I. **Announcements** Thanks for your help with blood lab! Great job! No lab this week. Study for Exam II, Dec 8, Mon!

II. **Endocrine Connections** Adrenals/Suprarenals
   LS pp 517-25 fig 17-18, 17-19; DC p 112 +...

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
   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 2011, the most recent yr

IV. **Autonomic Nervous System** LS ch 7 pp 178-85+...
   A. Sympathetic vs Parasympathetic branches fig 7-3
   B. Neurotransmitters & receptors fig 7-1 & 7-2, tab 7-2
   C. Actions tab 7-1
   D. Fight-or-flight stories!
U of O, EMU, Nov 17-21, 10 am – 4 pm

Oregon State University vs. University of Oregon
Civil War Blood Drive 2014
Thirteenth Annual • November 1-23

http://www.civilwarblooddrive.com/
Adrenals/Suprarenals

Adrenal gland

Adrenal medulla

Adrenal cortex

Mineralocorticoids (aldosterone)

Glucocorticoids (cortisol) and sex hormones (dehydroepiandrosterone)

Catecholamines (epinephrine and norepinephrine)

Cortex

Zona glomerulosa

Zona fasciculata

Zona reticularis

Medulla

Connective tissue capsule
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)
Epinephrine 80%
Norepinephrine 20%

F I G U R E 77-1
Secretion of adrenocortical hormones by the different zones of the adrenal cortex.

Guyton & Hall 2000
Nervous System

CNS  PNS

input  output
~99% of all neurons in humans!
CNS ~100 billion interneurons!!
~ 90% of Cells w/in CNS are not neurons but glial cells = neuroglia or nerve glue!
A single nerve cell may have as many as 200,000 inputs!
Nerve cell with multiple axons grown by adding a mitogen/neurogen \(\equiv\) nerve growth factor!
Sensory nerves especially, come in all shapes & sizes!

**Figure 46-1**

Several types of somatic sensory nerve endings.
Nerve Extremes: Far ends of the Continuum

A = Large to medium myelinated, up to 120 m/sec

C = Small unmyelinated, 0.25 m/sec

α, β, γ, δ

IV
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 a football field in < 1 second!
Saltatory/Leaping Conduction! Crucial Sensory & Motor Nerves

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

DC 2003
M. Supplementary motor area (on inner surface—not visible; programming of complex movements)

M. Premotor cortex (coordination of complex movements)

M. Primary motor cortex (voluntary movement)

Central sulcus

S. Primary sensory cortex (sensation)

A. Posterior parietal cortex (integration of somatosensory and visual input; important for complex movements)

A. Wernicke’s area (speech understanding)

A. Parietal-temporal-occipital association cortex (integration of all sensory input; important in language)

S. Primary visual cortex surrounded by higher-order visual cortex (sight)

A. Limbic association cortex (mostly on inner and bottom surface of temporal lobe; motivation and emotion; memory)

A. Prefrontal association cortex (planning for voluntary activity; decision making; personality traits)

A. Broca’s area (speech formation)

S. Primary auditory cortex surrounded by higher-order auditory cortex (hearing)

Key:

M. Motor cortex

A. Association cortex

S. Sensory cortex

LS 2006, cf: LS 2012 fig 5-8a
Two somatosensory cortical areas, somatosensory areas I and II.
Section Human Brain (from above)

- Left hemisphere
- Right hemisphere
- Frontal lobe
- Central sulcus
- Primary motor cortex
- Somatosensory cortex
- Parietal lobe
- Occipital lobe

Top view

Back (a)

Top

LS 2006; cf: LS 2012 fig 5-9
Sensory Homunculus

LS 2006; cf: LS 2012 fig 5-9
300 million axons enable R & L hemisphere cross-talk!!
MRI 061307
Lumbar spine
Lateral view

Disc herniation
Discs bulging

Oregon Imaging
MRI 061307
Lumbar spine
Axial view

9.4 x 8.1 mm
Protrusion
Helmets Cheap, Brains Expensive!!
Use Your Head, Get a Helmet!!

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

~540,000 bicyclists/yr visit emergency rooms
67,000 head injuries, 1 in 8 brain injuries
677 cyclists died in 2011 ≡ 2% of all traffic fatalities
9% of deaths children ≤ 14 yr, 69% o
> 54,000 cyclists have died since 1932

As of 2012, the population of
Albany, OR  51,322
Corvallis, OR  54,998
Springfield, OR  59,869

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

Helmets may reduce head & brain injury risk by 66-88%!
~$81 million/yr = direct 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.
Stories, Discussion, Questions or Comments!
Why overlap or dual innervation?

*Fine-tune control & safety!*

cf: LS 2012 fig 7-3

*Autonomic Nervous System*
PARASYMPATHETIC = RESTING, DIGESTIVE, HOUSEKEEPING FUNCTIONS
BI 121 + other exams!
Homeostasis is a dynamic balance between the autonomic branches.

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

- **Sympathetic**
  - Fight-or-flight: Sympathetic activity dominates.
Autonomic Neurotransmitters & Receptors

Cholinergic
Nicotinic
Muscarinic

Adrenergic
\[ \alpha = \text{Alpha} \]
\[ \beta = \text{Beta} \]

G&H 2011 p 731-3
**Parasympathetic**

Ach = Acetylcholine

Ach = Acetylcholine

= Nicotinic Receptor

= Muscarinic Receptor

**Sympathetic**

NE = Norepinephrine

= α Receptor ($\alpha_1$, $\alpha_2$)

= β Receptor ($\beta_1$, $\beta_2$)
Nicotine activates both Sympathetic & Parasympathetic post-ganglionic neurons!

Problem?

Like hammering the gas pedal & brake at the same time!!
Autonomic Nervous System Innervation
In Sympathetic Fight-or-Flight why is it important to activate the adrenals?
80% Epinephrine/Adrenaline (E)
20% Norepinephrine (NE)

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

Adrenals = Paired organs above kidneys

Output to blood
Fight-or-Flight Stories!

or

or

...choose this!!
<table>
<thead>
<tr>
<th>Organ</th>
<th>Effect of Sympathetic Stimulation</th>
<th>Effect of Parasympathetic Stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td>Increases heart rate and increases force of contraction of the whole heart</td>
<td>Decreases heart rate and decreases force of contraction of the atria only</td>
</tr>
<tr>
<td>Blood Vessels</td>
<td>Constricts</td>
<td>Dilates vessels supplying the penis and the clitoris only</td>
</tr>
<tr>
<td>Lungs</td>
<td>Dilates the bronchioles (airways)</td>
<td>Constricts the bronchioles</td>
</tr>
<tr>
<td>Digestive Tract</td>
<td>Decreases motility (movement)</td>
<td>Increases motility</td>
</tr>
<tr>
<td></td>
<td>Contracts sphincters (to prevent forward movement of tract contents)</td>
<td>Relaxes sphincters (to permit forward movement of tract contents)</td>
</tr>
<tr>
<td>Urinary Bladder</td>
<td>Inhibits digestive secretions</td>
<td>Stimulates digestive secretions</td>
</tr>
<tr>
<td>Eye</td>
<td>Relaxes</td>
<td>Contracts (emptying)</td>
</tr>
<tr>
<td>Liver (glycogen stores)</td>
<td>Dilates the pupil</td>
<td>Constricts the pupil</td>
</tr>
<tr>
<td>Adipose Cells (fat stores)</td>
<td>Adjusts the eye for far vision</td>
<td>Adjusts the eye for near vision</td>
</tr>
<tr>
<td>Exocrine Glands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exocrine pancreas</td>
<td>Inhibits pancreatic exocrine secretion</td>
<td>Stimulates pancreatic exocrine secretion (important for digestion)</td>
</tr>
<tr>
<td>Sweat glands</td>
<td>Stimulates secretion by sweat glands important in cooling the body</td>
<td>Stimulates secretion by specialized sweat glands in the armpits and genital area</td>
</tr>
<tr>
<td>Salivary glands</td>
<td>Stimulates a small volume of thick saliva rich in mucus</td>
<td>Stimulates a large volume of watery saliva rich in enzymes</td>
</tr>
<tr>
<td>Endocrine Glands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adrenal medulla</td>
<td>Stimulates epinephrine and norepinephrine secretion</td>
<td>None</td>
</tr>
<tr>
<td>Endocrine pancreas</td>
<td>Inhibits insulin secretion</td>
<td>Stimulates insulin secretion</td>
</tr>
<tr>
<td>Genitals</td>
<td>Controls ejaculation (males) and orgasm contractions (both sexes)</td>
<td>Controls erection (penis in males and clitoris in females)</td>
</tr>
<tr>
<td>Brain Activity</td>
<td>Increases alertness</td>
<td>None</td>
</tr>
</tbody>
</table>