NSC 201/BCS 240
Basic Neurobiology

Time: MWF 10:25–11:15 AM
Room: Lower Strong Auditorium

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Recitations:
T 2-3:15 PM Hylan 201
F 2-3:15 PM Gavett 310

Unit-Exam Review Sessions
Course organization

Textbook:
Neuroscience: Exploring the Brain
Bears, Connors, Paradiso, 4th edition

Course website:
https://learn.rochester.edu
www.bcs.rochester.edu/courses/240.html

Exams:
4 unit exams and
1 optional comprehensive final

Grading: 25% for each exam
• A 93-100
• A- 90-92
• B+ 87-89
• B 83-86
• B- 80-82
1. Neuroanatomy
   - cell biology
   - structure of the nervous system
   - neurodevelopment

2. Neurophysiology
   - neuronal membranes
   - synaptic transmission

3. Sensory and Motor Systems
   - mechanisms of perception
   - control of movement

4. Brain and Behavior
   - sleep-wake cycle
   - internal regulation
   - learning and memory
   - emotion
   - psychiatric disorders
Neurobiology

Neurobiology is the study of cells of the nervous system and the organization of these cells into functional circuits that process information and mediate behavior.

It is a sub-discipline of both biology and neuroscience.
Changing Views of the Brain

Prehistory
~1 million BC

Ancient Egypt
~3000 BC

Roman Empire
~200 AD

Renaissance
1949 AD

~7000 BC
Trepanation

~400 BC
Ancient Greece

~1700 AD

Hippocrates
Neuron Doctrine 1

Old: nerve cells are continuous (reticular theory)
**New**: nerve cells are separate, distinct entities (neuron doctrine)

Early 1800s Microscopes
First opportunity to examine tissue at high magnification

1839 Theodore Schwann
All tissues are composed of discrete units called cells
… but freshly prepared brain tissue has a uniform, cream-colored appearance so individual cells cannot be resolved.

(Franz) Nissl stain: basic dyes stain nuclei and ribosomes. Korbinian Brodmann (1909) defined upwards of 50 distinct regions of neocortex.
Old: nerve cells are continuous (reticular theory)
New: nerve cells are separate, distinct entities (neuron doctrine)

A Nissl-stained neuron looks like little more than a lump of protoplasm containing a nucleus. Neurons however have many projections, called neurites.

Do neurites of different neurons fuse together like blood vessels of the circulatory system (reticular theory) or are they distinct entities that communicate using signals (neuron doctrine).
Neuron Doctrine 3

Old: nerve cells are continuous (reticular theory)
New: nerve cells are separate, distinct entities (neuron doctrine)

1873 Camillo Golgi
Soaked brains in a silver chromate solution; a small percentage of neurons become darkly colored in their entirety (based on complexity, argued for reticular formation)

1900 Santiago Ramon y Cajal
Using Golgi methods, drew/worked out circuitry in many regions of the brain (advocate of neuron doctrine)
Neuron Doctrine 4

Old: nerve cells are continuous (reticular theory)
New: nerve cells are separate, distinct entities (neuron doctrine)

1950s Electron microscope
Uses an electron beam instead of light to form images; resolution 0.1nm (1 million times better than naked eye; 1 thousand x light) Result: neurons in contact, not continuity (the neuron doctrine wins!)

→ How is the nervous system organized?
Nerves as Wires

Old: Nerves are tubes that move fluid
New: nerves are “wires” that conduct electrical signals

1751 Ben Franklin
*Experiments and Observations on Electricity*

1800 Luigi Galvani and Emil du Bois-Reymond
- Electrical stimulation of nerves causes muscle movement

1810 Charles Bell and Francois Magendie
- Dorsal roots of spinal cord carry sensory information into brain
- Ventral roots: information out to muscles

→ How do neurons transmit information?
Localization of Function in the Brain

Old: All parts of brain participate in all functions
New: functions are localized

1823 Marie-Jean-Pierre Flourens
• Cerebellum: motor coordination
• Cerebrum: sensation/perception (cerebrum acts as a whole)

1861 Paul Broca
The left frontal lobe is responsible for the production of speech

➡️ What functions are localized in which parts of the brain?
Evolution of the Nervous System

Old: nervous systems in different species are distinct

New: nervous systems of different species evolved from common ancestors by natural selection

1859 Charles Darwin
On the Origin of Species
• Common behaviors: common mechanisms
• Specialized traits: specialized mechanisms

What mechanisms underlie different behaviors?
The history of modern neuroscience is still being written (e.g., UR-UPP).

Levels of analysis:
- molecular neuroscience
- cellular neuroscience
- systems neuroscience
- behavioral neuroscience
- cognitive neuroscience

Use of animals and humans in neuroscience research
- ensure experiments are worthwhile and well-planned
- eliminate or minimize pain and distress
- all possible alternatives considered first

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Description</th>
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<tbody>
<tr>
<td>Alzheimer’s disease</td>
<td>A progressive degenerative disease of the brain, characterized by dementia and always fatal</td>
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<td>Autism</td>
<td>A disorder emerging in early childhood characterized by impairments in communication and social interactions, and restricted and repetitive behaviors</td>
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<tr>
<td>Cerebral palsy</td>
<td>A motor disorder caused by damage to the cerebrum before, during, or soon after birth</td>
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<tr>
<td>Depression</td>
<td>A serious disorder of mood, characterized by insomnia, loss of appetite, and feelings of dejection</td>
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<tr>
<td>Epilepsy</td>
<td>A condition characterized by periodic disturbances of brain electrical activity that can lead to seizures, loss of consciousness, and sensory disturbances</td>
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<tr>
<td>Multiple sclerosis</td>
<td>A progressive disease that affects nerve conduction, characterized by episodes of weakness, lack of coordination, and speech disturbance</td>
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<td>Parkinson’s disease</td>
<td>A progressive disease of the brain that leads to difficulty in initiating voluntary movement</td>
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<tr>
<td>Schizophrenia</td>
<td>A severe psychotic illness characterized by delusions, hallucinations, and bizarre behavior</td>
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<td>Spinal paralysis</td>
<td>A loss of feeling and movement caused by traumatic damage to the spinal cord</td>
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<tr>
<td>Stroke</td>
<td>A loss of brain function caused by disruption of the blood supply, usually leading to permanent sensory, motor, or cognitive deficit</td>
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