

1 **Chapter 2: Biology and Psychology**

2 **Truth or Fiction?**

- The human brain is larger than that of any other animal.
- A single cell can stretch all the way from your spine to your toe.
- Messages travel in the brain by means of electricity.

3 **Truth or Fiction?**

- A brain cell can send out hundreds of messages each second – and manage to catch some rest in between.
- Fear can give you indigestion.
- If a surgeon were to stimulate a certain part of your brain electrically, you might swear that someone had stroked your leg.

4 **Truth or Fiction?**

- A hormone turns a disinterested male rodent into a doting father.
- Charles Darwin was nearly excluded from the voyage that led to the development of his theory of evolution because the captain of the ship did not like the shape of his nose.

5 **Truth or Fiction?**

- Your genetic code overlaps 25% with that of a carrot.
- Neanderthals are not necessarily extinct, they may be lurking in your genes.

6 **Preview of Chapter Two**

- The Nervous System
- The Brain
- The Endocrine System
- Evolution and Heredity

7 **The Nervous System: On Being Wired**

8 **Neurons**

- Glial cells
 - Nourish and insulate neurons; remove waste products
- Neuron, nerve cells
 - Dendrites
 - Axon
 - Myelin

9

10 **Neurons**

- Afferent Neurons
 - Transmit messages from sensory receptors to the spinal cord and brain
- Efferent Neurons
 - Transmit messages from brain or spinal cord to muscles and glands

11 **Neural Impulse**

- Electrochemical messages that travel within neurons
- Resting potential
 - Neuron is polarized

- Action potential
 - Positive charged ions enter and depolarize neuron

12 **Action Potential**

13 **Firing: Neuron to Neuron**

- Firing
 - Conduction of neural impulse along the length of a neuron
- Threshold
 - Incoming messages reach a strength at which neuron will fire

14 **Firing: Neuron to Neuron**

- All-or-none principle
 - Every time a neuron fires, it transmits an impulse of the same strength.
- Refractory period
 - Period of recovery time between firings

15 **Changes in Electrical Charges as a Neural Impulse is Transmitted Across an Axon**

16 **Firing: Neuron to Neuron**

- Synapse
 - Axon terminal button from the transmitting neuron, and
 - Dendrite or the body of a receiving neuron
 - Fluid-filled gap between the two (Synaptic cleft)

17

18 **Neurotransmitters**

- Neurotransmitters
 - chemical substances that communicate from one neuron to another
- Synaptic vesicles
 - Contain neurotransmitters in the axon terminals

19 **Neurotransmitters**

- Receptor site
 - On dendrite of receiving neuron
- Reuptake
 - Neurotransmitters reabsorbed

20 **Neurotransmitters**

- Excitatory neurons
 - Cause other neurons to fire
- Inhibitory neurons
 - Prevent other neurons from firing

21 **Neurotransmitters of Interest to Psychologists**

- Acetylcholine (ACh)
 - Controls muscle contractions
 - Formation of memories
 - Paralysis, Alzheimer's Disease

22 **Neurotransmitters of Interest to Psychologists**

- Dopamine
 - Pleasure, addiction, voluntary movement, learning, attention, memory, and emotional responses
 - Parkinson's disease
 - Schizophrenia

23 **Neurotransmitters of Interest to Psychologists**

- Norepinephrine
 - Accelerates heart rate, affects eating, linked to activity levels, learning and remembering
 - Mood disorders, depression, bipolar disorder

- 24 **Neurotransmitters of Interest to Psychologists**
- Serotonin
 - Emotional arousal and sleep
 - Eating disorders, alcoholism, depression, aggression, insomnia
- 25 **Neurotransmitters of Interest to Psychologists**
- Gamma-aminobutyric acid (GABA)
 - Inhibitory may help relax anxiety reactions
 - Depression
- 26 **Neurotransmitters of Interest to Psychologists**
- Endorphins
 - Occur naturally within the brain and bloodstream
 - Inhibit pain
 - May be connected to indifference to pain
 - Runner's high
- 27 **Parts of the Nervous System**
- Central Nervous System
 - Brain and spinal cord
 - Peripheral Nervous System
 - Sensory (afferent) and motor (efferent) neurons
- 28 **The Divisions of the Nervous System**
- 29 **Peripheral Nervous System**
- Somatic Nervous System
 - Sensory and motor neurons
 - Transmits messages to the brain and purposeful body movements from the brain
 - Autonomic Nervous System
 - Regulates glands and muscles of internal organs
 - Contains sympathetic and parasympathetic divisions
- 30 **Branches of Autonomic Nervous System**
- Sympathetic
 - Most active during emotional responses
 - Spend the body's reserves of energy
 - Parasympathetic
 - Most active during processes that restore body's reserve of energy
- 31 **The Parasympathetic and Sympathetic Branches of the Autonomic Nervous System**
- 32 **Central Nervous System**
- Spinal Cord
 - Transmits messages from sensory receptors to the brain and from the brain to muscle and glands
 - Spinal Reflex
 - Simple, unlearned response to stimulus, may involve only two neurons
 - Gray matter
 - White matter
- 33 **The Reflex Arc**
- 34 **The Brain: Wider Than the Sky**
- 35 **How Do Researchers Learn About the Functions of the Brain**
- Experimenting with the brain
 - Assessing damage from trauma and disease
 - Intentionally damaging parts of a brain
 - Electrical probes to stimulate parts of the brain
 - Electroencephalograph
 - Measurement of electrical activity – brain waves

36 **How Do Researchers Learn About the Functions of the Brain (continued)**

- Brain-Imaging Techniques
 - Computerized axial tomography (CAT or CT scan)
 - Positron emission tomography (PET scan)
 - Magnetic Resonance Imaging (MRI)
 - Functional Magnetic Resonance Imaging (fMRI)

37 **Structures and Functions of the Brain**

- Hindbrain
 - Medulla
 - Pons
 - Cerebellum
 - “Little brain”

38 **Hindbrain**

39 **Structures and Functions of the Brain**

- Reticular Activation System
 - From hindbrain, ascends through midbrain into lower part of forebrain
 - Vital to attention, sleep, arousal
 - Stimulation to RAS may be selective through learning

40 **Structures and Functions of the Brain**

- Forebrain
 - Thalamus
 - Relay station for sensory stimulation
 - Hypothalamus
 - Regulates body temperature, motivation and emotion
 - Limbic System
 - Amygdala, hippocampus and hypothalamus
 - Involved in memory and emotion

41 **The Limbic System**

42 **Structures and Functions of the Brain**

- Cerebrum
 - Responsible for thinking and language
 - Cerebral Cortex
 - Surface (gray matter) of cerebrum
 - Corpus Callosum
 - Connects two hemispheres

43 **Corpus Callosum**

44 **The Cerebral Cortex**

- Outer layer of cerebrum
- Two Hemispheres
- Four Lobes
 - Frontal, Parietal, Temporal and Occipital

45 **Cerebral Cortex VR**

46 **The Lobes of the Cerebral Cortex**

- Occipital Lobe
 - Vision
- Temporal Lobe
 - Hearing and Auditory functions
- Parietal Lobe
 - Somatosensory Cortex
- Frontal Lobe
 - Motor Cortex

47 **The Geography of the Cerebral Cortex**

48 **Thinking, Language, and the Cortex**

- Association areas
 - Not primarily involved in sensation or motor activity
 - Responsible for learning, thought, memory and language
- Association areas in Frontal Lobe
 - Responsible for executive functions

49 **Language Functions**

- Two hemispheres of the brain mirror and differ
 - Left hemisphere contains language functions for nearly all people
 - If damaged before age 13, speech functions would transfer to right hemisphere
- Two key language areas
 - Broca's area and Wernicke's area
 - Damage in either causes aphasia

50 **Language Functions**

- Wernicke's Area
 - Temporal Lobe
 - Wernicke's aphasia
 - Impairs ability to comprehend speech and think of words to express own thoughts
- Angular Gyrus
 - Translates visual into auditory information
 - Damage impairs reading ability

51 **Language Functions**

- Broca's Area
 - Frontal Lobe
 - Production of speech
 - Broca's aphasia
 - Understand language but speech slowly and laboriously

52 **Left Brain, Right Brain**

- Left-brained
 - Logical and intellectual
- Right-brained
 - Intuitive, creative and emotional
- Hemispheres do not act independently
 - Exaggerated idea

53 **Left Handedness**

- 8 to 10% people are left handed
 - More common in boys than girls
 - More common in gifted artists than general population
- Language and Health Problems
 - Dyslexia, stuttering
 - Migraine headaches, allergies
- Appears to have a genetic component

54 **Split-Brain Experiments**

- Severe cases of epilepsy may require split-brain operations
- Examples of "two brain" phenomenon
 - Caused by inability of one hemisphere to communicate with the other

55

56 **The Endocrine System:**

Chemicals in the Bloodstream

- 57 **Endocrine System**
- Comprised of ductless glands that secrete hormones into the bloodstream
 - Hormones
 - Regulate growth, metabolism and some behaviors
 - Maintain steady bodily states
- 58 **Pituitary and the Hypothalamus**
- Pituitary gland
 - Lies below hypothalamus
 - Labeled as “master gland”
 - Hormones secreted by pituitary gland
 - Hypothalamus regulates pituitary gland activity
- 59 **Pineal Gland**
- Pineal gland
 - Secretes melatonin
 - Helps regulate sleep-wake cycle
 - May affect onset of puberty
- 60 **Thyroid Gland**
- Thyroid gland
 - Produces thyroxin
 - Affects body’s metabolism
 - Hypothyroidism
 - Hyperthyroidism
 - Cretinism
- 61 **Adrenal Glands**
- Adrenal glands
 - Located above the kidneys
 - Cortical steroids
 - increase resistance to stress
 - promote muscle development
 - Epinephrine and norepinephrine
 - Helps arouse body in threatening situations
- 62 **Testes and Ovaries**
- Testes secrete testosterone
 - male sex characteristics
 - sex drive and aggressiveness
 - Ovaries secrete estrogen and progesterone
 - female sex characteristics
 - regulates menstrual cycle
- 63 **Evolution and Heredity:
The Nature of Nature**
- 64 **Darwin’s Theory of Evolution**
- Natural selection
 - Species and individuals compete for same resources
 - Mutations
 - Random genetic variations explain differences
 - Differences which affect the ability to adapt to change
- 65 **Evolutionary Psychology**

- Studies in which adaptation and natural selection are connected with behavior and mental processes
- Behavior patterns evolve and can be transmitted genetically from generation to generation
 - Instinctive or species specific behaviors

66 **Evolutionary Psychology**

- Instinct
 - Stereotyped patterns of behavior that are triggered in a specific situation
- Species-specific
 - Resists modification, not learned

67 **Heredity, Genetics and Behavioral Genetics**

- Heredity
 - Transmission of traits from parent to offspring, based on genes
- Genetics
 - Subfield of biology that studies heredity

68 **Heredity, Genetics and Behavioral Genetics**

- Behavioral Genetics
 - Focuses on individual differences
- Molecular Genetics
 - Attempts to identify specific genes connected with behaviors and mental processes

69 **Genes and Chromosomes**

- Gene
 - Basic unit of heredity
- Chromosomes
 - Structure within cell nucleus that carry genes
 - Humans have 46 chromosomes (23 pairs)
- DNA (deoxyribonucleic acid)
 - Substance that forms chromosomes
 - Double helix – contains genetic code
 - Nucleotides - A and T, C and G

70 **Cells, Chromosomes, and DNA**

71 **Genes and Chromosomes**

- Genes regulate development of specific traits
 - Some traits are determined by one gene
 - Other traits are polygenic
- Genotype
 - Individual's genetic makeup
- Phenotype
 - Actual appearance, based on genotype and environmental influences

72 **Down Syndrome**

- Extra chromosome on the 21st pair
- Condition more likely as mother's age at time of pregnancy increases
- Physical characteristics, cognitive impairment

73 **Kinship Studies**

- Focus on presence of traits and behavior patterns who are, or are not related biologically
- Twin studies
 - Monozygotic twins – share 100% genes
 - Differences represent environmental influences
 - Dizygotic twins – no more similar than sibling
- Adoption studies

74 **Selective Breeding**

- Process used to enhance desired physical and behavioral traits

– Done routinely with plants and animals