### Key to Teaching Strategies

- **L1**: Level 1 activities should be appropriate for students with learning difficulties.  
- **L2**: Level 2 activities should be within the ability range of all students.  
- **LLL**: Level 3 activities are designed for above-average students.

**COOP/LEARN**: Cooperative Learning activities are designed for small group work.  
**COOP**: These strategies represent student products that can be placed into a best-work portfolio.  
**P**: These strategies are useful in a block scheduling format.

---

### Materials List

<table>
<thead>
<tr>
<th>BioLab</th>
<th>p. 986</th>
<th>Microscope, microscope slides, dropper, aged tap water, Daphnia culture, dilute solutions of coffee, tea, cola, ethyl alcohol, tobacco, and cough medicine</th>
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<tbody>
<tr>
<td>MiniLabs</td>
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<td>Quick Demos</td>
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<td>Tape recording of common sounds</td>
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### Section 36.1
**The Nervous System**

| National Science Education Standards UCP 1-3, UCP 5; A.1, B.1, B.3; C.1, C.5, C.6 (2 sessions, 1 block) |

1. **Analyze** how nerve impulses travel within the nervous system.
2. **Recognize** the functions of the major parts of the nervous system.
3. **Compare** voluntary responses and involuntary responses.

**Focus On**: Evolution of the Brain, p. 978

**MiniLab 36-1**: Distractions and Reaction Time, p. 980

**BioTechnology**: Scanning the Mind, p. 998

---

### Section 36.2
**The Senses**

| National Science Education Standards UCP 1-3, UCP 5; C.1, C.5, C.6 (1 session) |

4. **Define** the role of the senses in the human nervous system.
5. **Recognize** how senses detect chemical, light, and mechanical stimulation.
6. **Identify** ways in which the senses work together to gather information.

**Inside Story**: The Eye, p. 985

**Problem-Solving Lab 36-1**, p. 986

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### Section 36.3
**The Effects of Drugs**

| National Science Education Standards UCP 1, UCP 2; A.1, A.2, C.6, E.1, E.2, E.3, F.1, F.6; G.1, G.2 (2 sessions, 1/2 block) |

7. **Recognize** the medicinal uses of drugs.
8. **Identify** the different classes of drugs.
9. **Interpret** the effect of drug misuse and abuse on the body.

**Problem-Solving Lab 36-2**, p. 989

**Careers in Biology**: Pharmacist, p. 990

**MiniLab 36-2**: Interpret a Drug Label, p. 991

**Design Your Own BioLab**: What drugs affect the heart rate of Daphnia?, p. 996

---

### Additional Resources

- **Spanish Resources**: [ELL](#)
- **English/Spanish Audiotapes**: [ELL](#)
- **Cooperative Learning in the Science Classroom**: [COOP/LEARN](#)
- **Lesson Plans/Block Scheduling**

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### Teacher Classroom Resources

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<th>Reproducible Masters</th>
<th>Transparencies</th>
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</table>

- **Section 36.1**: The Nervous System
  - Reinforcement and Study Guide, pp. 159-160
  - Critical Thinking/Problem Solving, pp. 36
  - BioLab and MiniLab Worksheets, p. 159
  - Laboratory Manual, pp. 261-264
  - Content Mastery, pp. 177-178, 180

- **Section 36.2**: The Senses
  - Reinforcement and Study Guide, p. 161
  - Concept Mapping, p. 36
  - Laboratory Manual, pp. 265-268
  - Content Mastery, pp. 177, 179-180
  - Tech Prep Applications, pp. 47-48

- **Section 36.3**: The Effects of Drugs
  - Reinforcement and Study Guide, p. 162
  - BioLab and MiniLab Worksheets, pp. 160-162
  - Content Mastery, pp. 177, 180
  - Tech Prep Applications, pp. 49-50

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### Assessment Resources

- **Chapter Assessment**, pp. 211-216
- **Mindjogger Videoquizzes**
- **Performance Assessment in the Biology Classroom**

**Chapter Assessment, pp. 49-50**

**BioLab and MiniLab Worksheets**, pp. 211-216

**Reinforcement and Study Guide**, pp. 47-48

**Laboratory Manual**, pp. 177-178, 180

**Content Mastery**, pp. 177, 179-180

**Tech Prep Applications**, pp. 47-48

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### GLENOCE Technology

The following multimedia resources are available from Glencoe.

- **Biology: The Dynamics of Life**
  - **CD-ROM**: [ELL](#)
  - BioQuest: Body Systems
  - Animation: Impulse Transmission in a Motor Neuron
  - Animation: Impulse Transmission Across a Synapse
  - Animation: The Sense of Sight
  - Animation: The Sense of Hearing

- **Impulse Transmission**:
  - Videodisc Program:
    - **Impulse Transmission**: Synapse
    - **Sense of Sight**

---

**Chapter 36 Organizer**

Refer to pages 45-51 of the Teacher Guide for an explanation of the National Science Education Standards correlations.
The body.

In order to maintain homeostasis in body systems and respond in receiving information from all stress that the nervous system reacts to environment.

The major theme in this chapter is theme development.

GETTING STARTED DEMO

GETTING STARTED DEMO

Creating a loud noise by slamming a book on your desk. Use student reaction to begin a discussion of how the nervous system receives information from all body systems and responds in order to maintain homeostasis in the body.

Stress that the nervous system reacts to environment.

Use student reaction to begin a discussion of how the nervous system reacts to environment.

Create a loud noise by slamming a book on your desk.

GETTING STARTED

Swapping Colors

Draw a picture of a green tree with red dots all over it. Stare at the drawing for one full minute. Then look at a sheet of white paper.

Neurons: Basic Units of the Nervous System

The basic unit of structure and function in the nervous system is the neuron, or nerve cell. Neurons (nerve cells) conduct impulses throughout the nervous system.

As shown in Figure 36.1, a neuron is a long cell that consists of three regions: a cell body, dendrites, and an axon.

Dendrites (DEN drites) are branchlike extensions of the neuron that receive impulses and carry them toward the cell body. The axon is a single extension of the neuron that carries impulses away from the cell body and toward other neurons, muscles, or glands.

Neurons fall into three categories: sensory neurons, motor neurons, and interneurons. Sensory neurons carry impulses from the body to the spinal cord and brain. Interneurons are found within the brain and spinal cord. They process incoming impulses and pass response impulses on to motor neurons. Motor neurons carry the response impulses away from the brain and spinal cord to a muscle or gland.

Vocabulary

neuron

dendrite

electron microscope

eukaryotic cell

efferent nerve

SYMPATHETIC NERVOUS SYSTEM

PARASYMPATHETIC NERVOUS SYSTEM

Figure 36.1 Dendrites and axons are extensions that branch out from the cell body of a neuron.

Neurons

Axon

Cell body

Dendrites

Myelin sheath

Nucleus

Neurons

A Focus

Before presenting the lesson, display Section Focus Transparency 87 on the overhead projector and have students answer the accompanying questions.

1 Focus

Prepare

Key Concepts

The method by which impulses travel in the nervous system—including electrical transmission along the neuron and chemical transmission at the synapse—are covered in this section. The organization and function of the major parts of the nervous system are discussed.

Planning

• Obtain a piece of cable for the first Quick Demo.

• Collect enough metersticks for student use in MiniLab 36-1.

• Acquire a rubber hammer for the second Quick Demo.

Internet Address Book

INTERNET ADDRESSES

www.glencoe.com/sec/science

Glencoe Science Web Site.

Visit the Nervous System, visit the Learning Styles

www.glencoe.com/sec/science

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

Multiple Learning Styles

Kinesthetic Portfolio, p. 975:

Quick Demo, p. 981; Project, p. 996

Visual-Spatial: Meeting Individual Needs, pp. 974, 988;

Reinforcement, p. 975; Display, p. 984; Portfolio, p. 985; Check for Understanding, p. 987

Interpersonal: Biology Journal, p. 994

Portfolio Assessment

Portfolio, TWE, pp. 975, 985, 993

Alternative Lab, TWE, pp. 980-981

Problem-Solving Lab, TWE, p. 986

Performance Assessment

MiniLab, SE, pp. 980, 991

BioLab, SE, pp. 996-997

Alternative Lab, TWE, pp. 980-981

Assessment, TWE, p. 977

MiniLab, TWE, p. 991

BioLab, TWE, pp. 996-997

Knowledge Assessment

Section Assessment, SE, pp. 982, 987, 995

Chapter Assessment, SE, pp. 999-1001

Assessment, TWE, pp. 984, 987, 995

Problem-Solving Lab, TWE, p. 989

Skill Assessment

Assessment, TWE, pp. 982, 992

MiniLab, TWE, p. 980

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Assessment Planner

BELLRINGER

1 Focus

BELLRINGER

BIOLOGY: The Dynamics of Life

SECTION FOCUS TRANSPARENCIES

Transparency Take an Order

Transparency Interview

Transparency Transparency

Prepare

Section 36.1

The Nervous System

What do you use the telephone for? To communicate with a friend in another location.

You may know that your message is transmitted as an electrical impulse across the telephone wires. Would it surprise you to know that a similar electrical impulse travels through your body, helping some parts to communicate with others? Like telephone wires between homes, nerve cell relays messages within the human body.

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As gated potassium channels close, the Na+/K+ pump restores the membrane and a negative charge within the ear rather than in the skin. A honking car horn. In response to a sound such as a tem would take to turn the head response to a stimulus. Ask students to write a paragraph that explains how a nerve is similar to a wire going from a controlling switch (stimulus) to a light bulb (effector). ELL

**2 Teach**

**Visual Learning**

**Figure 36.2** Spend a few minutes reviewing the sequence of events involved in the nervous system's response to a stimulus. Ask students what path the nervous system would take to turn the head in response to a sound such as a honking car horn. The path would be the same except for the initial receptors, which would be located in the ear rather than in the skin.

**Visual Learning**

**Figure 36.3** Ask: What effect does the Na+/K+ pump have on the charge of the normal resting neuron? It maintains a positive charge on the outside of the membrane and a negative charge within the membrane of a resting neuron. It exchanges three potassium ions (K+) and two sodium ions (Na+) ions into and out of the cell. The plasma membrane is said to be polarized. A polarized membrane has the potential to transmit an impulse.

**Relaying an impulse**

Suppose you’re in a crowded, noisy store and you feel a tap on your shoulder. Turning your head, you see the smiling face of a good friend. How did the shoulder tap get your attention? The touch stimulated sensory receptors located in the skin of your shoulder to produce an impulse. The sensory impulse was carried by the spinal cord to the brain. From your brain, an impulse was sent out to your motor neurons, which then transmitted the impulse to muscles in your neck. Your neck muscles then turned your head.

**Figure 36.2** shows how a stimulus, such as a tap on the shoulder, is transmitted through your nervous system. A neuron at rest

First, let’s look at a resting neuron—one that is not transmitting an impulse. You have learned that the plasma membrane controls the concentration of ions inside a cell. Because the plasma membrane of a neuron is more permeable to potassium ions ($K^+$) than it is to sodium ions ($Na^+$), more potassium ions exist within the cell membrane than outside it. Similarly, more sodium ions exist outside the cell membrane than within it.

The neuron membrane also contains an active transport system, called the sodium/potassium (Na+/K+) pump. This pump uses ATP to pump three sodium ions out of the cell for every two potassium ions it pumps in. As you can see in Figure 36.3, the action of the pump increases the concentration of positive charges on the outside of the membrane. In addition, the presence of many negatively charged proteins and organic phosphates means that the inside of the membrane is more negatively charged than the outside. Under these conditions, which exist when the cell is at rest, the Na+ channel is closed, preventing external sodium ions from entering the cell. Instead, the Na+/K+ pump pumps sodium ions (Na+) out of the cell and potassium ions (K+) into the cell, maintaining membrane potentials.

**White matter and gray matter**

Most axons are surrounded by a white covering of cells called the myelin sheath. Like the plastic coating on an electric wire, the myelin sheath tightly insulates the axon, hindering the movement of ions across its plasma membrane. The ions move quickly down the axon until they reach a gap in the sheath. At this point, the ions pass through the plasma membrane of the nerve cell and depolarization occurs. As a result, the impulse jumps from gap to gap, greatly increasing the speed at which it travels.

**Quick Demo**

To demonstrate what a nerve is like, show students the end of a cable, such as a telephone cable. Compare each wire to an axon and the individual wire wrappings to myelin sheaths. Explain that the whole cable represents a nerve.
The myelin sheath gives axons a white appearance. In the brain and spinal cord, masses of myelinated axons make up what is called “white matter.” Has anyone ever told you to “use your gray matter”? They were actually referring to a specific part of your brain. The absence of myelin in masses of neurons accounts for the grayish color of “gray matter” in the brain.

Connections between neurons

Although neurons lie end-to-end—axons to dendrites—they don’t actually touch. A tiny space lies between one neuron’s axon and another neuron’s dendrites. This junction between neurons is called a synapse. Impulses traveling to and from the brain must move across the synaptic space that separates the axon and dendrites. How do they make this leap?

As an impulse reaches the end of an axon, calcium channels open, allowing calcium to enter the end of the axon. As shown in Figure 36.5, the calcium causes vesicles in the axon to fuse with the plasma membrane, releasing their chemicals into the synaptic space by exocytosis. These chemicals, called neurotransmitters, diffuse across the space to the dendrites of the next neuron. As the neurotransmitters reach the dendrites, they signal receptor sites to open the ion channels. These open channels change the polarity in the neuron, initiating a new impulse. Enzymes in the synaptic space typically break down the neurotransmitters shortly after transmission, preventing the continual firing of impulses.

The Central Nervous System

What you make a call to a friend, your call travels through wires to a control center where it is switched over to wires that connect with your friend’s telephone. In the same manner, an impulse traveling through neurons in your body usually reaches the control center of the nervous system—your brain. When the brain and spinal cord together make up the central nervous system, which coordinates all your body’s activities.

Two systems work together

Another division of your central nervous system is the peripheral nervous system (PNS), which makes up all the nerves that carry messages to and from the central nervous system. It is similar to the telephone wires that run between phone system’s control center and the phones in individual homes. Together, the central nervous system (CNS) and the peripheral nervous system (PNS), shown in Figure 36.6, respect stimuli from the external environment.

Anatomy of the brain

The brain is the control center of the entire nervous system. For descriptive purposes, it is useful to divide the brain into three main sections: the cerebrum, the cerebellum, and the brain stem.

The cerebrum (the large brain) is divided into two halves, called hemispheres, that are connected by bundles of nerve fibers. Your consciousness, intelligence, memory, language, skeletal muscle movements, and senses are all controlled by the cerebrum. The outer surface of the cerebrum, called the cerebral cortex, is made up of gray matter. The cerebral cortex contains countless folds and grooves that increase its total surface area. This increase in surface area plays an important role in the evolution of human intelligence as greater surface area allowed more and more complex thought processes.

The cerebellum (or brain stem), located at the back of your head, controls your balance, posture, and coordination. The cerebellum is injured, your movements become jerky.

The brain stem is made up of the medulla oblongata, thepons, and the midbrain. The medulla oblongata is the part of the brain that controls involuntary activities such as breathing and heart rate. The pons and midbrain act as pathways connecting various parts of the brain with each other. Find out more about how the brain evolved by reading Focus On Evolution of the Brain. For the latest on technological advances in brain imaging, check out the BioTechnology section at the end of the chapter.

Activity

Have students take a right/left hemispheric mode indicator test to assess their personal approach to learning. Indicator tests are available from EXCEL INC, 200 W. Station St., Barrington, IL 60010.

Visual Learning

Figure 36.5 Draw attention to the illustration as you discuss the transmission of an impulse across a synapse.

Enrichment

Linguistic Have interested students read “Wide Hats and Narrow Minds” (from Stephen Jay Gould’s The Panda’s Thumb), which looks at the topic of brain size versus intelligence.

GLENCOE TECHNOLOGY

VIDEODISC The Infinite Voyage Fires of the Mind

Synaptic Development

(Ch. 5)

5 min. 30 sec.

CD-ROM Biology: The Dynamics of Life

Animation: Impulse Transmission

Across a Synapse

Disc 5

BIOLOGY JOURNAL

Spinal Cord Injuries

Linguistic Have students research the latest treatments for spinal cord injuries and the progress scientists have made in stimulating nerve cells to repair themselves. They should include a copy of their reports in their journals.

Enrichment

Linguistic The Chinese have used acupuncture as a complete system of medicine for thousands of years. The procedure involves inserting long, thin needles into specific areas of the patient’s body. Electrical impulses are then sent down the length of the needles. Acupuncture is used to relieve pain, cure cancer, and everything in between. It is also currently being used in China as a form of anaesthesia for patients undergoing surgery.

Have students research and report on acupuncture systems. How did the methods used then differ from those used today? The needles used to be turned to achieve the desired effect. New electrical impulses are used instead.

Assessment

Performance Assessment in the Biology Classroom, p. 49.

Preparing and Teaching a Lesson About the Nervous System. Have students carry out this activity to demonstrate their knowledge of the structure and function of the nervous system.

BIOLOGY JOURNAL

Involuntary Activities

Linguistic Ask students to list activities their bodies do without conscious thought. To get them started, have them consider what their bodies do while they are asleep.

Enrichment

Neuroscience Research

Linguistic Have students research and prepare a report, a visual device, or an audiovisual presentation on one of the following topics: sleep, split brain experimentation, dementia, Alzheimer’s disease, retrograde amnesia, or Penfield maps of the brain. Have students present their findings to the class.

P R O J E C T

Neuroscience Research

Basic Concepts Transparency

66 and Master

Resource Manager

STC Human Body

Vol. 2

Nervous System

Unit 2, Side 2, 1 min. 59 sec.

The Brain and Its Parts

NATIONAL GEOGRAPHIC

VIDEODISC

STC: Human Body

Vol. 2

Nervous System

Unit 2, Side 2, 1 min. 59 sec.

The Brain and Its Parts

976

977
Evolution of the Brain

As animals have evolved over hundreds of millions of years, there has been a tendency toward increasing complexity in the nervous system, and especially, in the brain. Brains had their beginnings as relatively simple bundles of nerve cells. But over time, the brains of vertebrate animals have become more complex and specialized. Humans possess the most complex brain in the animal kingdom, a remarkable organ that enables us to reason, wonder, and dream.

The simplest brain

Flatworms are the simplest animals that have an identifiable brain. A planarian, for example, has a mass of nerve tissue called a ganglion that lies beneath each eye. Extending back from these ganglia are long nerve cords that run the length of the body. Between the cords are cross connections that make the planarian nervous system look like a ladder.

The human brain

The human cerebrum is divided into the lobes of the brain stem—pons, midbrain, and medulla oblongata. Over the course of human evolution, the human brain has tripled in size. Scientists surmise that the increase in brain size accompanied the development of tools and other skills that enabled our ancestors to live in a greater variety of habitats.

Background

Functionally, the human brain can be divided into the lobes of the cerebrum (including the cerebral cortex), the cerebellum, and the brain stem—pons, midbrain, and medulla oblongata. As the brain evolved, areas that control vision, behavior, and coordination became prominent. Notice that in humans the brain is proportionally much larger than in many other vertebrates and that the area dedicated to thinking, the cerebrum, covers and dominates everything else.

Functionally, the human brain is divided into the lobes of the brain stem—pons, midbrain, and medulla oblongata. Over the course of human evolution, the human brain has tripled in size. Scientists surmise that the increase in brain size accompanied the development of tools and other skills that enabled our ancestors to live in a greater variety of habitats.

Teaching Strategies

Have students in groups draw a large outline of the brain on a piece of poster paper. Have them cut out magazine pictures that relate to the specializations of the brain and glue them on their outline. For instance, they could cut out eyes and place them in the occipital lobe to indicate that is where vision is interpreted. Have students make scale models of the brains in the different animals shown. When they have them compare the size of the cerebrum with the size of the animal. Which animal has the largest cerebrum for its body size? Which has the smallest?

Other resources:
- **GLENCOE TECHNOLOGY**
  - The Brain: Understanding Left and Right (Ch. 8), 6 min.
  - The Brain and Defining Our Talents (Ch. 9) 9 min. 30 sec.
- **VIDEODISC**
  - The Infinite Voyage: Fires of the Mind, The Brain and Memory (Ch. 8), 6 min.
  - Unseen Worlds: Magnetic Resonance Imaging: MRI a Medical Breakthrough (Ch. 6) 2 min. 30 sec.
  - Unseen Worlds: Brain Tumor Surgery: Made Possible by MRI (Ch. 7) 2 min. 30 sec.

Resources:
- **BioLab and MiniLab Workbooks**, p. 159
- **Resource Manager**

Enrichment

Have students research the work of evolutionary biologists such as Niles Eldridge and Stephen Jay Gould. What facts are they able to base their work on? How much do they have to infer from fossorial and other records?

Visual Learning

Visual-Spatial: Display models or posters of various vertebrate brains. Point out the differences among the brains.

Tying to Previous Knowledge

Review the evolutionary sequence of the various phyla, paying special attention to the evolutionary tree of the vertebrates.

Answers to Expanding Your View

1. The percentage of brain devoted to the sense of smell is much larger in these animals than in the human brain.
2. The cerebellum coordinates physical skills, such as walking. Damage to this area of the brain could cause a person to have jerky, uncoordinated movements.

Going Further

Students interested in the evolution and function of the brain can read Dragons of Eden, by Carl Sagan.
The Peripheral Nervous System

Remember that the peripheral nervous system carries impulses between the body and the central nervous system. For example, when a stimulus is picked up by receptors in your skin, it initiates an impulse in the sensory neurons. The impulse is carried to the CNS. There, the impulse transfers to motor neurons that carry the impulse to a muscle.

The peripheral nervous system can be separated into two divisions—the somatic nervous system and the autonomic nervous system.

The somatic nervous system is made up of 12 pairs of cranial nerves from the brain, 31 pairs of spinal nerves from the spinal cord, and all of their branches. These nerves are typically bundles of neuron axons bound together by connective tissue. The cell bodies of the neurons are found in clusters along the spinal column. Most nerves contain both sensory and motor axons.

The nerves of the somatic system relay information mainly between your skin, the CNS, and skeletal muscles. This pathway is voluntary, meaning that you can decide whether or not to move body parts under the control of this system. Try the MiniLab on this page to find out how distractions can affect the time it takes you to respond to a stimulus.

Reflexes in the somatic system

Sometimes a stimulus results in an automatic, unconscious response within the somatic system. When you touch something hot, you automatically jerk your hand away. Such an action is a reflex, an automatic response to a stimulus. Rather than proceeding to the brain for interpretation, a reflex impulse travels to the spinal column where it is sent directly back out to a muscle. The brain becomes aware of the reflex only after it occurs. Figure 36.7 on the next page shows the shortened route of a reflex impulse.

The autonomic nervous system

Imagine that you are spending the night alone in a creepy old house. Suddenly, a creak comes from the attic and you think you hear footsteps. Your heart begins to pound. Your breathing becomes rapid. Your thoughts race wildly as you try to figure out what to do—stay and confront the unknown, or run out of the house?

Your internal reactions to this scary situation are being controlled by your autonomic nervous system. The autonomic nervous system carries impulses from the CNS to internal organs. These impulses produce responses that are involuntary, or not under conscious control.

There are two divisions of the autonomic nervous system—the sympathetic nervous system and the parasympathetic nervous system. The sympathetic nervous system controls many internal functions during times of stress. When you are frightened, the sympathetic nervous system causes the release of a hormone that results in the fight-or-flight response you learned about earlier, as shown in Figure 36.6B. The parasympathetic nervous system controls the body's internal functions when it is at rest. It is in control when you are relaxing on a warm summer day after a picnic or reading quietly in your room.

Reflexes in the autonomic nervous system

A simple reflex involves impulses between sensory neurons, one interneuron, and one motor neuron.

Figure 36.7 A simple reflex

A reflex arc is the shortest route that an impulse can take from a sensory receptor through the spinal cord to a motor neuron.

Materials

paper clips unfolded in U-shapes, metric ruler

Background

Certain areas of the skin contain sensory neurons that are packed closely together, whereas other areas have neurons scattered up to centimeters apart. When two different stimuli depolarize parts of the same neuron, the brain interprets them as if they were one stimulus.

Practice Skills

observe and infer, compare and contrast, recognize cause and effect, collect and organize data, interpret data, experiment, analyze, summarize.

Teaching Strategies

If students find counting backwards awkward, have them whistle or sing a song as another kind of distraction.

Expected Results

A distraction should increase reaction time.

Analysis

1. As students learn to anticipate the drop, their reaction time should improve.
2. The distraction probably increased their reaction time. Answers may include being tired, sick, hungry, or otherwise preoccupied.
3. What other factors, besides distractions, would increase your reaction time?
4. How was your reaction time affected by the distraction?
5. Did your reaction time improve with practice? Explain.

Procedure

Work with a partner. Sit facing your partner as he or she stands. Have your partner hold the top of a meterstick above your hand. Hold your thumb and index finger about 2.5 cm away from either side of the lower end of the meterstick without touching it. Tell your partner to drop the meterstick straight down between your fingers.

Catch the meterstick between your thumb and finger as soon as it begins to fall. Measure how far it falls before you catch it. Practice several times.

Run ten trials, recording the number of centimeters the meterstick drops each time. Average the results.

Repeat the experiment, this time counting backwards from 100 by fives (100, 95, 90, . . .) as you wait for your partner to throw the meterstick drops each time. Average the results.

Analysis

1. Did your reaction time improve with practice? Explain.
2. How was your reaction time affected by the distraction (counting by fives)?
3. What other factors, besides distractions, would increase reaction time?

Assessment

Have students describe the sequence of events involved in their response to the falling meterstick. They should identify the stimulus (seeing the falling stick), the path of the impulse in their bodies, and the effect (grasping the stick). Use the Performance Task Assessment List for Events Chain in PASC, p. 91.

Kinesthetic Demonstrate the knee-jerk reflex using a rubber hammer. Point out that students did not choose to move their legs—they did so automatically.

3 Assess

Choice for Understanding

Make sure students understand that some parts of the nervous system are not under conscious control. Test their understanding by asking students to list body functions that they can and cannot control. Have them identify the part of the brain that controls each function.

Resource Manager

Laboratory Manual, pp. 261-264

1. Which areas of the skin did you find most sensitive? Least sensitive?
2. Responses will vary depending upon the areas tested. Regions of the back and inner arms will be less sensitive than areas of the palms and fingers.
3. Explain why two stimuli are felt as two points when the ends of the paper clip are moved farther apart. The two signals are detected by different sensory neurons.
4 Close
Discussion
Ask students what would happen if their cerebellum were damaged. For example, could they play a video game? probably not, because the cerebellum controls coordination.

The different divisions and subsystems of your nervous system are summarized in Figure 36.9. Each division plays a key role in communication and control within your body. Note that the sympathetic and parasympathetic systems are part of the autonomic nervous system. The autonomic and somatic systems are part of the peripheral nervous system. The peripheral nervous system feeds information to the central nervous system.

Sensory Chemicals
How are you able to smell and taste the lemonade? Chemical molecules of lemonade contact receptors in your nose and mouth as you sniff and drink the beverage. The receptors for smell are hairlike nerve endings located in the upper portion of your nose, as shown in Figure 36.10. Chemicals acting on these nerve endings initiate impulses in the olfactory nerve, which is connected to your brain. In the brain, this signal is interpreted as a particular odor.

The senses of taste and smell are closely linked. Think about what your sense of taste is like when your nose is stuffed up and you can smell nothing.

Figure 36.10. Olfactory nerve endings are in the upper portion of the nose. Smell molecules attach to these endings, initiating impulses in the olfactory nerve. (CNS) (voluntary) (involuntary) (visceral) (somatic) (nerve impulses) (olfactory bulb) (olfactory tract) (olfactory nerve) (olfactory receptor)
Concept Development

Ask students what kind of information the sense organs keep the body informed of. They inform the body of changes that occur in the surrounding. What is the reason for keeping the body informed? So that it can respond to changes in the environment.

Enrichment

Invite an audiologist to speak to the class about sound levels, how they are measured, and damage that may result from high levels. Have the audiologist demonstrate how hearing is tested.

Display

Visual-Spatial Obtain display models of the eye, ear, skin, or nose. Have students examine the models as they read about each sense.

Assessment

Knowledge: Have students write two questions about the sense of sight. Students should ask these questions of a classmate and then exchange questions with him or her.

2 Teach

Quick Demo

Auditory-Musical To show how important each sense is, play a tape of various common sounds that students can identify. Discuss the dependence of humans on senses and the adjustments that are made if one sense is lost.

2 Teach

Concept Development

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Problem-Solving Lab 36-1

Purpose

Students gain practice in determining whether statements are observations or inferences.

Process Skills

acquire information, define operationally, observe and infer, recognize cause and effect, think critically

Teaching Strategies

Refer students to the “Observing and Inferring” section in the Skill Handbook at the back of this text. The entire report can also be accessed on the Internet.

Thinking Critically

1. Student choices must include a specific number. A definition of the word "quantitative" should also be included in their answer.

2. Student choices should not include a specific number. A definition of the word "qualitative" should also be included in their answer.

3. Student may cite sentences that include "may be" or "can." A definition of the word "inference" should also be included in their answer.

4. Student answers may include the wearing of protective hearing devices and reducing volume or exposure time.

Assessment

Portfolio Ask students to research the meaning of the term disease and then prepare a poster listing noise-causing agents and their decibel ratings. Have them place the posters in their portfolios. Use the Performance Task Assessment List for Poster in PASC, p. 73.

Problem-Solving Lab 36-1

Interpreting and Analyzing

When are loud sounds dangerous to our hearing? Observations may be described as either qualitative or quantitative. A qualitative observation about a woman's height might be that she is tall. A quantitative observation about the same person might be that she is 1.92 m tall.

Analysis

"Hearing loss affects approximately 28 million people in the United States. Approximately 10 million of these impairments may be partially attributable to damage from exposure to loud sounds. Sounds that are sufficiently loud to damage sensitive inner ear structures can produce hearing loss that is not reversible. Very loud sounds of short duration, such as an explosion or gunfire, can produce immediate, severe, and permanent loss of hearing. Longer exposure to less intense but still hazardous sounds encountered in the workplace or during leisure activities, even a gradual toll on hearing sensitivity initially without the victim's awareness, is now recorded high-volume music, lawn care equipment, and airplanes are examples of potentially hazardous noise."


Thinking Critically

1. Choose and record two sentences or phrases from the passage above that provide examples of quantitative observations. Explain your selections.

2. Choose and record two sentences or phrases that provide examples of qualitative observations. Explain your selections.

3. Choose and record one sentence or phrase that provides an example of an inference. Explain your selection.

4. Suggest ways to minimize the type of noise exposure discussed in the last sentence.

Section Assessment

Understanding Main Ideas

1. Summarize the types of messages the senses receive.

2. When you have a cold, why is it hard to taste food?

3. Explain how your eyes detect light and dark.

4. What types of receptors are found in the skin?

Thinking Critically

5. Why might an ear infection lead to problems with balance?

Resource Manager

Reinforcement and Study Guide, p. 161

Content Mastery, p. 179

Concept Mapping, p. 36

Basic Concepts Transparency 69 and Master 69

Reaching Skills Transparencies 52, 53 and Masters 1, 2, 5

Laboratory Manual, pp. 265-268

Section Assessment

Understanding Main Ideas

1. The eyes respond to light. The ears respond to sound. Touch receptors respond to mechanical stimulation. The tongue and nose respond to chemicals.

2. The tasting of food involves the sense of smell and the sense of taste.

3. Light stimulates the rod or cone cells in the retina, which transmit a signal to the brain by way of the optic nerve.

4. Touch, temperature, pressure, and pain

5. Swelling associated with an ear infection causes fluid in the ear to put pressure on the semicircular canals and cause the hairs in the canals to signal a false sense of balance in the brain.

6. The ear, eardrum, malleus, incus, and stapes, fluid of cochlea, hairs of cochlea, auditory nerve to the brain

4 Close

Discussion

Ask students to identify which of the following professions could be undertaken by someone who has lost the sense of sight: architect, violinist, mathematician, public speaker, professional athlete, economist, physicist. What special tools (e.g., talking computers) would someone without sight have to use for each of the professions listed?

Assessment

Knowledges Provide students with a list of sensations (such as pain, pressure, cold, and heat) and ask them to place a check mark next to the sense organ that detects it.
The Effects of Drugs

Drugs Act on the Body

You probably hear the word drug used often, maybe even every day. A drug is a chemical that affects the body's functions. Most drugs interact with receptor sites on cells, probably the same ones used by neurotransmitters of the nervous system or hormones of the endocrine system. Some drugs increase the rate at which neurotransmitters are synthesized and released, or slow the rate at which they are broken down, as illustrated in Figure 36.14. Other drugs interfere with a neurotransmitter's ability to interact with its receptor. Explore how these different drugs work on neurotransmitters by doing the Problem-Solving Lab on the next page.

Medical Uses of Drugs

A medicine is a drug that, when taken into the body, helps prevent, cure, or relieve a medical problem. Some of the many kinds of medicines used to relieve medical conditions are discussed below.

Relieving pain

Headache, muscle ache, cramps— all are common pain sensations. You just studied how pain receptors in your body send signals to your brain. Medicines that relieve pain manipulate either the receptors that initiate the impulses or the central nervous system that receives them.

Pain relievers that do not cause a loss of consciousness are called analgesics. Some analgesics, like aspirin, work by inhibiting receptors at the site of pain from producing nerve impulses. Analgesics that work on the central nervous system are called narcotics. Many narcotics are made from the opium poppy flower, shown in Figure 36.15. Opium, as they are called, can be useful in controlled medical therapy because only these drugs are able to relieve severe pain.

Problem-Solving Lab 36-2

Formulating Models

How do different drugs affect the levels of neurotransmitters in synapses? Drugs can act on neurotransmitters in a number of different ways. For example, they may speed up or slow down the release of a neurotransmitter. The drugs may also be able to prevent the reabsorption of a neurotransmitter back into the dendrite and/or the axon. Or, they may block the release of the neurotransmitter from the axon end of a neuron. They may also prevent the breakdown of the neurotransmitter by blocking the enzyme responsible for this action.

Analysis

Examine the diagram shown here, which illustrates how neurotransmitters work.

Thinking Critically

1. Design three different drugs:
   a. One that will block the enzyme responsible for this action.
   b. One that will prevent the neurotransmitter from reaching its receptor site on the dendrite.
   c. One that will block the release of the neurotransmitter from the axon.

2. Draw three separate figures to show how each of your drugs works.

3. Predict the effects of each drug on the body. Explain your answer.

Problem-Solving Lab 36-2

Purpose

Students design drugs that will interact with the action of neurotransmitters.

Process Skills

apply concepts, formulate models, hypothesize, interpret scientific illustrations, predict, recognize cause and effect, think critically

Teaching Strategies

Review the nature of the synapse and how neurotransmitters work normally.

Encourage students to consider the shapes of the neurotransmitter molecules, enzymes, and binding sites when designing their blockers.

Allow students to work in small groups.

Thinking Critically

1. Student models will vary. Make sure each one produces the effect described.

2. Student figures should indicate how each of their drugs works.

3. (a) Message will be transmitted for a longer period of time than normal. (b) Message will not be received by target receptor. (c) Message will not be delivered to dendrite.

Assessment

Knowledge Ask students to make a diagram showing some type of neurotransmitter blocker. Ask them to interpret the drawing. Use the Performance Task Assessment List for Scientific Drawing in PASC, p. 55.

English Language Learners

Visual-Spatial Have students with limited English proficiency make a poster that summarizes the effects on different body systems of one drug that is misused or abused. Have students combine their posters to create a bulletin board display.

Resource Manager

Section Focus Transparency 89 and Master

Internet Address Book

Note Internet addresses that you find useful in the space below for quick reference.

GLENCOE TECHNOLOGY

VIDEO DISC The Infinite Voyage Pipers of the Brain: Neurotransmitters and the Chemical Basis of Mental Illness (Ch. 3), 3 min.

Internet Address Book

Dopamine and Antipsychotic Drugs

(Ch. 4), 7 min.

Using PCP to Study Schizophrenia

(Ch. 5), 7 min. 30 sec.
Pharmacist

Would you like to help people get well, but can’t stand the sight of blood? Then consider a career as a pharmacist.

Skills for the Job

Pharmacists read prescriptions written by doctors and other health professionals and carefully prepare the correct medicine. A few pharmacists still mix the medicine themselves; that is done by the drug manufacturer. Pharmacists must know how drugs interact and guide people in avoiding harmful combinations. They also help customers select over-the-counter medicines. Besides drugstores, pharmacists work in hospitals and nursing homes, and for drug companies and government agencies. To become a pharmacist, you must complete a five-year bachelor’s degree in pharmacy. You must also pass a state examination.

Careers in Biology

Animal Testing of Medicines

Linguistic Animals are used to test certain drugs. Some people believe that using animals is unnecessary. Ask students to do some research and then write an editorial for the student or local newspaper. Have them include a copy in their journals.

Quick Demo

Bring various over-the-counter drugs (such as aspirin, cough syrup, antacids, and so on) to hold up for the class. Compare such things as price, type of drug, type of packaging, and purpose of the drug.

Resource Manager

BioLab and MiniLab Workbooks, p. 160

BIOLOGY JOURNAL

GLENCOE TECHNOLOGY

VIDEO DISC

The Infinite Voyage of the Brain: Understanding Addiction

Ch. (8), 4 min.

Dopamine and the Craving of Narcotics

Ch. (9), 5 min.

Animal Testing of Medicines

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Figure 36.17 Babies born addicted to crack cocaine are usually low in birth weight, continually irritable, and may shake constantly.

Figure 36.18 Caffeine can trigger a condition called tachycardia, when the heart beats more than 100 times per minute.

Classes of Commonly Abused Drugs

Stimulants: Cocaine, amphetamines, caffeine, and nicotine

You already know that stimulants increase the activity of the central nervous system and the sympathetic nervous system. Increased CNS stimulation can result in mild elevation of alertness, increased nervousness, anxiety, or even convulsions. Caffeine stimulates the CNS by working on the part of the inner brain that governs emotions and basic drives, such as hunger and thirst. When these needs are met under normal circumstances, neurotransmitters—such as dopamine—are released to reward centers and the person experiences pleasure. Cocaine artificially increases levels of these neurotransmitters in the brain. As a result, false messages are sent to reward centers indicating that a basic drive has been satisfied. The user quickly feels a euphoric high called a rush. This sense of intense pleasure and satisfaction cannot be maintained; however, and soon the effects of the drug change. Physical hyperactivity follows, and the user is unable to sit still. Often, anxiety and depression set in.

Cocaine also disrupts the body’s circulatory system by interfering with the sympathetic nervous system. Although initially causing a slowing of the heart rate, it soon produces a great increase in heart rate and a narrowing of blood vessels, known as vasoconstriction. The result is high blood pressure. Heavy use of this drug compromises the immune system and often leads to heart abnormalities. Cocaine affects more than just the people who use it. As Figure 36.17 shows, babies of addicted mothers are sometimes born already dependent on this drug.

As you’ve already learned, amphetamines also cause vasoconstriction, a racing heart, and increased blood pressure. Other adverse side effects of amphetamine abuse include irregular heartbeats, chest pain, paranoia, hallucinations, and convulsions.

Not all stimulants are illegal. As shown in Figure 36.18, one stimulant in particular is as close as the nearest coffee maker or candy machine. Caffeine—a substance found in coffee, cola-flavored drinks, tea, and cola—is a CNS stimulant. Its effects include increased alertness and some mood elevation. Caffeine also causes an increase in heart rate and urine production, which can lead to dehydration.

Depressants: Alcohol and barbiturates

As you already know, depressants slow down the activities of the CNS. Most CNS depressants relieve anxiety, but most also produce noticeable sedation.

One of the most widely abused drugs in the world today is alcohol. Easily produced from various grains and fruits, such as those shown in Figure 36.19, this depressant is distributed throughout a person’s body via the bloodstream.

Unlike other drugs that act on specific receptors, alcohol probably acts on the brain by dissolving through the membranes of neurons. Once inside a neuron, alcohol disrupts important cellular functions. For instance, it appears to block the movement of sodium and calcium ions, which are important in the transmission of impulses and the release of neurotransmitters.
Barbiturates (four BIRCH ah rats) are sedatives and anti-anxiety drugs. When barbiturates are used in excess, the user’s respiratory and circulatory systems become depressed. Chronic use results in both tolerance and addiction.

Nicotinics: Opiates
Most narcotics are opiates, that is, they are derived from the opium poppy. They act directly on the brain. The most abused narcotic in the United States is heroin. It depresses the CNS, slows breathing, and lowers heart rate. Tolerance develops quickly, and withdrawal from heroin is painful.

Hallucinogens: Natural and synthetic
Natural hallucinogens have been known and used for thousands of years, but the abuse of hallucinogenic drugs did not become widespread in the United States until the 1960s, when new synthetic versions became widely available.

Hallucinogens (huh LEWS un uh june) stimulate the CNS—altering moods, thoughts, and sensory perceptions. Quite simply, the user sees, hears, feels, tastes, or smells things that are not actually there. This disorientation can impair the user’s judgement and place him or her in some potentially dangerous situations. Hallucinogens also increase heart rate, blood pressure, respiratory rate, and body temperature, and sometimes cause sweating, salivation, nausea, and vomiting. After large enough doses, convulsions of the body may even occur. Unlike the hallucinogens shown in Figure 36.21, LSD—or acid—is a synthetic drug. The mechanism by which LSD produces hallucinations is still debated, but it may involve the blocking of a CNS neurotransmitter.

Nicotine replacement therapy
Nicotine replacement therapy is one example of relatively successful drug treatment approach. People who are trying to break their addiction to tobacco often go through stressful withdrawals when they stop smoking cigarettes. To ease the intensity of the withdrawal symptoms, patients wear adhesive patches that slowly release small amounts of nicotine into their bloodstream, as shown in Figure 36.22. Alternatively, pieces of nicotine-containing gum are chewed periodically to temporarily relieve cravings.

Nicotine inhalers—similar to asthma inhalers—provide immediate relief. By gradually decreasing the amount of nicotine released by the patches—or the number of gum pieces chewed—cigarette smokers are able to minimize the withdrawal symptoms that often result in a failure to quit.

4 Close
Discussion
Ask students to discuss the consequences of introducing any type of drug into the body. Bring out that all drugs affect body function. Some drugs help the body establish and maintain homeostasis while other drugs, those most frequently abused, alter homeostasis.

Resource Manager
Reinforcement and Study Guide, p. 162
Content Mastery, pp. 177, 180
Tech Prep Applications, p. 49

Assessment
Knowledge
Have one student name a drug from the chapter and a second student categorize the drug as a stimulant, depressant, narcotic, or hallucinogen. Have a third student list a safe effect of the drug. Continue around the class until each student has been involved.

Evaluation
Have students write a paragraph explaining how nicotine replacement therapy helps smokers to stop smoking.

Enrichment
Intrapersonal Have interested students research how the following toxins affect the nervous system and what they are used for: saxitoxin (from red tide), phystostigmine, alpha-hun- garotin, tetrodotoxin, and disopropyl fluorophosphate.

Concept Development
Intrapersonal Have students find out how computers are allowing pharmacologists to design new drugs.

3 Assess
Check for Understanding
Linguistic Have students make a list of stimulants and depressants and write a paragraph about how these substances affect the body.

Reteach
Linguistic Have students write a paragraph explaining how nicotine replacement therapy helps smokers to stop smoking.

Extension
Have students research information about genetic susceptibility to alcoholism.

Biology Journal
Evaluating Advertising
Interpersonal Ask students to cut out cigarette ads from magazines. Post the ads on a bulletin board so all students can view them. In groups, have students discuss who the ads are likely to influence (the targeted audience). Ask students to select one ad and discuss its effectiveness.

Understanding Main Ideas
1. In what ways can drugs be used to treat cardiovascular problems?
2. What is the difference between aspirin and a narcotic?
3. How does nicotine affect the body?
4. How can drugs affect levels of neurotransmitters between neurons?

Thinking Critically
5. Suggest why a physician but not a pharmacist is legally permitted to write prescriptions.
6. Comparing and Contrasting Distinguish between stimulants and depressants, comparing their effects on the body. For more help, refer to Thinking Critically in the Skill Handbook.

Section Assessment
1. Drugs are used to normalize an irregular heartbeat, increase the heart’s pumping capacity, or enlarge small blood vessels.
2. Aspirin inhibits the production of impulses at the site of pain, while narcotics work on the central nervous system to relieve pain.
3. Nicotine will stimulate the central nervous system, causing an increase in heart rate, blood pressure, and breathing rate.
4. Drugs can increase or decrease the amount of neurotransmitters found between neurons.
5. A physician knows the medical history of the patient and can treat problems that might occur as side effects of the drug.
6. Stimulants increase the activity of the central and sympathetic nervous systems. Depressants decrease the activity of the central nervous system and increase the activity of the parasympa- thetic nervous system. Stimulants can increase alertness, nervousness, anxiety, heart rate, and breathing rate. Depressants do the opposite.

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THE EFFECTS OF DRUGS 995

Understanding Main Ideas
1. In what ways can drugs be used to treat a cardiovascular problem?
2. What is the difference between aspirin and a narcotic?
3. How does nicotine affect the body?
4. How can drugs affect levels of neurotransmitters between neurons?

Thinking Critically
5. Suggest why a physician but not a pharmacist is legally permitted to write prescriptions.
6. Comparing and Contrasting Distinguish between stimulants and depressants, comparing their effects on the body. For more help, refer to Thinking Critically in the Skill Handbook.

Section Assessment
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**Problem**

What are some possible materials you can use to dilute solutions of caffeine and tobacco?

**Hypotheses**

Based on what you learned in this chapter, which of the solutions listed under Possible Materials do you think are stimulants? Which are depressants? How will they affect the heart rate of Daphnia?

**Possible Materials**

- Caffeine
- Tobacco
- Ethyl alcohol
- Distilled water

**Safety Precautions**

- Students should prepare weak solutions of caffeine and tobacco.
- Dilute each solution with 1 part water to 1 part cola.
- Use the dropper to add small amounts of the solution to the Daphnia.

**Possible Procedures**

1. Use a dropper to place a single Daphnia on a slide.
2. Observe the animal and note any changes in heart rate.
3. Place two drops of the drug-containing substance directly to the slide.
4. When you are finished testing one drug, you will need to wash your hands and then filter the solution.

**Plan the Experiment**

1. Choose two drugs to test. Use the combination you choose to dilute caffeine and tobacco.
2. Plan to add two drops of the drug-containing substance directly to the slide.
3. When you are finished testing one drug, you will need to wash your hands and then filter the solution.
4. Plan to use a new Daphnia for each substance tested.

**Analyze and Conclude**

1. Making Inferences: Which drugs are stimulants? Which are depressants?
2. Checking Your Hypotheses: Compare your predicted results with the experimental data. Explain whether or not your data support your hypothesis regarding the drug's effects.
3. Drawing Conclusions: How do the drugs affect the heart rate of each animal?
4. Analyzing the Procedure: How would you alter your experiment if you did it again?
Thinking Critically

Any place in the body where blood flows and metabolic activity is occurring, positron emission tomography (PET) scanners can be used to monitor with PET scanners. This is because these isotopes emit detectable radiation, they can be tracked by the sensitive PET scanner. Computers create a picture of the radioisotope circulations through the body, it emits positively charged particles called positrons. The positrons collide with electrons in body tissues, causing the release of gamma rays that are detected by PET receptors.

Purpose

Students learn how radioactive isotopes are used in positron emission tomography (PET).

Background

PET scanners are excellent tools for studying the human brain. By monitoring either the blood flow to an area or the amount of glucose being metabolized there, doctors are able to pinpoint active sections of the brain.

Here’s how it works: The patient is injected with a compound containing radioactive isotopes. Because these isotopes emit detectable radiation, they can be tracked by the sensitive PET scanner. Computers create a picture of brain activity by converting the energy emitted from the radioisotopes into a colorful map. The image indicates the location of an activity, such as glucose utilization, and its relative intensity in various regions.

Applications for the Future

PET scanners are important in brain research, including the detection and diagnosis of brain tumors, the evaluation of damage due to stroke, and the mapping of brain functions. PET scans can also be used to see how learning takes place in the brain. The images on this page show activity in the left and right brains of two different people. Each person was given a list of nouns and asked to visualize them. The unpracticed brain (top) had no previous experience with this exercise and thus was forced to engage in a high level of brain activity to perform the task. The practiced brain (bottom), by comparison, was able to picture the words with much less brain activity. Biologists can discover functions of different parts of the brain and their roles in learning.

PET scans are also proving useful in the study of drug and alcohol addiction. Addicts can be given the addictive drug and then asked questions about their physical and emotional status while the scanner records metabolic activity in the brain. Researchers hope that information gained from the study of drug addiction will provide help in diagnosing and treating multi-depressive psychosis and schizophrenia.

Investigating the Technology

Thinking Critically

Any place where blood flows and metabolic activities occur. Students may mention different organ systems.

How to Use PET Scanners

To make use of PET scanners, students are injected with short-lived radioisotopes such as C-11, N-13, or O-15. As the radioisotope circulates through the body, it emits positively charged particles called positrons. The positrons collide with electrons in body tissues, causing the release of gamma rays that are detected by PET receptors.

Teaching Strategies

PET scanners can be used to measure activities that involve circulation of chemicals or chemical reactions in the body. Ask students to list some body activities that doctors might be able to monitor with PET scanners.

Investigating the Technology

Thinking Critically

Any place where blood flows and metabolic activities occur. Students may mention different organ systems.

Students can find out how PET scans are used to distinguish between the two types of breast tumor: those that have estrogen receptors and those that do not have estrogen receptors.

PET scan

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Any place where blood flows and metabolic activities occur. Students may mention different organ systems.

Students can find out how PET scans are used to distinguish between the two types of breast tumor: those that have estrogen receptors and those that do not have estrogen receptors.
1. Which of the following is NOT part of the brain?
   a. cerebrum  c. cerebellum  b. diencephalon  d.pons

2. Which of the following is NOT a type of neuron?
   a. internerveuron  b. sensory neuron  c. motor neuron  d. stimulus neuron

3. Which portion of the brain controls balance, posture, and coordination?
   a. cerebral cortex  b. cerebellum  c. medulla oblongata  d. pons

4. Which vision cells allow humans to see in low light?
   a. photoreceptors  b. cone cells  c. rods  d. retinal sheet

5. Which part of the ear is involved in maintaining balance?
   a. semicircular canals  b. cochlea  c. medulla oblongata  d. pons

6. Which drug type relieves pain by inhibiting receptors at the site of pain?
   a. stimulants  b. depressants  c. narcotics  d. analgesics

7. What type of drug is nicotine?
   a. stimulant  b. depressant  c. hallucinogen  d. synthetic

8. Which of these is NOT a type of receptor found in the dermis of the skin?
   a. pain  b. light  c. pressure  d. temperature

9. Which of the following drugs depresses the activities of the CNS?
   a. nicotine  b. alcohol  c. aspirin  d. opiate

10. Which type of neuron carries impulses toward the brain?
    a. sensory neuron  b. motor neuron  c. association neuron  d. none of the above

11. The basic unit of structure and function in the nervous system is the ________ or nerve cell.
    a. sensory neuron  b. motor neuron  c. association neuron  d. neuron

12. Most ________ are surrounded by a white covering called the ________, or myelin sheath.
    a. neurons  b. axons  c. synapses  d. dendrites

13. When a stimulus excites a neuron, ________ ions rush into the cell.
    a. sodium  b. potassium  c. calcium  d. charge

14. The ________ of the brain is the region between one neuron's axon and another neuron's dendrites.
    a. association  b. corpus  c. synapse  d. neuron

15. An ________ is a single extension of a neuron that carries messages ________ the cell body.
    a. nerve  b. neuron  c. axon  d. dendrite

16. A ________ is the region between one neuron's axon and another neuron's dendrites.
    a. synapse  b. cortex  c. dendrite  d. axon

17. Chemicals called ________ diffuse across synapses and stimulate neurons.
    a. neurotransmitters  b. hormones  c. neuropeptides  d. neurotransmitters

18. An ________ is a psychological or physiological dependence on a ________ drug.
    a. dependence  b. substance  c. withdrawal  d. tolerance

19. The ________ on the tongue contain sensory receptors that send taste signals to the brain.
    a. taste buds  b. taste cells  c. analgesic  d. sensory neuron

20. Alcohol is a ________ that slows the activities of the ________ system.
    a. depressant  b. central  c. brain  d. stimulant  e. peripheral

21. You are making a ferry crossing during rough weather and the horizon seems to be moving up and down as you hold on to the railing. You begin to feel seasick. Explain what is going on inside your body that might be causing this sensation.

22. Tetrahydrocannabinol, a chemical produced by the puffer fish, blocks sodium channels. How does this toxin help the fish capture its prey?

23. Explain how alcohol depresses the normal functions of a neuron.

24. Observing and Inferring. A medicine has this precaution on its label: “Avoid driving a motor vehicle while taking this medicine as it may cause drowsiness.” What type of drug does this medicine contain? Explain.

25. Concept Mapping. Complete the concept map by using the following vocabulary terms: neurotransmitters, axons, dendrites, synapses.

   - contain branch-like extensions called ________
   - contain long, single extensions called ________
   - release chemicals called ________
   - which diffuse across ________

26. How do a neuron and the fuse compare in terms of repeated use?
    a. Neither the fuse nor the neuron can be used repeatedly.
    b. The fuse can be used over and over, but the neuron must regrow before being reused.
    c. Both involve the combustion of oxygen.
    d. Both involve the combustion of oxygen.

27. As a part of his job in building a new highway, a construction worker is planning to light a fuse hooked to some TNT to blast out a portion of rock.

   - http://www.glencoe.com/sec/science

29. For additional review, use the assessment options for this chapter found on the Biology: The Dynamics of Life Interactive CD-ROM and on the Glencoe Science Web Site.
   - www.glencoe.com/sec/science


31. The medicine may contain a depressant or mild narcotic.

32. Alcohol blocks the movement of sodium and calcium ions, which are responsible for transmitting impulses.

33. As part of his job in building a new highway, a construction worker is planning to light a fuse hooked to some TNT to blast out a portion of rock.

34. APPLYING MAIN IDEAS

   1. Both involve the combustion of oxygen.
   2. Both involve the combustion of oxygen.
   3. Both involve the combustion of oxygen.
   4. Both involve the combustion of oxygen.

35. APPLYING MAIN IDEAS

   1. Both are due to the movement of an electric current down an axon similar to the movement of an electric current in a wire.
   2. Both are due to the movement of an electric current down an axon similar to the movement of an electric current in a wire.
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36. APPLYING MAIN IDEAS

   1. Both involve sodium channels.
   2. Both involve sodium channels.
   3. Both involve sodium channels.
   4. Both involve sodium channels.

37. APPLYING MAIN IDEAS

   1. Both are due to the movement of an electric current down an axon similar to the movement of an electric current in a wire.
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