**CHAPTER 2 – BIOLOGICAL FOUNDATIONS OF BEHAVIOR**

**MODULE 2.1 NEURONS: THE BODY'S WIRING**

After you have mastered the information in this unit, you will be able to:

* Define a neuron
* Identify the parts of a neuron
* Identify the types of neurons and the other types of cells in the nervous system
* Describe how a neural impulse is generated and transmitted from one neuron to another
* Discuss the roles of neurotransmitters in psychological functioning

Key Terms and Concepts:

Neurons

Brain

Soma

Axon

Terminal Buttons

Neurotransmitters

Synapse

Dendrite

Sensory Neurons

Motor Neurons

Glands

Hormones

Interneurons

Nerve

Glial Cells

Myelin Sheath

Nodes of Ranvier

Multiple Sclerosis (MS)

Ions

Resting Potential

Depolarization

Action Potential

All-or-None Principle

Refractory Period

Receptor Site

Reuptake

Enzymes

Neuromodulators

Antagonists

Schizophrenia

Hallucinations

Delusions

Parkinson’s Disease

Agonists

Stimulant

Amphetamine

Antidepressants

Endorphins

1. The Structure of the Neuron
   1. Basic building block of the nervous system
   2. Cells specialized for rapidly communicating information
   3. Neuron parts and functions
      1. Dendrites—receive information from adjoining neurons (or sensory receptors)
      2. Soma (cell body)—receives and stores information within the cell
      3. Nucleus—governs and directs action of the cell
      4. Axon—transmits neural impulse down length of cell
      5. Terminal buttons—branching at end of axon; contain neurotransmitters
   4. Types of neurons
      1. Sensory neurons—bring information from outside world to your brain
      2. Motor neurons—transmit responses from brain to muscles and glands
      3. Interneurons
         1. Connect neurons to other neurons
         2. Join sensory and motor neurons in spinal cord
   5. Synapses—chemical (neurotransmitter) connections between all neurons
2. Glial Cells
   1. Most numerous cells within the nervous system
   2. “Glue” to help hold neurons together
   3. Assist and support activity of neurons
   4. Form myelin sheath
      1. Fatty, protective covering on many neuron axons
      2. Forms over time, usually by age of 12
      3. Nodes of Ranvier (gaps in myelin sheath)—neural impulse may jump from node to node
      4. Multiple sclerosis (MS)—destruction of myelin sheath
3. How Neurons Communicate
   1. Ions involved: sodium, potassium, and chloride
   2. Resting potential—neuron not activated; cell has slightly negative charge
   3. Depolarization—stimulation leads sodium to enter cell; electrical charge now changed from negative to positive
   4. Action potential*—*neuron fires down length of axon; called a neural impulse
4. Neurotransmitters
   1. Synapse is tiny gap between one neuron and the next
   2. At synapse, the impulse changes from electrical to chemical
   3. Neurotransmitters are these chemical messengers across synapse
   4. Chemicals from adjacent neurons may either excite or inhibit cell firing
   5. Some important neurotransmitters
      1. Acetylcholine—for muscle contractions, and learning and memory
      2. Dopamine—related to muscle activity, also involved in emotional functioning
      3. Glutamate—keeps central nervous system aroused
      4. Serotonin—regulates emotion, satiety, and sleep
      5. Endorphins—body’s natural painkillers; similar chemically to narcotic drugs

**MODULE 2.2 THE PERIPHERAL NERVOUS SYSTEM: YOUR BODY'S INFORMATION SUPERHIGHWAY**

After you have mastered the information in this unit, you will be able to:

* Detail the organization of the nervous system
* Describe spinal reflexes
* Describe the autonomic nervous system
* Explain the relationship between the sympathetic and parasympathetic divisions of the autonomic nervous system

Key Terms and Concepts:

Nervous System

Central Nervous System

Spinal Cord

Spine

Reflex

Spinal Reflex

Peripheral Nervous System

Somatic Nervous System

Autonomic Nervous System

Sympathetic Nervous System

Parasympathetic Nervous System

1. Central Nervous System
   1. Consists of brain and spinal cord
      1. Spinal cord is a column of nerves about as thick as one’s thumb, encased in the spine
         1. Transmits information between brain and peripheral nervous system
         2. Spinal reflexes are the quickest possible response to stimuli, bypassing the brain and involving only two or three neurons
   2. Peripheral nervous system—components of nervous system other than brain and spinal cord
2. Peripheral Nervous System:
   1. Somatic nervous system
      1. Comprised of sensory and motor neurons
      2. Links communication between central nervous system and sense organs, muscles
   2. Autonomic nervous system—two further divisions
      1. Sympathetic nervous system
         1. Prepares body to meet physical demands or stress
         2. Increases heart rate, breathing, blood sugar
      2. Parasympathetic nervous system
         1. Slows bodily activity, conserves energy
         2. Fosters bodily processes, such as digestion

**MODULE 2.3 THE BRAIN: YOUR CROWNING GLORY**

After you have mastered the information in this unit, you will be able to:

* Discuss how the brain is organized and how its various parts function
* Describe the organization of the cerebral cortex
* Identify the major function associated with each of the four lobes of the cerebral cortex

Key Terms and Concepts:

Hindbrain

Medulla

Pons

Brainstem

Cerebellum

Midbrain

Reticular Formation

Forebrain

Thalamus

Basal Ganglia

Hypothalamus

Limbic System

Amygdala

Hippocampus

Cerebral Cortex

Cerebrum

Cerebral Hemispheres

Corpus Callosum

Occipital Lobes

Parietal Lobes

Somatosensory Cortex

Frontal Lobes

Motor Cortex

Temporal Lobes

Association Area

1. The Brain
   1. Hindbrain—lowest part of brain
      1. Evolutionarily the “oldest”
      2. Medulla—breathing, heart rate, swallowing
      3. Pons—conducts information; influences wakefulness and sleep
      4. Cerebellum—controls balance and coordination
   2. Midbrain—above the hindbrain
      1. Connects hindbrain with forebrain
      2. Reticular formation
         1. Neural network that connects to thalamus
         2. Involved in attention, alertness and arousal
         3. Filters out irrelevant information
   3. Forebrain—largest part of the brain, located at top and front
      1. Thalamus—relay station, routes information to appropriate brain area
      2. Basal ganglia—control movement and coordination
      3. Hypothalamus
         1. Under the thalamus; size of a pea
         2. Regulates hunger, thirst, body temperature
         3. Involved in reproduction, emotional states
         4. Directs activity of the endocrine system
      4. Limbic system—memory and emotional processing
         1. Amygdala—aggression, rage and fear
         2. Hippocampus—important role in formation of memories
2. Cerebral cortex
   1. Part of the forebrain
   2. Thin outer layer of cerebrum
   3. Two cerebral hemispheres (connected by corpus callosum)
   4. Each hemisphere—four lobes
      1. Occipital lobes—vision
      2. Parietal lobes
         1. Includes somatosensory cortex
         2. Touch, pressure, pain, temperature
         3. Area proportional to sensitivity of skin tissue
      3. Frontal lobes
         1. “Executive center”
         2. Accesses stored memories
         3. Used to solve problems, reason, carry out coordinated activities
         4. Involved in emotional states
         5. Motor cortex—voluntary movement
      4. Temporal lobes—hearing
   5. Consists largely of association areas—higher mental functions

**MODULE 2.4 METHODS OF STUDYING THE BRAIN**

After you have mastered the information in this unit, you will be able to:

* Describe the various recording and imaging techniques used to study brain functioning
* Discuss the experimental methods used to study brain functioning

Key Terms and Concepts:

Lesioning

Electrical Recording

1. Methods of Studying the Brain
   1. Recording and imaging techniques
      1. EEG (electroencephalograph)—records electrical activity in the brain
      2. CT (computed tomography) scan—measures reflection of an X-ray beam passing through body
      3. PET (positron emission tomography) scan—radioactive isotope reveals more active parts of brain
      4. MRI (magnetic resonance imaging)—gives picture of body’s soft matter; disrupted atoms give signals as they realign
   2. Experimental methods
      1. Lesioning
         1. Part of experimental animal’s brain is destroyed
         2. Researcher investigates effects of the brain tissue loss
      2. Electrical recording—electrodes in neurons/brain tissue reveal changes
      3. Electrical stimulation—observe results of mild electric current passed through brain

**MODULE 2.5 THE DIVIDED BRAIN: SPECIALIZATION OF FUNCTION**

After you have mastered the information in this unit, you will be able to:

* Discuss the major differences between the left and right hemispheres
* Describe how handedness is determined
* Discuss the main causes of brain damage and the effects of such damage on psychological functioning
* Explain the use of 'split-brain? patients to learn about brain lateralization

Key Terms and Concepts:

Lateralization

Broca’s Area

Wernicke’s Area

Aphasia

Plasticity

Stroke

Prefrontal Cortex

Laceration

Concussion

Epilepsy

Split-Brain Patients

1. The Brain at Work: Lateralization and Integration
   1. Lateralization
      1. Division of functions between left and right hemispheres
      2. Left brain: language, logical analysis, mathematical computations
         1. Broca’s area: production of speech
         2. Wernicke’s area: understanding meaning in language
         3. Aphasia: loss or impairment in language communication
      3. Right brain: spatial relations, recognizing faces, emotional expression
   2. Integration: Both hemispheres share work in performing most tasks
2. Handedness—hand dominance related to hemispheric specialization
   1. Left-handers may not follow typical pattern
   2. Genetic factors seem to play a role
   3. Prenatal hormones may also influence
   4. Twice as many males as females left-handed
3. Brain Damage and Psychological Functioning
   1. Head trauma—laceration or concussion
   2. Stroke
      1. Flow of blood to brain is blocked
      2. Cerebral hemorrhage—bleeding into the brain
   3. Brain plasticity—healthy part of brain may take over lost function
4. Exploring Psychology: Research on Split-Brain Patients: Does the Left Hand Know What the Right Hand is Doing?
   1. Corpus callosum may be severed as a treatment for severe epilepsy
   2. Patient holds a familiar object in the left hand—can use it but not name it
      1. The left hand connects to the right hemisphere, which lacks language capabilities
   3. Perception studies—researchers flash pictures to either left or right visual field
      1. Patients can only describe the picture if flashed to the right visual field (which connects to the left hemisphere)
   4. Split-brain patients appear quite normal in everyday behavior

**MODULE 2.6 THE ENDOCRINE SYSTEM: THE BODY'S OTHER COMMUNICATION SYSTEM**

After you have mastered the information in this unit, you will be able to:

* Identify the major endocrine glands
* Explain the role of hormones in behavior

Key Terms and Concepts:

Endocrine System

Pancreas

Diabetes

Homeostasis

Pituitary Gland

Pineal Gland

Adrenal Gland

Gonads

Ovaries

Testes

Germ Cells

Thyroid Gland

Premenstrual Syndrome (PMS)

1. The Endocrine System
   1. A grouping of glands
   2. Glands release secretions called hormones
   3. Regulates bodily processes such as growth, reproduction, and metabolism
   4. Maintains homeostasis—an internally balanced state
2. Important Glands
   1. Hypothalamus—secretes releasing factors that act on pituitary gland
   2. Pituitary gland
      1. “Master gland”—influences hormone activity of other glands
      2. Also promotes physical growth via GH (growth hormone)
   3. Pancreas
      1. Produces the hormone insulin
      2. Regulates amount of glucose in the blood
   4. Pineal gland
      1. Secretes melatonin
      2. Regulates sleep-wake cycles
   5. Adrenal glands
      1. Lie above the kidneys
      2. Adrenal cortex
         1. Secretes hormones that promote muscle development
         2. Stimulates liver to release sugar in times of stress
      3. Adrenal medulla—releases epinephrine and norepinephrine to deal with stress
   6. Gonads—sex glands
      1. Ovaries in women
         1. Produce egg cells for reproduction
         2. Secrete female hormones estrogen and progesterone
      2. Testes in men
         1. Produce sperm
         2. Secrete male sex hormone testosterone
3. Hormones and Behavior
   1. Testosterone is linked to aggressive behavior
   2. Thyroid hormones—influence metabolism; related to behavior
   3. PMS—hormone sensitivity appears to play a role

**MODULE 2.7 GENES AND BEHAVIOR: A CASE OF NATURE AND NURTURE**

After you have mastered the information in this unit, you will be able to:

* Discuss the role of genetic factors in human behavior
* Describe the methods used to study genetic influences on behavior

Key Terms and Concepts:

Genotype

Genes

Deoxyribonucleic Acid (DNA)

Chromosomes

Phenotype

Polygenic Traits

Familial Association Studies

Identical Twins

Zygote

Fraternal Twins

Twin Studies

Concordance Rates

Adoptee Studies

1. Genes
   1. Composed of deoxyribonucleic acid (DNA)
   2. Linked together on long strands called chromosomes
   3. Found in cell nucleus
   4. A child receives 23 chromosomes from each parent
   5. Human genome mapped in year 2000
   6. Only twins share identical genetic code
2. Genetic Influences on Behavior
   1. Genotype is the genetic code; phenotype is the gene’s physical or behavioral expression
      1. Phenotype depends on complex interaction of genes and environment
   2. Many psychological characteristics may be polygenic traits
   3. Genetic factors establish a predisposition; characteristics may not necessarily appear
3. Kinship Studies
   1. Familial association studies
      1. Closer genetic links related to more similar traits and behaviors
      2. Higher incidence of schizophrenia as genetic commonality increases
      3. Limitation: people sharing close genetic links often share similar environment
   2. Twin studies
      1. Monozygotic (identical) twins—identical genetic inheritance
      2. Dizygotic (fraternal) twins—genetic commonality like siblings
      3. Concordance rates suggest genetic contribution
      4. Identical twins more similar than fraternals on sociability, some psychological disorders
      5. Limitation: identical twins may share greater environmental similarity
   3. Adoptee studies
      1. Adopted children compared to biological and adoptive parents
      2. Shyness in children more likely to resemble biological parent
      3. Genetically identical (monozygotic) twins, reared apart
         1. Rare event, but a natural experiment
         2. Heredity seems to play major role in personality development

**MODULE 2.8 APPLICATION: LOOKING UNDER THE HOOD: SCANNING THE HUMAN BRAIN**

After you have mastered the information in this unit, you will be able to:

* Describe some cutting-edge applications of brain scanning

1. Memory and Cognitive Research
   1. Specific brain circuits may relate to specific memories
2. Personality Research
   1. Different patterns of brain activity in people who are more or less extraverted or neurotic
3. Personnel Selection
   1. Scans may indicate suitability for particular types of tasks
4. Diagnosing Psychological Disorders
   1. Scans may be used to detect signs of schizophrenia, bipolar disorder, and ADHD