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**

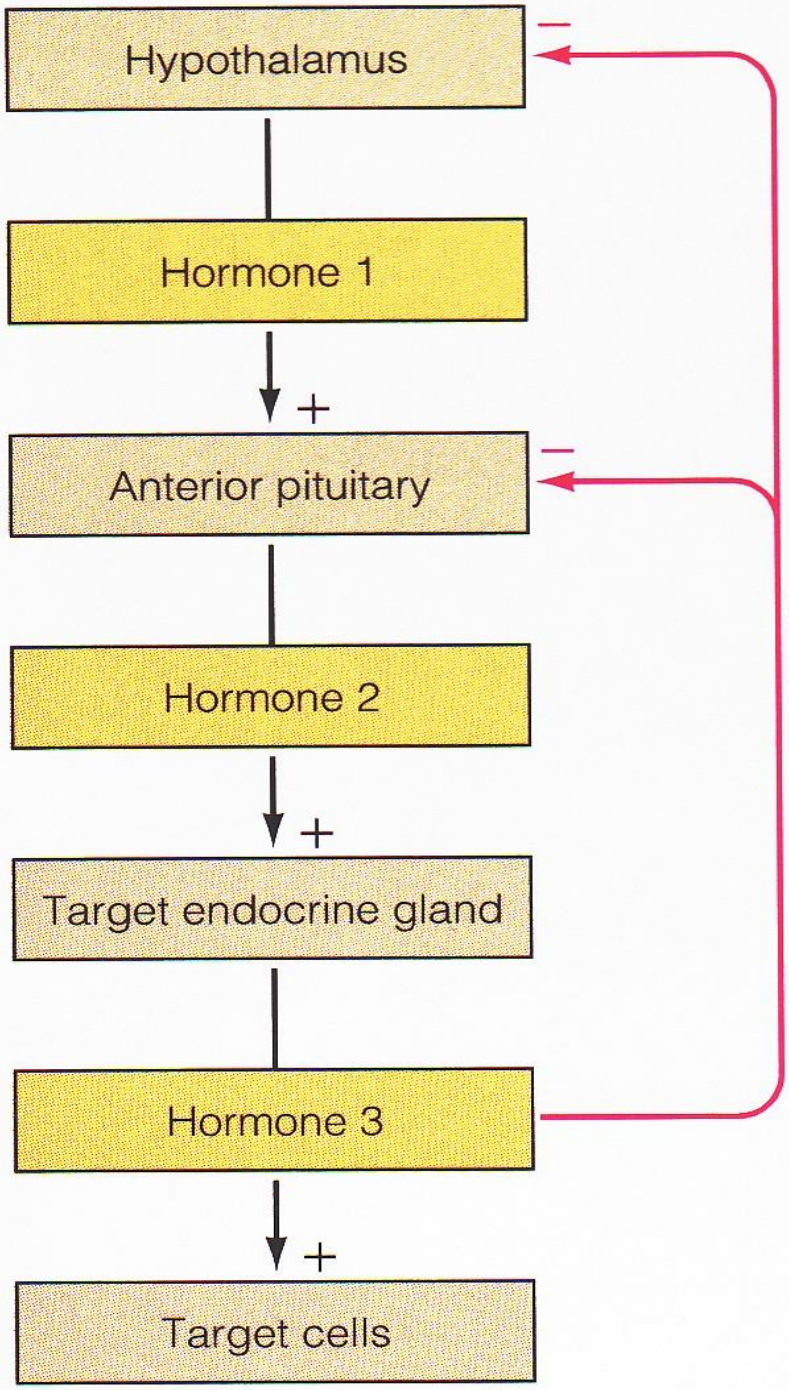
- **A. How is the nervous system organized? fig 5-1 p 108**
- **B. Neurons? What kind? fig 5-2 p 109**
- **C. Brain structure & function fig 5-7, 5-8 pp 116 – 7**
- **D. Protect your head with a helmet! Bicycle head injury statistics, NHTSA & BHSI**

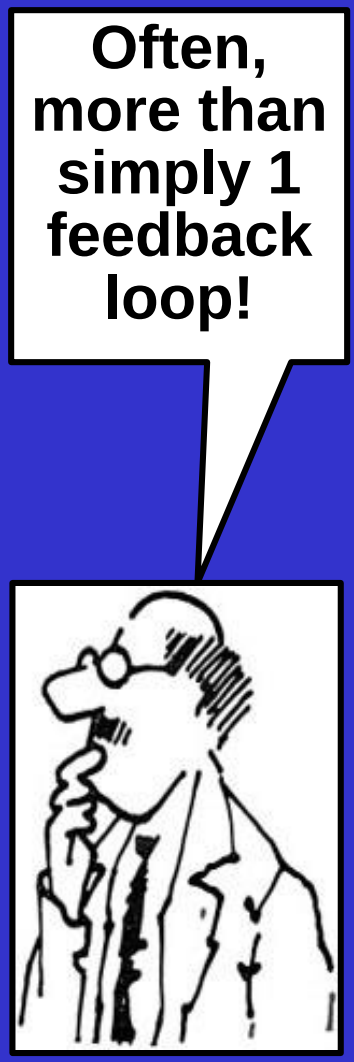
IV. ***Brain + Autonomic Nervous System Overview*** **DC pp 71-77, LS pp 178 – 85, tab 7-1 p 183 + Stories to remember *fight-or-flight!***

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

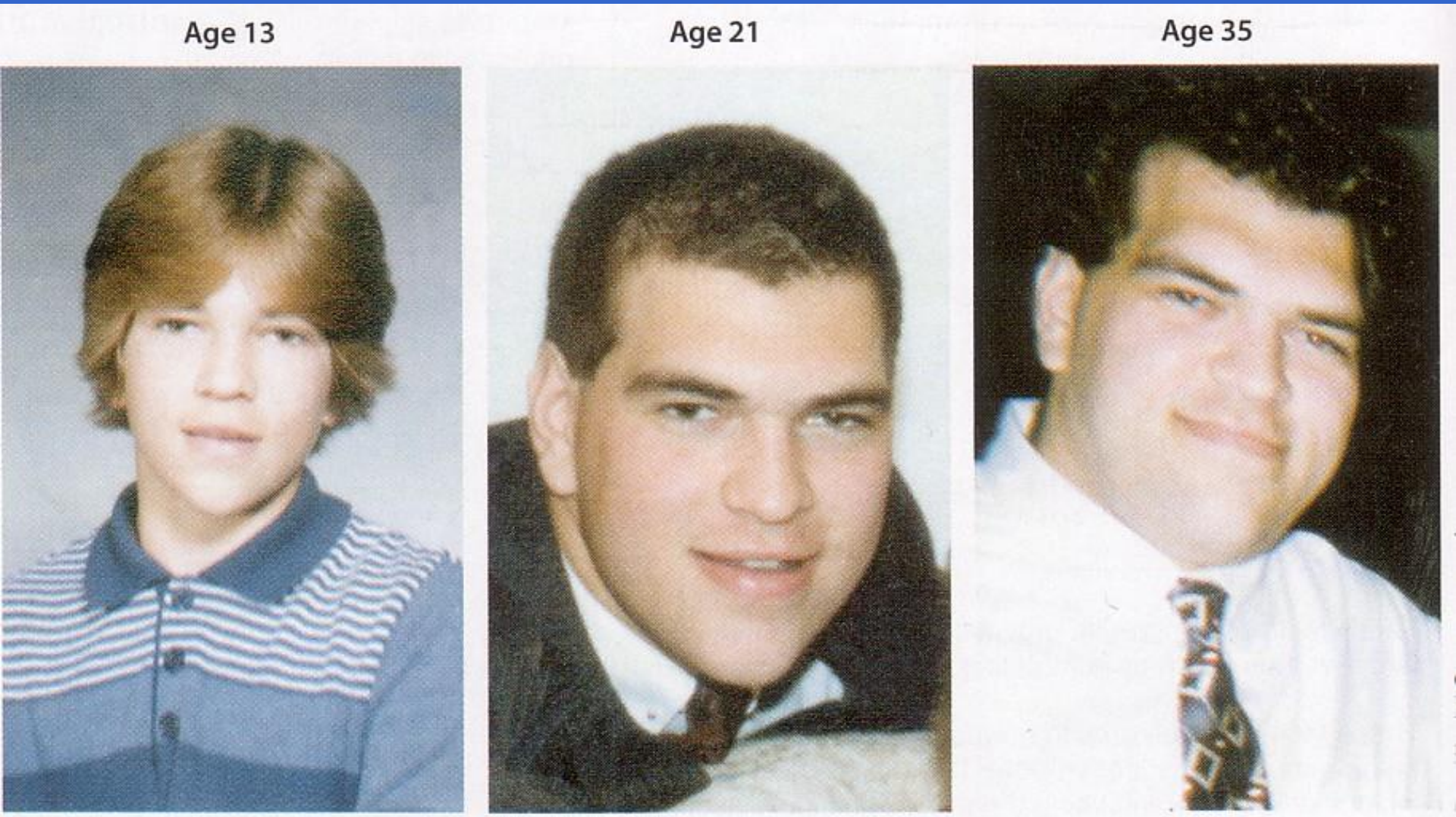
- **A. Normal function? Ca2+ for bones!…but what else? LS p 190**
- **B. What do black widow spider venom, botulism, curare & nerve gas have in common? Botox? LS p 189-91**


Hypothalamus
Hormone 1
+
Anterior pituitary
Hormone 2
+
Target endocrine gland
Hormone 3
+
Target cells
−
−
Negative feedback

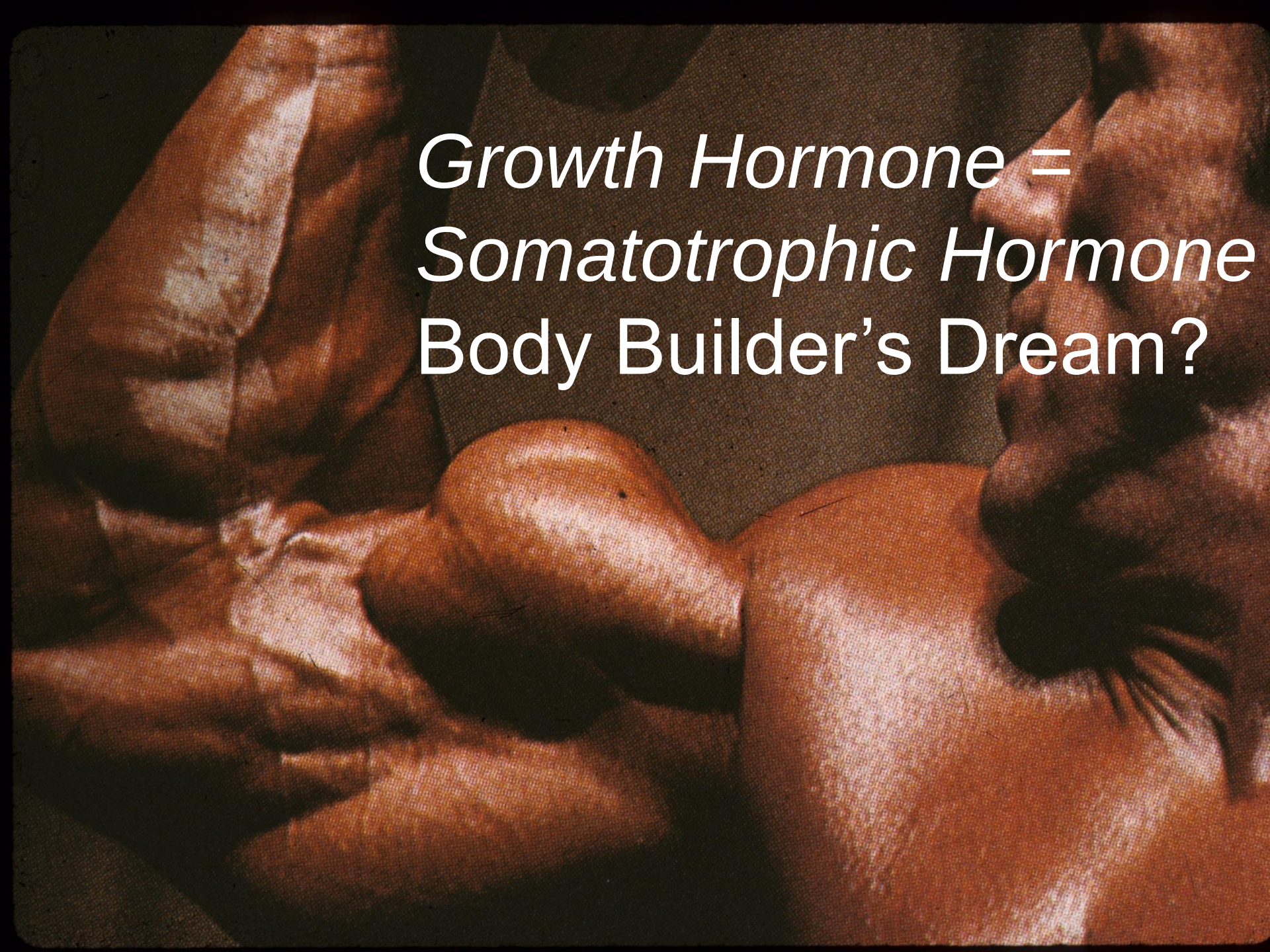

Often, more than simply 1 feedback loop!

LS 2006, cf: LS 2012
fig 17-10

Progression & Development of Acromegaly



LS 2012 fig 17-11


Growth Hormone =
Somatotrophic Hormone
Body Builder's Dream?

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

↑ Amino Acid uptake & Protein synthesis

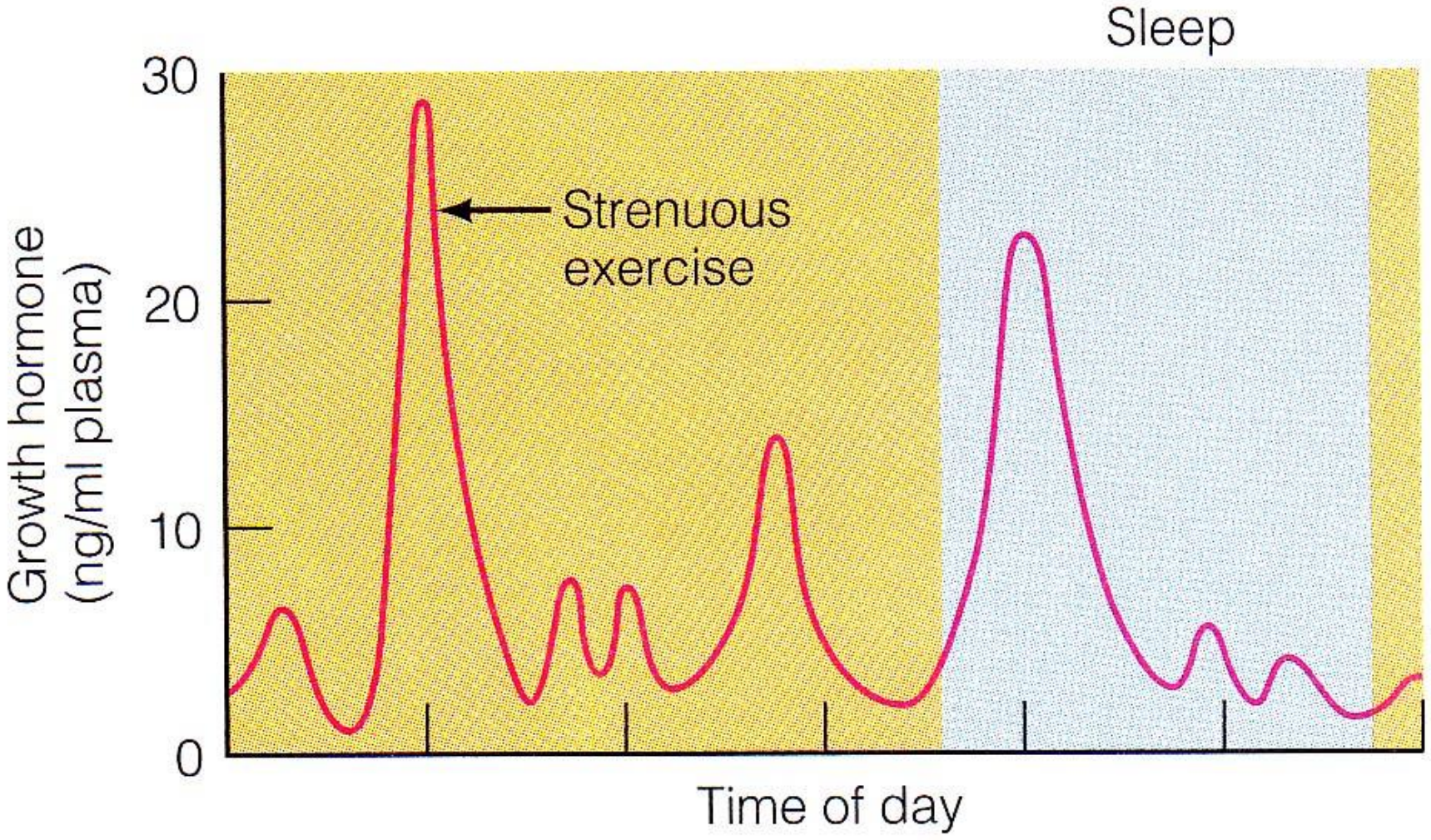
↑ Lipolysis & Fatty Acid mobilization

↓ Glucose uptake
(skeletal muscle & adipocytes)

↑ Glucose production
(liver glycogenolysis)

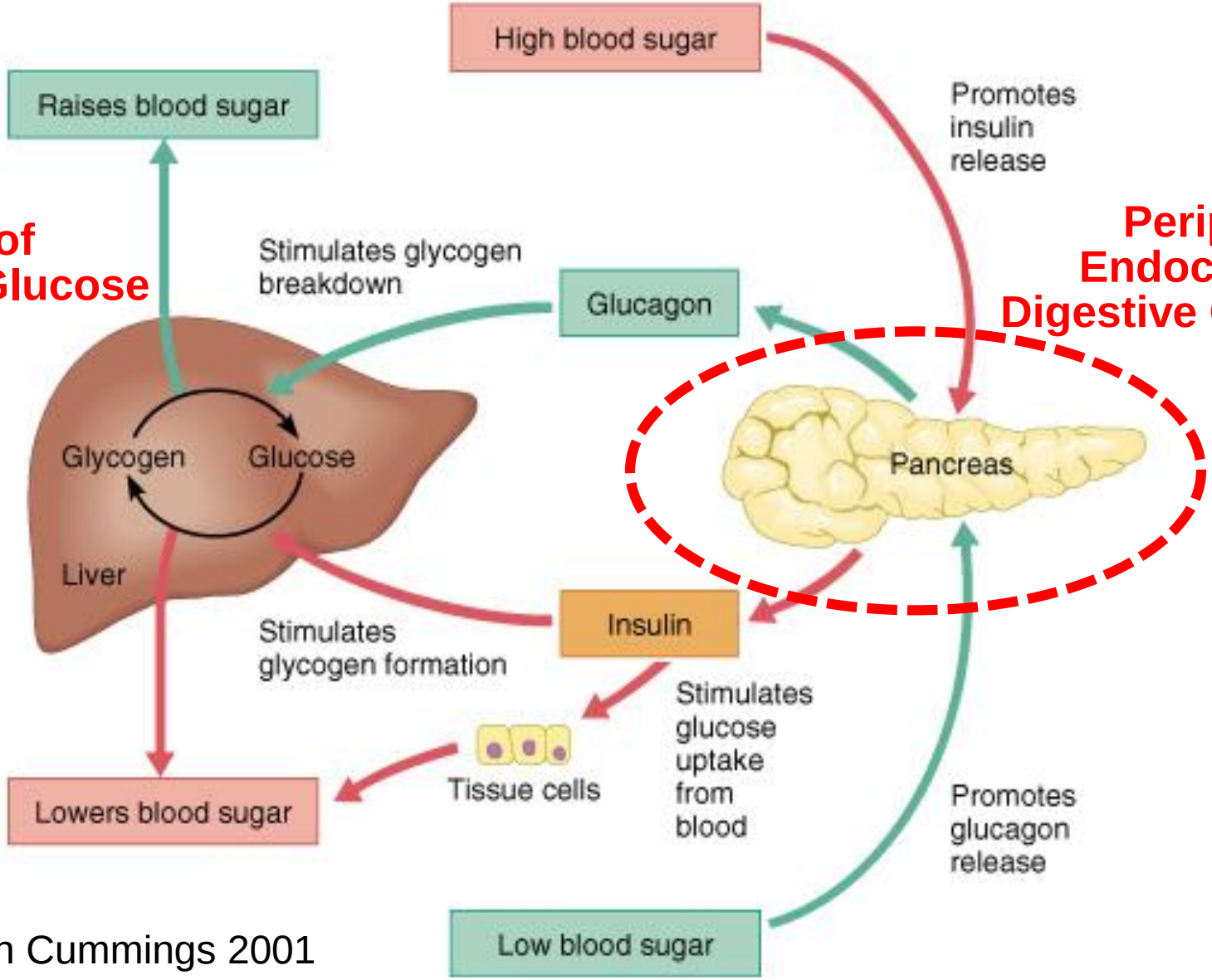
↑ Insulin secretion

Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per mililiter

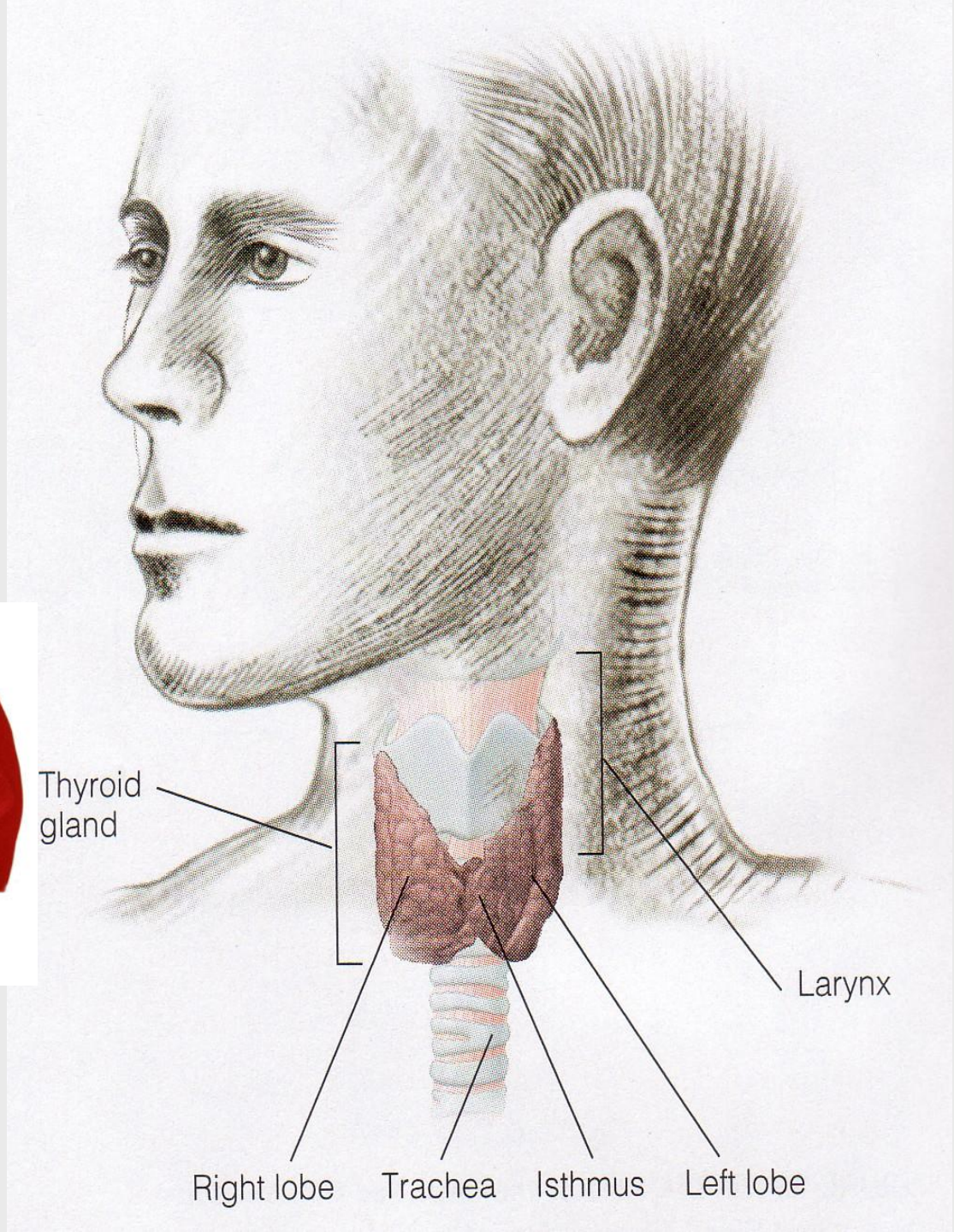
Insulin Stores Sugar, Glucagon Mobilizes Sugar!



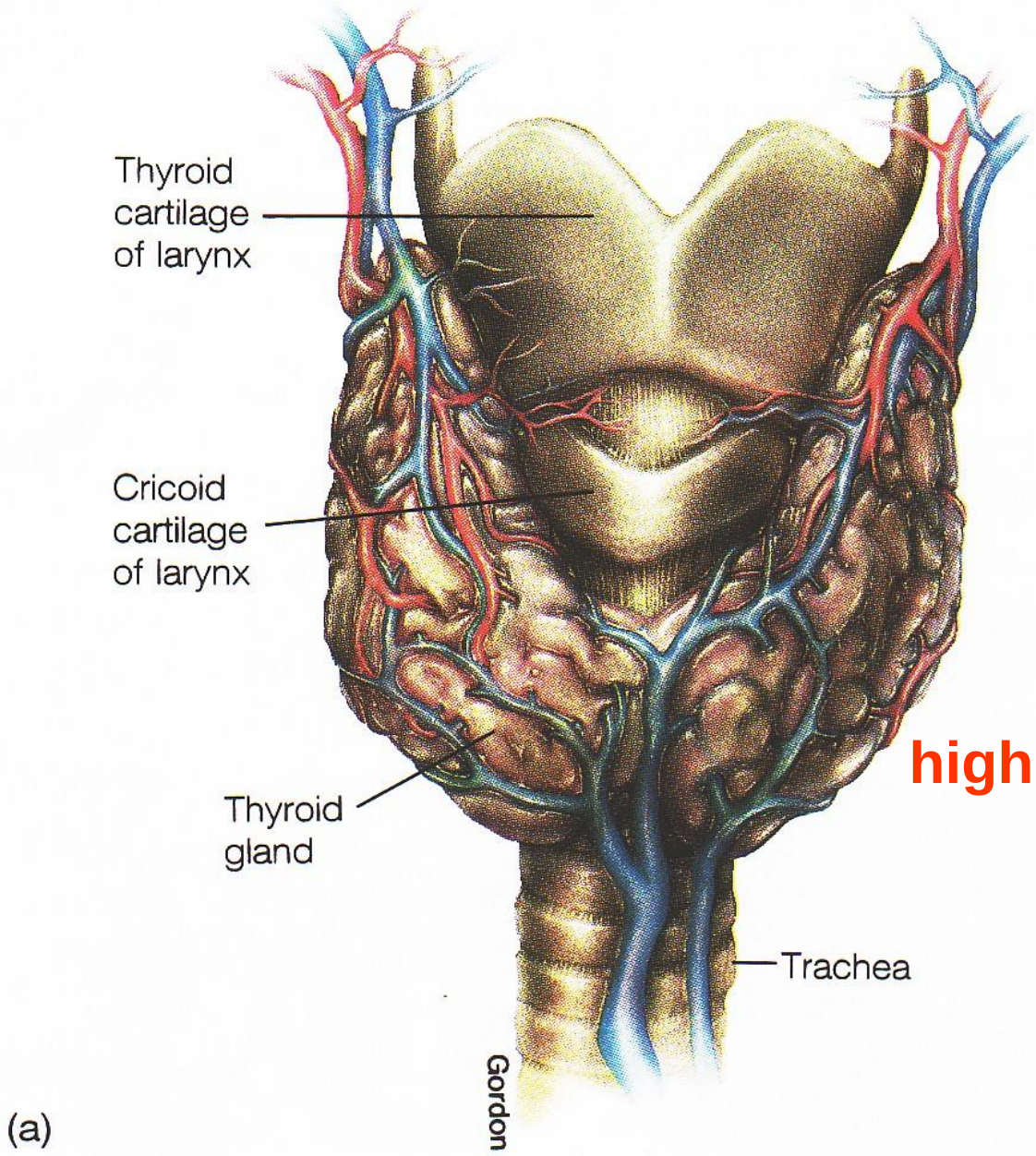
Benjamin Cummings 2001

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

https://www.fuseschool.org



DC 2003



Thyroid → **metabolism**
highly vascularized

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

DC 2003


DC 2003

LS 2012 fig 17-16

LS 2012 fig 17-17

Guyton & Hall 2000

Adrenals/Suprarenals

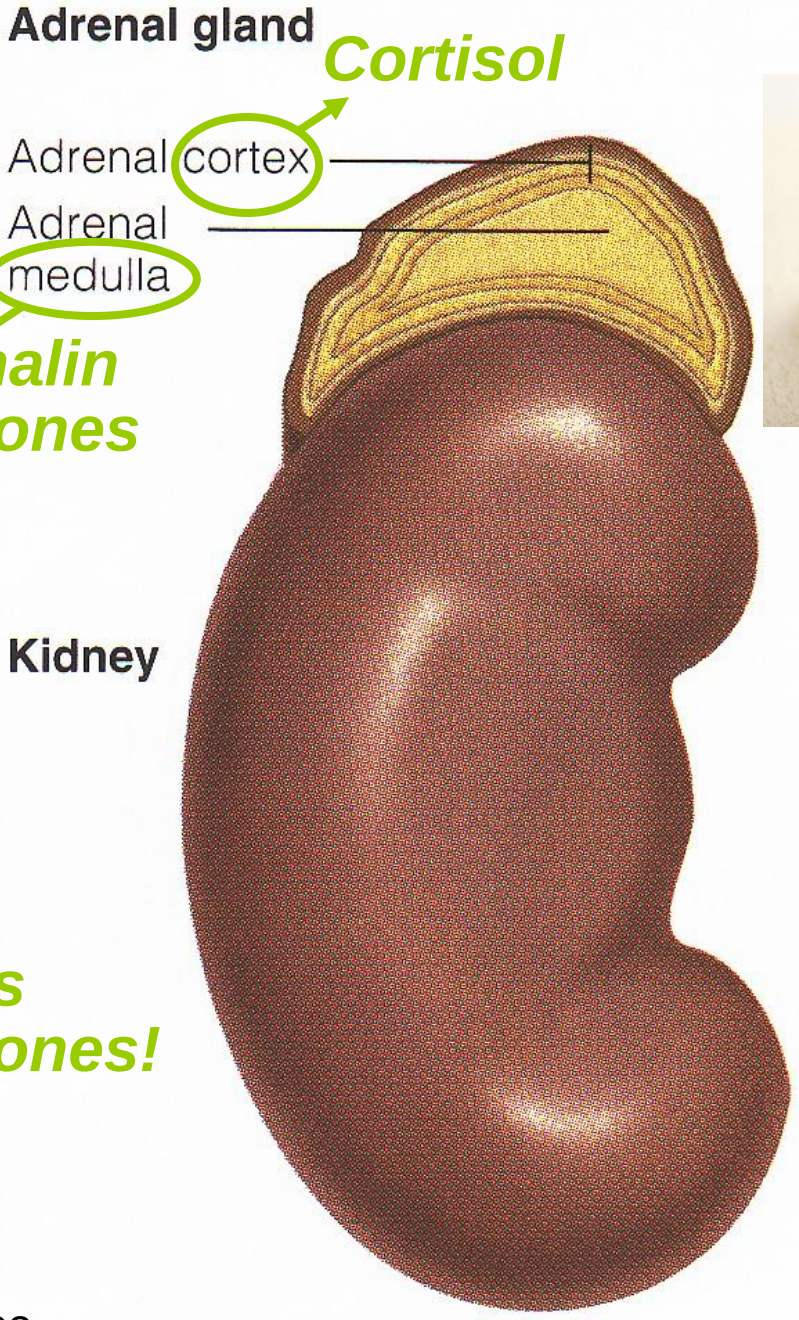
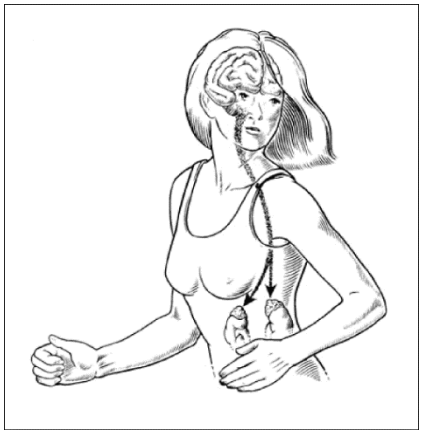


FIGURE 13-12
Adrenal Gland The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.

BI 121!!

Epinephrine 80%

Norepinephrine 20%



Guyton & Hall 2000

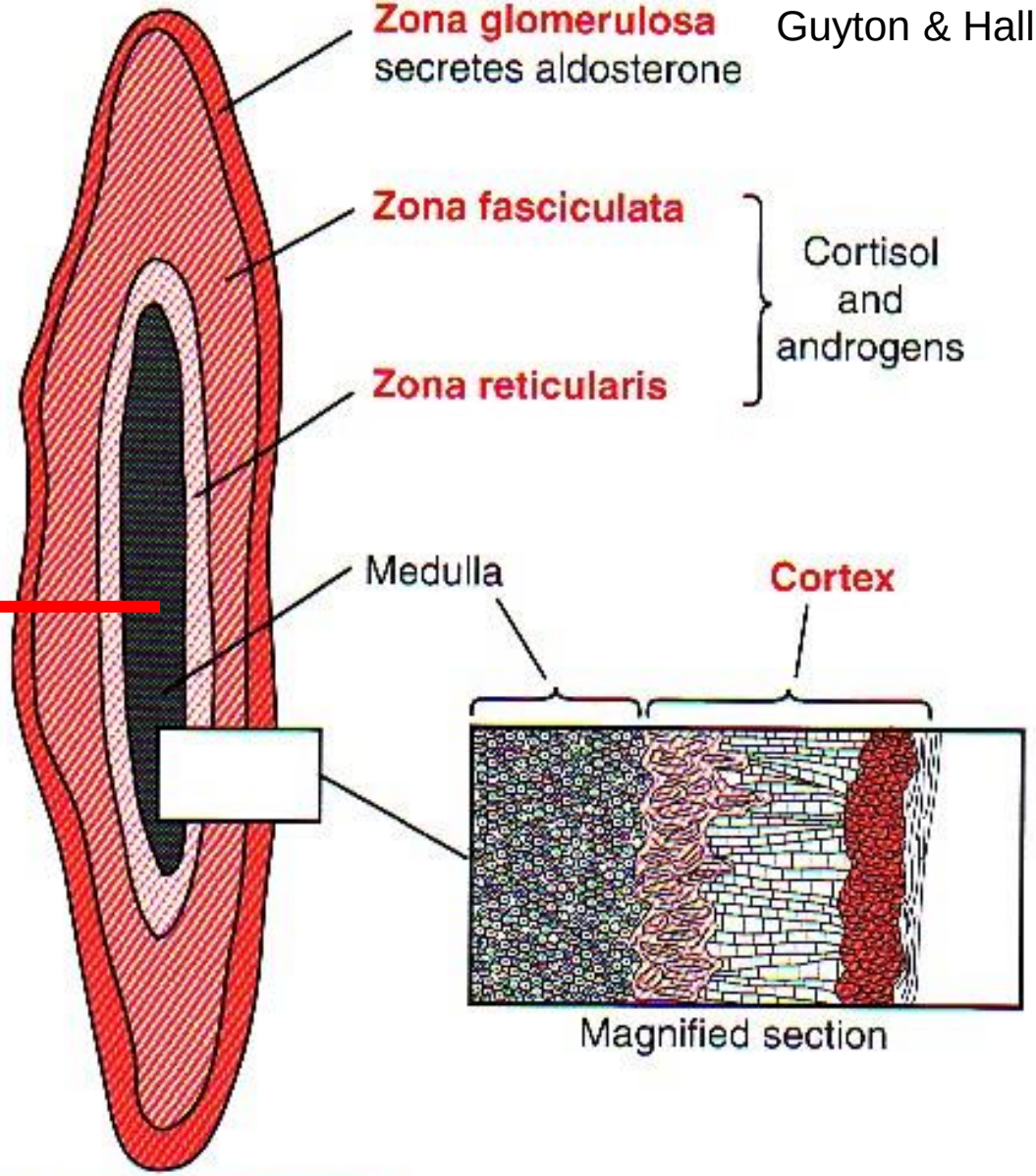
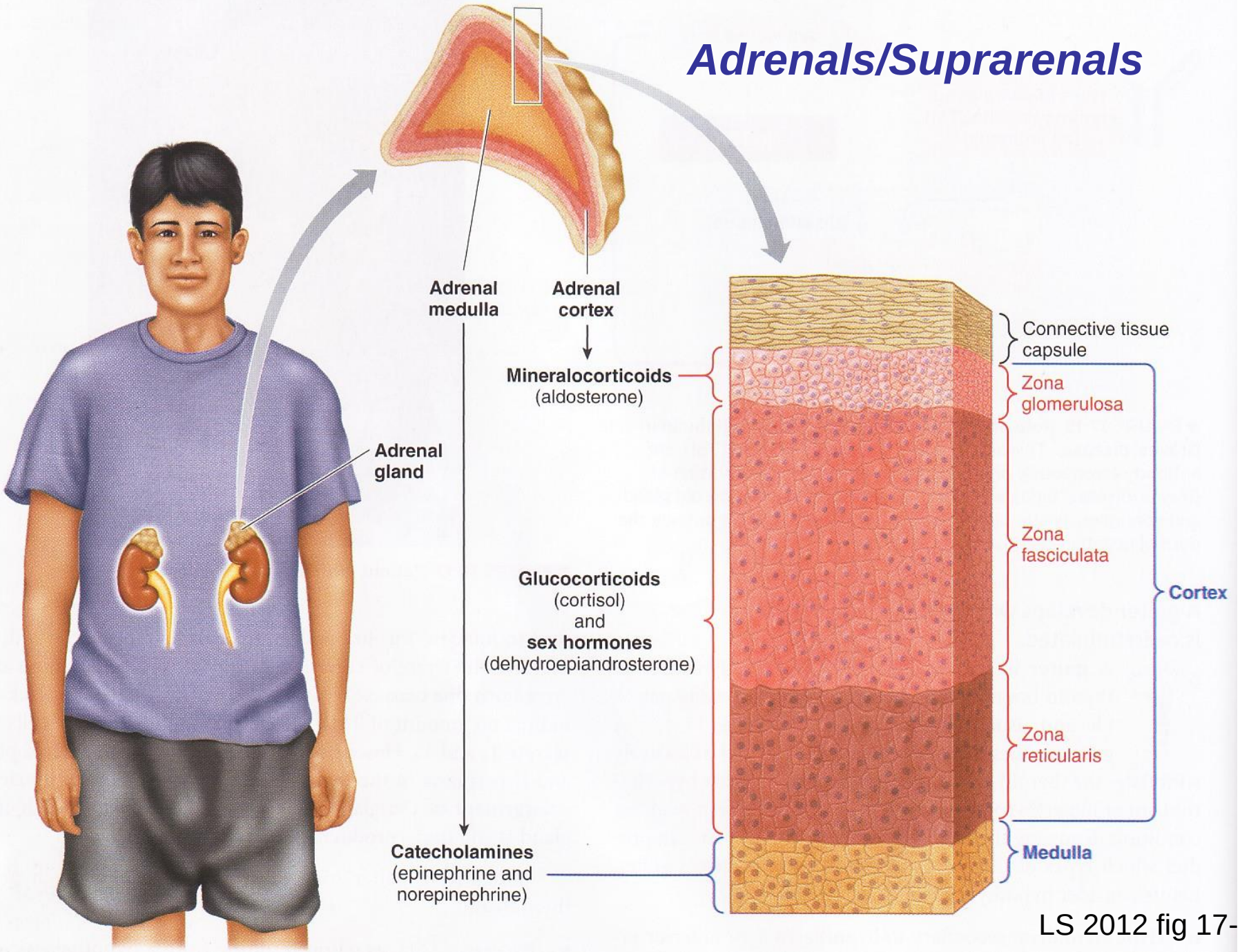


FIGURE 77–1

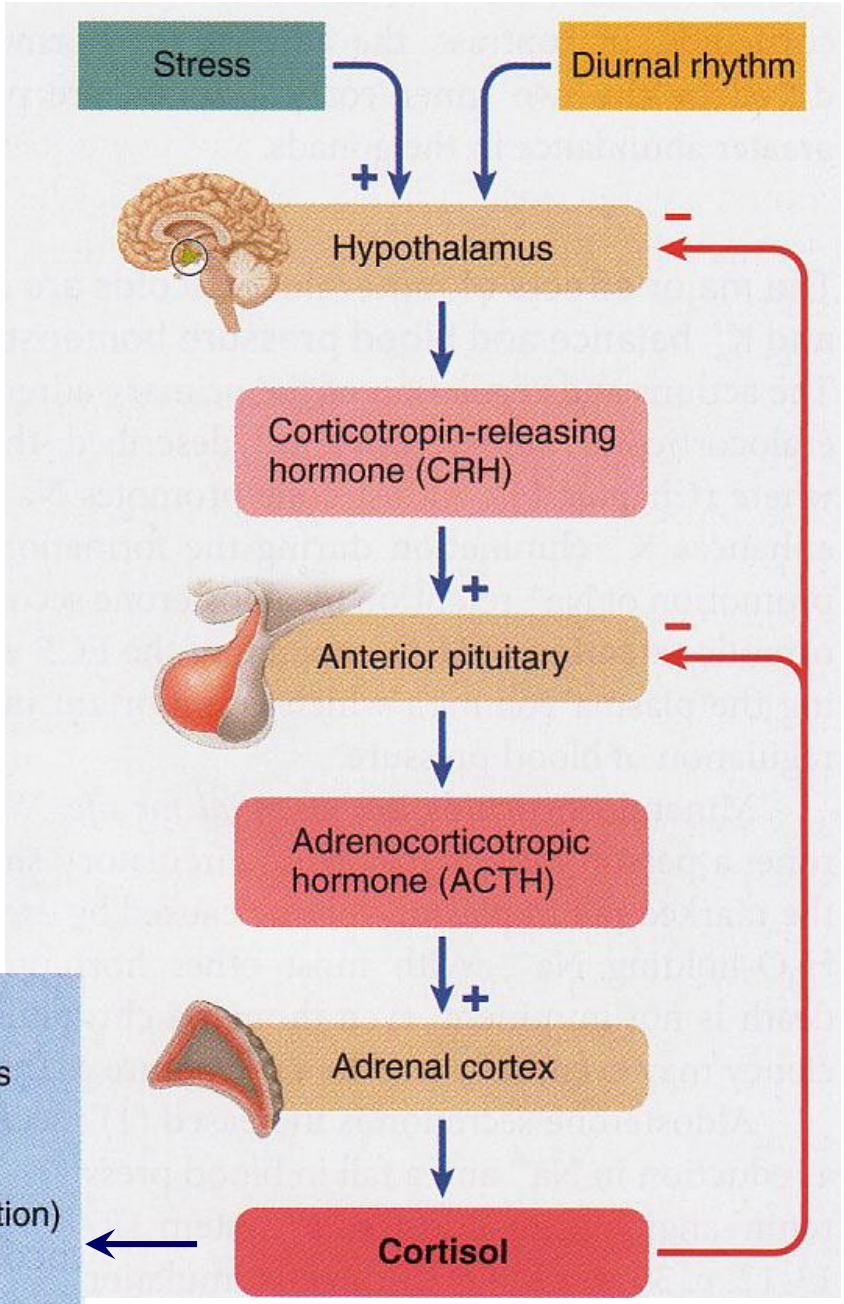
Secretion of adrenocortical hormones by the different zones of the adrenal cortex.

Adrenals/Suprarenals



LS 2012 fig 17-18

Stress Promotes Cortisol Secretion

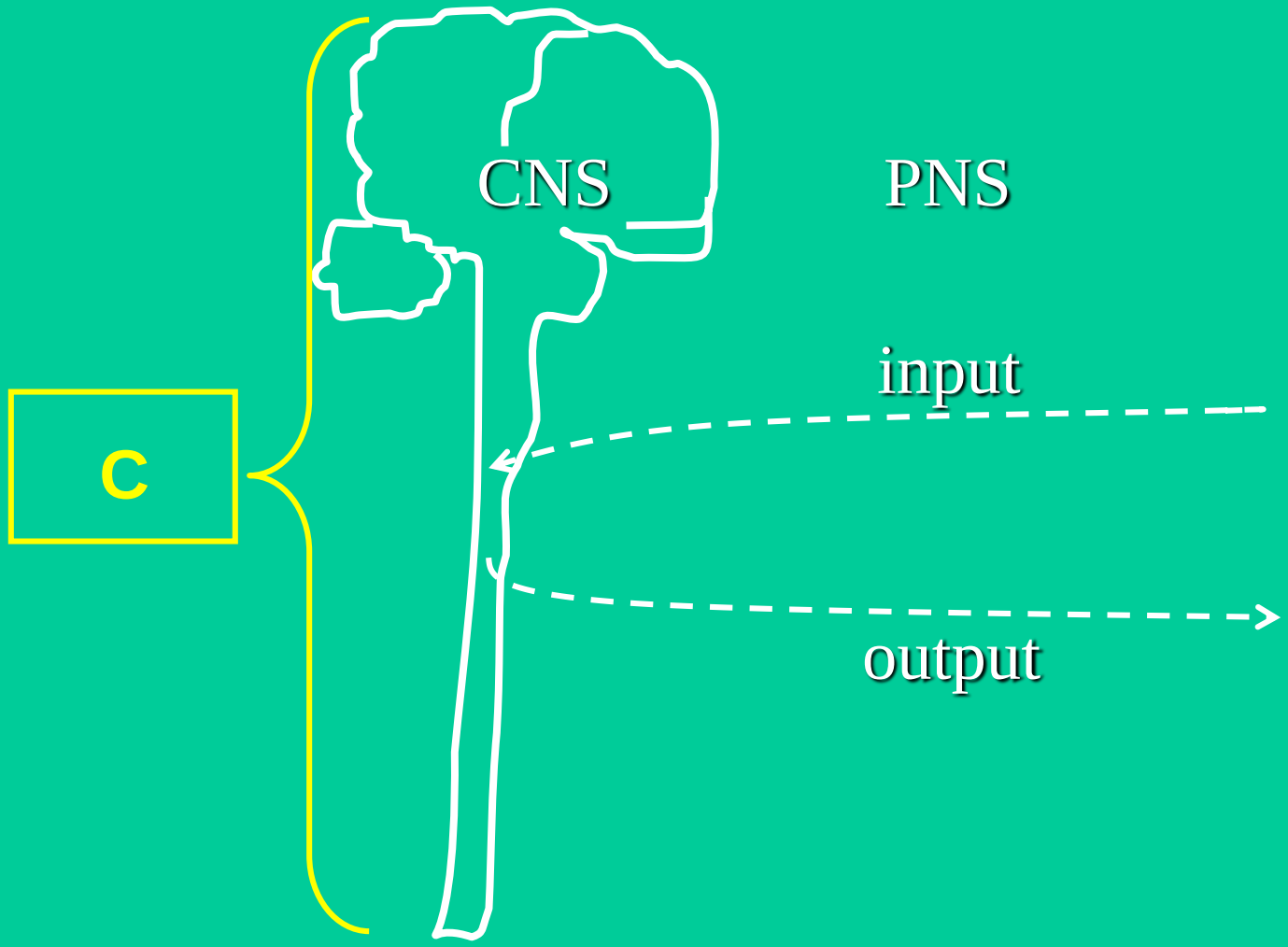


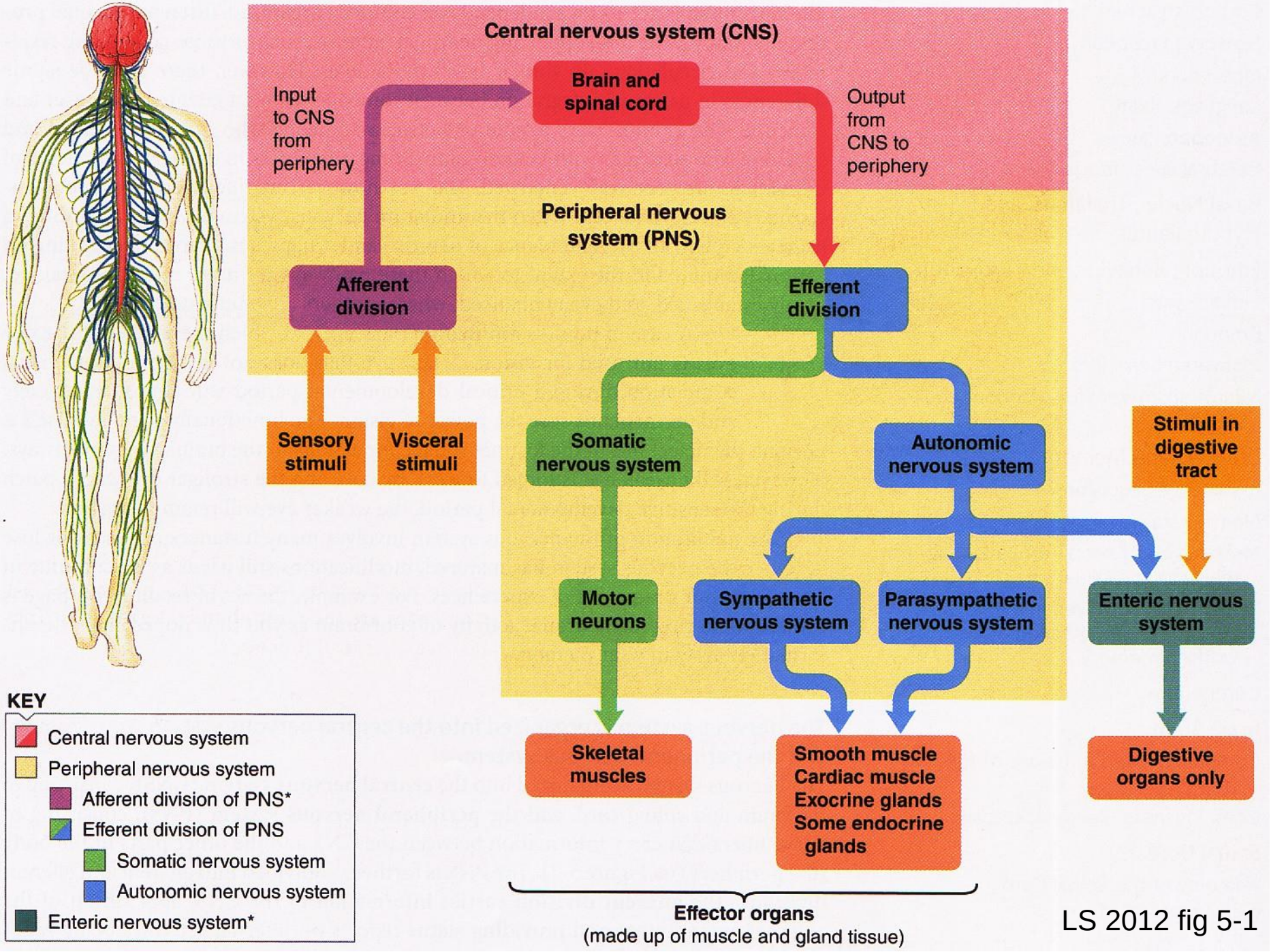
Metabolic fuels and building blocks available to help resist stress

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

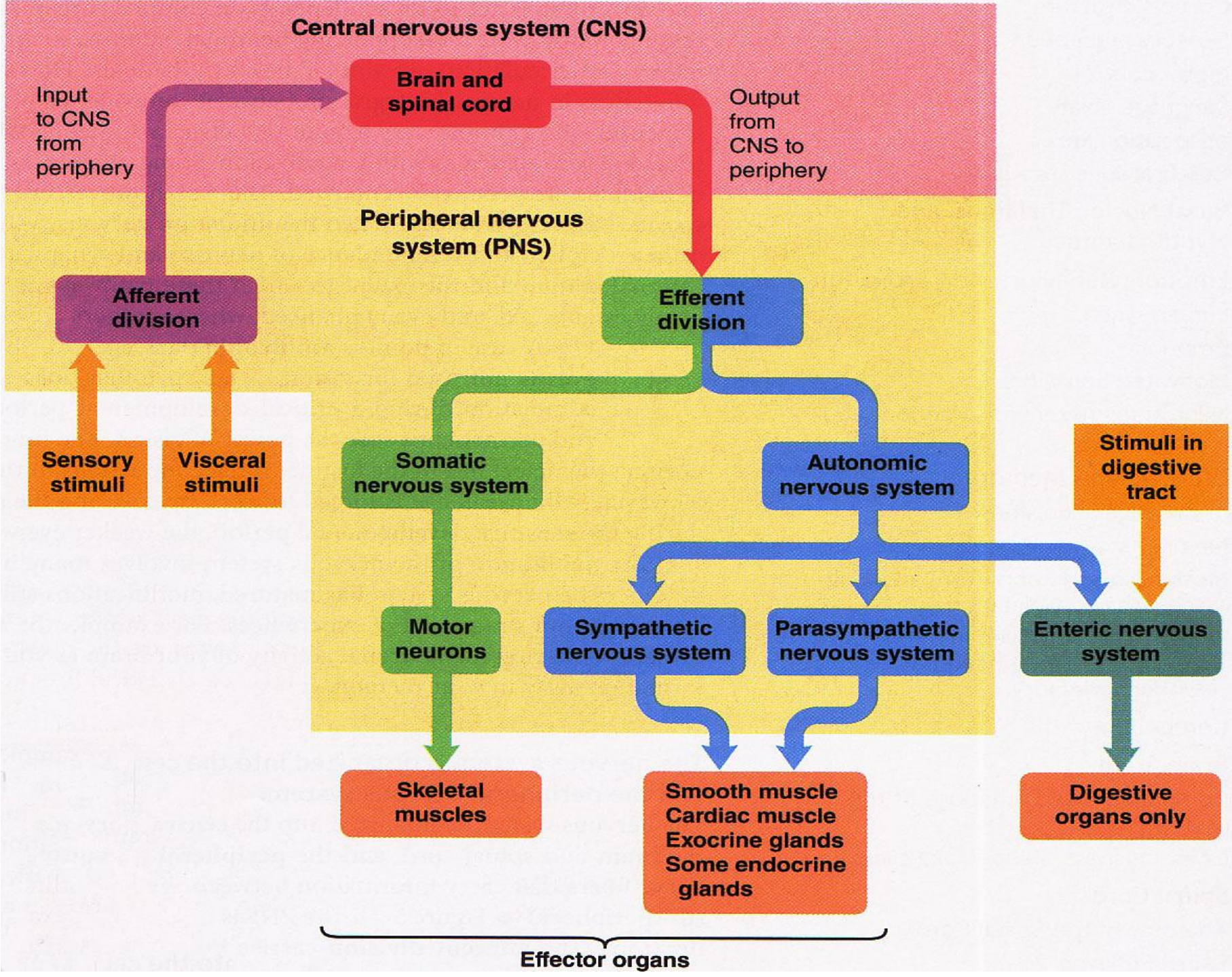
LS 2012 fig 17-19

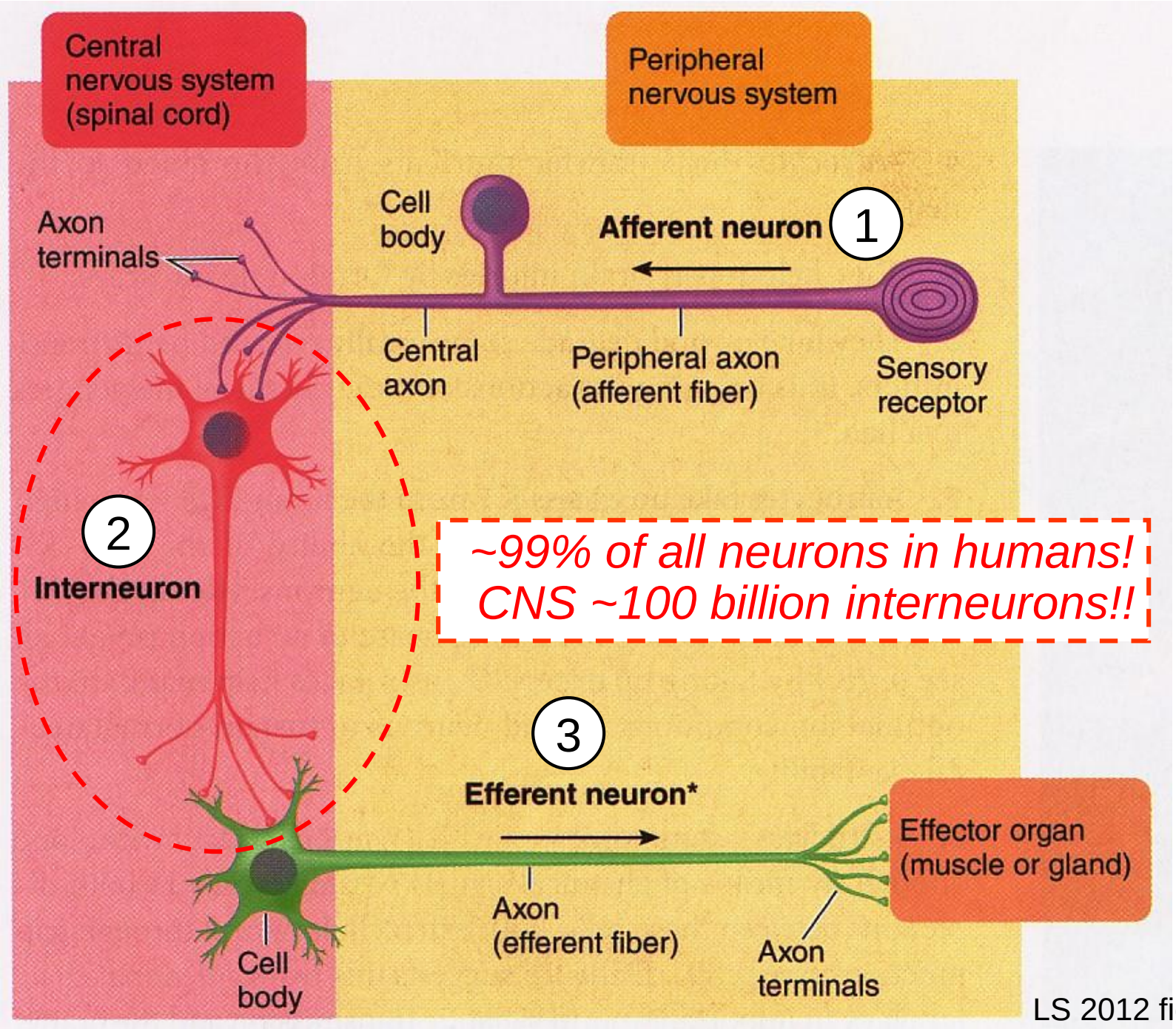
Nervous System





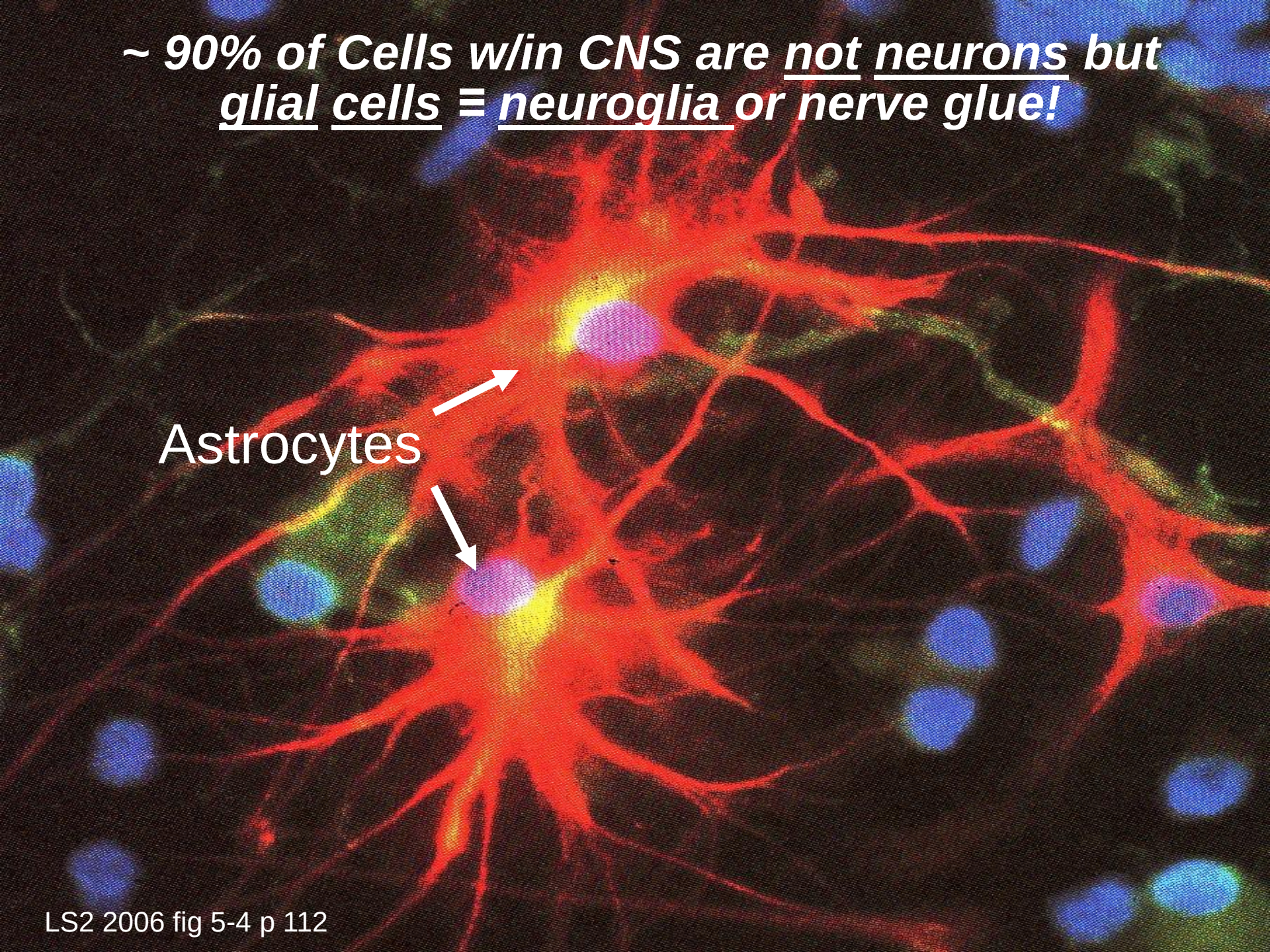
LS 2012 fig 5-1


Central nervous system (CNS)
Brain and spinal cord
Input to CNS from periphery
Output from CNS to periphery
Peripheral nervous system (PNS)
Afferent division
Efferent division
Sensory stimuli
Visceral stimuli
Somatic nervous system
Autonomic nervous system
Stimuli in digestive tract
Motor neurons
Sympathetic nervous system
Parasympathetic nervous system
Enteric nervous system
Skeletal muscles
Smooth muscle
Cardiac muscle
Exocrine glands
Some endocrine glands
Digestive organs only
Effector organs

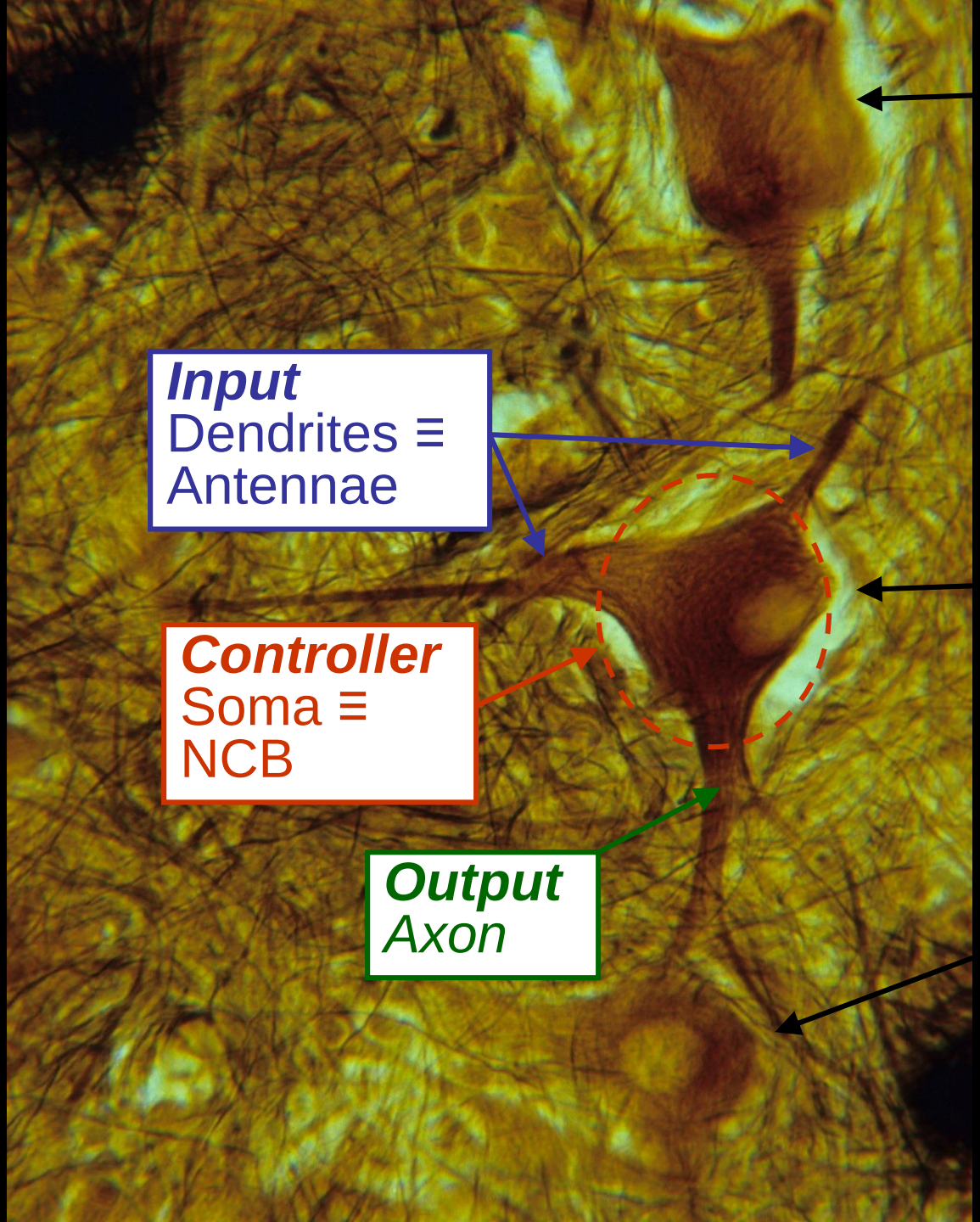


LS 2012 fig 5-2

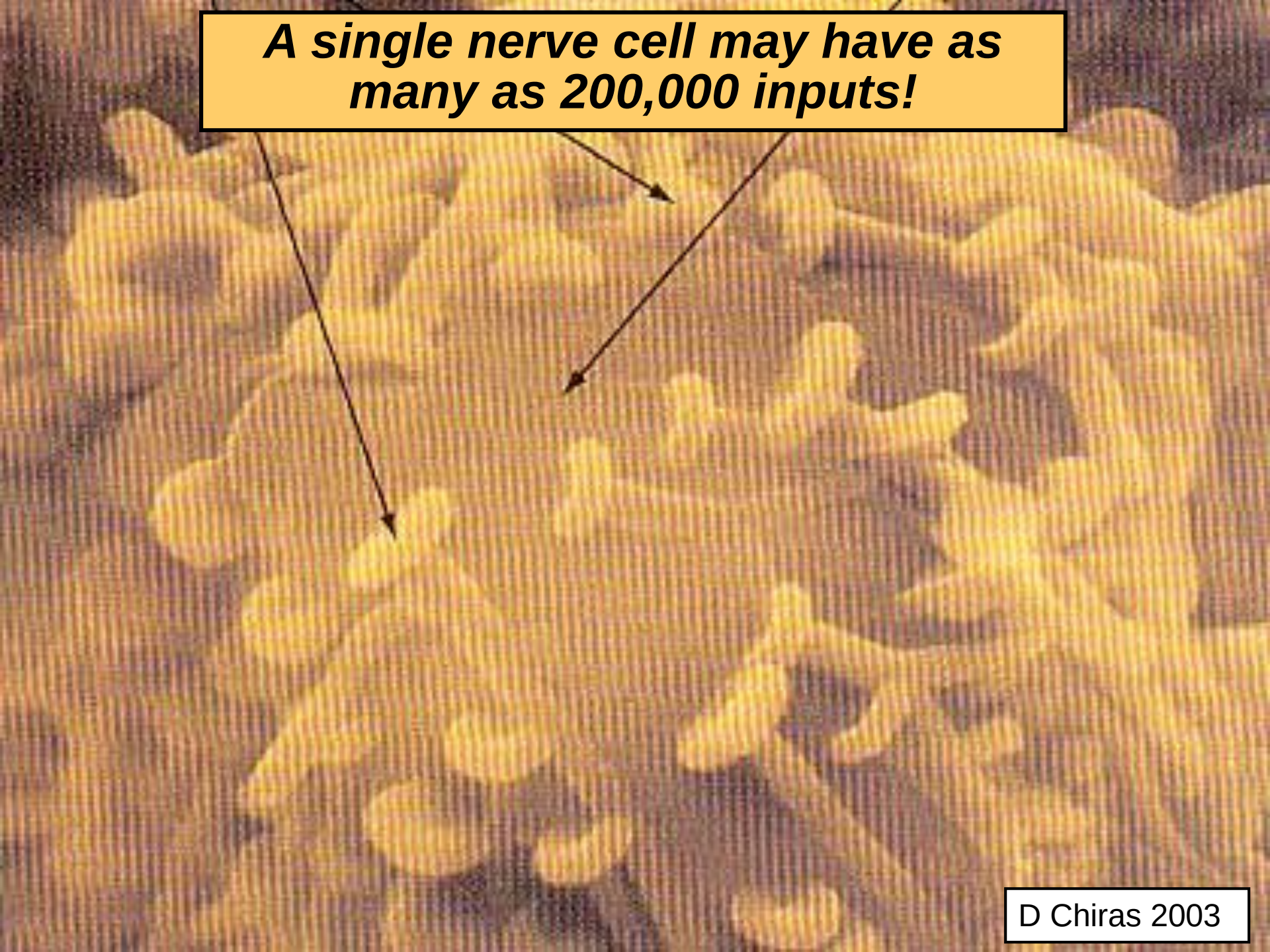
~ 90% of Cells w/in CNS are <u>not</u> <u>neurons</u> but <u>glial</u> <u>cells</u> ≡ <u>neuroglia</u> or nerve glue!



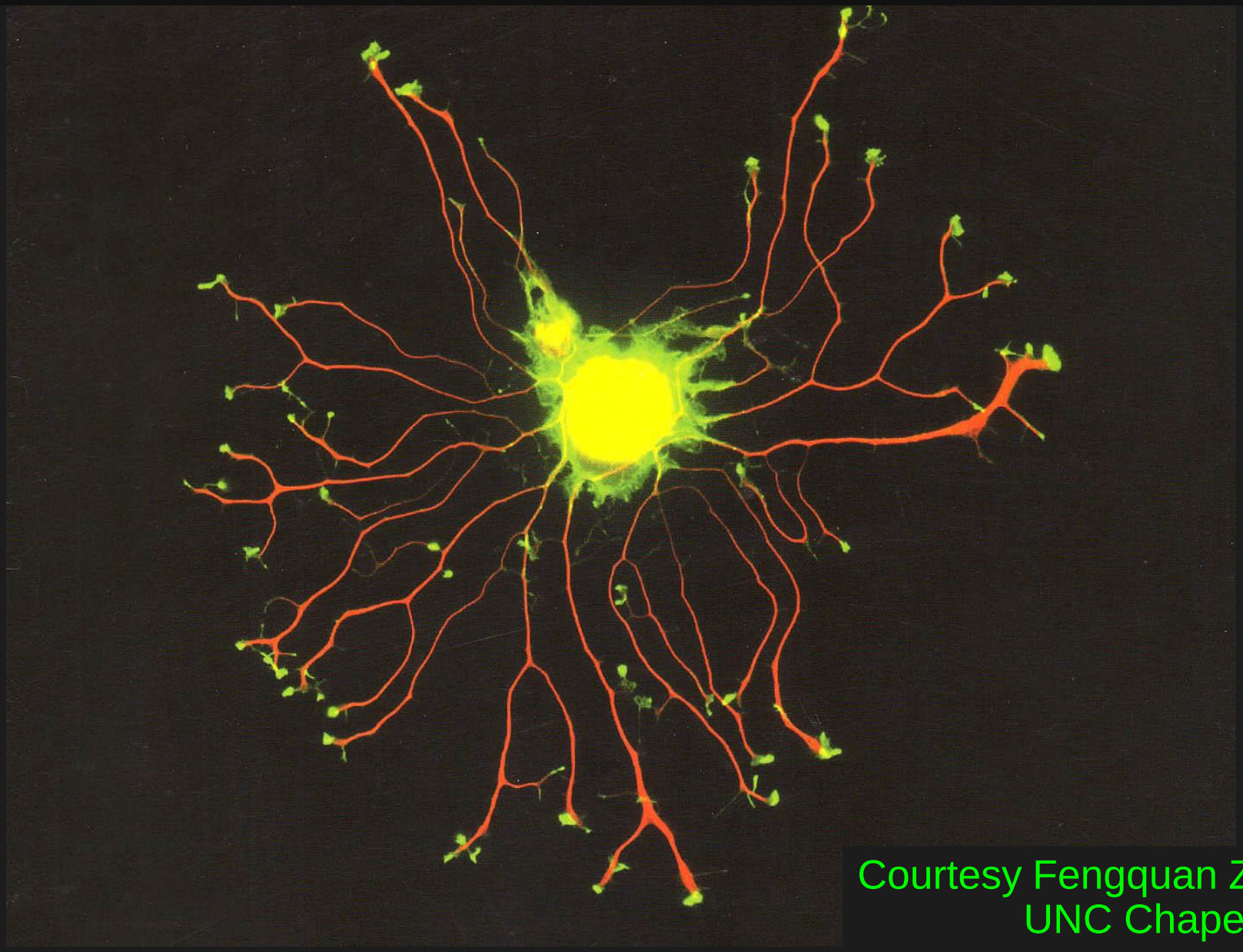
LS2 2006 fig 5-4 p 112



H. Howard 1980

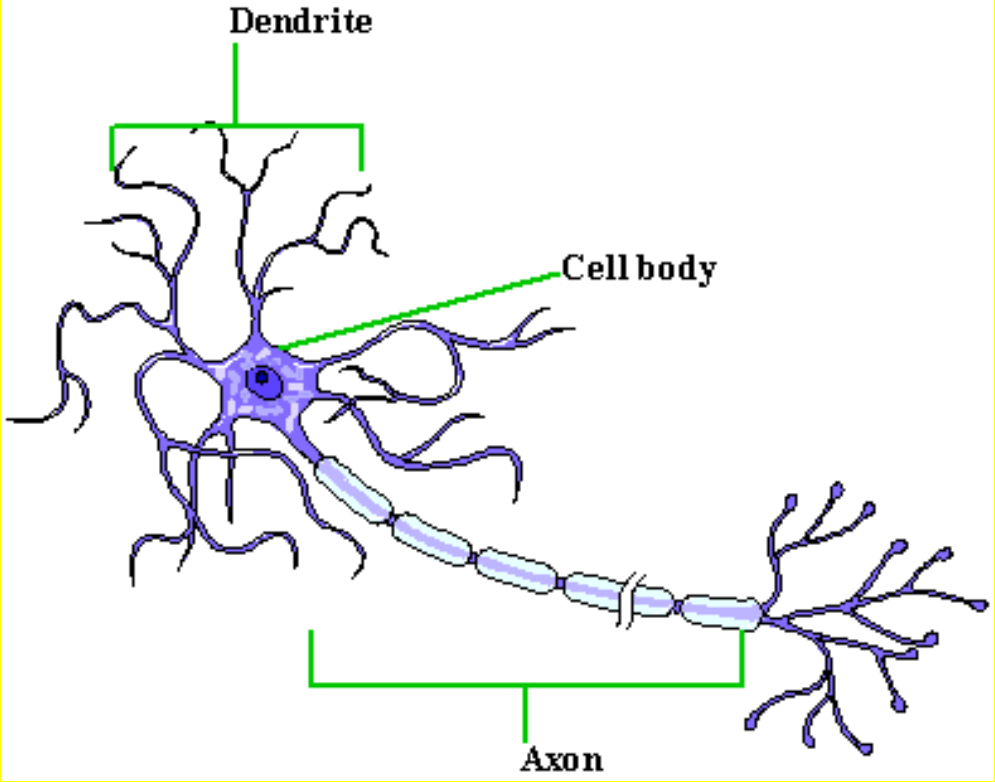

A single nerve cell may have as many as 200,000 inputs!
D Chiras 2003

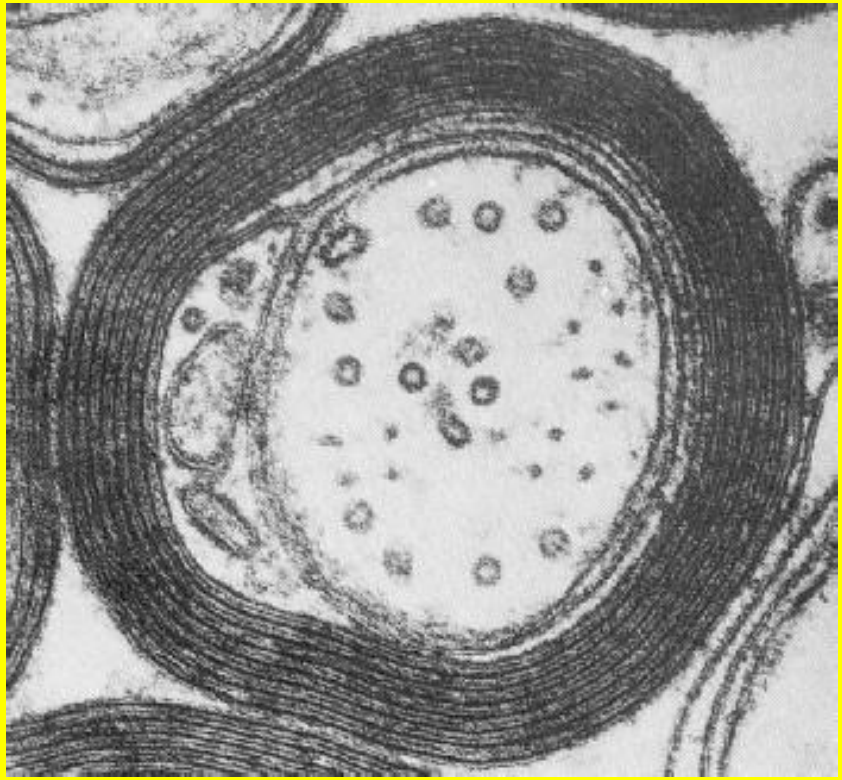
Nerve cell with multiple axons grown by adding a mitogen/neurogen ≡ nerve growth factor!



Courtesy Fengquan Zhou
UNC Chapel Hill

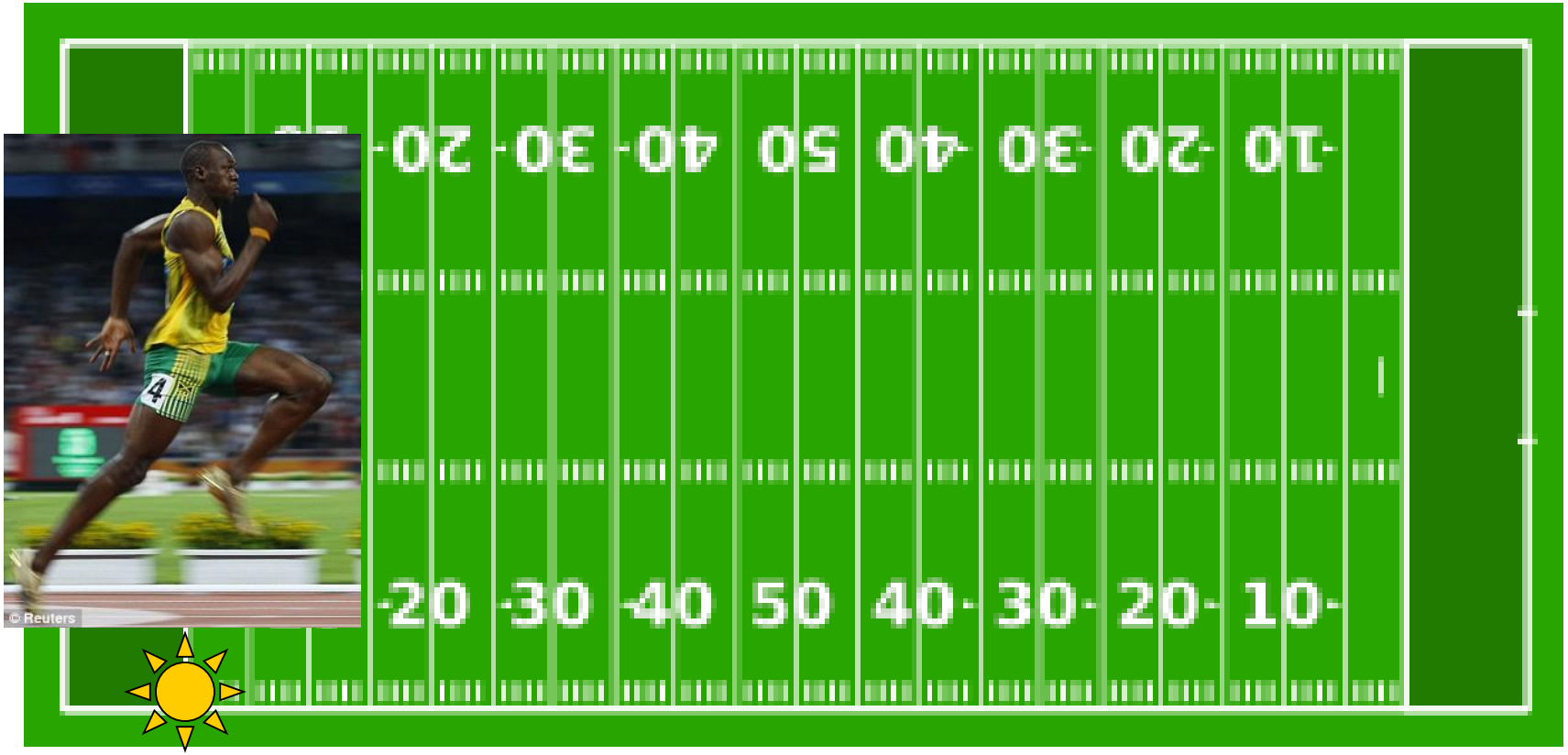
What is myelin?
Why is it important?





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

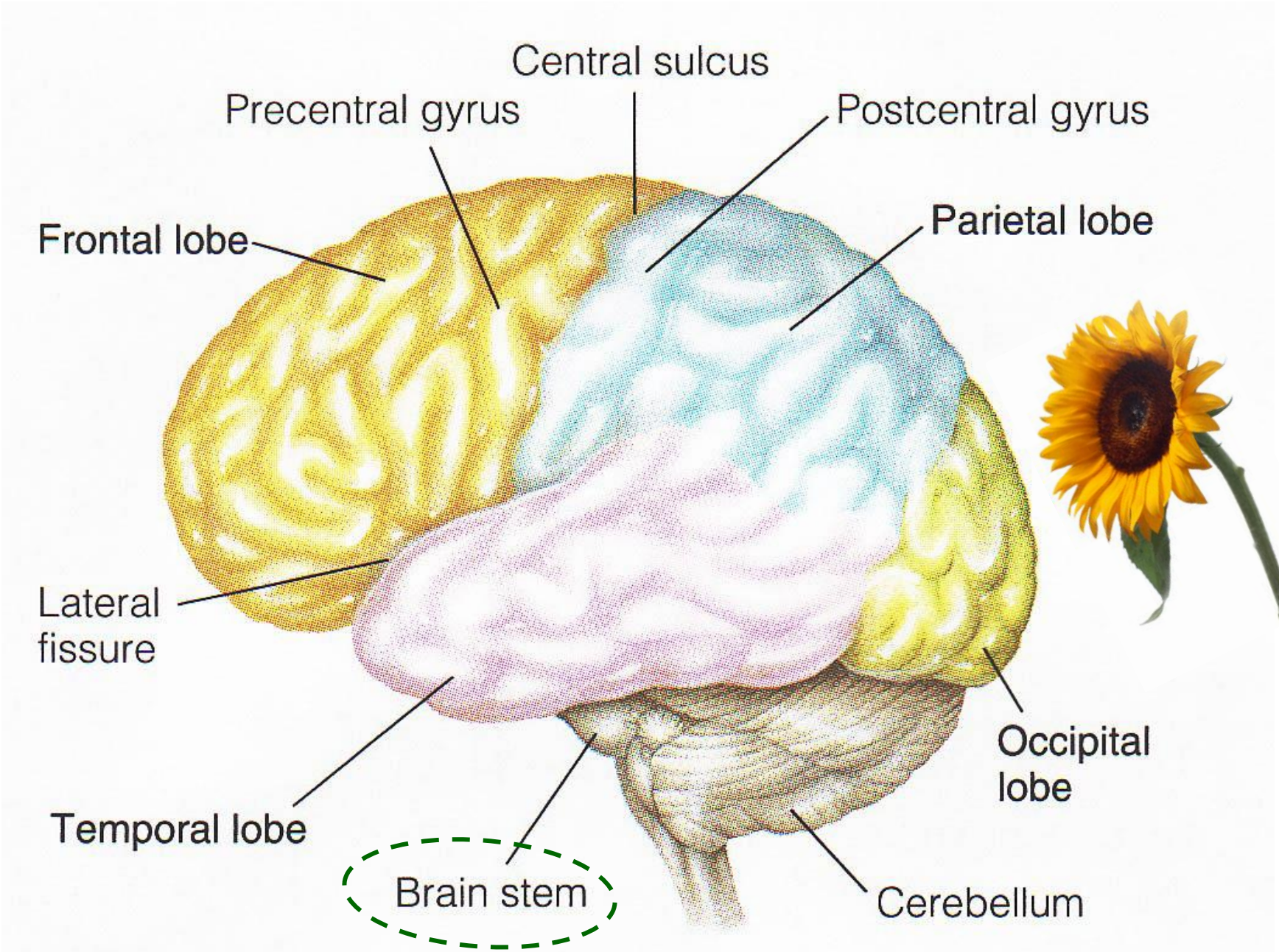
A large myelinated "survival" nerve can conduct impulses the length of football field in < 1 second!



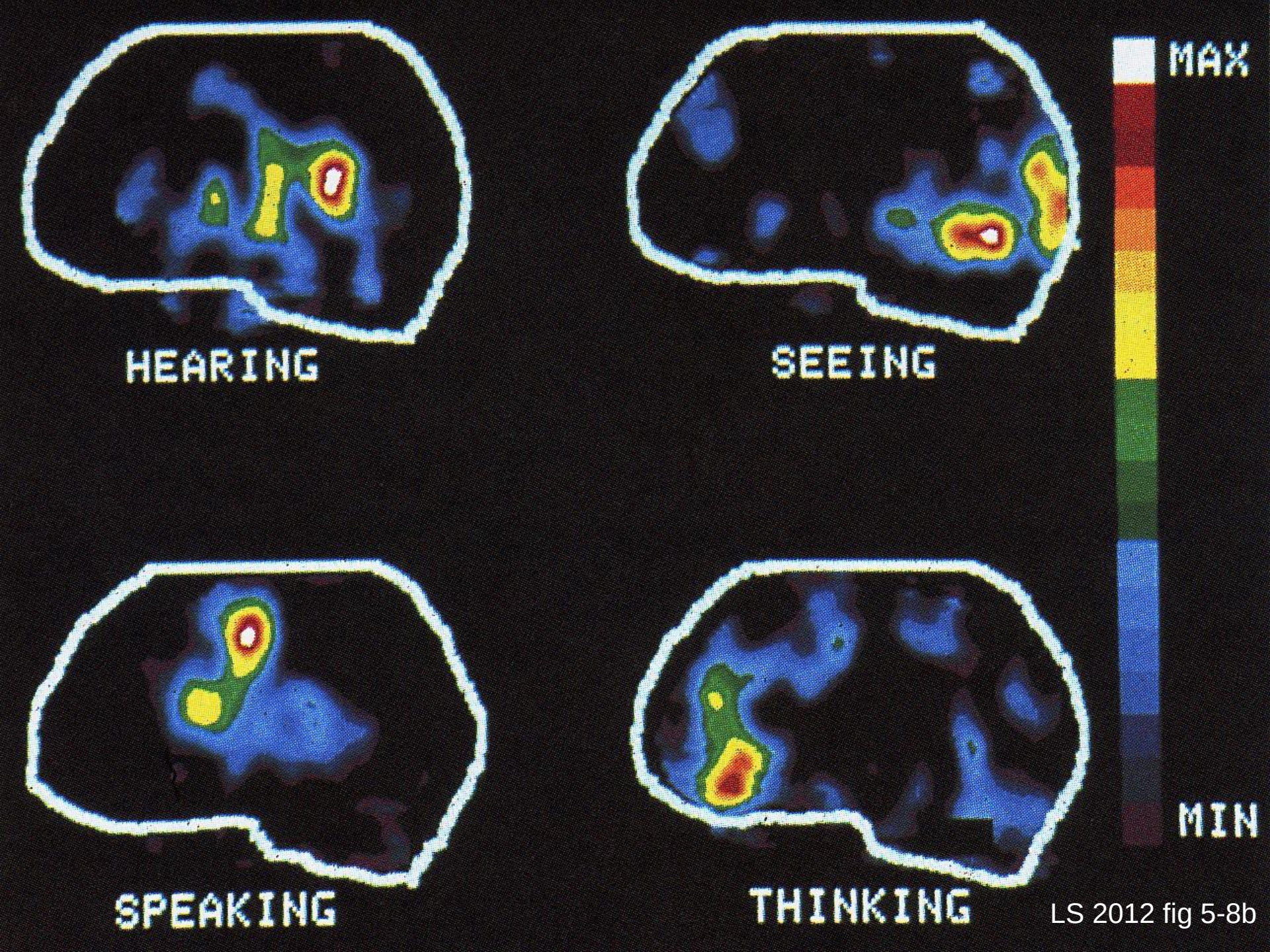
Saltatory/Leaping Conduction! Crucial Sensory & Motor Nerves

L. <u>salt</u>are to hop or leap! Fr. <u>salt</u>, sautier, sauté, leap, high air, vault

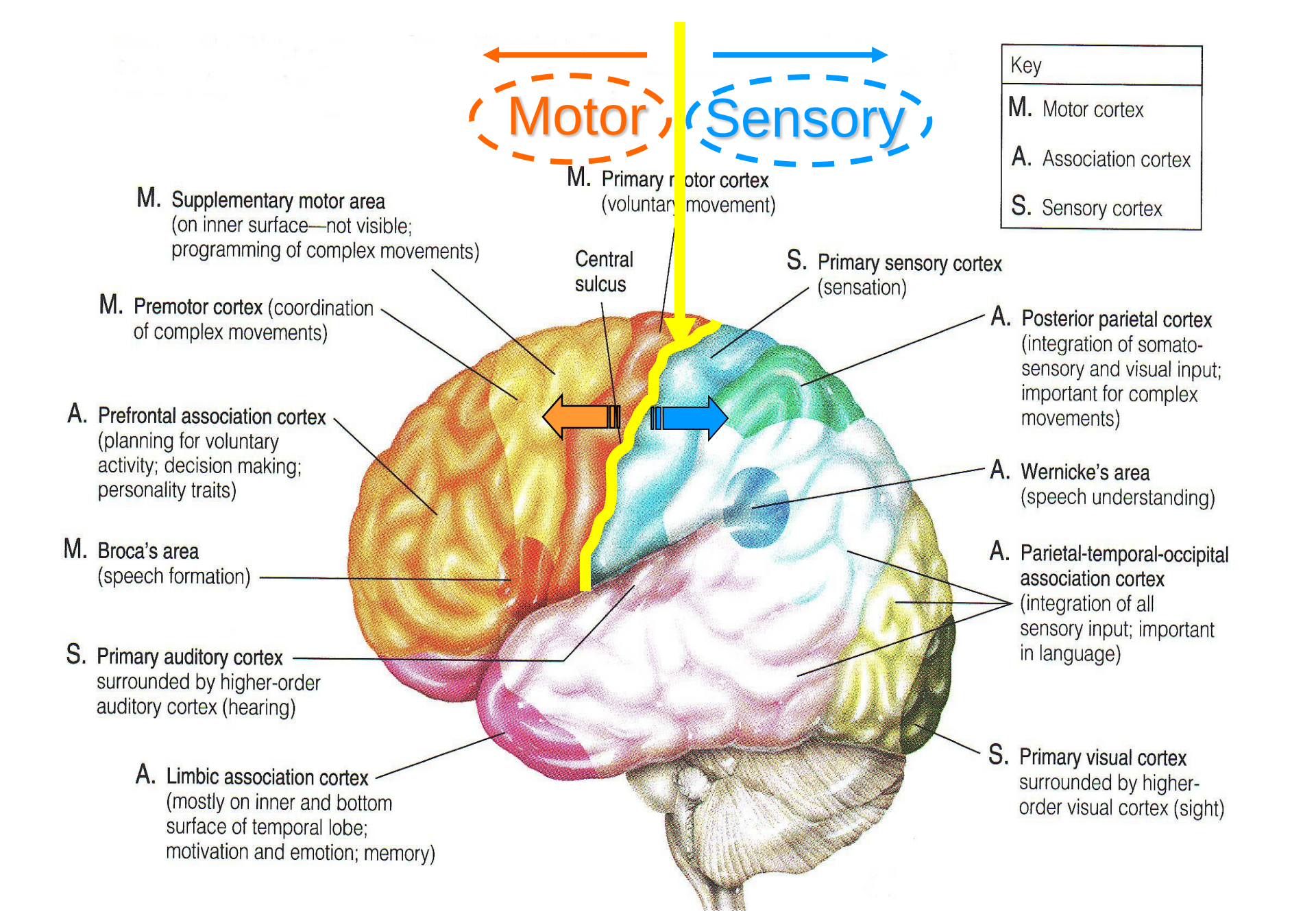
DC 2003



LS 2012 fig 5-7



LS 2012 fig 5-8b



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

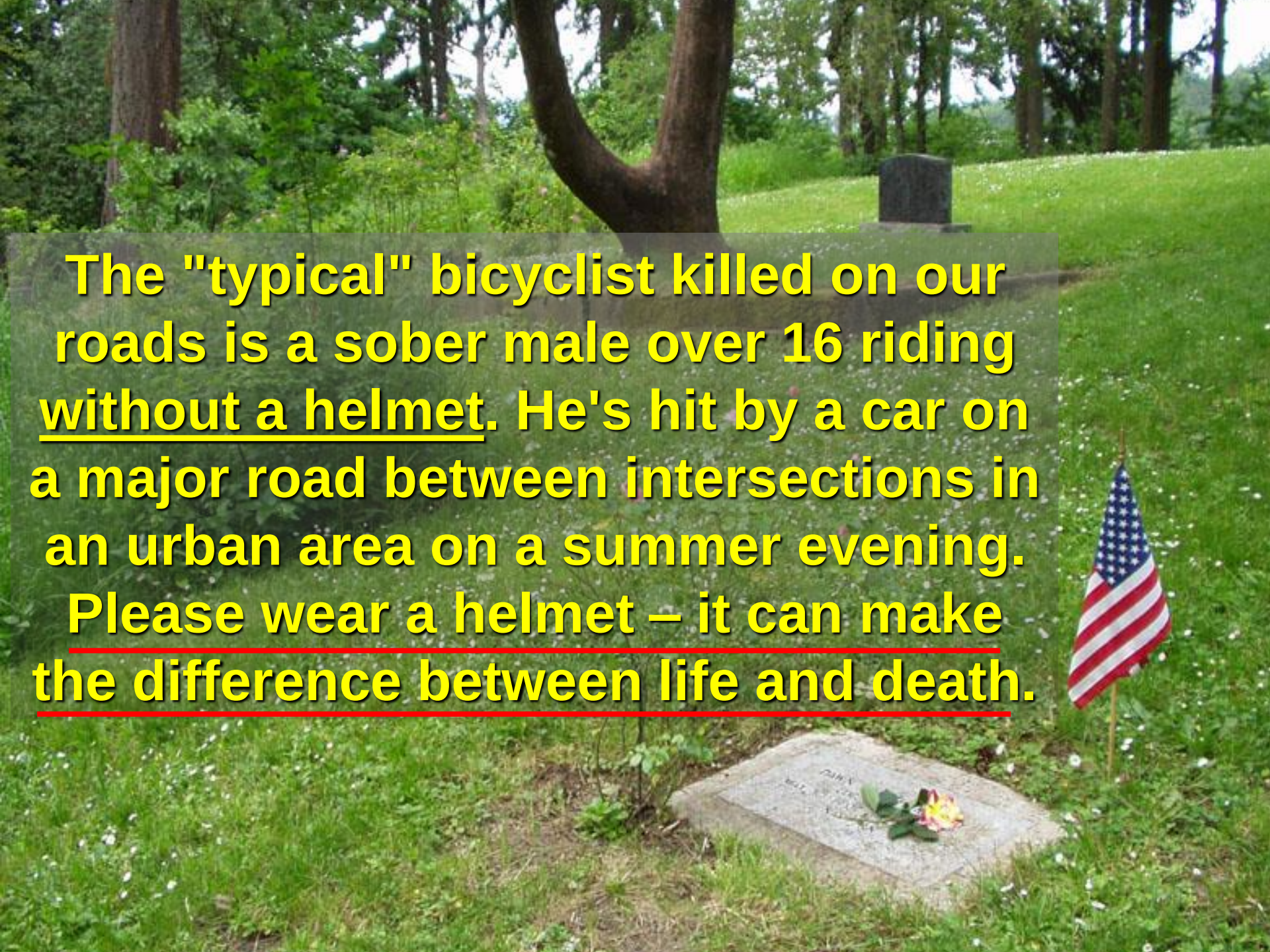
13% of deaths children ≤ 14 yr, 87% ♂

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%!

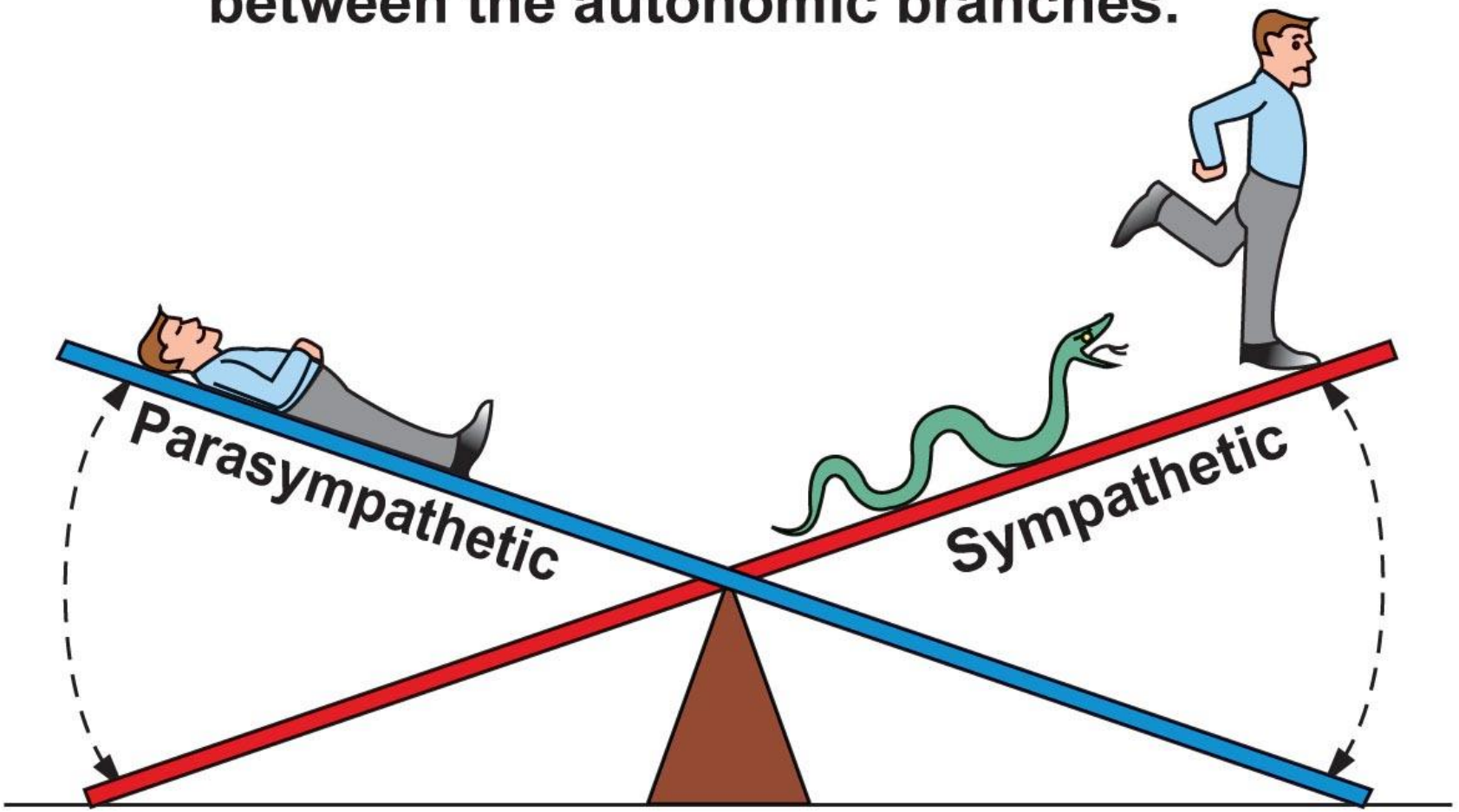
~$2.3 billion/yr = indirect injury costs from not using helmets!


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

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

Stories, Discussion, Questions or Comments!

Homeostasis is a dynamic balance between the autonomic branches.



Rest-and-digest: Parasympathetic activity dominates.

Fight-or-flight: Sympathetic activity dominates.

D Silverthorn 2010

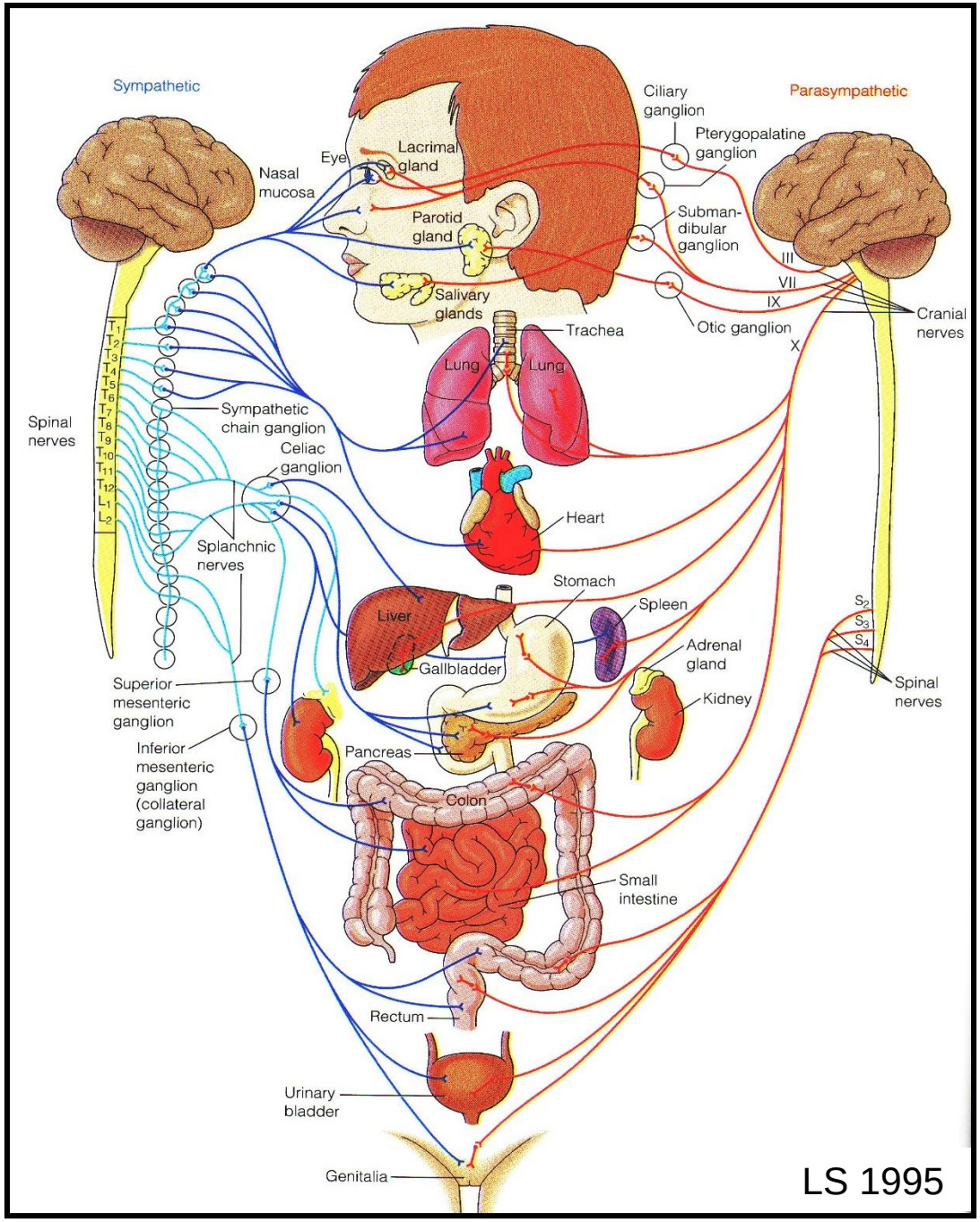

PARASYMPATHETIC = RESTING, DIGESTIVE, HOUSEKEEPING FUNCTIONS

FIGHT/FLIGHT/ALARM REACTION!!

Autonomic Nervous System

Why overlap or dual innervation?

Fine-tune control & safety!



cf: LS 2012 fig 7-3

Why adrenal activation & response important?

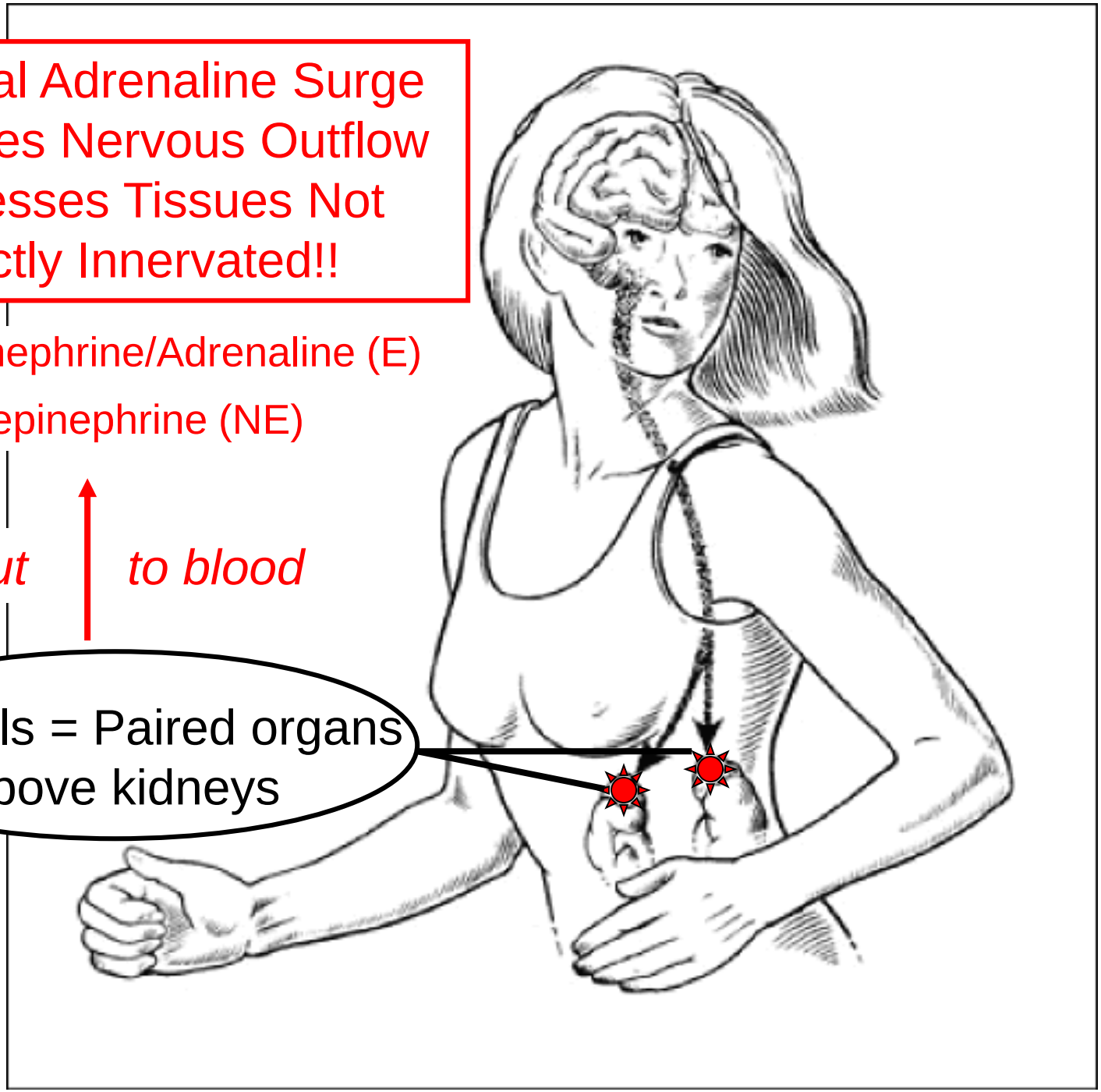
Hormonal Adrenaline Surge Reinforces Nervous Outflow & Accesses Tissues Not Directly Innervated!!

80% Epinephrine/Adrenaline (E)

20% Norepinephrine (NE)

Output *to blood*

Adrenals = Paired organs above kidneys



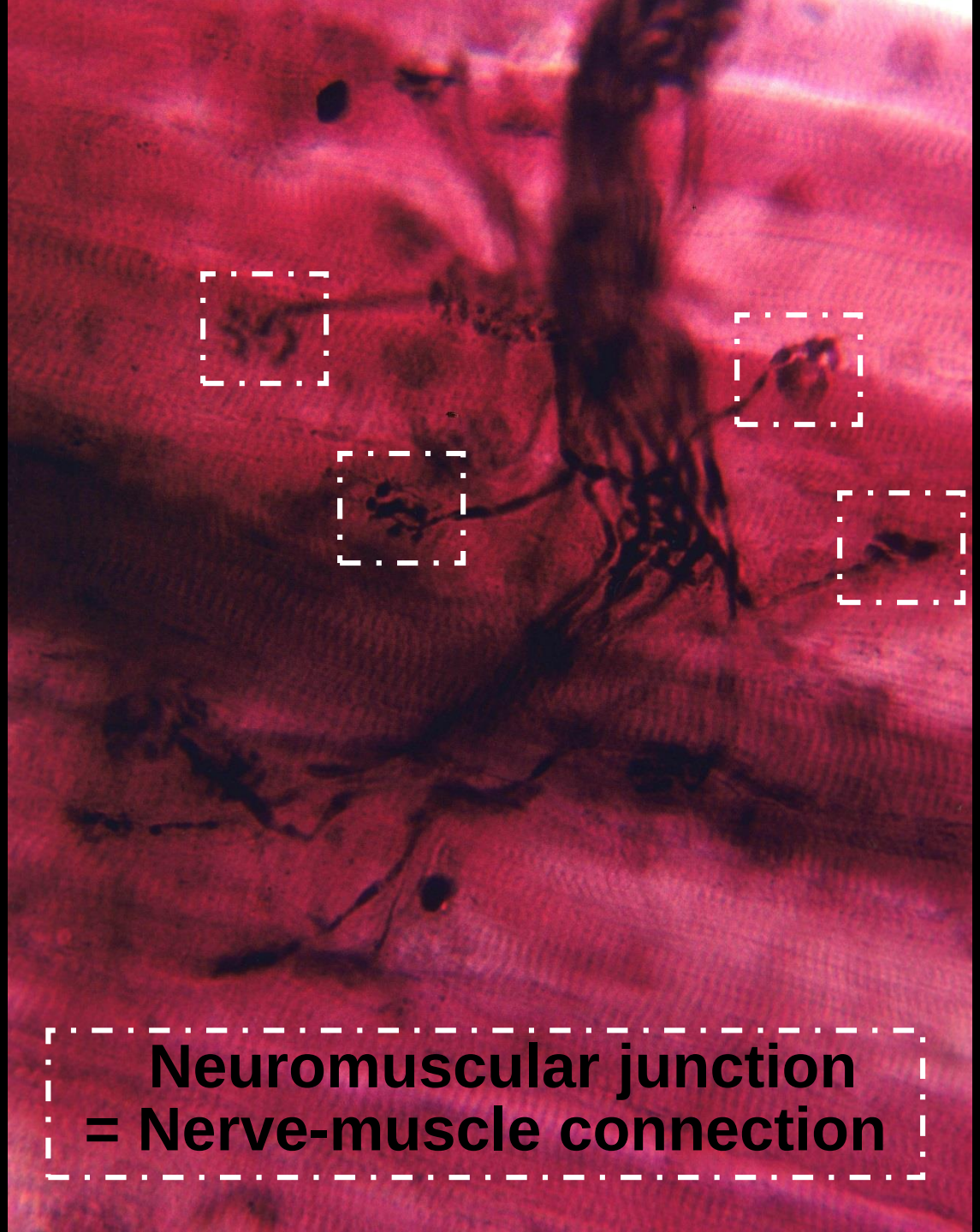
Fight-or-Flight Stories!

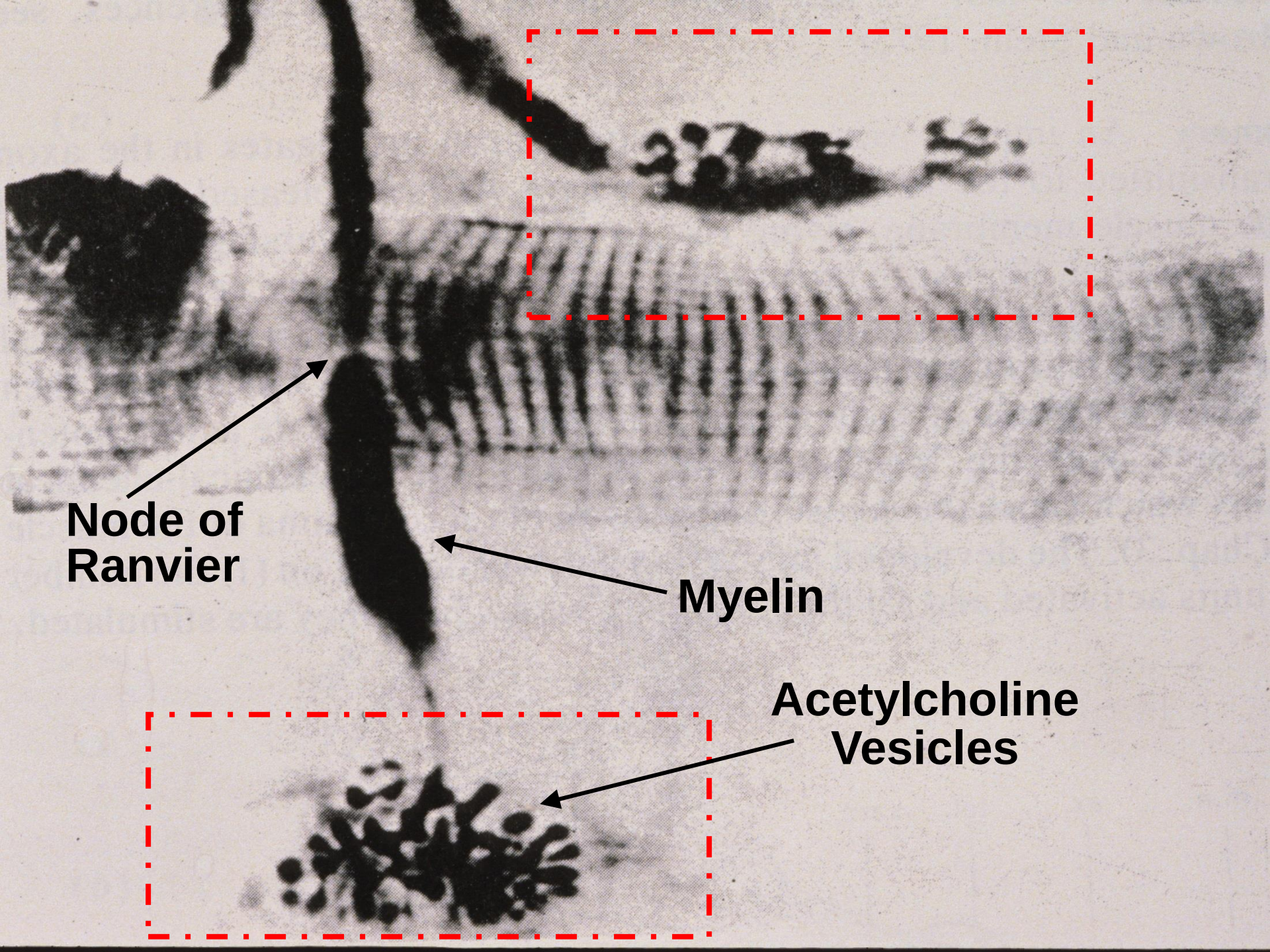
or

…choose this!!

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

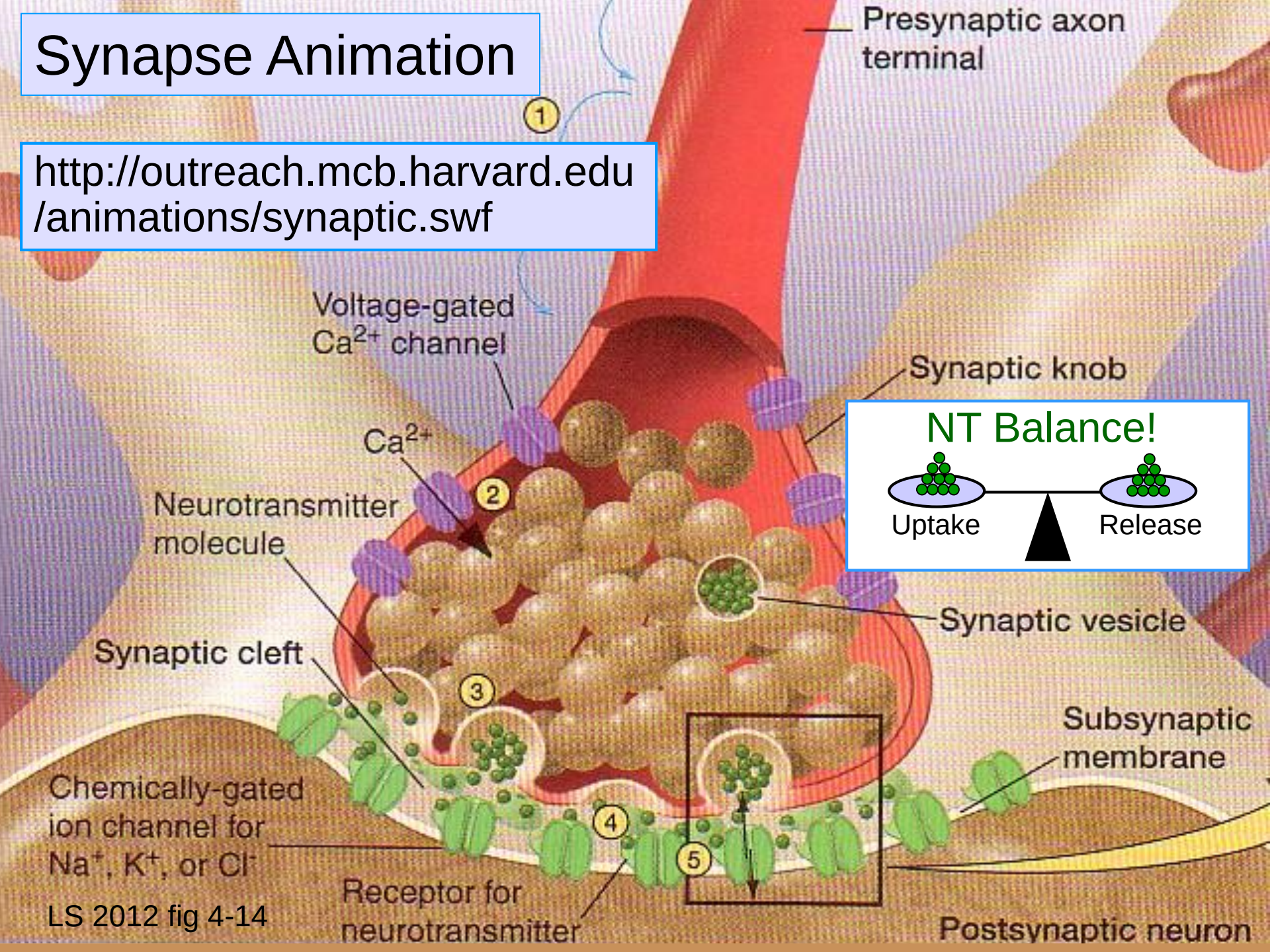
Organ	Effect of Sympathetic Stimulation	Effect of Parasympathetic Stimulation
Heart	Increases heart rate and increases force of contraction of the whole heart	Decreases heart rate and decreases force of contraction of the atria only
Blood Vessels	Constricts	Dilates vessels supplying the penis and the 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


Neuromuscular junction
= Nerve-muscle connection


Node of
Ranvier
Myelin
Acetylcholine
Vesicles

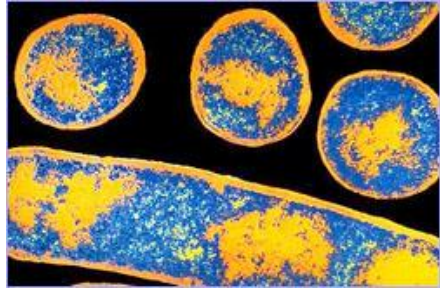
Synapse Animation

http://outreach.mcb.harvard.edu/animations/synaptic.swf



NT Balance!

LS 2012 fig 4-14




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+
7
Cation channel
Acetylcholinesterase
Local current flow between depolarized end plate and adjacent membrane
Motor end plate
Contractile elements within muscle fiber