Exam II Review Slides

BI 121 Lecture 8

…We're back & rarin' to go for last 2 weeks!

I. ***Announcements*** **HR & BP Lab 4 tomorrow + Required Notebook Check. Include Nutrition Analyses. Q?**
Please read Blood Chemistry Lab 5 twice < Thurs. Thanks!

II. ***Cardiovascular System*** **LS 2012 ch 9, Torstar Books 1984, DC 2013 Module 4, Guyton & Hall (G&H) 2011 +...**

A. **Circulatory vs Cardiovascular (CV)? cf + parts**
LS pp 229, CV vs Lymphatic, DC pp 23, 31

B. **CV Pulmonary & Systemic circuits**
DC fig 4-1 p 24, LS fig 9-2b p 231

C. **Arteries, capillaries, veins G&H +Torstar**

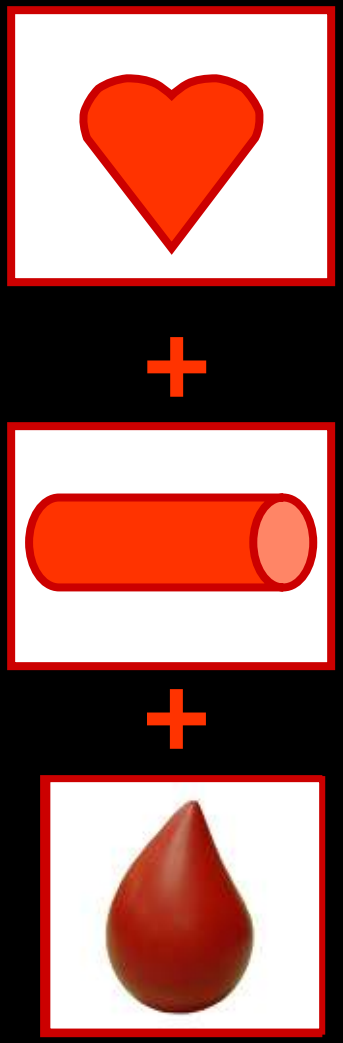
D. **Varicose veins? Phlebitis? DC**

E. **♥ layers, box, chambers, valves, inlets, outlets**
LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6

F. **Normal vs abnormal blood flow thru ♥ & CV system**
Billy has a hole in his ♥ SI Fox 2009 fig 13.16, 13.17

III. ***Comments on Exam I & Exams Returned***

Cardiovascular (CV) = Heart + Vessels + Blood!

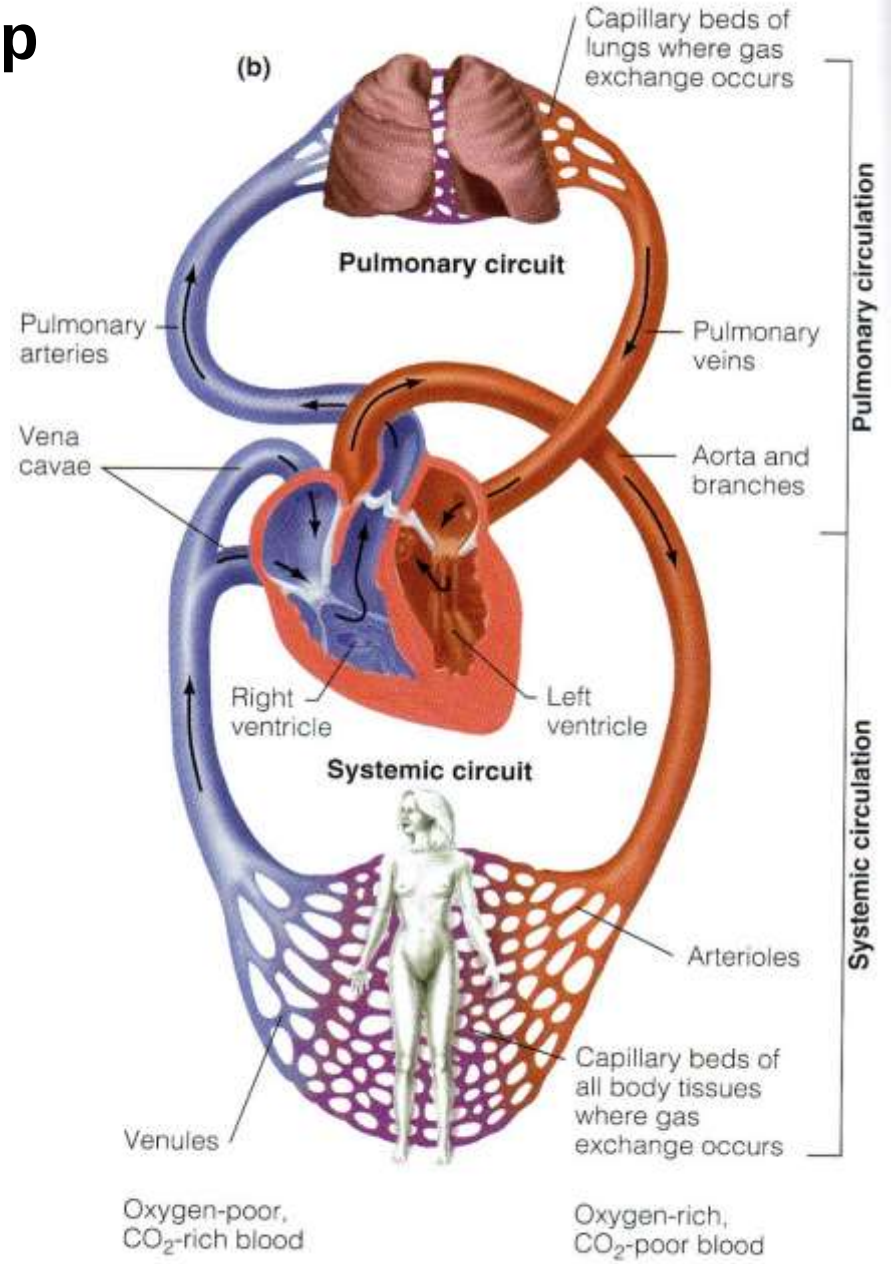


NB: Figure-8 loop

Pulmonary

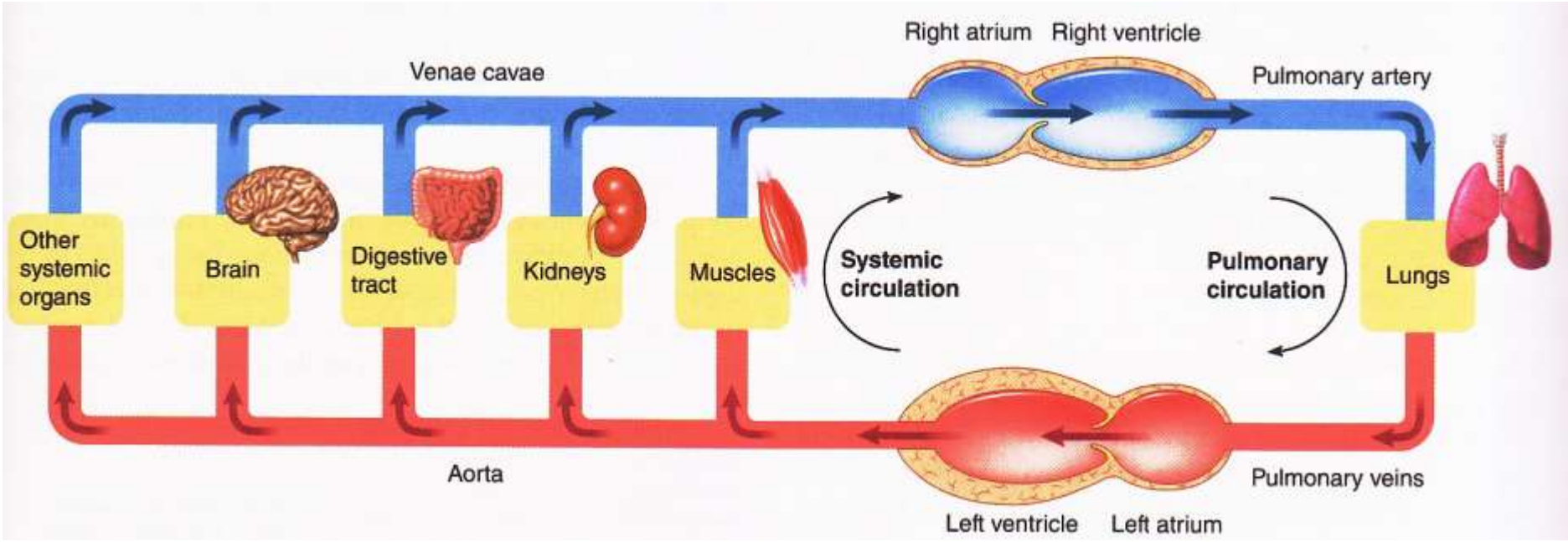
8

Systemic

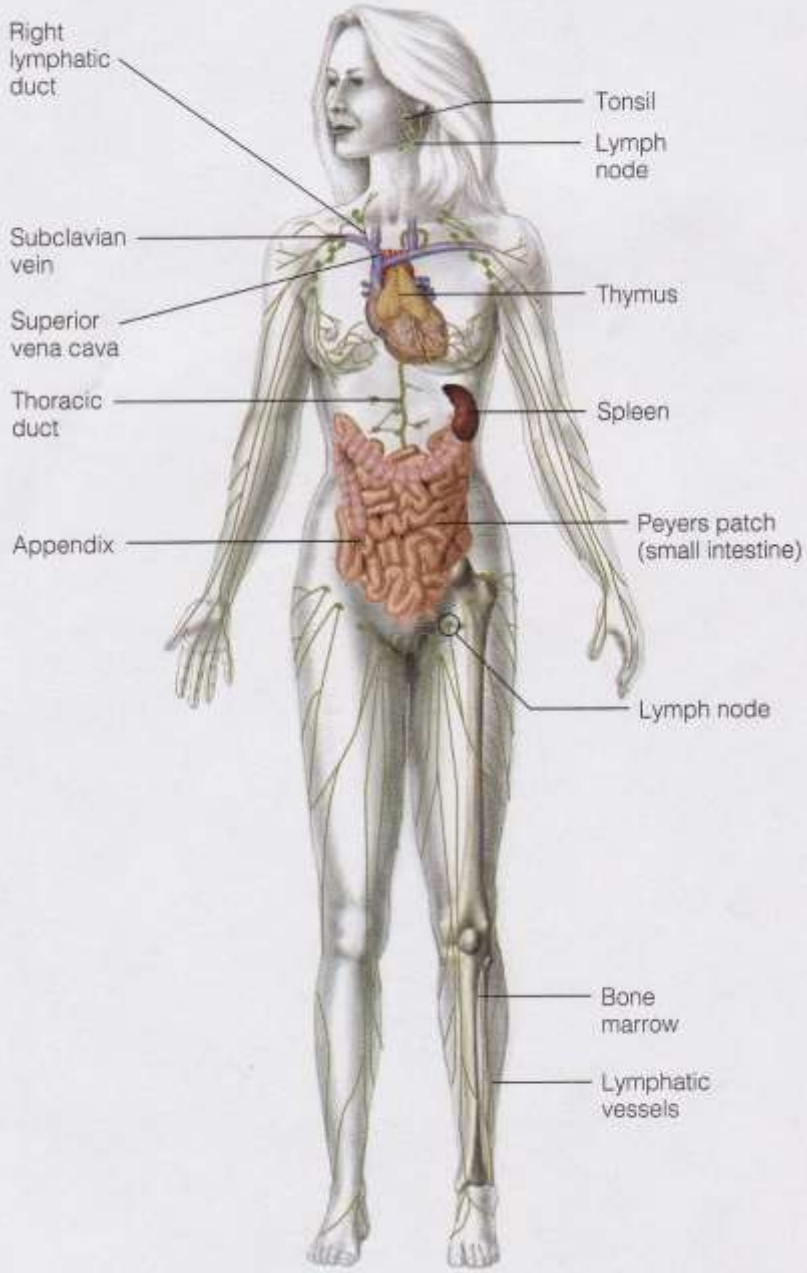


D Chiras 2013 fig 4-1b

Dual Pump Action & Parallel Circulation

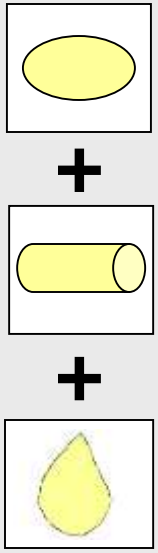


LS 2012 fig 9-2b p 231



Lymphatic System

1. **Lymph Nodes**
2. **Vessels**
3. **Lymph**

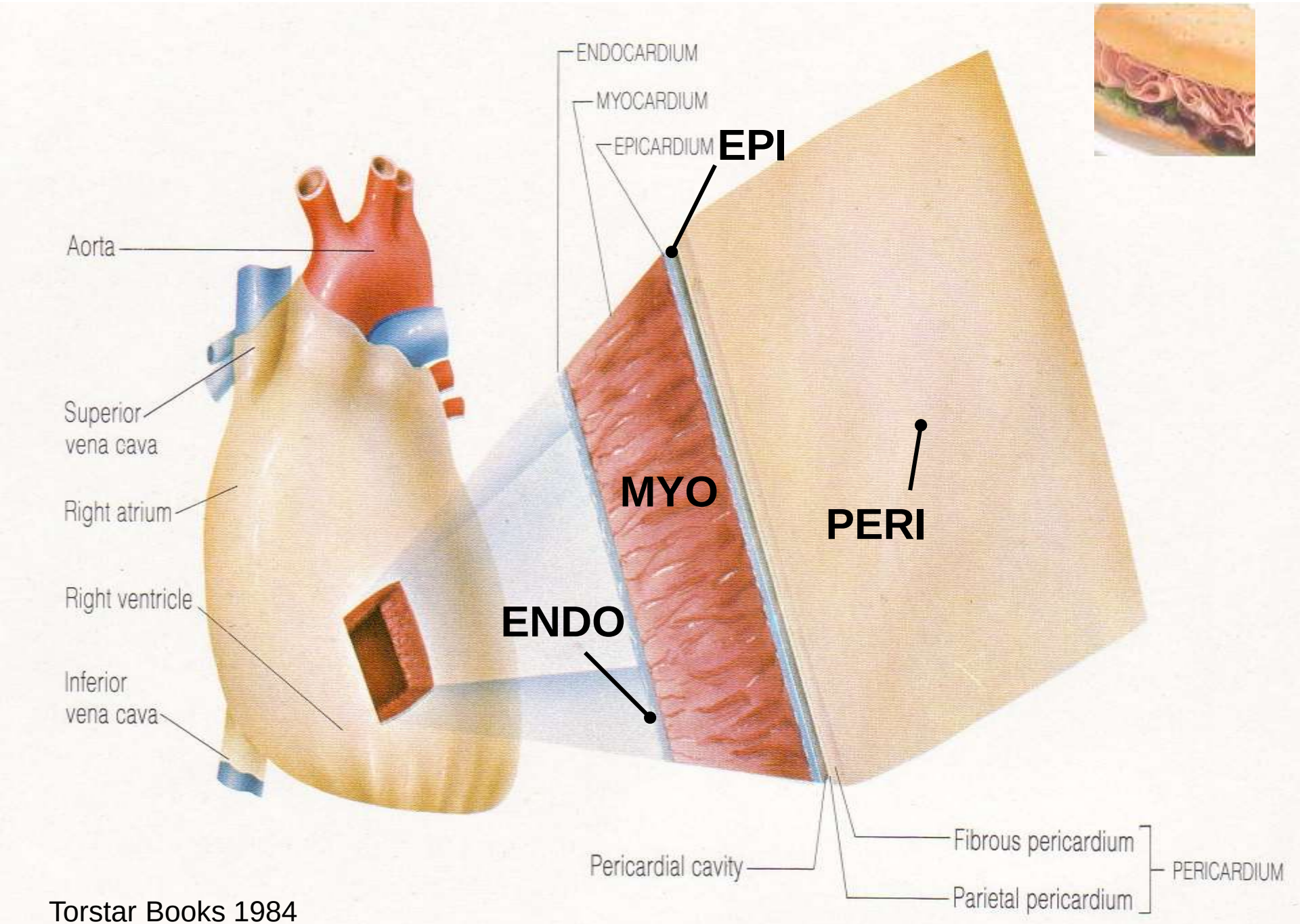


No pump!

DC 2003

Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm

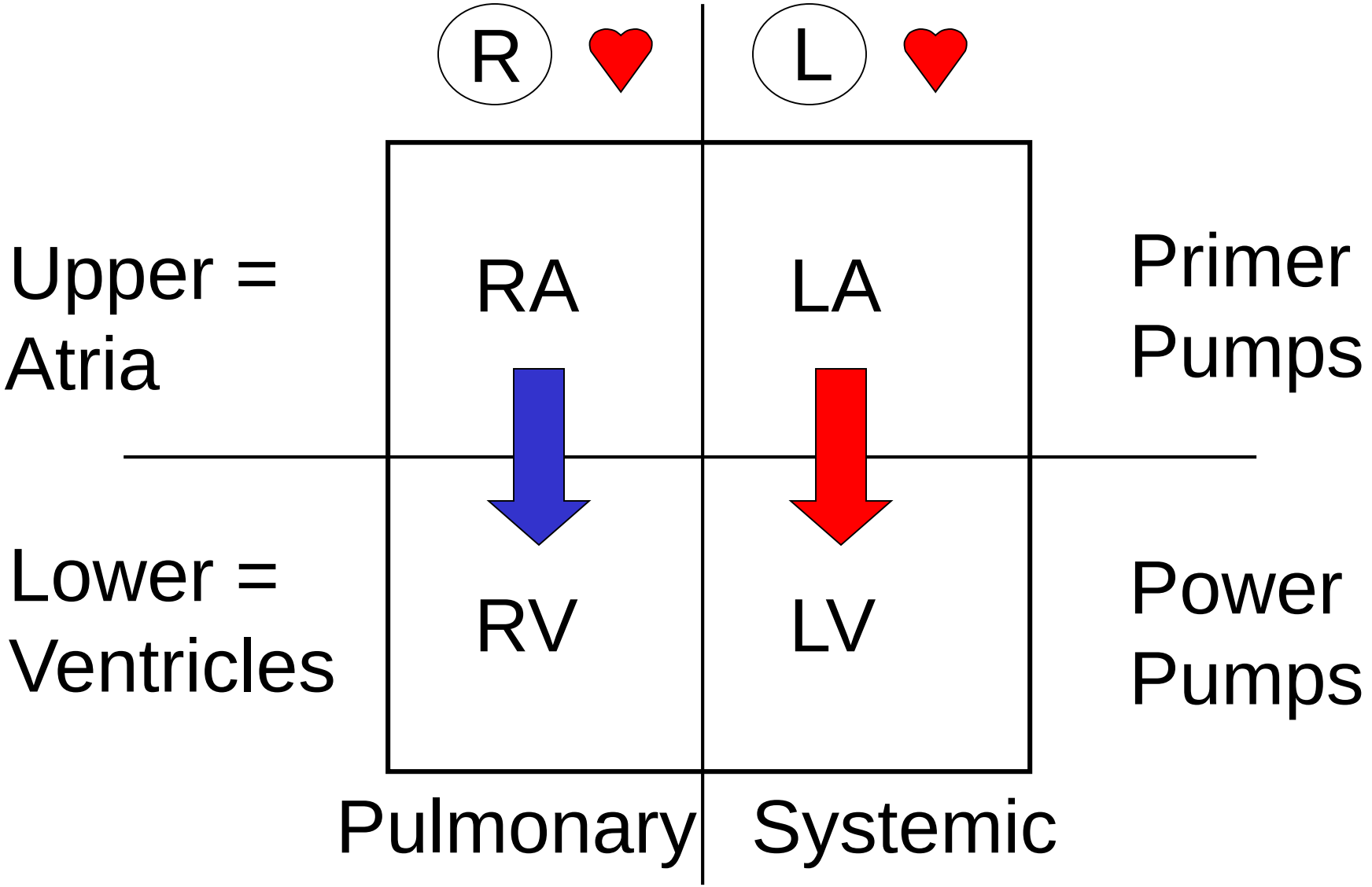
LS 2012 fig 10-21 p 283



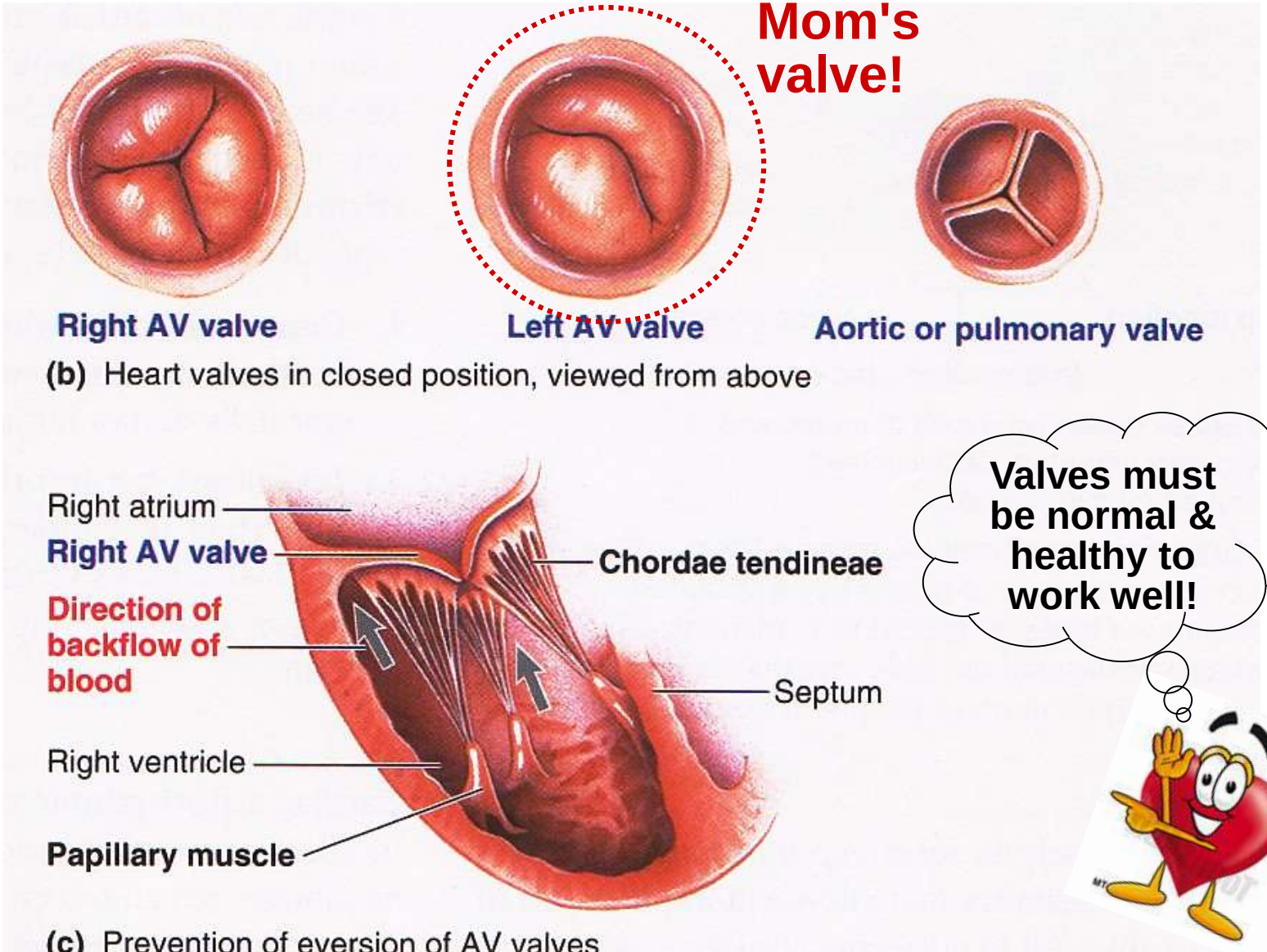
Torstar Books 1984

Human ♥ = 4-chambered box?

2 separate pumps?



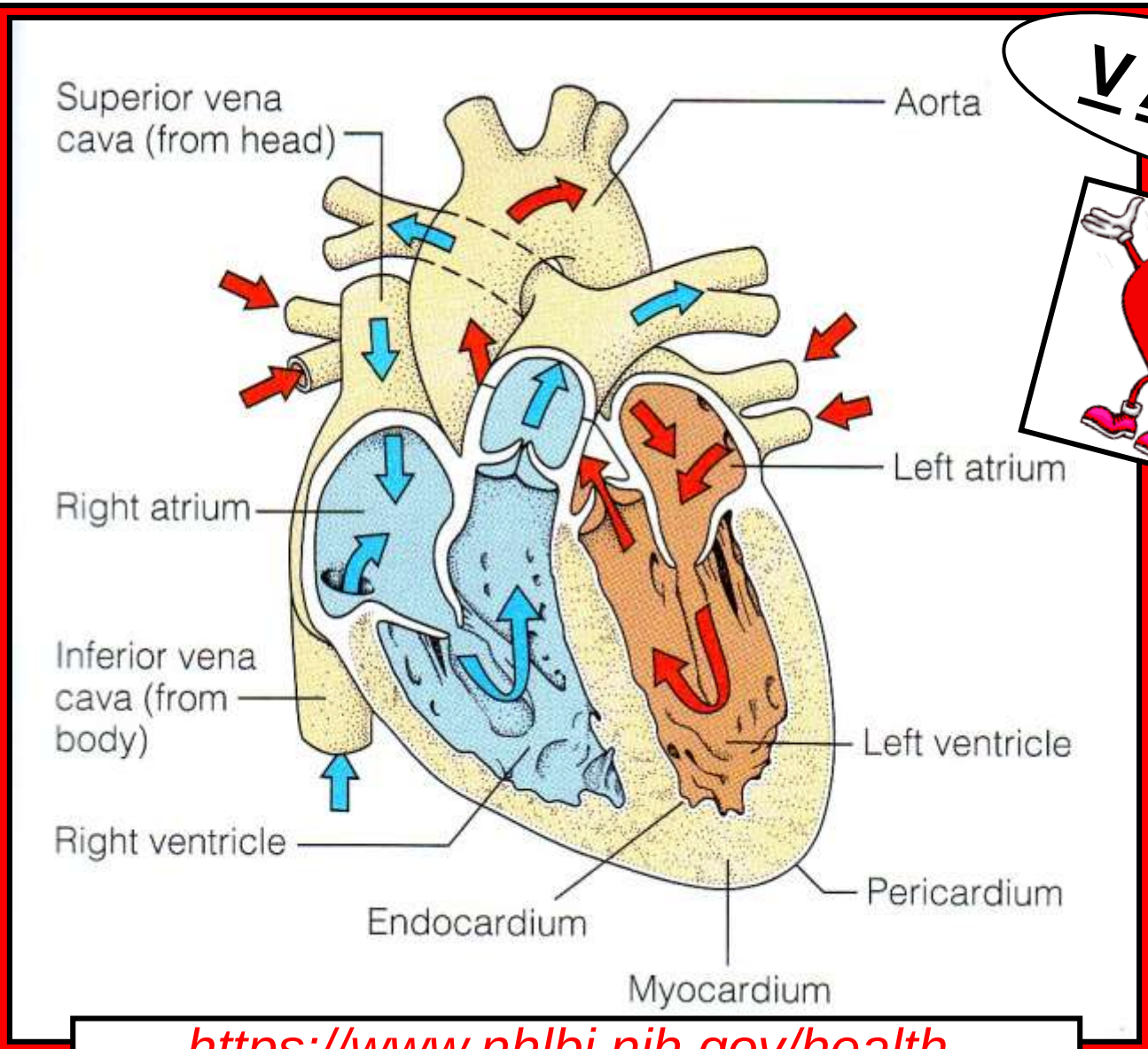
Heart Valves Ensure Unidirectional Blood Flow!

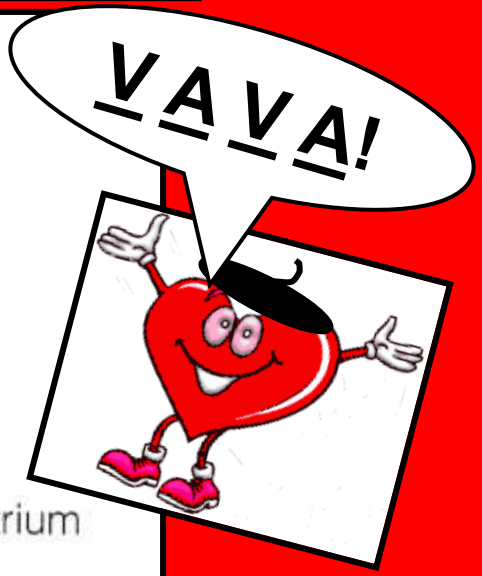


● FIGURE 9-4 Heart valves.

LS 2012 p 233

Veins → Atria → Ventricles → Arteries





https://www.nhlbi.nih.gov/health-topics/how-heart-works

LS2007

What about Exam I scores?...

BI 121 Lecture 9

I. ***Announcements*** Lab notebook due today! Lab 4 HR & BP. Thursday, Lab 5 Blood Chemistry. Read 2x pp 5-1 thru 5-6. Q?

II. ***Overview of Labs*** HR & BP. ♥Cycle. Blood chem lab review

III. ***Cardiovascular Connections*** LS 2012 ch 9
Normal *vs* abnormal blood flow! Q?

IV. ***CV Physiology in the News*** NHLBI & AHA websites
Nicole Kidman & exercise? ACSM, AHA, CDC guidelines

V. ***CV Pathophysiology & Risk Reduction*** LS ch 9, 10 +…

A. AMI, CVA, CVD, PVD, TIA, HTN? + surgical treatments
B. Atherosclerosis? LS fig 9-27, 9-25, 9-26 pp 266-8
C. How to minimize risk of CVDs? Treatment triad: Exercise, Diet, Drugs + Surgery
D. Food choices make a difference? What's HAPOC?

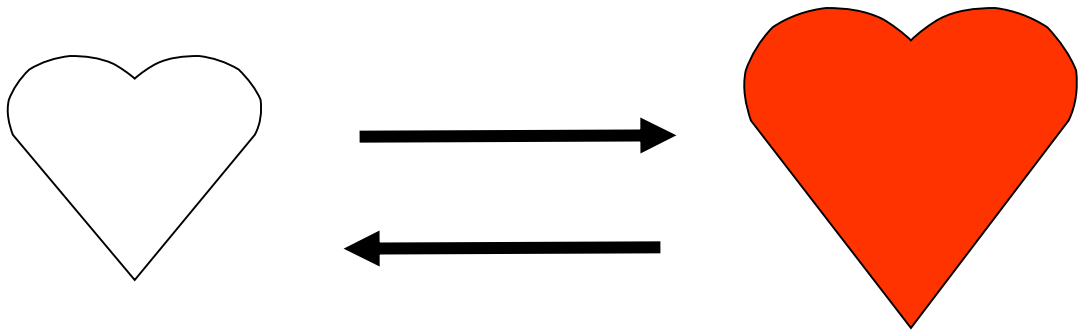
Cardiac Cycle

Systole

Contract
& Empty

Diastole

Relax
& Fill



How much aerobic?




Continuous exercise

≥ 50% muscle mass

≥ Conversational pace

20-60 min/session

3-5 days/wk






http://www.acsm.org/about-acsm/media-room/news-releases/2011/08/01/acsm-issues-new-recommendations-on-quantity-and-quality-of-exercise

How much strength?

- ✓2-3 days/wk
- ✓8-10 exercises for major muscle groups
- ✓≥ 1 set/exercise
- ✓8-12 (most) or 10-15 (frail/> 50-60 yr) repetitions/set

CVDs

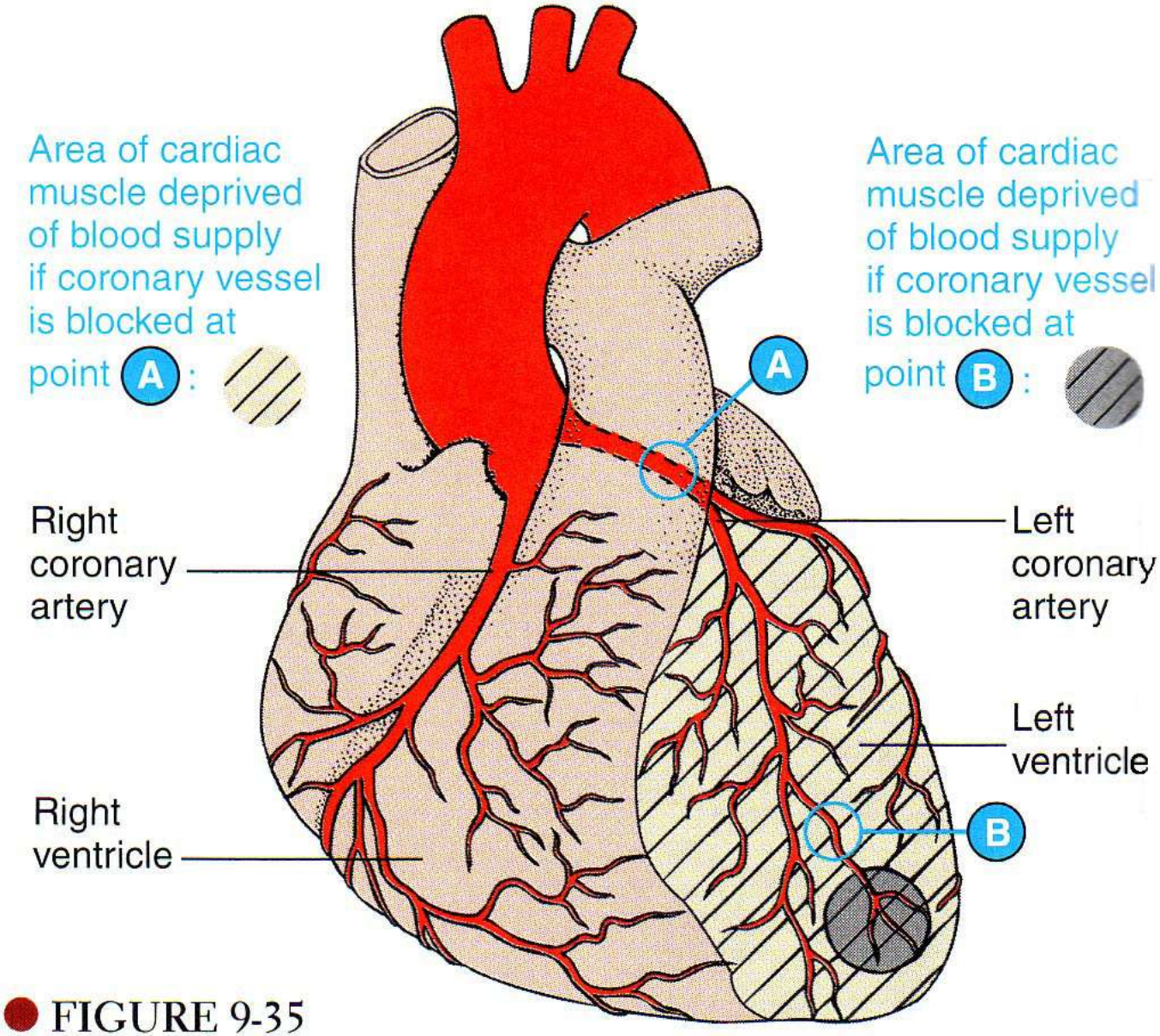
AMI

CVA

TIA

HTN

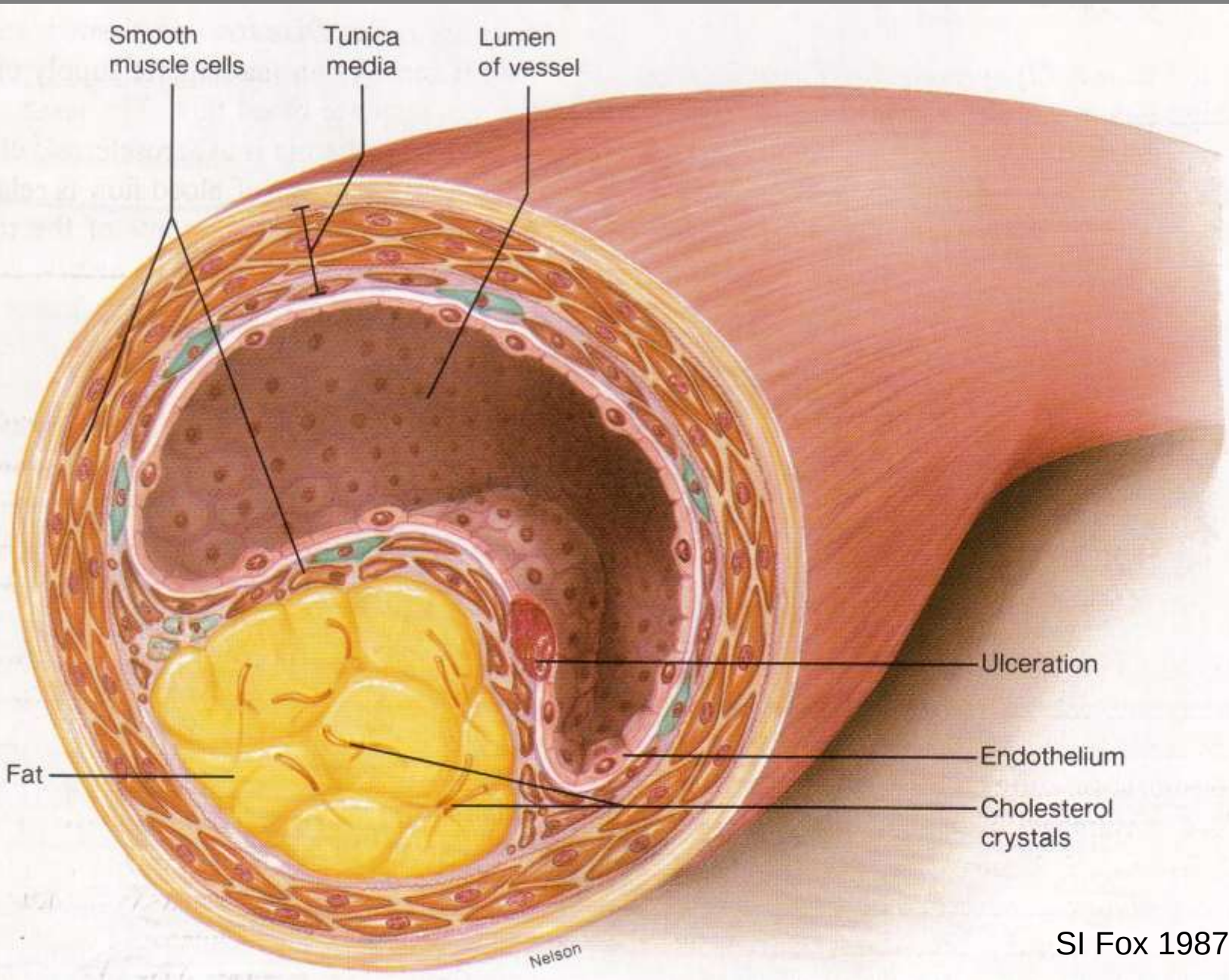
PVD



● FIGURE 9-35

Extent of myocardial damage as a function of the size of the occluded vessel

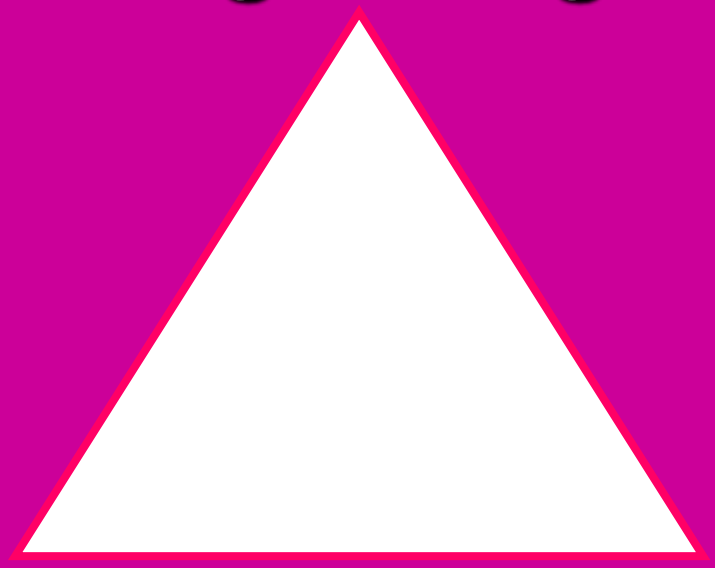
L Sherwood 2004 p 336



SI Fox 1987 p 370

Treatment Triad

NB: Last blasted resort!!



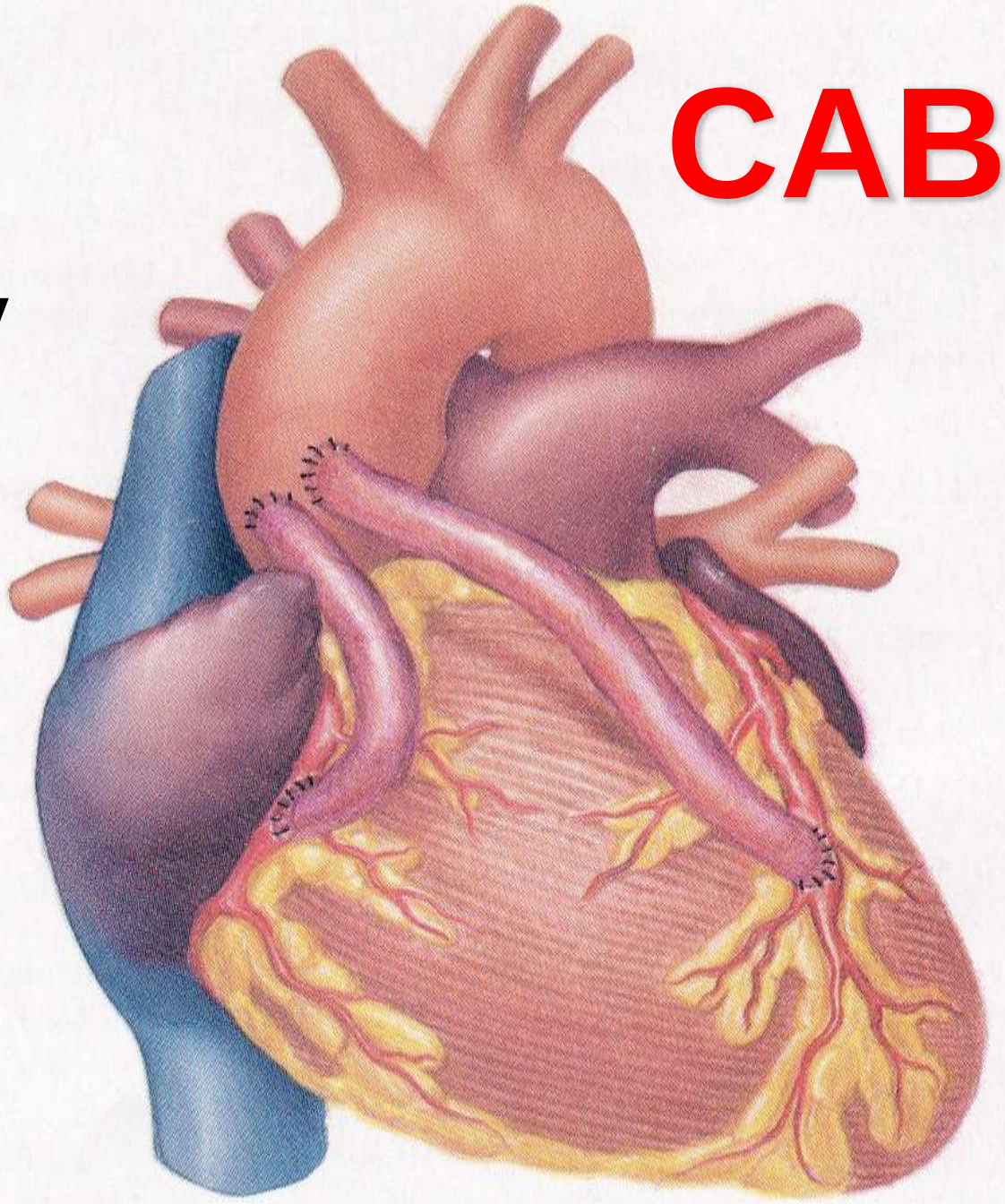
CABG

Coronary

Artery

By-pass

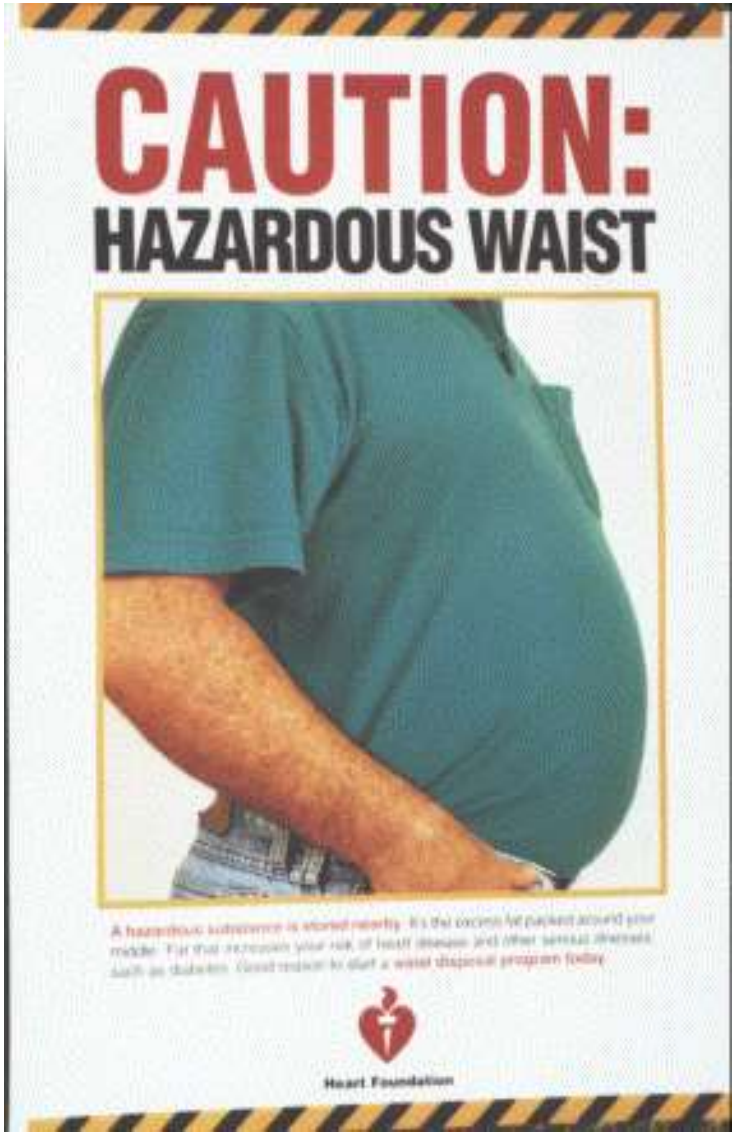
Graft



Apple type of obesity predisposed to CVD!

Pear **type of fat pattern…**

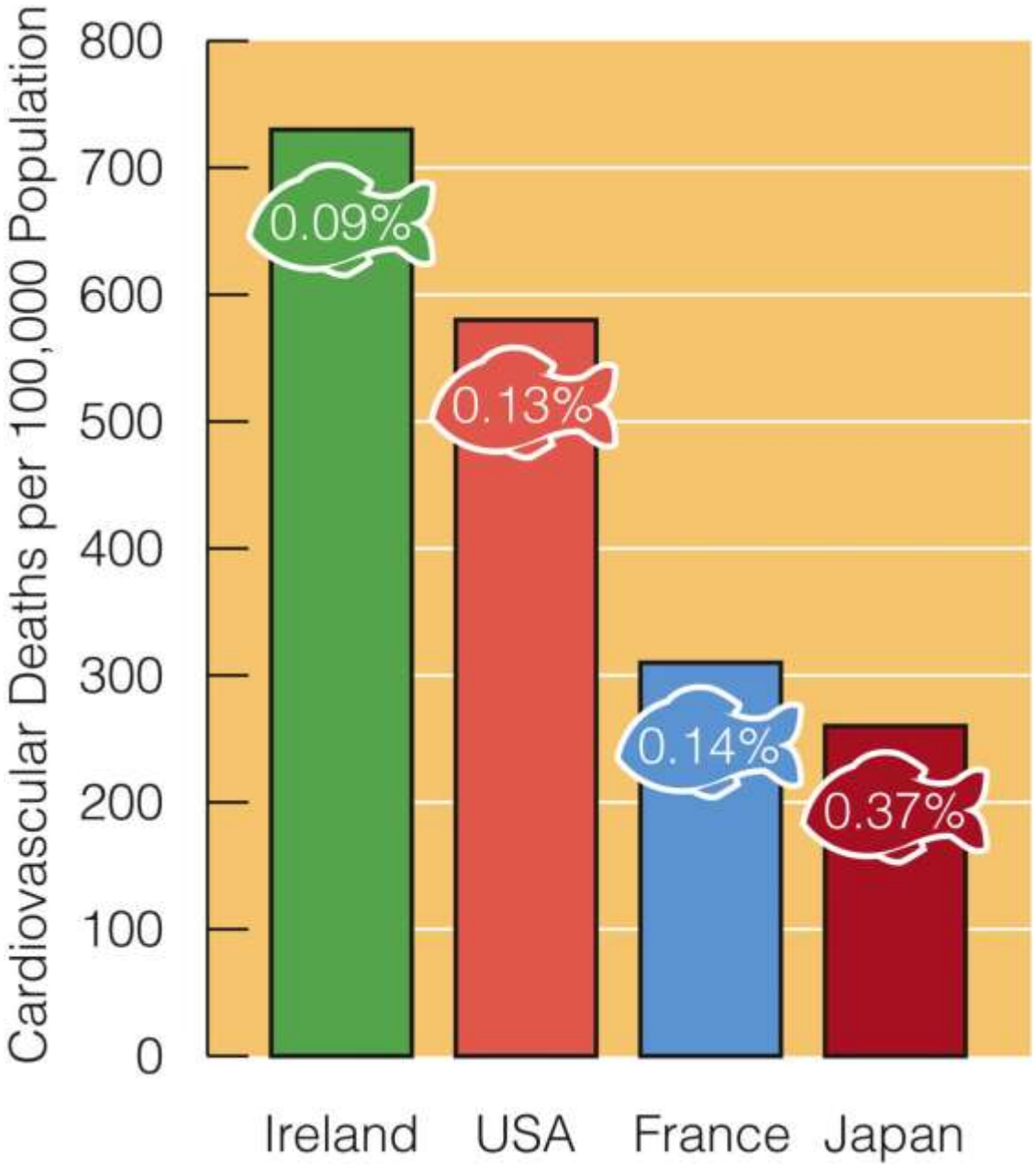
implies lower disease risk!



Eat more apples…

to help prevent the apple type of obesity!

Fish Oil Intakes & Cardiovascular Death Rates

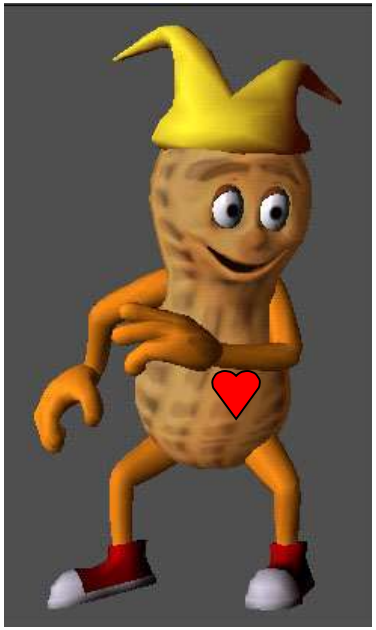


S&W 2011
fig 5-12 p 167

Healthy Oils to Minimize Atherosclerosis

HAPOC?

H A P O C



BI 121 Lecture 10

...Fun lab week with much personal data!

I. ***Announcements*** **Remember to read Lab 5 before Thursday. Thanks for helping us be well-prepared. Q from last time? Calculating grade from estimated final. Keys to success? Q?**

II. ***CVDs Prevention & Treatment Follow-up or Q?***
Exercise,dietary modifications anti-inflammatory oils?

III. ***Blood Form & Function*** **LS ch 11 pp 296-304, 309-12**
DC Module 5 + SI Fox + ***National Geographic*** **Lennart Nilsson**

A. **Formed vs. nonformed/cells vs. plasma fig+tab 11-1**

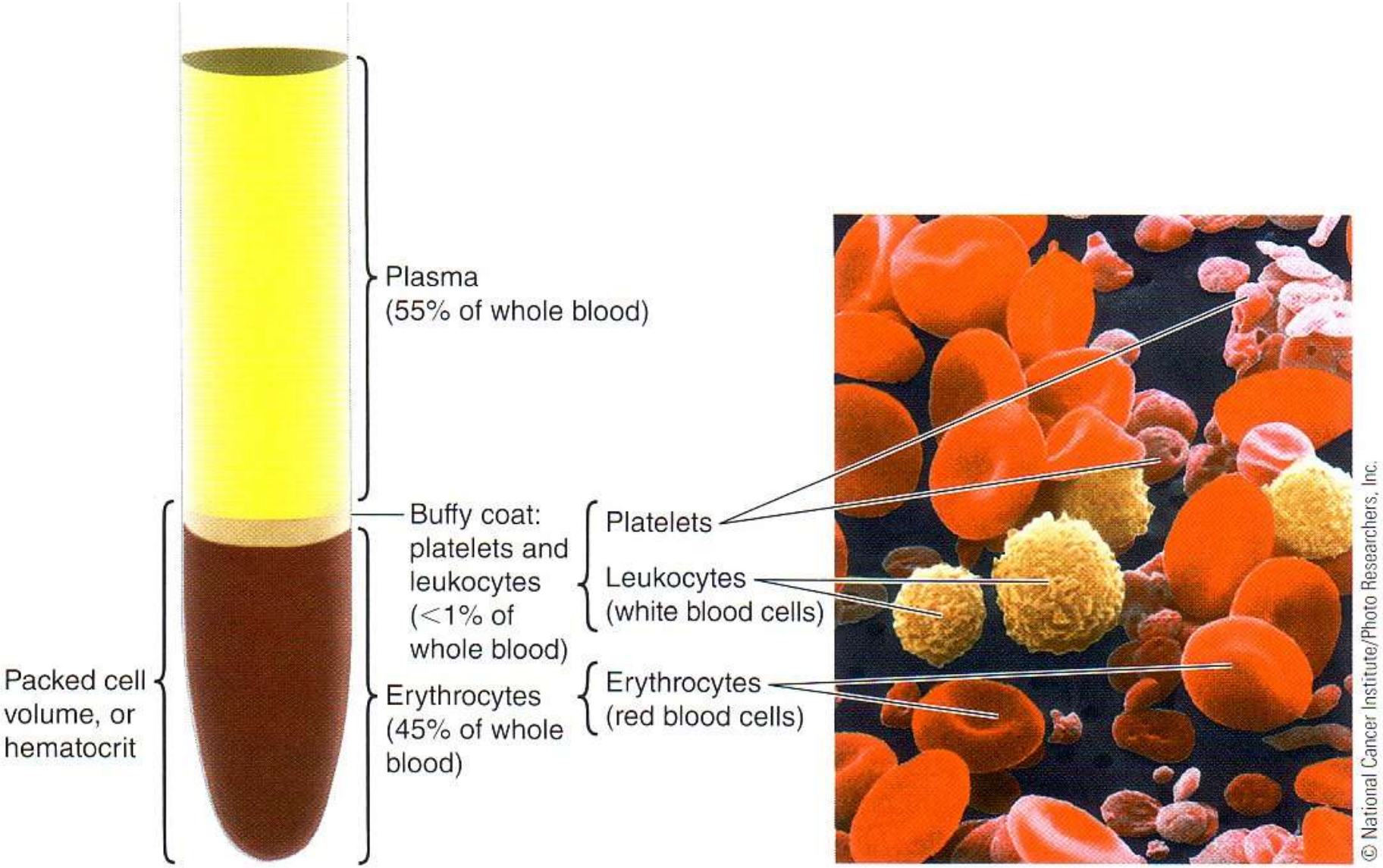
B. **Red blood cells/erythrocytes: O_2-carrying sickle cells, ABO blood typing, Rh factor pp 299-304.**

C. **White blood cells/leukocytes: Defense/immunity differential + general functions pp 309-12**

D. **Platelets/thrombocytes: Initial clotting p 304**

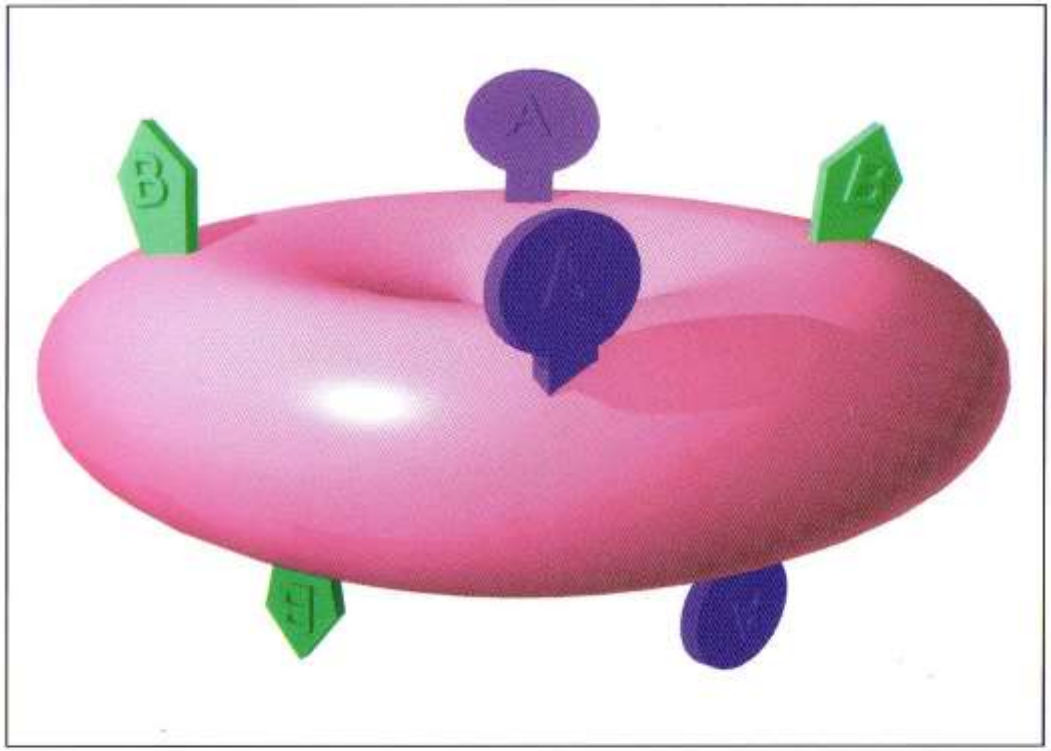
IV. ***Blood Glucose & Diabetes Mellitus*** **LS ch 17, DC Module 13**

What's in Blood? Plasma & Blood Cells



LS 2012 fig 11-1

AB



A & B Antigens

(Agglutinogens)

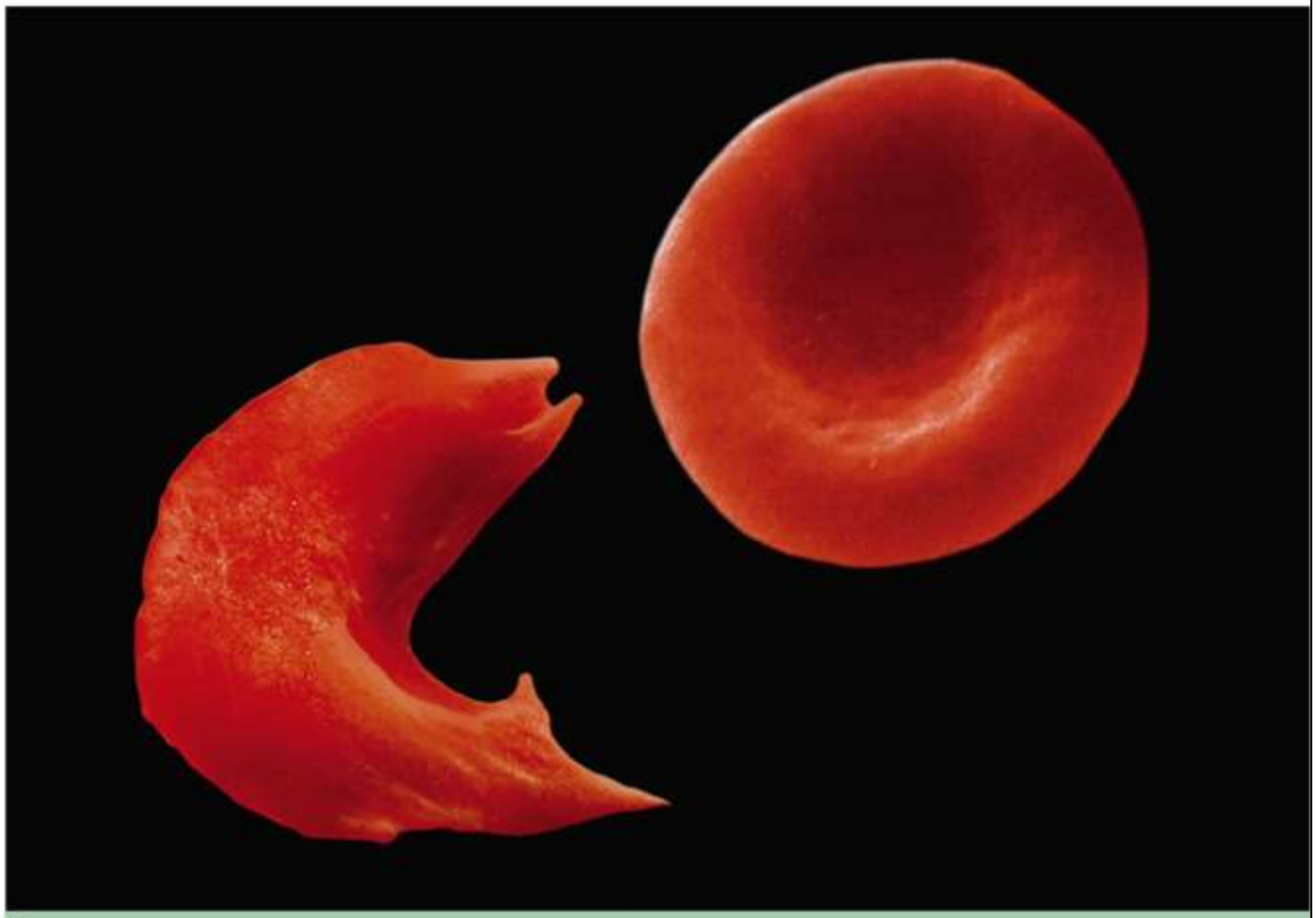
Erythroblastosis Fetalis?

eg, Rh- mom
Rh+ baby

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

Sickle-shaped blood cells

Normal red blood cells



What a difference one amino acid can make!

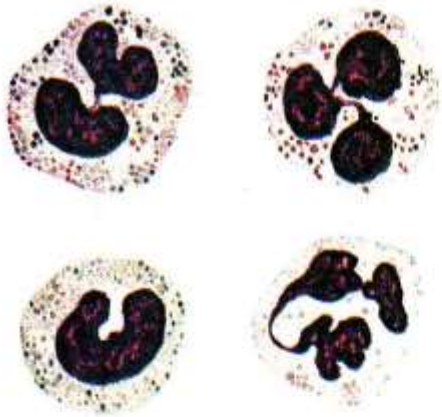
Amino acid sequence of normal hemoglobin:

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

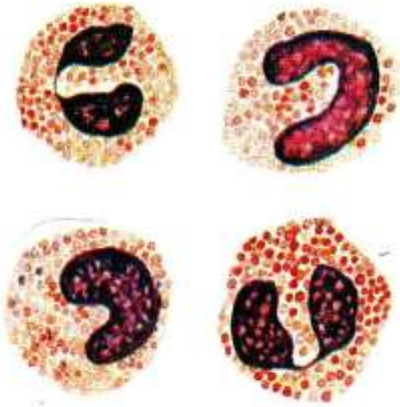
Amino acid sequence of sickle-cell hemoglobin:

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

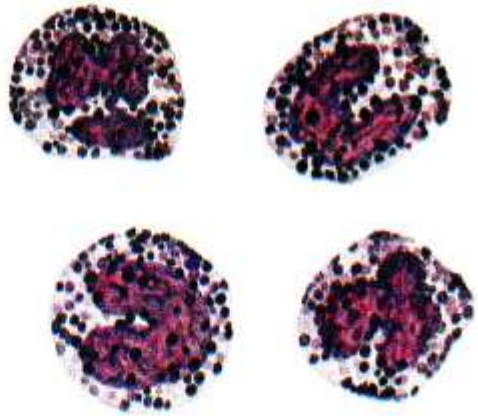
S&W 2011 fig 6-5 p 194



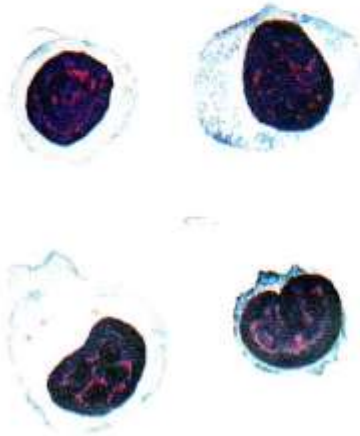
NEUTROPHILS



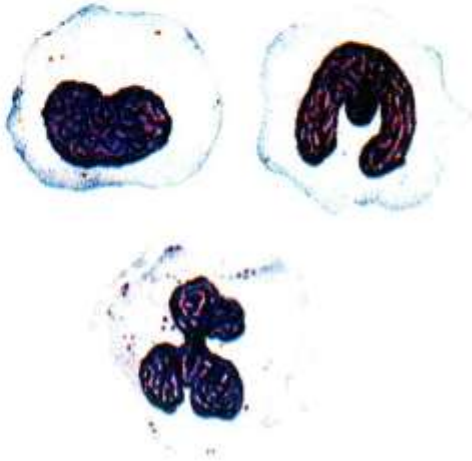
EOSINOPHILS



BASOPHILS



LYMPHOCYTES

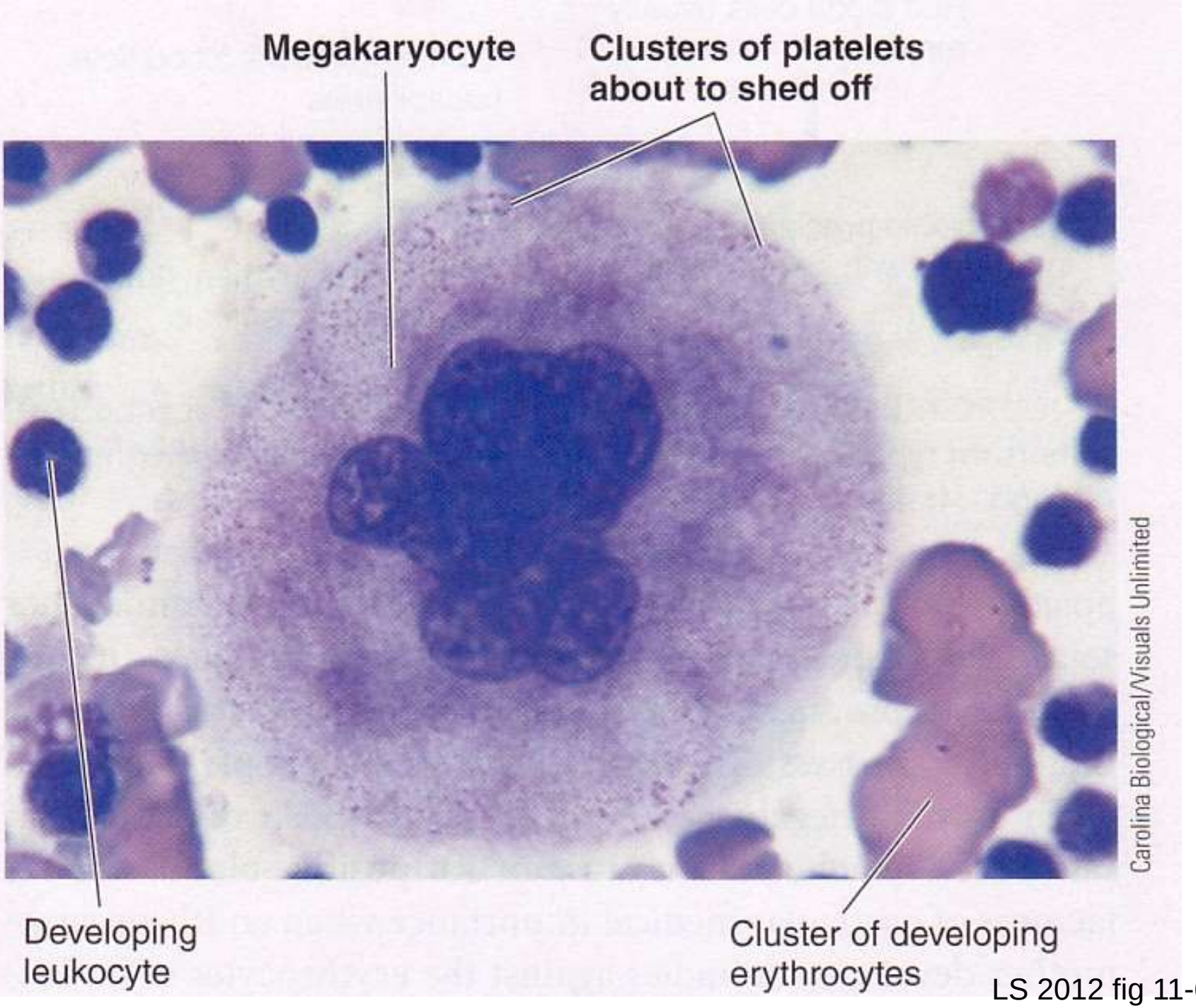


MONOCYTES

PLATELETS

ERYTHROCYTES

SI Fox 2009 fig 10-2



LS 2012 fig 11-6

BI 121 Lecture 11

Fun lab today! Lifetime data!
Thanks for being prepared!

I. ***Blood Cell Connections*** **Q?**

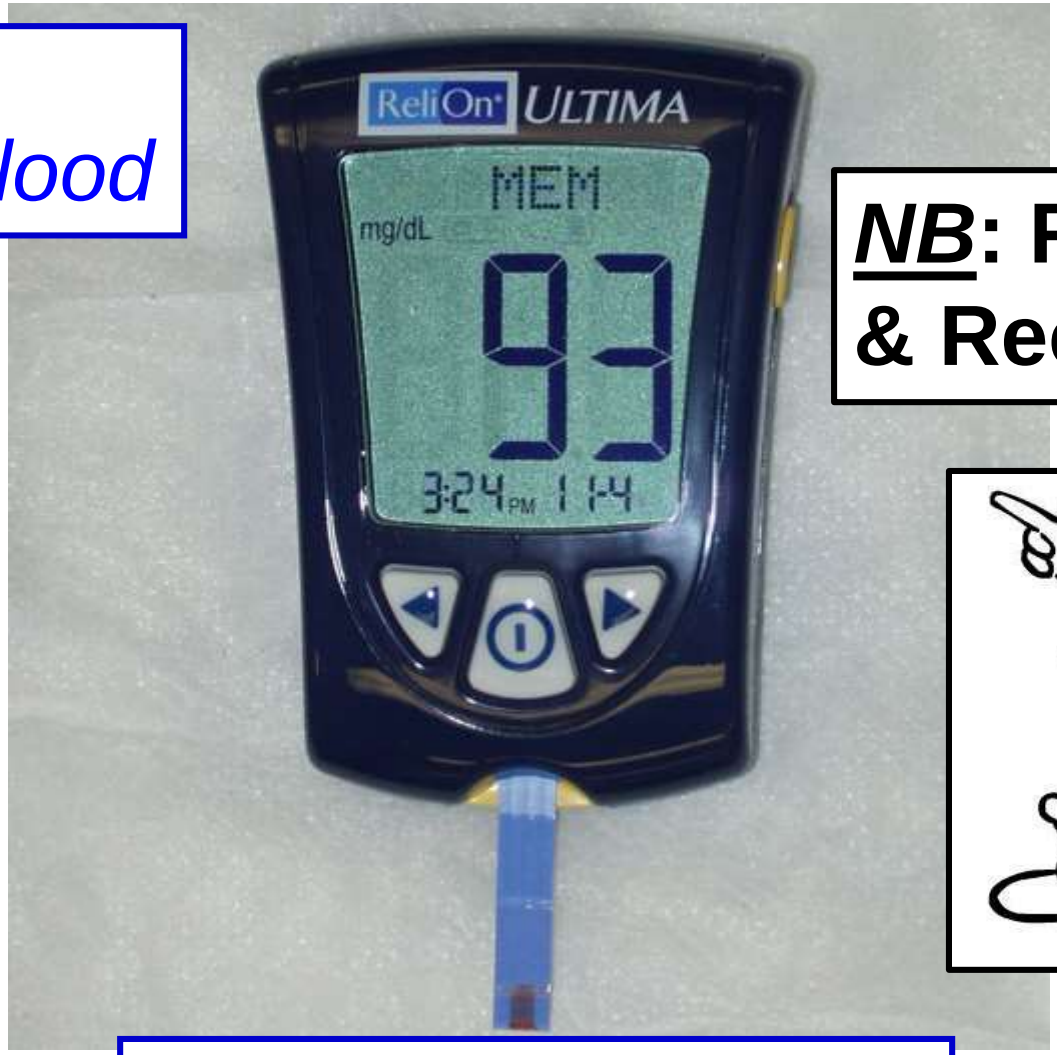
II. ***Lab 5 Review: Safety & Techniques*** **Q?**

III. ***Blood Glucose & Insulin*** **LS pp 530-2, DC pp 110-2**

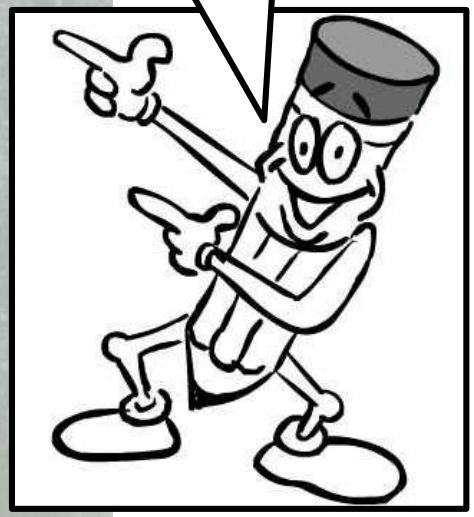
IV. ***Introduction to Endocrinology*** **LS ch 17, DC Module 13, SI Fox+**

- **A. Endocrine vignette: Cushing's syndrome LS fig17-20 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 2. Thyroid 3. Adrenals

Glucose:
Sugar in Blood



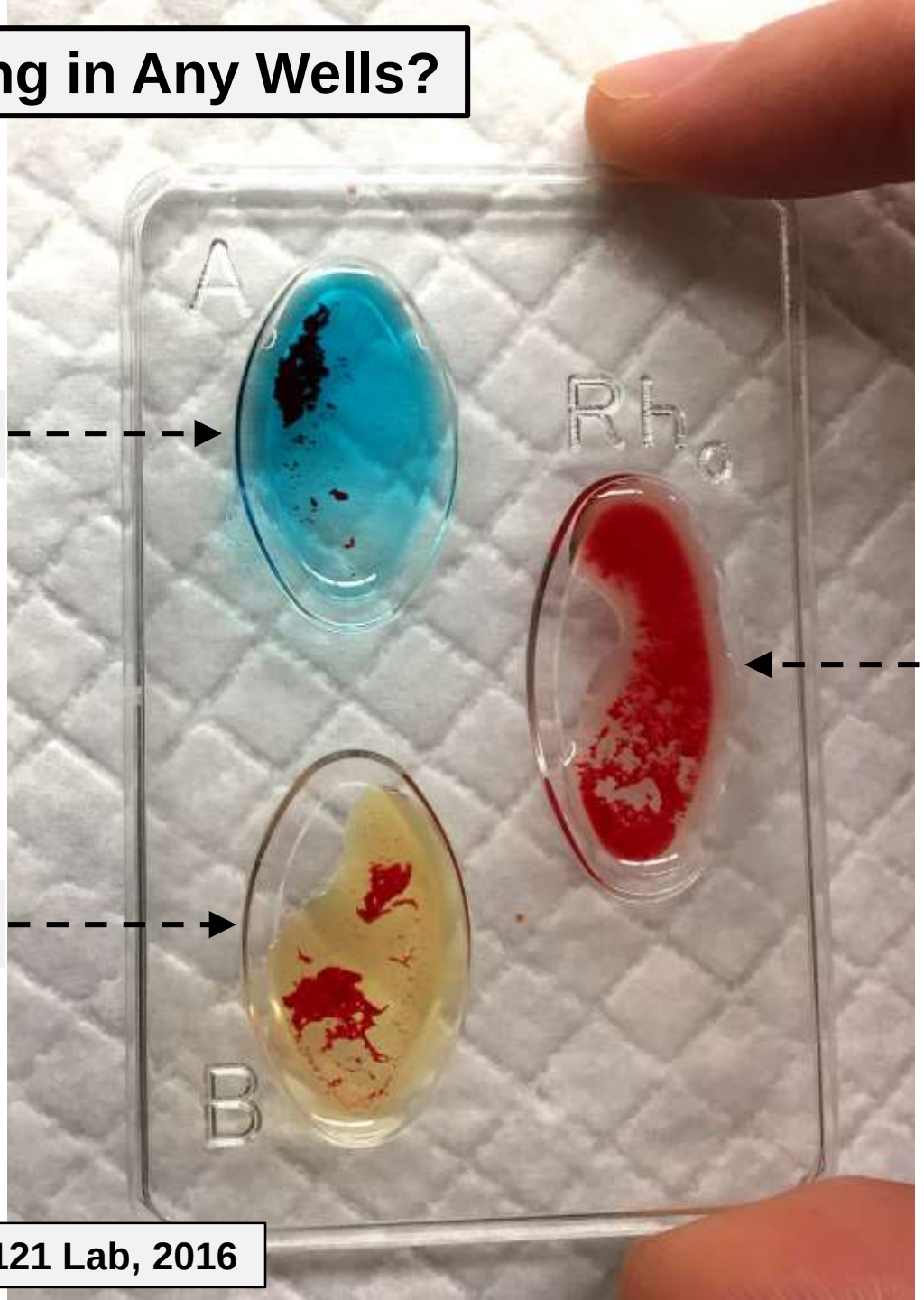
***NB*: Read & Record!**



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

1^0 Q? Clumping in Any Wells?

Type AB+



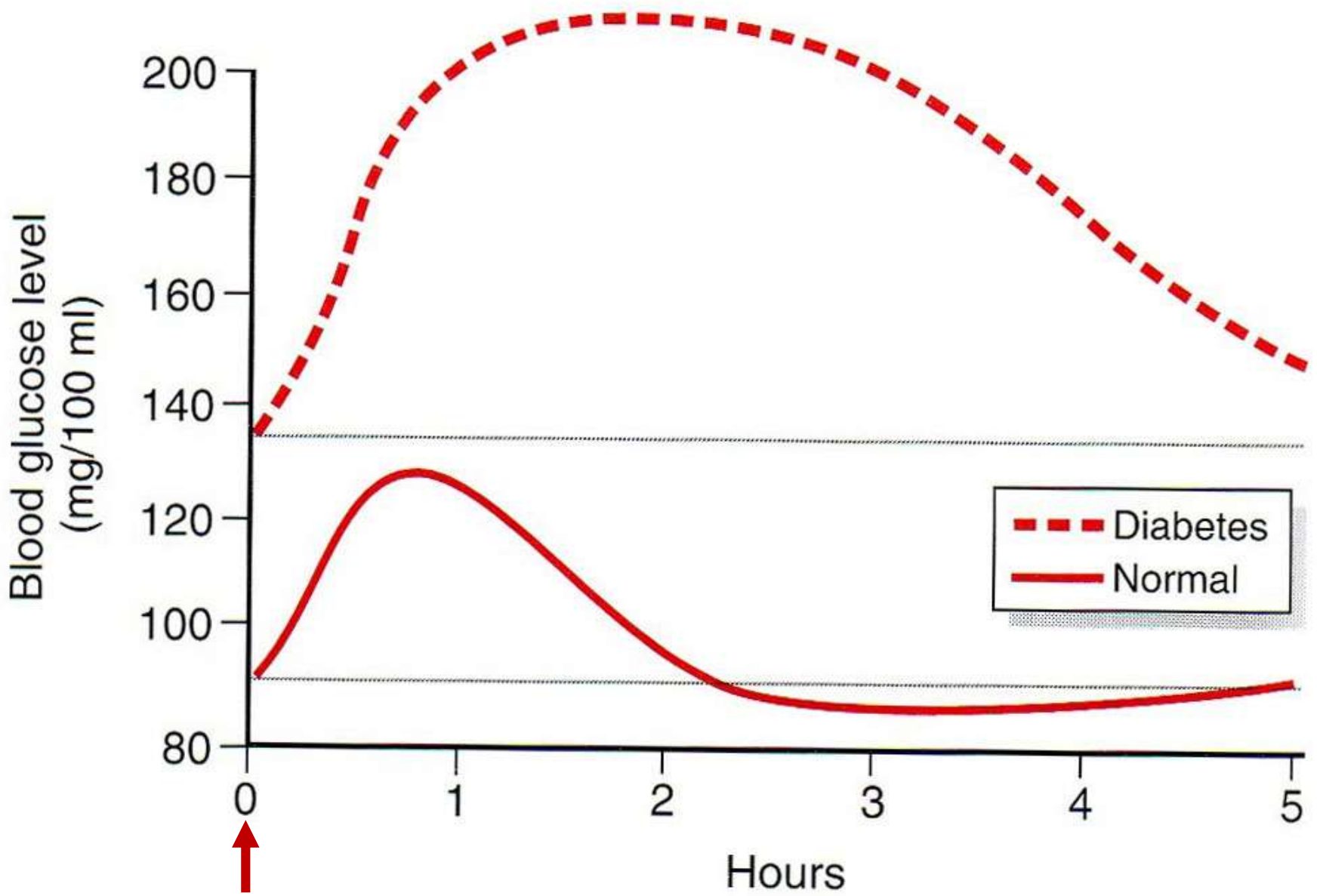
Here?

Here?

Here?

Source: S Wong, BI 121 Lab, 2016

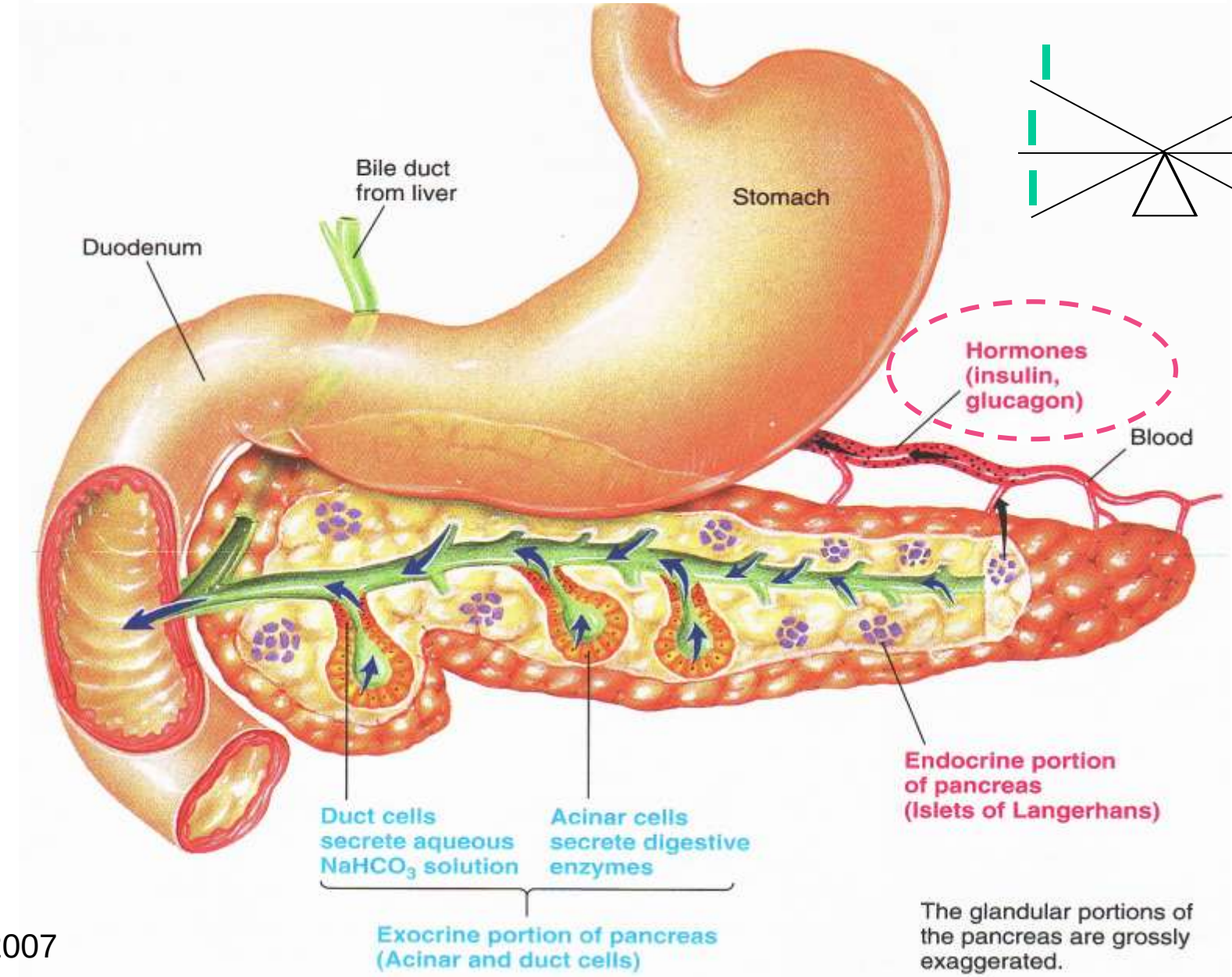
Diabetic & Normal Response to Glucose Load



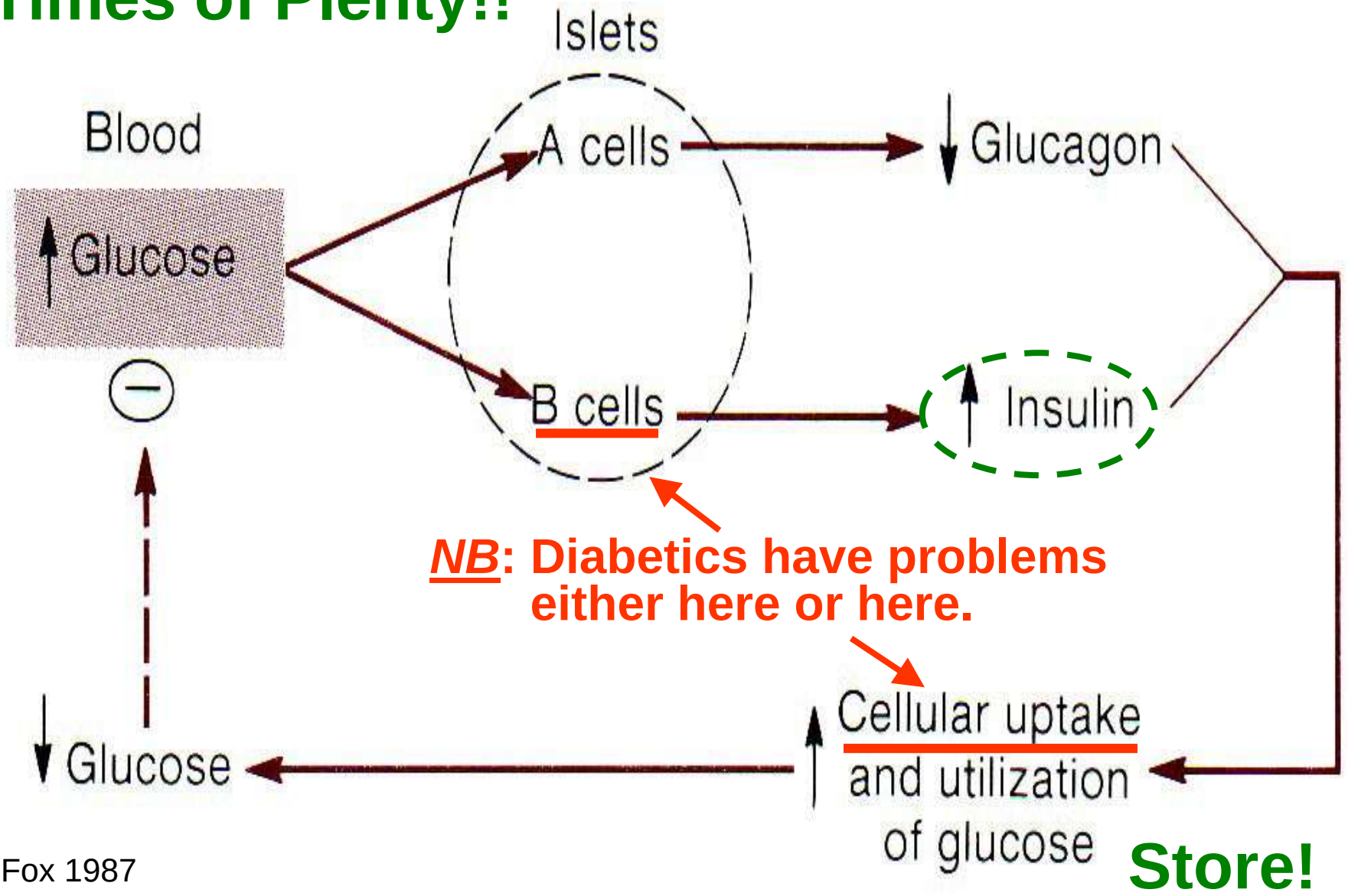
Ingest Glucola or eat meal

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 4-7

Warning Signs of Diabetes

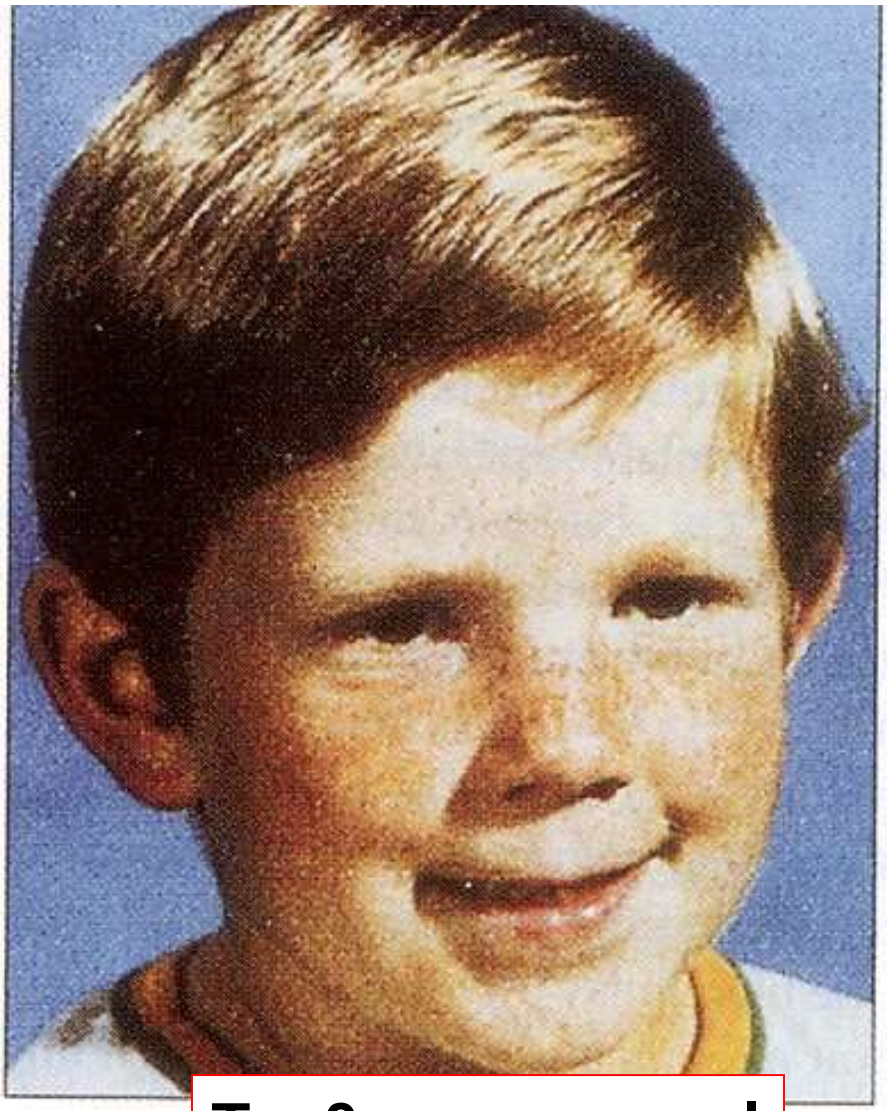
These signs appear reliably in type 1 diabetes and, often, in the later stages of type 2 diabetes.

- 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

S&W 2011 tab 4-7 p 131

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

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



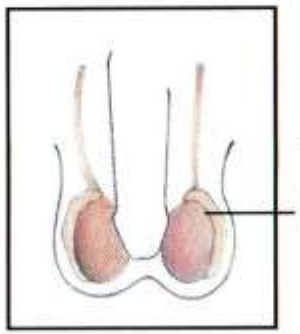
T = 0, near normal

T = 4 months later

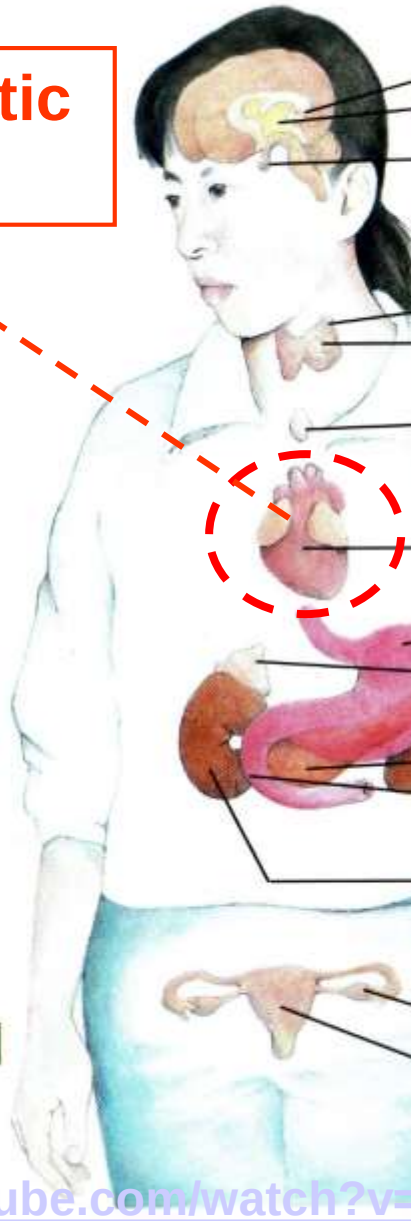
Endocrine System

ANP = Atrial Natriuretic Polypeptide

- Solely endocrine function
- Mixed function
- Complete function uncertain



Testes in male



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

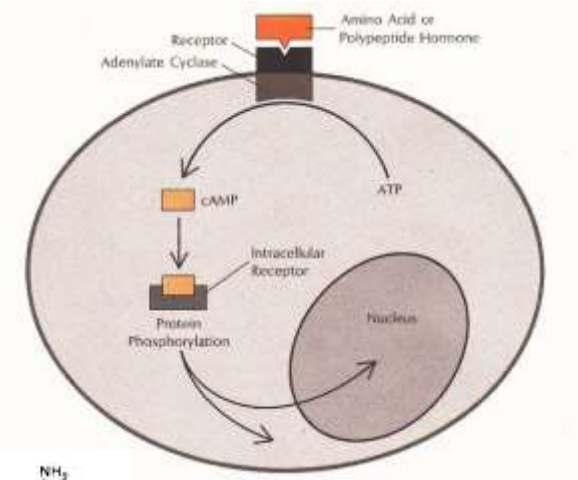
https://www.youtube.com/watch?v=IRJE8c3ghRE

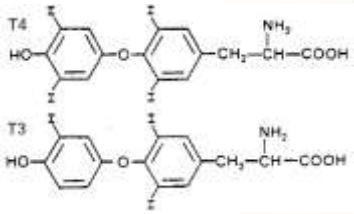
https://www.hopkinsallchildrens.org/Patients-Families/Health-

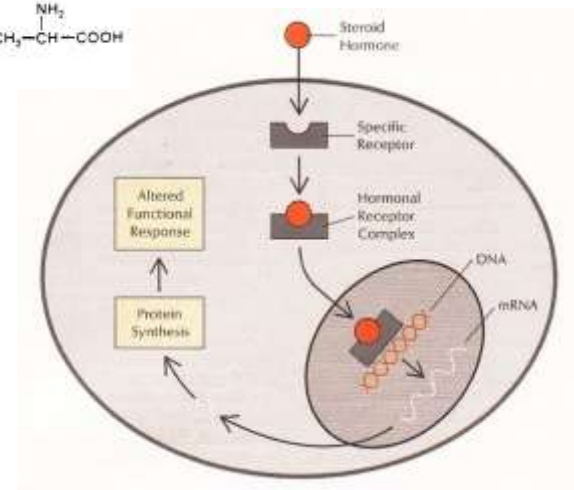
Hormone/Endocrine Classifications

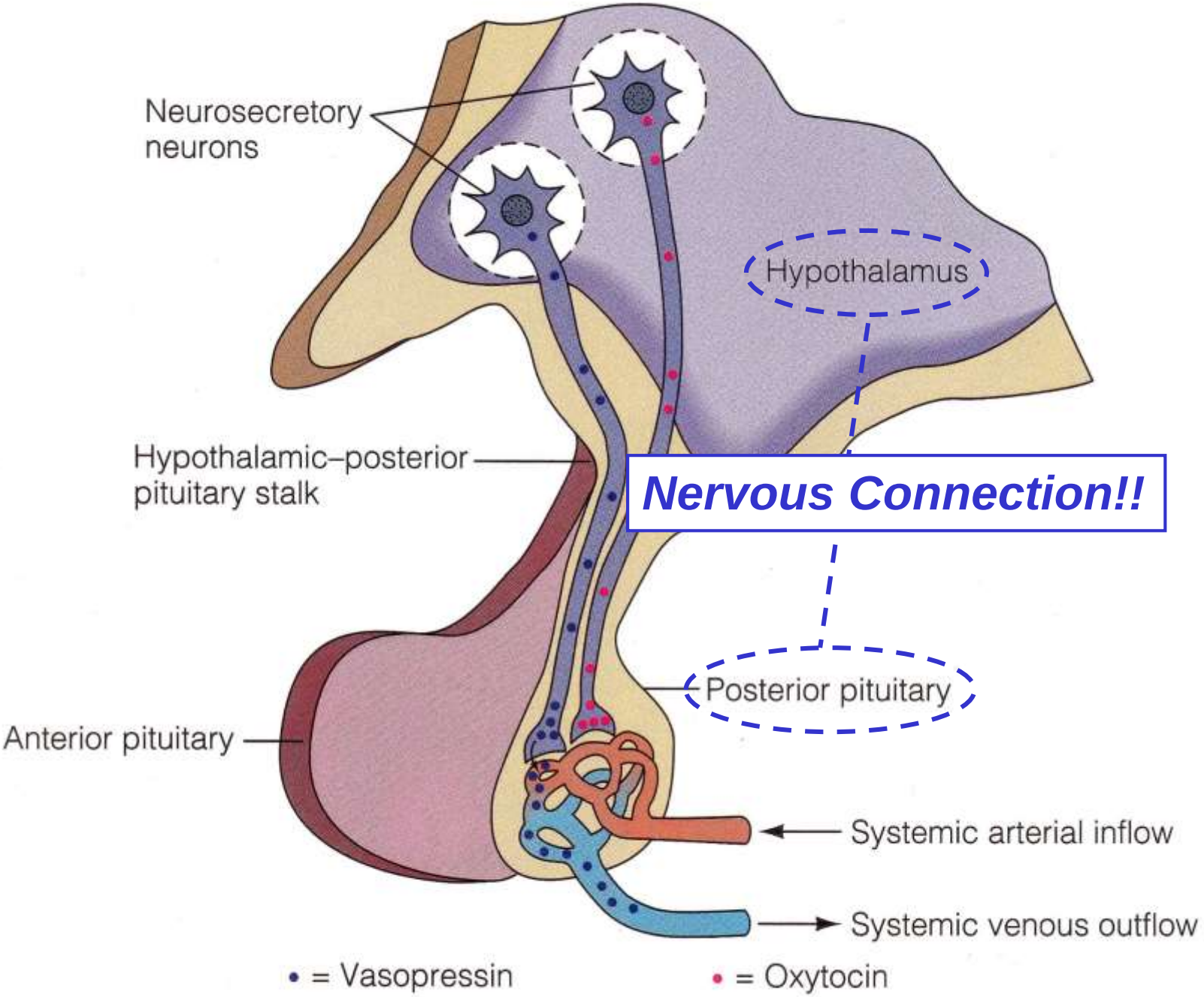
Exogenous

Endogenous



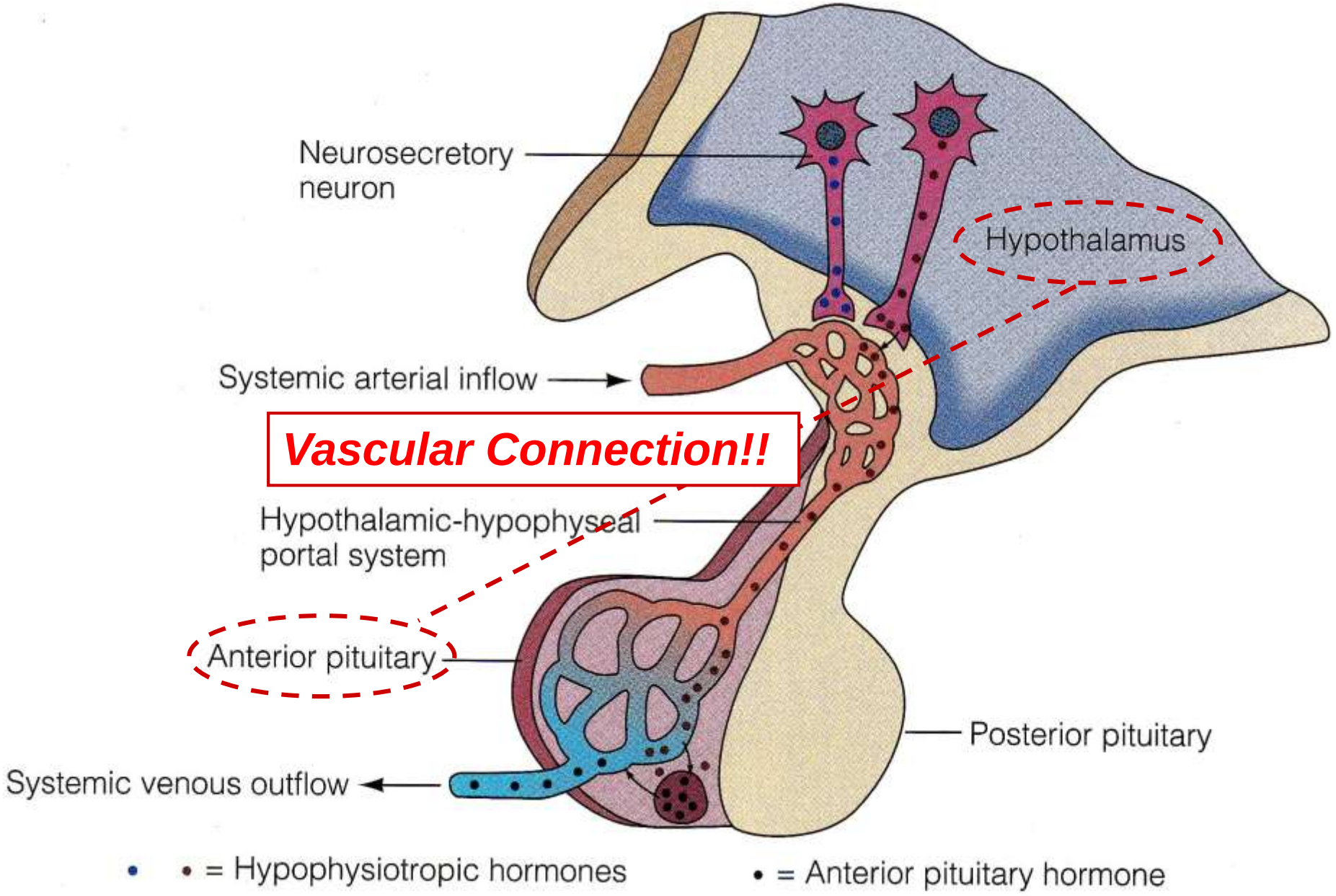




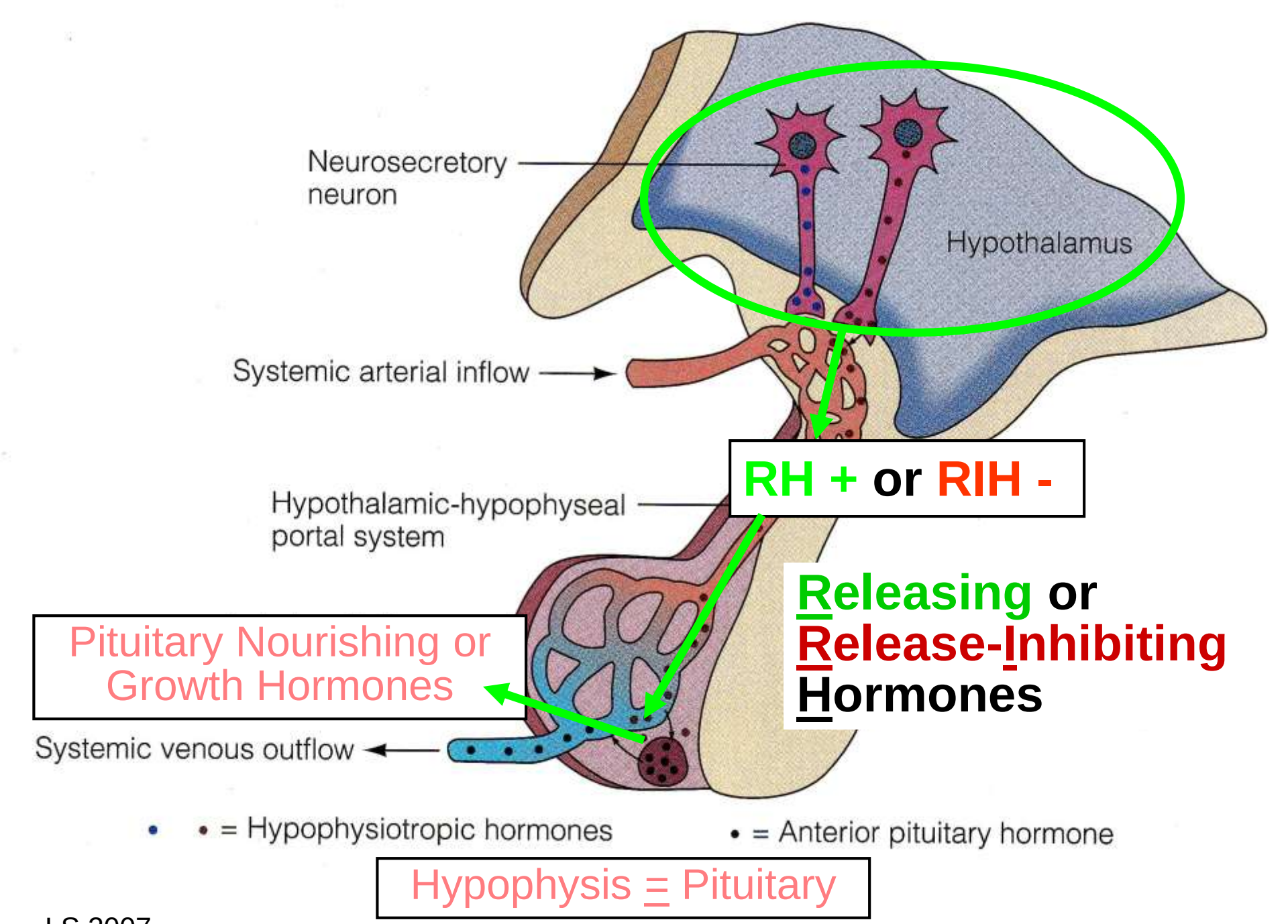

Neurosecretory neurons
Hypothalamus
Hypothalamic–posterior pituitary stalk
Nervous Connection!!
Posterior pituitary
Anterior pituitary
Systemic arterial inflow
Systemic venous outflow
• = Vasopressin
• = Oxytocin

LS 2007

Hypothalamus-Anterior Pituitary Vascular Connection!



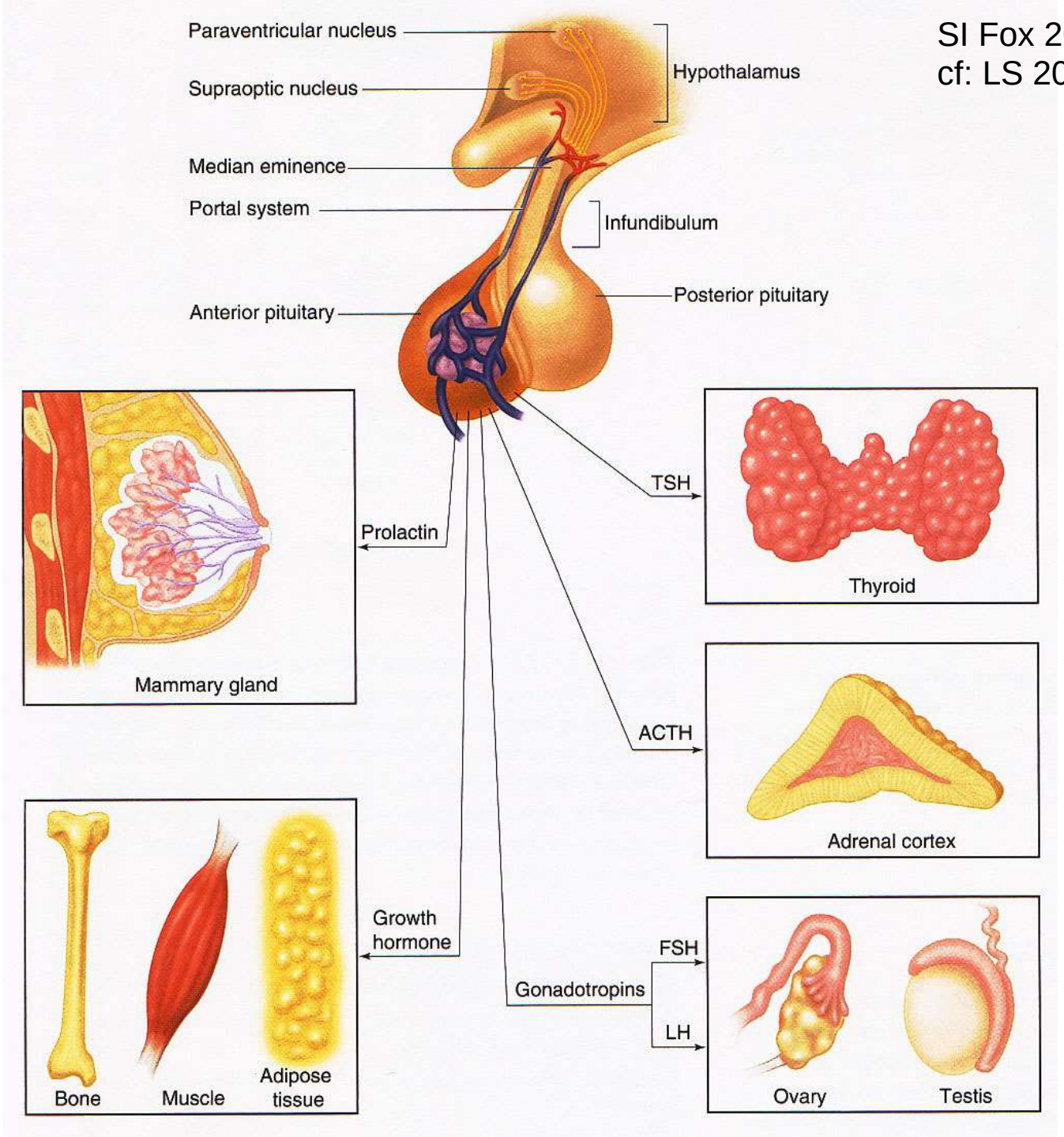
LS 2007



Hypophysis = Pituitary

LS 2007

SI Fox 2008
cf: LS 2012 fig 17-5



Thanks for your help with blood chemistry!...

Bl 121 Lecture 12

I. ***Announcements*** **Optional notebook check + Lab 6 tomorrow. Pulmonary Function Testing. Exam II > your Q on Thurs. Q?**

II. ***Endocrine Connections*** **Feedback loops, growth hormone, thyroid & adrenals DC Module 13 pp 109-13, LS pp 513-36**

III. ***Nervous System & Excitable Cells*** **DC Module 9, LS ch 5, 4, 7**

- **A. How is the nervous system organized? fig 5-1 p 108**
- **B. Neurons? What kind? fig 5-2 p 109**
- **C. Brain structure & function fig 5-7, 5-8 pp 116 – 7**
- **D. Protect your head with a helmet! Bicycle head injury statistics, NHTSA & BHSI**

IV. ***Brain + Autonomic Nervous System Overview*** **DC pp 71-77, LS pp 178 – 85, tab 7-1 p 183 + Stories to remember *fight-or-flight!***

V. ***Neuromuscular Connections*** **LS ch 7 pp 186-92, DC pp 69-71**

How does the signal cross the nerve-muscle gap? LS fig 7-5

- **A. Normal function? Ca2+ for bones!…but what else? LS p 190**
- **B. What do black widow spider venom, botulism, curare & nerve gas have in common? Botox? LS p 189-91**

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

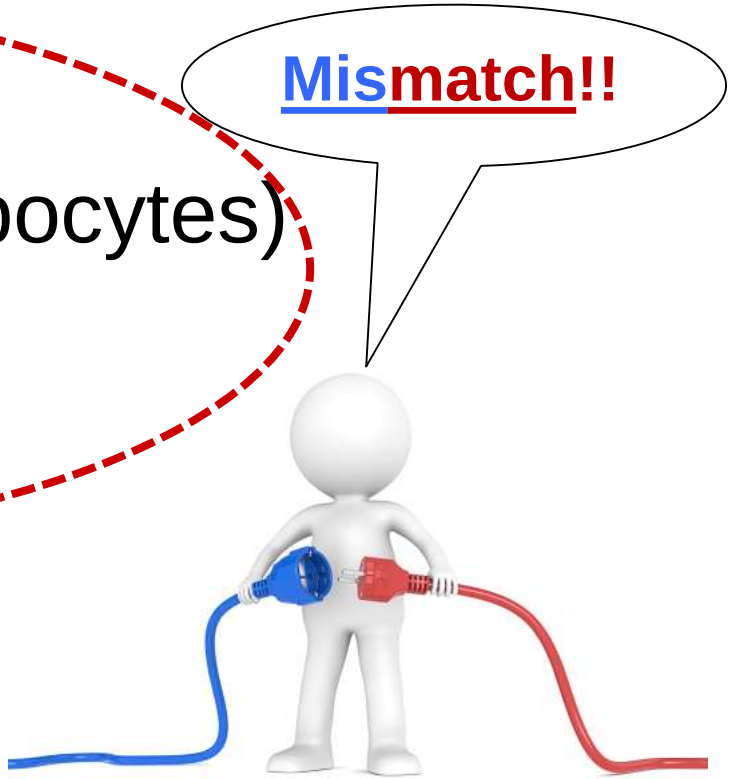
↑ Amino Acid uptake & Protein synthesis

↑ Lipolysis & Fatty Acid mobilization

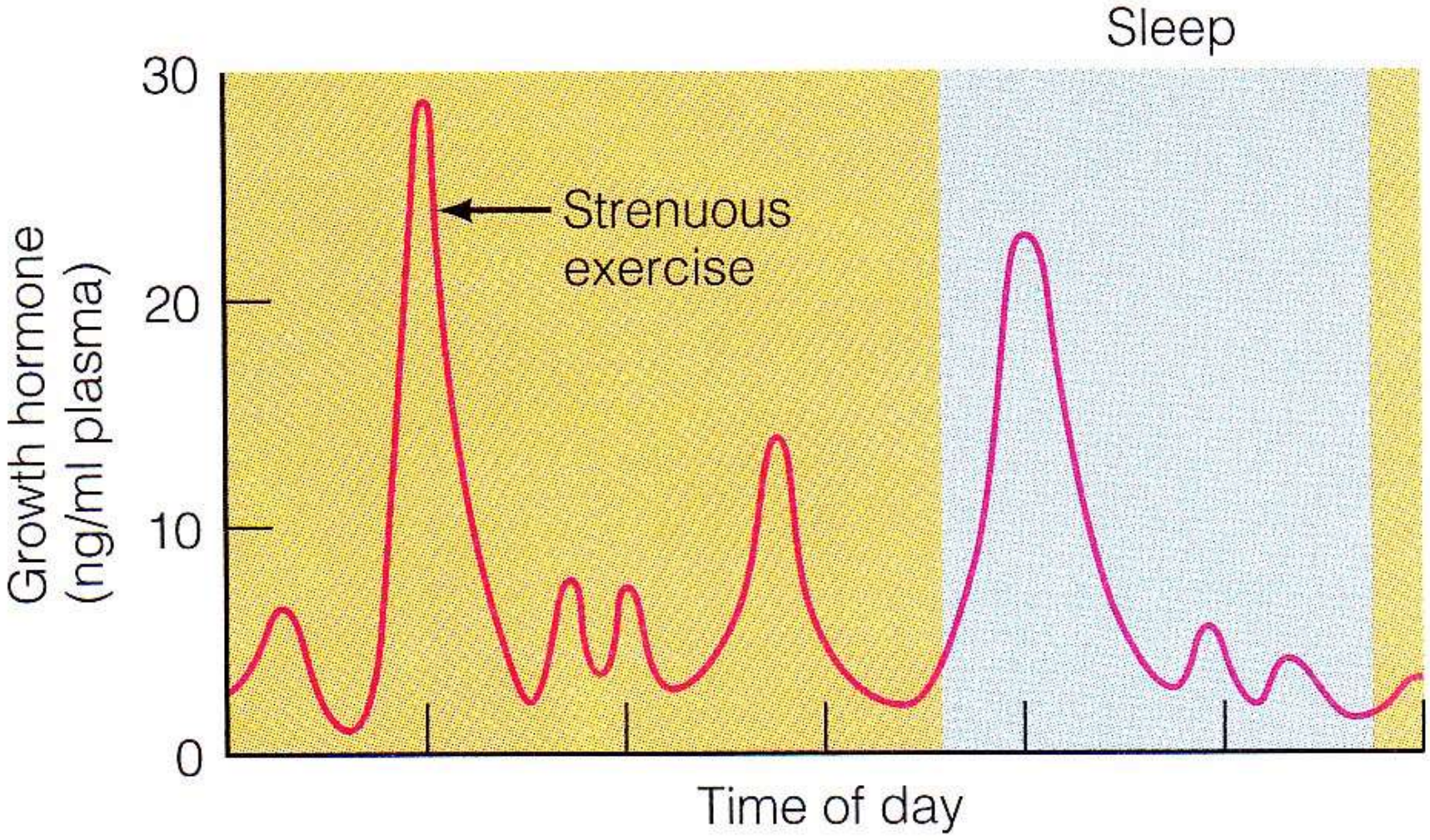
↓ Glucose uptake
(skeletal muscle & adipocytes)

↑ Glucose production
(liver glycogenolysis)

↑ Insulin secretion

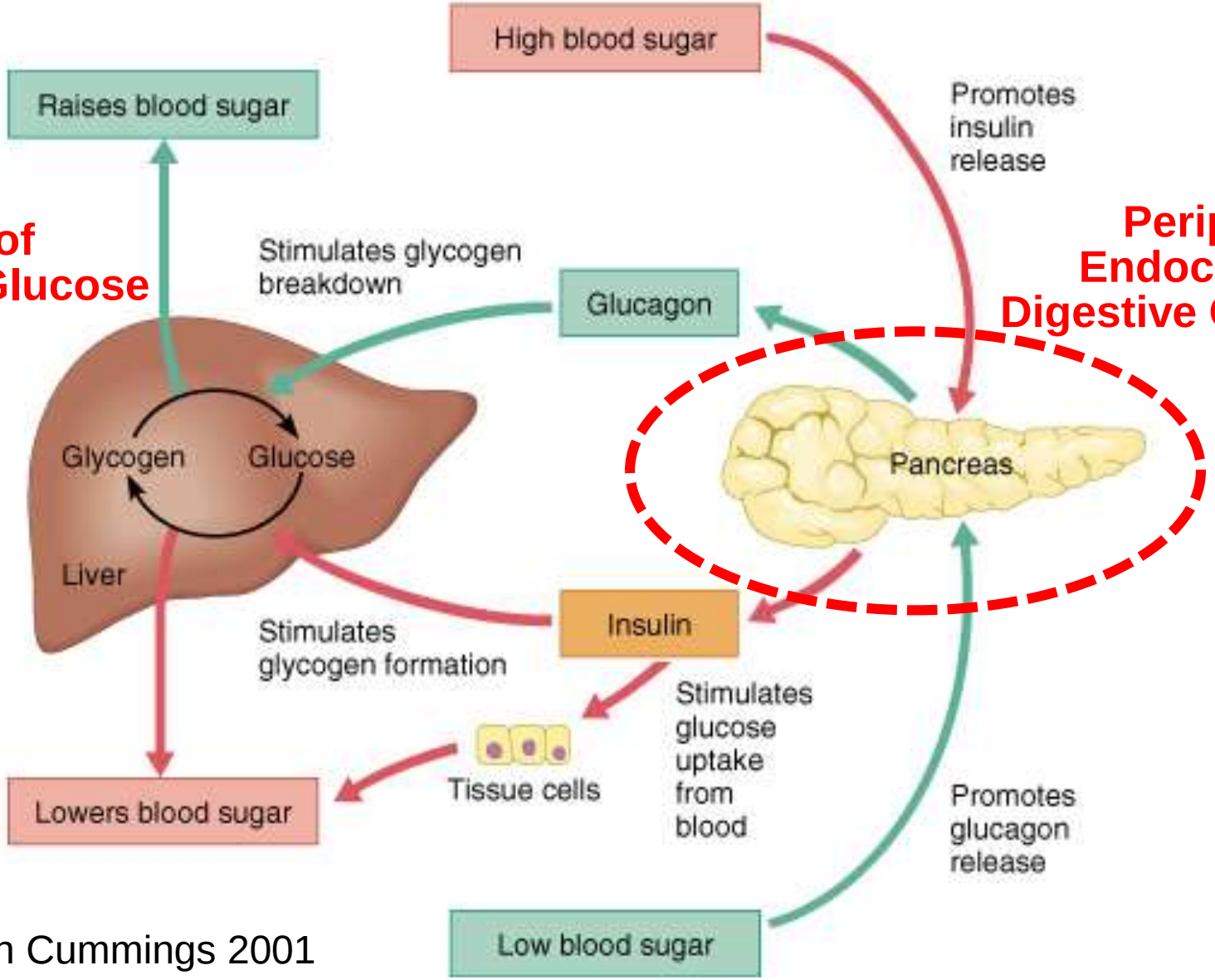


Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per mililiter

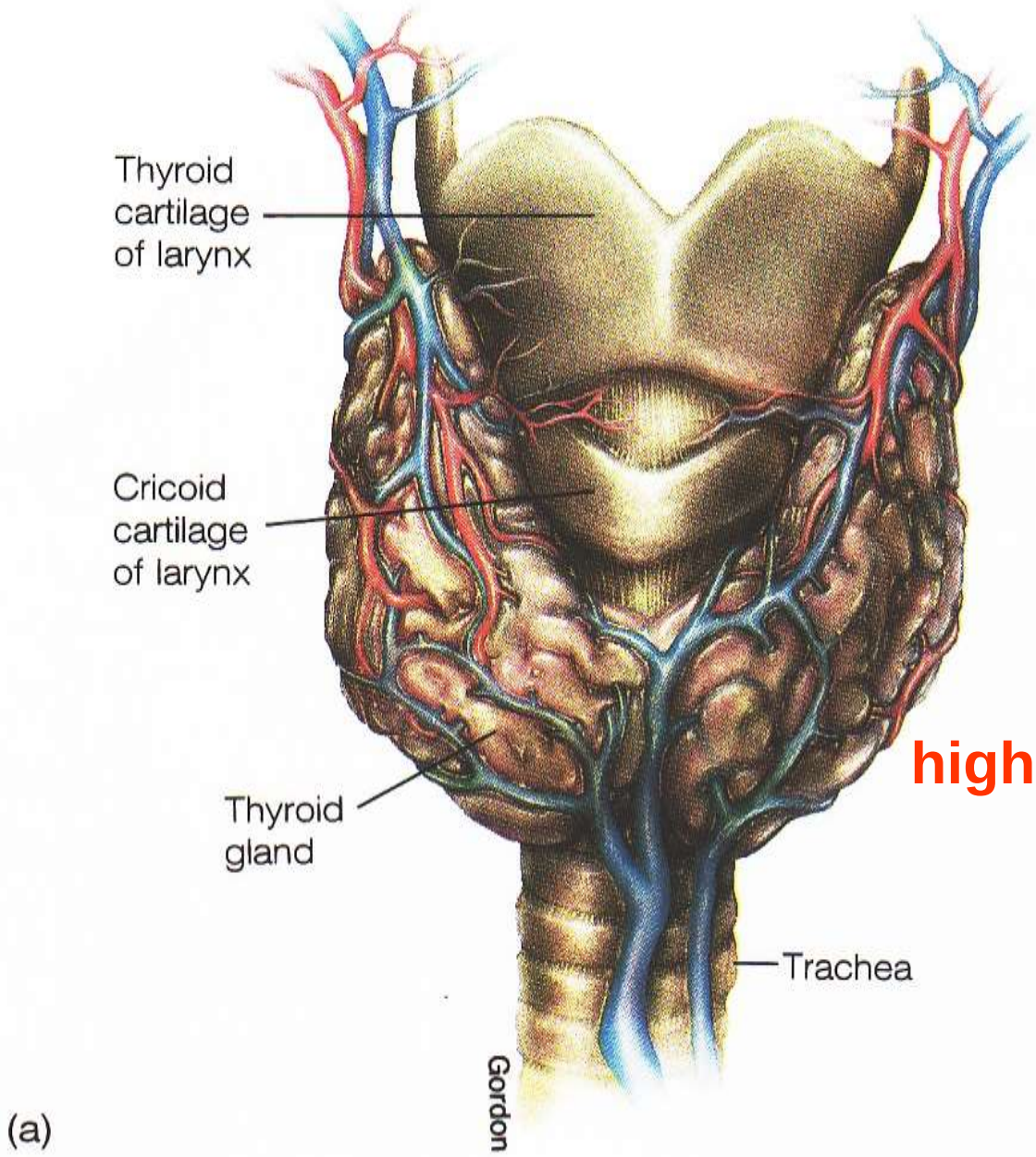
Insulin Stores Sugar, Glucagon Mobilizes Sugar!



Benjamin Cummings 2001

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

https://www.fuseschool.org



Thyroid → **metabolism**
highly vascularized

https://ed.ted.com/lessons/how-does-the-thyroid-manage-your-metabolism-emma-bryce

DC 2003

Adrenals/Suprarenals

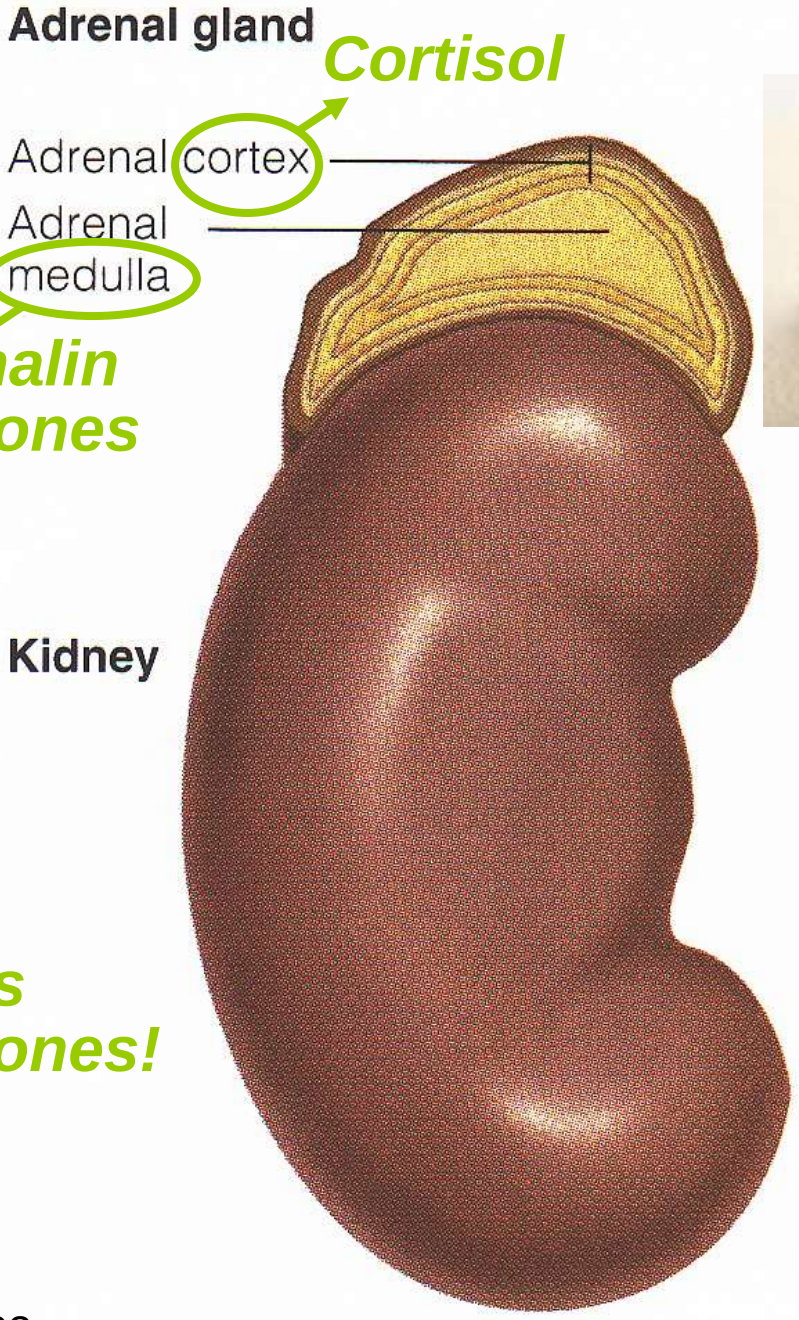


FIGURE 13-12
Adrenal Gland The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.

DC 2003

Epinephrine 80%
Norepinephrine 20%

Guyton & Hall 2000

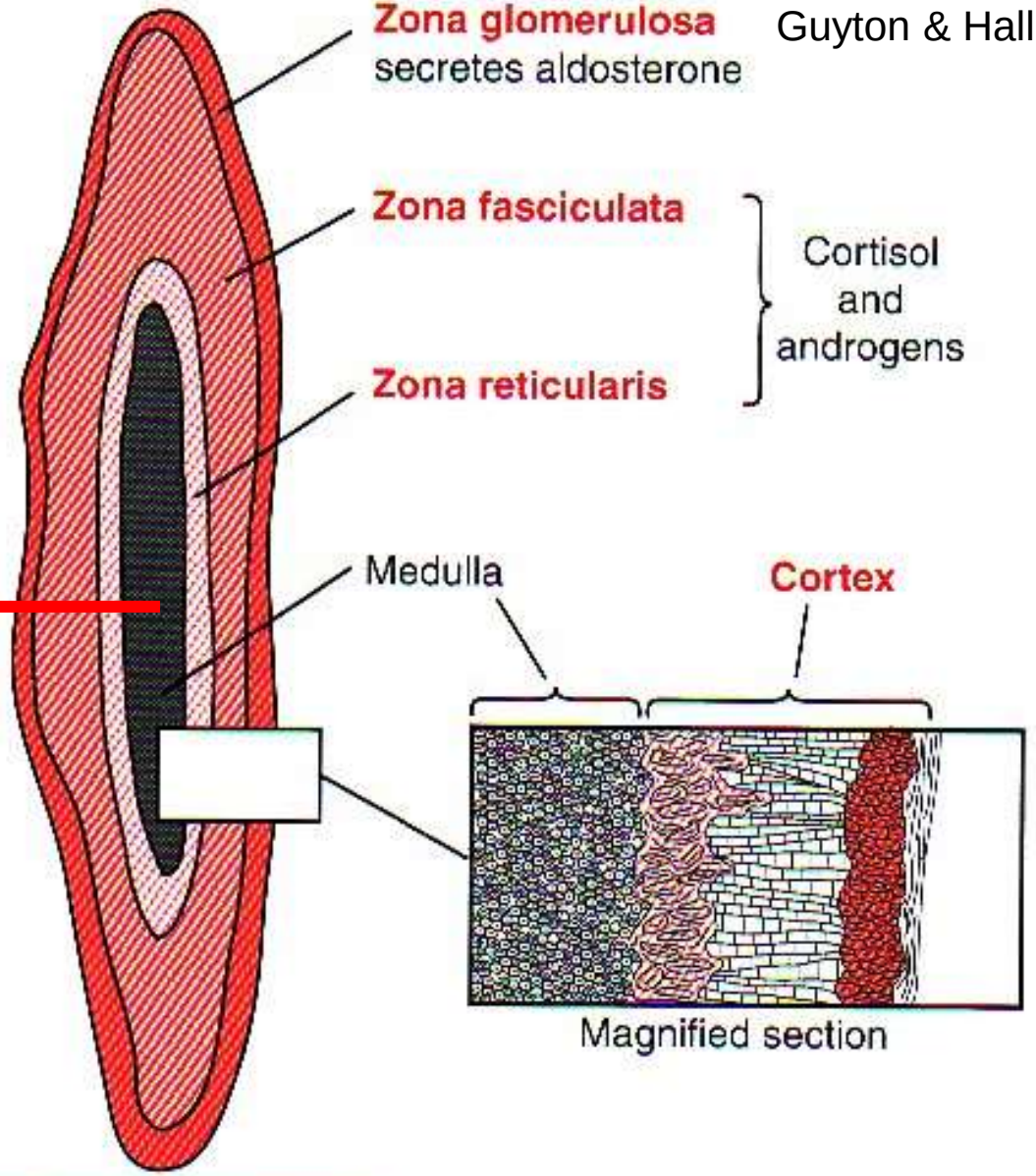
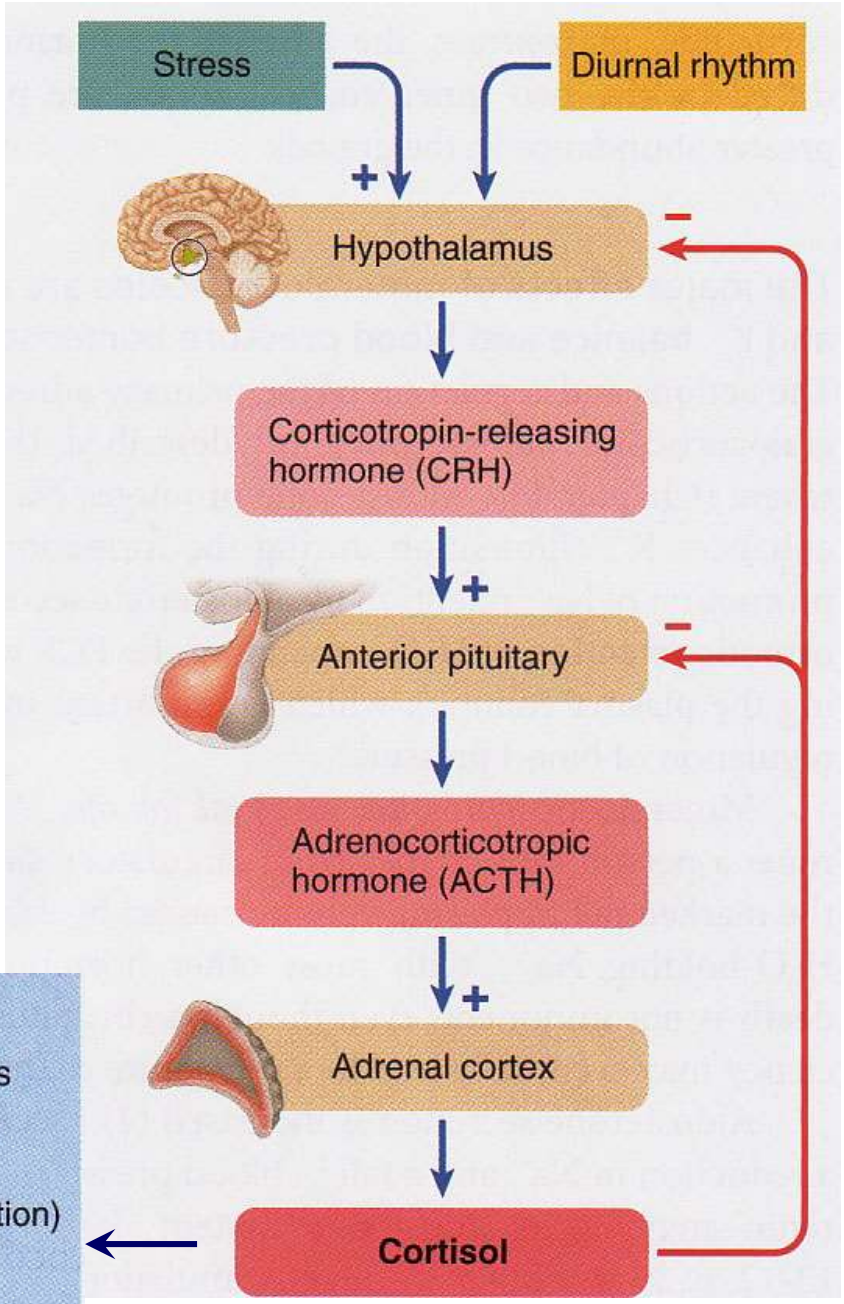


FIGURE 77-1

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

Stress Promotes Cortisol Secretion

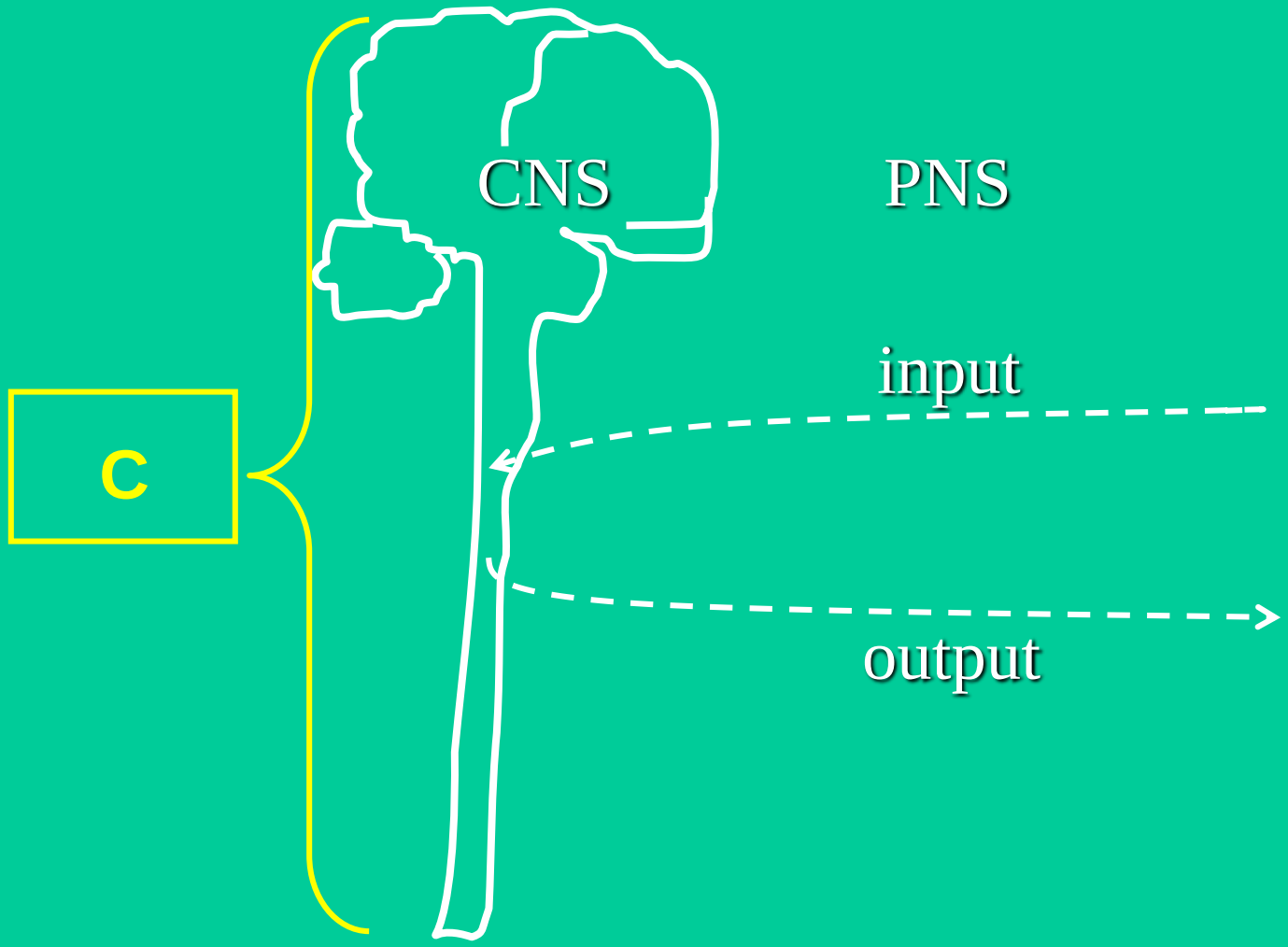


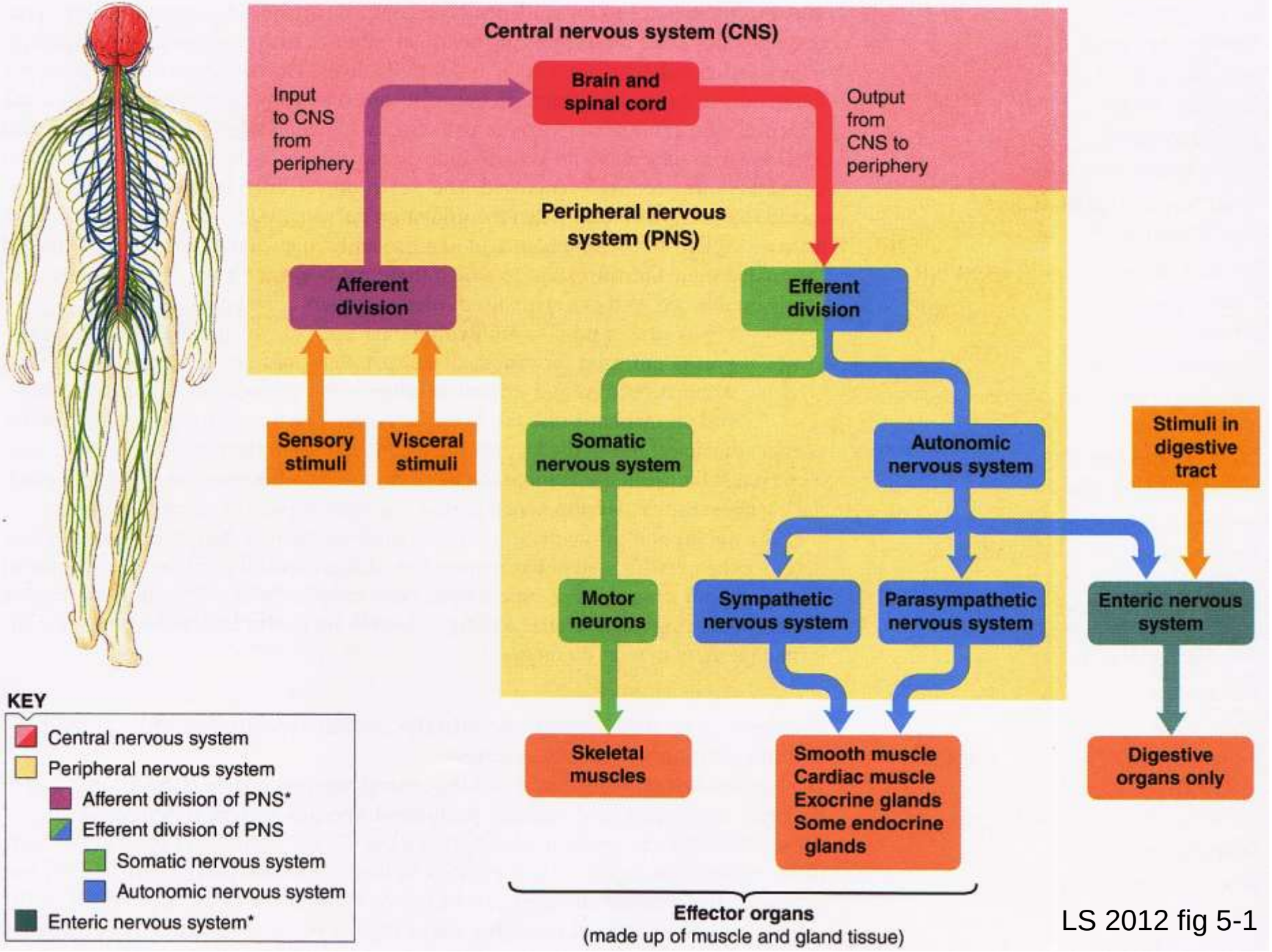
Metabolic fuels and building blocks available to help resist stress

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

LS 2012 fig 17-19

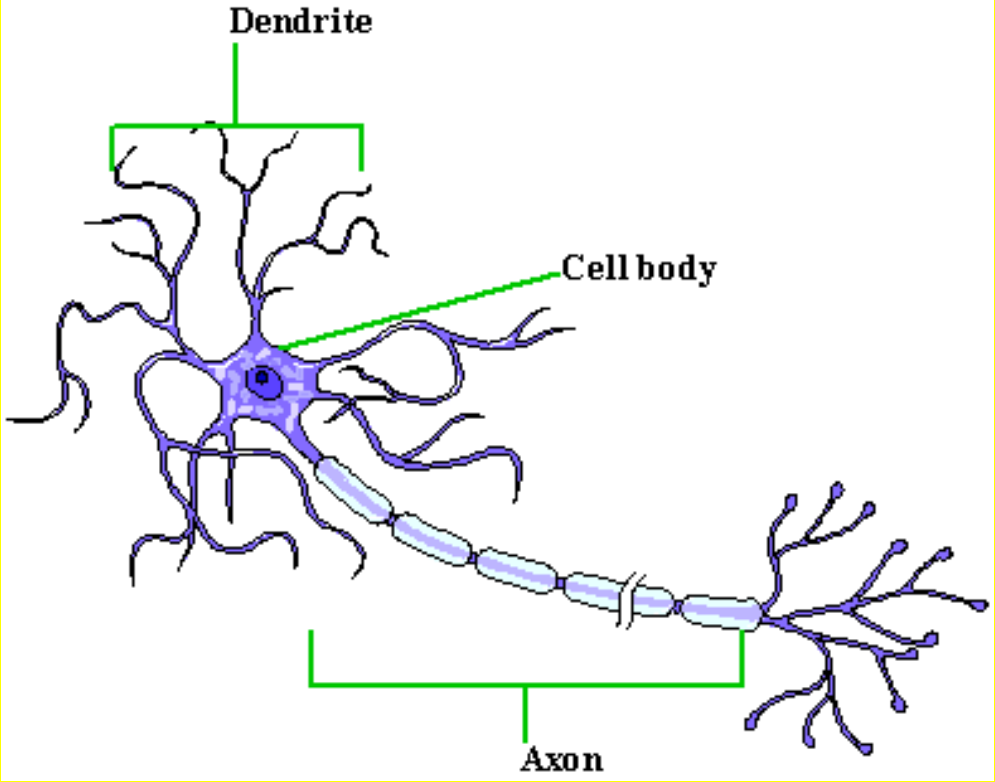
Nervous System

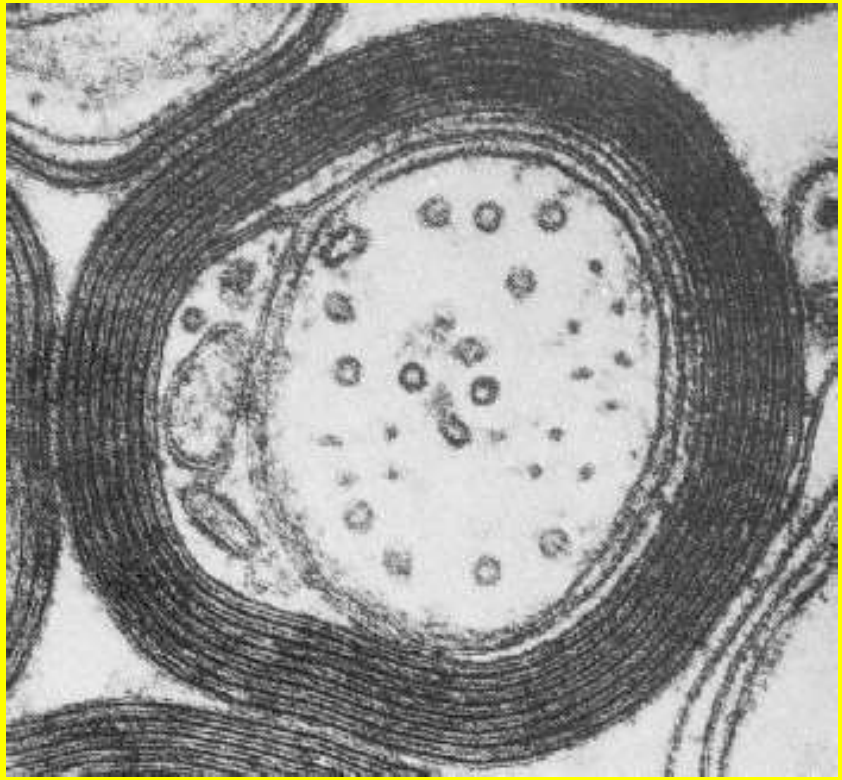




LS 2012 fig 5-1

What is myelin?
Why is it important?

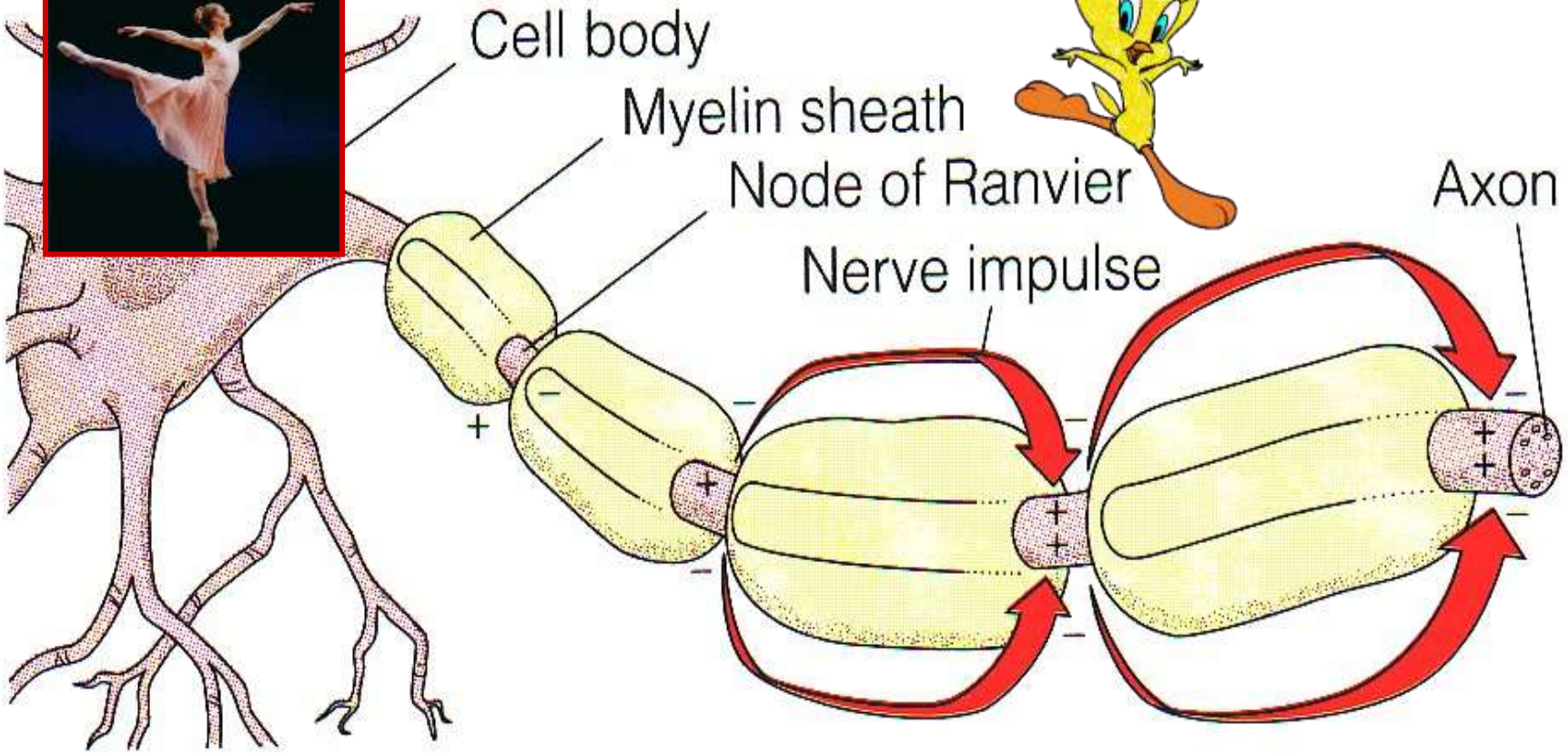




Lipid insulative coat

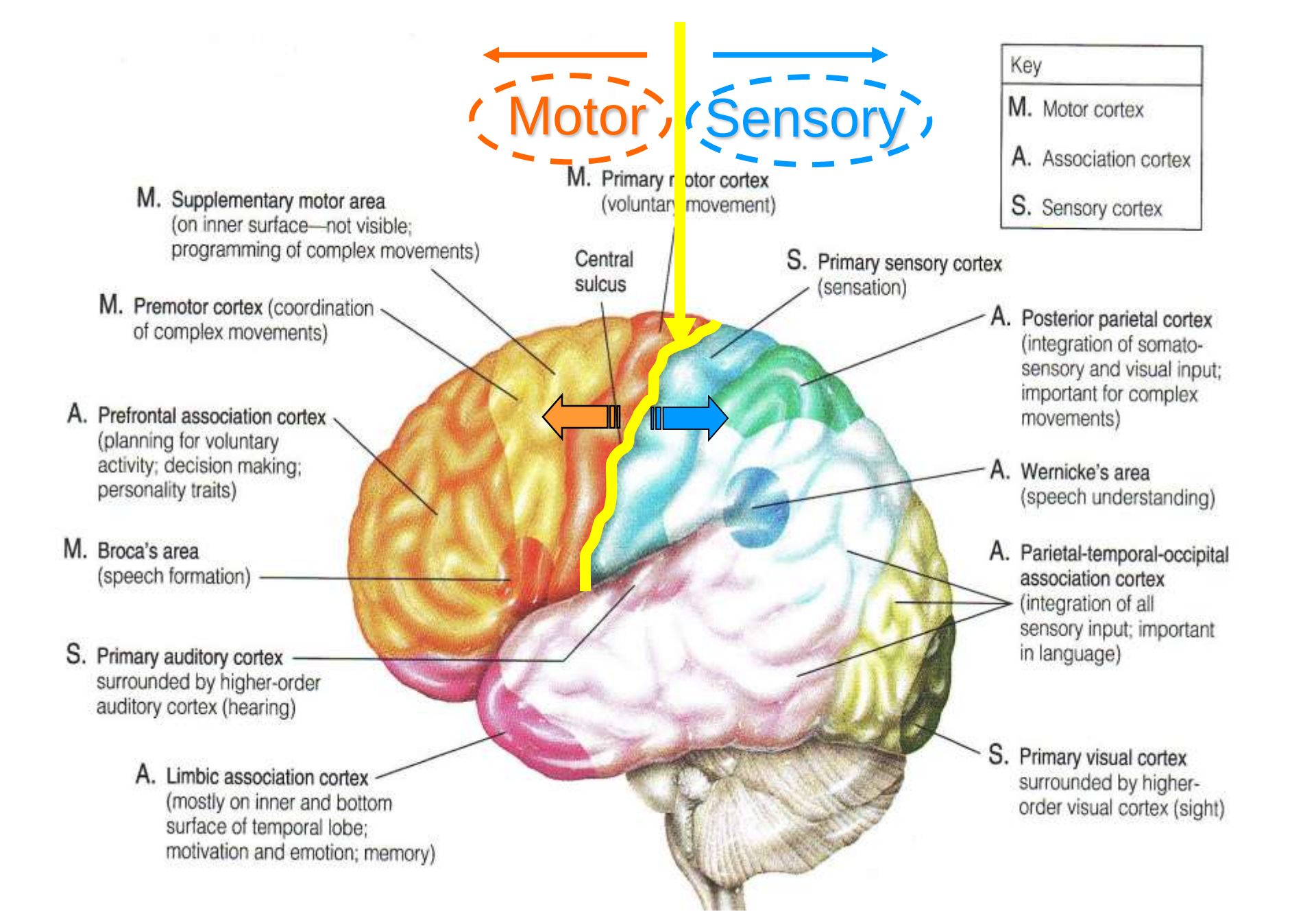
↑ $\vec{v}$, conserves ions & ATP

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% ♂

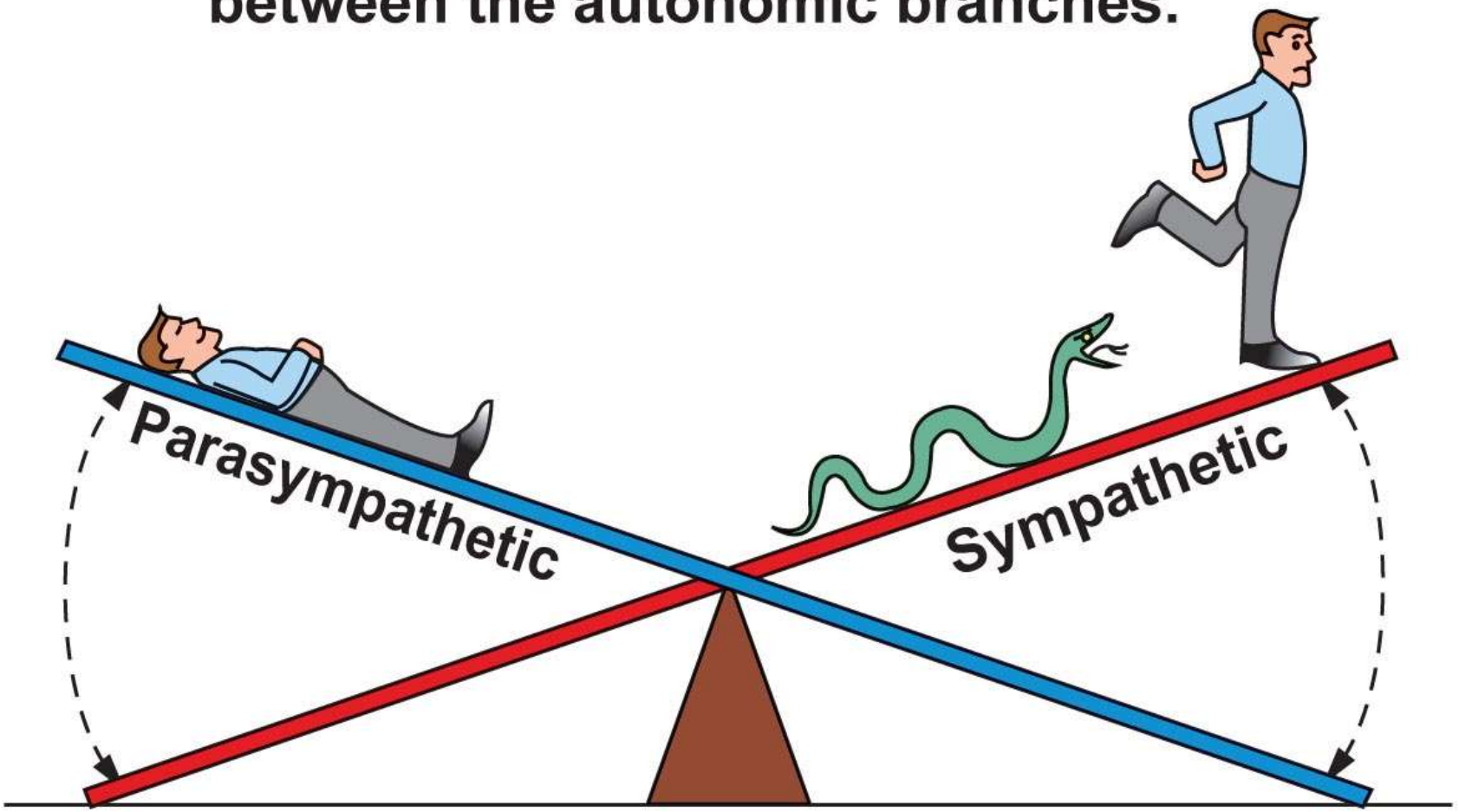
11% involved wrong-way riding!

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!

Homeostasis is a dynamic balance between the autonomic branches.



Rest-and-digest: Parasympathetic activity dominates.

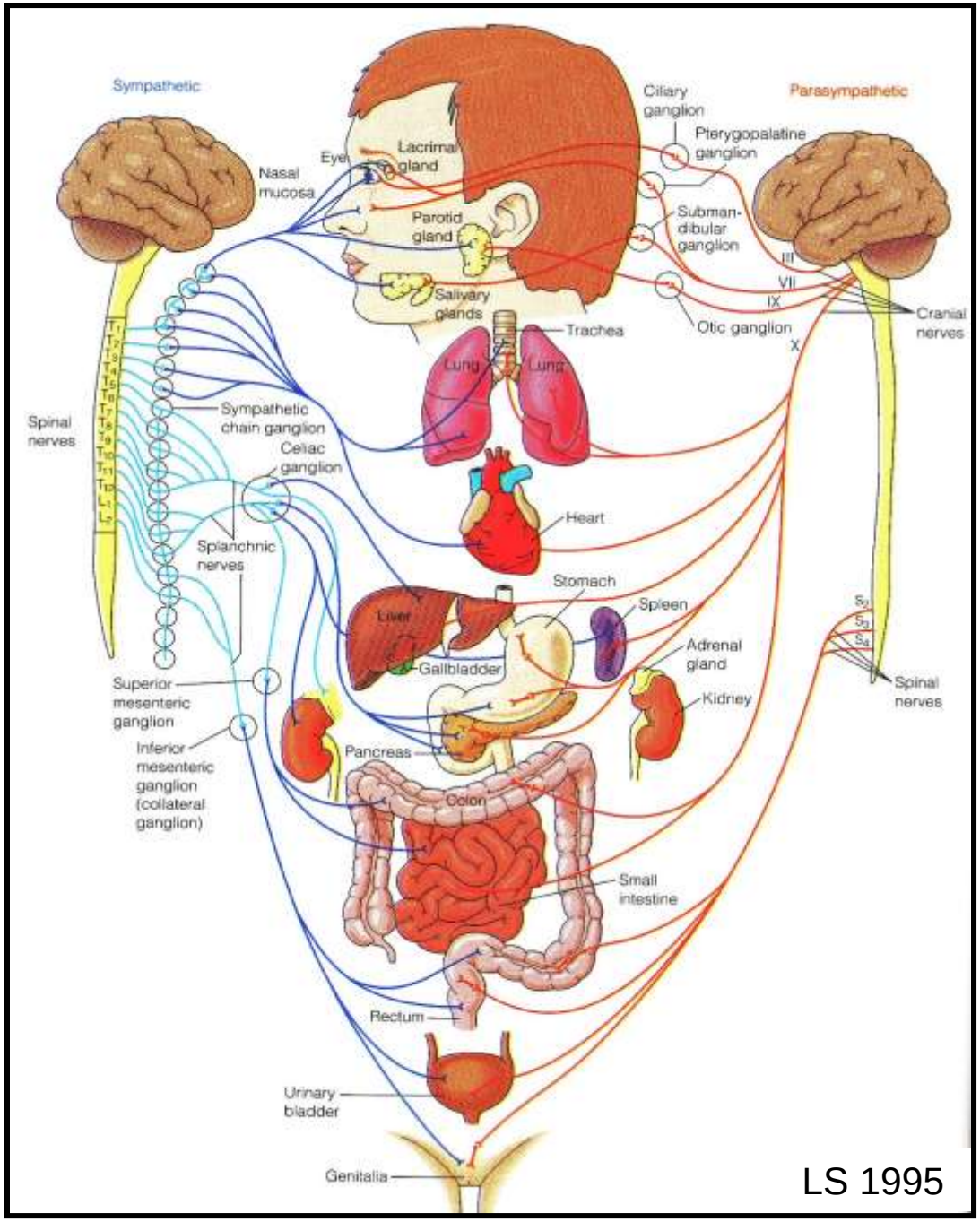
Fight-or-flight: Sympathetic activity dominates.

D Silverthorn 2010

Autonomic Nervous System

Why overlap or dual innervation?

Fine-tune control & safety!



cf: LS 2012 fig 7-3

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

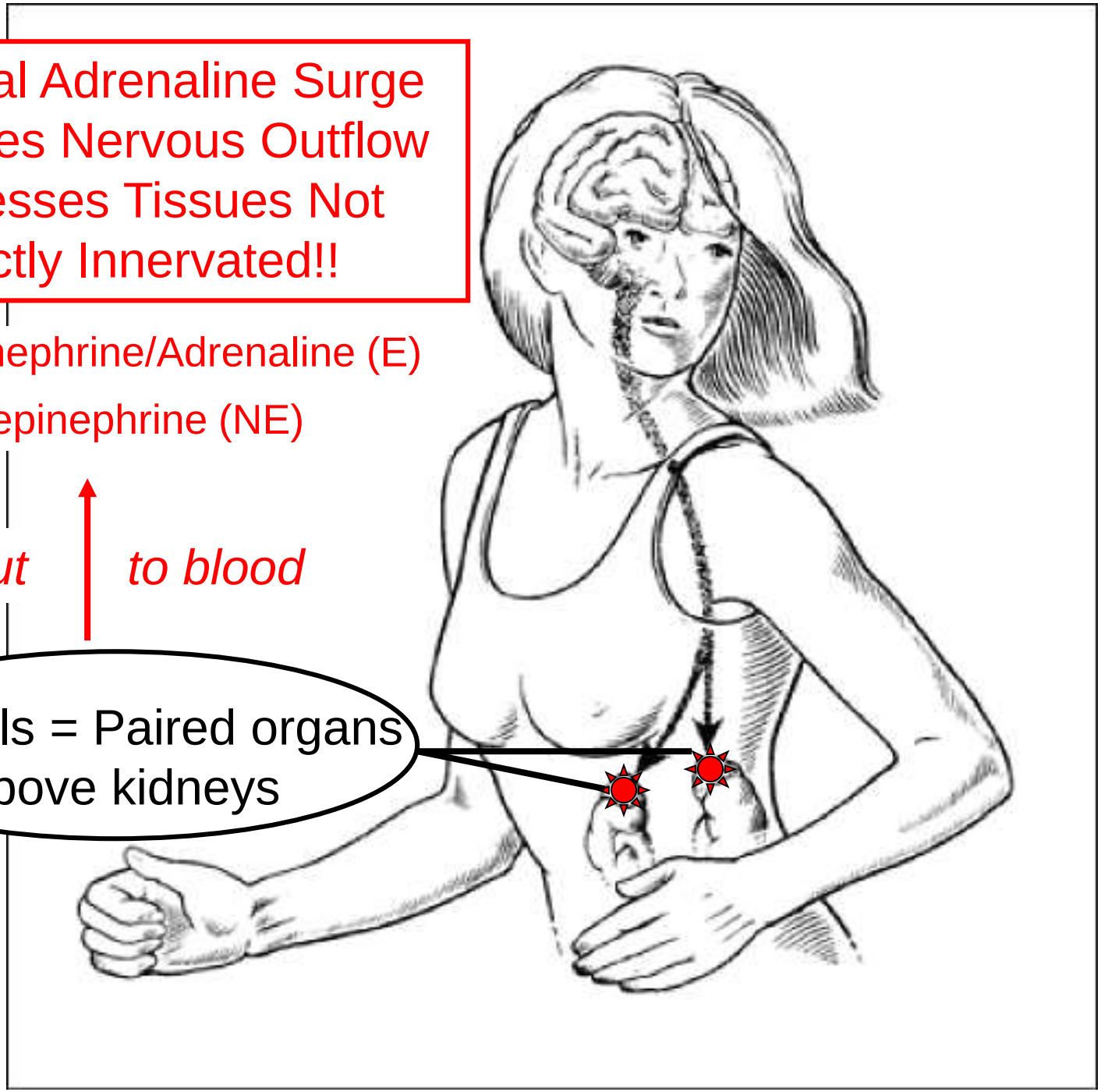
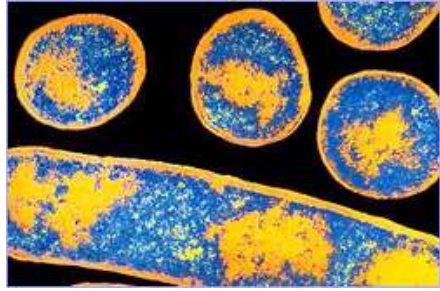
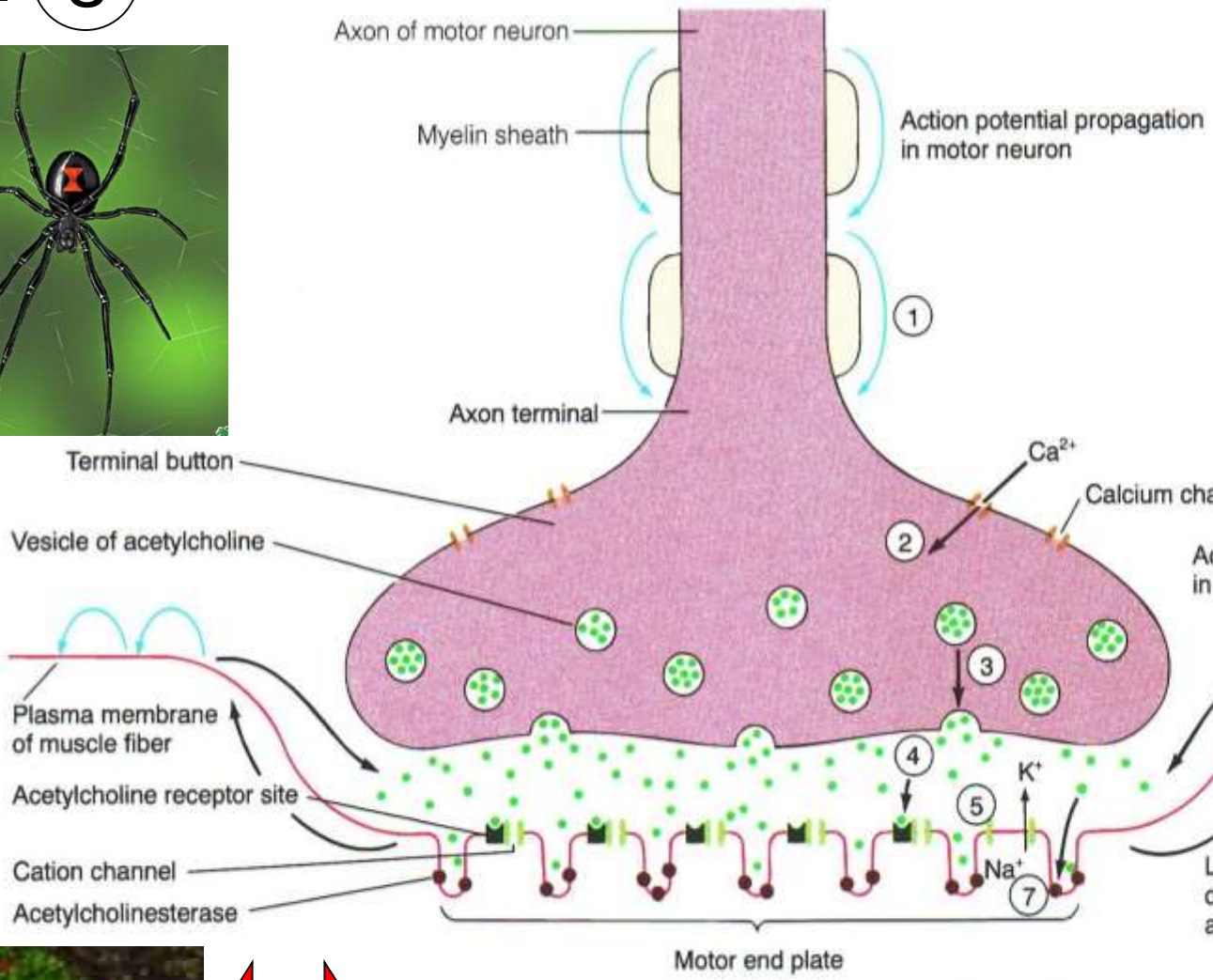


Table 7-1 Effects of Autonomic Nervous System on Various Organs

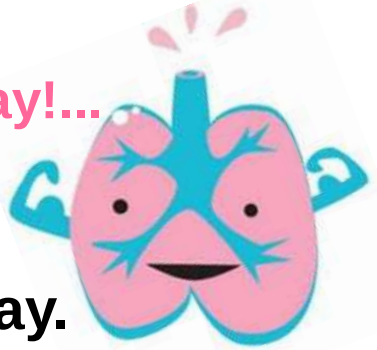
Organ	Effect of Sympathetic Stimulation	Effect of Parasympathetic Stimulation
Heart	Increases heart rate and increases force of contraction of the whole heart	Decreases heart rate and decreases force of contraction of the atria only
Blood Vessels	Constricts	Dilates vessels supplying the penis and the clitoris only
Lungs	Dilates the bronchioles (airways)	Constricts the bronchioles
Digestive Tract	Decreases motility (movement)	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




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

Pulmonary Function Testing today! Hooray!...



BI 121 Lecture 13

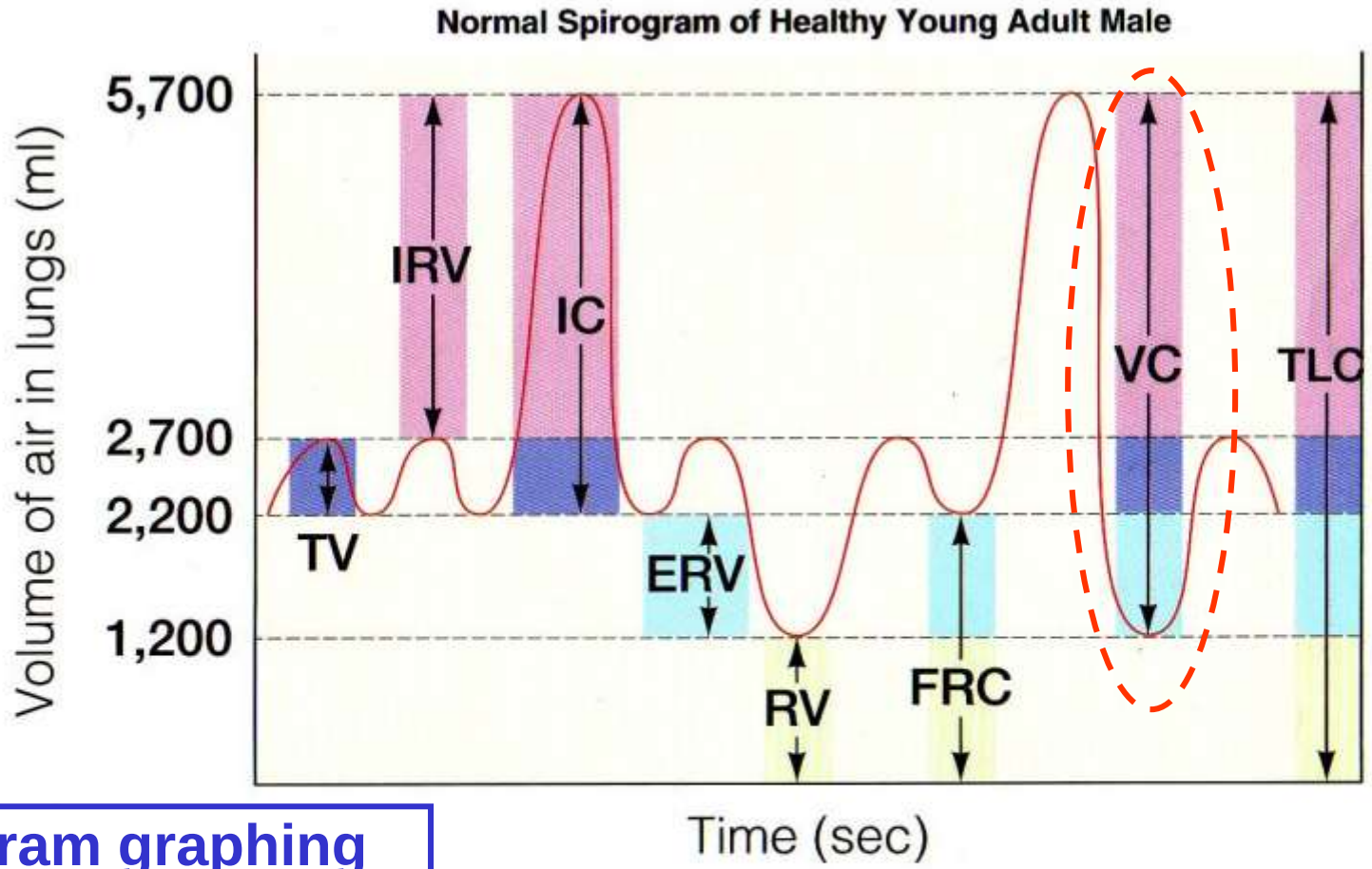
I. ***Announcements*** **Optional notebook ✓ + Lab 6 today. Pulmonary Function Testing. Final exam > your Q on Wed. Q?**

II. ***Pulmonary Function Lab Overview***

III. ***Neuromuscular Junction Overview*** **LS pp 186-92, DC pp 69-70**

IV. ***Muscle Structure, Function & Adaptation*** **LS ch 8, DC Module 12**

- **A. Muscle types: cardiac, smooth, skeletal LS fig 8-1 p 194-6**
- **B. How is skeletal muscle organized? LS fig 8-2, DC fig 12-2**
- **C. What do thick filaments look like? LS fig 8-4, DC fig 12-4**
- **D. How about thin filaments? LS fig 8-5**
- **E. Banding pattern? LS fig 8-3, fig 8-7**
- **F. How do muscles contract? LS fig 8-6, 8-10**
- **G. What's a cross-bridge cycle? LS fig 8-11 +…**
- **H. Summary of skeletal muscle contraction**
- **I. Exercise adaptation variables: *mode*, *intensity*, *duration*, *frequency*, *distribution*, *individual* & environmental char...?**
- **J. 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)

Links That May Be Helpful!

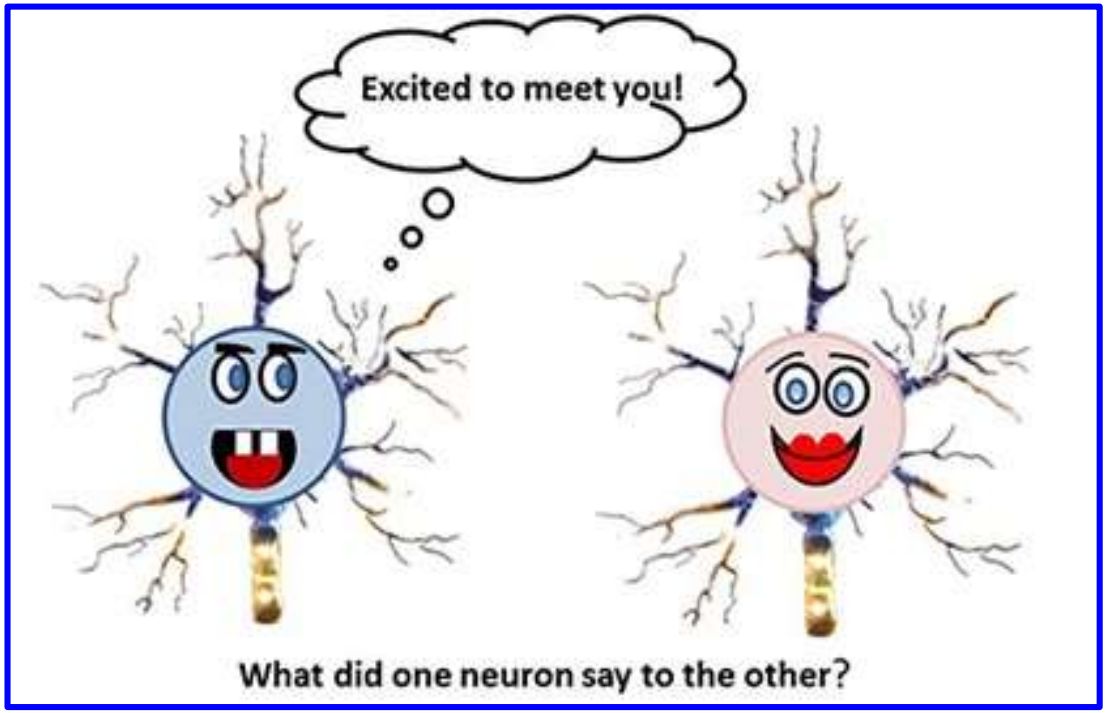
https://www.youtube.com/watch?v=6RbPIOq0O3w

https://www.youtube.com/watch?v=mItV4rC57kM

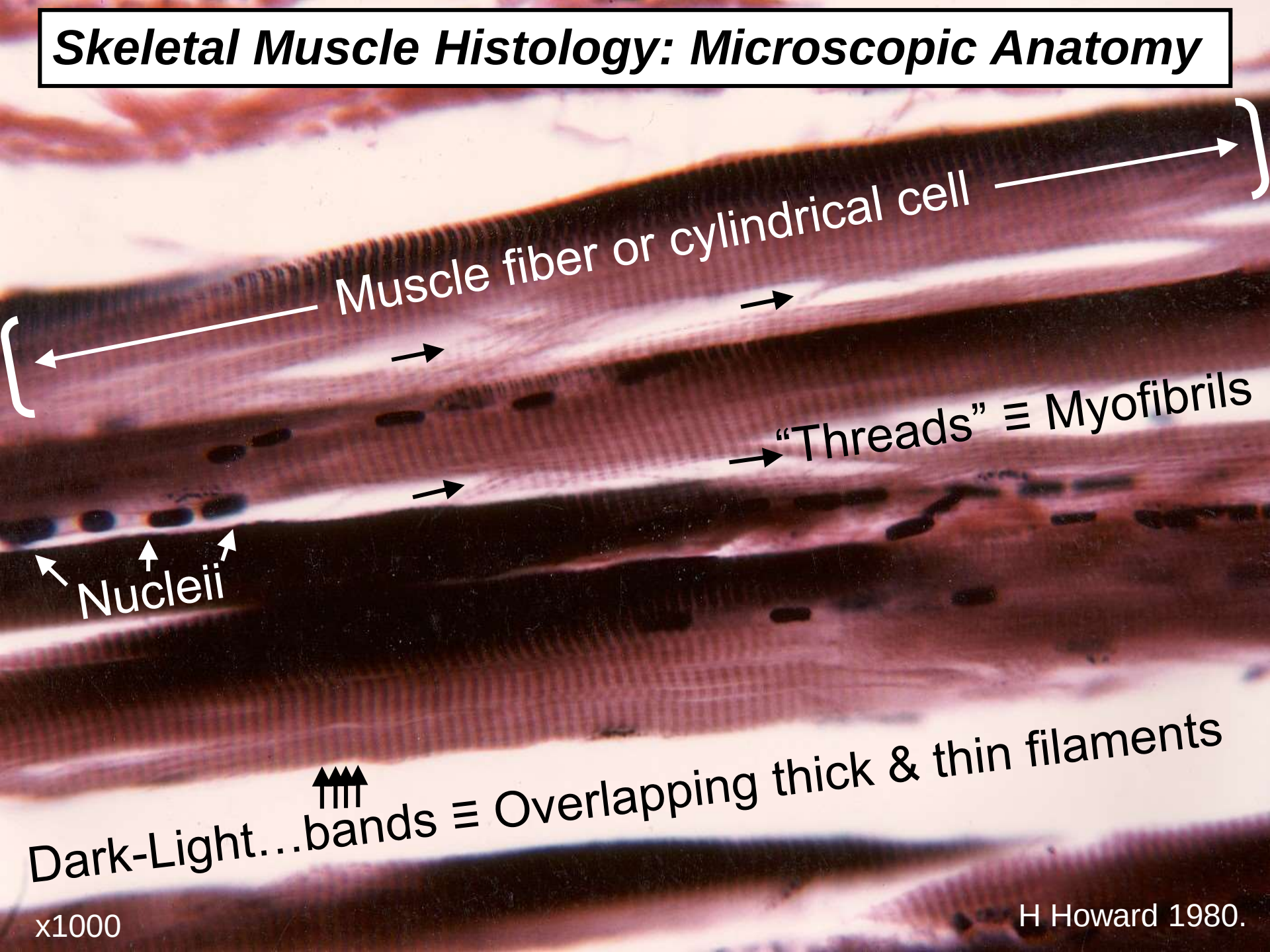
https://www.youtube.com/watch?v=WhowH0kb7n0

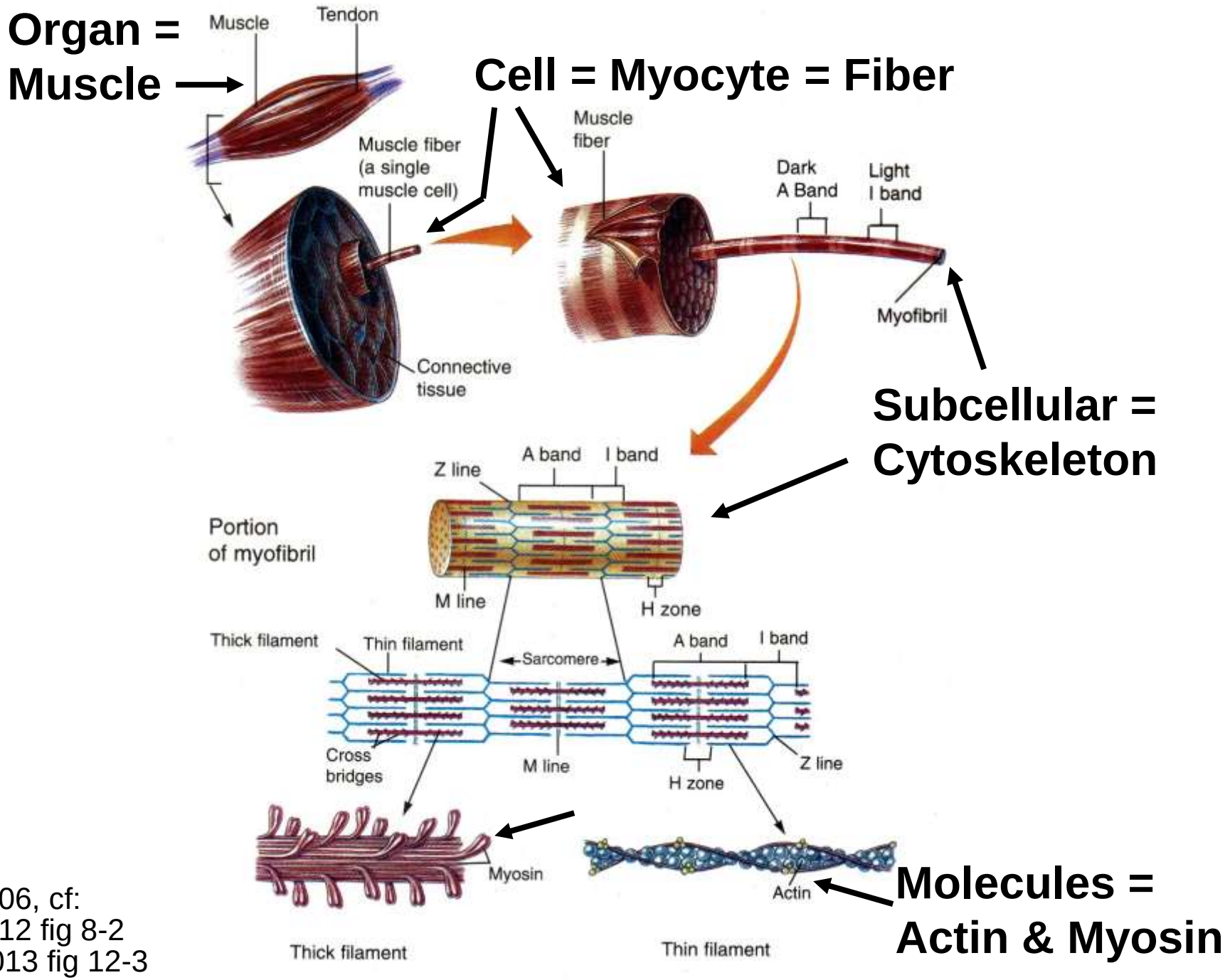
http://sites.sinauer.com/psychopharm2e/animation03.01.html

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

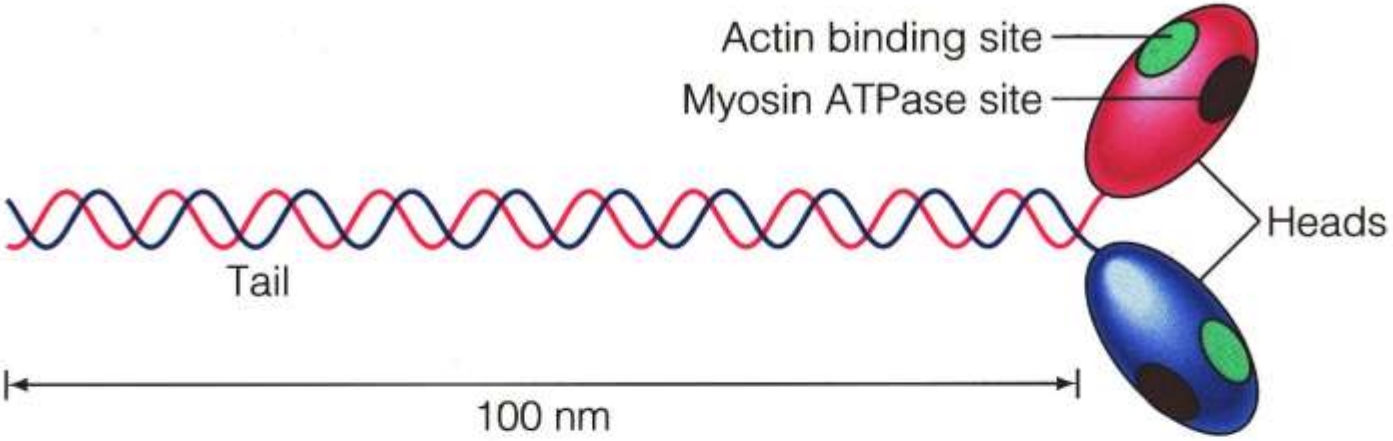


Skeletal Muscle Histology: Microscopic Anatomy



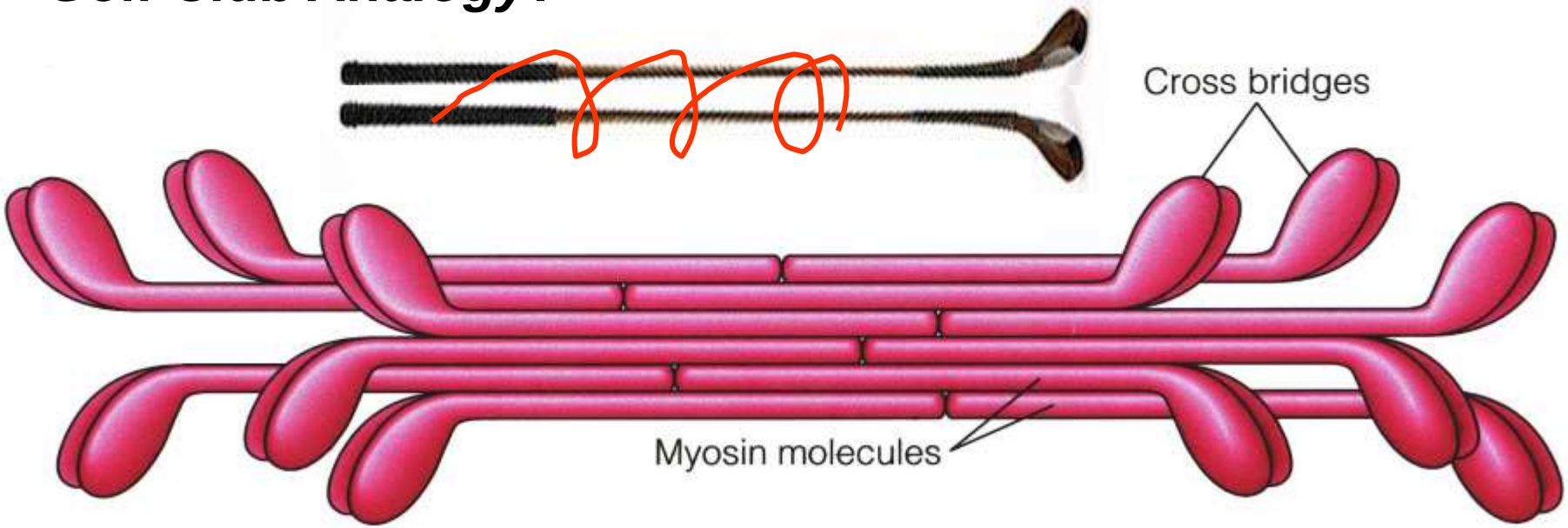


LS 2006, cf:
LS 2012 fig 8-2
DC 2013 fig 12-3



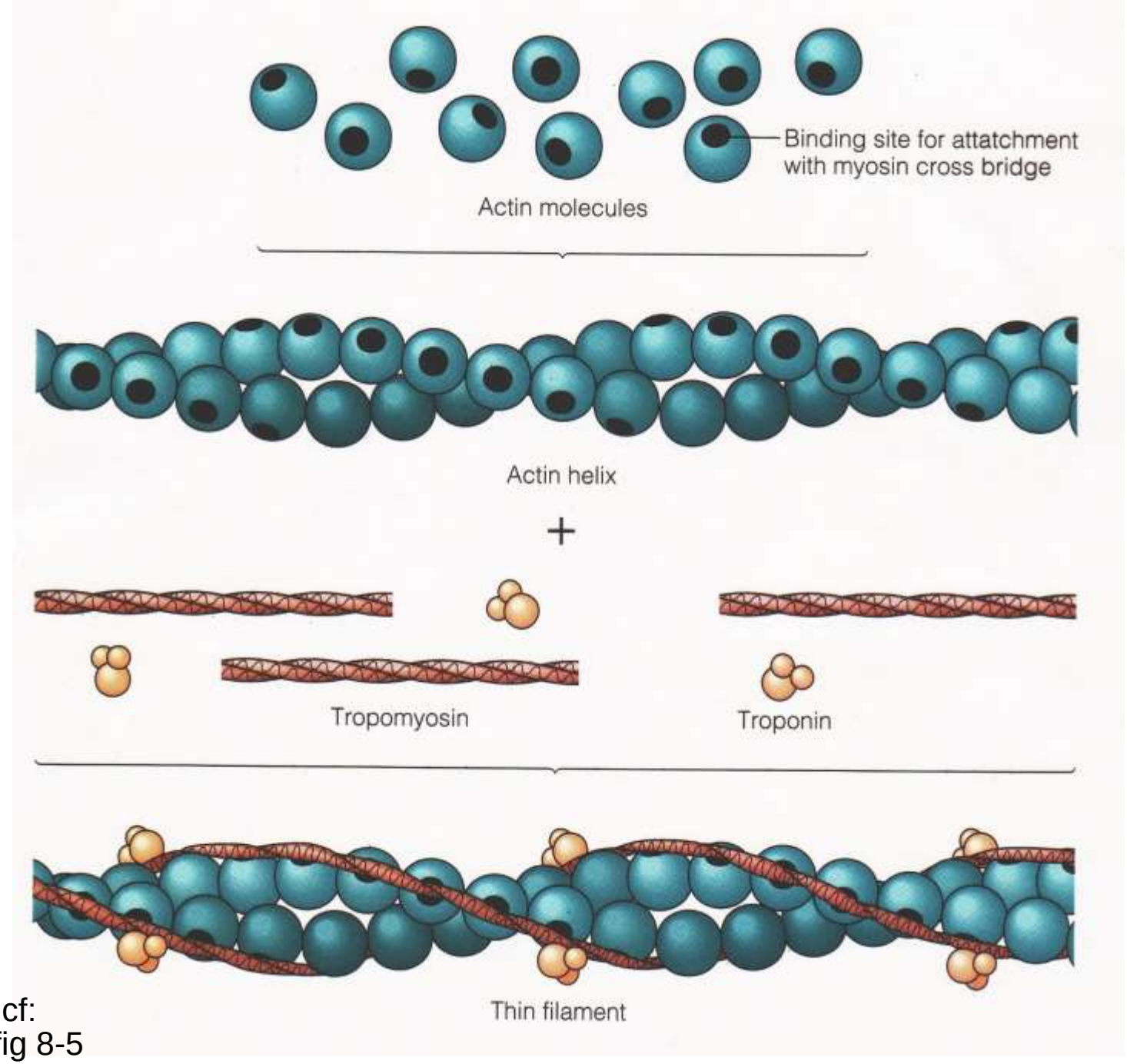
(a)

Golf Club Analogy?

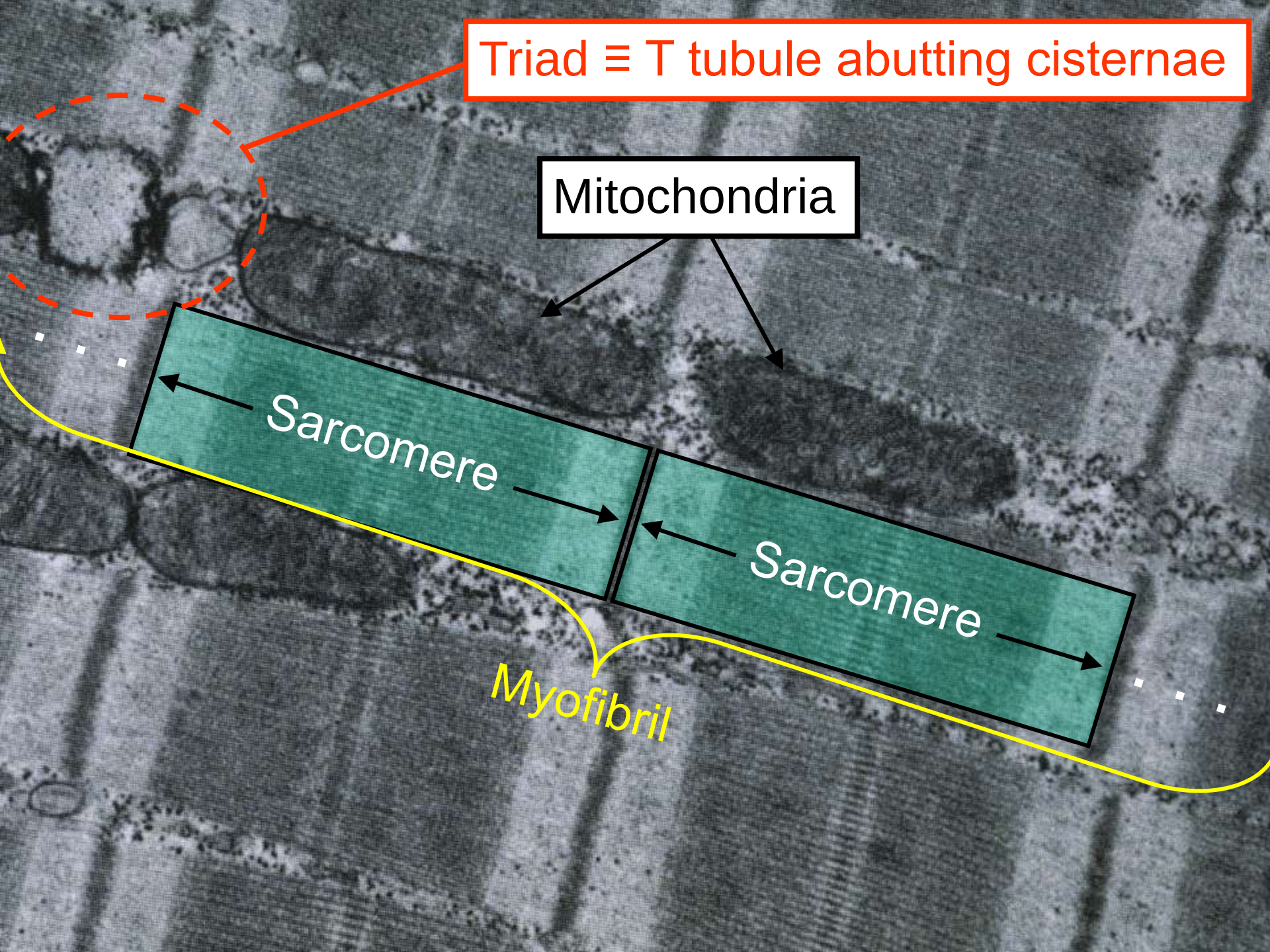


(b)

LS 2006, cf:
LS 2012 fig 8-4

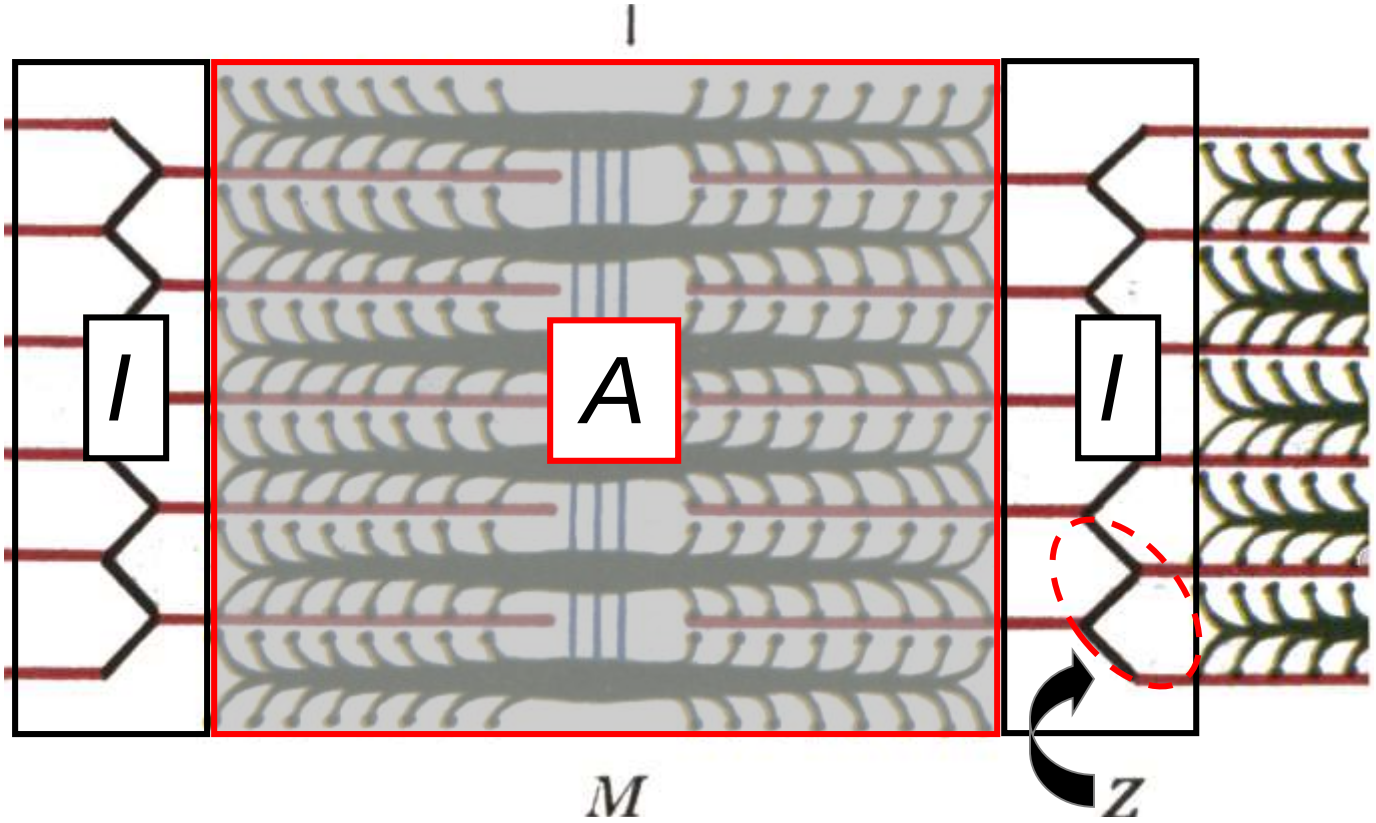


LS 2006, cf:
LS 2012 fig 8-5


Triad ≡ T tubule abutting cisternae
Mitochondria
Sarcomere
Sarcomere
Myofibril

A Band = Dark Band

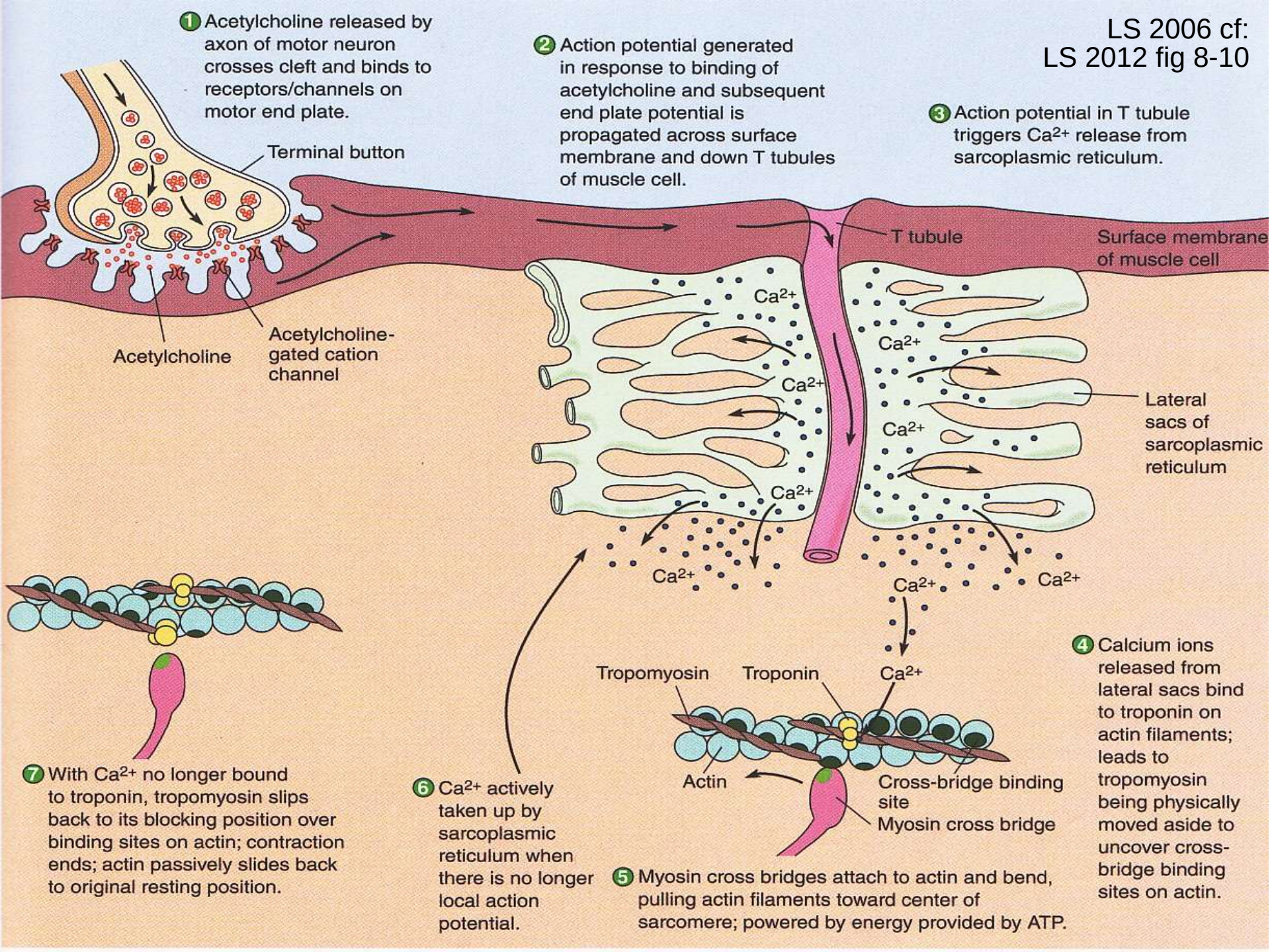
*A*nisotropic = Light Can't Shine Through



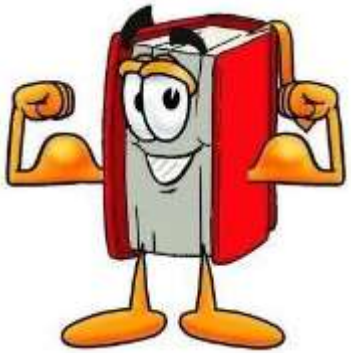
I Band = Light Band

*I*sotropic = Light Can Shine Through

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

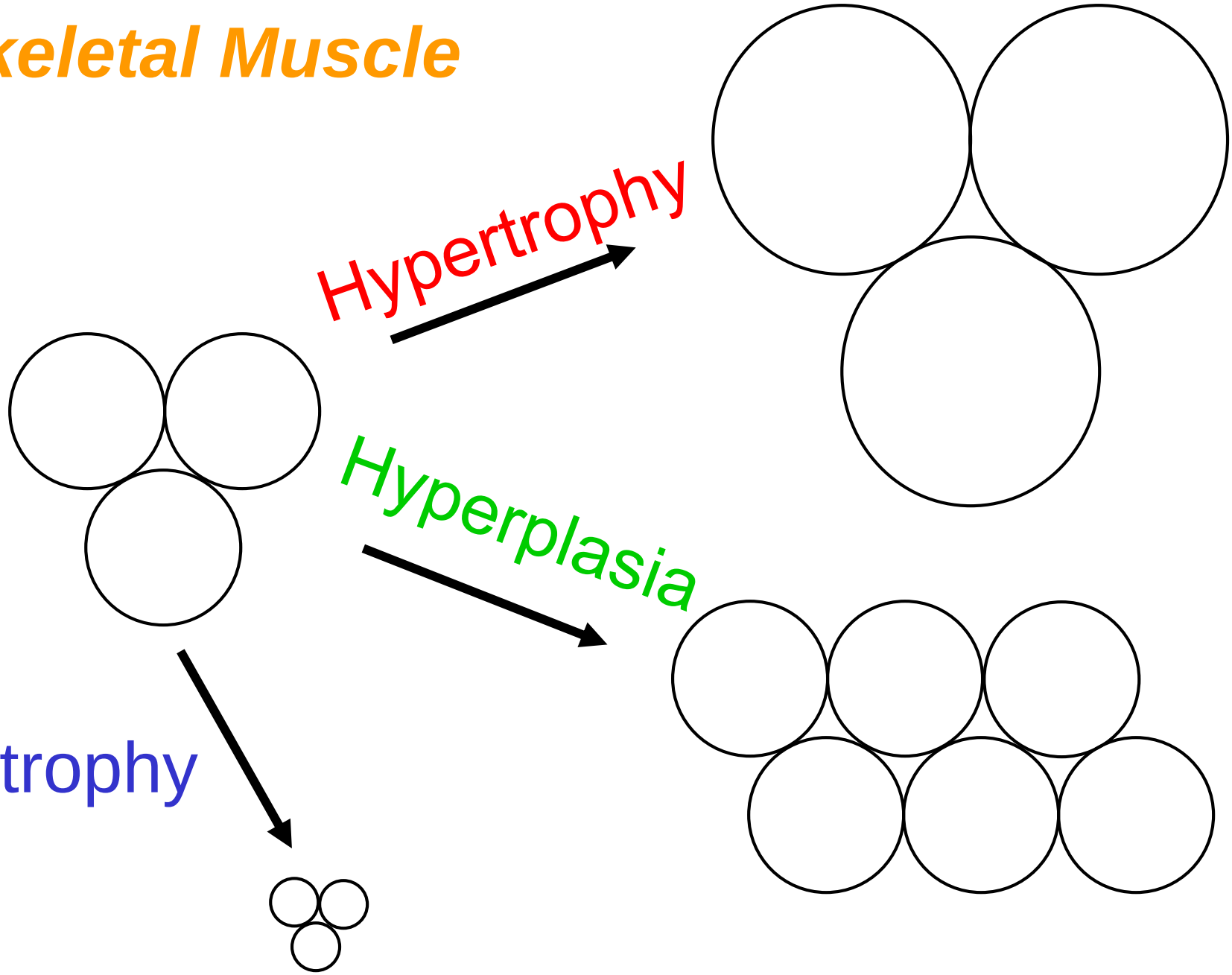
https://ed.ted.com/lessons/what-makes-muscles-grow-jeffrey-siegel

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/

Skeletal Muscle



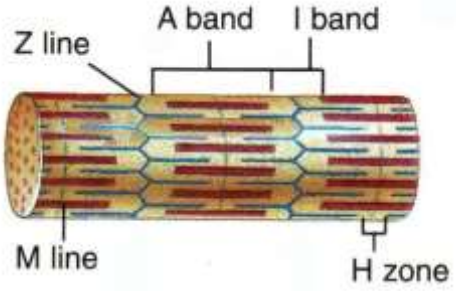
Myofibril

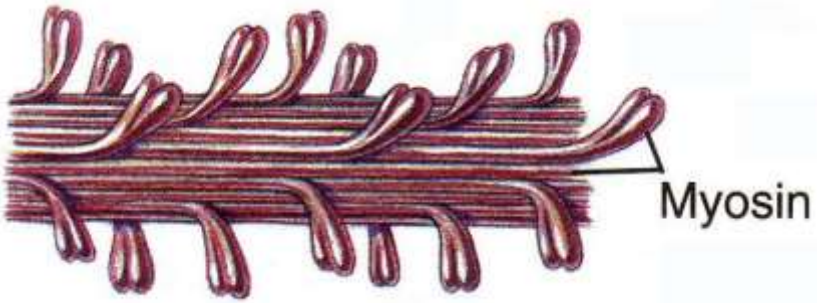
Hypertrophy: *Increased*

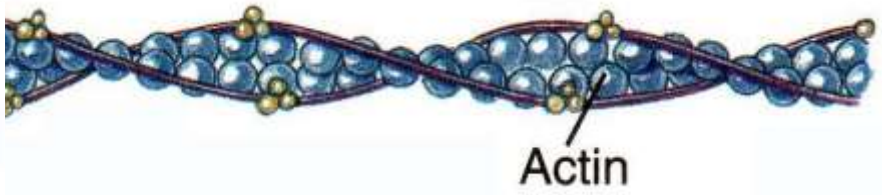
Number of Myofibrils

Thick & Thin Filaments

Myosin & Actin Molecules

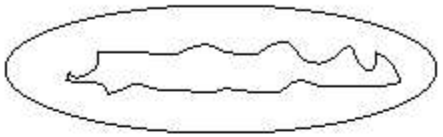






AEROBIC w/O_2

ANAEROBIC



MITOCHONDRIA

CYTOSOL

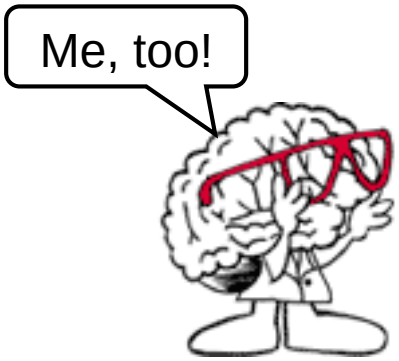
Glycolysis

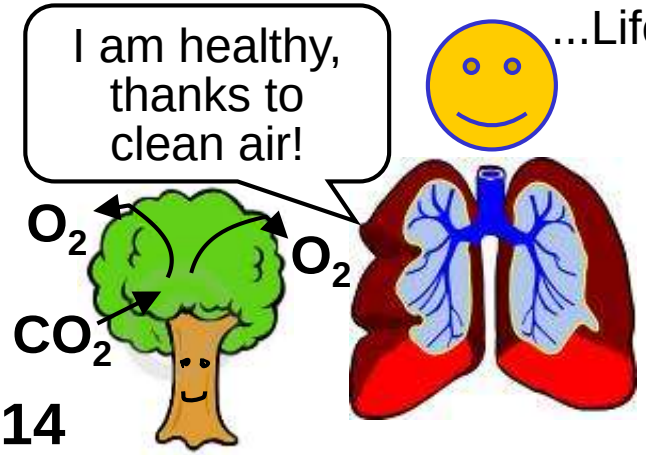
Immediate/ATP-PC

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

Changes in Muscle Due to Endurance Training

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





BI 121 Lecture 14

I. ***Announcements*** **Optional notebook check today. Discussion-Review followed by final exam tomorrow. Q?**

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

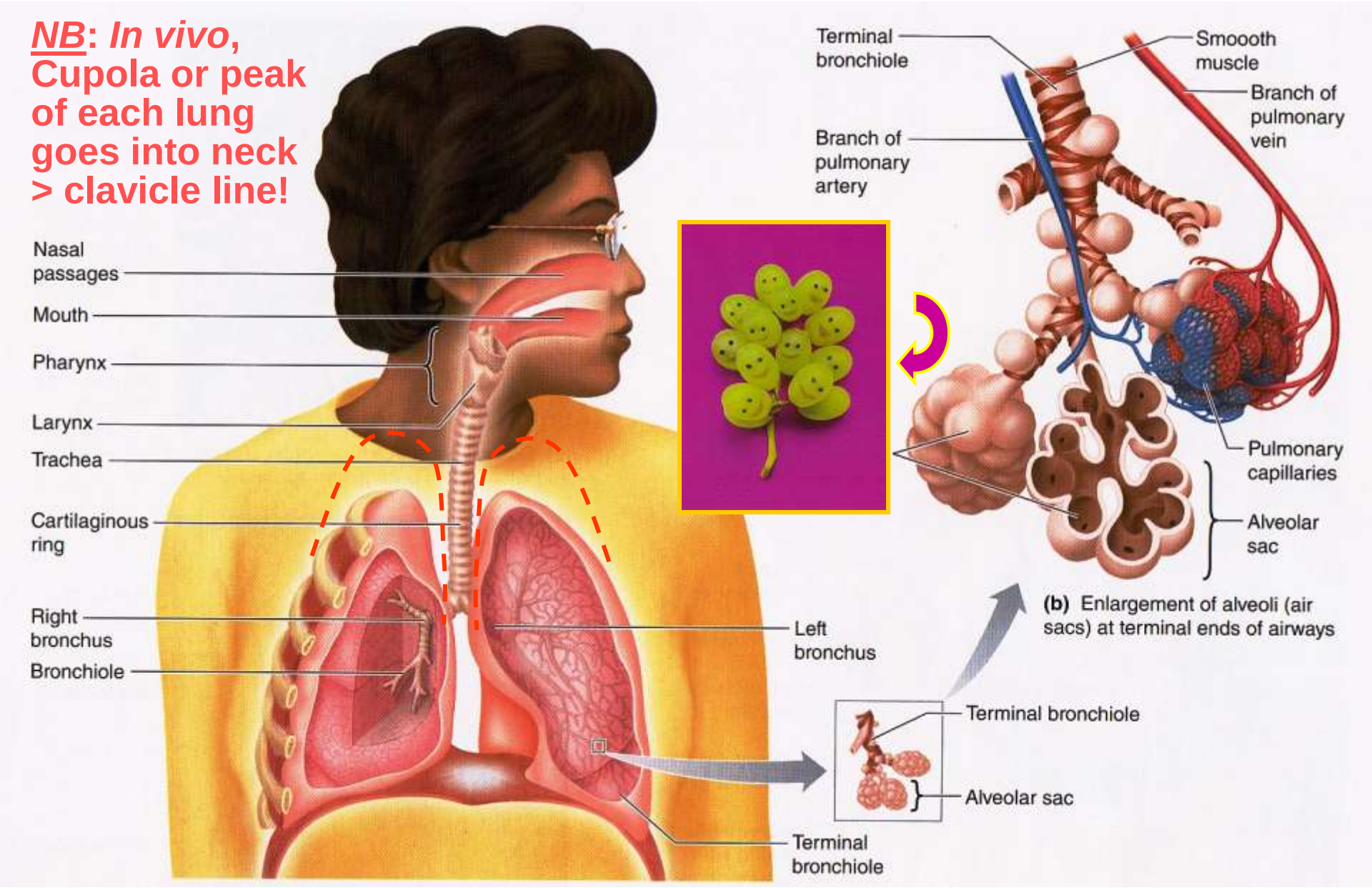
- **A. Steps of respiration? External *vs.* cellular/internal? LS fig 12-1 pp 345-7**
- **B. Respiratory system anatomy LS fig 12-2 p 347, DC, SI Fox+...**
- **C. Histology LS fig 12-4 pp 347-9, DC fig 7-4 p 54**
- **D. How do we breathe? LS fig12-12, fig12-25 pp 349-56, 373-8**
- **E. Gas exchange LS fig 12-19 pp 362-5**
- **F. Gas transport LS tab 12-3 pp 365-70**

III.Physiology of Cigarette Smoking

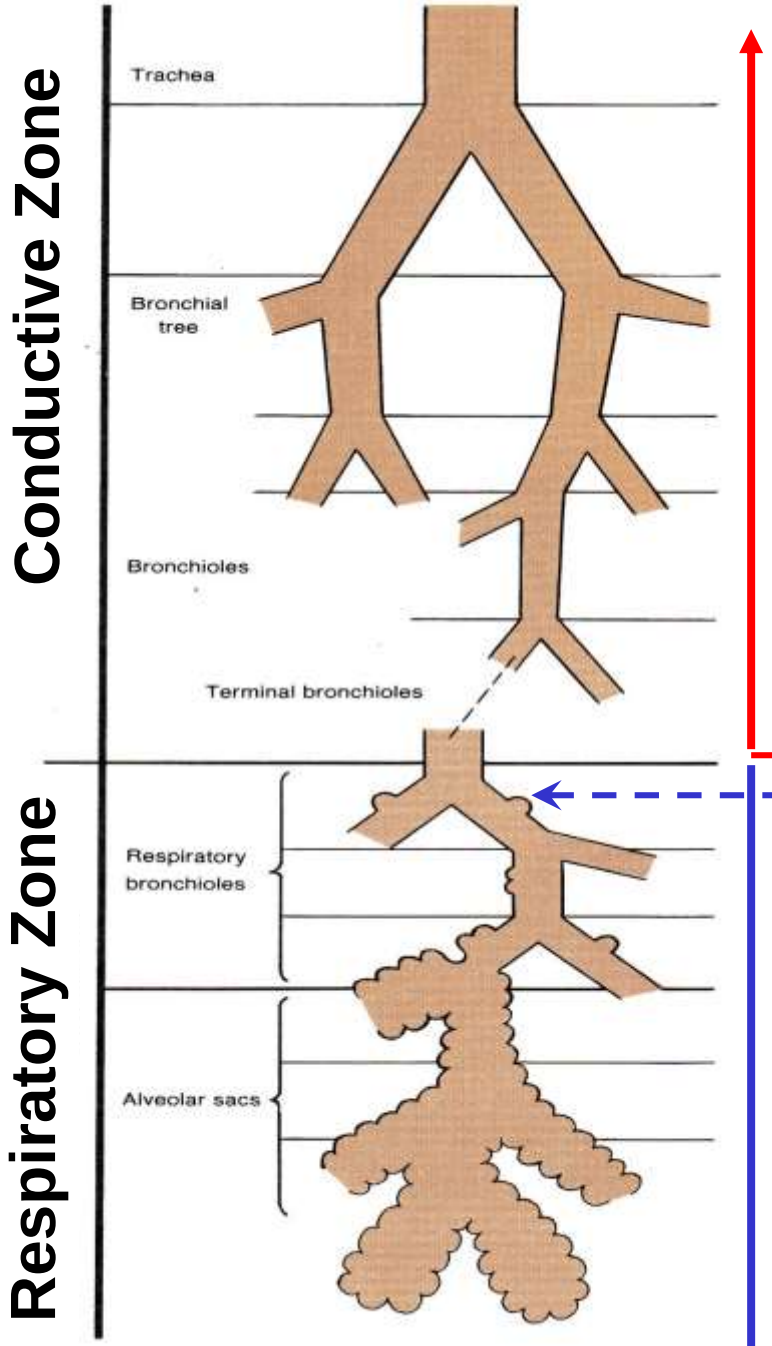
- **A. ANS, autonomic nerves & nicotine? Route of chemicals,...**
- **B. Emphysema? 2nd-hand smoke?... LS pp 356, 365**
- **C. UO Smoke-Free since Fall 2012! Help is available!**

Respiratory System Anatomy

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



LS 2012 fig 12-2

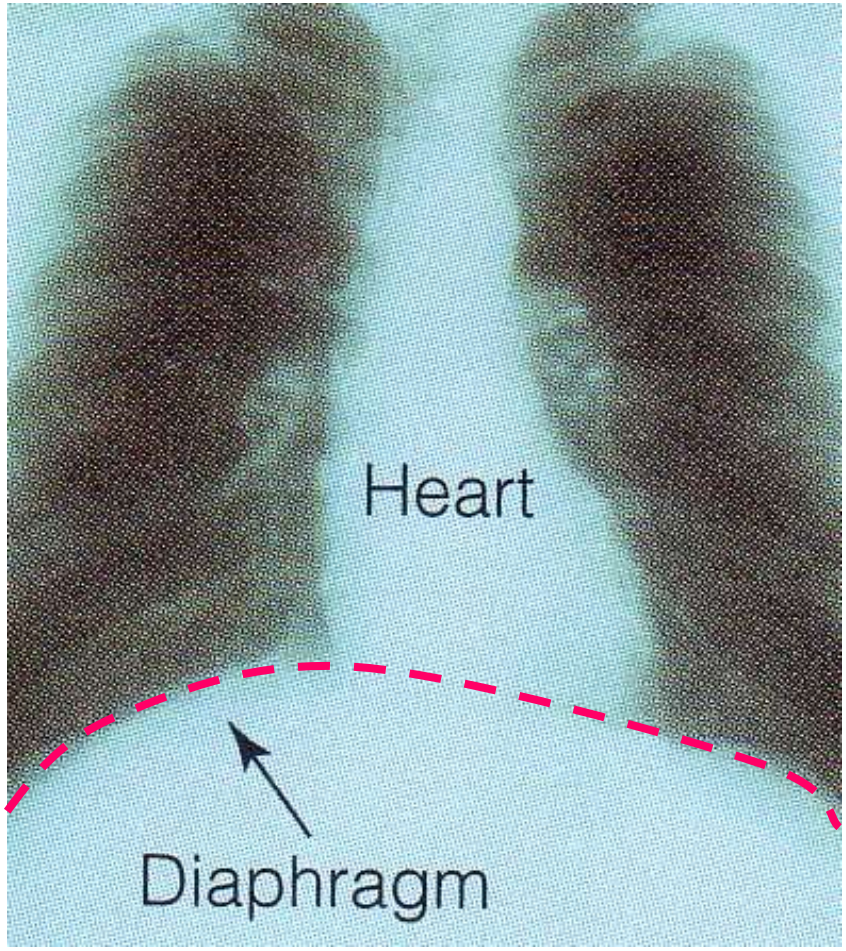


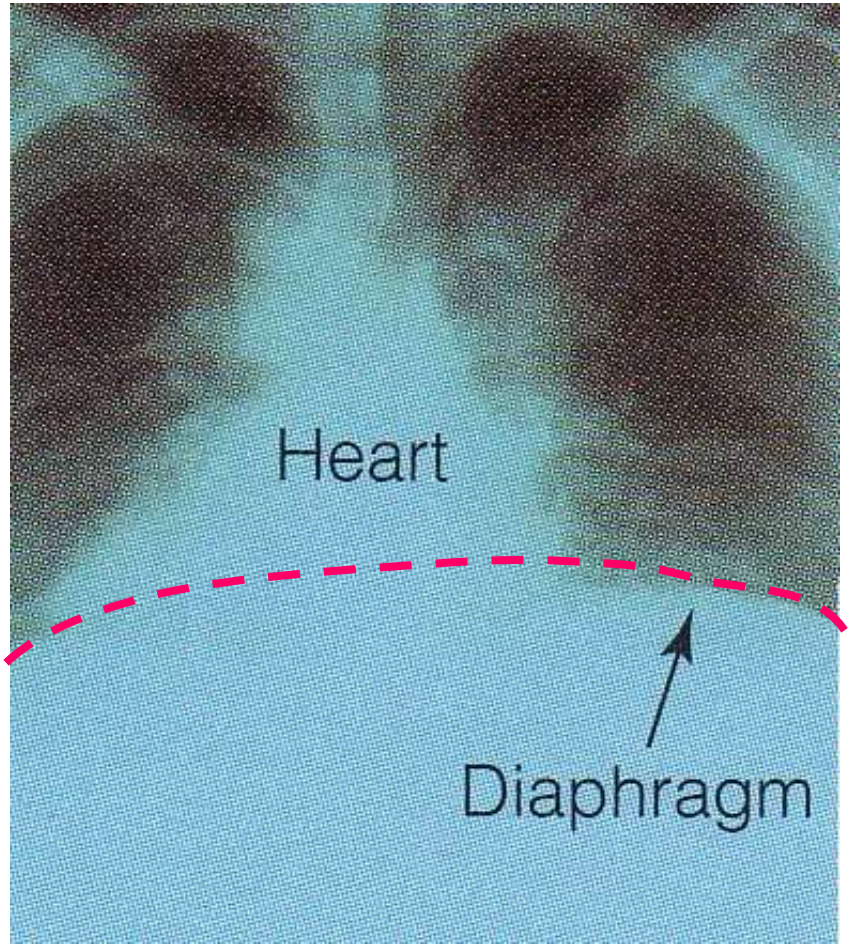
No Gas Exchange

1st alveolar outpouching!

Gas Exchange

SI Fox





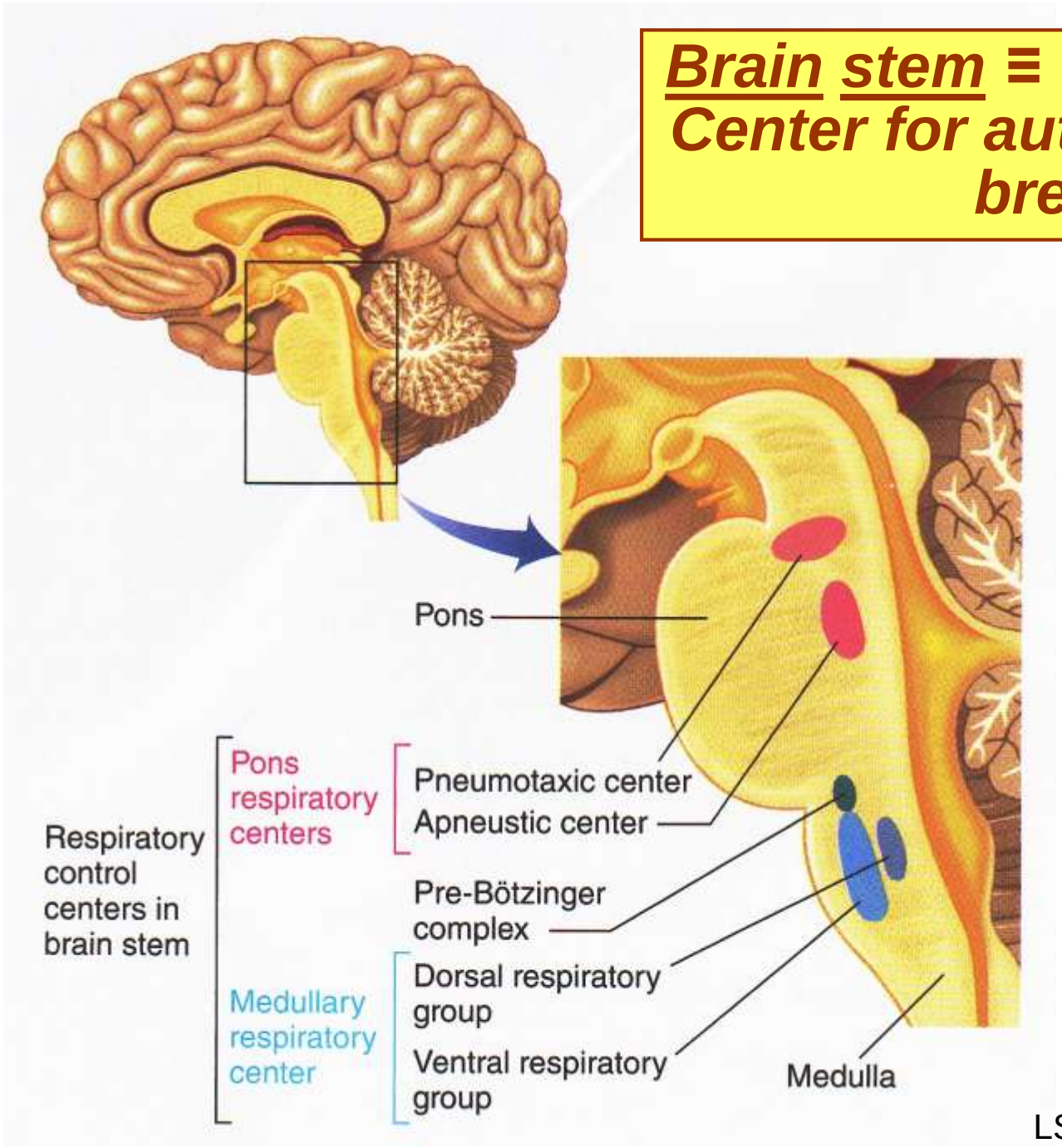
<u>Inhale</u> (active)

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

<u>Contract</u> & flatten diaphragm

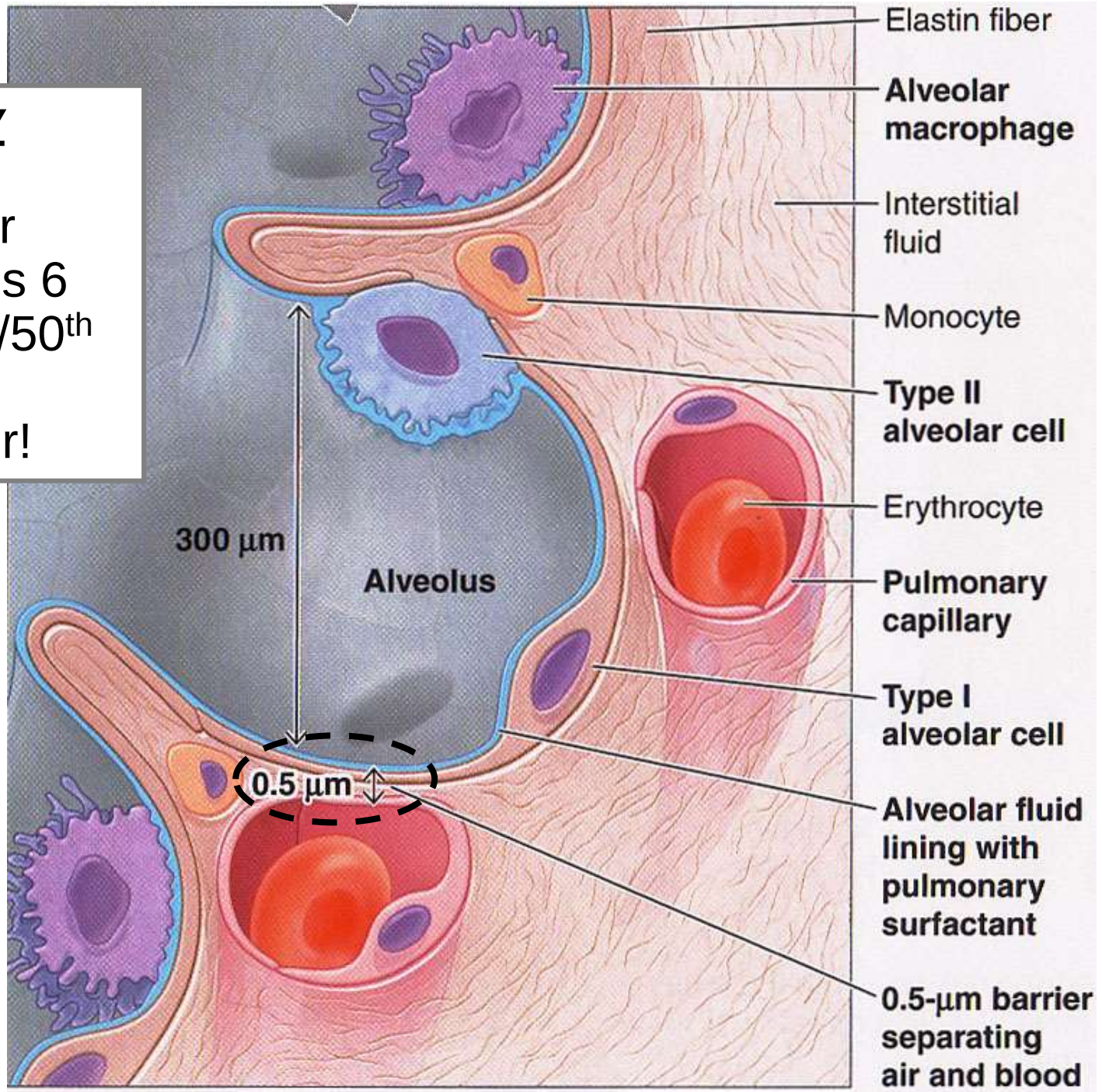
<u>Relax</u> & pouch up diaphragm!

Brain stem ≡ Control Center for automatic breathing!



LS 2012 fig 12-25

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

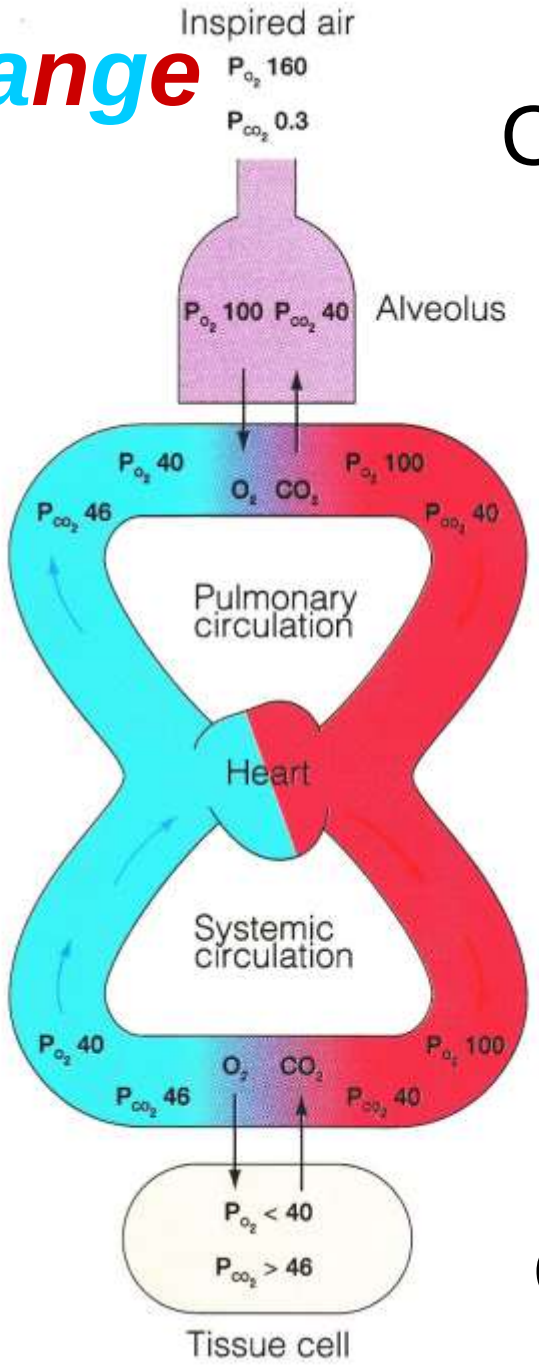


LS 2012 fig 12-4a
cf: DC 2013 fig 7-4

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)

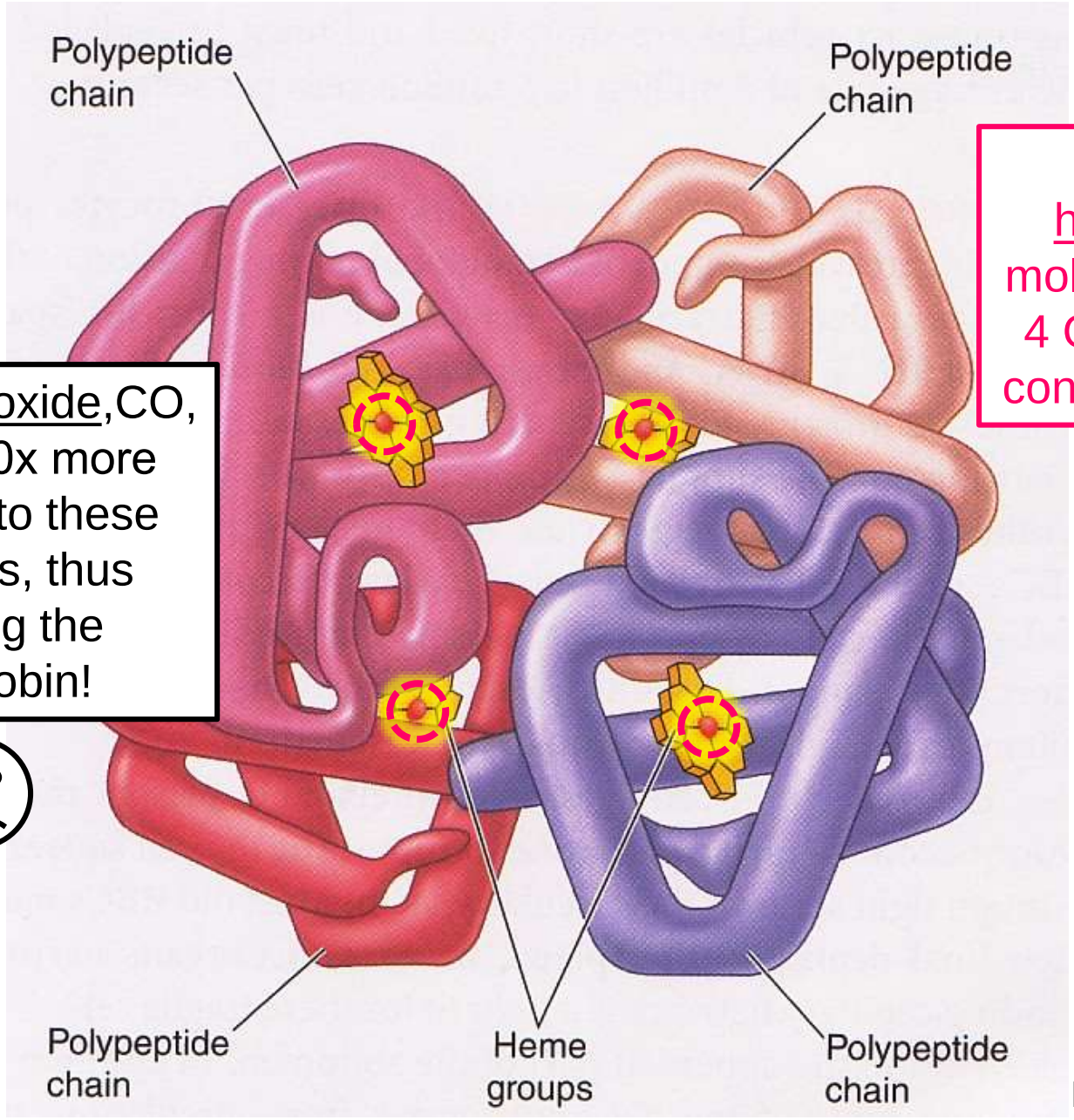
Numbers are mm Hg pressure.

CO_2 HIGH

O_2 LOW

cf: LS 2012 fig 12-19

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



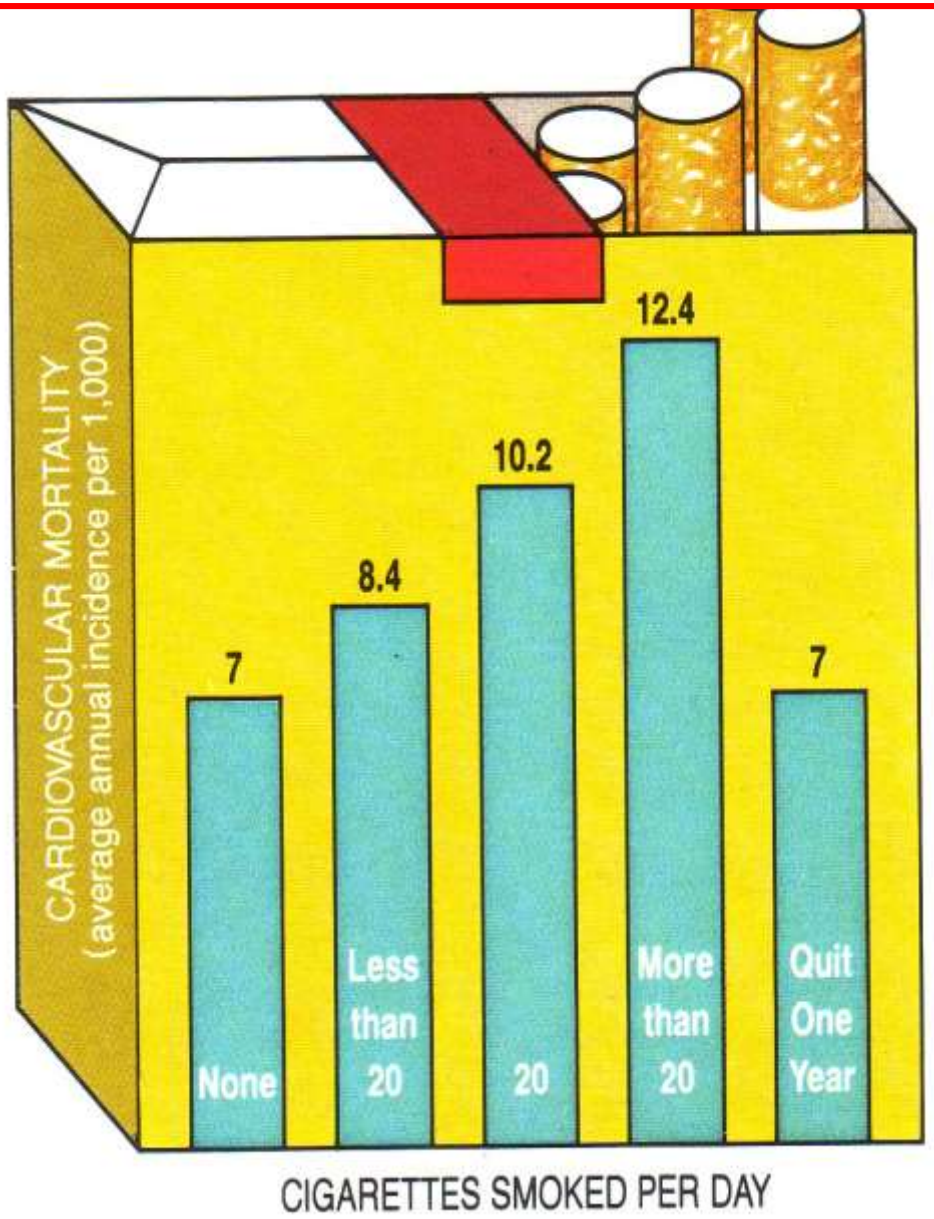
<u>Each hemoglobin</u> molecule carries 4 O_2 on 4 iron-containing disks!

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

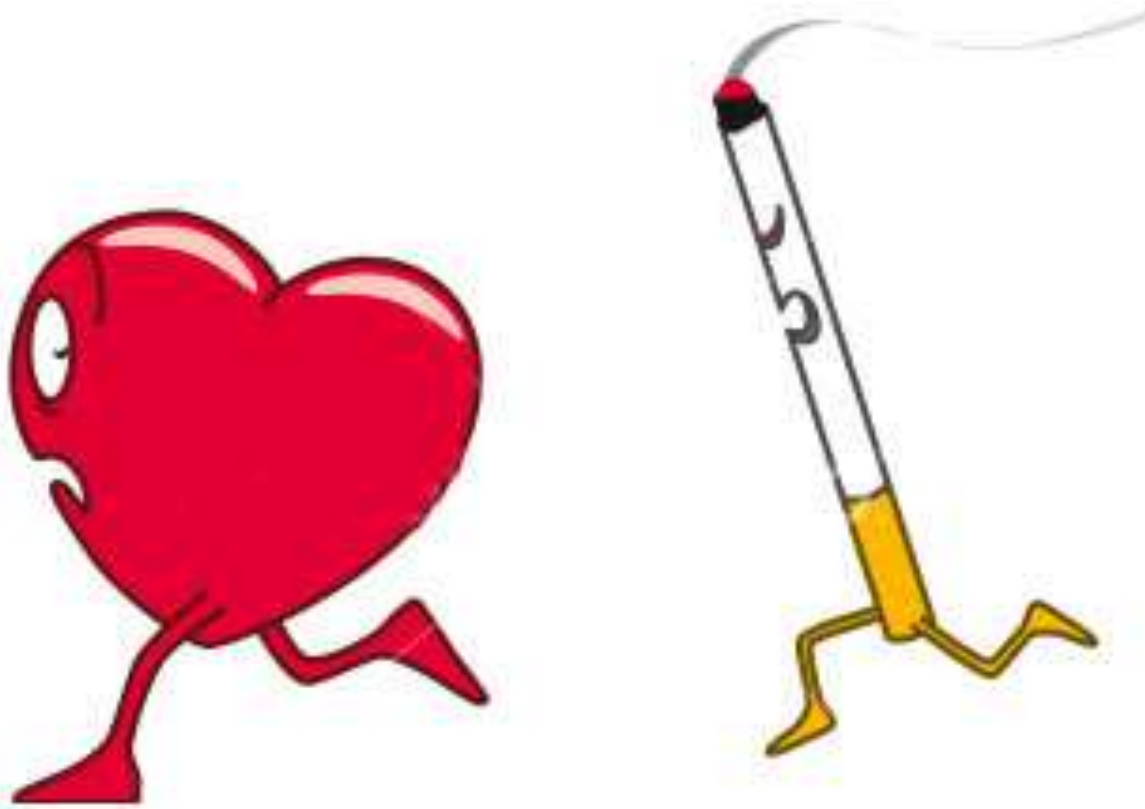
☹

LS 2012 fig 11-2

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

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 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*.**

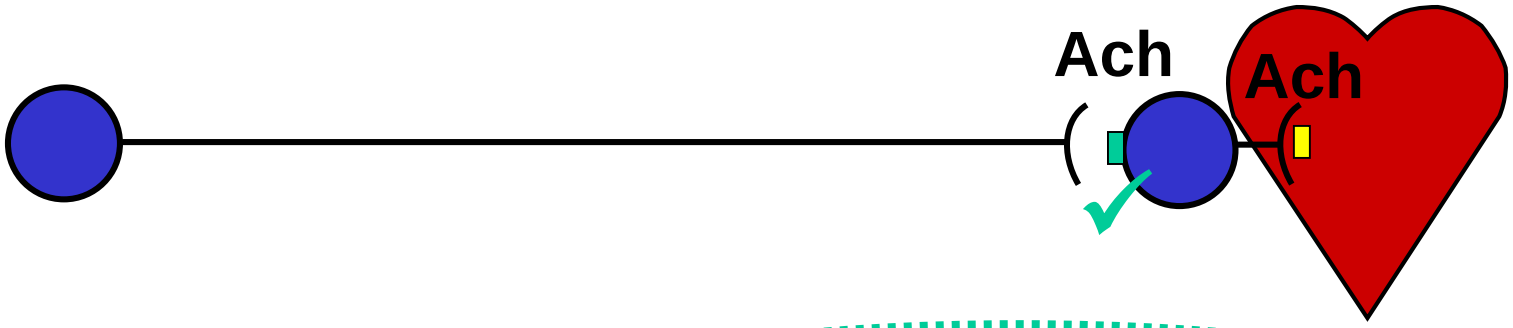
freebase nicotine!!

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

Parasympathetic

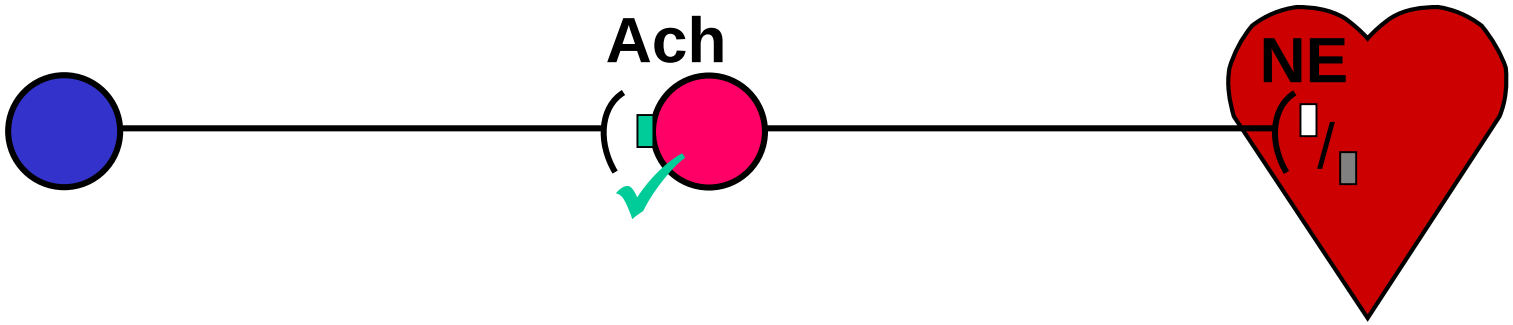


Ach = Acetylcholine

= Nicotinic Receptor

= Muscarinic Receptor

Sympathetic



NE = Norepinephrine

= α Receptor (α_1 , α_2)

= β Receptor (β_1 , β_2)

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

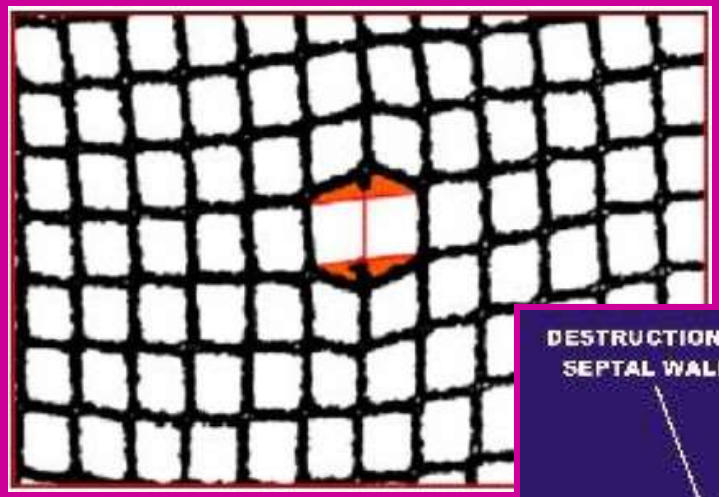
↓

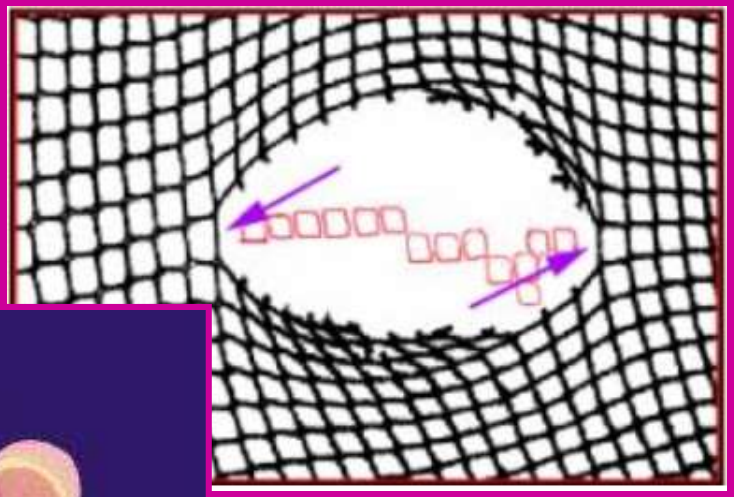
Brain

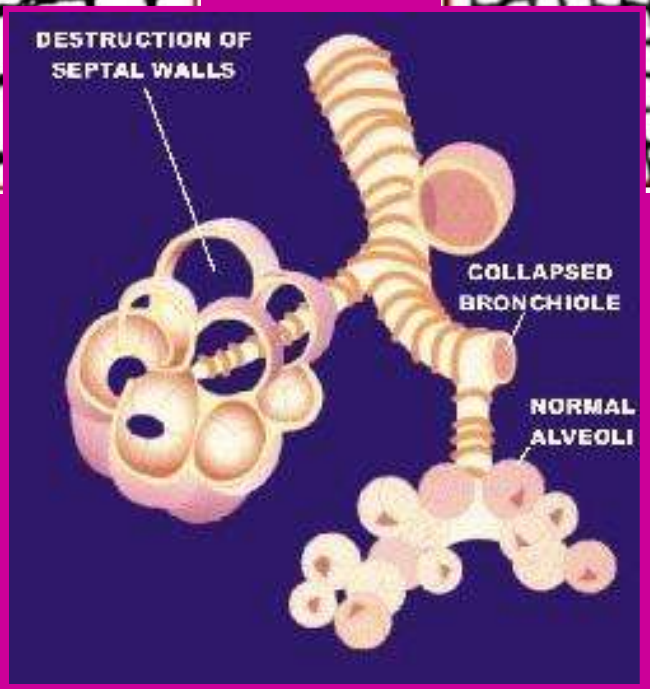
Systemic Circulation

Respiratory Membrane

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







Internet Journal of Pathology
Mayo Clinic Health

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

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

ScienceNews
MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC

News: Health, Toxicology, Pollution

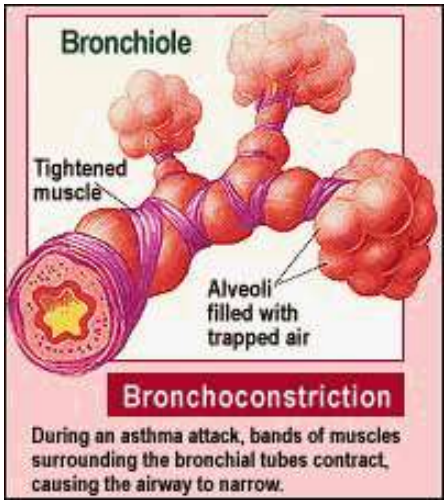
Health risks of e-cigarettes emerge

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.sciencenews.org/article/health-risks-e-cigarettes-emerge

SMOKING ≡ ASTHMA?



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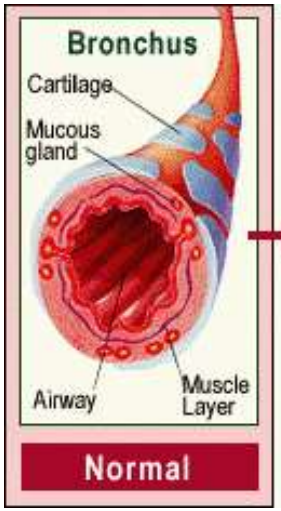

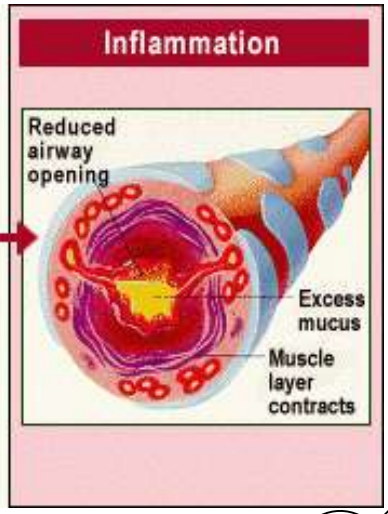

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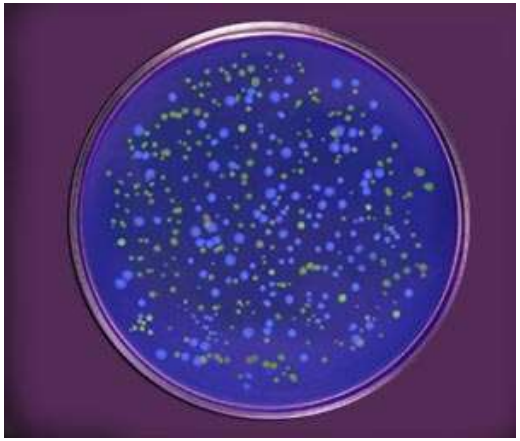

Petri-dish Effect