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