Applied Neuroscience

Columbia Science Honors Program Fall 2016





Introduction to Applied Neuroscience

- Course Basics
- Introduction to Principles of Neuroscience
- Discussion of Brain Anatomy

Define Neuroscience





Output Motion Emotions Personality Language Behavior

- What is inside?
- What does it do?
- How does it do it?

Biology in Neuroscience



Chemistry in Neuroscience



Math and Physics in Neuroscience



Computation in Neuroscience





What does the study of neuroscience entail?

- Synthesizing multiple disciplines
- Collaborating across fields
- Using multiple model systems



A Review of Fundamental Concepts

Cell Structure



Cellular Identity



Different subsets of **genes** are expressed in different cells, allowing cellular diversity

Genes and DNA

- All genetic information is stored in chromosomes
- Chromosomes contain genes.
- Genes are made of DNA





The Central Dogma



Proteins

- Chains of amino acids held together by peptide bonds
- They have complicated 3D structures
- Essential parts of organisms and participate in virtually every process within cells



Immunofluorescence of Cells



GREEN = neurons RED = astrocytes BLUE = nuclei

The nervous system is a network



Cells of the brain

1. NEURONS



- The human brain contains 100 billion neurons.
- Each neuron can 'pass information'
 - How does information travel through a neuron?

1) The Neuron Doctrine

The neuron is the basic cellular component of brain circuits



The brain is made up of small building blocks called **<u>neurons</u>**. They connect and send messages to each other.

These neurons act like telephone lines passing messages from one area of the brain to another.

Neurons communicate with each other by electrical and chemical signals

Society for Neuroscience *Brain Facts*, 2008

Neurons have diverse forms and functions

Neuronal Diversity

- Even within the brain, groups of neurons express specific subsets of genes, leading to diversity within neurons
 - Morphology (shape)
 - Location within the brain
 - Connections with other neurons
 - Function

The Neuron

The neuron is the basic cellular component of brain circuits

D Three types of multipolar cells

Neuronal Classification by Connection

Neuronal Diversity by Morphology

Cells of the brain

NEURONS GLIA

Glia

Central nervous system: oligodendrocytes, astrocytes Peripheral nervous system: Schwann cells

Although there are about 100 billion neurons in the brain, there may be about 10 to 50 times that **many glial** cells in the brain.

of Ranvier

MRI- Magnetic Resonance Imaging

- Ipsilateral
- Contralateral

same side opposite side

- Afferent
- Efferent

arriving **e**xiting