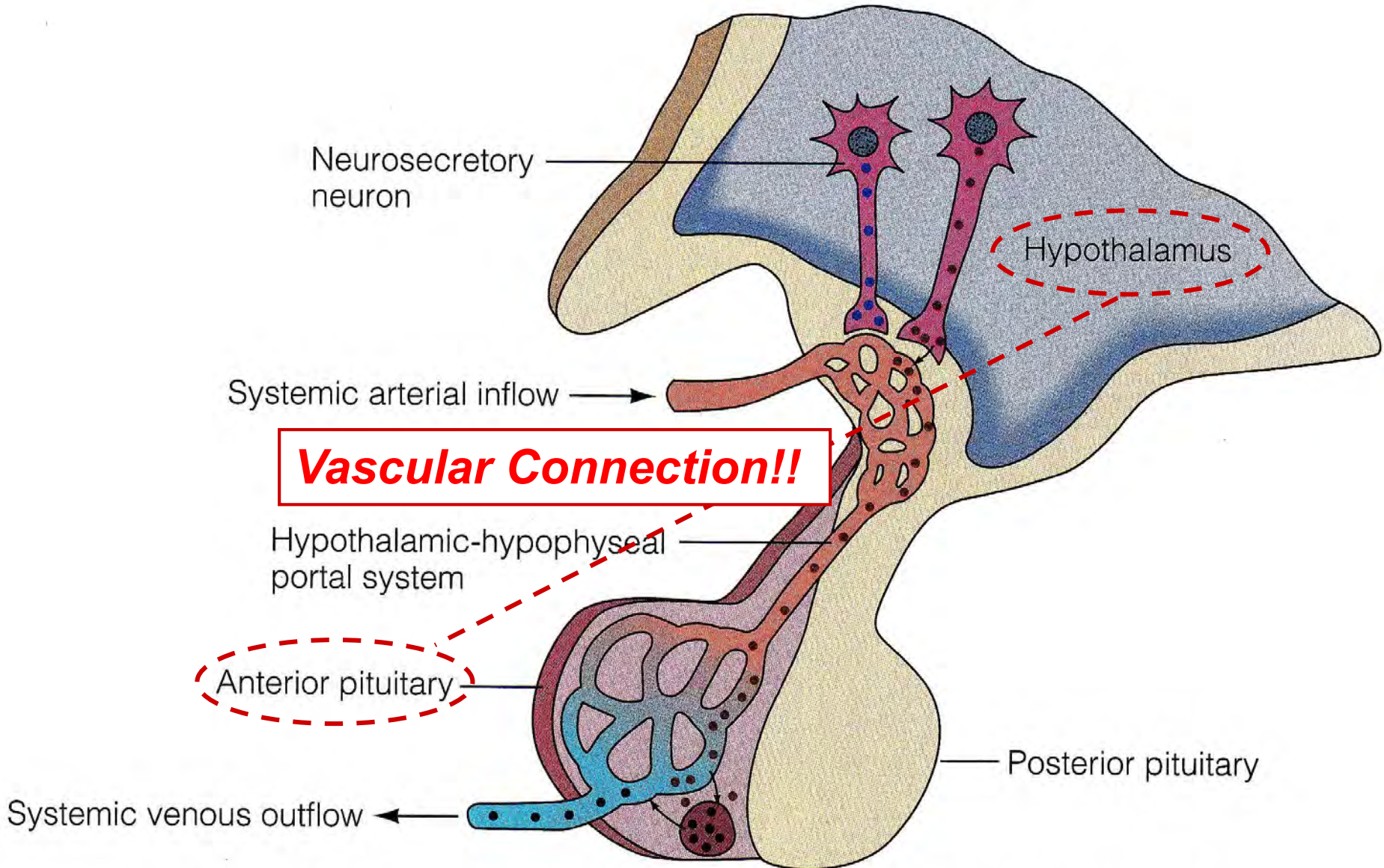


Good Things Come in Small Packages!



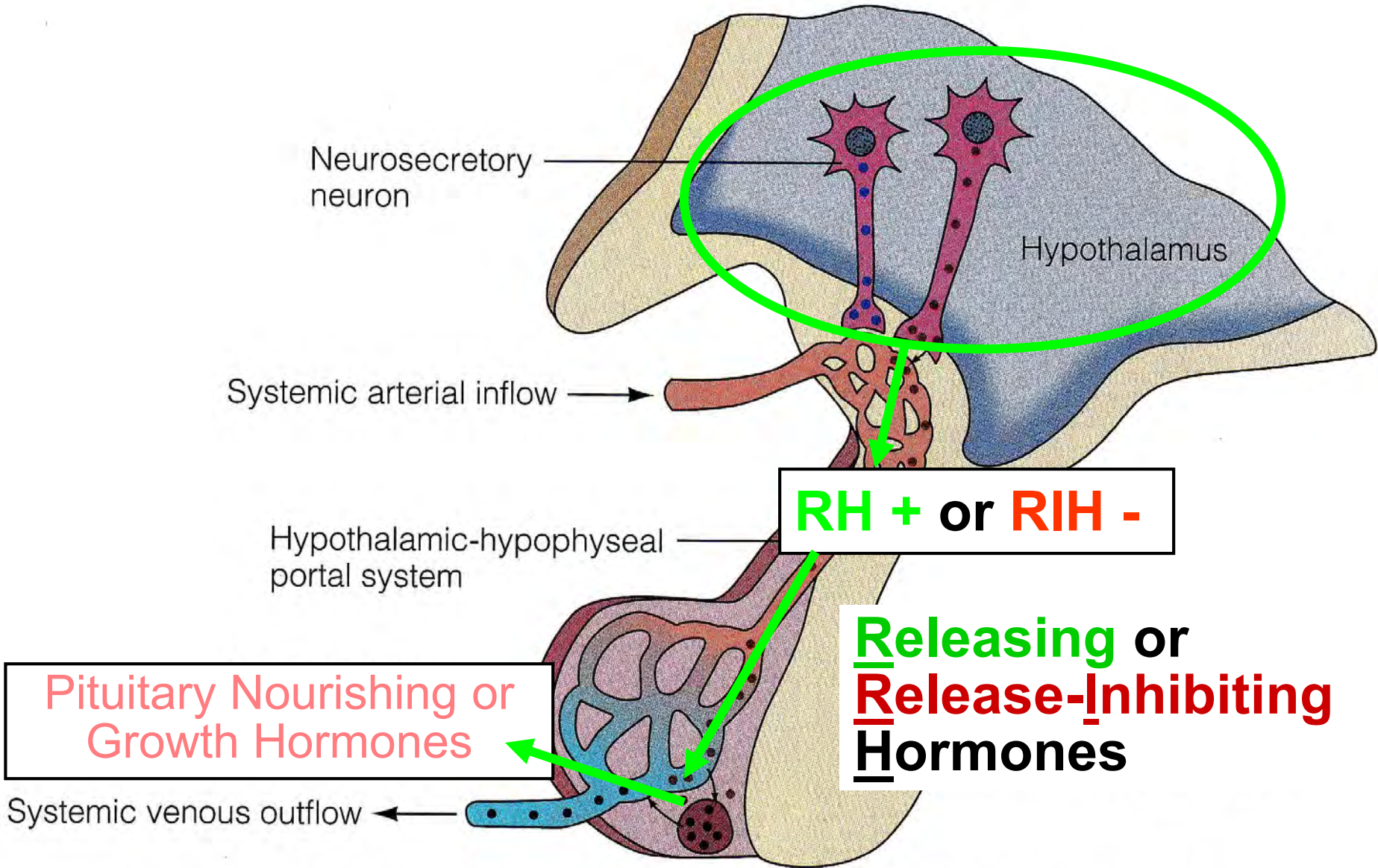


Hypothalamus-Anterior Pituitary Vascular Connection!



• = Hypophysiotropic hormones

• = Anterior pituitary hormone



RH + or RIH -

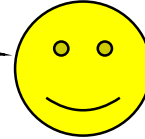
Releasing or Release-Inhibiting Hormones

Pituitary Nourishing or Growth Hormones

- = Hypophysiotropic hormones
- = Anterior pituitary hormone

Hypophysis ≡ Pituitary

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**

A. Hypothalamus-Anterior pituitary intimate circulation

B. Anterior pituitary hormones DC pp 105-7, LS pp 502-6

C. GH: Body builder's dream? Fountain of youth?

LS pp 506-11

D. Peripheral endocrine organs

DC pp 109-13, LS pp 513-36

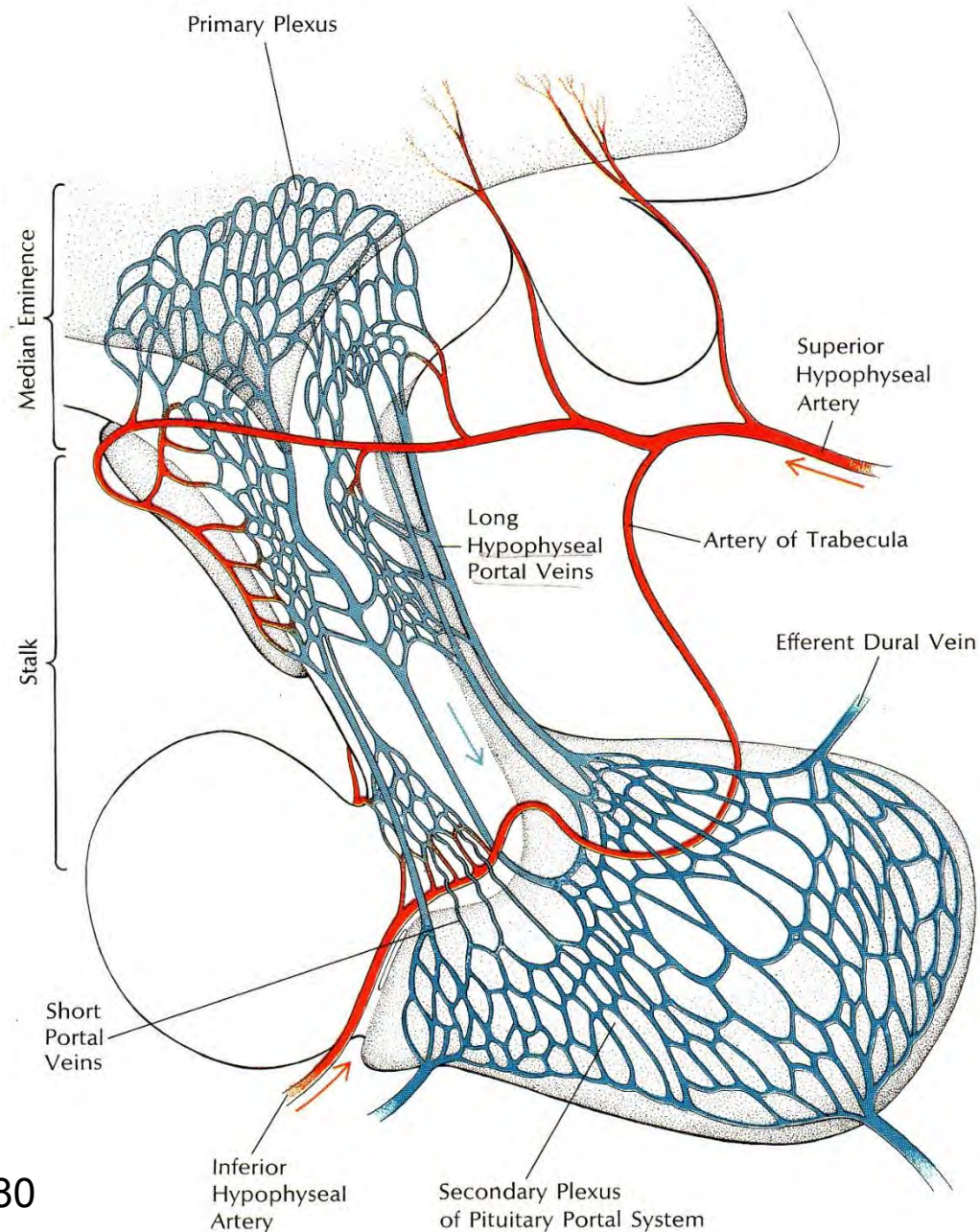
1. Pancreas (insulin – glucagon see-saw!)

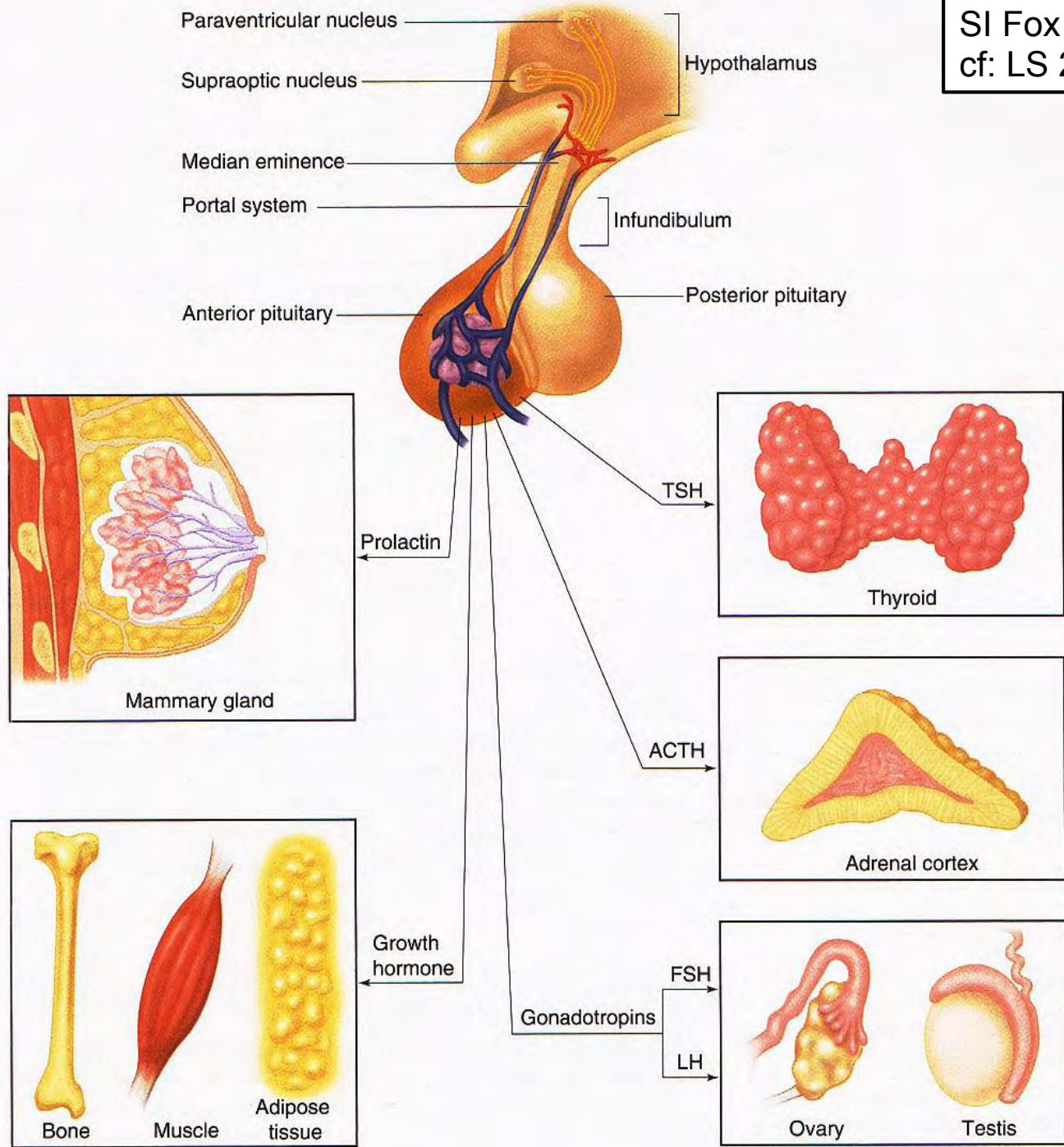
2. Thyroid

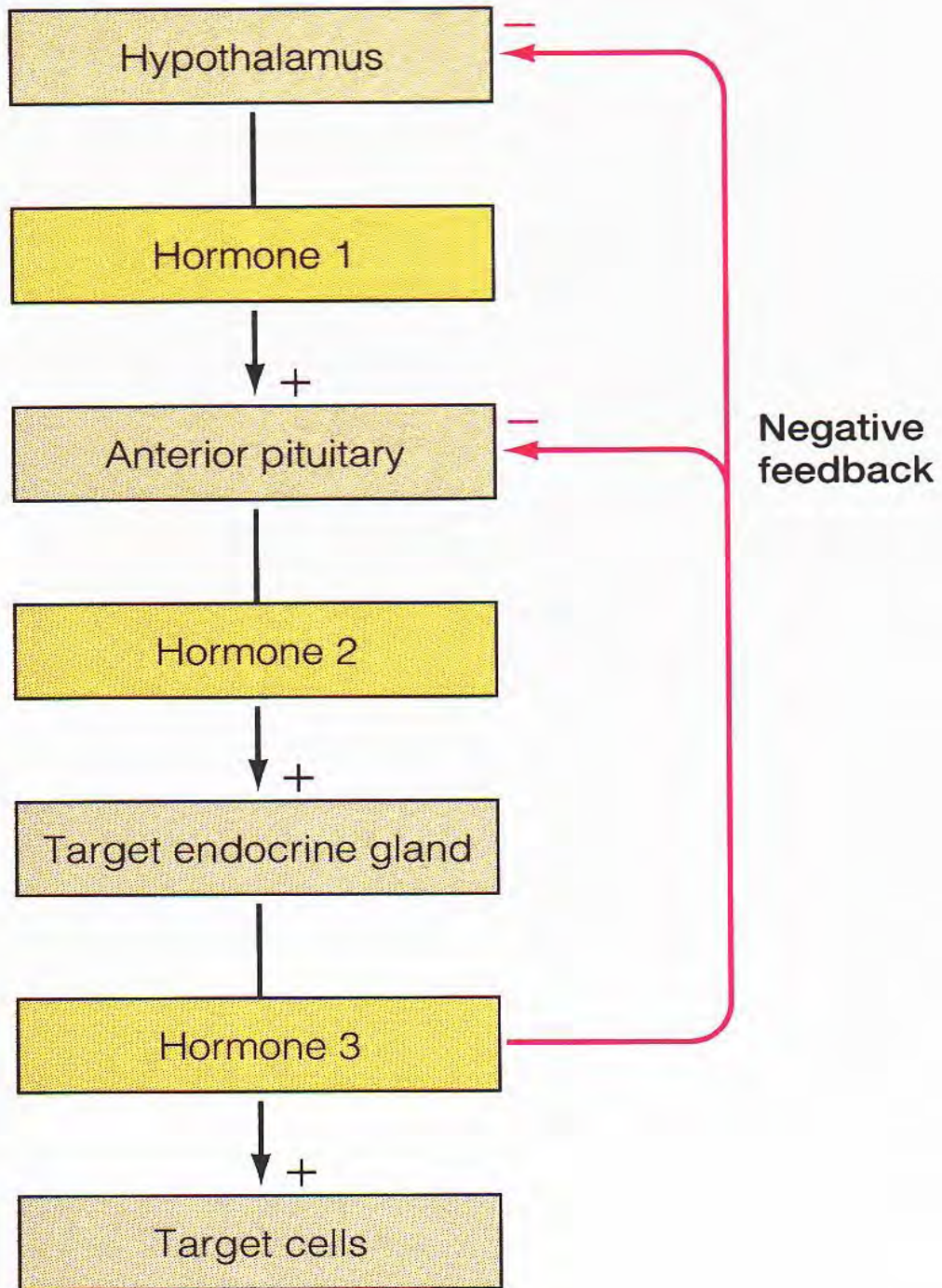
3. Adrenals

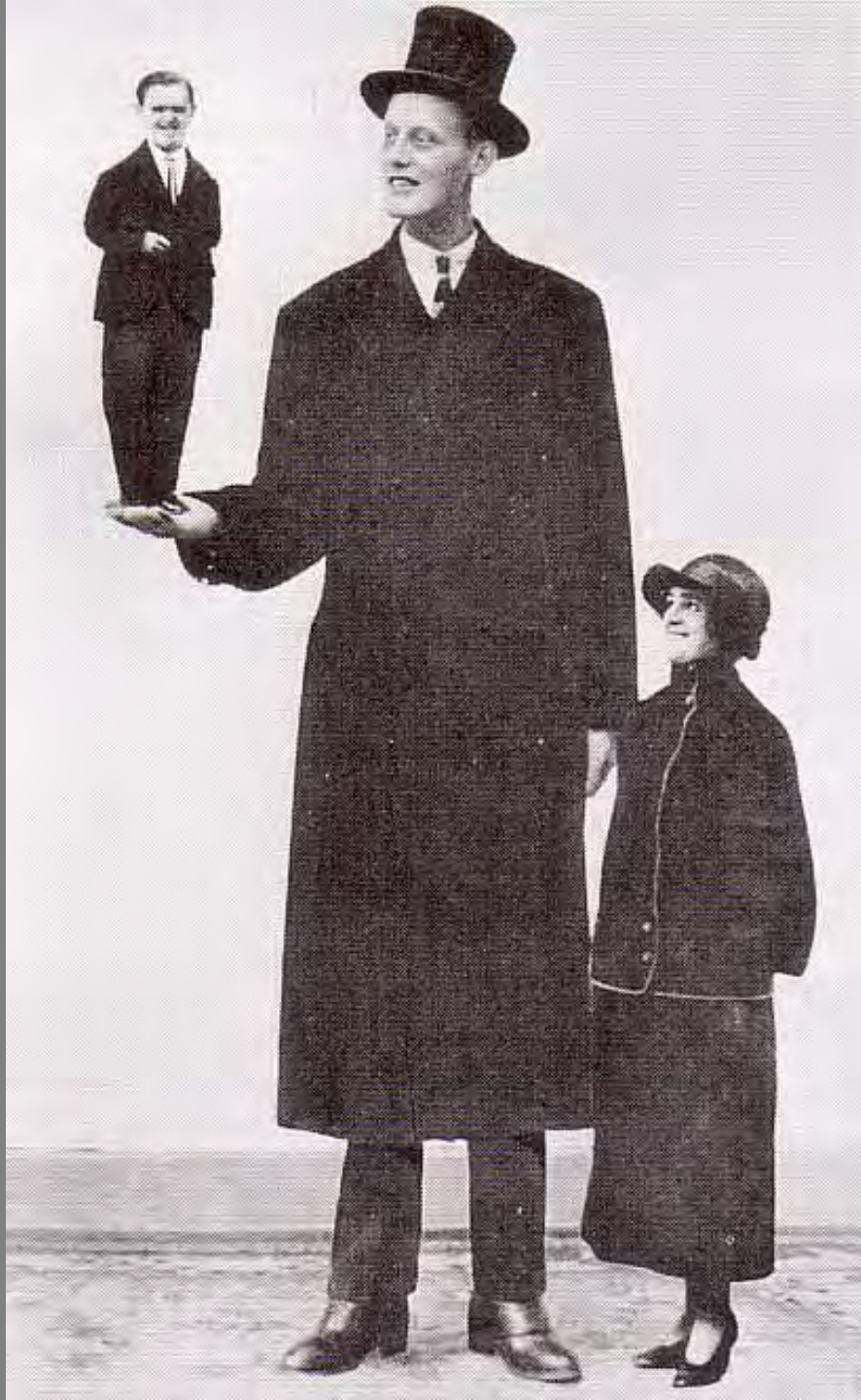
IV. **Introduction to the Nervous System** LS ch 5, DC Module 9

Capillary-Venule-Capillary Intimate Circulation

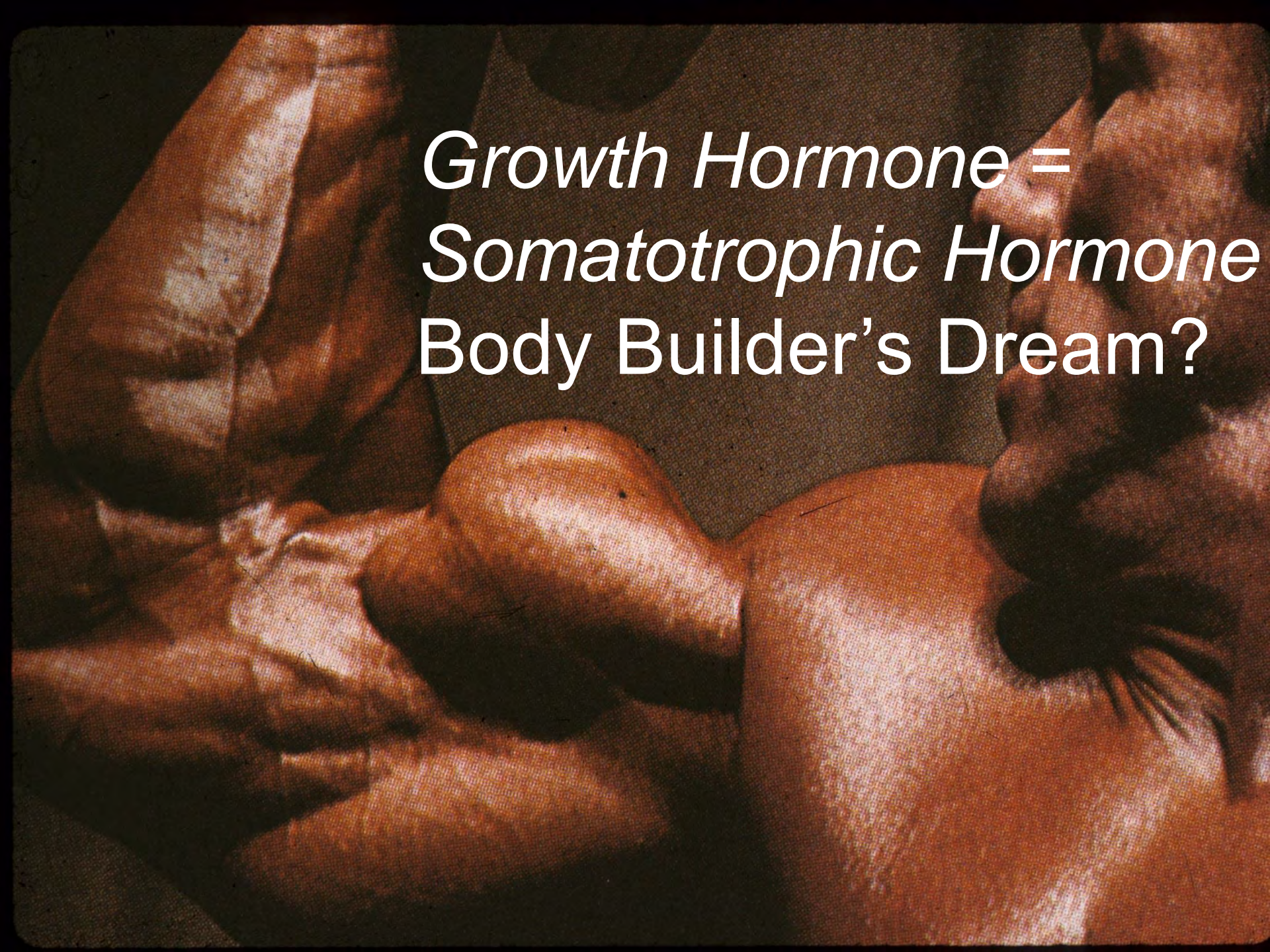








LS 2006, cf: LS 2012
fig 17-10



*Growth Hormone =
Somatotrophic Hormone
Body Builder's Dream?*

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

↑ Amino Acid uptake & Protein synthesis

↑ Lipolysis & Fatty Acid mobilization

↓ Glucose uptake
(skeletal muscle & adipocytes)

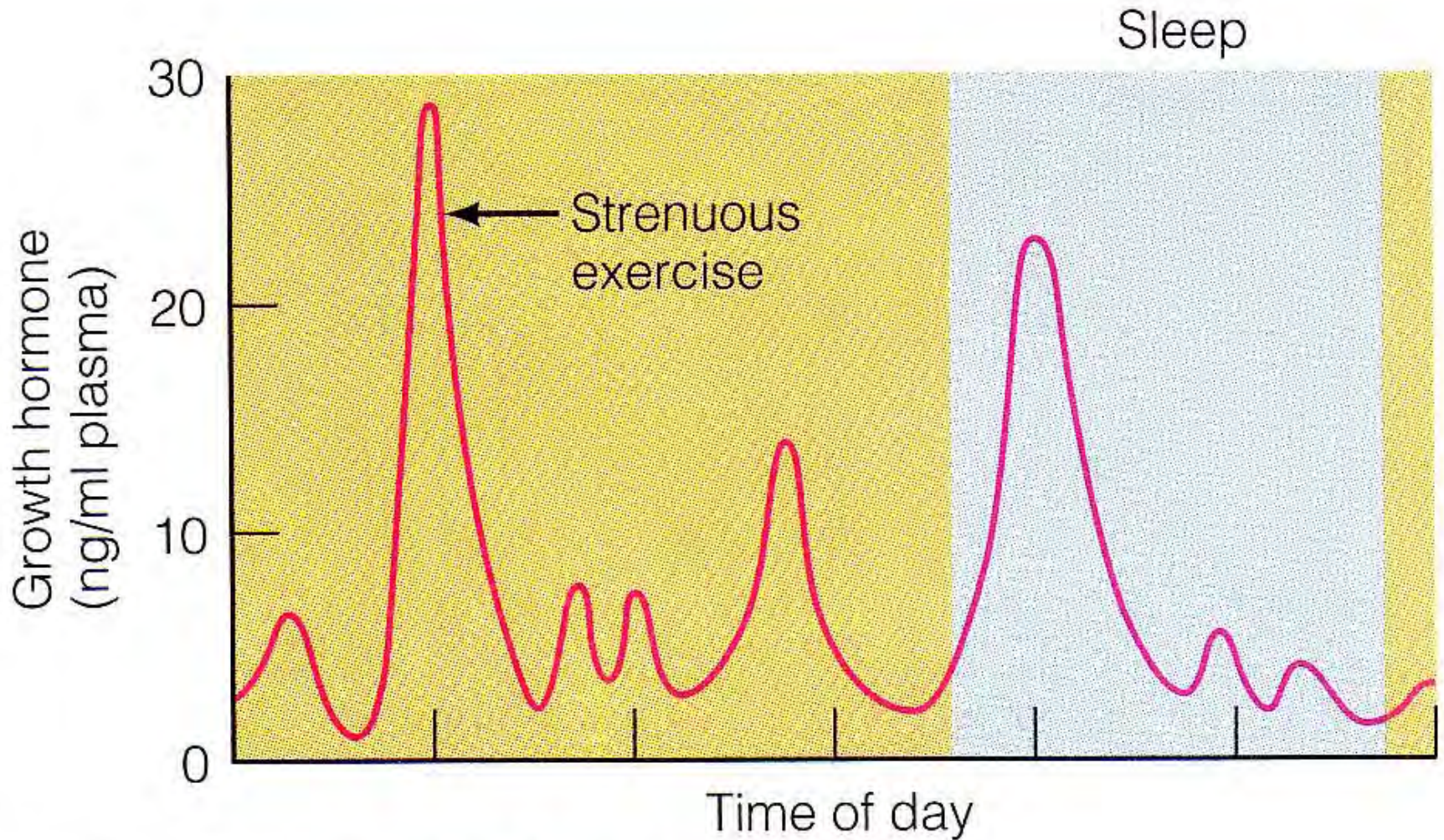
↑ Glucose production
(liver glycogenolysis)

↑ Insulin secretion

Mismatch!!

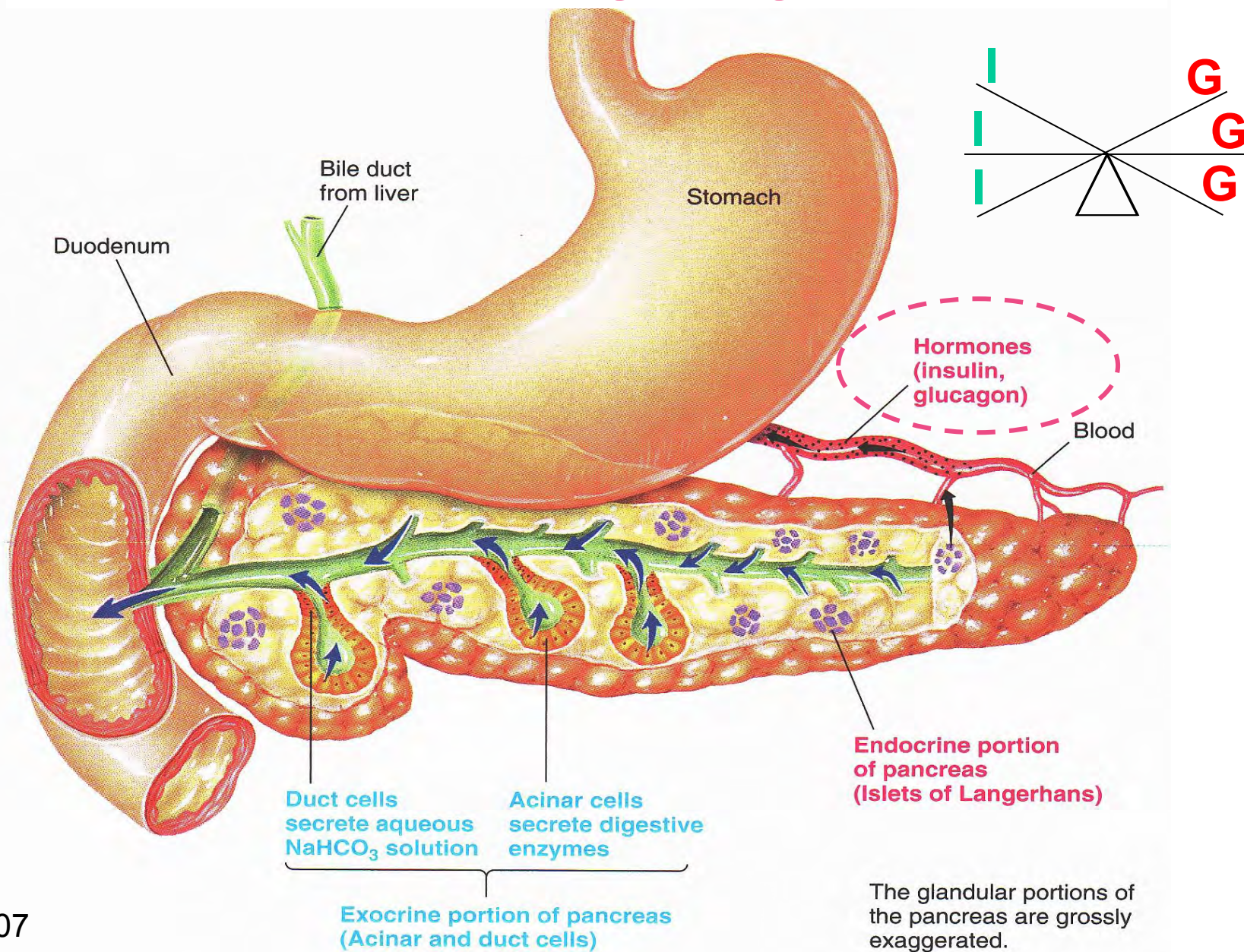


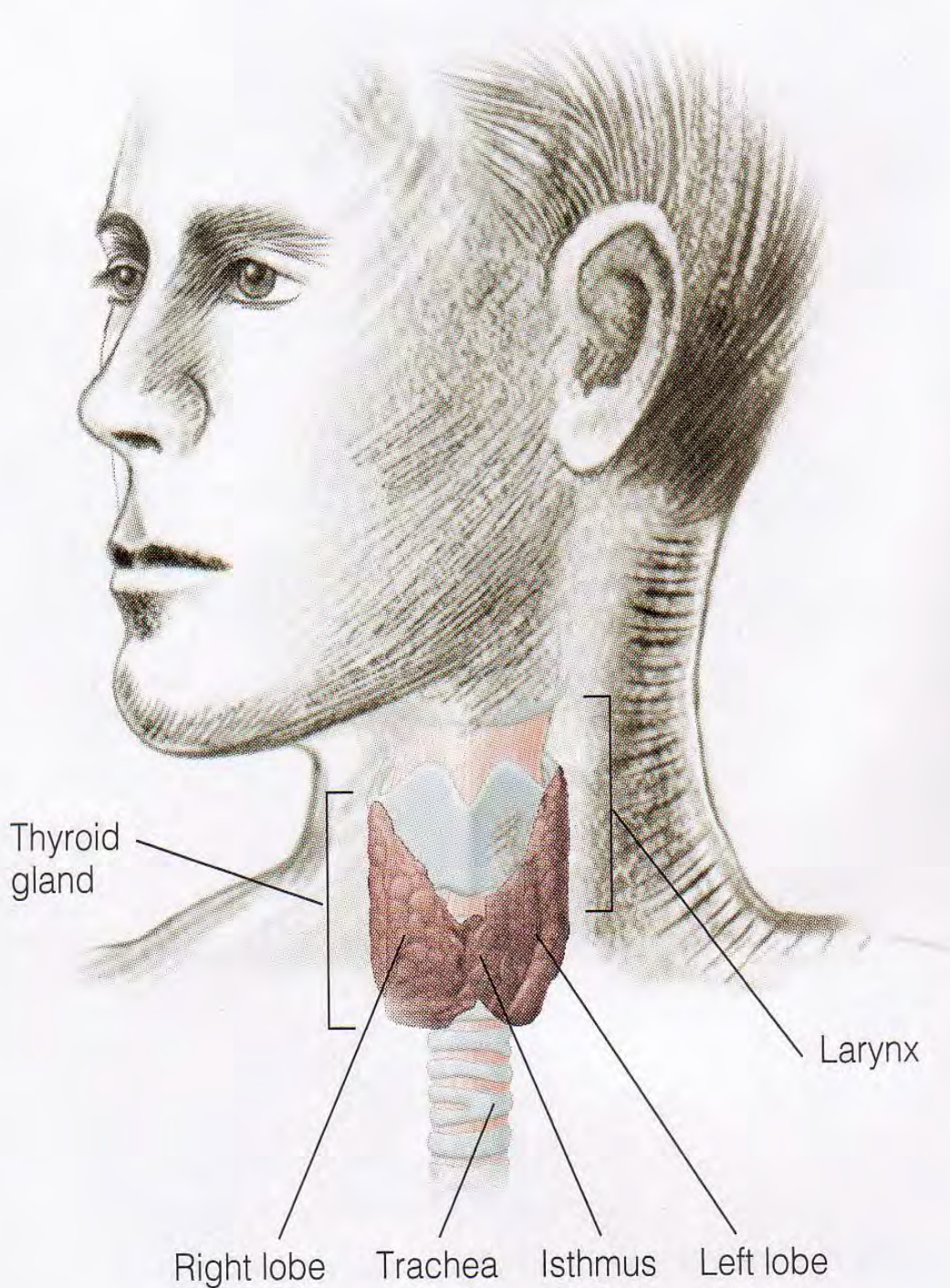
Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per milliliter

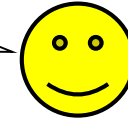
Endocrine Pancreas: Insulin (I) & Glucagon (G) See-Saw Hormones in Regulating Blood Glucose





BI 121 Lecture 12

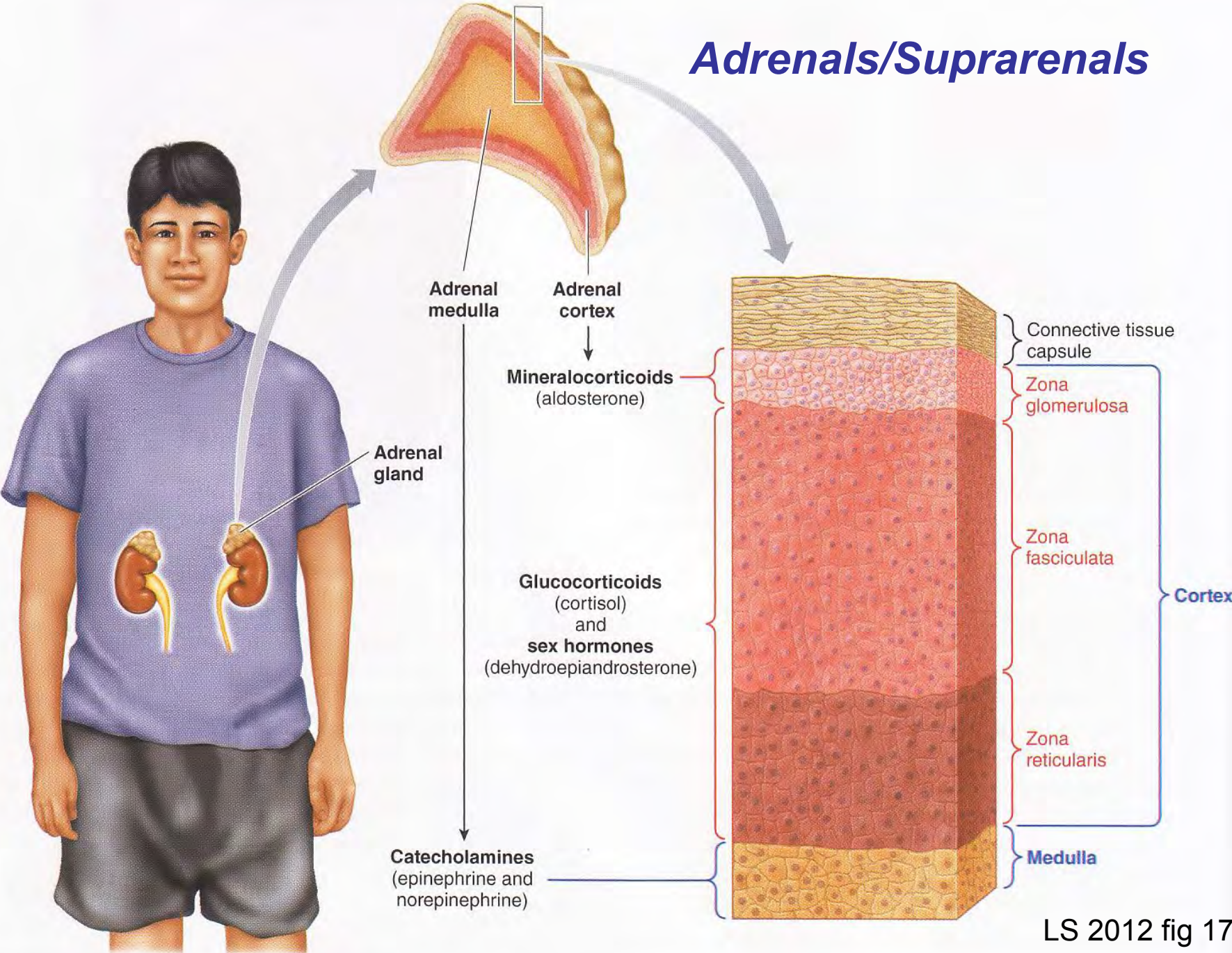
Thanks to you, Katie, Kelsey,
Steph, Janelle & Patrick!



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, Thurs, 8 am!
- II. Endocrine Connections** Peripheral Endocrine Organs...
Adrenals. Q? DC Module 13 p 109-13, LS ch 17 pp 513-36
- 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!

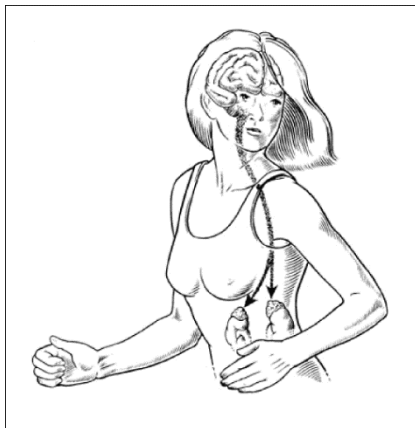
Adrenals/Suprarenals



BI 121!!



Epinephrine
80%
Norepinephrine
20%



Guyton & Hall 2000

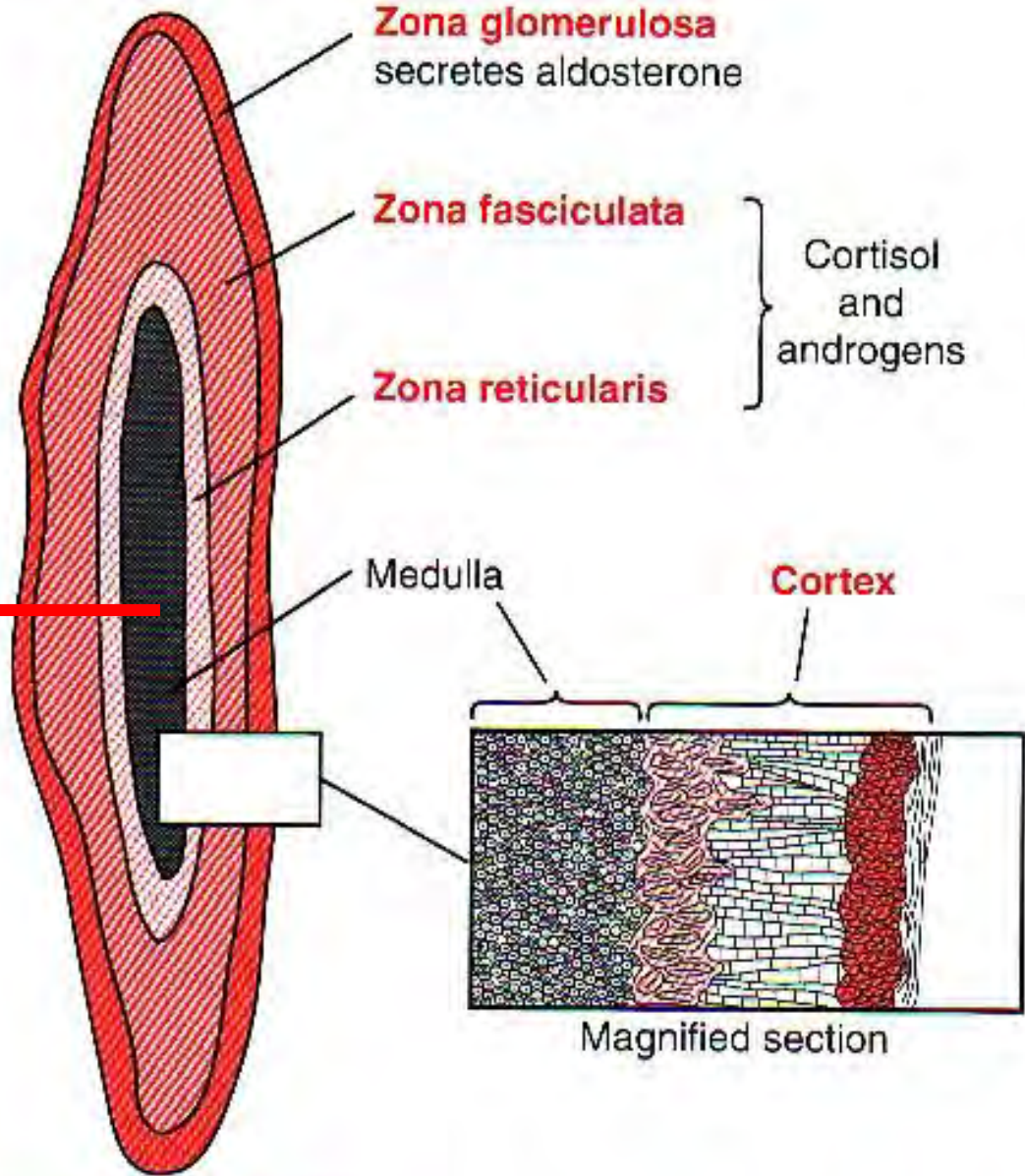
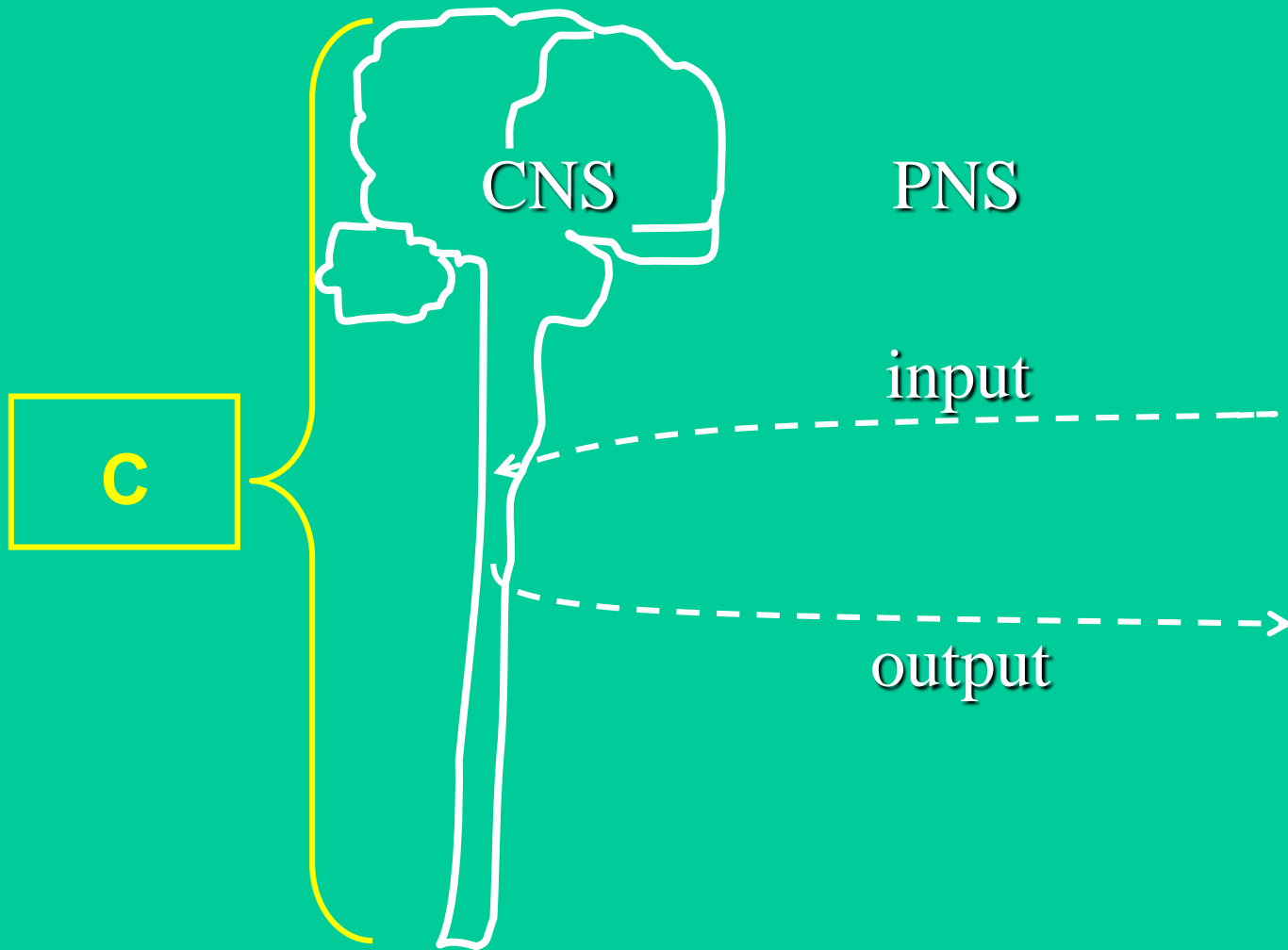
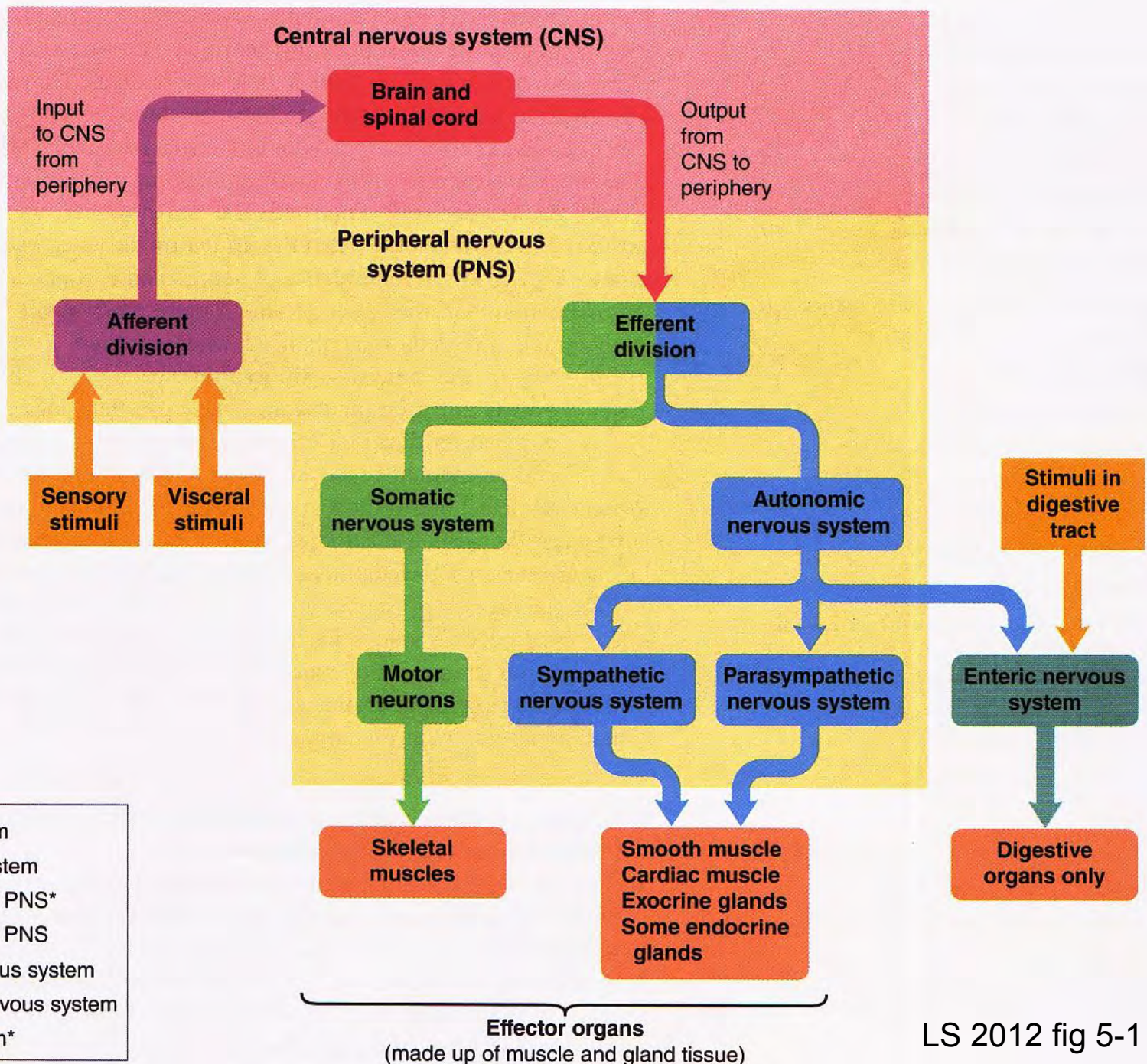
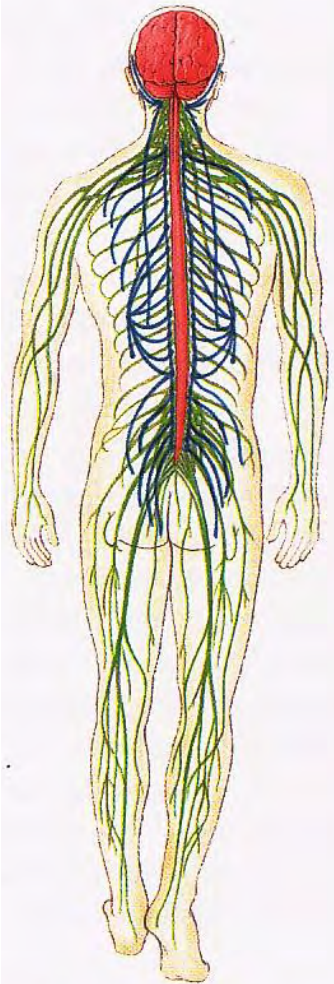


FIGURE 77 - 1

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

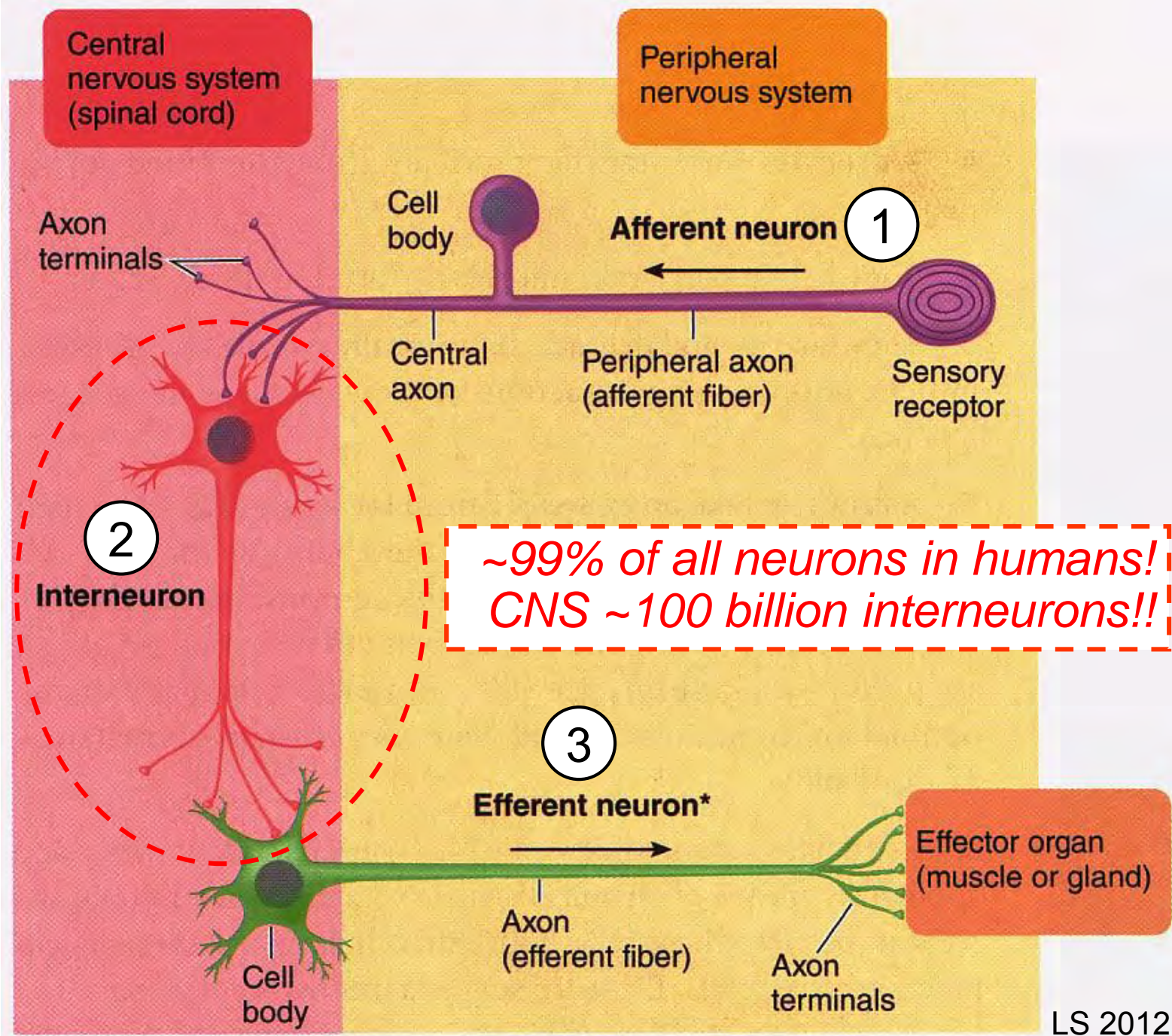
Nervous System



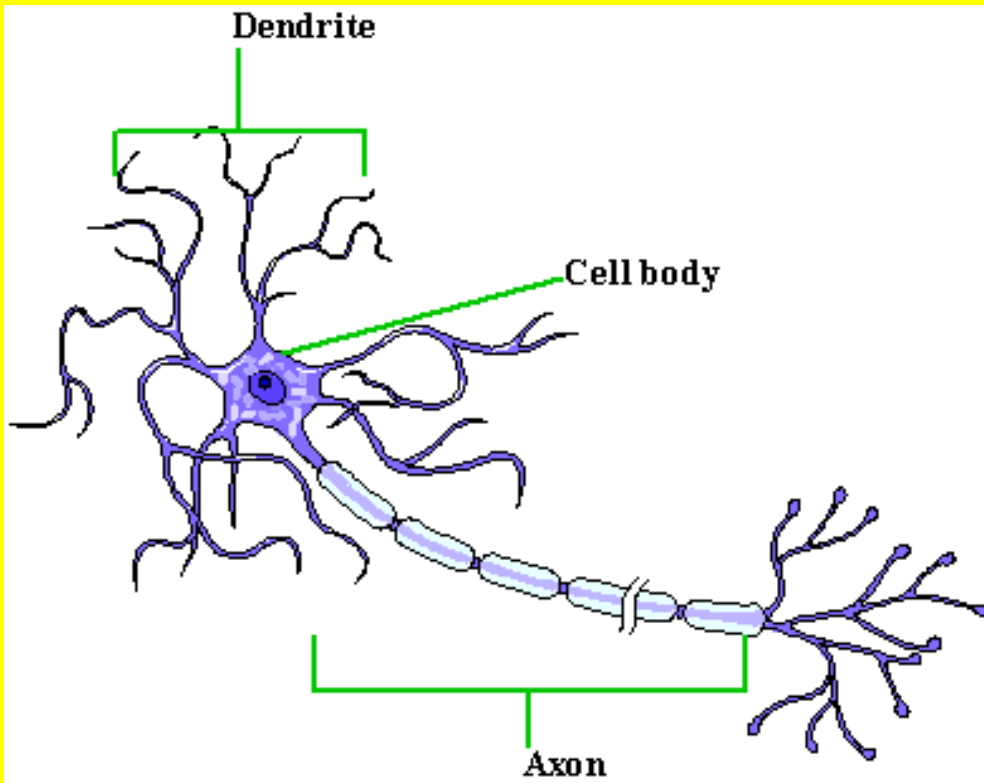


KEY

- Central nervous system
- Peripheral nervous system
- Afferent division of PNS*
- Efferent division of PNS
- Somatic nervous system
- Autonomic nervous system
- Enteric nervous system*

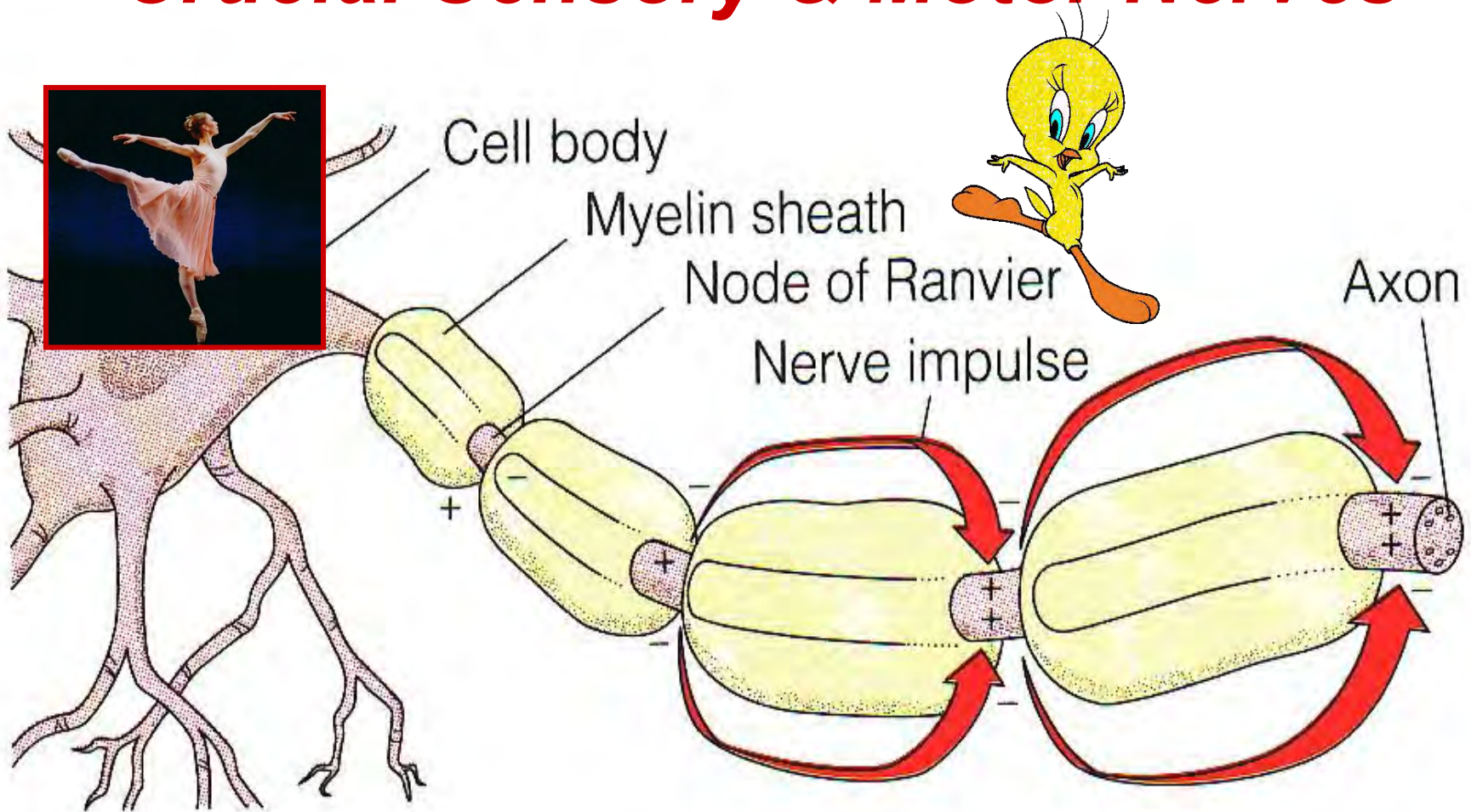


What is myelin? Why is it important?

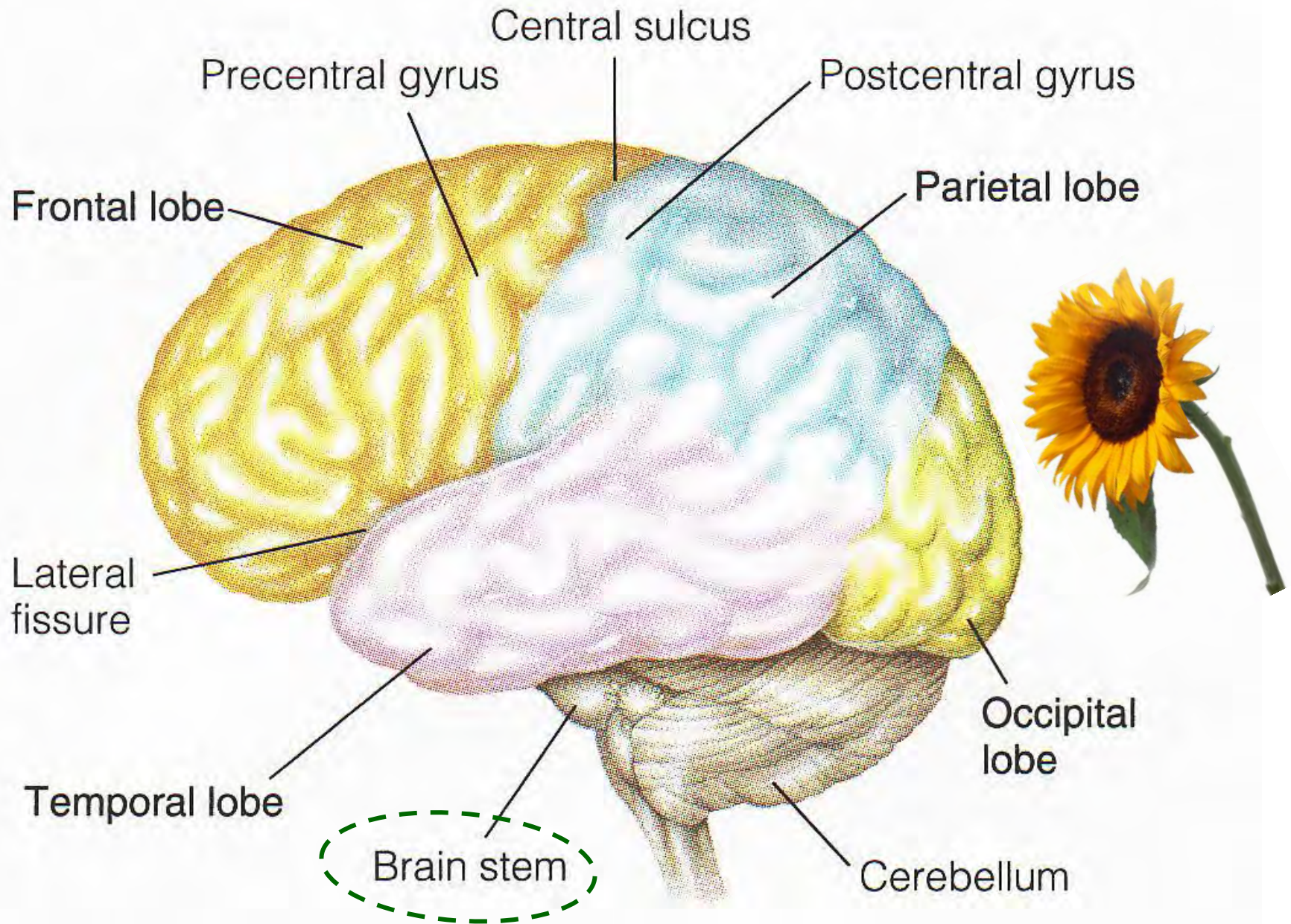


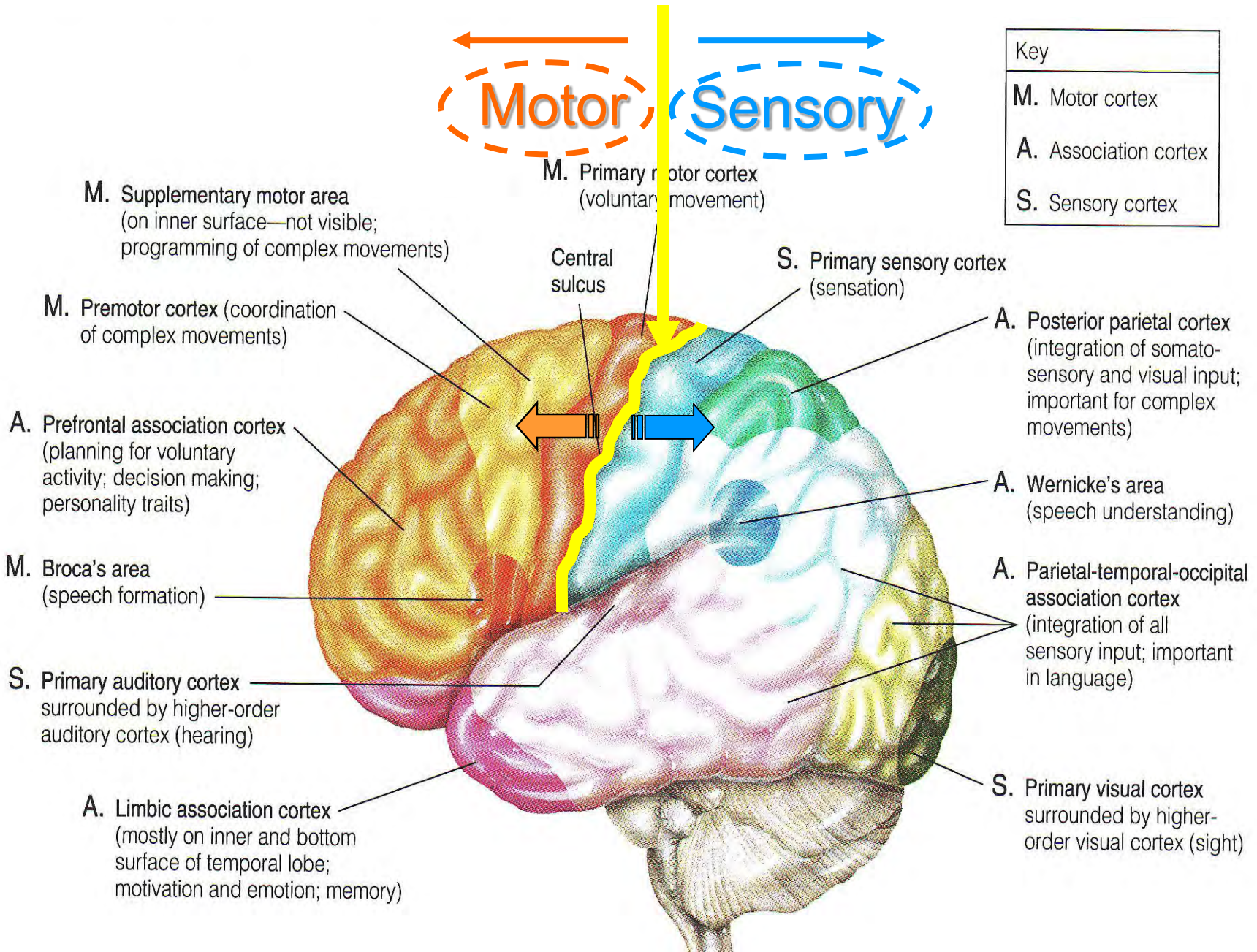
Lipid insulative coat
 $\uparrow \vec{v}$, *conserves ions & ATP*

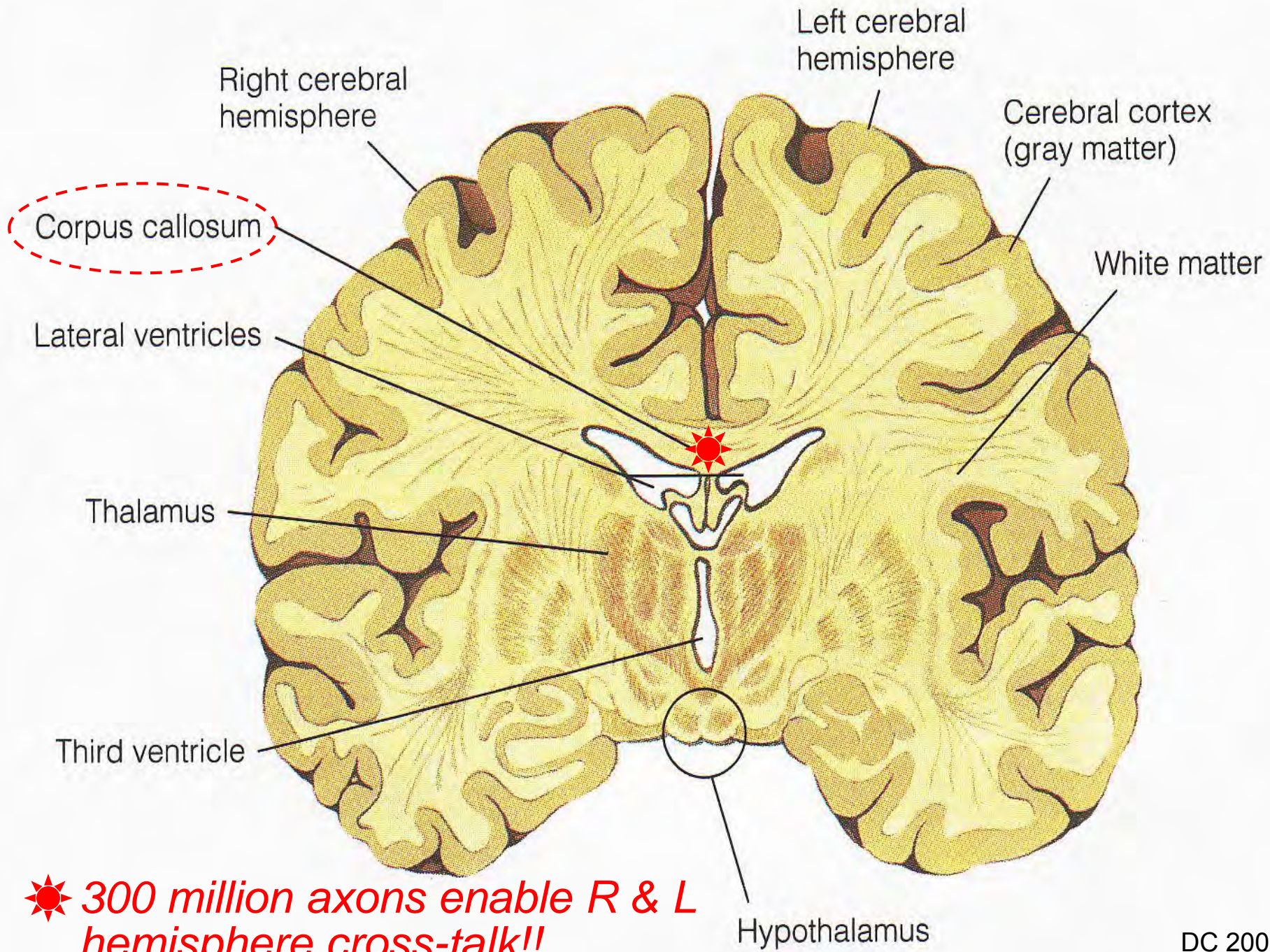
Saltatory/Leaping Conduction! *Crucial Sensory & Motor Nerves*



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







★ 300 million axons enable R & L hemisphere cross-talk!!



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

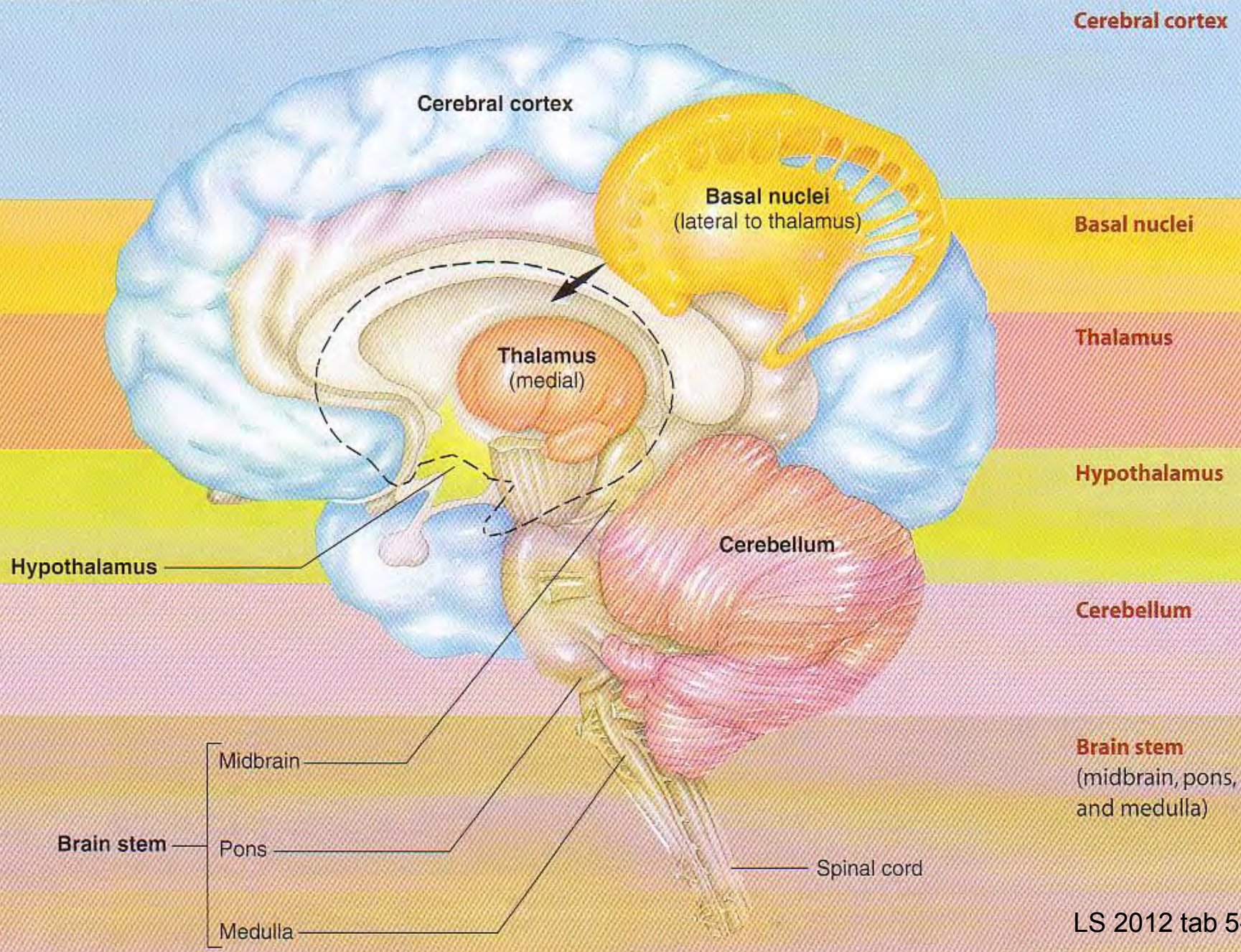
B. Why are nerve & muscle unique? ch 4 p 71

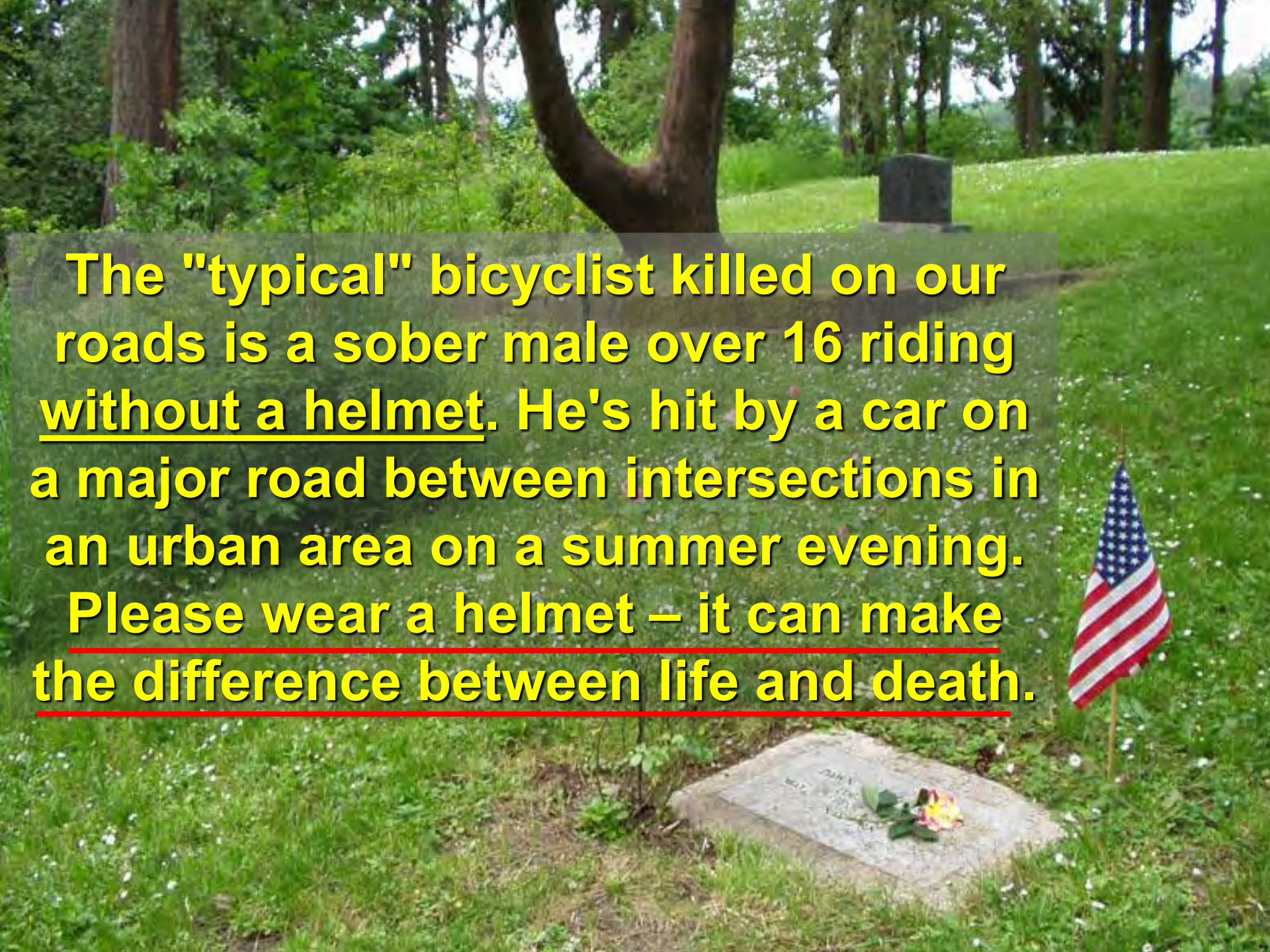
C. How do excitable cells signal? ch 3 pp62-7; ch 4 pp74-83

D. How does the signal cross the nerve-muscle gap?
ch 7 p 185-92 fig 7-5 p 190

1. Ca²⁺ bones!...but what else? p 190

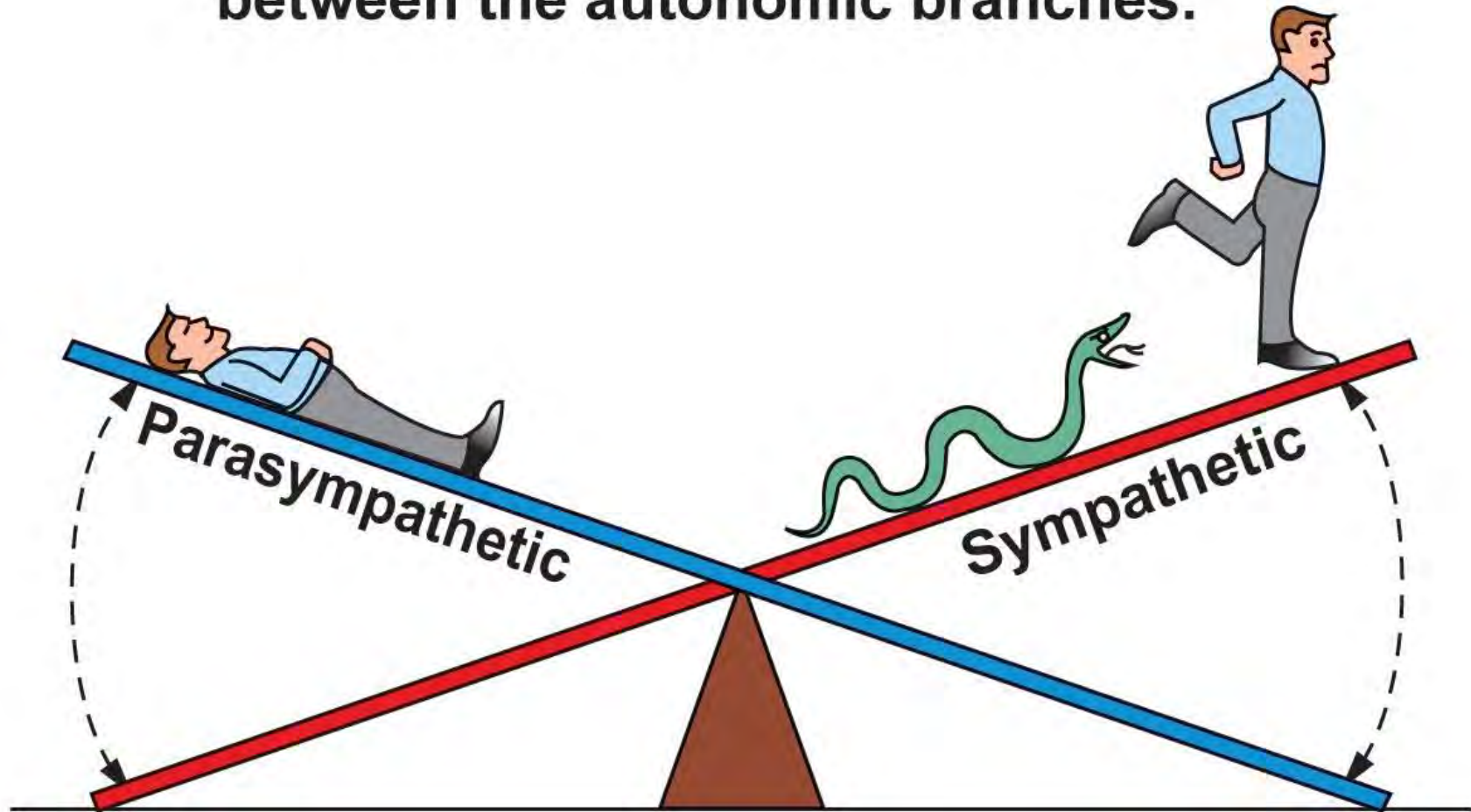
2. What do black widow spider venom, botulism, curare & nerve gas have in common? Botox pp 189-92



A photograph of a cemetery. In the foreground, there is a low, rectangular gravestone with a small bouquet of colorful flowers resting on it. To the right of the gravestone, a small American flag is planted in the grass. In the background, a large, dark tree trunk is visible, and further back, another gravestone stands on a grassy slope. The scene is set in a lush, green environment with many trees and bushes.

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

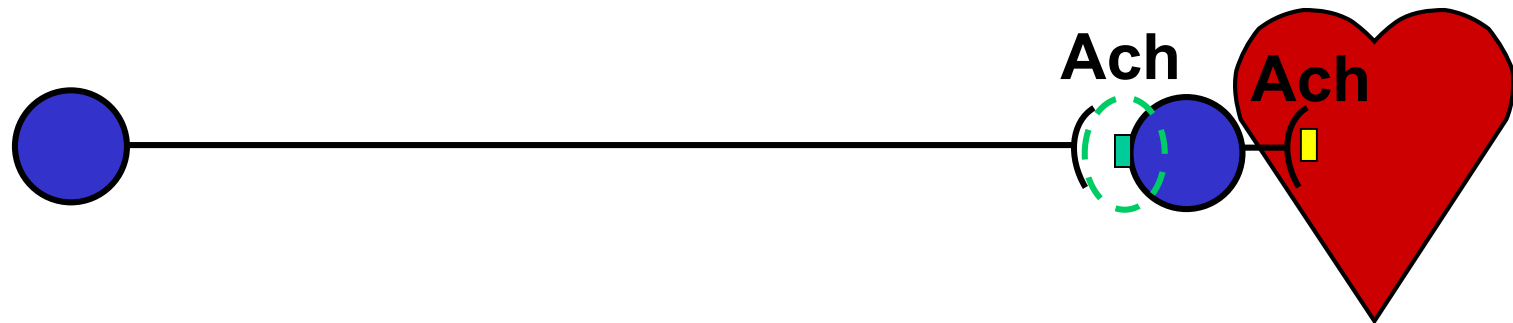
Homeostasis is a dynamic balance between the autonomic branches.



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

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

Parasympathetic

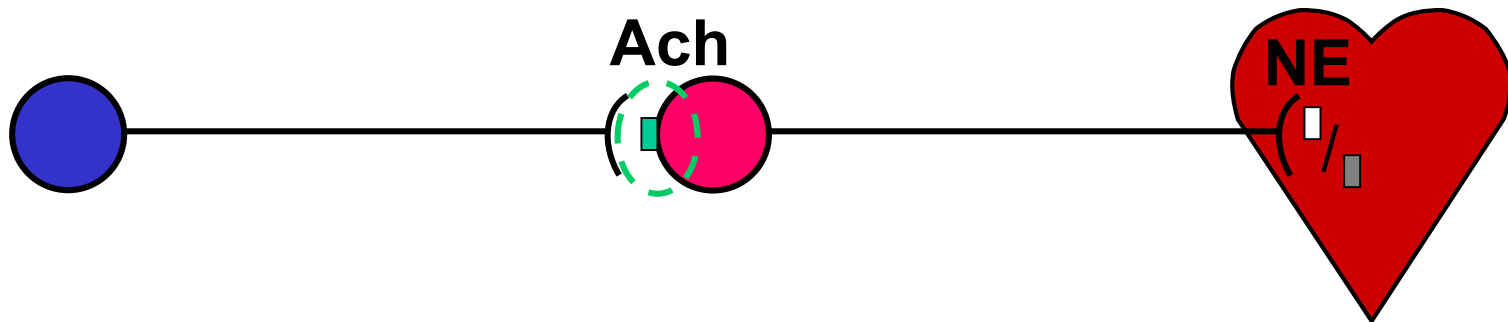


Ach = Acetylcholine

■ = 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!!

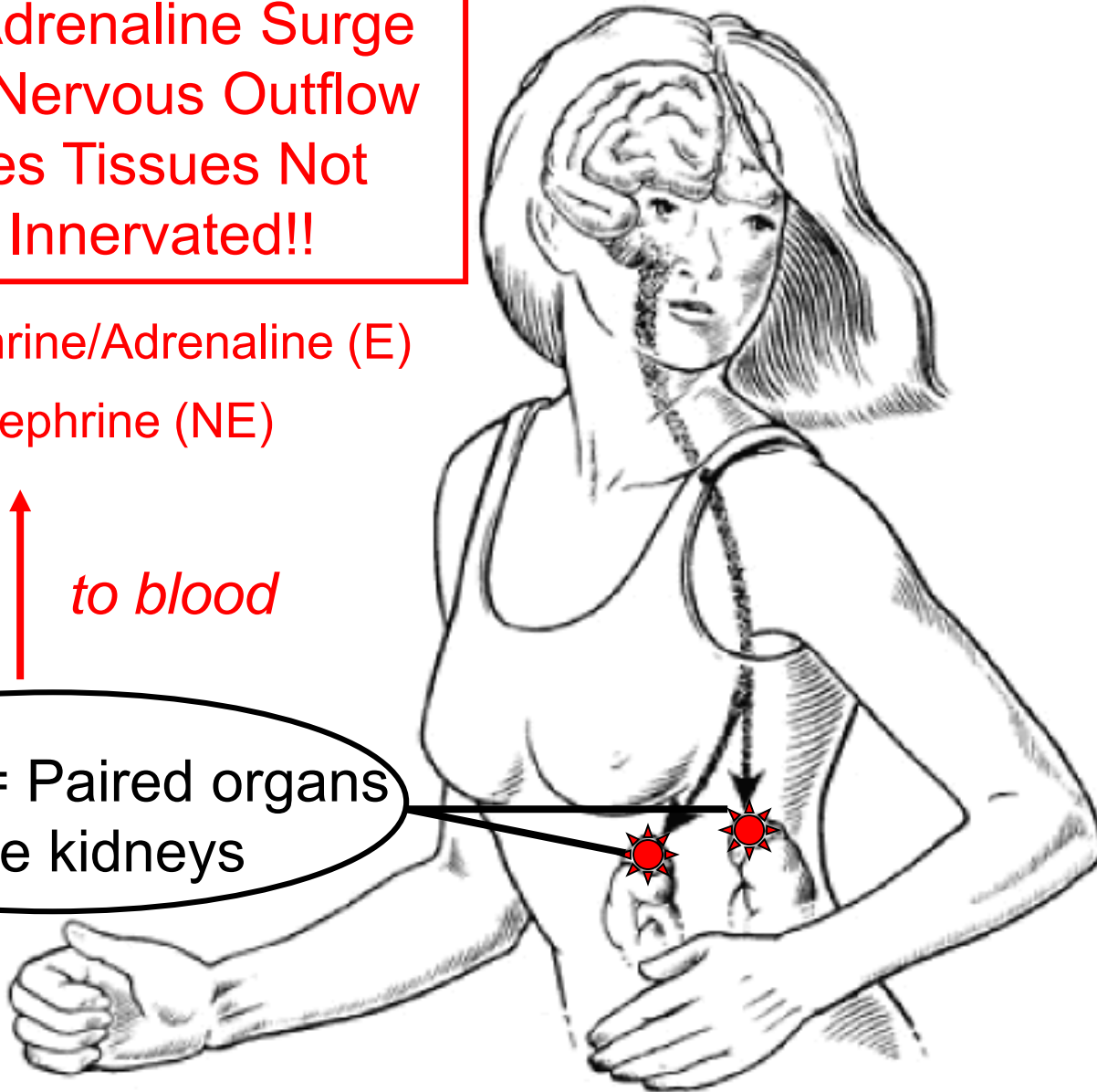


**Hormonal Adrenaline Surge
Reinforces Nervous Outflow
& Accesses Tissues Not
Directly Innervated!!**

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

Output ↑ *to blood*

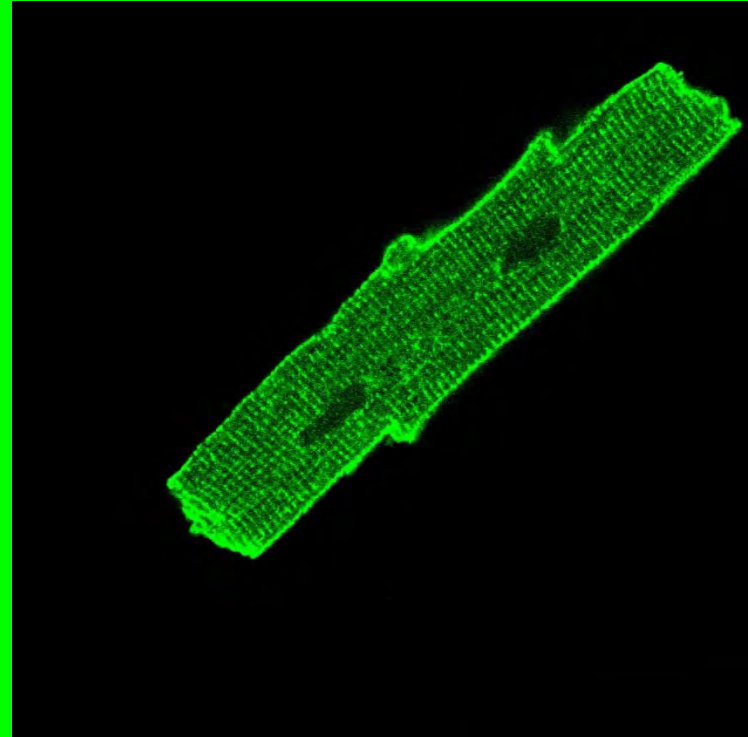
Adrenals = Paired organs
above kidneys



▲ 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!

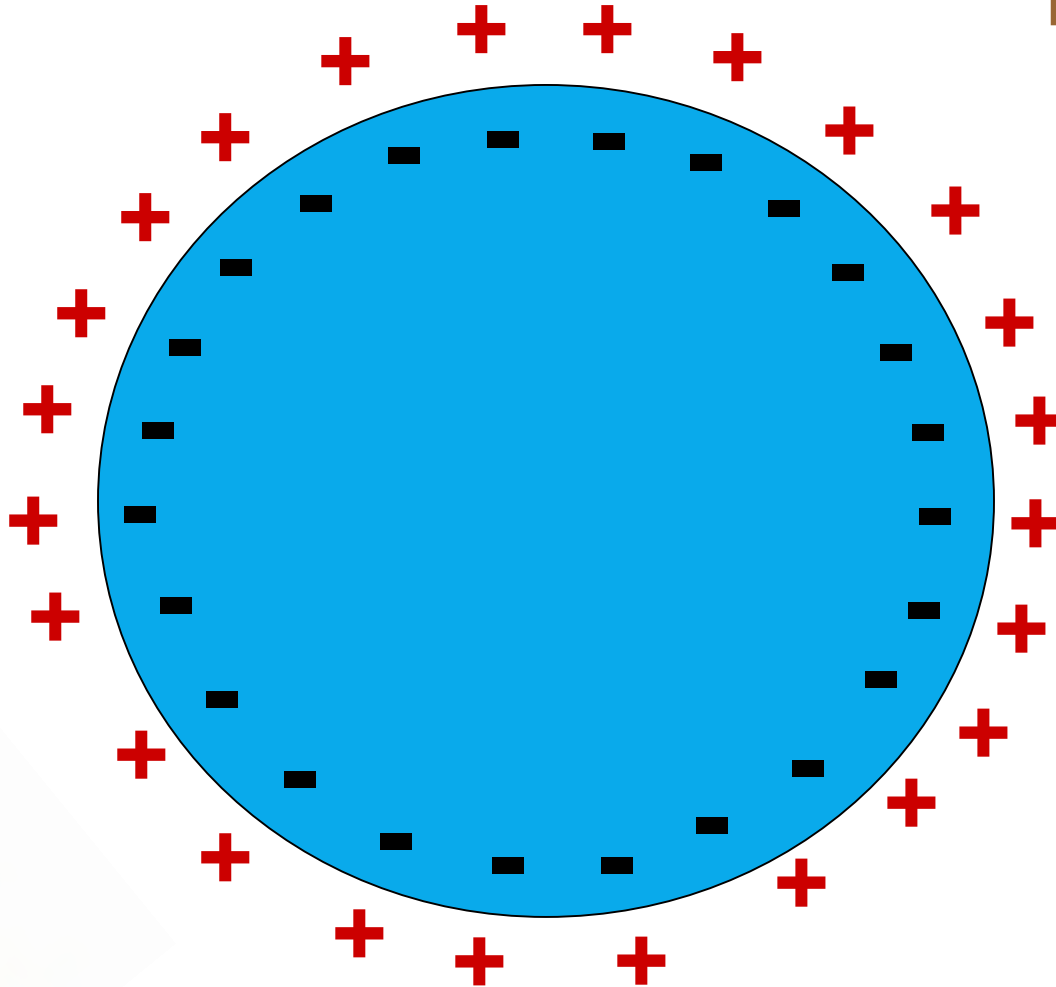
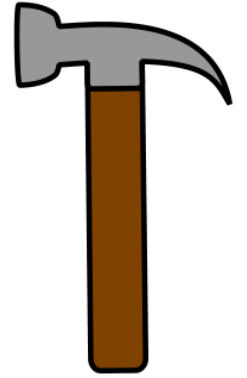


Stimulate Cell @ Rest

Thermal



Mechanical



1

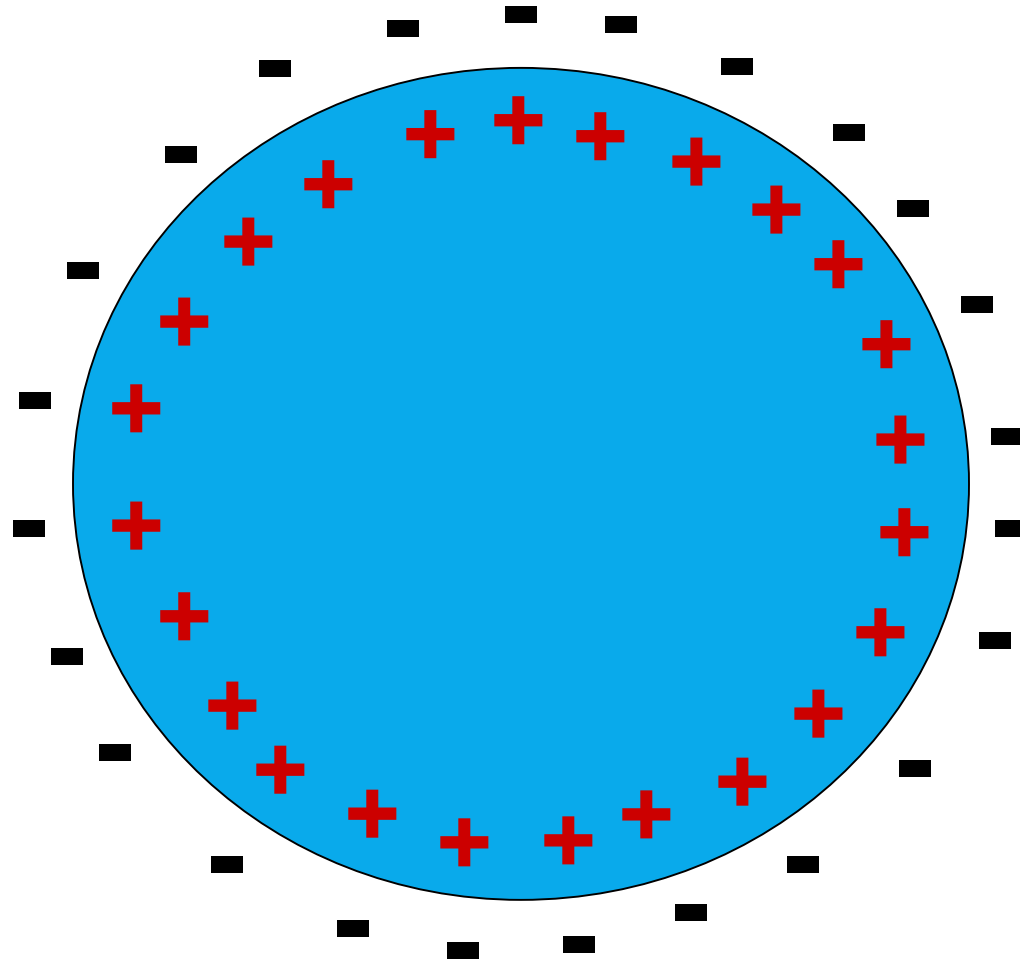


Electrical



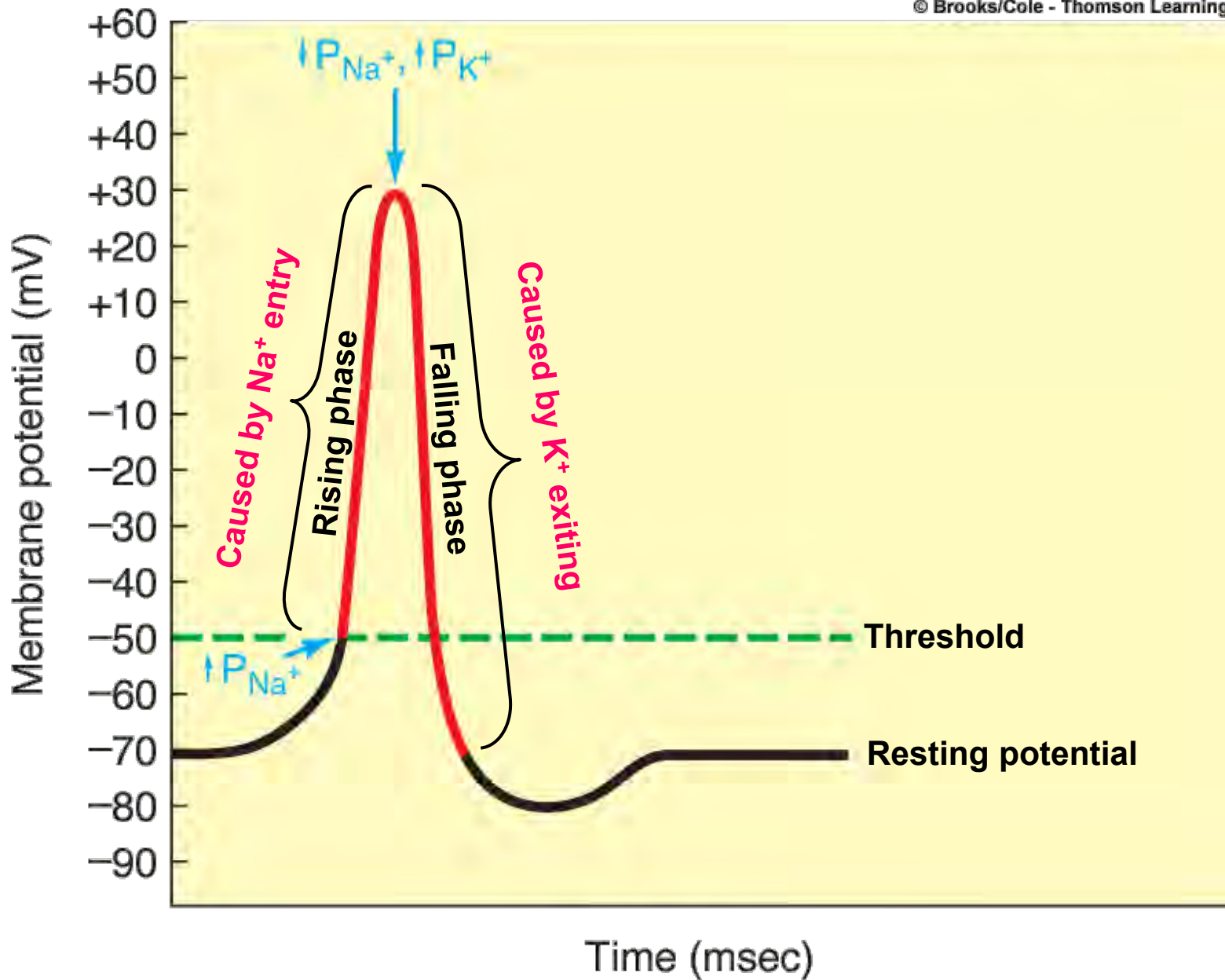
Chemical

Action Potential has occurred!



5

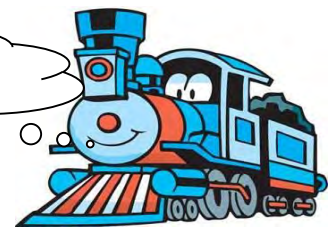
Brief (1-2 ms) reversal to + inside cell!



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, Dec 7, 8 am Q?**

II. Nervous System Connections LS 7

A. How does the signal cross the nerve-muscle gap?

ch 7 p 185-92 fig 7-5 p 190

B. 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 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? 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 +...

G. Summary of skeletal muscle contraction, videos courtesy David Bolinsky, *XVIVO* & Malcolm Campbell, *Davidson C.*

H. Exercise adaptation variables, strength vs. endurance tr.

Links That May Be Helpful!

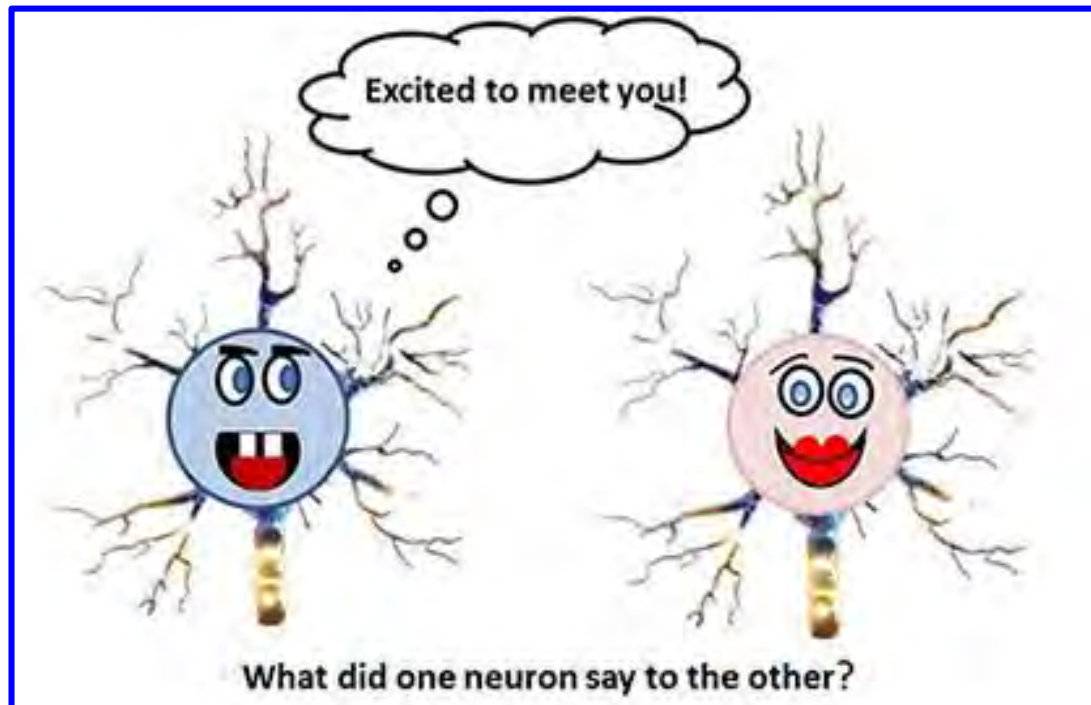
<https://www.youtube.com/watch?v=6RbPIOq0O3w>

<https://www.youtube.com/watch?v=mltV4rC57kM>

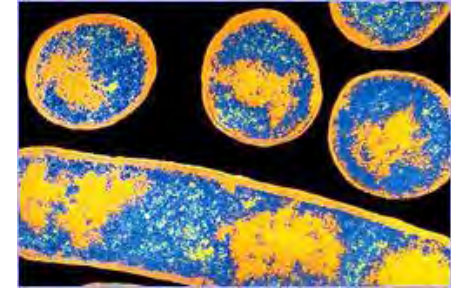
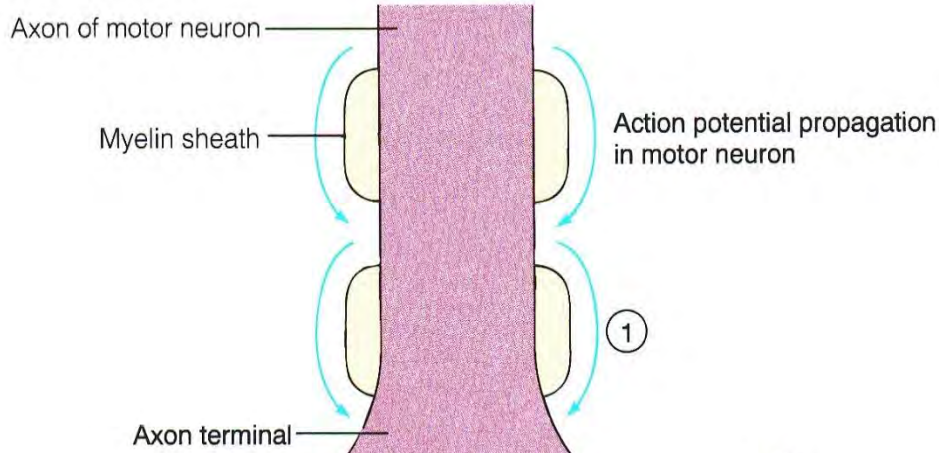
<https://www.youtube.com/watch?v=WhowH0kb7n0>

<http://sites.sinauer.com/psychopharm2e/animation03.01.html>

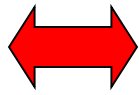
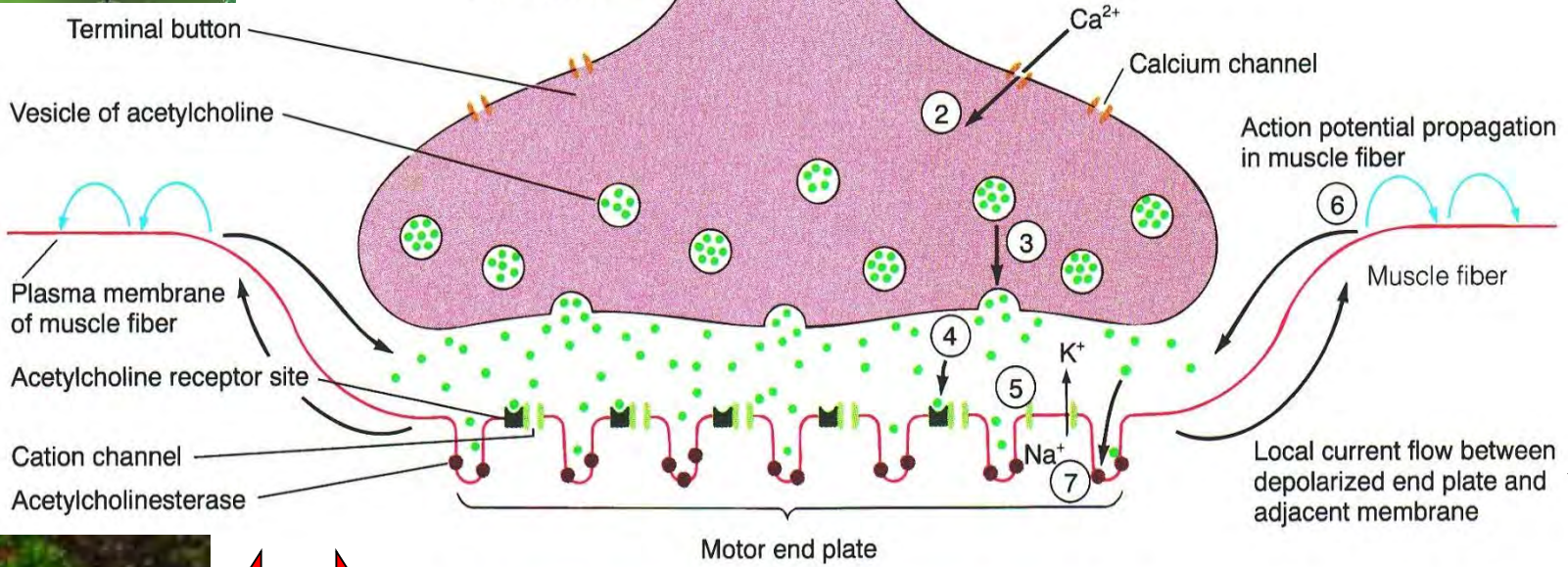
<https://www.youtube.com/watch?v=VitFvNvRIIY>



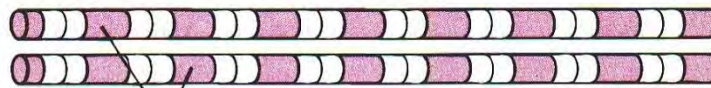
↑ 3



~~3~~



4



Contractile elements within muscle fiber

Local current flow between depolarized end plate and adjacent membrane

~~7~~



Striated muscle

Unstriated muscle

Skeletal muscle

Cardiac muscle

Smooth muscle

Ed Reschke

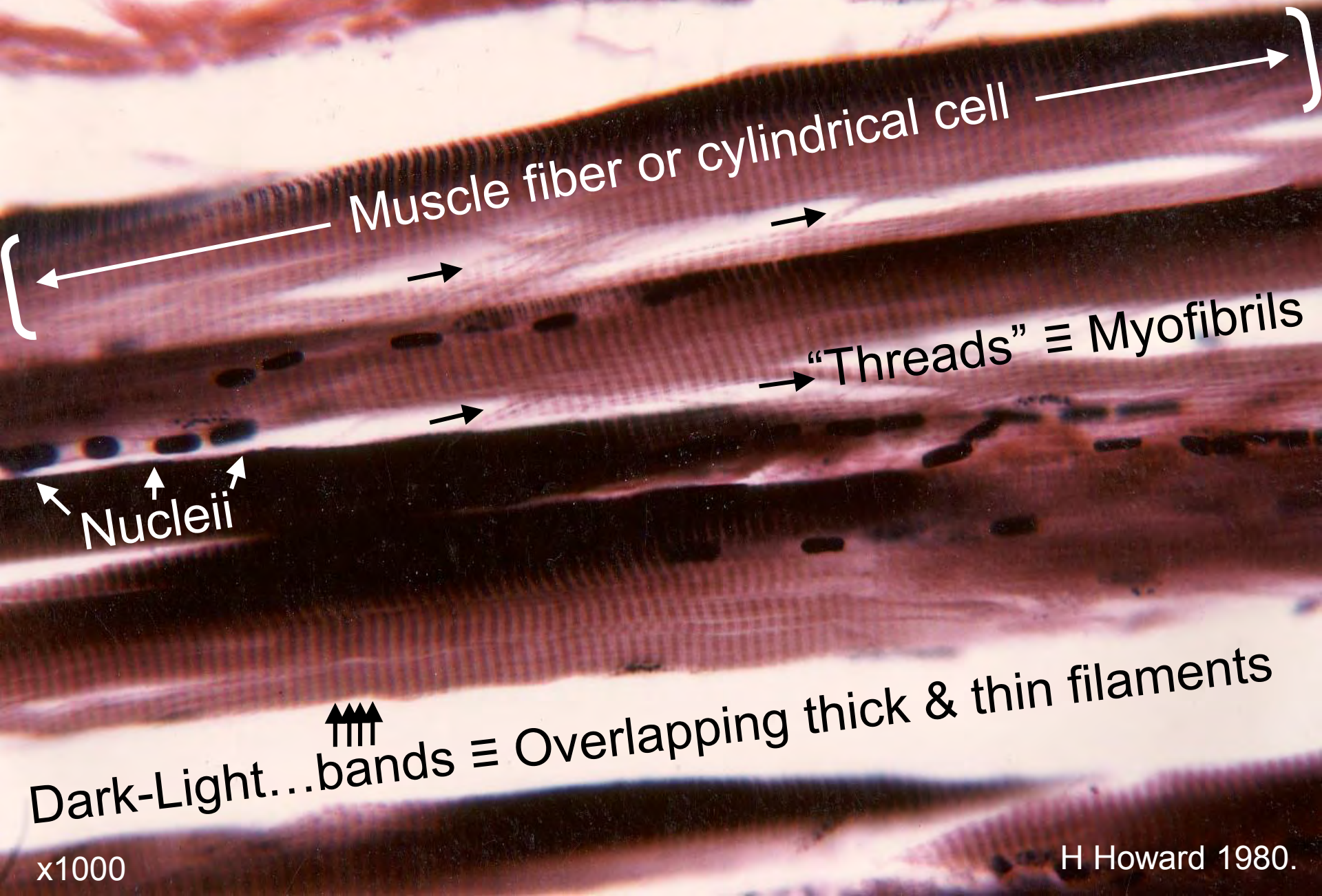
Ed Reschke

Biophoto/Photo Researchers, Inc.

Voluntary muscle

Involuntary muscle

Skeletal Muscle Histology: Microscopic Anatomy



Muscle fiber or cylindrical cell

Nucleii

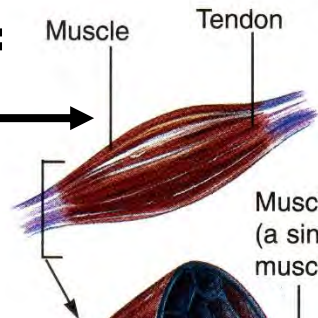
"Threads" ≡ Myofibrils

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

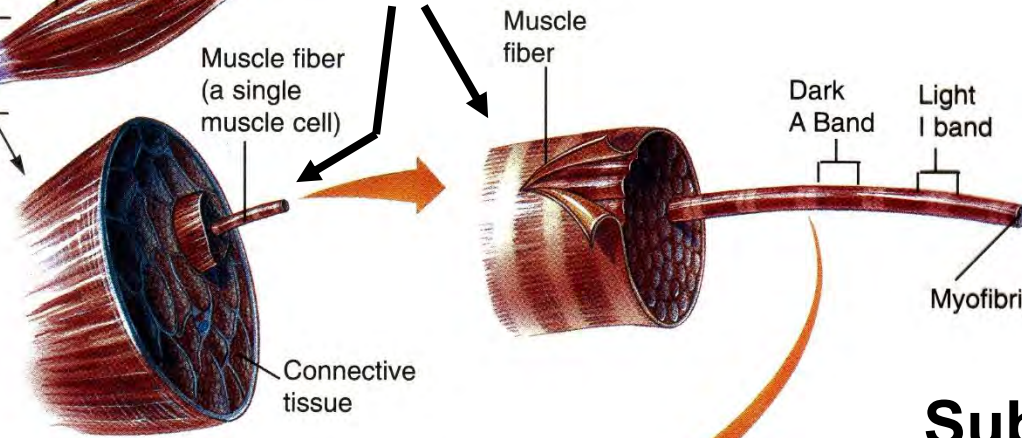
x1000

H Howard 1980.

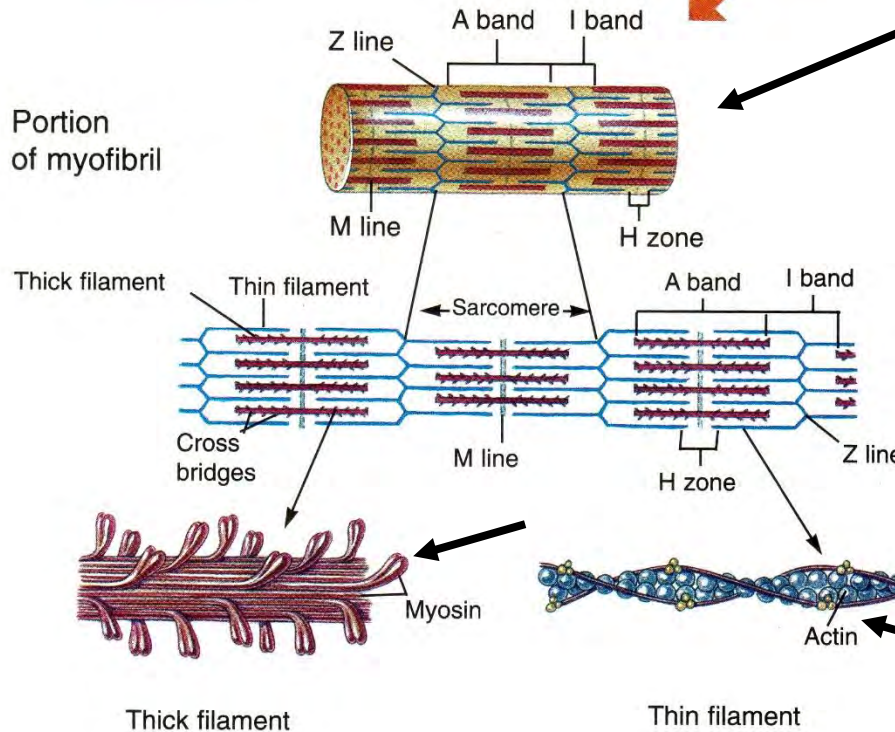
**Organ =
Muscle**



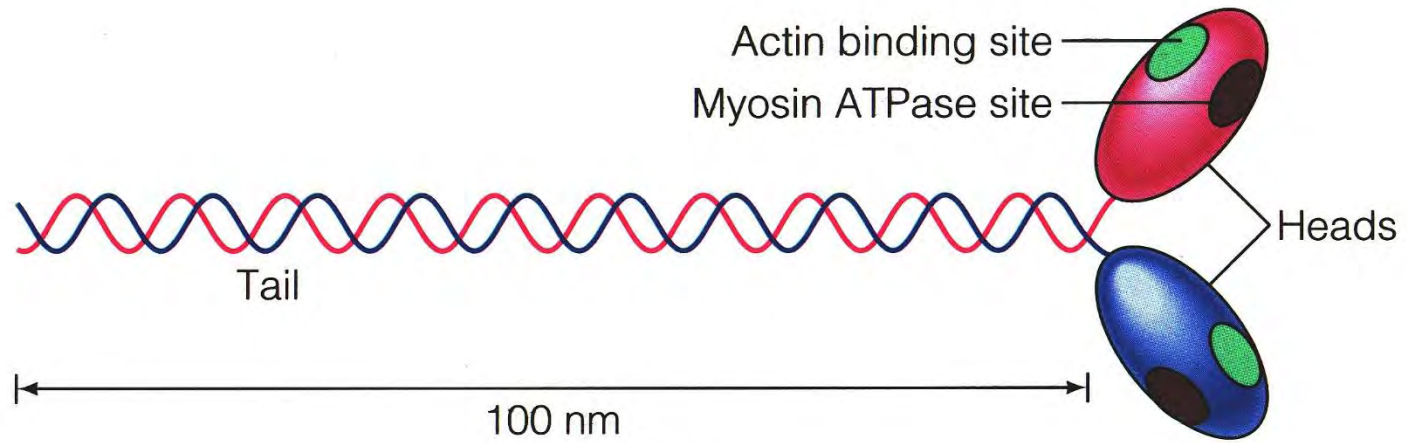
Cell = Myocyte = Fiber



**Subcellular =
Cytoskeleton**

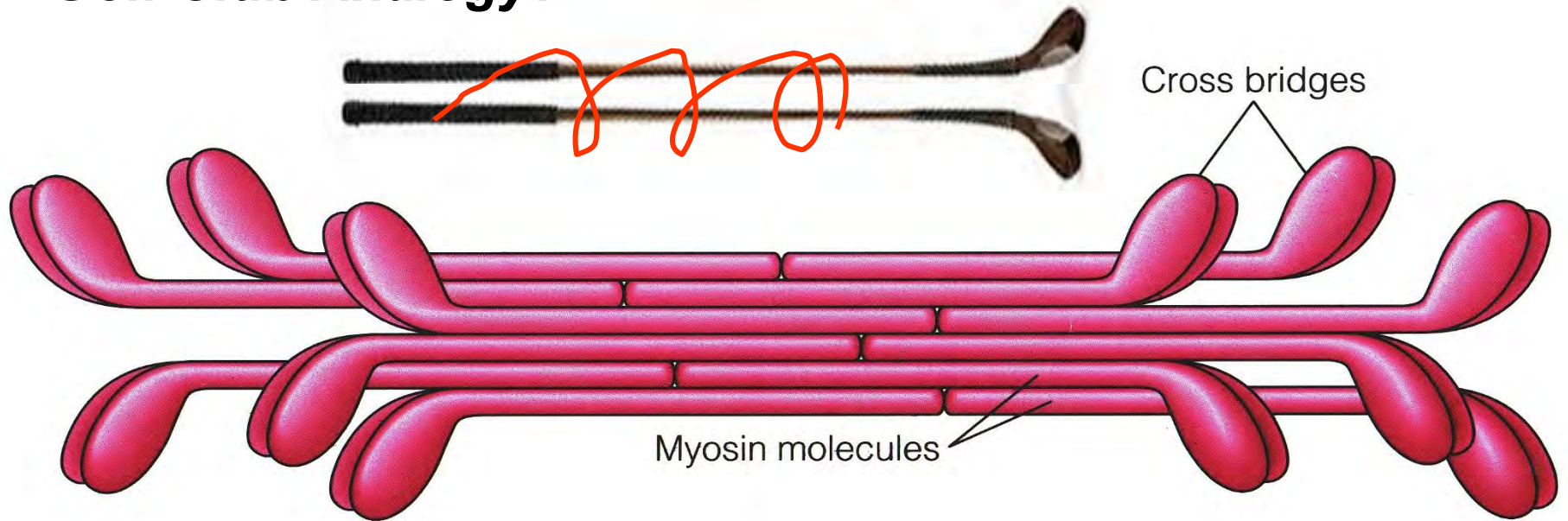


**Molecules =
Actin & Myosin**



(a)

Golf Club Analogy?



(b)

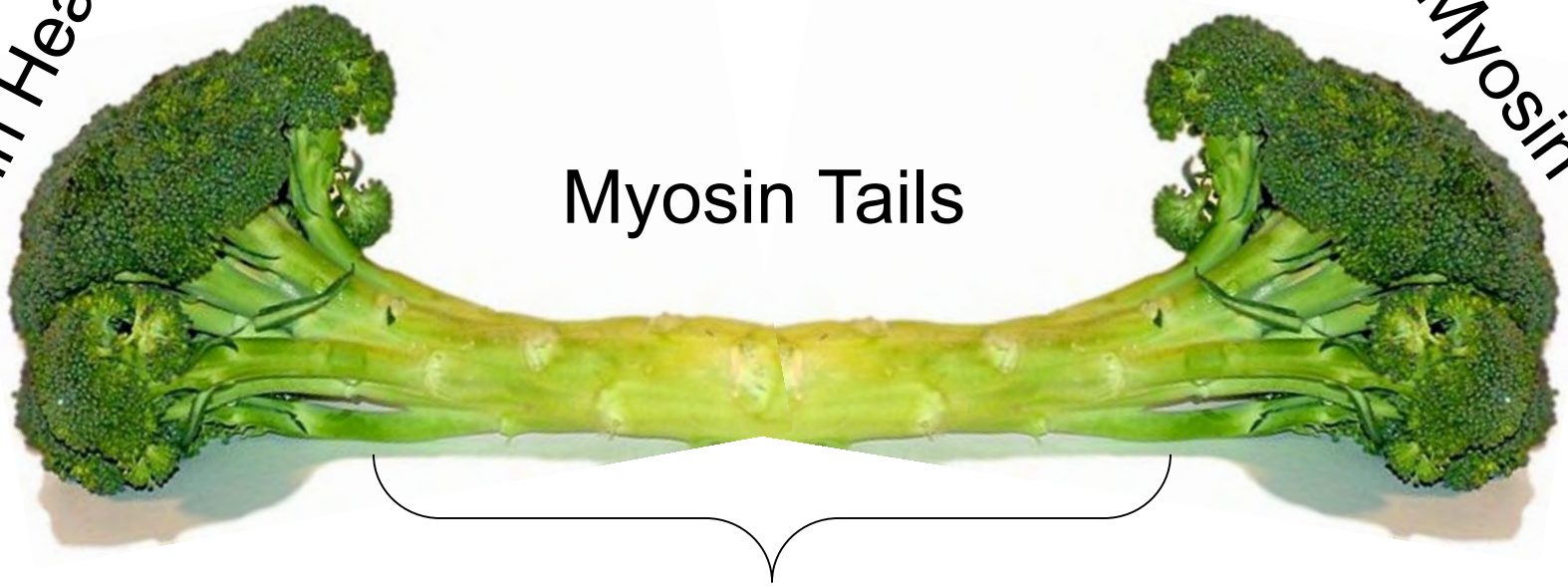
Broccoli Analogy?

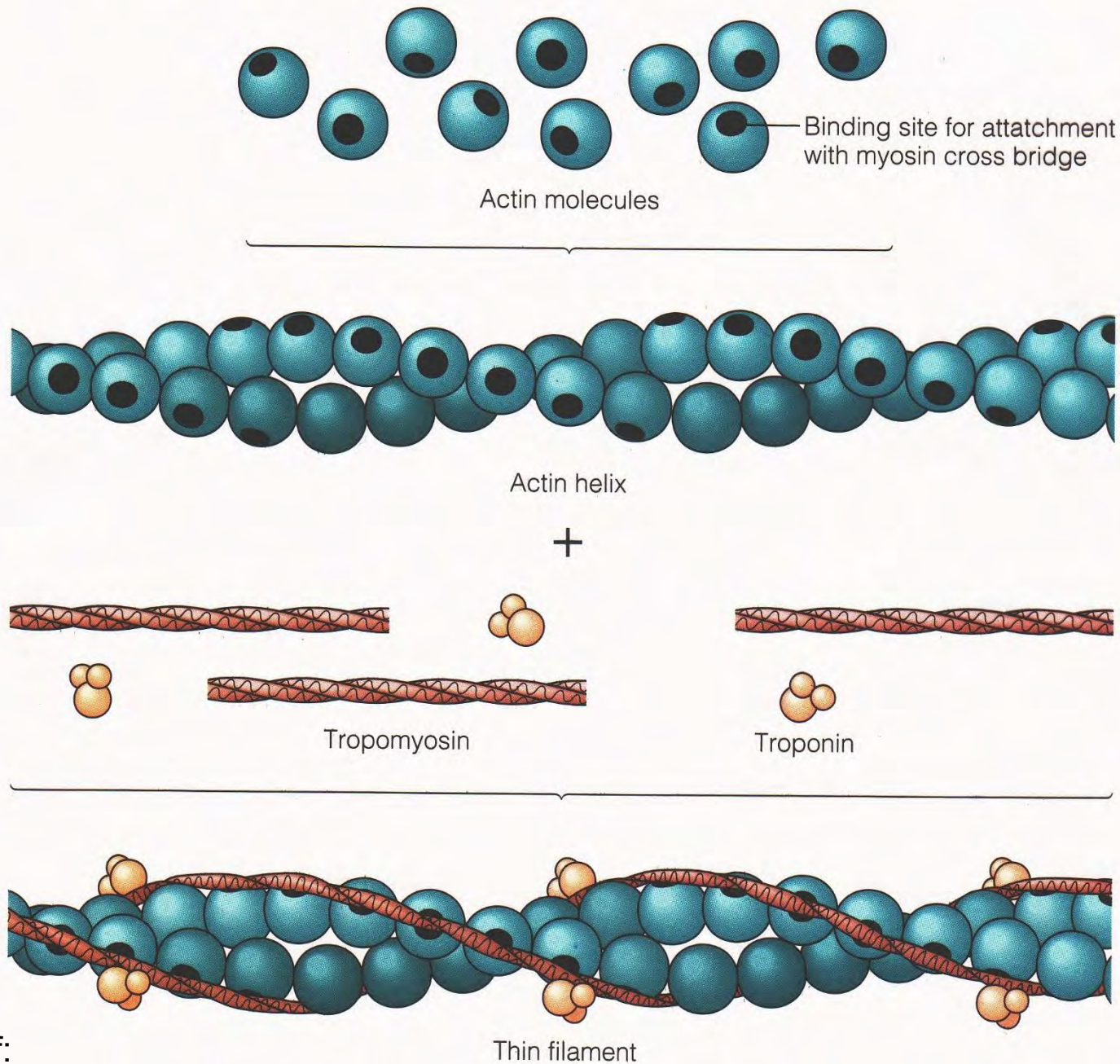
Myosin Heads

Myosin Heads

Myosin Tails

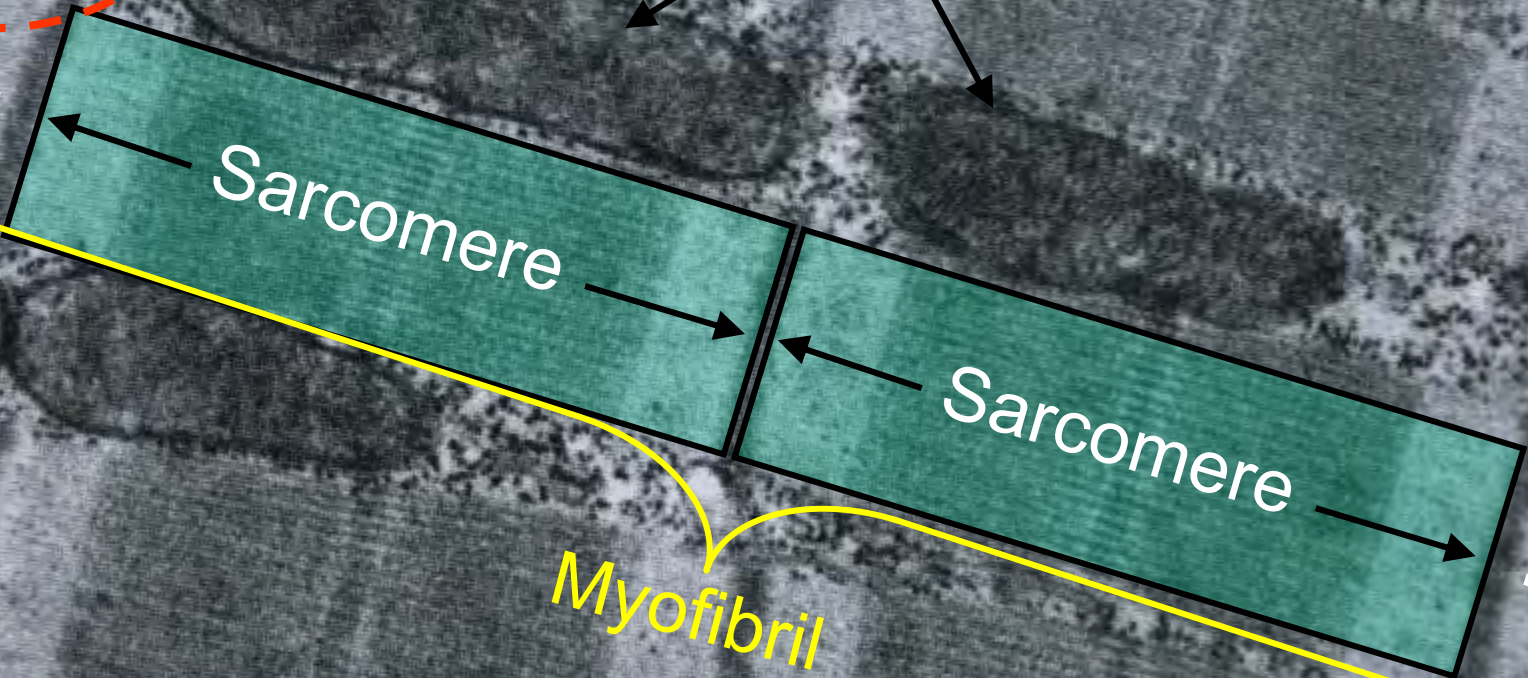
Bare Zone





Triad \equiv T tubule abutting cisternae

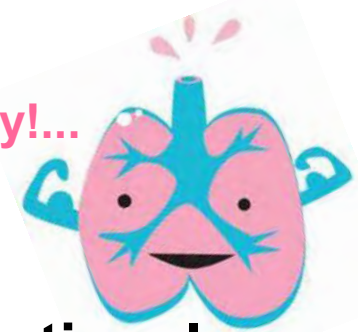
Mitochondria



Myofibril

BI 121 Lecture 15

More personal data today! Hooray!...



I. Announcements Civil War Blood Drive!

Lab 6, Pulmonary Function Testing (PFT) + optional notebook check today. Exam II Dec 7 Thursday, 8 am!

II. Skeletal Muscle Structure & Function Connections

Banding pattern, crossbridge cycling, crucial calcium!

Contraction & relaxation LS ch 8, DC Module 12

III. Skeletal Muscle & Other Exercise Adaptations Endurance

vs. Strength training, the Energy Continuum LS ch 8 +...

IV. Introduction to PFT Lab 6 Pulmonary Function Testing

Lab Manual, pp 6-1 thru 6-8

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

A. Steps of respiration? External vs. cellular/internal?

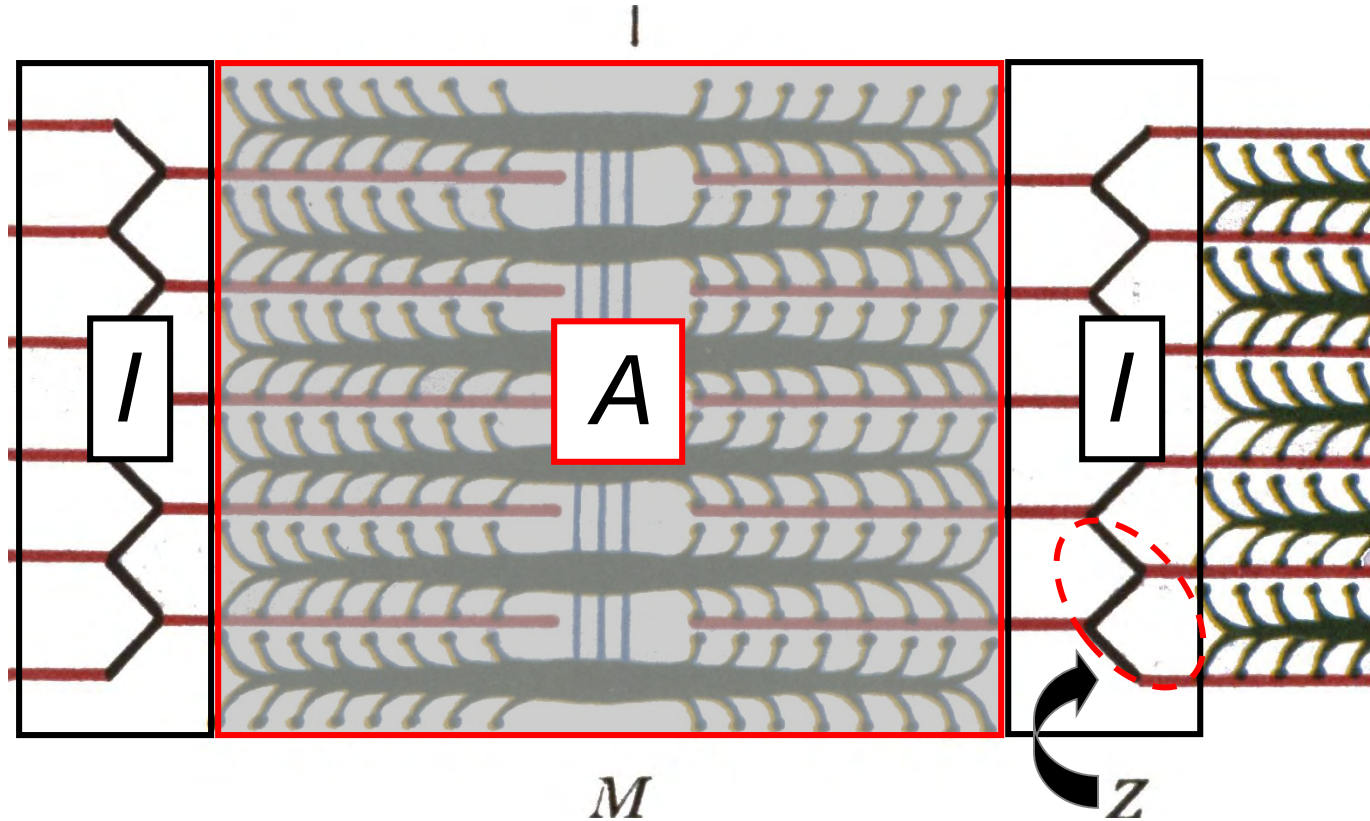
LS fig 12-1 pp 345-347

B. Respiratory anatomy LS fig 12-2 p 347, DC, Fox +...

C. Histology LS fig 12-4 pp 347-349, DC

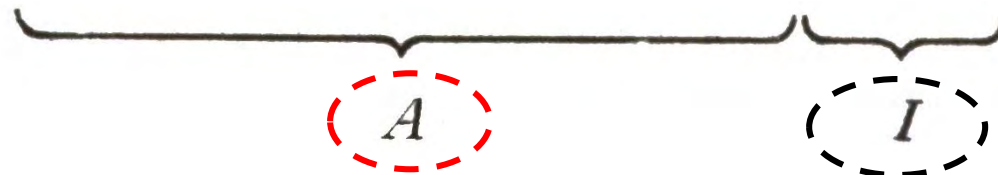
A Band = Dark Band

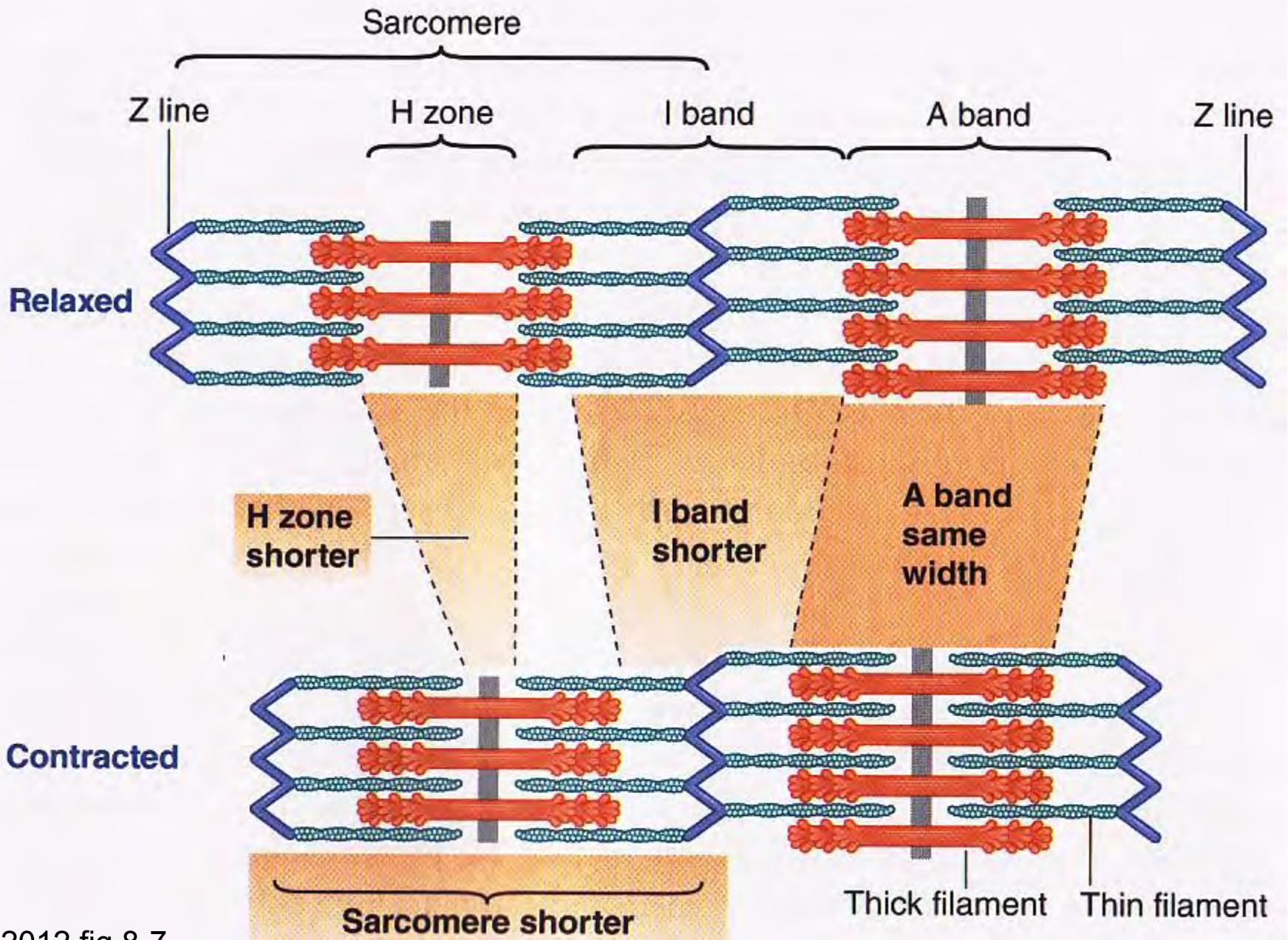
Anisotropic = Light Can't Shine Through



I Band = Light Band

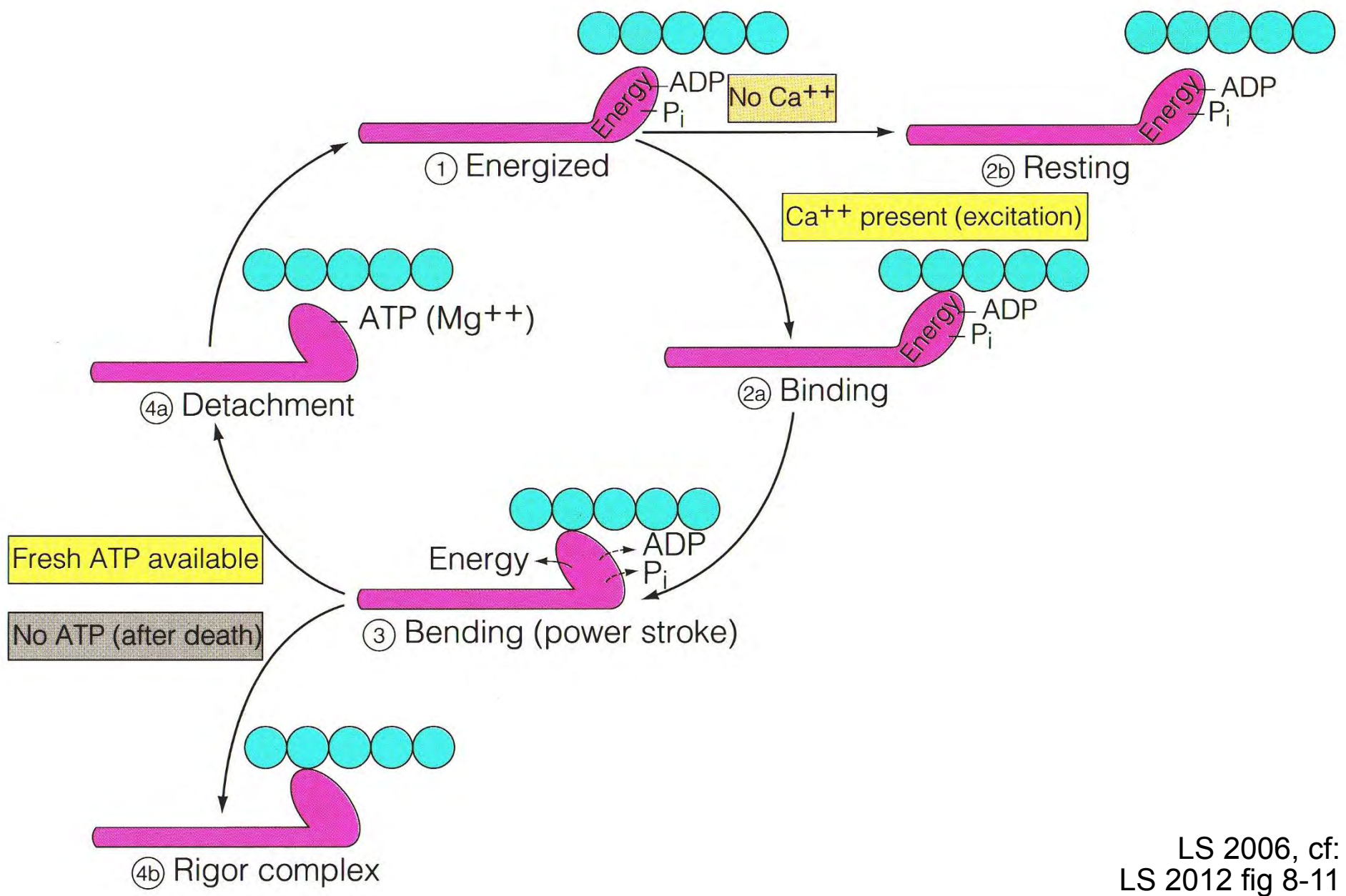
Isotropic = Light Can Shine Through





LS 2012 fig 8-7

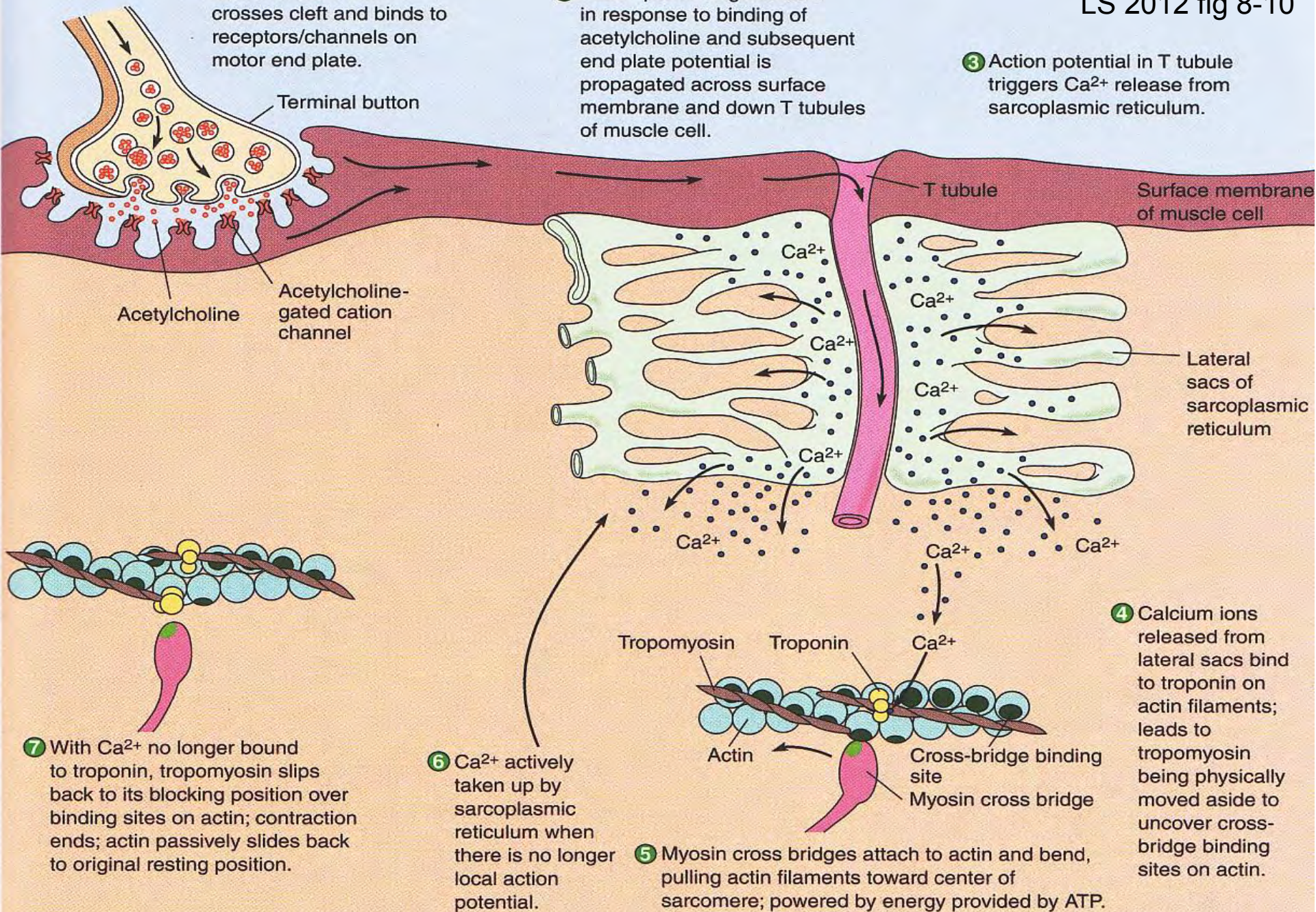
Cross-Bridge Cycle



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

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

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

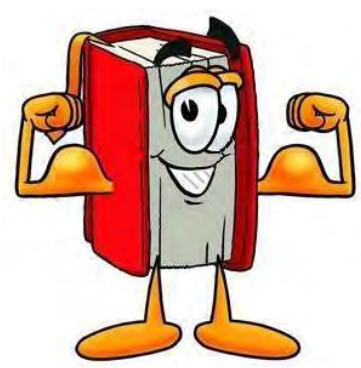


⑦ With Ca^{2+} no longer bound to troponin, tropomyosin slips back to its blocking position over binding sites on actin; contraction ends; actin passively slides back to original resting position.

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

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

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



Muscle Contraction Resources



<https://www.ncbi.nlm.nih.gov/books/NBK9961/>

<https://www.youtube.com/watch?v=jUBBW2Yb5KI>

<https://www.youtube.com/watch?v=sJZm2YsBwMY>

***A. Malcolm Campbell
Davidson College, Davidson, NC
www.bio.davidson.edu/courses/movies.html***

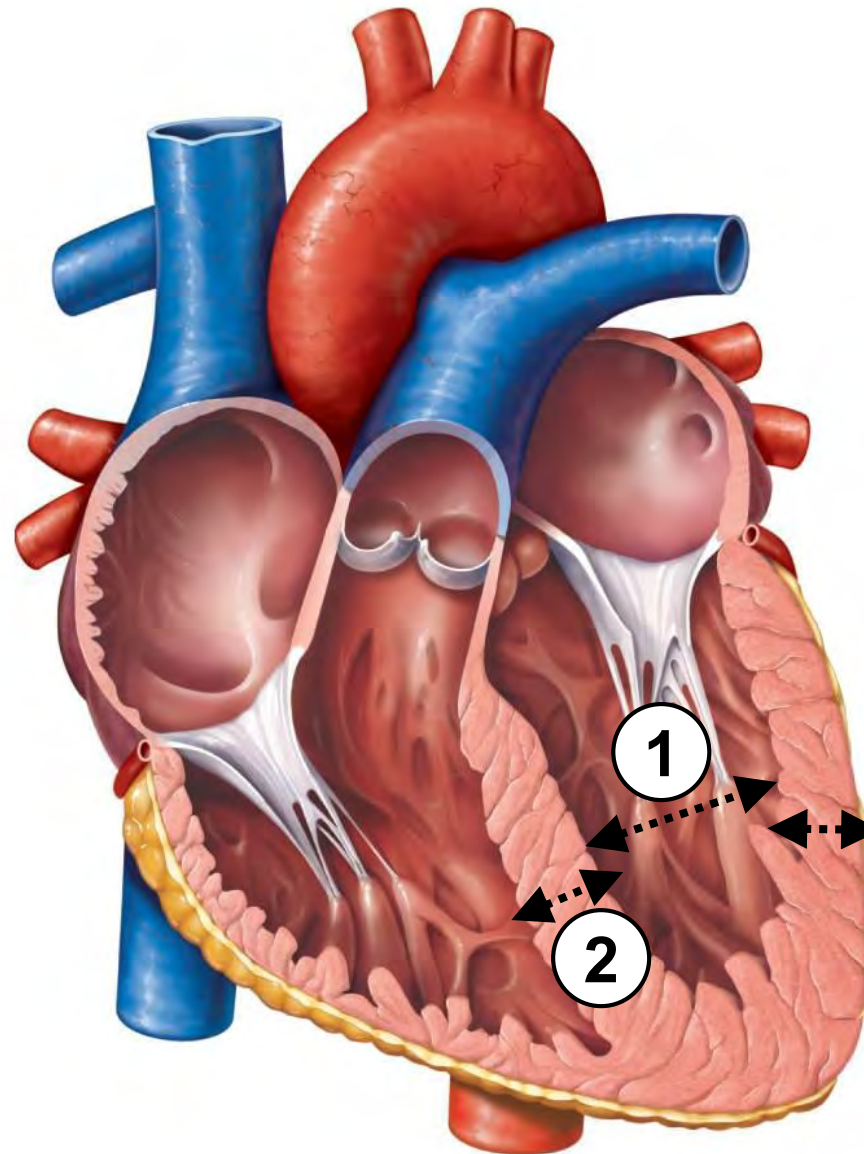
***David Bolinsky, XVIVO
Rocky Hill, CT
<http://www.xvivo.net/>***

Adaptations to Exercise?

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



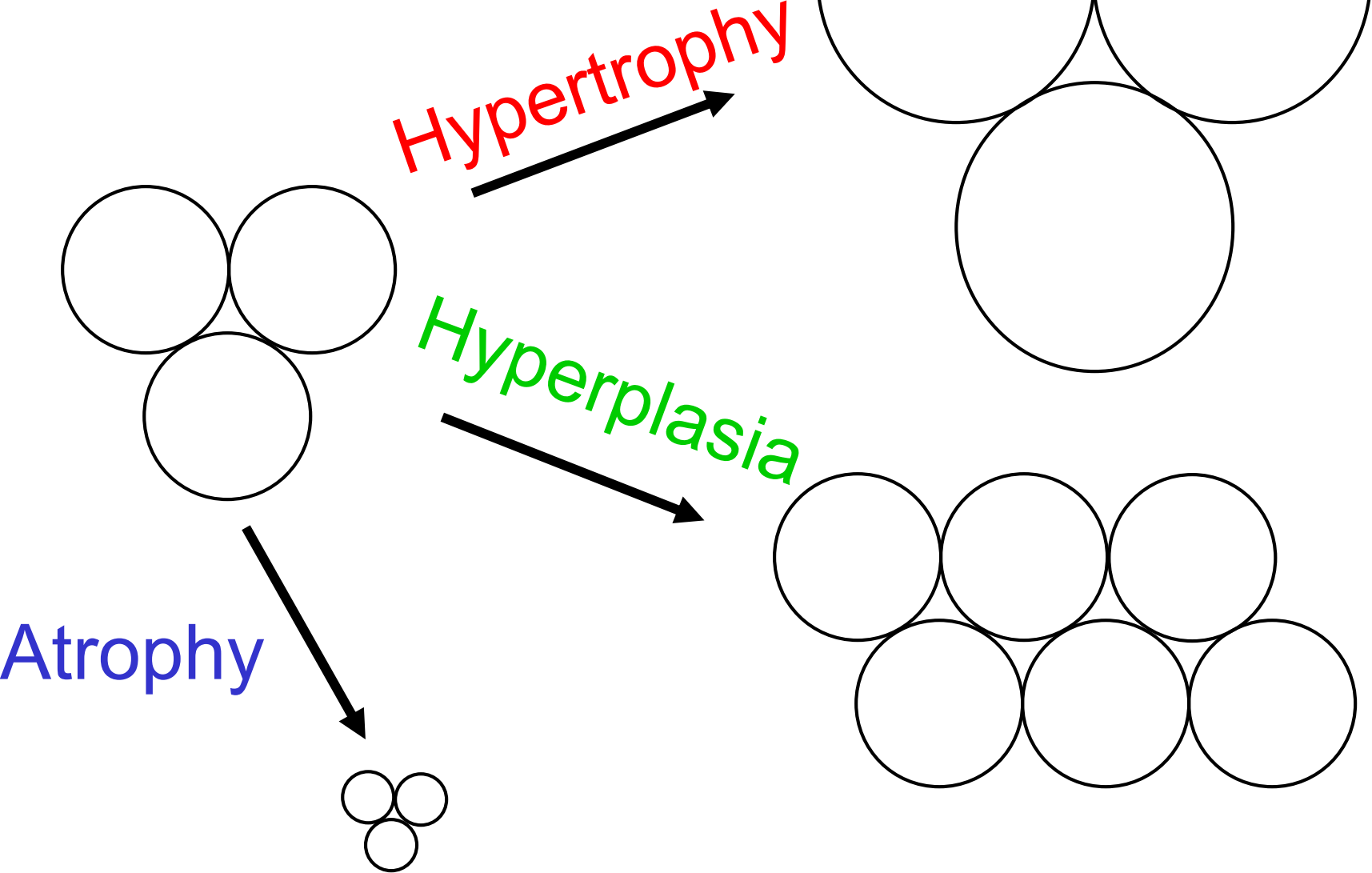
Cardiac Adaptations to Exercise: **① Endurance vs. ② Strength Training**



NB: ① > ↑ LBM

① + ②

Skeletal Muscle





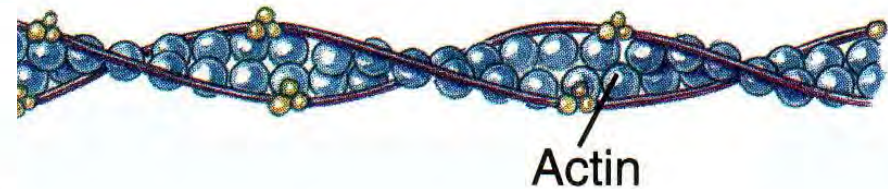
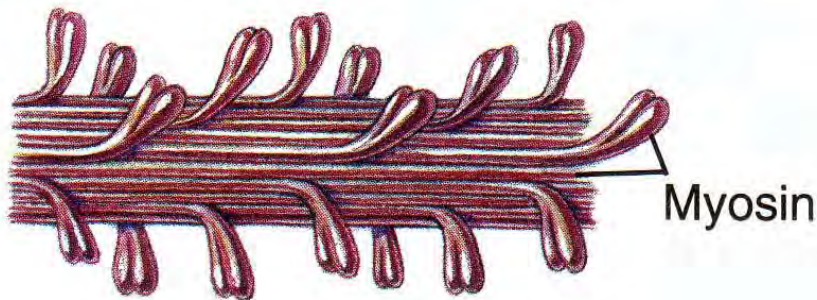
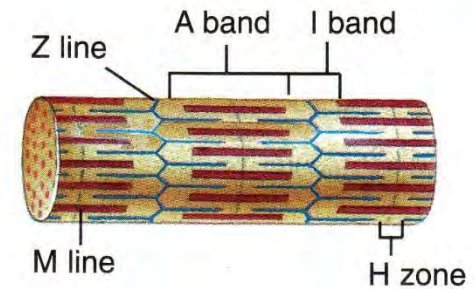
Myofibril

Hypertrophy: *Increased*

Number of Myofibrils

Thick & Thin Filaments

Myosin & Actin Molecules



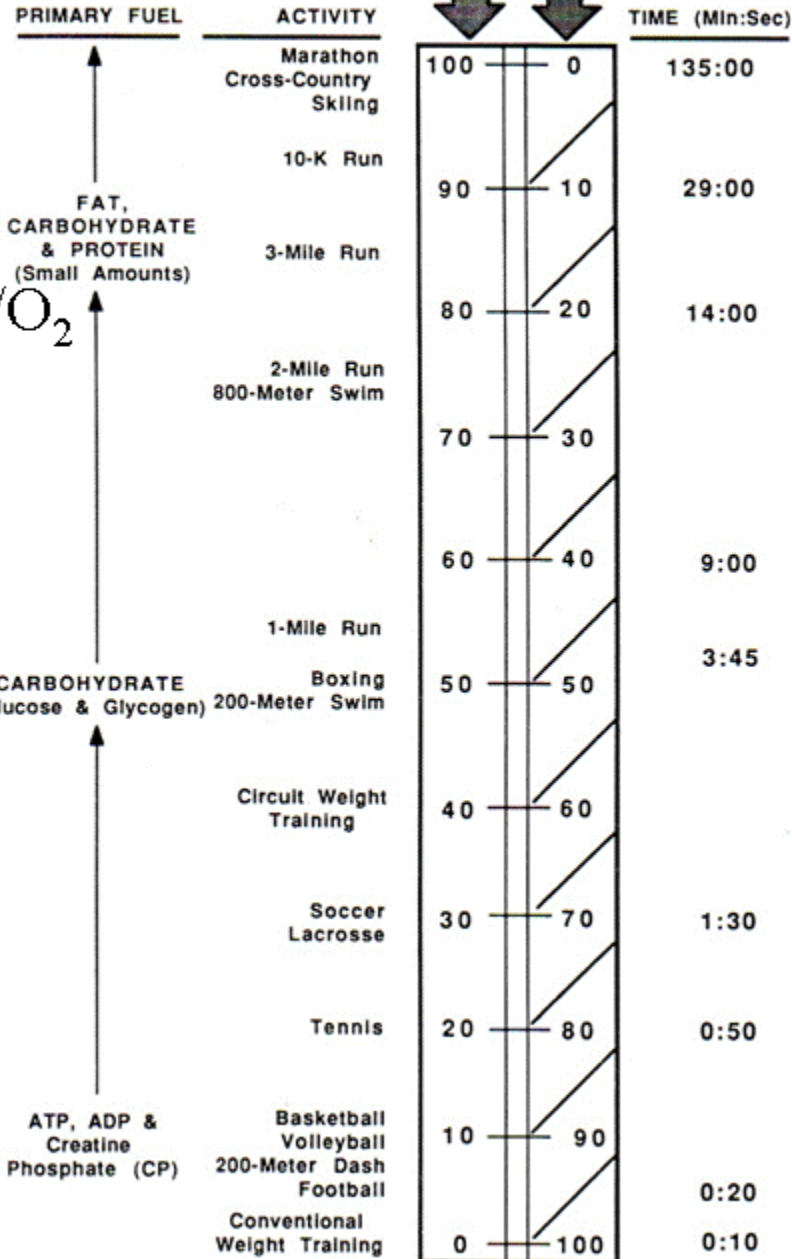
Characteristics of Skeletal Muscle Fibers

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



AEROBIC

w/O₂



MITOCHONDRIA

CYTOSOL

Glycolysis

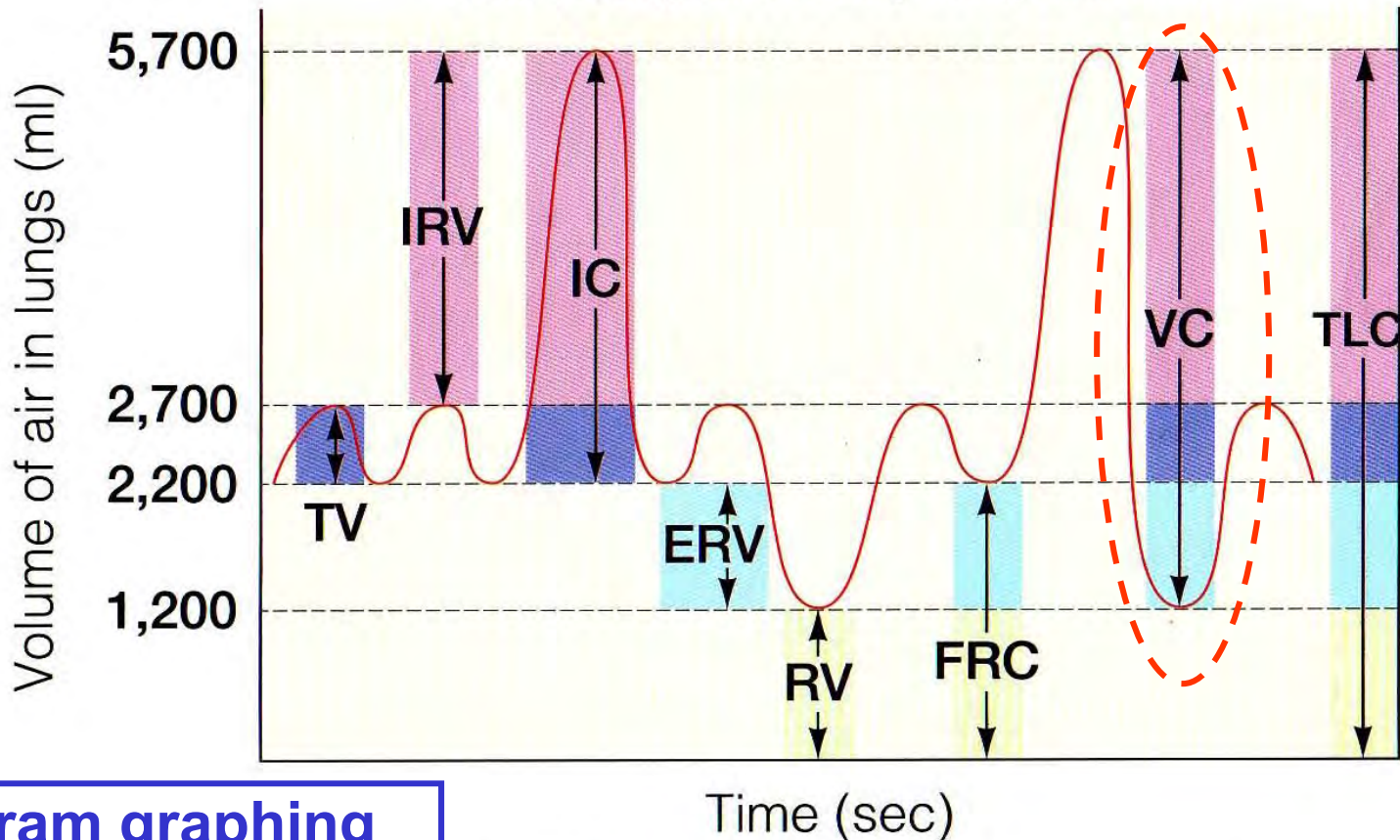


Immediate/ATP-PC



ANAEROBIC

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)

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



BI 121 Lecture 16

- I. Announcements** Notebooks? **Exam II, Dec 7th Thurs 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

Extremes of the energy continuum!

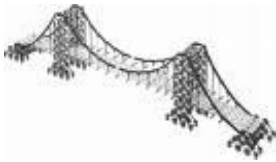


Lombo's simplified steps!

1 Breathe in & out!



2 Cross membranes!



3 Move with blood!

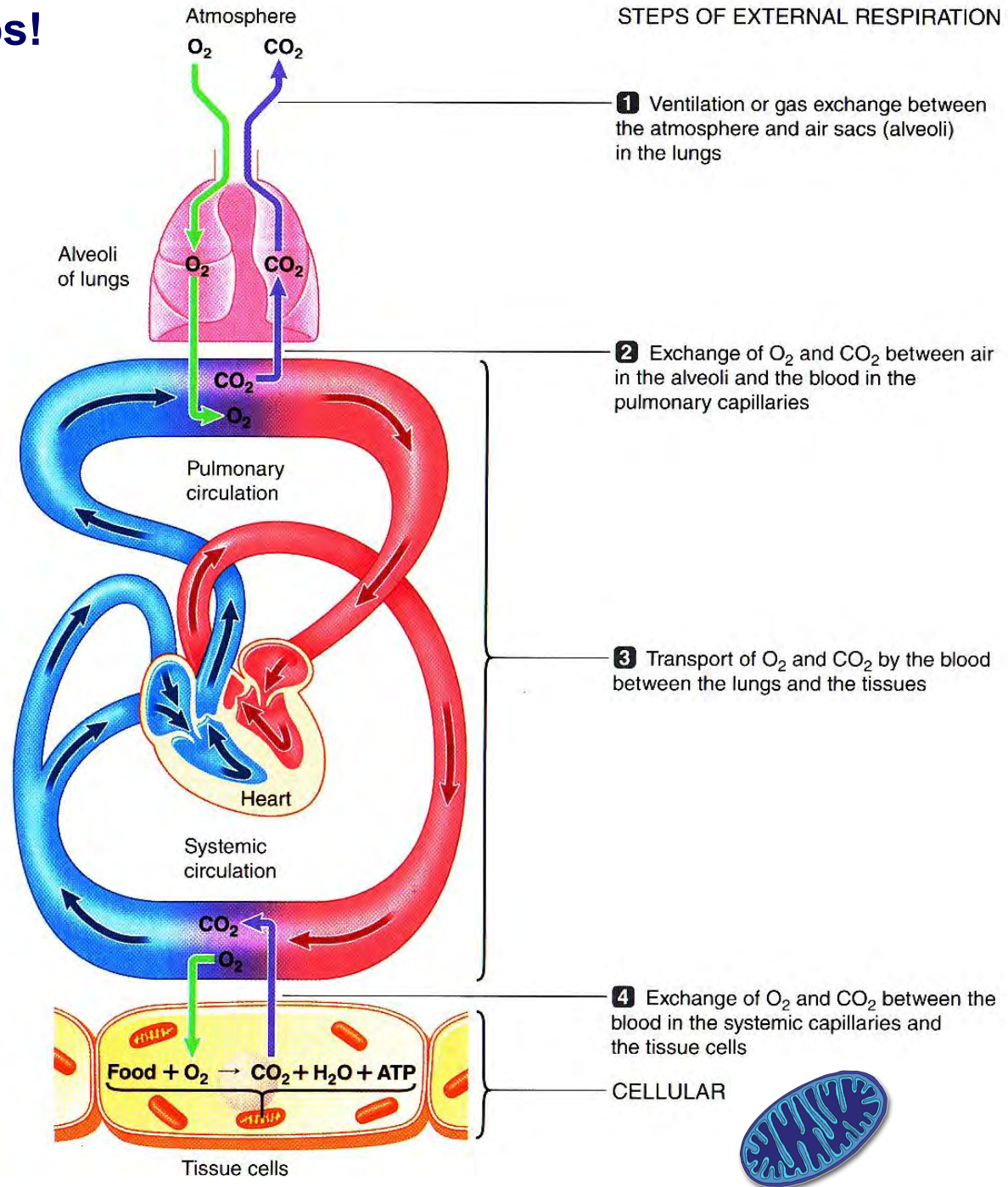
Go with the flow!



4 Cross membranes!

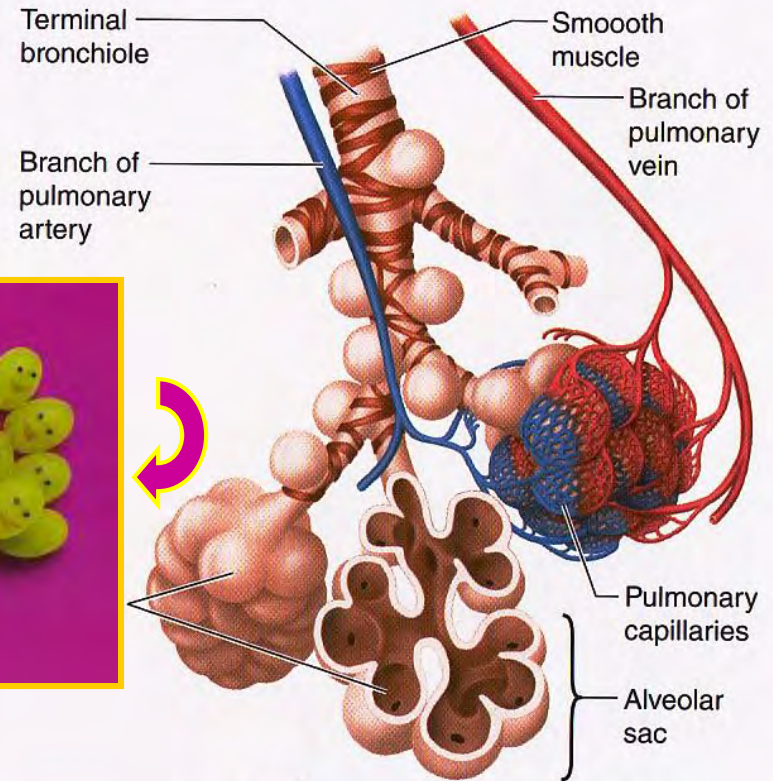
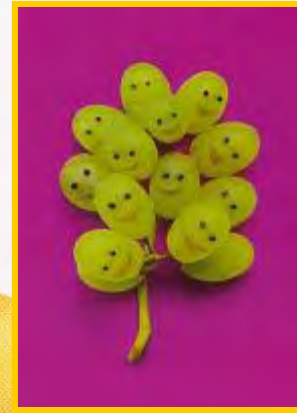
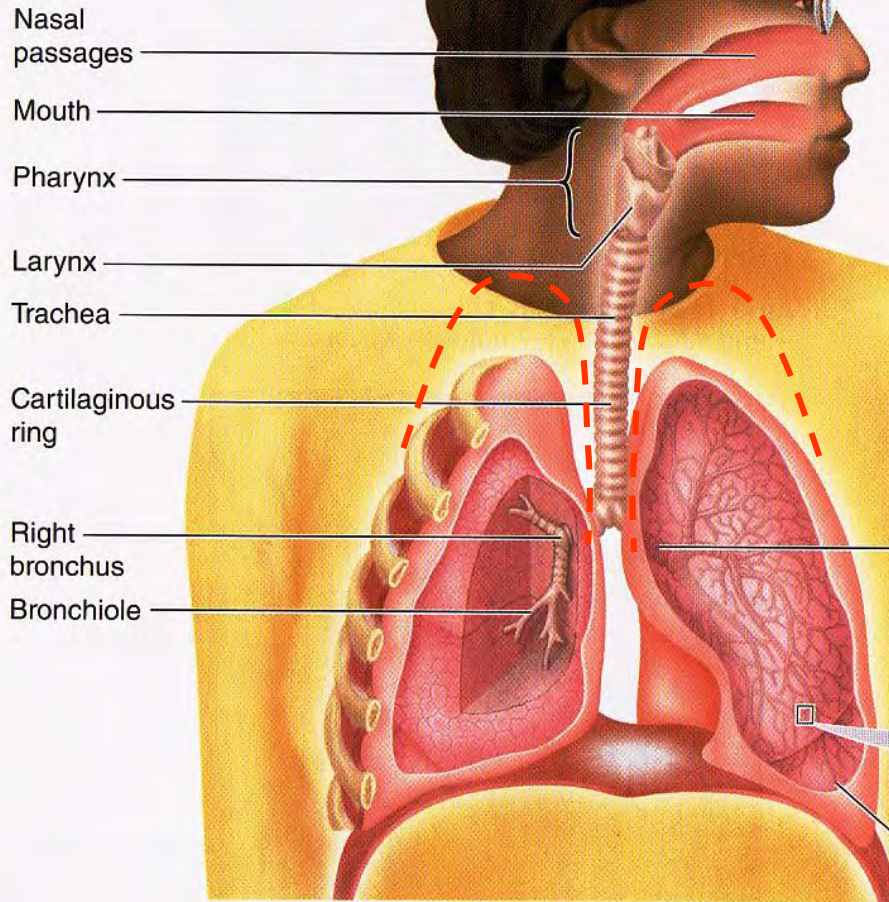


STEPS OF EXTERNAL RESPIRATION

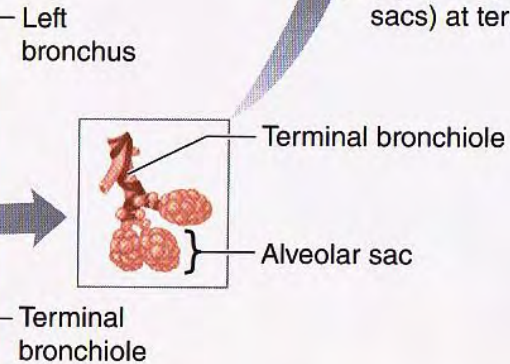


Respiratory System Anatomy

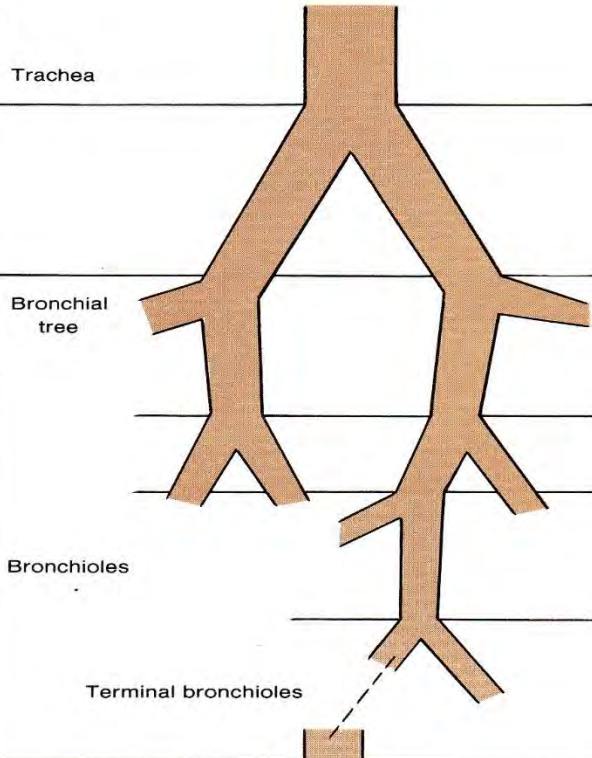
NB: In vivo,
Cupola or peak
of each lung
goes into neck
> clavicle line!



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

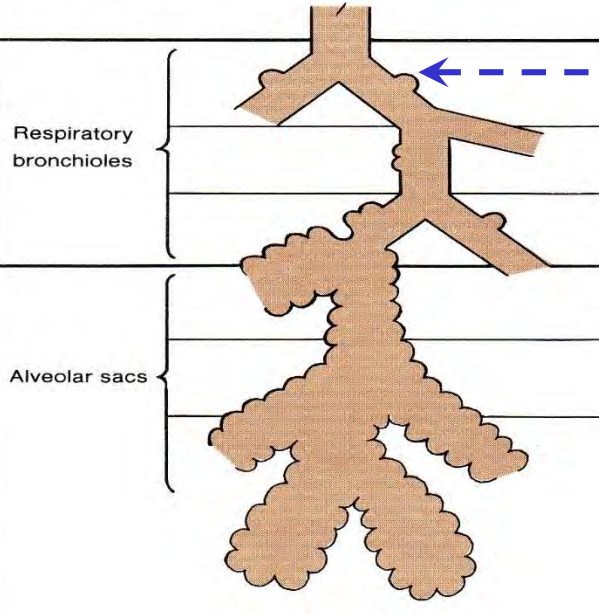


Conductive Zone



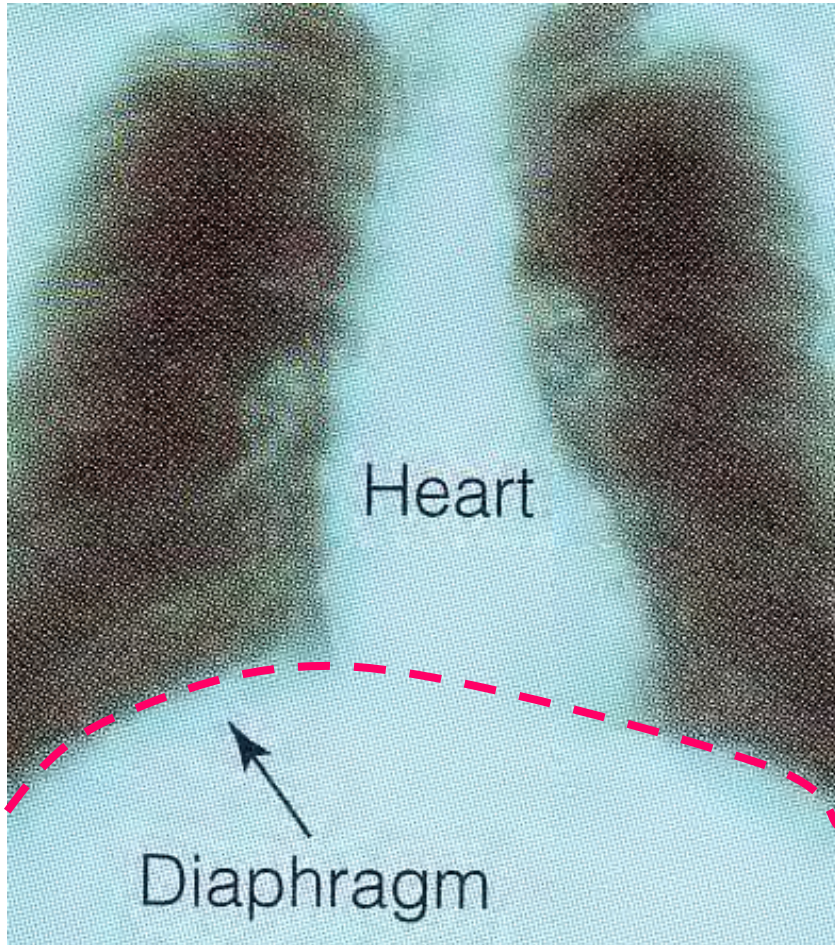
No Gas Exchange

Respiratory Zone



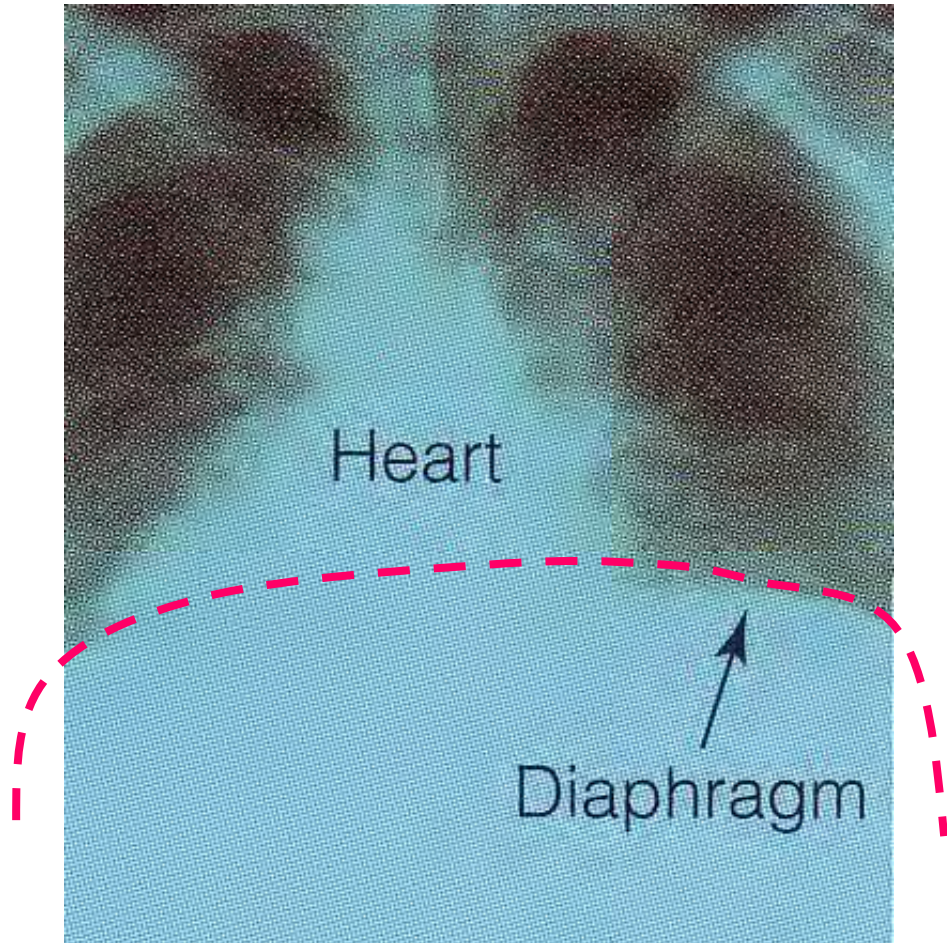
-1st alveolar outpouching!

Gas Exchange



Inhale (active)

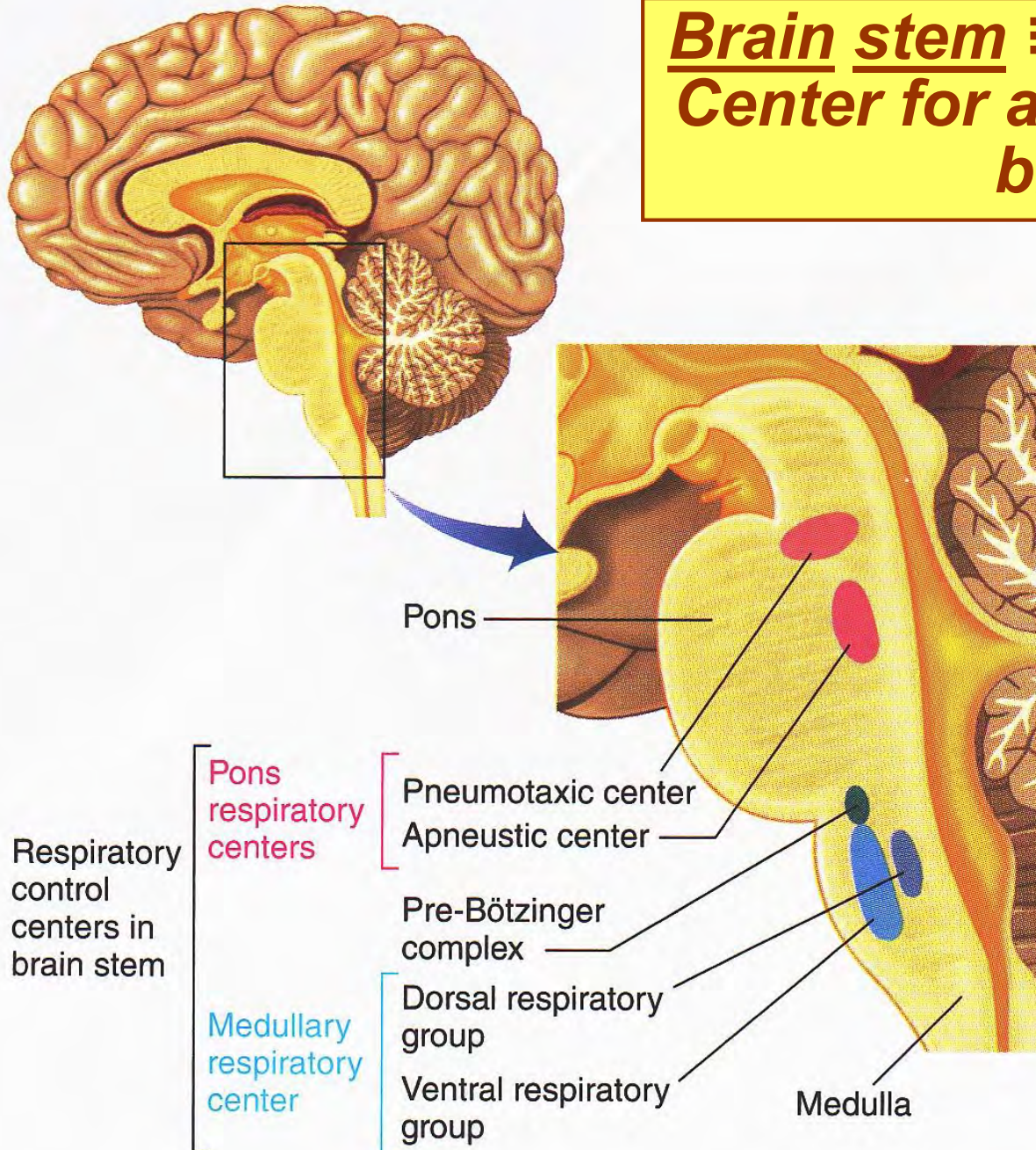
Contract & flatten diaphragm



Exhale (passive @ rest)

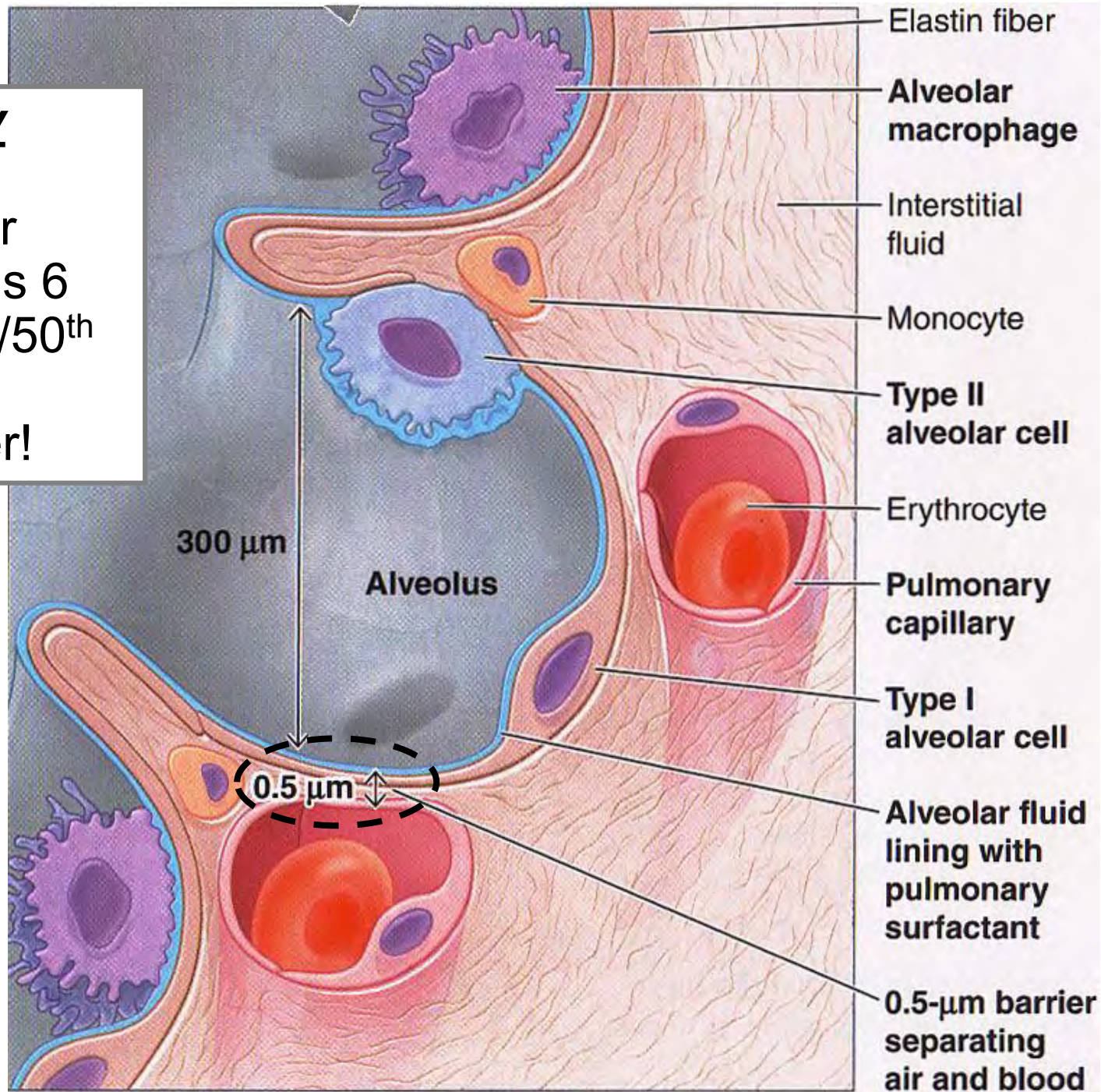
Relax & pouch up diaphragm!

Brain stem ≡ Control Center for automatic breathing!



Respiratory 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)

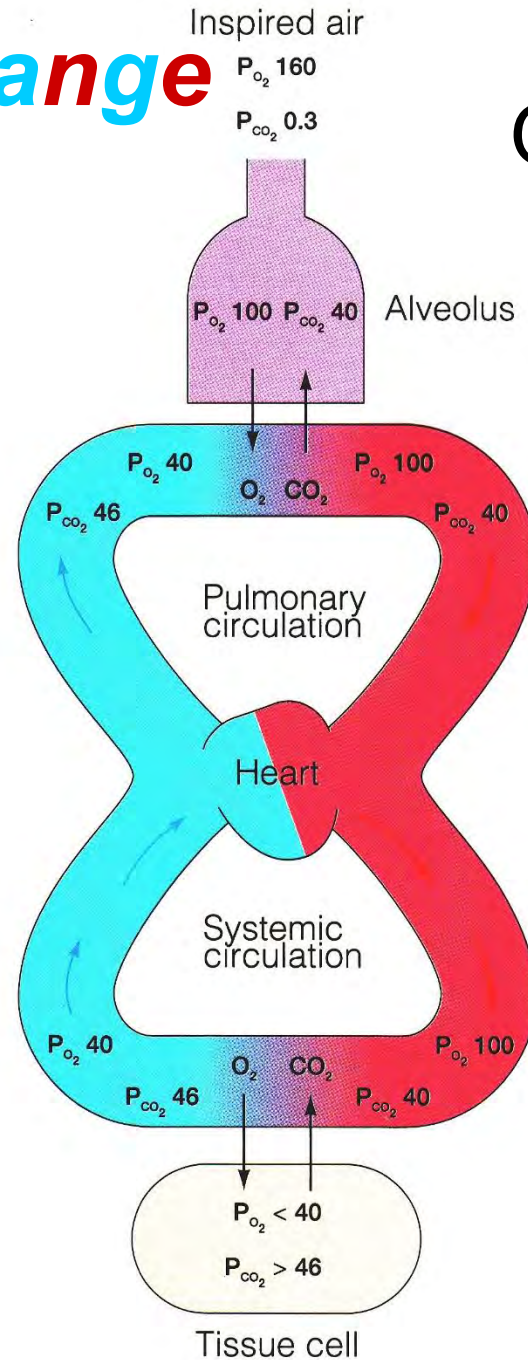
CO₂ partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

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

O_2 is carried mainly by red blood cell hemoglobin!

Polypeptide chain

Polypeptide chain

Each
hemoglobin
molecule carries
4 O_2 on 4 iron-
containing disks!

Carbon monoxide, CO,
binds $\geq 200x$ more
powerfully to these
same sites, thus
poisoning the
hemoglobin!



Polypeptide chain

Heme groups

Polypeptide chain

BI 121 Lecture 17

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



**I. Announcements Exam II Thursday Dec 7th
@ 8:00 am! 12 n lab section report to 112 HUE,
1 pm lab section 130 HUE. Others, except AEC, here!
Discussion-Review, this Thursday, here in 100 WIL!**

**II. Respiratory System Connections LS ch 12, DC Module 7+
LS fig 12-5, 12-6, 12-8, 12-9, pp 349-52**

A. Pulmonary membranes?

B. What happens in a gunshot wound or impalement injury? Pneumothorax?

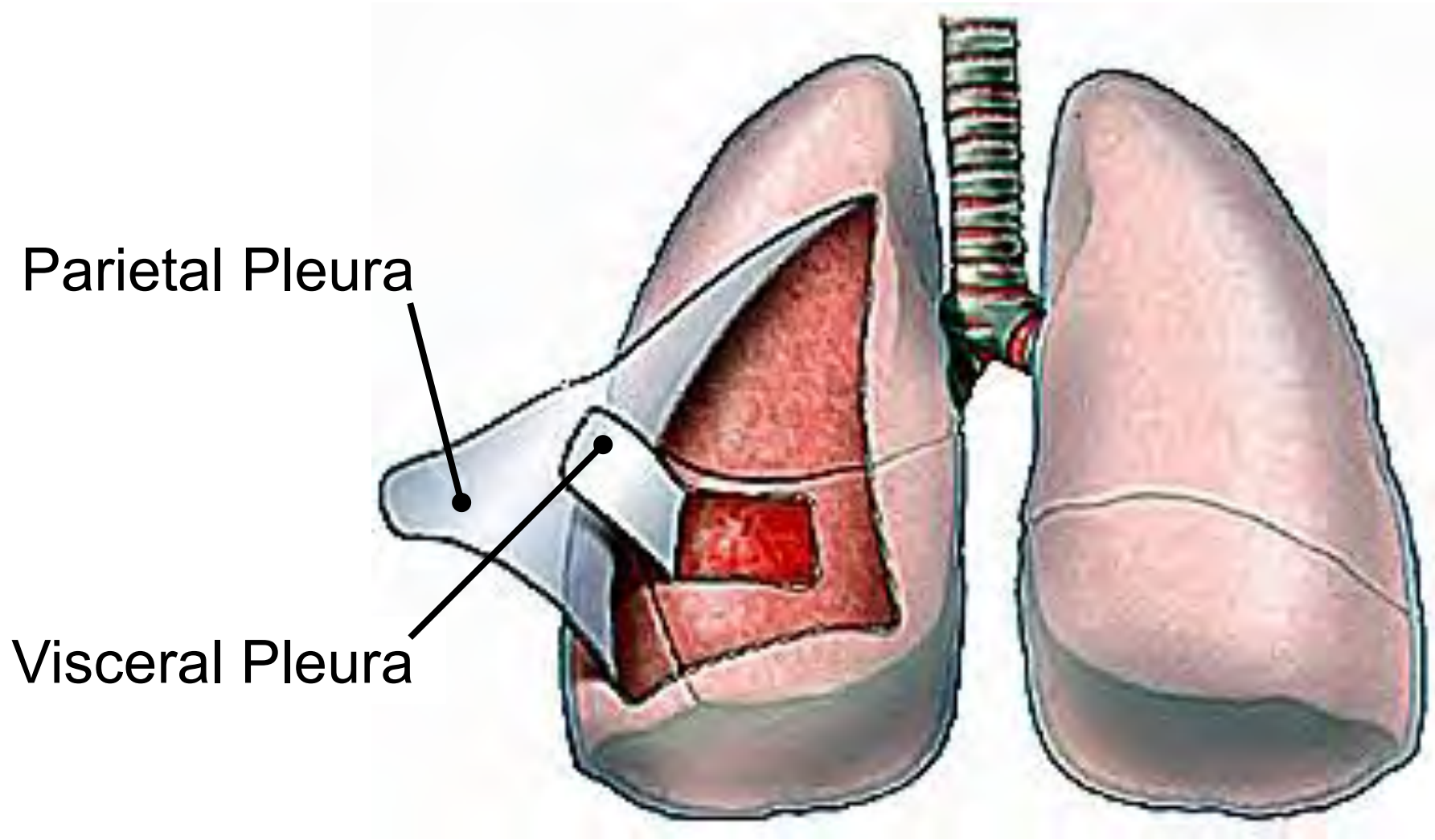
III. Physiology of Cigarette Smoking LS + DC + ACS +...

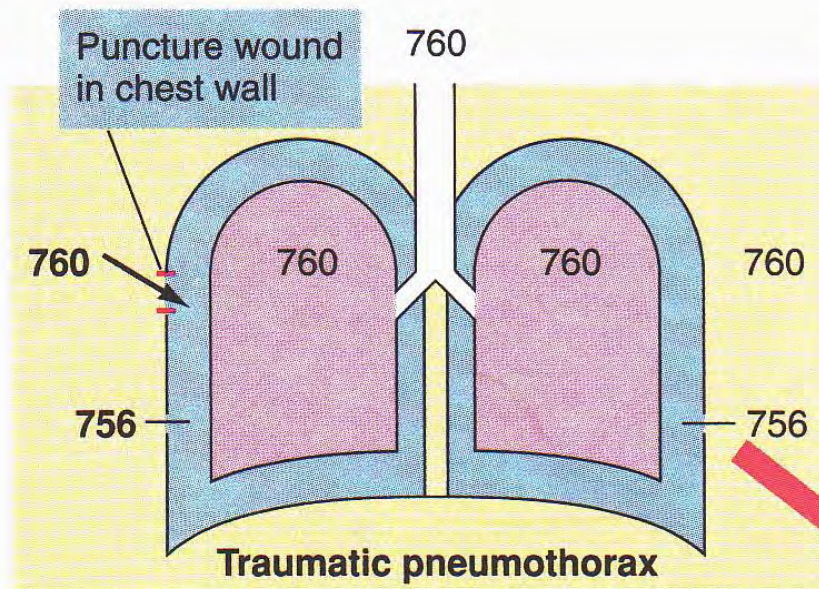
A. ANS, autonomic nerves & nicotine? Chemical route

B. Emphysema? 2nd-hand smoke?... LS p 356, 365

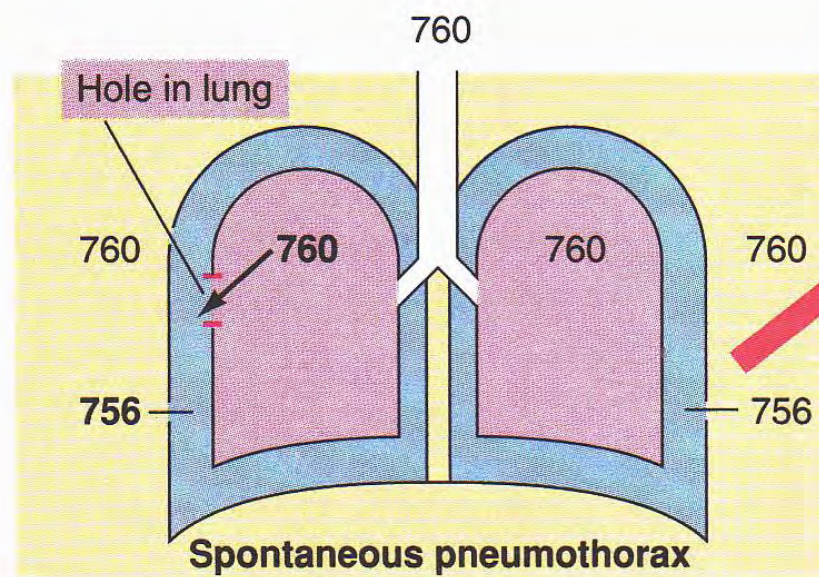
C. UO Smoke-Free since Fall 2012! Help is available!

Pleura/Peritonea/Lung Membranes

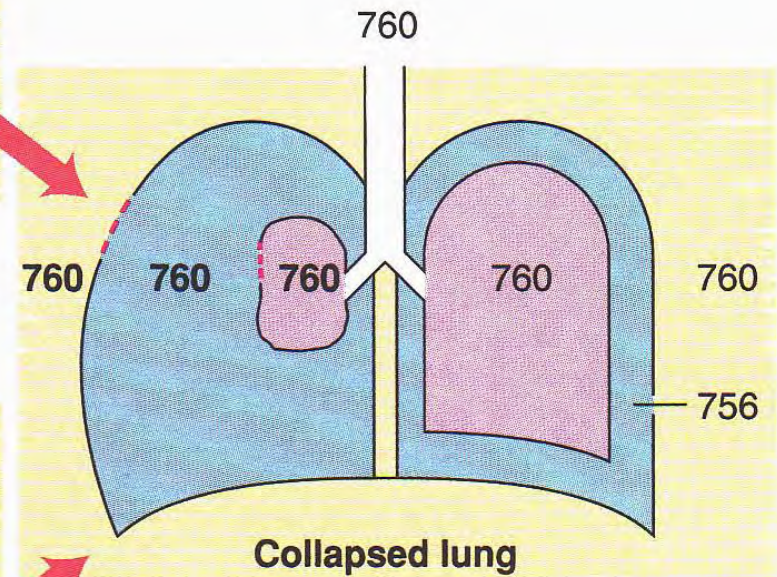




(a)

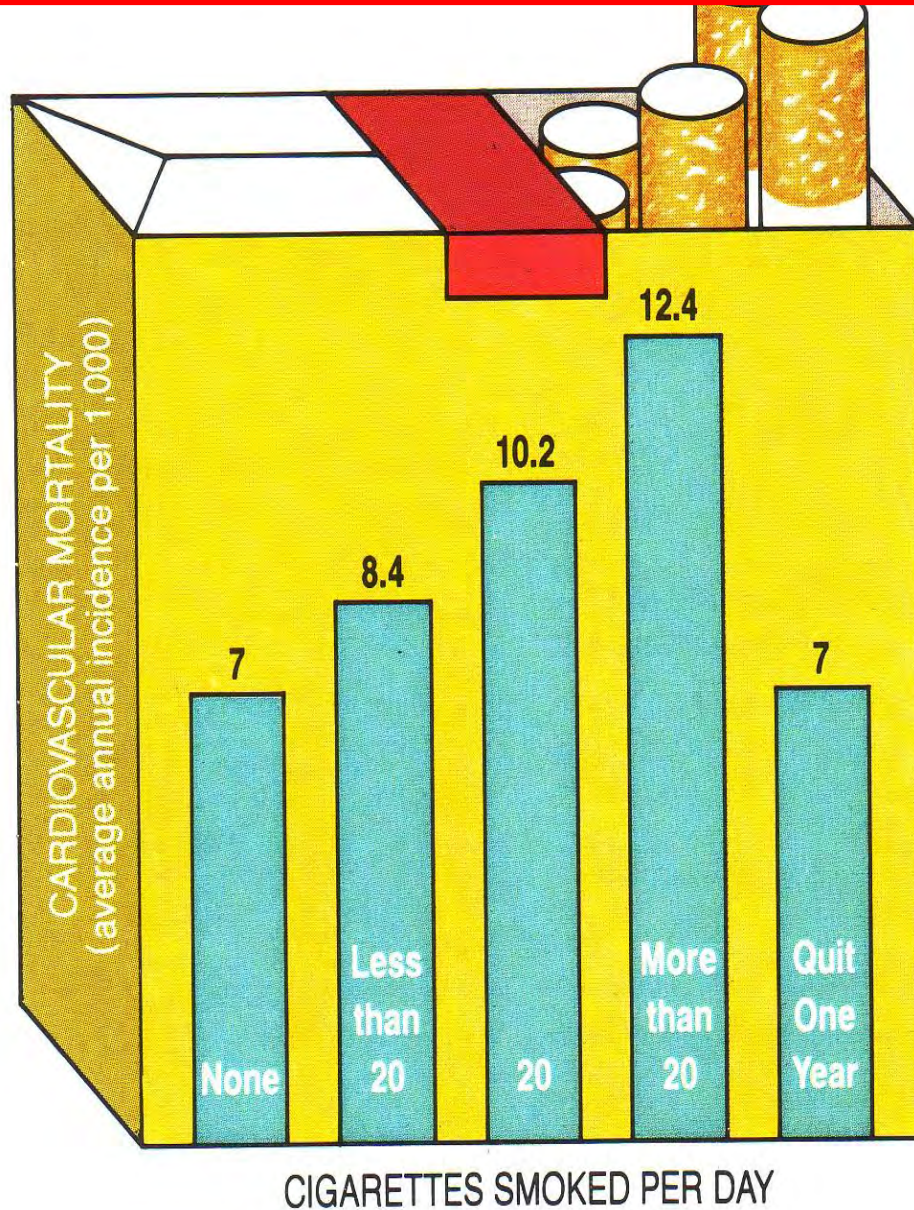


(c)

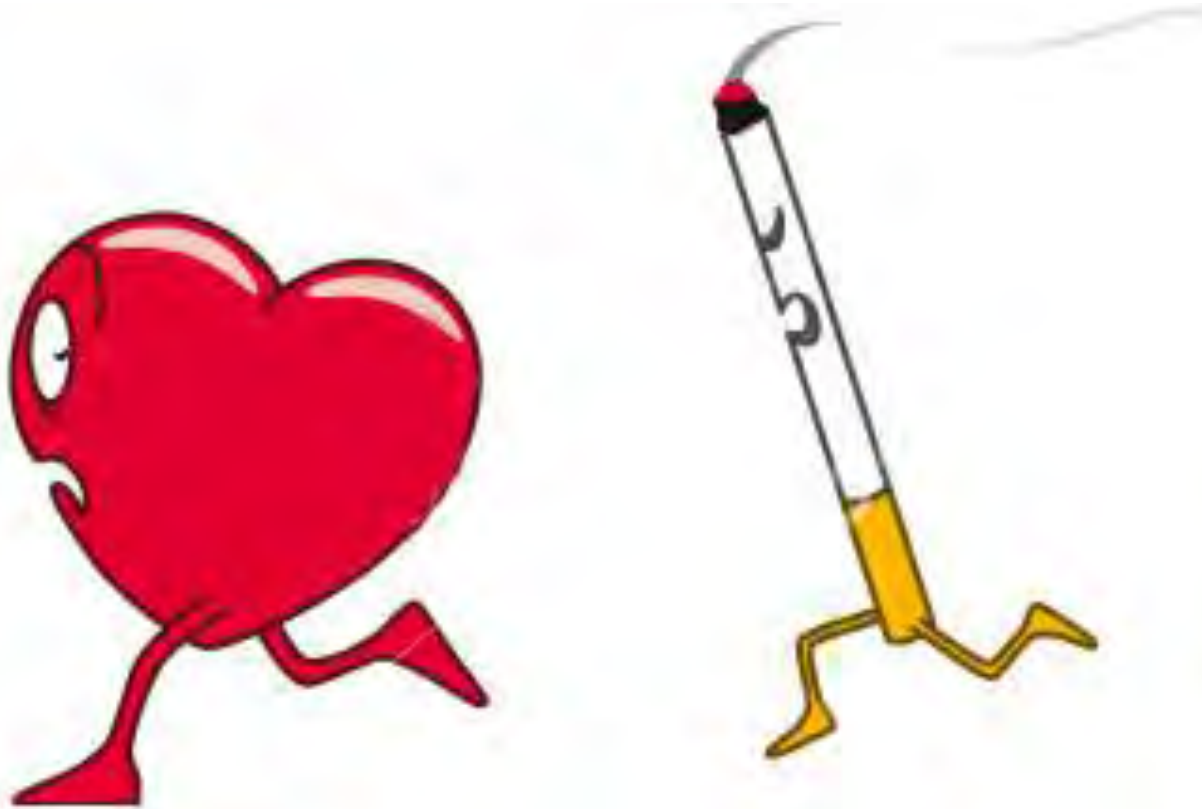


(b)

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)**

**[https://www.cdc.gov/tobacco/data_statistics/sgr/
/2010/consumer_booklet/pdfs/consumer.pdf](https://www.cdc.gov/tobacco/data_statistics/sgr/2010/consumer_booklet/pdfs/consumer.pdf)**

**Cigarette + Smoke: > 7000 Chemicals; ~600 Tobacco Company Additives
Atherogenic, Carcinogenic (C), Tumor Initiating, Tumor Promoting (TP),
Toxic (T), Cornucoppia of Unknowns, Synergistic, Reactive...?**

| | | |
|-------------------------|----|---------------------------------|
| 4-aminobiphenyl | C | 140 ng <u>per cigarette</u> ... |
| benz(a)anthracene | C | 40-200 ng |
| benzene | C | 400 µg |
| benz(o)pyrene | C | 40-70 ng |
| carbon monoxide | T | 26.8-61 mg |
| formaldehyde | C | 1500 µg |
| hydrazine | C | 90 ng |
| hydrogen cyanide | T | 14-110 µg |
| 2-naphthylamine | C | 70 ng |
| nitrogen oxides | T | 500-2000 µg |
| N-nitrosodimethylamine | C | 200-1040 ng |
| N-nitrosodiethanolamine | C | 43 ng |
| N-nitrospyrrolide | C | 30-390 ng |
| phenol | TP | 70-250 µg |
| polonium 210 | C | 0.5-1.6 pCi |
| quinoline | C | 15-20 µg |
| O-toluidine | C | 3 µg |

SOURCES: US Surgeon General's Office, American Cancer Society, American Heart Association.



freebase nicotine!!

Ammonia converts nicotine, the additive agent in tobacco, into a more volatile form, Pankow said. “Ammonia is the thing that helps tobacco companies hook the smoker by providing a means of delivering the nicotine.”

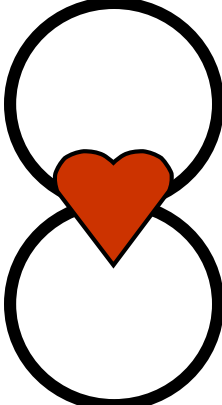
Last October, a former tobacco industry employee revealed that secret industry documents indicated that ammonia was added to tobacco to double the impact of nicotine. Research now indicates that ammonia can boost nicotine availability up to 100x! The Oregon Graduate Institute (now a part of [OHSU](http://www.ohsu.edu)) was the 1st to research!

<http://pubs.acs.org/doi/abs/10.1021/es970402f>
<http://www.nasw.org/users/sperkins/nicotine.html>

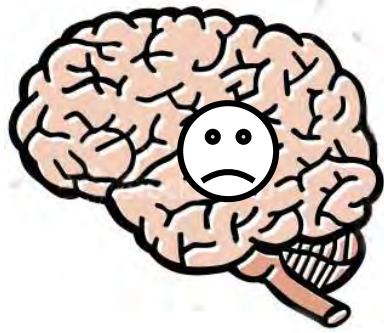
***Cigarettes ≡ Patient-Assisted Drug-Delivery System
Inhaling Bypasses the Systemic Circulation
& Is Powerfully Reinforcing!***



Pulmonary

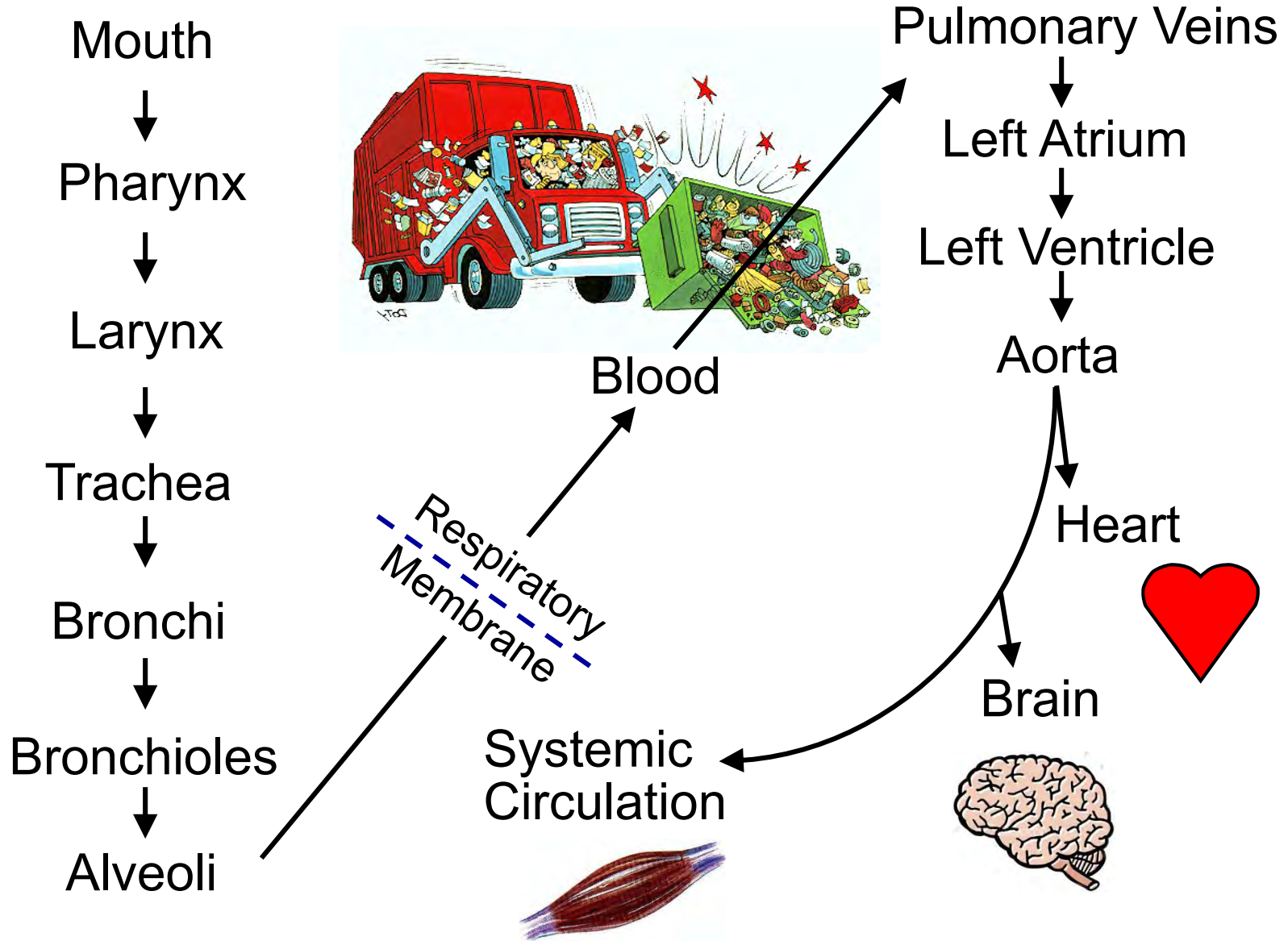


Systemic

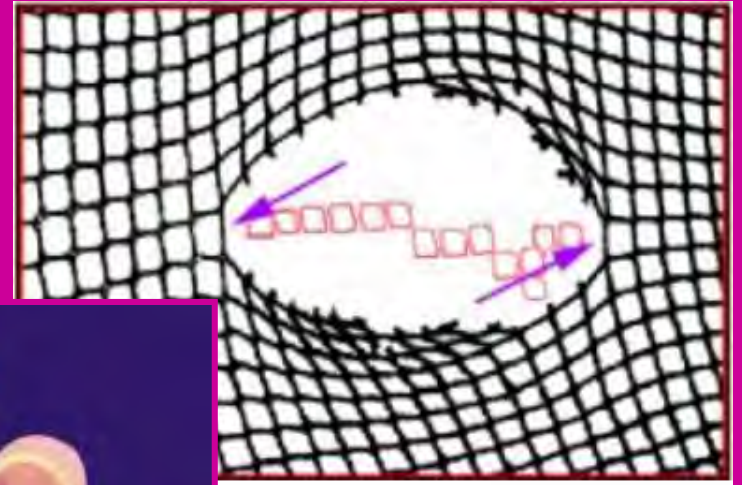
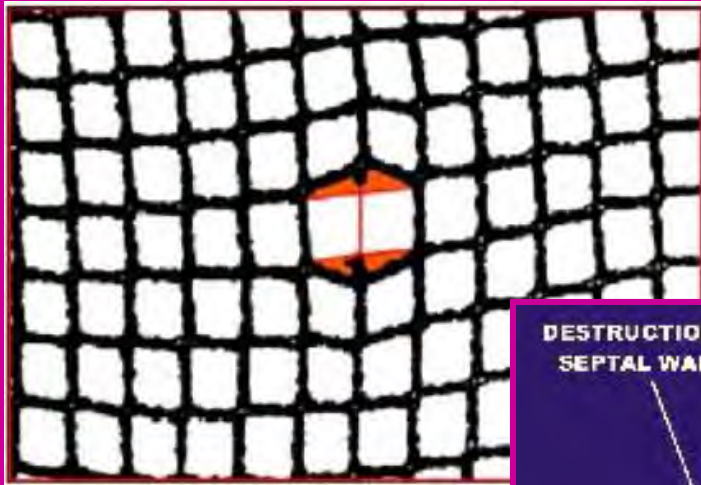


Tracing the Route of Cigarette Smoke

Puff to Brain Time 5 to 8 seconds!!



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



**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!

A photograph of a man in a tuxedo and a woman in a formal dress. The man is on the left, smiling and looking towards the woman on the right. He has a lit cigarette in his mouth. The woman is looking back at him. The background is a soft, out-of-focus grey.

"Mind if I smoke?"

"Care if I die?"

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

News: Health, Toxicology, Pollution

Health risks of e-cigarettes emerge

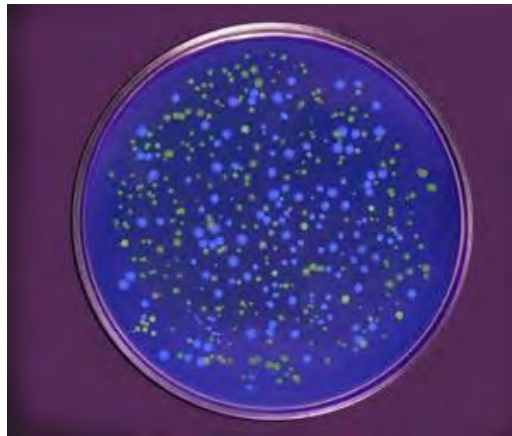
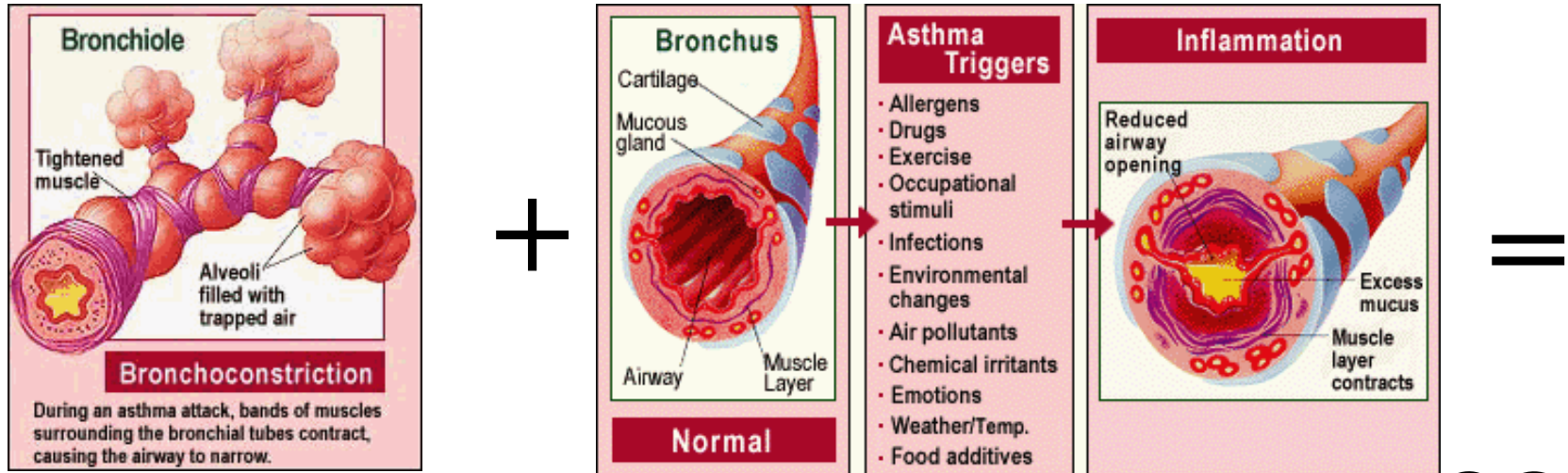
Vaping pollutes lungs with toxic chemicals and may even make antibiotic-resistant bacteria harder to kill

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



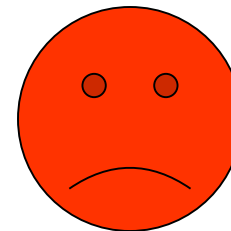
<https://www.sciencenews.org/article/health-risks-e-cigarettes-emerge>

SMOKING ≡ ASTHMA?



**Petri-dish
Effect**

Ugh!!
Cough!
Cough!!



Nicotine Addiction & Help Quitting Smoking

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

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

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

2nd-Hand Smoke Addictive?

<http://www.ncbi.nlm.nih.gov/pubmed?term=2nd%20hand %20smoke%20addictive>

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

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

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