



Exam II Review Slides



Exam II!
Whee!



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 thru 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?

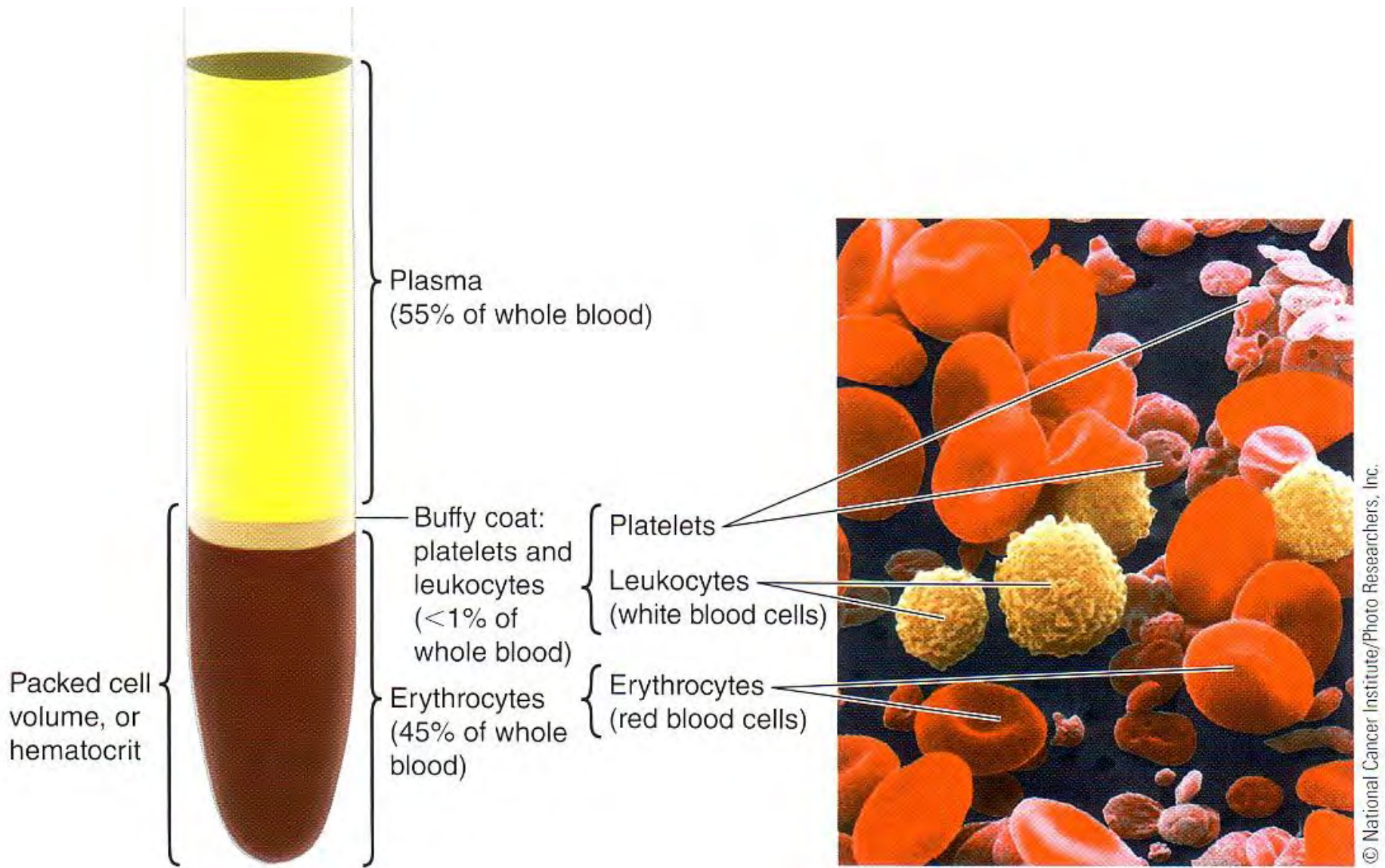
C. Diabetes + Treatment LS ch 17 pp 532-5

IV. Exam Comments & Return

Ghost, marshmallow
or white blood cell?



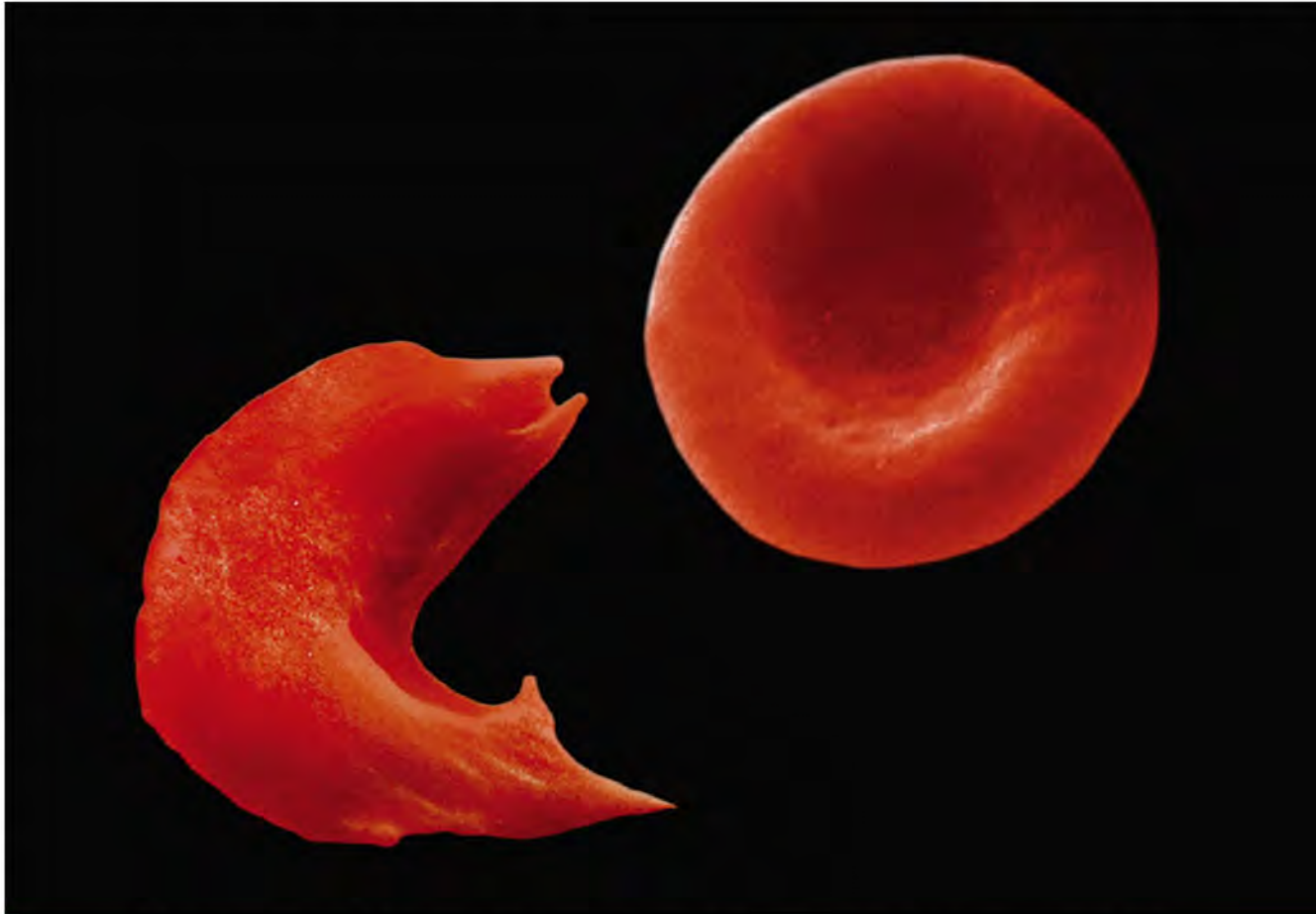
What's in Blood? Plasma & Blood Cells



Sickle-shaped blood cells

Normal red blood cells

© Dr. Stanley Flegler/Visuals Unlimited



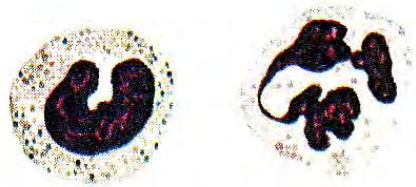
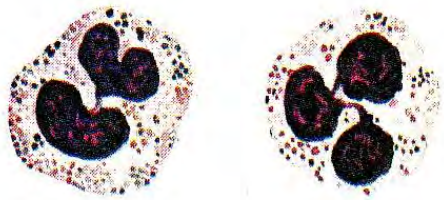
What a difference one amino acid can make!

Amino acid sequence of normal hemoglobin:

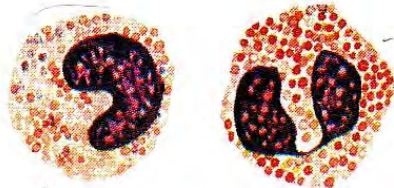
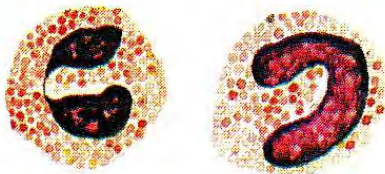
Val — His — Leu — Thr — Pro — Glu — Glu

Amino acid sequence of sickle-cell hemoglobin:

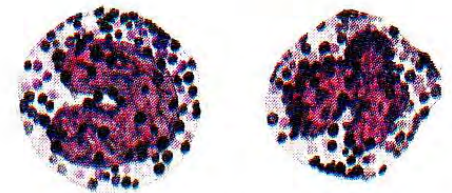
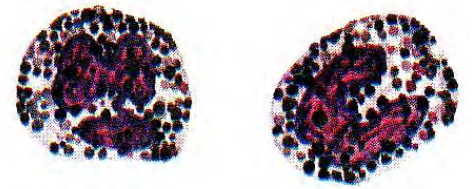
Val — His — Leu — Thr — Pro — Val — Glu



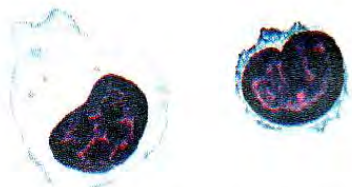
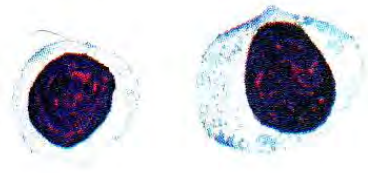
NEUTROPHILS



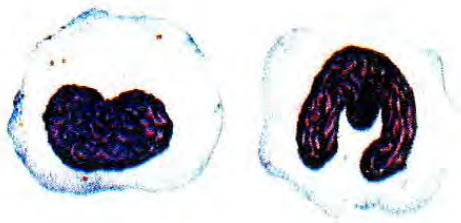
EOSINOPHILS



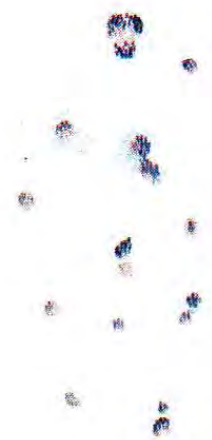
BASOPHILS



LYMPHOCYTES



MONOCYTES



PLATELETS



ERYTHROCYTES

AB



A & B Antigens
(Agglutinogens)

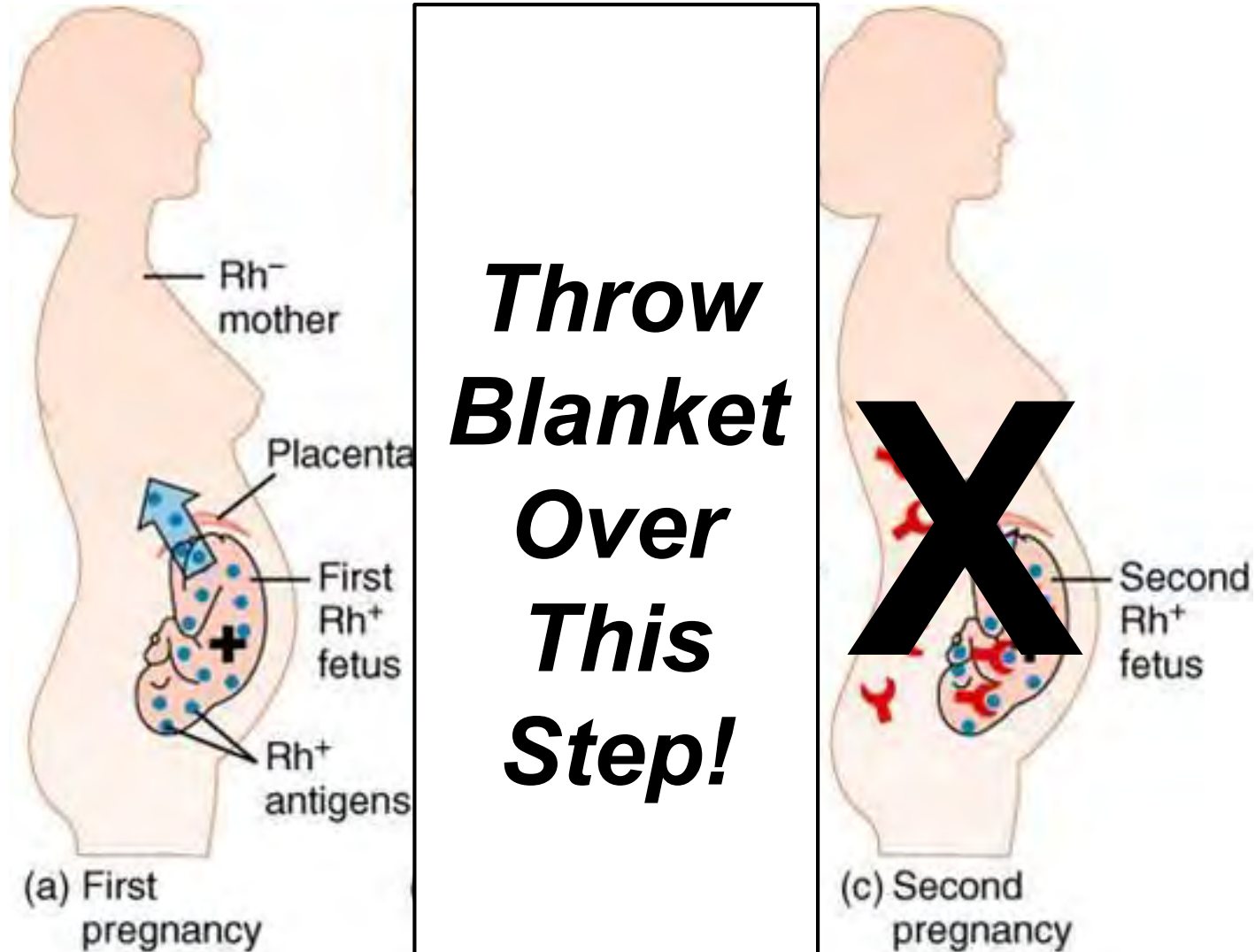
Erythroblastosis Fetalis?

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



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



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

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. Blood Glucose, Insulin Diabetes Connections** DC Module 13+...
- IV. 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**

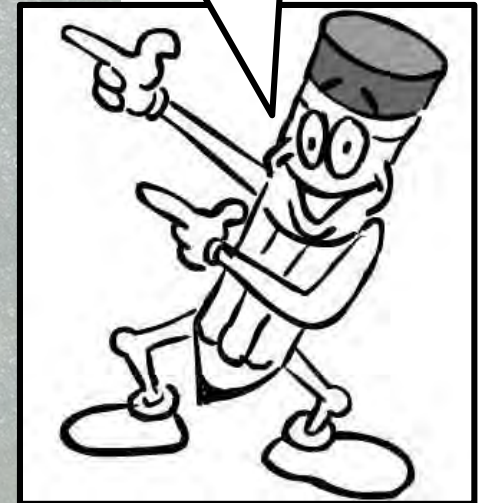
***No food, drink or gum in lab!
Thanks sincerely!***



Glucose:
Sugar in Blood



**NB: Read
& Record!**



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

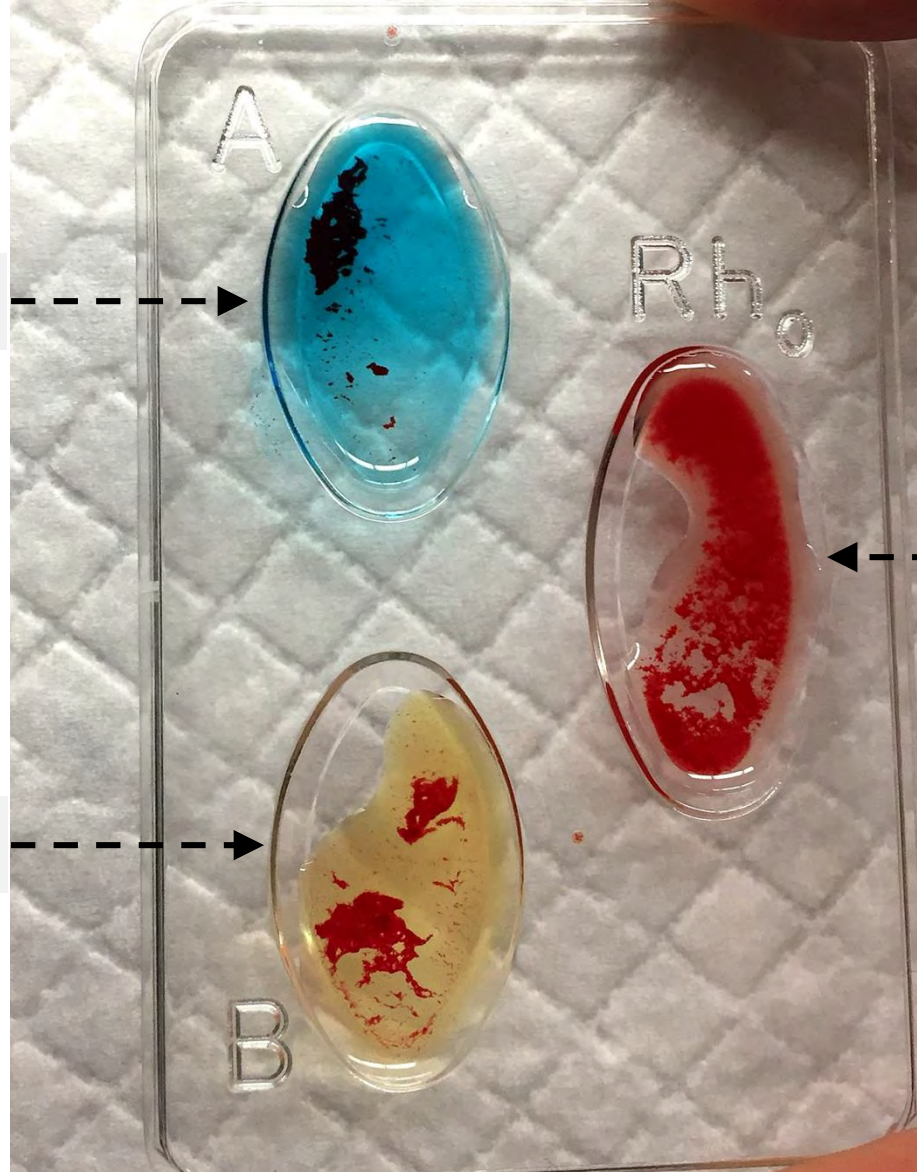
1^o Q? Clumping in Any Wells?

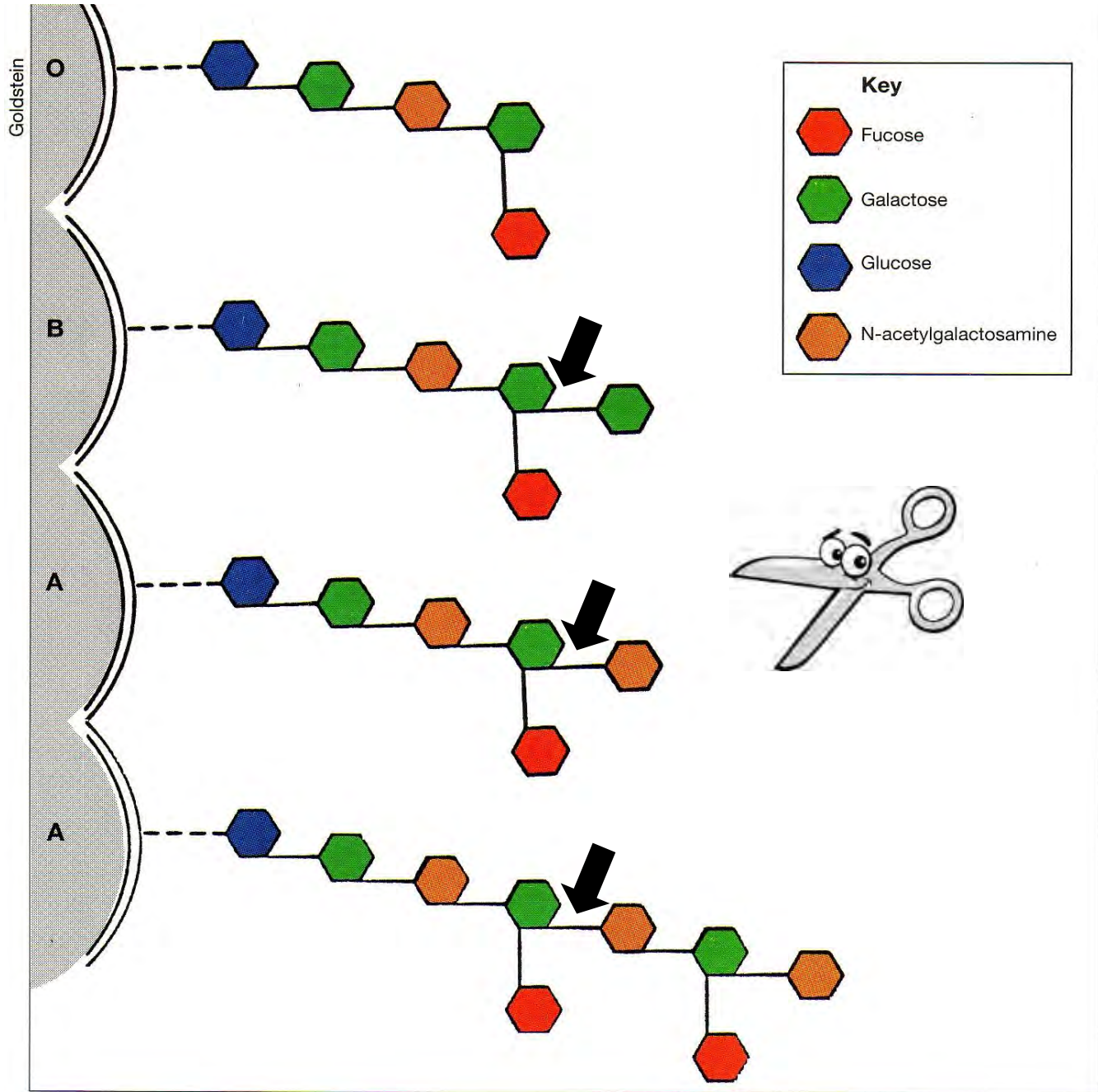
Type AB+

Here?

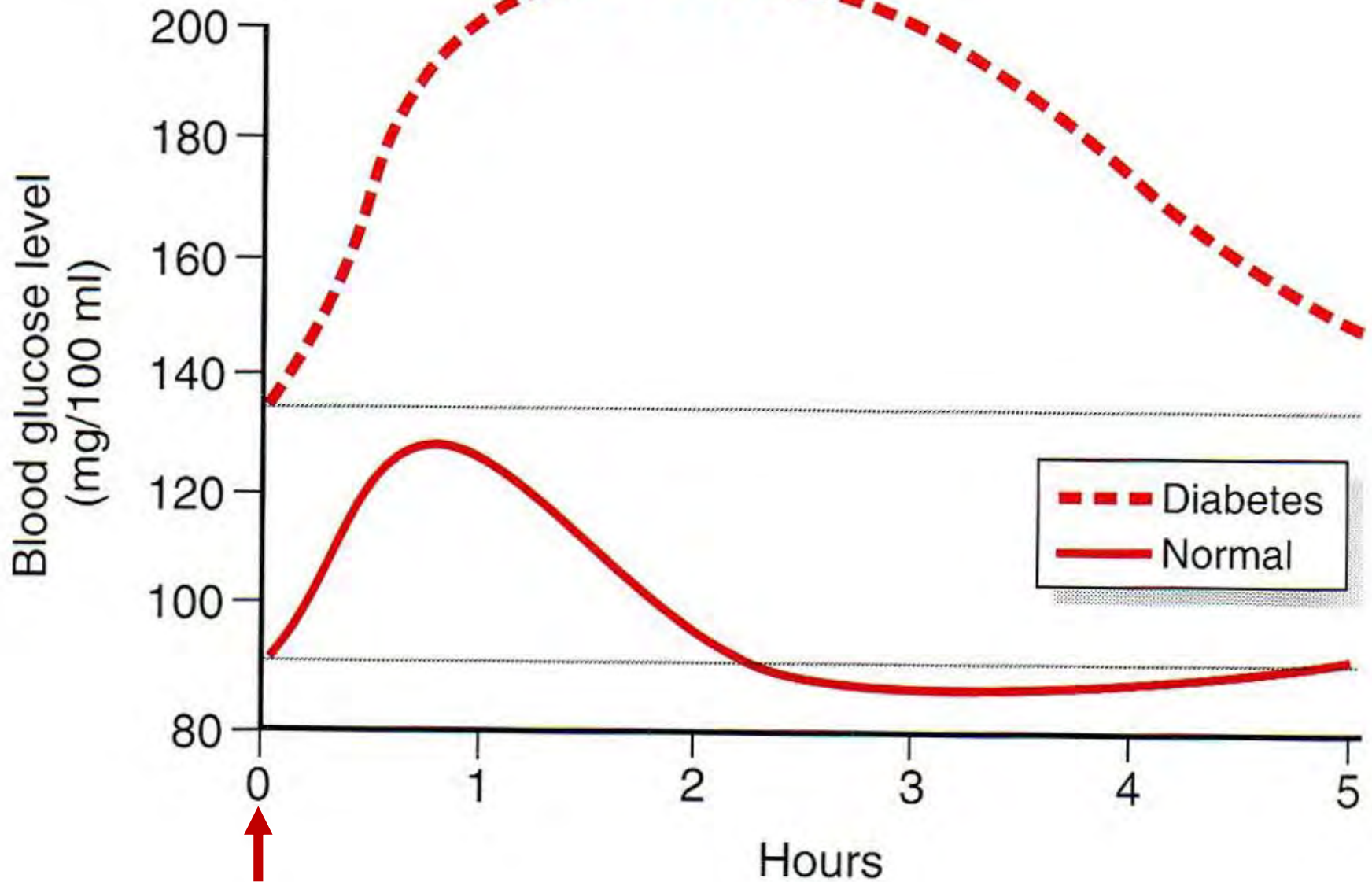
Here?

Here?



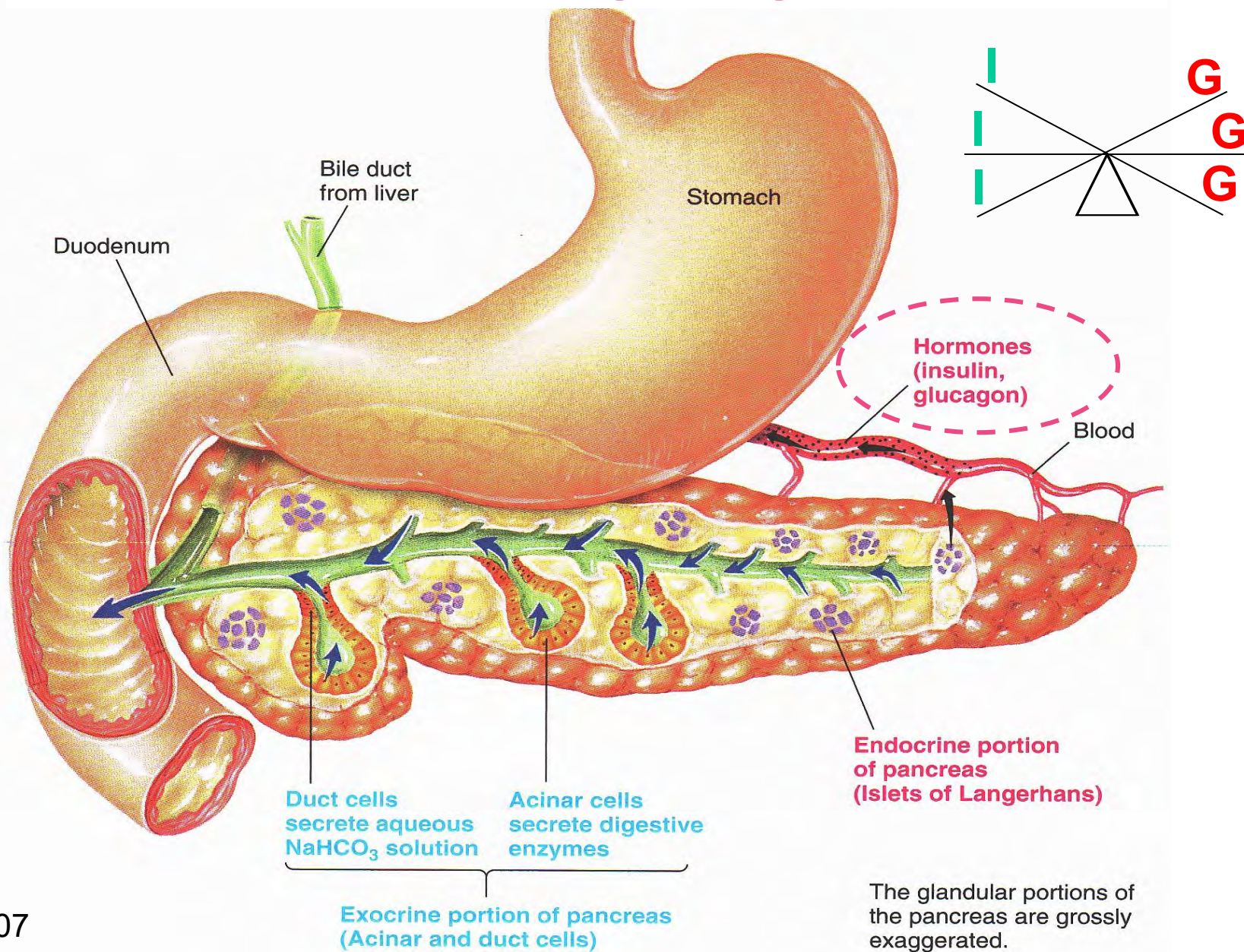


Diabetic & Normal Response to Glucose Load



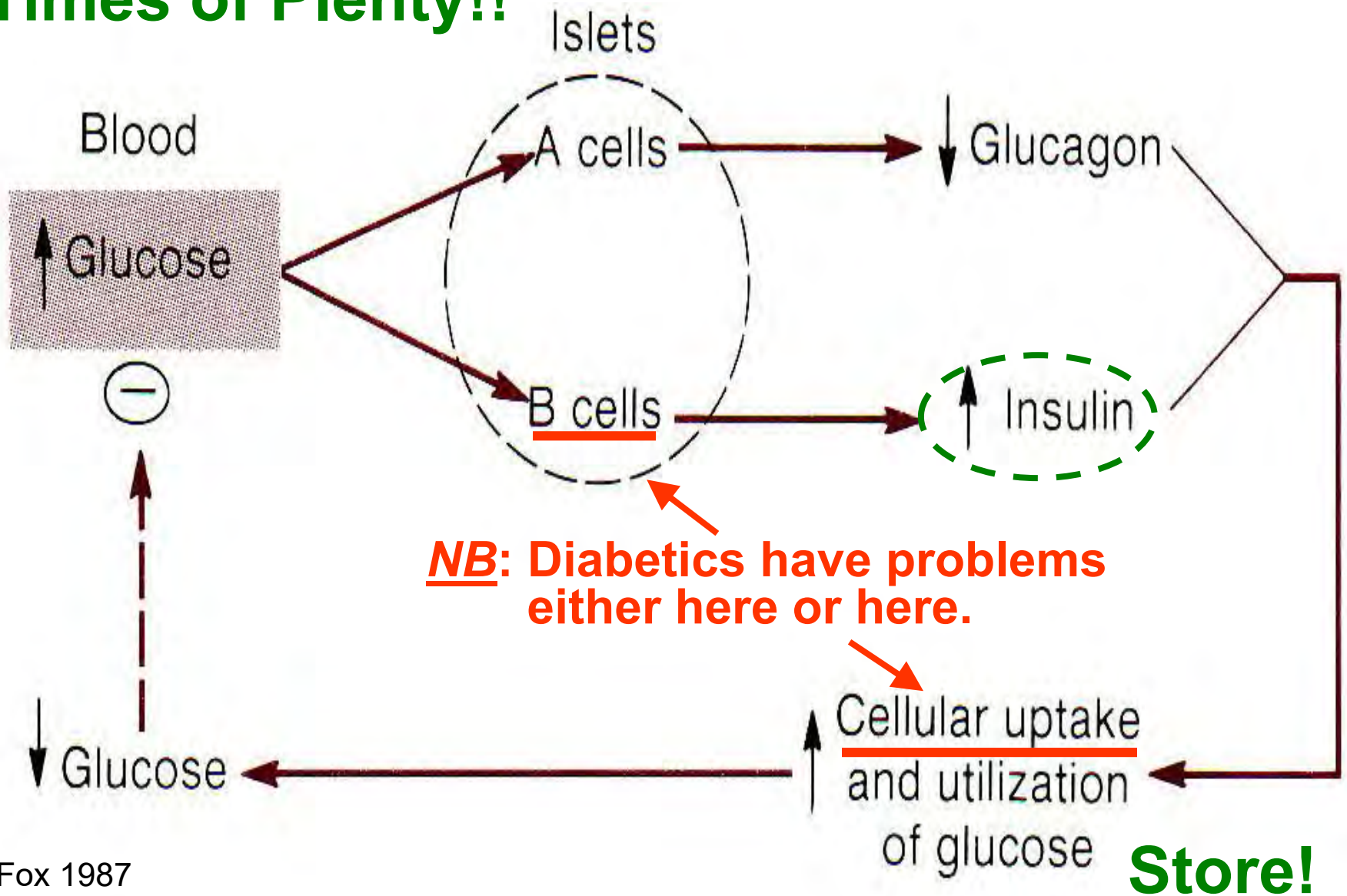
Ingest Glucola or eat meal

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



The glandular portions of the pancreas are grossly exaggerated.

Times of Plenty!!



Fox 1987

<https://ed.ted.com/lessons/what-does-the-pancreas-do-emma-bryce>

<https://www.youtube.com/watch?v=8dgoeYPoE-0>

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!

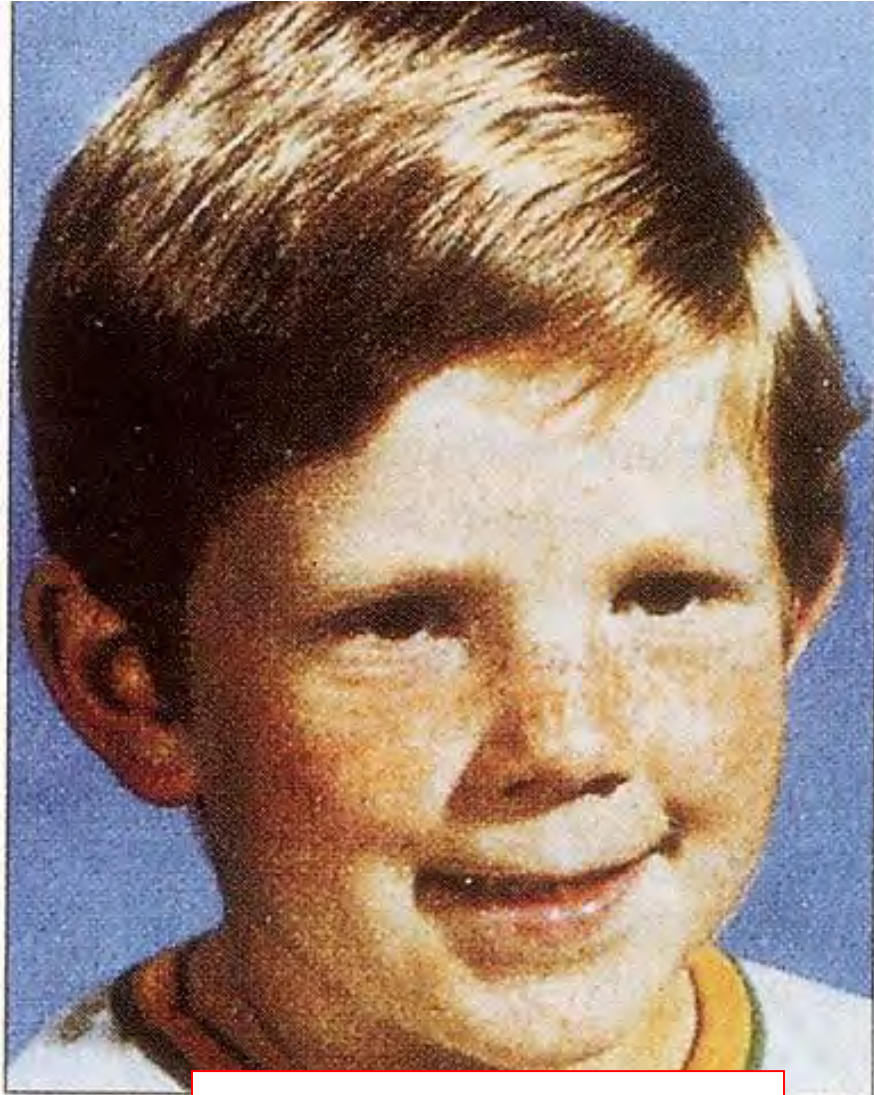
Medication



Exercise

Diet

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



T = 0, near normal

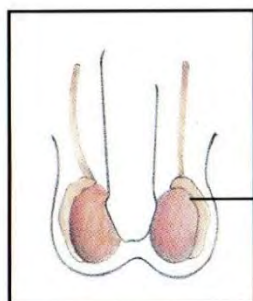


T = 4 months later

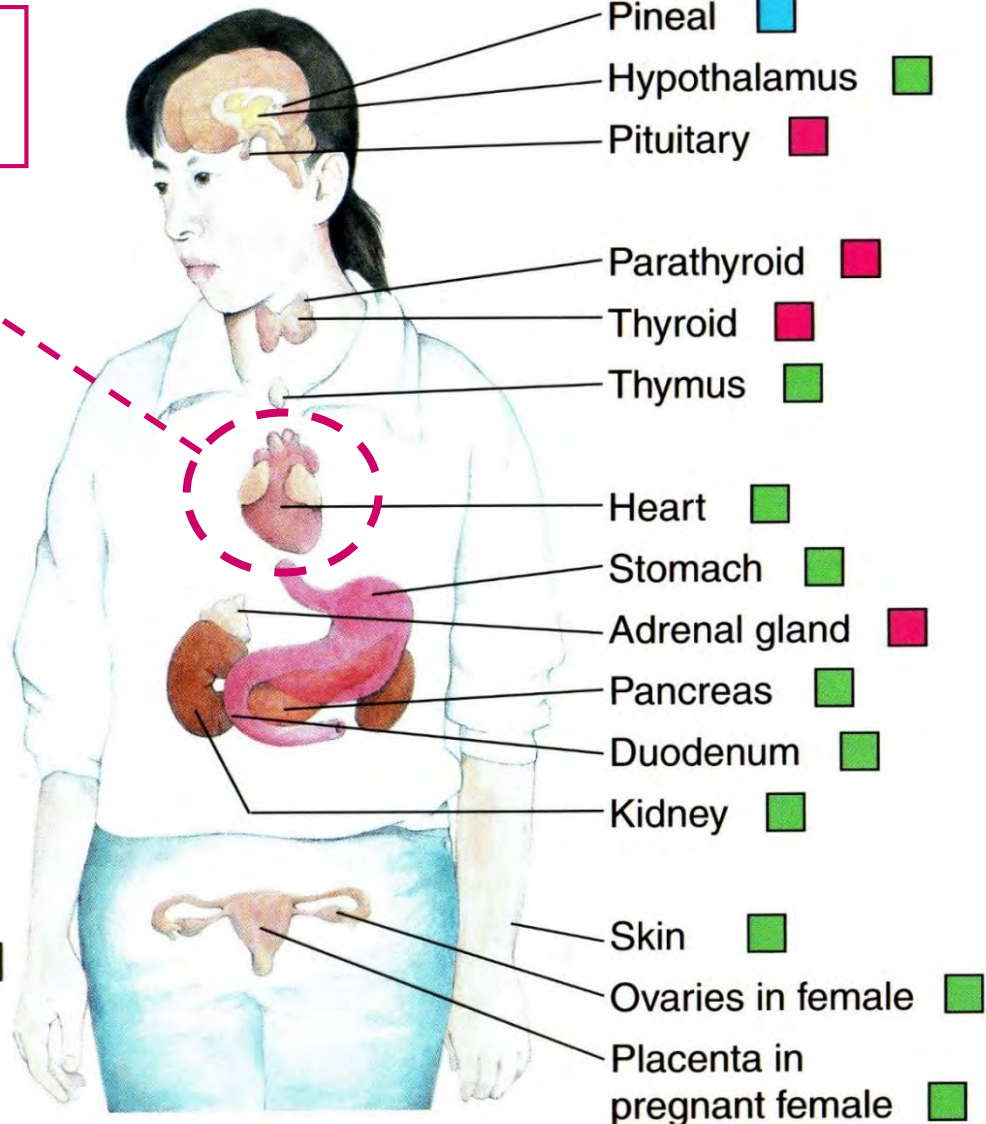
Endocrine System

ANP = Atrial Natriuretic Polypeptide

- Solely endocrine function
- Mixed function
- Complete function uncertain



Testes in male ■



https://www.ted.com/talks/emma_bryce_how_do_your_hormones_work

<https://www.youtube.com/watch?v=IRJE8c3ghRE>

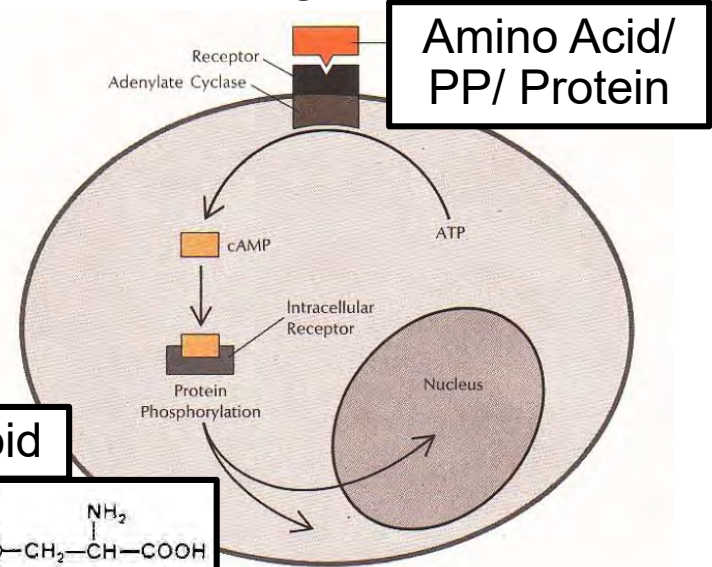
<https://www.hopkinsallchildrens.org/Patients-Families/Health-Library/HealthDocNew/Movie-Endocrine-System>

Hormone/Endocrine Classifications?

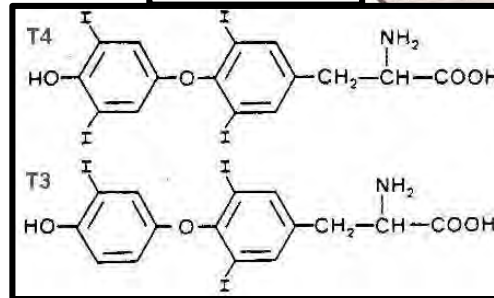
Exogenous



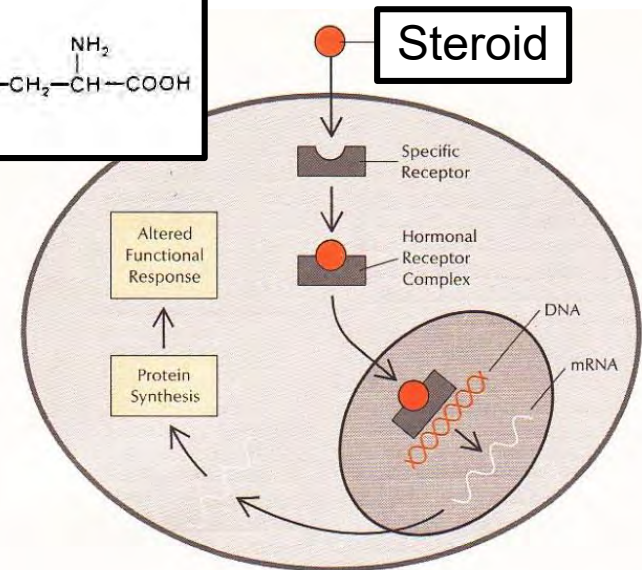
Endogenous

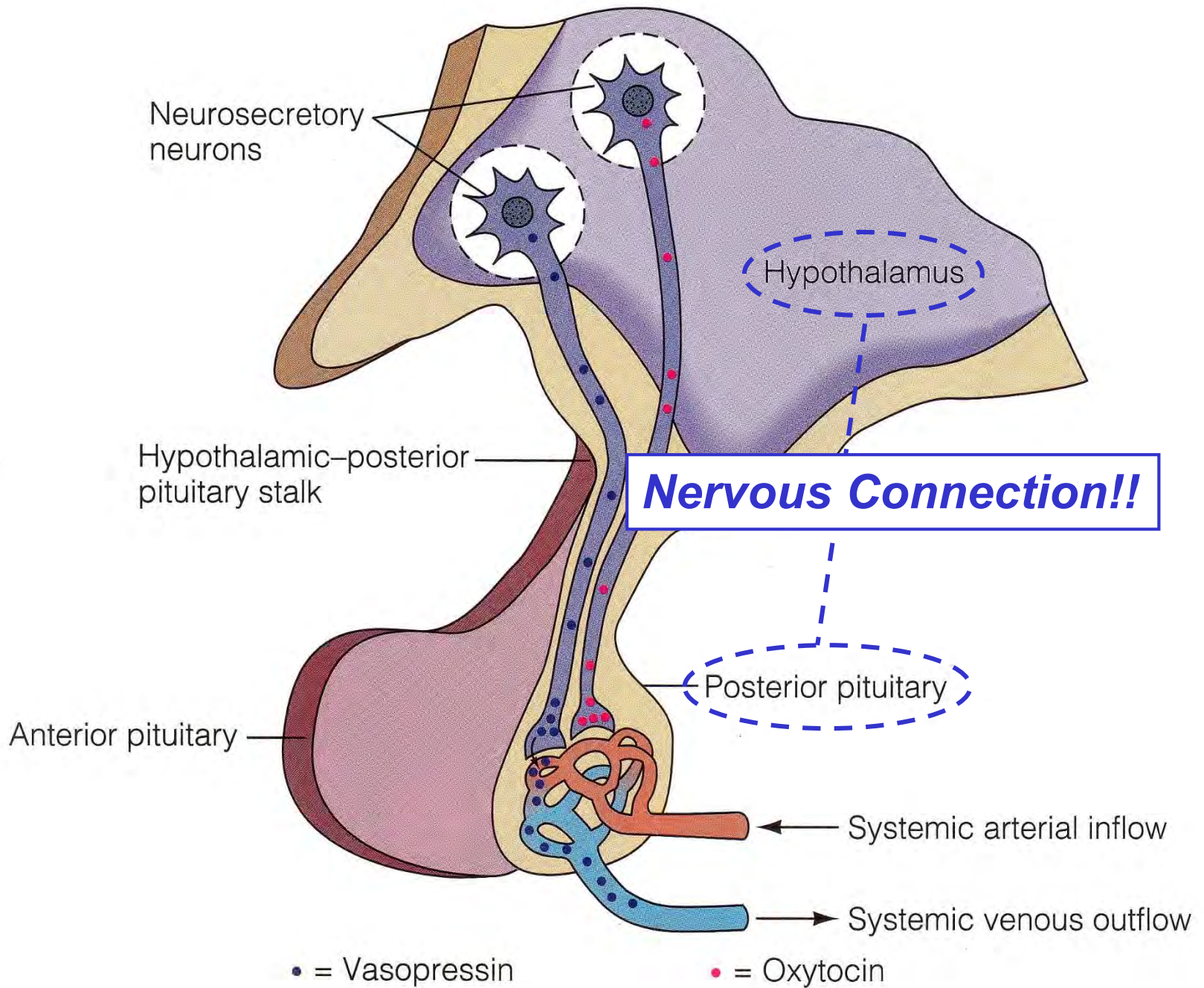


Thyroid

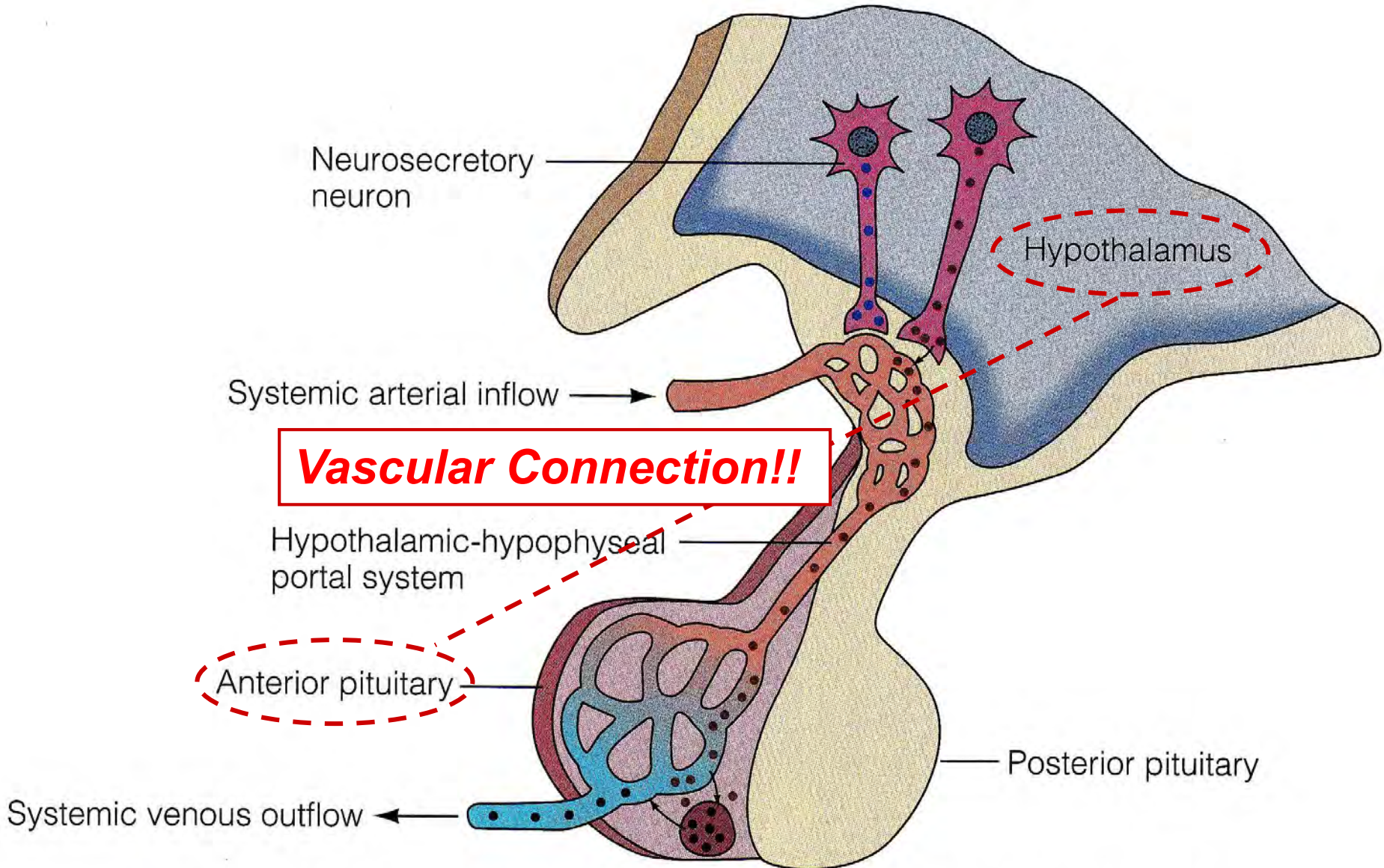


Steroid

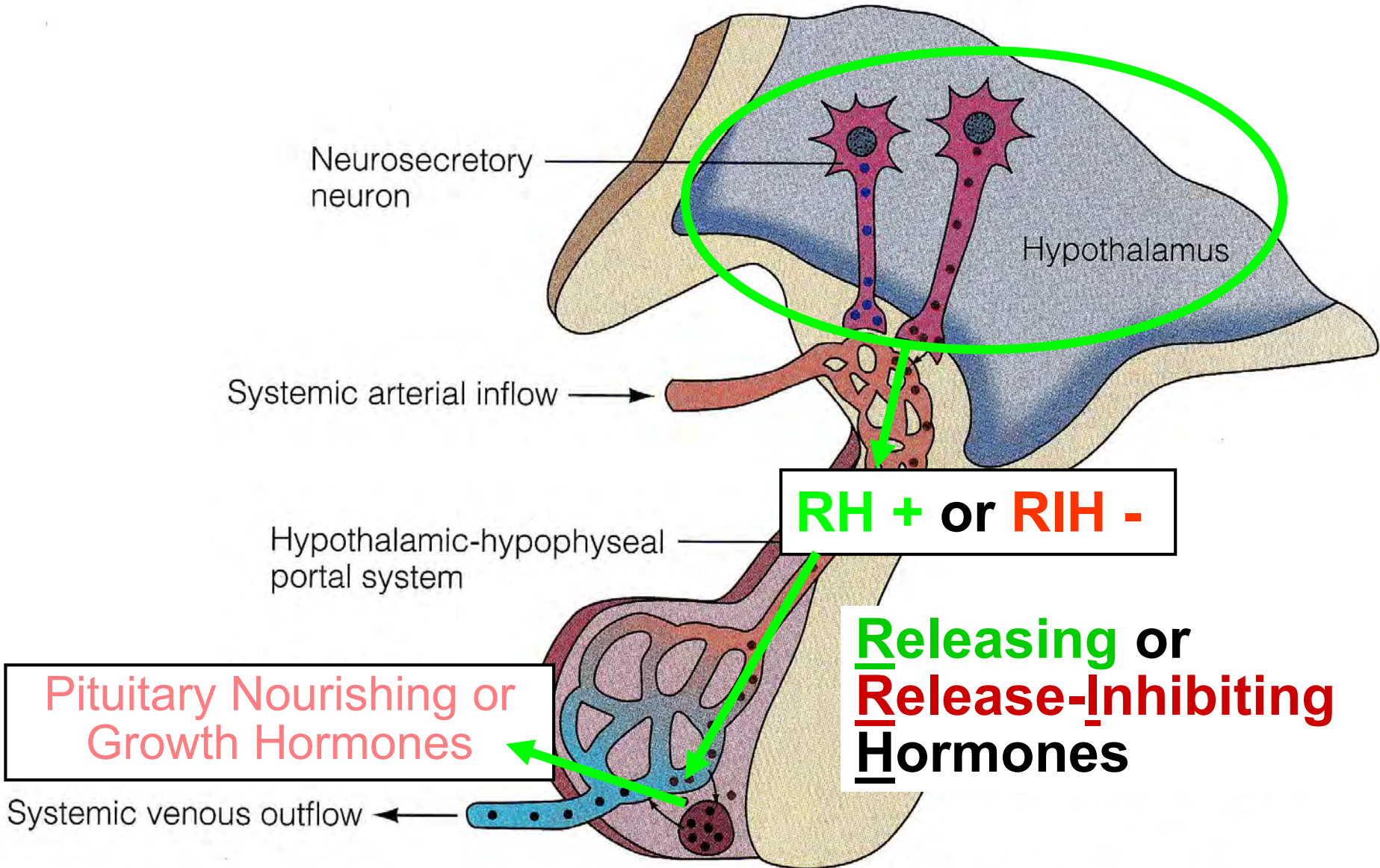




Hypothalamus-Anterior Pituitary Vascular Connection!



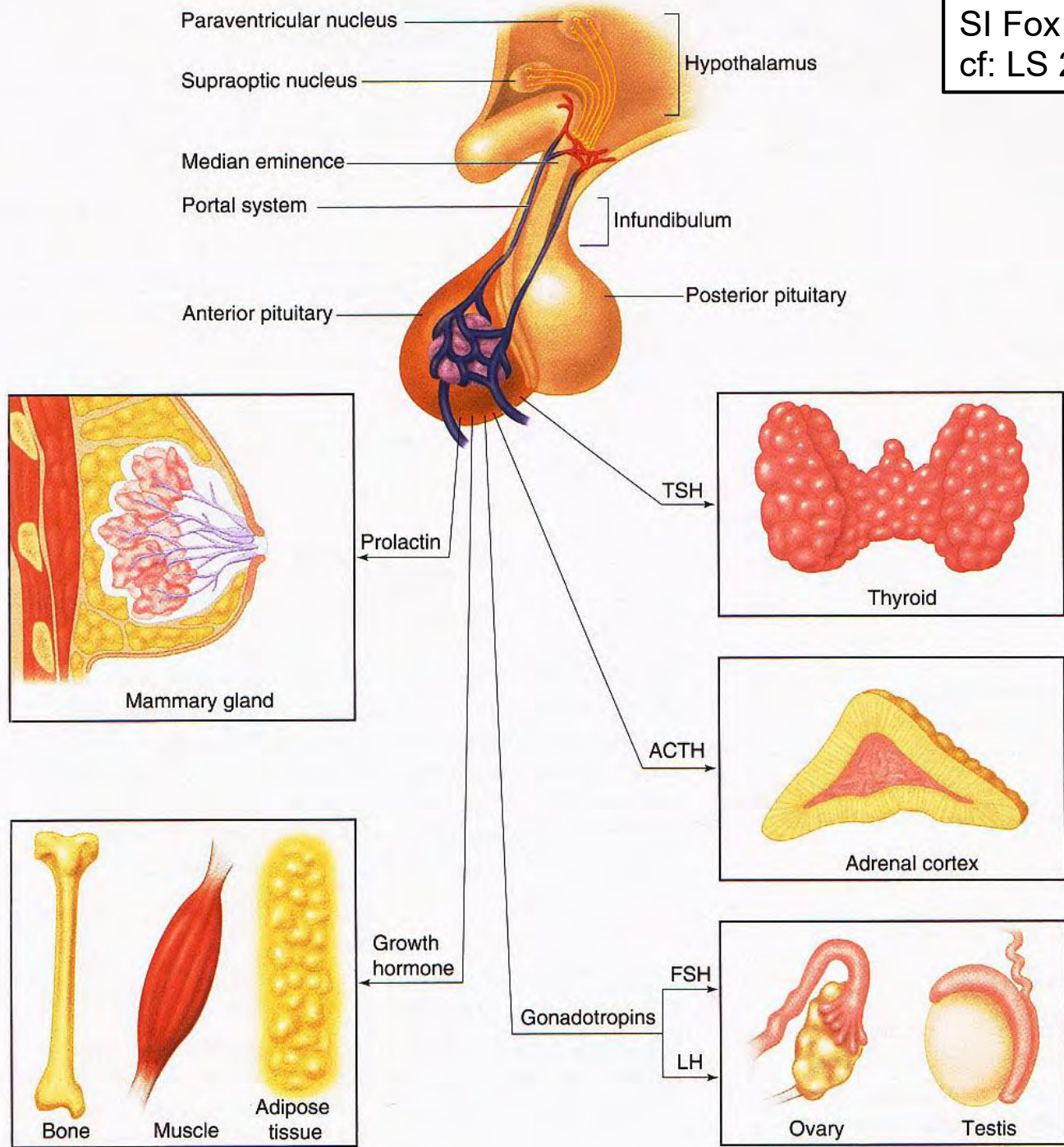
- = Hypophysiotropic hormones
- = Anterior pituitary hormone

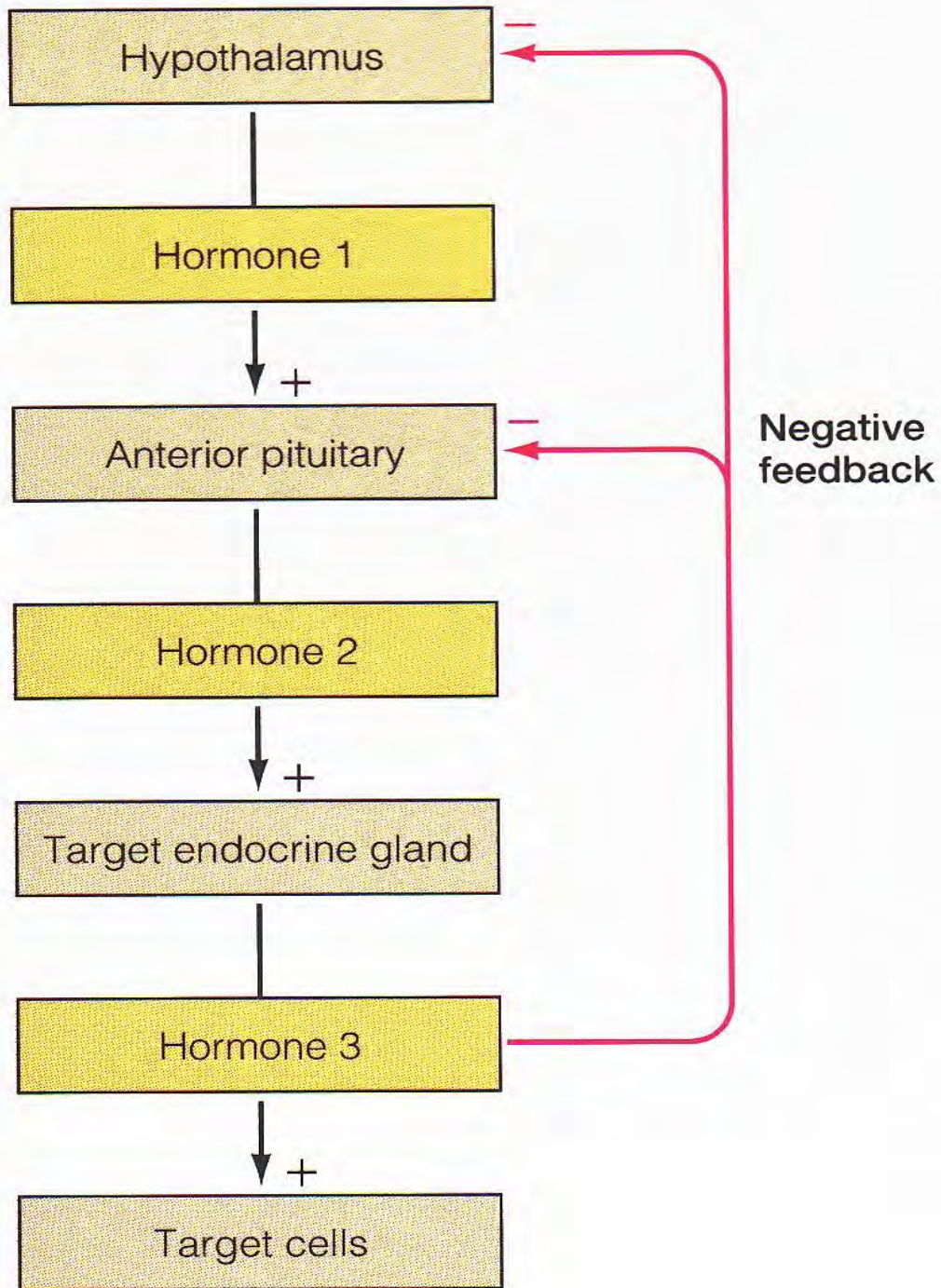


• = Hypophysiotropic hormones

• = Anterior pituitary hormone

Hypophysis ≡ Pituitary





**Often,
more than
simply 1
feedback
loop!**



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

↑ Amino Acid uptake & Protein synthesis

↑ Lipolysis & Fatty Acid mobilization

↓ Glucose uptake
(skeletal muscle & adipocytes)

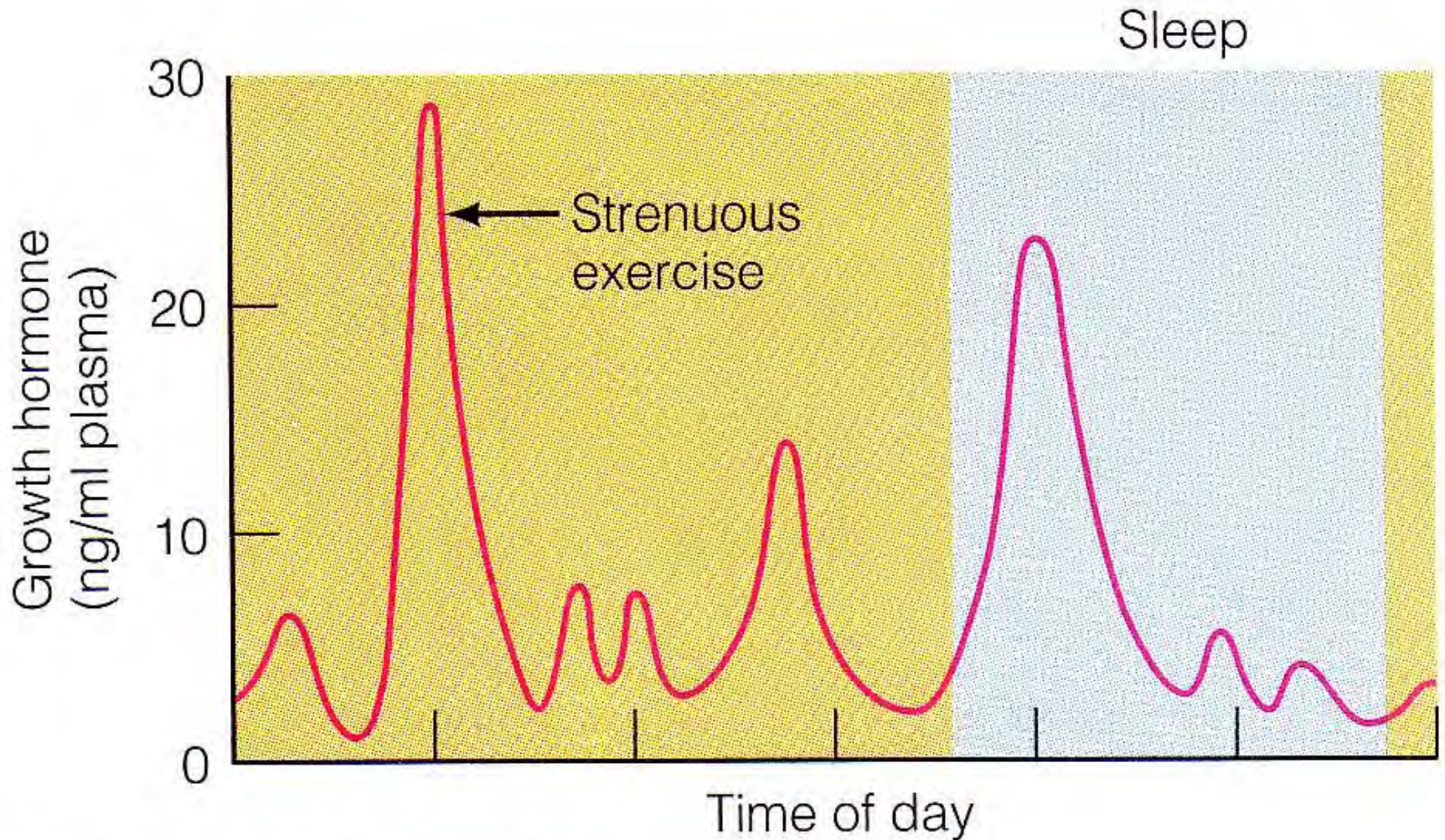
↑ Glucose production
(liver glycogenolysis)

↑ Insulin secretion

Mismatch!!



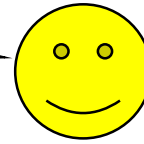
Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per milliliter

BI 121 Lecture 11

Personal data I can use for a lifetime!!

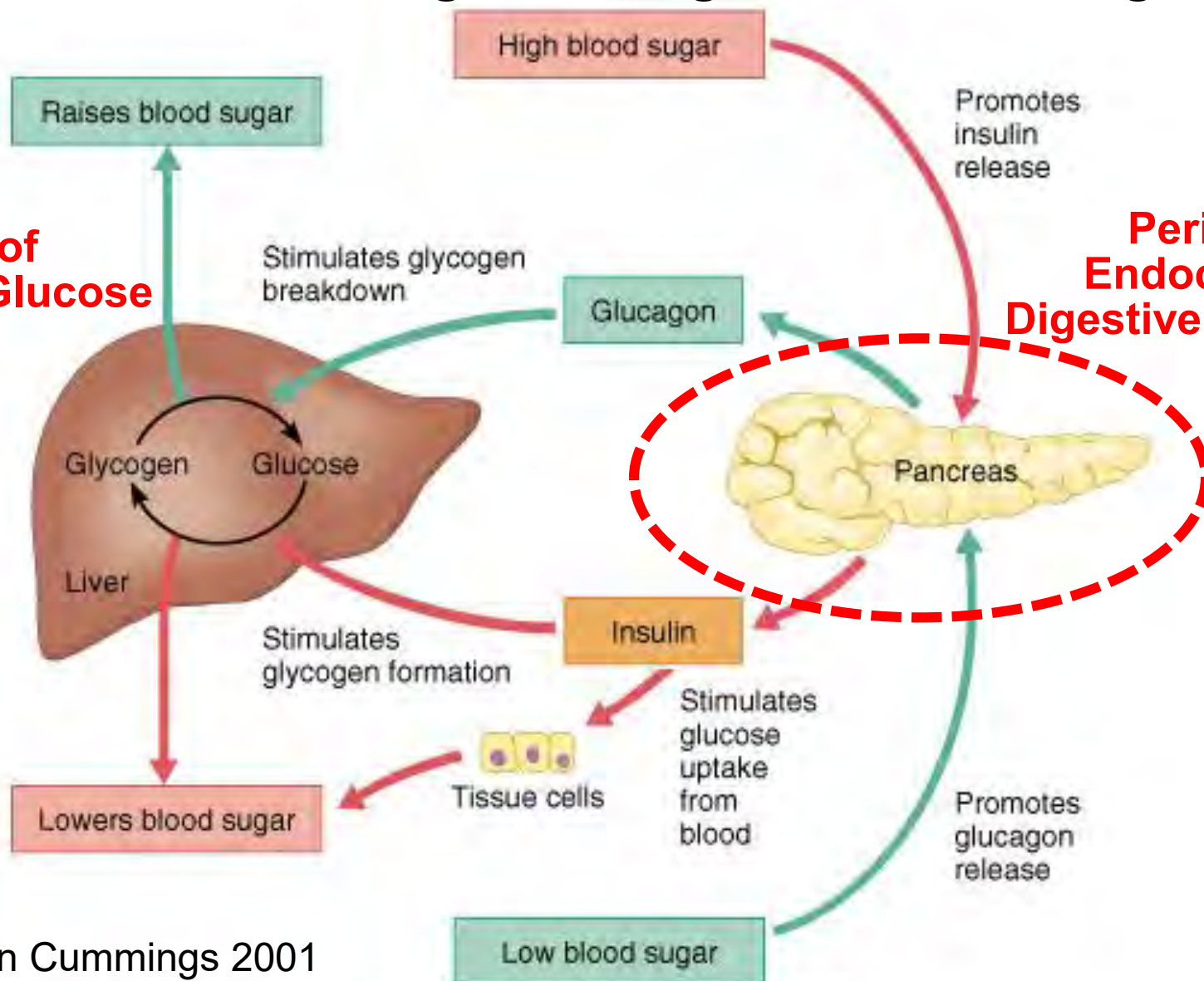


Heck yeah!

- I. Announcements **Blood Chemistry Lab today!** Fun!!
Personal data!!! If you haven't already done so, please review Lab 5 in LM & in e-mail. Thanks! Q from last t?
- II. **Safety & Techniques Review for Blood Chem Lab** Q?
- III. **Endocrine Connections** Peripheral endocrine organs
DC pp 109-13, LS pp 513-36
 - A. Pancreas (insulin – glucagon see-saw!)
 - B. Thyroid
 - C. Adrenals
- IV. **Introduction to the Nervous System** LS ch 5, DC Module 9
 - A. Organization? LS fig 5-1 DC p 67
 - B. Neurons? What kind? Classes? Velocity? LS fig 5-2, 5-4
 - C. 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, 2013 & 2014*

Insulin Stores Sugar, Glucagon Mobilizes Sugar!

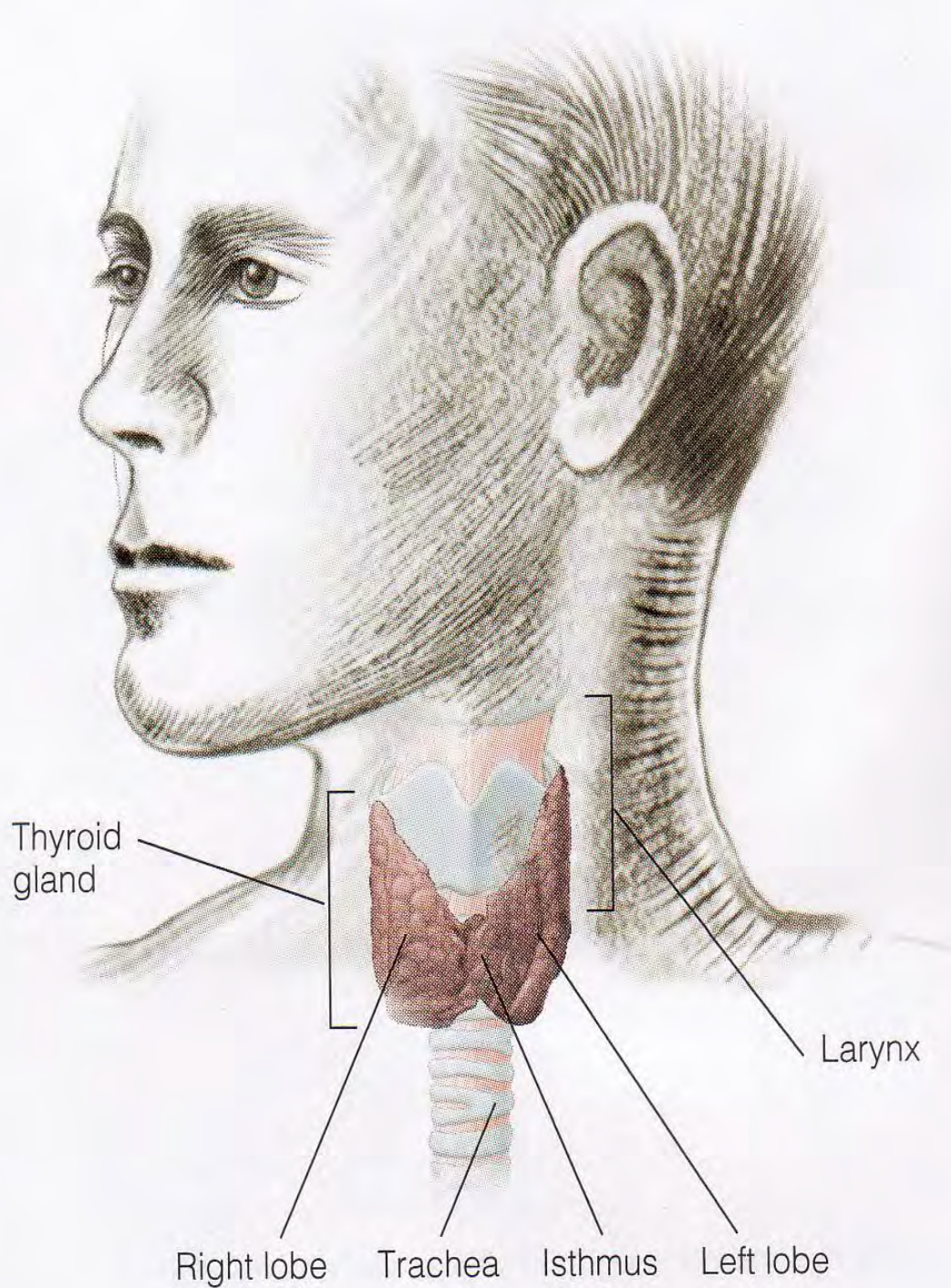
**~ 4-6 hr of
Stored Glucose**



Benjamin Cummings 2001

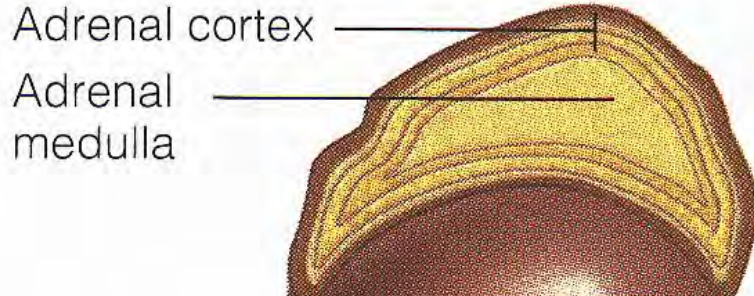
<https://www.youtube.com/watch?v=y9Bdi4dnSlg>

<https://www.fuseschool.org>





Adrenal gland



Kidney

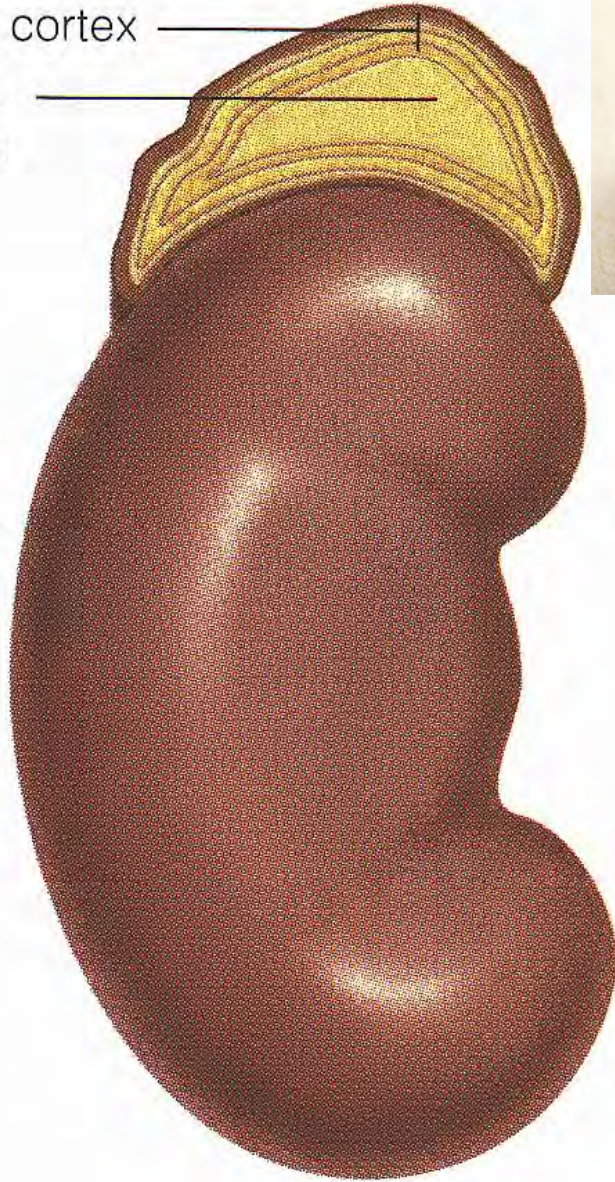
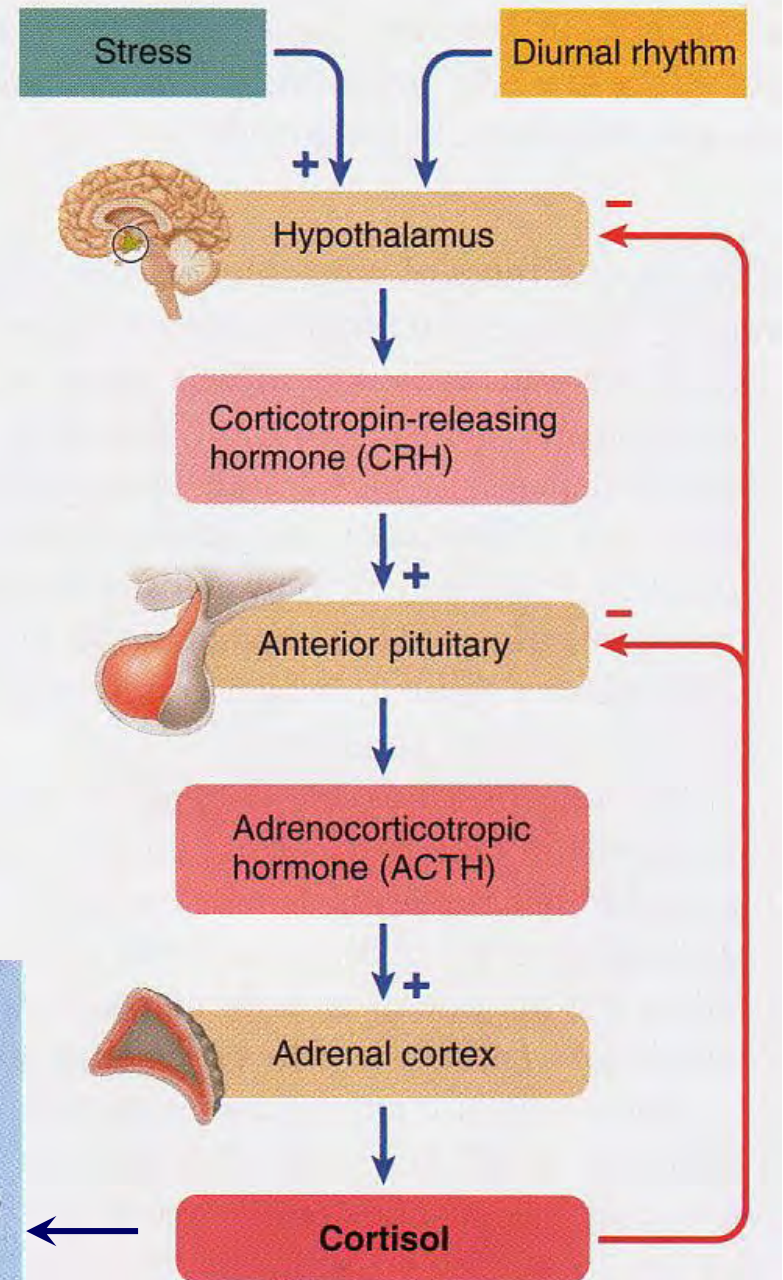


FIGURE 13-12

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

Stress Promotes Cortisol Secretion



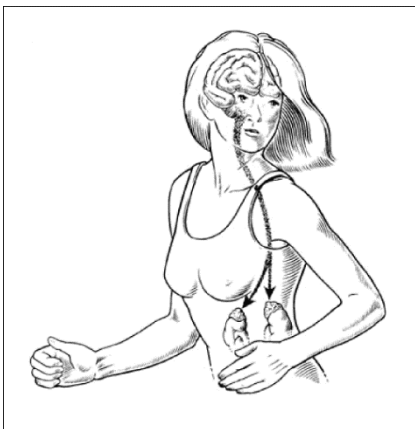
Metabolic fuels and building blocks available to help resist stress

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

BI 121!!



Epinephrine
80%
Norepinephrine
20%



Guyton & Hall 2000

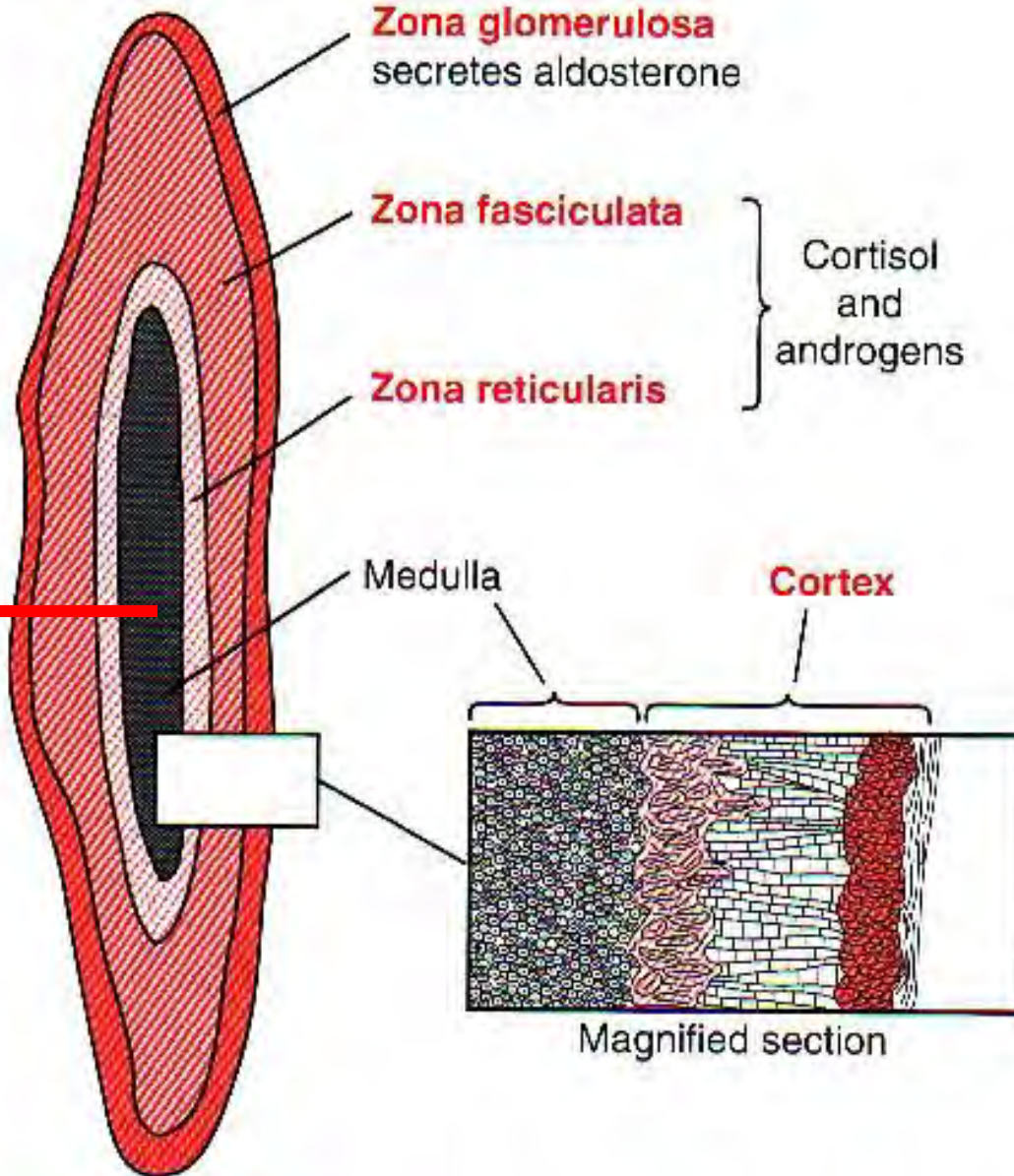
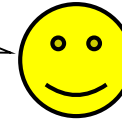


FIGURE 77 - 1

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

Thanks to you, Courtney, Eli,
Nelson & Katie!

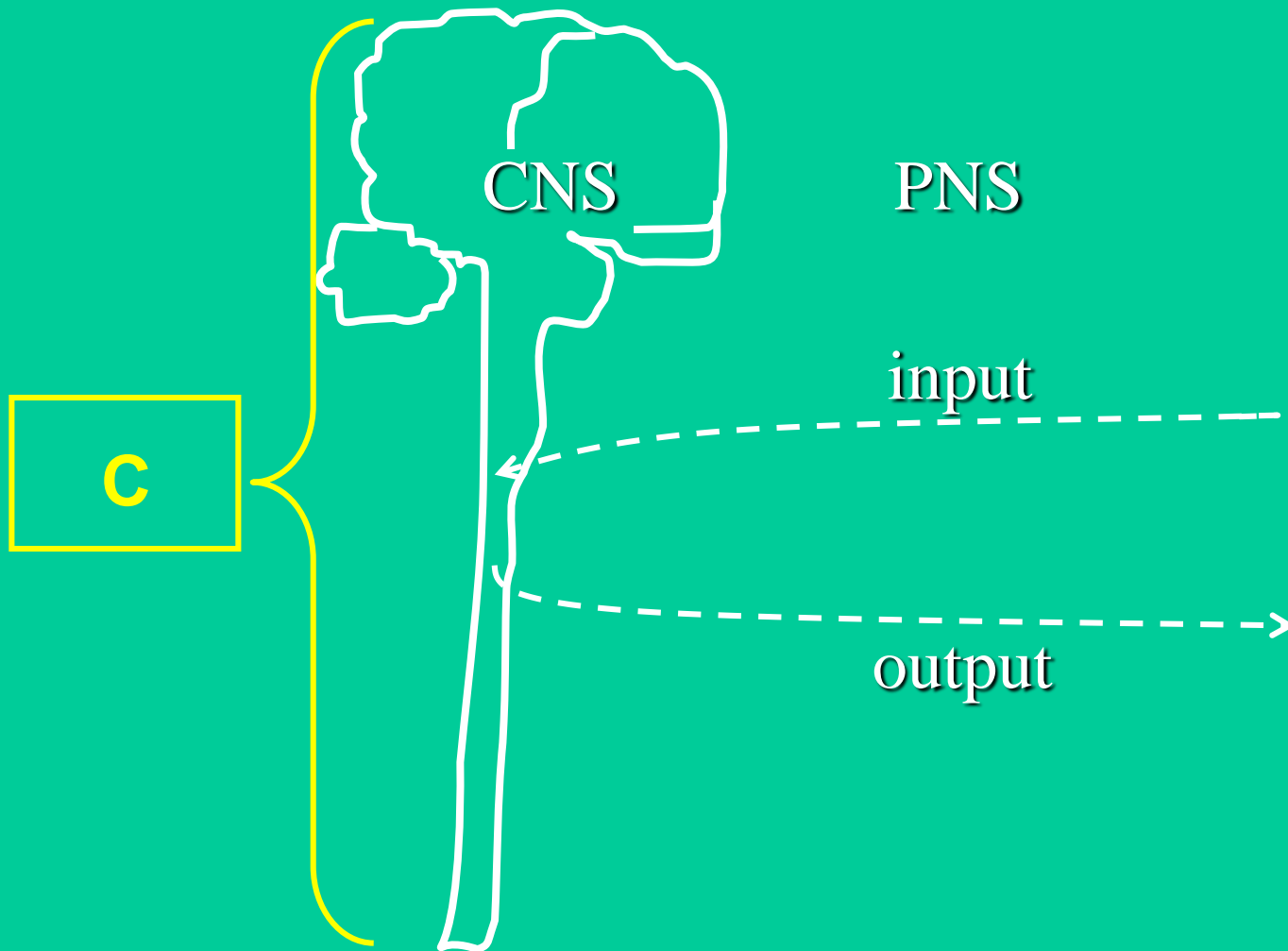


For your effort
& your 🩸 !!

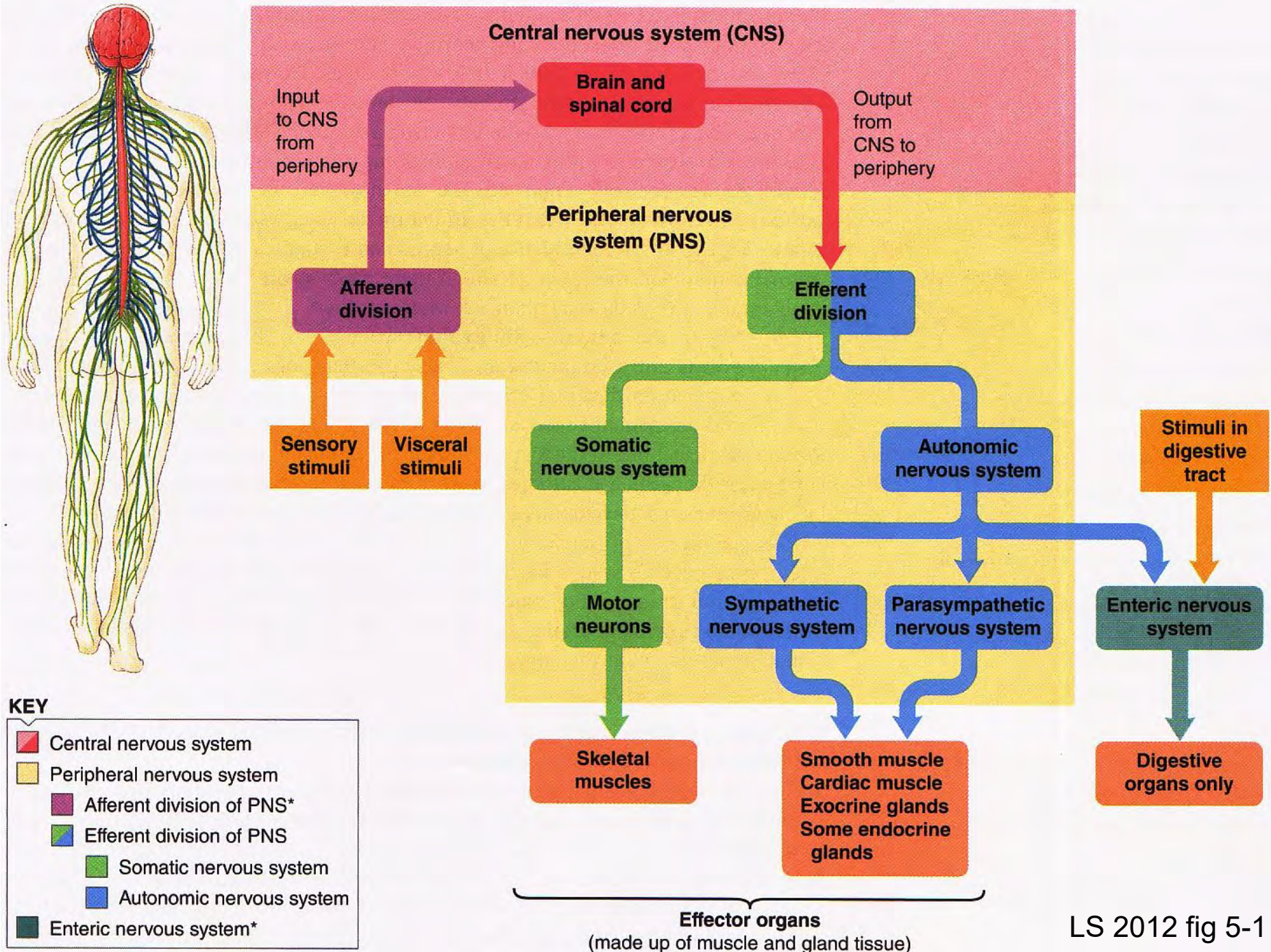
BI 121 Lecture 12

- I. Announcements Thanks for your help with blood lab! Great job! No lab this week. Study for Exam II, Dec 7, Friday, 8 am!
- II. 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
- III. 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!

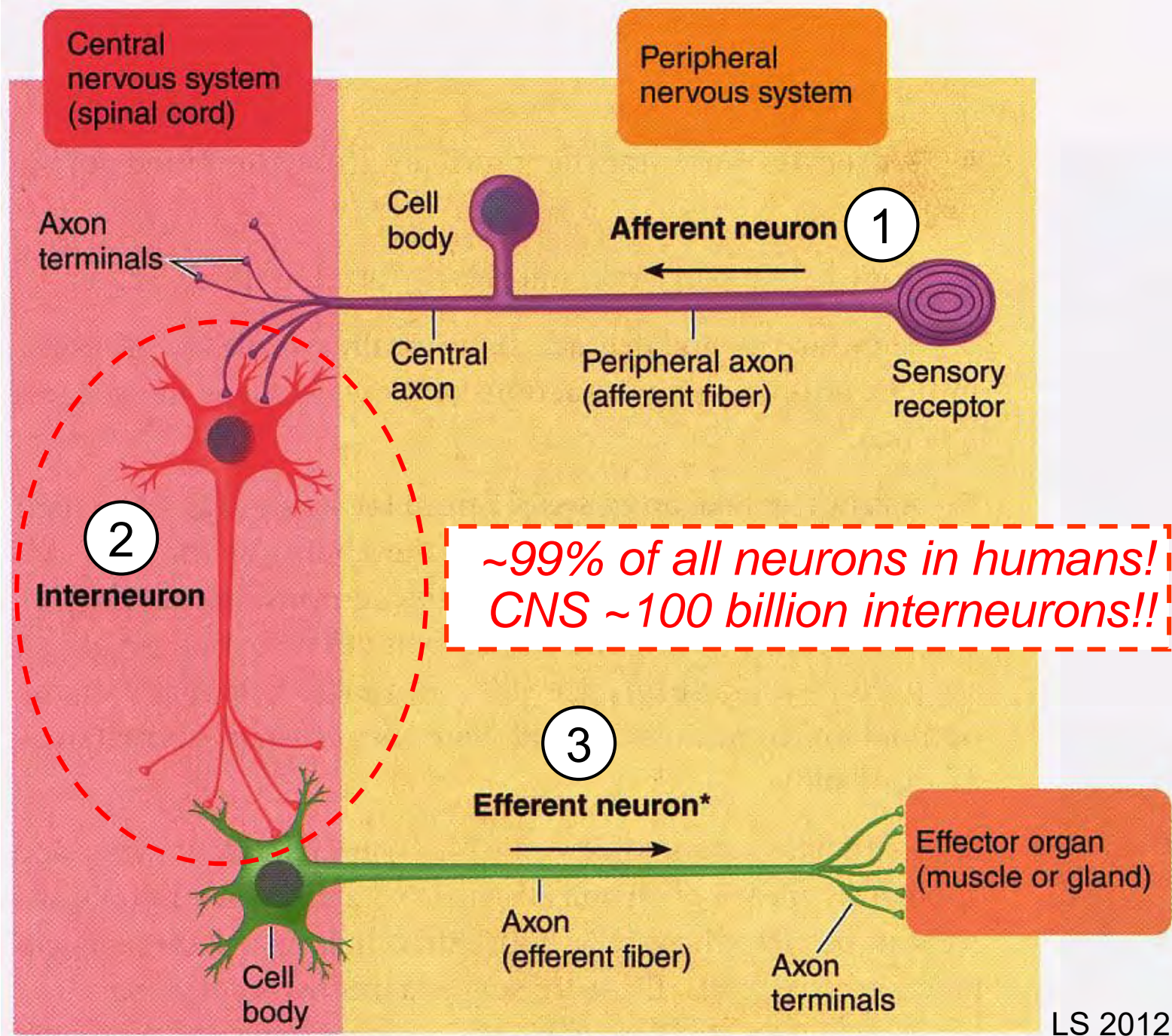
Nervous System



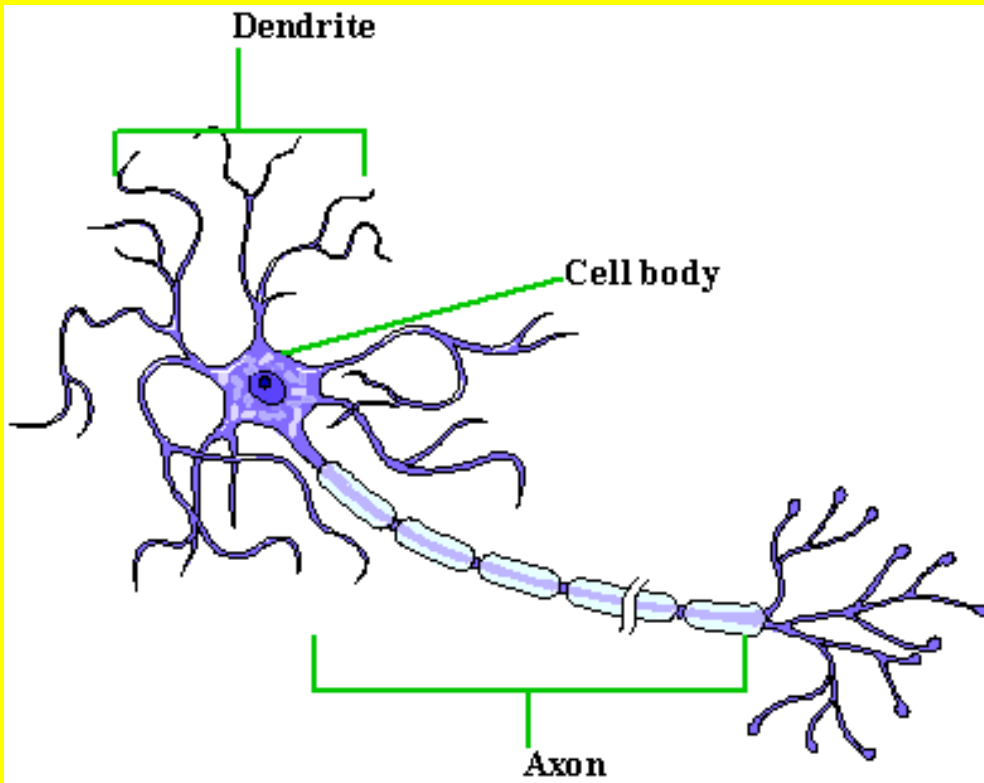
https://www.youtube.com/watch?v=uU_4uA6-zcE&vl=ko



LS 2012 fig 5-1

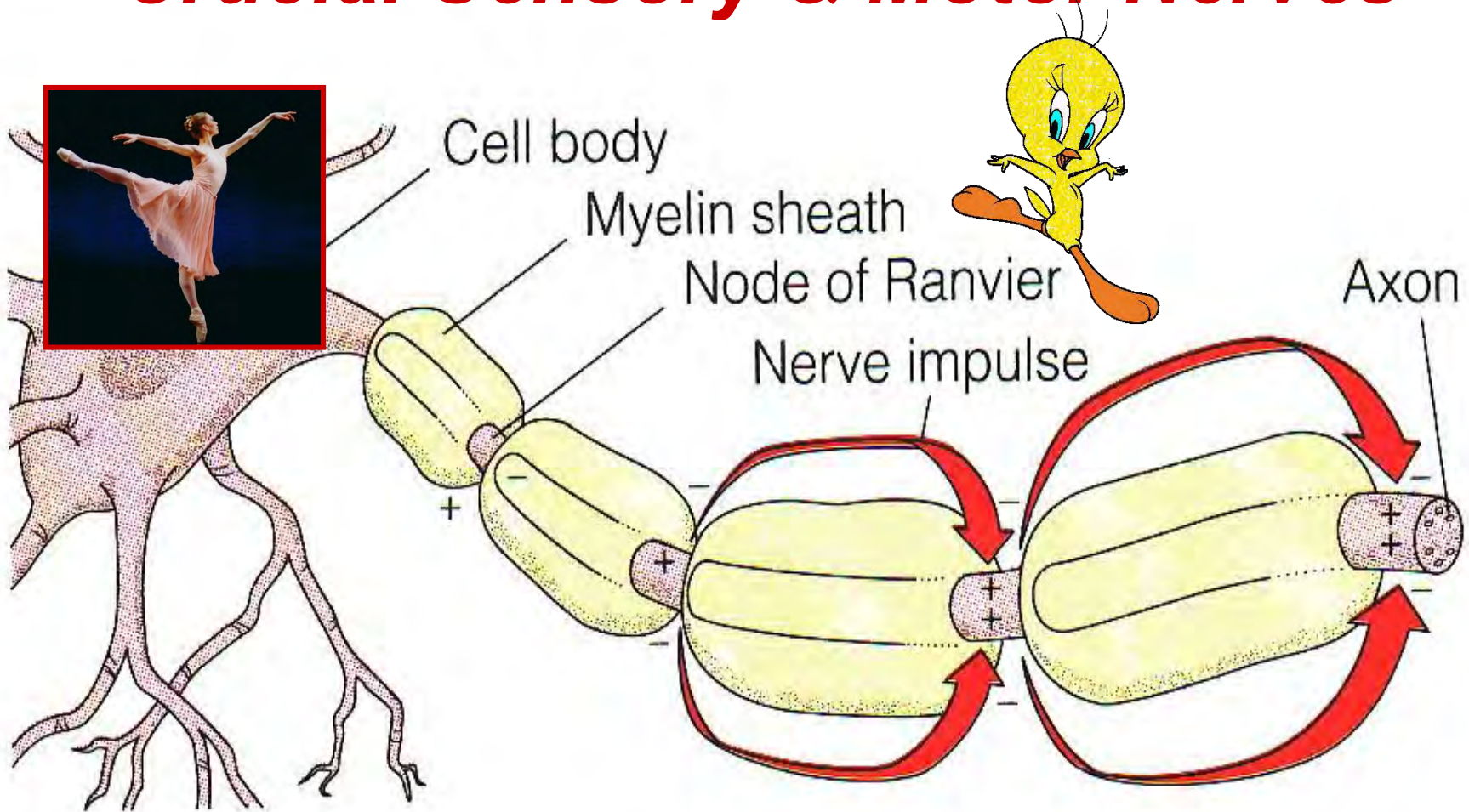


What is myelin? Why is it important?

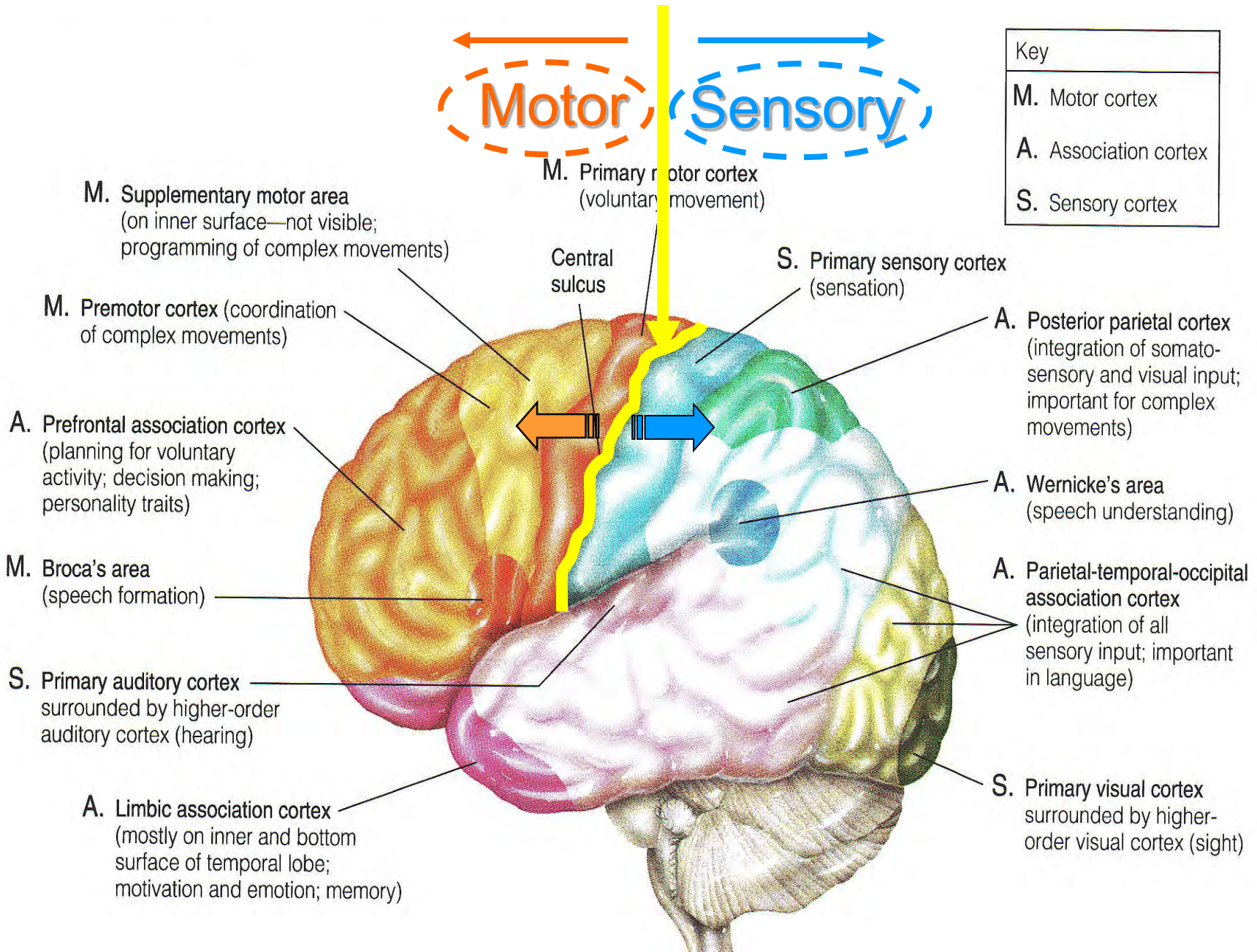


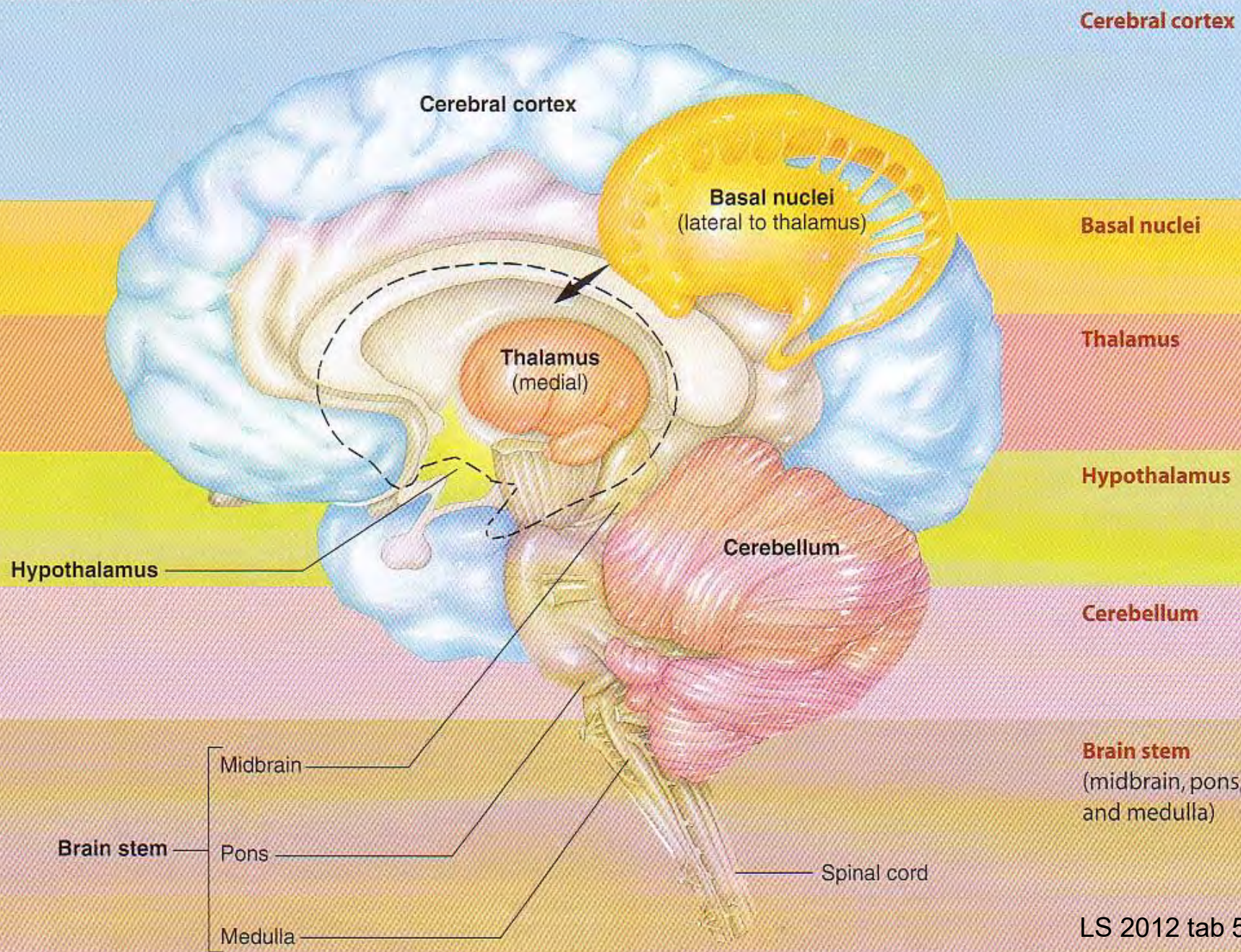
Lipid insulative coat
 $\uparrow \vec{v}$, *conserves ions & ATP*

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



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





Cerebral cortex

Basal nuclei

Thalamus

Hypothalamus

Cerebellum

Brain stem
(midbrain, pons,
and medulla)



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% σ

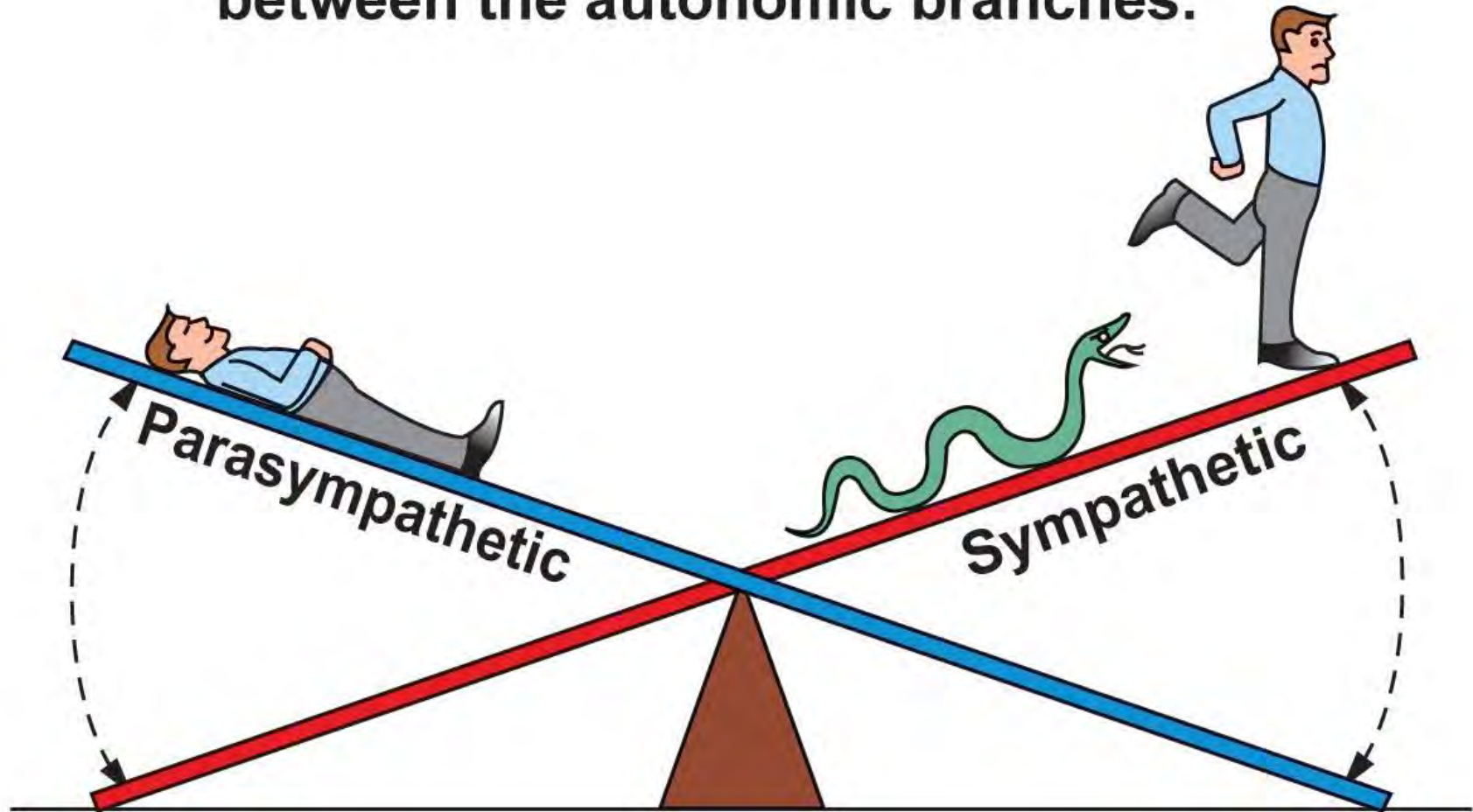
11% involved wrong-way riding!

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!

Homeostasis is a dynamic balance between the autonomic branches.



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

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

BI 121 Lecture 13



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



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. Nervous System Connections NS organization video.

<https://www.youtube.com/watch?v=qPixX-9t7E>

Brain + spinal cord (CNS). What disease involves the basal nuclei? **Protect your head with a helmet!** Bicycle head injury statistics *NHTSA & BHSI, 2014 data*

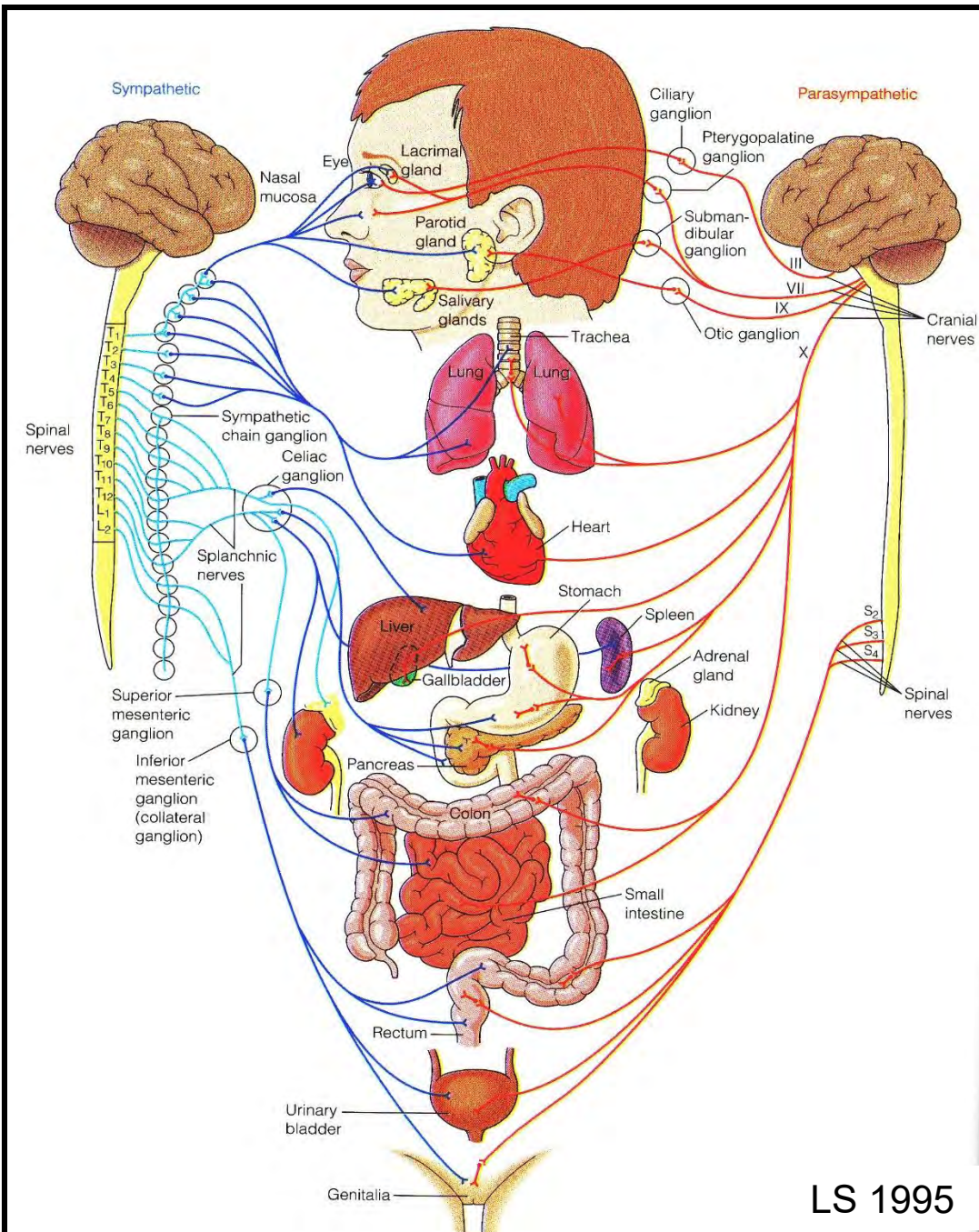
III. Peripheral Nervous System LS sections of ch 3, 4, & 7

- 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

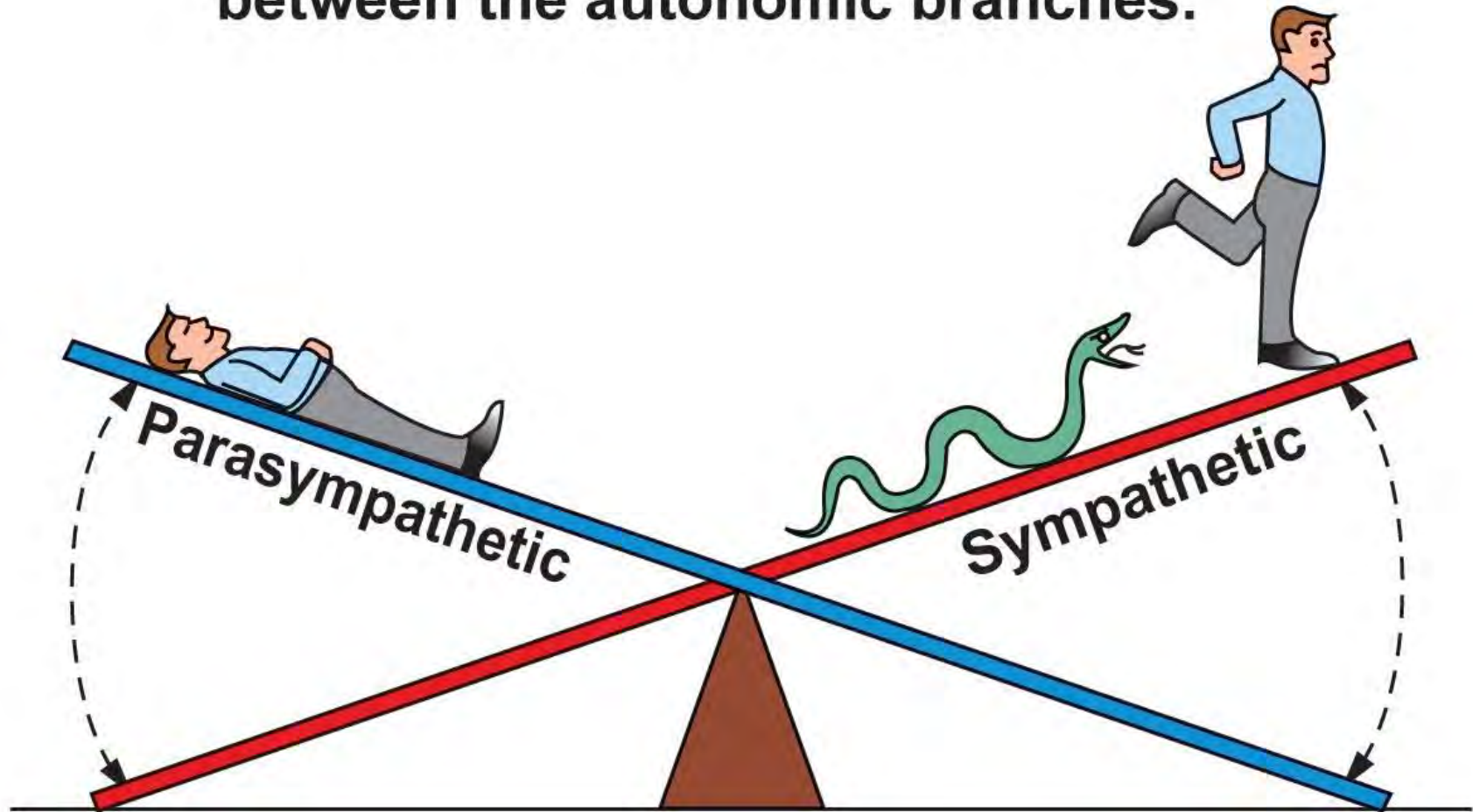
Autonomic Nervous System

Why overlap or dual innervation?

Fine-tune control & safety!



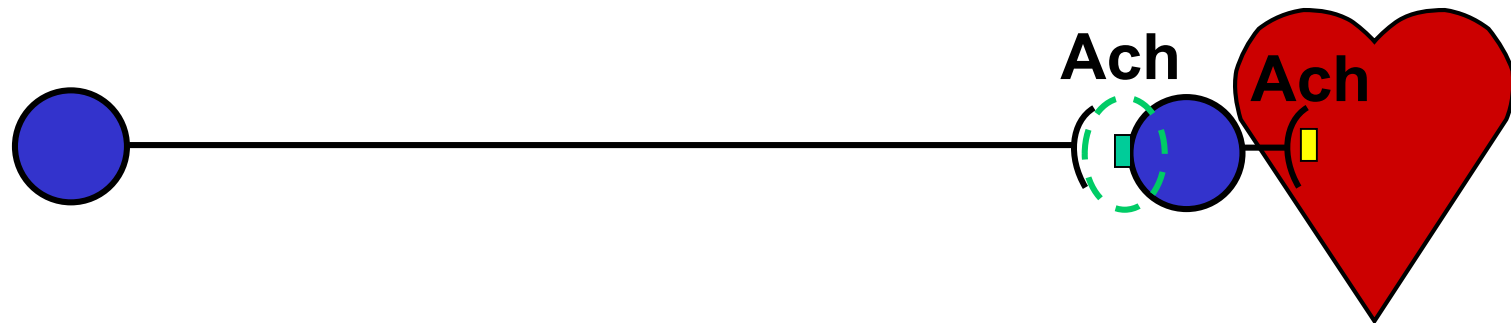
Homeostasis is a dynamic balance between the autonomic branches.



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

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

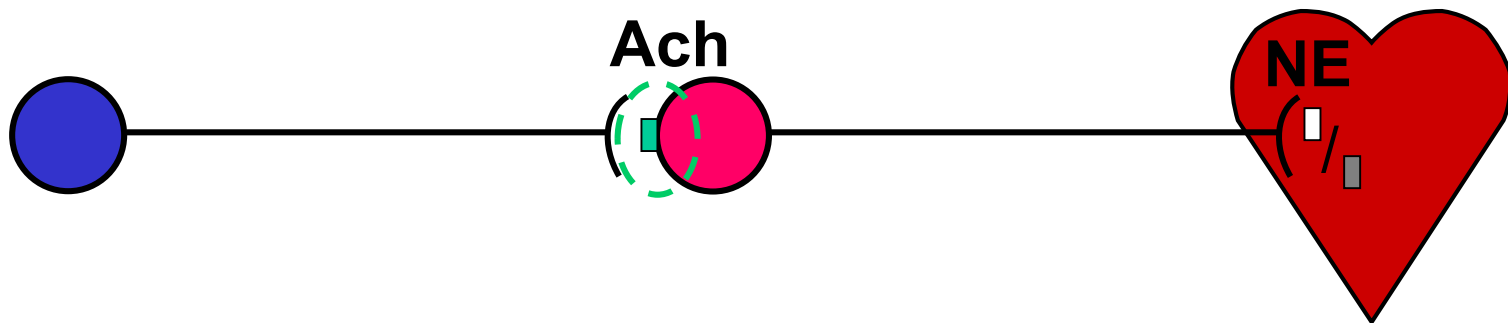
Parasympathetic



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!!

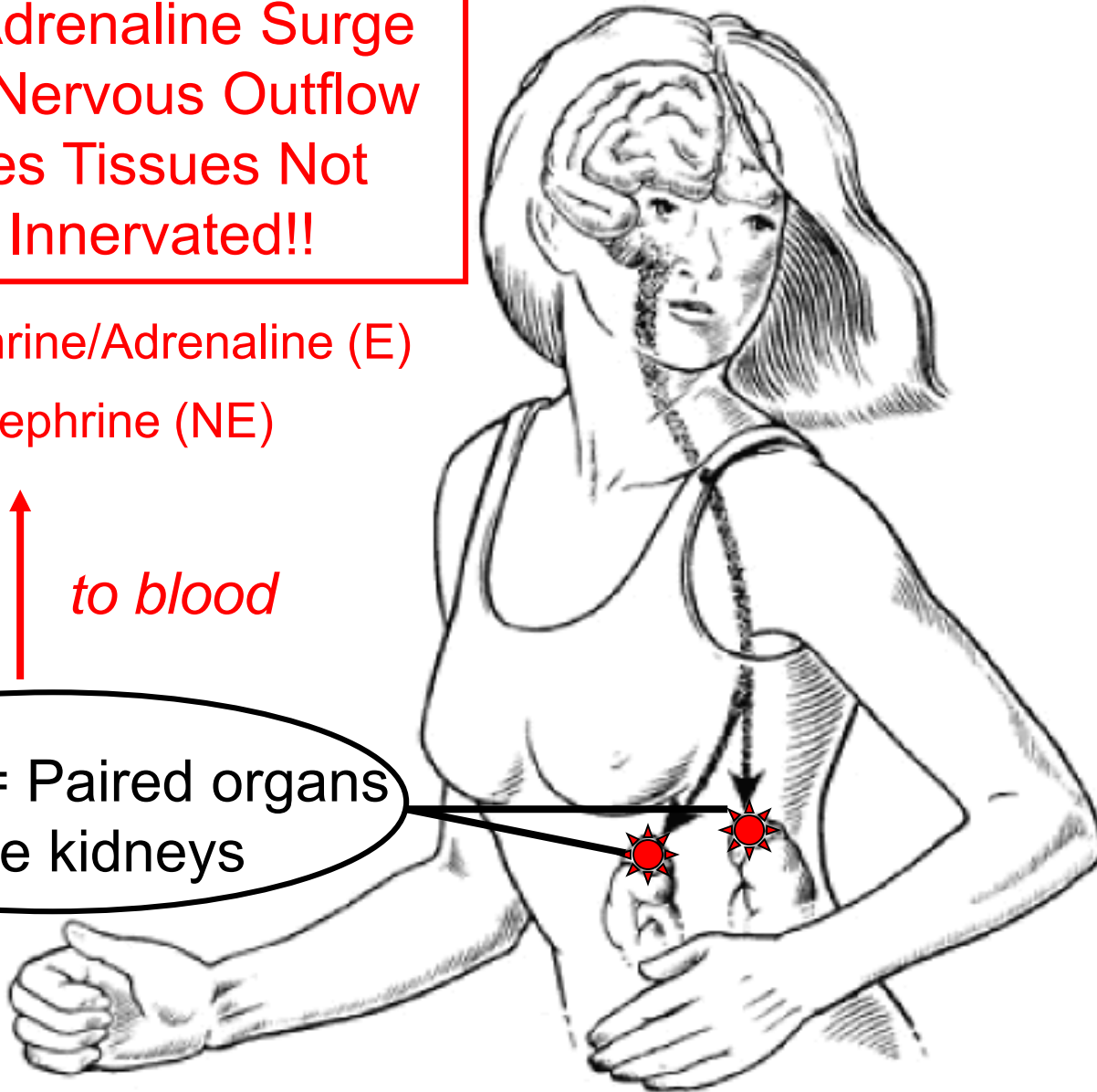


Hormonal Adrenaline Surge
Reinforces Nervous Outflow
& Accesses Tissues Not
Directly Innervated!!

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

Output ↑ *to blood*

Adrenals = Paired organs
above kidneys



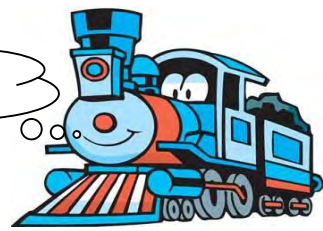
▲ Table 7-1 Effects of Autonomic Nervous System on Various Organs

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

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 Fri Dec 7, 8am Q?**

II. Nervous System Connections LS ch 3, 4 & 7; DC Module 9

A. Why nerve & muscle unique? How do they signal?

LS pp 62-67, 74-83

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

LS p 185-92 fig 7-5 p 190; DC pp 69-71 fig 9-4

1. Ca^{2+} bones!...but what else? LS p 190

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

III. Muscle Structure & Function LS ch 8 + DC Mod 12

A. Muscle types: cardiac, smooth, skeletal LS fig 8-1

B. How is skeletal muscle organized? LS fig 8-2, DC fig 12-2

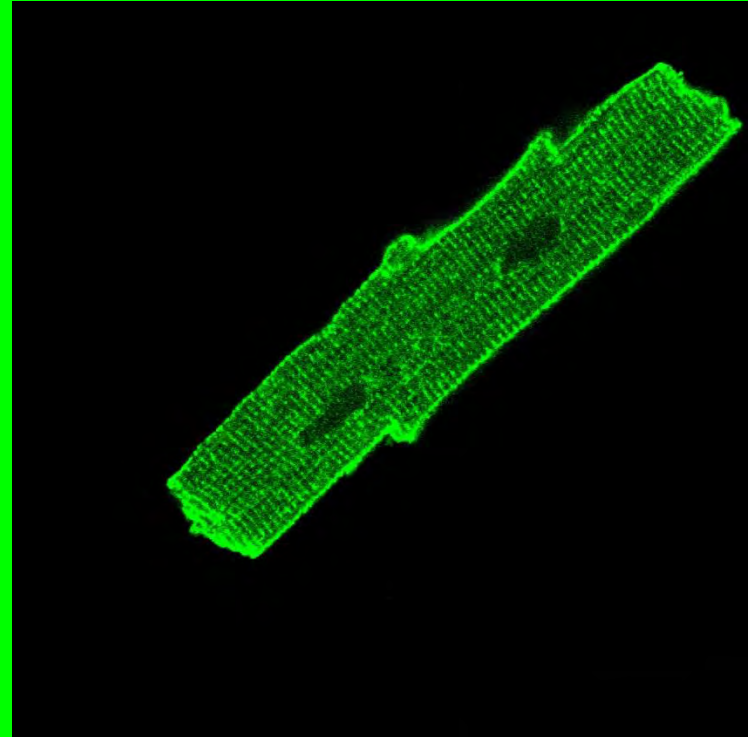
C. What do thick filaments look like? LS fig 8-4, DC fig 12-4

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 +...

Why are nerve & muscle unique?



They are excitable!!

Action Potentials \equiv Spikes \equiv Impulses

Ultra-short reversal of membrane potential

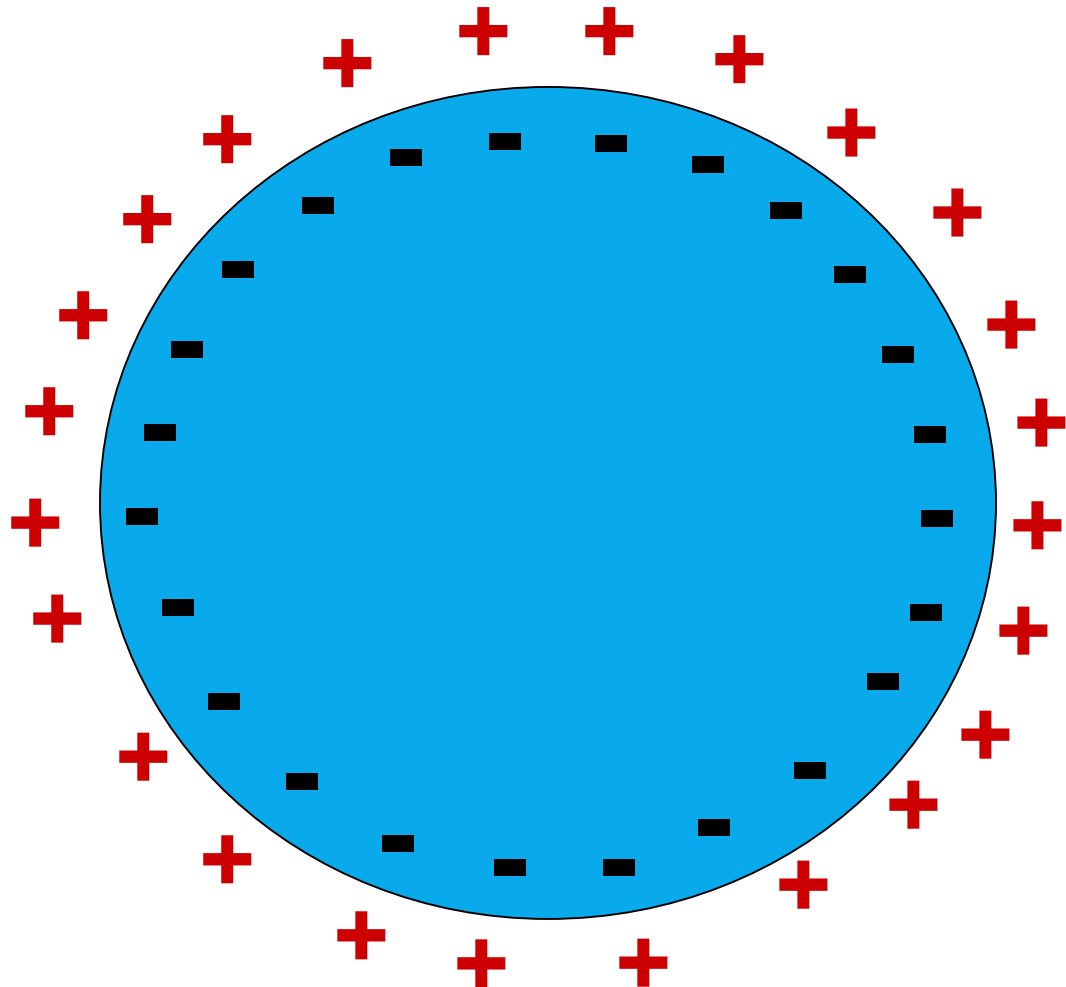
Only in nerve and muscle cells

Maintains strength over distance

Primary way nerves & muscles communicate!



"Resting"/Membrane Potential?



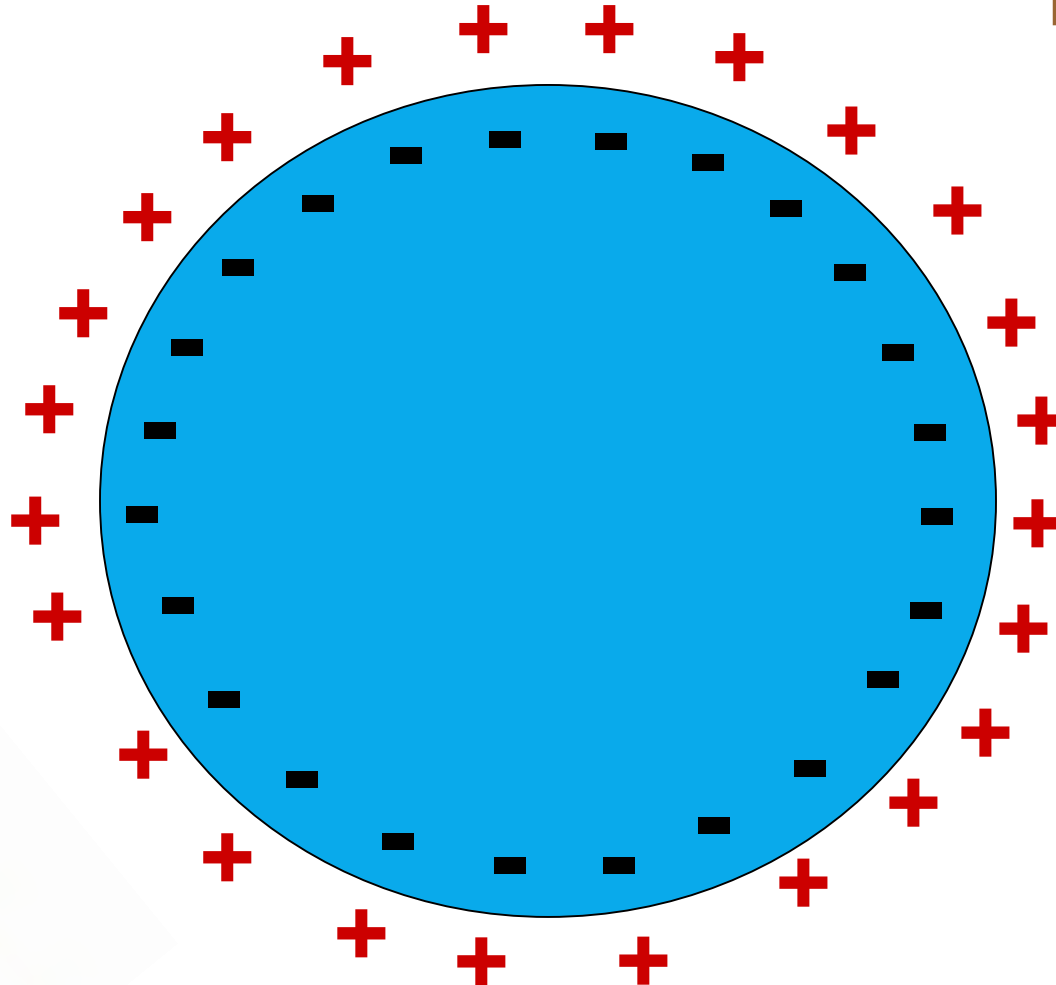
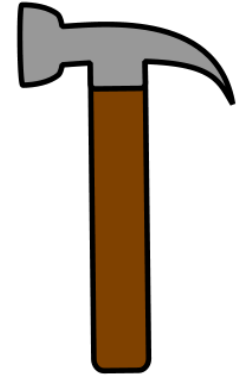
Cells are slightly negative inside!

Stimulate Cell @ Rest

Thermal



Mechanical



1

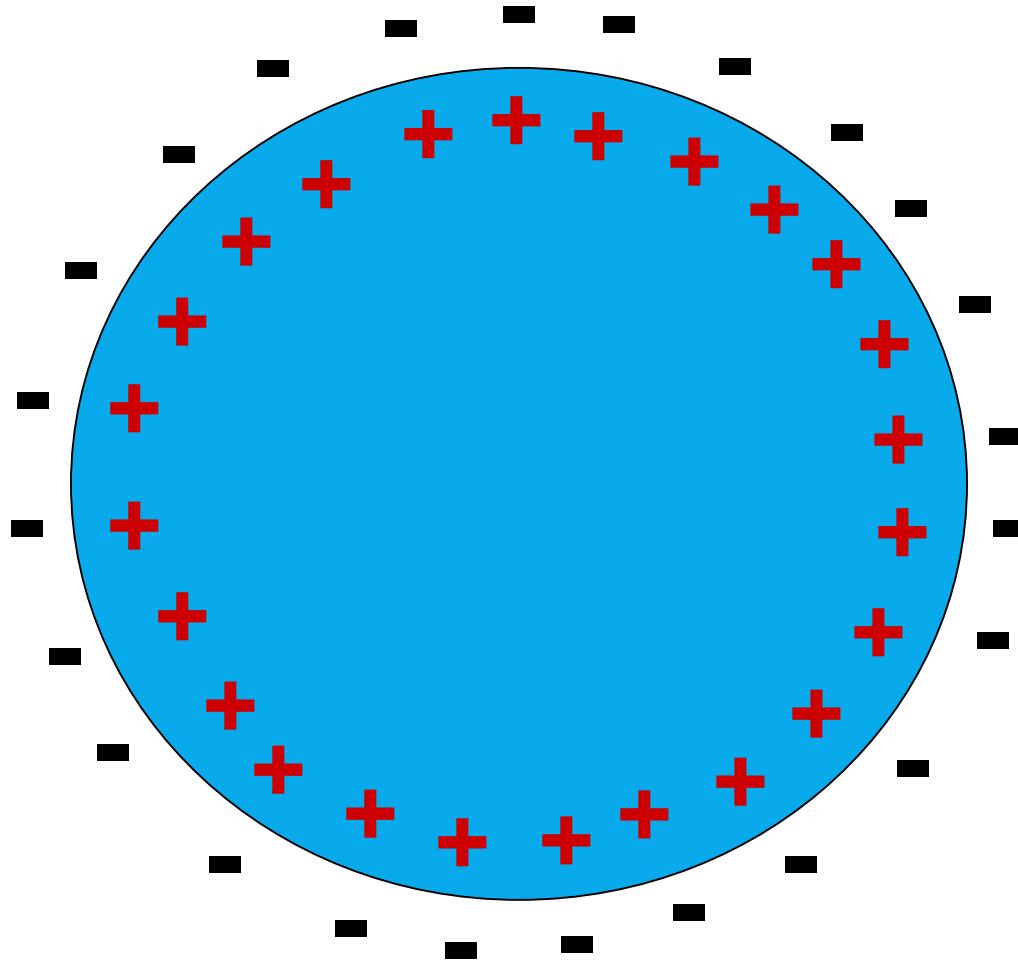


Electrical



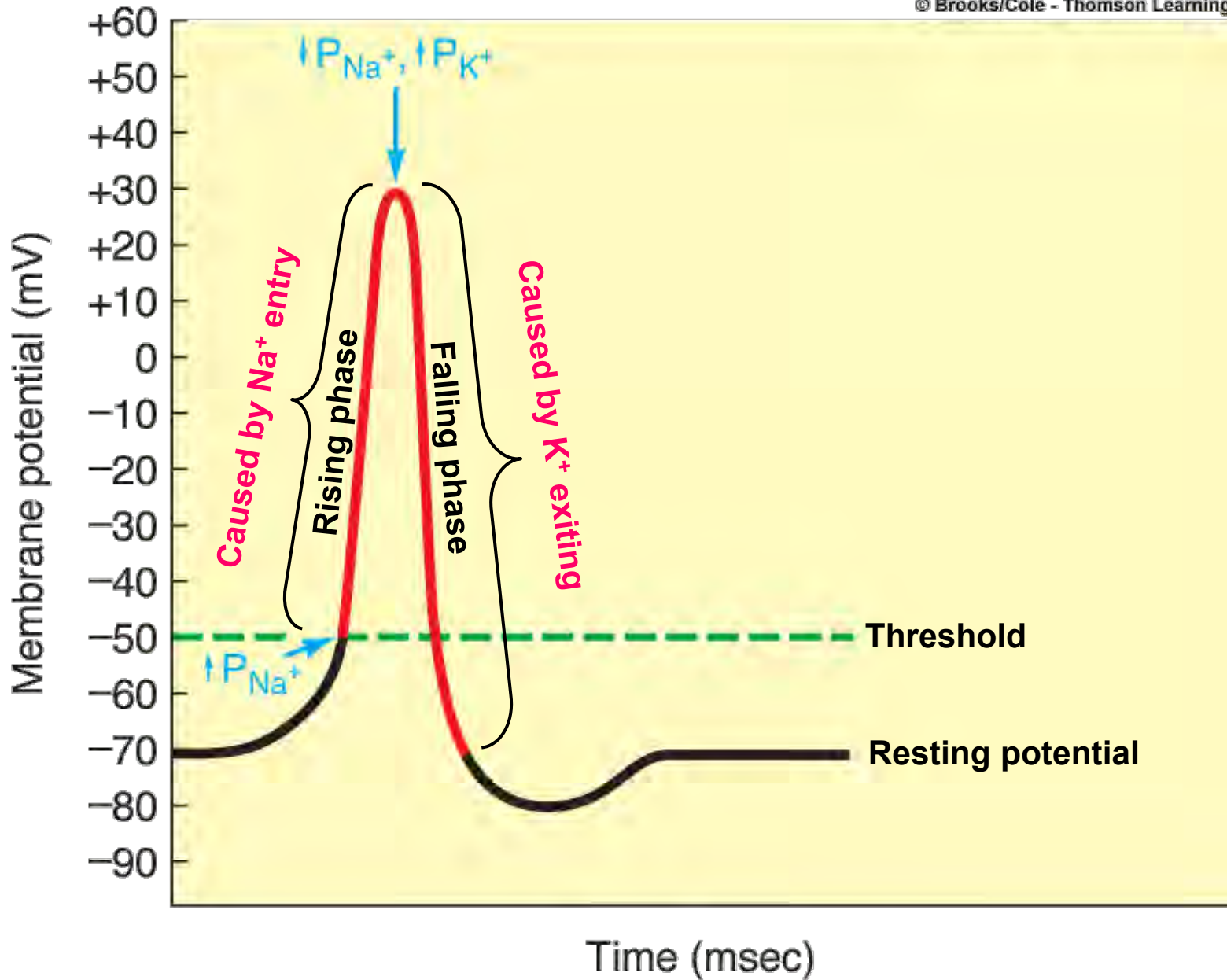
Chemical

Action Potential has occurred!



5

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



Other Links That May Be Helpful!

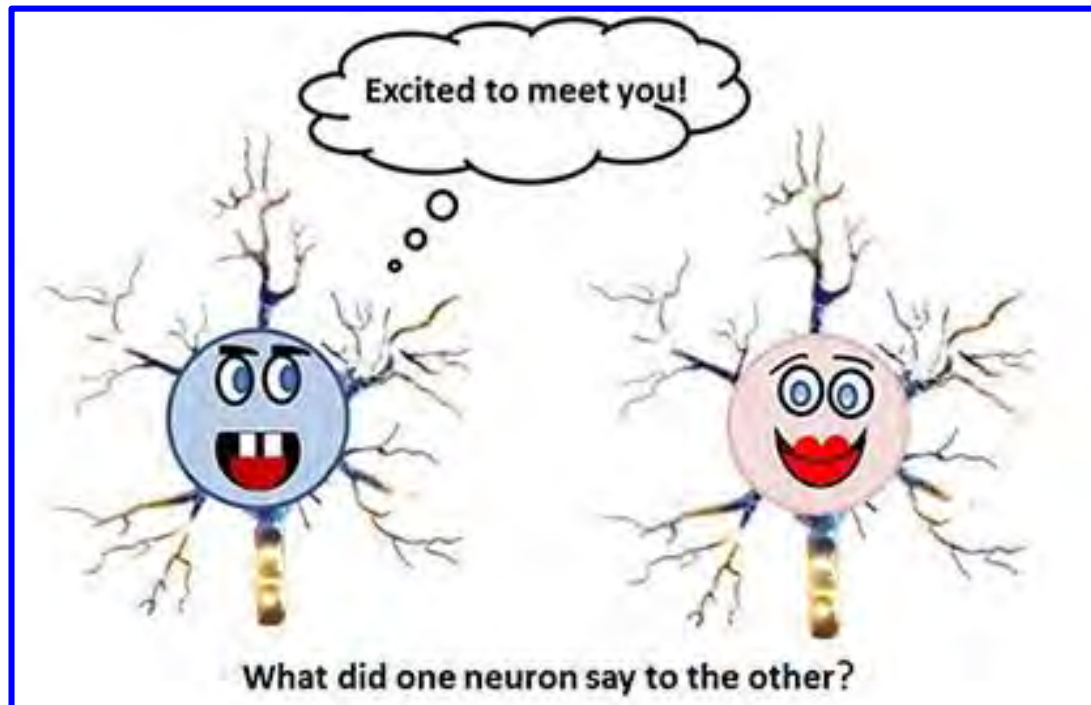
<https://www.youtube.com/watch?v=6RbPIOq0O3w>

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

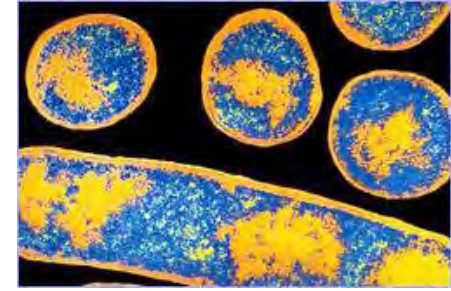
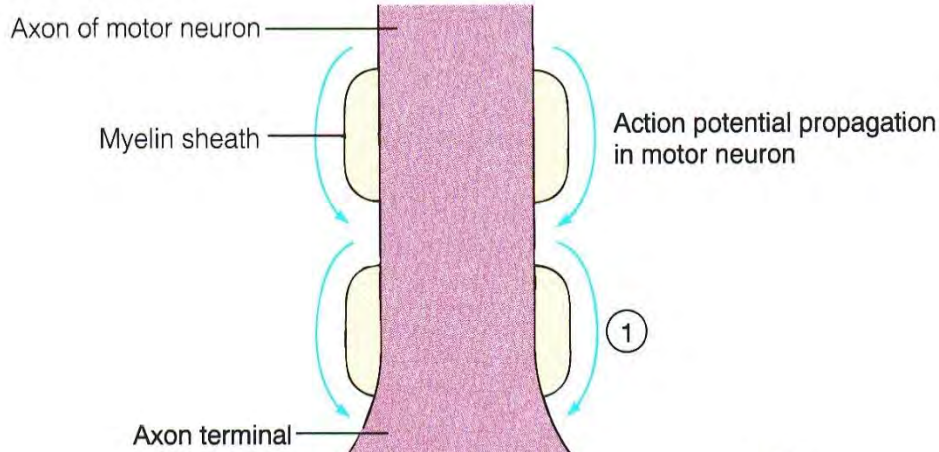
<https://www.youtube.com/watch?v=WhowH0kb7n0>

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

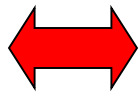
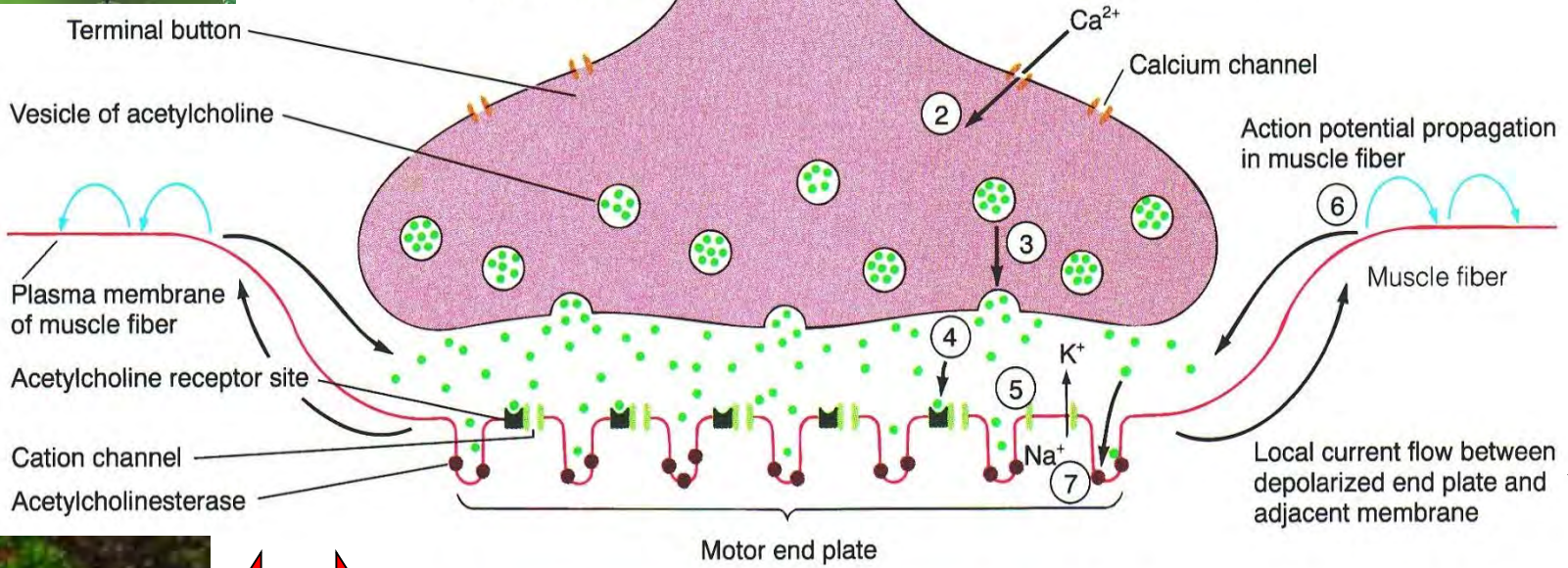
<https://www.youtube.com/watch?v=VitFvNvRIIY>



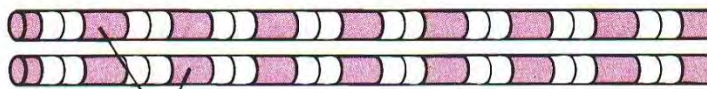
↑ 3



~~3~~



4



~~7~~

Striated muscle

Unstriated muscle

Skeletal muscle

Cardiac muscle

Smooth muscle

Ed Reschke

Ed Reschke

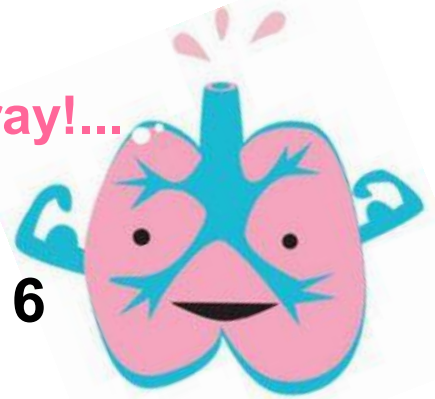
Biophoto/Photo Researchers, Inc.

Voluntary muscle

Involuntary muscle

Pulmonary Function Testing today! Hooray!....

BI 121 Lecture 15



I. Announcements Optional notebook ✓ + Lab 6
Pulmonary Function Testing today. Q?

II. Pulmonary Function Lab Overview

III. Muscle Structure & Function LS ch 8, DC Module 12

A. How is skeletal muscle organized? LS fig 8-2, DC fig 12-2

B. What do thick filaments look like? LS fig 8-4, DC fig 12-4

C. How about thin filaments? LS fig 8-5

D. Banding pattern? LS fig 8-3, fig 8-7

E. How do muscles contract? LS fig 8-6, 8-10

F. What's a cross-bridge cycle? LS fig 8-11 +...

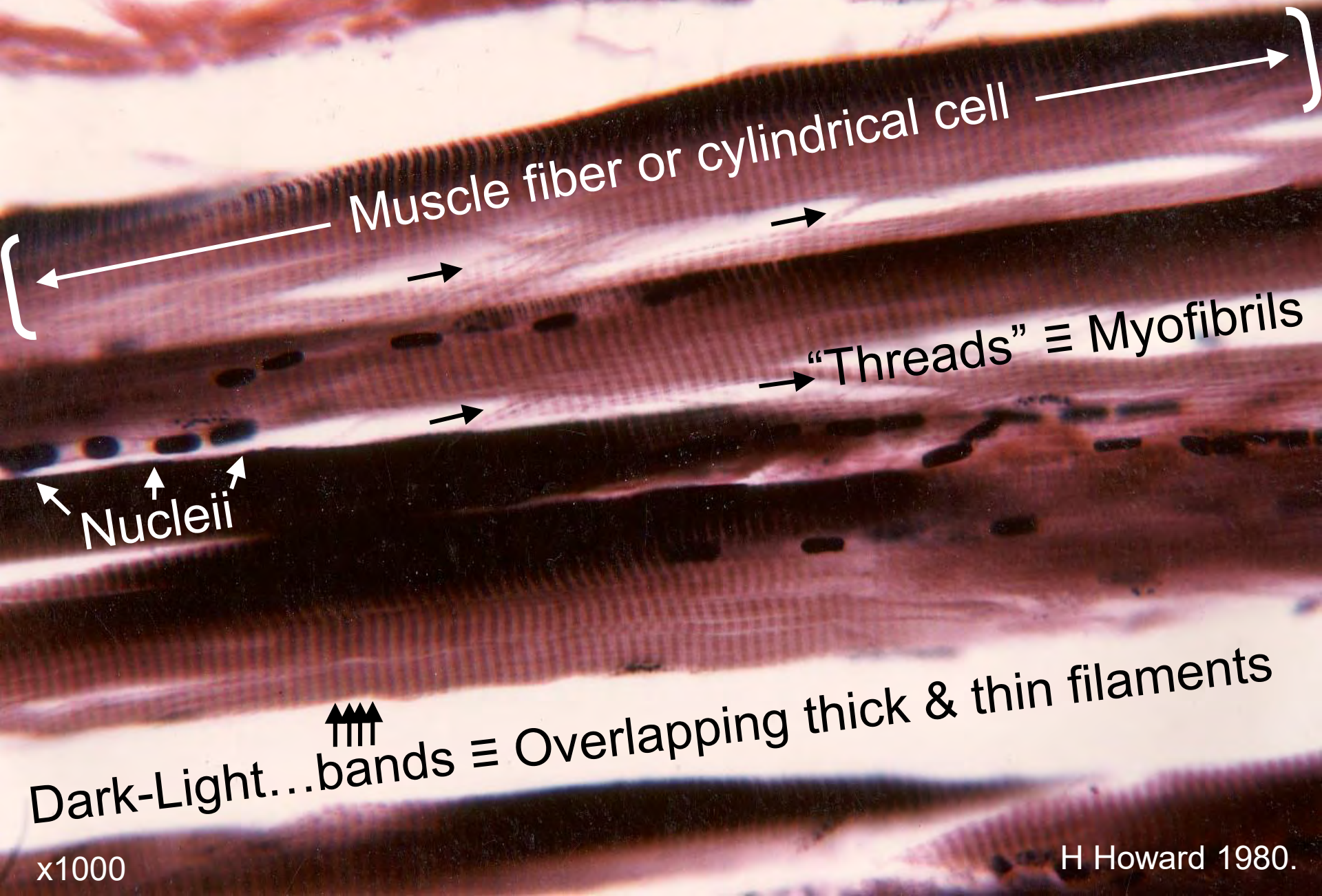
G. Summary of skeletal muscle contraction

H. Exercise adaptation variables: *mode, intensity, duration, frequency, distribution, individual & environmental char...?*

I. Endurance vs. strength training continuum? fiber types...



Skeletal Muscle Histology: Microscopic Anatomy



Muscle fiber or cylindrical cell

Nucleii

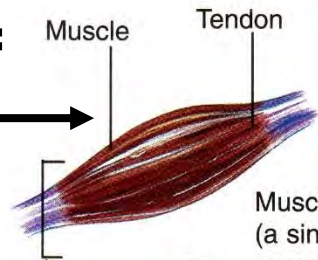
"Threads" ≡ Myofibrils

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

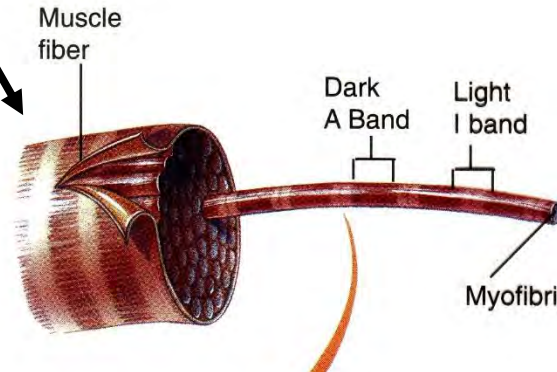
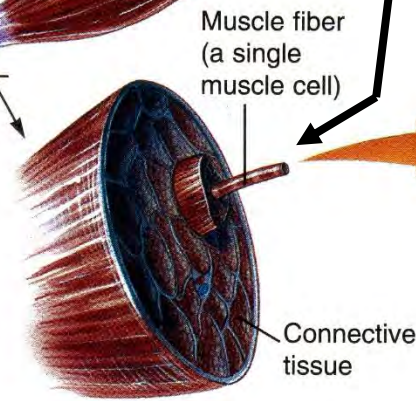
x1000

H Howard 1980.

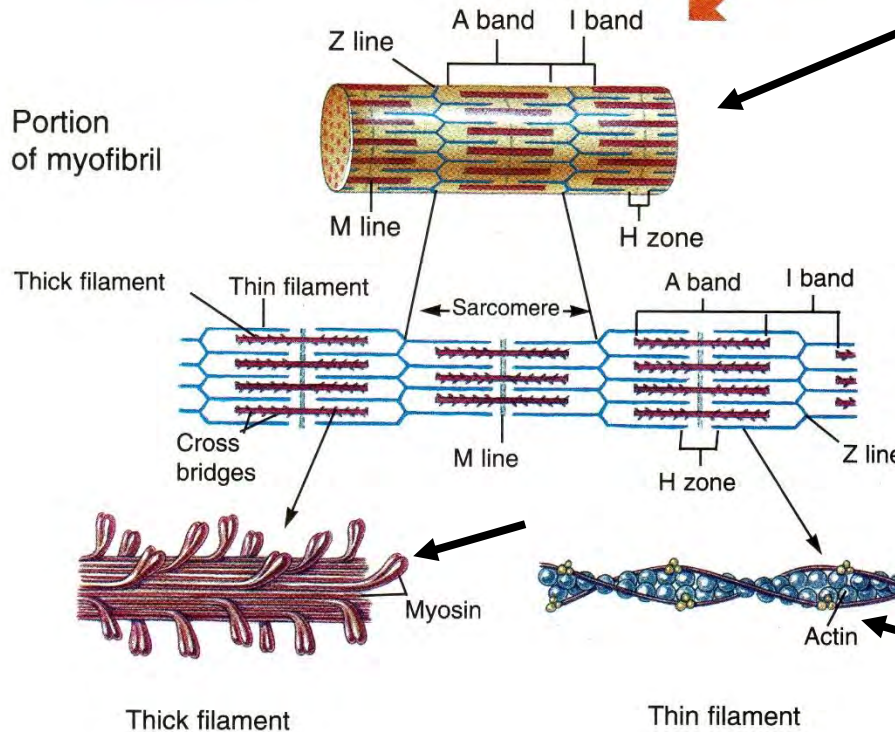
**Organ =
Muscle**



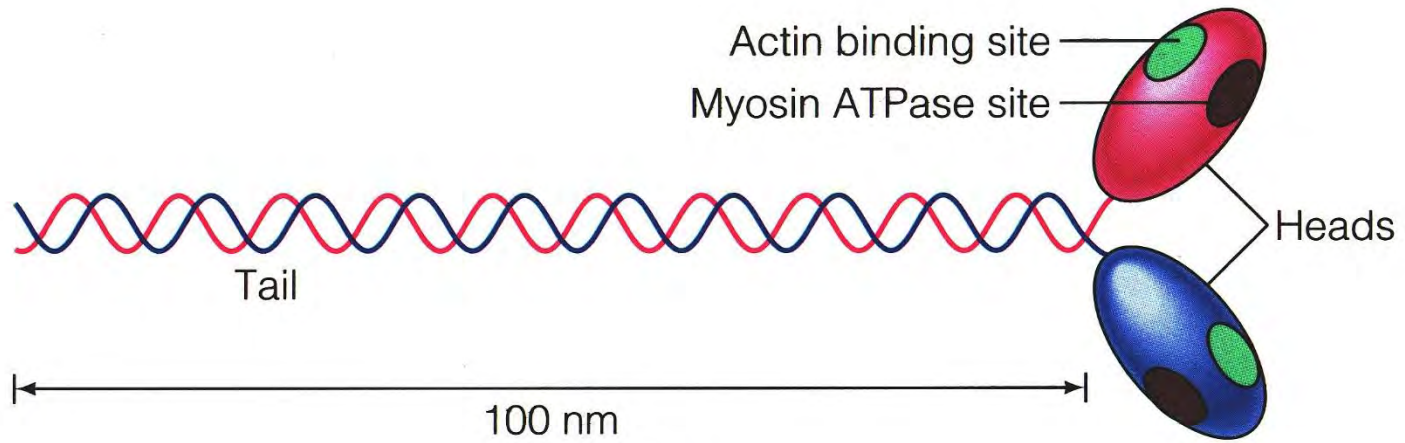
Cell = Myocyte = Fiber



**Subcellular =
Cytoskeleton**

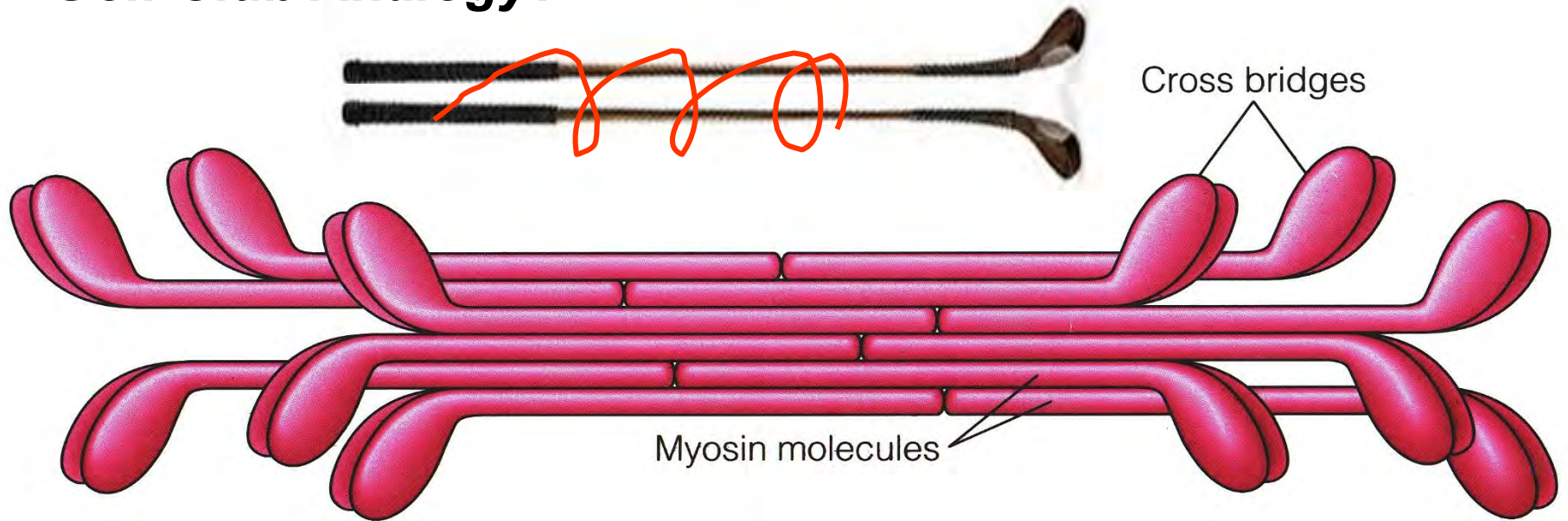


**Molecules =
Actin & Myosin**

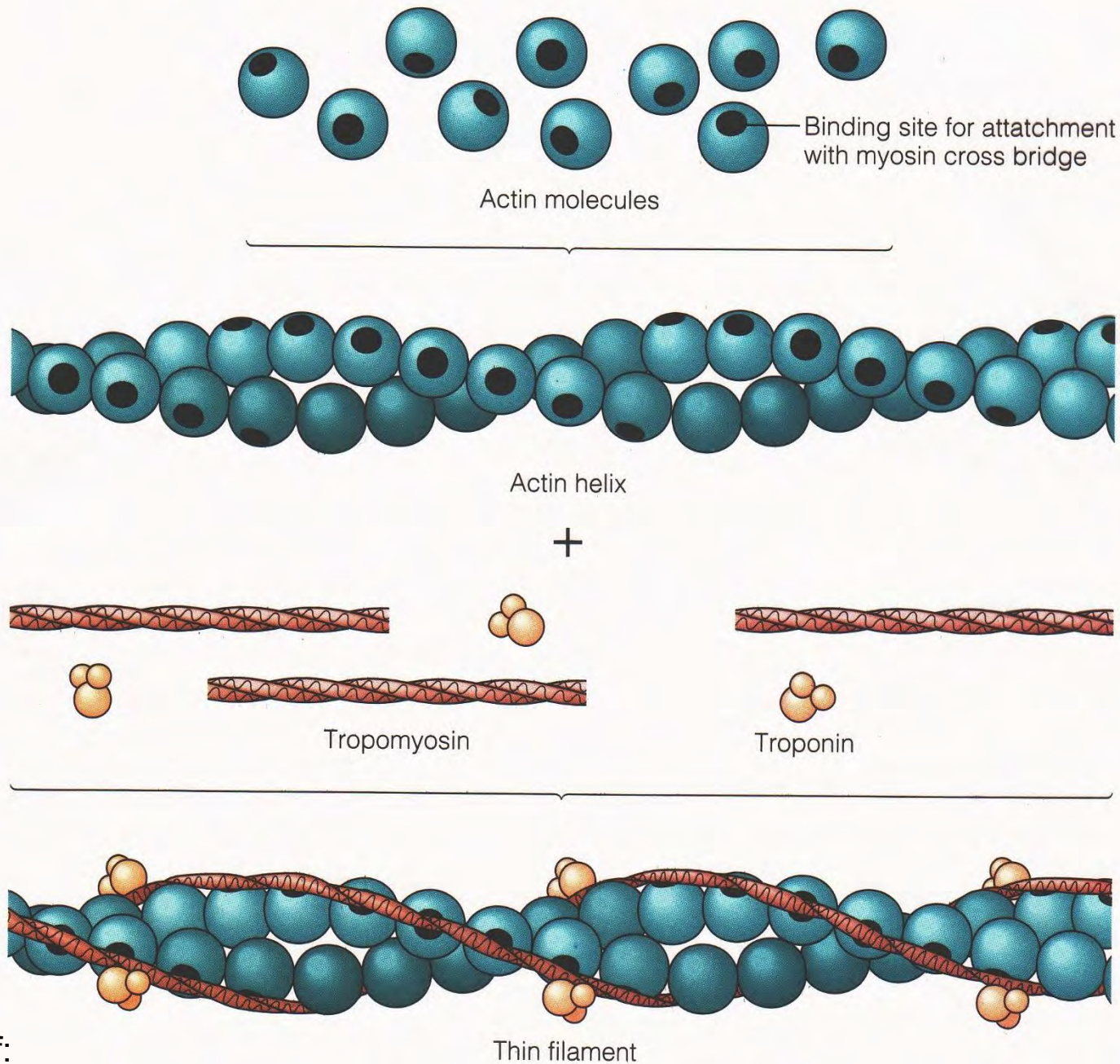


(a)

Golf Club Analogy?



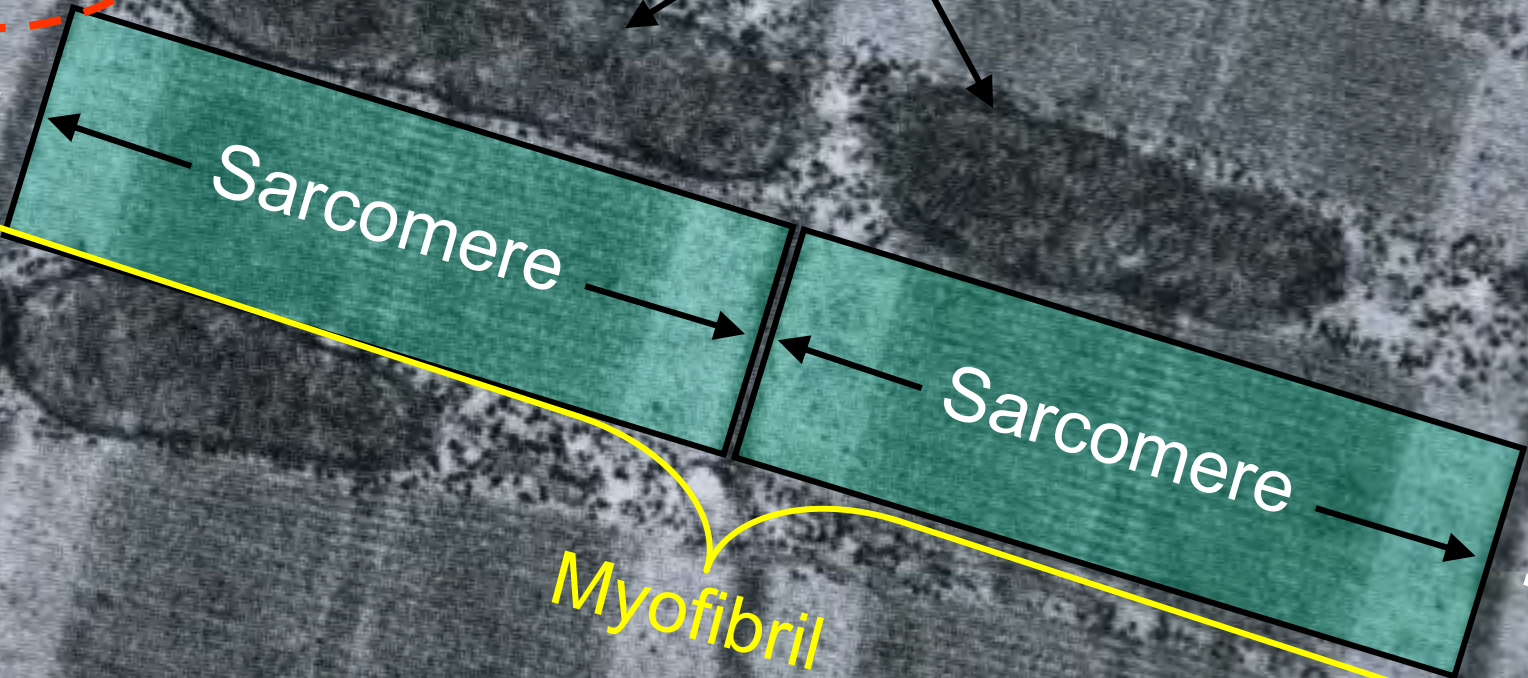
(b)



LS 2006, cf:
 LS 2012 fig 8-5

Triad \equiv T tubule abutting cisternae

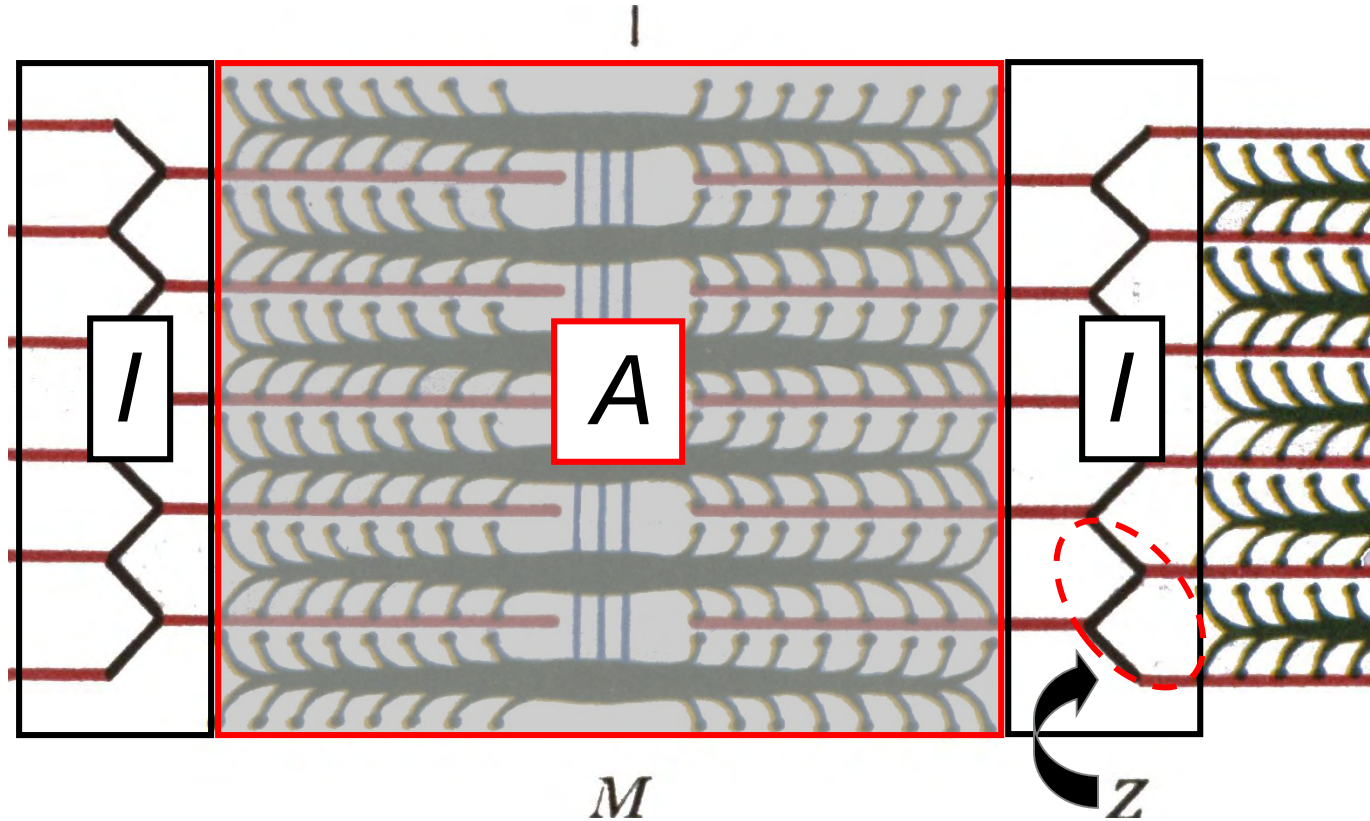
Mitochondria



Myofibril

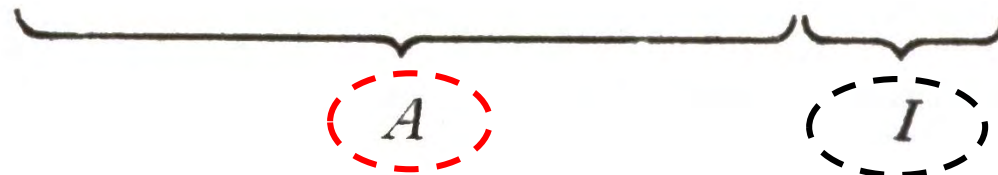
A Band = Dark Band

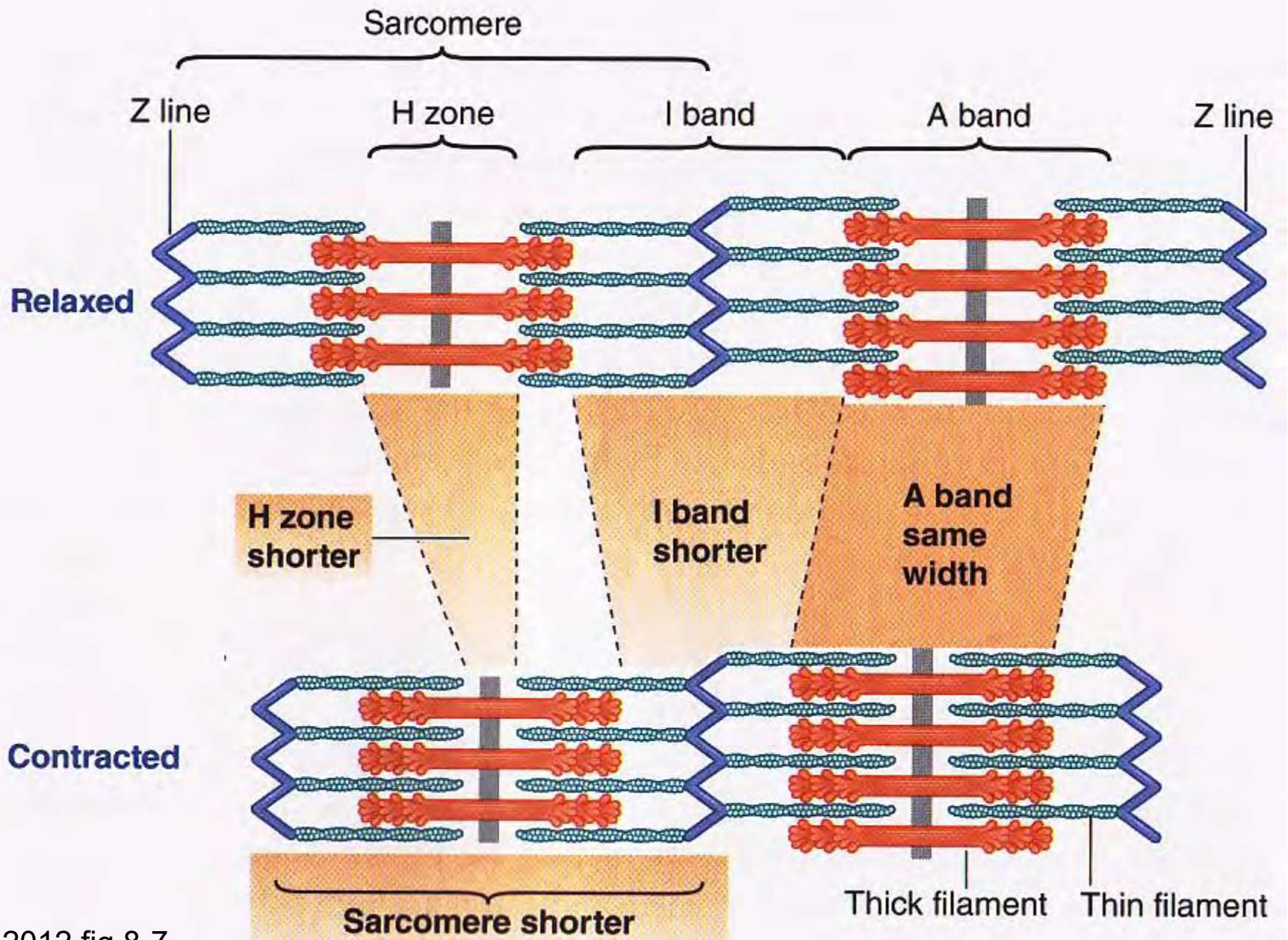
Anisotropic = Light Can't Shine Through



I Band = Light Band

Isotropic = Light Can Shine Through





LS 2012 fig 8-7



I. Announcements Notebooks? **Exam II, Dec 7th**
Friday 8 am. Review session in class next Thurs. Q?

II. Muscle Contraction & Adaptation LS ch 8, DC Mod 12

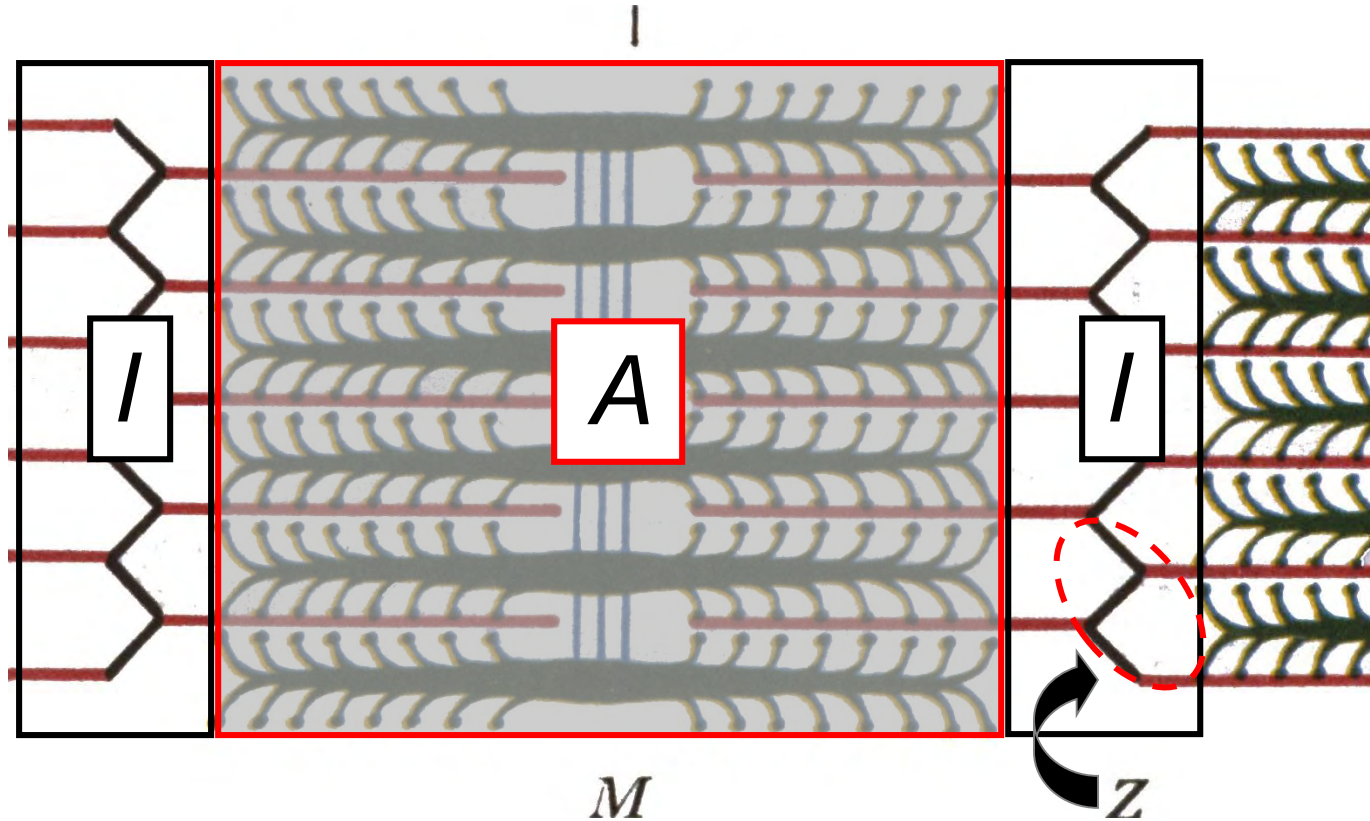
- A. Banding pattern? LS fig 8-3, fig 8-7
- B. How do muscles contract? LS fig 8-6, 8-10
- C. What's a cross-bridge cycle? LS fig 8-11 +...
- D. Summary of skeletal muscle contraction
- E. Exercise adaptation variables: *mode, intensity, duration, frequency, distribution, individual & environmental char...?*
- F. Endurance vs. strength training continuum? fiber types...

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

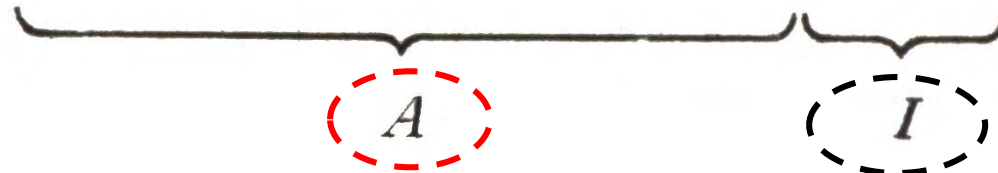
A Band = Dark Band

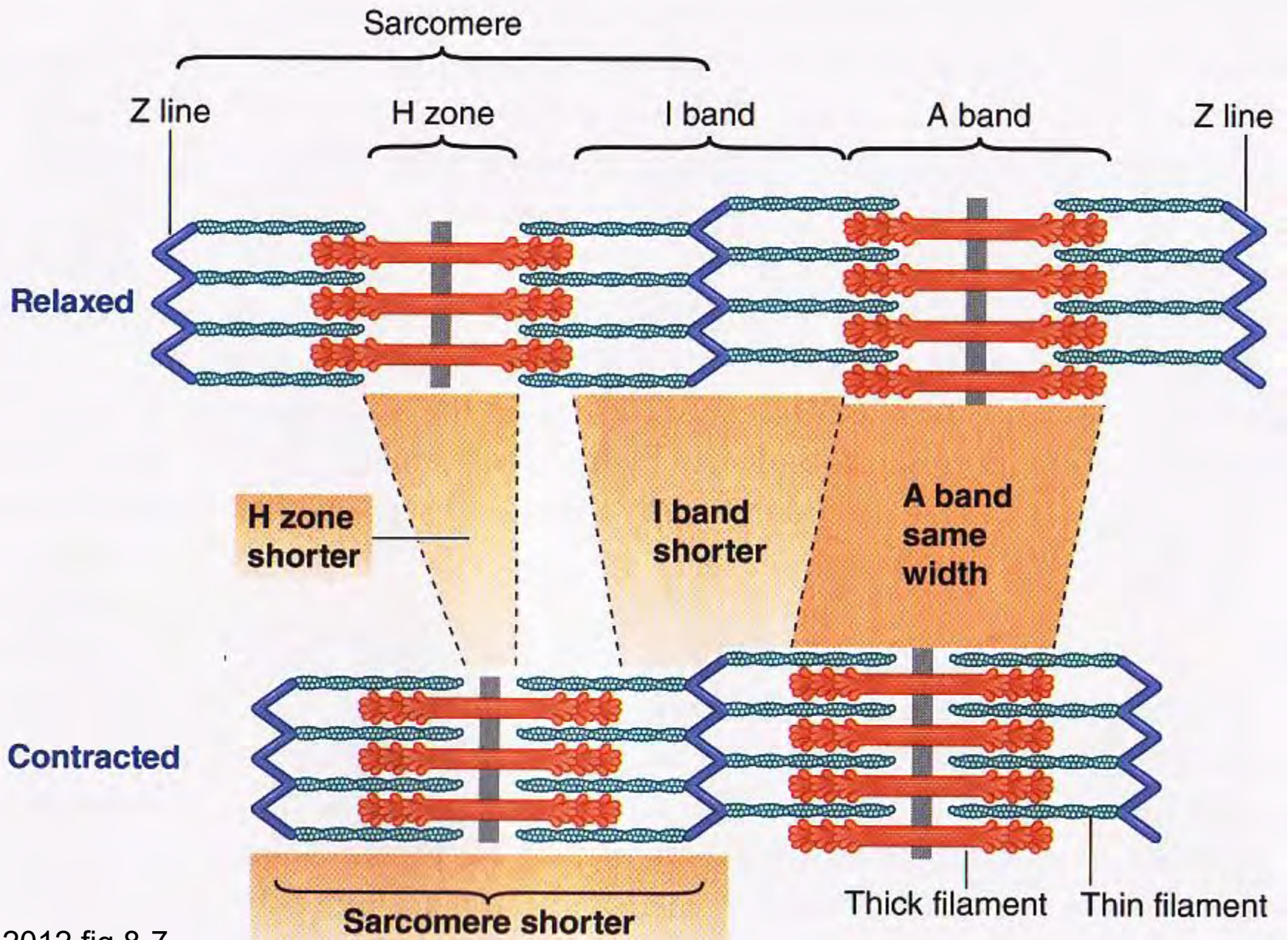
Anisotropic = Light Can't Shine Through



I Band = Light Band

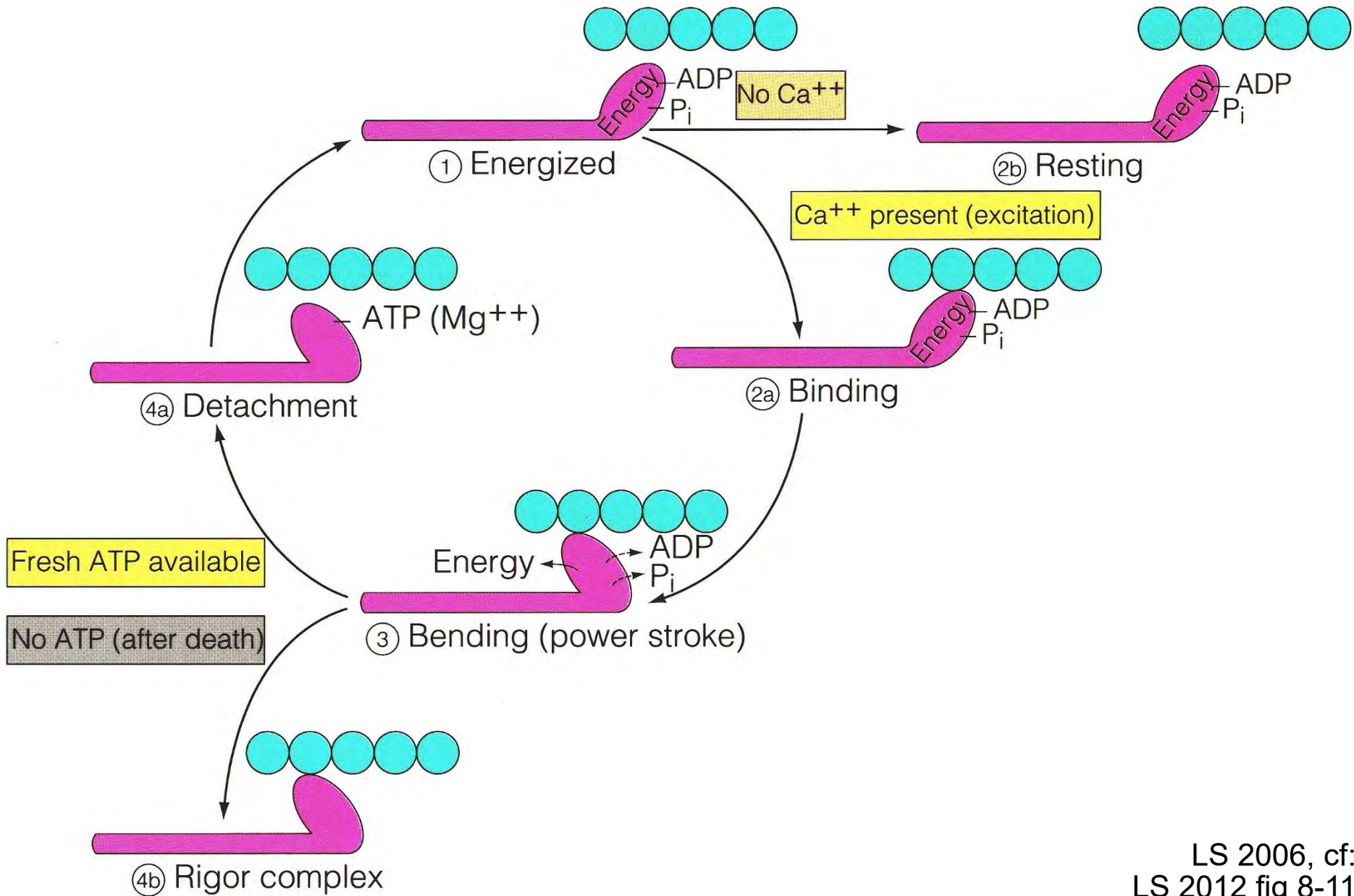
Isotropic = Light Can Shine Through



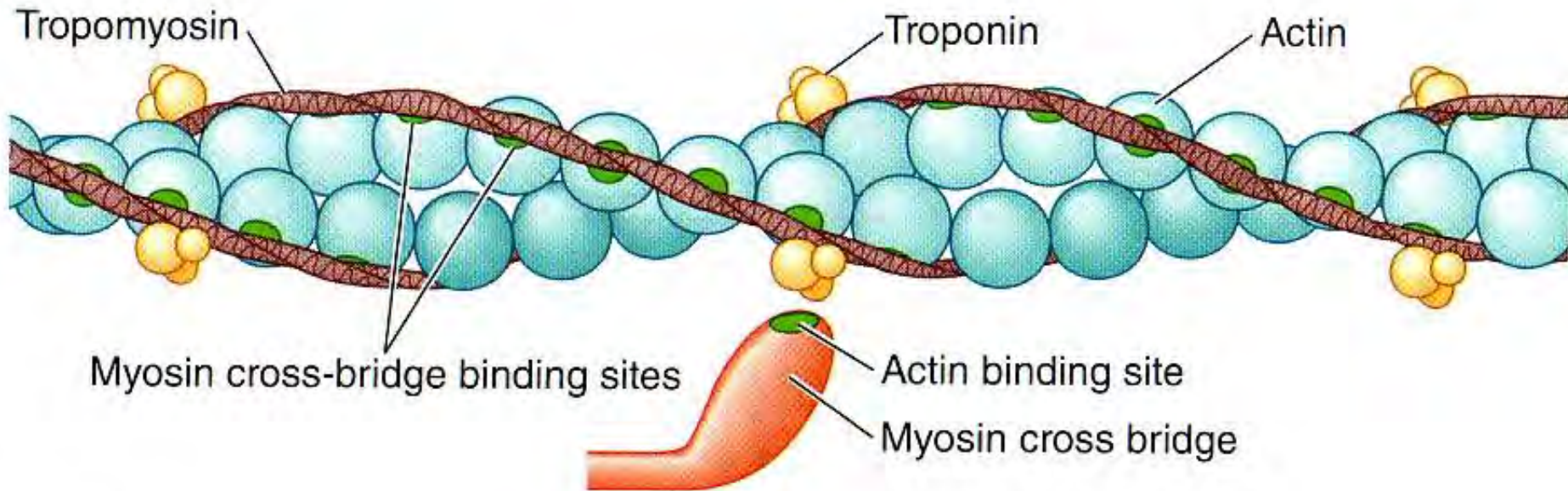


LS 2012 fig 8-7

Cross-Bridge Cycle



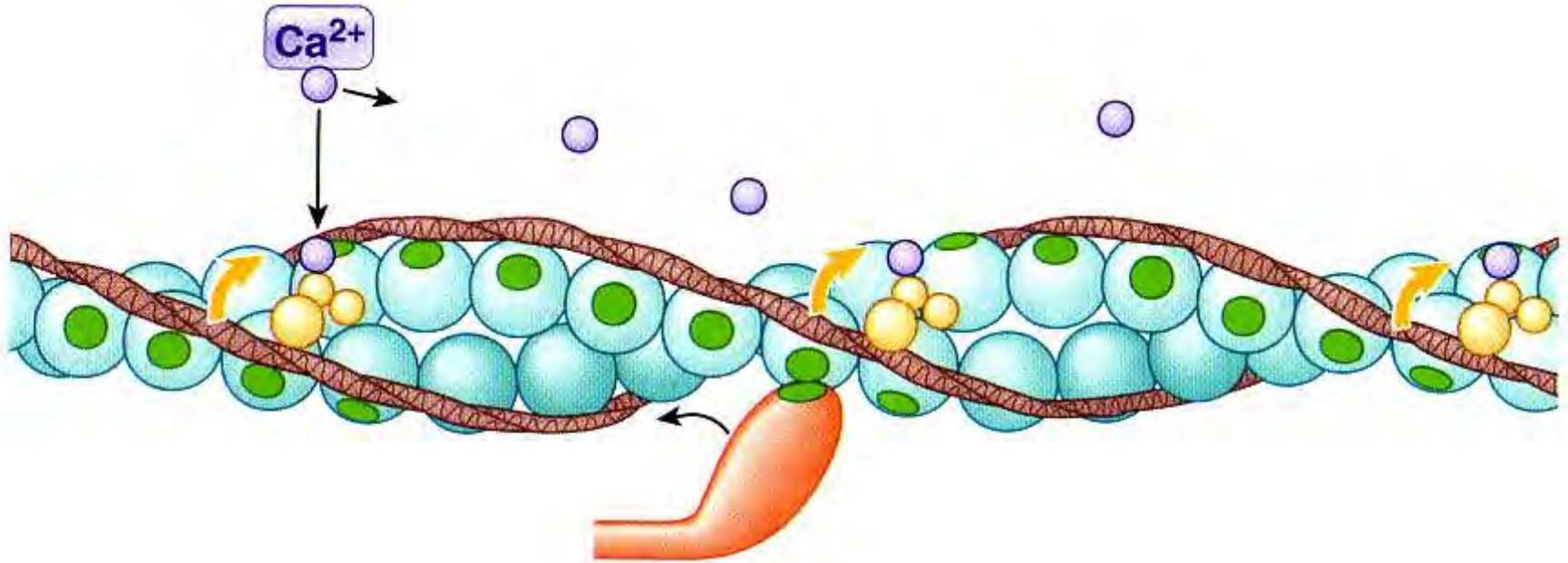
Relaxed: No Cross-Bridge Binding



(a) Relaxed

- 1** No excitation.
- 2** No cross-bridge binding because cross-bridge binding site on actin is physically covered by troponin–tropomyosin complex.
- 3** Muscle fiber is relaxed.

Excited: Calcium Triggers Cross-Bridge Binding



(b) Excited

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

Summary
We are
almost
there!

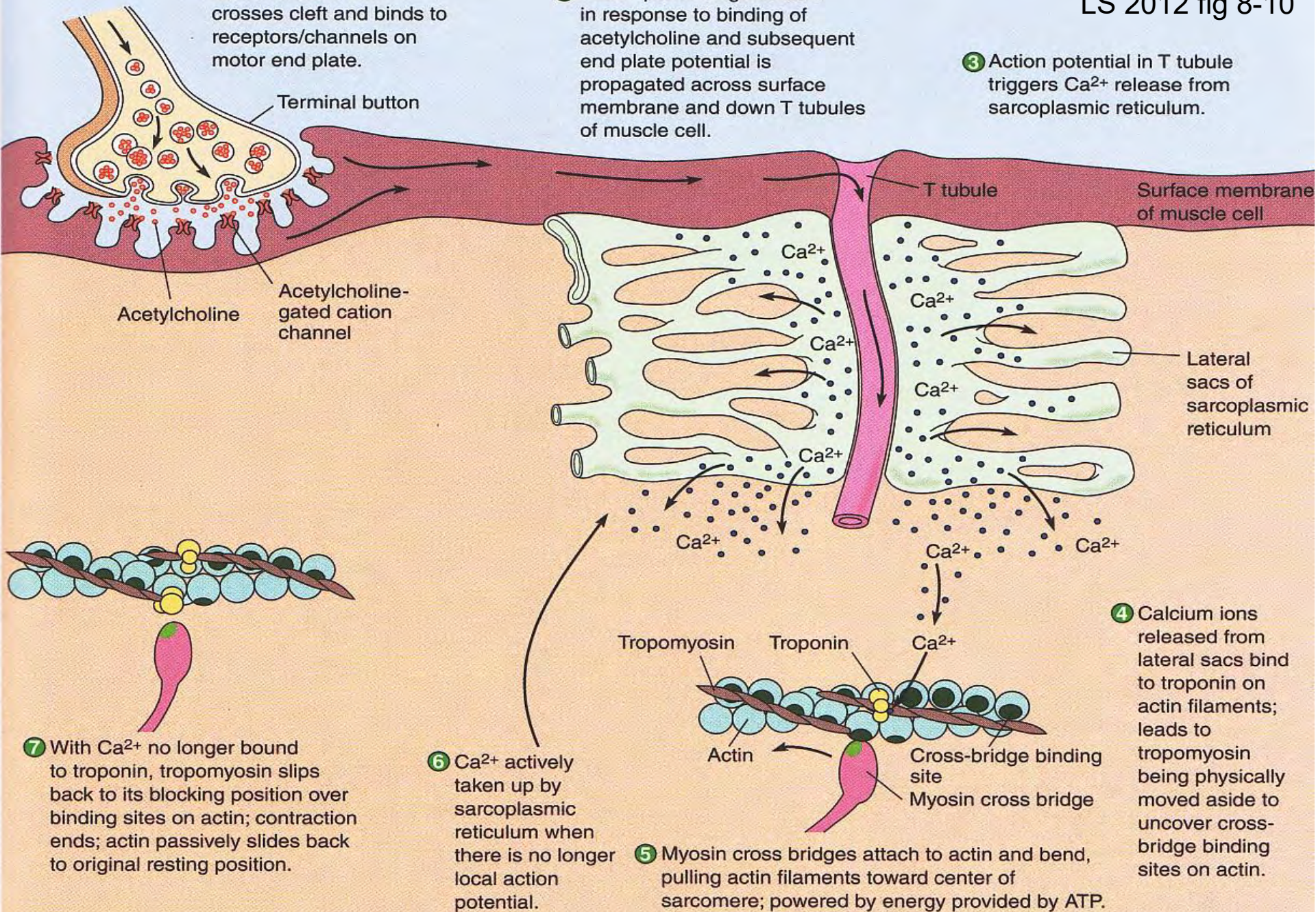


<https://www.youtube.com/watch?v=Ktv-CaOt6UQ>

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.

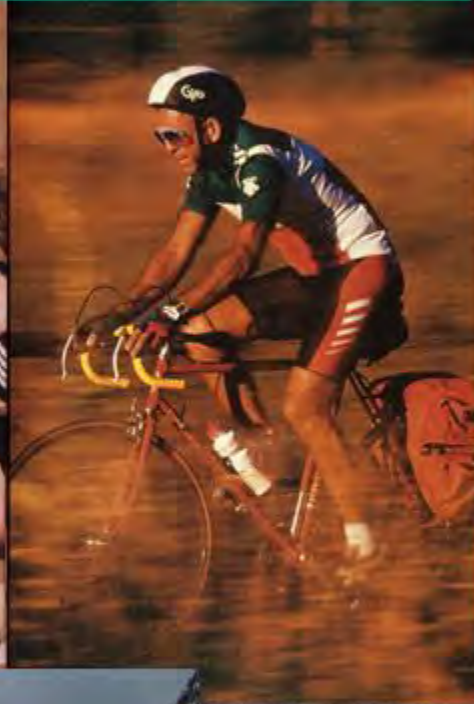
⑥ Ca^{2+} actively taken up by sarcoplasmic reticulum when there is no longer local action potential.

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.

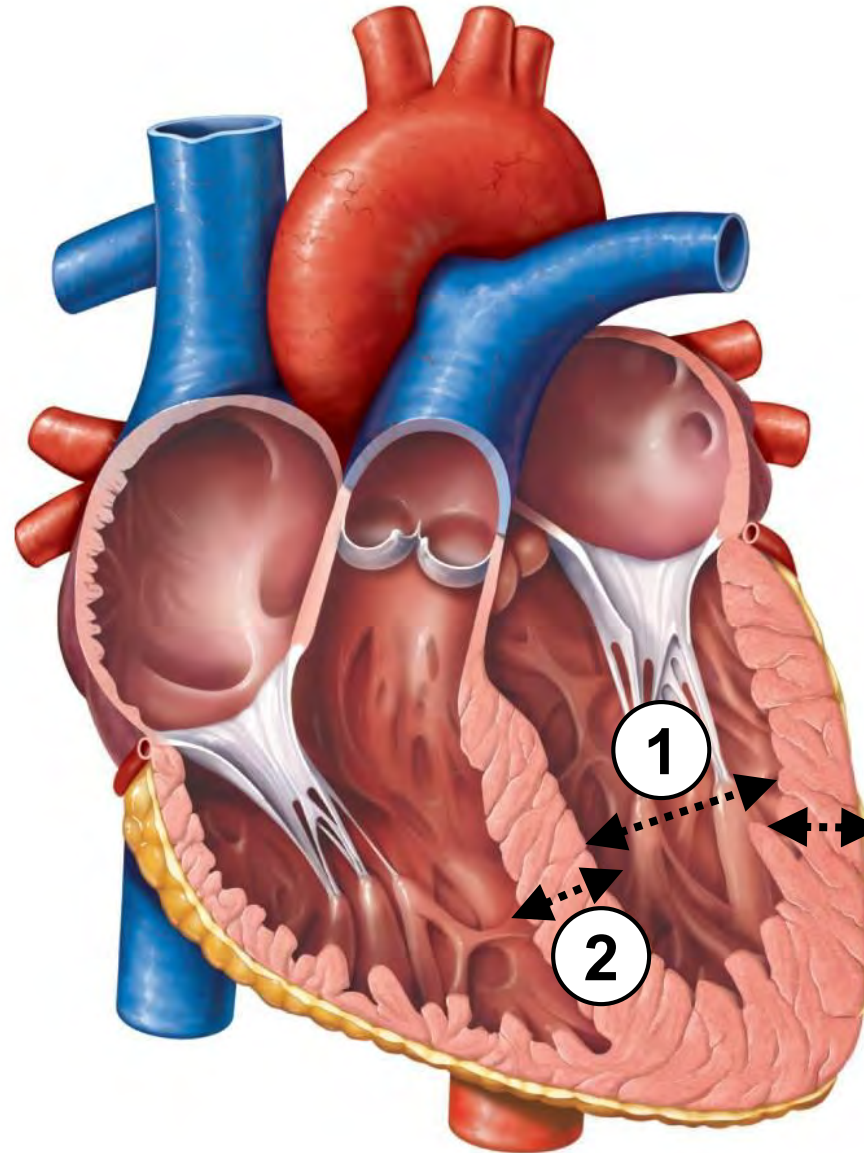
Adaptations to Exercise?

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



Cardiac Adaptations to Exercise:

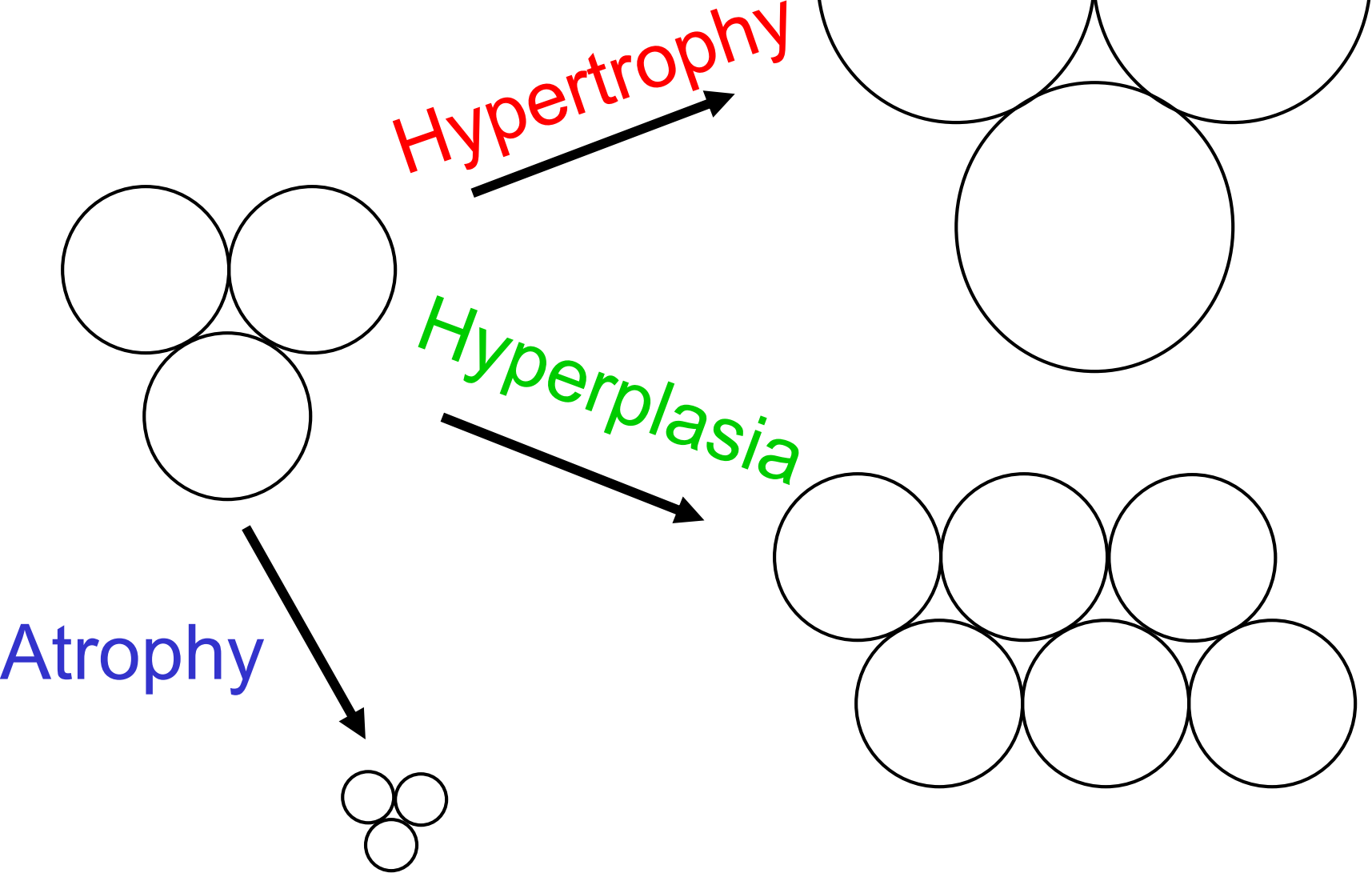
① Endurance vs. ② Strength Training



NB: ① > ↑ LBM

① + ②

Skeletal Muscle



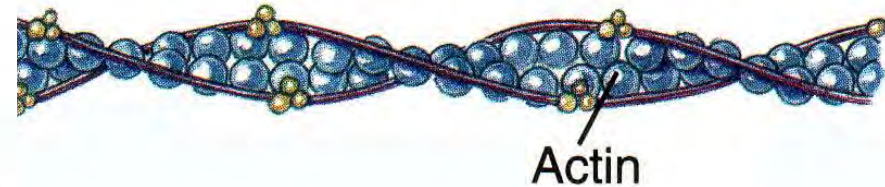
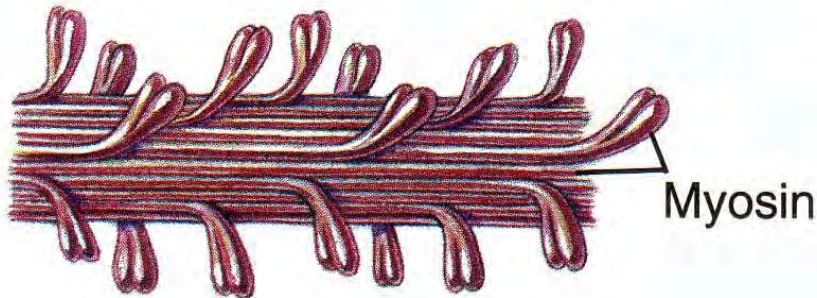
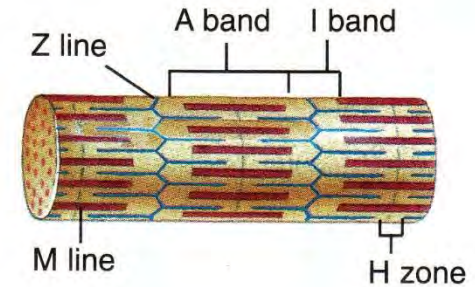


Hypertrophy: *Increased*

Number of Myofibrils

Thick & Thin Filaments

Myosin & Actin Molecules



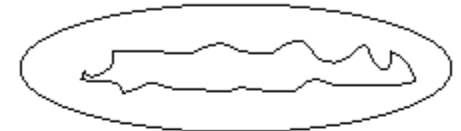
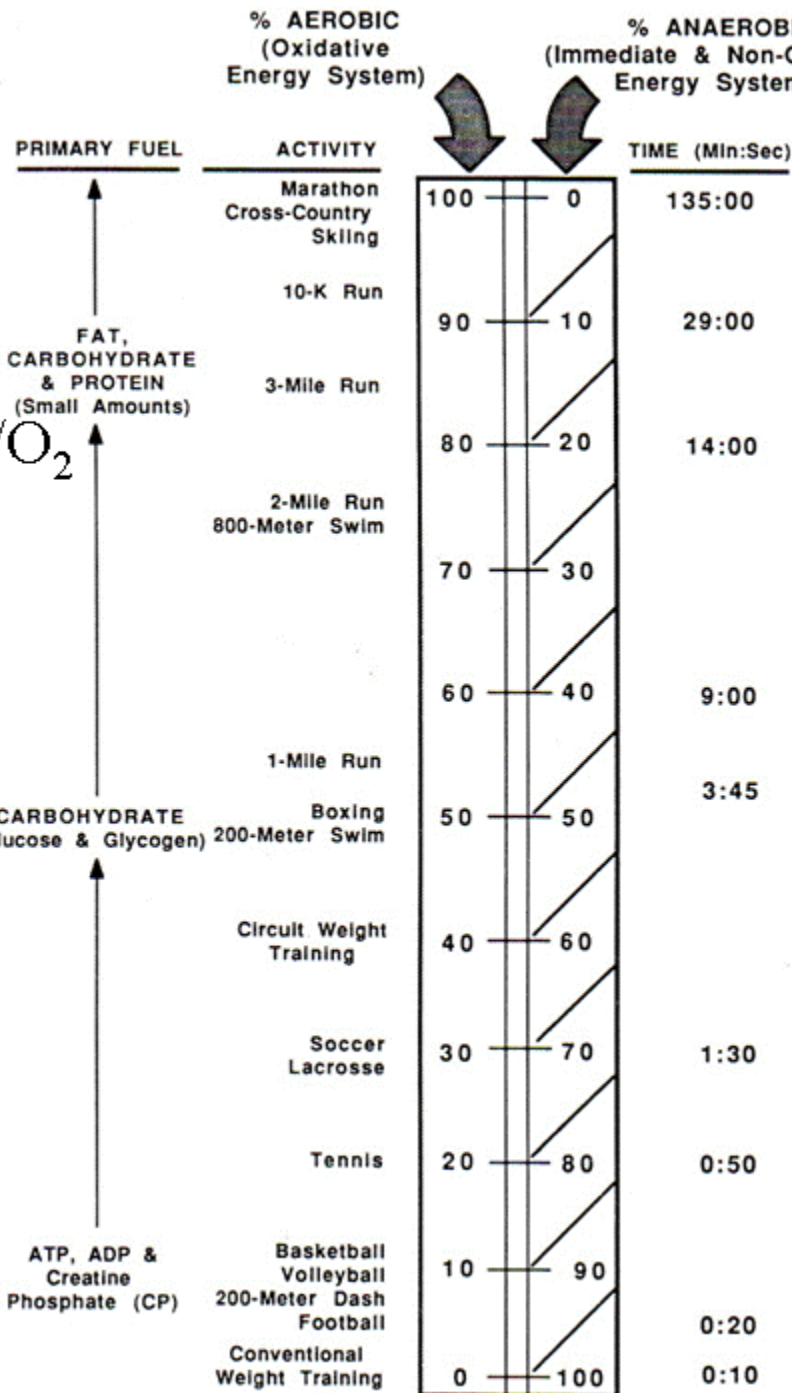
Characteristics of Skeletal Muscle Fibers

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



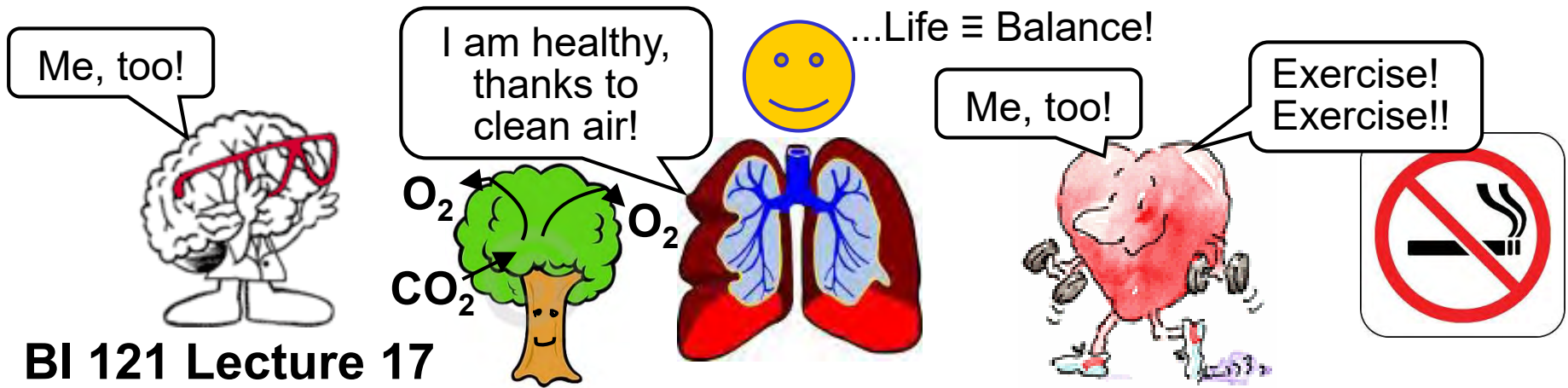
ANAEROBIC

Muscle Changes 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)?

Muscle Changes Due to Endurance Training

- ↑ Mitochondria, # & size
- ↑ Mitochondrial (aerobic) enzymes including those specific for fat burning
- ↑ Vascularization of muscles (better blood flow)
- ↑ Stores of fat in muscles accompanied by
- ↓ Triglycerides/fats in bloodstream
- ↑ Enzymes: activation, transport, breakdown (β -oxidation) of fatty acids
- ↑ Myoglobin (enhances O₂ transport)
- ↑ Resting energy levels which inhibit sugar breakdown
- ↑ Aerobic capacity of all three fiber types.



BI 121 Lecture 17

I. Announcements Exam II next Friday, Dec 7th @ 8:00 am!

12 n lab section go to 5 KLA; 1 pm lab section go to 13 KLA;
2 pm lab section go to 21 KLA. Discussion-Review Thurs. Q?

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

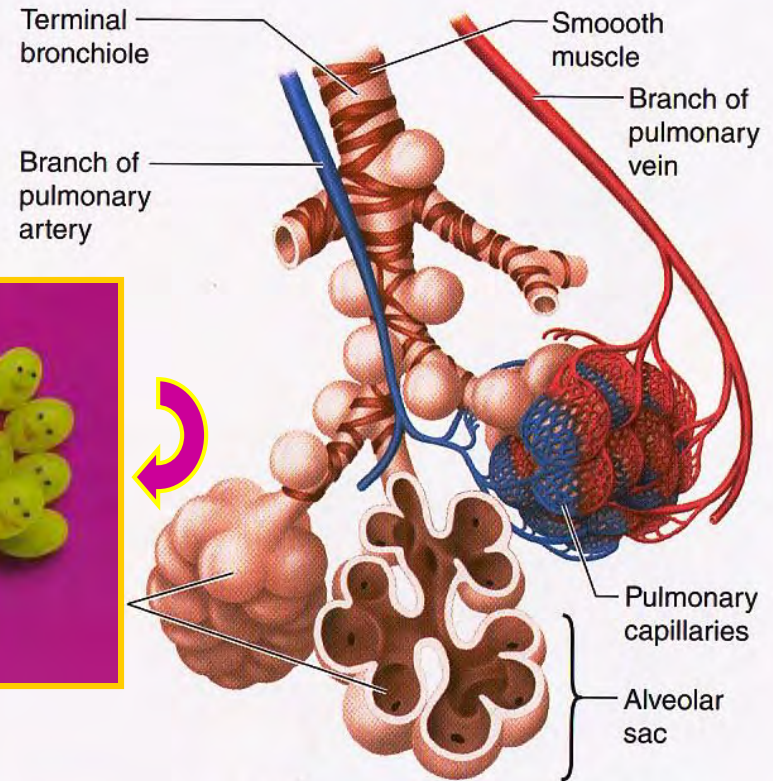
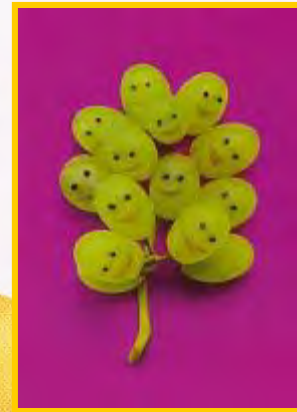
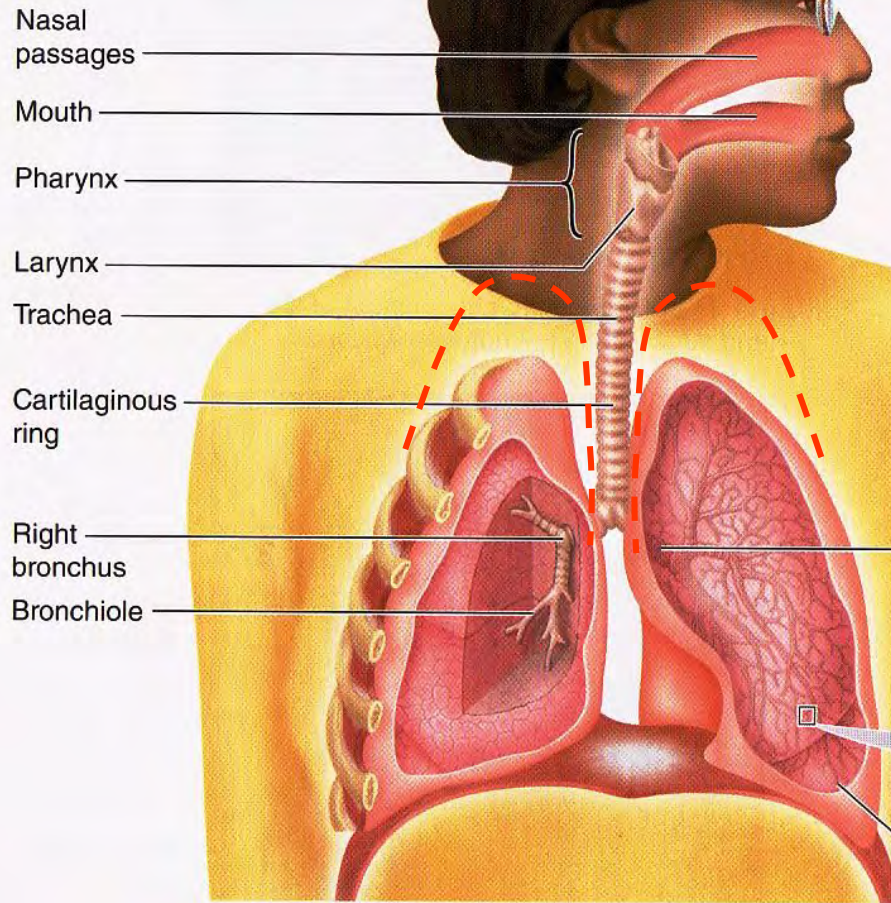
- A. Respiratory system anatomy LS fig 12-2 p 347, DC, SI Fox+...
- B. Histology LS fig 12-4 pp 347-9, DC fig 7-4 p 54
- C. How do we breathe? LS fig12-12, fig12-25 pp 349-56, 373-8
- D. Gas exchange LS fig 12-19 pp 362-5
- E. Gas transport LS tab 12-3 pp 365-70

III. Physiology of Cigarette Smoking

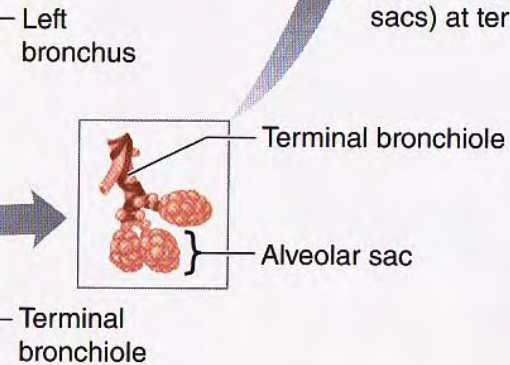
- A. ANS, autonomic nerves & nicotine? Route of chemicals,...
- B. Emphysema? 2nd-hand smoke?... LS pp 356, 365
- C. UO Smoke-Free since Fall 2012! Help is available!

Respiratory System Anatomy

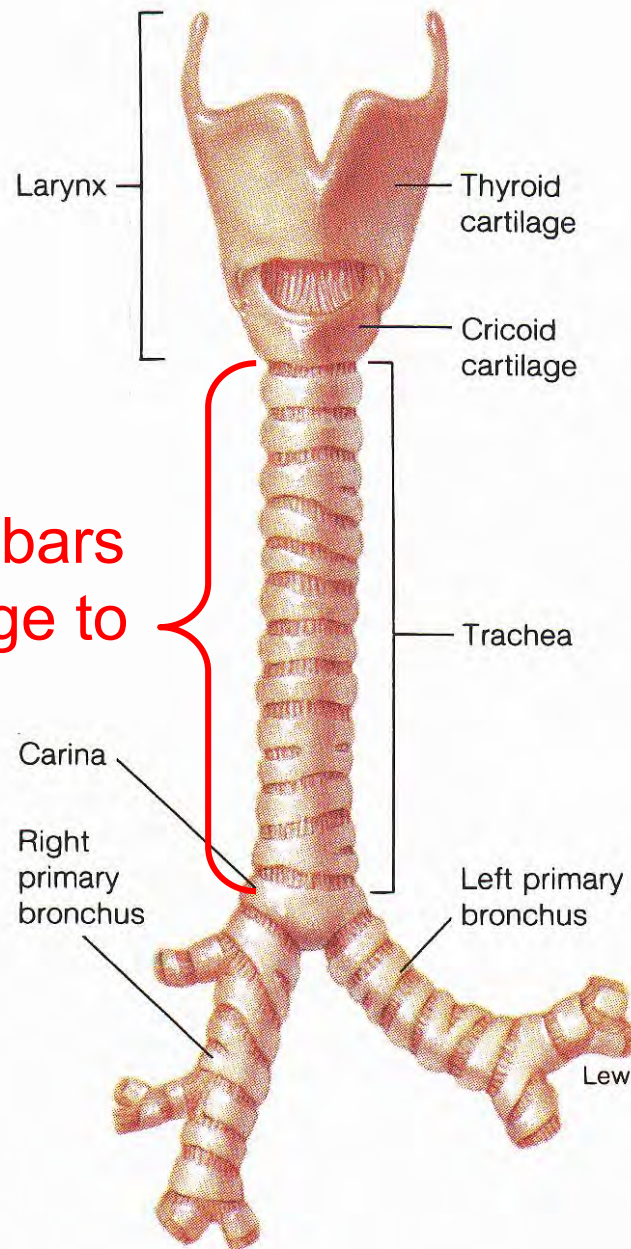
NB: In vivo,
Cupola or peak
of each lung
goes into neck
> clavicle line!



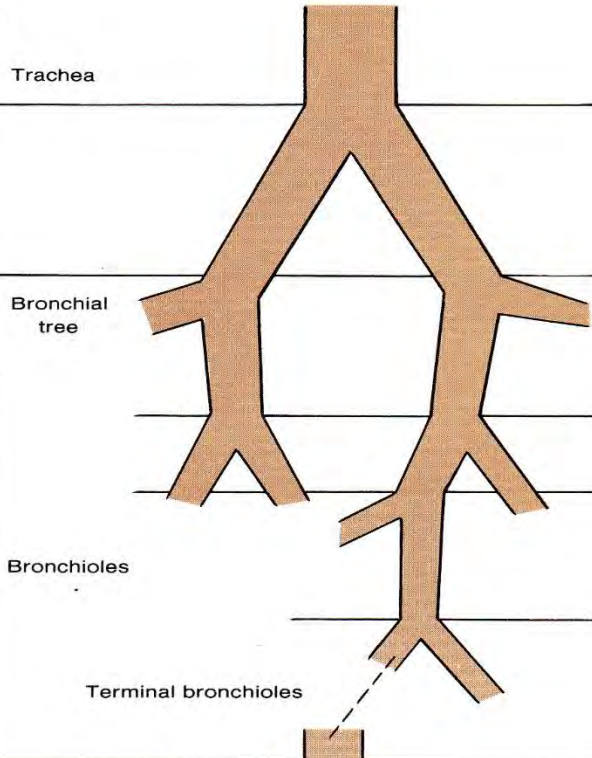
(b) Enlargement of alveoli (air sacs) at terminal ends of airways



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

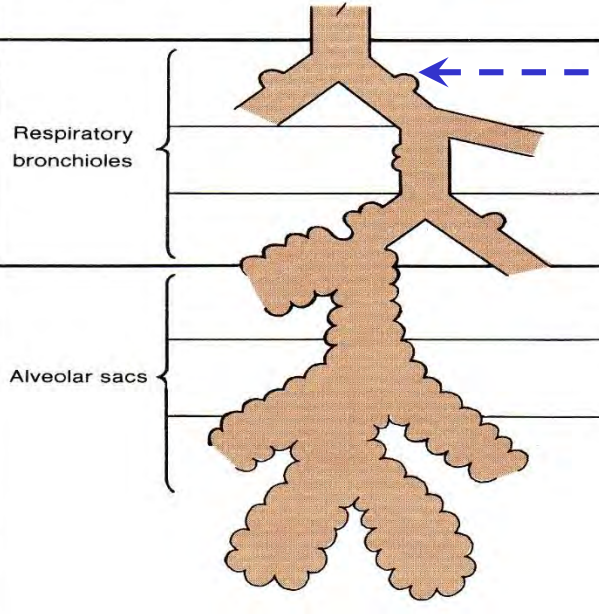


Conductive Zone



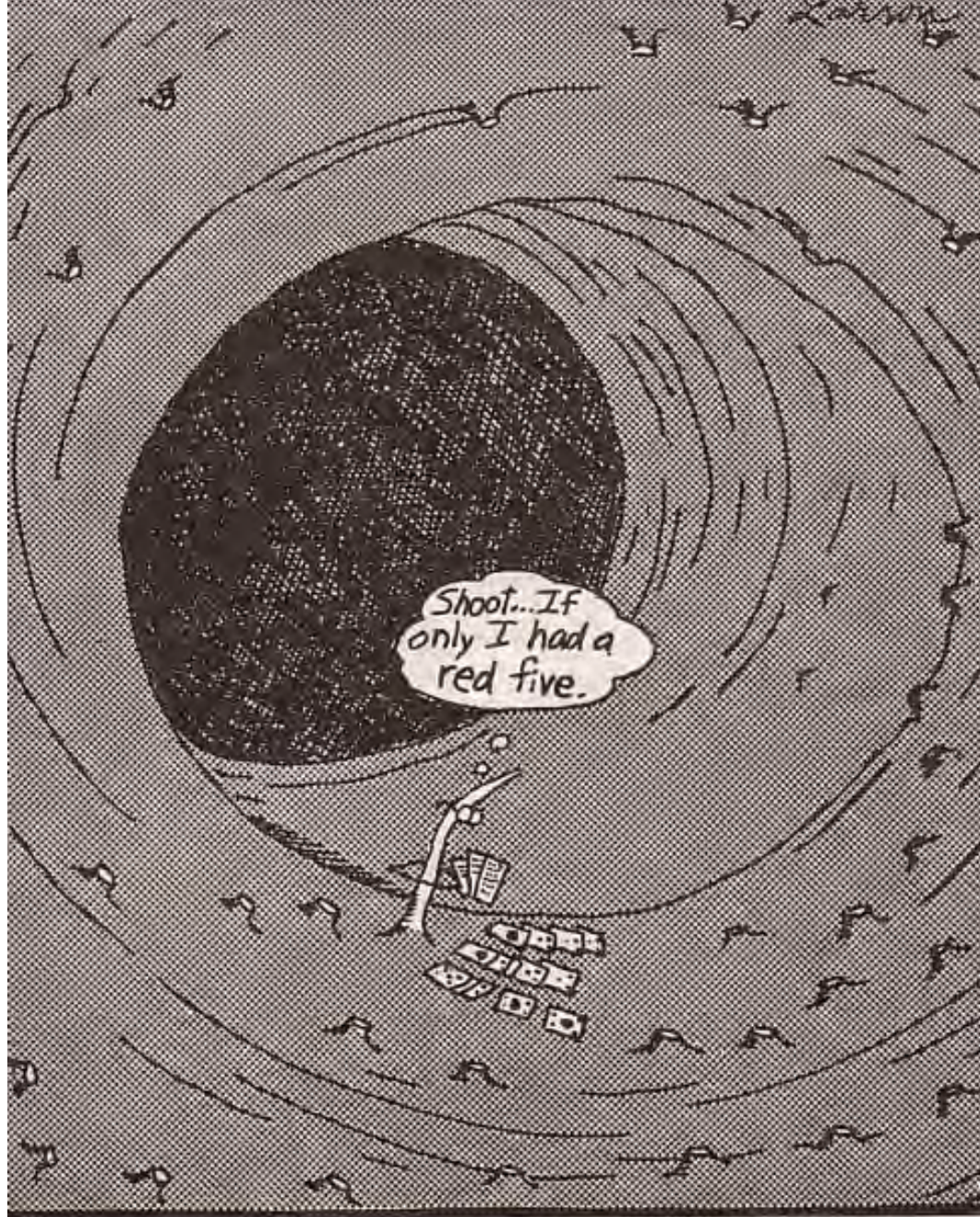
No Gas Exchange

Respiratory Zone



-1st alveolar outpouching!

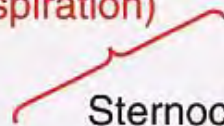
Gas Exchange



The last cilium on a smoker's lung

Muscles of Ventilation

Accessory muscles of inspiration
(contract only during forceful inspiration)



Sternocleidomastoid

Scalenus

Internal intercostal muscles

NB: Diaphragm is the chief muscle of ventilation!

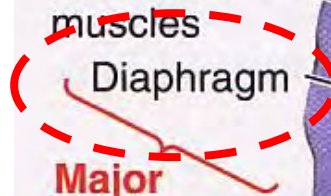
Sternum

Ribs

External intercostal muscles

Diaphragm

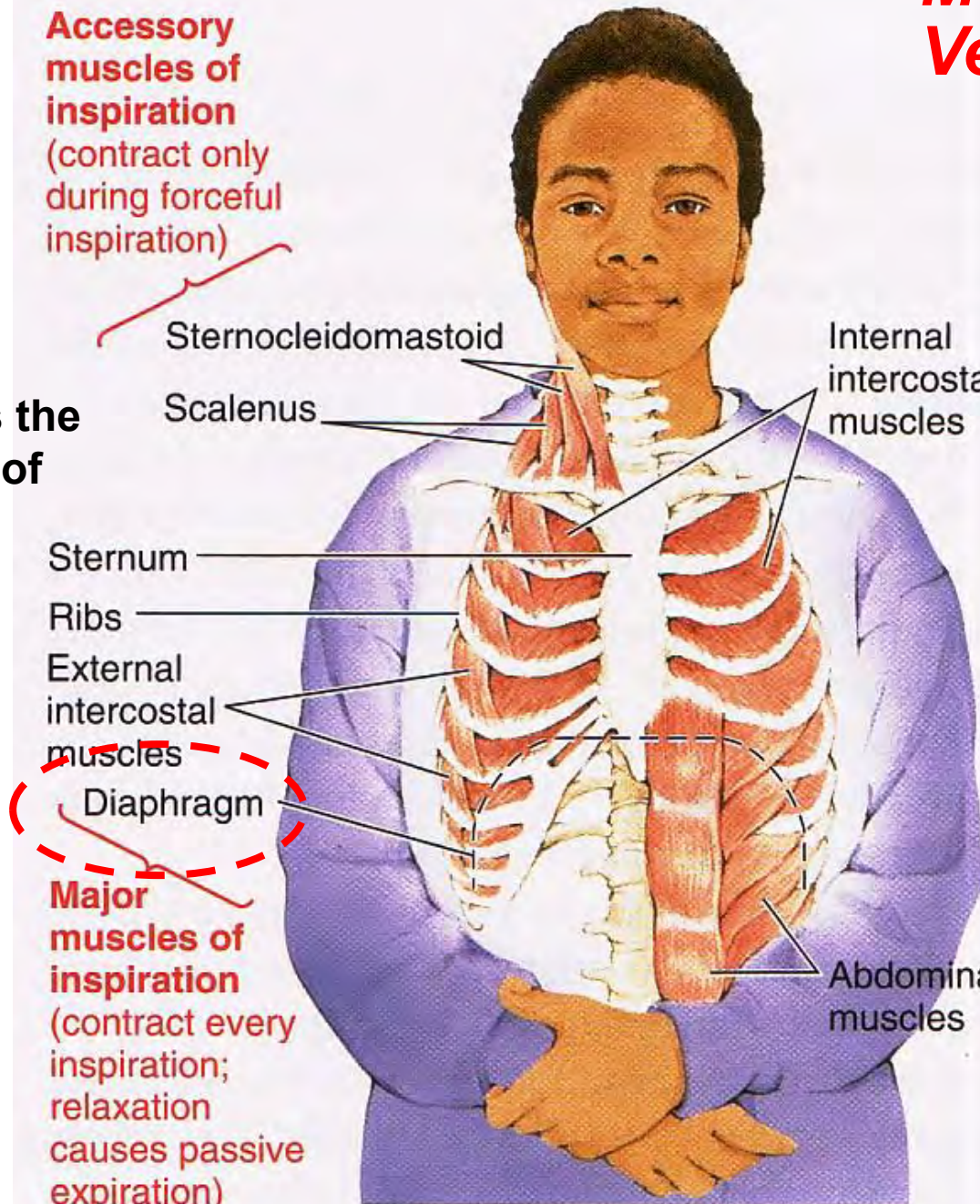
Major muscles of inspiration
(contract every inspiration; relaxation causes passive expiration)

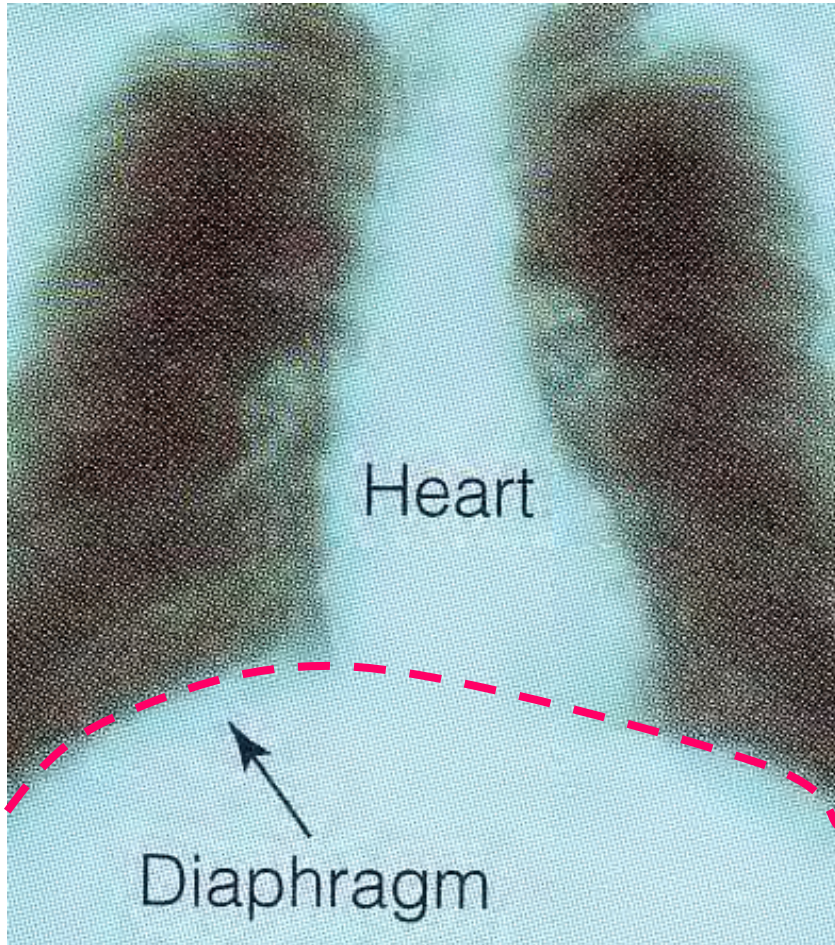


Muscles of active expiration
(contract only during active expiration)



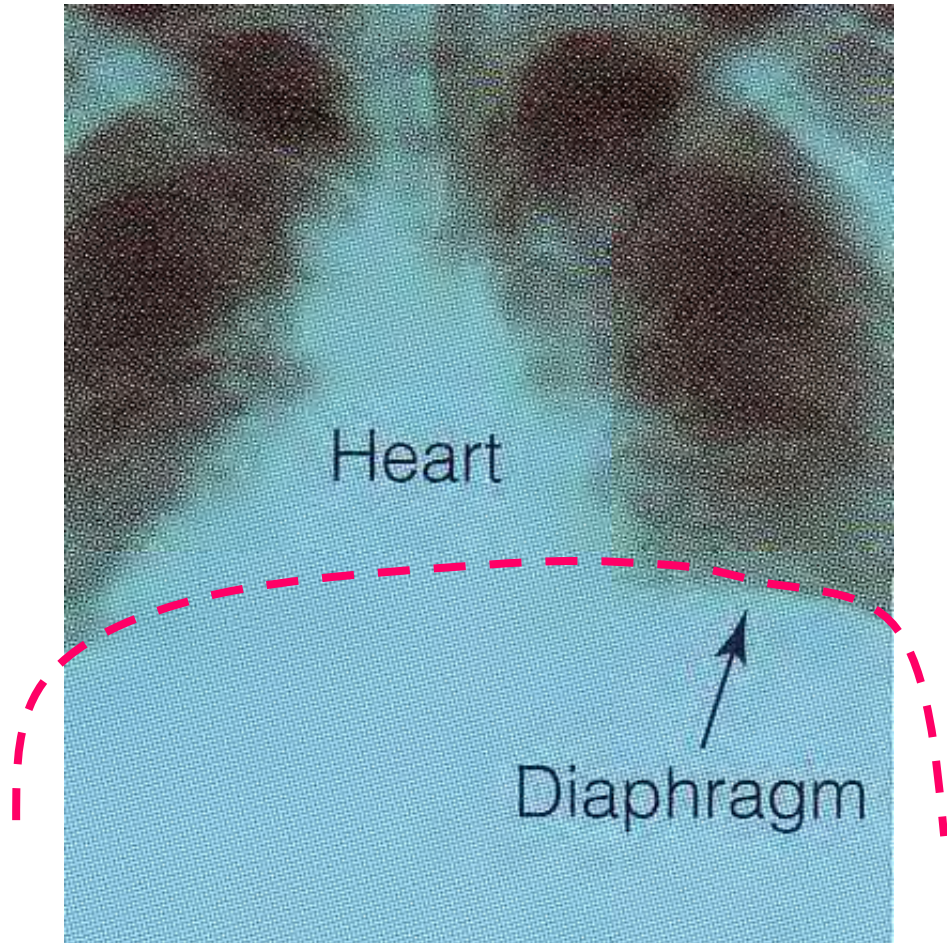
Abdominal muscles





Inhale (active)

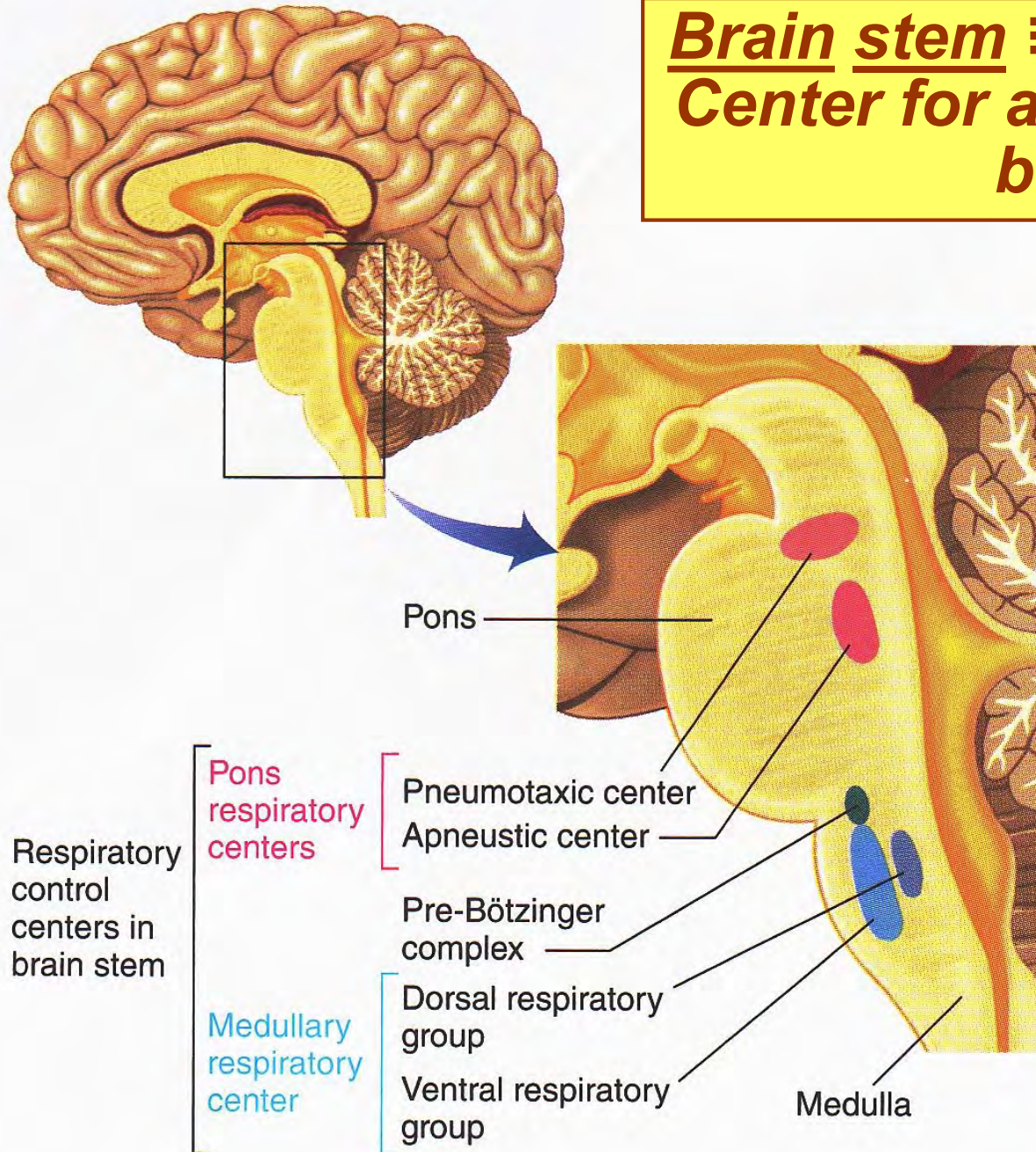
Contract & flatten diaphragm



Exhale (passive @ rest)

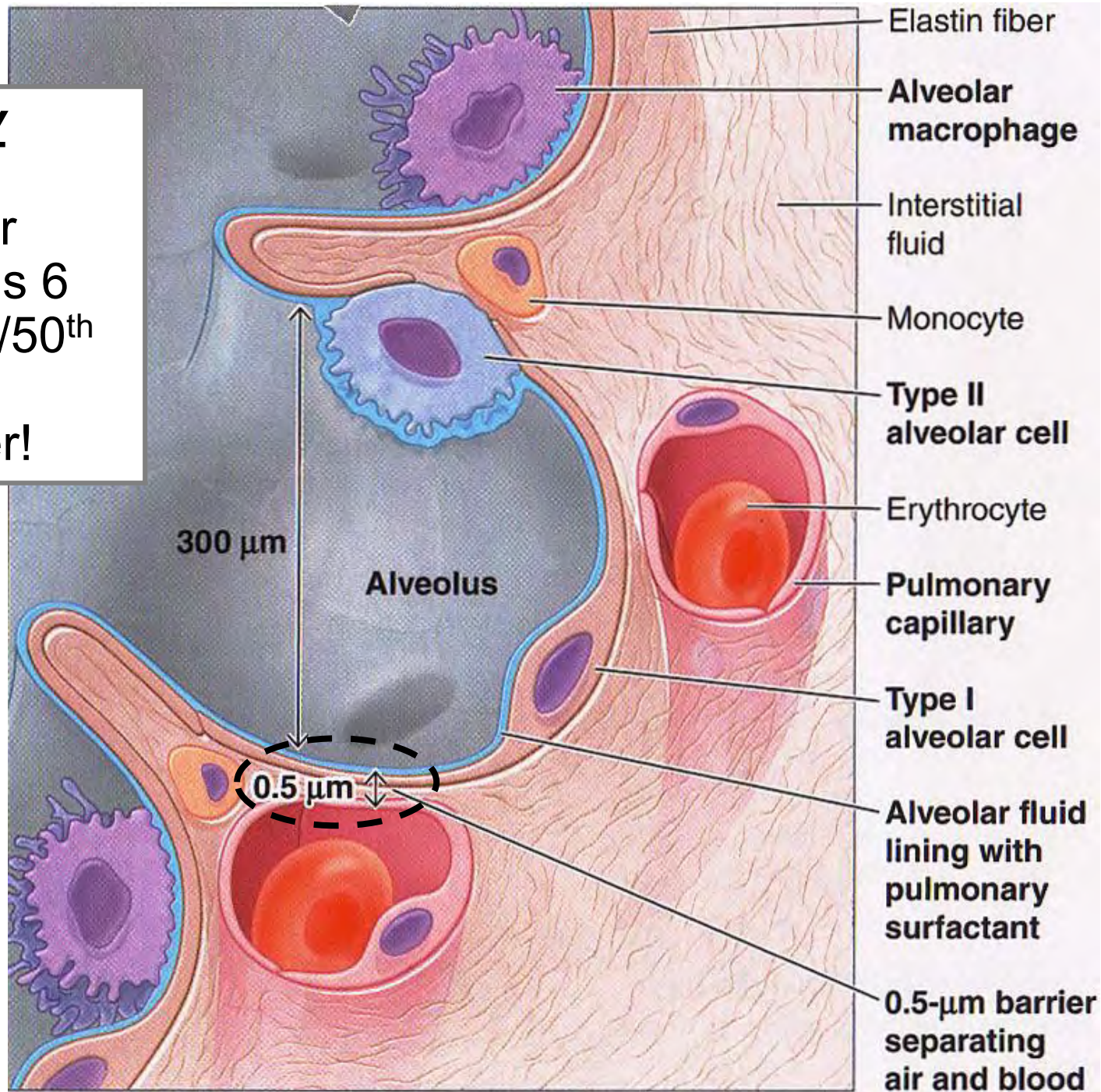
Relax & pouch up diaphragm!

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)

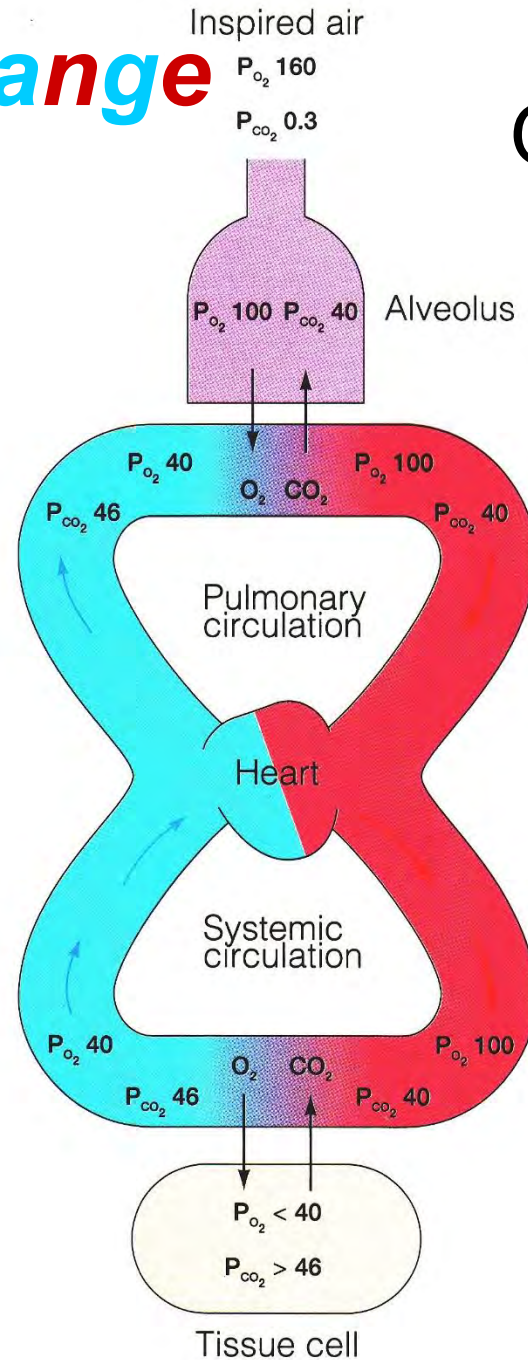
CO₂ partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

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

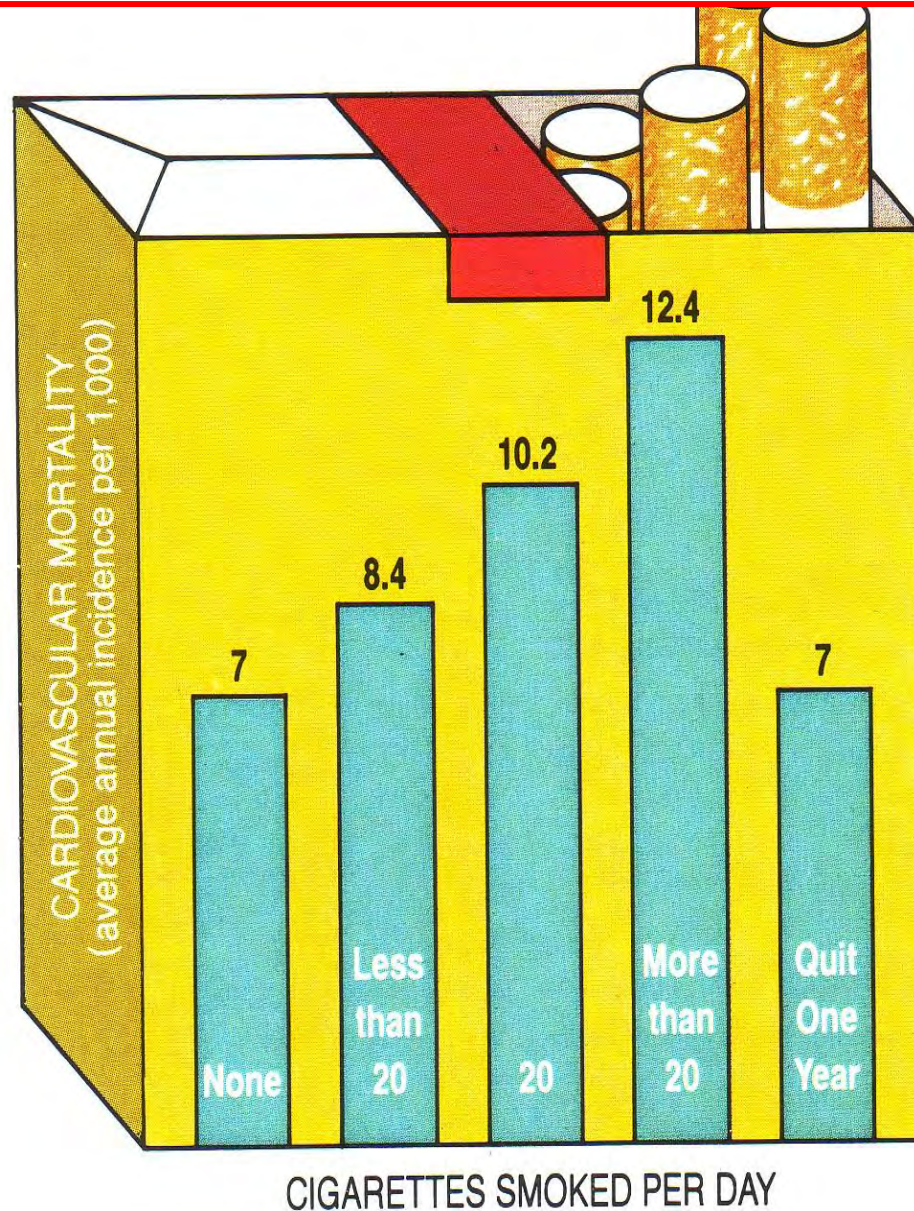
Polypeptide chain

▲ TABLE 12-3

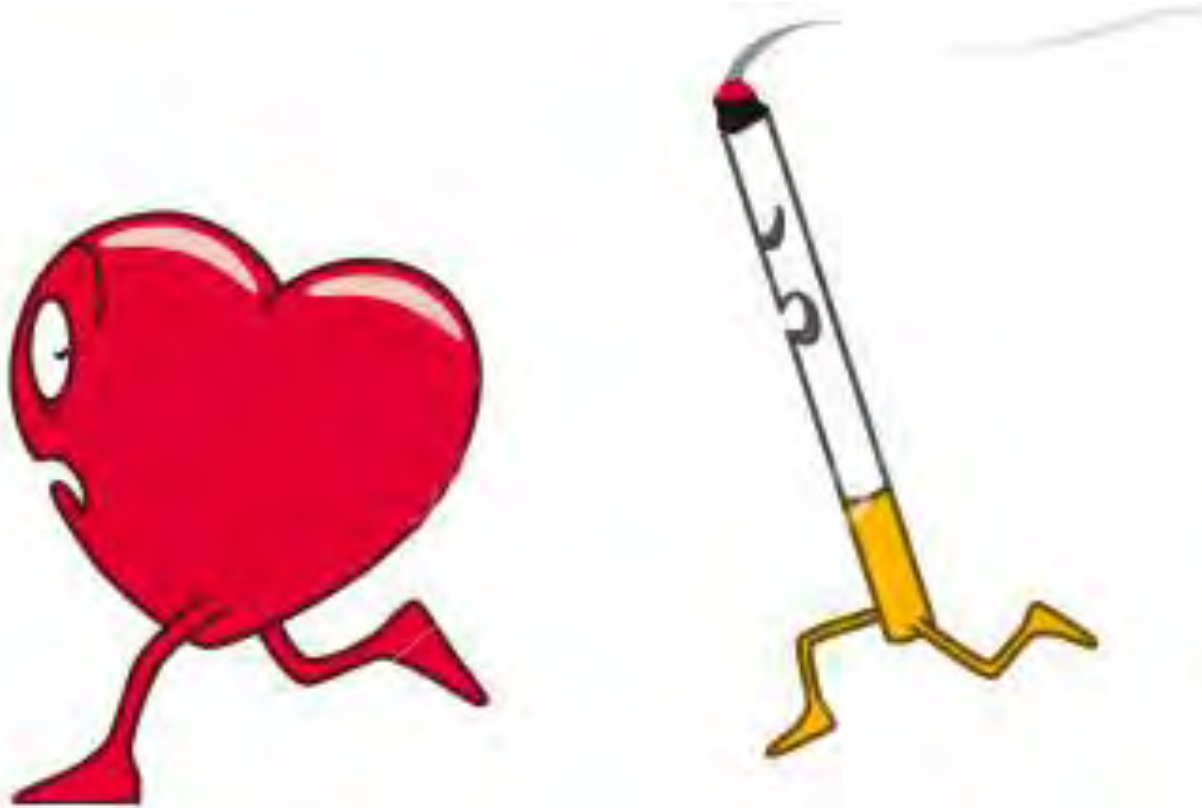
Methods of Gas Transport in the Blood

GAS	METHOD OF TRANSPORT IN BLOOD	PERCENTAGE CARRIED IN THIS FORM
O_2	Physically dissolved	1.5
	Bound to hemoglobin	98.5
CO_2	Physically dissolved	10
	Bound to hemoglobin	30
	As bicarbonate (HCO_3^-)	60

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.”

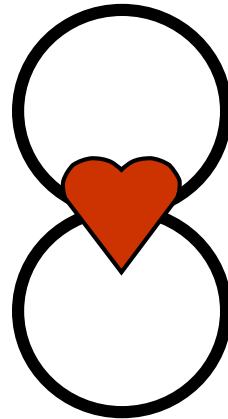
Last October, a former tobacco industry employee revealed that secret industry documents indicated that ammonia was added to tobacco to double the impact of nicotine. Research now indicates that ammonia can boost nicotine availability up to 100x! The Oregon Graduate Institute (now a part of [OHSU](http://www.ohsu.edu))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

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

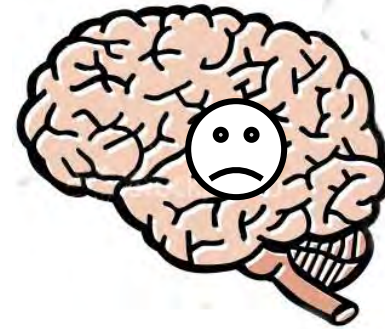
Cigarettes ≡ Patient-Assisted Drug-Delivery System Inhaling Bypasses the Systemic Circulation & Is Powerfully Reinforcing!



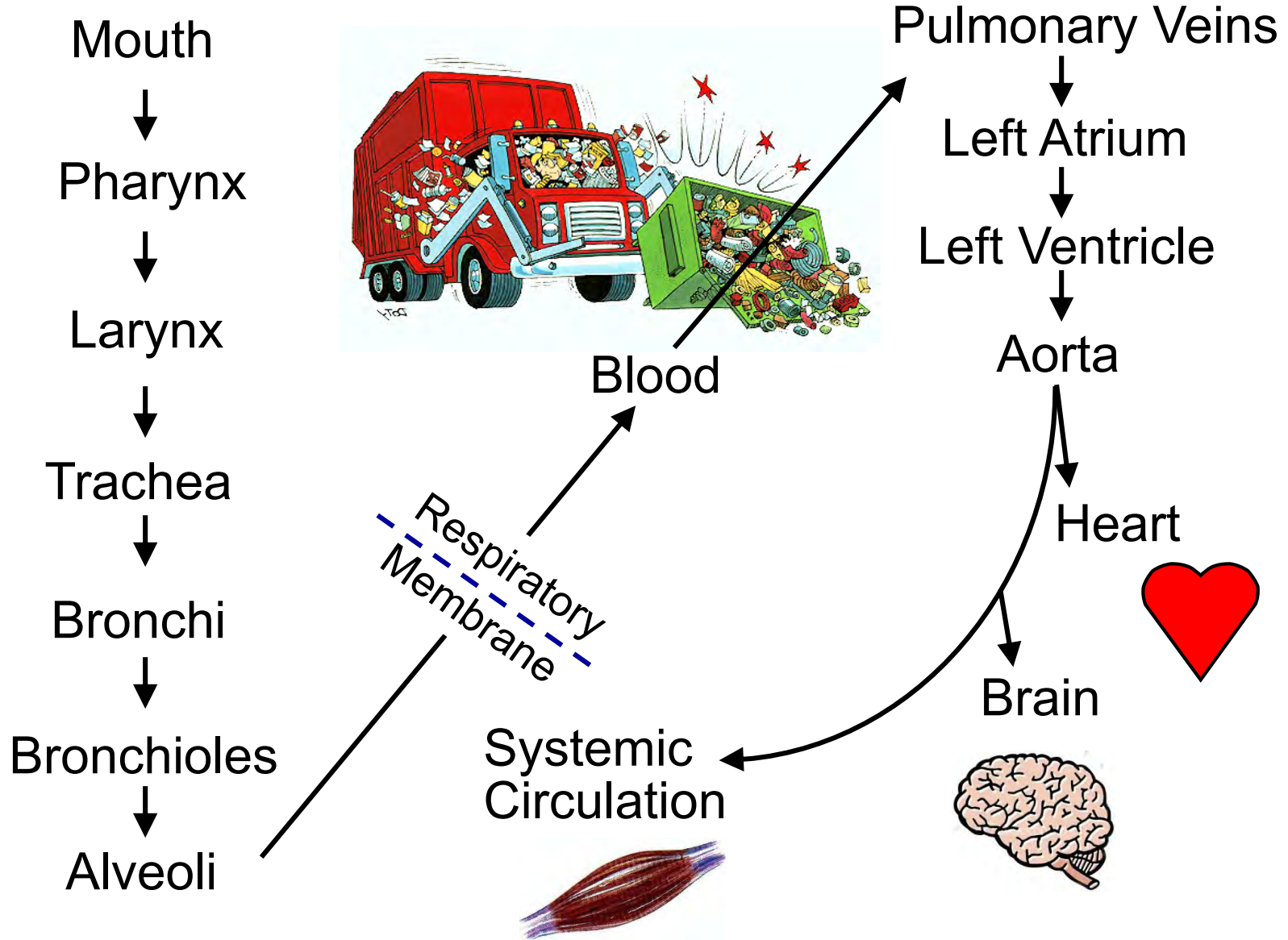
Pulmonary



Systemic



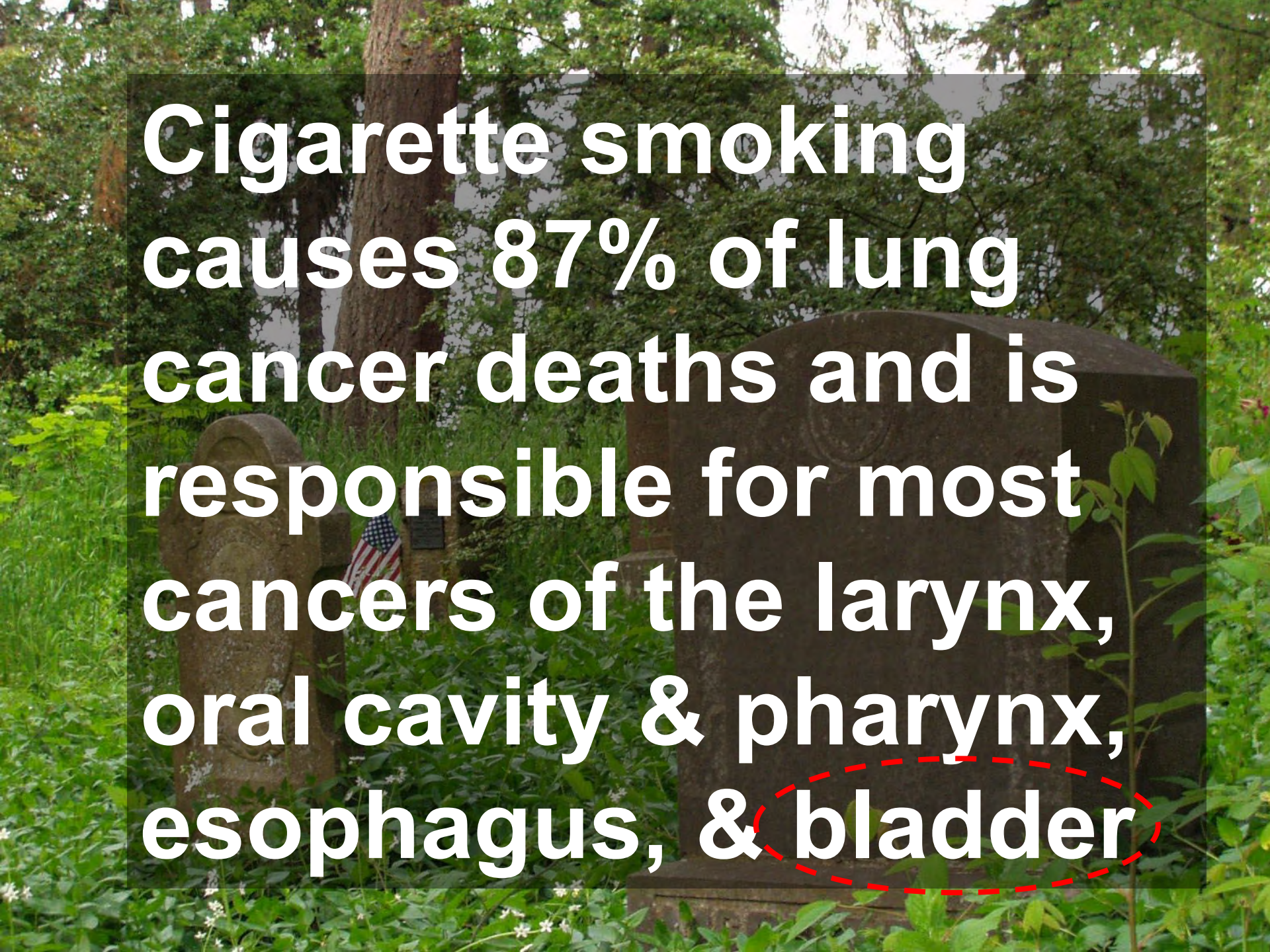
Tracing the Route of Cigarette Smoke Puff to Brain Time 5 to 8 seconds!!



Keep it Basic?

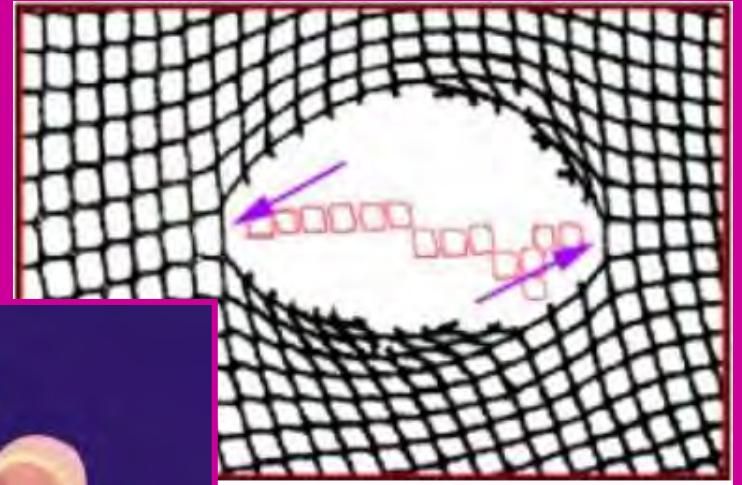
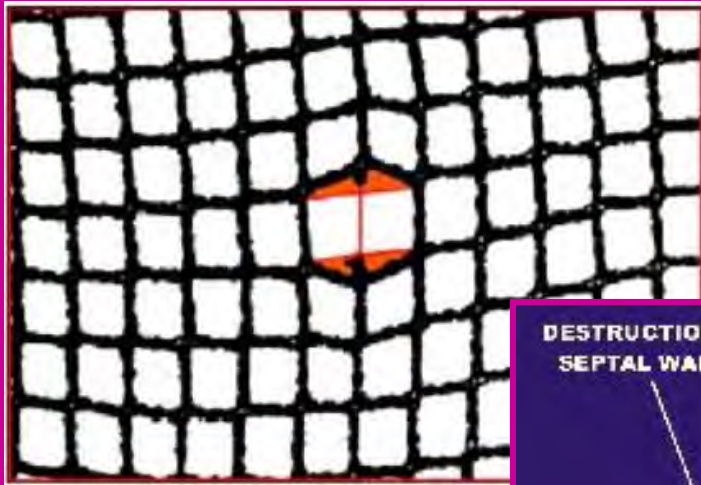
Cigarette smoking is the most important preventable cause of premature death in the U.S. accounting for 443,000 annual deaths.

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



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

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



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



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

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

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

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

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

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



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

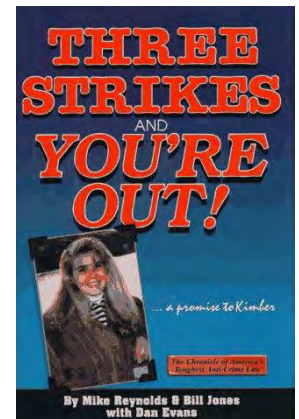
On the Pill & Smoke?

Increased Risk of:

1. Blood Clots

2. Heart Attack

3. Strokes!



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

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

A photograph of a man in a tuxedo smoking a cigarette, looking at a woman. The man is on the left, smiling slightly, with a lit cigarette in his mouth. The woman is on the right, looking towards the man. The background is a dark, textured wall.

"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

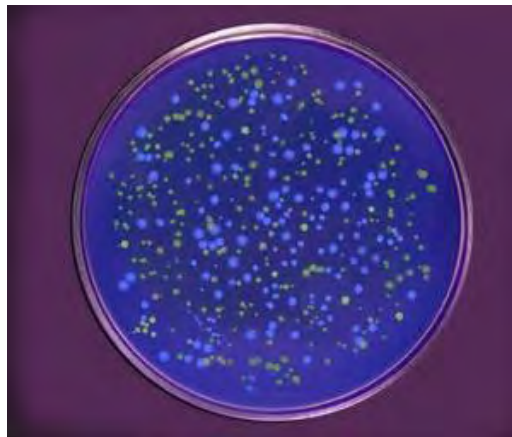
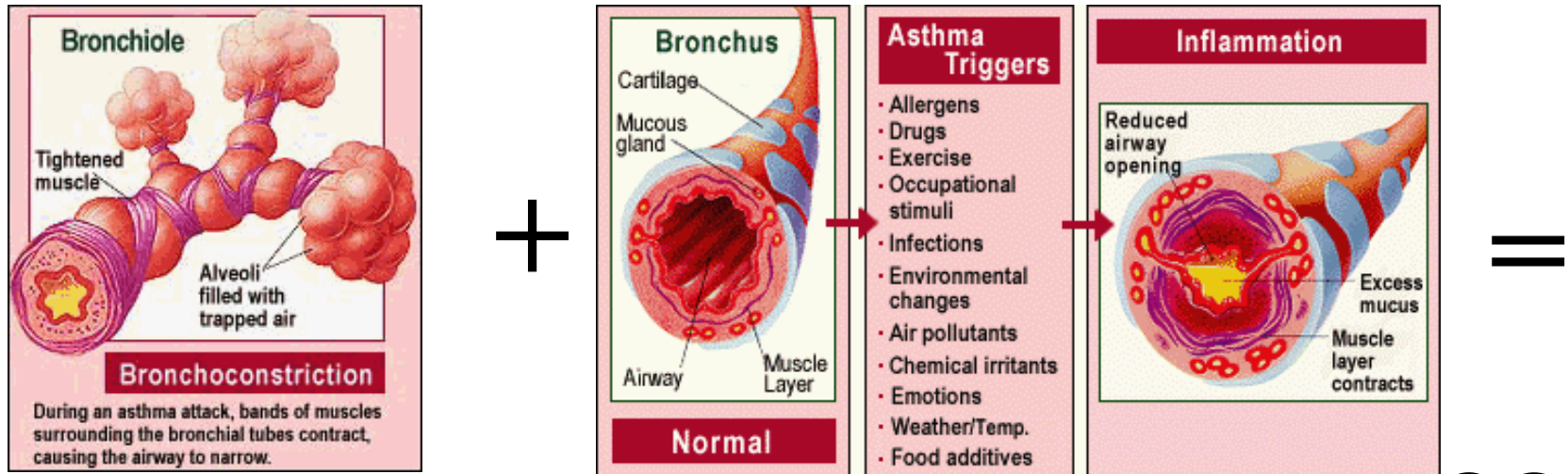
Vaping pollutes lungs with toxic chemicals and may even make antibiotic-resistant bacteria harder to kill

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



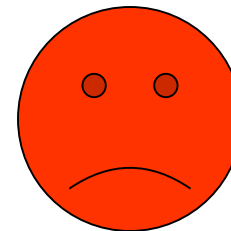
<https://www.sciencenews.org/article/health-risks-e-cigarettes-emerge>

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>