

Chapter 3

The Biological basis of Behavior

PSY 100

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Communication in the Nervous System

- Hardware:
 - **Glia** – structural support and insulation
 - **Neurons** – communication
 - **Soma** – cell body
 - **Dendrites** – receive
 - **Axon** – transmit away

Neural Communication: Insulation and Information Transfer

- **Myelin sheath** – speeds up transmission
- **Terminal Button** – end of axon; secretes neurotransmitters
- **Neurotransmitters** – chemical messengers
- **Synapse** – point at which neurons interconnect

The Neural Impulse: Electrochemical Beginnings

- **Hodgkin & Huxley (1952)** - giant squid
 - Fluids inside and outside neuron
 - Electrically charged particles (ions)
 - Neuron at rest – negative charge on inside compared to outside
 - -70 millivolts – **resting potential**

The Neural Impulse: The Action Potential

- Stimulation causes cell membrane to open briefly
- Positively charged sodium ions flow in
- Shift in electrical charge travels along neuron
- **The Action Potential**
- **All – or – none law**

The Synapse: Chemicals as Signal Couriers

- **Synaptic cleft**
- **Presynaptic neuron**
 - Synaptic vesicles
 - Neurotransmitters
- **Postsynaptic neuron**
 - Receptor sites

When a Neurotransmitter Binds: The Postsynaptic Potential

- Voltage change at receptor site – **postsynaptic potential (PSP)**
 - Not all-or-none
 - Changes the probability of the postsynaptic neuron firing
- Positive voltage shift – **excitatory PSP**
- Negative voltage shift – **inhibitory PSP**

Signals: From Postsynaptic Potentials to Neural Networks

- One neuron, signals from thousands of other neurons
- Requires integration of signals
 - PSPs add up, balance out
 - Balance between IPSPs and EPSPs
- Neural networks
 - Patterns of neural activity
 - Interconnected neurons that fire together or sequentially
- Synaptic connections
 - Elimination and creation
 - Synaptic pruning

Neurotransmitters

- Specific neurotransmitters work at specific synapses
 - Lock and key mechanism
- **Agonist** – mimics neurotransmitter action
- **Antagonist** – opposes action of a neurotransmitter
- 15 – 20 neurotransmitters known at present
- Interactions between neurotransmitter circuits

Organization of the Nervous System

- **Central nervous system (CNS)** – brain and spinal cord
 - **Afferent** = toward the CNS/ **Efferent** = away from the CNS
- **Peripheral nervous system** – nerves that lie outside the central nervous system
 - **Somatic nervous system**– voluntary muscles and sensory receptors
 - **Autonomic nervous system (ANS)** – controls automatic, involuntary functions
 - **Sympathetic** – Go (fight-or-flight)
 - **Parasympathetic** – Stop

Studying the Brain: Research Methods

- Electroencephalography (EEG)
- Damage studies/lesioning
- Electrical stimulation (ESB)
- Brain imaging –
 - computerized tomography
 - positron emission tomography
 - magnetic resonance imaging

Brain Regions and Functions

- **Hindbrain** – vital functions – medulla, pons, and cerebellum
- **Midbrain** – sensory functions – dopaminergic projections, reticular activating system
- **Forebrain** – emotion, complex thought – thalamus, hypothalamus, limbic system, cerebrum, cerebral cortex

The Cerebrum: Two Hemispheres, Four Lobes

- **Cerebral Hemispheres** – two specialized halves connected by the **corpus collosum**
 - **Left hemisphere** – verbal processing: language, speech, reading, writing
 - **Right hemisphere** – nonverbal processing: spatial, musical, visual recognition
- **Four Lobes:**
 - **Occipital** – vision
 - **Parietal** - somatosensory
 - **Temporal** - auditory
 - **Frontal** – movement, executive control systems

The Endocrine System: Glands and Hormones

- **Hormones** – chemical messengers in the bloodstream
 - **Pulsatile** release by **endocrine glands**
 - **Negative feedback system**
- **Endocrine glands**
 - **Pituitary** – “master gland,” growth hormone
 - **Thyroid** - metabolic rate
 - **Adrenal** - salt and carbohydrate metabolism
 - **Pancreas** - sugar metabolism
 - **Gonads** - sex hormones

Genes and Behavior: The Interdisciplinary Field of Behavioral Genetics

- **Behavioral genetics** = the study of the influence of genetic factors on behavioral traits
- Basic terminology:
- **Chromosomes** – strands of **DNA** carrying genetic information
 - Human cells contain **46 chromosomes** in pairs (sex-cells – 23 single)
 - Each chromosome – thousands of genes, also in pairs
- **Dominant, recessive**
- **Homozygous, heterozygous**
- **Genotype/Phenotype and Polygenic Inheritance**

Research Methods in Behavioral Genetics

- **Family studies** – does it run in the family?
- **Twin studies** – compare resemblance of identical (monozygotic) and fraternal (dizygotic) twins on a **trait**

- **Adoption** studies – examine resemblance between adopted children and their biological and adoptive parents

Modern Approaches to the Nature vs. Nurture Debate

- **Molecular Genetics** = the study of the biochemical bases of genetic inheritance
 - **Genetic mapping** – locating specific genes - **The Human Genome Project**
- **Behavioral Genetics**
 - The **interactionist** model
 - Richard Rose (1995) – “We inherit dispositions, not destinies.”

Evolutionary Psychology: Behavior in Terms of Adaptive Significance

- Based on Darwin’s ideas of **natural selection**
 - **Reproductive success** key
- **Adaptations** – behavioral as well as physical
 - Fight-or-flight response
 - Taste preferences
 - Parental investment and mating

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