

Chapter 2: The Biology of the Mind

- Phrenology-Franz Gall, early 1800s
 - The study of bumps on the skull and their relationship to mental abilities and character traits
 - Yield one big idea—that the brain might have different areas that do different things (localization of function)
- Biological Psychology (Electrochemical communication)
 - Neurons (nerve cells)—“atoms” of the mind
 - Cell body: cell’s life support center
 - Dendrites: receive messages from other cells
 - Axon: passes messages away from cell body to other neurons
 - Myelin sheath: covers the axon of some neurons and helps speed neural impulses
 - Terminal branches of axon: form junctions with other cells
 - Action potential: a neural impulse that travels down an axon like a wave
 - When does the cell send an action potential?
 - The threshold is reached when excitatory signals outweigh the inhibitory signals by a certain amount
 - “All-or-none” response
 - Gap between cells is called a synapse
 - also called “synaptic junction” or “synaptic gap”
 - Neurons use chemicals called neurotransmitters
 - Neurotransmitters: chemicals used to send a signal across the synaptic gap
 - Reuptake (recycling neurotransmitters)
 - Chemicals that are not received are taken back up into the sending neuron to be used again
 - Types of neurotransmitters
 - Serotonin
 - Affects mood, hunger, sleep, arousal
 - Undersupply linked to depression
 - Dopamine
 - Influences movement, learning, attention, emotion
 - Oversupply linked to schizophrenia
 - Undersupply linked to tremors and decreased mobility in Parkinson’s Disease and ADHD
 - How neurotransmitters are received
 - When the key fits, the site is opened
 - Keys that almost fit (agonist vs. antagonist)
 - Agonist
 - Molecule fills the receptor site and activates it, acting like the neurotransmitter
 - MIMICS neurotransmitter
 - Ex. morphine mimics the action of endorphins
 - Antagonist
 - Molecule fills the lock so that the neurotransmitter cannot get in and activate the receptor site

- o BLOCKS neurotransmitter
 - o Ex. antihistamine inhibits action of histamine
- o Nervous System
 - Central Nervous System (CNS)
 - Brain and spinal cord
 - Peripheral Nervous System (PNS)
 - “the rest” of the nervous system
- o Types of neurons
 - Sensory neurons carry messages IN from the body's tissues and sensory receptors to the CNS for processing
 - Motor neurons carry instructions OUT from the CNS out of the body's tissues
 - Interneurons process information between sensory input and motor output
- o “Nerves”
 - Neural cables containing many axons
 - Part of PNS—connects muscles, glands, and sense organs to the CNS
- o Parts of PNS
 - Autonomic: controls self-regulated action of internal organs and glands
 - Somatic: controls voluntary movement of skeletal muscles
- o Parts of Autonomic NS
 - Sympathetic (arousing)
 - Fight or flight
 - Short term use only
 - Accelerated heart beat, stimulates glucose, inhibits digestion, dilates pupils
 - Parasympathetic (calming)
 - Rest and digest
 - Slows heartbeat, stimulates digestion, contracts pupils
- o Neural networks
 - Brain is a web of neural networks
 - “Neurons that fire together, wire together”
 - Interneurons in the spine
 - Spinal cord is full of interneurons that sometimes have a “mind of their own”
 - Ex. They trigger your hand to pull away from a flame
 - This is called a reflex action
- Endocrine System: refers to a set of glands that produce chemical messengers called hormones, body's chemical communication system
 - o Sends messages through the bloodstream
 - o “slow but sure”
 - o Hormones are produced in various glands around the body
 - Adrenal glands
 - Produce hormones such as epinephrine, norepinephrine, and cortisol
 - Sympathetic NS responds to stress by sending a message to adrenal glands to release hormones
 - Effect: increased heart rate, blood pressure, and blood sugar—these provide energy for the fight or flight
 - Pituitary Gland

- “master gland”—regulates other glands
 - Controlled by the hypothalamus
 - Produces growth hormone (esp. during sleep) and oxytocin, the “bonding” hormone
- Areas of the brain and their functions
 - In order from evolutionary oldest → newest (most simple actions done by brainstem/cerebellum, most complex actions done by cortex)
 - Brainstem & cerebellum: coordinates the body
 - Brainstem: includes pons and medulla
 - Medulla controls the most basic functions such as heartbeat and breathing
 - Pons helps coordinate automatic and unconscious movements
 - Thalamus (“inner chamber”)
 - “sensory switchboard”
 - Receives information from senses, sends it to higher brain regions
 - Reticular (“netlike”) formation
 - Enables alertness (arousal)
 - Cerebellum (“little brain”)
 - Helps coordinate voluntary movement
 - Also enables nonverbal learning and memory
 - Limbic (border) system: manages emotions and connects thought to body
 - Hippocampus: processes conscious memories, works with amygdala to form emotionally charged memories
 - Amygdala: processes emotions (esp. rage and fear), helps to stamp in memories
 - Hypothalamus: lies below the thalamus, relates body temperature and ensures adequate food and water intake (homeostasis), also involved in sex drive
 - Cortex (the outer covering): integrates information
 - Cerebral cortex: outer grey “bark” structure that is wrinkled in order to create more surface area for 20+ billion neurons, inner white stuff—axons linking parts of the brain, 180+ billion glial cells which feed and protect neurons and assist neural transmission
 - Brain has left and right hemispheres, 4 lobes
 - Frontal lobe: involved in speaking and muscle movements and in making plans and judgments (higher-order thinking skills)
 - Parietal lobe: include the sensory cortex
 - Occipital lobe: include the visual areas, receive visual information from the opposite visual field
 - Temporal lobe: include the auditory processing areas
 - Motor & Sensory Strips
 - Output: motor cortex (left hemisphere section controls the body’s right side)
 - Input: sensory cortex (left hemisphere section receives input from the body’s right side)
 - Association function of cortex: more complex animals have more cortical space devoted to integrating/associating information
 - Frontal lobes: active in “executive functions” such as judgment, planning, and inhibition of impulses, also active in the use of working memory and the processing of new memories