Psychology Core Concepts 8th edition Zimbardo Solutions Manual

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CHAPTER 2:
BIOPSYCHOLOGY, NEUROSCIENCE, AND HUMAN NATURE

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LECTURE GUIDE

Introduction

Key Question

How Are Genes and Behavior Linked?

2.1 Core Concept

Evolution has fundamentally shaped psychological processes because it favors genetic variations that produce adaptive behavior.

- The psychological specialty of **biopsychology,** which studies the interaction of biology, behavior, and mental processes, to find the answers to this question.

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- **Evolution** is the process by which succeeding generations of organisms change as they adapt to changing environments.

2.1 Lecture Outline: Evolution and Natural Selection

Web Resources:

- General Resources for Biological Psychology

- In 1831, Charles Darwin, sailing on the *Beagle*, a British research ship surveying the coast of South America, studied native species of plants and animals, collected specimens, and kept detailed records of unusual life forms.
- He made the case for evolution in his book, *On the Origin of Species* (1859), which fundamentally changed the way that people viewed their relationship to other living things.

2.1.1. The Evidence that Convinced Darwin

- Darwin observed that organisms carefully adapted to their environment.
- Within a species, individual organisms varied.
- Darwin thought that individual variation would give some organisms a survival and reproduction advantage over others of the same species.
- Those individuals, better adapted to their environment, would be more likely to flourish and reproduce, leaving more offspring with greater adaptability.
- Darwin called this "weeding out" process **natural selection**.
- Through natural selection, an organism gradually changes as it adapts to the demands of its environment (survival of the fittest).

B. Evolutionary Explanations for Psychological Processes

- Understanding this process of evolution and natural selection helps us to make sense of many of the observations that we make in psychology. For example, phobias most often involve stimuli that signaled danger to our ancestors.
- Evolution has been misunderstood since its development and publication. Neither Darwin nor any other evolutionary scientist has said that humans are descended from monkeys. Rather, they have said that people and monkeys had a common ancestor millions of years ago.
- Evolution has been accepted by most scientists for more than a century.

2.2 Lecture Outline: Genetics and Inheritance

- **Genes** encode molecular information that can become inherited traits.
- Experience makes each individual unique.
- Individuals receive half of their genes from each parent; genes are shuffled randomly before being passed along; this hybrid inheritance produces a unique **genotype.**

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- A genotype is like a blueprint; the resulting structure is the **phenotype**, comprised of physical characteristics as well as the hidden biological traits of the chemistry and wiring of the individual's brain.
- While the phenotype is based on biology, it acts in partnership with the environmental factors such as nutrition, disease, stress, and experiences.

2.2.1. Chromosomes, Genes, and DNA

- Almost every cell in the body carries a complete set of biological instructions, the **genome**, comprised of 23 pairs of **chromosomes** (Figure 2.1). Each chromosome is made up of a tightly coiled chain of **DNA (deoxyribonucleic acid**).
- **Genes**, containing a single protein, encoded in short segments of DNA, make up the instructions for development.
- Genes differ slightly from one organism to the next, and provide the biological source for the variation that occurs in the expression of the traits in some individuals.
- The genetic code uses just four substances, called **nucleotides**.
- Of the 46 chromosomes (23 pairs), two, the sex chromosomes, named X and Y, carry genetic information for a male or female phenotype; the X chromosome is inherited from the biological mother and either an X or a Y chromosome is inherited from the biological father—upon pairing, the combination of XX produces a female; the combination of XY produces a male.

2.2.2. Genetic Explanation for Psychological Processes

- Genes influence psychological characteristics such as intelligence, personality, mental disorders, reading and language disabilities, and perhaps sexual orientation.
- Multiple genes, rather than just one, are thought to be responsible for a specific psychological disorder.
- Heredity never acts alone, and even identical twins, with the same genotype, are each unique.

2.3 Lecture Outline: The Brave New World of Epigenetics

- The **nature versus nurture** question has been replaced by the statement "**nature *and* nurture**."
- The study of how environmental forces alter gene expression is called **epigenetics**.

2.3.1. Genome Basics

- Your genome is your own personal genetic code—it is what makes you you.
- Each person has over 25,000 genes, making up over 3 billion pairs of DNA in every cell.

2.3.2. More About the Genome

- A single strand of DNA is very long—as tall as an average adult—so in order for all of that to fit in the body, it has a double-helix structure.
- A special protein that it is wrapped around is called a **histone**.

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- Even though each cell has the same genetic material, they develop differently because of signals from outside our body (in the environment). The combination of internal and external factors creates the variations between cells and people.
- Each time a gene is turned on or off, a tag is left behind. These residual chemical tags create the **epigenome**.

2.3.3. How Life Experiences Change the Epigenome

- Examine the text's discussion of how research into the manner in which rats cope with stress affects their epigenetic results.

PSYCHOLOGY MATTERS: Choosing Your Children's Genes

Scientists already have the ability to control and alter the genes of animals, although the success rate of cloning is between 1% and 2% of attempts. Psychologists expect this information to tell us something about the genetic basis for human differences in abilities, emotions, and resistance to stress. Although much of this knowledge lies in the future, we now know how to test for genetic diseases such as Tay-Sachs disease, Down Syndrome, and sickle-cell anemia.

This new genetic knowledge will be accompanied by ethical problems that will have to be worked out

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Key Question

How Does the Body Communicate Internally?

2.2 Core Concept

The brain coordinates the body's two communications systems, the nervous system and the endocrine system, which use similar chemical processes to communicate with targets throughout the body.

2.4 Lecture Outline: The Neuron: Building Block of the Nervous System

Lecture Launchers/Discussions Topics:

- Neurotransmitters: Chemical Communicators of the Nervous System
- Synaptic Transmission and Neurotransmitters
- The Brain
- Too much or too little: Hormone Imbalances
- Would You Like Fries with That Peptide?

Classroom Activities, Demonstrations, and Exercises:

- Using Reaction Time to Show the Speed of Neurons
- The Dollar Bill Drop
- Using Dominoes to Understand the Action Potential
- Demonstrating Neural Conduction: The Class as a Neural Network

Web Resources:

- Neurons/Neural Processes

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- The Nervous System

- The neuron is a cell specialized to receive, process, and transmit information to other cells.

2.4.1. Types of Neurons

- **Sensory neurons**, or **afferent neurons**, that carry messages toward the brain; **motor neurons**, **or efferent neurons**, that carry messages away from the brain; and **interneurons**, that carry messages between nerve cells.

2.4.2. How Neurons Work

- "Receivers," or **dendrites,** collect sensory messages from other cells or by direct stimulation of the sense organs.
- The message received can be excitatory or inhibitory in nature.

1. The Action Potential
   - When arousal in the cell body reaches a critical level, the cell fires.
   - The **action potential** is a nerve impulse caused by an electrical charge in the axon when the axon is roused out of its **resting potential** state.
   - The **all or none principle:** either the axon fires or it does not.

2. Synaptic Transmission
   - The electrical charge must jump the **synaptic gap**, which it does by stimulating the **terminal bulb** to release special chemicals, called **neurotransmitters**.
   - Neurotransmitters must find a matching site on the other side of the synaptic gap; if not, they are broken down—the **reuptake** process.

3. Neurotransmitters
   - **Terminal buttons** at the end of axons have vesicles that burst and release **neurotransmitters** into the synapse.
   - Some take messages across to the next neuron, while others are reabsorbed in a process called **reuptake.**

2.4.3. Glial Cells: A Support Group for Neurons

- **Glial** cells provide structural support for neurons and help form new synapses during learning.
- They make up the **myelin sheath**, a fatty insulation that covers, insulates, and protects the enclosed cells.

2.4.4 Neural Plasticity

- The brain can adapt or modify itself, a process known as **plasticity.**
- Plasticity helps to account for the brain's ability to compensate for injury.
- It also accounts for the human ability to adapt to our experiences.

2.4.5. Brain Implants

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- Brain implants of computer chips are currently under study as a means of restoring some motor control to those whose brains have been severely injured.

2.5 Lecture Outline: The Nervous System

- The **nervous system**, consisting of all the nerve cells, functions as a single, complex, and interconnected unit.

2.5.1. The **central nervous system** (CNS) is composed of the brain and spinal cord.

- The brain makes complex decisions, coordinates our body functions, and initiates most of our behaviors.
- The spinal cord serves as a neural connecting cable.

1. Reflexes
   - **Reflexes**, simple responses not requiring the brain, are coordinated by the spinal cord.
   - Voluntary movements require the brain, and damage to the spinal cord can produce paralysis.

2. Contralateral Pathways
   - Most sensory and motor pathways cross over to the opposite side of the brain in **contralateral pathways.**
   - This fact is important in understanding how damage to one side of the brain often results in disabilities to the other side of the body.

2.5.2. The Peripheral Nervous System

- The **peripheral nervous system (PNS)** connects the central nervous system to the rest of the body.
- It consists of two divisions, each of which has two parts.

1. The Somatic Division of the PNS
   - The PNS's **somatic nervous system**'s sensory component connects the sense organs to the brain and its motor component links the CNS with the skeletal muscles.
   - The **afferent** (sensory) system sends messages to the brain and the **efferent** (motor) system sends messages to the muscles to act on them.

2. The Autonomic Division of the PNS
   - The PNS's **autonomic nervous system** that carries signals that regulate the internal organs that perform such functions as digestion, heart rate, respiration, and arousal is self-regulating and independent.
   - The **sympathetic** division is often called the "fight or flight" system because it arouses the heart, lungs, and other organs in stressful situations.
   - The **parasympathetic** division returns the body to a calm state.

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2.6 Lecture Outline: The Endocrine System

- The **endocrine system** moves chemical substances, **hormones,** through the bloodstream.
- Hormones carry messages that influence body functions, behaviors, and emotions.

2.6.1. How Does the Endocrine System Respond in a Crisis?

- In a crisis, the endocrine system works in parallel with the parasympathetic nervous system to sustain body processes.
- The hormone epinephrine, sometimes called adrenalin, is released into the bloodstream, sustaining the body's "fight or flight" reaction.

2.6.2. What Controls the Endocrine System?

- A "master gland," the **pituitary gland**, oversees the endocrine system.
- It, in turn, receives messages from the hypothalamus, a brain component.

PSYCHOLOGY MATTERS: How Psychoactive Drugs Affect the Nervous System
Psychoactive drugs have the ability to enhance or inhibit natural chemical processes in our brains, through their interaction with neurotransmitters. Those that enhance or mimic neurotransmitters are called **agonists**. Those that inhibit neurotransmitters are **antagonists.**

Drugs can have unwanted side effects. The brain's many neural pathways interconnect its components. Each neural pathway employs a single neurotransmitter for widely different functions. Because of the interconnections along the neural pathway belonging to a specific neurotransmitter, a drug used for a particular purpose may affect the other locations on the neural pathway as well.

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Key Question
How Does the Brain Produce Behavior and Mental Processes?
2.3 Core Concept
The brain is composed of many specialized modules that work together to create mind and behavior.

2.7 Lecture Outline: Windows on the Brain

Lecture Launchers/Discussions Topics

- Berger's Wave
- Neural Effects of a Concussion
- The Phineas Gage Story
- Understanding Hemispheric Function
- Brain's Bilingual Broca

Classroom Activities, Demonstrations, and Exercises:

- Mapping the Brain

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- Review of Brain Imaging Techniques
- The Importance of a Wrinkled Cortex
- Lateralization Activities
- Looking Left, Looking Right
- Brain and Nervous System
- Psychology in Literature: *The Man Who Mistook His Wife For a Hat*

Web Resources:

- The Brain

- Technology has made it possible to see inside the brain; each technological device employs a different method and yields different results.

2.7.1. Sensing Brain Waves with the EEG

- **EEG**s record weak voltage patterns called brain waves through electrodes pasted on the scalp.
- The EEGs senses which parts of the brain are the most active.

2.7.2. Mapping the Brain with Electric Probes

- About half a century ago, Walter Penfield, a Canadian neurologist, stimulated patients' exposed brains with a gentle current and recorded the responses, trying to locate the exact areas of diseased brain tissue to avoid removing healthy tissue.
- He found that the brain's surface had distinct regions with distinct functions and that stimulating a certain spot would produce a unique physical response or memory.

2.7.3. Computerized Brain Scans

- Electric probes can map the brain during brain surgery.
- **CT** scanning creates a digital image of the brain from X-rays.
- **PET** show scans brain activity by sensing low-level radioactive glucose sugar.
- **MRI** uses brief, powerful pulses of magnetic energy to create highly detailed pictures of brain activity.
- **fMRI** records both brain activity and structure.

2.7.4. Which Scanning Method Is Best?

- Each technique has strengths and weaknesses and offers the most for different medical or research based needs.

2.8 Lecture Outline: Three Layers of the Brain

- The most primitive layer of the brain is the **brain stem**, an extension of the spinal cord, which regulates most instinctual responses and basic life processes.
- Located on top of the brain stem are the limbic system and the cerebrum; the addition of these two layers during the evolutionary process has greatly expanded the powers of the human brain.
- The cerebral cortex is the outer covering of the cerebrum.

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2.8.1. The Brain Stem and Its Neighbors

- The brain stem serves as a conduit for nerve pathways carrying messages from the rest of the body to the brain.
- It links together information-processing regions: the **medulla** regulating basic body functions; the **pons**, housing nerve circuits that regulate the sleep and dreaming cycle; the **reticular formation**, the brain's core that keeps the brain awake and alert; the **thalamus**, directing the brain's incoming and outgoing sensory and motor traffic; and the cerebellum, enabling motor coordination and balance.

2.8.2. The Limbic System: Emotions, Memories, and More

- Only mammals have a fully developed limbic system, a diverse collection of structures wrapped around the thalamus, enhancing capacity for emotions and memory and maintaining a balanced condition within the body.

1. The Hippocampus and Memory
   - The **hippocampus** enables the memory system.
   - It is critical in spatial memory.
   - It is also critical to memory storage, and when much of H. M.'s hippocampus was removed to control severe seizures, he lost his ability to form new memories.

2. The Amygdala and Emotion
   - The **amygdala** uses memories to aid in emotional responses, both positive and negative.
   - It may coordinate with the hippocampus so that emotions are related to memories.
   - This may explain some of the symptoms of posttraumatic stress disorder (PTSD)
   - The amygdala may also be unusually formed in people who suffer from autism spectrum disorder.

3. The Hypothalamus and Control over Motivation
   - By monitoring the body's blood, detecting small changes in temperature, fluid levels, and nutrients, the **hypothalamus** keeps the body stable and balanced.
   - It also sends messages to higher processing centers, making them aware of its needs.

2.8.4. The Cerebral Cortex: The Brain's Thinking Cap

- Two **cerebral hemispheres** are connected by a band of fibers, the **corpus callosum**.
- These two hemispheres form a thick cap—the **cerebrum—**over the brain that accounts for two-thirds of the brain's total mass and protests most of the limbic system.
- The outer layer, the **cerebral cortex**, is wrinkled to allow billions of cells to squeeze into the tight space inside the skull.
- The lobes of the cerebral cortex have centers that perform specialized functions.

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2.9 Lecture Outline: Lobes of the Cerebral Cortex

- Initially studied using phrenology, which supposed that the bumps on one's skull could tell you about the brain structures underneath.
- The lobes of the central cortex have centers that perform specialized functions.

2.9.1. The Frontal Lobes

- The **frontal lobes** handle the most advanced mental functions.
- The **motor cortex** sends messages to motor nerves and to voluntary messages.

1. The Left Frontal Lobe's Role in Speech
   - The **left frontal lobe** is involved in speech production; damage to the region known as Broca's area can leave a person without the ability to talk.

2. Mirror Neurons Discovered in the Frontal Lobes
   - **Mirror neurons** appear to fire when we observe others performing an action, as if we had performed it ourselves, possibly enabling language acquisition in children, as children learn by mimicking, possibly underlying empathy and understanding.
   - The discovery of mirror neurons is recent, and while correlations with behaviors and mental processes may be surmised, correlation is not causation and we are not yet certain about the purpose of mirror neurons.

2.9.2. The Parietal Lobes

- At the rear of each frontal lobe are the **parietal lobes,** which specialize in sensation.
- A special parietal strip, the **somatosensory cortex**, mirrors the adjacent strip of motor cortex in the front lobe and serves as the primary processing area for the sensations of touch, pressure, pain, and pressure from all over the body.
- Serving as the primary processing area for sensation, it relates this information to a mental map of the body to help locate the source of the sensation.
- Other maps in the parietal lobe help keep track of other positions of parts of the body.

2.9.3. The Temporal Lobes

- The **temporal lobes** are located on the lower side of each hemisphere.
- The **auditory cortex**, located in the temporal lobes, helps to make sense of sounds.
- Wernicke's area helps process the meaning of language.
- Portions of the temporal lobes support the visual cortex in the recognition of faces, and the right temporal lobe helps to interpret the emotional tone of language.

2.9.4. The Occipital Lobes

- The **occipital lobes** receive messages from the eyes from which the **visual cortex** constructs ongoing visual images of the world around us.
- After processing in the visual cortex, the brain sends messages to separate cortical areas for the processing of color, movement, shape, and shading.
- They work with the adjacent areas in the parietal lobes to locate objects in space and work with the temporal regions to produce visual memories.

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2.9.5. The Association Cortex

- The **association cortex** processes raw data, associating it into higher thinking.
- Regions of the brain coordinate and cooperate to understand and respond to the world.

2.10 Lecture Outline: Cerebral Dominance

- Although they work together**, cerebral dominance** is the tendency for each hemisphere to take the lead in different tasks.

2.10.1. Language and Communication

- The left hemisphere usually dominates language functions, while the right hemisphere interprets the emotional tone of speech.

2.10.2. Different Processing Styles

- The two hemispheres make differing but complementary contributions to the same task—the left hemisphere, analytical and verbal, and the right hemisphere, holistic, emotional, and spatial.

2.10.3. Some People Are Different—But That's Normal

- Dominance patterns are not always the same from one person to another.

2.10.4. Male and Female Brains

- On average, men have slightly larger brains than women.
- The hypothalamus, believed to be associated with sexual behavior and gender identity, is larger in males.
- No one has identified psychological differences associated with differences in brain size or other physical attributes.

2.10.5. The Strange and Fascinating Case of the Split Brain

- In rare and extreme cases, the corpus callosum has been cut by surgeons to treat almost continuous epileptic seizures.
- Split-brain patients appear mentally and behaviorally unaffected by this procedure except in unusual circumstances.
- The two hemispheres receive different information, however, and cannot communicate between hemispheres.

1. Two Consciousnesses
    - When the two hemispheres of split brain patients receive different information, they behave as if they were two separate individuals—**duality of consciousness.**

2.10.6. Understanding Brain Damage

- Three general principles can help us to understand the problems that brain injury patients face and the location of injuries received:

- As each side of the brain communicates with the opposite side of the body, brain damage is likely to have occurred on the opposite side from the visible symptoms.
- For most people, speech is a left hemisphere function.
- Each lobe of the brain has a specialized function, and the symptoms indicate the lobe that was damaged.

PSYCHOLOGY MATTERS: Contact Sports and Traumatic Brain Injury
Public interest in the manner in which contact sports affects the brains of the participants has spiked in recent years. Tragic suicides among some of these athletes, notably NFL star Junior Seau, has forced leagues to conduct research and take notice. TBI, or traumatic brain injury, might be a very high price for these athletes to pay.

CRITICAL THINKING APPLIED: Left Brain Versus Right Brain

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Chapter 2 Key Questions

1. How are genes and behavior linked?
2. How does the body communicate internally?
3. How does the brain produce behavior and mental processes?

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Chapter 2 Core Concepts

1. Evolution has fundamentally shaped psychological processes because it favors genetic variations that produce adaptive behavior.
2. The brain coordinates the body's two communication systems, the nervous system and the endocrine system, which use similar chemical processes to communicate with targets throughout the body.
3. The brain is composed of many specialized modules that work together to create mind and behavior.

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Chapter 2 Psychology Matters

1. Choosing Your Children's Genes
2. How Psychoactive Drugs Affect the Nervous System
3. Contact Sports and Traumatic Brain Injury

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▼ LECTURE LAUNCHERS AND DISCUSSION TOPICS

Neurotransmitters: Chemical Communicators of the Nervous System
Synaptic Transmission and Neurotransmitters
The Brain
Too much or too little: Hormone Imbalances
Would You Like Fries with That Peptide?
Berger's Wave
Neural Effects of a Concussion
The Phineas Gage Story
Understanding Hemispheric Function
Brain's Bilingual Broca

Lecture/Discussion: Neurotransmitters: Chemical Communicators of the Nervous System

In 1921, a scientist in Austria put two living, beating hearts in a fluid bath that kept them beating. He stimulated the vagus nerve of one of the hearts. This is a bundle of neurons that serves the parasympathetic nervous system and causes a reduction in the heart's rate of beating. A substance was released by the nerve of the first heart and was transported through the fluid to the second heart. The second heart reduced its rate of beating. The substance released from the vagus nerve of the first heart was later identified as *acetylcholine*, one of the first neurotransmitters to be identified. Although many other neurotransmitters have now been identified, we continue to think of acetylcholine as one of the most important neurotransmitters. Curare is a poison that was discovered by South American Indians. They put it on tips of the darts they shoot from their blowguns. Curare blocks acetylcholine receptors; paralysis of internal organs results. The victim is unable to breathe and dies. A substance in the venom of black widow spiders stimulates release of acetylcholine at the synapses. Botulism toxin, found in improperly canned foods, blocks release of acetylcholine at the synapses and has a deadly effect. It takes less than one millionth of a gram of this toxin to kill a person. A deficit of acetylcholine is associated with Alzheimer's disease, which afflicts a high percentage of older adults.

Many neurotransmitters have been identified in the years since 1921, and there is increasing evidence of their importance in human behavior. Psychoactive drugs affect consciousness because of their effects on synaptic transmission. For example, cocaine and amphetamines prolong the action of certain neurotransmitters and opiates imitate the action of natural neuromodulators called endorphins. It appears that the neurotransmitters dopamine, norepinephrine, and serotonin are associated with some of the most severe forms of mental illness.

There are probably only a few ounces of these substances in the body, but they may have a profound effect on mood, memory, perception, and behavior. Could intelligence be primarily a matter of having plenty of the right neurotransmitter at the right synapses?

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Lecture/Discussion: Synaptic Transmission and Neurotransmitters

Point out to students that neurons do not touch each other. Instead, two neurons are connected through a small space called a *synapse* into which flow substances called *neurotransmitters* that either enhance or impede impulses moving from one neuron to the next. During the first half of the 1900s, there was controversy over whether synaptic transmission was primarily chemical or electric. By the 1950s, it was apparent that the communication between the neurons was chemical. During this period, some synapses showed what was termed *gap junction* or electrical transmission between neurons at the synapse. Recent research has shown that electrical synaptic transmission may be more frequent than neuroscientists once believed (Bennett, 2000). Even though the transmission of information between neurons at the synapses is primarily chemical, some electrical synapses are known to exist in the retina, the olfactory bulb, and the cerebral cortex (Bennett, 2000).

Use "The Wave," an activity at sports arenas, as an analogy for the action potential. Like The Wave, the action potential travels the length of the neuron; the neuron does not experience the action potential all at once. To extend the analogy, mention that right after people stand up in The Wave, they are somewhat tired and must recover (i.e., refractory period) to be prepared for the next go-round (i.e., action potential).

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Lecture/Discussion: The Brain

To set the mood for your discussion of the brain, try the following: (1) talk about the relatively small size of the brain; (2) discuss its role in humankind's most amazing accomplishments; (3) discuss its role in humankind's most destructive actions; and (4) note that, to our knowledge, the brain is probably the only thing in the universe that can ponder its own existence (by asking your students to think about it, the statement is supported).

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Lecture/Discussion: Too much or too little: Hormone Imbalances

Students may find it interesting to hear more about the various problems caused by problems within the endocrine system. The following disorders/medical problems are associated with abnormal levels within the pituitary, thyroid, and adrenal glands.

> **Pituitary malfunctions**
> *Hypopituitary Dwarfism*
> If the pituitary secretes too little of its growth hormone during childhood, the person will be very small, although normally proportioned.

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Giantism
If the pituitary gland over-secretes the growth hormone while a child is still in the growth period, the long bones of the body in the legs and other areas grow very, very long—a height of 9 feet is not unheard of. The organs of the body also increase in size, and the person may have health problems associated with both the extreme height and the organ size.

Acromegaly
If the over-secretion of the growth hormone happens after the major growth period is ended; the person's long bones will not get longer, but the bones in the face, hands, and feet will increase in size, producing abnormally large hands, feet, and facial bone structure. The famous wrestler/actor, Andre the Giant (Andre Rousimoff), had this condition.

Thyroid malfunctions
Hypothyroidism
In hypothyroidism, the thyroid does not secrete enough thyroxin, resulting in a slower than normal metabolism. The person with this condition will feel sluggish and lethargic, have little energy, and tends to be obese.

Hyperthyroidism
In hyperthyroidism, the thyroid secretes too much thyroxin, resulting in an overly active metabolism. This person will be thin, nervous, tense, and excitable. He or she will also be able to eat large quantities of food without gaining weight (and I hate them for that—oh, if only we came equipped with thyroid control knobs!).

Adrenal Gland Malfunctions
If there is a problem with over-secretion of the sex hormones in the adrenals, **virilism** and **premature puberty** are possible problems. Virilism results in women with beards on their faces and men with exceptionally low, deep voices. Premature puberty, or full sexual development while still a child, is a result of too many sex hormones during childhood. There is a documented case of a 5-year old Peruvian girl who actually gave birth to a son (Strange, 1965). Puberty is considered premature if it occurs before the age of 8 in girls and 9 in boys. Treatment is possible using hormones to control the appearance of symptoms, but it must begin early in the disorder.

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Lecture/Discussion: Would You Like Fries with That Peptide?

Toast and juice for breakfast. pasta salad for lunch. An orange, rather than a bagel, for an afternoon snack. These sound like reasonable dietary choices, involving some amount of

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deliberation and free will. However, our craving for certain foods at certain times of the day may be more a product of the brain than of the mind.

Sarah F. Leibowitz, Rockefeller University, has been studying food preferences for over a decade. What she has learned is that a stew of neurochemicals in the paraventricular nucleus, housed in the hypothalamus, plays a crucial role in helping to determine what we eat and when. Two in particular—Neuropeptide Y and galanin—help guide the brain's craving for carbohydrates and for fat.

Here's how they work: Neuropeptide Y (NPY) is responsible for turning on and off our desire for carbohydrates. Animal studies have shown a striking correlation between NPY and carbohydrate intake; the more NPY produced, the more carbohydrates eaten, both in terms of meal size and duration. Earlier in the sequence, the stress hormone cortisol seems responsible, along with other factors, for upping the production of Neuropeptide Y. This stress ⇨ cortisol ⇨ Neuropeptide Y ⇨ carbohydrate craving sequence may help explain becoming overweight due to high carbohydrate intake. But weight and craving rely on fat intake as well. Leibowitz has found that the neuropeptide galanin plays a critical role in this case. Galanin is the on/off switch for fat craving, correlating positively with fat intake; the more galanin produced, the heavier an animal will become. Galanin also triggers other hormones to process the fat consumed into stored fat. Galanin itself is triggered by metabolic cues resulting from burning fat as energy, but also from another source: estrogen.

Neuropeptide Y triggers a craving for carbohydrates, galanin triggers a craving for fat, but the two march to different drummers throughout a day's cycle. Neuropeptide Y has its greatest effects in the morning (at the start of the feeding cycle), after food deprivation (such as dieting), and during periods of stress. Galanin, by contrast, tends to increase after lunch and peaks toward the end of our daily feeding cycle.

The implications of this research are many. For example, the findings suggest that America's obsession with dieting is a losing proposition (but not around the waistline). Skipping meals, gulping appetite suppressers, or experiencing the stress of dieting will trigger Neuropeptide Y to encourage carbohydrate consumption, which in turn can foster overeating. Paradoxically, then, by trying to fight nature, we may stimulate it even more. As another example, the onset and maintenance of anorexia may be tied to the chemical cravings in the hypothalamus. Anorexia tends to develop during puberty, a time when estrogen is helping to trigger galanin's craving for fat consumption. Some women (due to societal demands, obsessive-compulsive tendencies, or other pressures) react to this fat trigger by trying to accomplish just the opposite: subsisting on very small, frequent, carbohydrate-rich meals. The problem is that the stress and starvation produced by this diet cause Neuropeptide Y to be released, confining dietary interest to carbohydrates but also affecting the sex centers nearby in the hypothalamus. Specifically, Neuropeptide Y may act to shut down production of gonadal hormones.

Marano, H. E. (1993, January/February). Chemistry and craving. *Psychology Today*, pp. 30–36, 74.

http://www.rockefeller.edu/labheads/leibowitz/research.php

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Lecture/Discussion: Berger's Wave

Ask if anyone knows what is meant by the term *Berger's wave*. Explain that the study of electrical activity in the brain was once limited to studies in which different kinds of measuring devices were attached to the exposed brains of animals. Studies involving humans were rare because researchers could only measure the electrical activity of the living human brain in individuals who had genetic defects of their skull bones that cause the skin of their scalps to be in direct contact with the surfaces of their brains.

All this changed when a German physicist named Hans Berger, after several years of painstaking research, discovered that it was possible to amplify and measure the electrical activity of the brain by attaching special electrodes to the scalp that, in turn, sent impulses to a machine that graphed them. In his research, Berger discovered several types of waves, one of which he called the "alpha" wave for no other reason than its having been the first one he discovered ("alpha" is the first letter of the Greek alphabet). He kept his research a secret until he published an article about it in 1929.

Obviously, Berger achieved one of the most important discoveries in the history of neuroscience. However, his life was not a happy one. Shortly after his article was published, the Nazis rose to power in Germany, which greatly distressed him. In addition, his work wasn't valued in Germany; he was far better known in the United States. As a result, Berger fell into a deep depression in 1941 and hanged himself.

The alpha wave is also sometimes called *Berger's wave* in honor of Berger's discovery.

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Lecture/Discussion: Neural Effects of a Concussion

During the fall term, when college football is in season, it is especially appropriate to stress the discussion of the neuronal and behavioral effects of concussion. Chances are good that in any given class, you will have several students who will report having had a concussion in the past, usually as a result of participation in football or other sports activities, or as a result of an automobile accident. You can ask the students to discuss their experiences with the class, asking what kind of physiological and cognitive effects occurred. The most common effects include loss of vision (blackout), blurred vision, ringing in the ears, nausea/vomiting, and not being able to think clearly. However, the physiological and cognitive effects vary between individuals; some may not have experienced nausea at all, whereas others only experienced blurred vision. It is important to point out the variability between individuals, because it can be inferred that concussions vary greatly in terms of the severity of brain damage and the brain areas affected.

The brain sits in the cranium surrounded by cerebral fluid. When a severe blow to the head occurs, the brain may collide with the cranium, then "bounce back" and collide with the opposite

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side of the cranium. For example, if a football player falls and hits the back of his or her head, the brain may hit the back of the cranium, then the front. At this point, you might ask students what brain areas would be affected in this example ("occipital and frontal lobes" are a pretty decent answer). Therefore, both vision and some cognitive functioning may be affected. At the neuronal level, a concussive blow to the head results in a twisting or stretching of the axons, which in turn creates swelling. Eventually, the swelling may subside and the neuron may return to its normal functioning. However, if the swelling of the axon is severe enough, the axon may disintegrate. A more severe blow to the head may even sever axons, rendering those neurons permanently damaged. Either way, neuronal signaling is disrupted, either temporarily or permanently. Depending on the brain areas where the damaged axons are located, different physiological symptoms may occur.

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Lecture/Discussion: The Phineas Gage Story

Recently, the journal *History of Psychiatry* reprinted the original presentation of the case study of Phineas P. Gage, noteworthy in psychology for surviving having an iron tamping rod driven through his skull and brain. The case notes, by physician John M. Harlow, reveal aspects of the event that provide greater detail about Gage and his unfortunate accident.

Phineas Gage stood five feet six inches tall, weighed 150 pounds, and was 25 years old at the time of the incident. By all accounts, this muscular foreman of the Rutland and Burlington Railroad excavating crew was well-liked and respected by his workers, due in part to "an iron will" that matched "his iron frame." He had scarcely known illness until his accident on September 13, 1848, in Cavendish, Vermont. Here is an account of the incident, in Harlow's own words:

> He was engaged in charging a hold (sic) drilled in the rock, for the purpose of blasting, sitting at the time upon a shelf of rock above the hole. His men were engaged in the pit, a few feet behind him... The powder and fuse had been adjusted in the hole, and he was in the act of 'tamping it in,' as it is called...While doing this, his attention was attracted by his men in the pit behind him. Averting his head and looking over his right shoulder, at the same instant dropping the iron upon the charge, it struck fire upon the rock, and the explosion followed, which projected the iron obliquely upwards...passing completely through his head, and high into the air, falling to the ground several rods behind him, where it was afterwards picked up by his men, smeared with blood and brain.

The tamping rod itself was three feet seven inches in length, with a diameter of 1¼ inches at its base and a weight of 13¼ pounds. The bar was round and smooth from continued use, and it tapered to a point 12 inches from the end; the point itself was approximately ¼ inch in diameter.

The accounts of Phineas' frontal lobe damage and personality change are well-known and

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are corroborated by Harlow's presentation. Details of Phineas' subsequent life (he lived 12 years after the accident) are less known. Phineas apparently tried to regain his job as a railroad foreman, but his erratic behavior and altered personality made it impossible to do so. He took to traveling, visiting Boston and most major New England cities and New York, where he did a brief stint at Barnum's sideshow. He eventually returned to work in a livery stable in New Hampshire, but in August 1852, he turned his back on New England forever. Gage lived in Chile until June of 1860, then left to join his mother and sister in San Francisco. In February 1861, he suffered a series of epileptic seizures, leading to a rather severe convulsion at 5 a.m. on February 20. The family physician unfortunately chose bloodletting as the course of treatment. At 10 p.m., May 21, 1861, Phineas eventually died, having suffered several more seizures. Although an autopsy was not performed, Phineas' relatives agreed to donate his skull and the iron rod (which Phineas carried with him almost daily after the accident) to the Museum of the Medical Department of Harvard University.

Miller (1993) also briefly notes that John Martyn Harlow himself had a rather pedestrian career, save for his association with the Gage case. Born in 1819, qualifying for medical practice in 1844, and dying in 1907, he practiced medicine in Vermont and later in Woburn, Massachusetts, where he engaged in civic affairs and apparently amassed a respectable fortune as an investor. Like Gage himself, Harlow was an unremarkable person brought into the annals of psychology by one remarkable event.

Harlow, J. M. (1848). Passage of an iron rod through the head. *Boston Medical and Surgical Journal, 39*, 389–393.

Harlow, J. M. (1868). Recovery from the passage of an iron bar through the head. Paper read before the Massachusetts Medical Society.

Miller, E. (1993). Recovery from the passage of an iron bar through the head. *History of Psychiatry, 4*, 271–281.

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Lecture/Discussion: Understanding Hemispheric Function

A variation on the rather dubious statement that "we only use one-tenth of our brain" is that "we only use one-half (hemisphere) of our brain." Research suggests that each cerebral hemisphere is specialized to perform certain tasks (e.g., left hemisphere/language; right hemisphere/visuospatial relationships), with the abilities of one hemisphere complementary to the other. From this came numerous distortions, oversimplifications, and unwarranted extensions, many of which are discussed in two interesting reviews of this trend toward "dichotomania" (Corballis, 1980; Levy, 1985). For example, the left hemisphere has been described variously as logical, intellectual, deductive, convergent, and Western, while the right hemisphere has been described as intuitive or creative, sensuous, imaginative, divergent, and Eastern. Even complex tasks are described as right- or left-hemispheric because of their language component. In every individual, one hemisphere supposedly dominates, affecting that person's mode of thought, skills, and approach to life. One commonly cited but questionable test for

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dominance is to note the direction of gaze when a person is asked a question (left gaze signaling right-hemisphere activity; right gaze showing left-hemisphere activity). Advertisements have claimed that artistic abilities can be improved if the right hemisphere is freed, and the public schools have been blamed for stifling creativity by emphasizing left-hemisphere skills and by neglecting to teach the children's right hemisphere.

Corballis and Levy explode these myths and trace their development. In reality, the two hemispheres are quite similar and can function remarkably well even if separated by split-brain surgery. Each hemisphere does have specialized abilities, but the two hemispheres work together in all complex tasks. For example, writing a story involves left-hemispheric input concerning syntax but right-hemispheric input for developing an integrated structure and for using humor or metaphor. The left hemisphere is not the sole determinant of logic, nor is the right hemisphere essential for creativity. Disturbances of logic are more prevalent with right-hemisphere damage, and creativity is not necessarily affected. Although one hemisphere can be somewhat more active than the other, no individual is purely "right brained" or "left brained." Also, eye movement and hemispheric activity patterns poorly correlate with cognitive style or occupation. Finally, because of the coordinated, interactive manner of functioning of both hemispheres, educating or using only the right or left hemisphere is impossible (without split-brain surgery). (Note: Suggestions for a student activity on this topic are given in the following Demonstrations and Activities section of this manual).

Corballis, M.C. (1980). Laterality and myth. *American Psychologist, 35*, 284–295.
Levy, J. (1985). Right brain, left brain: Fact or fiction? *Psychology Today, 19*, 38–45.

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Lecture/Discussion: Brain's Bilingual Broca

Se potete parlare Italiano, allore potete capire questa sentenza. Of course, if you only speak English, you probably only understand *this* sentence. If you speak both languages, then by this point in the paragraph you should be really bored.

Bilingual speakers who come to their bilingualism in different ways show different patterns of brain activity. Joy Hirsch of Memorial Sloan-Kettering Cancer Center in New York and her colleagues monitored the activity in Broca's area in the brains of bilingual speakers who acquired their second language starting in infancy, and compared it to the activity of bilingual speakers who adopted a second language in their teens. Participants were asked to silently recite brief descriptions of an event from the previous day, first in one language and then in the other. A functional magnetic resonance image (fMRI) was taken during this task. All of the 12 adult speakers were equally fluent in both languages, used both languages equally often, and represented speakers of English, French, and Turkish, among other tongues.

Hirsch and her colleagues found that among the infancy-trained speakers, the same region of Broca's area was active, regardless of the language they used. Among the teenage-trained speakers, however, a different region of Broca's area was activated when using the acquired language. Similar results were found in Wernicke's area in both groups. Although the

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full meaning of these results is a matter of some debate (do they reflect sensitivity in Broca's area to language exposure, or pronounced differences in adult versus childhood language learning?), they nonetheless reveal an intriguing link between la testa e le parole.

Bower, B. (1997, July 12). Brains show signs of two bilingual roads. *Science News, 152,* 23.

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▼ ACTIVITIES, DEMONSTRATIONS, AND EXERCISES

Using Reaction Time to Show the Speed of Neurons
The Dollar Bill Drop
Using Dominoes to Understand the Action Potential
Demonstrating Neural Conduction: The Class as a Neural Network
Mapping the Brain
Review of Brain Imaging Techniques
The Importance of a Wrinkled Cortex
Lateralization Activities
Looking Left, Looking Right
Brain and Nervous System
Psychology in Literature: *The Man Who Mistook His Wife for a Hat*

Activity: Using Reaction Time to Show the Speed of Neurons

I always begin this demonstration by asking students if they believe that there is a difference in reaction time if the impulse has to travel farther. Most frequently, students answer in the affirmative. Here is a simple demonstration of the time required to process information along sensory neurons in the arm and can be done by asking students to form a line by holding hands. Ask a student to start and stop a stopwatch. Then begin by asking for volunteers. The number of students who volunteer is irrelevant. Instruct the students to close their eyes and to squeeze the hand of the person next to them when they feel the person on the opposite side squeeze their hand. The last person in line should signal the timekeeper that his or her hand has been squeezed by raising a free hand. Have the student stop the watch and record the elapsed time. Repeat the process until the reaction times appear to be stable. Take the final reaction time and divide by the number of students in the line to obtain the average reaction time.

Next, ask the students to squeeze the next person's shoulder instead of hand. The average reaction time should now decrease since the sensory information has a shorter distance to travel. The difference in average reaction time obtained from the two procedures represents, roughly, the average conduction time for sensory information between the hand and shoulder.

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Activity: The Dollar Bill Drop

After engaging in the neural network exercise, try following it up with the dollar bill drop experiment (Fisher, 1979), which not only delights students but also clearly illustrates the speed of neural transmission. Ask students to get into pairs and to come up with one crisp, flat, one-dollar bill (or something bigger, if they trust their fellow classmates!) between them. First, each member of the pair should take turns trying to catch the dollar bill with their nondominant (for most people, the left) hand as they drop it from their dominant (typically right) hand. To do this, they should hold the bill vertically so that the top, center of the bill is held by the thumb and middle finger of their dominant hand. Next, they should place the thumb and middle finger of their nondominant hand around the dead center of the bill, as close as they can get without touching it. When students drop the note from one hand, they should be able to easily catch it with the other before it falls to the ground.

Now that students are thoroughly unimpressed, ask them to replicate the drop, only this time one person should try to catch the bill (i.e., with the thumb and middle finger of the nondominant hand) while the other person drops it (i.e., from the top center of the bill). Student "droppers" are instructed to release the bill without warning, and "catchers" are warned not to grab before the bill is dropped. (Students should take turns playing dropper and catcher.) There will be stunned looks all around as dollar bills whiz to the ground. Ask students to explain why it is so much harder to catch it from someone other than themselves. Most will instantly understand that when catching from ourselves, the brain can simultaneously signal us to release and catch the bill, but when trying to catch it from someone else, the signal to catch the bill can't be sent until the eyes (which see the drop) signal the brain to do so, which is unfortunately a little too late. Fisher, J. (1979). *Body Magic*. Briarcliff Manor, NY: Stein and Day.

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Activity: Using Dominoes to Understand the Action Potential

Walter Wagor suggests using real dominoes to demonstrate the so-called "domino effect" of the action potential as it travels along the axon. For this demonstration, you'll need a smooth table-top surface (at least 5 feet long) and one or two sets of dominoes. Set up the dominoes beforehand, on their ends and about an inch apart, so that you can push the first one over and cause the rest to fall in sequence. Proceed to knock down the first domino in the row, and students should clearly see how the "action potential" is passed along the entire length of the axon. You can then point out the concept of refractory period by showing that, no matter how hard you push on the first domino, you will not be able to repeat the domino effect until you take the time to set the dominoes back up (i.e., the resetting time for the dominoes is analogous to the refractory period for neurons). You can then demonstrate the all-or-none characteristic of the axon by resetting the dominoes and by pushing so lightly on the first domino that it does not fall. Just as the force on the first domino has to be strong enough to knock it down before the rest of the dominoes will fall, the action potential must be there in order to perpetuate itself along the entire axon. Finally, you can demonstrate the advantage of the myelin sheath in axonal

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transmission. For this demonstration, you'll need to set up two rows of dominoes (approximately 3 or 4 feet long) next to each other. The second row of dominoes should have foot-long sticks (e.g., plastic rulers) placed end-to-end in sequence on top of the dominoes. By placing the all-domino row and the stick-domino row parallel to each other and pushing the first domino in each, you can demonstrate how much faster the action potential can travel if it can jump from node to node rather than having to be passed on sequentially, single domino by single domino. Ask your students to discuss how this effect relates to myelination.

Wagor, W. F. (1990). Using dominoes to help explain the action potential. In V. P. Makosky, C. C. Sileo, L. G. Whittemore, C. P. Landry, & M. L. Skutley (Eds.), *Activities handbook for the teaching of psychology: Vol. 3* (pp. 72-73). Washington, DC: American Psychological Association.

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Activity: Demonstrating Neural Conduction: The Class as a Neural Network

In this engaging exercise (suggested by Paul Rozin and John Jonides), students in the class simulate a neural network and get a valuable lesson in the speed of neural transmission. Depending on your class size, arrange 15 to 40 students so that each person can place his or her right hand on the right shoulder of the person in front of them. Note that students in every other row will have to face backwards in order to form a snaking chain so that all students (playing the role of individual neurons) are connected to each other. Explain to students that their task as a neural network is to send a neural impulse from one end of the room to the other. The first student in the chain will squeeze the shoulder of the next person, who, upon receiving this "message," will deliver (i.e., "fire") a squeeze to the next person's shoulder and so on, until the last person receives the message. Before starting the neural impulse, ask students (as "neurons") to label their parts; they typically have no trouble stating that their arms are axons, their fingers are axon terminals, and their shoulders are dendrites.

To start the conduction, the instructor should start the timer on a stopwatch while simultaneously squeezing the shoulder of the first student. The instructor should then keep time as the neural impulse travels around the room, stopping the timer when the last student/neuron yells out "stop." This process should be repeated once or twice until the time required to send the message stabilizes (i.e., students will be much slower the first time around as they adjust to the task). Next, explain to students that you want them to again send a neural impulse, but this time you want them to use their ankles as dendrites. That is, each student will "fire"" by squeezing the ankle of the person in front of them. While students are busy shifting themselves into position for this exercise, ask them if they expect transmission by ankle-squeezing to be faster or slower than transmission by shoulder-squeezing. Most students will immediately recognize that the ankle-squeezing will take longer because of the greater distance the message (from the ankle as opposed to the shoulder) has to travel to reach the brain. Repeat this transmission once or twice and verify that it indeed takes longer than the shoulder squeeze.

This exercise—a student favorite—is highly recommended because it is a great ice-

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breaker during the first few weeks of the semester and it also makes the somewhat dry subject of neural processing come alive.

Rozin, P., & Jonides, J. (1977). Mass reaction time measurement of the speed of the nerve impulse and the duration of mental processes in class. *Teaching of Psychology, 4*, 91-94.

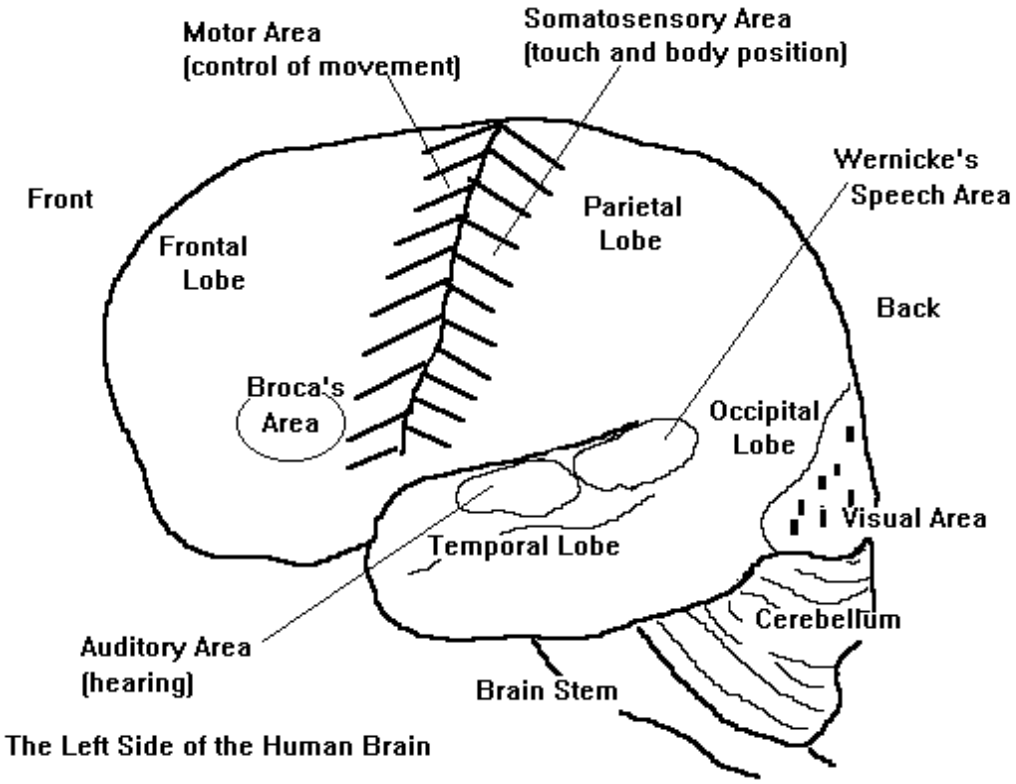
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Activity: Mapping the Brain

Many students, especially those with little background in the sciences, will find it a challenge to keep track of the location of all the parts of the brain outlined in the text. One simple way to reinforce their learning of brain structure is to have students locate the various parts on a photocopied diagram of the brain. The brain diagram and the student instructions for this exercise are included as **Handout Master 2.1**. The day before you present this activity, ask students to bring colored pencils or markers to class. On the day of the activity, divide students into small groups and distribute copies of the diagram of the brain and the accompanying questions in the student handouts. Within their groups, they can help each other locate each part of the brain and then color code them using their pencils or markers. They can also indicate the function of each part on the diagram. This exercise is very useful for helping students to memorize brain anatomy, and the color-coded diagram serves as a helpful study guide.

For your convenience, a completed diagram and suggested answers to the questions are furnished below.

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1. This is a diagram of the left side of the brain.
   - *Left-side functions*: The left hemisphere controls touch and movement of the right side of the body, vision in the right half of the visual field, comprehension and production of speech, reading ability, mathematical reasoning, and a host of other abilities.
   - *Right-side functions*: The right hemisphere controls touch and movement of the left side of the body, vision in the left half of the visual field, visual-spatial ability, map-reading, art and music appreciation, analysis of nonverbal sounds, and a host of other abilities.
2. The front of the brain is on the left side of the diagram; the back of the brain is on the right.
3. The cerebrum is the sum of the frontal, parietal, temporal, and occipital lobes. The cerebellum is labeled on the diagram above.
   - The cerebrum is responsible for higher forms of thinking, including a variety of specific abilities described under motor cortex, visual cortex, somatosensory cortex, and auditory cortex. The cerebral cortex also contains vast association areas whose specific functions are poorly defined but may include reasoning and decision making, planning appropriate behavior sequences, and knowing when to stop. The limbic system, which appears to be strongly involved in regulating emotions, is also part of the cerebrum.
   - The cerebellum aids in the sense of balance and motor coordination.

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4. The frontal, parietal, temporal, and occipital lobes are labeled on the diagram above.
5. The motor cortex is labeled on the diagram above. The motor cortex in each hemisphere controls movements on the opposite side of the body.
6. The visual cortex is labeled on the diagram above. The visual cortex in each hemisphere receives information from the visual field on the opposite side.
7. The auditory cortex is labeled on the diagram above. The auditory cortex is responsible for processing sounds.
8. The somatosensory cortex is labeled on the diagram above. The somatosensory cortex on each side receives information about touch, joint position, pressure, pain, and temperature from the opposite side of the body.
    - Broca's and Wernicke's areas are labeled on the diagram above. Broca's area is often referred to as the motor speech area. It is responsible for our ability to carry out the movements necessary to produce speech. Wernicke's area is often referred to as sensory speech area. It is mainly involved in comprehension and planning of speech.
9. Neurons would be found all over the drawing. (The brain is made up of billions of neurons.) Each neuron is very tiny compared to the size of the brain, so no single neuron would be visible to the naked eye in a drawing at this scale. The cell bodies of the largest neurons in the brain are about 1/20 of a millimeter in diameter!
10. The brain stem is labeled on the diagram above. Different parts of the brain stem are involved in regulation of sleep and wakefulness, dreaming, breathing, heart rate, and attentional processes.

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Activity: Review of Brain-Imaging Techniques

Objectives: To review information on brain-imaging techniques
Materials: None
Procedures: Ask students to tell which brain-imaging technique could answer each of the following questions:

1. How do the brains of children and adults differ with regard to energy consumption? (PET)
2. In what ways do brain waves change as a person falls asleep? (EEG)
3. In which part of the brain has a stroke patient experienced a disruption of blood flow? (CT, MRI)
4. What is the precise location of a suspected brain tumor? (CT, MRI)
5. How can brain structures be examined without exposing a patient to radiation? (MRI)
6. How can scientists view structures and their functions at the same time? (fMRI)
7. What techniques allow scientists to view changes in the magnetic characteristics of neurons as they fire? (SQUID, MEG)

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Activity: The Importance of a Wrinkled Cortex

At the beginning of your lecture on the structure and function of the brain, ask students to explain why the cerebral cortex is wrinkled. There are always a few students who correctly answer that the wrinkled appearance of the cerebral cortex allows it to have a greater surface area while fitting in a relatively small space (i.e., the head). To demonstrate this point to your class, hold a plain, white sheet of paper in your hand and then crumple it into a small, wrinkled ball. Note that the paper retains the same surface area, yet is now much smaller and is able to fit into a much smaller space, such as your hand. You can then mention that the brain's actual surface area, if flattened out, would be roughly the size of a newspaper page (Myers, 1995). Laughs usually erupt when the class imagines what our heads would look like if we had to accommodate an unwrinkled, newspaper-sized cerebral cortex!

Myers, D. G. (1995). *Psychology* (4th ed.). New York: Worth.

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Activity: Lateralization Activities

Procedure:
There are several demonstrations that illustrate the lateralization of the brain. Several have been described by Filipi and Gravlin (1985). A variant by Morton Gernsbacher requires students to move their right hand and right foot simultaneously in a clockwise direction for a few seconds. Next, ask that the right hand and left foot be moved in a clockwise direction. Then, have students make circular movements in opposite directions with the right hand and the left foot. Finally, have students attempt to move the right hand and right foot in opposite directions. This generally produces laughter, as students discover that this procedure is most difficult to do even though they are sure—before they try it—that it would be no problem to perform. A simple alternative activity is to ask students to pat their head and to rub their stomach clockwise and then switch to a counterclockwise motion. The pat will show slight signs of rotation as well.

The brain is lateralized to some extent, and this makes some activities difficult to perform. Challenge your students to explain why activities of these types are difficult to execute. This will generally lead to interesting discussions and the assertion by some students that this type of behavior is no problem. Generally, students who have been trained in martial arts, dance, and/or gymnastics have less difficulty completing these activities due to rigorous physical training.

Kemble, E. D. (1987). Cerebral lateralization. In V. P. Makosky, L. G. Whittemore, and A. M. Rogers (Eds.). *Activities handbook for the teaching of psychology* (Vol. 2) (pp. 33–36). Washington, D.C.: American Psychological Association.

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Kemble, E. D., Filipi, T., & Gravlin, L. (1985). Some simple classroom experiments on cerebral lateralization. *Teaching of Psychology, 12*, 81–83.

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Activity: Looking Left, Looking Right

Objective: To demonstrate that lateral eye movements are associated with thinking
Materials: Left and Right Hemisphere Questions (Handout 2.2)
Procedure: It has been theorized that when language-related tasks are being performed in the left hemisphere, the eyes look to the right; when nonlanguage, spatial abilities are being used in the right hemisphere, the eyes look to the left. This is a relatively easy class activity. After pairing up, one student asks the questions and records lateral eye movements, while the other attempts to answer the questions.

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Activity: Brain and Nervous System

In this activity, we will use the brain and the nervous systems to study psychology. First, identify the particular parts of the brain and the nervous systems that you will use when studying psychology. For example, your occipital lobe helps you see the pages. Which parts will be most important during a) regular studying and b) exams? How can you maximize the functions of the brain to help in your psychology studies?

- Figure 2.1 The Corpus Callosum (p. 44)
- Figure 2.2 Testing a Split-Brain Patient (p. 44)

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Activity: Psychology in Literature

The Man Who Mistook His Wife for a Hat
Oliver Sacks' national bestseller chronicles over 20 case histories of patients with a variety of neurological disorders. His compassionate retelling of bizarre and fascinating tales includes patients plagued with memory loss, useless limbs, violent tics and jerky mannerisms, the inability to recognize people or objects, and unique artistic or mathematical talents despite severe mental deficits. A reading of this absorbing book will surely increase your students' understanding of the connection between the brain and the mind, and will also give them invaluable insights into the lives of disordered individuals. Ask your students to write a book report focusing on a few of the cases that most interest them, and to apply principles from the

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text and lecture to the stories. As a more elaborate project, you might consider assigning this book at the end of the semester, as many of the cases are ripe with psychological principles that may be encountered later in the course (e.g., perception, memory, mental retardation).

Sacks, O. (1985). *The man who mistook his wife for a hat*. New York: Harper Collins.
Staff (1995, May/June). PT interview: Oliver Sacks; the man who mistook his wife for a ... what? *Psychology Today*, 28–33.

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▼ **Handout Masters for Chapter 2: The Biological Perspective**
2.1 Mapping the Brain
2.2 Localization of Function Exercise
2.5 The Basic Structure of the Neuron

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Handout Masters
2.1 Mapping the Brain—Instructions

Label the diagram of the brain to show or answer the following questions.

1. Is this a drawing of the left side or the right side of the brain? What are the particular functions of that side of the brain as compared to the other hemisphere?

   Left-side functions: Right-side functions:

2. Where is the front of the brain? Where is the back?

3. Label the cerebrum and cerebellum and describe their functions.

   Cerebral functions: Cerebellar functions:

4. Label the four lobes of the cerebral cortex.

5. Label the motor cortex and describe its function.

6. Label the visual cortex and describe its function.

7. Label the auditory cortex and describe its function.

8. Label the somatosensory cortex and describe its function.

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9. Label Broca's and Wernicke's areas and describe their functions.

10. Where would you expect to find neurons in this drawing and how big would they be if they were drawn?

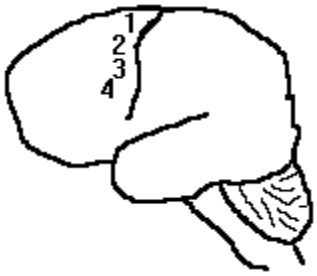
11. Label the brain stem. What is its function?

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Handout Master 2.2

Localization of Function Exercise

Case 1. Dr. Holmes sees a series of patients with gunshot injuries to parts of their frontal lobe. The location of the damage to each person's brain is indicated in the drawing. Patient 1 has some paralysis of his right hip and thigh muscles. Patient 2 has paralyzed trunk muscles on his right side. Patient 3's right arm is paralyzed. Patient 4 shows paralysis of the muscles on the right side of her face.



Case 1:

a. What method is being used to study brain function?

b. What does this part of the brain do?

c. What can you say about the representation of this function in the brain based on this information (what are the rules of organization)?

Case 2. Dr. Broca's patient (J) has suddenly lost his ability to speak, apparently due to a stroke. After J dies, Dr. Broca studies the brain and discovers an area of damage in the location

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marked with J in the drawing below. Later another patient (K) dies and Dr. Broca is amazed to discover that this patient has damage to the comparable area of the brain on the right side with *no* effect on speech.



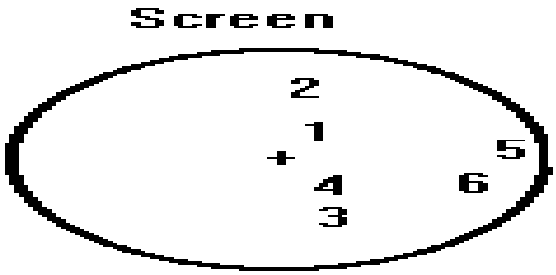
Case 2:

a. **What method is being used to study brain function?**

b. **What does the area of the brain marked J do?**

c. **What can we say about the lateralization of this function based on the information provided?**

Case 3. Dr. Brightman is doing surgery on a patient to remove a rapidly growing tumor in the patient's brain. The patient is awake during the surgery. To check out where he is, Dr. Brightman applies a brief pulse of electricity to various areas of the brain and asks the patient to describe the sensation. The patient is looking up at a screen with a cross in the middle of it; he is fixating on the cross. After each point on the brain is touched, the patient reports seeing flashing lights and points to the area on the screen where he sees the lights.



Case 3:

a. **What method is being used to study brain function?**

b. **What does this area of the brain do?**

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c. What can we say about how this function is mapped on the brain based on the information provided?

Case 4. Dr. Penfield is operating on the brain of a young woman with intractable epilepsy. He is going to remove the part of the brain where the seizure starts. He does not want to remove the wrong part, so the patient is awake during surgery, and Dr. Penfield identifies where he is in the brain by applying brief pulses of electricity to various parts of her brain. As Dr. Penfield touches each part of her brain, the patient reports feeling a tingling sensation on various parts of her body. At point 1, she feels tingling on her right thigh. At point 2, she feels tingling on the right part of her rib cage. At point 3, she reports a tingling on her right hand. At point 4, she feels a sensation on the right side of her face.



Case 4:

a. What method is being used to study brain function?

b. What function is localized in this part of the brain?

c. How is this function mapped on the brain (how is it organized)?

Case 5. Dr. Lashley is doing experiments on brain function. He persuades a Doe College student to participate in his experiment. The student is injected with radioactive glucose and then asked to listen to recordings of various sounds for half an hour in a darkened room. Then the student's head is scanned to determine where in the brain the radioactivity has collected. The most intensely radioactive area is indicated on the drawing below.

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Case 5:

a. **What method is being used to study brain function?**

b. **What does this area do?**

Case 6. Dr. Gross places an electrode in part of the hypothalamus of a rat and measures the electrical activity in the hypothalamus during various activities. She finds that the part of the hypothalamus where the electrode is located is most active just before the rat eats.

Case 6:

a. **What method is being used to study brain function?**

b. **What does this part of the hypothalamus do?**

Case 7. Dr. Sperry cuts the corpus callosum of a young woman to stop the spread of intractable epilepsy from one side of the brain to the other. After the woman has had time to recover from the surgery, Dr. Sperry tests her on various tasks. Dr. Sperry finds no impairment on most tasks. There are two exceptions. When the patient is asked to close her eyes and name an object placed in her hand, she can do so correctly for things placed in her right hand, but not for things placed in her left hand. (She has no problems with paralysis or lack of sensation, however.) When she is given a task where she is asked to close her eyes and feel something with her left hand, then pick it out of a group of objects using her right hand, she is also unable to do so.

Case 7:

a. **What method is being used to study function?**

b. **What does the corpus callosum do?**

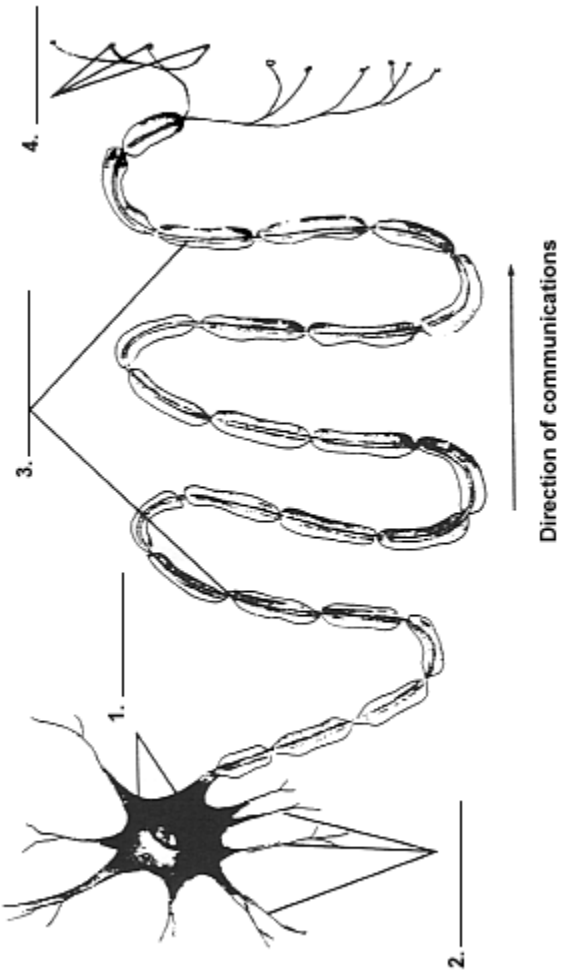
c. **What accounts for the two specific impairments described here?**

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Handout Master 2.5: The Basic Structure of the Neuron

Identify the parts of the neuron discussed in the text.



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Web Resources

General/Comprehensive

Biological and Physiological Resources: http://psych.athabascau.ca/html/aupr/biological.shtml
Links to several sites and interesting topical articles relevant to biological and physiological psychology. A good starting point for a number of assignments, such as writing short papers or assembling study guide terms. Maintained by the Centre for Psychology Resources at Athabasca University, Alberta, Canada.

Neuroguide.com—Neurosciences on the Internet: http://www.neuroguide.com/
A resource for all things related to neuroscience: databases, diseases, research centers, software, biology, psychology, journals, tutorials, and so much more.

Neuropsychology Central: http://www.neuropsychologycentral.com/
Links to resources related to neuropsychology, including brain images, and extensive, well-organized links to other sites.

Neuroscience for Kids: http://faculty.washington.edu/chudler/neurok.html
Don't be put off by the name! This site can be enjoyed by people of all ages who want to learn about the brain. A fun, superbly organized site providing information and links to other neuroscience sites. Includes informative pages regarding Brain Basics, Higher Functions, Spinal Cord, Peripheral Nervous System, The Neuron, Sensory Systems, Methods and Techniques, Drug Effects, and Neurological and Mental Disorders. Even includes a nice answer to the perennial question, "Is it true that we only use 10% of our brain?"
http://faculty.washington.edu/chudler/tenper.html

Society for Neuroscience: www.sfn.org
An organization specializing in neuroscience that explains its technicalities in comprehensible ways. A website replete with information for instructors and students. Many visual aids and links.

Whole Brain Atlas: http://www.med.harvard.edu:80/AANLIB/home.html
Prepared by Keith Johnson, MD, and J. Alex Becker at Harvard University. Site includes brain images, information about imaging techniques, and information about specific brain disorders.

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Neurons/Neural Processes

Basic Neural Processes Tutorials: http://psych.hanover.edu/Krantz/neurotut.html

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A good site for your students to help them learn about basic brain functioning.

Making Connections—The Synapse: http://faculty.washington.edu/chudler/synapse.html
Clear, comprehensible, explanation of how synapses work, with nice illustrations, prepared by Eric Chudler.

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Nervous System

Gallery of Neurons: http://faculty.washington.edu/chudler/gall1.html
Colorful photographs of neurons.

Self-Quiz for Chapter on the Human Nervous System:
http://www.psychwww.com/selfquiz/ch02mcq.htm
Self-quiz prepared by Russ Dewey at Georgia Southern University. Covers material typically found in an introductory psychology textbook chapter with a title like "Brain and Behavior" or "Neuropsychology."

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The Brain

Brain and Behavior: http://serendip.brynmawr.edu/bb/
This mega-site contains lots of links to information about the brain and behavior and the bond between the two. Students can complete several interactive exercises to learn more about brain functions.

Brain Connection: The Brain and Learning: http://www.brainconnection.com/
A newspaper-style web page that contains interesting articles, news reports, activities, and commentary on brain-related issues.

Brain Function and Pathology: http://www.waiting.com/brainfunction.html
Concise table of diagrams of brain structures, descriptions of brain functions, and descriptions of signs and symptoms associated with brain structures and functions.

Brain Model Tutorial: http://pegasus.cc.ucf.edu/~Brainmd1/brain.html
This tutorial teaches students about the various parts of the human brain and allows them to test their knowledge of brain structures.

Brain: Right Down the Middle: http://faculty.washington.edu/chudler/sagittal.html
Useful drawing and succinct information about the location and functions of brain structures that can be seen on the midsagittal plane, presented by Eric Chudler.

Drugs, Brains, and Behavior: http://www.rci.rutgers.edu/~lwh/drugs/

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An online textbook detailing the effects of various substances on the brain, authored by C. Robin Timmons & Leonard W. Hamilton.

Lobes of the Brain: http://faculty.washington.edu/chudler/lobe.html
Succinct information about the location and functions of the four lobes of the cerebrum, presented by Eric Chudler. Includes link to "Lobes of the Brain Review," a very brief quiz on functions associated with major lobes of the brain. Answers provided online: http://faculty.washington.edu/chudler/revlobe.html.

One Brain…or Two?: http://faculty.washington.edu/chudler/split.html
Information on lateralization of function and how the functions of the hemispheres may be studied, presented by Eric Chudler.

She Brains / He Brains
http://faculty.washington.edu/chudler/heshe.html: Nice summary of evidence for sex-related differences in brain structure, prepared by Eric Chudler.

What Does Handedness Have to Do with Brain Lateralization (and Who Cares?):
http://www.indiana.edu/~primate/brain.html
Very nice page on lateralization of function in the brain.

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Evolution and Natural Selection

The Evidence that Convinced Darwin (type "evidence" in the search box.)
http://www.pbs.org/wgbh/evolution/index.html

Applications to Psychology (type "Application to Psychology" in the search box.)
http://www.pbs.org/wgbh/evolution/index.html

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