BI 121 Lecture 11

… Fun lab today! Data for a lifetime!
Thanks for being prepared!

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

***II. 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 (insulin, glucagon, diabetes) 2. Thyroid 3. Adrenals

***III. Nervous System & Excitable Cell Connections* 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***
- **E. Autonomic nervous system overview LS pp 178 – 85**

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

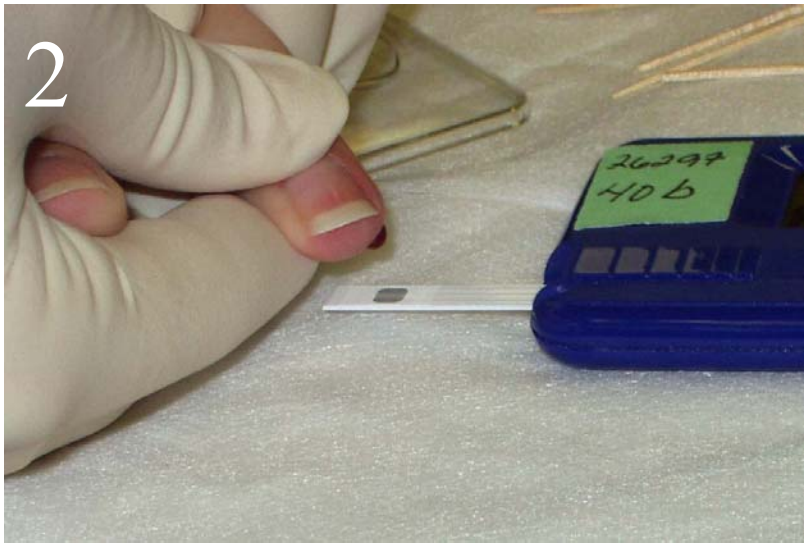
PREPARATION

WASH & DRY

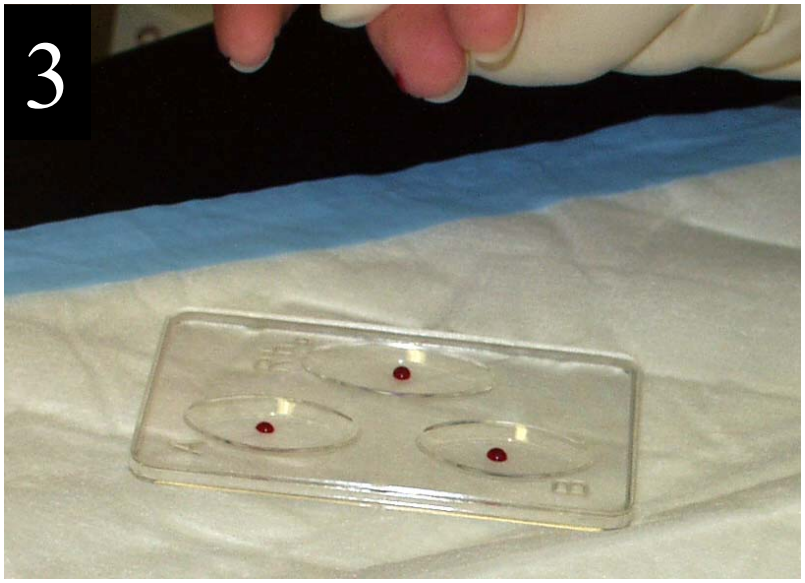
ALCOHOL

SAMPLE+TESTS

OBTAIN μSAMPLE

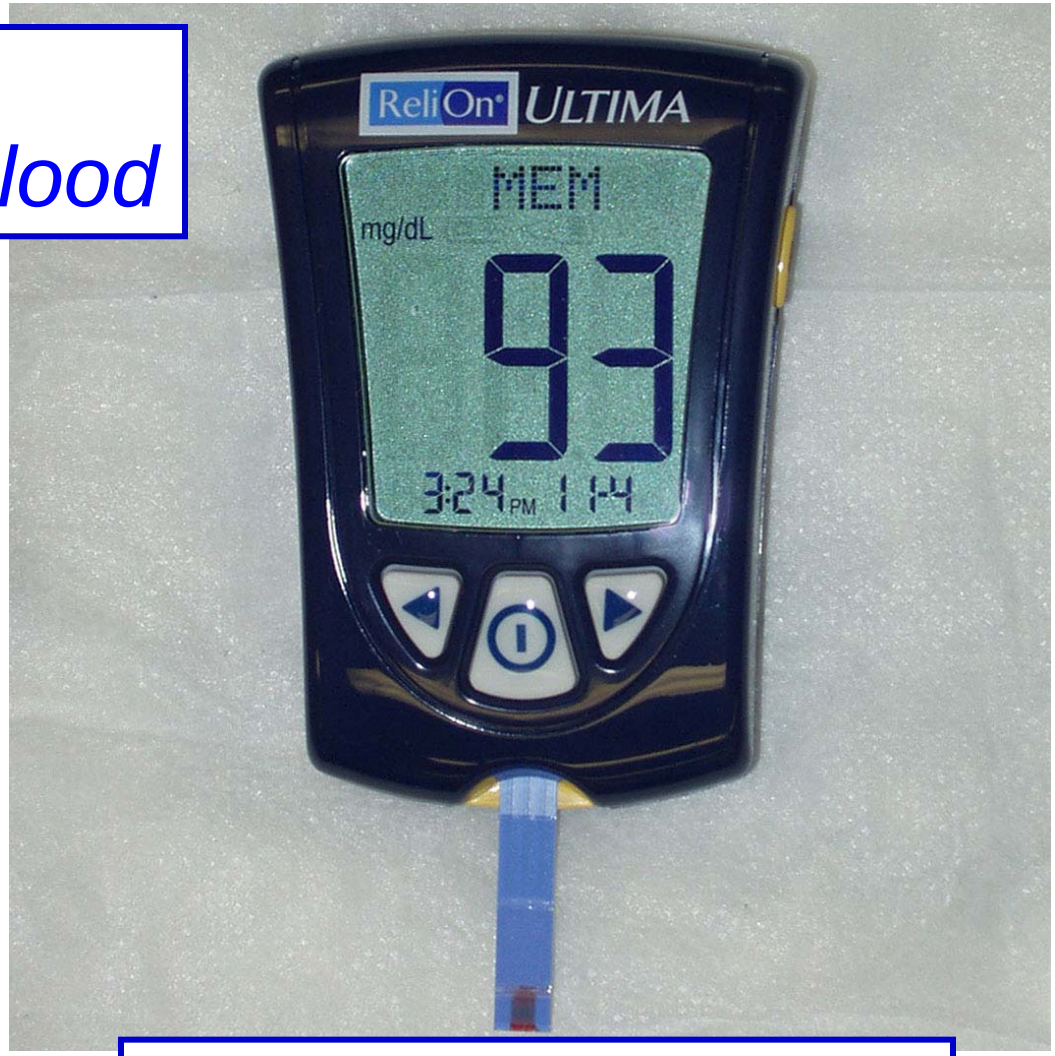


BLOOD GLUCOSE



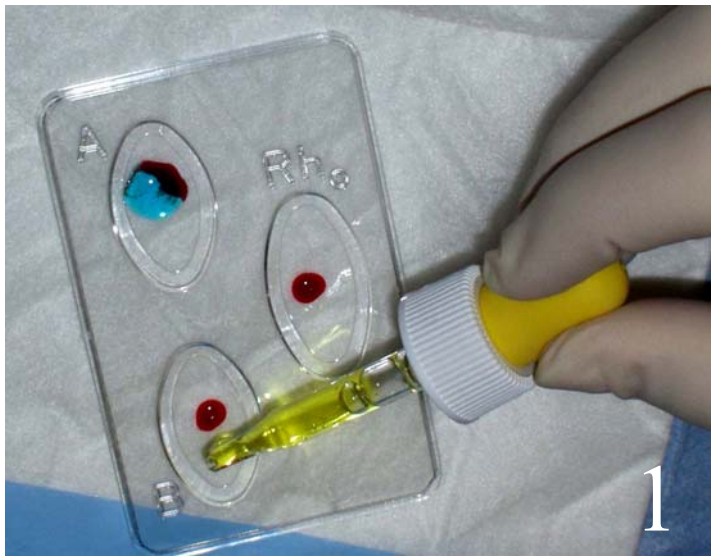
BLOOD TYPING

Glucose:
Sugar in Blood

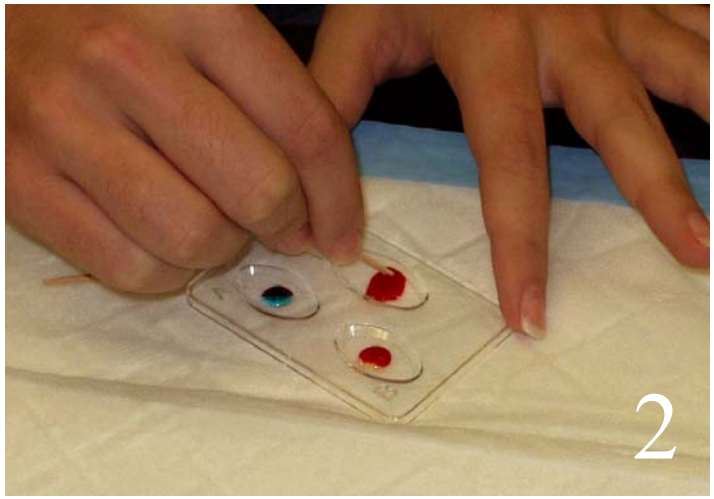


Normal: 70-99
Pre-Diabetes: 100-125
Diabetes: ≥ 126 mg/dL

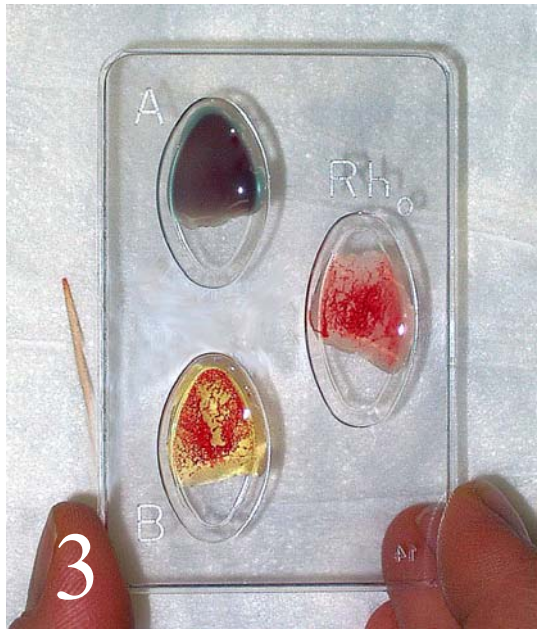
BLOOD TYPING



ADD ANTISERA



MIX W/TOOTHPICKS



READ & RECORD!!

CLEAN-UP!

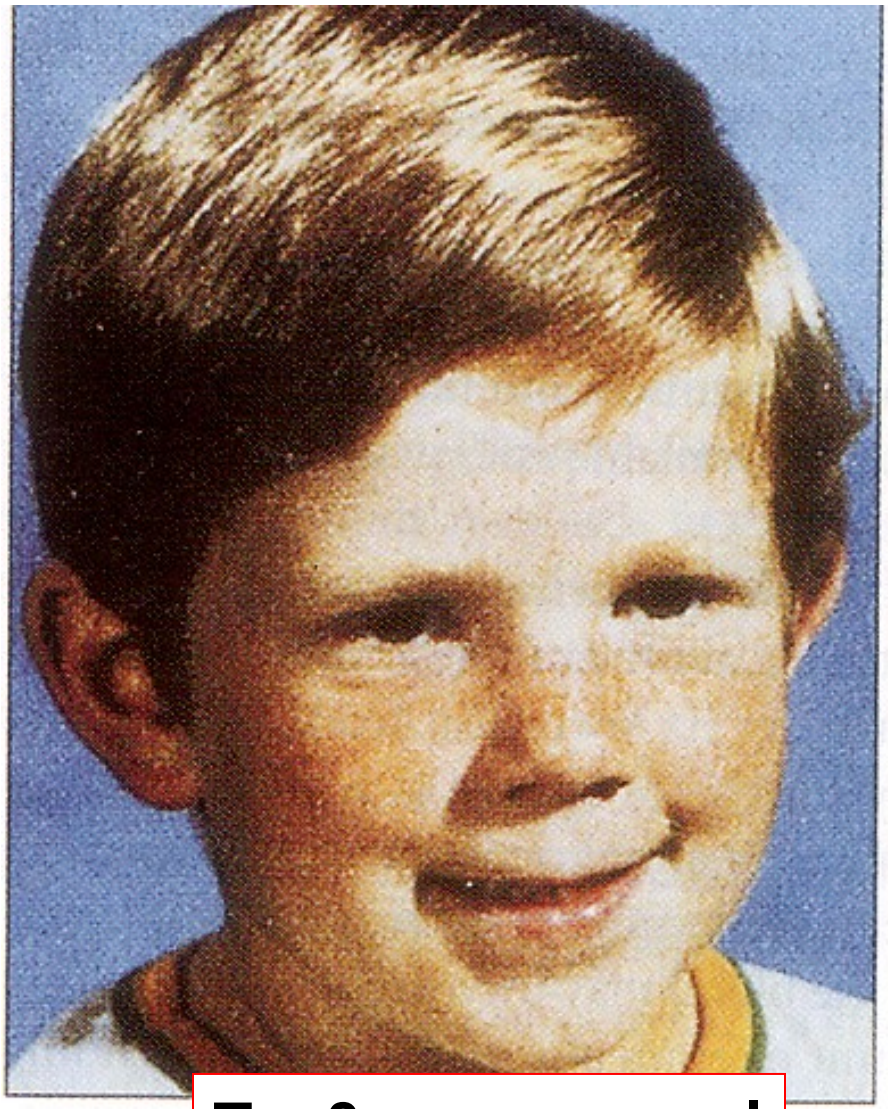
FOLD DIAPER

BLOOD PRODUCTS

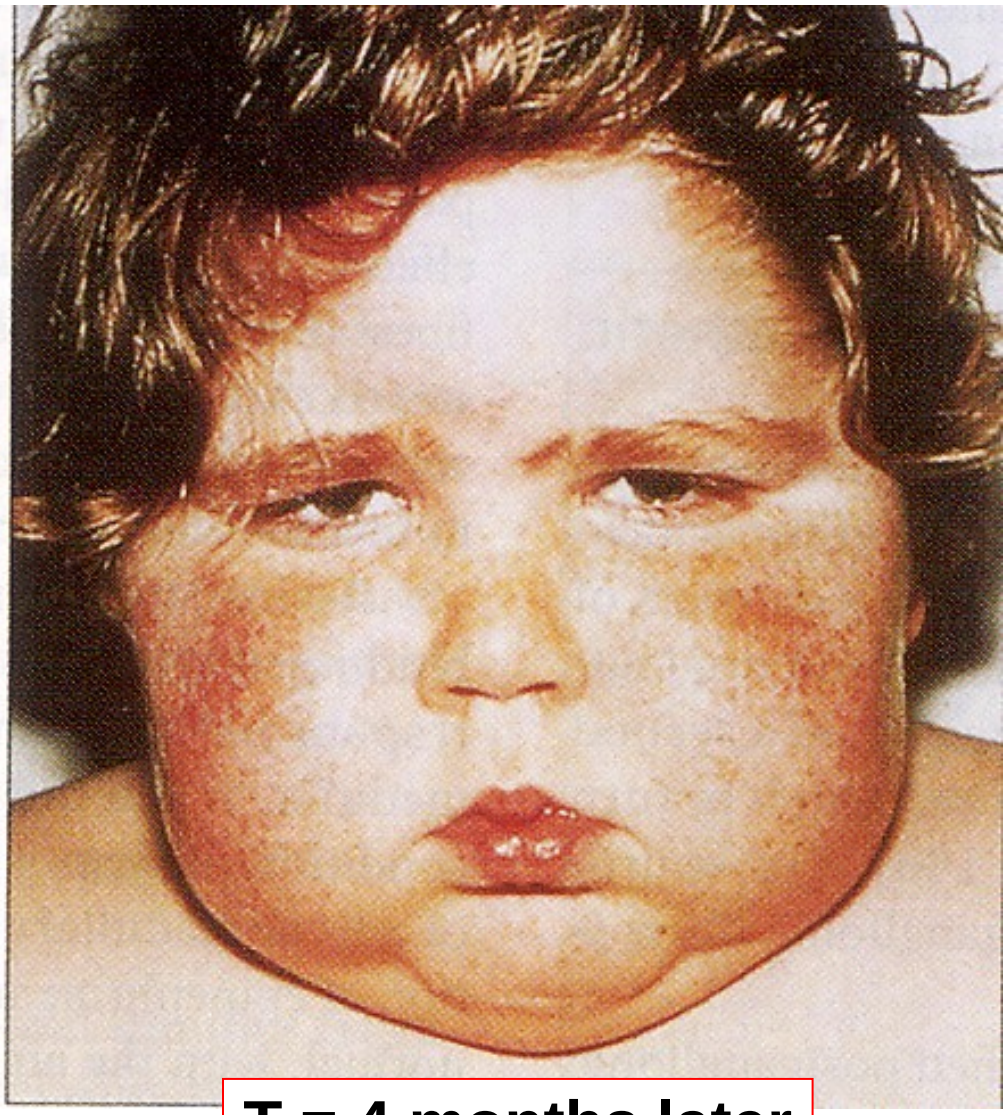
REWASH!!

Q about Blood Chem Lab?

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



T = 0, near normal

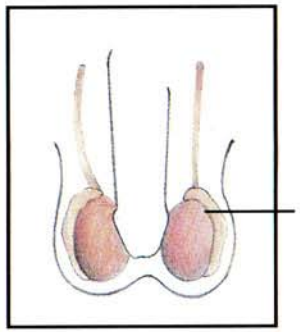


T = 4 months later

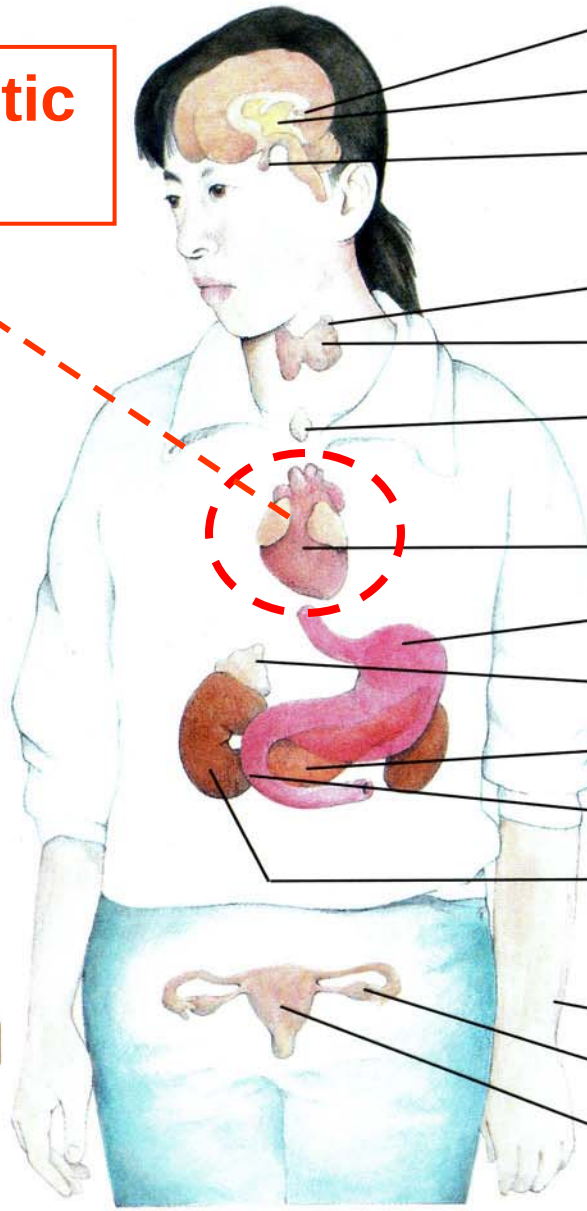
Endocrine System

ANP = Atrial Natriuretic Polypeptide

- Solely endocrine function
- Mixed function
- Complete function uncertain



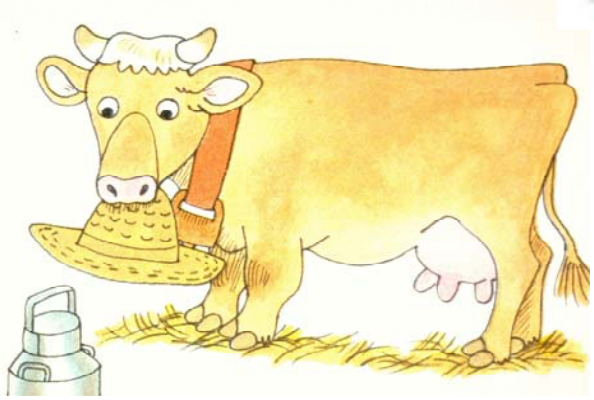
Testes in male



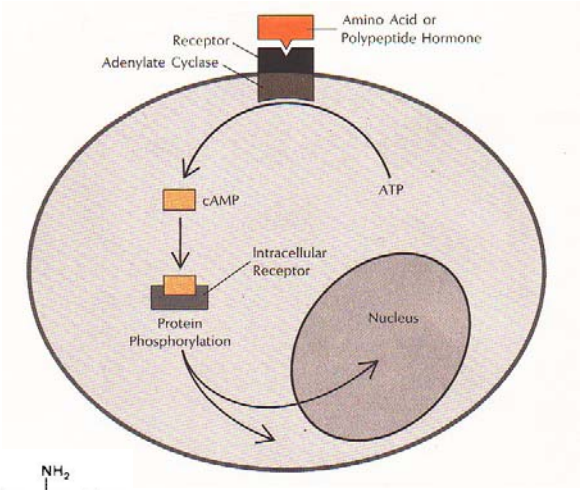
- Pineal
- Hypothalamus
- Pituitary
- Parathyroid
- Thyroid
- Thymus
- Heart
- Stomach
- Adrenal gland
- Pancreas
- Duodenum
- Kidney
- Skin
- Ovaries in female
- Placenta in pregnant female

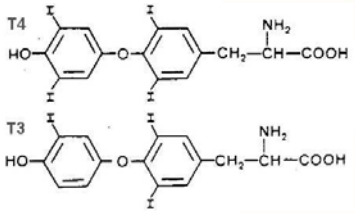
Hormone/Endocrine Classifications

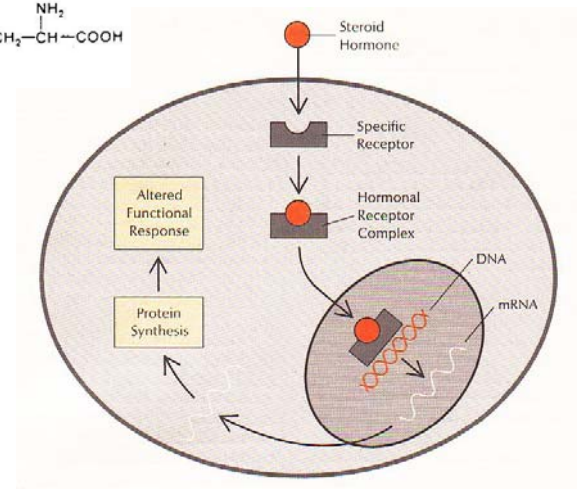
Exogenous



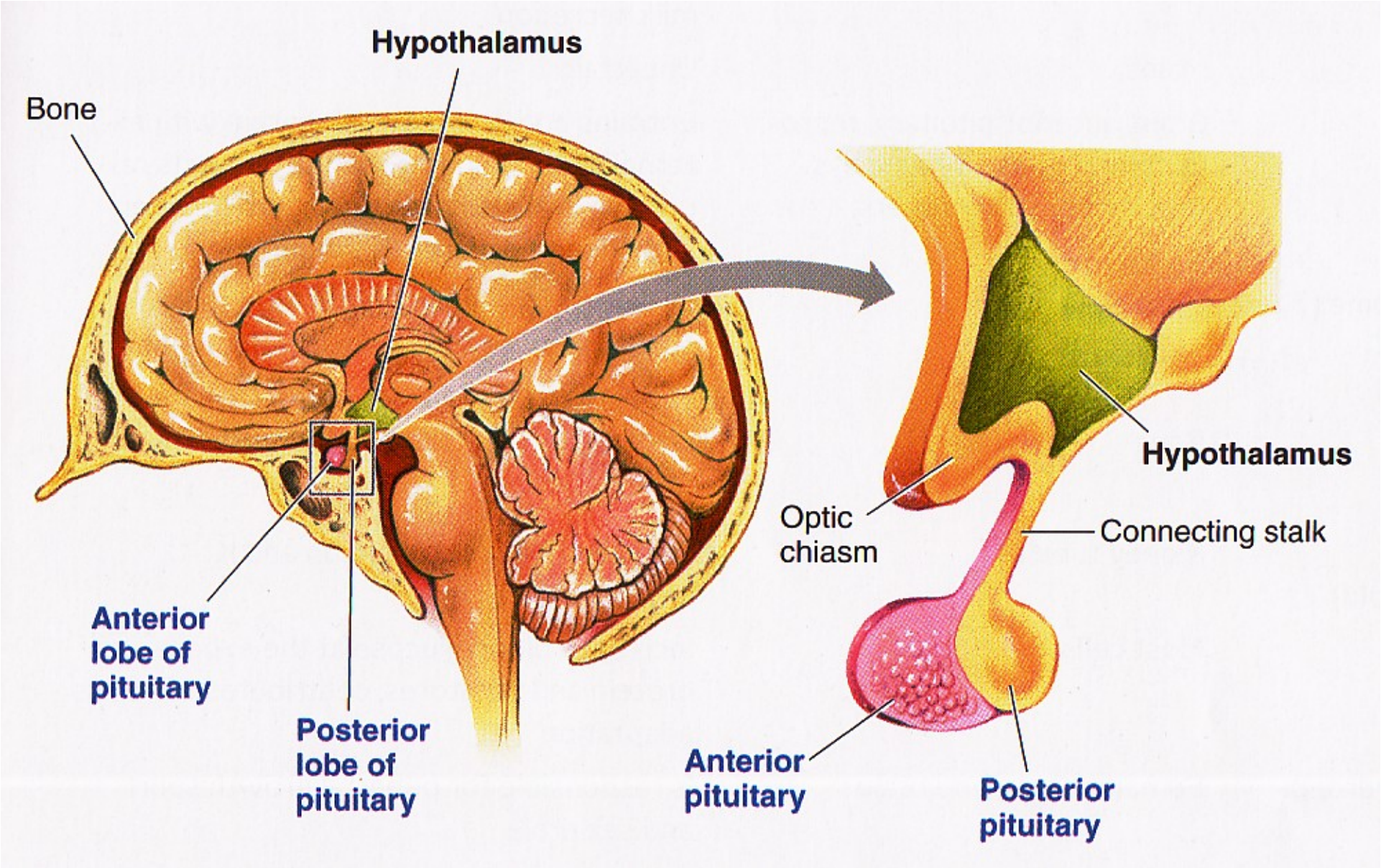
Endogenous





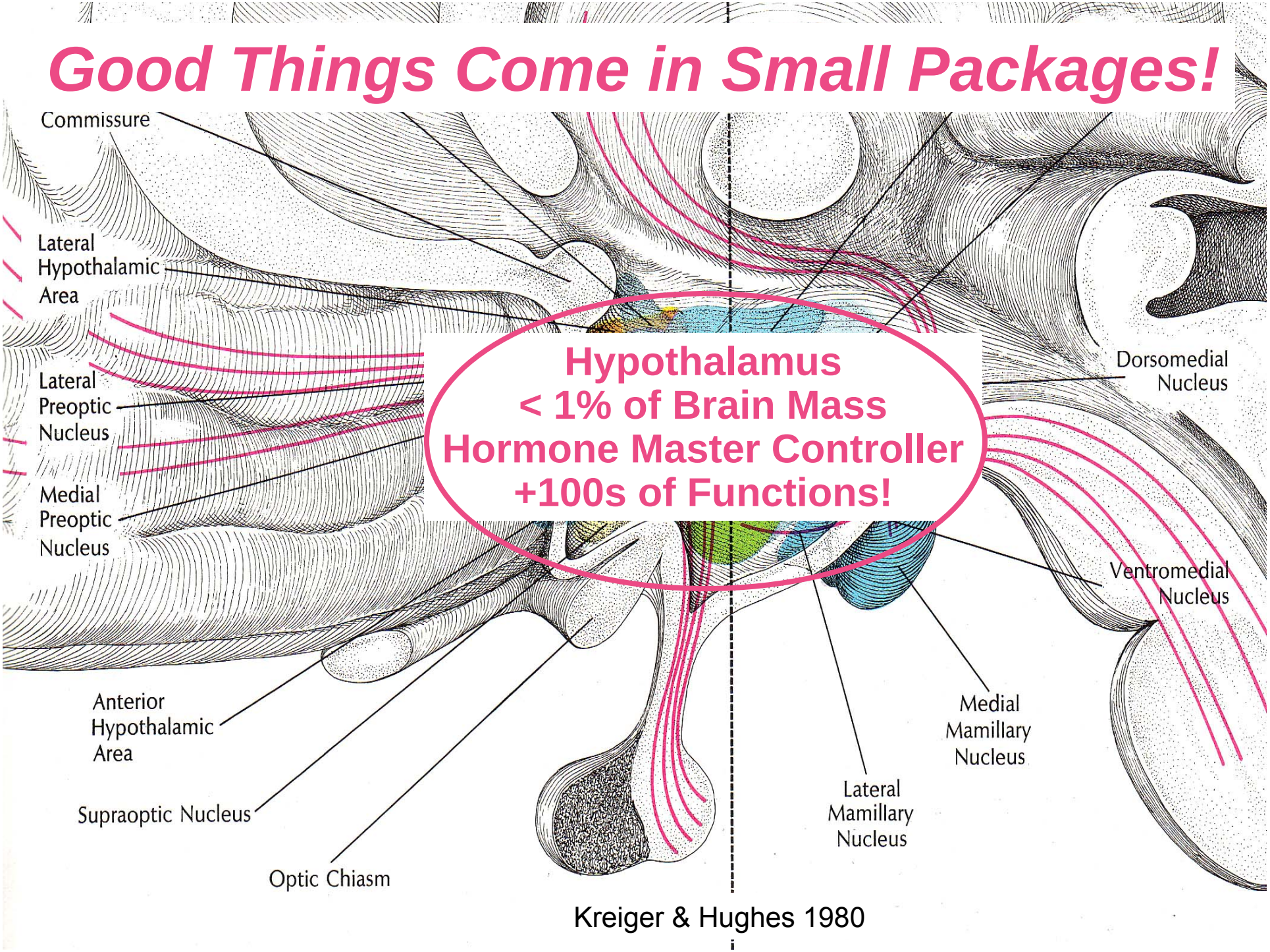


Hypothalamus & Pituitary: Intimate Relationship

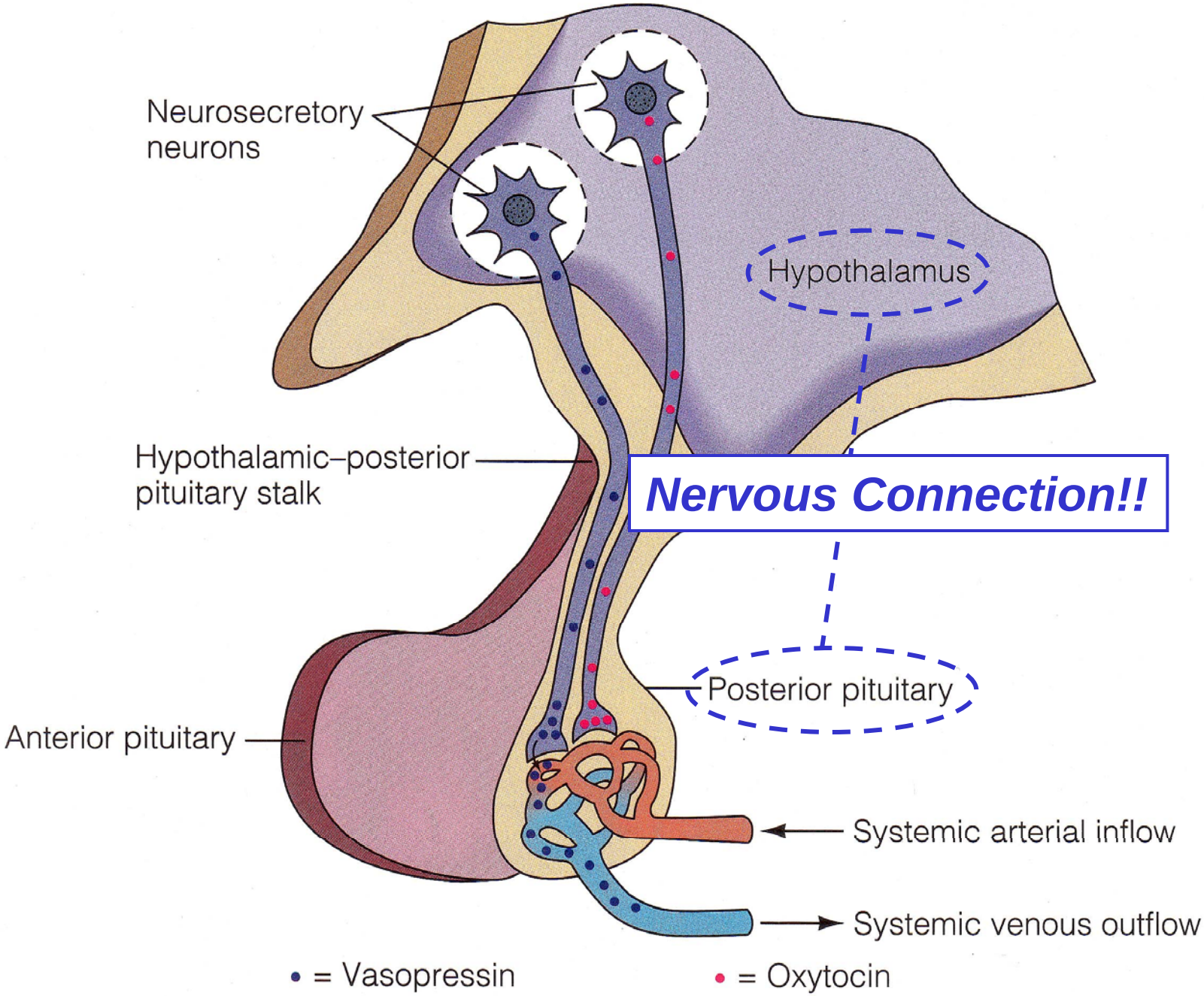


LS 2012 fig 17-3

Good Things Come in Small Packages!

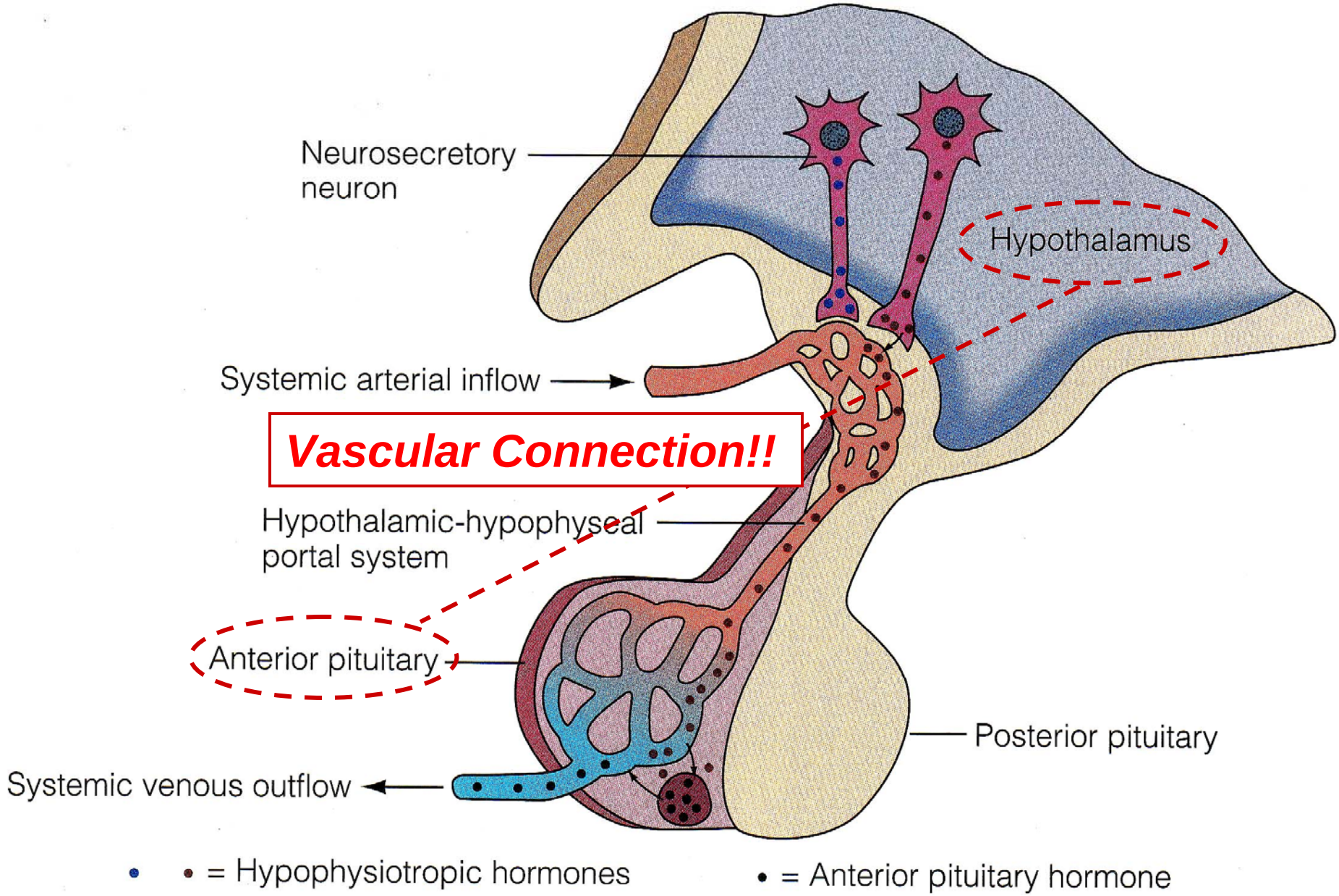


Kreiger & Hughes 1980

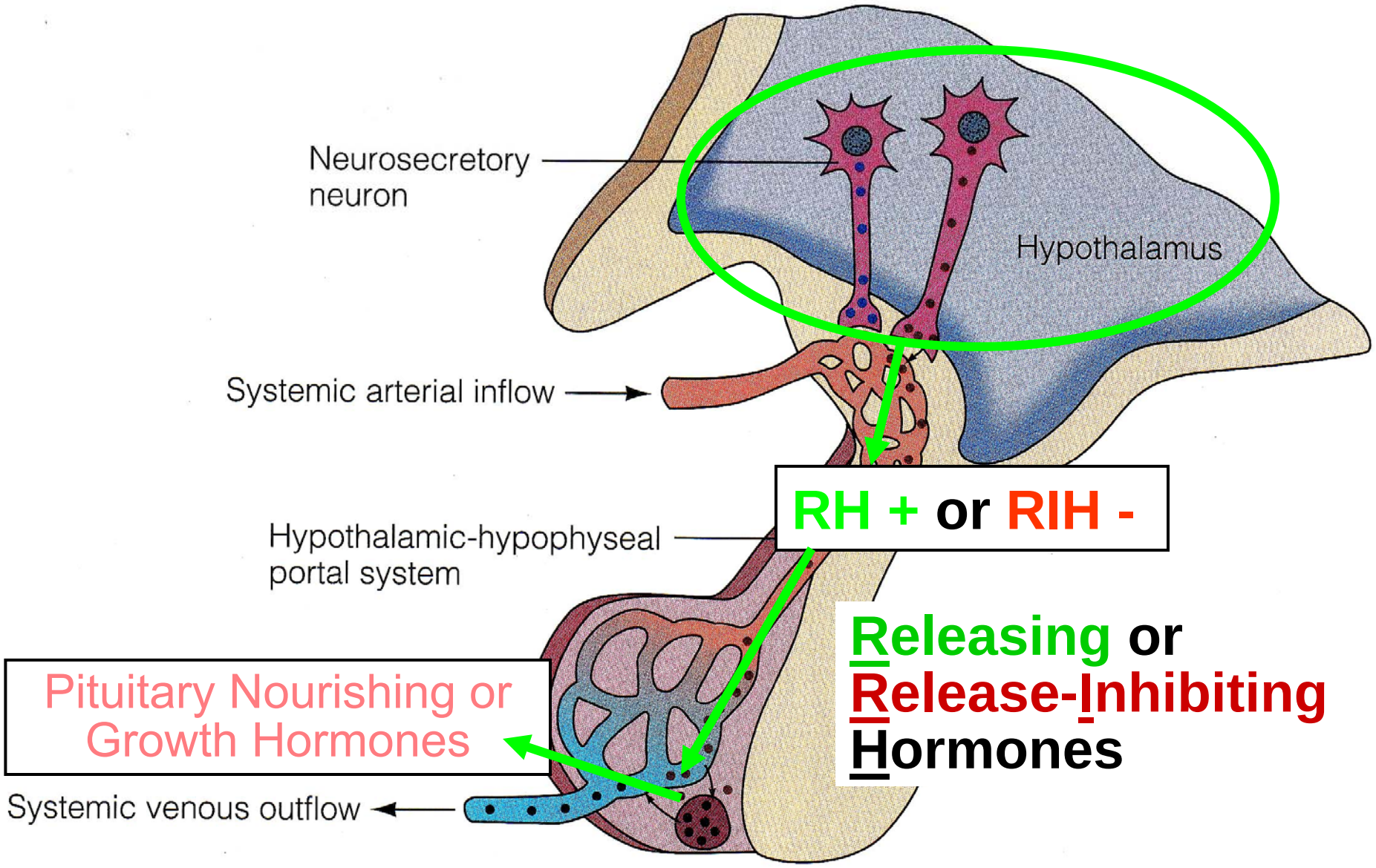

Neurosecretory neurons
Hypothalamus
Hypothalamic–posterior pituitary stalk
Nervous Connection!!
Posterior pituitary
Anterior pituitary
Systemic arterial inflow
Systemic venous outflow
• = Vasopressin
• = Oxytocin

LS 2007

Hypothalamus-Anterior Pituitary Vascular Connection!



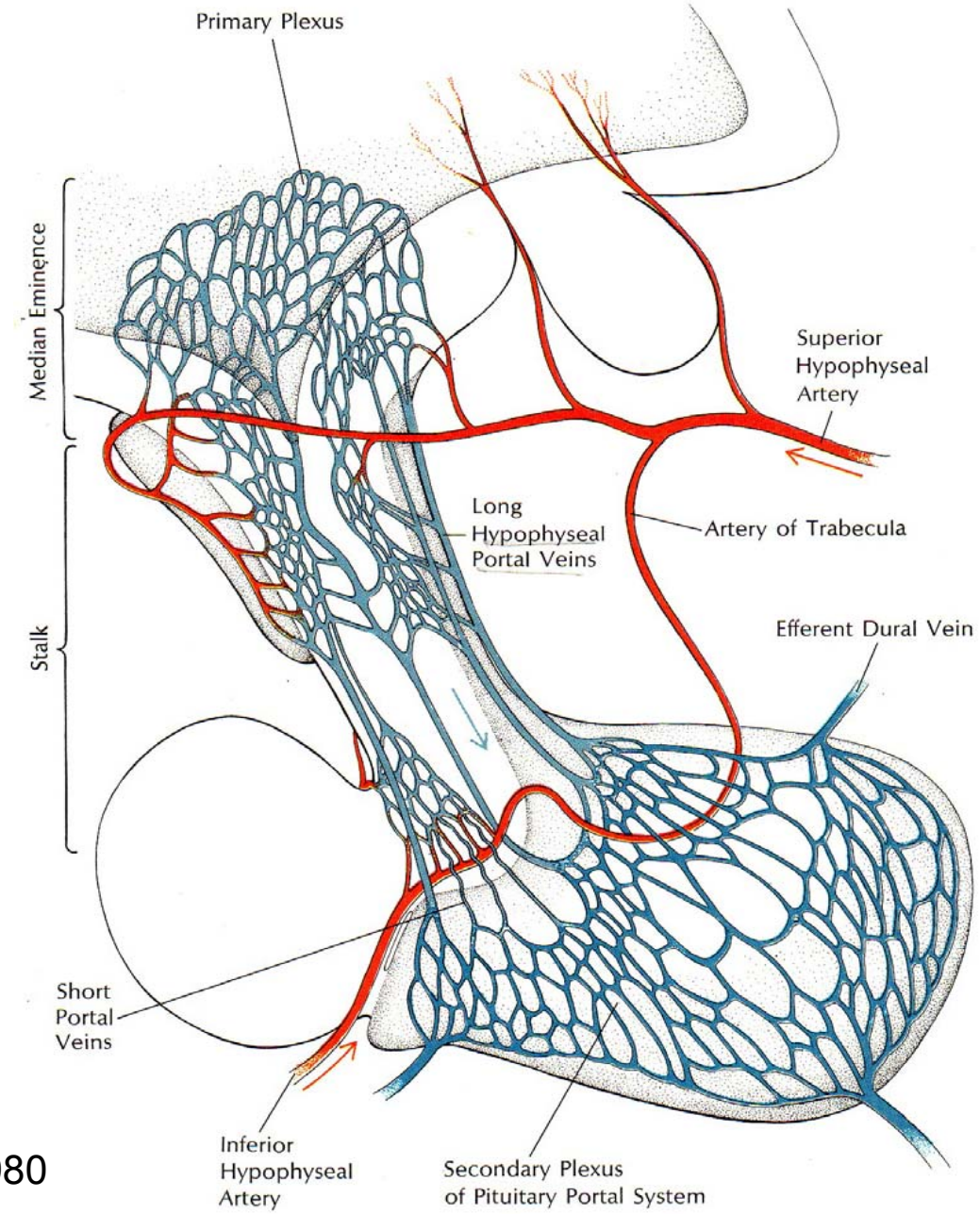
LS 2007



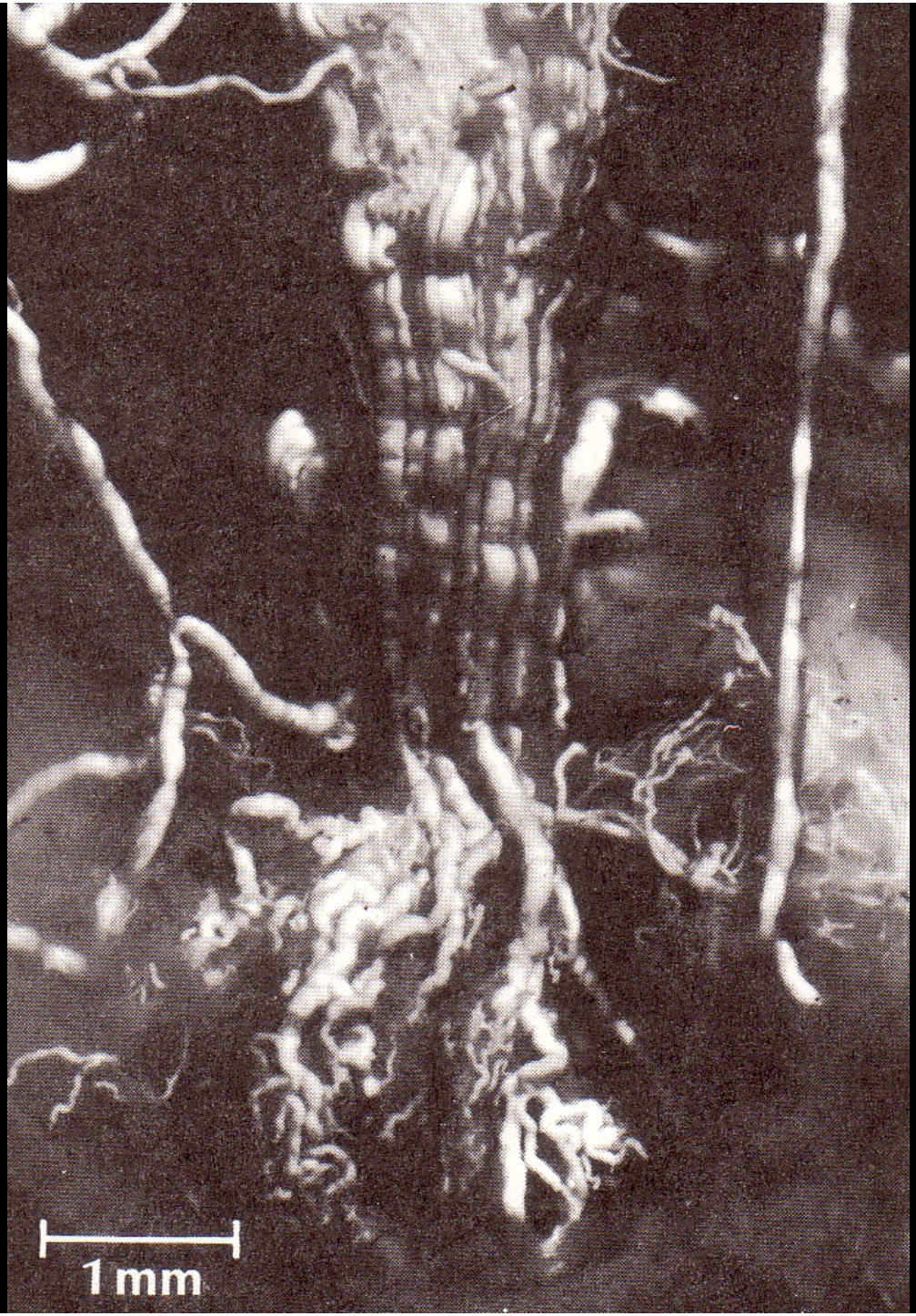
Hypophysis = Pituitary

LS 2007

Capillary-Venule-Capillary Intimate Circulation

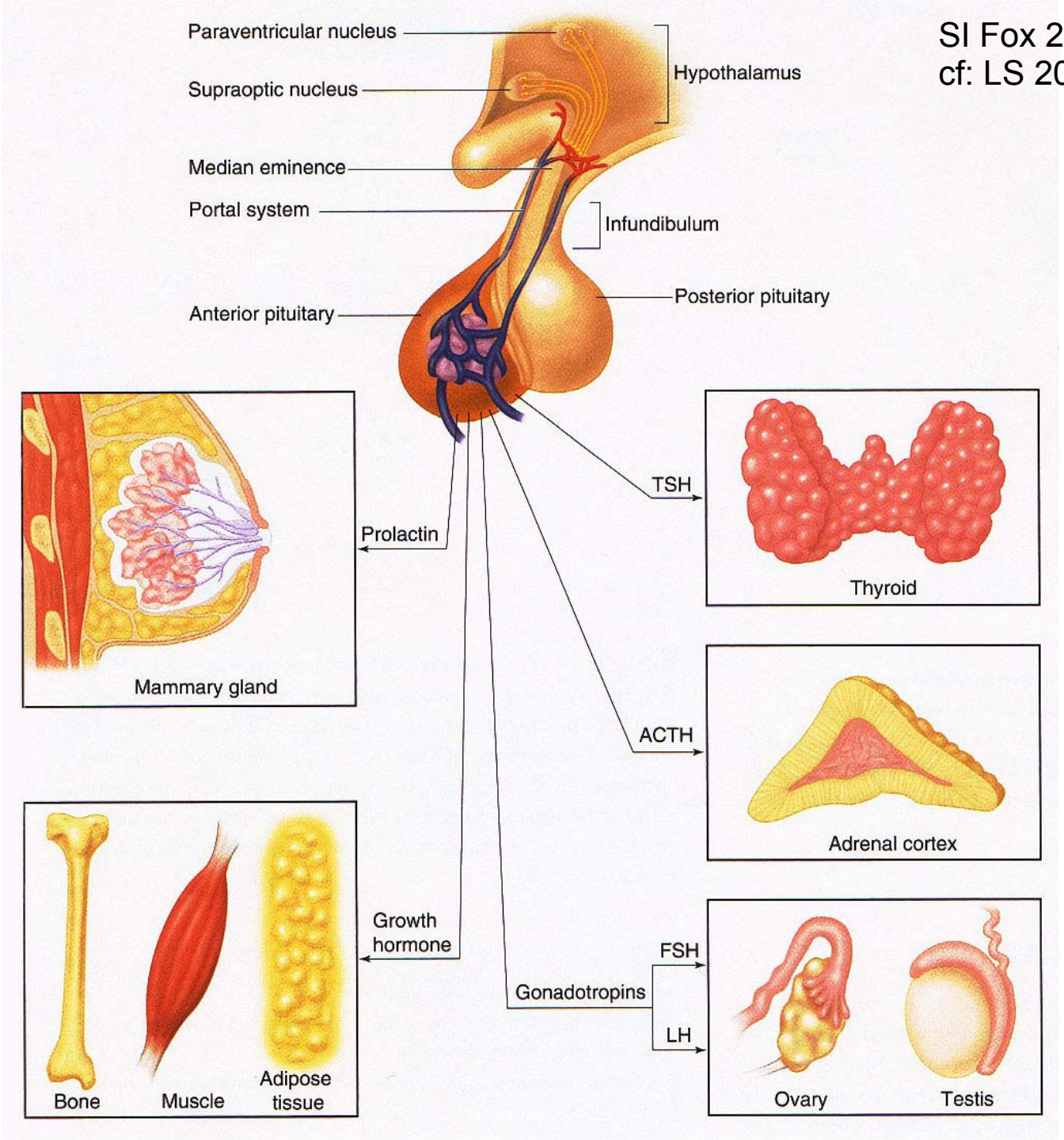


Krieger & Hughes 1980

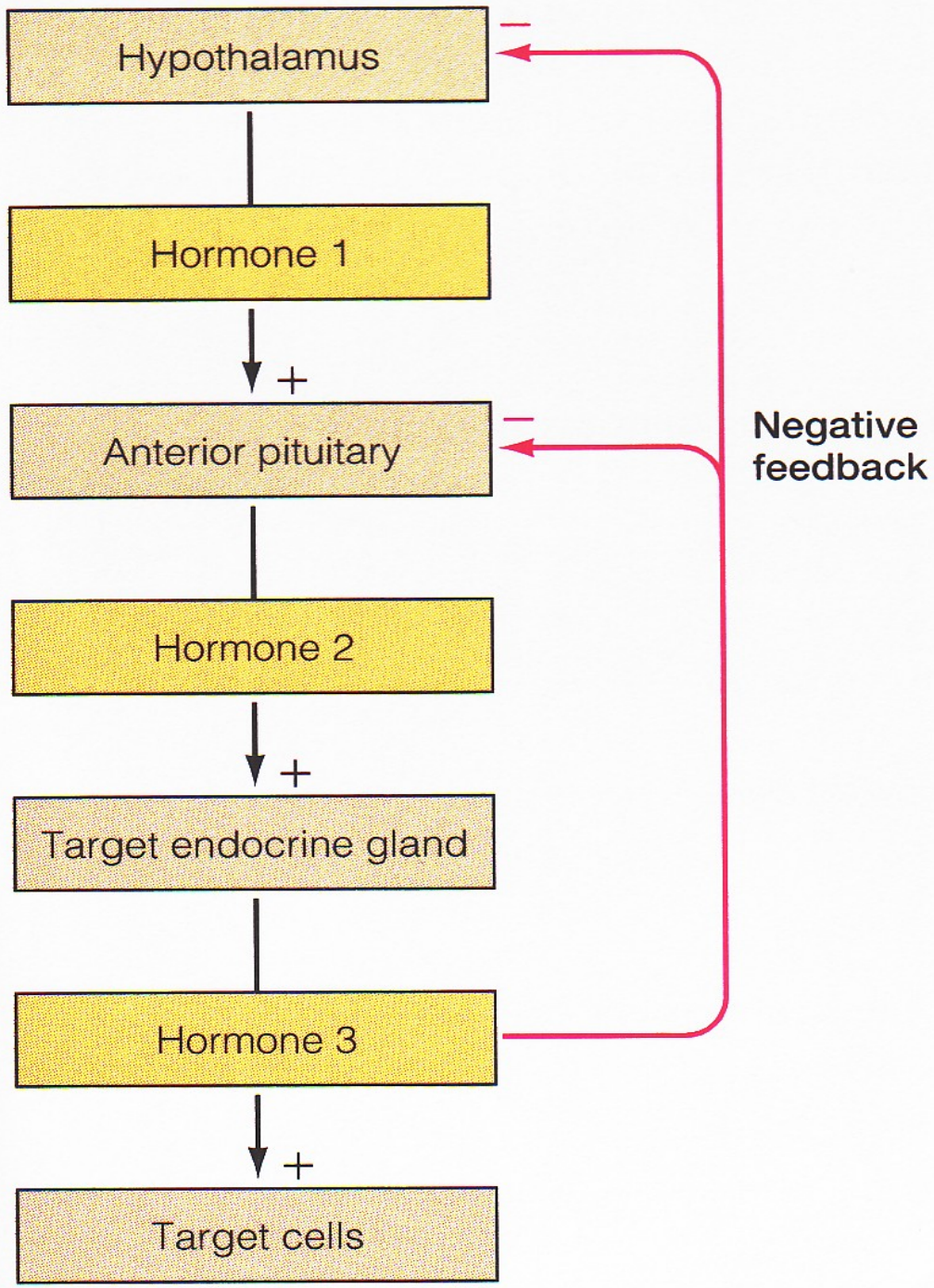


Krieger & Hughes 1980

SI Fox 2008
cf: LS 2012 fig 17-5



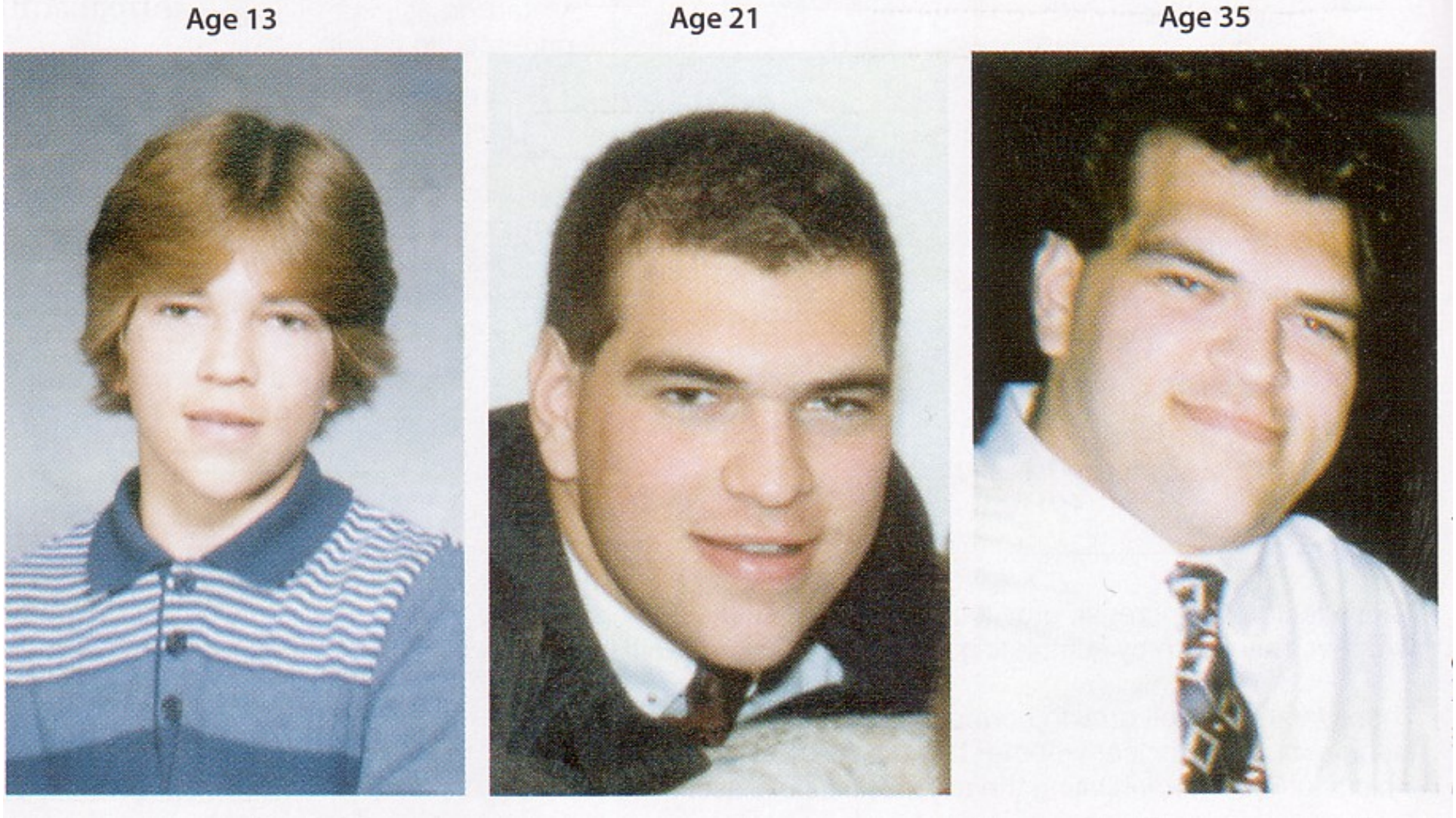
Discussion &/or Break?


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

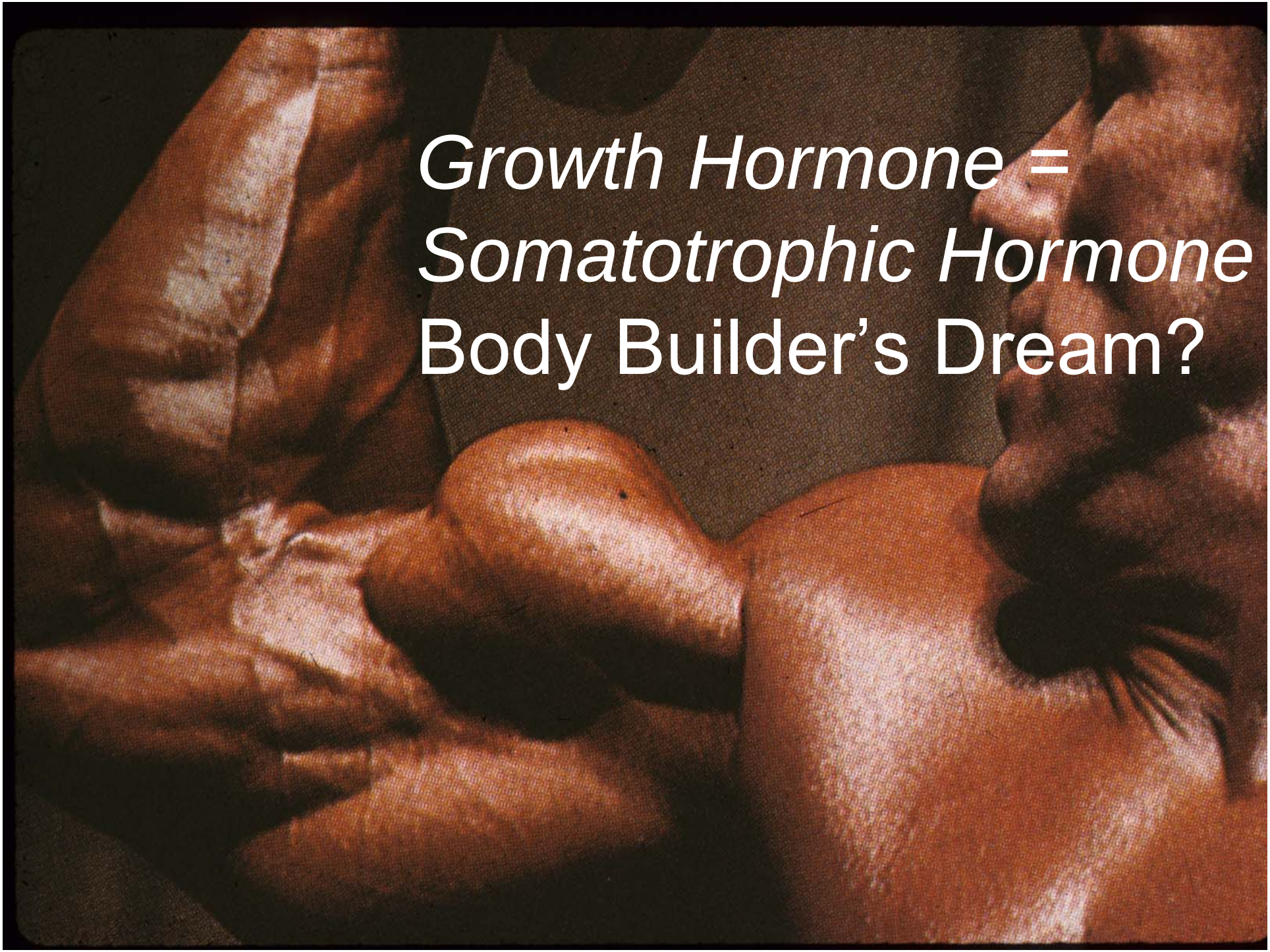
LS 1991

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

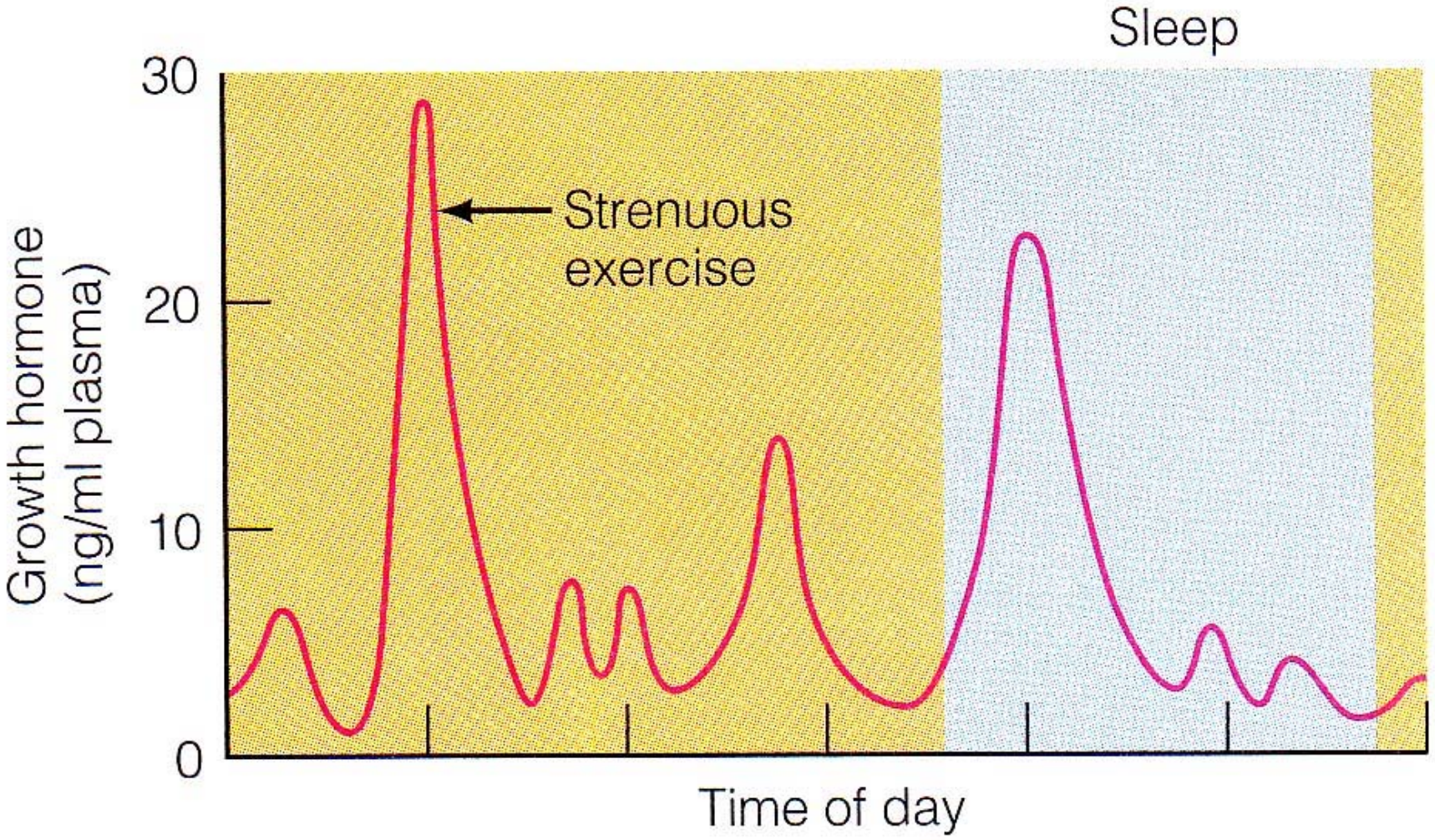
↑ Lipolysis & Fatty Acid mobilization

↓ Glucose uptake
(skeletal muscle & adipocytes)

↑ Glucose production
(liver glycogenolysis)

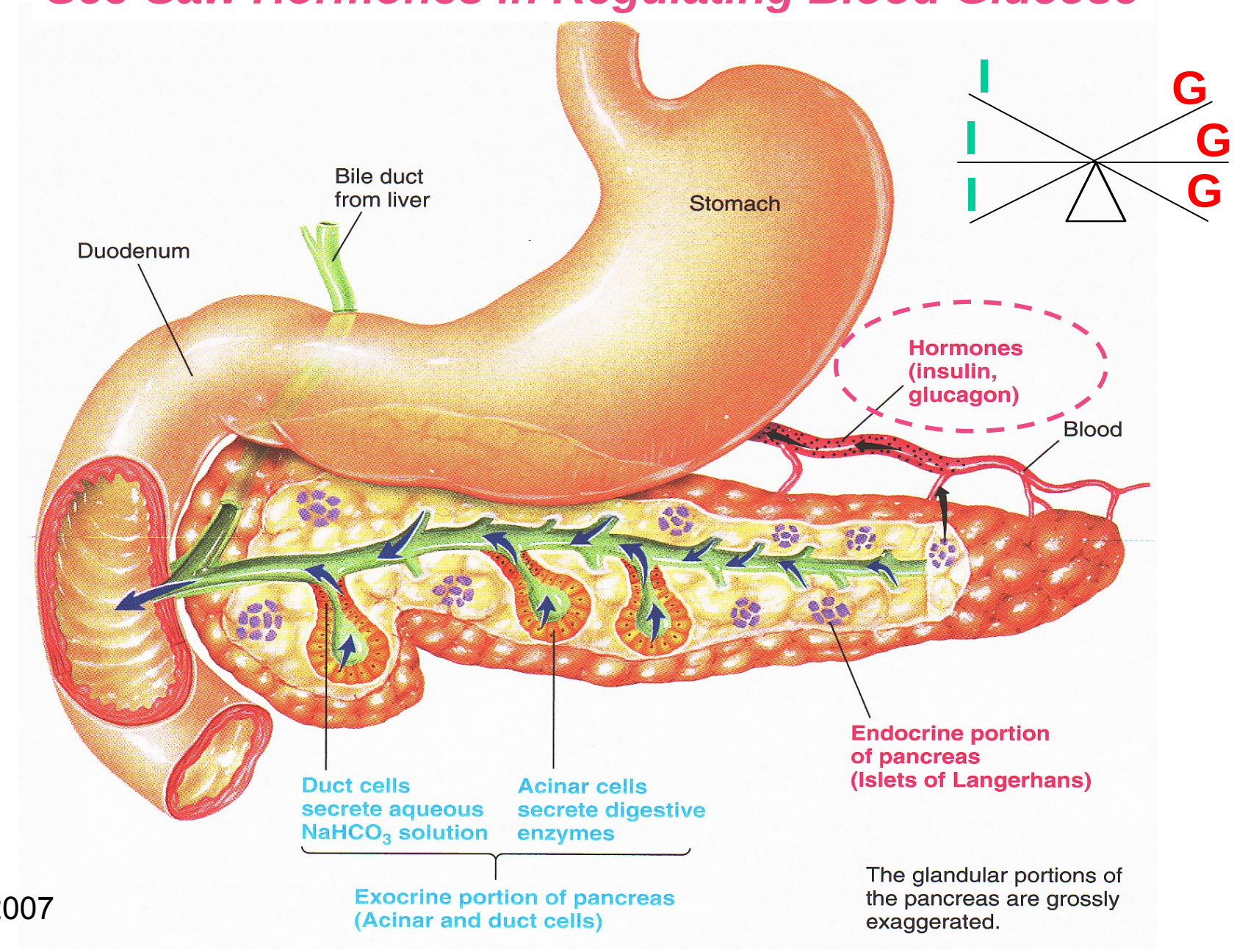
↑ Insulin secretion

Increase GH naturally with exercise & sleep!!



ng/ml = nanograms per mililiter

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



LS 2007

Proinsulin with C-Connecting Peptide

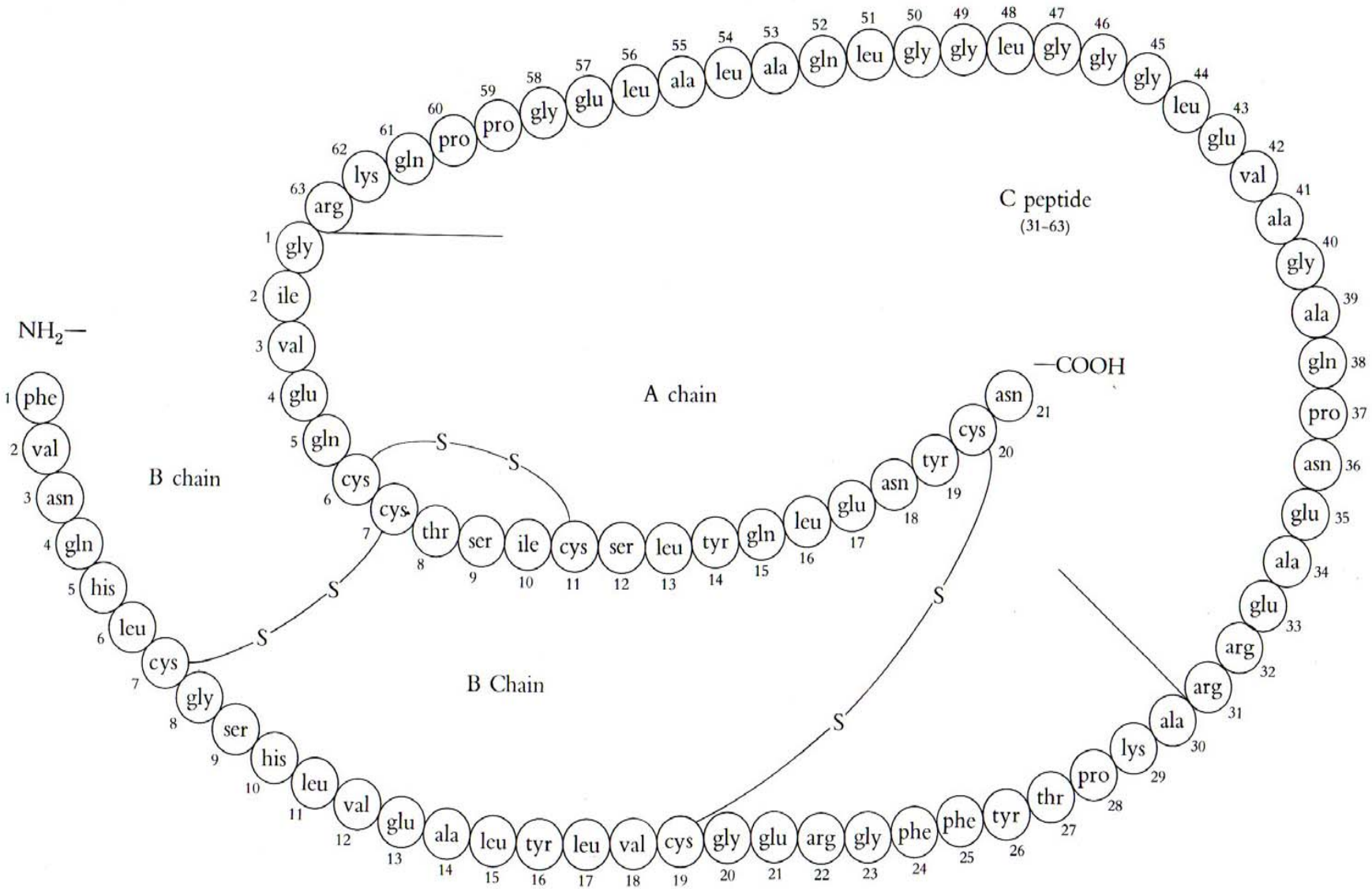


FIG. 10-4. Amino acid sequence of a mammalian proinsulin molecule. Note how the insulin molecule can be formed by cleaving this polypeptide chain at two locations to liberate the C peptide.

DO Norris 1980

TABLE 4-7

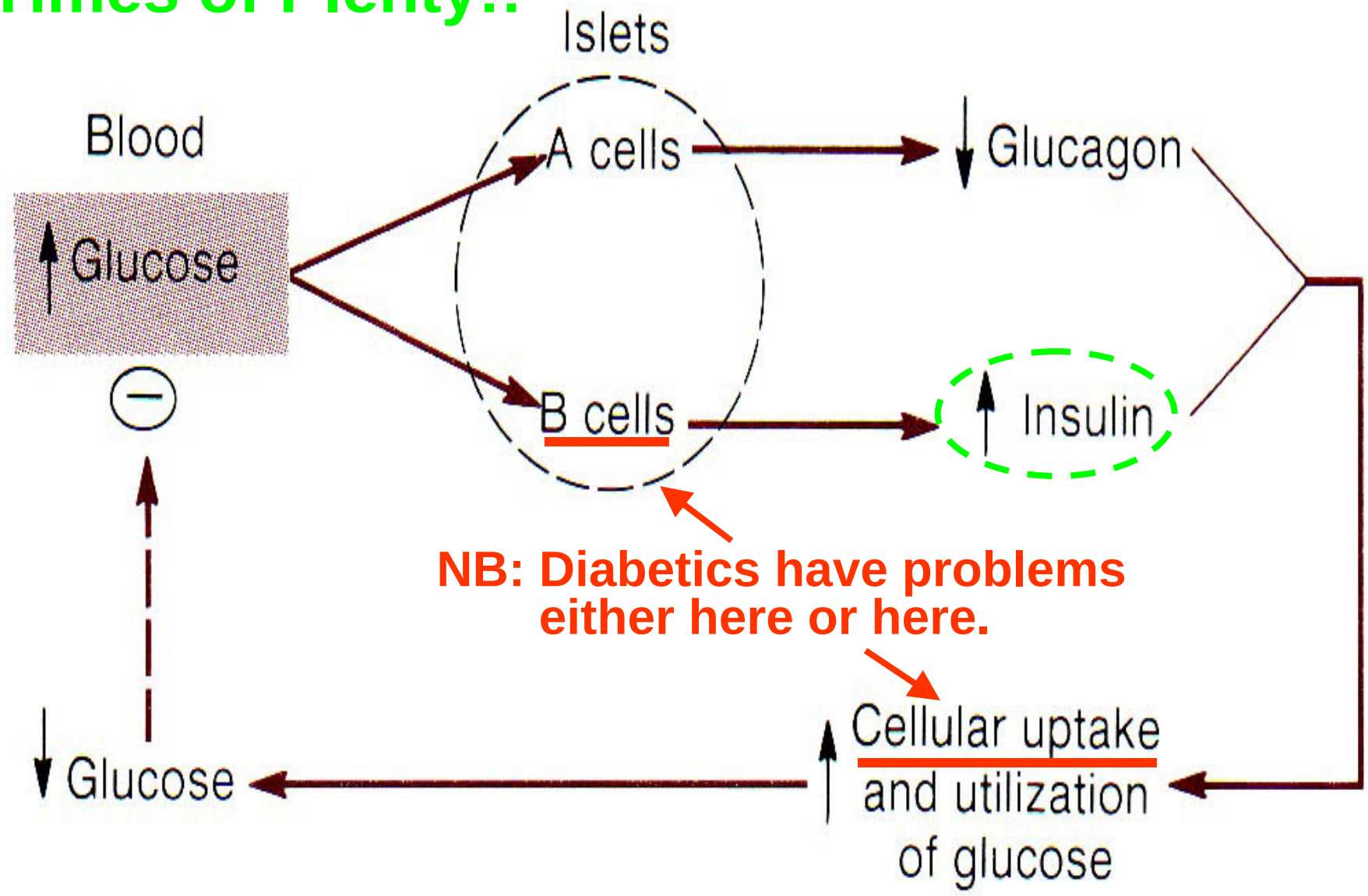
Warning Signs of Diabetes

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

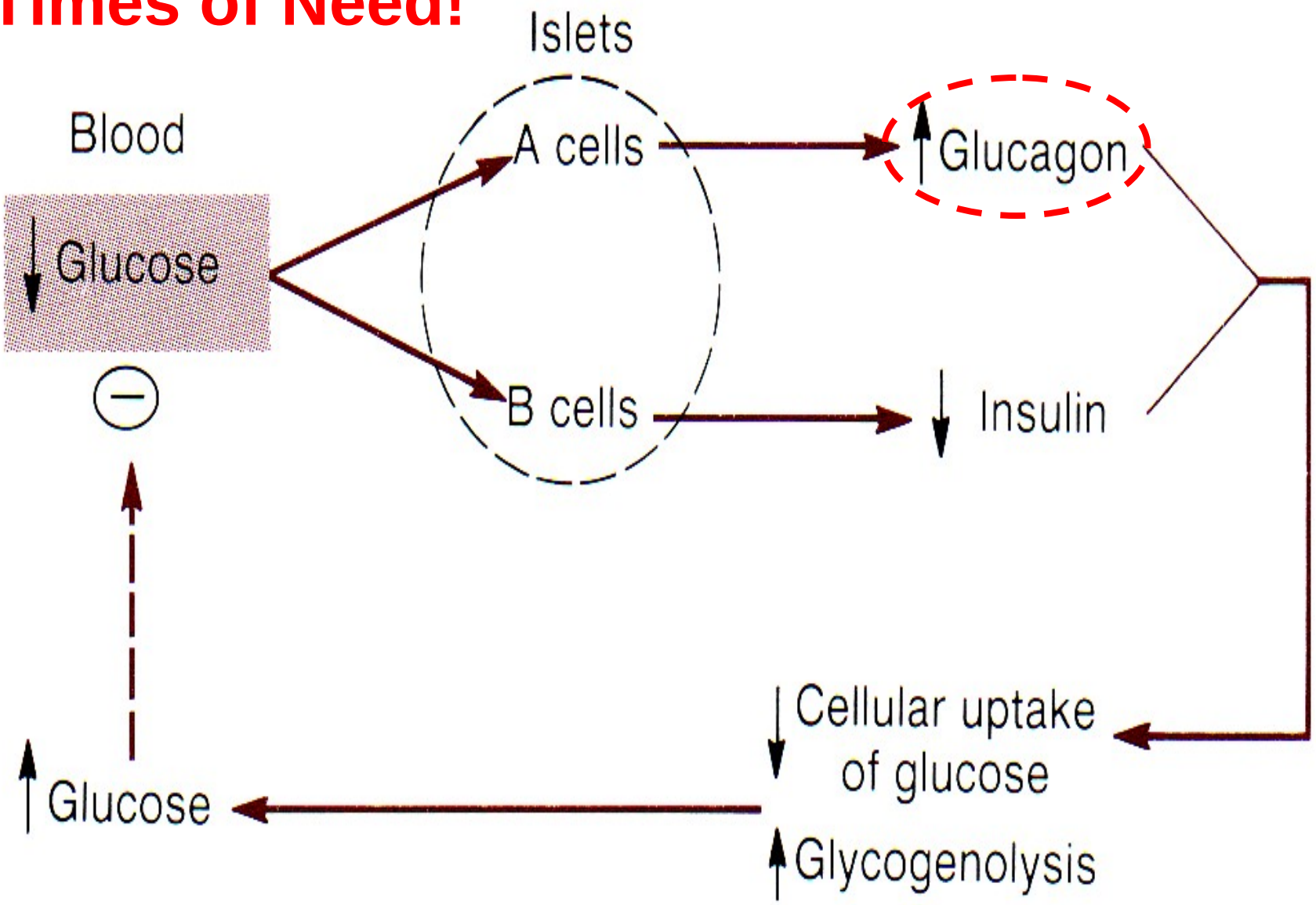
Times of Plenty!!



Fox 1987

Store!

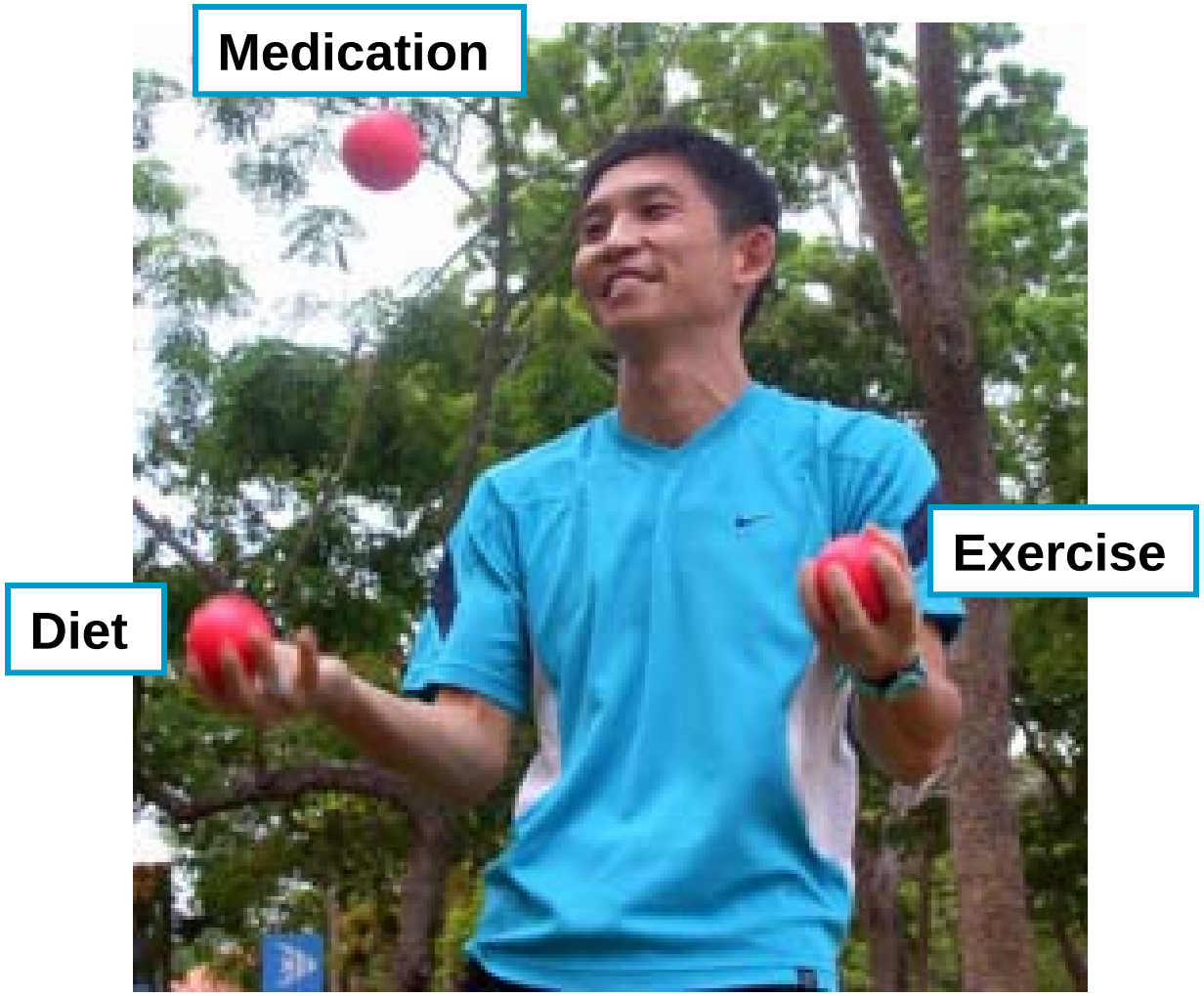
Times of Need!



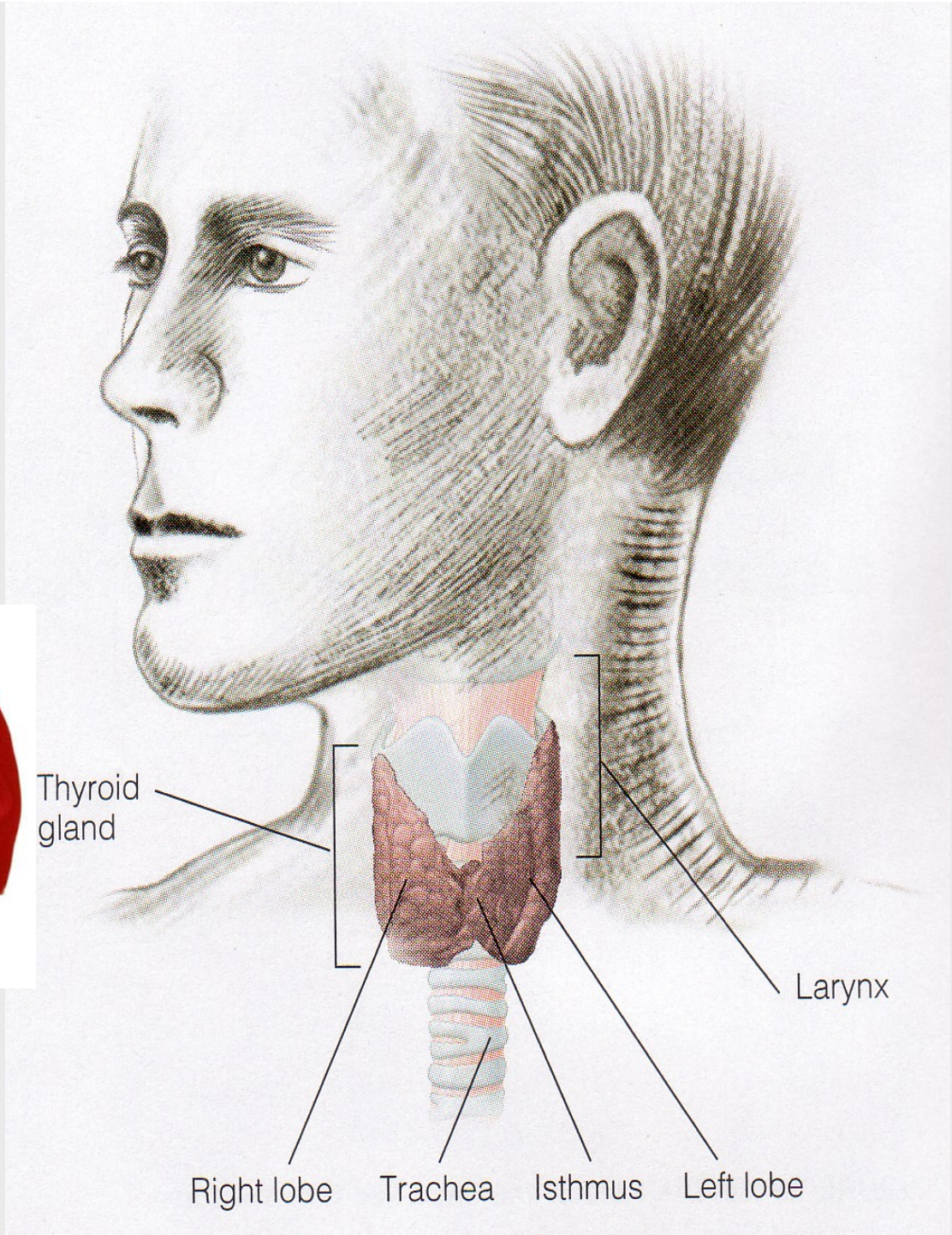
Fox 1987

Mobilize!!

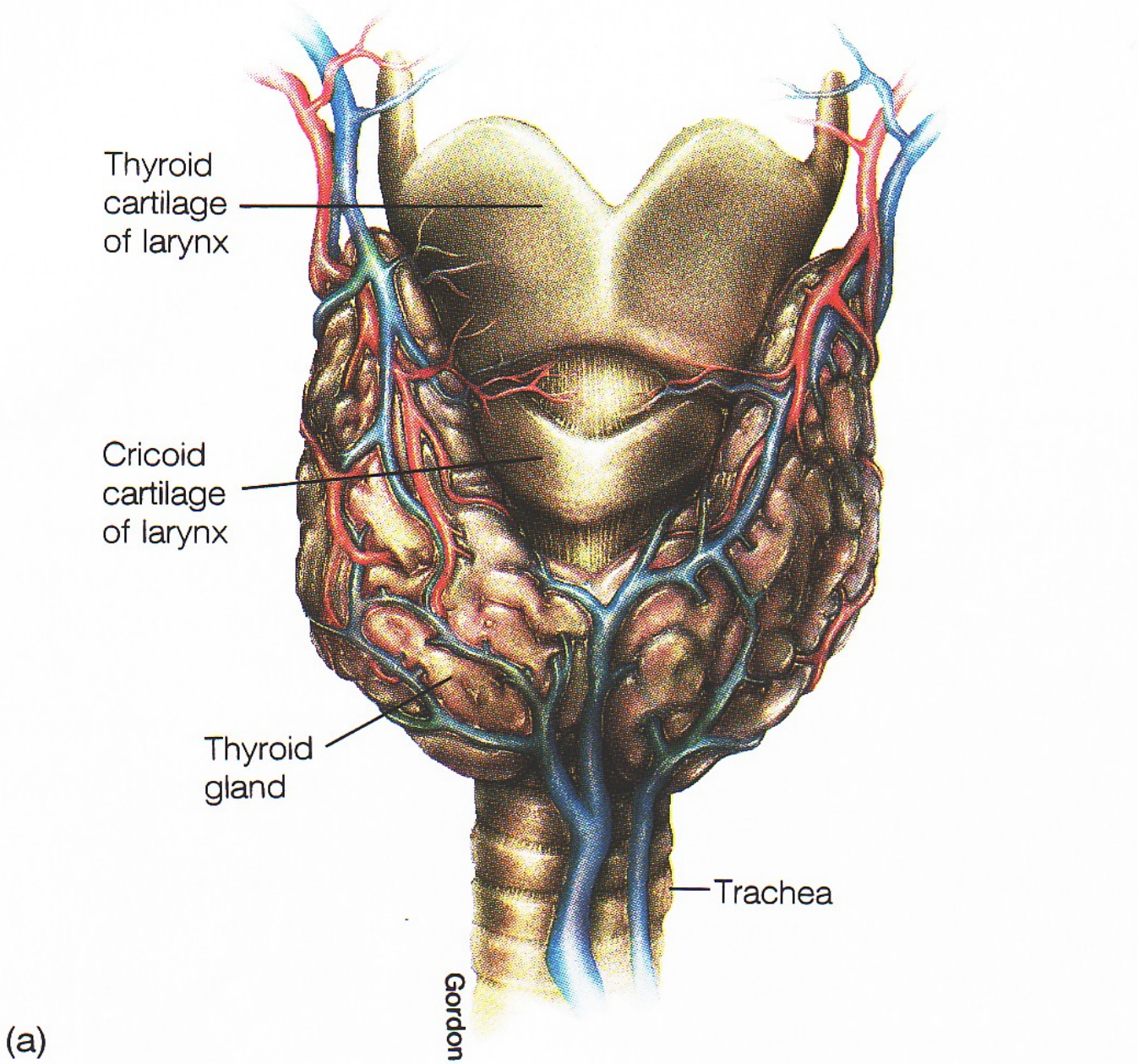
Diabetics must constantly juggle diet, exercise & medication to control blood glucose!



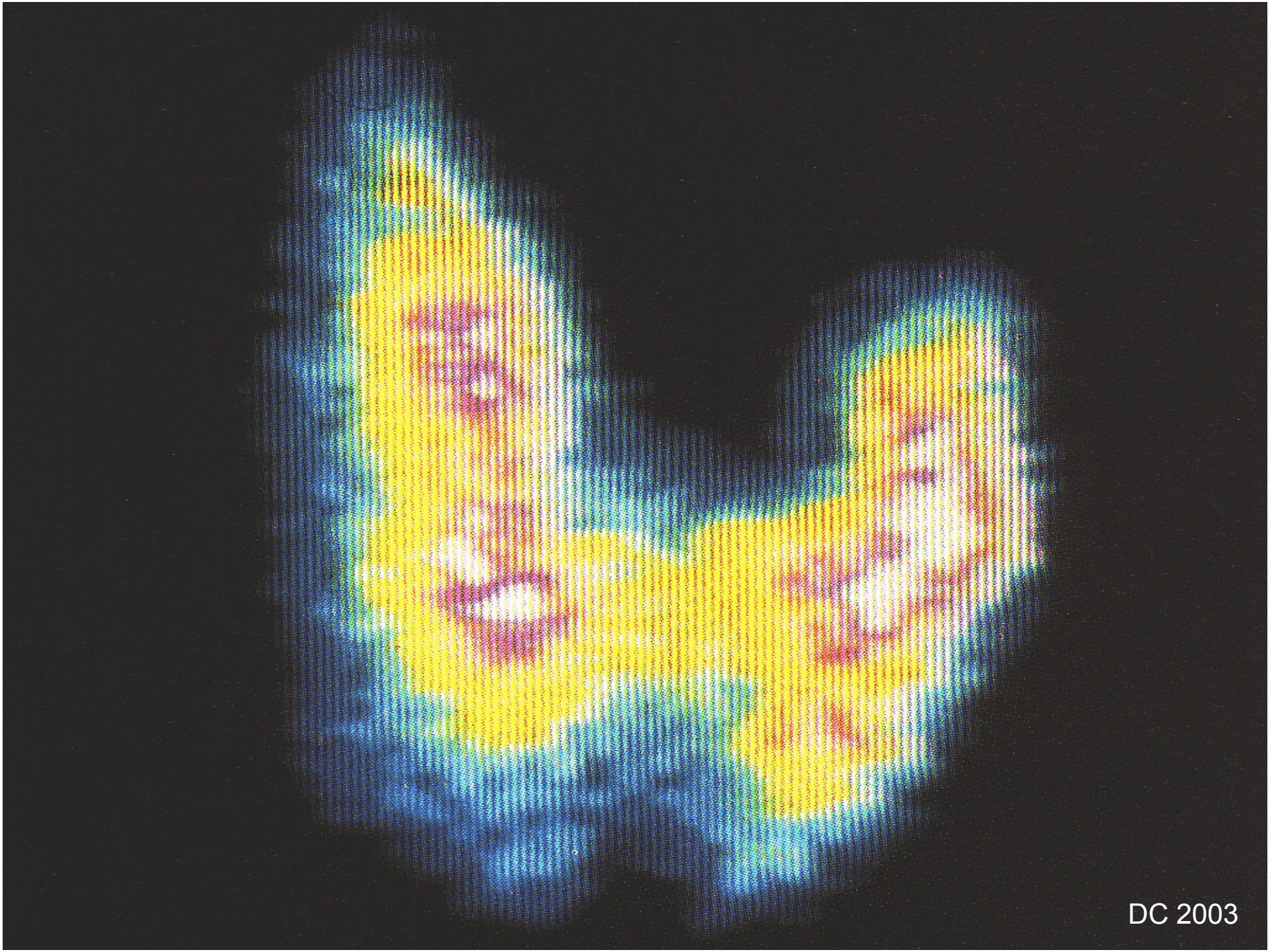
Like others, diabetics benefit from whole grains, vegetables, fruits, legumes & non-/low-fat milk products!

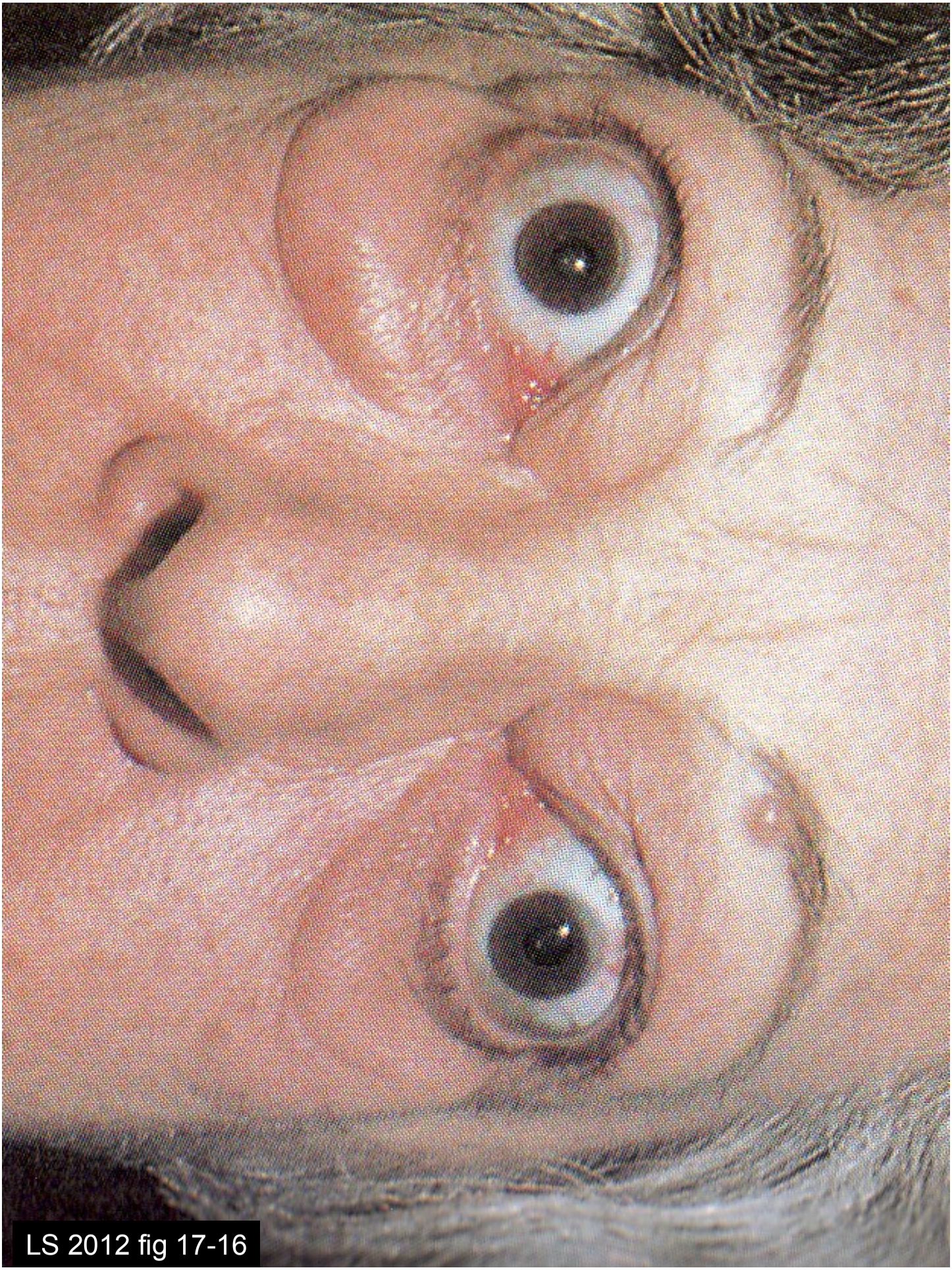


DC 2003


Thyroid cartilage of larynx
Cricoid cartilage of larynx
Thyroid gland
Trachea
Gordon
(a)

DC 2003


DC 2003



LS 2012 fig 17-16

LS 2012 fig 17-17

Guyton & Hall 2000

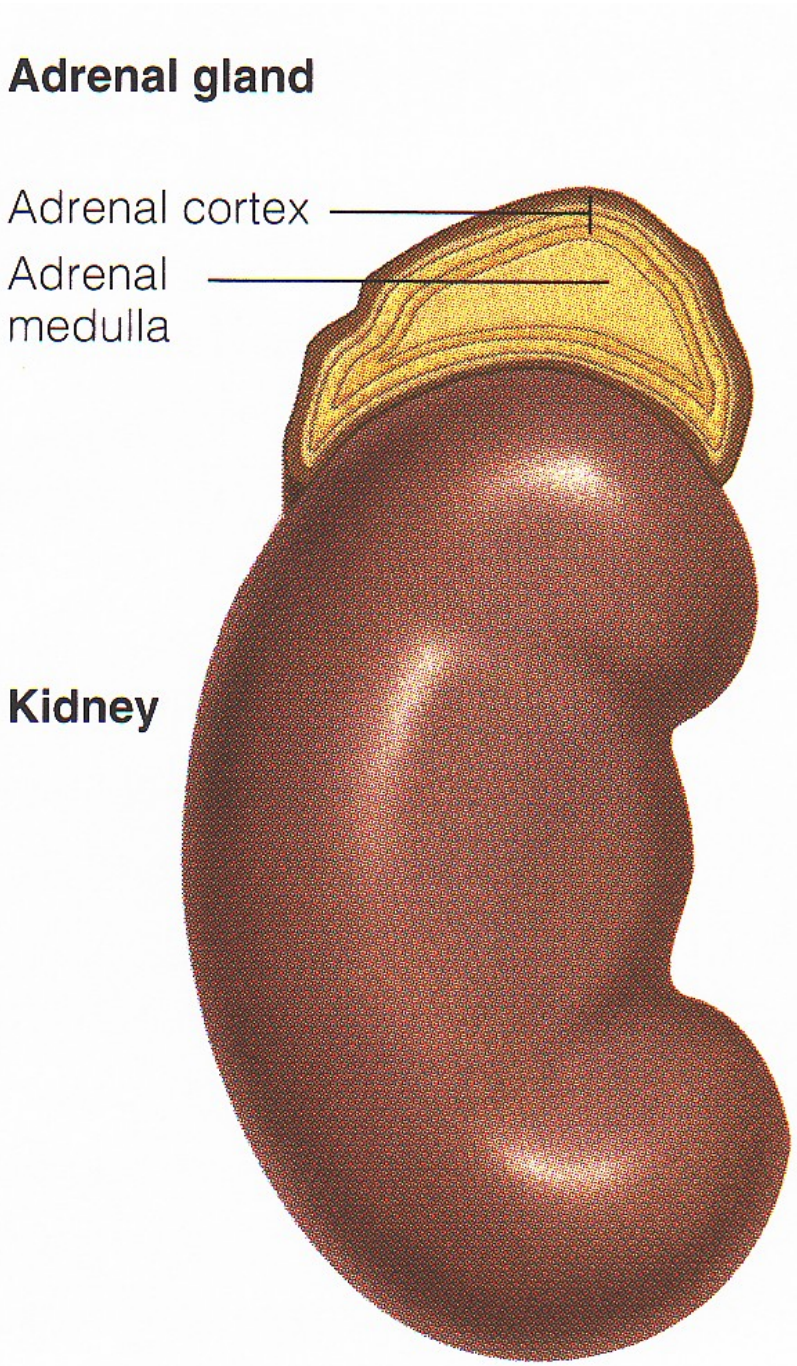


FIGURE 13-12
Adrenal Gland The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.

BI 121!!

Epinephrine 80%

Norepinephrine 20%

Guyton & Hall 2000

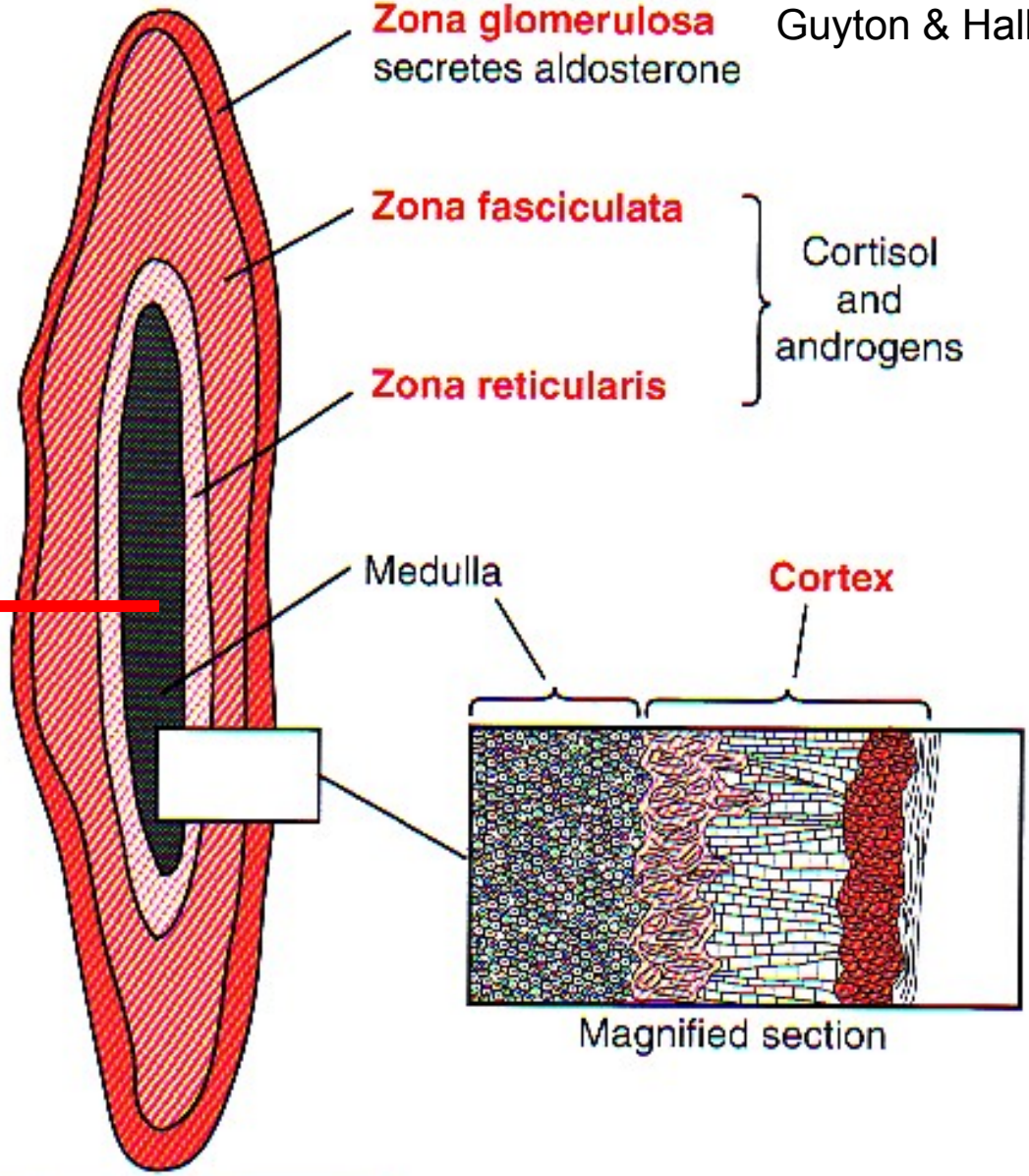
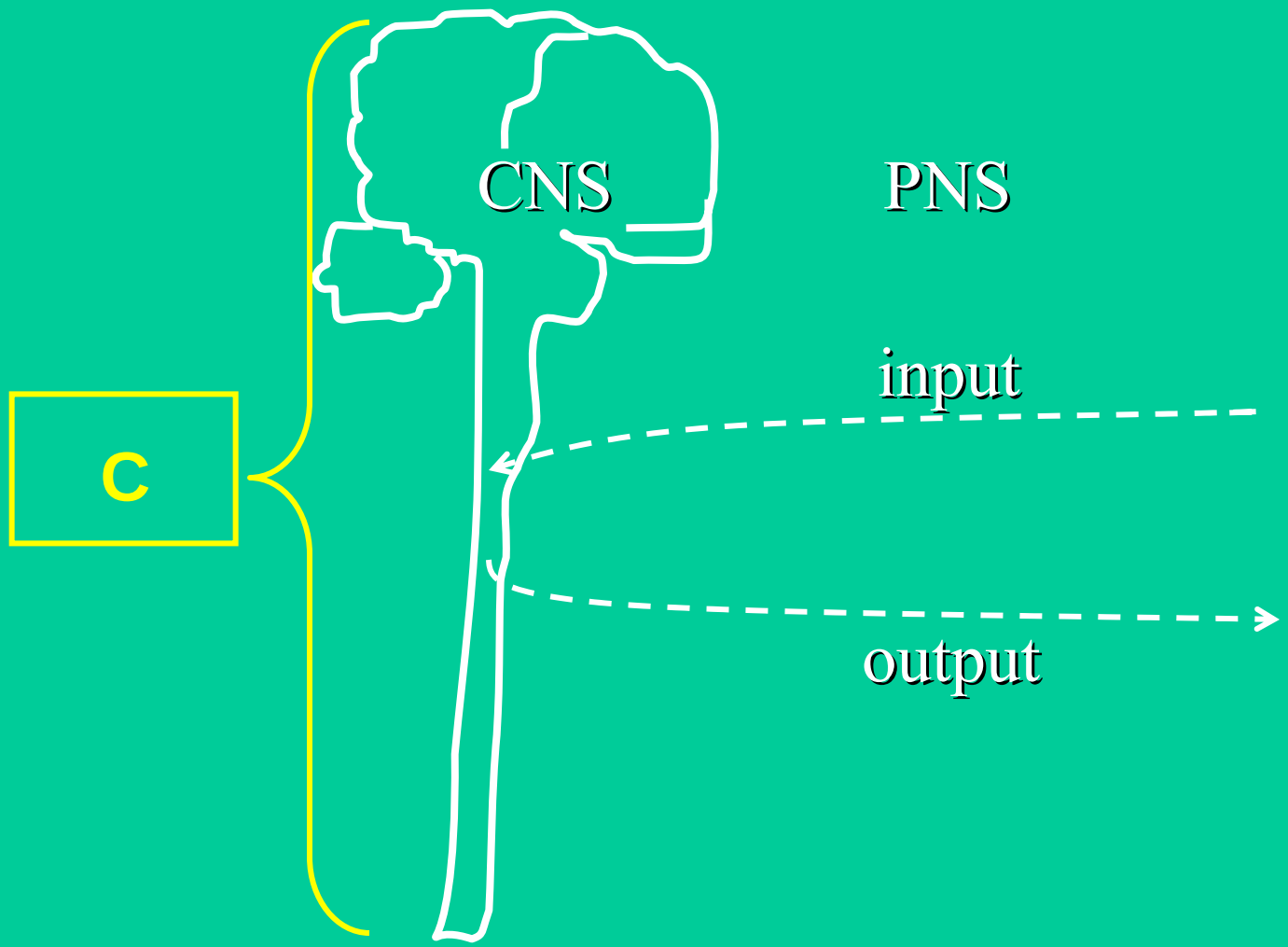
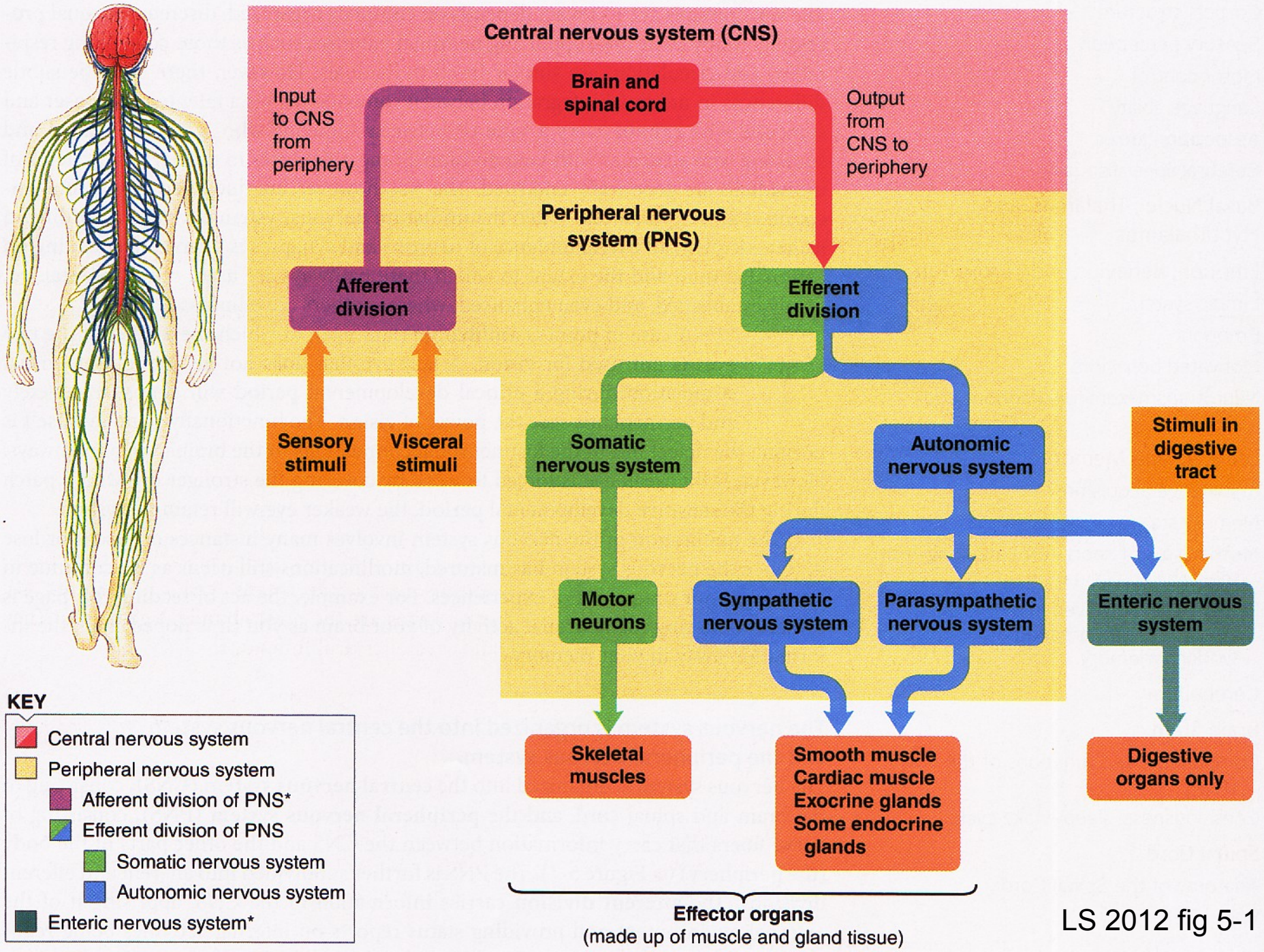


FIGURE 77–1

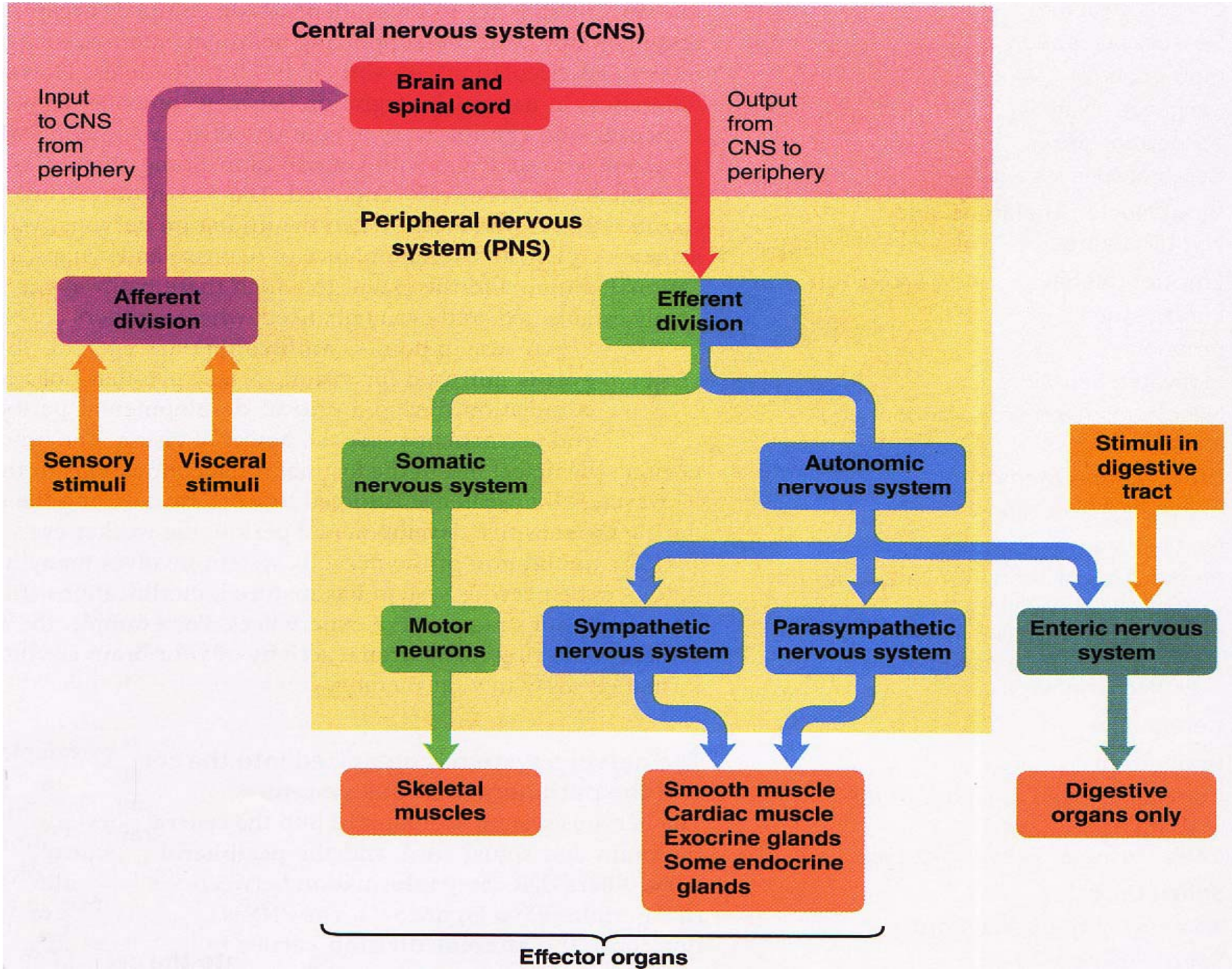
Secretion of adrenocortical hormones by the different zones of the adrenal cortex.

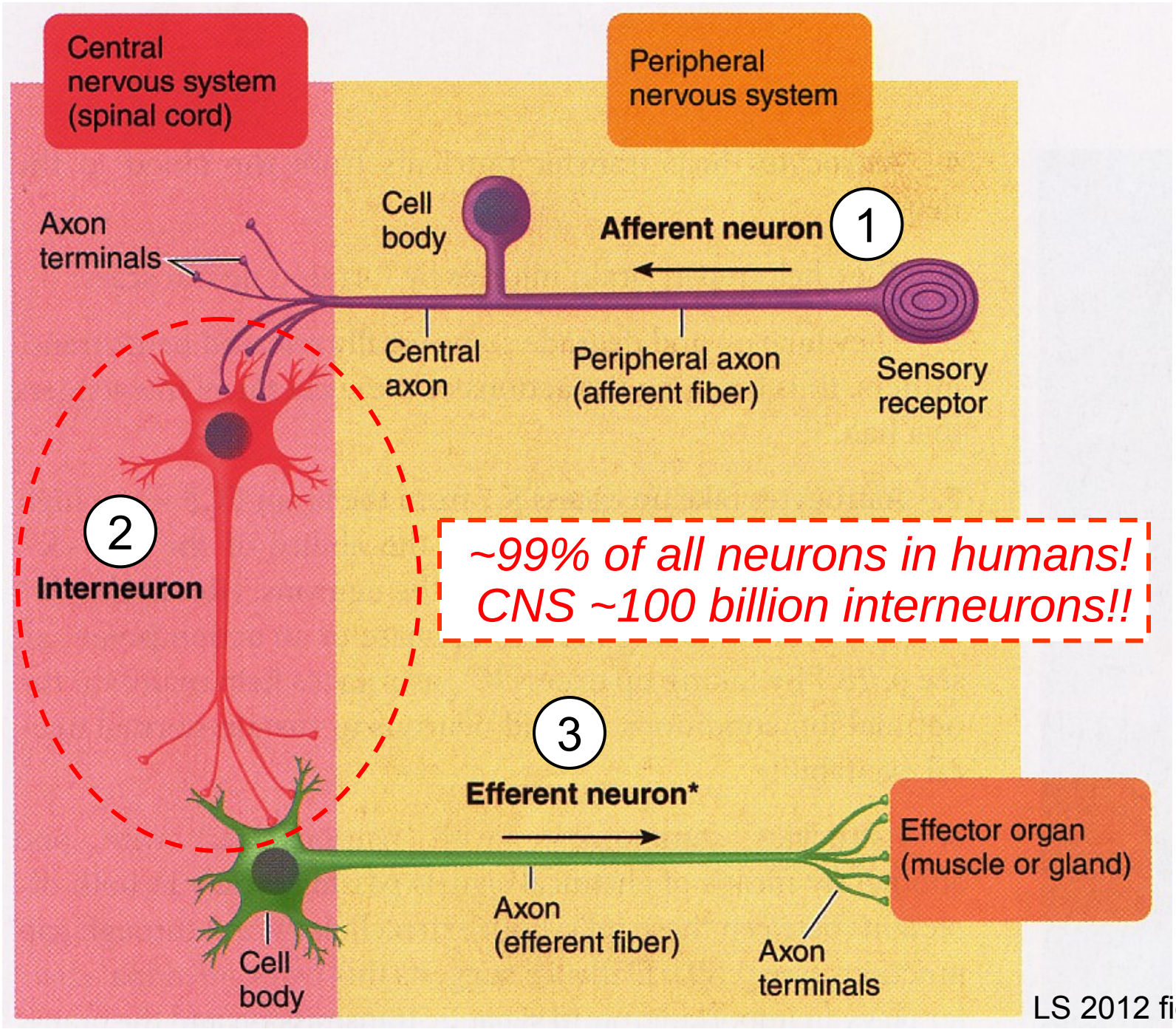
Nervous System



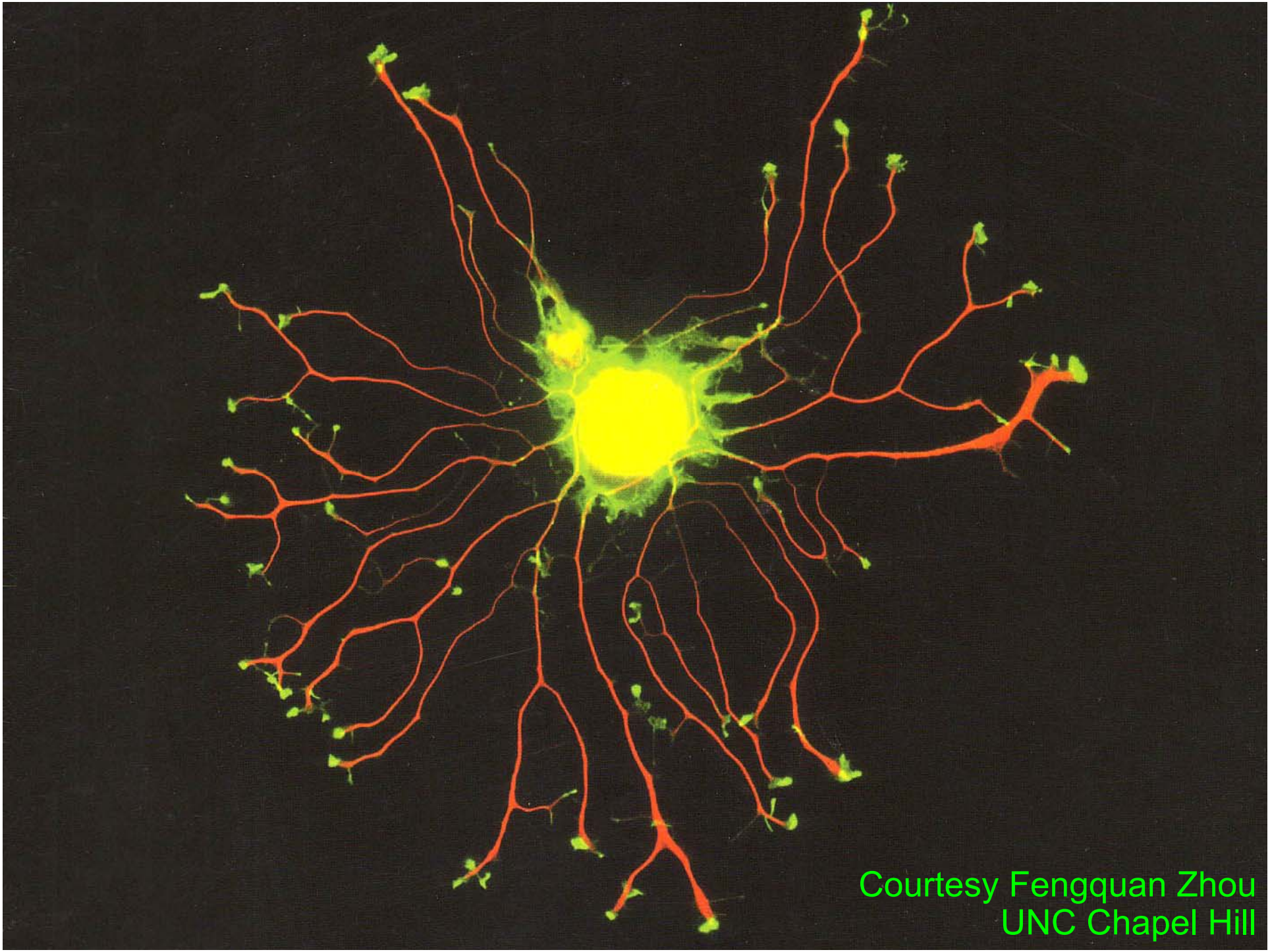


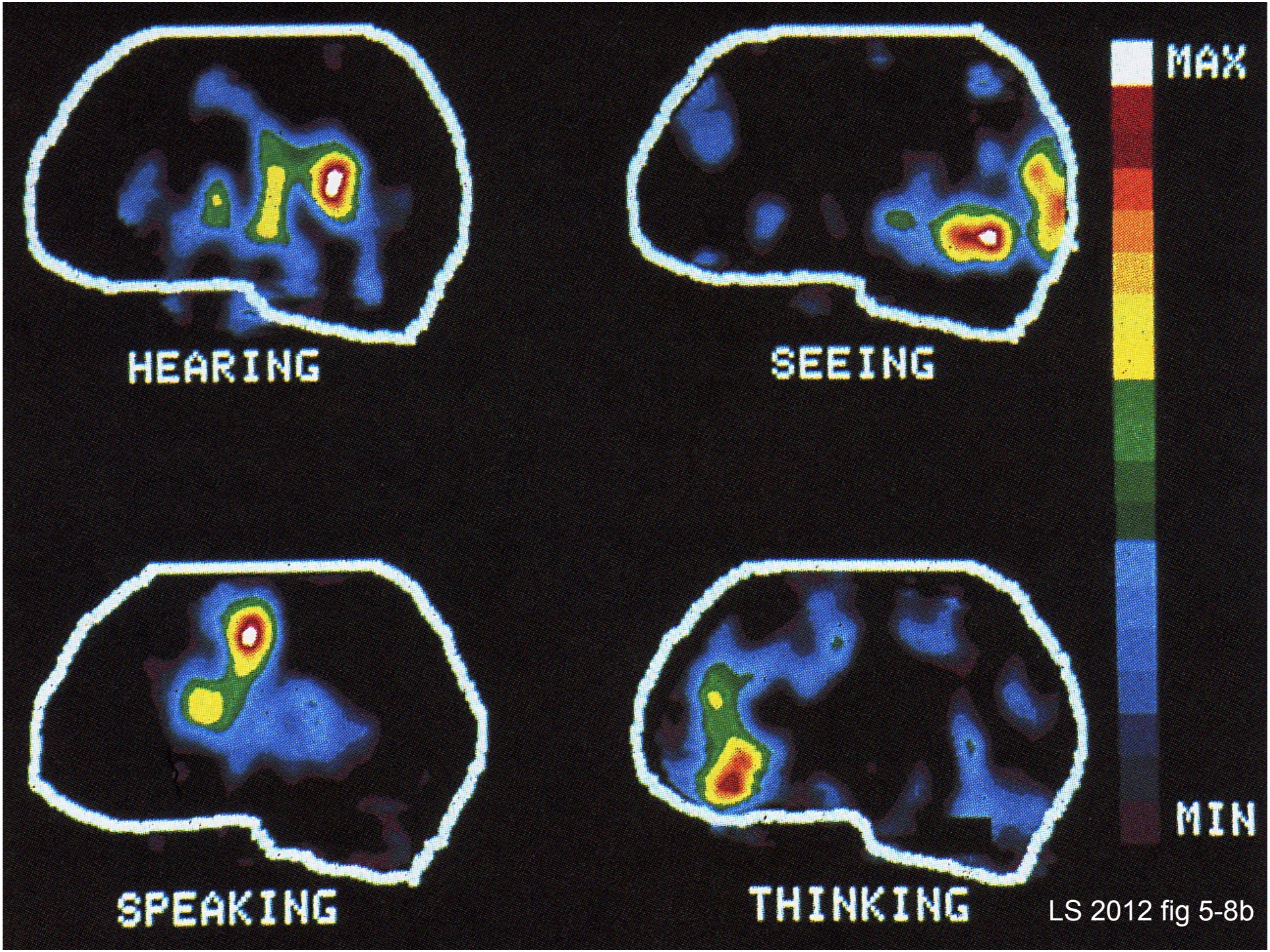
LS 2012 fig 5-1


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

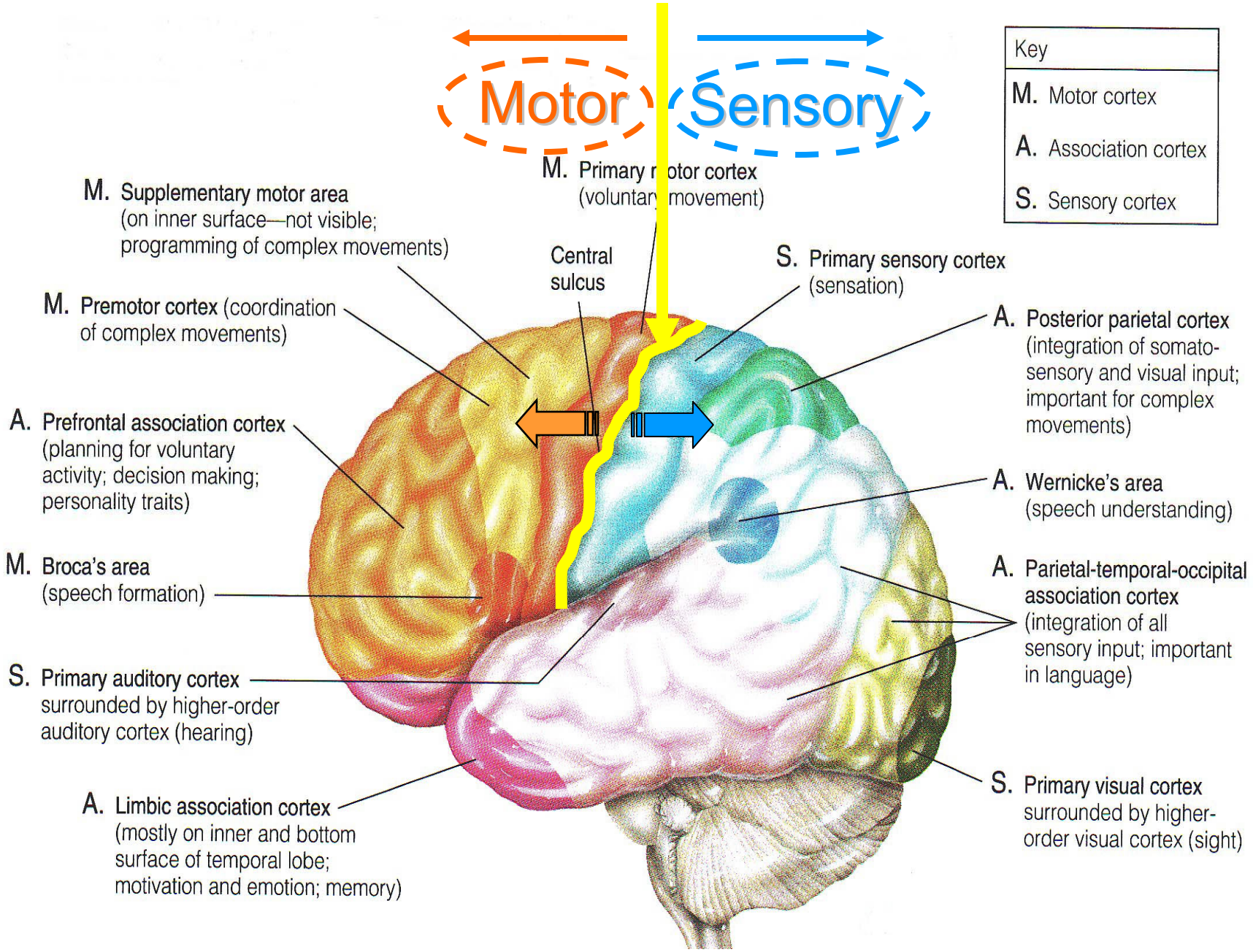


LS 2012 fig 5-2


Courtesy Fengquan Zhou
UNC Chapel Hill



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/811156.pdf
http://www.bhsi.org/stats.htm

~540,000 bicyclists/yr visit emergency rooms

67,000 head injuries, 1 in 8 brain injuries

716 cyclists died in 2008 ≡ 2% of all traffic fatalities

½ of deaths children < 15 yr

53,000 cyclists have died since 1932

that's more than the population of

Springfield, OR	52,864
Bend, OR	52,029
Corvallis, OR	49,322

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

Helmets may prevent 45-88% of brain injuries!

~$81 million/yr = direct injury costs from not using helmets!


The "typical" bicyclist killed on our roads is a sober male over 16 not wearing a helmet riding on a major road between intersections in an urban area on a summer evening when hit by a car. Please wear a helmet – it can make the difference between life and death.

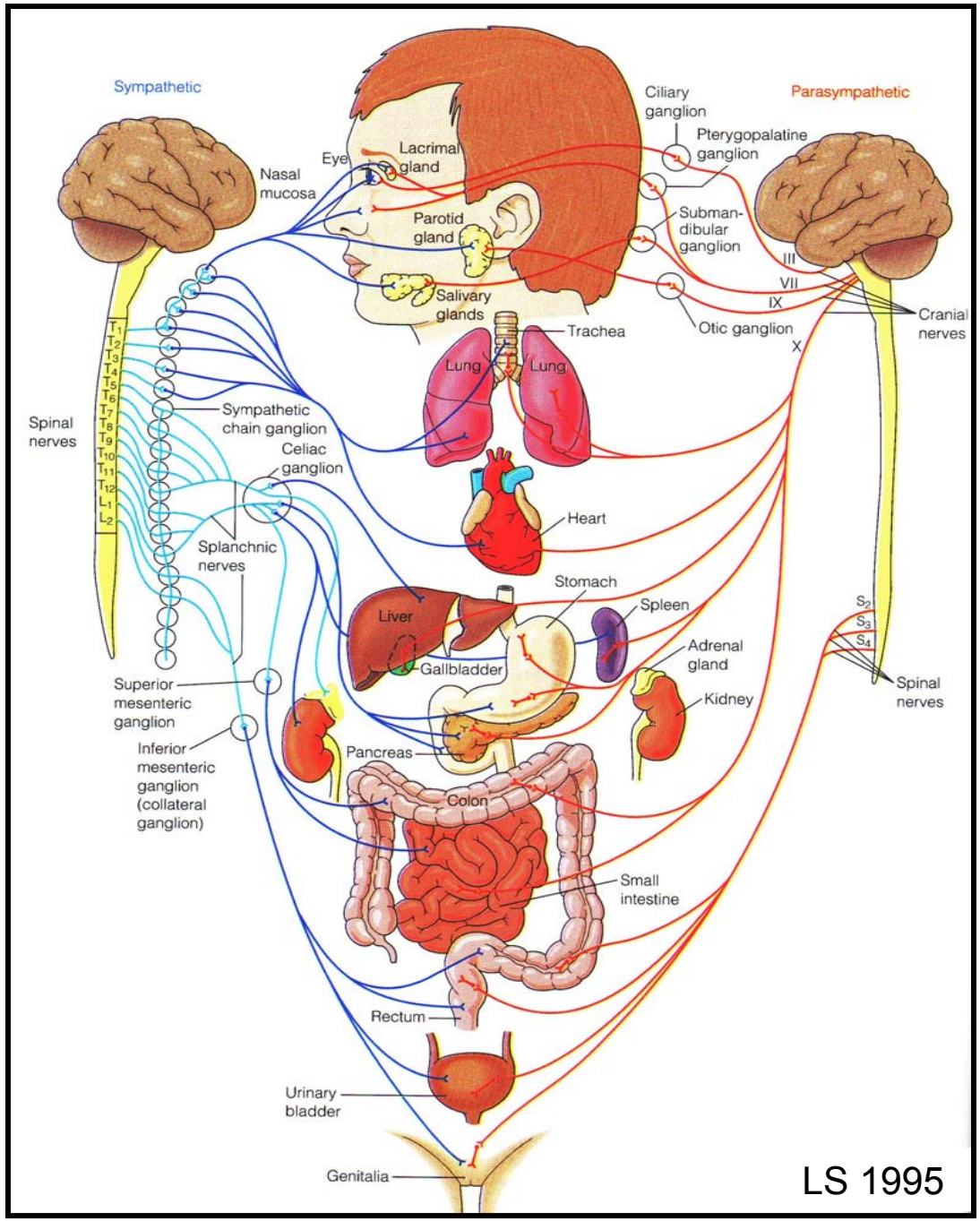
Discussion &/or Break?

Autonomic Nervous System

Why overlap or dual innervation?

Fine-tune control & safety!

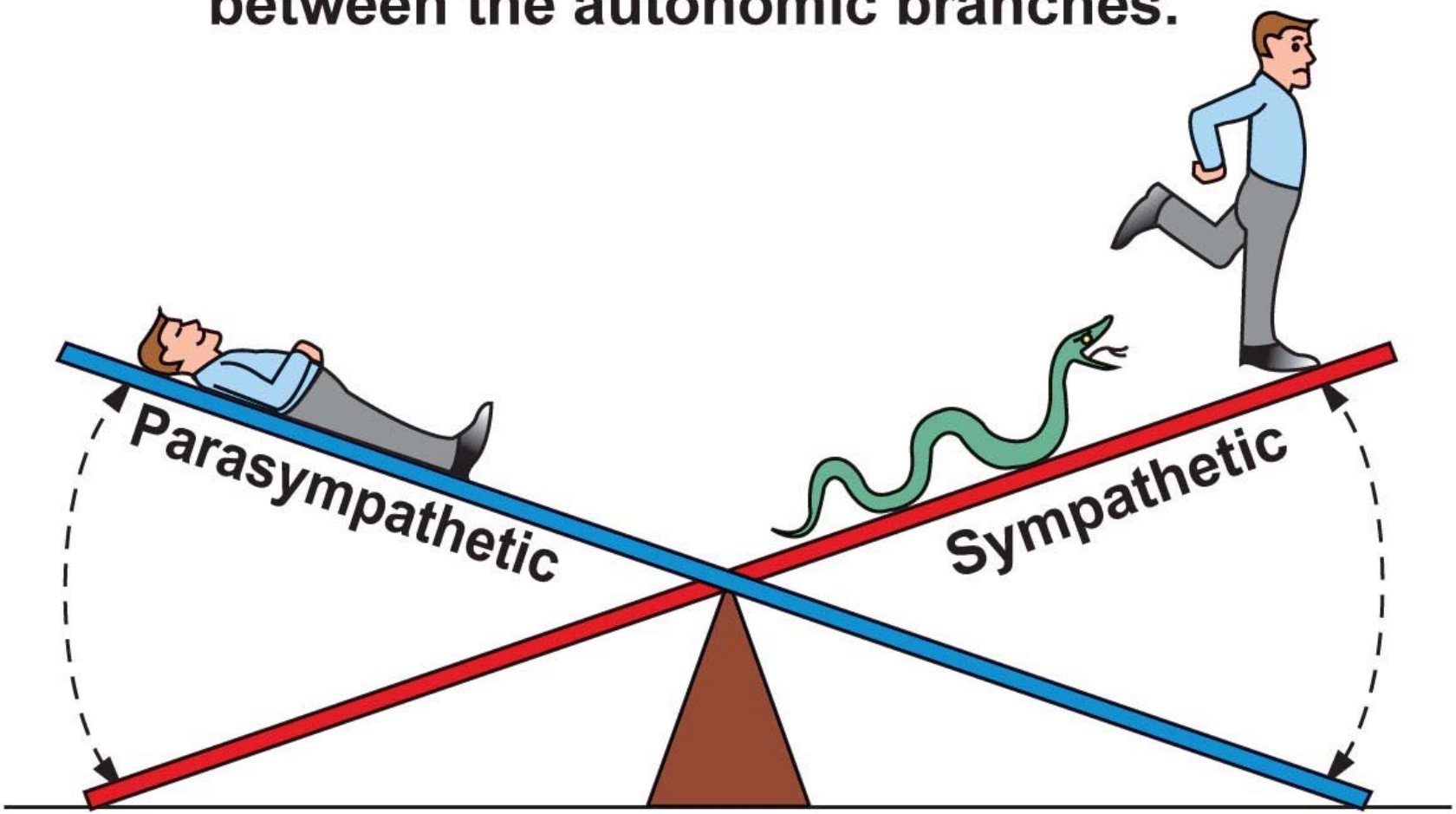
cf: LS 2012 fig 7-3




PARASYMPATHETIC = RESTING, DIGESTIVE, HOUSEKEEPING FUNCTIONS

FIGHT/FLIGHT/ALARM REACTION!!

Homeostasis is a dynamic balance between the autonomic branches.



Rest-and-digest: Parasympathetic activity dominates.

Fight-or-flight: Sympathetic activity dominates.

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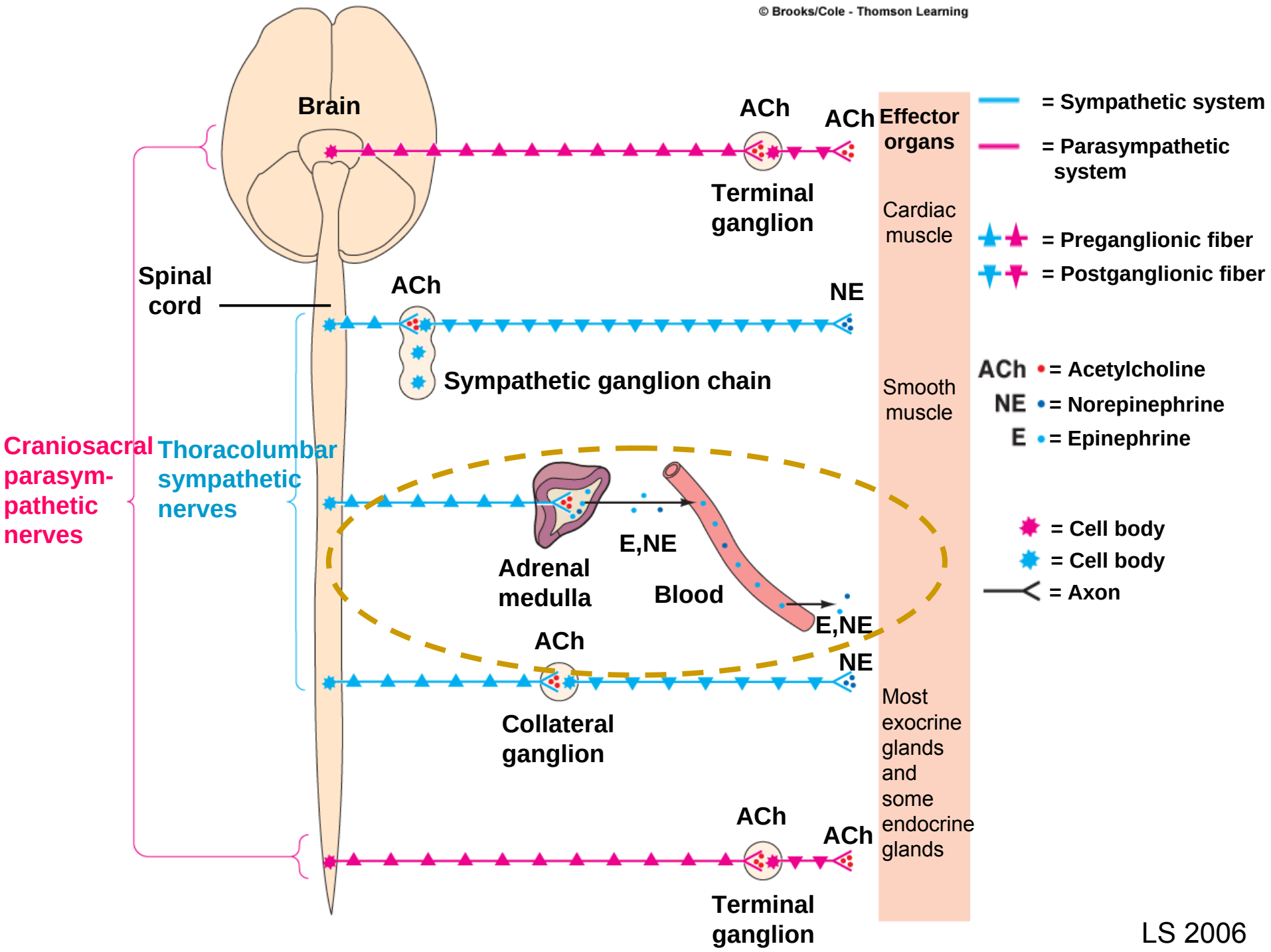
D Silverthorn 2010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Brain
Spinal cord
ACh
ACh
Terminal ganglion
ACh
NE
Sympathetic ganglion chain
Craniosacral parasym-pathetic nerves
Thoracolumbar sympathetic nerves
Adrenal medulla
E,NE
Blood
E,NE
ACh
NE
Collateral ganglion
ACh
ACh
Terminal ganglion
Effector organs
Cardiac muscle
Smooth muscle
Most exocrine glands and some endocrine glands
= Sympathetic system
= Parasympathetic system
= Preganglionic fiber
= Postganglionic fiber
ACh = Acetylcholine
NE = Norepinephrine
E = Epinephrine
= Cell body
= Cell body
= Axon

LS 2006

Why adrenal activation & response important?

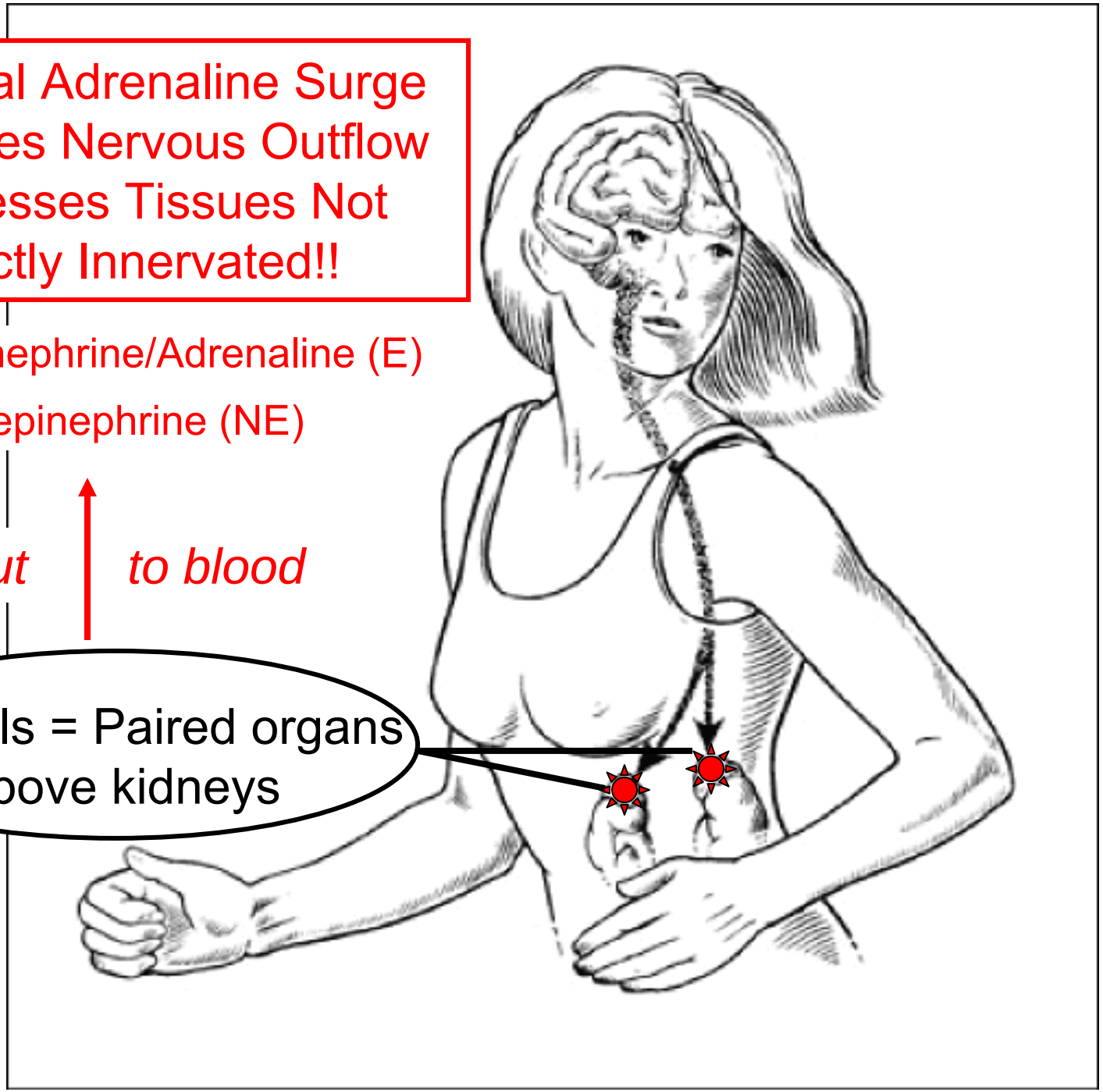
Hormonal Adrenaline Surge Reinforces Nervous Outflow & Accesses Tissues Not Directly Innervated!!

80% Epinephrine/Adrenaline (E)

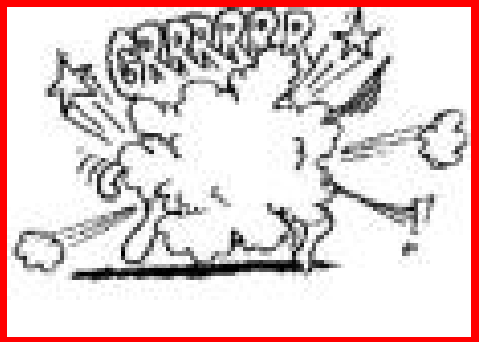
20% Norepinephrine (NE)

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

LS 2012