Chapter 3: Neurons and Synapses

Outline

A. Starting Out: The Kabuki Actor and the Puffer fish

B. The Cells of the Brain

1. Neurons: A Close-Up View

-The definition, location, and parts of a neuron

-Dendrites and their role

-Somas and their function

-The nucleus

-Axons and their role

-The axon terminal

2. Many Different Types of Neurons

-Afferent nerves and efferent nerves

-Multipolar, bipolar, and monopoly neurons

3. Glial Cells

-Glial cells and their function

-Types of glial cells and the differences between them

-Myelin sheath and its importance to neural functioning

-Nodes of Ranvier

C. Research Methods: Visualizing Neurons and Their Products

-Golgi staining

-Nissl staining

-Autoradiography

-Immunocytochemistry

D. Synaptic Transmission: Chemical Signaling in the Brain

1. Release of Neurotransmitter at the Synapse

-How neurons communicate

-Loewi’s experiment

-The synaptic cleft

-Synaptic vesicles

-The release of neurotransmitter

2. Types of Neurotransmitters

-The types of neurotransmitters and the functions of each

-Monoamines

-Catecholamines

-Amino acids

-Peptide neurotransmitters

-Retrograde transmitters

3. Receptors

-Receptors and their function in synaptic transmission

-Ions

-The different ways neurotransmitters can be cleaned-up

4. Postsynaptic Potentials

-Resting membrane potential

-Neurotransmitter binding

-Excitatory postsynaptic potential (EPSP)?

-Inhibitory postsynaptic potential (IPSP)?

-Electrical synapses, or gap junctions

E. The Bigger Picture: Psychoactive Drugs

-Agonists and the drugs which fall into this category

-Antagonist, and the drugs which fall into this category

F. Spikes: Electrical Signaling in the Brain

1. Adding Up the Signals

-Action potentials

-The difference between a temporal and a spatial summation

-Depolarization

2. How an Action Potential Travels

-The ions which play key roles in making action potentials

-Ion concentration during cell resting state

-The function of the voltage-gated ion channels

-Concentration gradient and electrical gradient

3. Myelinating Axons to Make the Action Potential Travel Faster

-The role of the myelin sheath in synaptic transmission

-Damage to the myelin sheath

-Saltatory conduction

-Scarring of the myelin sheath

4. Action Potentials Reach the Terminals and Cause Neurotransmitter Release

-The role of calcium in action potentials

-Action potential reaches the axon terminal

-Neurotransmitter release into the synaptic cleft

G. Case Study: Multiple Sclerosis

H. Neuroscience of Everyday Life: The Magic of a Local Anesthetic

-How does local anesthetic work?

I. What Do Spikes Mean? The Neural Code

1. Encoding Stimuli in Spikes

-How the brain encodes stimuli in spikes

-Rate coding

-How the presence of a stimulus effects firing

2. Decoding Spikes

-How a neuron is a coincidence detector

J. Research Methods: Recording Action Potentials with Electrodes

K. Individuals and Populations

1. Populations of Neurons

-Local coding and its unlikeliness

-Population coding

-Coalitions

-The advantages to forming a coalition

2. Forming a Coalition: What Constitutes a Group?

-The ways neurons form into groups

3. Open Questions for Future Investigation