The Nervous and Endocrine Systems

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Chapter 1: The Nervous and Endocrine Systems

Chapter Outline

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1.3 Worksheet Answer Keys

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- Types of Neurons

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**Pacing the Lessons**

Use the **Class Periods per Lesson** table below as a guide for the time required to teach the lessons of this chapter.

<table>
<thead>
<tr>
<th>Lesson</th>
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- Class periods are assumed to be 60 minutes long.

**Online Resources**

See the following Web sites for appropriate laboratory activities:

1. In this lab, students will map the density of sensory receptors in skin on different parts of the body. (Lesson 22.1)
   - http://outreach.mcb.harvard.edu/teachers/Summer05/ElizabethMick/Homonculus.pdf

2. This group inquiry lab allows students to investigate the effects of environment on memory. (Lesson 22.1)

3. In this lab, students will model how the endocrine system uses feedback mechanisms to maintain homeostasis. (Lesson 22.2)

These Web sites may also be helpful:

1. These neurobiology lesson plans were developed by high school teachers for use in high school introductory or advanced biology classes. They include activities, labs, and PowerPoint presentations.
   - http://outreach.mcb.harvard.edu/lessonplans_S05.htm

2. This URL provides lesson plans to teach the endocrine system to high school biology students.
   - http://www.eduref.org/Virtual/Lessons/Science/Anatomy/ANA0005.html
Key Concept

Neurons are the structural and functional units of the nervous system. They carry electrical messages called nerve impulses. The central nervous system includes the brain and spinal cord. The peripheral nervous system includes all the nervous tissue outside of the central nervous system. The peripheral system has several divisions and subdivisions that transmit nerve impulses between the central nervous system and the rest of the body. Human senses include sight, hearing, balance, taste, smell, and touch. Sensory organs respond to sensory stimuli and send nerve impulses to the brain, which interprets them and forms a response. Psychoactive drugs affect the central nervous system. They may be abused and lead to addiction. Disorders of the nervous system include strokes, injuries, and Alzheimer’s disease.

Standards

• CA.9–12.IE.1.d; CA.9–12.LS.9.b, c, d, e
• NSES.9–12.A.1.6; NSES.9–12.C.6.1; NSES.9–12.F.1.1, 4
• AAAS.9–12.6.C.2, 3

Lesson Objectives

• Describe the structure of a neuron, and identify types of neurons.
• Explain how nerve impulses are transmitted.
• Identify parts of the central nervous system and their functions.
• Outline the divisions and subdivisions of the peripheral nervous system.
• Explain how sensory stimuli are perceived and interpreted.
• State how drugs affect the nervous system.
• Identify several nervous system disorders.

Lesson Vocabulary

• action potential: reversal of electrical charge across the membrane of a resting neuron that travels down the axon of the neuron as a nerve impulse
• autonomic nervous system (ANS): division of the peripheral nervous system that controls involuntary activities not under conscious control such as heart rate and digestion
• axon: long extension of the cell body of a neuron that transmits nerve impulses to other cells
• brain: central nervous system organ inside the skull that is the control center of the nervous system
• brain stem: lowest part of the brain that connects the brain with the spinal cord and controls unconscious functions such as heart rate and breathing
• **cell body**: central part of a neuron that contains the nucleus and other cell organelles
• **central nervous system (CNS)**: one of two main divisions of the nervous system that includes the brain and spinal cord
• **cerebellum**: part of the brain below the cerebrum that coordinates body movements
• **dendrite**: extension of the cell body of a neuron that receives nerve impulses from other neurons
• **drug abuse**: use of a drug without the advice of a medical professional and for reasons not originally intended
• **drug addiction**: situation in which a drug user is unable to stop using a drug
• **interneuron**: type of neuron that carries nerve impulses back and forth between sensory and motor neurons
• **motor neuron**: type of neuron that carries nerve impulses from the central nervous system to muscles and glands
• **myelin sheath**: lipid layer around the axon of a neuron that allows nerve impulses to travel more rapidly down the axon
• **nerve**: one of many cable-like bundles of axons that make up the peripheral nervous system
• **nerve impulse**: electrical signal transmitted by the nervous system
• **nervous system**: human body system that carries electrical messages throughout the body
• **neuron**: nerve cell; structural and functional unit of the nervous system
• **neurotransmitter**: chemical that carries a nerve impulse from one nerve to another at a synapse
• **peripheral nervous system (PNS)**: one of two major divisions of the nervous system that consists of all the nervous tissue that lies outside the central nervous system
• **psychoactive drug**: drug that affects the central nervous system, generally by influencing the transmission of nerve impulses in the brain
• **resting potential**: difference in electrical charge across the plasma membrane of a neuron that is not actively transmitting a nerve impulse
• **sensory neuron**: type of neuron that carries nerve impulses from tissue and organs to the spinal cord and brain
• **sensory receptor**: specialized nerve cell that responds to a particular type of stimulus such as light or chemicals
• **somatic nervous system (SNS)**: division of the peripheral nervous system that controls voluntary, conscious activities and reflexes
• **spinal cord**: thin, tubular bundle of nervous tissue that extends from the brain stem down the back to the pelvis and connects the brain with the peripheral nervous system
• **synapse**: place where an axon terminal meets another cell

### Teaching Strategies

#### Introducing the Lesson

Use the colorful, well-illustrated PowerPoint presentation at the URL below to introduce students to the human nervous system. The presentation covers the same topics as the FlexBook lesson and will help stimulate student interest in the nervous system.

- [http://outreach.mcb.harvard.edu/teachers/Summer05/ElizabethMick/TheNervousSystem.pptx](http://outreach.mcb.harvard.edu/teachers/Summer05/ElizabethMick/TheNervousSystem.pptx)

#### Activity

Assign the Web quest at the URL below. Students will be directed to a series of Web sites that help them understand the structure and function of neurons and the connection between neurotransmission and addiction to psychoactive drugs. Then students will use what they learn create a poster, pamphlet, or oral presentation. The pdf document provides resources, graphics, worksheets, a quiz, and grading rubrics.
1.1. The Nervous System

Differentiated Instruction

Have kinesthetic learners and any visually impaired students do the hands-on modeling activity at the URL below. They will make bead neurons and use them to model the transmission of nerve impulses. SN

- http://brainu.org/bead-neuron

Enrichment

Suggest that interested students do the spinal cord injury Web quest at the URL below. They will learn more about spinal cord injuries and paralysis, as well as technological innovations to provide functional electrical stimulation to paralyzed patients. Students will be asked to reflect on how development of the innovations required the collaboration of many scientists and engineers and how it serves as model for the scientific process.


Science Inquiry

Have groups of students try to solve the case study problem presented in the first URL below. The pdf document will lead them through the case study and require them to develop a series of increasingly refined hypotheses about the cause of the patient’s symptoms (the correct diagnosis is amyotrophic lateral sclerosis, or Lou Gehrig’s disease). The second URL provides additional instructions for teachers, including ideas for assessment.

- http://outreach.mcb.harvard.edu/teachers/Summer05/KatieHorne/ALSCaseStudy.pdf
- http://outreach.mcb.harvard.edu/teachers/Summer05/KatieHorne/ALSpresentation.pdf

Chemistry Connection

Elaborate on the chemistry of neurotransmitters. This will help students understand how therapeutic drugs (such as antidepressants) and other psychoactive drugs (such as cocaine) affect neurotransmission and brain function. See the Web sites below for additional information.

- http://www.chemistrydaily.com/chemistry/Neurotransmitter

Reinforce and Review

Lesson Worksheets

Copy and distribute the lesson worksheets in the CK-12 Biology Workbook. Ask students to complete the worksheets alone or in pairs as a review of lesson content.
Review Questions

Have students answer the Review Questions that are listed at the end of the lesson in their FlexBook.

- Sample answers to these questions will be provided upon request. Please send an email to teachers-requests@ck12.org to request sample answers.

Points to Consider

In this lesson, you learned that the nervous system enables electrical messages to be sent through the body very rapidly.

- Often, it’s not necessary for the body to respond so rapidly. Can you think of another way the body could send messages that would travel more slowly? What about a way that makes use of the network of blood vessels throughout the body?
  - (Sample answer: Messages could travel in the blood.)

- Instead of electrical nerve impulses, what other way might messages be transmitted in the body? Do you think chemical molecules could be used to carry messages? How might this work?
  - (Sample answer: The chemical molecules might travel to specific cells and affect how they function.)
1.2 The Endocrine System

Key Concept

The endocrine system consists of glands that secrete hormones into the bloodstream. It is regulated by the hypothalamus, which controls the pituitary gland. The pituitary is the “master gland” of the endocrine system. Its hormones regulate other endocrine glands, which include the thyroid gland and pancreas. Hormones work by binding to receptors in or on target cells. Most hormones are controlled by negative feedback, which brings things back to normal when they start to become too extreme. Endocrine system disorders include endocrine gland tumors and type 1 diabetes.

Standards

- CA.9–12.IE.1.d; CA.9–12.LS.9.c, g, i
- NSES.9–12.A.1.6
- AAAS.9–12.5.C.5, 7; AAAS.9–12.6.C.2, 3; AAAS.9–12.6.E.1; AAAS.9–12.11.A.1, 3; AAAS.9–12.11.C.5

Lesson Objectives

- List the glands of the endocrine system and their effects.
- Explain how hormones work by binding to receptors of target cells.
- Describe feedback mechanisms that regulate hormone secretion.
- Identify three endocrine system disorders.

Lesson Vocabulary

- **adrenal glands**: pair of endocrine glands located above the kidneys that secrete hormones such as cortisol and adrenaline
- **endocrine system**: human body system of glands that release hormones into the blood
- **gonads**: glands that secrete sex hormones and produce gametes; testes in males and ovaries in females
- **hypothalamus**: part of the brain that secretes hormones
- **pancreas**: gland near the stomach that secretes insulin and glucagon to regulate blood glucose and enzymes to help digest food
- **parathyroid glands**: pair of small glands in the neck that secrete hormones that regulate blood calcium
- **pineal gland**: gland of the endocrine system that secretes the hormone melatonin that regulates sleep-wake cycles
- **pituitary gland**: master gland of the endocrine system that secretes many hormones, the majority of which regulate other endocrine glands
- **target cell**: type of cell on which a particular hormone has an effect because it has receptor molecules for the hormone
- **thyroid gland**: large endocrine gland in the neck that secretes hormones that control the rate of cellular metabolism throughout the body

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### Teaching Strategies

#### Introducing the Lesson

Ask volunteers to explain how a thermostat controls the air temperature inside a house. Add to their explanation as necessary so that the process of negative feedback is adequately explained. Tell the class that similar processes are at work in the human body and they are controlled by the endocrine system, which they will read about in this lesson.

#### Activity

Have students work through the blood sugar homeostasis animation at the URL below. By exploring this example in depth, they will gain an appreciation of the complexity of hormone regulation and how it maintains homeostasis.

- [http://outreach.mcb.harvard.edu/animations.htm](http://outreach.mcb.harvard.edu/animations.htm)

#### Differentiated Instruction

Ask students to make a Frayer model for the vocabulary term “hormone.” They should provide a definition, drawing, example, and non-example of the term. **ELL, LPR**

#### Enrichment

Ask a few creative students to write a rap or song about the endocrine system. It should identify the endocrine glands and their hormones and also explain how hormones work. Give the students a chance to perform their rap or song for the rest of the class.

#### Science Inquiry

Assign the inquiry activity at the URL below. In the activity, students will make hormone-receptor models to understand how hormones bind to specific receptors before initiating a cellular response.

- [http://www.pbs.org/wgbh/nova/teachers/activities/3313_03_nsn.html](http://www.pbs.org/wgbh/nova/teachers/activities/3313_03_nsn.html)

#### Health Connection

Tell students that hormones may play an important role in mental as well as physical health. Relate hormone imbalances to disorders such as depression and anxiety. To learn more, go to the URLs below.

- [http://www.timesonline.co.uk/tol/life_and_style/health/article3639679.ece](http://www.timesonline.co.uk/tol/life_and_style/health/article3639679.ece)
- [http://apt.rcpsych.org/cgi/reprint/5/2/126.pdf](http://apt.rcpsych.org/cgi/reprint/5/2/126.pdf)
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Lesson Worksheets

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Review Questions

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Points to Consider

In this lesson, you learned that endocrine hormones can affect cells throughout the body because they travel in the blood through the circulatory system.

- Do you know what organs make up the circulatory system?
  - (The circulatory system includes the heart, blood, and blood vessels.)
- Can you explain what causes blood to move through the system?
  - (The heart pumps blood through the system.)
1.3 Worksheet Answer Keys

• The worksheet answer keys are available upon request. Please send an email to teachers-requests@ck12.org to request the worksheet answer keys.