Exam II Review Slides

BI 121 Lecture 9

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 ≥ 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**

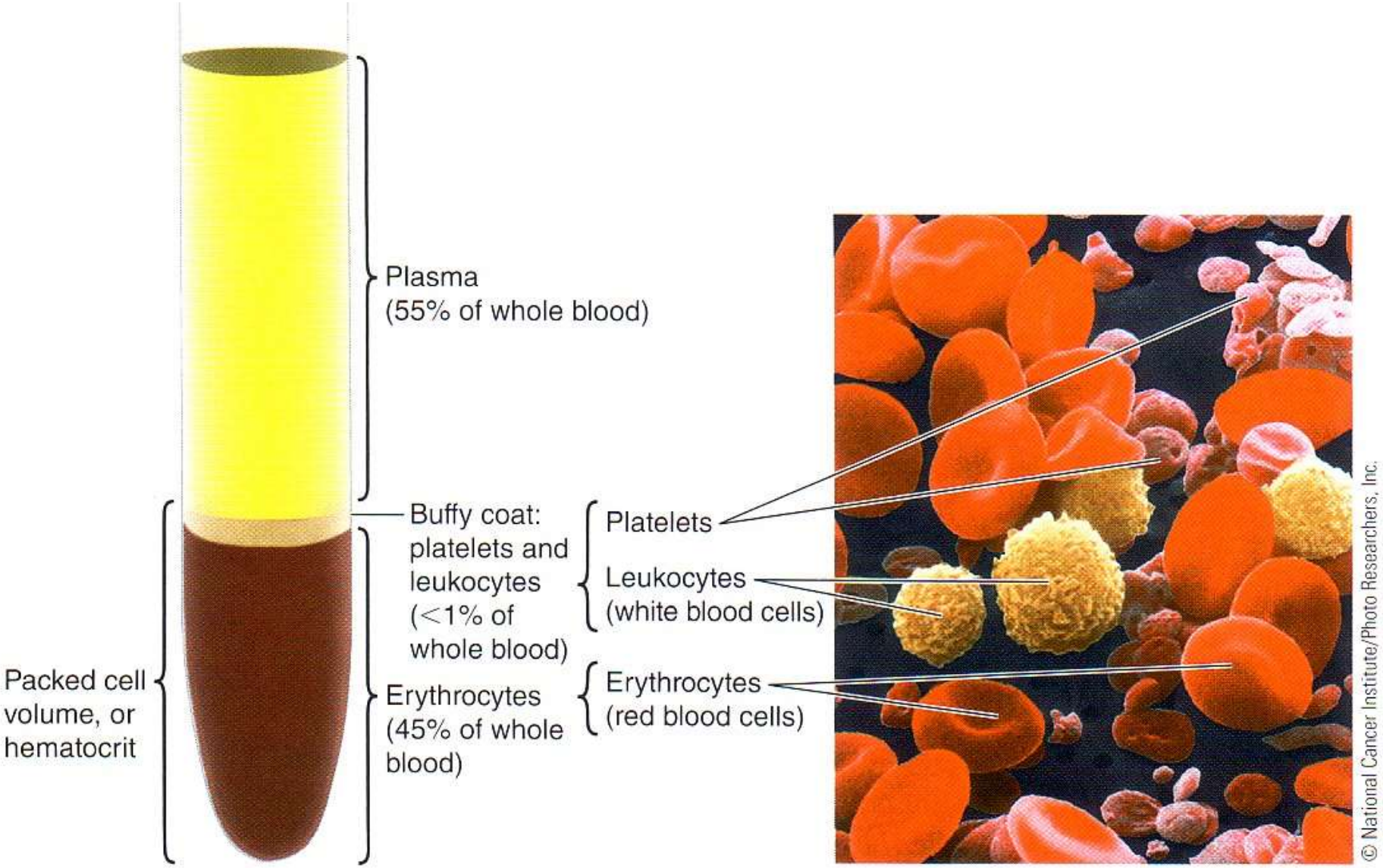
III. ***Blood Chemistry Lab: Basics*** **LM + LS ch 11 & 17**

- **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?

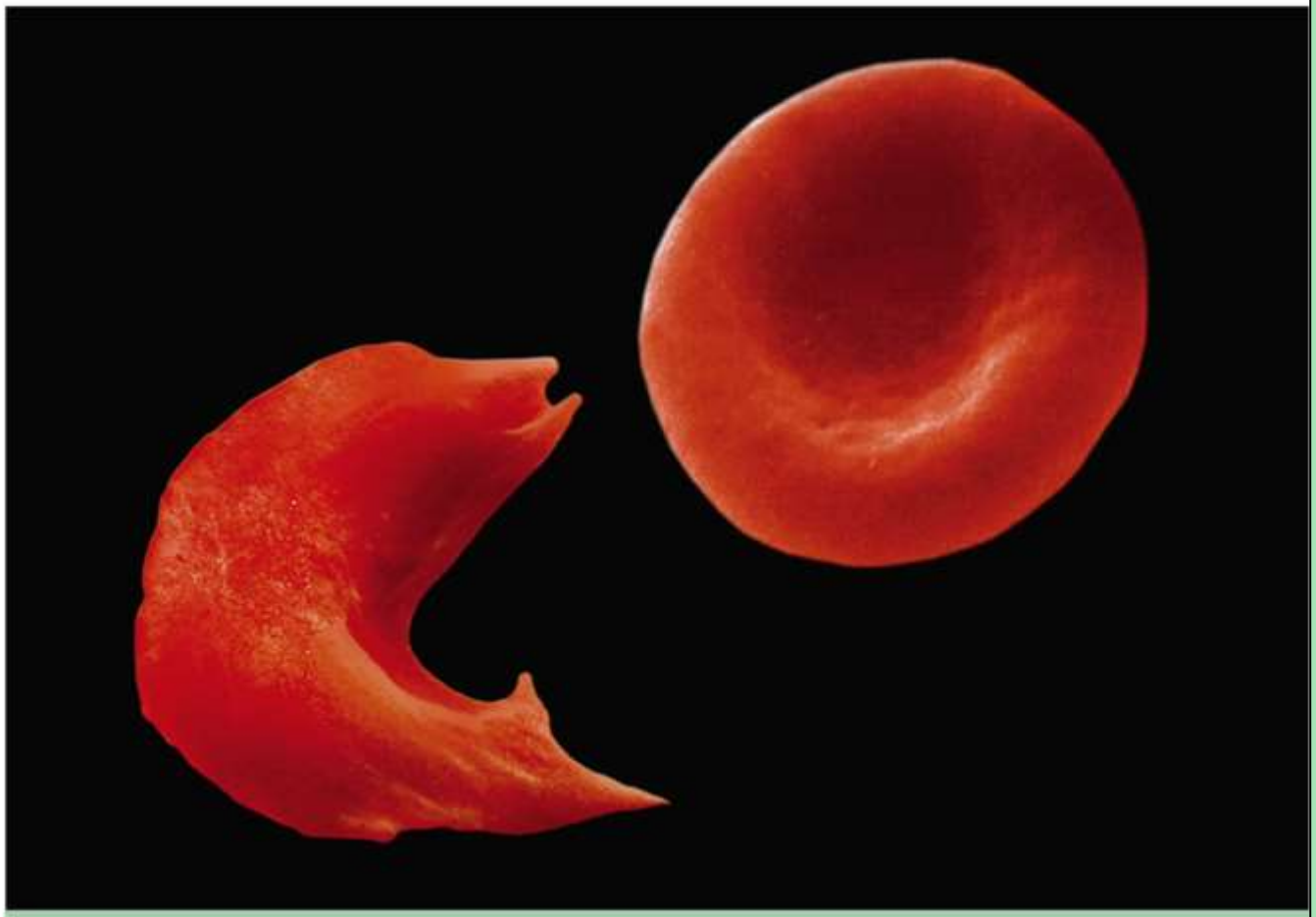
What's in Blood? Plasma & Blood Cells



LS 2012 fig 11-1

Sickle-shaped blood cells

Normal red blood cells



What a difference one amino acid can make!

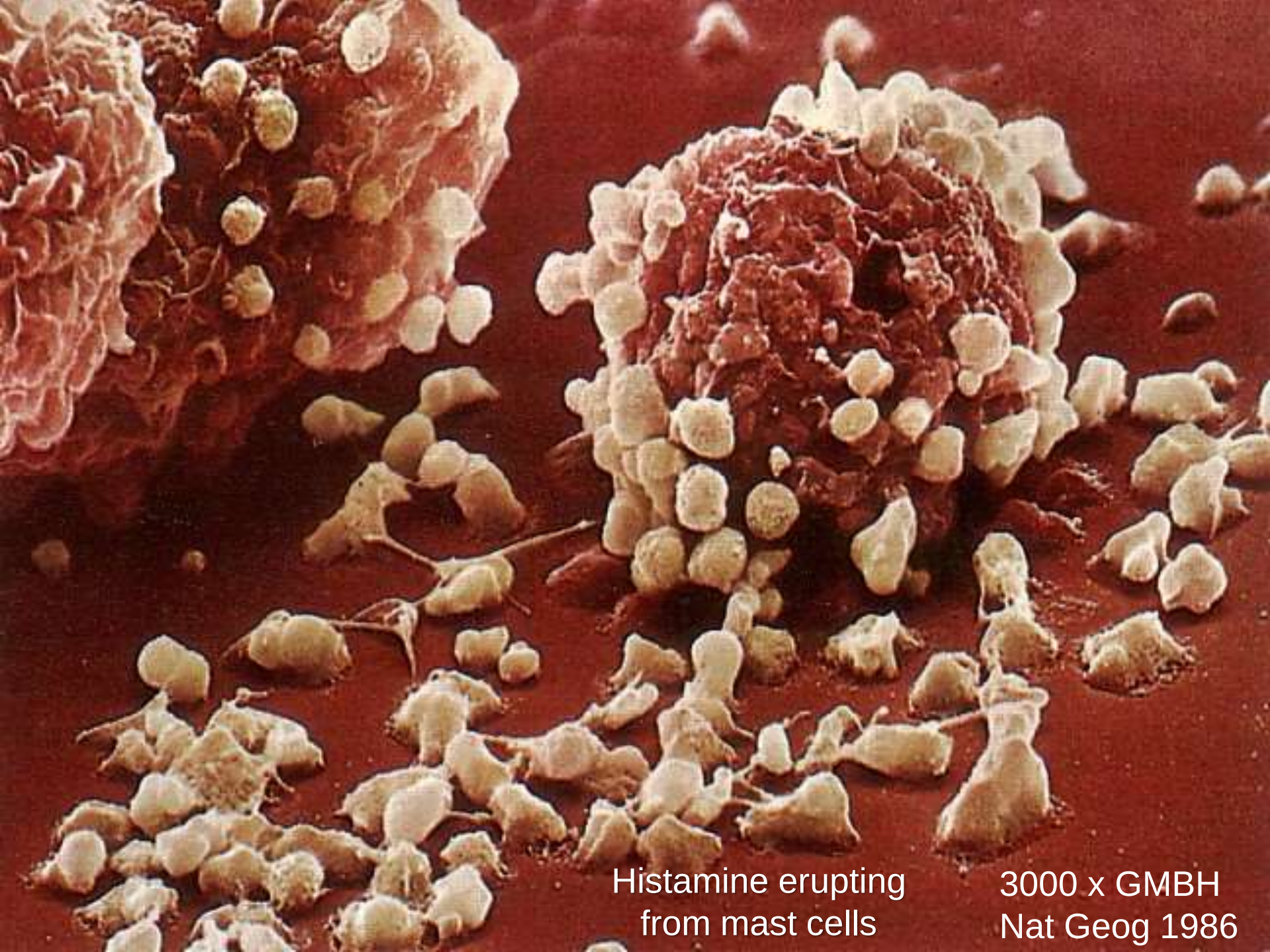
Amino acid sequence of normal hemoglobin:

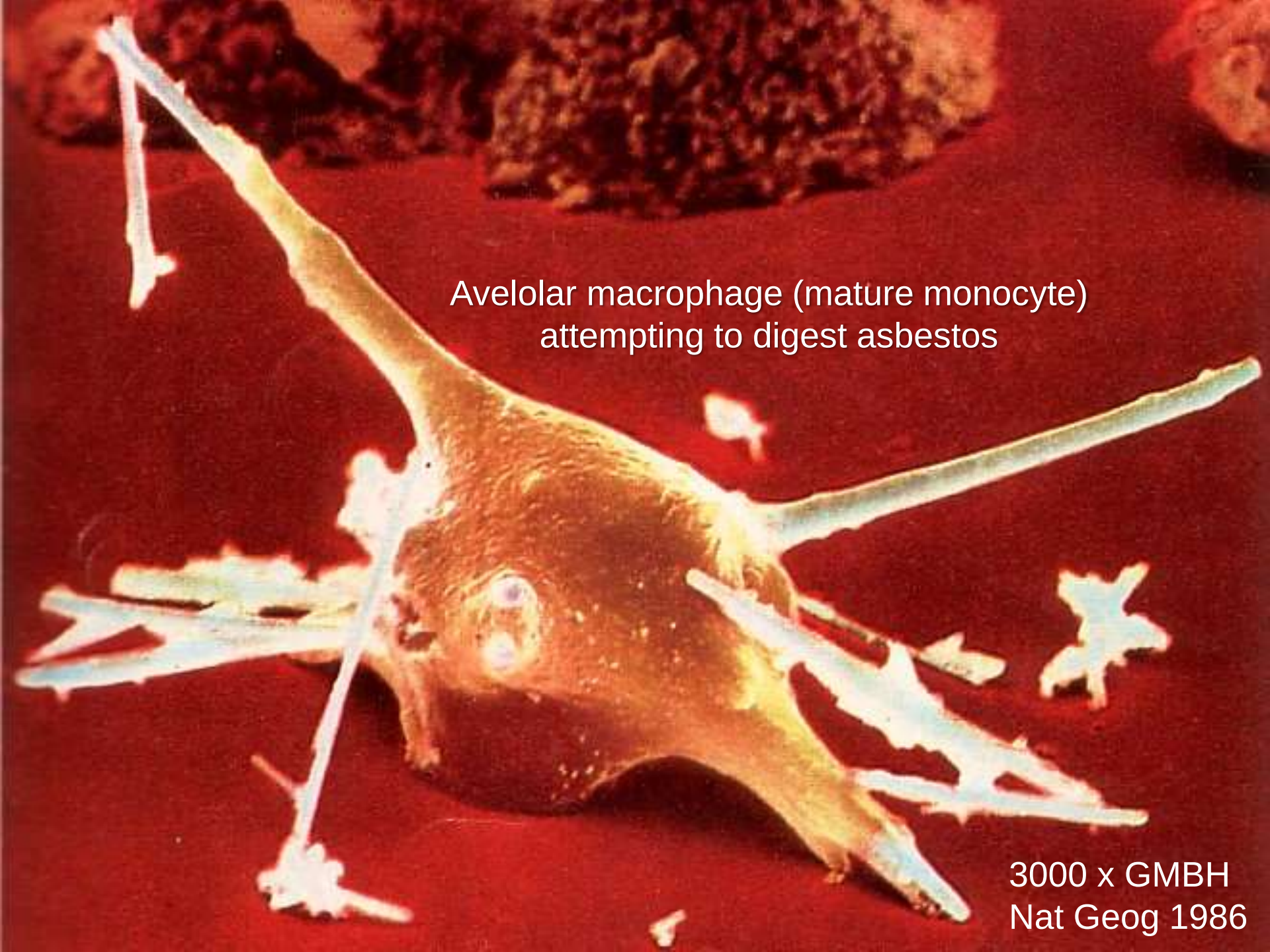
Val – His – Leu – Thr – Pro – Glu – Glu

Amino acid sequence of sickle-cell hemoglobin:

Val – His – Leu – Thr – Pro – Val – Glu

S&W 2011 fig 6-5 p 194


Histamine erupting
from mast cells
3000 x GMBH
Nat Geog 1986


Avelolar macrophage (mature monocyte)
attempting to digest asbestos
3000 x GMBH
Nat Geog 1986

HIV attacking T-helper cell lymphocyte, commander-in-chief of the immune system

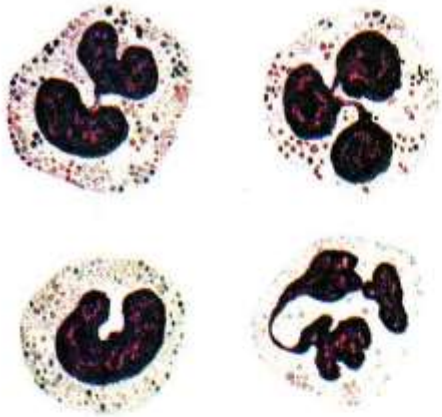
30,000 x GMBH
Nat Geog 1986

Dr. Louis Picker of OHSU on track to cure HIV!

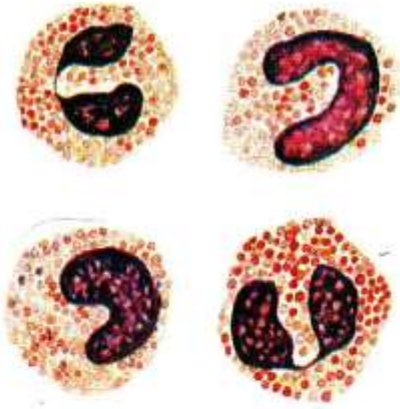
http://www.oregonlive.com/health/index.ssf/2015/11/louis_pickers_hiv_vaccine_erad.html

http://www.oregonlive.com/health/index.ssf/2015/11/superstar_scientist_dr_louis_p.html

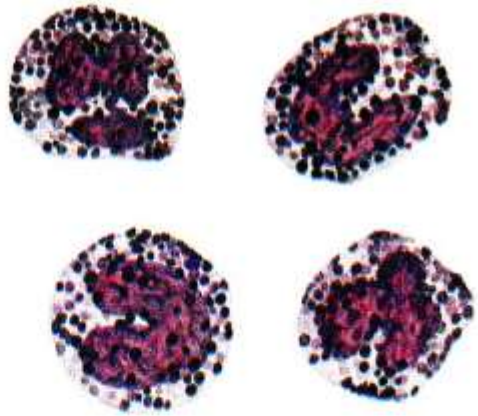
https://www.youtube.com/watch?v=ITwG6O9G81g



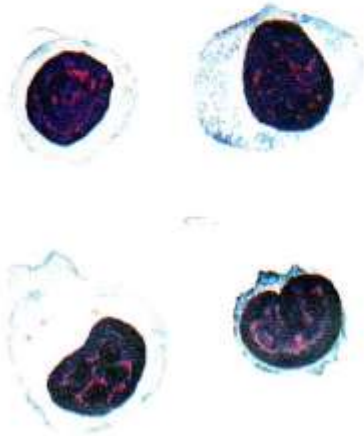
NEUTROPHILS



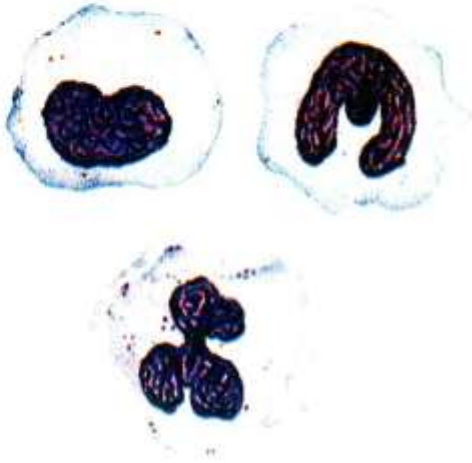
EOSINOPHILS



BASOPHILS



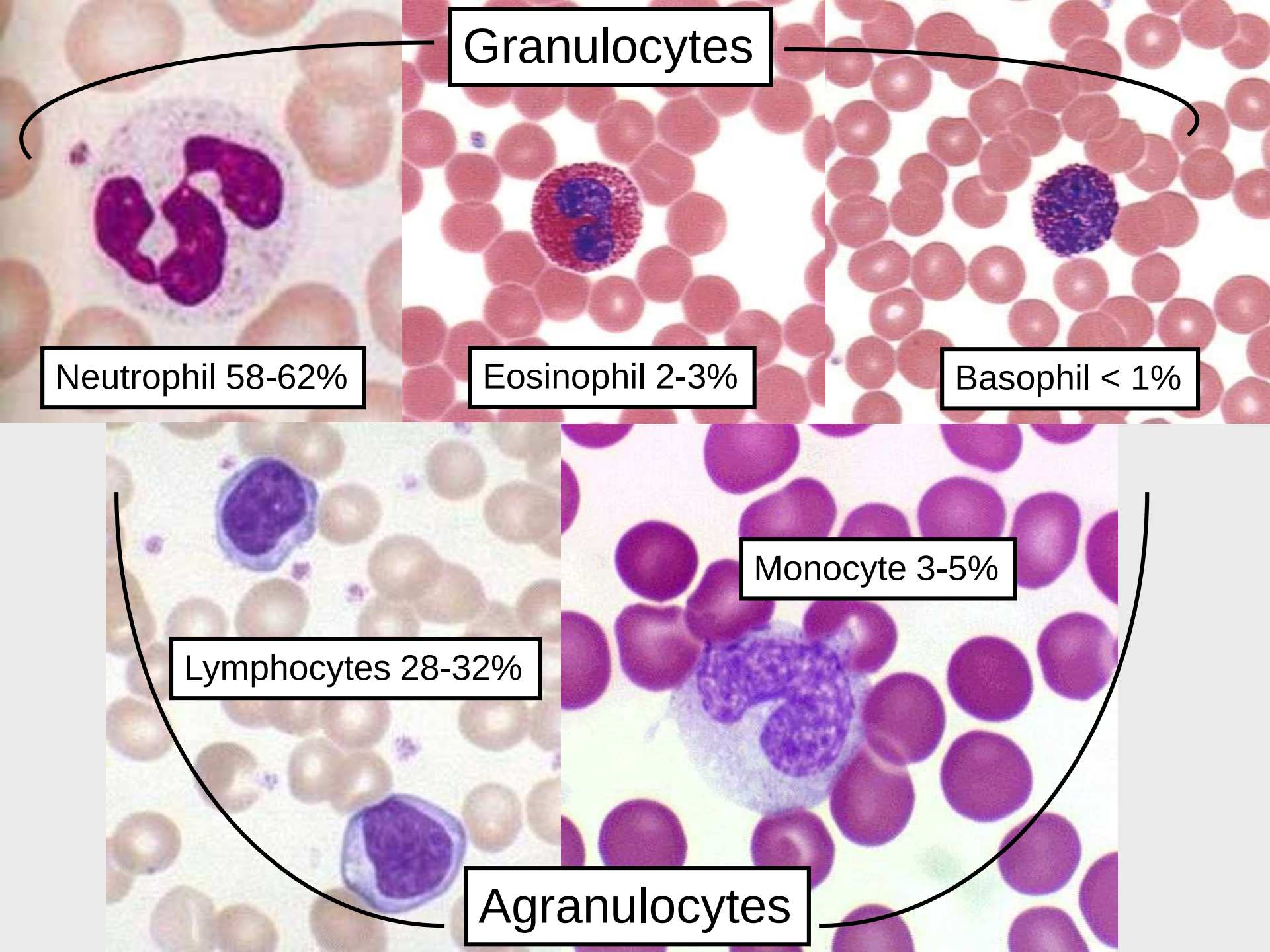
LYMPHOCYTES

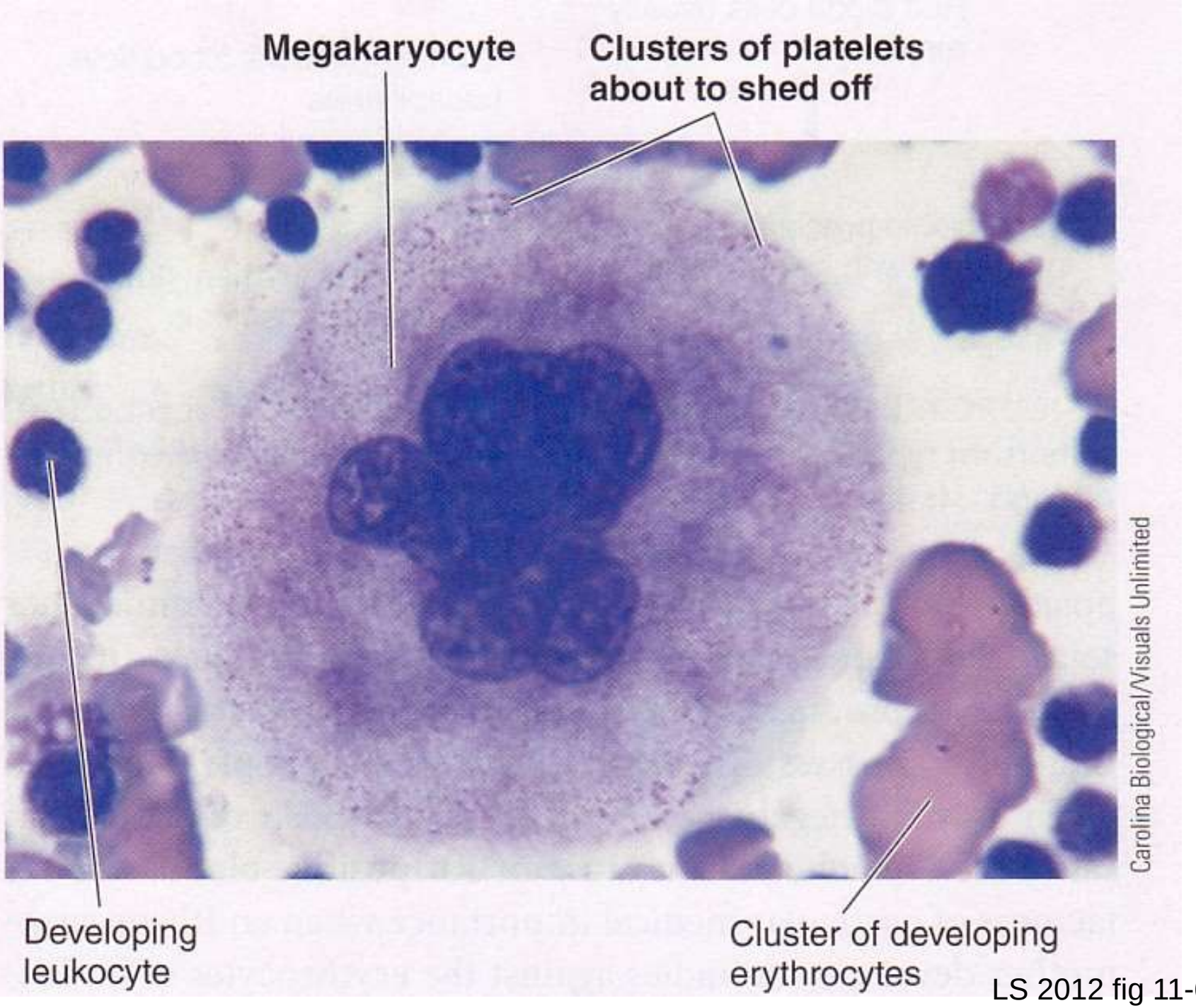


MONOCYTES

PLATELETS

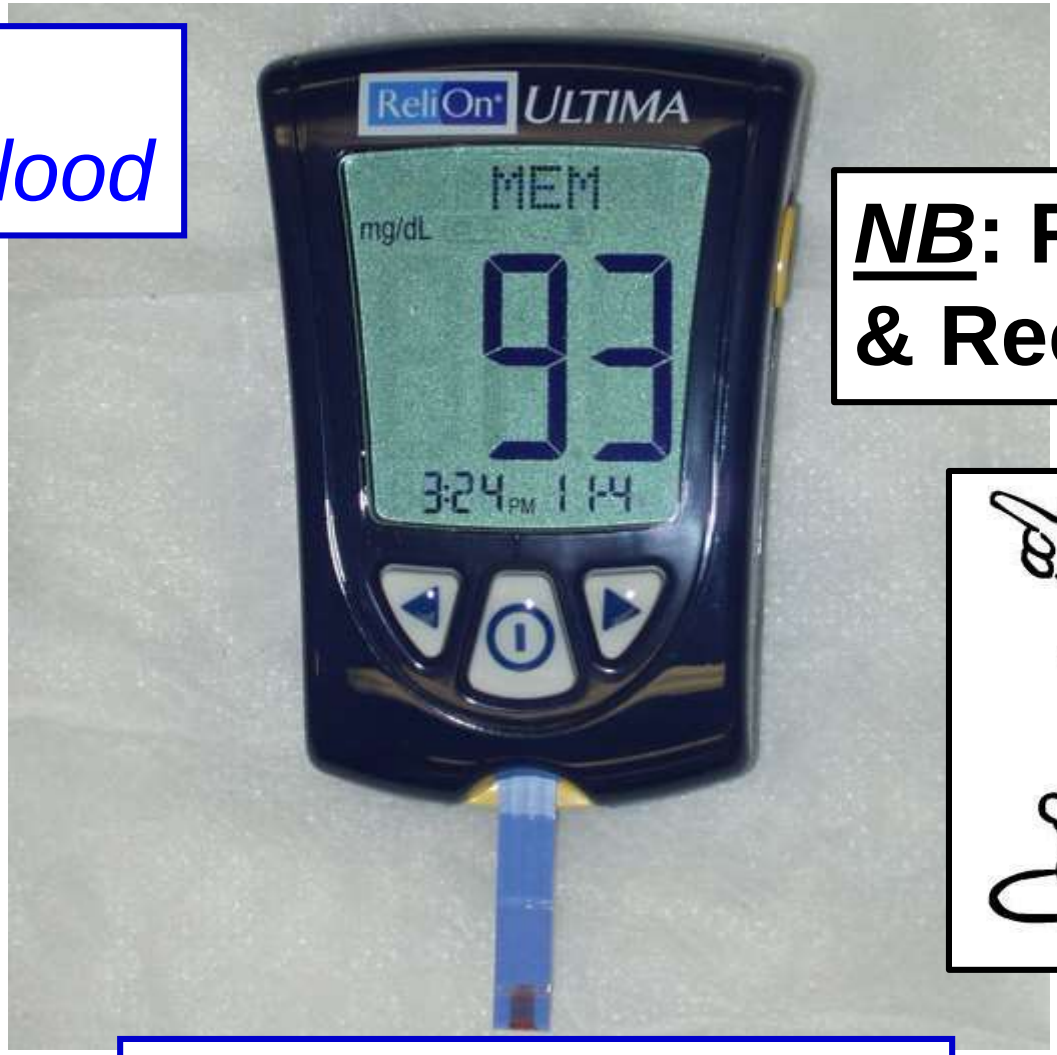
ERYTHROCYTES


Granulocytes
Neutrophil 58-62%
Eosinophil 2-3%
Basophil < 1%
Lymphocytes 28-32%
Monocyte 3-5%
Agranulocytes

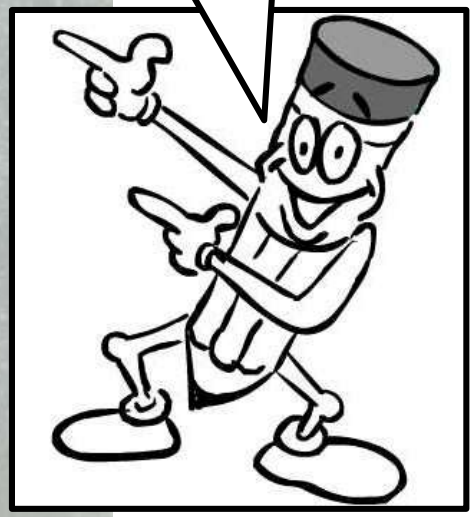


LS 2012 fig 11-6

Glucose:
Sugar in Blood



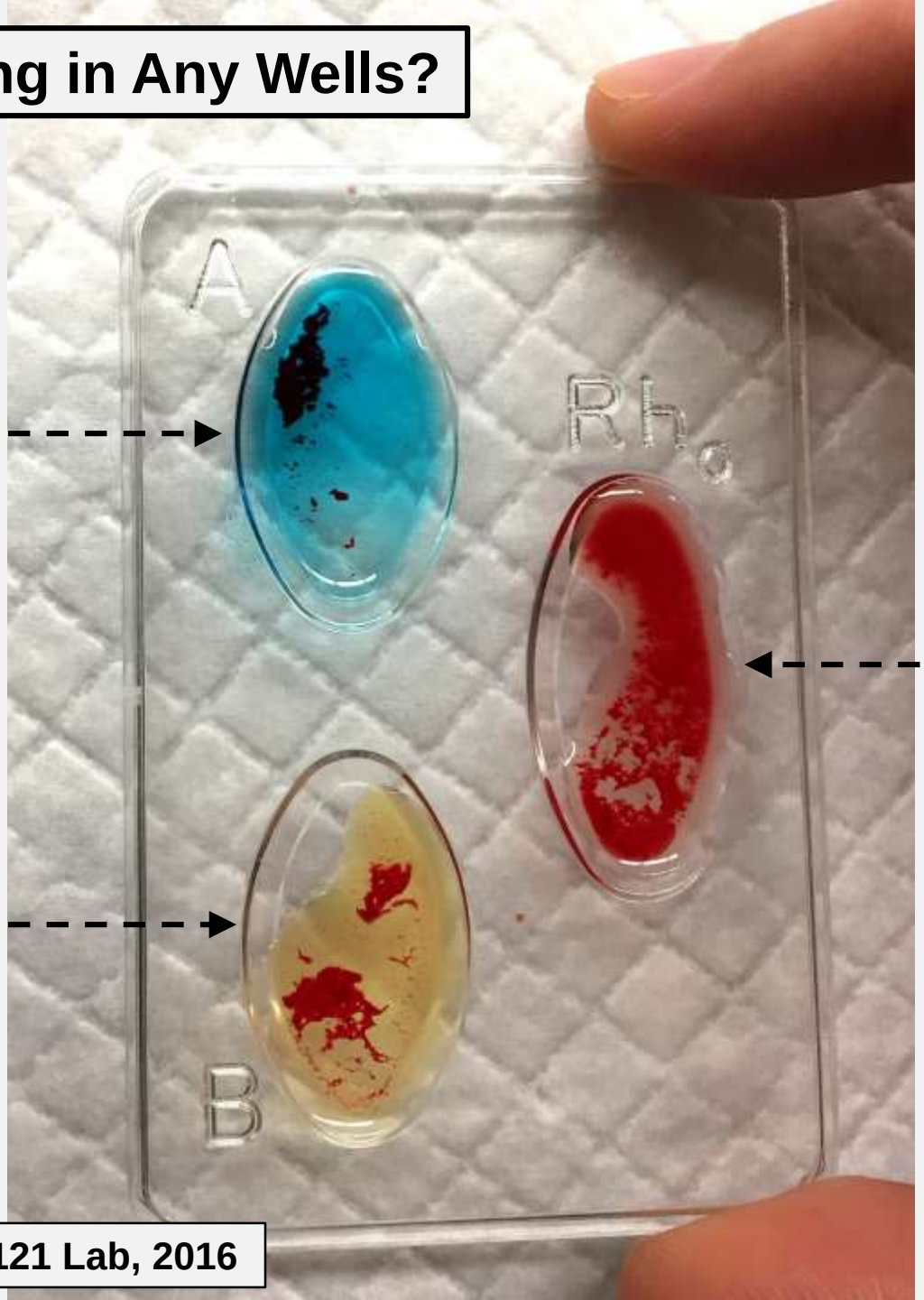
***NB*: Read & Record!**



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

1^0 Q? Clumping in Any Wells?

Type AB+



Here?

Here?

Here?

Source: S Wong, BI 121 Lab, 2016

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 HUE down hall from lab. Estimate grade? Q?**

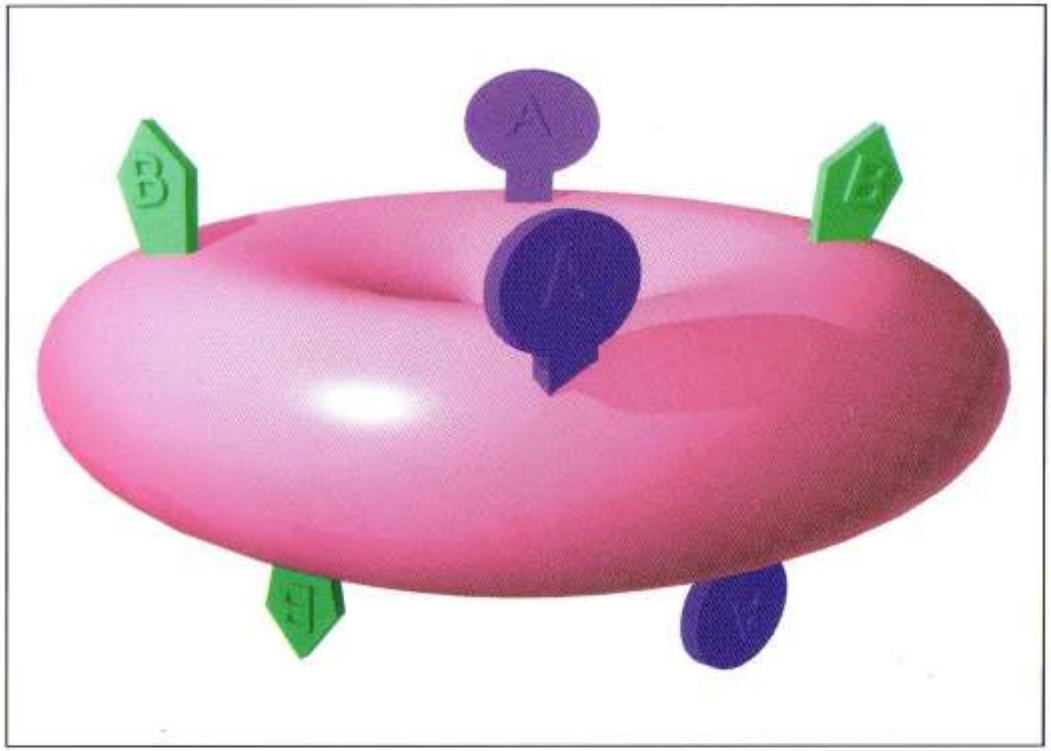
II. ***Blood Typing*** **LS ch 11 + 17, DC Module 5, Q?**

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

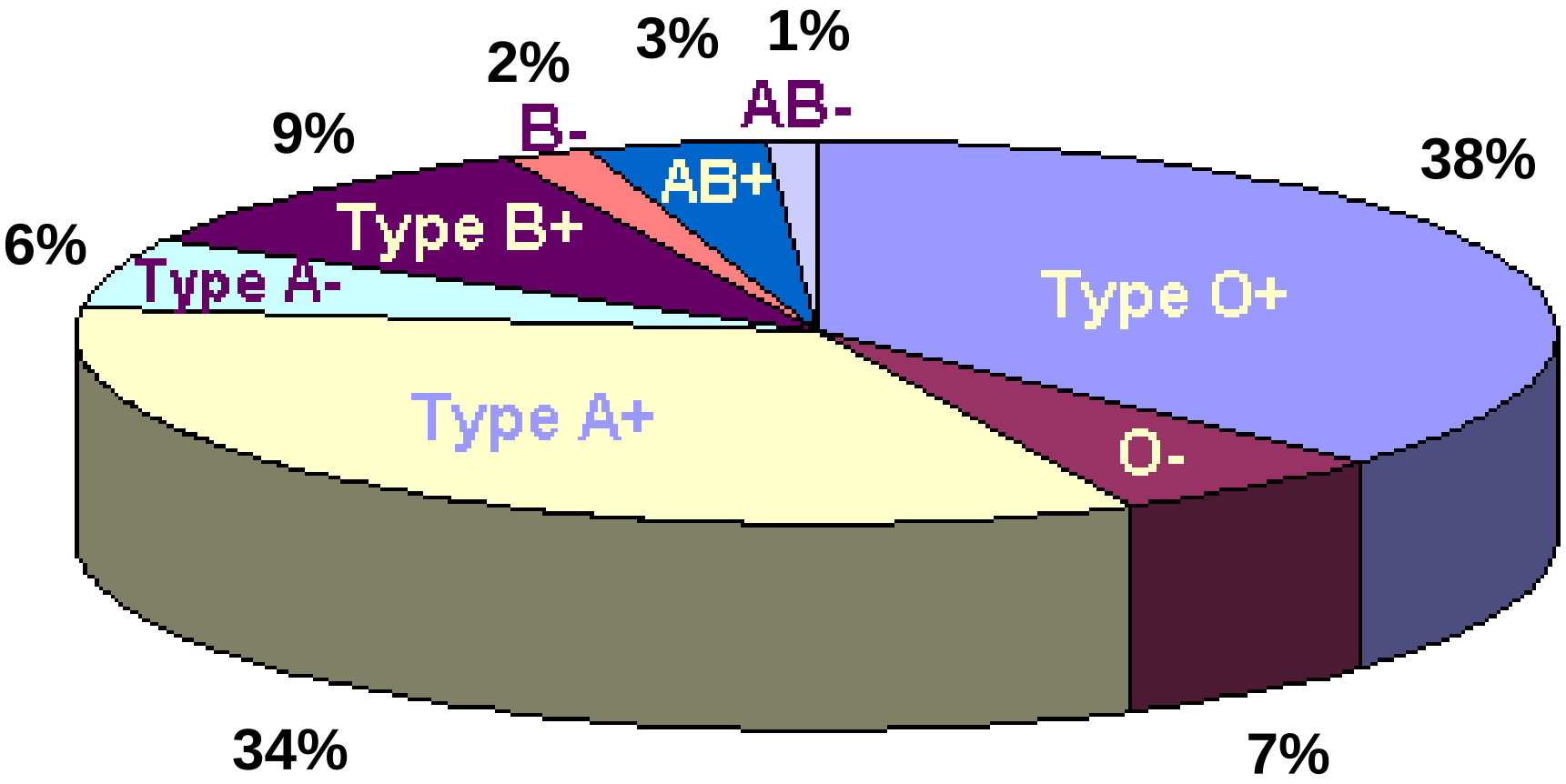
AB



A & B Antigens

(Agglutinogens)

Blood Type Distribution within the United States



NB: **O+ & A+ make up > 2/3, + > -**

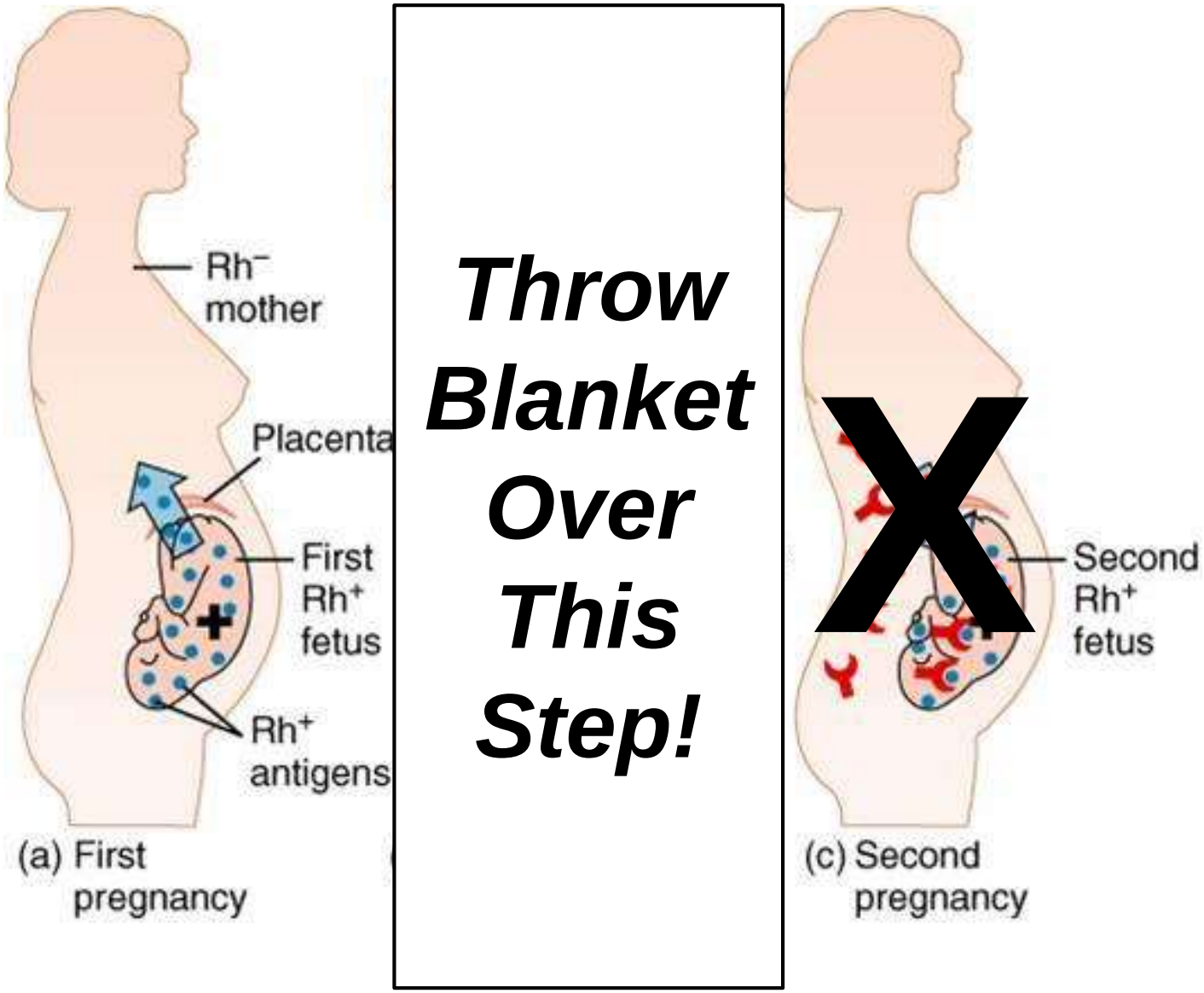
Erythroblastosis Fetalis?

eg, *Rh-* mom
Rh+ baby

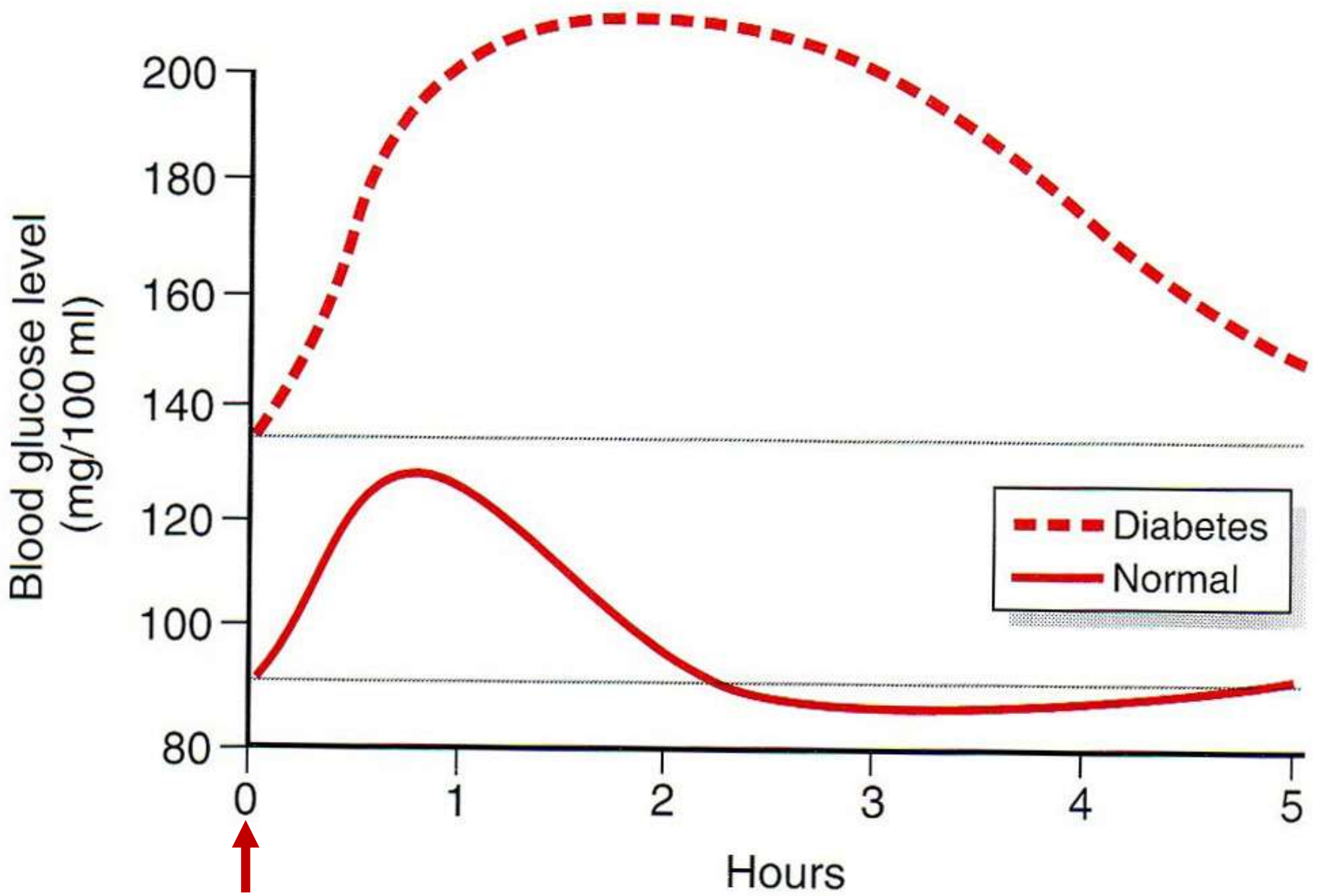
https://www.nlm.nih.gov/medlineplus/rhincompatibility.html

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

Erythroblastosis Fetalis or Hemolytic Disease of the Unborn/Newborn



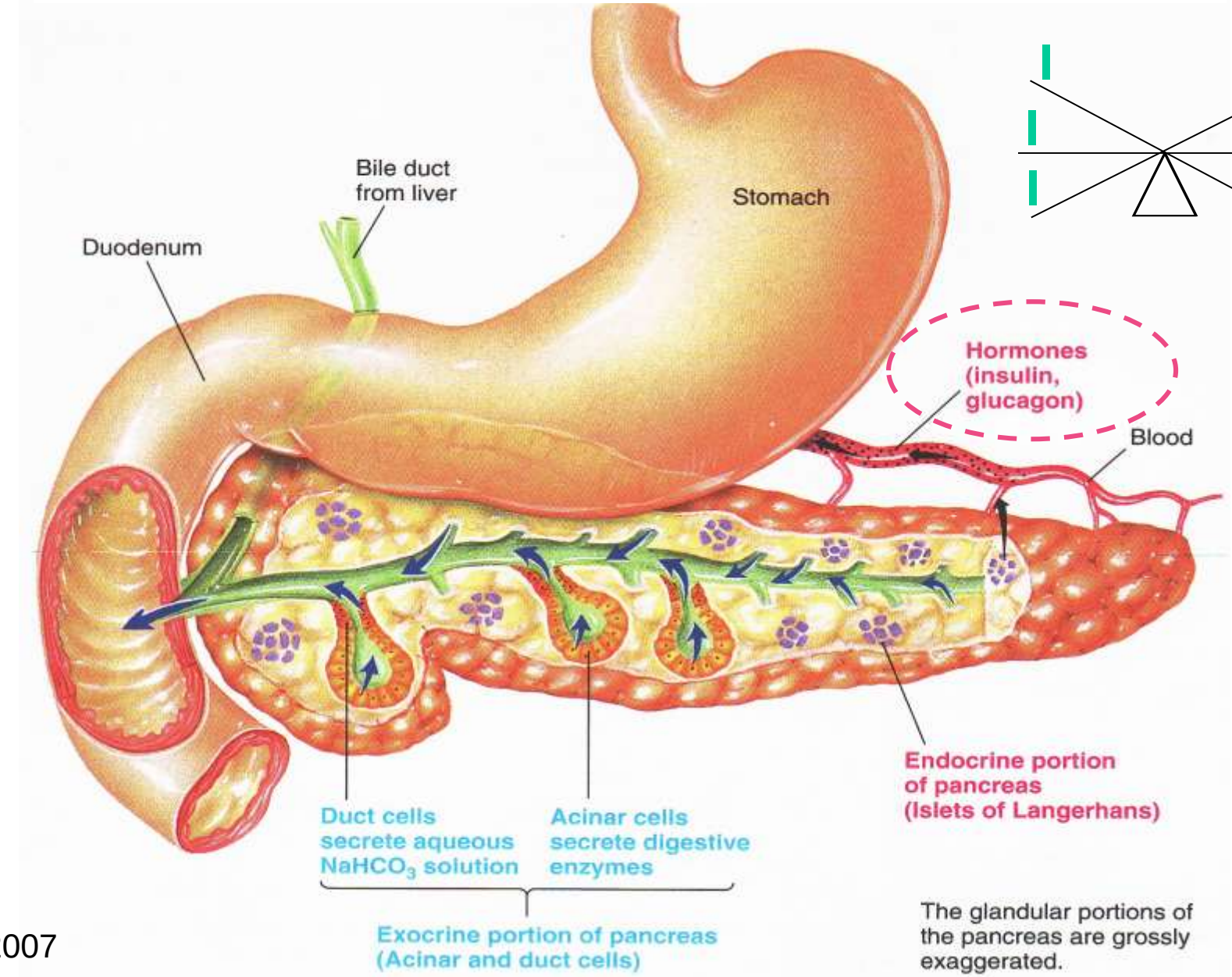
Diabetic & Normal Response to Glucose Load



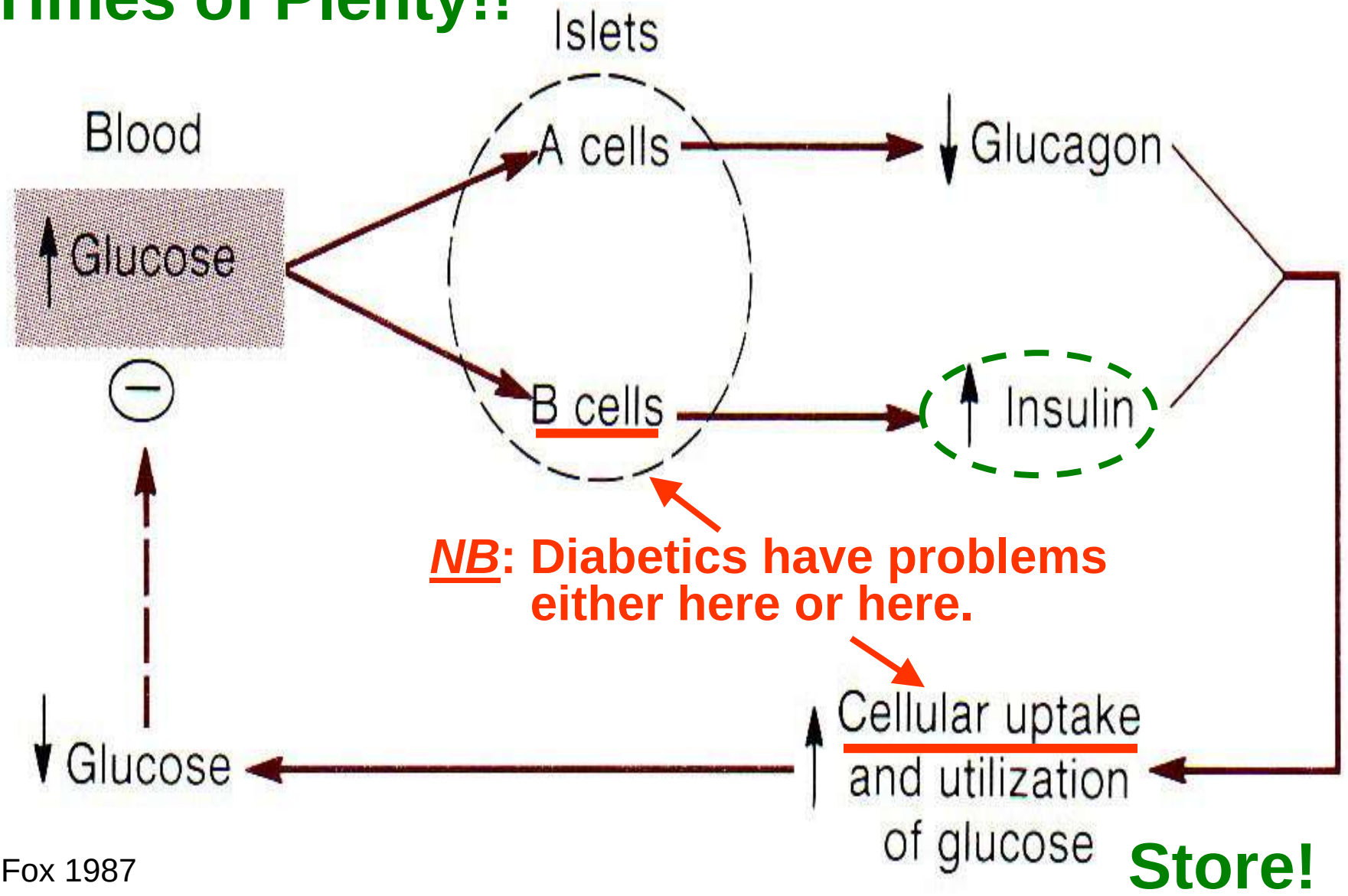
Ingest Glucola or eat meal

Guyton & Hall 2000

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



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

Table 4–8

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)

S&W 2014 tab 4-8 p 139

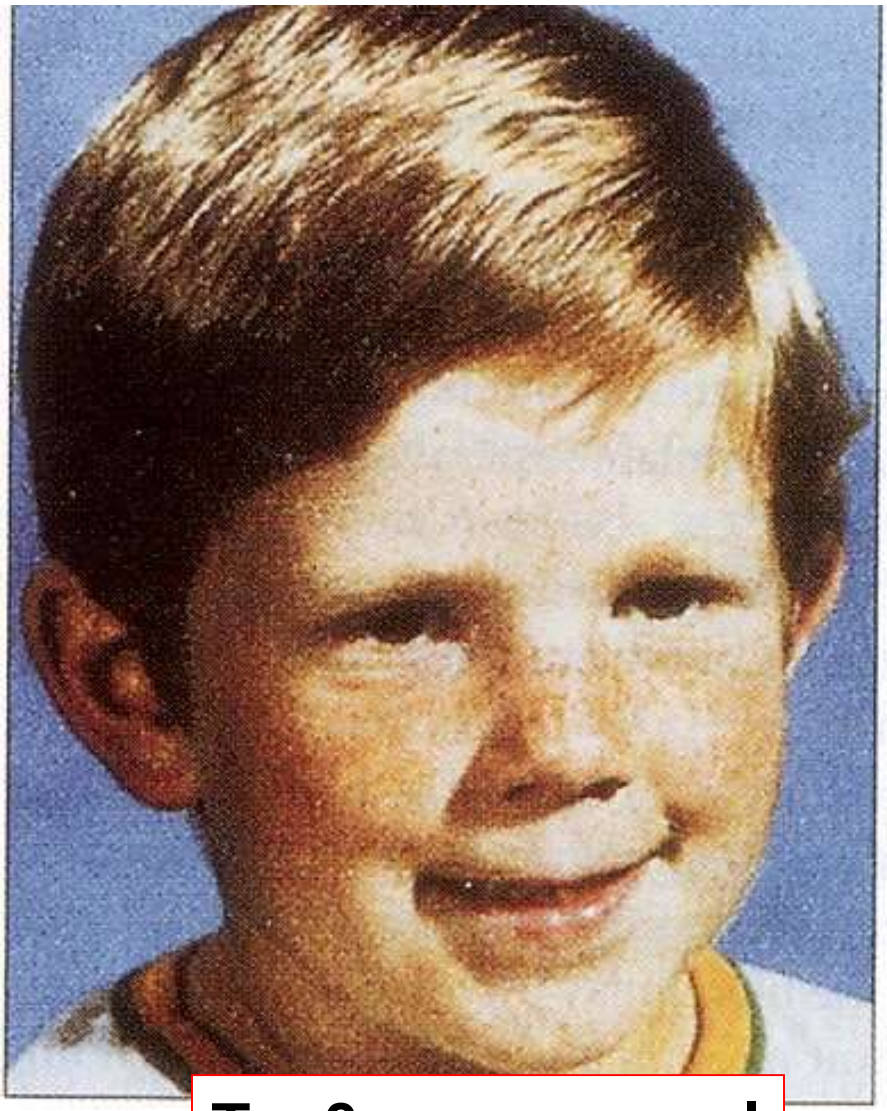
Like others, diabetics benefit from whole grains, vegetables, fruits, legumes & non-/low-fat milk products!

S&W 2011 p 133

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

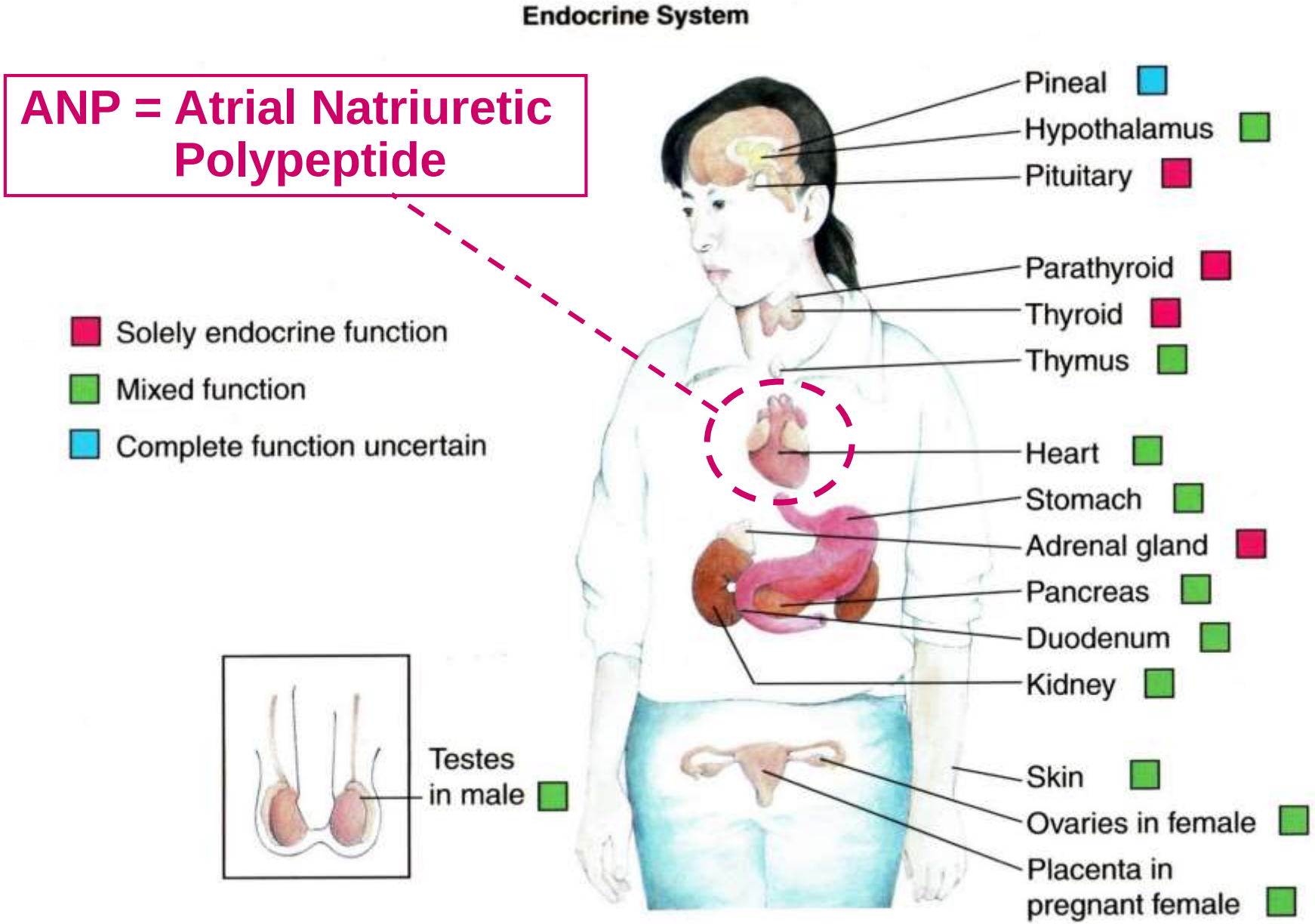
S&W 2011 p 135

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



T = 0, near normal

T = 4 months later



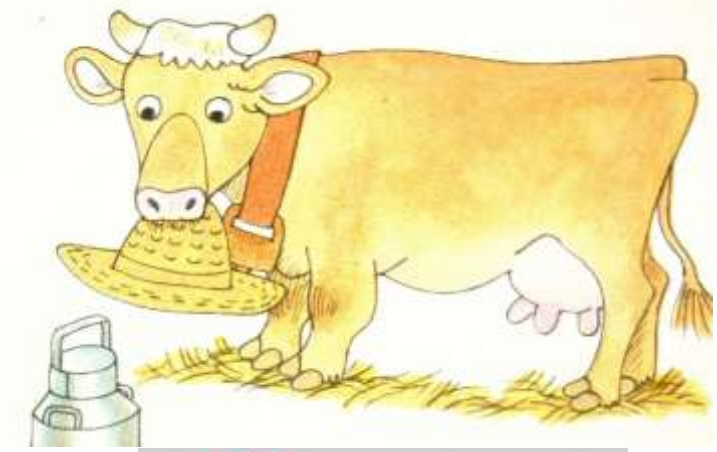
https://www.ted.com/talks/emma_bryce_how_do_your_hormones_work

https://www.youtube.com/watch?v=lRJE8c3ghRE

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

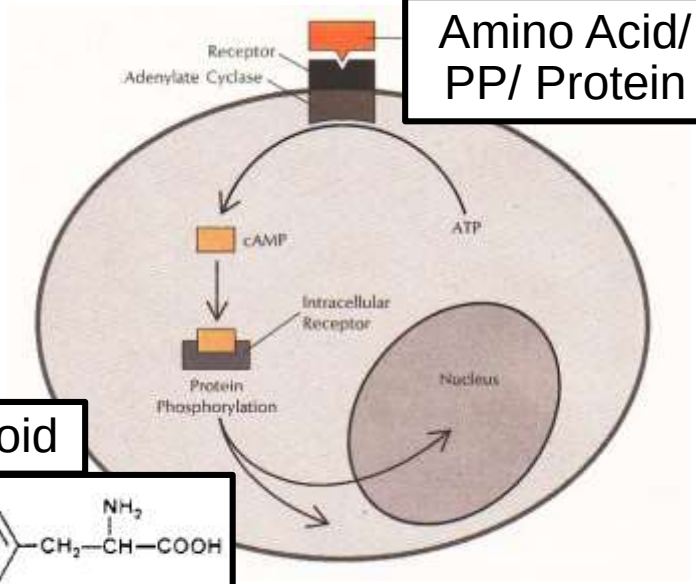
Hormone/Endocrine Classifications?

Exogenous

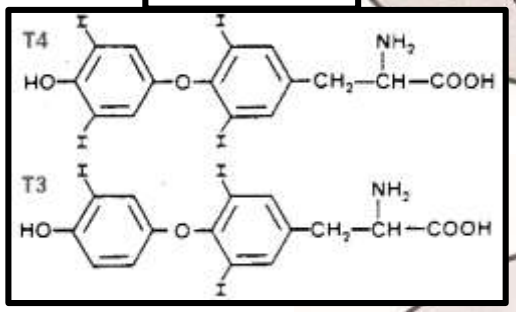


Endogenous

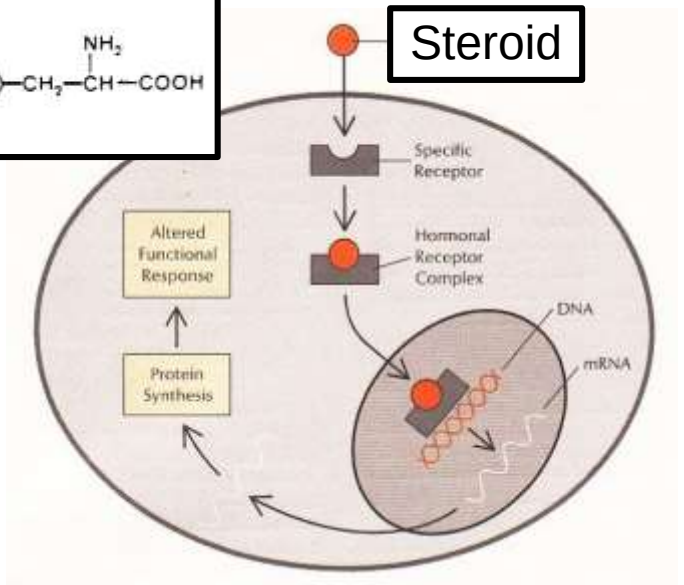
Amino Acid/ PP/ Protein



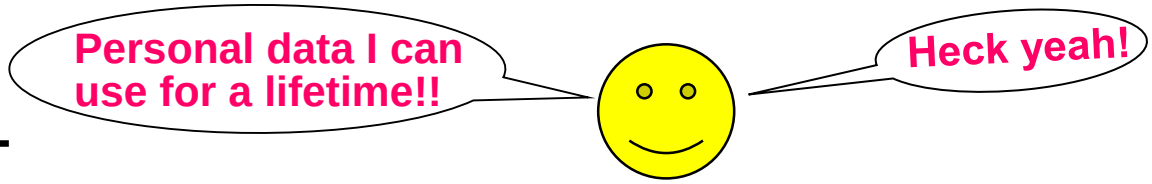
Thyroid



Steroid



BI 121 Lecture 11



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?**

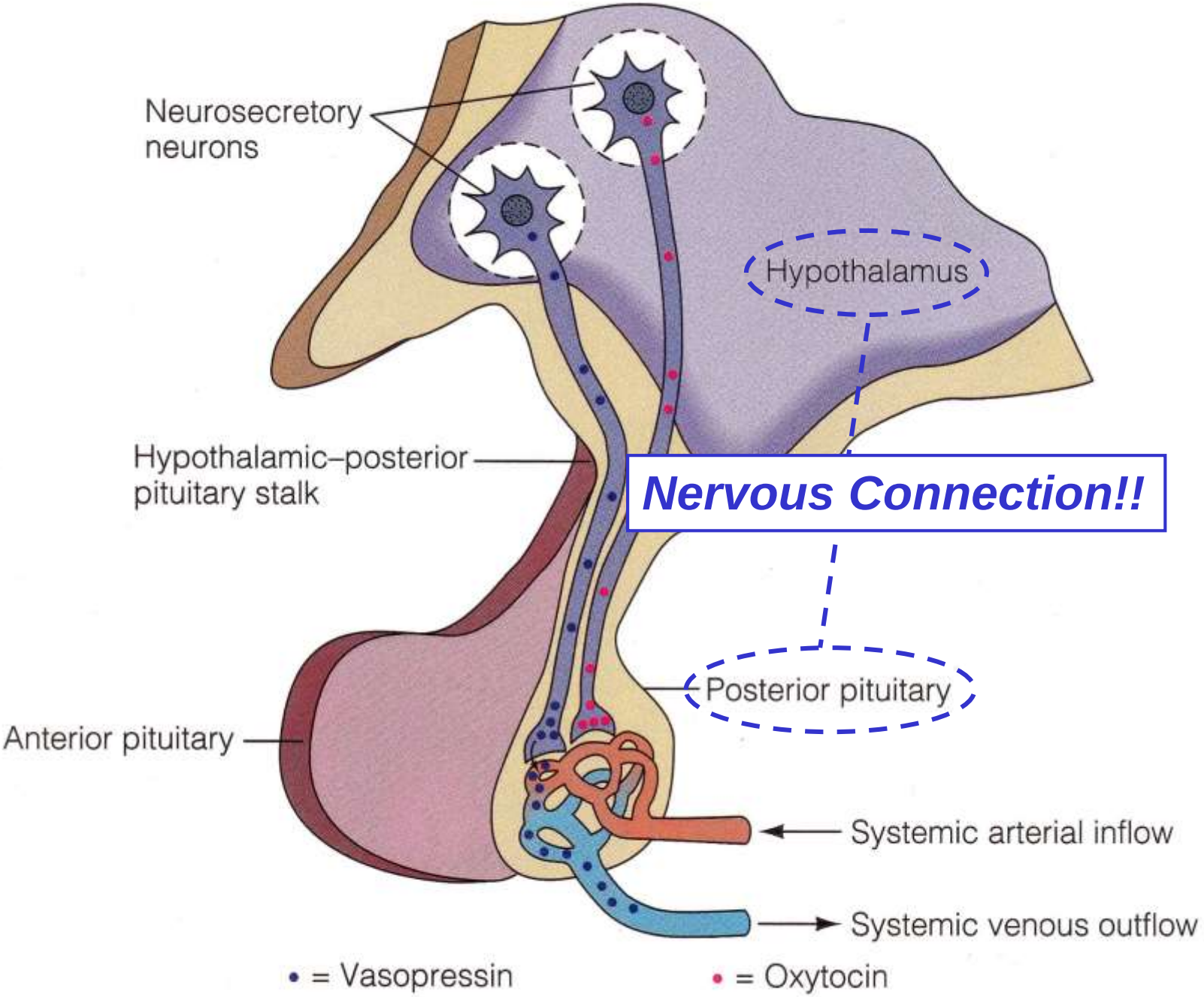
II. ***Safety & Techniques Review for Blood Chem Lab*** **Q?**

III. ***Endocrine Connections*** **Peripheral endocrine organs** DC pp 109-13, LS pp 513-36

- **A. Pancreas (insulin – glucagon see-saw!)**
- **B. Thyroid**
- **C. Adrenals**

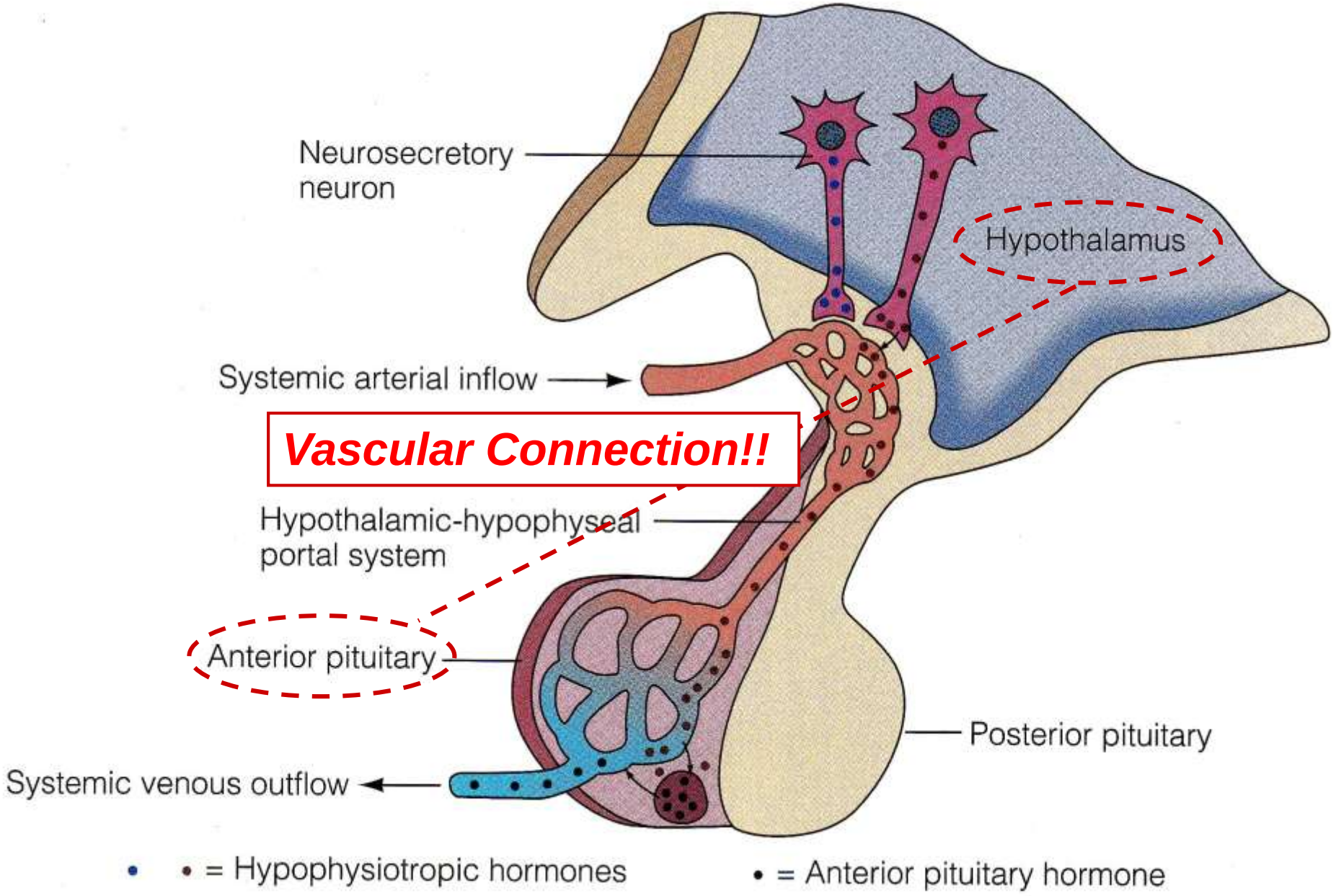
IV. ***Introduction to the Nervous System*** **LS ch 5, DC Module 9**

- **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

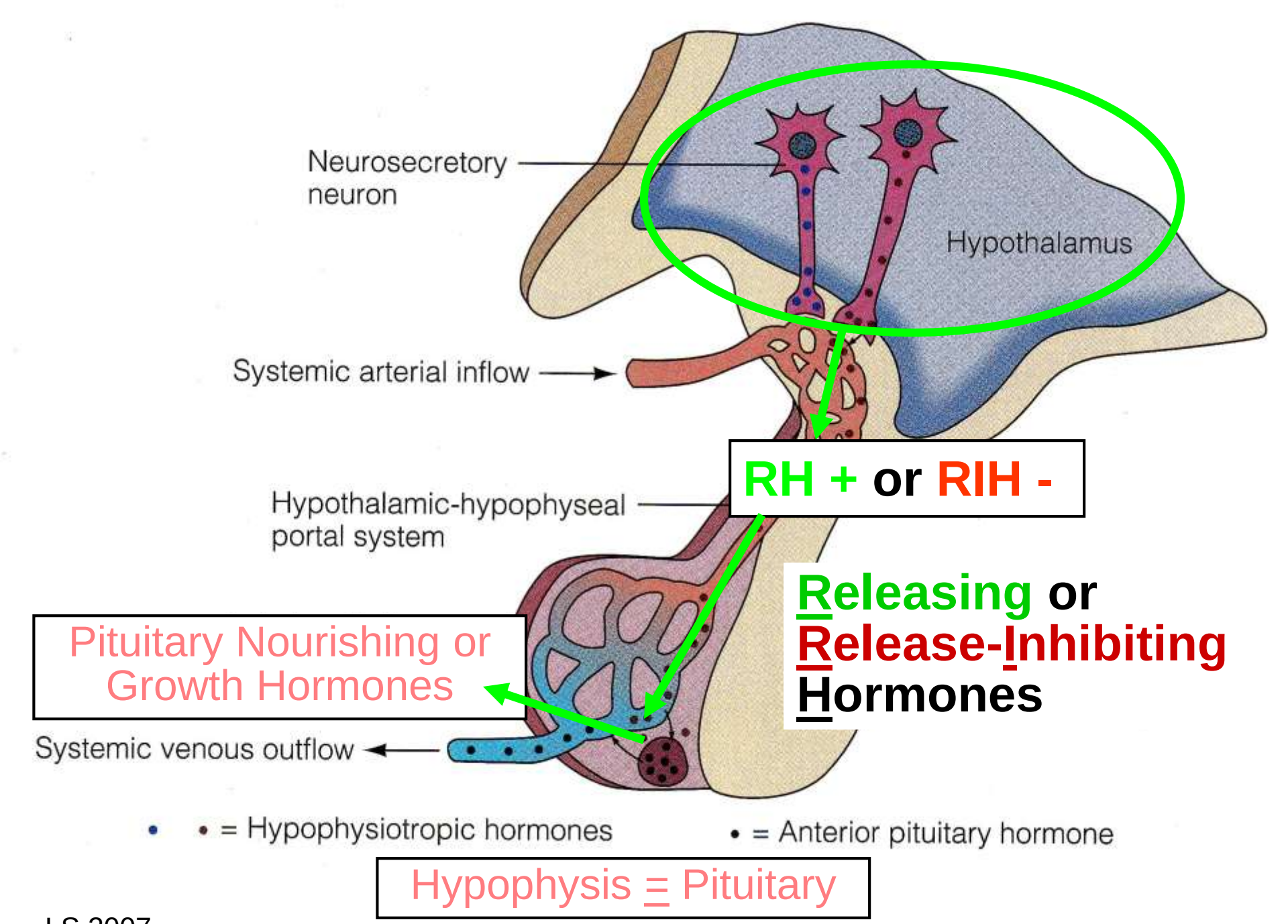

Neurosecretory neurons
Hypothalamus
Hypothalamic–posterior pituitary stalk
Nervous Connection!!
Posterior pituitary
Anterior pituitary
Systemic arterial inflow
Systemic venous outflow
• = Vasopressin
• = Oxytocin

LS 2007

Hypothalamus-Anterior Pituitary Vascular Connection!



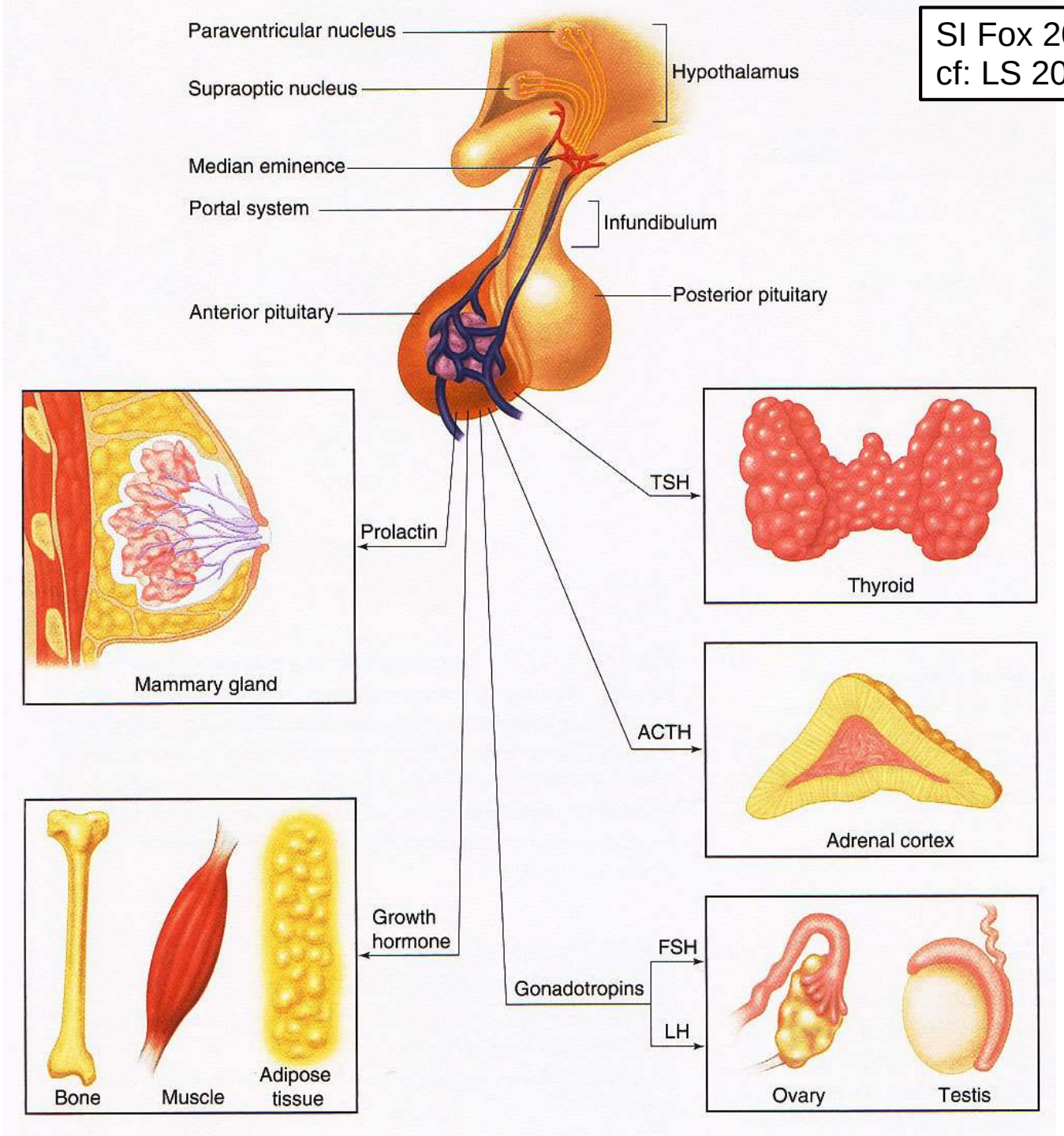
LS 2007



Hypophysis = Pituitary

LS 2007

SI Fox 2008
cf: LS 2012 fig 17-5



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

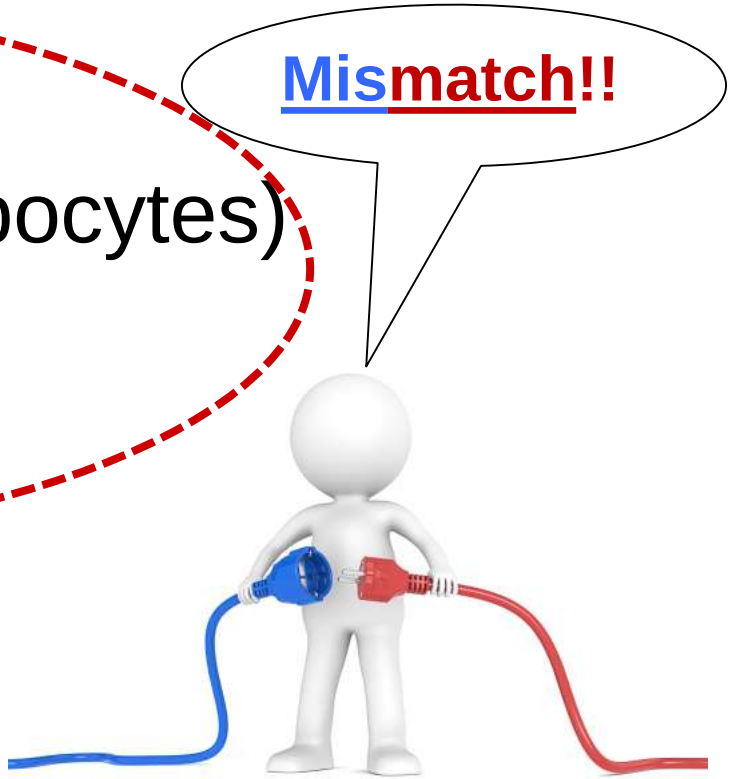
↑ Amino Acid uptake & Protein synthesis

↑ Lipolysis & Fatty Acid mobilization

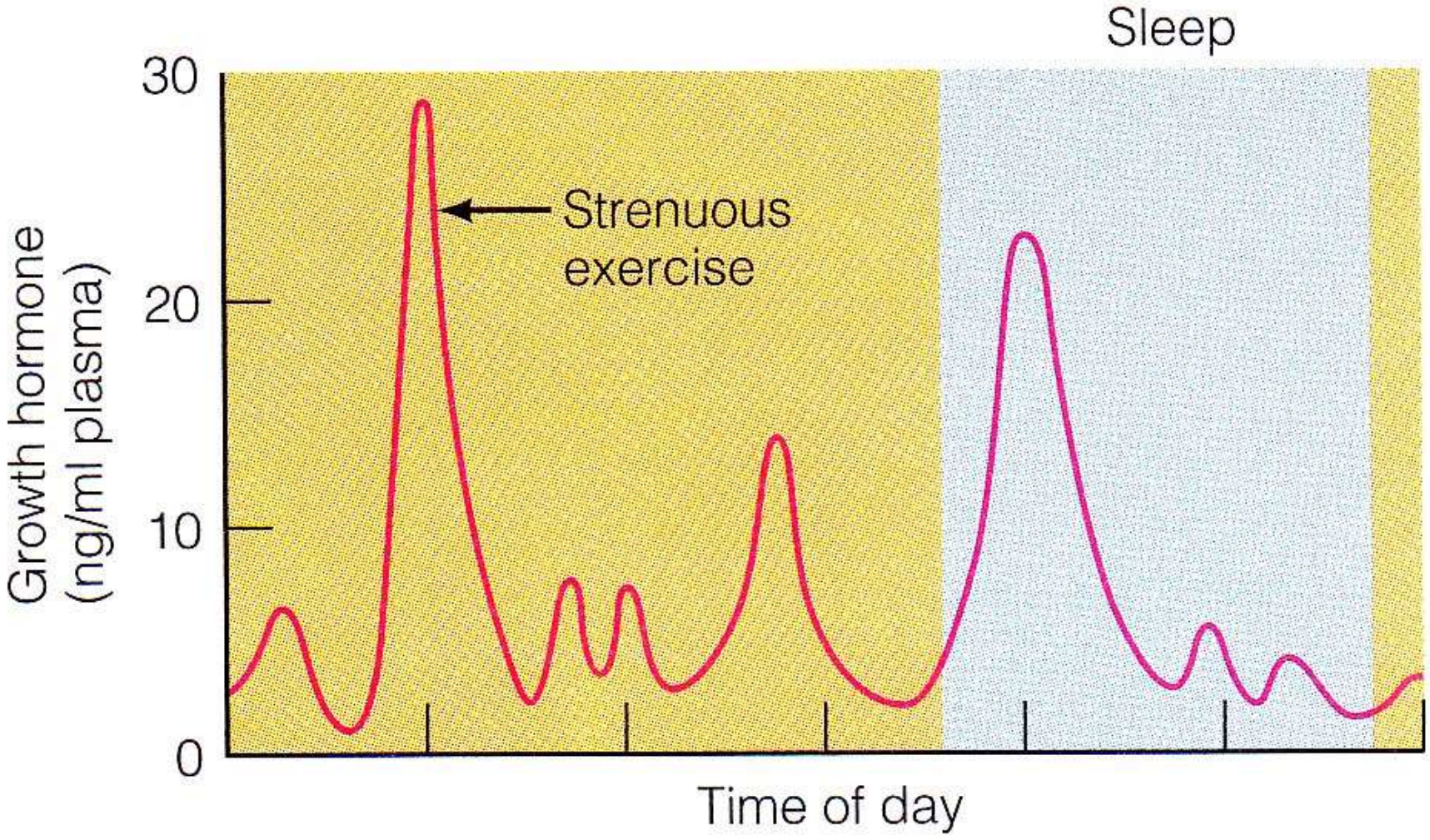
↓ Glucose uptake
(skeletal muscle & adipocytes)

↑ Glucose production
(liver glycogenolysis)

↑ Insulin secretion

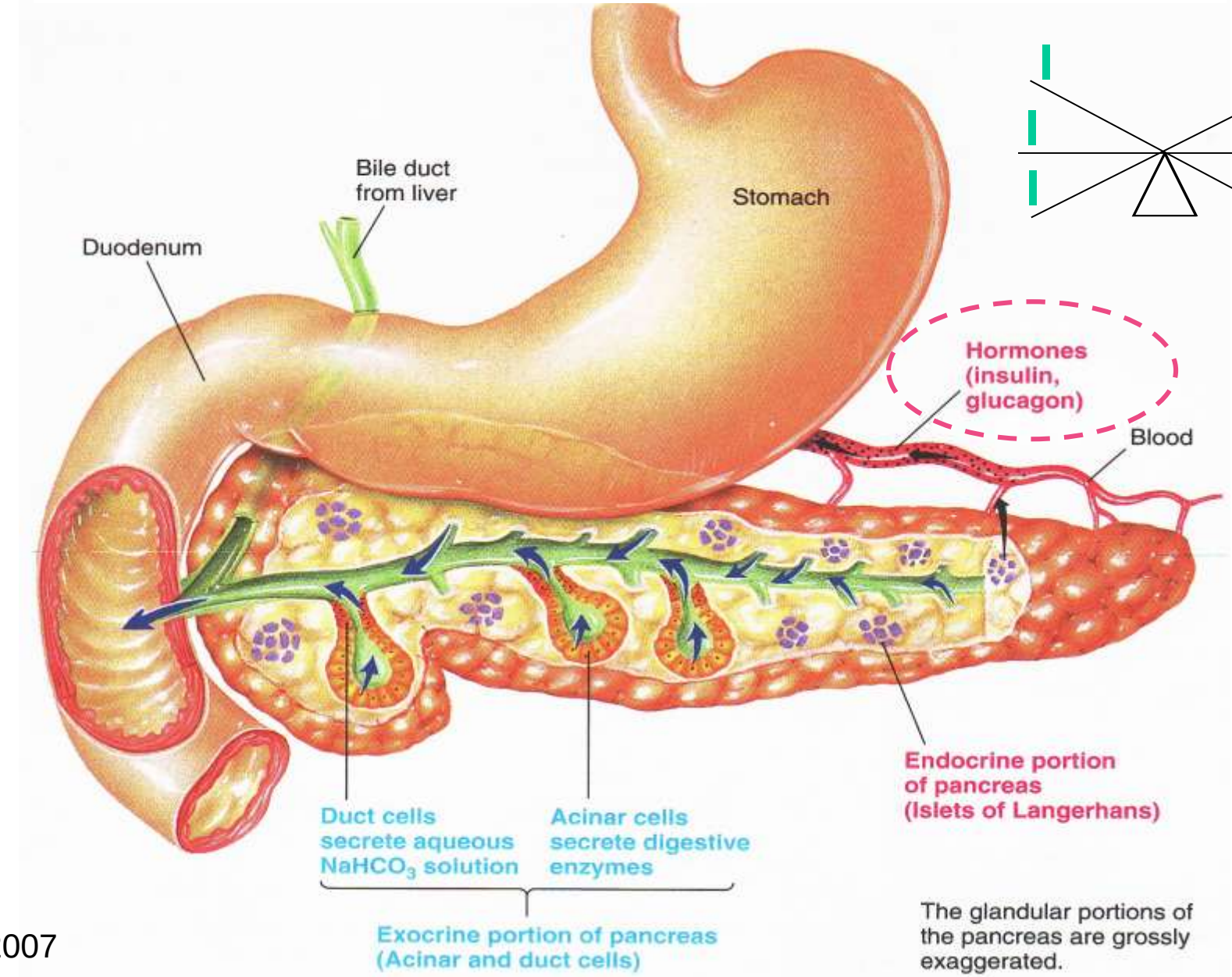


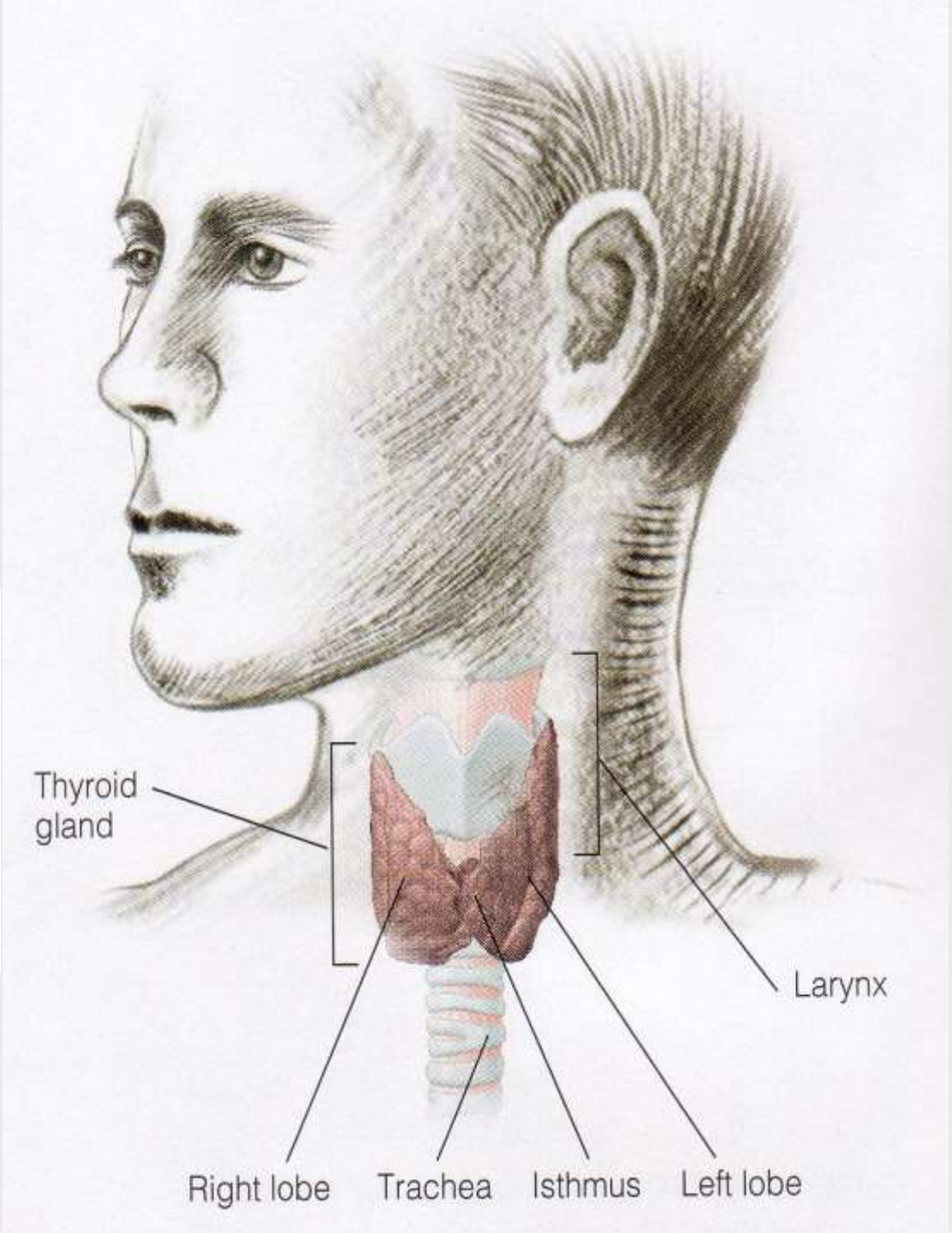
Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per mililiter

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





DC 2003

Thanks to you, Bella, Heather, Tim & Katie!

For your effort & your  !!

BI 121 Lecture 12

I. *Announcements* Thanks for your help with blood lab!
No lab this week. Study for Exam II, Dec 13, Friday 8 am!

II. *Endocrine Connections* Adrenals DC pp 112-3, LS pp 517-25
https://www.ted.com/talks/emma_bryce_how_do_your_hormones_work

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

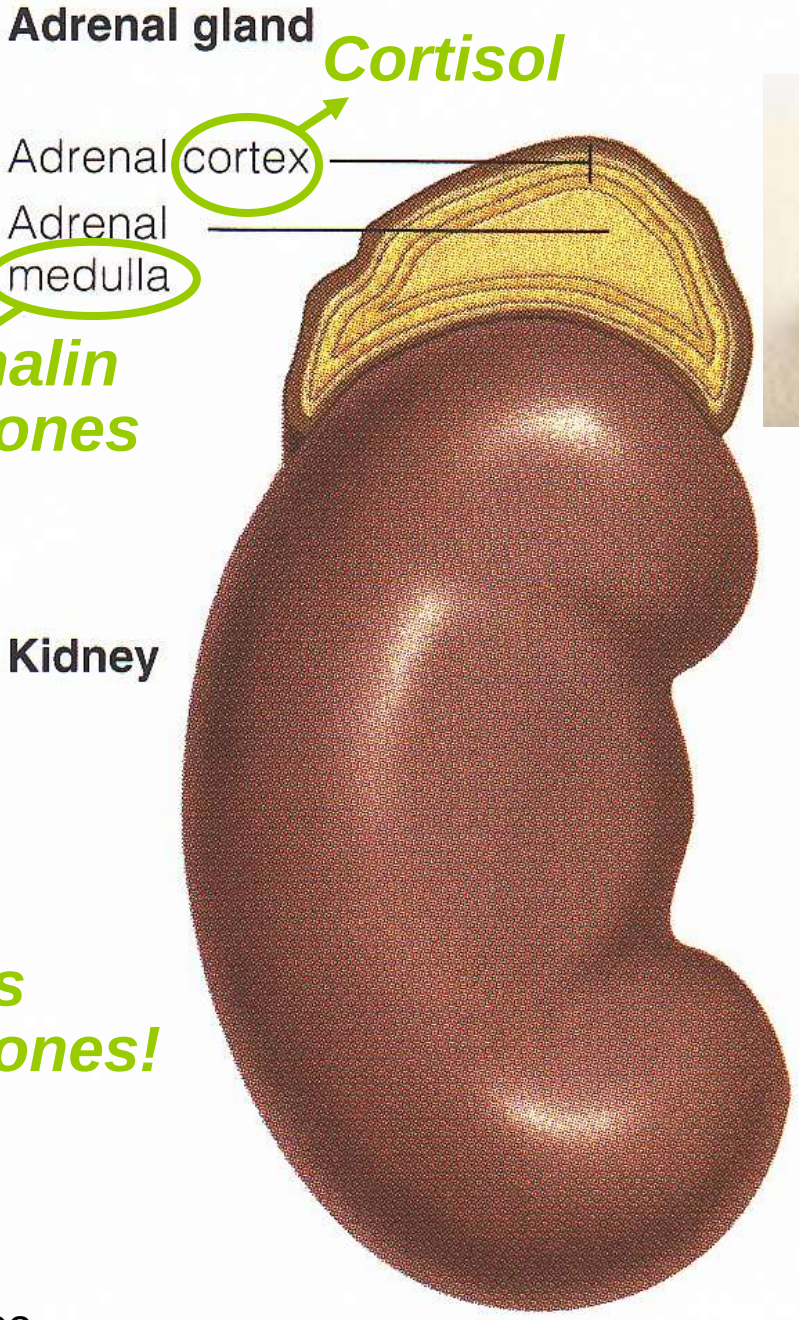


FIGURE 13-12
Adrenal Gland The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.

DC 2003

Epinephrine 80%
Norepinephrine 20%

Guyton & Hall 2000

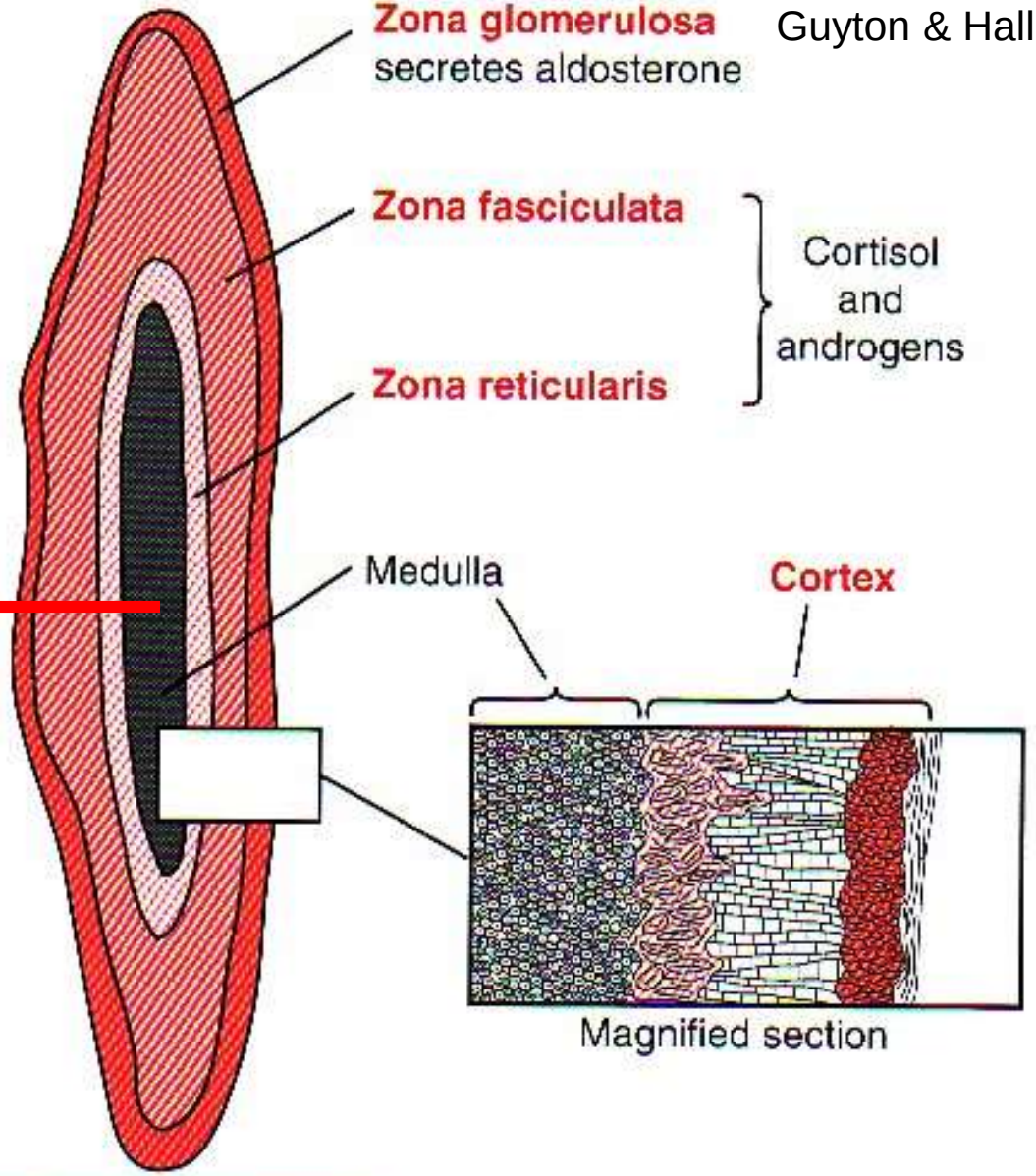
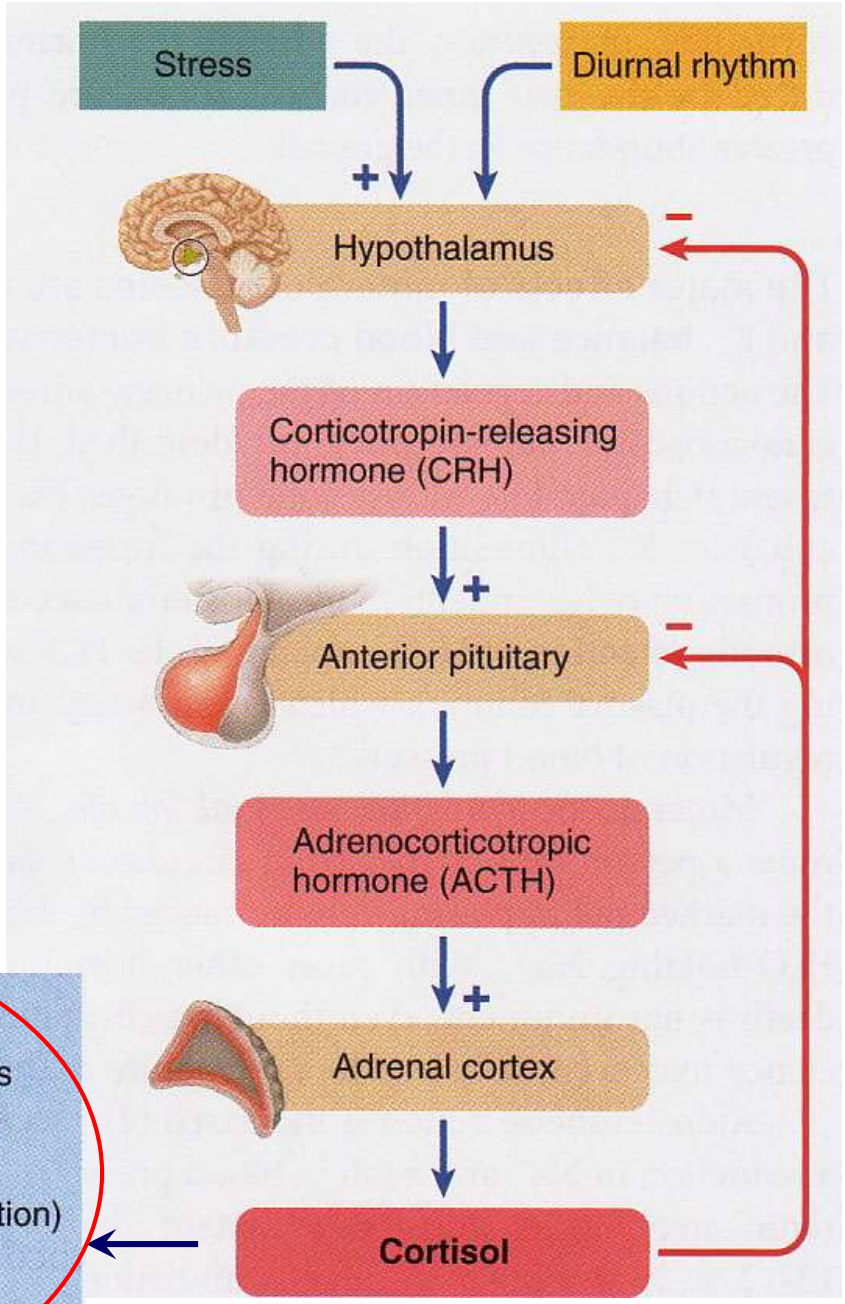


FIGURE 77-1

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

Stress Also Promotes Cortisol Secretion!

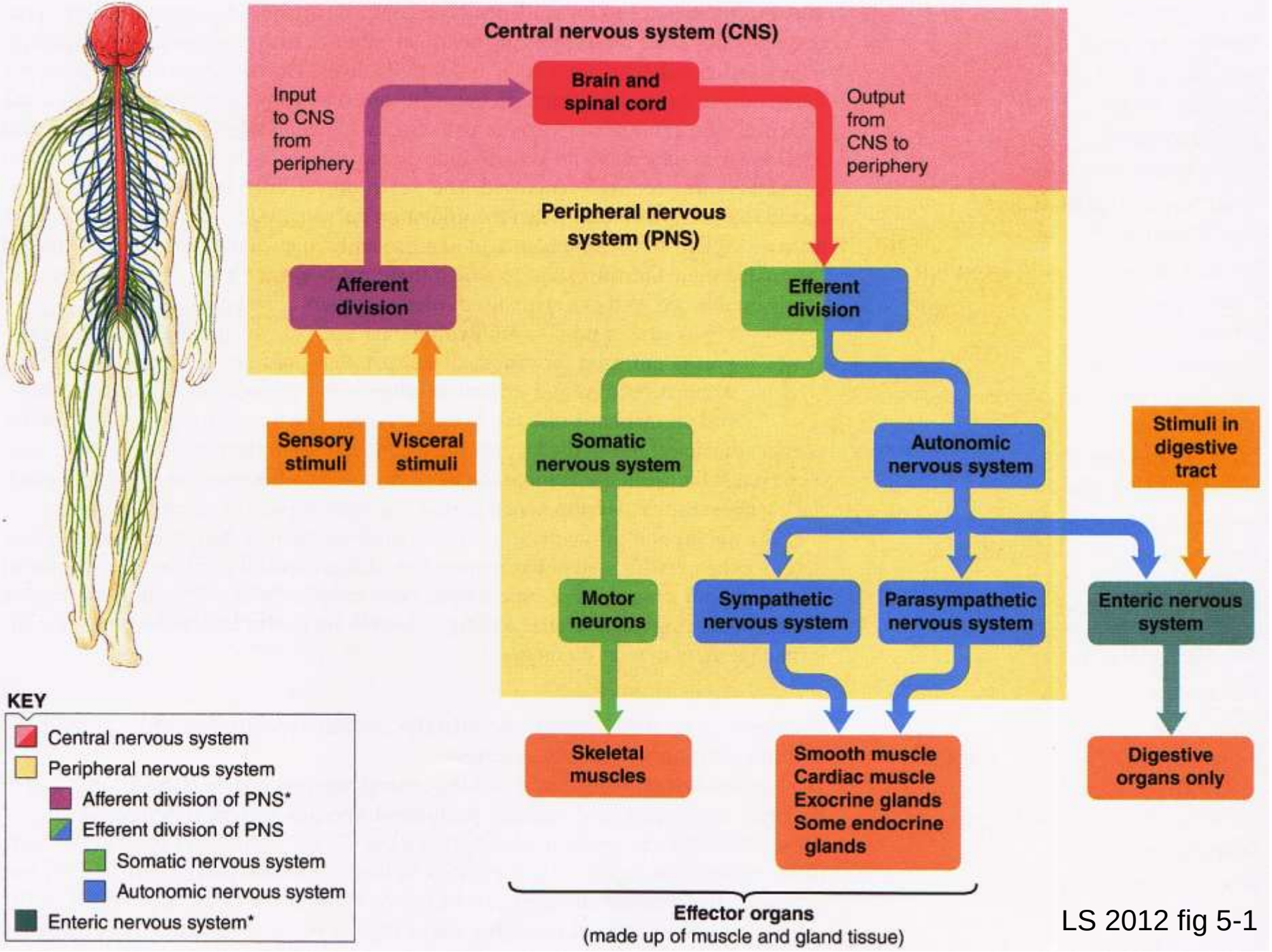
Cushing's Syndrome Excess Nutrients!



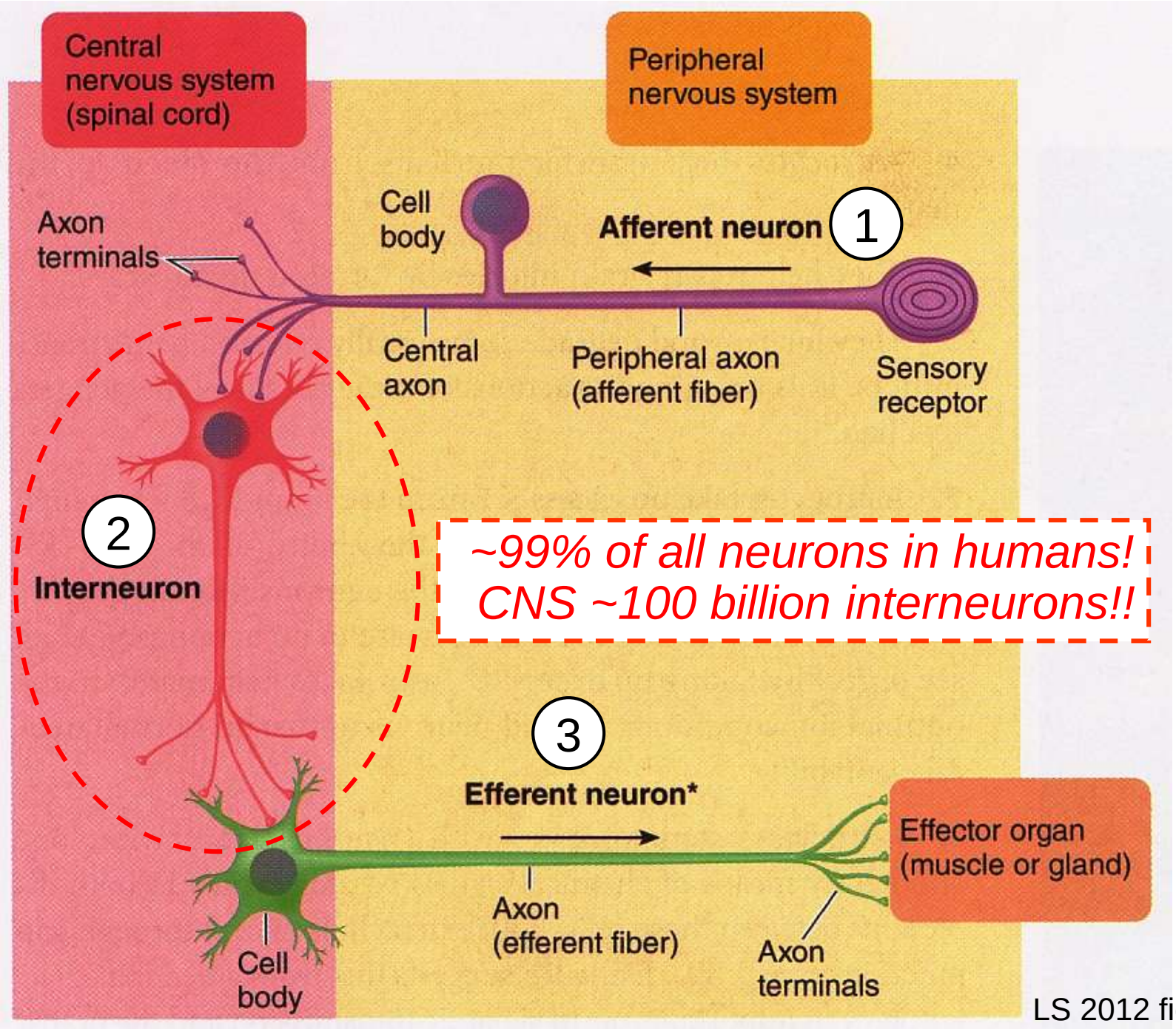
Metabolic fuels and building blocks available to help resist stress

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

LS 2012 fig 17-19

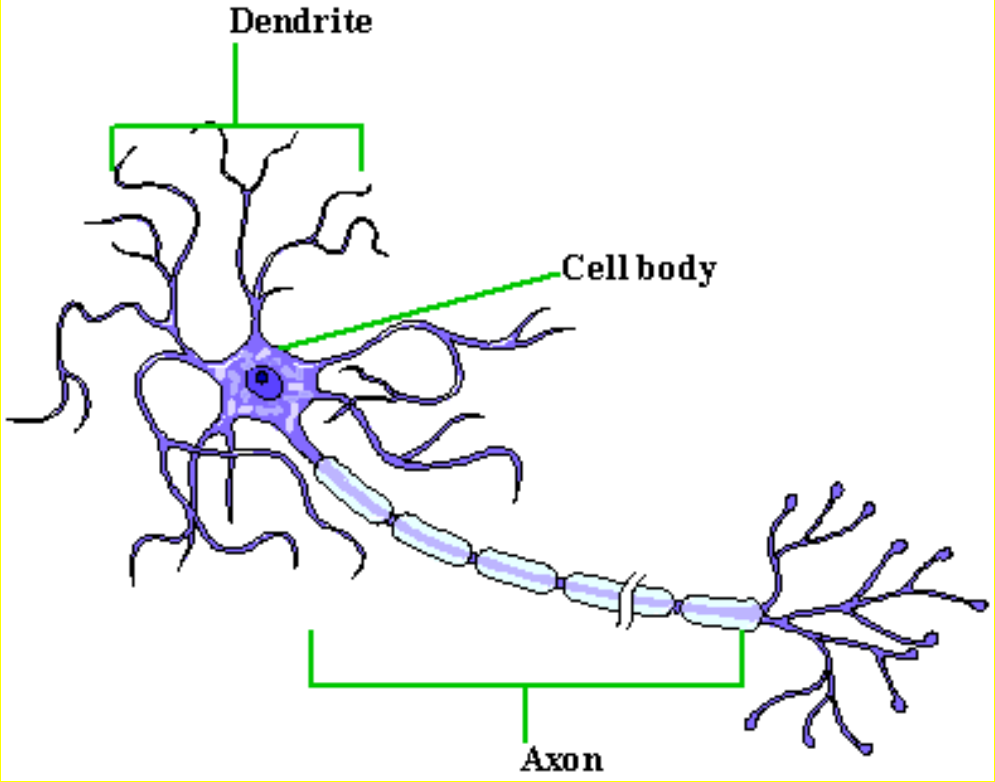


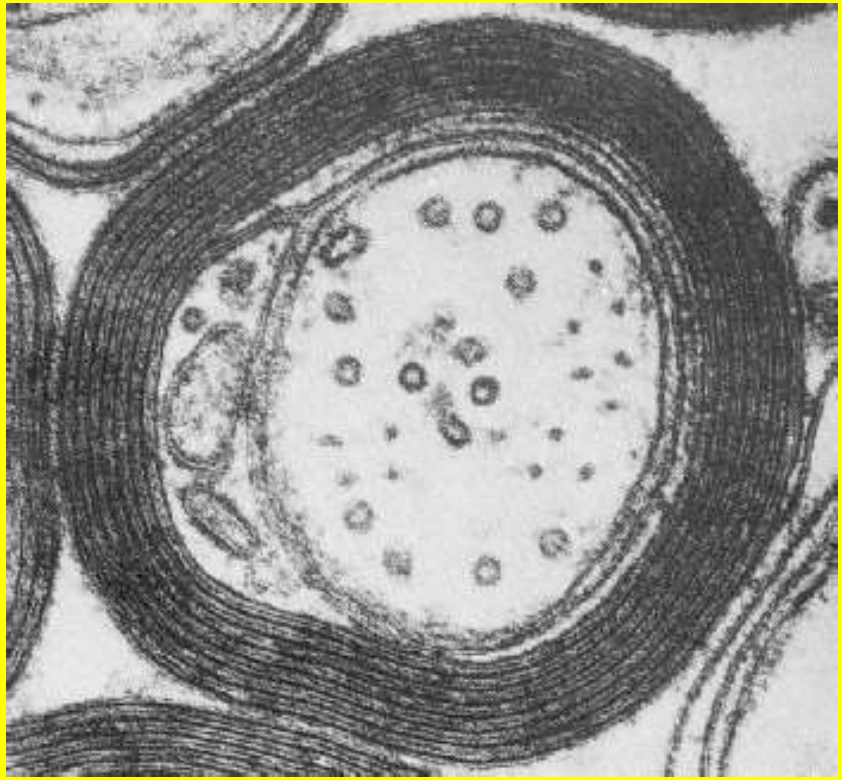
LS 2012 fig 5-1



LS 2012 fig 5-2

What is myelin?
Why is it important?

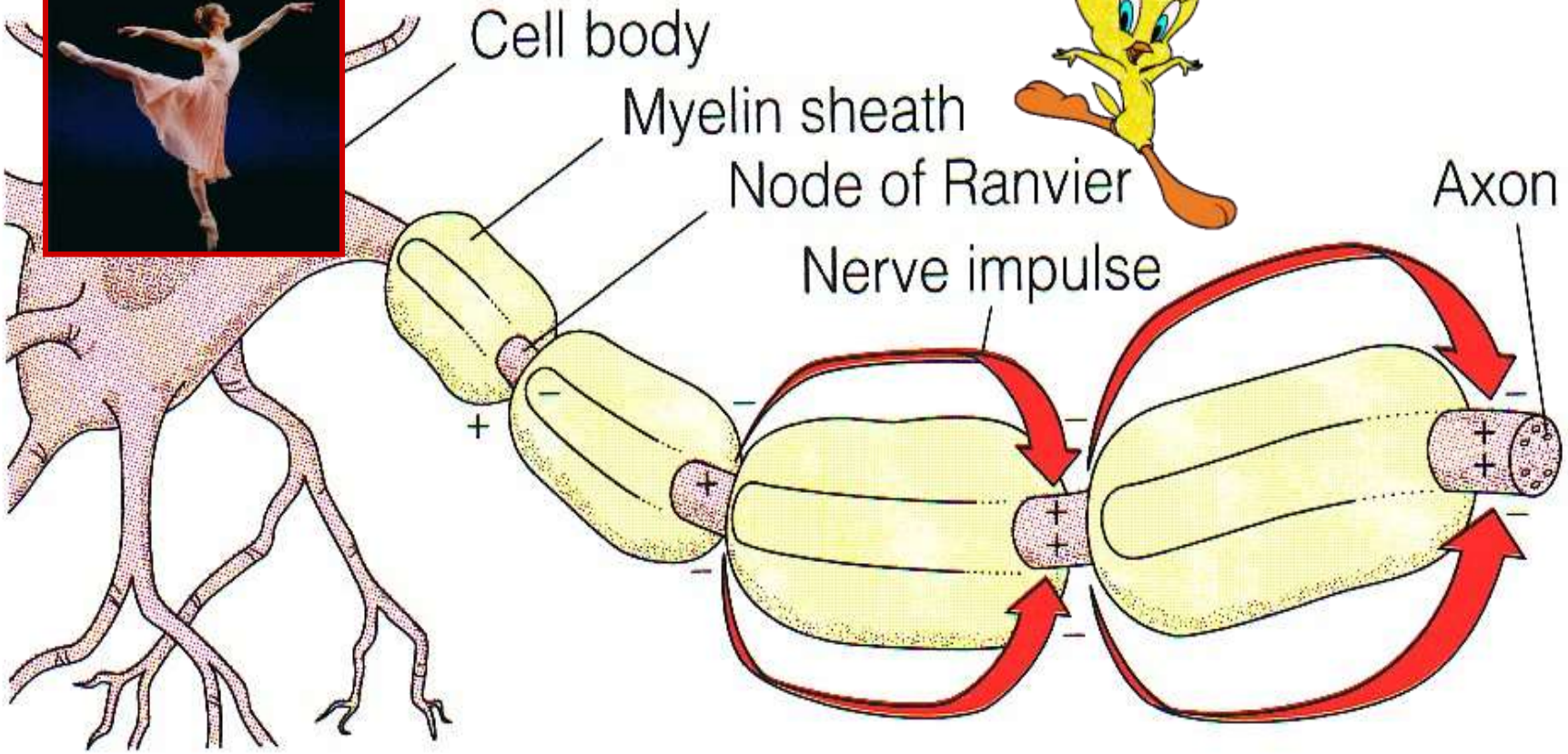




Lipid insulative coat

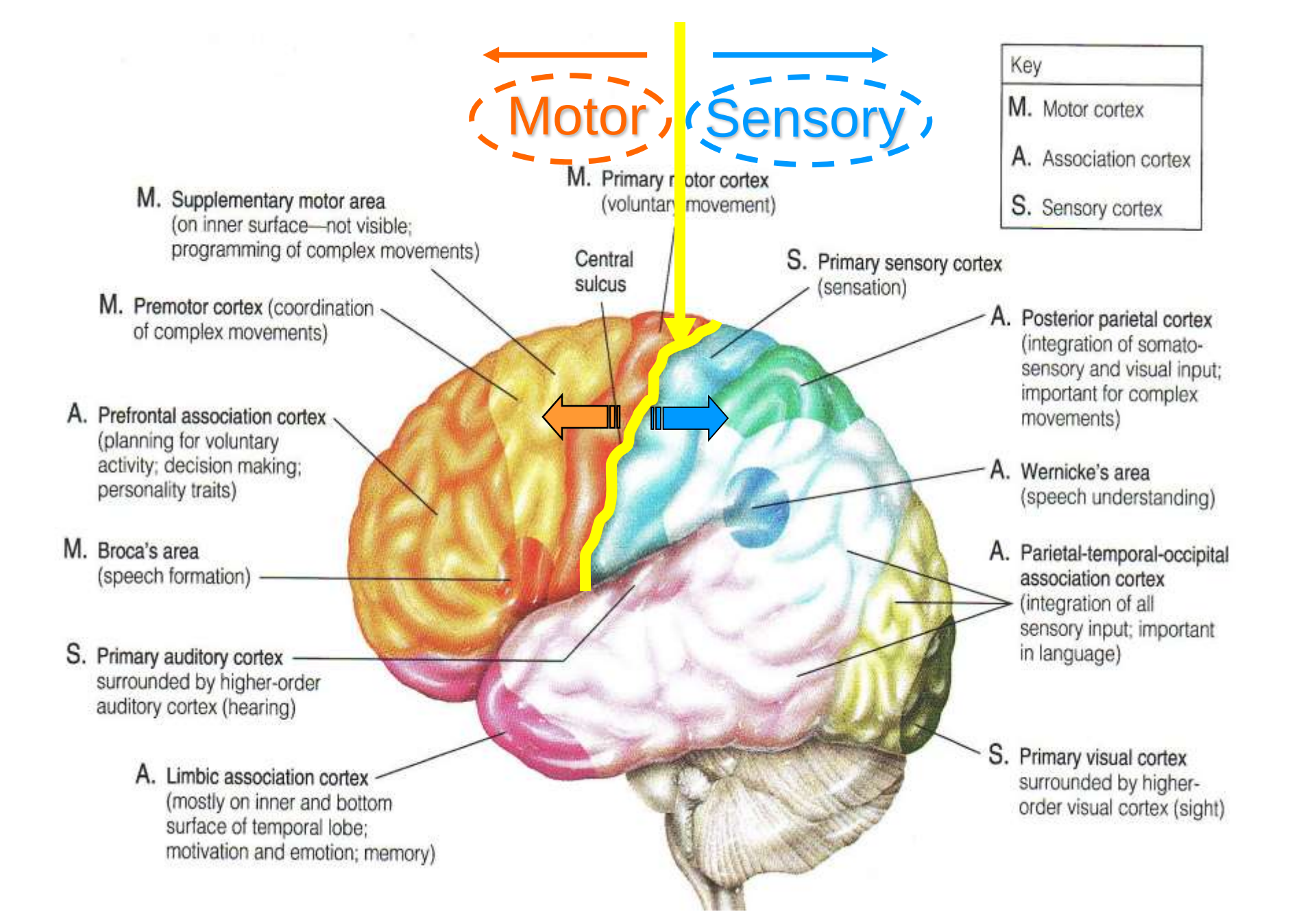
↑ $\vec{v}$, conserves ions & ATP

Saltatory/Leaping Conduction!
Crucial Sensory & Motor Nerves



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

DC 2003



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

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

http://www-nrd.nhtsa.dot.gov/Pubs/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 ≡ ~ 2% of all traffic fatalities

13% of deaths children ≤ 14 yr, 87% ♂

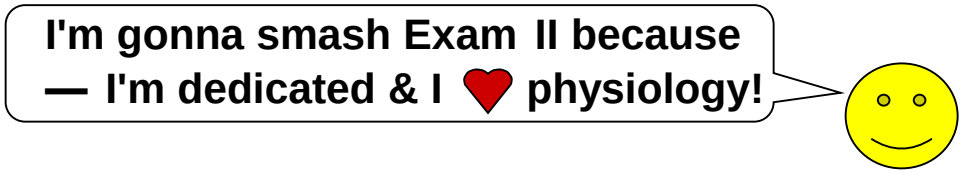
11% involved wrong-way riding!

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

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

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

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



BI 121 Lecture 13

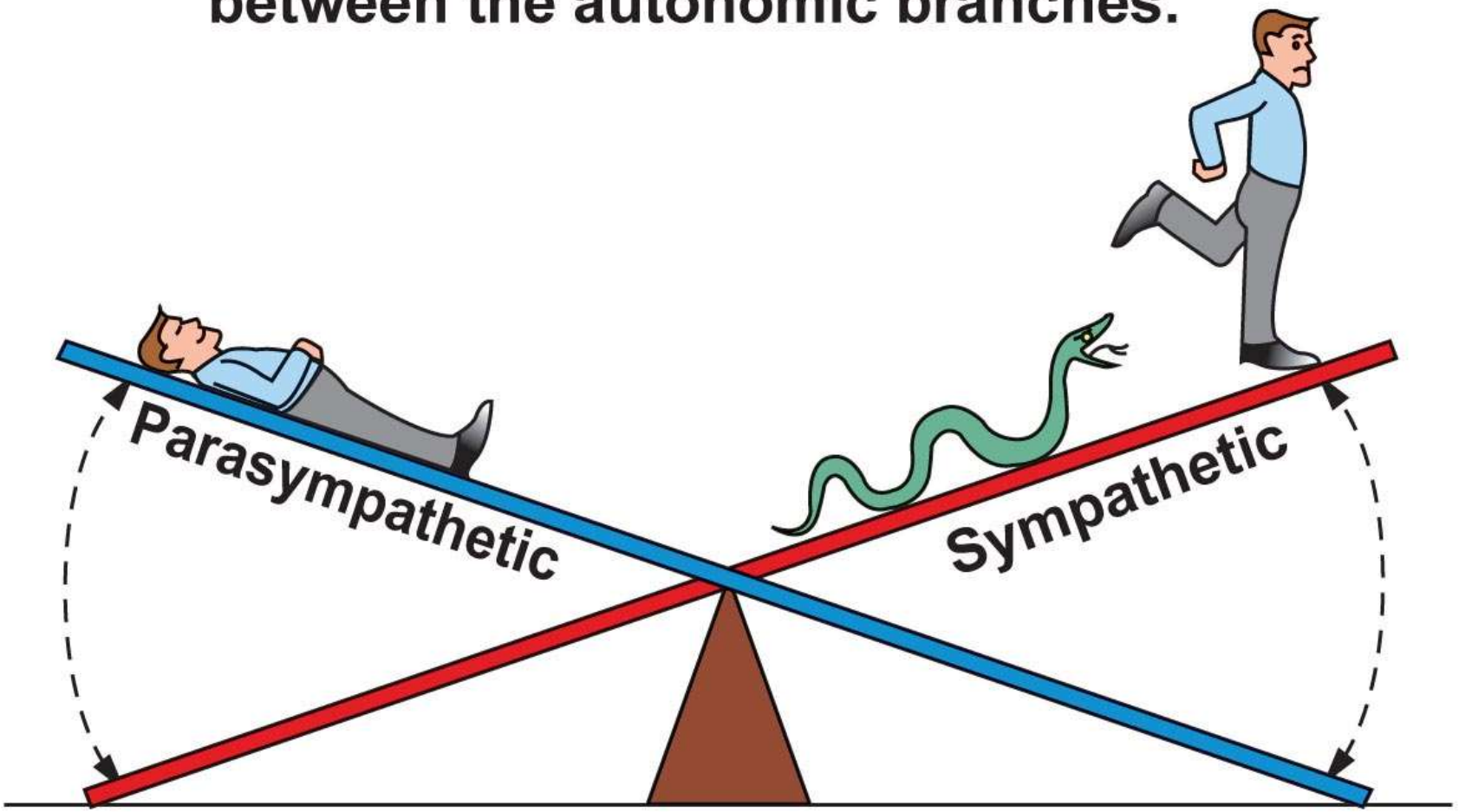
I. ***Announcements*** **No lab today – Study for Exam II!!**
Optional Lab notebook check after last Lab 6, Mac pulmonary function testing (PFT) next Thursday. Q?

II. ***Nervous System Connections*** **NS organization video.**
https://www.youtube.com/watch?v=qPix_X-9t7E

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

Homeostasis is a dynamic balance between the autonomic branches.

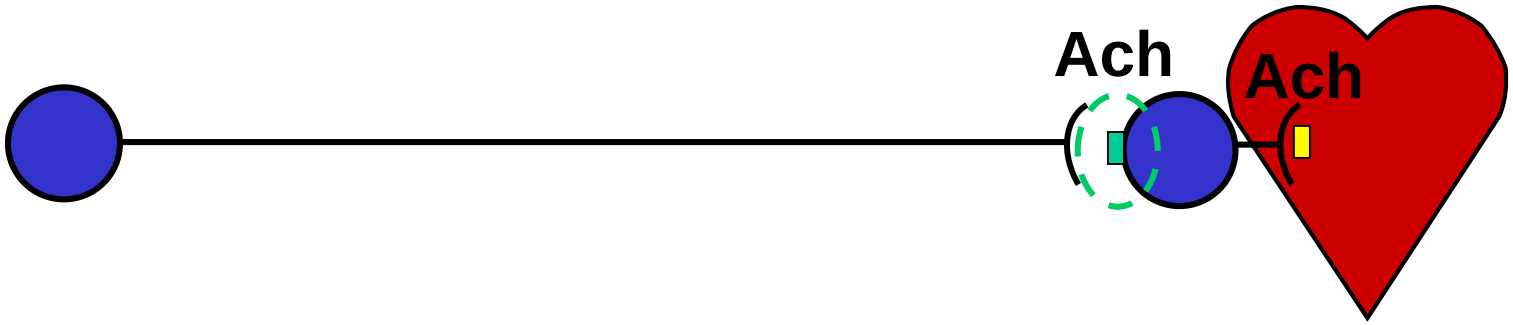


Rest-and-digest: Parasympathetic activity dominates.

Fight-or-flight: Sympathetic activity dominates.

D Silverthorn 2010

Parasympathetic

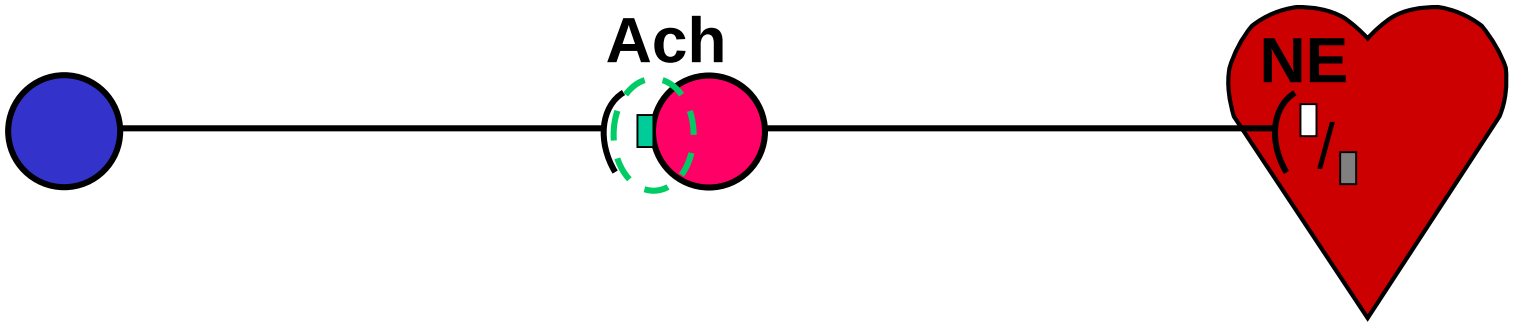


Ach = Acetylcholine

= Nicotinic Receptor

= Muscarinic Receptor

Sympathetic



NE = Norepinephrine

= α Receptor (α_1 , α_2)

= β Receptor (β_1 , β_2)

Nicotine activates <u>both</u> Sympathetic & Parasympathetic post-ganglionic neurons!

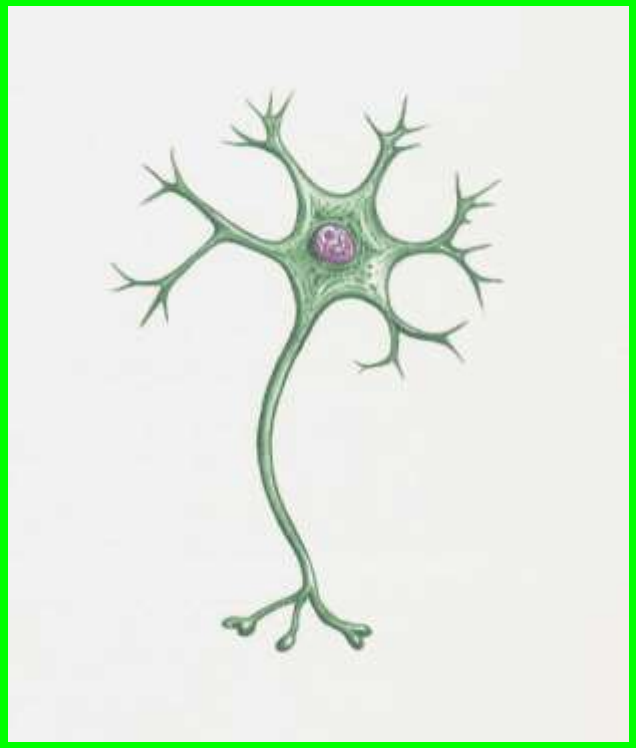
Problem?

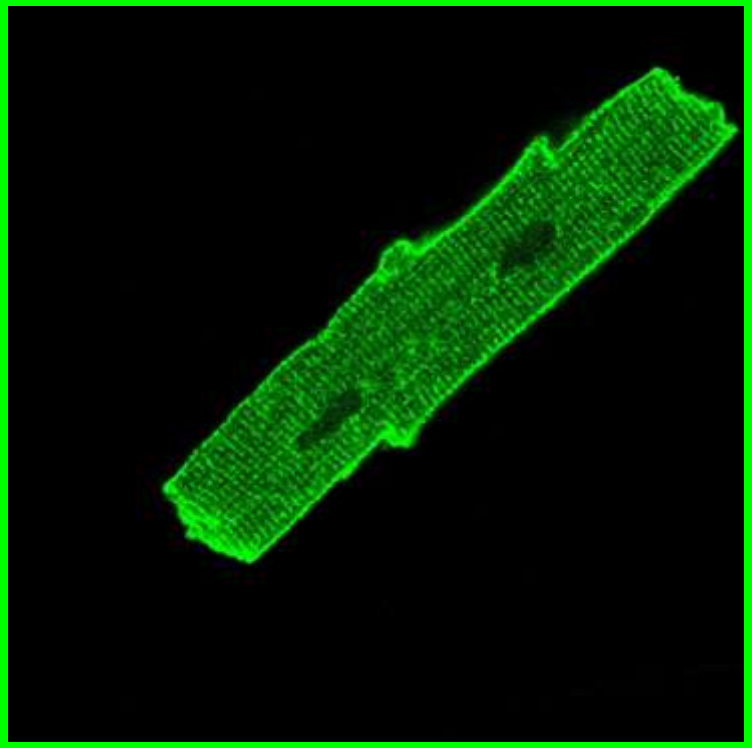
Like hammering the gas pedal & brake at the same time!!

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)	Increases motility
	Contracts sphincters (to prevent forward movement of tract contents)	Relaxes sphincters (to permit forward movement of tract contents)
	Inhibits digestive secretions	Stimulates digestive secretions
Urinary Bladder	Relaxes	Contracts (emptying)
Eye	Dilates the pupil	Constricts the pupil
	Adjusts the eye for far vision	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		
Exocrine pancreas	Inhibits pancreatic exocrine secretion	Stimulates pancreatic exocrine secretion (important for digestion)
Sweat glands	Stimulates secretion by sweat glands important in cooling the body	Stimulates secretion by specialized sweat glands in the armpits and genital area
Salivary glands	Stimulates a small volume of thick saliva rich in mucus	Stimulates a large volume of watery saliva rich in enzymes
Endocrine Glands		
Adrenal medulla	Stimulates epinephrine and norepinephrine secretion	None
Endocrine pancreas	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?



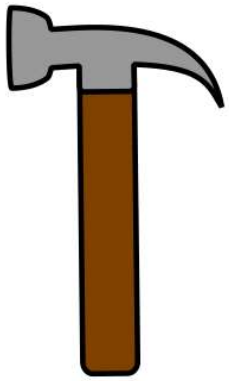


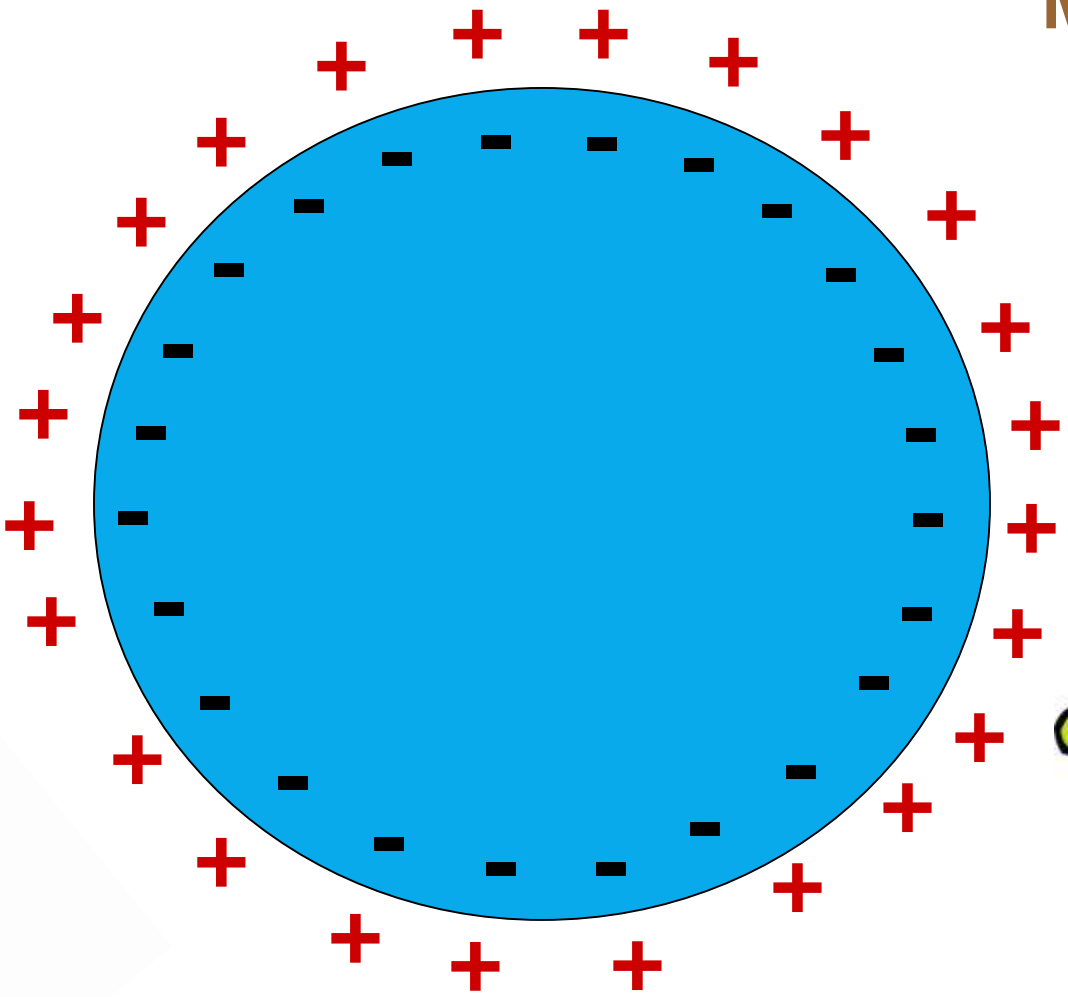
They are excitable!!

Stimulate Cell @ Rest

Thermal

Mechanical



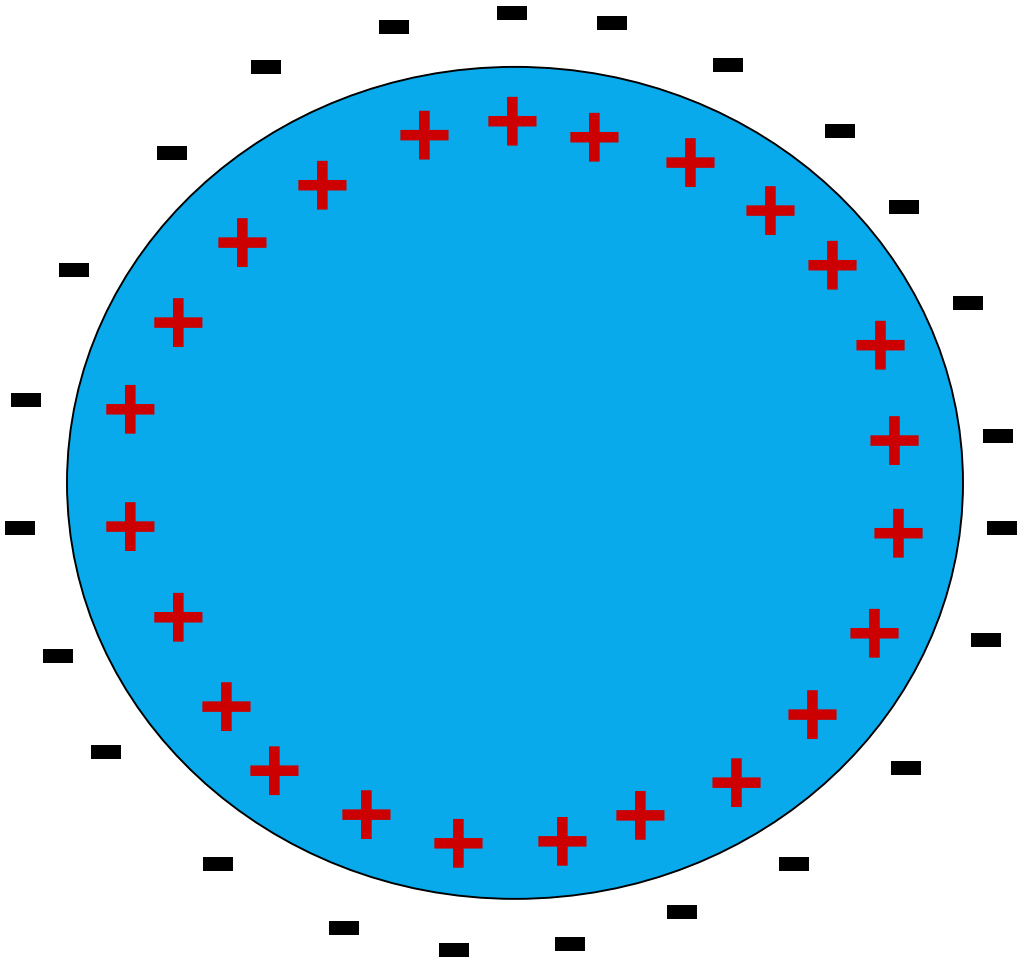


1

Electrical

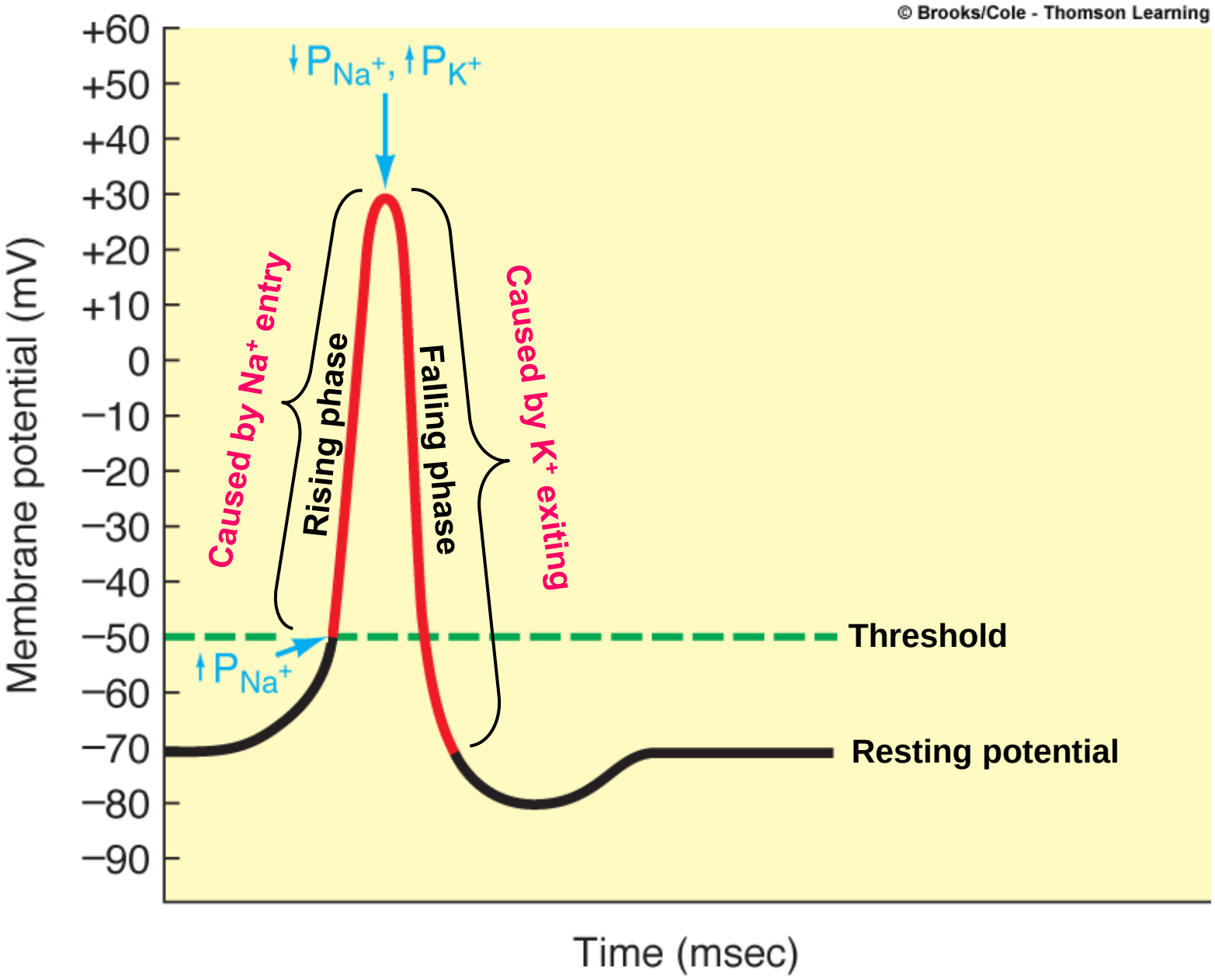
Chemical

Action Potential has occurred!

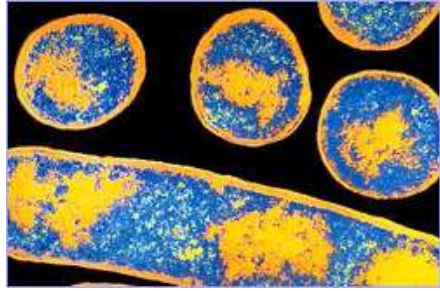


5

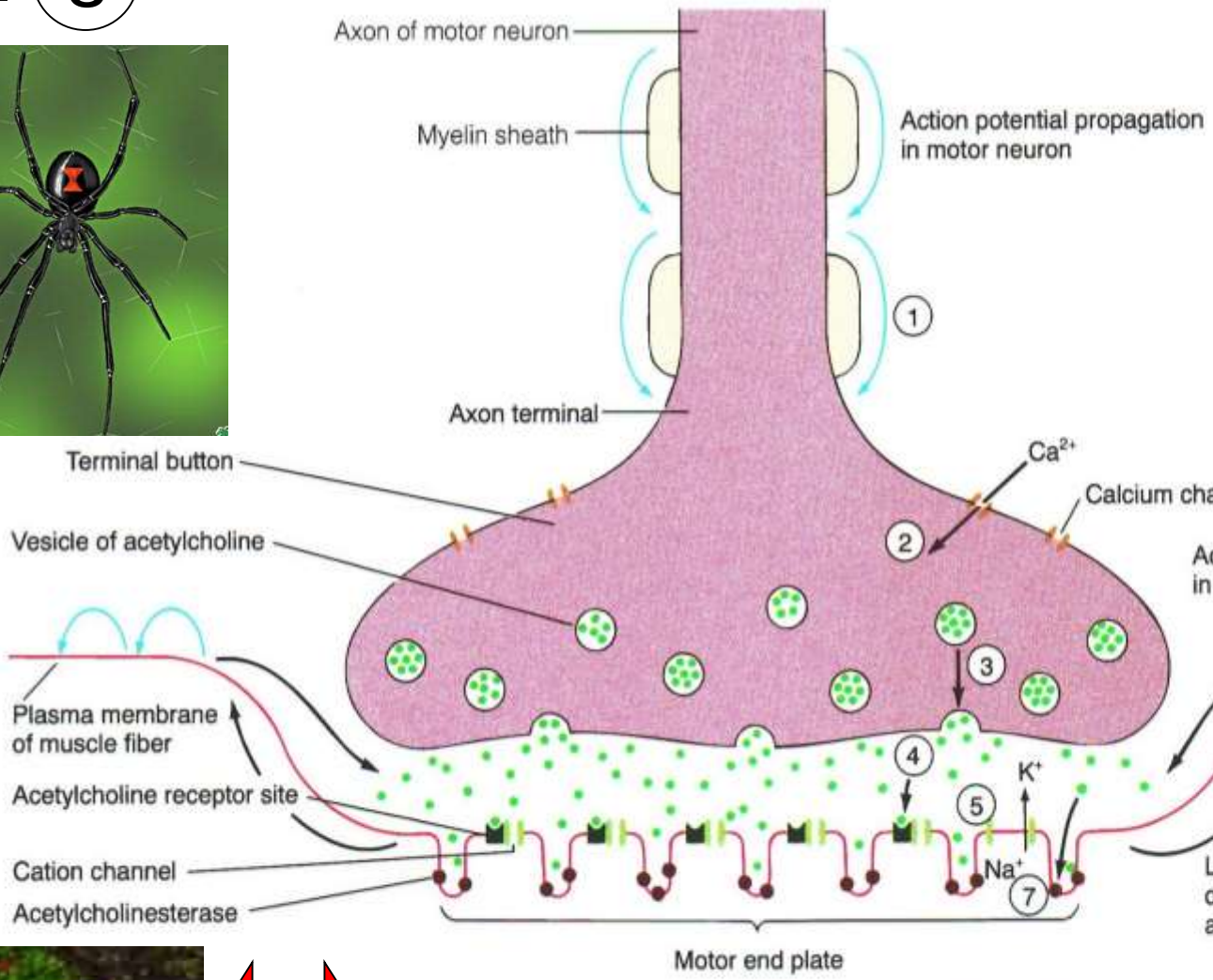
Brief (1-2 ms) reversal to + inside cell!



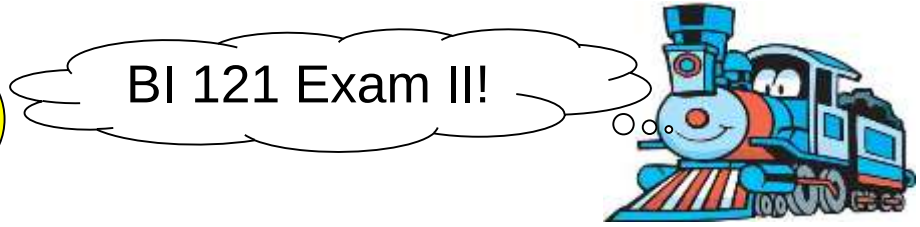
LS 2012 fig 4-8




Campbell's
CLASSICS
BEAN
BACON


Axon of motor neuron
Myelin sheath
Action potential propagation in motor neuron
1
Axon terminal
Terminal button
Ca2+
Calcium channel
Vesicle of acetylcholine
2
Action potential propagation in muscle fiber
6
3
Muscle fiber
Plasma membrane of muscle fiber
4
K+
Acetylcholine receptor site
5
Na+
Cation channel
7
Local current flow between depolarized end plate and adjacent membrane
Acetylcholinesterase
Motor end plate
Contractile elements within muscle fiber

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



BI 121 Lecture 14

I. ***Announcements*** Last Lab 6, Pulmonary Function Testing + Optional notebook ✓ this Thur. **Exam II Fri Dec 13, 8am** Q? **American Heart Association 2019 Philadelphia update.**

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

- A. Fight-or-Flight Stories!
- 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

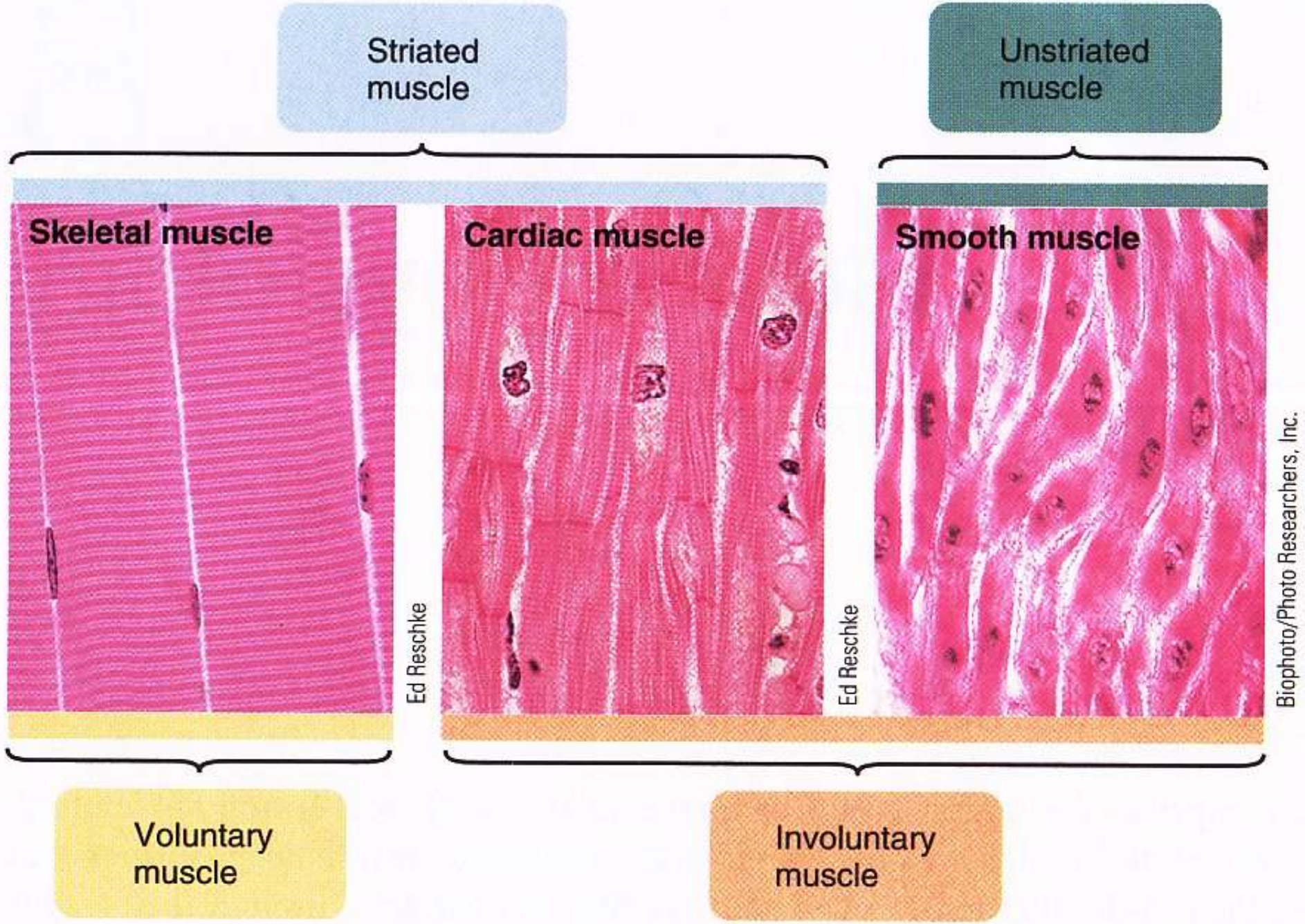
III. ***Muscle Structure & Function*** LS ch 8 + DC Mod 12

- 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 +…

Fight-or-Flight Stories!

or

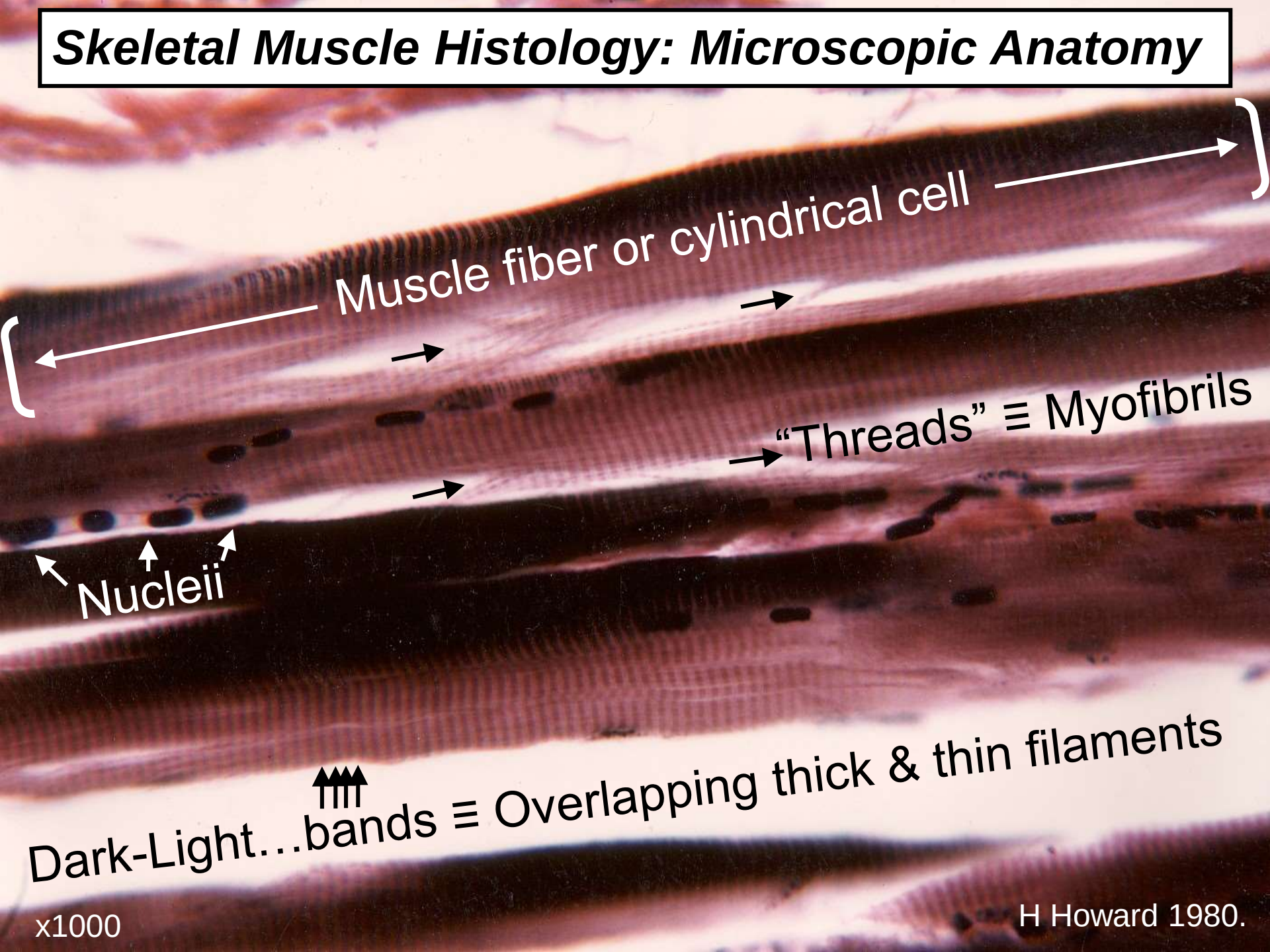
…choose this!!



https://www.youtube.com/watch?v=VVL-8zr2hk4

LS 2012 fig 8-1

Skeletal Muscle Histology: Microscopic Anatomy

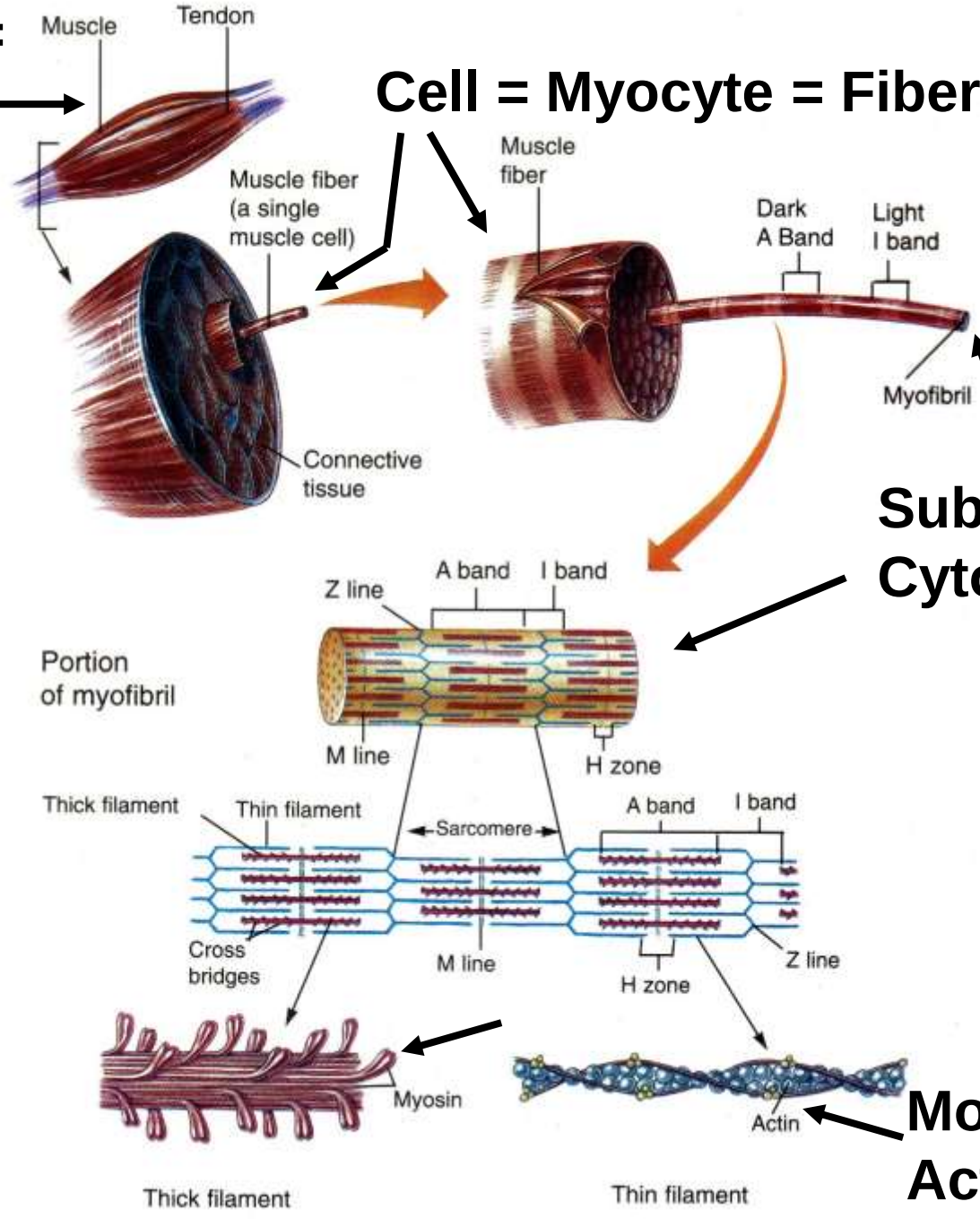


Organ = Muscle

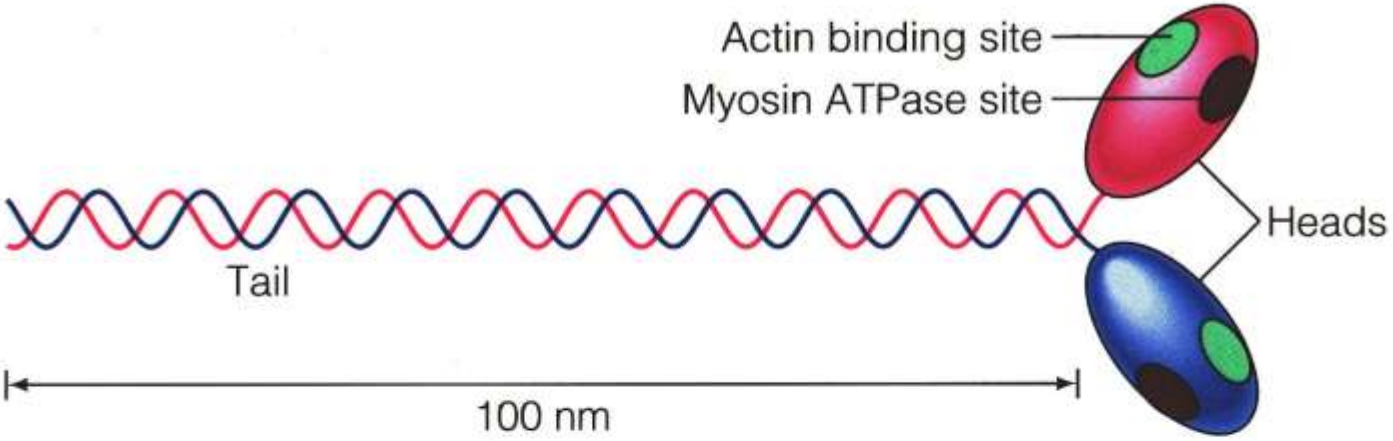
Cell = Myocyte = Fiber

Subcellular = Cytoskeleton

Molecules = Actin & Myosin

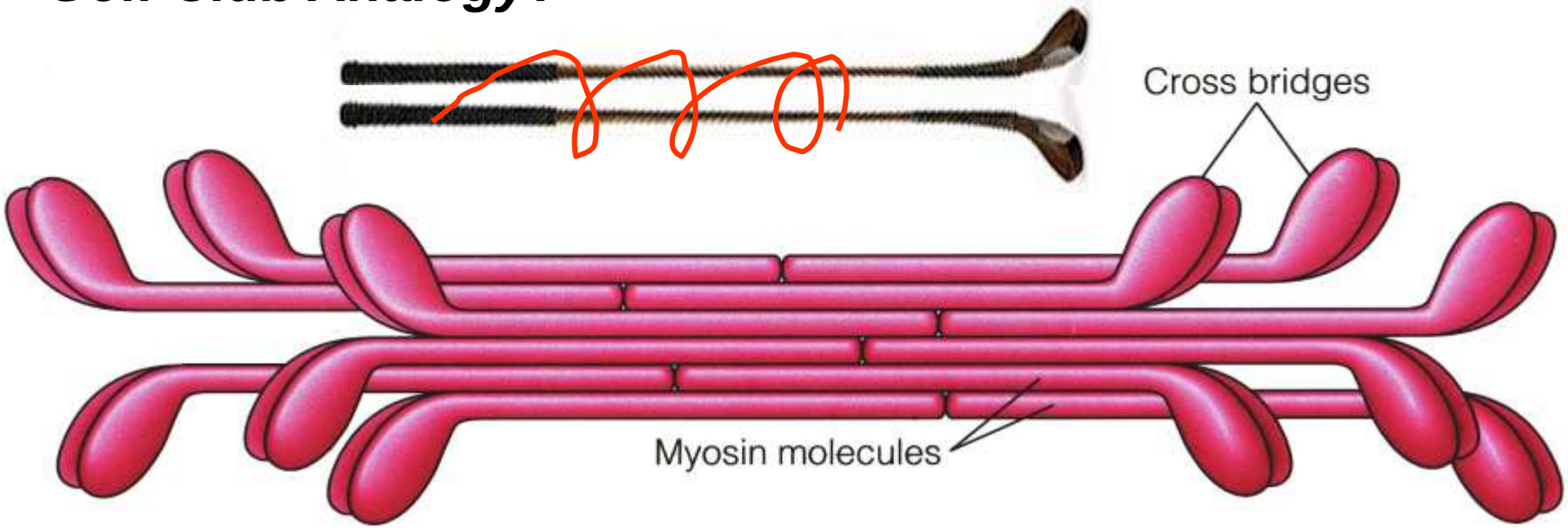


LS 2006, cf:
LS 2012 fig 8-2
DC 2013 fig 12-3



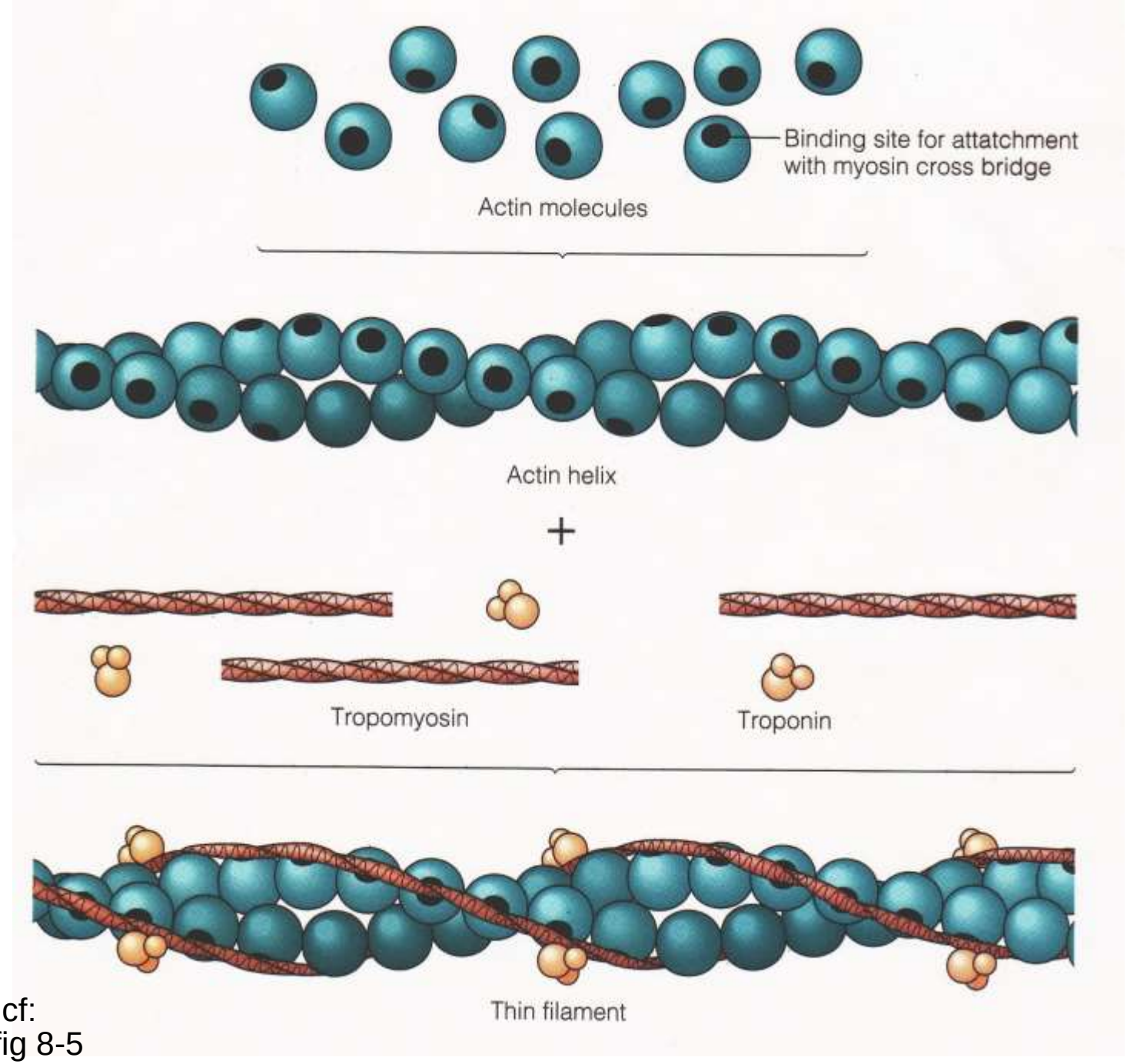
(a)

Golf Club Analogy?



(b)

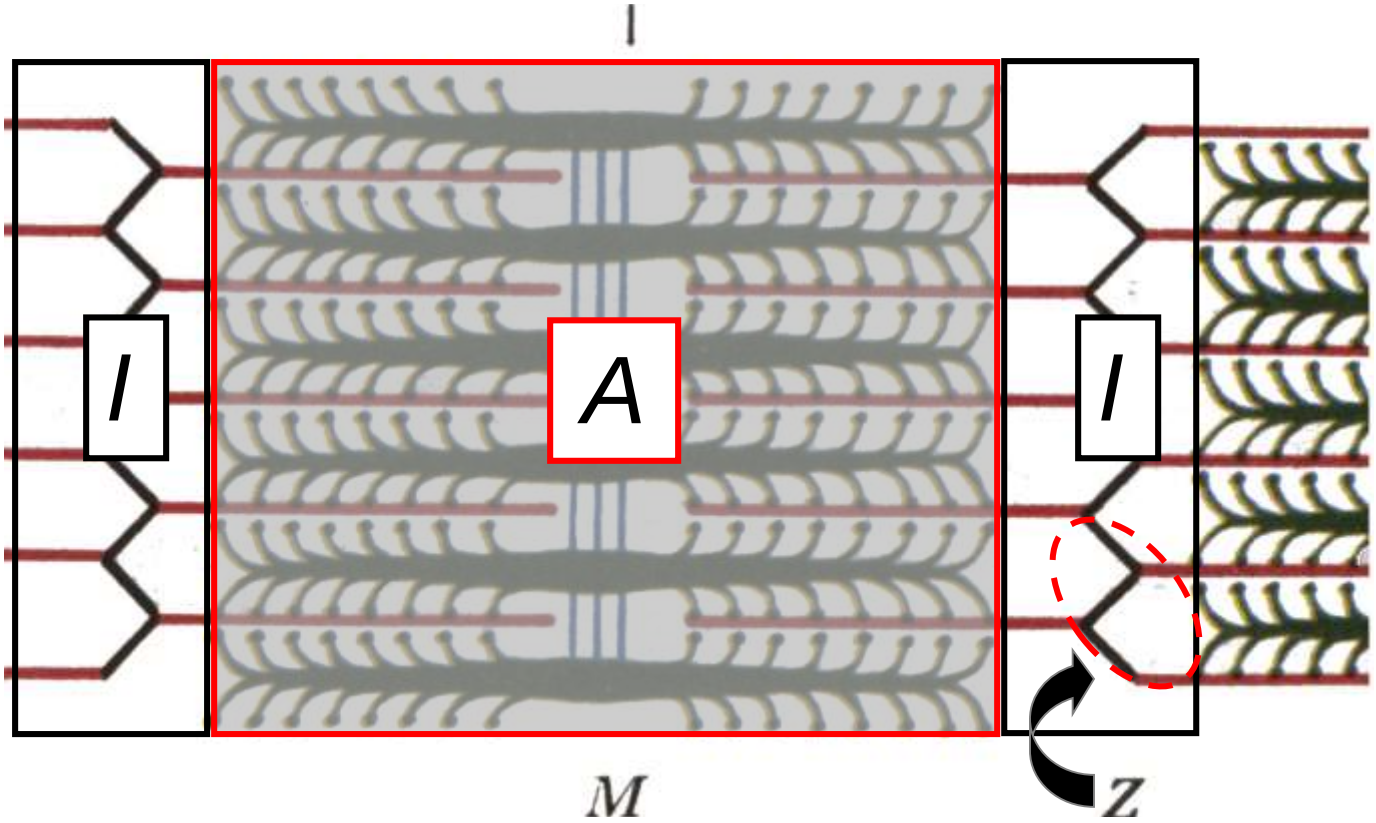
LS 2006, cf:
LS 2012 fig 8-4



LS 2006, cf:
LS 2012 fig 8-5

A Band = Dark Band

*A*nisotropic = Light Can't Shine Through



I Band = Light Band

*I*sotropic = Light Can Shine Through

Pulmonary Function Testing today! Hooray!...

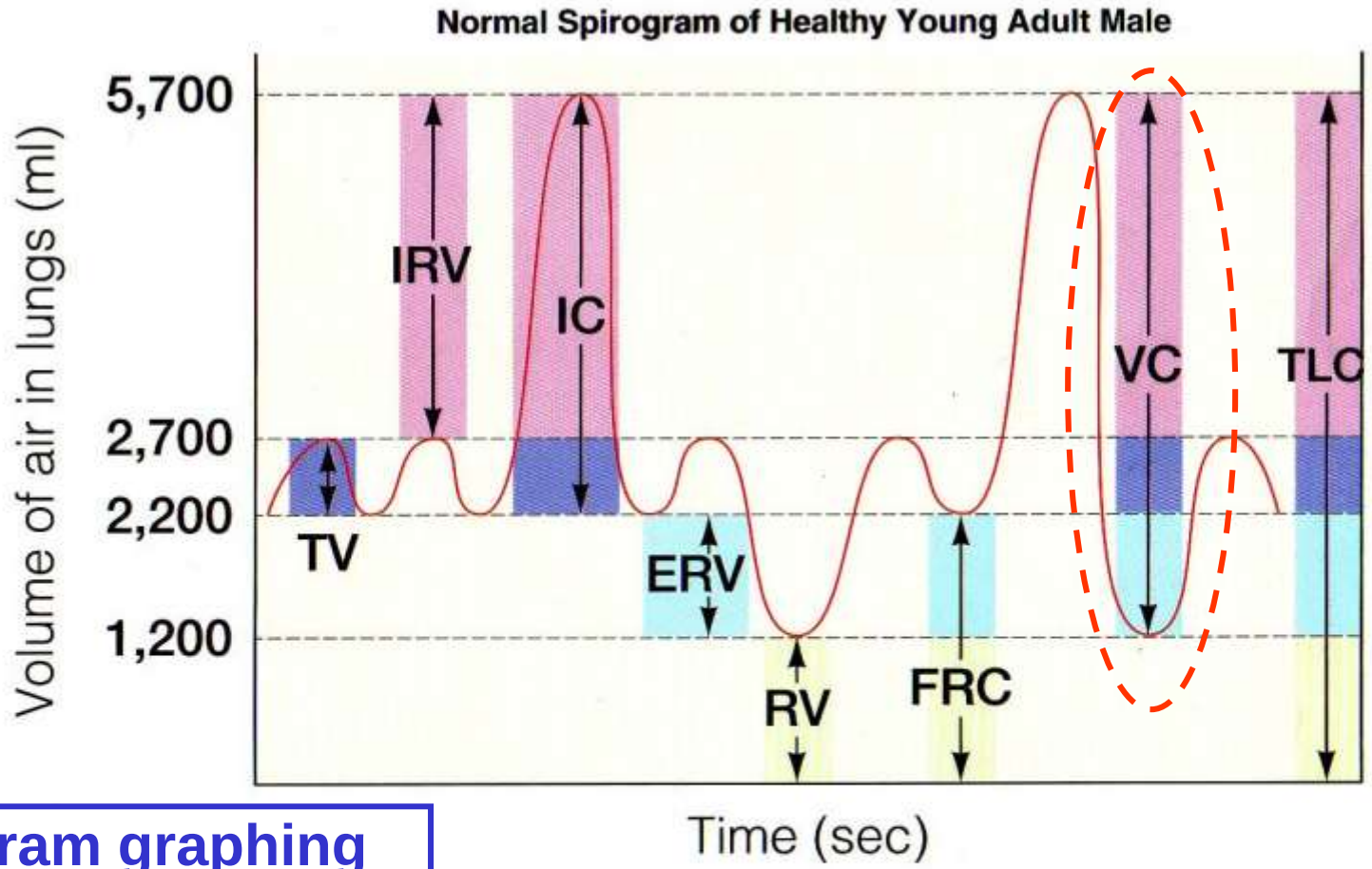
BI 121 Lecture 15

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**

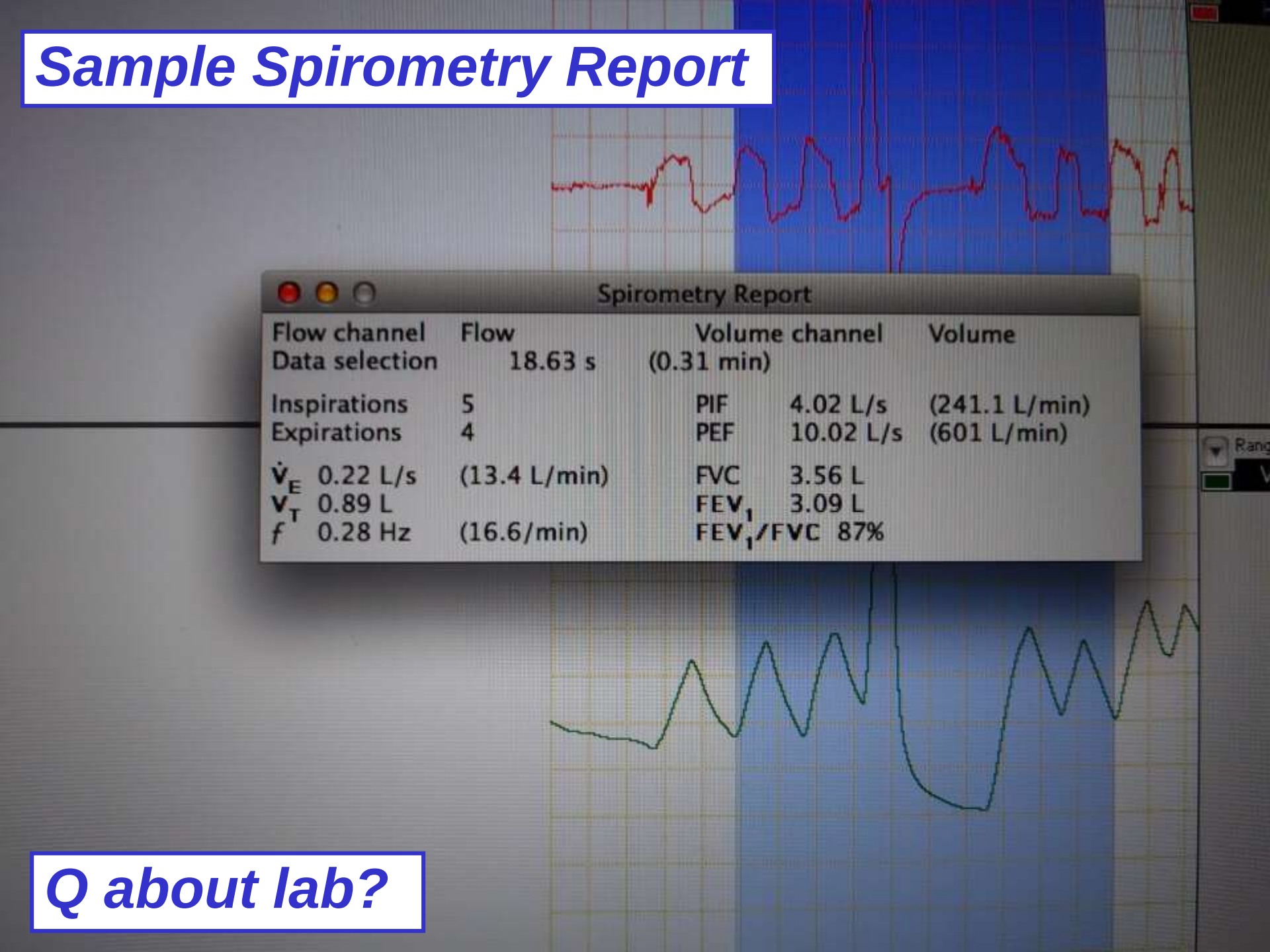
- **A. Skeletal muscle organization review LS fig 8-2, DC fig 12-2**
- **B. Banding pattern? LS fig 8-3, fig 8-7**
- **C. How do muscles contract? LS fig 8-6, 8-10**
- **D. What's a cross-bridge cycle? LS fig 8-11+…**
- **E. Summary of skeletal muscle contraction**
- **F. Exercise adaptation variables: *mode*, *intensity*, *duration*, *frequency*, *distribution*, *individual* & environmental char...?**
- **G. Endurance *vs.* strength training continuum? fiber types...**



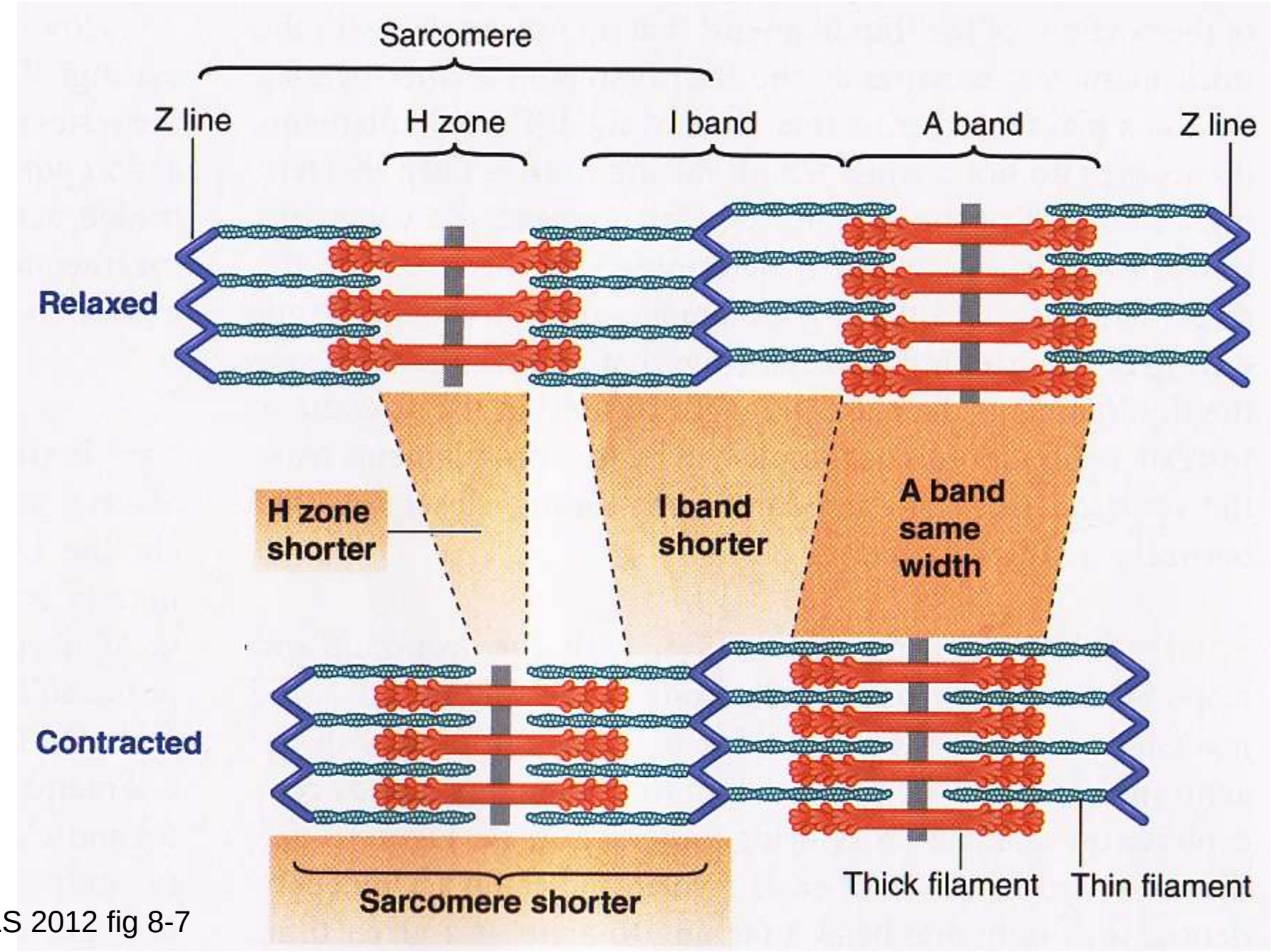
Spirogram graphing complete *PFT* from computer simulation.

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)

Sample Spirometry Report

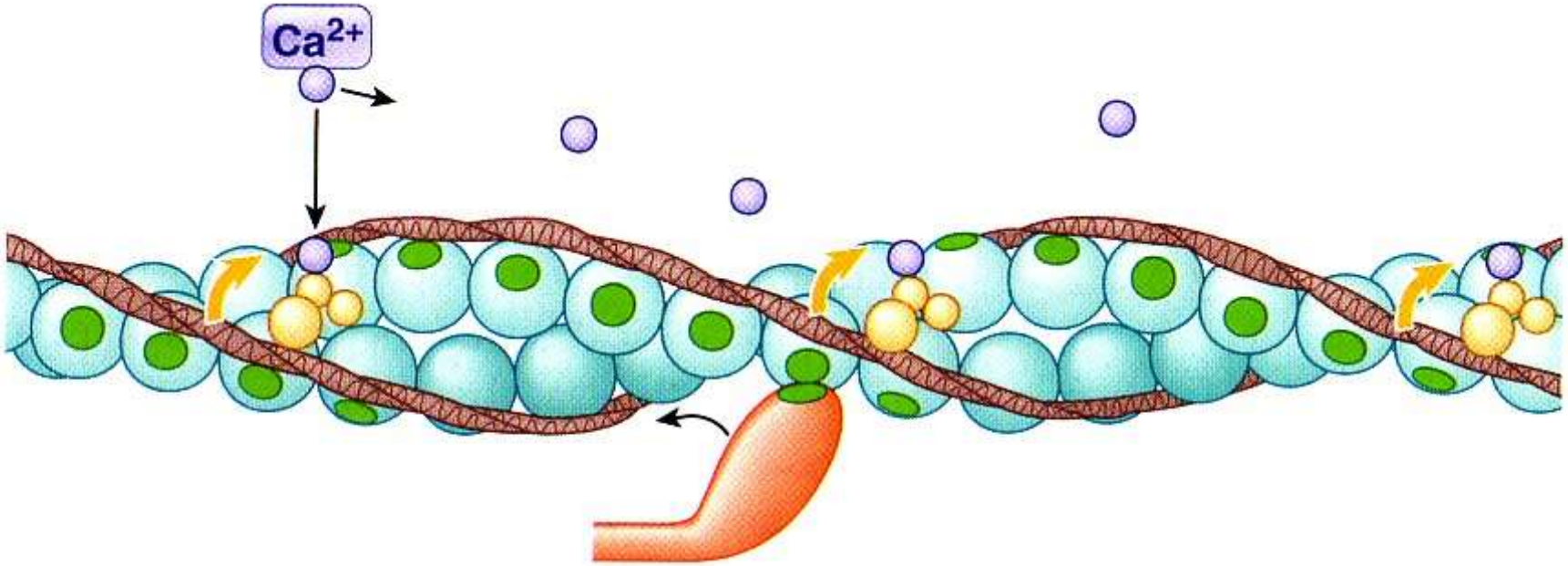


Q about lab?



LS 2012 fig 8-7

Excited: Calcium Triggers Cross-Bridge Binding



(b) Excited

1. Muscle fiber is excited and Ca^{2+} is released.

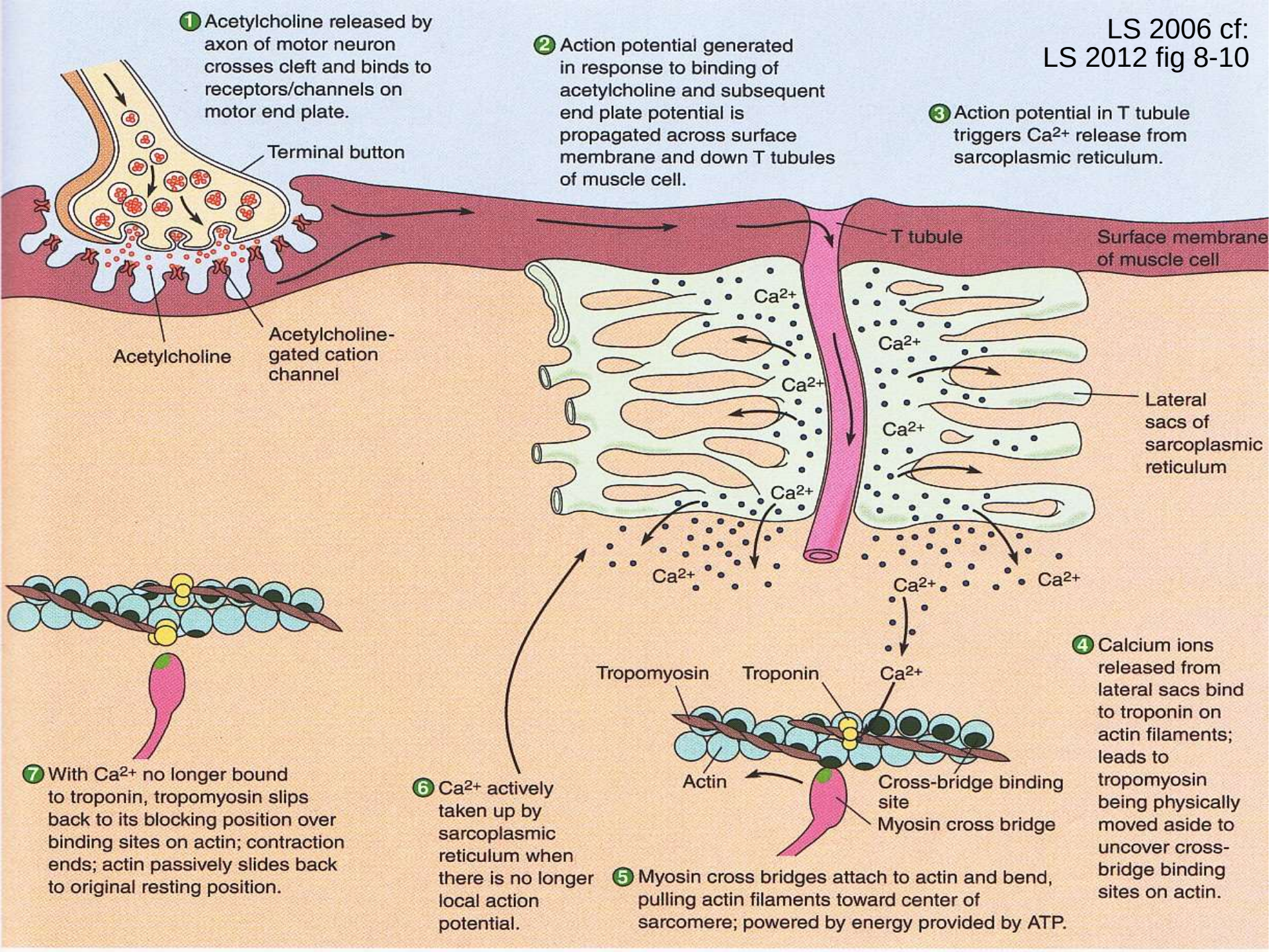
2. Released Ca^{2+} binds with troponin, pulling troponin–tropomyosin complex aside to expose cross-bridge binding site.

3. Cross-bridge binding occurs.

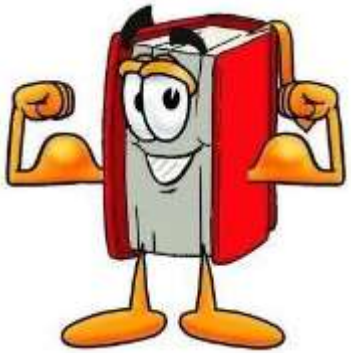
4. Binding of actin and myosin cross bridge triggers power stroke that pulls thin filament inward during contraction.

LS 2012 fig 8-6b

LS 2006 cf:
LS 2012 fig 8-10



Muscle Contraction Resources



https://ed.ted.com/lessons/how-your-muscular-system-works-emma-bryce

https://ed.ted.com/on/s3Zzdm8u

https://ed.ted.com/lessons/what-makes-muscles-grow-jeffrey-siegel

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

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

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

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

BI 121 Lecture 16

I. ***Announcements*** Notebooks? Exam II, Dec 13th
Friday 8 am. Review session in class next Thurs. Q?

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

A. Summary of skeletal muscle contraction
Malcolm Campbell & David Bolinsky videos

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

C. 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

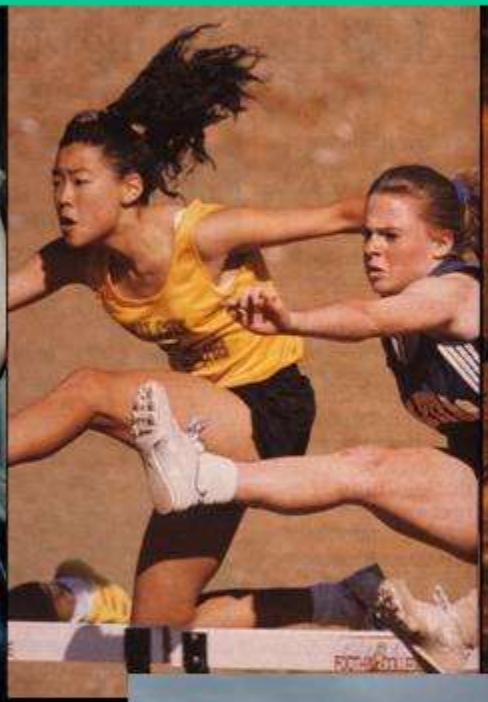
B. Respiratory anatomy LS fig 12-2 p 347, DC, Fox +...

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

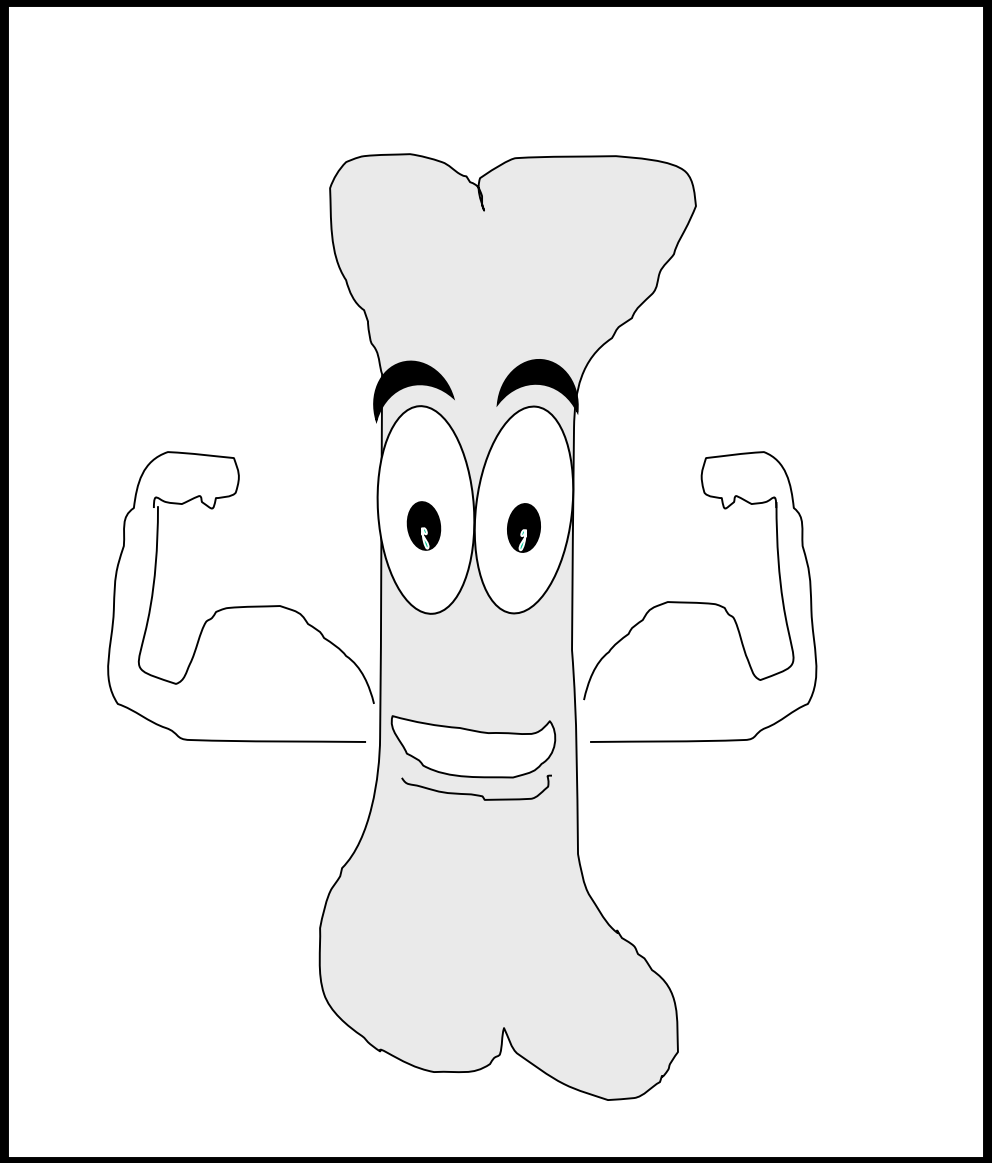
D. How do we breathe? LS fig 12-12, fig 12-25 pp 349-356, pp 373-378

Adaptations to Exercise?

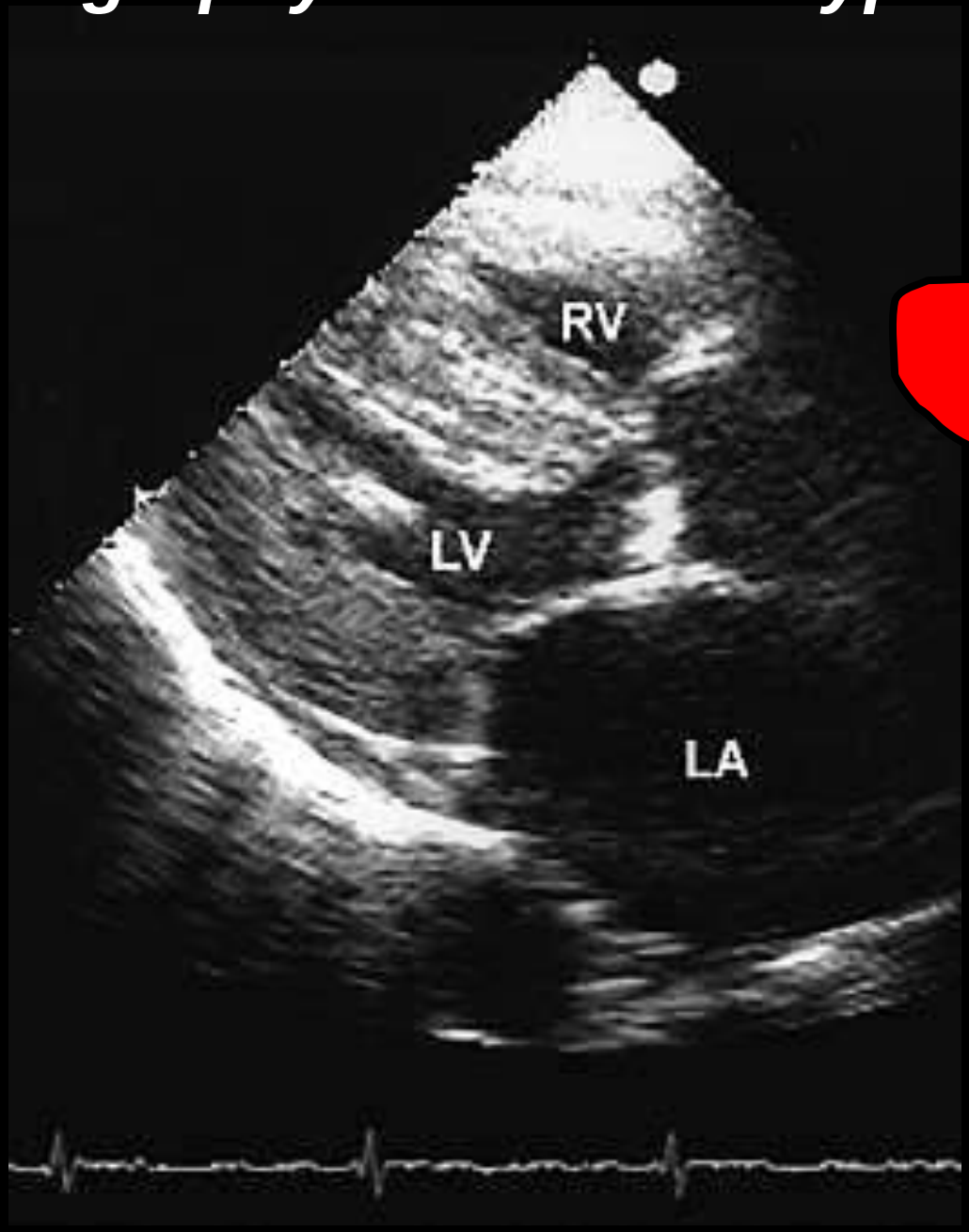
Mode, Intensity, Duration, Frequency,
Distribution of Training Sessions?
Conditions of Environment? Individual?



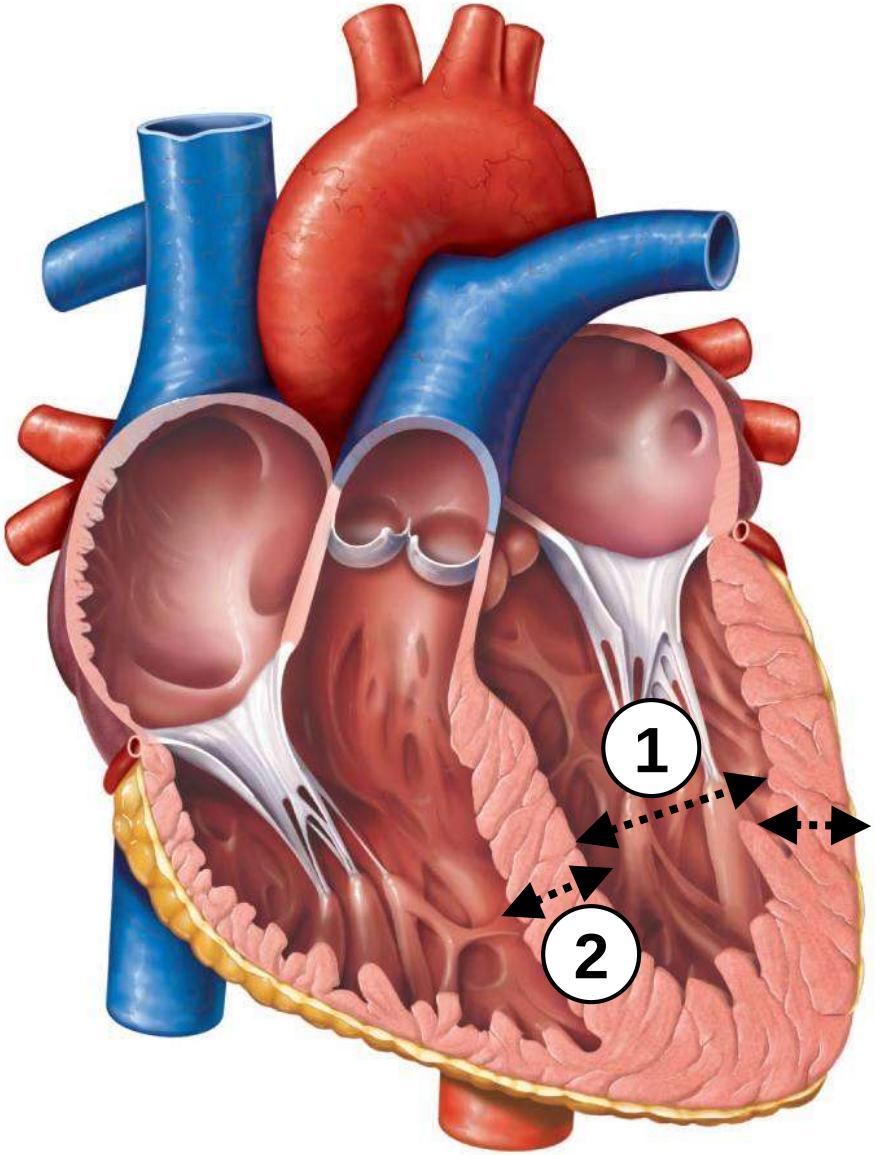
As muscles tug on bones, bones get stronger, too!...many systems adapt!!



Echocardiography documents hypertrophy...



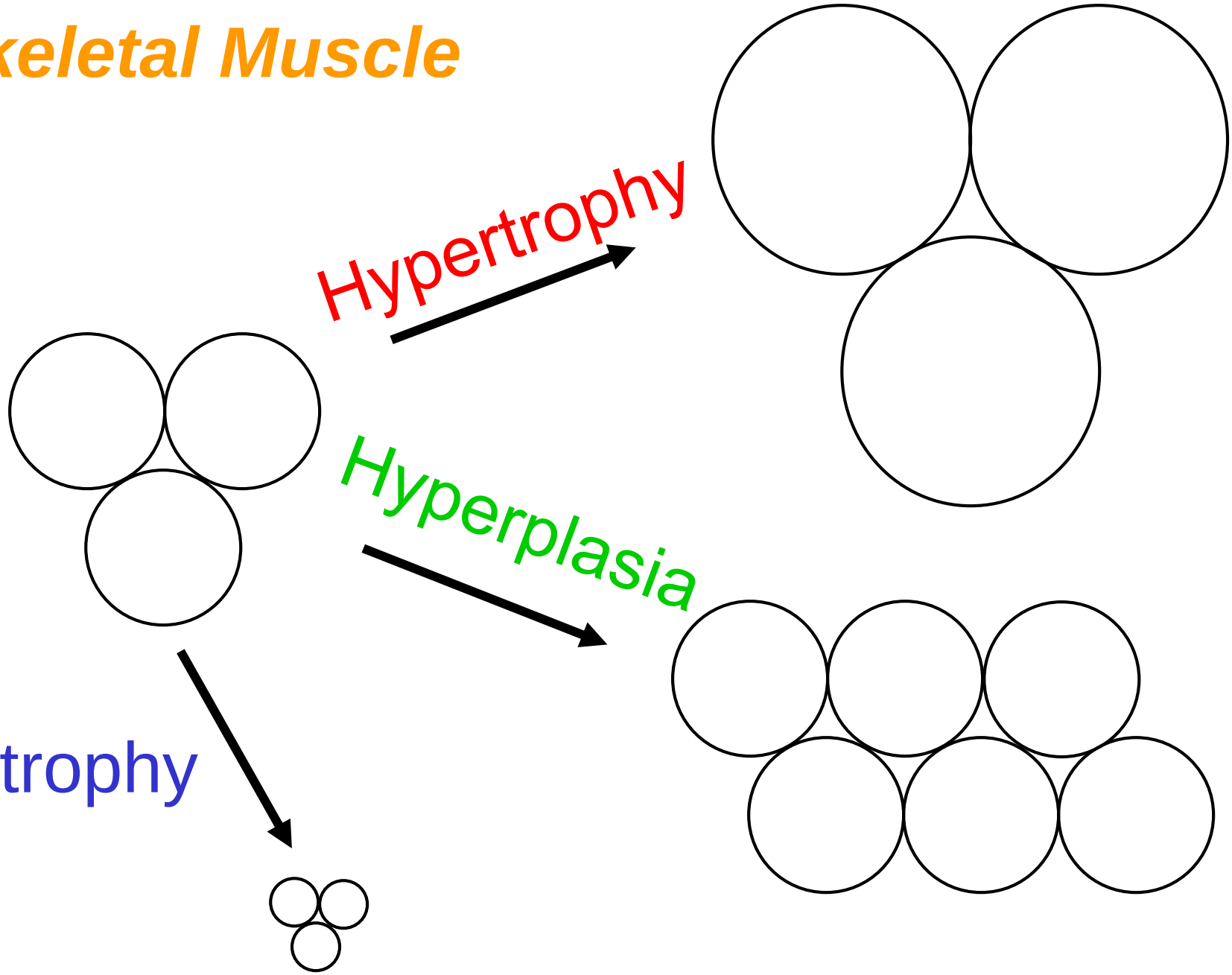
Cardiac Adaptations to Exercise: ① Endurance vs. ② StrengthTraining



NB: ① > ↑ LBM

1 + 2

Skeletal Muscle



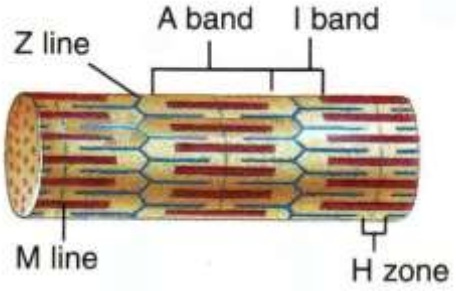
Myofibril

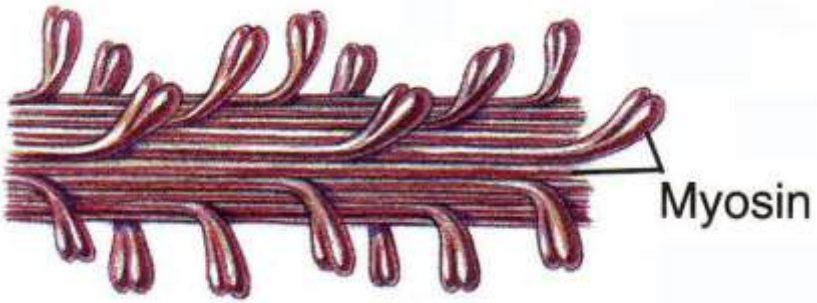
Hypertrophy: *Increased*

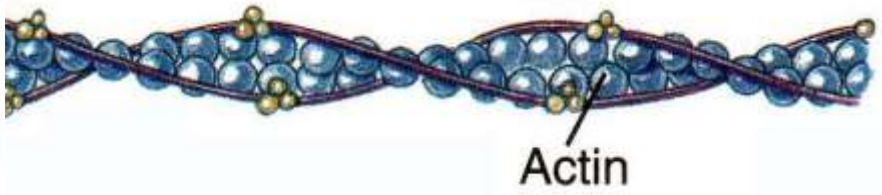
Number of Myofibrils

Thick & Thin Filaments

Myosin & Actin Molecules







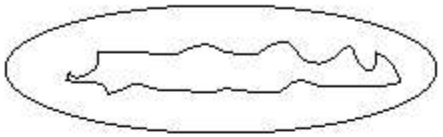
Characteristics of Skeletal Muscle Fibers

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

LS 2012 tab 8-1 modified
> VP Lombardi 1989

AEROBIC w/O_2

ANAEROBIC



MITOCHONDRIA

CYTOSOL

Glycolysis

Immediate/ATP-PC

PRIMARY FUEL	ACTIVITY	% AEROBIC (Oxidative Energy System)	% ANAEROBIC (Immediate & Non-Oxidative Energy Systems)	TIME (Min:Sec)
FAT, CARBOHYDRATE & PROTEIN (Small Amounts)	Marathon Cross-Country Skiing	100	0	135:00
	10-K Run	90	10	29:00
	3-Mile Run	80	20	14:00
	2-Mile Run 800-Meter Swim	70	30	
		60	40	9:00
	1-Mile Run			3:45
CARBOHYDRATE (Glucose & Glycogen)	Boxing 200-Meter Swim	50	50	
	Circuit Weight Training	40	60	
	Soccer Lacrosse	30	70	1:30
	Tennis	20	80	0:50
ATP, ADP & Creatine Phosphate (CP)	Basketball Volleyball 200-Meter Dash Football	10	90	0:20
	Conventional Weight Training	0	100	0:10

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 O_2 transport)
- ↑ Resting energy levels which inhibit sugar breakdown
- ↑ Aerobic capacity of all three fiber types.

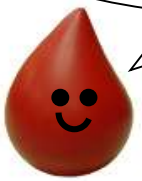
Lombo's simplified steps!

1 **Breathe in & out!**

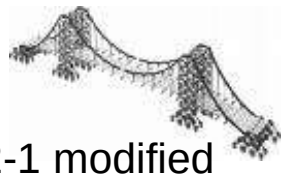
2 **Cross membranes!**

3 **Move with blood!**

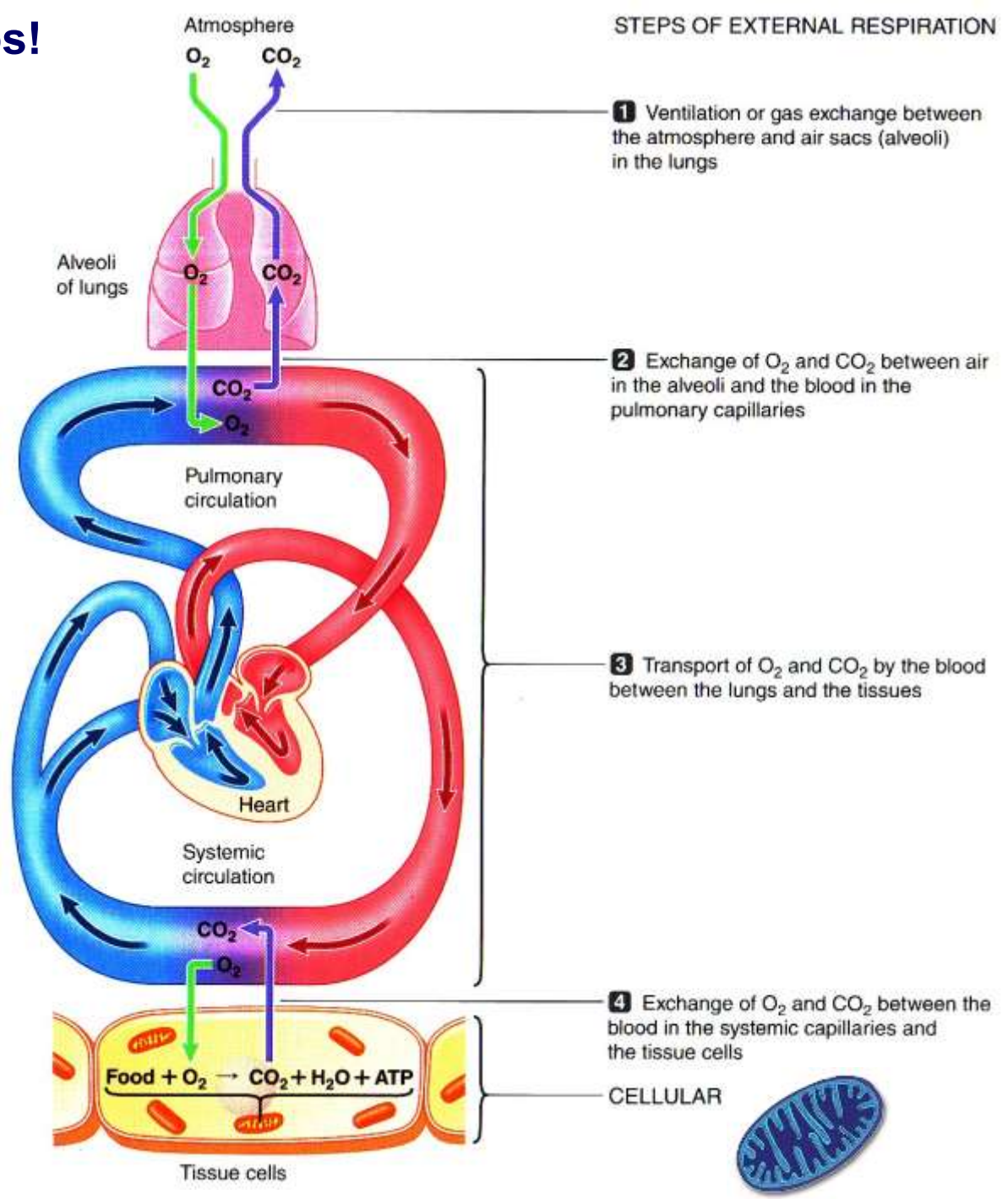
Go with the flow!



4 **Cross membranes!**

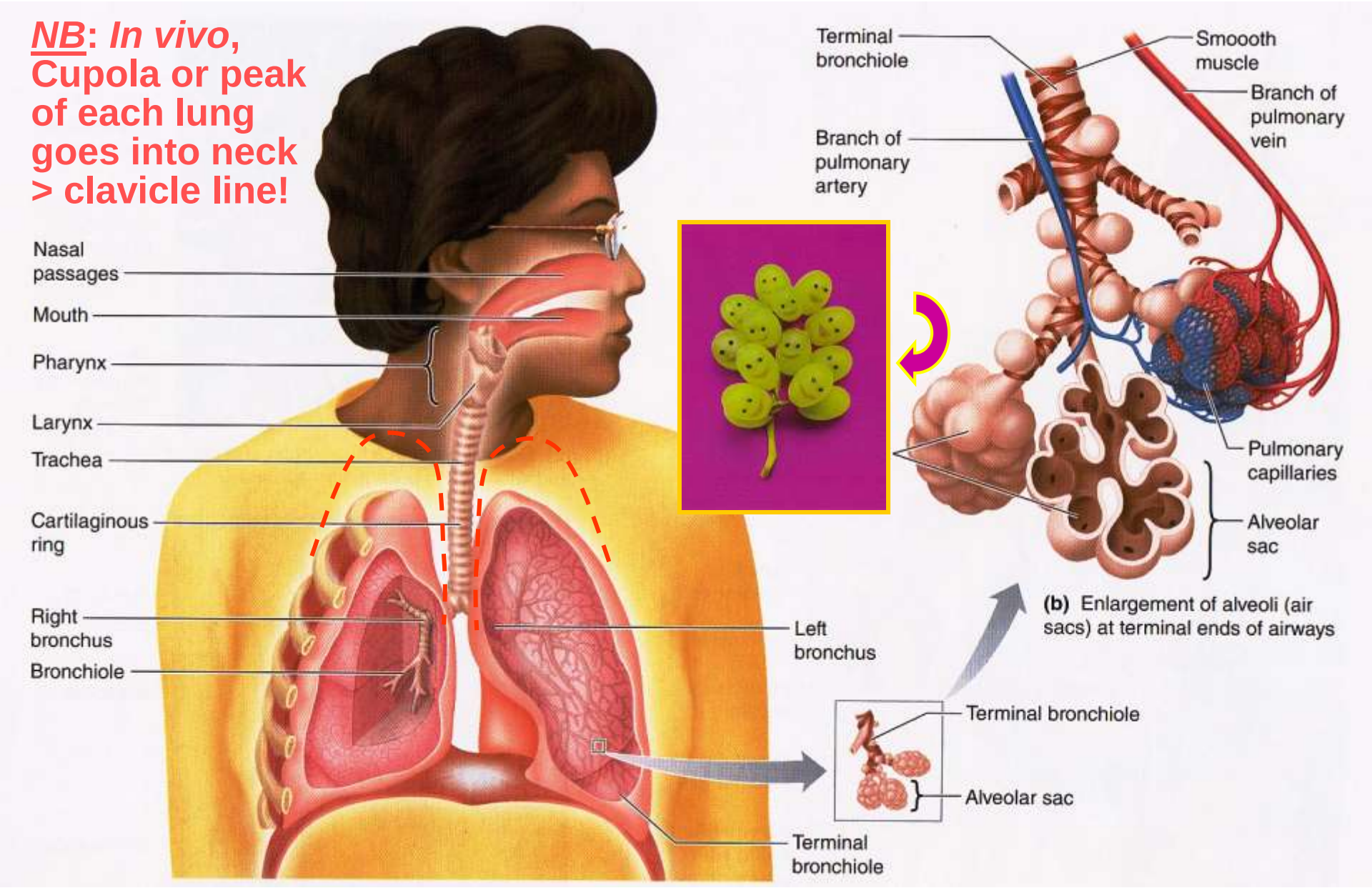


LS 2012 fig 12-1 modified



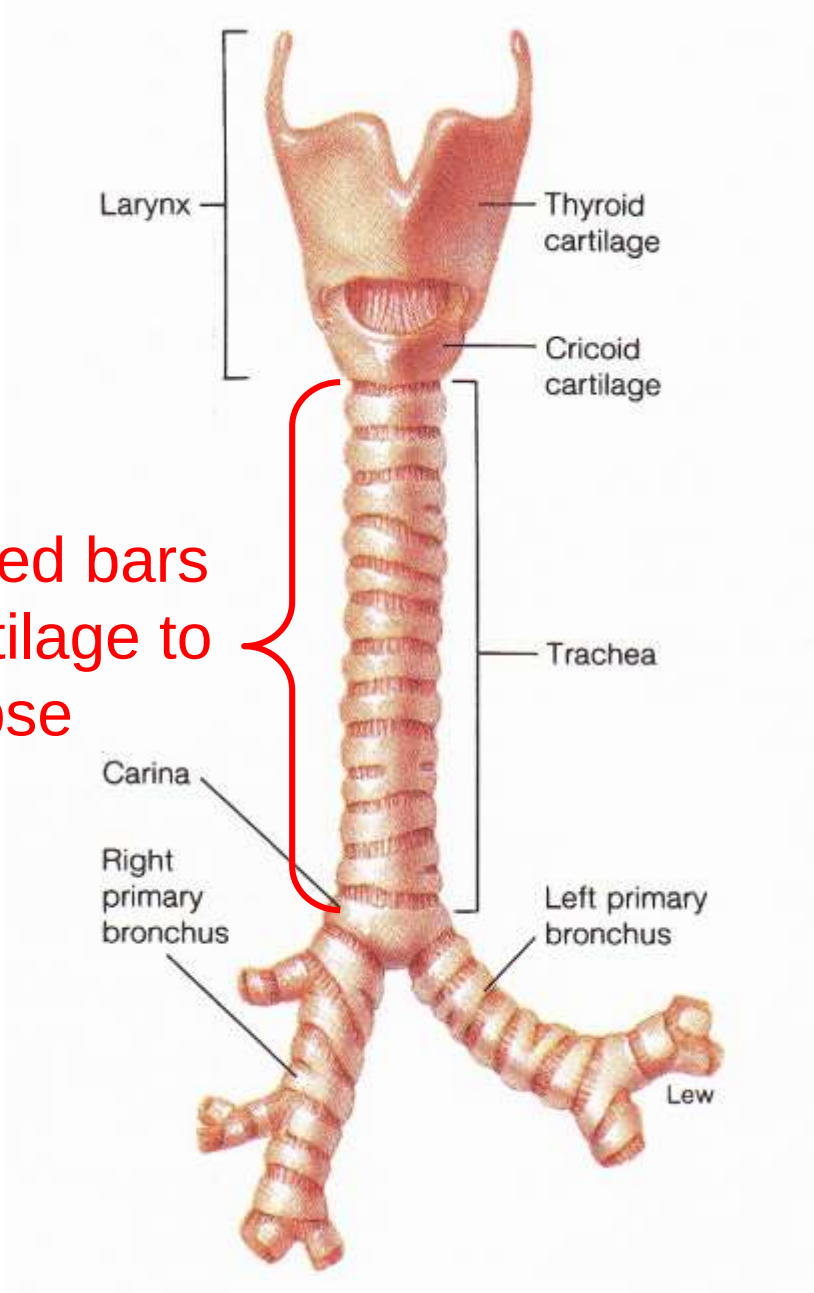
Respiratory System Anatomy

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

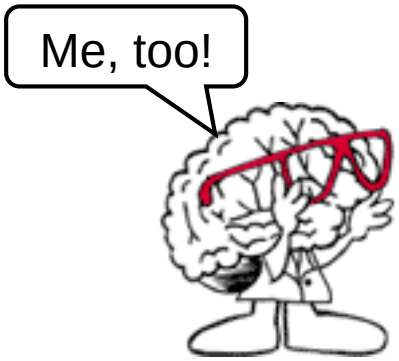


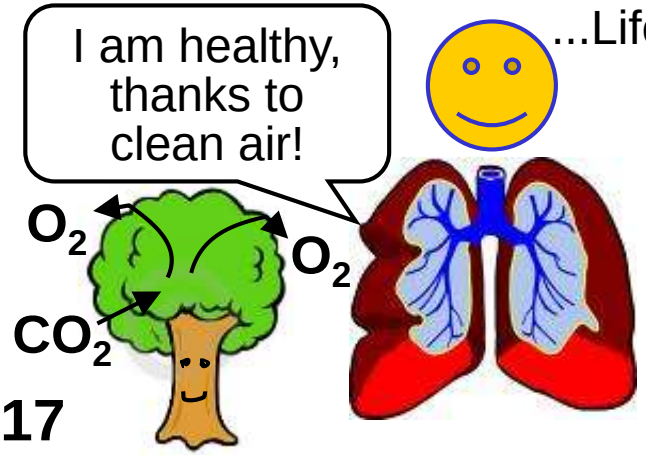
LS 2012 fig 12-2

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



DC 2003





...Life ≡ Balance!

BI 121 Lecture 17

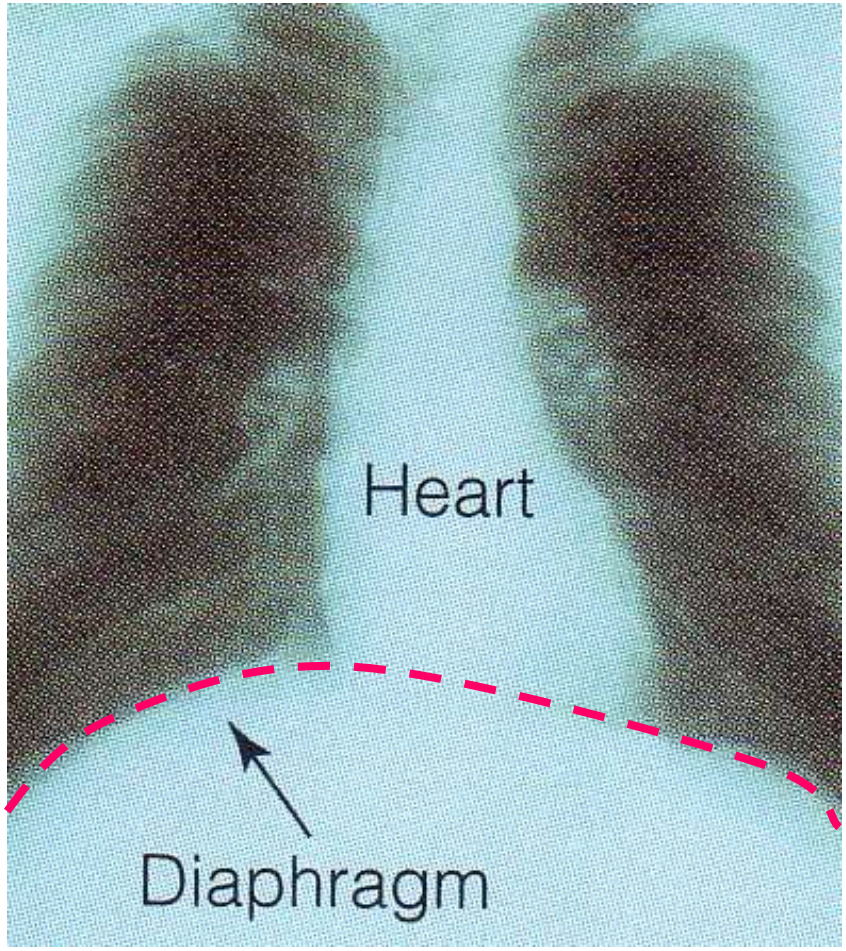
I. ***Announcements*** **Exam II next Friday, Dec 13th @ 8:00 am!**
10 am lab section go to 5 KLA; 11 am lab section go to 130 HUE.
Discussion-Review this Thursday. Q?

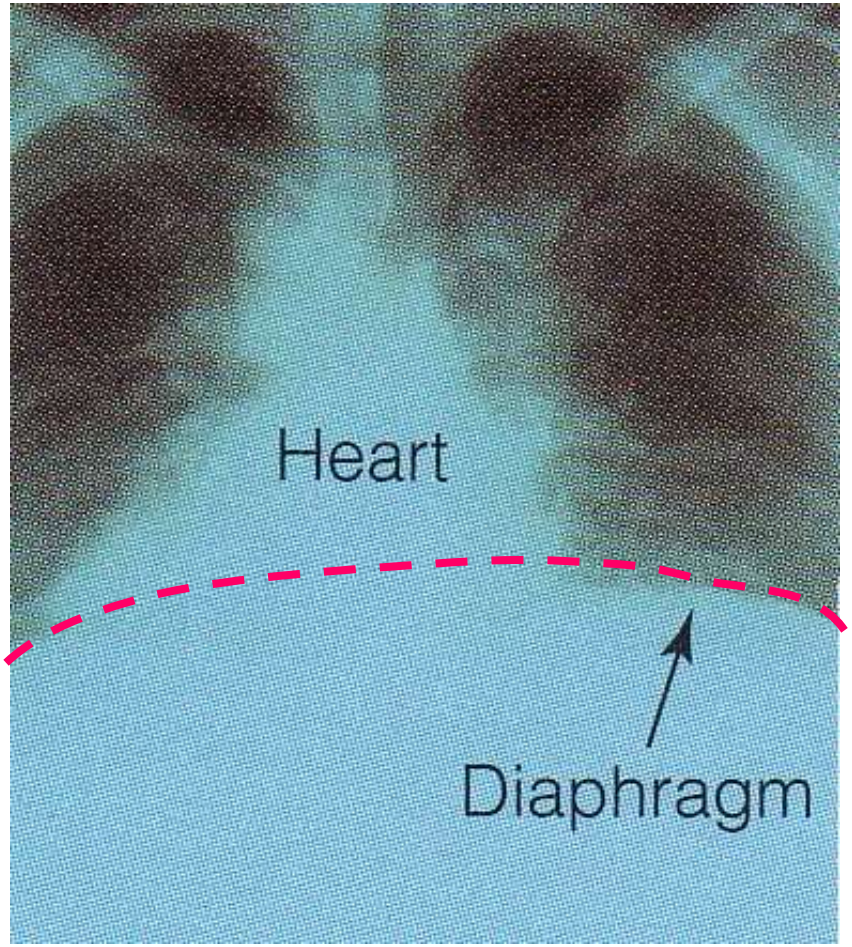
II. ***Respiratory Connections*** **LS ch 12, DC Module 7, SI Fox +...**

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

III. ***Physiology of Cigarette Smoking & Vaping***

A. **ANS, autonomic nerves & nicotine? Route of chemicals,...**
B. **Emphysema? 2nd-hand smoke?... LS pp 356, 365**
C. **Physiology of Vaping? Harmless? AHA 2019 Conference +**
D. **UO Smoke-Free since Fall 2012! Help is available!**





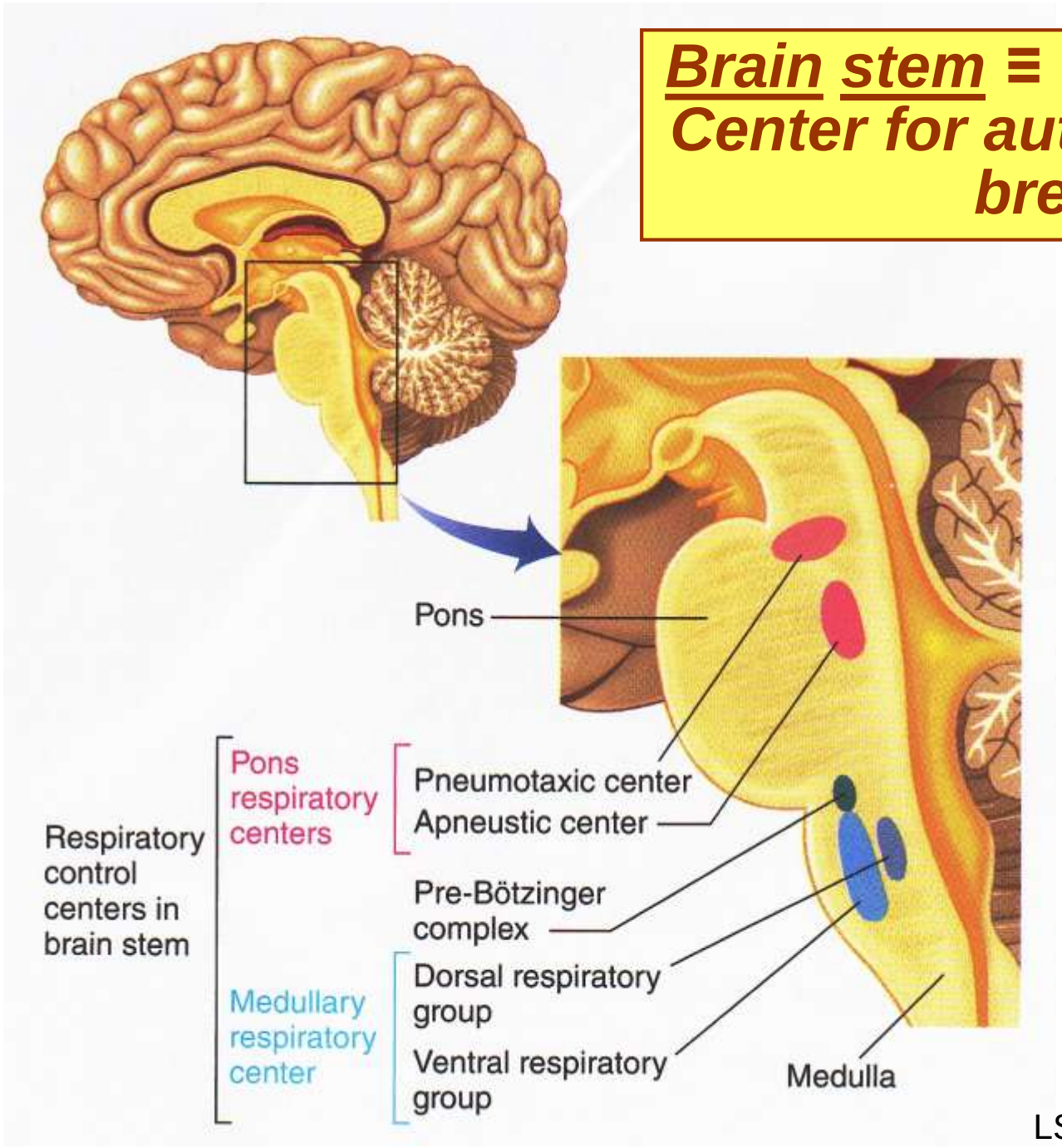
<u>Inhale</u> (active)

<u>Exhale</u> (passive @ rest)

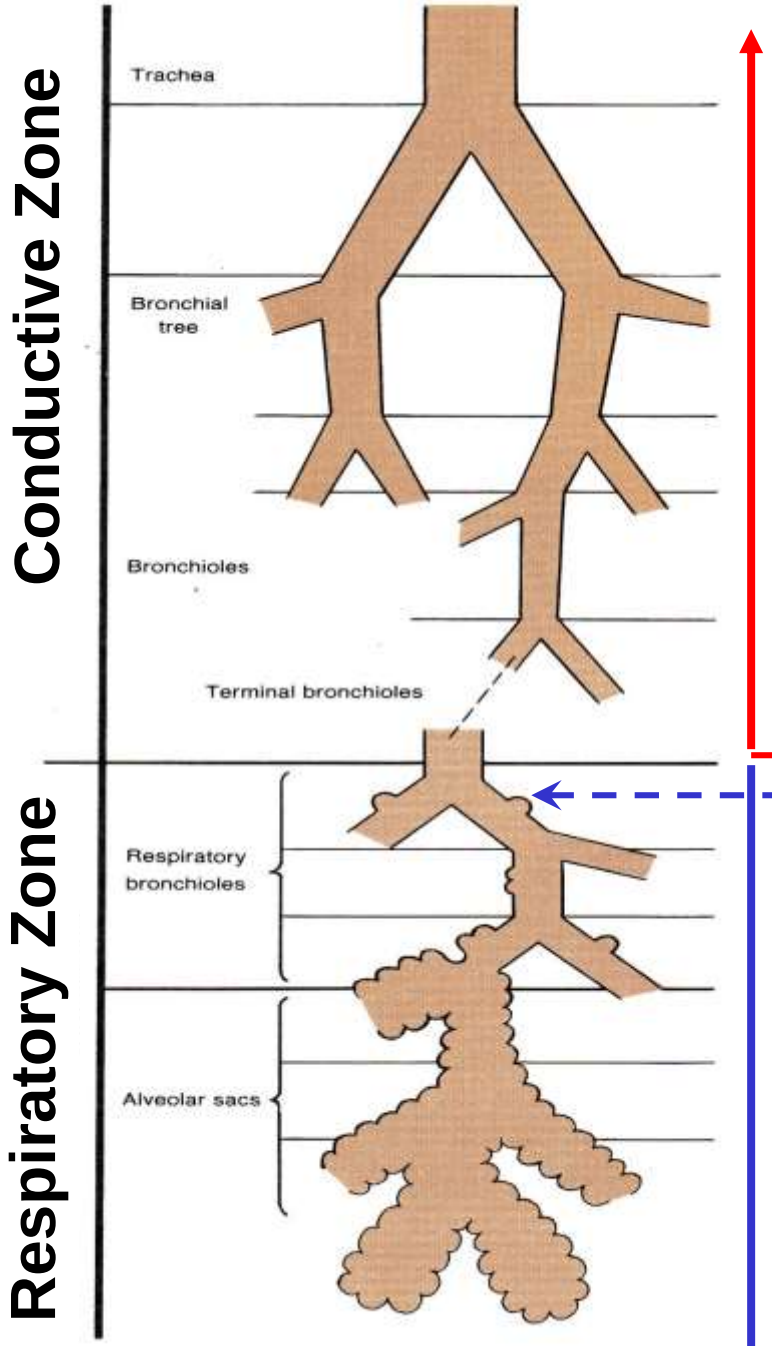
<u>Contract</u> & flatten diaphragm

<u>Relax</u> & pouch up diaphragm!

Brain stem ≡ Control Center for automatic breathing!



LS 2012 fig 12-25



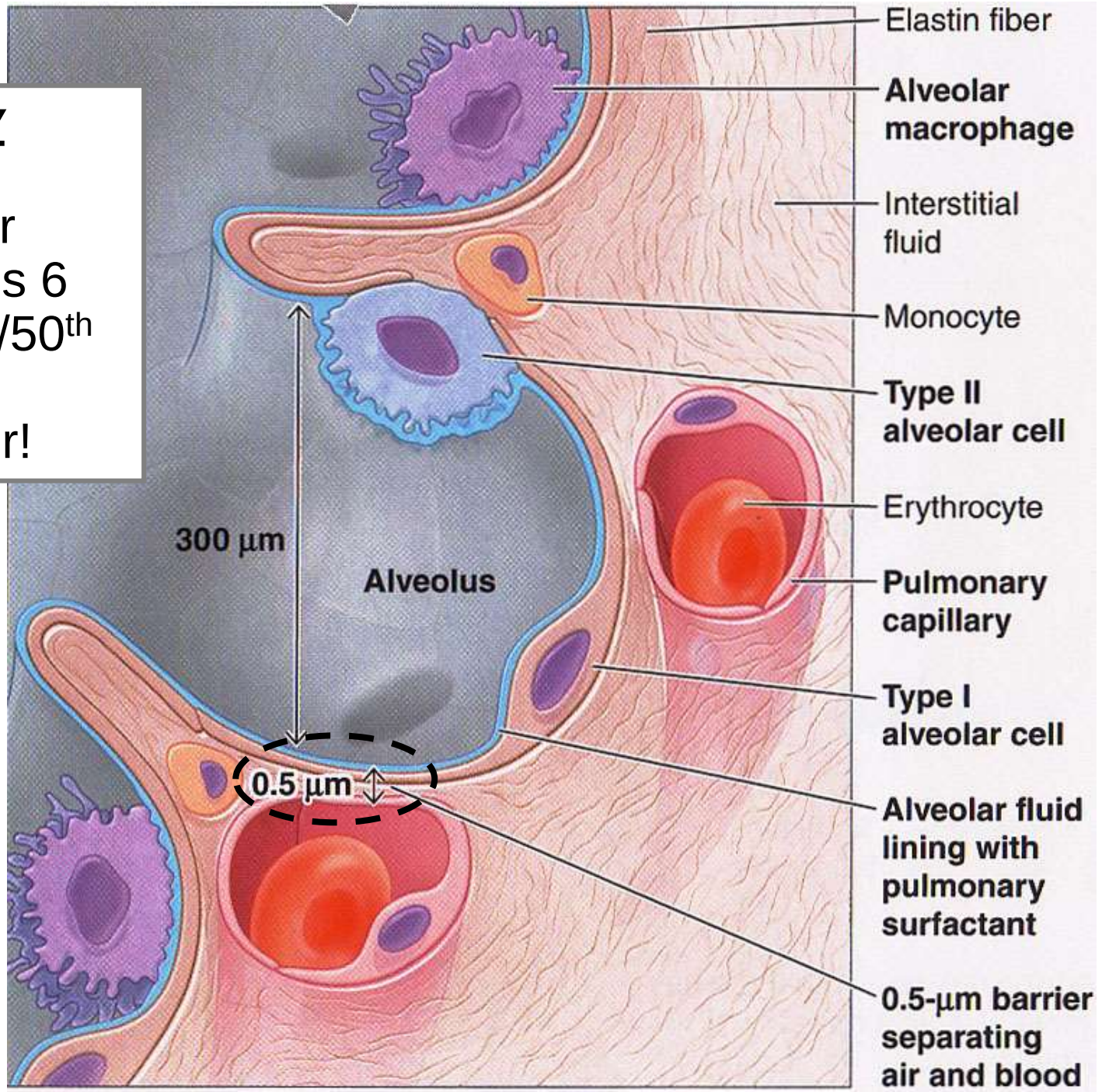
No Gas Exchange

1st alveolar outpouching!

Gas Exchange

SI Fox

Respiratory membrane separates air from blood, is 6 layers, yet 1/50th thickness of tracing paper!

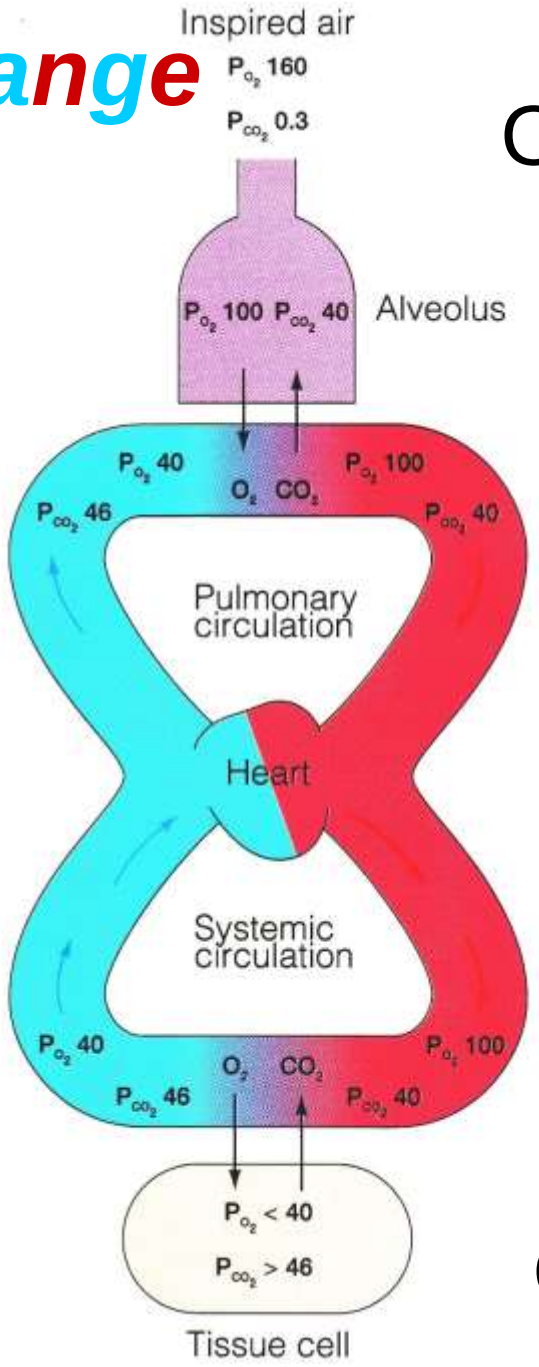


LS 2012 fig 12-4a
cf: DC 2013 fig 7-4

Gas Exchange

CO_2 LOW

O_2 HIGH



Across pulmonary capillaries:
O_2 partial pressure gradient from alveoli to blood = 60 mm Hg (100 → 40)

CO_2 partial pressure gradient from blood to alveoli = 6 mm Hg (46 → 40)

Across systemic capillaries:
O_2 partial pressure gradient from blood to tissue cell = 60 mm Hg (100 → 40)

CO_2 partial pressure gradient from tissue cell to blood = 6 mm Hg (46 → 40)

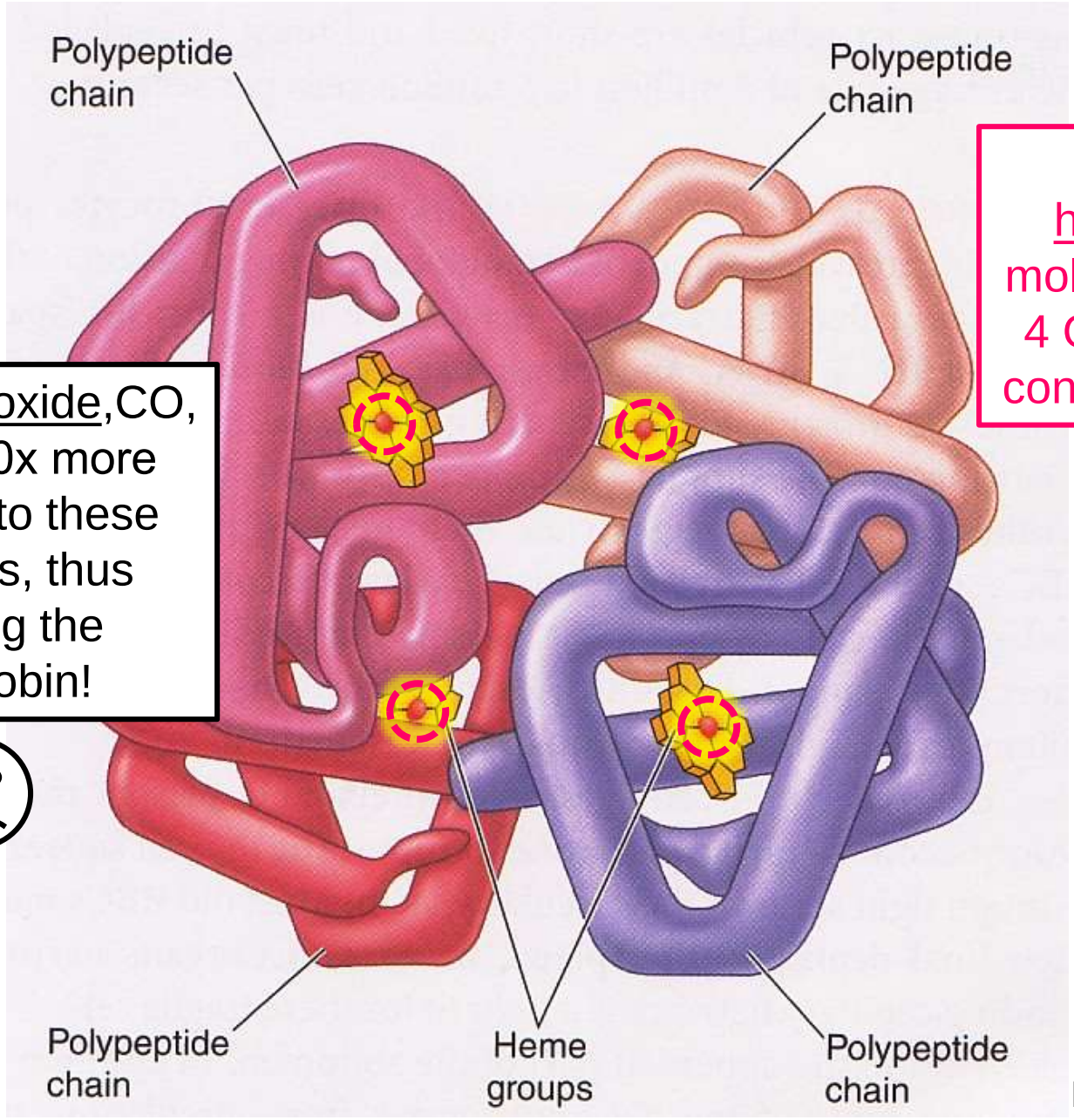
Numbers are mm Hg pressure.

CO_2 HIGH

O_2 LOW

cf: LS 2012 fig 12-19

O_2 is carried mainly by red blood cell <u>hemoglobin</u>!



<u>Each hemoglobin</u> molecule carries 4 O_2 on 4 iron-containing disks!

<u>Carbon monoxide</u>,CO, binds ≥ 200x more powerfully to these same sites, thus poisoning the hemoglobin!

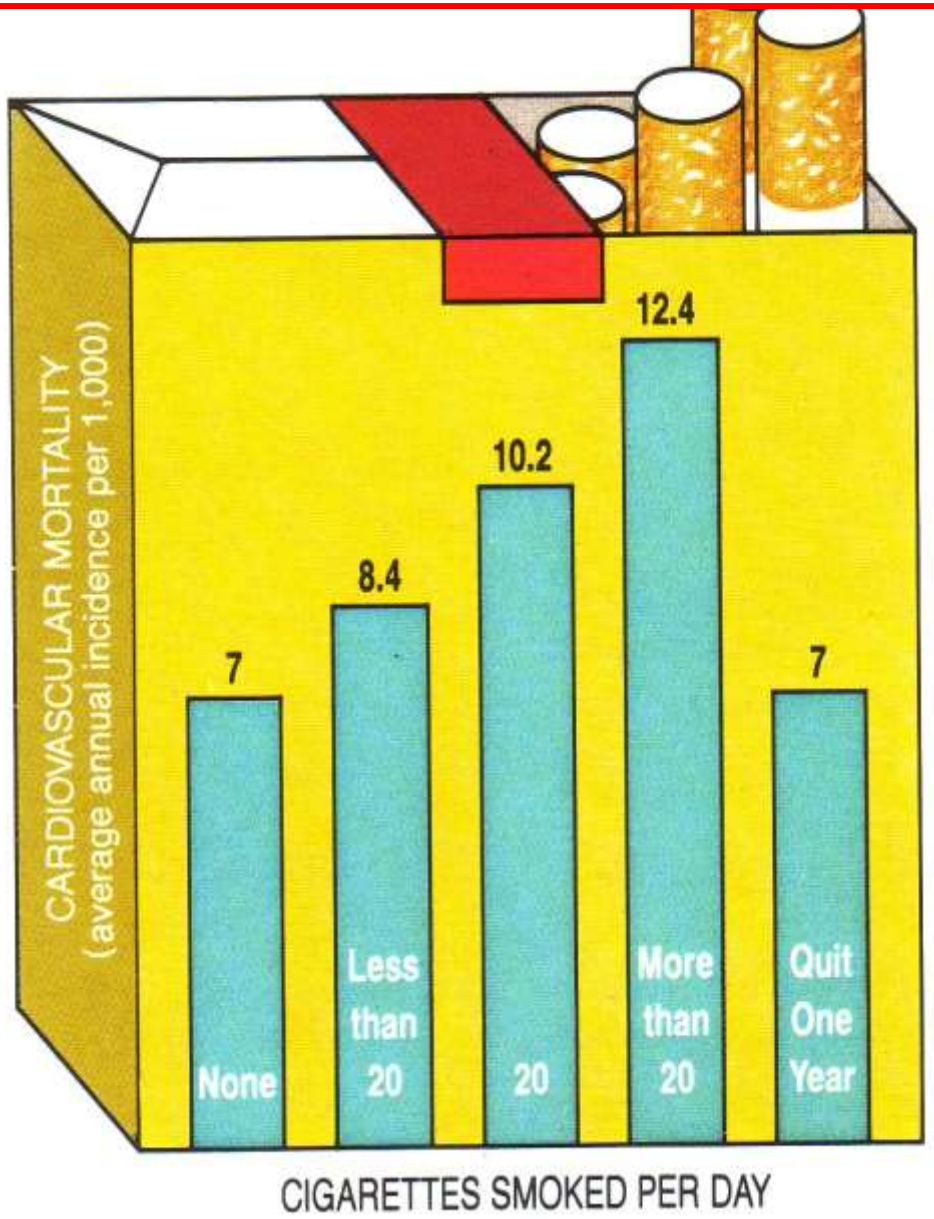
☹

LS 2012 fig 11-2

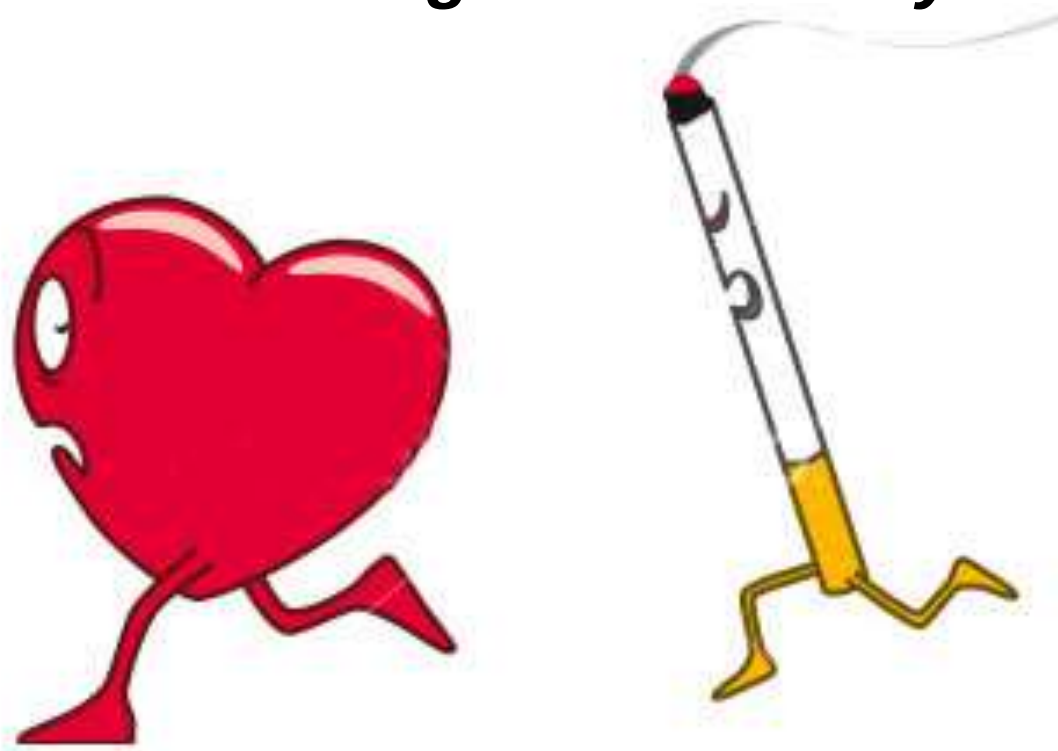
American Cancer Society Great American Smoke Out!

http://www.cancer.org/healthy/stayawayfromtobacco/greatamericansmokeout/

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



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



Tobacco smoke = Deadly mix of > 7000 chemicals!

https://www.lung.org/stop-smoking/smoking-facts/whats-in-a-cigarette.html

https://www.cdc.gov/tobacco/data_statistics/fact_sheets/index.htm

https://www.cancer.org/cancer/cancer-causes/tobacco-and-cancer/carcinogens-found-in-tobacco-products.html

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 per cigarette...
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-napthylamine	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!!

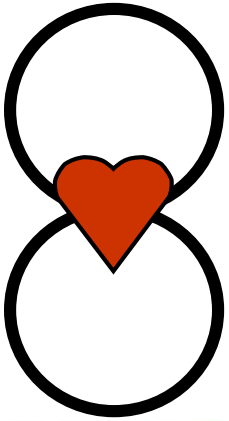
Ammonia converts nicotine, the additive agent in tobacco, into a more volatile form, Pankow said. “Ammonia is the thing that helps tobacco companies hook the smoker by providing a means of delivering the nicotine.”

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) was the 1st to research!

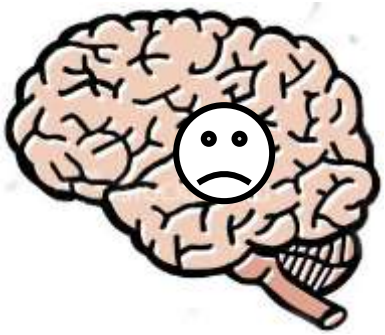
http://pubs.acs.org/doi/abs/10.1021/es970402f
http://www.nasw.org/users/sperkins/nicotine.html

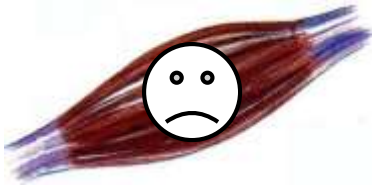
Cigarettes ≡ Patient-Assisted Drug-Delivery System
Inhaling Bypasses the Systemic Circulation
& Is Powerfully Reinforcing!

Pulmonary



Systemic





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

Mouth

↓

Pharynx

↓

Larynx

↓

Trachea

↓

Bronchi

↓

Bronchioles

↓

Alveoli

Blood

Pulmonary Veins

↓

Left Atrium

↓

Left Ventricle

↓

Aorta

↓

Heart

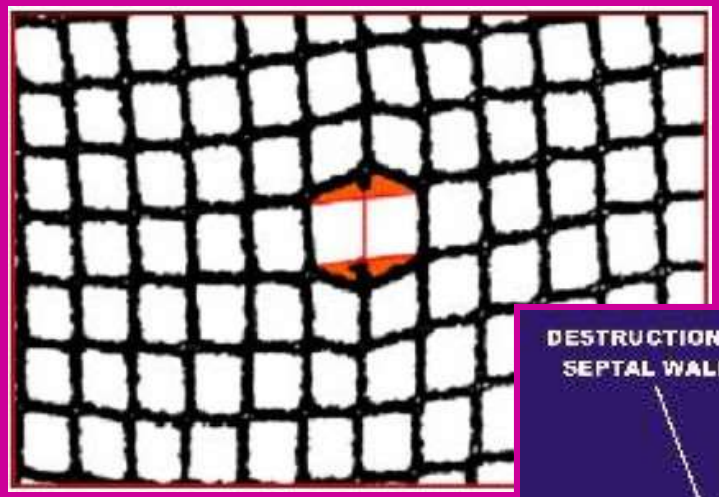
↓

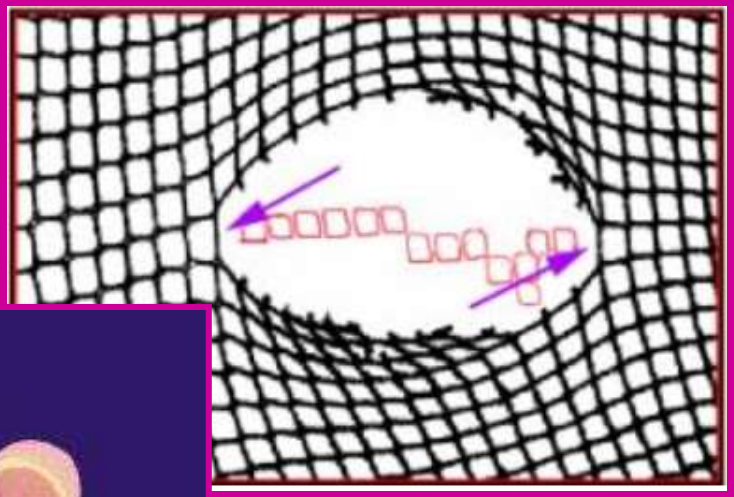
Brain

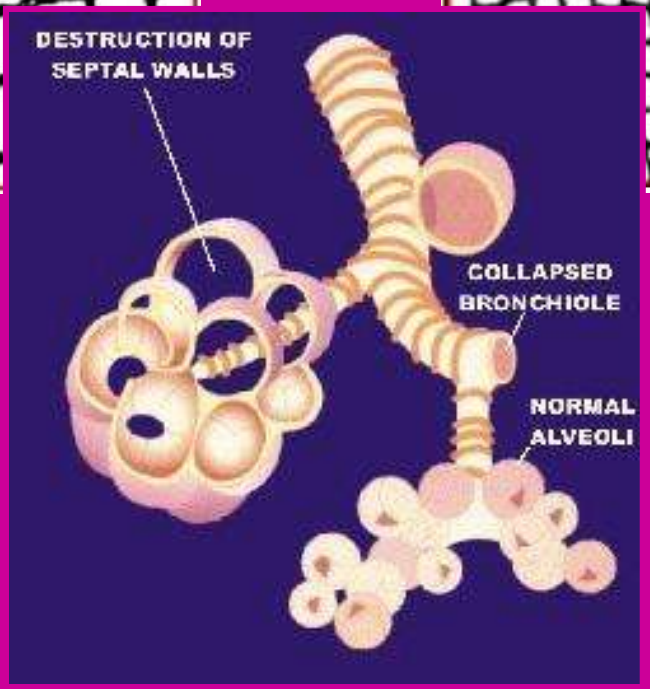
Systemic Circulation

Respiratory Membrane

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







Internet Journal of Pathology
Mayo Clinic Health

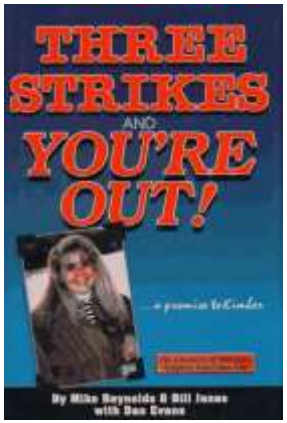
On the Pill & Smoke?

Increased Risk of:

1. Blood Clots

2. Heart Attack

3. Strokes!



Breathing *2nd-hand smoke* for as little as *½ hr* activates platelets almost as much as if you were a pack-a-day smoker

ScienceNews
MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC

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.sciencenewsforstudents.org/collections/vaping

https://www.intechopen.com/books/frontiers-in-i-staphylococcus-aureus-i-/effects-of-electronic-e-cigarette-vapor-on-staphylococcal-virulence-are-e-cigarettes-safer-than-conv

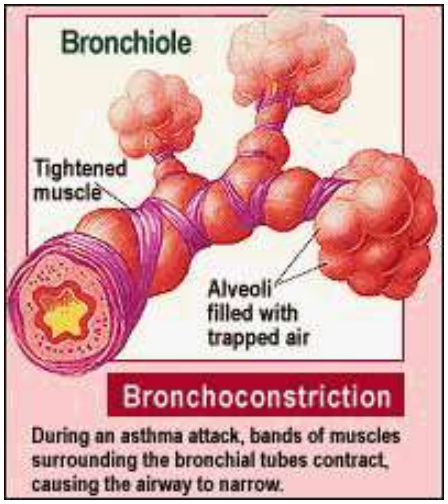
As of 102919, 1299 Illnesses, 29 Deaths in 49 States, Washington DC & US Virgin Islands Vaping Causes Acute Lung Inflammation & Decreased Gas Exchange

https://www.sciencenews.org/article/vaping-tied-nearly-1300-lung-injuries-29-deaths-united-states

https://www.physiology.org/doi/full/10.1152/ajplung.00492.2018

https://www.npr.org/sections/health-shots/2019/10/10/768588170/how-vaping-nicotine-can-affect-a-teenage-brain

SMOKING ≡ ASTHMA?



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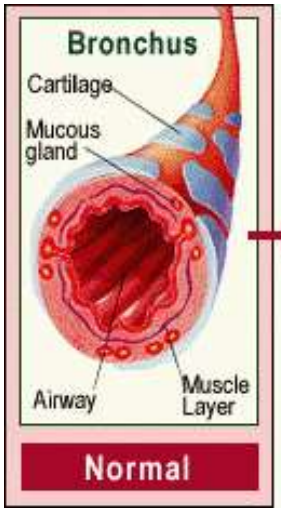

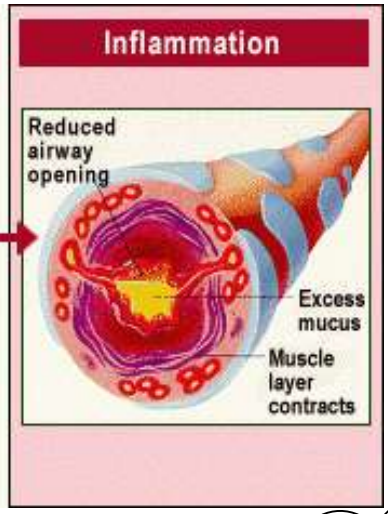

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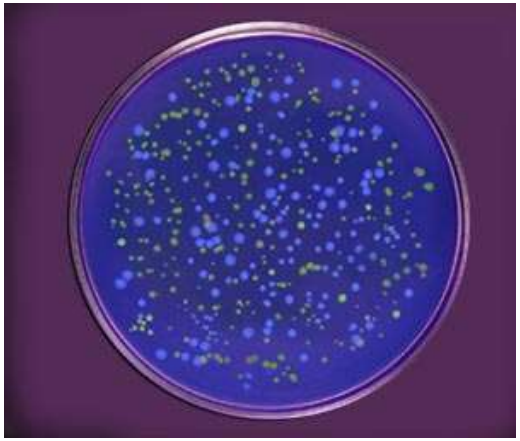
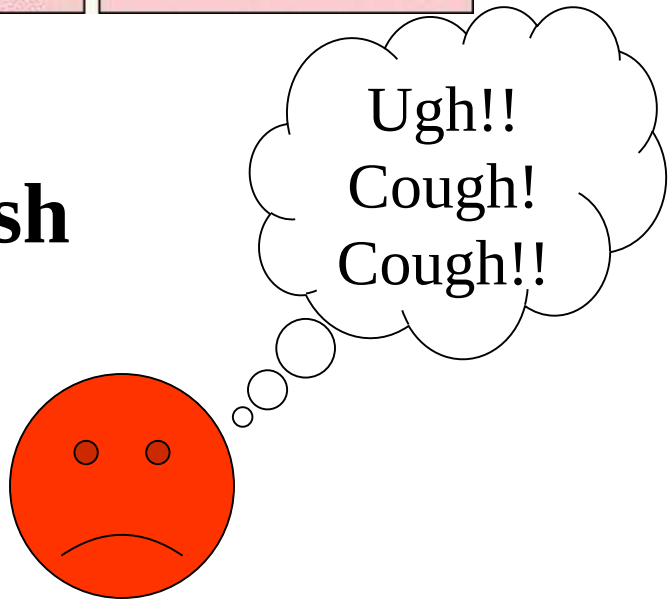


Petri-dish Effect



Nicotine Addiction & Help Quitting Smoking

http://www.cancer.org/healthy/stayawayfromtobacco/guidetoquittingsmoking/guide-to-quitting-smoking-help-phys-nrt

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

Vaping & Lung Injury?

https://www.ncbi.nlm.nih.gov/pubmed/?term=vaping+lung+injury