INSTRUCTOR'S MANUAL

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Psychology: Core Concepts

Seventh Edition

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CHAPTER 2:

BIOPSYCHOLOGY, NEUROSCIENCE, AND HUMAN NATURE

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► LECTURE GUIDE

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LECTURE GUIDE

2.1 HOW ARE GENES AND BEHAVIOR LINKED? (text p. 43)

Lecture Launchers/Discussions Topics:
- Leading Off the Chapter (p. 83)

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2.1. LECTURE OUTLINE: How Are Genes and Behavior Linked? (text p. 43)

2.1 Key Question

How Are Genes and Behavior Linked?
- The psychological specialty of **biopsychology,** which studies the interaction of biology, behavior and mental processes, to find the answers to this question.

2.1 Core Concept

Evolution has fundamentally shaped psychological processes because it favors genetic variations that produce adaptive behavior.
- **Evolution** is the gradual process of biological change that occurs in a species as it adapts to its environment.

I. Evolution and Natural Selection
- 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.

A. 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.

B. Application to Psychology
- 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.

II. Genetics and Inheritance

- **Genes** encode 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.**
- 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.

A. Chromosomes, Genes, and DNA
  - 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 (deozyribonucleic 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.

B. 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.
  - The quality of life of individuals with Down Syndrome, a disorder associated with an extra chromosome, depends heavily upon the quality of the environment. While this disorder includes mental and physical impairment, life skills training allows those with Down Syndrome to learn to care for themselves, work, and establish some personal independence.

C. "Race" and Human Variation
  - Certain features of skin color and other physical characteristics are related to ancestry in the same part of the world. Darker skin offered some protection from the sun and is associated with tropical parts of the world, while lighter skin is associated with higher latitudes, where less sun protection was needed.
  - Biologists tell us that there are no physical characteristics that divide people into "racial groups".
  - We are all one species.
  - "Race" is a socially defined term not a precise biological one. As a socially defined category, it can exert powerful influences upon behavior.

PSYCHOLOGY MATTERS: Choosing Your Children's Genes (text p. 48)
Scientists already have the ability to control and alter the genes of animals, although the success rate of cloning is between 1 and 2 percent 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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2.2 HOW DOES THE BODY COMMUNICATE INTERNALLY? (text p. 49)

2.2 LECTURE OUTLINE: How Does the Body Communicate Internally? (text p. 49)

2.2 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.

I. The Neuron: Building Block of the Nervous System
- The neuron is a cell specialized to receive, process, and transmit information to other cells.

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

B. How Neurons Work
- "Receivers", or **dendrites,** collect sensory messages from other cells or by direct stimulation of the sense organs.

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.

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.

Synchronous Firing

- **Synchronous firing** is a process used by a small minority of neurons in the brain that communicate directly without sending chemical messengers.
- Their operation has not been fully understood by researchers.

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.

C. Brain Implants

- 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.

D. 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.

II. The **Nervous System**, consisting of all the nerve cells, functions as a single, complex interconnected unit.

A. 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.

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.

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.

B. 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.

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.

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.

III. The Endocrine System

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

A. 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.

B. 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 (text p. 60)
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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2.3 HOW DOES THE BRAIN PRODUCE BEHAVIOR AND MENTAL PROCESSES? (text p. 63)

Lecture Launchers/Discussions Topics:

2.3 LECTURE OUTLINE: How Does the Brain Produce Behavior and Mental Processes? (text p. 62)

2.3 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.

II. Windows on the Brain

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

A. 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.

B. Mapping the Brain with Electric Probes
- About half a century ago, Walter Penfield, a brain surgeon, 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.

C. Computerized Brain Scans
- Electric probes can map the brain during brain surgery.
- **CT** scanning creates 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.

D. Which Scanning Method Is Best?

- Each technique has strengths and weaknesses.

II. 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.

A. 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.

B. 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.

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.

The Amygdala and Emotion

- The **amygdala** uses memories to aid in emotional responses, both positive and negative.

Pleasure Centers and the Limbic System

- Pleasure centers within the limbic system create good feelings when aroused by electrical stimulation or by addictive drugs.
- Reward centers also enable us to respond to humor.

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.

C. 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.

III. Lobes of the Cerebral Cortex
- The lobes of the central cortex have centers that perform specialized functions.

A. The Frontal Lobes
- The **frontal Lobes** handle the most advanced mental functions:
- The **motor cortex** sends messages to motor nerves and to voluntary messages;

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, since 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.

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.

B. 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 of help locate the source of the sensation.
- Other maps in the parietal lobe help keep track of other positions of parts of the body.

C. 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.

D. 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.

E. The Association Cortex
- The **association cortex** processes raw data, associating it into higher thinking.

F. The Cooperative Brain
- Regions of the brain coordinate and cooperate to understand and respond to the world.

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

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

B. 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.

C. Some People Are Different – But That's Normal
- Dominance patterns are not always the same from one person to another.

D. 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.

E. 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.

F. 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.**

G. What's It to *You*?
- Three general principles can help us to understand the problems that brain injured patients face and the location of injuries received:
  - Since 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: Using Psychology to Learn Psychology (text p. 79)
Contrary to the old belief, we use all of our brain, not just 10 percent. Students who understand brain science can use its principles to become better students.

CRITICAL THINKING APPLIED: Left Brain Versus. Right Brain (text p. 80)

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CHAPTER SUMMARY

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Teaching Objectives for Chapter 2

After reading this chapter, the student should be able to:

1. Explain what the field of neuroscience studies.
2. Describe the processes of evolution and natural selection and their relevance to psychological processes.
3. Describe the fundamental components of genetic processes – DNA, genes, and chromosomes– and their influence on human behavior and experience.
4. Discuss why psychologists are interested in evolution.
5. Diagram the essential anatomy of a neuron.
6. Explain how neurons communicate, using both electrical and chemical systems.
7. Diagram the structure and components of the nervous system.
8. Explain how the endocrine system relates to the nervous system.
9. Describe the influence of hormones on behavior.
10. Describe ways to study the brain.
11. Describe the important anatomical structures of the brain and their specific functions.
12. Discuss the specialized functioning of the two hemispheres of the 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: Within your lifetime, parents may be able to select genetic traits for their children. What price will we pay for these choices?
2. How Psychoactive Drugs Affect the Nervous System: Chemicals used to alter thoughts and feelings usually affect the actions of hormones or neurotransmitters. In so doing, they may also stimulate unintended targets, where they produce unwanted side effects.
3. Using Psychology to Learn Psychology: The fact that we employ many different regions of the cerebral cortex in learning and memory may be among neuroscience's most practical discoveries.

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Songs to Launch the Lecture

"If I Only Had a Brain" (*Wizard of Oz* soundtrack)
"Brain Damage" (Pink Floyd)

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▼ LECTURE LAUNCHERS AND DISCUSSION TOPICS

Lecture/Discussion: Leading Off the Chapter

Your students may find the presence of a chapter on "biology" puzzling in a psychology textbook. An effective lead off for the chapter is to point out our tendency to take for granted the integrity and normal functioning of the nervous system. Only when there is damage through stroke, disease, or brain trauma do we realize its importance. If there is an example from your personal life that is apropos here, such as a family member with a neurological disease, consider sharing it with your students. Students may add their own stories as well to highlight the importance of studying "biology" in a psychology class.

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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 that 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 the amphetamines prolong the action of certain neurotransmitters and opiates imitate the action of natural neuromodulators called the 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.

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
Among the disorders that can result from malfunctioning of the adrenal glands are **Addison's Disease** levels of cortisol). In the former, fatigue, low blood pressure, weight loss, nausea, diarrhea, and muscle weakness are some of the symptoms, while for the latter, obesity, high blood pressure, a "moon" face, and poor healing of skin wounds is common.

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 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 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 carbohydrate, 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 which, 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: Freak Accidents and Brain Injuries

Students may be interested in the unusual cases of individuals who experience bizarre brain injuries due to freak accidents with nail guns. The most fascinating example involved Isidro Mejias, a construction worker in Southern California, who had six nails driven into his head when he fell from a roof onto his coworker who was using a nail gun. X-ray images of the imbedded nails can be found at the USA Today link on the next page. Incredibly, none of the nails caused serious damage to Mejia's brain. One nail lodged near his spinal cord, while another came very close to his brain stem. Immediate surgery and treatment with antibiotics prevented deadly infections that could have been caused by the nails. In a similar accident, a construction worker in Colorado ended up with a nail lodged in his head due to a nail gun mishap. Unlike Mejia, Patrick Lawler, didn't realize he had a nail in his head for six days. The nail was discovered when he visited a dentist due to a "toothache." It appears that Lawler fired a nail into the roof of his mouth. The nail barely missed his brain and the back of his eye.

http://www.usatoday.com/news/nation/2004–05–05-nail-head_x.htm
Nail Gun /Victim Lives. *Current Science*, A Weekly Reader publication, Sept. 10, 2004, v90 (1), Page 14.
http://www.summitdaily.com/article/20050119/NEWS/50119002/0/FRONTPAGE

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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 ("black out"), 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 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 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: Workplace Problems: Left Handedness

Between Canada and the United States, there are approximately 33 million people who are left handed. This presents a severe detriment to the work place. It has been shown that left handed individuals are more likely to have accidents at work than are right handed individuals, in fact 25% more likely and if they are working with tools and machinery, 51% more likely. Accommodations such as being able to rearrange the work area and having tools available that are either left or right hand adapted would make the workplace a safer place to be. Have students suggest ways that the work place could be made safer or even what could be done in the classroom that would make it easier for students who are left handed to take notes or tests. What about the mouse on computers? The mouse is actually made for people who are right handed. How adaptable must a left handed person become in order not to be frustrated by using a right handed mouse?

Gunsch, D. For Your Information: Left-handed workers struggle in a right-handed work world. *Personnel Journal, 93*, 23–24.

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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 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 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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Lecture/Discussion: The Results of a Hemispherectomy

Matthew is eight years old now. Two years ago surgeons removed half of his brain.

His first three years were completely normal. Just before he turned four, however, Matthew began to experience seizures, which did not respond to drug treatment. The seizures were severe (life threatening) and frequent (as often as every three minutes). The eventual diagnosis was Rasmussen's encephalitis, a rare and incurable condition of unknown origin.

The surgery, a hemispherectomy, was performed at Johns Hopkins Hospital in Baltimore. A few dozen such operations are performed each year in the U.S., usually as a treatment for Rasmussen's and for forms of epilepsy that destroy the cortex but do not cross the corpus callosum. After surgeons removed Matthew's left hemisphere, the empty space quickly filled with cerebrospinal fluid.

The surgery left a scar that runs along one ear and disappears under his hair; however, his face has no lopsidedness. The only other visible effects of the operation are a slight limp and limited use of his right arm and hand. Matthew has no right peripheral vision in either eye. He undergoes weekly speech and language therapy sessions. For example, a therapist displays cards that might say "fast things", and Matt must name as many fast things as he can in 20 seconds. He does not offer as many examples as other children his age. However, he is making progress in the use of language perhaps as a result of fostering and accelerating the growth of dendrites.

The case of Matthew indicates the brain's remarkable plasticity. It is interesting to note that Matt's personality never changed through the seizures and surgery

Boyle, M. (1997, August 1). Surgery to remove half of brain reduces seizures. *Austin American-Statesman*, A18.
Swerdlow, J. L. (1995, June). Quiet miracles of the brain. *National Geographic, 87*, 2-41.
Adapted from Davis, S. F., & Palladino, J. J. (1996) *Interactions: A newsletter to accompany Psychology*, *1(Spr)*, 4.

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Lecture/Discussion: Additional Discussion Questions

1. How would a biopsychologist and a neuroscientist work together to study a brain disorder?

2. Why should we study evolution and Darwin in an introductory psychology course? Give specific examples.

3. Does heredity determine our psychological destiny? Why or why not? Give evidence from the chapter.

4. Your friend is complaining about all of the biology in his psychology class. Since you completed Introduction to Psychology last year, you have a good idea about why he is studying what seems to be biology. What will you tell him?

5. The text raises excellent questions about ethical issues related to using technology in genetics, such as:

   - If you could select three genetic traits for your children, which ones would you select?
   - How would you feel about raising children you have adopted or fostered but to whom you are not genetically related?
   - If a biological child of yours might be born disabled or fatally ill because of your genetic heritage, would you have children anyway? What circumstances or conditions would affect your decision?
   - If you knew you might carry a gene responsible for a serious medical or behavioral disorder, would you want to be tested before having children? Would it be fair for a prospective spouse to require you to be tested before conceiving children? Would it be fair for the state to make such a requirement?
   - How do you feel about cloning? Where would you draw the line? As the text states, most of us are against cloning humans, but what about cloning other life forms, such as fruit flies for research, or cows for greater milk production? What about cloning human organs for transplantation to replace an individual's diseased or damaged organs? Note that an advantage of being able to clone your own organs (for example, your own kidney because you were born with a genetic kidney disorder) may likely eliminate – or at least reduce – the need for antirejection medications that suppress a person's immune system.

- Currently many parents are saving (freezing) their newborn babies' umbilical cords so that in the event that child someday needs to clone body parts they will have the child's own cells available. Is this a better option than throwing out the umbilical cord (as has always been done in the past)? What about using stem cells from aborted fetuses to develop a cure for Alzheimer's disease?

▼ ACTIVITIES, DEMONSTRATIONS, AND EXERCISES

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" (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 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-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: Human Neuronal Chain

Objective: To illustrate that the transmission of messages in the nervous system is not instantaneous
Materials: 20 students standing, facing forward, in a line; a stopwatch
Procedure: Ask the last student to tap either shoulder of the next person and each subsequent person to continue the process through the entire line, always using the same shoulder and never crossing the body (i.e., left hand to right shoulder). Use the stopwatch to time how long it takes for the last person to receive the stimulus.

Harcum, E. R. (1988). Reaction time as a behavioral demonstration of neural mechanisms for a large introductory psychology class. *Teaching of Psychology, 15,* 208–209.

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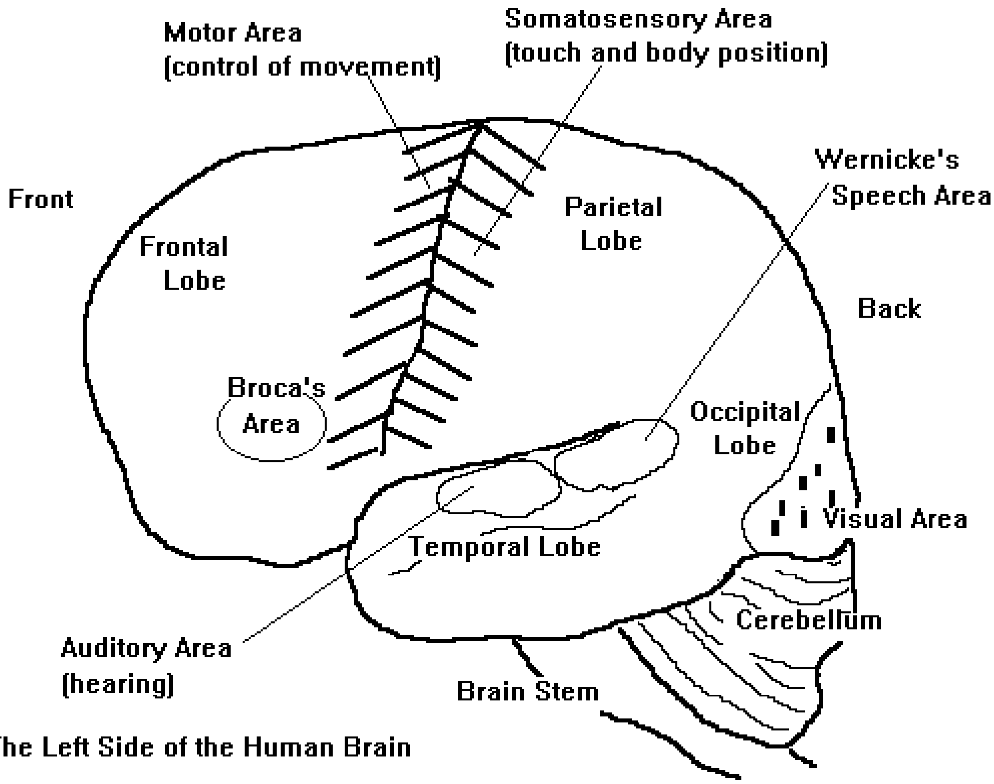
Activity: Mapping the Brain

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.



The Left Side of the Human Brain

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.
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 a sensory speech area. It is mainly involved in comprehension and planning of speech.
10. 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!
11. 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: Trip to the Hospital

Objective: To demonstrate brain imaging techniques
Materials: Local or regional hospital
Procedure: Arrange a trip to the local or regional hospital to see their CAT, PET, MRI and fMRI facilities. Being able to see and hear about this equipment firsthand far exceeds what students can gain from the text. Such a trip can be undertaken only if you have a small class, recitation, or laboratory section. A voluntary sign-up list also can be used. You will have to make your plans well in advance and at the convenience of the hospital staff. If the size of your class precludes this field trip, you could invite a local physician or one of the technicians to discuss these procedures. It will be helpful if he or she can arrange to bring examples of the records or scans that are produced for evaluation of neurological disorders. You should plan to ask your guest speaker to compare modern procedures to earlier evaluations of neurological disorders.

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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: Probing the Cerebral Cortex

Use: Pearson Introductory Psychology Teaching Films

SYNOPSIS: This clip contains commentary by Wilder Penfield, a pioneer in mapping the areas of the cerebral cortex. Penfield discusses the work that led to electrode-stimulation of the cortex. He also interviews a brain surgery patient about her experiences during surgery: Stimulation of various areas of her cortex produced memories of past events and the perception of music playing.

Form a Hypothesis
Q What happens when Penfield stimulates a small area of the temporal lobe, called the auditory cortex?
A The patient "hears" sounds.

Test Your Understanding
Q What are the four lobes of the cerebral cortex?
A The four lobes of cerebral cortex are occipital, parietal, temporal, and frontal.
Q What are the functions of the somatosensory cortex, motor cortex, and association cortex areas?
A Somatosensory cortex interprets sensations and coordinates the motor behavior of skeletal muscles. Association areas, located on all four cortical lobes, are involved in the integration of various brain functions, such as sensation, thought, memory, planning, etc.
Q What two areas of the association cortex specialize in language?
A Wernicke's area, located toward the back of the temporal lobe, is important in understanding the speech of others. Broca's area is essential to sequencing and producing language.

Thinking Critically
Q What four types of research methods are commonly used in the study of behavioral neuroscience?
A Microelectrode techniques are used to study the functions of individual neurons.

Macroelectrode techniques, such as an EEG, record activities of brain areas. Structural imaging, such as computerized axial tomography or CAT scans, is useful for mapping brain structures. Functional imaging, in which specific brain activity can be recorded in response to tasks or stimulation, offers the potential to identify specific brain areas and functions.

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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 right the 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's 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.
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: Localization of Function Exercise

This exercise has several functions. It is designed to get students to review the methods which are used to study the brain and where particular functions are localized. It is also intended to make students think critically about how we know what we know about functional localization. The examples included are based on real life examples of situations which have provided information about localization of functions in the brain. Some of the situations described may be difficult for students to conceptualize. Be prepared to assist students in conceptualizing each situation. Students can do this exercise individually or in small groups. Group work is probably preferable because students can learn by bouncing ideas off of each other. The student handout for this activity is included as **Handout Master 2.2**. Suggested answers are included below.

1. The lesion method is being used to study brain function. Students may be puzzled by this, thinking that the

lesion method always involves *intentionally* damaging part of the brain to study its function. This is not the case; much of the information we have about functional localization comes from fairly old studies of veterans who received gunshot wounds to their brains.

This part of the brain controls movement on the opposite side of the body. It is the *motor* area of the cerebral cortex. By looking at the drawing we can see that damage high up on the brain results in paralysis which is lower down on the body and vice versa. It is as if the body is "mapped" upside down and backwards on the motor cortex. (If you have a drawing of the "motor homunculus" it would be helpful to share this with the students after they have completed this exercise.)

2. The lesion method is being used to study brain function. Based on the information provided, the part of the brain labeled J is responsible for the ability to speak.The area marked J controls the ability to speak; it is on the left side of the brain. The equivalent area on the right side of the brain must be doing something else since damage to this area does not produce any affect on speech.

3. The function of this part of the brain is being studied with the electrical stimulation method. Students may be surprised, and horrified, to find out that people are often awake during surgery on their brains. This is necessary because in real life the brain is not color coded, nor does it come with nice little labels saying what its different parts do. During surgery, surgeons have a general idea where they are, but one part looks pretty much the same as the next. When the surgeon is planning to remove a part of the brain, for example, an area where a tumor is located or an area where a patient's epileptic seizures tend to start, he/she does not want to remove a part which would result in a marked decrement in the patient's quality of life (for example, a speech area). Therefore, it is fairly routine to stimulate an awake patient's brain during surgery to verify the function of the areas the surgeon is working near. During surgery, the scalp, bone, and membranes covering the brain must be anesthetized, so that the patient does not feel pain. The brain itself does not have pain receptors, so that working on the brain is not physically painful.

This part of the brain appears to process visual information; in fact, it is the *visual* cortex. When this part of the brain is stimulated electrically, neurons are activated in much the same way that they would be by natural visual stimulation. Therefore, the patient reports seeing a visual stimulus that is not actually there.

The information provided suggests that there is an upside-down and backwards map of the visual world on the visual cortex (note the similarity to the upside-down and backwards map of the body on the motor cortex in the first example). Note that the left side of the brain is being stimulated. Yet, when the patient fixates on the cross in the middle of the screen, all of the points of light that he reports are to the right of the fixation point. Therefore, the information from the right side of the visual field is relayed to the left side of the brain. Note also, that when points which are higher up on the cortex are stimulated, the patient reports seeing flashing lights in the lower part of the visual field; conversely, when points lower down on the visual cortex are stimulated, the patient reports flashing lights in the upper part of the visual field. Hence, the notion of an upside-down and backwards map of the visual world in the visual cortex.

4. The function of this part of the brain is being studied through the electrical stimulation method.

This part of the brain is responsible for the sense of touch (among other things) on the opposite side of the body. The area being stimulated is the *somatosensory* cortex.

By looking at the drawing we can see that stimulation high up on the brain results in a tingling sensation which is lower down on the body and vice versa. It is as if the body is "mapped" upside down and backwards on the somatosensory cortex. (If you have a drawing of the "sensory homunculus" it would be helpful to share this with the students after they have completed this exercise.) The notion of the world being mapped upside down and backwards on the brain should be starting to sound like a recurring theme by now!

5. The method being used is positron emission tomography (PET scanning). This area is responsible for processing information concerning sounds; it is the *auditory* cortex.

6. A needle electrode is being used to record the electrical activity of this part of the brain. The evidence suggests that this part of the brain may be responsible for triggering eating behavior; alternately, it may be responsible for the sensation of hunger.

7. The lesion method is being used to study brain function, but this time, in contrast to examples 1 and 2, the damage to the brain was created intentionally.

The corpus callosum relays information from one side of the brain to the other when it is intact. In this example, because the corpus callosum is cut, information cannot be relayed from one side of the brain to the other. This explains the two specific deficits noted in this example.

The patient is unable to name an object placed in her left hand because the sensory information from that hand is relayed to the right side of her brain, which has little or no language or speech ability.

The patient is unable to pick out an object with her right hand that she has already felt with her left hand because that would require comparison of sensory information relayed to the two sides of the brain, which is no longer possible with the corpus callosum cut.

Students may wonder why it is important that the patient kept her eyes closed in these two examples. This was done because each eye, when open, sends information to both sides of the brain. If the patient had had her eyes open in these examples, information would have been sent to both sides of the brain, and the patient would not have had difficulty with these tasks.

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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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Assignment: The Brain Diagram

Students often have trouble encoding the location and function of the different parts of the brain, both because (a) they glance too quickly over the colorful textbook illustrations and (b) their eyes tend to glaze over during class discussion of the brain's structure and function. As an easy remedy to this problem, try asking students to draw their own colorful rendition of the human brain, an active learning strategy that ensures that they encode and think about the parts of the brain rather than passively glossing over them in the text. Prior to the class period in which you will be discussing the brain, ask students to read Chapter 2 and to hand-draw a diagram of the brain (in a cross-section) on a clean white sheet of unlined paper. For each of the following sections of the brain, students should color and label the appropriate structure, and also list at least one or two of its major functions: (a) the cerebral cortex, including the four lobes, (b) the thalamus, (c) the hypothalamus, (d) the hippocampus, (e) the amygdala, (f) the cerebellum, (g) the pons, and (h) medulla. Added benefits of this assignment are that it is easy to grade, students enjoy doing it (and it is an easy and fun way for them to get points), and it can be used by students as a study aid for the exam.

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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 studying psychology?

- 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 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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Activity: Crossword Puzzle

Frequently instructors want an activity that is interactive for their students as well as a reinforcement of the material just covered in the lecture. An activity such as a crossword puzzle can fulfill both criteria. Copy and distribute **Handout Master 2.3** to students as a homework or in-class review assignment.

The answers for the crossword puzzle are:
Across
1. neurotransmitter that causes the receiving cell to stop firing. Inhibitory
3. the cell body of the neuron, responsible for maintaining the life of the cell. soma

4. endocrine gland located near the base of the cerebrum which secretes melatonin. pineal
7. glands that secrete chemicals called hormones directly into the bloodstream. endocrine
8. long tube-like structure that carries the neural message to other cells. axon
10. chemical found in the synaptic vesicles which, when released, has an effect on the next cell. neurotransmitter
13. bundles of axons coated in myelin that travels together through the body. nerves
14. branch-like structures that receive messages from other neurons. dendrites
15. endocrine gland found in the neck that regulates metabolism. thyroid
17. thick band of neurons that connects the right and left cerebral hemispheres. Corpus Callosum
19. part of the nervous system consisting of the brain and spinal cord. Central

Down

2. part of the limbic system located in the center of the brain, it acts as a relay from the lower part of the brain to the proper areas of the cortex. thalamus
4. endocrine gland that controls the levels of sugar in the blood. pancreas
5. fatty substances produced by certain glial cells that coat the axons of neurons to insulate, protect, and speed up the neural impulse. myelin
6. the basic cell that makes up the nervous system and which receives and sends messages within that system. Neuron
8. chemical substances that mimic or enhance the effects of a neurotransmitter on the receptor sites of the next cell. Agonists
9. part of the lower brain that controls and coordinates involuntary, rapid, fine motor movement. cerebellum
11. process by which neurotransmitters are taken back into the synaptic vesicles. reuptake
12. a group of several brain structures located under the cortex and involved in learning, emotion, memory, and motivation. Limbic
16. chemicals released into the bloodstream by endocrine glands. Hormones
18. brain structure located near the hippocampus, responsible for fear responses and memory of fear. Amygdala

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Handout Masters
2.1Mapping 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.

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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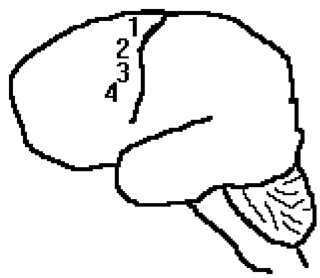
Handout Master 2.2

Localization of Function Exercise

Case 1. Dr. Holmes sees a series of patients with gunshot injuries to parts of their frontal lobes. 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.

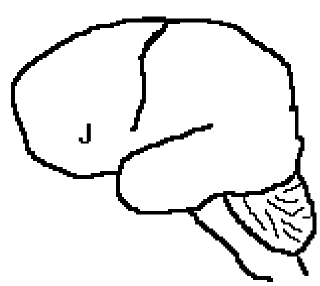


Case 1: a. What method is being used to study brain function?

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 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.

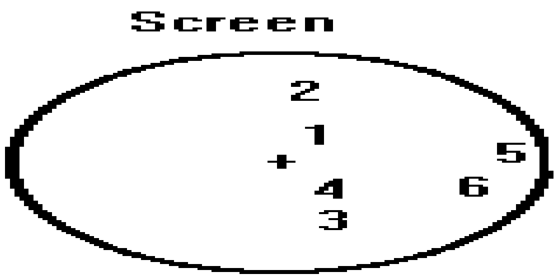


Case 2: a. What method is being used to study brain function?

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.

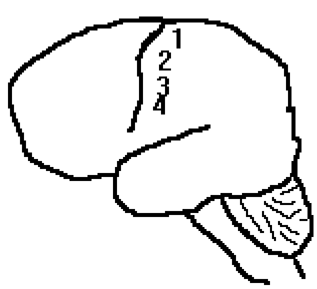


Case 3: a. What method is being used to study brain function?

b. What does this area of the brain do?

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.

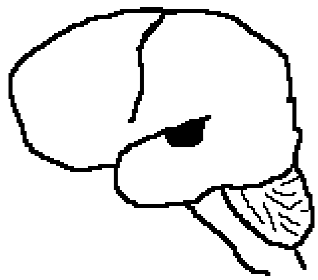


Case 4: a. What method is being used to study brain function?

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.



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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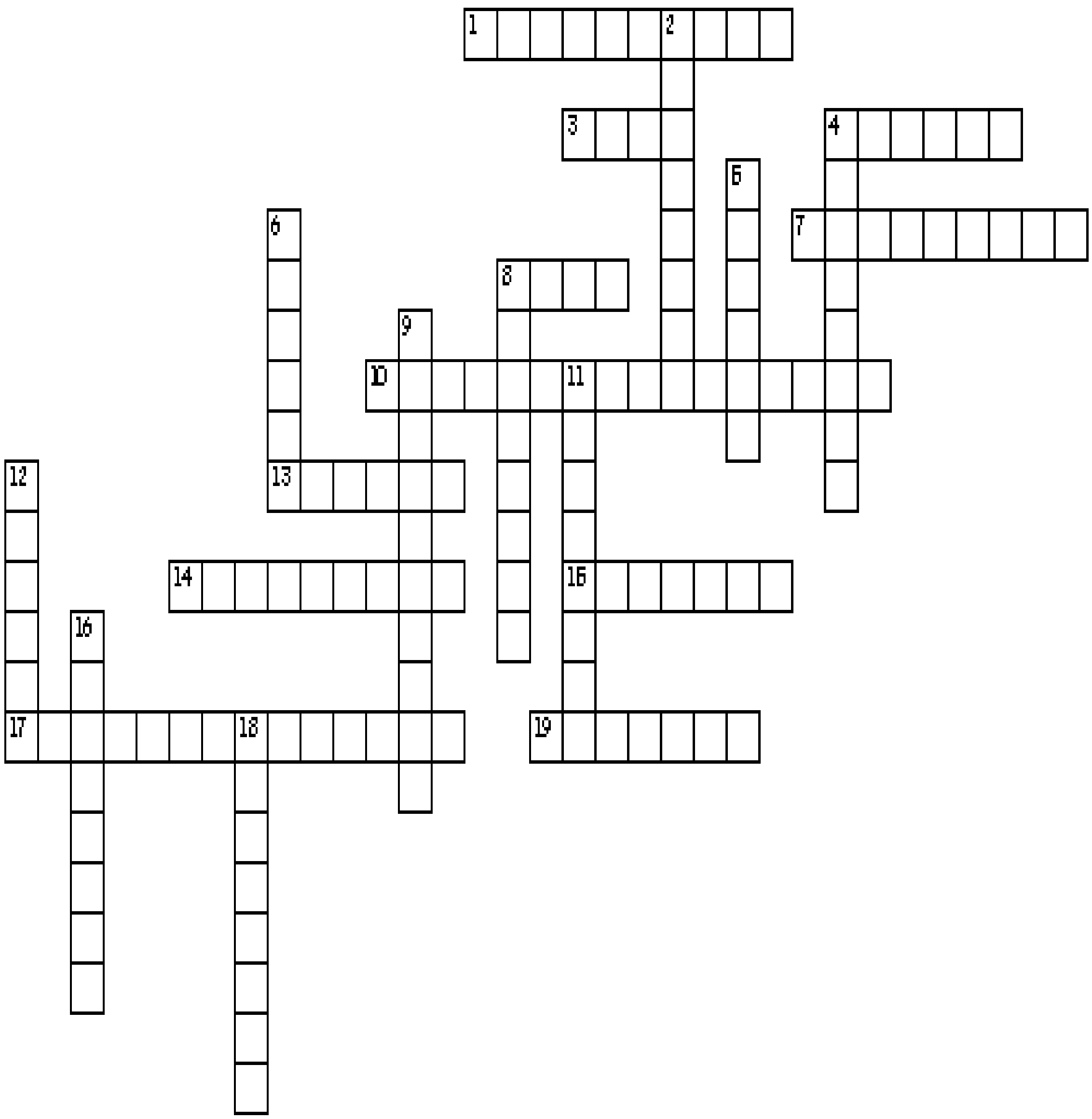
Handout Master 2.3

Crossword Puzzle activity

Biopsychology



Across

1. neurotransmitter that causes the receiving cell to stop firing.
3. the cell body of the neuron, responsible for maintaining the life of the cell.
4. endocrine gland located near the base of the cerebrum which secretes melatonin.
7. glands that secrete chemicals called hormones directly into the bloodstream.
8. long tube-like structure that carries the neural message to other cells.
10. chemical found in the synaptic vesicles which, when released, has an effect on the next cell.
13. bundles of axons coated in myelin that travel together through the body.
14. branch-like structures that receive messages from other neurons.
15. endocrine gland found in the neck that regulates metabolism.
17. thick band of neurons that connects the right and left cerebral hemispheres.
19. part of the nervous system consisting of the brain and spinal cord.

Down

2. part of the limbic system located in the center of the brain, it acts as a relay from the lower part of the brain to the proper areas of the cortex.
4. endocrine gland that controls the levels of sugar in the blood.
5. fatty substances produced by certain glial cells that coat the axons of neurons to insulate, protect, and speed up the neural impulse.
6. the basic cell that makes up the nervous system and which receives and sends messages within that system.
8. chemical substances that mimic or enhance the effects of a neurotransmitter on the receptor sites of the next cell.
9. part of the lower brain that controls and coordinates involuntary, rapid, fine motor movement.
11. process by which neurotransmitters are taken back into the synaptic vesicles.
12. a group of several brain structures located under the cortex and involved in learning, emotion, memory, and motivation.
16. chemicals released into the bloodstream by endocrine glands.
18. brain structure located near the hippocampus, responsible for fear responses and memory of fear.

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Handout Transparency Master 2.4

The Automatic Nervous System

Describe how each organ is affected by the sympathetic and parasympathetic nervous system.

Organ	*Sympathetic*	*Parasympathetic*
Adrenal Medulla		
Bladder		
Blood Vessels Abdomen Muscles Skin		
Heart		
Intestines		
Liver		
Lungs		
Pupil of Eye		
Salivary Glands		
Sweat Glands		

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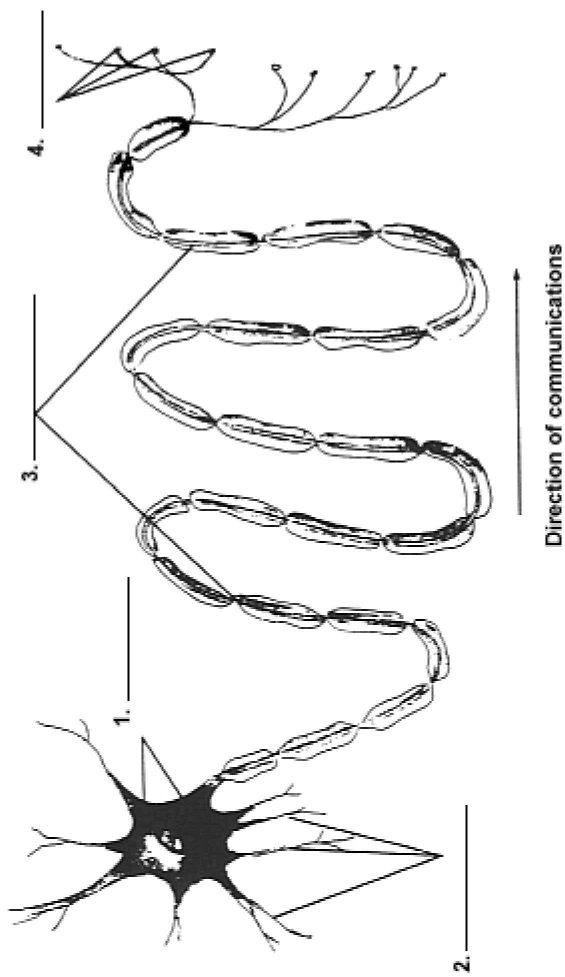
Handout Master 2.5: The Basic Structure of the Neuron

Identify the parts of the neuron discussed in the text.



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Handout Master

Fill in the Blank Chapter 2

<u>Chapter Two: Neuroscience the Biological Perspective</u>

1. An extensive network of specialized cells that carry information to and from all parts of the body is called the __________________ _______________.
2. The basic cell that makes up the nervous system and which receives and sends messages within that system is called a ___________________.
3. The long tube-like structure that carries the neural message to other cells on the neuron is the ________________
4. On a neuron, the branch-like structures that receive messages from other neurons is the ____________________.
5. The cell body of the neuron, responsible for maintaining the life of the cell and contains the mitochondria is the __________________.
6. The fatty substances produced by certain glial cells that coat the axons of neurons to insulate, protect, and speed up the neural impulse is the __________________.
7. The bundles of axons in the body that travel together through the body are known as the _______________.
8. The charged particles located inside and outside of the neuron are called _____________.
9. The state of the neuron when not firing a neural impulse is known as the _________________ _____________________.
10. ______________________ refers to the fact that a neuron either fires completely or does not fire at all.
11. The ______________ ______________ are sack-like structures found inside the synaptic knob containing chemicals.
12. ___________________________ are chemicals found in the synaptic vesicles which, when released, has an effect on the next cell.
13. The _______________________ neurotransmitter causes the receiving cell to fire.
14. The ___________________________ mimic or enhance the effects of a neurotransmitter on the receptor sites of the next cell, increasing or decreasing the activity of that cell.
15. The ___________________ ________________ a long bundle of neurons that carries messages to and from the body to the brain that is responsible for very fast, lifesaving reflexes.
16. A neuron that carries information from the senses to the central nervous system and is also known as the afferent is called a _____________________ _________________ .
17. All nerves and neurons that are not contained in the brain and spinal cord but that run through the body itself are in the ___________________ _____________________ system.
18. The division of the PNS consisting of nerves that carry information from the senses to the CNS and from the CNS to the voluntary muscles of the body is the _______________ _________________ system.
19. The ____________________ __________________ system division of the PNS consisting of nerves that control all of the <u>*involuntary*</u> muscles, organs, and glands sensory pathway nerves coming from the sensory organs to the CNS consisting of sensory neurons.
20. The part of the ANS that is responsible for reacting to stressful events and bodily arousal is called the ________________________ ___________________ of the nervous system.
21. A machine designed to record the brain wave patterns produced by electrical activity of the surface of the brain is called an __________________________.
22. The part of the lower brain located behind the pons that controls and coordinates involuntary, rapid, fine motor movement is called the _______________________.
23. The part of the limbic system located in the center of the brain, this structure relays sensory information from the lower part of the brain to the proper areas of the cortex and processes some sensory information before sending it to its proper area and is called the ________________________ .
24. The larger swelling above the medulla that connects the top of the brain to the bottom and that plays a part in sleep, dreaming, left–right body coordination, and arousal is called the ______________________.
25. The ______________________ _________________ is an area of neurons running through the middle of the medulla and the pons and slightly beyond that is responsible for selective attention.
26. The ________________________ is a curved structure located within each temporal lobe, responsible for the formation of long-term memories and the storage of memory for location of objects.

27. The ____________________ is a brain structure located near the hippocampus, responsible for fear responses and memory of fear.
28. The _______________ is the outermost covering of the brain consisting of densely packed neurons, responsible for higher thought processes and interpretation of sensory input.
29. The thick band of neurons that connects the right and left cerebral hemispheres is called the _________________ ________________.
30. The section of the brain located at the rear and bottom of each cerebral hemisphere containing the visual centers of the brain is the called the ________________ ________________.
31. The sections of the brain located at the top and back of each cerebral hemisphere containing the centers for touch, taste, and temperature sensations is called the _______________________ ____________________________.
32. The __________________ _________________ is the area of the cortex located just behind the temples containing the neurons responsible for the sense of hearing and meaningful speech.
33. The ____________________ ______________________ are areas of the cortex located in the front and top of the brain, responsible for higher mental processes and decision making as well as the production of fluent speech.
34. The _____________________ glands secrete chemicals called hormones ***directly*** into the bloodstream.
35. The endocrine glands located on top of each kidney that secrete over 30 different hormones to deal with stress, regulate salt intake, and provide a secondary source of sex hormones affecting the sexual changes that occur during adolescence are called the ___________________ ____________________.

Words for Fill-in-the-Blanks

Adrenal glands
Agonists
All or none
Amygdala
Autonomic Nervous
Axon
Cerebellum
Corpus Callosum
Cortex
Dendrites
Electroencephalograph
Endocrine
Excitatory
Frontal Lobes
Hippocampus
Ions
Myelin
Nerves
Nervous system
Neuron
Neurotransmitters
Occipital cortex
Parietal Cortex
Peripheral Nervous
Pons
Resting potential
Reticular formation
Sensory
Soma
Somatic Nervous
Spinal Cord

Sympathetic Division
Synaptic Vesicles
Temporal Lobes
Thalamus

<u>Answers to Fill-in-the-blanks: Neuroscience: The Biological Perspective</u>

1. Nervous system
2. Neuron
3. Axon
4. Dendrites
5. Soma
6. Myelin
7. Nerves
8. Ions
9. Resting potential
10. All or none
11. Synaptic Vesicles
12. Neurotransmitters
13. Excitatory
14. Agonists
15. Spinal Cord
16. Sensory
17. Peripheral Nervous
18. Somatic Nervous
19. Autonomic Nervous
20. Sympathetic Division
21. Electroencephalograph
22. Cerebellum
23. Thalamus
24. Pons
25. Reticular formation
26. Hippocampus
27. Amygdala
28. Cortex
29. Corpus Callosum
30. Occipital cortex
31. Parietal Cortex
32. Temporal Lobes
33. Frontal Lobes
34. Endocrine
35. Adrenal glands

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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, M.D. 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
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.

Neural Processes Tutorial: http://psych.hanover.edu/Krantz/neurotut.html
An excellent interactive animated tutorial.

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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, 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.

The Brain Observatory: http://thebrainobservatory.ucsd.edu
Images of the brain and information on the process of digitizing H.M.'s brain

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/
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.

What is the Cerebellum? http://www.sfn.org/content/Publications/BrainBackgrounders/cerebellum.htm
Information about the structure and function of the cerebellum, prepared by the Society for Neuroscience.

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Phineas Gage

Phineas Gage Information Page: http://www.deakin.edu.au/hbs/GAGEPAGE
Everything you ever wanted to know about Phineas Gage is on this page prepared by Malcolm Macmillan at Deakin University, Victoria, Australia.

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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Video Resources:

NEW MyPsychLab Video Series
Episode 3: Biological Psychology

1. The Big Picture: My Brain Made Me Do It.
2. The Basics: How the Brain Works? Part 1
3. The Basics: How the Brain Works? Part 2
4. Special Topics: The Plastic Brain
5. Thinking Like a Psychologist: The Pre-Frontal Cortex: The Good, The Bad, and The Criminal
6. In the Real World Application: Too Much, or Too Little, of a Good Thing
7. What's In It For Me?: Biology of the High

This new video series offers instructors and students the most current and cutting edge introductory psychology video content available anywhere. These exclusive videos take the viewer into today's research laboratories, inside the body and brain through breathtaking animations, and out into the street for real-world applications. Guided by the Design, Development and Review team, a diverse group of introductory psychology professors, this comprehensive new series features 17 half-hour episodes organized around the major topics of the introductory psychology course syllabus. For maximum flexibility, each 30-minute episode features several brief clips that bring psychology to life.

FEATURES
Format
The MyPsychLab video series was designed with flexibility in mind. Each half-hour episode in the MyPsychLab video series is made up of several five-minute clips, which can be viewed separately or together:

- *The Big Picture* introduces the topic of the episode and draws in the viewer.
- *The Basics* uses the power of video to present foundational topics, especially those that students find difficult to understand.
- *Special Topics* dives deeper into high-interest and often cutting-edge topics, showing research in action.
- *Thinking Like a Psychologist* models critical thinking and explores research methods.
- *In the Real World* focuses on applications of psychological research.
- *What's In It for Me?* These clips show students the relevance of psychological research to their lives.

Flexible Delivery
Students can access the videos anytime within MyPsychLab, and each clip is accompanied by enriching self-assessment quizzes. Instructors can access the videos for classroom presentation in MyPsychLab or on DVD (0205035817).

Other Pearson Psychology Video Collections:

Introductory Psychology Teaching Films Boxed Set ISBN (0131754327)
Offering you an easy to use multi-DVD set of videos, more than 100 short video clips of 5–15 minutes in length from many of the most popular video sources for Psychology content, such as ABC News; the Films for the Humanities series; PBS; and more!

Pearson Education Teaching Films Introductory Psychology: Instructor's Library 2-Disk DVD Annual Edition (ISBN 0205652808)
Annual updates of the most popular video sources for Psychology content, such as ABC News; the Films for the Humanities series; PBS; and more in 5-15 minute clips on an easy to use DVD!

Lecture Launcher Video for Introductory Psychology (ISBN 013048640X)
This 60-minute videotape includes twenty-five segments covering all of the major topics in introductory psychology. All of the segments have been selected from videotapes in the Films for Humanities & Sciences collection. The segments are intended to provide brief illustrations of concepts, and to serve as a starting point for classroom discussions.

FILMS FOR HUMANITIES AND SCIENCES VIDEO LIBRARY (http://www.films.com) Qualified adopters can select videos on various topics in psychology from the extensive library of *Films for the*

Humanities and Sciences. Contact your local sales representative for a list of videos and ISBN's.

Other video series are available, ask your Pearson sales representative for more details.

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MULTIMEDIA RESOURCES

On-line Resources: MyPsychLab www.mypsychlab.com

See/Hear/Learn/Explore More Icons integrated in the text lead to web-based expansions on topics, allowing instructors and students access to extra information, videos, podcasts, and simulations. The in-text icons are not exhaustive—there are many more resources available to instructors and students on-line at www.MyPsychLab.com.

What Is MyPsychLab? MyPsychLab is a learning and assessment tool that enables instructors to assess student performance and adapt course content. Students benefit from the ability to test themselves on key content, track their progress, and utilize individually tailored study plan. In addition to the activities students can access in their customized study plans, instructors are provided with extra lecture notes, video clips, and activities that reflect the content areas their class is still struggling with. Instructors can bring these resources to class, or easily post on-line for students to access.

Instructors and students have been using MyPsychLab for over 10 years. To date, over 600,000 students have used MyPsychLab. During that time, three white papers on the efficacy of MyPsychLab were published. Both the white papers and user feedback show compelling results: MyPsychLab helps students succeed and improve their test scores. One of the key ways MyPsychLab improves student outcomes is by providing continuous assessment as part of the learning process. Over the years, both instructor and student feedback have guided numerous improvements, making MyPsychLab even more flexible and effective.

Pearson is committed to helping instructors and students succeed with MyPsychLab.
To that end, we offer a Psychology Faculty Advisor Program designed to provide peer to-peer support for new users of MyPsychLab. Experienced Faculty Advisors help instructors understand how MyPsychLab can improve student performance. To learn more about the Faculty Advisor Program, please contact your local Pearson representative.
In addition to the eText and complete audio files, the New MyPsychLab video series, MyPsychLab offers these valuable and unique tools:

MyPsychLab assessment questions: over 3,000 questions, distinct from the test bank, but designed to help instructors easily assign additional quizzes and tests, all that can be graded automatically and loaded into an instructor's grade book.

MyPsychLab study plan: students have access to a **personalized study plan**, based on Bloom's Taxonomy, arranges content from less complex thinking–like remembering and understanding–to more complex critical thinking–like applying and analyzing. This layered approach promotes better critical-thinking skills, and helps students succeed in the course and beyond.

NEW Experiments Tool – On-line experiments help students understand scientific principles and practice through active learning – fifty new experiments, inventories, and surveys are available through MyPsychLab.

APA assessments: A unique bank of assessment items allows instructors to assess student progress against the American Psychological Association's Learning Goals and Outcomes. These assessments have been keyed to the APA's latest progressive Learning Outcomes (basic, developing, advanced).

ClassPrep available in MyPsychLab. Finding, sorting, organizing, and presenting your instructor resources is faster and easier than ever before with ClassPrep. This fully searchable database contains hundreds and hundreds of our best teacher resources, such as lecture launchers and discussion topics, in-class and out-of-class activities and assignments, handouts, as well as video clips, photos, illustrations, charts, graphs, and animations. Instructors can search or browse by topic, and it is easy to sort your results by type, such as photo, document, or animation. You can create personalized folders to organize and store what you like, or you can download resources. You can also upload your own content and present directly from ClassPrep, or make it available on-line directly to your students.

MyPsychLab Highlights for Chapter 2: Bipsychology, Neuroscience, and Human Nature

NEW Experiments Tool to promote active learning
Experiment: Hemispheric Specialization
Survey: Do You Fly or Fight?

Audio File of the Chapter
A helpful study tool for students—they can listen to a complete audio file of the chapter. Suggest they listen while they read, or use the audio file as a review of key material.

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CLASSROOM or PERSONAL RESPONSE SYSTEM ("CLICKER" QUESTIONS)

Pearson Education has partnerships with leading classroom response systems on the market. For more information about Classroom Response Systems and our partnerships, please go to http://www.pearsonhighered.com/crs.

Written by Cathleen Campbell-Raufer of Illinois State University, the classroom response questions (**ISBN 020525330X**) are designed to complement the critical thinking theme of the Zimbado/Johnson/McCann Psychology: Core Concepts, Seventh Edition textbook. Students become active learners and the immediate feedback provides you with insight into their learning. Clicker questions are available for download at the instructor's resource center at www.pearsonhighered.com/irc, as well as on the Instructor's Resource DVD (ISBN 0205854397).

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NEW INTERACTIVE POWERPOINT SLIDES

These slides, available on the Instructor's Resource DVD (ISBN 0205854397), bring the *Psychology: Core Concepts* design right into the classroom, drawing students into the lecture and providing wonderful interactive activities, visuals, and videos. A video walk-through is available and provides clear guidelines on using and customizing the slides. The slides are built around the text's learning objectives and offer many links across content areas. Icons integrated throughout the slides indicate interactive exercise, simulations, and activities that can be accessed directly from the slides if instructors want to use these resources in the classroom.

A SET OF STANDARD LECTURE POWERPOINT SLIDES written by Beth M. Schwartz, Randolph College, is also offered and includes detailed outlines of key points for each chapter supported by selected visuals from the textbook. A separate *Art and Figure* version of these presentations contains all art from the textbook for which Pearson has been granted electronic permissions.
Both sets of PowerPoint slides are available for download at the instructor's resource center at www.pearsonhighered.com/irc, as well as on the Instructor's Resource DVD (ISBN 0205854397).

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ACCESSING ALL RESOURCES for Zimbardo/Johnson/McCann*, Seventh Edition*:

For a list of all student resources available with Zimbardo/Johnson/McCann, go to www.mypearsonstore.com, enter the text ISBN (0205183468) and check out the "Everything That Goes With It" section under the book cover.

For access to the instructor supplements for Zimbardo/Johnson/McCann, *Psychology: Core Concepts, Seventh Edition*, simply go to http://pearsonhighered.com/irc and follow the directions to register (or log in if you already have a Pearson user name and password).

Once you have registered and your status as an instructor is verified, you will be e-mailed a login name and password. Use your login name and password to access the catalogue. Click on the "online catalogue" link, click on "psychology" followed by "introductory psychology" and then the Zimbardo/Johnson/McCann *Psychology: Core Concepts, Seventh Edition* text. Under the description of each supplement is a link that allows you to download and save the supplement to your desktop.

For technical support for any of your Pearson products, you and your students can contact http://247.pearsoned.com.

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