Introduction
Intro to Unit

1. Title:
   “Human Nervous System”

2. Grade:
   Fifth

3. Target Group:
   Content-Based ESOL Class

4. Source of Written Reading Material:


5. Source of Lessons:

6. Goals:
   1. I want my students to know what the nervous system is.
   2. I want my students to know the main parts of the nervous system.
   3. I want my students to know how the nervous system works.
   4. I want my students to know some health problems related to the nervous system.
<table>
<thead>
<tr>
<th>ESL Language</th>
<th>Language Objectives</th>
<th>Content Objectives</th>
<th>Learning Strategies</th>
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</thead>
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<tr>
<td>Knowledge</td>
<td></td>
<td>1. Names of the main parts of the nervous system and its functions.</td>
<td>1. Brainstorm</td>
</tr>
<tr>
<td>Students will know</td>
<td>Vocabulary</td>
<td>2. Health problems related to the nervous system.</td>
<td>2. Think-Pair-Share</td>
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<td></td>
<td></td>
<td>3. How the nervous system work.</td>
<td>3. Create and use graphic organizers</td>
</tr>
<tr>
<td>Skills</td>
<td></td>
<td>1. Write a paragraph about a part of the brain or the spinal cord and a function of it.</td>
<td>4. Take notes</td>
</tr>
<tr>
<td>Students will be able to</td>
<td></td>
<td>2. Answer the questions, draw the conclusions about health problems related to a damaged area of the nervous system and record it on a bulletin board.</td>
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<td></td>
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<td>3. Compare and contrast voluntary and involuntary actions using Venn diagram.</td>
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<td>4. Explain the path of a reflex.</td>
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<tr>
<td>Awareness</td>
<td></td>
<td>1. Identify three parts of the nervous system.</td>
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<tr>
<td>Students will</td>
<td></td>
<td>2. Name three main parts of the brain and identify a function of each.</td>
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<td></td>
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<td>3. Identify functions of the spinal cord.</td>
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<td>4. Discuss health problems that appear when a certain part of the nervous system is damaged.</td>
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<td>5. Recall the differences between involuntary and voluntary actions.</td>
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<td>6. Name three kinds of nervous cells and describe their functions.</td>
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<td>7. Diagram and describe the path of a reflex.</td>
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<tr>
<td></td>
<td></td>
<td>Aware that the brainstem is essential for life.</td>
<td>1. Brainstorm</td>
</tr>
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</table>
What is the nervous system?

Nerve cell
### FUNCTIONAL/NOTIONAL CHART

**Lesson #1 “What Is the Nervous System?”**  
**Pre-Production ELLs - Physical Response Only**

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
</table>
| Order – demonstrate understanding  
(Performing teachers orders e.g. by pointing) | Directions            | Find a __________.     | Verbs - commands  
Nouns -singular | Part, branch, cell,  
drawing, picture |
|                         | Directions            | Find __________.       | Nouns -plural    | Parts, branches, cell,  
drawings, pictures |
<p>| Order                   | Directions            | Look at the __________. | Verb – command   | Picture, drawings            |
| Describing (pointing to...) | Anatomy of nervous cell | Look ____ the picture. | Prepositions     | At, below, above             |
|                         |                       | A cell has ____ branch/-es. | Adjectives, numerals | Many, one, two              |</p>
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<td>Order</td>
<td>Directions</td>
<td>Find a ________</td>
<td>Verb - command Nouns -singular</td>
<td>Part, branch, cell, drawing, picture</td>
</tr>
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<td>Order</td>
<td>Directions</td>
<td>Find ________</td>
<td>Verb - command Nouns -plural</td>
<td>Parts, branches, cell, drawings, pictures</td>
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<td>Order</td>
<td>Directions</td>
<td>Look at the ________</td>
<td>Verb – command</td>
<td>Picture, drawings</td>
</tr>
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<td>Order</td>
<td>Directions</td>
<td>Look ____ the picture.</td>
<td>Prepositions</td>
<td>At, below, above</td>
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<tr>
<td>Describing</td>
<td>Anatomy of a nerve cell</td>
<td>A cell has ___ branch/-es.</td>
<td>Adjectives, numerals</td>
<td>Many, one, two</td>
</tr>
<tr>
<td>Describing</td>
<td>Functions of nervous system</td>
<td>A nervous cell can _____ messages.</td>
<td>Verb, modal</td>
<td>Receive, send</td>
</tr>
<tr>
<td>Statement</td>
<td>Comparing a toy robot to the nervous system</td>
<td>____ cannot ______.</td>
<td>Verb, modal, negative</td>
<td>Robots, toys, feel, understand</td>
</tr>
<tr>
<td>Describing</td>
<td>Comparing a toy robot to the nervous system</td>
<td>A____has a _____.</td>
<td>Verb, modal Noun singular Indefinite article</td>
<td>Toy, robot, computer part, wire</td>
</tr>
<tr>
<td>Describing</td>
<td>Comparing a toy robot to the nervous system</td>
<td>_____have _______.</td>
<td>Verb, modal Noun, plural</td>
<td>Toys, robots, computers, parts, wires</td>
</tr>
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### FUNCTIONAL/NOTIONAL CHART

**Lesson #1 “What Is the Nervous System?”**

**Speech Emergence ELLs**

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<thead>
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<tr>
<td>Order</td>
<td>Directions</td>
<td>Find a ________</td>
<td>Verb - command</td>
<td>Part, branch, cell, drawing, picture</td>
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<td>Order</td>
<td>Directions</td>
<td>Find ________</td>
<td>Verb - command</td>
<td>Parts, branches, cell, drawings, pictures</td>
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<td>Order</td>
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<td>Look at the ________</td>
<td>Verb - command</td>
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<td>Look ____ the picture</td>
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<td>At, below, above</td>
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<td>Adjectives, numerals</td>
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<td>Statement</td>
<td>Comparing robots and toys to nervous system</td>
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<td>Verb, modal, negative</td>
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<td>A ____ has a ____ .</td>
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<td>Verb, modal</td>
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### FUNCTIONAL/NOTIONAL CHART

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Speech Emergence ELLs

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<td>Describe</td>
<td>Two types of nerve branches</td>
<td>Some branches are</td>
<td>Adjectives, Verb, plural, present tense</td>
<td>Long, short</td>
</tr>
<tr>
<td>Describe</td>
<td>Two types of nerve branches</td>
<td>____ branches are ____</td>
<td>Adjectives, quantifiers</td>
<td>Some, many, few, long, short</td>
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<td>Order</td>
<td>Directions</td>
<td>Find a _______.</td>
<td>Verb - command</td>
<td>Part, branch, cell,</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Nouns -singular</td>
<td>drawing, picture</td>
</tr>
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<td>Find _______.</td>
<td>Verb - command</td>
<td>Parts, branches, cell,</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Noun singular</td>
<td>part, wire</td>
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<td>parts, wires</td>
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<td>Describe</td>
<td>Two types of nerve branches</td>
<td>____ branches are ____</td>
<td>Verb, plural, present tense</td>
<td></td>
</tr>
<tr>
<td>Inquiry</td>
<td>Discussing nerves</td>
<td>How ____ is the ____?</td>
<td>Quantifiers</td>
<td>Some, many, few, long, short</td>
</tr>
<tr>
<td>Compare</td>
<td>Nerves are compared to certain objects</td>
<td>____ are as ____ as _____ (adjective)</td>
<td>Attributive adjectives, Equative construction</td>
<td>Long, short, branches, arm, distance</td>
</tr>
<tr>
<td>Statement</td>
<td>Functions of nerves</td>
<td>____ controlled by the ____</td>
<td>Verbs, passive voice</td>
<td>Nerves, pencils, wires big, small</td>
</tr>
</tbody>
</table>
A Note for Teachers

This lesson contains a variety of different activities. However, it is hardly possible to incorporate all of them in one lesson. Therefore, I recommend to choose the ones that would suite your students' needs the best.

Respectfully,

Armand Zakarauskas
Lesson #1  What Is the Nervous System?
Nerve Cell

Lesson Plan

I. Objectives
A. Content objectives:

All students will:
- know the main parts of the human nervous system (HNS) and its functions.
- be able to identify three main parts of a nerve cell.

Advanced and intermediate ELLs will:
- be able to describe how messages travel through the different parts of a nerve cell.
- compare and contrast functions of the long and short branches of the HNS.

Speech emergence ELLs will:
- be able to answer questions in short sentences about parts of a nerve cell and how messages travel in nerve cells.

Early production ELLs will:
- be able to answer questions using yes/no or simple words about parts of a nerve cell and how messages travel in nerve cells.

Pre-production ELLs will:
- be able to answer questions pointing to parts of a nerve cell and draw the path that messages travel in nerve cells.

B. Language objectives:

Advanced ELLs will:
- write two paragraphs describing the HNS, its parts, and main functions; a nerve cell, its main parts and how messages travel in a nerve cell.

Intermediate ELLs will:
- write one paragraph about a nerve cell.

Discussing the HNS and nerve cells advanced and intermediate ELLs will be able to use in their conversations:
- questions for specific information (How is the ___?)
- passive voice constructions (___ controlled by the ____.)
- equative constructions (___ as adjective as _____.)

Speech emergence ELLs will:
- show their understanding about the HNS and a nerve cell through closed activities by filling correct words in the blanks.
- respond with short sentences using modals (can, cannot), numerals (many, one, two, ...).
show understanding about some prepositions (at, below, above).

*Early production ELLs* will:
- show their understanding about the HNS and a nerve cell by answering true/false questions about the HNS and nerve cells.
- respond with one or two words using nouns (cell, parts, branches), adjectives (long, short), numerals (one, two).

*Pre-production ELLs* will:
- identify new vocabulary words in the text.
- respond to the teacher’s directions (Find the ___, look at the ___.) by pointing to, and drawing the correct object.

II. Materials

- skeleton (pp.35-37)
- prepared charts, diagrams (pp.9, 20-24, 26, 32, 33)
- transparencies (pp.20, 41-58)
- adapted reading materials (pp.13-15) (O.L. see index pp. 2-4‘)
- activity sheets (pp.23-24, 26-34), O.L. (index pp.10-11)
- paper
- scissors
- glue
- toy-robot with control system (p.38)

III. Background knowledge  (5 min.)

*Advanced and intermediate ELLs* will:
- fill K-W-L charts about the HNS (p.19)

*Speech emergence and early production ELLs* will:
- brainstorm about a cell, its parts (students studied cells in previous lessons) and the HNS.

*Pre-production ELLs* will:
- point to parts of the human body and parts of a cell (p.58).

IV. Procedures  (45 min.)

A. *Instruction:*
- Teacher (T) will summarize information students (Ss) brainstormed or presented in their KWL forms. This information will lead to the conclusion that the HNS consists of three main parts.

- T will help Ss to locate approximate positions of the HNS in the skeleton (pp.35-37).

- The list of new words and their definitions (p.17) will be posted on the word wall and will be gradually introduced during the lesson. T will repeatedly pronounce and
explain the meaning of new words pointing to objects (computer p.39) and pictures (nerve cell p.49-56), using gestures (showing on his/her arm how the messages travel).

- T will demonstrate how the toy robot (p.38) works. Ss will identify its main parts. Through questioning T will help define analogy between a toy robot and the human body with respect to control system. Ss will compare the role of a robot control system with the role of the nervous system in the human body. Noticing analogy between the HNS and a robot control system Ss will try to articulate the main functions of the HNS. Ss will recognize similarities and differences between a toy robot and the HNS.

- Using transparencies and graphs (pp.49-56), T will introduce a nerve cell as the most important component of the HNS. Ss will notice differences between the nerve cell and other cells. T will help Ss to identify three main parts of a nerve cell. T will help and guide Ss to understand how messages travel through an nerve cell.

- While introducing new materials, T will repeat the important statements several times (p.18), making pauses and slowing the speech pace. Key concepts will be written on the blackboard and illustrated with, charts, diagrams and pictures (see Materials p.9).

- T will use gestures, point to his/her or student’s head and spine while talking about the HNS. T will demonstrate an approximate length of a nerve cell’s long branch on his/her arm.

B. Reading activities: (15 min.)

- For these activities advanced and intermediate ELLs will be paired with speech emergence, early production and pre-production ELLs. More advanced ELLs will read modified text (p.13-15). They will explain and help the less advanced ELLs to read and understand summarized and simplified text (p.16).

- While reading, students will work on their activity sheets. All ELLs will label main parts of HNS and nerve cells (p.23)

- Advanced and intermediate fluency ELLs will compare and contrast nerve cell’s branches using VENN diagram (p.24)

- Speech emergence ELLs will describe nerve cell’s branches using T-chart (p.26). Also they will work on the activity matching terms with their descriptions (p.27). If needed, their partners (more advanced ELLs) will help them by reading the terms and descriptions.

- T will help all students by explaining the directions and modeling the first sentence of each activity.

- Early production ELLs will find the right words in the columns describing the nerve cell and its parts (p.28). They will also work on the closed activity where they will have to fill in the blanks with the correct word from the word bank (p.29). In the last activity advanced partners will help early production ELLs to read the statements
about HNS and the nerve cell. Early production ELLs will circle T if the statement is true or F if the statement is false (p.30).

- **Pre-production ELLs** will have to find new words in the text from a given list while more advanced students will read the text to them (p.31).

### C. Post-reading activities: (10 min.)

- Advanced ELLs will write two paragraphs about the HNS and the nerve cell (p.32).
- Intermediate fluency ELLs will write one paragraph about the nerve cell (p.33).
- The rest of the students will do a project (hands on activity) (p.34). T will explain the directions and guide during the process. ELLs will have to cut the parts of the nerve cell and glue them together. They will have to show how the cells are connected. Later they will draw arrows indicating the route of the message.

### D. Evaluation

- The students’ new knowledge will be evaluated through oral and written activities.

  a) **Oral component:**

  - T will ask questions and **pre-production ELLs** will point to the proper parts of the HNS and the nerve cell, e.g.: *Where is a long branch of a nerve cell?*

  - T will ask questions and **early production ELLs** will replay with yes/no or one-two words answers, e.g.: 1. *This is the brain, isn’t it? Say yes or no.* 2. *Does a nerve cell have one or many long branches?*

  - T will ask questions and **speech emergence ELLs** will answer with short sentences. They will name and describe the main parts of the HNS and the nerve cell, e.g.: *What are the main parts of the human nervous system?*

  - **Intermediate fluency** and **advanced ELLs** will orally describe the HNS and the nerve cell, compare different nerve cell’s branches, and express their opinion.

  b) **Written component:**

  - Finished written activities will help T to evaluate ELLs’ new knowledge. Depending on the proficiency levels, Ss will work on activities during reading time and finish post-reading activities.

### E. Closure (5 min.)

- Advanced and **intermediate fluency ELLs** will summarize in a few sentences the new information they learned.
• **Speech emergence ELLs** will state the lesson’s key points using simple sentences.

• **Early production ELLs** will point and name the main parts of the HNS and a nerve cell.

• T will name the parts of the HNS and the nerve cell and **pre-production ELLs** will point to them on the charts or on their finished projects.
Lesson #1  
What Is the Nervous System  
Nerve Cell

Descriptive Narrative

In designing modifications for this fifth grade ESOI science class, I addressed the needs of different levels of ELLs and made the lesson more contextualized. In modifying the original lesson I added lots of visuals: charts, diagrams, pictures, and real objects. I suggested using lots of gestures when teaching vocabulary, activating prior knowledge and presenting a new lesson. Gestures and visuals would make input more comprehensible to ELLs.

To make text more comprehensible, I designed a word bank/word search activity. Two simplified versions of student text (modified text for advanced and intermediate ELLs, summarized text for less advanced students) were created. This would allow students of different levels be engaged in literacy activities. Summarized text is presented in shorter sentences and is more comprehensible for less fluent ELLs. It can also be used as a pre-teaching tool and would help ELLs follow the lesson.

The teacher’s talk should be comprehensible. For this purpose linguistic load was reduced in my lesson. The teacher should deliver lesson in short and simple sentences. The pace of speech should be slower. Pauses may be very helpful for students to comprehend a new material. I suggested to repeat key ideas several times and write them on the board.

All students should have opportunities to interact with other students. For this purpose I paired more advanced students with less advanced. I expect that more advanced students would serve as models and help less advanced students to read a new text and with writing assignments. Interaction with a partner would create a safe and stimulating environment for all students and would make them comfortable completing different activities.

Different activities appropriate for students fluency levels were proposed in my lesson. This would increase opportunities for all students meaningfully participate in the lesson and be engaged. The teacher should monitor and guide students throughout their activities. He/she should explain directions and model how to perform tasks.

The following strategies are incorporated in Lesson 1:
- Activating previous knowledge
- Visuals
- Modeling
- Developing vocabulary
- Modifying and simplifying text
- Framing main ideas
- Slowing teacher’s talk
- Repeating key ideas several times
- Teacher questioning and response strategies
- Pair-share
- Activities appropriate for fluency levels
- Real oral and written language
1. The Nervous System

Words to Know:
- nervous system
- nerve cell
- nerve
- brain
- spinal cord

Getting Started: Have you ever played with a toy robot? These toys have parts that move like parts of your body move. Some robots can even talk! What controls the robot's actions?!
What can you do that a robot cannot do?²

What system controls the body?
Most robots are controlled by a system of wires connected to a computer. The wires carry messages to and from the computer. These messages can make a robot do many things.

Like the robot, your body has a system that controls its actions. Most of the actions of the body are controlled by the nervous system. The nervous system is a control system made up of the brain, the spinal cord, and the nerves. Find these three parts in the drawing. Which part is found inside the head?²

Answers will vary, but may include the following: wires, batteries, computer, buttons, electricity.

Computers control robots.
Wires carry messages.

Nervous system controls body.
The main parts are: brain, spinal cord, nerves.
Nerves carry messages. Messages control body actions.

Nervous system is made up of nervous cells. A nerve cell receives and sends messages. A nerve cell has one long and many short branches.

A short branch carries messages to the cell body.

A long branch of one cell connects to a short branch of the other cell. Long branch carries messages from the cell body.

Messages can go only one way.

The Brain

5Answers will depend on the length of the student's arm.

5Answers will vary but may include the following: think, feel, laugh, cry, be angry, love someone.
Most **nerve cells** are found in **bundles**. A bundle of **nerve cells** is called a **nerve**. Some nerves are very small. Others are as big around as a pencil or your little finger. You can compare a nerve to an electric cable, which is made up of many small wires. To what parts of the nerve would you compare the small wires?\(^5\)

**What are the three parts of the brain?**

The main organ of the nervous system is the **brain**. The brain is the control center of the body. Most of the messages that move through the nervous system enter and leave the brain. In what way is the brain like the computer in a robot?\(^6\)

As the drawing shows, the brain has three parts. They are the **cerebrum** (SEH reh bruhm), the **cerebellum** (SEH reh bell um), and the **brainstem**. Each part of the brain controls certain activities.

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\(^{5}\)The nerve cells
\(^{6}\)In the robot, messages are carried into and out of the computer by wires.
Lesson #1  What Is the Nervous System
Nerve Cell

Summary

- Computers control robots.
- Wires connect computers and robots.
- The nervous system controls the body.
- There are three parts of the nervous system.
- Those parts are: the brain, the spinal cord, and nerves.
- The brain is like a computer.
- Nerves are like wires.
- Nerves carry messages.
- Messages control the body actions.
- Nerve cells make up the nervous system.
- Nerve cells receive and send messages.
- Nerves cells have long and short branches.
- A nerve cell has one long and many short branches.
- A long branch connects to short branches of another cell.
- Short branches carry messages to a cell body.
- Messages travel from a cell body to long branches.
- A long branch carries messages to short branches.
Lesson #1  What Is the Nervous System  
Nerve Cell

<table>
<thead>
<tr>
<th>Word Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>control</strong> - make someone or something do what you want</td>
</tr>
<tr>
<td><strong>system</strong> - a group of related parts that work together as a whole</td>
</tr>
<tr>
<td><strong>wire</strong> - thin metal in the form of a string</td>
</tr>
<tr>
<td><strong>connect</strong> - to join two or more things together</td>
</tr>
<tr>
<td><strong>message</strong> - a piece of information send from one person or place to another</td>
</tr>
<tr>
<td><strong>action</strong> - process of doing something</td>
</tr>
<tr>
<td><strong>cell</strong> - the smallest part of a living thing that can exist alone</td>
</tr>
<tr>
<td><strong>receive</strong> - get</td>
</tr>
<tr>
<td><strong>arrange</strong> - to put a group of things or people in a particular order or position</td>
</tr>
<tr>
<td><strong>bundle</strong> - group of wires</td>
</tr>
<tr>
<td><strong>compare</strong> - examine two or more things in order to show how they are similar to or different from each other</td>
</tr>
</tbody>
</table>
Lesson #1 What Is the Nervous System
Nerve Cell

Reducing Linguistic Load

Example

Slow pace, clear enunciation, shorter sentences, repetition, pauses between phrases or sentences

- The nervous system controls the body. (2)
- Three parts are: the brain, the spinal cord, and nerves. (3)
- Nerves carry messages. (2)
- Messages control the body actions. (2)

- Nerve cells make up the nervous system. (2)
- Nerve cells receive and send messages. (2)
- Nerves cells have long and short branches. (2)
- A nerve cell has one long and many short branches. (2)
- A long branch connects to short branches of another cell. (2)
- Short branches carry messages to a cell body. (2)
- Messages travel from a cell body to long branches. (2)
- A long branch carries messages to short branches. (2)
<table>
<thead>
<tr>
<th>What I Know</th>
<th>What I Want To Learn</th>
<th>What I Have Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson #1 What Is the Nervous System
Nerve Cell

Main Parts of Nervous System

- Brain
- Nerves
- Spinal cord
Lesson #1 What Is the Nervous System
Nerve Cell

Nerve cell

- Short branches
- Long branch
- Cell body
Lesson #1 What Is the Nervous System
Nerve Cell

The Route of the Message

Nerve Cell Body #1

Nerve Cell #1
Long Branch

Connection between
Long branch of nerve cell #1 and
Short branch of nerve cell #2

Nerve Cell #2
Short Branch

Nerve Cell Body #2
Nervous System
Nerve Cells.

Label the main parts of
the nervous system and the nerve cell.
Venn Diagram

A Venn diagram is used to compare and contrast two people, two places or two things. Write how two topics are the same and different in the circles below.

Topic 1: Nerve cell's long branch
Topic 2: Nerve cell's short branch

BOTH
A Venn diagram is used to compare and contrast two people, two places or two things. Write how two topics are the same and different in the circles below.

**Topic 1** Nerve cell’s long branch
- One branch
- Receive messages from the cell body
- Send messages to the short branches

**Topic 2** Nerve cell’s short branch
- Many branches
- Parts of nerve cell
  - Connected to the cell body
  - Receive messages
  - Send messages
  - Connection
- Receive messages from long branch
- Send messages to the cell body
t-Chart (speech Emergence) ELLs

<table>
<thead>
<tr>
<th>Short branch</th>
<th>Many</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Massages travel from the connection to the cell body.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Long branch</th>
<th>One</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Messages travel from the cell body to the connection.</td>
</tr>
</tbody>
</table>
Lesson #1  What Is the Nervous System
Nerve Cell

Activity
(Speech Emergence: ELLs)

Directions:
Mach each term in Column A with its description in Column B. Write the correct letter in the space provided.

_____  1. parts of nervous system        a) brain
_____  2. can be compared to cable wires  b) short branch
_____  3. parts of nervous cell          c) long branch
_____  4. can be compared to a computer  d) brain, spinal cord, nerves
_____  5. carries messages to the cell body e) nerves
_____  6. carries messages from the cell body f) cell body, short branches, long branch
**Lesson #1 What Is the Nervous System**

**Nerve Cell**

**Describing Nerve Cell**

1. It has  
   - one  
   - two  
   - three  
   - many  
   long branch/-es

2. It has  
   - one  
   - two  
   - three  
   - many  
   short branch/-es

3. It  
   - creates  
   - gets/sends  
   - blocks  
   messages

4. It’s long branch  
   - sends message  
   to  
   from  
   around  
   cell’s body

5. It’s short branch  
   - sends message  
   to  
   from  
   around  
   cell’s body

6. It’s long branch  
   sends message to  
   short branch  
   receives message from
Activity
(Early Production ELLs)

Directions:
Fill in the blanks. Use the words from the word bank.

Word Bank

| short | wires | nerves | arranged | long |

1. The brain works like a ________________.
2. ___________ are like wires.
3. Most of the body ____________ are controlled by nervous system.
4. Nerve cells are ____________ end to end.
5. __________ branch carry messages to a cell body.
6. __________ branch carry messages from a cell body.
7. Short branches look like __________.
Lesson #1 What Is the Nervous System
Nerve Cell

**True or False**

(Early production ELLs)

1. The nervous system controls the body systems. T/F
2. The nervous system is made up of two parts: the brain and nerves. T/F
3. Nerves carry messages to and from almost all parts of the body. T/F
4. A nerve cell cannot send messages. T/F
5. Most of nerve cells are arranged end to end. T/F
6. A nerve cell has many long branches and a one short branch. T/F
7. Messages travel from short branches to long branches. T/F
8. Messages travel both ways in a long branch. T/F
9. A nerve cell's long branch can be as long as an arm. T/F
10. Nerve cells look the same as cells of other systems. T/F
11. A bundle of nerve cell branches is called a nerve. T/F
Lesson #1 What Is the Nervous System
Nerve Cell

Activity
(Pre-production ELLs)

Human Nervous System
Nerve Cell

Directions
Find these words in the text:

- nerve
- computer
- branch
- system
- message
- compare
- human
- actions
- control
- cell
- wires
- receive
- connect
- arranging
Lesson #1 What Is the Nervous System
Nerve Cell

(Intermediate Fluency ELLs)

Write a paragraph about nerve cell.

A nerve cell is a cell that receives and sends
Lesson #1 What Is the Nervous System
Nerve Cell

(Advanced ELLs)

Write two paragraphs how the nervous system controls actions.

Describe the nervous system in a first paragraph.
Describe a nervous cell and how messages travel in a second paragraph.
NERVE CELLS

Create your nerve cells. Connect nerve cell #1 with nerve cell #2.

Directions:

1. Cut

2. Think

3. Glue

Nerve cell body #1

Nerve cell body #2

Short branches

Long branches
The Human Skeleton
The Human Skeleton
The Human Skeleton
Toy Robot
A Bundle of Wires
Brain and Spinal Cord
Brain, Spinal Cord and Nerves

NERVOUS SYSTEM - SPINAL NERVES

cerebrum
cervical nerves (innervate the neck and the arms)

brachial plexus

spinal cord

intercostal nerves

lumbar plexus

lumbar and sacral nerves (innervate the legs and pelvic organs)

sacral plexus
The Central and Peripheral Nervous Systems

Brain
Cerebellum
Spinal cord
Brachial plexus
Musculocutaneous nerve
Radial nerve
Median nerve
Ulnar nerve
Median nerve
Ulnar nerve
Common peroneal nerve
Deep peroneal nerve
Superficial peroneal nerve
Intercostal nerve
Subcostal nerve
Lumbar plexus
Sacral plexus
Femoral nerve
Pudendal nerve
Scatic nerve
Muscular branches of femoral nerve
Saphenous nerve
Tibial nerve

12 cranial nerves
8 cervical nerves
12 thoracic nerves
5 lumbar nerves
5 sacral nerves
1 coccygeal nerve
Chorda of vertebral ganglia, part of the nerve network of the autonomic system
Brain

Zebu

*Bos indicus*

1 cm

Univ. of Wisconsin-Madison Brain Collection

64-322
The Spinal Cord
Nerve cell

Axon Terminals (transmitters)

Schwann's Cells (they make the myelin)

Node of Ranvier

Axon (the conducting fiber)

Myelin Sheath (insulating fatty layer that speeds transmission)

NEURON

Dendrites (receivers)

Cell Body

Nucleus

©EnchantedLearning.com
The Nerve Cell
Nerve Cell

- Multipolar Neuron
Nerve cells, parts and connection

Parts of the Neuron and the Synapse

- Dendrites
- Axon
- Synapse
- Cell Body

Area of Synapse, Enlarged

- Sacs filled with Neurotransmitter
- Axon Terminal

Membrane of Target Cell [Postsynaptic Cell]

Synaptic Gap

Receptor
Nerve Cells

Histology Lab Part 2: Slide 53
A bundle of nerve cells
Nerve Cell

nerve cell
Nerve Cell
An Arm
Cell

- Endoplasmic reticulum
- Nucleolus
- Nuclear membrane
- Nucleus
- Mitochondrion
- Ribosomes
- Chloroplast
- Vacuole
- Cytosplasm
- Cell membrane
- Cell wall
Lesson 2
What are the parts of the brain?
Lesson #2  What are the parts of the brain?

**FUNCTIONAL/NOTIONAL CHART**
Lesson # 2 “What are the parts of the brain?”
Pre-Production ELLs – Total Physical Response Only

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order –demonstrate understanding (Performing teachers orders e.g. by pointing)</td>
<td>Directions</td>
<td>Find a ________</td>
<td>Verbs - commands</td>
<td>Brain, cerebrum</td>
</tr>
<tr>
<td>Demonstrate (TPR)</td>
<td>Parts of brain</td>
<td>A ______ is ______ (noun) (adjective)</td>
<td>Noun singular Adjectives</td>
<td>Brain, brainstem big, small</td>
</tr>
</tbody>
</table>
## FUNCTIONAL/NOTIONAL CHART

**Lesson #2 “What are the parts of the brain”**

**Early Production ELLs**

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement</td>
<td>Talking about the brain functions</td>
<td>I see a _________. (gerund)</td>
<td>Gerund</td>
<td>Drawing, painting</td>
</tr>
<tr>
<td>Illustrate</td>
<td>Discussing brain functions</td>
<td>The _____ controls what you ______. (noun) (verb)</td>
<td>Verbs describing senses</td>
<td>Brain see, hear, smell, feel</td>
</tr>
<tr>
<td>Identifying</td>
<td>Talking about anatomy of the brain</td>
<td>The _____ has ______ (noun) (numeral) parts.</td>
<td>Numerals</td>
<td>Cerebrum, cerebellum two, four</td>
</tr>
<tr>
<td>Describing</td>
<td>Functions of the brain</td>
<td>The cerebrum controls ______ thinking. (pronoun)</td>
<td>Personal pronoun gerund</td>
<td>Your, our, my</td>
</tr>
</tbody>
</table>
Lesson #2 What are the parts of the brain?

**FUNCTIONAL/NOTIONAL CHART**
Lesson #2 “What are the parts of the brain?”
Speech Emergence ELLs

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparing</td>
<td>Parts of the nervous system</td>
<td>The _______ is larger than the _______. (noun)</td>
<td>Comparative adjectives</td>
<td>Brain, cerebellum</td>
</tr>
<tr>
<td>Summarizing</td>
<td>Parts of the brain</td>
<td>The _______ is the smallest part of the _______. (noun)</td>
<td>Superlative adjectives</td>
<td>Brainstem, brain</td>
</tr>
<tr>
<td>Comparing</td>
<td>Anatomy of the brain</td>
<td>The _______ is folded like a _______. (noun)</td>
<td>Past participle, passive voice, indefinite article A</td>
<td>Cerebrum, cerebellum, paper</td>
</tr>
<tr>
<td>Describing</td>
<td>Talking about brain parts</td>
<td>Its surface is _______. (past participle)</td>
<td>Personal pronoun, past participle, passive voice</td>
<td>Folded, wrinkled</td>
</tr>
</tbody>
</table>
Lesson #2  What are the parts of the brain?

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry</td>
<td>Comparing parts of the nervous system</td>
<td>In what ways is the ____ like the ____? (noun)</td>
<td>Wh questions for specific information</td>
<td>Brain, computer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nerves, wires</td>
</tr>
<tr>
<td>Concluding</td>
<td>Functions of the brain</td>
<td>It is a piece of ____ (non-count. noun)</td>
<td>Partitive nouns with noun-countable nouns</td>
<td>Paper, information</td>
</tr>
<tr>
<td>Describing</td>
<td>Functions of the brain</td>
<td>________ is controlled by (gerund) the ________ (noun)</td>
<td>Verb gerund, Passive voice</td>
<td>Coughing, sneezing, swallowing, breathing, brainstem, brain</td>
</tr>
<tr>
<td>Comparing</td>
<td>Discussing the anatomy of the brain</td>
<td>Like the _____, the _____ (object 2) (object 1) has many ____ (nouns)</td>
<td>Comparative phrases</td>
<td>cerebrum, cerebellum, folds</td>
</tr>
</tbody>
</table>
Lesson Plan

I. Objectives
   A. Content objectives:

   All students will:
   • know the three main parts of the brain.

   Advanced and intermediate ELLs will:
   • be able to describe the anatomy of the brain.
   • be able to explain the main functions of the brain.
   • compare and contrast appearances and functions of the cerebrum and cerebellum.

   Speech emergence ELLs will:
   • be able to answer questions in short sentences about the three parts of the brain and the important functions of each part.

   Early production ELLs will:
   • be able to answer questions using yes/no or simple words about the three parts of the brain and its important functions.

   Pre-production ELLs will:
   • be able to answer questions pointing to parts of the brain and, using TPR, show some of its functions.

   B. Language objectives:

   Advanced ELLs will:
   • write about the three parts of the brain and its main functions.

   Intermediate ELLs will:
   • write several facts about the three parts of the brain and its main functions.

   Discussing the brain advanced and intermediate ELLs will be able to use in their conversations:
   • questions for specific information (In what ways is the ___ like the ___?)
   • gerund with passive voice constructions (Breathing (gerund) is controlled by ____.)
   • comparative phrases (Like the ___, the ___ has many ___.)
   • partitive nouns with non-countable nouns (It's a piece of _____.)

   Speech emergence and early production ELLs will:
   • show their understanding about the brain, its parts and main functions through closed activities by filling the correct words in the blanks.

   Speech emergence ELLs will:
   • respond with short sentences using comparative and superlative adjectives (larger, smallest).
   • use passive voice construction when talking about the surface of the brain (The ____ is folded like a ____).
• show understanding about some personal nouns (Its surface is_____.)

**Early production ELLs** will:
• show their understanding of the brain, its parts and functions by answering yes/no to questions about the brain.
• respond with one or two words using gerunds (thinking, breathing), personal pronouns (your, our, my), numerals (two, four).

**Pre-production ELLs** will:
• identify new vocabulary words in the text.
• respond to the teacher’s directions (Find the_____) by pointing to or using TPR.

**II. Materials**

• skeleton (p.35-37)
• prepared charts, diagrams, transparencies (pp.84-93)
• adapted, summarized and simplified reading materials (pp. 68-73) (O.L. see index pp.18-21)
• activity sheets (pp.75-82), O.L. (index pp.24-26)
• Oxford Picture Dictionary
• pictures (93-94)
• X-Ray (p.95)
• pencils

**III. Background knowledge** (5 min.)

All students will:
• brainstorm about the brain and its parts (students will look at pictures of the brain pp.93-94) and try to predict the functions of the brain.

**IV. Procedures** (20 min.)

A. **Instruction:**
• Teacher (T) will summarize the information the students (Ss) brainstormed. This information will lead to the conclusion that the brain consists of three main parts.

• T will help Ss to locate parts of the brain in the skeleton (pp.35-37) and name them.

• The list of new words and their definitions (p.37) will be posted on the word wall and will be gradually introduced during the lesson. T will repeatedly pronounce and explain the meaning of new words pointing to the pictures in the Oxford Picture Dictionary, and using gestures demonstrate how to balance the body and what it means to be clumsy. T will point to surfaces, showing whether they are smooth or rough.

• T will frame the key phrases by writing them on the blackboard, e.g. “The brain has three main parts: cerebrum, cerebellum and brainstem”. The key concepts will be illustrated with charts, diagrams and pictures (see Materials).
Using transparencies, pictures and diagrams, T will introduce the brain as the most important component of the HNS. Ss will notice differences between the parts of the brain. T will help Ss to identify the three main parts of the brain. T will point to certain parts of the brain and identify the functions these parts perform. T will encourage students to brainstorm the functions of the body (smell, sight, memory, speech etc.). Teacher will point to the specific region on the brain map (p.90) that is responsible for each function. While talking about the brainstem, T will bring Ss attention to the fact that this is the most important part of the brain. It controls vital body functions such as breathing and heartbeat. Damage to this part can cause immediate death. Teacher will suggest that car accidents, or diving into a pool with insufficient amount of water can cause brainstem damage and sudden death.

While introducing the new materials, T will repeat the important statements several times, make pauses and slow the speech pace. The key concepts will be written on the blackboard and illustrated with graphs, charts, diagrams and pictures (see Materials p.64).

T will use gestures, point to his/her or a student’s head while talking about the brain.

B. Reading activities: (15 min.)

- For these activities advanced and intermediate ELLs will be paired with speech emergence, early production and pre-production ELLs. More advanced ELLs will read modified text (pp.68-71). They will explain and help the less advanced ELLs to read and understand summarized or simplified texts (pp.72-76).

- While reading, students will work on their activity sheets. All ELLs will label the main parts of the brain (pp.75-79).

- Advanced and intermediate fluency ELLs will compare and contrast the cerebrum and cerebellum using a Venn diagram (p.80). They will write a few facts about each part of the brain and their functions (pp.78-79).

- Speech emergence and early production ELLs will work on the closed activity where they will fill in the blanks with the correct words (pp.76-77). If needed, their partners (more advanced ELLs) will help them by reading the terms and descriptions.

- T will help all students by explaining the directions and modeling the first sentence of each activity.

- Pre-production ELLs will find and circle the words in the sentences (p.75) describing the brain and its parts. They will do so when they hear the words or see them written on the blackboard or in their simplified texts (p.). More advanced students will help them to read the simplified text.

C. Post-reading activities: (10 min.)

- T will ask Ss to fold their arms across their chest. T will ask which arm is on top. T will model it. He/she will explain (pointing to the arm and the part of his/her head) that the side of the brain that has dominance would be the opposite side to the arm that is on top. Ss will practice doing it and will find which side of their brain is dominant.

- Information Gap activity (pp.81-82) Ss will work in groups of four – two pairs together. One student of each pair is more English proficient than the other. Each pair will get one of two
worksheets. By talking to each other, they will fill in the missing information about the parts of the brain and its functions.

D. Evaluation

- The students’ new knowledge will be evaluated through oral and written activities.

a) Oral component:

- T will ask questions and pre-production ELLs will point to the proper parts of the brain and their parts, e.g.: Where is the cerebrum?

- T will ask questions and early production ELLs will reply with yes/no or one-two words answers, e.g.: 1. This is the cerebellum, isn’t it? Say yes or no. 2. Does the brain have one or three parts?

- T will ask questions and speech emergence ELLs will answer with short sentences. They will name and describe the main parts of the brain and its functions, e.g.: What are the main parts of the brain?

- Intermediate fluency and advanced ELLs will orally describe the brain, its main three parts and its functions. They will compare cerebrum and cerebellum. They will be able to express their opinion about the importance of the certain parts of the brain and possible dangers.

b) Written component:

- Finished written activities will help T to evaluate ELLs’ new knowledge. Depending on proficiency levels, Ss will work on activities appropriate to their fluency levels during reading time.

E. Closure (5 min.)

- Advanced and intermediate fluency ELLs will summarize in a few sentences the new information they learned.

- Speech emergence ELLs will state the lesson’s key points using simple sentences.

- Early production ELLs will point and name the main parts of brain on the diagrams. Ss will name the important functions of three parts of the brain.

- T will name the parts of the brain and pre-production ELLs will point to them on the diagrams. Using TPR they will able to show their understanding of certain functions of the brain.
Lesson #2 What are the parts of the brain?

Descriptive Narrative

In re-designing this lesson for the fifth grade ESL classroom I included many modifications.

The lesson was further contextualized by increasing the number of visuals. I included lots of charts, diagrams and pictures. I created my own diagrams to make this lesson more comprehensible.

The original text was modified. I outlined the key points of the paragraphs on the sides. The new words were highlighted and explained in the “word bank”. For the visual representation of the unknown words I recommended the Oxford Picture Dictionary. This will help students comprehend the new information faster. High frequency vocabulary should be chosen when possible. Teacher should gradually introduce new words. Gestures, modeling should be used when necessary to help understanding the meaning of new words. I suggested repeating the new words and phrases several times. They should be written on the board or word wall.

I created several versions of the text. A summarized version is recommended for speech emergency ELLs; a simplified version, which includes diagrams, for pre-production and early production ELLs. The sentences in these texts are shorter and easier to understand, but at the same time they have new important information.

I created five different versions of the listening guide, appropriate for five language proficiency levels. This would allow students of all different levels to be engaged in literacy activities.

In the modified lesson there is much opportunity for small group work and academic language between peers. The small group setting will make ELLs feel safer and is less intimidating. Therefore, better results can be expected from these students. I recommend to pair less proficient students with more proficient ELLs. I think this grouping configuration supports language and content objectives. This will create an environment where all students will be engaged most of the time.

The following strategies are incorporated in Lesson 2:

- Activating previous knowledge
- Visuals
- Modeling
- Developing vocabulary
- Modifying and simplifying text
- Framing main ideas
- Pacing teacher’s speech
- Repeating key ideas several times
- Teacher questioning and response strategies
- Using questions appropriate for language fluency levels
- Pair-share
- Meaningful activities appropriate for fluency levels
- Real oral and written language
Most nerve cells are found in bundles. A bundle of nerve cells is called a \textit{nerve}. Some nerves are very small. Others are as big around as a pencil or your little finger. You can compare a nerve to an electric cable, which is made up of many small wires. To what parts of the nerve would you compare the small wires?\footnote{The nerve cells in the robot, messages are carried into and out of the computer by wires.}

\textbf{What are the three parts of the brain?}

The main organ of the nervous system is the \textit{brain}. The brain is the control center of the body. Most of the messages that move through the nervous system enter and leave the brain. In what way is the brain like the computer in a robot?\footnote{The nerve cells in the robot, messages are carried into and out of the computer by wires.}

As the drawing shows, the brain has three parts. They are the \textit{cerebrum} (se \textit{REE} brum), the \textit{cerebellum} (ser \textit{uh} \textit{BEL} um), and the \textit{brainstem}. Each part of the brain controls \textit{certain} activities.
Choosing Up Sides

Quick! Without thinking about it, fold your arms across your chest. Which arm is on top? The answer tells which side of your brain—left or right—has dominance (DAHM uh nuns). Dominance means "having control over." Suppose your right arm was on top. Then the left side of your brain probably has dominance.

Right-brain dominance or left-brain dominance can be shown in other body parts besides your arms. It can also be shown in your legs, hands, feet, eyes, and ears.

How can you test for dominance?

Design a test to show which part of a person’s brain has dominance. The test should include two of the body parts named above. Test five of your classmates. Compare your results with those of other classmates. Which side of the brain shows dominance in most of your classmates?

The largest part of the brain is the cerebrum. From the top, the cerebrum looks like a large walnut. Notice that its surface is folded like a piece of crumpled paper. The folding allows more nerve cells to fit inside the skull.

The cerebrum also has a right half and a left half. The right half controls the left half of the body. The left half controls the right half of the body. If you are right-handed, the left side of the cerebrum is usually a little larger. If you are left-handed, which side would probably be larger?  

The right side of the cerebrum is the largest part of the brain.
The cerebrum controls all your thinking. It also controls the movements of many muscles. Look at the “map” of the cerebrum. Notice that different regions control different activities. Find the regions that control what you see, hear, smell, and feel.

The cerebellum, or second part of the brain, lies just under the back part of the cerebrum. Like the cerebrum, the cerebellum has many deep folds. But it is much smaller than the cerebrum. The cerebellum helps muscles work together. The cerebellum also helps the body keep its balance.

Without the cerebellum, movements would be clumsy instead of smooth. You would not be able to pick up a pencil without dropping it. To pick up a pencil, muscles in the eyes, arm, and fingers must work together. The cerebellum controls these muscles so they work together smoothly.
The brainstem is the smallest part of the brain. It controls heartbeat, breathing.

The brainstem is the third and smallest part of the brain. Find this part in the drawing. The brainstem controls many actions that help keep you alive. For example, the brainstem controls the heartbeat, breathing, and the digestion of food. The brainstem controls these actions automatically, or without you having to think about them. Coughing, sneezing, and swallowing are also controlled by the brainstem.

What does the spinal cord do?

Notice that the brainstem is really the wide top part of the spinal cord. The spinal cord is a thick cord of nerves in the middle of the back. The spinal cord carries messages to and from the brain.

As the drawing shows, the spinal cord runs through a hole in each bone of the backbone. The backbone protects the soft tissue of the spinal cord. Why is it important that the spinal cord be protected? What bones protect the brain? The skull bones

If the spinal cord was damaged, messages might not be able to travel to and from the brain.
Lesson #2  What are the parts of the brain?

Summary

- The brain controls the body.
- There are three parts of the brain.
- They are the cerebrum, the cerebellum and the brainstem.
- The cerebrum is the largest part.
- There are two parts of the cerebrum.
- The cerebrum controls thinking.
- The cerebrum controls what we feel, smell, hear, and feel.
- The cerebellum is below the cerebrum.
- The cerebellum controls our balance.
- The cerebellum controls the muscle work.
- The brainstem is the smallest part.
- The brainstem controls the heartbeat and the breathing.
Lesson #2 What are the parts of the brain?

Parts of the Brain

The brain has three parts.

They are the cerebrum, cerebellum and brainstem.

Functions

The cerebrum controls thinking and the senses.

The cerebellum controls balance.

The brainstem controls breathing and heartbeat.
Lesson #2 What are the brain parts?

Word Bank

Certain - that is known, sure, without doubt
Walnut - kind of nut
Surface - top part of something
Fold - to bend a piece of paper
Crumpled - with lots of lines or folds
Balance - stay steady and not fall
Clumsy - moving in not smoothly way and breaking things
Smooth - without bumps, when moves easily
Region - area, part of the body
Lesson #2 What are the parts of the brain?

**Listening Guide  Level – Pre-production**

# Parts of the Brain

DIRECTIONS: As we discuss and read about the main parts of the brain, circle the words below that you hear or see written on the blackboard or in the textbook.

1. The cerebrum is the largest part of the brain. It controls thinking, learning and the senses.

2. The cerebellum is much smaller than the cerebrum. It controls the body balance.

3. The brainstem is the smallest part of the brain. It controls the heartbeat, breathing and the digestion of food.
Lesson #2 What are the parts of the brain?

Listening Guide  Level – Speech Emergence

Parts of the Brain

DIRECTIONS: As we discuss and read about the parts of the brain, fill in the blanks with the correct words.

1. The cerebrum is the _____ part of the brain. It controls _____, learning and the senses.
2. The cerebellum is much _____ than the ______. It controls the body ______.
3. The brainstem is the _____ part of the brain. It controls the _____, _____ and the digestion of ________.
Lesson #2 What are the parts of the brain?

Listening Guide Level – Early Production

Parts of the Brain

DIRECTIONS: As we discuss and read about the brain and its parts, fill in the blanks with the correct word provided to you in the word bank.

WORD BANK

| smallest | food | balance | largest |

1. The cerebrum is the _____ part of the brain. It controls thinking, learning and the senses.

2. The cerebellum is much smaller than the cerebrum. It controls the body ________.

3. The brainstem is the _______ part of the brain. It controls the heartbeat, breathing and the digestion of __________.
Lesson #2 What are the parts of the brain?

Listening Guide Level - Intermediate fluency

Parts of the Brain

DIRECTIONS: As we discuss and read about the main parts of the brain, finish the sentences.

1. The cerebrum is ______________________ . It controls ______________________ .

   The cerebellum is ______________________ . It controls ______________________ .

2. The brainstem is ______________________ . It controls ______________________ .
Lesson #2 What are the parts of the brain?

Listening Guide  Level - Advanced

Parts of the Brain

DIRECTIONS: As we discuss and read about the brain and its main parts, write two facts about each part.

1. 

2. 

3. 

Lesson #2   What are the Parts of the Brain?

Venn Diagram

DIRECTIONS: Compare / contrast the cerebrum and cerebellum. Use information about appearance and functions of these two parts of the brain.
Lesson #2  What are the parts of the brain?

The Brain and Its Parts

Information gap task

<table>
<thead>
<tr>
<th>Name Part</th>
<th>Size</th>
<th>Property</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebrum</td>
<td>It is the biggest part of the brain</td>
<td>It has two parts</td>
<td></td>
</tr>
<tr>
<td>Cerebellum</td>
<td>It lies under the brain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brainstem</td>
<td>It is connected to the spinal cord</td>
<td></td>
<td>Controls breathing, heartbeat</td>
</tr>
</tbody>
</table>
Lesson #2  *What are the parts of the brain?*

### The Brain and Its Parts

Information gap task

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<td>Cerebrum</td>
<td>It has two parts</td>
<td></td>
<td>Controls thinking, senses</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>It is mid size</td>
<td></td>
<td>Controls balance</td>
</tr>
<tr>
<td>Brainstem</td>
<td>It is the smallest part of the brain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson #2  What are the parts of the brain?

The brain and its parts

Information gap task

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<td>It is connected to the spinal cord</td>
<td>Controls breathing, heartbeat</td>
</tr>
</tbody>
</table>
Lesson #2 What are the parts of the brain?

Parts of the Brain

- Cerebrum
- Brainstem
- Cerebellum
Lesson #2  What are the parts of the brain?

Main parts and functions
Brain

Cerebrum
(thinking, senses)

Brainstem
(breathing, heartbeat)

Cerebellum
(balance)
Lesson #2  **What are the parts of the brain?**

**The Route of Messages**

- **Brain** → **Spinal cord** → **Nerves**
Lesson #2  What are the parts of the brain?

The Route of Messages

Brain

Spinal cord

Nerves

Sense organs  
(eyes, ears, nose, tongue, skin)

Spinal cord

Nerves

Muscles
Lesson #2  What are the brain parts?

Brain Functions

- moving the body
- touching
- tasting
- writing
- seeing
- hearing
- smell
- reading
- speech understanding
- memory
- learning
- speaking
The Brain and the Spinal Cord
Lesson #2  What are the brain parts?

Brain Functions
Brain

Zebu

*Bos indicus*

1 cm

Univ. of Wisconsin-Madison Brain Collection

64-322
The brain
Lesson 3
What does the spinal cord do?
Lesson #3  What does the spinal cord do?

**FUNCTIONAL/NOTIONAL CHART**
Lesson #3 “What does the spinal cord do?”
Pre-Production ELLs – Total Physical Response Only

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order -demonstrate</td>
<td>Directions</td>
<td>Look at the ______.</td>
<td>Verbs - commands,</td>
<td>Picture, drawing, spinal</td>
</tr>
<tr>
<td>understanding</td>
<td></td>
<td></td>
<td>Nouns - singular</td>
<td>cord</td>
</tr>
<tr>
<td>Order -demonstrate</td>
<td>Directions</td>
<td>Write the ______.</td>
<td>Verbs - commands,</td>
<td>Word, name</td>
</tr>
<tr>
<td>understanding (TPR)</td>
<td></td>
<td></td>
<td>Nouns - singular</td>
<td></td>
</tr>
</tbody>
</table>
Lesson #3 What does the spinal cord do?

**FUNCTIONAL/NOTIONAL CHART**  
Lesson #3 "What does the spinal cord do?"  
Early Production ELLs

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describing</td>
<td>Talking about the spinal cord</td>
<td>This is a ________ (adjective) part of the spinal cord.</td>
<td>Adjectives - opposites</td>
<td>Wide, narrow</td>
</tr>
<tr>
<td>Identify</td>
<td>Discussing functions of the spinal cord</td>
<td>Messages travel ______ the brain. (preposition)</td>
<td>Prepositions</td>
<td>To, from</td>
</tr>
<tr>
<td>Directions</td>
<td>Discussing anatomy of spinal cord</td>
<td>Look at the ______.</td>
<td>Verb, order</td>
<td>Spinal cord, cerebrum, brain</td>
</tr>
</tbody>
</table>
Lesson #3 What does the spinal cord do?

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussing</td>
<td>Anatomy of the spinal cord</td>
<td>It is in the <strong>middle</strong> of the _____ (noun).</td>
<td>Noun as an adjective</td>
<td>Brain, road, spinal cord</td>
</tr>
<tr>
<td>Summarizing</td>
<td>Discussing anatomy of the spinal cord</td>
<td>The spinal cord is a _____ of nerves. (noun)</td>
<td>Verb, present tense</td>
<td>Bundle, cord</td>
</tr>
<tr>
<td>Formulate ideas</td>
<td>Anatomy of the spinal cord</td>
<td>Bone protects ______.</td>
<td>Subject-verb agreement</td>
<td>Organs, tissues</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bones protect ______.</td>
<td>present tense, singular</td>
<td></td>
</tr>
<tr>
<td>Making interpretations</td>
<td>Discussing functions of the spinal cord</td>
<td>Messages travel <strong>from</strong> ______ to the ______. (noun) (noun)</td>
<td>Prepositions</td>
<td>Brain, spinal cord, muscles</td>
</tr>
<tr>
<td>Discussing</td>
<td>Spinal cord's functions</td>
<td>____ <strong>will</strong> ______.</td>
<td>Personal pronoun; aux. verb, future tense</td>
<td>You, I, we, he, she travel, listen, hear, say</td>
</tr>
</tbody>
</table>
Lesson #3 What does the spinal cord do?

**FUNCTIONAL/NOTIONAL CHART**

**Lesson # 3 “What does the spinal cord do?”**

**Intermediate Fluency ELLs**

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry, asking questions</td>
<td>Talking about the spinal cord</td>
<td><strong>What</strong> do bones protect ____?</td>
<td>Wh questions for specific information</td>
<td>Brain, heart, lungs</td>
</tr>
<tr>
<td>Making conclusions</td>
<td>Discussing the role of the spinal cord</td>
<td>The spinal cord is <strong>very</strong> _____.</td>
<td>Adverb, intensifier</td>
<td>Important, long, thin</td>
</tr>
<tr>
<td>Interpreting</td>
<td>Discussing the role of the back bone</td>
<td>____ are important <strong>because</strong> they _____.</td>
<td>Conjunction</td>
<td>Bones, nerves, protect nerves, send messages</td>
</tr>
<tr>
<td>Identifying</td>
<td>Discussing the anatomy of the spinal cord</td>
<td>The cord that <strong>is made of</strong> ____ <strong>is called</strong> the _____.</td>
<td>Verb, passive voice</td>
<td>Nerves, spinal cord wires, electric cord</td>
</tr>
<tr>
<td>Identifying</td>
<td>Discussing the anatomy of the spinal cord</td>
<td><strong>That</strong> cord is made of _____.</td>
<td>Relative pronoun</td>
<td>Nerves, wires</td>
</tr>
</tbody>
</table>


Lesson Plan

I. Objectives
   A. Content objectives:

   All students will:
   - know the spinal cord and its role.

   Advanced and intermediate ELLs will:
   - be able to describe the anatomy of the spinal cord.
   - be able to explain the functions of the spinal cord.

   Speech emergence ELLs will:
   - be able to answer questions in short sentences about the spinal cord and its important functions.

   Early production ELLs will:
   - be able to answer questions using yes/no or simple words about the spinal cord and its role.

   Pre-production ELLs will:
   - be able to answer questions pointing to the spinal cord and, using TPR, show some of its functions.

   B. Language objectives:

   Advanced ELLs will:
   - Write a paragraph about the spinal cord and its role in the human nervous system (HNS).

   Intermediate ELLs will:
   - write several facts about the spinal cord.

   Discussing the spinal cord, advanced and intermediate ELLs will be able to use in their conversations:
   - questions for specific information (What bones protect _____?)
   - passive voice constructions (The cord is made of _____.)
   - conjunction “because” (The _____ is important because _____.)
   - adverb-intensifier “very” (The spinal cord is very _____.)
   - relative pronoun (That cord is _____.)

   Speech emergence and early production ELLs will:
   - show their understanding of the spinal cord and its role through closed activities by filling the correct words in the blanks.

   Speech emergence ELLs will:
   - respond with short sentences using prepositions “to, from” (Messages travel to the _____ from the _____.)
• use present tense when discussing the anatomy of the spinal cord (The ____ is a ____ of nerves.).
• use future tense in their responses about the role of the spinal cord (I will _____.)
• use personal pronouns “you, I, we, he, she” in their responses (I will _____.)
• respond with short sentences using subject-verb agreement correctly.

Early production ELLs will:
• show their understanding of the spinal cord and its role by answering yes/no questions about the spinal cord.
• respond with one or two words using adjectives “wide” part, “narrow” part.
• respond with one or two words using prepositions “to, from” when discussing the route of the message in the spinal cord.

Pre-production ELLs will:
• identify new vocabulary words in the text and write them on a sheet of paper.
• respond to the teacher’s directions (Write the ____.) by pointing to or using TPR.

II. Materials

• skeleton (pp.35-37)
• prepared charts, diagrams, transparencies (pp.115-123)
• Oxford Picture Dictionary
• X-Rays, CT scan (pp.124-125)
• adapted, summarized and simplified reading materials (pp.105-108) (O.L. see index pp.35-36)
• activity sheets (pp.110-114)
• paper
• crayons, pencils

III. Background knowledge

All students will: (10 min.)
• review the main parts of the brain and its functions by responding to the teachers questions with full sentences (advanced and intermediate ELLs), short sentences (speech emergence), one - two words or answer yes/no (early production ELLs) and pointing to the pictures or using TPR (pre-production ELLs).
• brainstorm about the spinal cord and its parts (students will look at of the spinal cord pp.123, 118-121) and will try to predict the function it performs.

IV. Procedures

A. Instruction: (20 min.)
• Teacher (T) will summarize the information the students (Ss) brainstormed. This information will lead to the conclusion that the spinal cord is an important connective part between the brain and the nerves.
• T will help Ss to locate the spinal cord in the skeleton (pp.35-37).
• The list of new words and their definitions (p. 114) will be posted on the word wall and will be gradually introduced during the lesson. T will repeatedly pronounce and explain the meaning of new words pointing to the pictures in the Oxford Picture Dictionary or diagrams (pp.118-121). T will point to the top of the skull illustrating the meaning of the word “top”, and to the holes in the skull, illustrating the meaning of the word “hole”.
• T will frame the key phrases by writing them on the blackboard, e.g. “The backbone protects the spinal cord”. The key concepts will be illustrated with charts, diagrams and pictures (see Materials p.101).

• Using transparencies, pictures, diagrams, and the skeleton, T will introduce the spinal cord as a very important component of the HNS. Ss will understand that the spinal cord carries messages from the sense organs to the brain and from the brain to the muscles. T will point to the part of the backbone on the skeleton where the brainstem connects to the spinal cord. Pointing to the holes in the backbone T will explain how the nerves come to the spinal cord. Students will match the parts of the body to certain areas of the spinal cord that are connected, e.g. arms are connected with the upper part of the spinal cord. Students will predict what would happen if the message couldn’t travel through the certain part of the spinal cord (disease or accident). T will show X-Ray (p.124) and CT scan (p.125) pointing to the backbone, spinal cord and the place of the damage to the spinal cord. T will mention possible consequences (paralysis) of such health problems.

• While introducing the new materials, T will repeat the important statements several times, make pauses and slow the speech pace. The key concepts will be written on the blackboard and illustrated with graphs, charts, diagrams and pictures (see Materials p.101).
• T will use gestures, point to his/her or a student’s head, spine and arms while talking about the spinal cord.

B. Reading activities: (15 min.)

• For these activities advanced and intermediate ELLs will be paired with speech emergence, early production and pre-production ELLs. More advanced ELLs will read modified text (pp.105-106). They will explain and help the less advanced ELLs to read and understand summarized or simplified texts (pp.107-108 ).
• While reading, students will work on their activity sheets. All ELLs will label the spinal cord (pp.110-114).
• Advanced and intermediate fluency ELLs will write a few facts about the spinal cord and its role (pp.113-114).
• Speech emergence and early production ELLs will work on the closed activity where they will fill in the blanks with the correct words (pp.111-112).
• T will help all students by explaining the directions and modeling the first sentence of each activity.
• Pre-production ELLs will find and circle the words in the sentences (p.110) describing the spinal cord. They will do so when they hear the words or see them written on the blackboard or in their simplified text (p.108). More advanced students will help them to read the simplified text.
C. Post-reading activities: (5 min.)

- All Ss will draw the brain connected to the spinal cord. Ss will identify and label the most important parts.

D. Evaluation

- The students' new knowledge will be evaluated through oral and written activities.

a) Oral component:

- T will ask questions and pre-production ELLs will point to the proper parts of the brain and their parts. E.g.: Where is the spinal cord?

- T will ask questions and early production ELLs will reply with yes/no or one-two words answers, e.g.: 1. The spinal cord is connected to the brain, isn't it? Say yes or no. 2. Is the spinal cord long or short?

- T will ask questions and speech emergence ELLs will answer with short sentences. They will describe the spinal cord and its functions, e.g.: What protects the spinal cord?

- Intermediate fluency and advanced ELLs will orally describe the spinal cord and its role. They will be able to express their opinion about the importance of the spinal cord and possible dangers.

b) Written component:

- Finished written activities will help T to evaluate ELLs' new knowledge. Depending on the proficiency levels, Ss will work on activities appropriate to their fluency levels during reading time.

E. Closure (5 min.)

- Advanced, intermediate fluency and speech emergency ELLs will state a few facts about the spinal cord.

- Early production ELLs will point and name the main parts of the brain and spinal cord on the diagrams or their drawing. Ss will name the functions of the spinal cord and backbone.

- T will name the spinal cord, backbone, and nerves. Pre-production ELLs will point to them on the diagrams. Using TPR they will be able to show their understanding that the spinal cord carries messages to and from the brain.
Lesson #3  What does the spinal cord do?

**Descriptive Narrative**

This third lesson of the unit about the Human Nervous System was also modified so that students of all language proficiency levels could comprehend the new material.

Content and language objectives were clearly defined. I recommend posting them either on the board or on the wall, so that they can be clearly seen during the lesson.

I included many modifications in my lesson. The number of visuals was increased. I included lots of pictures, charts, and diagrams, including ones I created myself. They made the lesson clear and meaningful.

I modified the original text by outlining the key points of the paragraphs and summarizing them on the sides. I highlighted and explained new words in the "word bank". For the visual representation of the unknown words, the Oxford Picture Dictionary is recommended.

I created several versions of the text: a summarized version for speech emergence ELLS and a simplified version, which includes diagrams, for pre-production and early production ELLS.

In an effort to engage all students at levels appropriate to their academic language, I developed five different versions of the listening guide. The instructions are presented in a correct and temporal sequence. This will accommodate all students and will encourage them to be engaged most of the time.

Proper grouping is a very important factor to make the lesson successful. Peer-share and peer-tutoring are powerful tools that encourage students to interact. This leads to language development, and, therefore, supports content and language goals and objectives. I recommended to pair less proficient students with more proficient ELLs expecting that more advanced students will help less advanced students.

The following strategies are incorporated in Lesson 3:

- Activating previous knowledge
- Visuals
- Modeling
- Developing vocabulary
- Modifying and simplifying text
- Framing main ideas
- Pacing teacher's speech
- Repeating key ideas several times
- Teacher questioning and response strategies
- Using questions appropriate for language fluency levels
- Pair-share
- Meaningful activities appropriate for fluency levels
- Real oral and written language
The brainstem is the third and smallest part of the brain. Find this part in the drawing. The brainstem controls many actions that help keep you alive. For example, the brainstem controls the heartbeat, breathing, and the digestion of food. The brainstem controls these actions automatically, or without you having to think about them. Coughing, sneezing, and swallowing are also controlled by the brainstem.

**What does the spinal cord do?**

Notice that the brainstem is really the wide top part of the spinal cord. The **spinal cord** is a thick cord of nerves in the middle of the back. The spinal cord carries messages to and from the brain.

As the drawing shows, the spinal cord runs through a hole in each bone of the backbone. The backbone protects the soft tissue of the spinal cord. Why is it important that the spinal cord be protected? What bones protect the brain? The skull bones

If the spinal cord was damaged, messages might not be able to travel to and from the brain.
How messages travel through the parts of the nervous system

Look at the drawing on this page. Notice that nerves from all parts of the body are connected to the spinal cord. The spinal cord, brain, and nerves work together in controlling actions.

Messages from the brain travel down the spinal cord to the nerves. Then the nerves carry the messages to all parts of the body. Messages from all parts of the body travel from the nerves into the spinal cord. Then the spinal cord carries the messages up to the brain. In the next section, you will learn more about how the brain, spinal cord, and nerves work together.

Lesson Review

1. List the three parts of the nervous system.
2. What are the three parts of the brain? Name one thing that each part controls.
3. What does the spinal cord do?

Think! Do you think a person could live for very long with a damaged brainstem? Explain your answer.
Lesson #3  What does the spinal cord do?

Summary

➢ The brainstem becomes the spinal cord.

➢ Nerves make up the spinal cord.

➢ The spinal cord connects the brain and nerves.

➢ The spinal cord carries messages to the brain.

➢ The spinal cord carries messages from the brain.

➢ The backbone protects the spinal cord.

➢ Nerves go to the spinal cord.

➢ The spinal cord, brain and nerves control actions.
Lesson 3  What does the spinal cord do?

The Spinal Cord

1. The spinal cord is made up of nerves.
2. Nerves from all parts of the body come to the spinal cord.
3. The spinal cord connects the brain and nerves.
4. The backbone protects the spinal cord.
Lesson #3  What does the spinal cord do?

Word Bank

Cord - group of wires
Tissue - cells form soft organ
Really - very, very much
Drawing - a picture that you make with a pencil
Hole - an empty space in something that should be solid
Top - the highest part of something
Lesson #3  What does the spinal cord do?

Listening Guide  Level Pre-production

The Spinal Cord

DIRECTIONS: As we discuss and read about the spinal cord, circle the words below that you hear or see written on the blackboard or in the textbook.

1. The spinal cord is a thick cord of nerves.

2. The backbone protects the soft tissue of the spinal cord.

3. Nerves from all parts of the body are connected to the spinal cord.
Lesson #3 What does the spinal cord do?

Listening Guide Level - Early Production

The Spinal Cord

DIRECTIONS: As we discuss and read about the spinal cord, fill in the blanks with the correct words provided to you in the word bank.

WORD BANK

backbone  connected  nerves

1. The spinal cord is a thick cord of __________.

2. The ________ protects the soft tissue of the spinal cord.

3. Nerves from all parts of the body are ____________ to the spinal cord.
DIRECTIONS: As we discuss and read about the spinal cord, fill in the blanks with the correct words.

1. The spinal cord is a thick ______ of nerves.
2. The backbone protects the soft ______ of the spinal cord.
3. Nerves from all parts of the body are ____________ to the spinal cord.
Lesson #3  What does the spinal cord do?

Listening Guide   Level - Intermediate fluency

The Spinal Cord

DIRECTIONS: As we discuss and read about the spinal cord, fill in the blanks with the correct words and phrases.

1. The spinal cord is ________________________.

2. The _______ protects ____________________.

3. __________________________ connected to the spinal cord.
Lesson #3  What does the spinal cord do?

**Listening Guide  Level - Advanced**

**The Spinal Cord**

DIRECTIONS: As we discuss and read about the spinal cord, write three facts about it.

1. 
2. 
3. 
Lesson 3  What does the spinal cord do?

The Spinal Cord
Lesson #3 What does the spinal cord do?

The Route of Messages

- Brain
  - Spinal cord
    - Nerves
      - Sense organs
        (eyes, ears, nose, tongue, skin)
  - Spinal cord
    - Nerves
      - Muscles
Lesson #3 What does the spinal cord do?
Brain, Spinal Cord and Nerves

NERVOUS SYSTEM - SPINAL NERVES

cerebrum

brachial plexus

spinal cord

lumbar plexus

sacral plexus

cervical nerves (innervate the neck and the arms)

intercostal nerves

lumbar and sacral nerves (innervate the legs and pelvic organs)
Brain, Spinal Cord and Nerves

The Central and Peripheral Nervous Systems

- Brain
- Cerebellum
- Spinal cord
- Brachial plexus
- Musculocutaneous nerve
- Radial nerve
- Median nerve
- Ulnar nerve
- Tercosternal nerve
- Obturator nerve
- Ulnar nerve
- Common peroneal nerve
- Deep peroneal nerve
- Superficial peroneal nerve
- Intercostal nerve
- Subcostal nerve
- Lumbar plexus
- Sacral plexus
- Femoral nerve
- Pudendal nerve
- Sciatic nerve
- Saphenous nerve
- Tibial nerve
- 12 cranial nerves
- 8 cervical nerves
- 12 thoracic nerves
- 5 lumbar nerves
- 5 sacral nerves
- 1 coccygeal nerve

Chain of vertebral ganglia, part of the nerve network of the autonomic system
Brain and Spinal Cord
Lesson #3 What does the spinal cord do?

Spinal Cord

- Spinal cord
- Intervertebral disk
- Vertebral body
Lesson #3 What does the spinal cord do?

Spinal Cord

- Vertebral body
- Spinal nerve
- Pedicle
- Spinous process
- Spinal cord
X-Ray of the Spinal Cord Injury
Lesson #3 What does the spinal cord do?

CT Scan of the Spinal Cord Injury
Lesson 4
Actions of the nervous system
Lesson #4  **Actions of the nervous system**

**FUNCTIONAL/NOTIONAL CHART**  
Lesson #4  "Actions of the nervous system"  
Pre-Production ELLs - Total Physical Response Only

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order -demonstrate understanding (TPR)</td>
<td>Directions</td>
<td>Cross your ________</td>
<td>Verbs - commands personal pronoun</td>
<td>Legs, hands</td>
</tr>
<tr>
<td>Order -demonstrate understanding through performing the task</td>
<td>Directions</td>
<td>Draw the ________</td>
<td>Verbs - commands</td>
<td>Reflex, nerves</td>
</tr>
<tr>
<td></td>
<td>Directions</td>
<td>Point inside the ________</td>
<td>Prepositions</td>
<td>Picture, body, drawing</td>
</tr>
<tr>
<td></td>
<td>Directions</td>
<td>Point outside the ________</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Directions</td>
<td>Circle ________ parts.</td>
<td>Numerals</td>
<td>Two, three, four</td>
</tr>
<tr>
<td></td>
<td>Directions</td>
<td>Look at the ________</td>
<td>Verbs - commands prepositions</td>
<td>Reflex, picture, drawing</td>
</tr>
</tbody>
</table>
Lesson #4  Actions of the nervous system

FUNCTIONAL/NOTIONAL CHART
Lesson #4 “Actions of the nervous system”
Early Production ELLs

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify</td>
<td>Talking about the reflex</td>
<td>This action is a/an __________ action. (adjective)</td>
<td>Demonstrative pronoun, singular, verb-present tense, subject-verb agreement indefinite article a/an, adjective</td>
<td>Voluntary, involuntary</td>
</tr>
<tr>
<td>Identify</td>
<td>Talking about the reflex</td>
<td>These actions are __________ actions. (adjective)</td>
<td>Demonstrative pronoun, plural, verb-present tense, subject-verb agreement adjective</td>
<td>Voluntary, involuntary</td>
</tr>
<tr>
<td>Discuss</td>
<td>How does the reflex work</td>
<td>Skin picks up messages about __________.</td>
<td>Phrasal verb, preposition</td>
<td>Heat, pain, pressure</td>
</tr>
<tr>
<td>Demonstrate</td>
<td>How does the reflex work</td>
<td>Cross your __________.</td>
<td>Verb, order Personal pronouns</td>
<td>Legs, arms, fingers</td>
</tr>
</tbody>
</table>
Lesson #4 Actions of the nervous system

### FUNCTIONAL/NOTIONAL CHART

**Lesson #4 “Actions of the nervous system”**

**Speech Emergence ELLs**

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classify</td>
<td>Grouping nerve cells</td>
<td>The <strong>first</strong> group is made of _______.</td>
<td>Ordinal numbers</td>
<td>Sensory cells, motor cells, connecting cells</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(noun phrase)</td>
<td>Passive voice</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Some</strong> actions are _______.</td>
<td>Adjectives as determiners</td>
<td>Voluntary, involuntary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(adjective)</td>
<td>Verb- present tense, subject verb agreement</td>
<td></td>
</tr>
<tr>
<td>Label</td>
<td>Discussing the role of the reflex</td>
<td>Messages <strong>may</strong> travel the _______.</td>
<td>Verb-modal preposition</td>
<td>To, from brain, spinal cord, muscles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(preposition) (noun)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predict</td>
<td>Discussing the reflex</td>
<td><strong>Sometimes</strong> _______ <strong>don’t</strong> travel to the _______.</td>
<td>Adverb contraction</td>
<td></td>
</tr>
<tr>
<td>Interpret</td>
<td>Discussing the reflex</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**FUNCTIONAL/NOTIONAL CHART**  
Lesson #4 “Actions of the nervous system”  
Intermediate Fluency ELLs

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>SITUATION</th>
<th>FORMULA</th>
<th>GRAMMAR</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry, questioning</td>
<td>Talking about the reflex</td>
<td>What actions does the ______ control?</td>
<td>Wh questions for specific information present tense</td>
<td>Brain, cerebrum, cerebellum</td>
</tr>
<tr>
<td>Suggesting</td>
<td>Discussing the role of the reflex</td>
<td>You might ______ to ______. (verb) (verb)</td>
<td>Verb-modal verb-infinitive</td>
<td>Decide, think, do, write, say</td>
</tr>
<tr>
<td>Differentiating</td>
<td>Discussing the role of different nerve cells</td>
<td>Nerve cells can be ______. (past participle)</td>
<td>Verb-modal with the passive voice</td>
<td>Grouped, classified, divided</td>
</tr>
<tr>
<td>Discussing</td>
<td>Discussing how the reflex works</td>
<td>The cells pick up the ______.</td>
<td>Definite article with plural nouns, phrasal verb</td>
<td>Messages, information</td>
</tr>
</tbody>
</table>
Lesson Plan

I. Objectives

A. Content objectives:

All students will:
- know the difference between voluntary and involuntary actions
- identify three groups of nerve cells.

Advanced and intermediate ELLs will:
- be able to describe the importance of involuntary actions.
- compare/contrast voluntary and involuntary actions.
- be able to describe how messages travel through different groups of nerve cells.
- explain the path of a reflex.

Speech emergence ELLs will:
- be able to answer questions in short sentences about three groups of nerve cells and how messages travel in these nerve cells.
- explain in short sentences the differences between voluntary and involuntary actions.
- identify the main parts of a reflex path.

Early production ELLs will:
- be able to answer questions using yes/no or simple words when comparing voluntary and involuntary actions.
- be able to answer questions using yes/no or simple words about three main groups of nerve cells and how messages travel in these nerve cells.
- identify the main parts of a reflex path.

Pre-production ELLs will:
- be able to answer questions pointing to different groups of nerve cells and show the path that messages travel.

B. Language objectives:

Advanced ELLs will:
- write short paragraphs about each group of nerve cells, explaining the role and location of these nerve cells.

Intermediate ELLs will:
- write one paragraph about three groups of nerve cells.

Advanced and intermediate ELLs will:
- use modal with passive voice when discussing the role of different nerve cells (e.g. Nerve cells can be grouped___.)
- use wh questions with present tense for specific information when talking about reflex (What actions does the _______ control?)
- use modals with infinitives when discussing the role of the reflex (You might _____ to ___).

Speech emergence ELLs will:
• show their understanding of different groups of nerve cells through a closed activity by filling the correct words in the blanks.
• respond with short sentences using ordinal numbers and passive voice construction when talking about different groups of nerve cells (The first group is made of ___.)
• respond with short sentences using correct subject-verb agreement with present tense, adjectives as determiners when labeling certain actions (Some actions are ___.)
• show understanding of usage of adverbs and contractions when discussing about a reflex (Sometimes ___ don’t travel to the _____.)

Early production ELLs will:
• show their understanding of different groups of nerve cells through closed activity by filling the correct words in the blanks from the “word bank”.
• respond with one or two words using demonstrative pronouns (this, these), personal pronouns (your, my), prepositions (about), phrasal verb (pick up) when talking about actions of the nervous system.

Pre-production ELLs will:
• identify new vocabulary words in the text.
• respond to the teacher’s directions (Cross your ___. Draw the ___. Circle ____ parts.) by pointing, drawing the correct object.
• respond with TPR when discussing how the messages travel (T: “Show me how the message travels from your brain to your fingers!”)

II. Materials

• skeleton (pp.35-37)
• prepared charts, diagrams, transparencies (pp.151-161)
• adapted, summarized and simplified reading materials (pp.135-141) (O.L. see index pp.47-51)
• activity sheets (pp.143-149), O.L. (index pp.54-55)
• paper
• pencils
• candle

III. Background knowledge (5 min.)

Review:
• Teacher (T) will quickly review the last three lessons. Students will be asked simple questions about nerve cells, their parts, how messages travel in nerve cells, the are main parts of the brain and spinal cord, their roles and functions. T will use different types of questions depending on the students’ language proficiency levels (see lesson plans 1, 2 and 3).

IV. Procedures (45 min.)

A. Instruction:

Warm-up activity:
• T will ask the students to cross their legs. T will model how to tap firmly the top of the leg below the knee with the edge of the hand. Students will try to predict the reason the leg kicks forward.

• T will ask Ss if they knew their legs would kick forward. T will name this as an involuntary action. Ss will try to guess more examples of involuntary actions. T will introduce voluntary actions (T will raise a hand). Students will give more examples.
of voluntary actions. Ss with T guidance will try to define voluntary and involuntary actions. Ss will find similarities and differences between these actions.

- The list of new words and their definitions (p.142) will be posted on the word wall and will be gradually introduced during the lesson. T will repeatedly pronounce and explain the meaning of new words pointing to the real objects (e.g. edge - the edge of the table) and pictures in the Oxford Picture Dictionary. T will model and use gestures (e.g. showing on his/her leg how to tap properly the top of the leg) to make new information more comprehensible.

- Using transparencies, charts, and diagrams (see Materials p.131), T will introduce three groups of nerve cells. Using T prepared diagrams and charts, T will show and explain the route messages travel from the skin to the spinal cord and brain then back to the spinal cord and muscles. T will use slower speech, make pauses between the steps and repeat these several times.

- While introducing the new materials, T will frame the key concepts. They will be written on the blackboard (e.g. “Connecting nerve cells connect sensory nerve cells with motor nerve cells”). This will be illustrated with charts, and diagrams (see Materials p.131).

- T will use gestures, point to his/her fingers showing the route the messages travel from the fingers through the spinal cord to the brain. T will bring to the students attention the fact that processes in the brain help us understand what is happening to our bodies and what the body should do next e.g. T will ask students to put a book on their hands. T will ask students what they feel. T will show how the message about pressure travels to the brain. If the pressure is strong, the brain will send a message to the hand to move it from under the book.

- T will light the candle. T will ask a volunteer in a quick manner to put his hand above the flame. Student will immediately pull his/her hand away. T will ask: “Did you think about pulling your hand away?” Using this example and diagrams (pp.158-161), T will explain a reflex as an automatic action. T will repeat several times the main parts of a reflex and how the messages travel. T will stress that the brain has no role in a reflex (p.160).

B. Reading activities: (15 min.)

- For these activities advanced and intermediate ELLs will be paired with speech emergence, early production and pre-production ELLs. More advanced ELLs will read modified text (pp.135-139). They will explain and help less advanced ELLs to read and understand summarized and simplified text (pp.140-141).

- While reading, students will work on their activity sheets. All ELLs will label the path the messages travel (pp.143-147).

- Advanced and intermediate fluency ELLs will write short paragraphs about three groups of nervous cell, explaining the role they play in the pathway of the messages (pp.146-147).

- Speech emergence and early production ELLs will work on the closed activities where they will have to fill in the blanks with the correct words (pp.144-145).
T will help all students by explaining the directions and modeling the first sentences of each activity.

- Early production ELLs will find and circle the words in the sentences about the three groups of nerve cells (p.143). They will do so when they hear the words or see them written on the blackboard or in their simplified text (p.141). More advanced students will help them read the simplified text.

C. Post-reading activities: (10 min.)

- All students will draw a reflex. T will again point to the diagrams (pp.158-161) and explain the route of a reflex.
- Information Gap activity (pp.148-149) Ss will work in groups of four – two pairs together. One student of each pair is more English proficient than the other. Each pair will get one of two worksheets. By talking to each other, they will fill in the missing information about three groups of nerve cells.

D. Evaluation

- The students' new knowledge will be evaluated through oral and written activities.
  
  a) Oral component:
  
  - T will ask questions and pre-production ELLs will point to the parts of the HNS and the proper group of nerve cells on the diagrams, e.g.: Where are the sensory nerve cells?
  - T will ask questions and early production ELLs will reply with yes/no or one-two words answers, e.g.: 1. This is a connecting nerve cell, isn’t it? Say yes or no. 2. Are there are two or three groups of nerve cells?
  - T will ask questions and speech emergence ELLs will answer with short sentences about three groups of nerve cells and how messages travel in these nerve cells. E.g.: What are the three groups of nerves cells?
  - Intermediate fluency and advanced ELLs will compare voluntary and involuntary actions and describe three groups of nerve cells and their role in the pathway of messages. They will describe a reflex.

  b) Written component:

  - Finished written activities will help T to evaluate ELLs’ new knowledge. Depending on the proficiency levels, Ss will work on their activities during reading time.

E. Closure (5 min.)

- Advanced and intermediate fluency ELLs will summarize in a few sentences the new information they learned.
- Speech emergence ELLs will state the lesson’s key points using simple sentences.
• Early production ELLs will point to the main parts of a reflex and name them.

• T will name the parts of a reflex and pre-production ELLs will point to them on the diagrams and their finished projects.
Lesson #4  **Actions of the nervous system**

**Descriptive Narrative**

This fourth lesson of the unit about the Human Nervous System has many modifications. It will help ELLs of all language proficiency levels the better comprehend new material.

Content and language objectives were clearly defined.

I continued to include lots of visuals, with my own created diagrams. The text was modified similarly as it was done in lessons 1-3. This lesson is slightly different from the others, because it covers the paths messages travel. Therefore, to make it comprehensible, I outlined on the sides the steps that messages take from the stimuli to the brain and back, rather than summarizing the paragraphs. The new words were highlighted and explained in the “word bank”. I particularly stressed the importance of the proper pace of the teacher’s speech. To make the routes of the messages understandable for the students, the teacher should use a slower pace, paraphrase when necessary, make pauses after each step, repeat those steps several times, and use diagrams and charts. L1 is highly recommended for clarification purposes. Students should work in pairs and explain to each other the steps that messages take. The teacher should regularly provide feedback to students on their output. I included an extra demonstration (“Involuntary reaction to the flame”), which would help to illustrate and better understand a reflex.

As in previous lessons I created several versions of the text: a summarized version for speech emergence ELLs; a simplified version, which includes diagrams, for pre-production and early production ELLs.

I think that grouping less proficient students with more proficient ELLs would be very beneficial to students as it would promote interaction, encourage pair-sharing and pair tutoring. It would lead to language development, and better comprehension of the content material.

The teacher should assess students based on their performances. I think both oral and written components should be taken into consideration. The teacher should check student understanding throughout the lesson. The questions should promote higher-order thinking. I suggested a variety of question types appropriate for each language proficiency level. Finished written activities will help to evaluate ELLs’ new content and language knowledge. Differentiated written activities, appropriate for each language proficiency level, were created for this lesson.

The following strategies are incorporated in Lesson 4:

- Activating previous knowledge
- Visuals
- Modeling
- Developing vocabulary
- Modifying and simplifying text
- Framing main ideas
- Pacing teacher’s speech
- Repeating key ideas several times
- Teacher questioning and response strategies
- Using questions appropriate for language fluency levels
- Pair-share
- Meaningful activities appropriate to fluency levels
- Real oral and written language
2. Actions of the Nervous System

Words to Know
sensory nerve cells
motor nerve cells
connecting nerve cells
reflex

Getting Started Cross your legs at the knees. With the edge of your hand, firmly tap the top leg just below the knee. What happens? ¹ Think about the part of the nervous system that might control this action.

¹The leg kicks forward.

What actions does the nervous system control?

When you tap your knee with your hand, your leg jerks forward automatically. Many of the actions controlled by the nervous system happen without your thinking about it. Actions that are controlled without having to think about them are involuntary actions. The activities of the heart and lungs are involuntary actions. Why is it important that heartbeat and breathing be controlled automatically? ²

²These actions help to keep you alive. If you had to think about making your heart beat or your lungs breathe, you would not be able to do other things.
Now think about actions that you decide to do. You might decide to pick up a pencil or open a book. Actions that are controlled by thinking about them are voluntary actions. Like involuntary actions, voluntary actions are controlled by the nervous system. The actions of the muscles of your skeletal system are voluntary. Some of these voluntary actions are shown here.

How does the nervous system control actions?
As you learned, nerve cells carry messages that control the actions of the body. Nerve cells can be divided into three groups.

The first group is the sensory nerve cells. **Sensory nerve cells** are nerve cells that carry messages to the spinal cord and brain. Some sensory nerve cells pick up messages from inside your body. Many others pick up messages from outside your body. These **sensory nerve cells** are found in the sense organs—your eyes, ears, nose, tongue, and skin. For example, sensory nerve cells in your skin pick up messages about heat, cold, pain, and pressure.
1. The telephone rings. The noise is an outside message that the boy picks up with his ears.

2. Sensory nerve cells carry the message to connecting nerve cells in the brain. The boy now knows that the telephone is ringing. Then the brain "decides" that the boy should walk to the telephone.

The second group of nerve cells is the motor nerve cells. **Motor nerve cells** are nerve cells that carry messages away from the brain and spinal cord. Many motor nerve cells carry messages that make your muscles move.

The third group of nerve cells is the connecting nerve cells. **Connecting nerve cells** are nerve cells that connect sensory nerve cells with motor nerve cells. Connecting nerve cells are found within the brain and spinal cord. Look at the drawing to see how the three kinds of nerve cells work together.

Sometimes messages take shortcuts. They may travel from sensory to motor nerve cells.
3. Connecting nerve cells in the brain and spinal cord carry the message "walk" to the motor nerve cells.

4. The motor nerve cells carry the message to the muscles. The boy walks toward the telephone.

without going to the brain. Suppose, for example, that you touch something hot. Without thinking about it, you pull your hand away quickly. The muscles in your hand act before your brain gets the message about what is happening.

Now think about what happened when you tapped your knee. Remember that your leg jerked forward automatically. Both of these actions are examples of reflexes (ree' fleks ihz). A reflex is a quick, automatic action. Because reflexes are very fast, they help protect the body from harm. How does pulling away quickly from something hot protect your hand?³

³This action helps prevent your skin from getting burned.
1. When the girl touches the sharp thorn, sensory nerve cells receive the pain message. These nerve cells carry the message to the spinal cord.

2. Connecting nerve cells in the spinal cord carry the message to motor nerve cells.

3. The motor nerve cells carry the message to muscles in the hand.

The drawing shows what happens during a reflex. Follow the path of the message as you read.

Notice that the path of the reflex message is short, because it does not include the brain. So reflexes take less time than other actions. A reflex may happen in as little as 1/100 second.

Lesson Review

1. How do involuntary actions differ from voluntary actions?
2. List the three groups of nerve cells and tell what each group does.

Think! Trace the path of the reflex message that begins when your knee is tapped and ends when your leg jerks forward.
Summary

- Actions without thinking are involuntary actions.
- Heartbeat and breathing are involuntary actions.
- Actions with thinking are voluntary actions.
- Lifting is a voluntary action.
- There are three groups of nerve cells.
- They are sensory, motor and connecting nerve cells.
- Eyes, ears, nose, tongue and skin have sensory nerve cells.
- Sensory nerve cells pick the message from the sense organs.
- Motor nerve cells carry messages to the muscles.
- They make muscles move.
- Connecting nerve cells are in the brain and spinal cord.
- They connect sensory nerve cells and motor nerve cells.
- Sometimes messages do not go to the brain.
- Reflex is an automatic action.
- Reflex is a fast reaction without thinking.
- The brain is not a part of reflex.
1. There are three groups of nerve cells

2. They are sensory, motor and connecting nerve cells.

3. Sensory nerve cells are in the ears, eyes, nose, tongue, and skin.

4. Motor nerves are in the muscles.

5. Connecting nerve cells connect sensory nerve cells and motor nerve cells.
**Word Bank**

<table>
<thead>
<tr>
<th><strong>Sensory</strong></th>
<th>using your senses of sight, hearing, feeling, taste, and smell</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor</strong></td>
<td>makes you move</td>
</tr>
<tr>
<td><strong>Connect</strong></td>
<td>put things together</td>
</tr>
<tr>
<td><strong>Tap</strong></td>
<td>to hit your fingers or foot lightly against something</td>
</tr>
<tr>
<td><strong>Firmly</strong></td>
<td>not very hard but not softly</td>
</tr>
<tr>
<td><strong>Forward</strong></td>
<td>position that is in front of you</td>
</tr>
<tr>
<td><strong>Jerk</strong></td>
<td>to move with a quick movement</td>
</tr>
<tr>
<td><strong>Involuntary</strong></td>
<td>movement without thinking or control</td>
</tr>
<tr>
<td><strong>Voluntary</strong></td>
<td>movement, when you want to do something</td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td>weight that is being put on something</td>
</tr>
<tr>
<td><strong>Shortcut</strong></td>
<td>a quicker way of doing something</td>
</tr>
<tr>
<td><strong>Thorn</strong></td>
<td>a sharp point that grows on the stem of a plant</td>
</tr>
<tr>
<td><strong>Edge</strong></td>
<td>a side</td>
</tr>
<tr>
<td><strong>Suppose</strong></td>
<td>imagine</td>
</tr>
</tbody>
</table>
Lesson #4  Actions of the nervous system.

Listening Guide  Level Pre-production

Nervous System and Actions

Directions: As we discuss and read about how the nervous system controls actions, circle the words below that you hear or see written on the blackboard or in the text.

1. Sensory nerve cells pick up messages from sense organs and carry them to the spinal cord and brain.
2. Motor nerve cells carry messages from the brain and spinal cord to muscles.
3. Connecting nerve cells connect sensory nerve cells with motor nerve cells. They are in the brain and spinal cord.
Nervous System and Actions

DIRECTIONS: As we discuss and read about how the nervous system controls actions, fill in the blanks with the correct words provided to you in the word bank.

WORD BANK

| muscles | connect | sense |

1. Sensory nerve cells pick up messages from ______ organs and carry them to the spinal cord and brain.

2. Motor nerve cells carry messages from the brain and spinal cord to ________.

3. Connecting nerve cells ______ sensory nerve cells with motor nerve cells. They are in the brain and spinal cord.
Nervous System and Actions

DIRECTIONS: As we discuss and read about how nervous system controls actions, fill in the blanks with the correct words.

1. Sensory nerve cells pick up messages from ______ organs and carry them to the _________________.

2. Motor nerve cells carry messages from the _______________ to _____________.

3. Connecting nerve cells connect ___________ with ____________. They are in the _________________.

(eyes, ears, nose, tongue, skin)
DIRECTIONS: As we discuss and read about how nervous system controls actions, finish the following sentences.

1. Sensory nerve cells ____________________________.
2. Motor nerve cells ____________________________.
3. Connecting nerve cells ________________________.
Lesson #4 Actions of the nervous system

Listening Guide  Level – Advanced

Nervous System and Actions

(eyes, ears, nose, tongue, skin)

Brain

Spinal cord

DIRECTIONS: As we discuss and read about how nervous system controls actions, write about three groups of nerve cells and their functions.

1. 

2. 

3. 

### Actions of the nervous system

Information Gap task

<table>
<thead>
<tr>
<th>Name of nerve cells</th>
<th>Location</th>
<th>Getting messages from</th>
<th>Sending messages to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory nerve cells</td>
<td>Sense organs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor nerve cells</td>
<td></td>
<td>From the spinal cord, (brain)</td>
<td></td>
</tr>
<tr>
<td>Connecting nerve cells</td>
<td>In the brain or spinal cord</td>
<td>Connect sensory cells with motor cells, (brain)</td>
<td>Connect sensory cells with motor cells, (brain)</td>
</tr>
</tbody>
</table>
### Actions of the nervous system

**Information Gap task**

<table>
<thead>
<tr>
<th>Name of nerve cells</th>
<th>Location</th>
<th>Getting messages from</th>
<th>Sending messages to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory nerve cells</td>
<td>From sense organs</td>
<td></td>
<td>To the spinal cord, (brain)</td>
</tr>
<tr>
<td>Motor nerve cells</td>
<td>Outside the spinal cord</td>
<td></td>
<td>To muscles</td>
</tr>
<tr>
<td>Connecting nerve cells</td>
<td></td>
<td></td>
<td>Connect sensory cells with motor cells, (brain)</td>
</tr>
</tbody>
</table>
**Actions of the nervous system**

Information Gap task

<table>
<thead>
<tr>
<th>Name of nerve cells</th>
<th>Location</th>
<th>Getting messages from</th>
<th>Sending messages to</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensory nerve cells</strong></td>
<td>Sense organs</td>
<td>From sense organs</td>
<td>To the spinal cord, (brain)</td>
</tr>
<tr>
<td><strong>Motor nerve cells</strong></td>
<td>Outside the spinal cord</td>
<td>From the spinal cord, (brain)</td>
<td>To muscles</td>
</tr>
<tr>
<td><strong>Connecting nerve cells</strong></td>
<td>In the brain or spinal cord</td>
<td>Connect sensory cells with motor cells, (brain)</td>
<td>Connect sensory cells with motor cells, (brain)</td>
</tr>
</tbody>
</table>
Nervous System and Actions

- **Sense organs** (eyes, ears, nose, tongue, skin)
- **Brain**
- **Spinal cord**
- **Connecting nerve cells**
- **Sensory nerve cells**
- **Motor nerve cells**
- **Muscles**
Main Parts of Nervous System

- Brain
- Nerves
- Spinal cord
Lesson #4 Actions so the nervous system

- Types of Nerve Cells
  - Sensory Nerve Cells
  - Motor Nerve Cells
  - Connecting Nerve Cells
Lesson #4  Actions of the nervous system

The Route of Messages

Brain

- Spinal cord
  - Nerves
    - Sense organs
      - (eyes, ears, nose, tongue, skin)
  - Nerves
    - Muscles
Lesson #4  Actions of the nervous system

The Route of Messages

- **Brain**: Connecting nerve cells

- **Spinal cord**: Connecting nerve cells, nerves, Sensory nerve

- **Skin**: Sensory nerve cells

- **Muscles**: Motor nerves
Brain, Spinal Cord and Nerves

The Central and Peripheral Nervous Systems
NERVOUS SYSTEM - SPINAL NERVES

- cerebrum
- cervical nerves (innervate the neck and the arms)
- brachial plexus
- intercostal nerves
- spinal cord
- lumbar and sacral nerves (innervate the legs and pelvic organs)
- lumbar plexus
- sacral plexus
Lesson #4 Actions of the nervous system

Reflex
A reflex arc is the pathway that a nerve reflex, such as the knee jerk reflex, follows.

1. A tap on the knee stimulates sensory receptors, generating a nerve signal.
2. The signal travels along a nerve pathway to the spinal cord.
3. At the spinal cord, the signal is transmitted from the sensory nerve to a motor nerve.
4. The motor nerve sends the signal back to a muscle in the thigh.
5. The muscle contracts, causing the lower leg to jerk upward. The entire reflex occurs without involving the brain.
Lesson #4  Actions of the nervous system

Reflex

Actions of the nervous system

- Sensory neuron (incoming information)
- Motor neuron (outgoing information)
- Skin receptors
- Muscle pulls finger away

To the brain

Connecting nerve

Spinal cord
Lesson #4  Actions of the nervous system

Reflex

Sensory nerve cells
Afferent neuron
Motor nerve
Muscle
Spinal cord
Brain
Connecting nerve cell
Checklists
## Human Nervous System

### Function Checklist

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<td>Demonstrate</td>
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<tr>
<td>Compare/contrast</td>
<td>1,2</td>
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<td>Discuss</td>
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FLA 518: Sheltered ELL Strategies Checklist

Write the page numbers and any other identifying features to identify those parts of your lessons that employ the following strategies.

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<td>+</td>
<td>+</td>
<td>+</td>
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<td>135-137</td>
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</tbody>
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Original Lessons
INDEX

ORIGINAL LESSONS
What is the nervous system?

nervous system: body system made up of the brain, the spinal cord, and all the nerves that controls body activities

neuron [NOOR-ahn]: nerve cell
Getting Started  Have you ever played with a toy robot? These toys have parts that move like parts of your body move. Some robots can even talk! What controls the robot's actions? What can you do that a robot cannot do?

What system controls the body?

Most robots are controlled by a system of wires connected to a computer. The wires carry messages to and from the computer. These messages can make a robot do many things.

Like the robot, your body has a system that controls its actions. Most of the actions of the body are controlled by the nervous system. The nervous system is a control system made up of the brain, the spinal cord, and the nerves. Find these three parts in the drawing. Which part is found inside the head?

1. Answers will vary, but may include the following: wires, batteries, computer, buttons, electricity.
How does the nervous system control actions?

The nervous system carries messages to and from all parts of the body. These messages control the actions of parts of the body.

Messages travel through the nervous system along nerve cells. A nerve cell is a cell that can receive and send messages. Most nerve cells are arranged end to end. In this way, messages travel from one cell to the next.

Look at the drawing of nerve cells. Notice that branches stretch out from the cell body, or central part. These branches carry messages into and out of the nerve cell. Find the many short branches that look like tree branches. The short branches receive messages from other nerve cells and carry them toward the cell body. Now find the single long branch on the other side of the cell. The long branch carries messages from the cell body to other nerve cells. Some long branches are very long. A single long branch runs the length of your arm. How long is this branch in your arm?²

²Answers will vary but may include the following: think, feel, laugh, cry, be angry, love someone.
³The Brain
⁴Answers will depend on the length of the student's arm.
Most nerve cells are found in bundles. A bundle of nerve cells is called a nerve. Some nerves are very small. Others are as big around as a pencil or your little finger. You can compare a nerve to an electric cable, which is made up of many small wires. To what parts of the nerve would you compare the small wires?

What are the three parts of the brain?

The main organ of the nervous system is the brain. The brain is the control center of the body. Most of the messages that move through the nervous system enter and leave the brain. In what way is the brain like the computer in a robot?

As the drawing shows, the brain has three parts. They are the cerebrum (se REE brum), the cerebellum (ser uh BEL um), and the brainstem. Each part of the brain controls certain activities.

---

5 The nerve cells
6 In the robot, messages are carried into and out of the computer by wires.
Every school has an office. It is a very important place. Messages come into the office. Messages go out. Most plans for the whole school are made in the office.

In your body, the job of receiving and sending messages is done by the nervous system. The nervous system controls all of your body's activities. The nervous system is made up of the brain, the spinal cord, and branching nerves.

The brain and spinal cord alone make up the central nervous system.

You have learned that the sense organs receive stimuli. But what happens to the stimuli after they are received? For example, how do you decide to answer the telephone, or raise your hand in class?

This is how the nervous system works.

- Stimuli from the sense organs change to electrical signals.
- These electrical signals do not stay in the sense organs. Nerves carry the signals to the brain and spinal cord.
- The brain decides what each stimulus is. The brain also decides how to respond to each stimulus.
- Nerves carry "what to do" messages away from the brain. The messages go to the part of the body that will answer or respond to the stimuli.

Most "what to do" messages go to muscles. Some, however, go to glands. Most responses are carried out by muscles.

Note: In some cases, the spinal cord, not the brain, receives and sends messages of how to respond to a stimulus. You will learn more about this in Lesson 22.
NERVE CELLS

The nerves of the nervous system are made up of nerve cells. Each nerve cell is called a neuron [NOOR-ahn].

Neurons are well suited to performing their job of carrying messages. A group of neurons looks like a string of space-age telephones.

Look at Figure A. It shows a message moving along two neurons.

Neurons form a pathway along which electrical signals travel. At one end of the pathway is a sense organ. At the other end is the muscle or gland that responds to the stimuli.

Figure A
NERVOUS SYSTEM

Function: Control most body activities
Components: Brain, spinal cord, nerves

The nervous system is the body's communication and control center. The CENTRAL NERVOUS SYSTEM includes the BRAIN and SPINAL CORD. Most information is routed through the spinal cord. The brain is the command center where all available information is interpreted and acted upon. The PERIPHERAL (per-IF-er-al) NERVOUS SYSTEM is made up of the nerves outside of the central nervous system. This network gathers the information from the body and its surroundings, then sends these messages to the brain and spinal cord by way of forty-three pairs of nerves.
NERVE CELLS

System: Nervous
Amount: About 15 billion
Location: Whole body
Function: Carry information to and from the brain

Nerve cells called NEURONS send signals to and from the brain. They are made up of three parts: the CELL BODY, its branches or DENDRITES (DEN-drites), and the AXON. Electric signals travel from the cell body, through the axon, to the terminals. The space between a nerve cell and the next nerve or other body cell is the SYNAPSE (SIN-aps). Nerve cells pass a chemical message across this fluid-filled boundary to the next cell in line.
<table>
<thead>
<tr>
<th>Topic</th>
<th>NERVOUS SYSTEM</th>
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<tr>
<td><strong>What I Want To Learn</strong></td>
<td></td>
</tr>
<tr>
<td><strong>What I Have Learned</strong></td>
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</table>
NERVES CARRY MESSAGES IN ONE DIRECTION ONLY

- Some nerves carry messages to the brain and spinal cord.
- Other nerves carry messages away from the brain and spinal cord.

**Figure C**

1. Nerves that carry stimuli lead __________ the brain and spinal cord. to, away from

2. Nerves that carry messages for responses lead __________ the spinal cord. to, away from

3. In what energy form are nervous system signals? _______________

**FIND THE PARTS**

Find the parts of the nervous system. Write their names on the correct lines. Choose from the parts listed below.

- A brain
- B spinal cord
- C nerves
- Name the parts that make up the central nervous system.

**Figure D**

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FILL IN THE BLANK

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some words may be used more than once.

nerves
one direction
receives
backbone

sends
spinal cord
away from
stimuli

muscles
to
brain
response

1. The nervous system ___________ and ___________ messages.
2. The parts of the nervous system are: the ___________, ___________, and ___________.
3. Nerves carry messages in only ___________.
4. Some nerves carry messages ___________ the brain and spinal cord. Some nerves carry messages ___________ the brain and spinal cord.
5. ___________ are carried to the brain and spinal cord by nerves.
6. Messages of ___________ are carried away from the brain and spinal cord.
7. The ___________ "decides" what to do about most stimuli.
8. Most messages of response are sent to ___________.
9. Most responses are carried out by ___________.
10. The spinal cord is protected by the ___________.

MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. parts of the nervous system</td>
<td>a) an action</td>
</tr>
<tr>
<td>2. stimulus</td>
<td>b) brain, spinal cord, and nerves</td>
</tr>
<tr>
<td>3. response</td>
<td>c) a signal to do something</td>
</tr>
<tr>
<td>4. brain and spinal cord</td>
<td>d) carry messages</td>
</tr>
<tr>
<td>5. nerves</td>
<td>e) central nervous system</td>
</tr>
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LESSON 1

CONTENT OBJECTIVES
A. **Identify** three parts of the nervous system.
B. **Name** the three main parts of the brain and **identify** a function of each.
C. **Identify** the functions of the spinal cord.

**Think! Conclude** that the brainstem is essential to life.

ACTIVITY OBJECTIVES
Design and **use** a test for dominance in a body part.
Design and **conduct** an experiment.
**Evaluate** and **modify** an inference based on additional observations.

SKILL ACTIVITY OBJECTIVE
**Identify** relevant data.

FOCUSING THE LESSON

Vocabulary
Write the **Words to Know** on the chalkboard and pronounce them. Call attention to nervous system. Remind students that they already know the word system and ask a volunteer to tell its meaning. (Set of things or parts that form a whole) Explain that nervous refers to nerves. Help students think of meanings for the new term nervous system. Explain that nerve cell, nerve, brain, and spinal cord are terms that name parts of the nervous system.

Choose from the following warm-up exercises.

**Getting Started** Have students discuss the questions asked in Getting Started. Ask students who own or have played with a toy robot to describe its actions.

**Warm-up Activity** Have several students with wind-up toys stand a few feet from a wall. Ask them to wind the toys. As the toys are let go, tell the students to walk toward the wall. Ask the class to compare the actions of the toys to those of the students. (The students stop moving at the wall. The toys keep moving but go nowhere.) Ask students to infer the differences between humans and wind-up toys. (Humans can make decisions, but wind-up toys cannot.)

Assign part A, page 125, of the Student Resource Book prior to the lesson. Assign part B, page 125, during the lesson.

Teacher Options

**READING STRATEGY**
After students have read the lesson, work with them to create a graphic organizer for the lesson. You may wish to use a semantic map or a flow chart. Allow time for students to discuss the organizer and to suggest other methods of organizing the lesson.

**EXTENSION**

**Long-term Project** Have students observe a young child, such as a brother, sister, or neighbor, for a few days. Ask them to list the young child's actions. Then have students compare their lists. Discuss with students how the nervous system controls each action.
How does the nervous system control actions?

The nervous system carries messages to and from all parts of the body. These messages control the actions of parts of the body.

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Look at the drawing of nerve cells. Notice that branches stretch out from the cell body, or central part. These branches carry messages into and out of the nerve cell. Find the many short branches that look like tree branches. The short branches receive messages from other nerve cells and carry them toward the cell body. Now find the single long branch on the other side of the cell. The long branch carries messages from the cell body to other nerve cells. Some long branches are very long. A single long branch runs the length of your arm. How long is this branch in your arm?

Answers will vary but may include the following: think, feel, laugh, cry, be angry, love someone.

TEACHING/GUIDED LEARNING
What system controls the body?

Have students read the rest of page 512 and study the drawing. Ask: What is a system? (In an organism, a system is a group of body parts, such as organs, that work together to perform a function.) The word system also describes groups of people or organizations that work together. For example, the legal system is made up of judges, lawyers, and various kinds of courts to carry out justice.

CHECK FOR UNDERSTANDING
Ask: What system controls the body? (The nervous system, which is made up of the brain, the spinal cord, and the nerves) What is different about how the actions of robots and the actions of people are controlled? (A robot’s actions are controlled by a computer and wires. A person’s actions are controlled by a brain, a spinal cord, and nerves.)

TEACHING/GUIDED LEARNING
How does the nervous system control actions?

Before students read this page, call attention to the drawing of nerve cells. Emphasize that they should refer to the drawing as they read how messages travel through the nervous system. Ask: What are the basic units of the nervous system? (Nerve cells) In which direction does a message travel along a nerve cell? (A message is received by short branches, carried to the cell body and then along the long branch to another nerve cell.)

SOCIAL STUDIES-SCIENCE CONNECTION
Have each student make a map of the corridors and stairs in their school or the streets and highways in their neighborhood. Then have them compare this to a map of nerve cells and nerves in the human body.
- Have students read the first paragraph on this page. Ask: What is a nerve? (A bundle of nerve cells)

**FOR UNDERSTANDING**

Ask: How does the nervous system control actions? (The nervous system carries messages to and from all parts of the body through nerve cells that are bundled together to form nerves.)

On the chalkboard, draw two nerve cells next to each other. Have students draw arrows to show the direction a message travels from one nerve cell to the next.

**TEACHING/GUIDED LEARNING**

**What are the three parts of the brain?**

Instruct students to read the rest of this page and the next page. Ask them to locate the three parts of the brain in the drawing. Explain to students that the brain needs a constant supply of blood. If the blood flow is cut off, permanent brain damage occurs after about four minutes.

Most nerve cells are found in bundles. A bundle of nerve cells is called a nerve. Some nerves are very small. Others are as big around as a pencil or your little finger. You can compare a nerve to an electric cable, which is made up of many small wires. To what parts of the nerve would you compare the small wires?

**What are the three parts of the brain?**

The main organ of the nervous system is the brain. The brain is the control center of the body. Most of the messages that move through the nervous system enter and leave the brain. In what ways is the brain like the computer in a robot?

As the drawing shows, the brain has three parts. They are the cerebrum (see ree brum), the cerebellum (ser ee bel um), and the brainstem. Each part of the brain controls certain activities.

**Parts of the brain**

Teacher Options

**EXTENSION**

Have students report on the brain structure of another mammal, a reptile, or a bird. Have them analyze and diagram the brain of the animal, and point out whether the animal has a cerebrum, a cerebellum, and a brainstem.

**MATHEMATICS-SCIENCE CONNECTION**

Have students experiment with surface areas. Ask them to cut a piece of plastic wrap or thin fabric into a 50 cm x 50 cm (20 in. x 20 in.) square. Tell them that this area is roughly equal to the surface area of the human cerebrum—about 2,500 cm² (400 in²). Have them fold the plastic or fabric square. Challenge students to describe how folding affects the surface area of a structure.
NERVES CARRY MESSAGES IN ONE DIRECTION ONLY

- Some nerves carry messages to the brain and spinal cord.
- Other nerves carry messages away from the brain and spinal cord.

Figure C
1. Nerves that carry stimuli lead ___ to ___ the brain and spinal cord.
2. Nerves that carry messages for responses lead ___ away from ___ the spinal cord.
3. In what energy form are nervous system signals? ___ electrical ___

FIND THE PARTS

Find the parts of the nervous system. Write their names on the correct lines. Choose from the parts listed below.

A brain
B spinal cord
C nerves

spinal cord
branching nerves
brain

Name the parts that make up the central nervous system.

brain
spinal cord
FILL IN THE BLANK

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some words may be used more than once.

1. The nervous system ________ receives ________ and ________ sends ________ messages.

2. The parts of the nervous system are: the ________ brain ________, ________ spinal cord ________, and ________ nerves ________.

3. Nerves carry messages in only ________ one direction ________.

4. Some nerves carry messages ________ to ________ the brain and spinal cord. Some nerves carry messages ________ away from ________ the brain and spinal cord.

5. ________ Stimuli ________ are carried to the brain and spinal cord by nerves.

6. Messages of ________ response ________ are carried away from the brain and spinal cord.

7. The ________ brain ________ “decides” what to do about most stimuli.

8. Most messages of response are sent to ________ muscles ________.

9. Most responses are carried out by ________ muscles ________.

10. The spinal cord is protected by the ________ backbone ________.

MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>1. parts of the nervous system</td>
</tr>
<tr>
<td>c</td>
<td>2. stimulus</td>
</tr>
<tr>
<td>a</td>
<td>3. response</td>
</tr>
<tr>
<td>e</td>
<td>4. brain and spinal cord</td>
</tr>
<tr>
<td>d</td>
<td>5. nerves</td>
</tr>
</tbody>
</table>

a) an action
b) brain, spinal cord, and nerves
c) a signal to do something
d) carry messages
e) central nervous system
What are the parts of the brain?

cerebellum [ser-uh-BELL-um]: part of the brain that controls balance and body motion
cerebrum [suh-REE-brum]: large part of the brain that controls the senses and thinking
medulla [muh-DULL-uh]: part of the brain that controls heartbeat and breathing rate
Most nerve cells are found in bundles. A bundle of nerve cells is called a nerve. Some nerves are very small. Others are as big around as a pencil or your little finger. You can compare a nerve to an electric cable, which is made up of many small wires. To what parts of the nerve would you compare the small wires?

What are the three parts of the brain?

The main organ of the nervous system is the brain. The brain is the control center of the body. Most of the messages that move through the nervous system enter and leave the brain. In what way is the brain like the computer in a robot?

As the drawing shows, the brain has three parts. They are the cerebrum (se Ree brum), the cerebellum (ser uh bel um), and the brainstem. Each part of the brain controls certain activities.
Quick! Without thinking about it, fold your arms across your chest. Which arm is on top? The answer tells which side of your brain—left or right—has dominance (DAMH uh nuns). Dominance means "having control over." Suppose your right arm was on top. Then the left side of your brain probably has dominance.

Right-brain dominance or left-brain dominance can be shown in other body parts besides your arms. It can also be shown in your legs, hands, feet, eyes, and ears.

**How can you test for dominance?**

Design a test to show which part of a person's brain has dominance. The test should include two of the body parts named above. Test five of your classmates. Compare your results with those of other classmates. Which side of the brain shows dominance in most of your classmates?

The largest part of the brain is the cerebrum. From the top, the cerebrum looks like a large walnut. Notice that its surface is folded like a piece of crumpled paper. The folding allows more nerve cells to fit inside the skull.

The cerebrum also has a right half and a left half. The right half controls the left half of the body. The left half controls the right half of the body. If you are right-handed, the left side of the cerebrum is usually a little larger. If you are left-handed, which side would probably be larger?  

7 The right side
The cerebrum controls all your thinking. It also controls the movements of many muscles. Look at the “map” of the cerebrum. Notice that different regions control different activities. Find the regions that control what you see, hear, smell, and feel.

The cerebellum, or second part of the brain, lies just under the back part of the cerebrum. Like the cerebrum, the cerebellum has many deep folds. But it is much smaller than the cerebrum. The cerebellum helps muscles work together. The cerebellum also helps the body keep its balance.

Without the cerebellum, movements would be clumsy instead of smooth. You would not be able to pick up a pencil without dropping it. To pick up a pencil, muscles in the eyes, arm, and fingers must work together. The cerebellum controls these muscles so they work together smoothly.
The brainstem is the third and smallest part of the brain. Find this part in the drawing. The brainstem controls many actions that help keep you alive. For example, the brainstem controls the heartbeat, breathing, and the digestion of food. The brainstem controls these actions automatically, or without you having to think about them. Coughing, sneezing, and swallowing are also controlled by the brainstem.

**What does the spinal cord do?**

Notice that the brainstem is really the wide top part of the spinal cord. The **spinal cord** is a thick cord of nerves in the middle of the back. The spinal cord carries messages to and from the brain.

As the drawing shows, the spinal cord runs through a hole in each bone of the backbone. The backbone protects the soft tissue of the spinal cord. Why is it important that the spinal cord be protected? What bones protect the brain? The skull bones

---

> If the spinal cord was damaged, messages might not be able to travel to and from the brain.
The brain is the control center of your body. The brain is made up of a mass of nervous tissue. It is protected by your skull.

The main job of the brain is to receive messages and decide what to do. These messages may come from inside or outside your body. Your brain responds to the messages and then controls all of your body’s activities.

The brain is made up of three main parts. They are the cerebrum [suh-REE-brum], the cerebellum [ser-uh-BELL-um], and the medulla [muh-DULL-uh].

Different parts of the brain control different activities.

CEREBRUM  The cerebrum is the largest part of the brain. It controls the senses, thought, memory, and learning. It also controls certain voluntary muscles. You use voluntary muscles for activities like walking, talking, and writing.

CEREBELLUM  The cerebellum is located at the back of the brain. It works with the cerebrum to control voluntary muscles. The cerebellum controls body movements. The cerebellum also helps you keep your balance.

MEDULLA  The medulla is the smallest part of the brain. It is a thick stalk at the base of the skull. The medulla connects the brain to the spinal cord. It controls many vital involuntary functions. For example, the medulla controls breathing, digestion, and heartbeat. It also controls sneezing and blinking.
The brain, which controls most functions of the body, is divided into three main parts. Linking the brain with the spinal cord, the MEDULLA regulates involuntary activities such as breathing and digestion. The CEREBELLUM controls certain movements and keeps the body balanced. The CEREBRUM is divided into two halves covered by a thin layer of millions of nerve cell bodies. This layer is the CEREBRAL CORTEX, where many important functions are regulated, such as the processing of most sensory information, control of voluntary movement, speech, judgement and reasoning.
Look at Figure A. It shows the parts of the cerebrum that control certain activities. Then answer the questions below.

Figure A

1. What might happen if you were hit very hard on the back of your head? __________
2. What might happen if you were hit very hard on the front of your head? __________
3. What might happen if you were hit hard on the side of your head—towards the middle? __________
4. The brain is one of the most protected parts of your body.
   a) What protects your brain? __________
   b) Why does it protect so well? __________
   c) Of what is it made? __________
5. a) What is the largest part of the brain? __________
   b) What is the smallest part of the brain? __________
**LABEL THE DIAGRAM**

Label the main parts of the brain.

![Brain Diagram]

**Figure B**

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**COMPLETE THE CHART**

Twelve actions are listed below. Each action is controlled by a different part of the brain. Place a check [✓] in the proper box (or boxes) for each action.

<table>
<thead>
<tr>
<th>ACTION</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>cerebrum</td>
</tr>
<tr>
<td>1. hearing</td>
<td></td>
</tr>
<tr>
<td>2. seeing</td>
<td></td>
</tr>
<tr>
<td>3. moving the body</td>
<td></td>
</tr>
<tr>
<td>4. heartbeat</td>
<td></td>
</tr>
<tr>
<td>5. tasting</td>
<td></td>
</tr>
<tr>
<td>6. balance</td>
<td></td>
</tr>
<tr>
<td>7. sneezing</td>
<td></td>
</tr>
<tr>
<td>8. learning</td>
<td></td>
</tr>
<tr>
<td>9. breathing</td>
<td></td>
</tr>
<tr>
<td>10. speaking</td>
<td></td>
</tr>
<tr>
<td>11. memory</td>
<td></td>
</tr>
<tr>
<td>12. blinking</td>
<td></td>
</tr>
</tbody>
</table>
**MULTIPLE CHOICE**

*In the space provided, write the letter of the word that best completes each statement.*

1. The control center of your body is your  
   a) eye.  
   b) heart.  
   c) brain.  
   d) lungs.

2. The largest part of the brain is the  
   a) cerebrum.  
   b) cerebellum.  
   c) medulla.  
   d) nerves.

3. The main job of the brain is to carry  
   a) oxygen.  
   b) blood.  
   c) messages.  
   d) hormones.

4. The brain is connected to the spinal cord by the  
   a) cerebrum.  
   b) medulla.  
   c) cerebellum.  
   d) inner ear.

5. Heartbeat and breathing are controlled by the  
   a) cerebrum.  
   b) kidneys.  
   c) cerebellum.  
   d) medulla.

**MATCHING**

*Match each term in Column A with its description in Column B. Write the correct letter in the space provided.*

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<tr>
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<td>b) control center</td>
</tr>
<tr>
<td>3. skull</td>
<td>c) smallest part of brain</td>
</tr>
<tr>
<td>4. cerebrum</td>
<td>d) protects brain</td>
</tr>
<tr>
<td>5. brain</td>
<td>e) controls balance</td>
</tr>
</tbody>
</table>
Have students read the first paragraph on this page. Ask: What is a nerve? (A bundle of nerve cells)

CHECK FOR UNDERSTANDING
- How does the nervous system control actions? (The nervous system carries messages to and from all parts of the body through nerve cells that are bundled together to form nerves.)

On the chalkboard, draw two nerve cells next to each other. Have students draw arrows to show the direction a message travels from one nerve cell to the next.

TEACHING/GUIDED LEARNING
What are the three parts of the brain?
- Instruct students to read the rest of this page and the next page. Ask them to locate the three parts of the brain in the drawing. Explain to students that the brain needs a constant supply of blood. If the blood flow is cut off, permanent brain damage occurs after about four minutes.

- Parts of a nerve

Most nerve cells are found in bundles. A bundle of nerve cells is called a nerve. Some nerves are very small. Others are as big around as a pencil or your little finger. You can compare a nerve to an electric cable, which is made up of many small wires. To what parts of the nerve would you compare the small wires?

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Teacher Options

EXTENSION ACTIVITY

Have students report on the brain structure of another mammal, a reptile, or a bird. Have them analyze and diagram the brain of the animal, and point out whether the animal has a cerebrum, a cerebellum, and a brainstem.

MATHEMATICS-SCIENCE CONNECTION
Have students experiment with surface areas. Ask them to cut a piece of plastic wrap or thin fabric into a 50 cm x 50 cm (20 in. x 20 in.) square. Tell them that this area is roughly equal to the surface area of the human cerebrum—about 2,500 cm² (400 in²). Have them fold the plastic or fabric square. Challenge students to describe how folding affects the surface area of a structure.
ACTIVITY

Quick! Without thinking about it, fold your arms across your chest. Which arm is on top? The answer tells which side of your brain—left or right—has dominance. Dominance means “having control over.” Suppose your right arm was on top. Then the left side of your brain probably has dominance.

Right-brain dominance or left-brain dominance can be shown in other body parts besides your arms. It can also be shown in your legs, hands, feet, eyes, and ears.

How can you test for dominance?

Design a test to show which part of a person’s brain has dominance. The test should include two of the body parts named above. Test five of your classmates. Compare your results with those of other classmates. Which side of the brain shows dominance in most of your classmates?

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The cerebrum also has a right half and a left half. The right half controls the left half of the body. The left half controls the right half of the body. If you are right-handed, the left side of the cerebrum is usually a little larger. If you are left-handed, which side would probably be larger?\(^7\)

\(^7\)The right side

Problem Solving

OBJECTIVES

- Design and use a test for dominance in a body part.
- Design and conduct an experiment.
- Identify relevant data.

TIME ALLOTMENT

Period 1: 15-20 minutes
Period 2: 30-35 minutes

PREPARATION

You may want to have available reference and trade books about the brain and nervous system.

Safety Reminders: Review student plans carefully for potential hazards. Avoid overcrowding. Be sure there are no physical obstructions that could cause injury.

GUIDING THE ACTIVITY

- Have students prepare a tally of the number of students that are left-brain and right-brain dominant as shown by their folding their arms across their chests.
- Be sure students make predictions about what their results may mean before they do the tests. Students may ask classmates to cross their legs or ankles (similar to arm crossing test), pick up a pencil, or kick a wad of paper. In each case, a preference for left or right will be demonstrated.

For additional support material for this activity, see page 511b.

- Write the terms cerebrum, cerebellum, and brainstem on the chalkboard. Point out that just because one part is larger than another, that is no reason to assume that it is more important. Ask: What benefit is there in the cerebrum having many folds and creases? (The folded surface allows more surface area to fit inside the skull than would a flat surface.)

☐ Assign pages 115-116 of the Activities Masters.

☐ Use Activity Transparency Master 1 with this activity.
Direct attention to the map of the cerebrum and the drawings of the cerebellum and the brainstem as students read to the end of this section. Ask: What are some of the activities controlled by the cerebrum? (Hearing, sight, smell, touch, muscle movement) Emphasize that the actions of each side of the body are controlled by the opposite side of the cerebrum.

Ask: What would happen if the brain cells that control hearing were damaged? (The person would not be able to hear.)

Write cerebellum on the chalkboard. Have volunteers record beneath it the main body functions controlled by the cerebellum. (Helps muscles work together, helps body balanced) Point out that the cerebrum and the cerebellum work together to control smooth and coordinated actions, such as walking.

Ask: What would happen if the part of the brain that controls balance were damaged? (A person would not be able to stand. He or she would fall when attempting to stand.)

The cerebrum controls all your thinking. It also controls the movements of many muscles. Look at the “map” of the cerebrum. Notice that different regions control different activities. Find the regions that control what you see, hear, smell, and feel.

The cerebellum, or second part of the brain, lies just under the back part of the cerebrum. Like the cerebrum, the cerebellum has many deep folds. But it is much smaller than the cerebrum. The cerebellum helps muscles work together. The cerebellum also helps the body keep its balance.

Without the cerebellum, movements would be clumsy instead of smooth. You would not be able to pick up a pencil without dropping it. To pick up a pencil, muscles in the eyes, arm, and fingers must work together. The cerebellum controls these muscles so they work together smoothly.

Teacher Options
RETEACHING A Different Modality
(Kinesthetic) Have students study a take-apart model of the human brain. If one is not available, provide them with three colors of clay from which to make their own models. Have students identify each brain part and briefly describe the job of the cerebrum, the cerebellum, and the brainstem. Then ask students to use the model to tell about what happens when a person eats a juicy strawberry. (The cerebrum controls the decision to eat the strawberry and the actions of picking it up, biting it, and sensing its flavor. The cerebellum directs the muscles in the hands, fingers, arms, and mouth. The brainstem controls the digestion of the fruit.)
The brainstem is the third and smallest part of the brain. Find this part in the drawing. The brainstem controls many actions that help keep you alive. For example, the brainstem controls heartbeat, breathing, and the digestion of food. The brainstem controls these actions automatically, or without you having to think about them. Coughing, sneezing, and swallowing are also controlled by the brainstem.

What does the spinal cord do?
Notice that the brainstem is really the wide top part of the spinal cord. The spinal cord is a thick cord of nerves in the middle of the back. The spinal cord carries messages to and from the brain.

As the drawing shows, the spinal cord runs through a hole in each bone of the backbone. The backbone protects the soft tissue of the spinal cord. Why is it important that the spinal cord be protected? What bones protect the brain? The skull bones.

If the spinal cord was damaged, messages might not be able to travel to and from the brain.

Point out that the third part of the brain is the brainstem. Ask: What two parts of the nervous system does it connect? (The brain and the spinal cord) Write brainstem on the chalkboard. Have volunteers record beneath it the main body functions controlled by the brainstem. (Actions such as heartbeat, breathing, and digestion that happen automatically)

Ask: What do you think would happen if the part of the brainstem that controls breathing were damaged? (The person could not breathe.) Explain that unless the person were attached to an artificial breathing machine, he or she would die.

Have students locate the three parts of the brain by touching their skulls in the regions that cover each part of the brain. (The cerebrum is covered by the forehead and top of skull. The cerebellum is covered by the back of skull. The brainstem is covered by the lower back of skull and the top of neck.)

CHECK FOR UNDERSTANDING
Ask: What are the three parts of the brain? (The cerebrum, which controls thinking and reasoning and directs movement; the cerebellum, which directs muscles to work together, controls balance, and adjusts the movements of the body; the brainstem, which controls actions such as heartbeat, breathing, and digestion)
On separate index cards, write each of the various body functions controlled by the three parts of the brain. Have students, one at a time, tell which part of the brain controls each function.

TEACHING/GUIDED LEARNING
What does the spinal cord do?
Have students read the first two paragraphs of this section and locate the spinal cord in the drawing. Ask students to describe the job of the spinal cord. (Carries messages between the brain and other parts of the body.) Then ask: What is the spinal cord connected to? (The brainstem) What is the spinal cord made of? (A thick cord of nerves) Encourage students to feel their own backbone.

EXTENSION
Have students work in groups to list different actions, such as sneezing and laughing. Challenge students to identify which actions are controlled by the cerebrum, the cerebellum, the brainstem, or a combination of these parts of the brain.

QUESTIONS STUDENTS ASK
What kinds of cells make up the nervous system? There are two kinds of cells: glial cells and neurons. Glial cells make up 90 percent of the nerve cells, and neurons make up 10 percent. However, neurons occupy 50 percent of the volume. Glial cells are those that support and protect; neurons are the nerve cells that conduct impulses from one part of the body to another. Signals are transmitted in only one direction through neurons.
Look at Figure A. It shows the parts of the cerebrum that control certain activities. Then answer the questions below.

![Figure A]

**Figure A**

1. What might happen if you were hit very hard on the back of your head? __________
   
   **Lose sense of seeing**

2. What might happen if you were hit very hard on the front of your head? __________

   **Lose memory, ability to learn**

3. What might happen if you were hit hard on the side of your head—towards the middle? __________

   **Lose sense of taste, hearing**

4. The brain is one of the most protected parts of your body.
   a) What protects your brain? **Skull**
   b) Why does it protect so well? **It is hard**
   c) Of what is it made? **Bone**

5. a) What is the largest part of the brain? **Cerebrum**
   b) What is the smallest part of the brain? **Brain stem**
LABEL THE DIAGRAM

Label the main parts of the brain.

![Brain Diagram]

**Figure B**

COMPLETE THE CHART

Twelve actions are listed below. Each action is controlled by a different part of the brain. Place a check [✓] in the proper box (or boxes) for each action.

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<td>7. sneezing</td>
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<td></td>
</tr>
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<td>12. blinking</td>
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</table>
MULTIPLE CHOICE

In the space provided, write the letter of the word that best completes each statement.

1. The control center of your body is your
   a) eye.           b) heart.
   c) brain.         d) lungs.
2. The largest part of the brain is the
   a) cerebrum.     b) cerebellum.
   c) medulla.       d) nerves.
3. The main job of the brain is to carry
   a) oxygen.       b) blood.
   c) messages.     d) hormones.
4. The brain is connected to the spinal cord by the
   a) cerebrum.     b) medulla.
   c) cerebellum.   d) inner ear.
5. Heartbeat and breathing are controlled by the
   a) cerebrum.     b) kidneys.
   c) cerebellum.   d) medulla.

MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

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<td>cerebellum</td>
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</tr>
<tr>
<td>skull</td>
<td>c) smallest part of brain</td>
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<tr>
<td>cerebrum</td>
<td>d) protects brain</td>
</tr>
<tr>
<td>brain</td>
<td>e) controls balance</td>
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What does the spinal cord do?
The brainstem is the third and smallest part of the brain. Find this part in the drawing. The brainstem controls many actions that help keep you alive. For example, the brainstem controls the heartbeat, breathing, and the digestion of food. The brainstem controls these actions automatically, or without you having to think about them. Coughing, sneezing, and swallowing are also controlled by the brainstem.

**What does the spinal cord do?**

Notice that the brainstem is really the wide top part of the spinal cord. The **spinal cord** is a thick cord of nerves in the middle of the back. The spinal cord carries messages to and from the brain.

As the drawing shows, the spinal cord runs through a hole in each bone of the backbone. The backbone protects the soft tissue of the spinal cord. Why is it important that the spinal cord be protected? What bones protect the brain? The skull bones

If the spinal cord was damaged, messages might not be able to travel to and from the brain.
Look at the drawing on this page. Notice that nerves from all parts of the body are connected to the spinal cord. The spinal cord, brain, and nerves work together in controlling actions.

Messages from the brain travel down the spinal cord to the nerves. Then the nerves carry the messages to all parts of the body. Messages from all parts of the body travel from the nerves into the spinal cord. Then the spinal cord carries the messages up to the brain. In the next section, you will learn more about how the brain, spinal cord, and nerves work together.

Lesson Review

1. List the three parts of the nervous system.
2. What are the three parts of the brain? Name one thing that each part controls.
3. What does the spinal cord do?

Think! Do you think a person could live for very long with a damaged brainstem? Explain your answer.
Spinal Cord

Stretching from the brain into the lower back, the spinal cord resembles a long white worm covered with blood vessels. Much like the trunk of a tree, the spinal cord branches off into thousands of miles of tiny nerves that reach all parts of the body. When the nerves send out their impulses, these electrical waves travel first to the spinal cord, then up into the brain. This all happens in less than a second.

Because it is such an integral part of the nervous system, the spinal cord is protectively encased within the bony backbone. An injury to the spinal cord cuts off the communication of impulses between the nerve branches and the brain. This can cause paralysis, which is the loss of feeling and movement in parts of the body.

If the damage occurs to the lower part of the cord, only the lower impulses are blocked, paralyzing the body below the waist. When the damage takes place on the higher part of the cord, it blocks off all nerve impulses from below the neck. In this case, the entire body, except the head and neck, will suffer paralysis.
Thirty one pairs of nerves branch out from your spinal cord. These nerves are inside the spinal column (backbone). The backbone protects the nerves.

Your spinal cord runs down the center of your back. It extends from the base of the brain to the tailbone.

Some emergency responses must happen extra fast. There is no time for the brain to decide how to respond. Delay can cause severe injury—or even death.

In these cases, the spinal cord—not the brain, sets up the response. The response takes place even before the message reaches the brain.

These emergency responses to stimuli are called reflexes. You will learn more about reflexes in Lesson 22.
The spinal cord is a bundle of nerve fibers about as thick as a pencil. It extends four-fifths of the way down the back, inside a hollow, fluid-filled chain of bones called the SPINAL COLUMN. The spinal cord does not usually process information, but sends it to and from the brain. Reflex movements are controlled by the spinal cord. If you start to burn your hand, certain nerve pathways in the spinal cord send the signals on to the brain but also signal muscles to react by pulling your hand away. This pathway is called a REFLEX ARC. The brain will later interpret the pain and its source.
The Spinal Cord

The spinal cord is a thick bundle of nerve fibers with a tough protective covering. It extends four-fifths of the way down the back, inside the spinal column, which is a hollow chain of bones called vertebrae (VER-tuh-bray). Every part of the body is connected to the central nervous system by 43 pairs of nerves. Each pair is like a two lane highway with impulses traveling in one direction in one nerve and back again in the other nerve. 31 pairs of nerves connect to the spinal cord and 12 pairs go to and from the brain by way of the medulla. These nerves crisscross at the medulla so that the right side of the body is controlled by the left side of the brain and vice versa.

See if you can find these words from the story hidden in the puzzle below.
The Spinal Cord
The brainstem is the third and smallest part of the brain. Find this part in the drawing. The brainstem controls many actions that help keep you alive. For example, the brainstem controls the heartbeat, breathing, and the digestion of food. The brainstem controls these actions automatically, or without you having to think about them. Coughing, sneezing, and swallowing are also controlled by the brainstem.

What does the spinal cord do?

Notice that the brainstem is really the wide top part of the spinal cord. The spinal cord is a thick cord of nerves in the middle of the back. The spinal cord carries messages to and from the brain.

As the drawing shows, the spinal cord runs through a hole in each bone of the backbone. The backbone protects the soft tissue of the spinal cord. Why is it important that the spinal cord be protected?

What bones protect the brain?

The skull bones

If the spinal cord was damaged, messages might not be able to travel to and from the brain.
Help students interpret the drawing of how messages travel through the parts of the nervous system.

For Understanding

As... What does the spinal cord do? (Carries messages to and from the brain)

Write spinal cord, brain, and nerves on separate cards. Have students put them in the order that messages travel from the brain to the body or from the body to the brain.

Assign the Lesson Review. The answers follow.

**Lesson Review** (Practice)

1. The brain, the spinal cord, and the nerves. **Objective A**
2. The cerebrum controls thinking, muscle movements, and also the activities shown on the “map” on page 516. The cerebellum helps muscles work together and helps the body keep its balance. The brainstem controls many actions that keep you alive, including heartbeat, breathing, and the digestion of food. **Objective B**
3. The spinal cord carries messages to and from the brain. The spinal cord, brain, and nerves work together to control actions. **Objective C**

Think! A person would probably not be able to live for very long because the brainstem controls heartbeat, breathing, and other actions that help keep a person alive.

**Closing the Lesson**

**Lesson Summary**

Ask: How do nerve cells, nerves, the brain, and the spinal cord work in controlling the body? (Answers may include the following: nerve cells send and receive messages; nerves are bundles of nerve cells; the brain is the control center of the body; the spinal cord carries messages between the brain and the nerves of the body.)

**Lesson Connection**

**Life Science to Physical Science** Scientists are trying to develop computers with intelligence like that of humans. It is difficult, however, to develop a program for imagination or the ability to connect unrelated events from past experience.

**Teacher Options**

**Language Arts-Science Connection**

Have students interview a health professional, such as a family physician or school nurse, to create their own brain fact sheets. Guide them to find out the brain’s average mass and volume, major illnesses and traumas that affect the brain, and diagnostic tools that help doctors study the brain. Challenge students to organize and record as many facts about the brain as they can.

**Extension**

Provide students with models, illustrations, or actual specimens of the brains of several animals. Have them observe and discuss similarities and differences. Ask students to speculate how brain size and structure might influence an animal’s behavior.

Assign part C, page 126, of the Student Resource Book.
Interpreting data

Skills

Identifying useful data

When you do an experiment, you do not always use all the data you obtain. It is important to know which data you need and which you do not need.

Practicing the skill

1. The brain gets energy from a sugar called glucose. Scientists gave a group of people a written test. At the same time, they measured the sugar that these people's brains used. The table shows the results.

<table>
<thead>
<tr>
<th>Person's initials</th>
<th>Age</th>
<th>Correct answers</th>
<th>Units of sugar used</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.K.</td>
<td>18</td>
<td>11</td>
<td>52</td>
</tr>
<tr>
<td>R.D.</td>
<td>25</td>
<td>15</td>
<td>42</td>
</tr>
<tr>
<td>L.N.</td>
<td>19</td>
<td>19</td>
<td>40</td>
</tr>
<tr>
<td>S.E.</td>
<td>22</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>C.W.</td>
<td>23</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>S.B.</td>
<td>24</td>
<td>21</td>
<td>30</td>
</tr>
<tr>
<td>D.M.</td>
<td>20</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>B.G.</td>
<td>21</td>
<td>33</td>
<td>25</td>
</tr>
</tbody>
</table>

2. Which data in the table would you use to answer this question: Did the brains of people with high test scores use more sugar than the brains of people with low scores?

Thinking about the skill

Tell about another time when you had to choose which information you needed and which you did not.

Applying the skill

Suppose you wanted to learn if people's age affected their test scores. Which data would you look at?

Activity

Health-science connection

Have students find out what a spinal tap is and what doctors learn about patients by studying spinal fluid. Have students find out about possible injuries to the spinal cord, why they usually cannot be reversed, and how to avoid such injuries.

Skill trace: Interpreting data

Identify relevant data

<table>
<thead>
<tr>
<th></th>
<th>Practice</th>
<th>Test</th>
<th>Re-teach</th>
<th>Maintain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduce</td>
<td>p. 519</td>
<td>Chapter 15 Test Master</td>
<td>Skill Master p. 69</td>
<td>TE p. 535</td>
</tr>
<tr>
<td>p. 67</td>
<td>Skill Master</td>
<td>Test Master</td>
<td>Skill Master</td>
<td>TE</td>
</tr>
</tbody>
</table>

Assign pages 67-68 of the Skill Activity Masters.
The Spinal Cord

- Spinal cord
- Spinal column
- Nerve
What is a reflex?

reflex: automatic response to a stimulus
These actions help to keep you alive. If you had to think about making your heart beat or your lungs breathe, you would not be able to do other things.

2. Actions of the Nervous System

Getting Started  Cross your legs at the knees. With the edge of your hand, firmly tap the top leg just below the knee. What happens? Think about the part of the nervous system that might control this action.

1 The leg kicks forward.

What actions does the nervous system control?

When you tap your knee with your hand, your leg jerks forward automatically. Many of the actions controlled by the nervous system happen without your thinking about it. Actions that are controlled without having to think about them are involuntary actions. The activities of the heart and lungs are involuntary actions. Why is it important that heartbeat and breathing be controlled automatically?²
Now think about actions that you decide to do. You might decide to pick up a pencil or open a book. Actions that are controlled by thinking about them are voluntary actions. Like involuntary actions, voluntary actions are controlled by the nervous system. The actions of the muscles of your skeletal system are voluntary. Some of these voluntary actions are shown here.

**How does the nervous system control actions?**

As you learned, nerve cells carry messages that control the actions of the body. Nerve cells can be divided into three groups.

The first group is the sensory nerve cells. **Sensory nerve cells** are nerve cells that carry messages to the spinal cord and brain. Some sensory nerve cells pick up messages from inside your body. Many others pick up messages from outside your body. These sensory nerve cells are found in the sense organs—your eyes, ears, nose, tongue, and skin. For example, sensory nerve cells in your skin pick up messages about heat, cold, pain, and pressure.

> "When the going gets tough, the tough get going!" Meet a very tough young girl and her family in *Mine for Keeps*, page 542.
1. The telephone rings. The noise is an outside message that the boy picks up with his ears.

2. Sensory nerve cells carry the message to connecting nerve cells in the brain. The boy now knows that the telephone is ringing. Then the brain “decides” that the boy should walk to the telephone.

The second group of nerve cells is the motor nerve cells. **Motor nerve cells** are nerve cells that carry messages away from the brain and spinal cord. Many motor nerve cells carry messages that make your muscles move.

The third group of nerve cells is the connecting nerve cells. **Connecting nerve cells** are nerve cells that connect sensory nerve cells with motor nerve cells. Connecting nerve cells are found within the brain and spinal cord. Look at the drawing to see how the three kinds of nerve cells work together.

Sometimes messages take shortcuts. They may travel from sensory to motor nerve cells.
3. Connecting nerve cells in the brain and spinal cord carry the message "walk" to the motor nerve cells.

4. The motor nerve cells carry the message to the muscles. The boy walks toward the telephone.

without going to the brain. Suppose, for example, that you touch something hot. Without thinking about it, you pull your hand away quickly. The muscles in your hand act before your brain gets the message about what is happening.

Now think about what happened when you tapped your knee. Remember that your leg jerked forward automatically. Both of these actions are examples of reflexes (REE fleks ihz). A reflex is a quick, automatic action. Because reflexes are very fast, they help protect the body from harm. How does pulling away quickly from something hot protect your hand?³

³This action helps prevent your skin from getting burned.
1. When the girl touches the sharp thorn, sensory nerve cells receive the pain message. These nerve cells carry the message to the spinal cord.

2. Connecting nerve cells in the spinal cord carry the message to motor nerve cells.

3. The motor nerve cells carry the message to muscles in the hand.

4. The girl pulls her hand away.

The drawing shows what happens during a reflex. Follow the path of the message as you read.

Notice that the path of the reflex message is short, because it does not include the brain. So reflexes take less time than other actions. A reflex may happen in as little as \( \frac{1}{100} \) second.

**Lesson Review**

1. How do involuntary actions differ from voluntary actions?

2. List the three groups of nerve cells and tell what each group does.

Think! Trace the path of the reflex message that begins when your knee is tapped and ends when your leg jerks forward.
The moment you are born you do certain things by yourself. You cry, you yawn, your eyes blink, your lips search for food.

You were not taught how to do these things. You were born knowing how to do them.

These kinds of responses are called reflexes.

There are many kinds of reflexes. But they are all alike in certain ways.

- Reflexes are not learned. They are inborn.
- You do not control or think about reflexes. They happen by themselves. They are automatic and involuntary responses.
- A reflex is done exactly the same way every time.

In most cases, you do not know a reflex is happening. For example, jumping away from a speeding car is a reflex. You respond without thinking. You know about it only after the response has taken place.

The same is true when you touch a hot pot. You pull your hand away before your brain “feels” the pain.

Reflexes are very important. They protect us and help us stay alive. Reflexes control most of our body organs.
Reflexes usually occur very quickly. This is because reflexes do not involve the brain. They are controlled by the spinal cord. Look at the example below to help you understand the path of a reflex.

**Figure A**

The **stimulus**: touching a hot object.

The **response**: pulling the hand away.

- **FIRST** Cells in the skin detect heat. Nerves send the message of “heat” to the spinal cord. The spinal cord decides what to do.

- **SECOND** Nerves carry this message of “what to do” away from the spinal cord. It goes to the muscles of the hand.

- **THIRD** The message tells the muscles to “let go” of the hot object.

At this point, the brain does not know what is happening. However, while messages are moving along the reflex path, the spinal cord is sending messages to the brain. Once the brain receives these messages, it sends messages to your hand. Then, you feel pain. That is why a reflex action is usually followed by a loud “OUCH!”
REFLEXES HELP YOU STAY ALIVE

They control important body organs.

**Figure B** Reflexes control your heartbeat.

1. What happens to your heartbeat if you are excited?

2. What happens to your heartbeat if you are asleep?

They protect you from injury.

**Figure D** When you trip, your hands move automatically to protect your face.

**Figure E** When dust gets in your eyes you tear, and your eyelids flutter—automatically.

3. What part of your body do you seem to protect first automatically?

4. How does this reflex protect you?
COMPLETING SENTENCES

Choose the correct word or term for each statement. Write your choice in the spaces provided.

1. Reflexes are ______ learned, inborn.

2. You ______ control reflexes.

can, cannot

3. Reflexes ______ planned.

are, are not

4. Reflexes ______ happen by themselves.

do, do not

5. You ______ know that most reflexes are happening.

do, do not

6. Reflex responses are carried out by ______. (Careful, this one is tricky.)

nerves, muscles

7. Most reflexes are very ______.

slow, fast

8. A reflex always happens ______.

the same way, in different ways

9. Reading ______ a reflex.

is, is not

10. Blinking when something enters your eye ______ a reflex.

is, is not

WORD SCRAMBLE

Below are several scrambled words you have used in this Lesson. Unscramble the words and write your answers in the spaces provided.

1. PONSESER

2. XERFEL

3. NAIP

4. NORBNI

5. SULUMITS
LESSON 2

CONTENT OBJECTIVES
A. Recall the difference between involuntary and voluntary actions.
B. Name the three kinds of nerve cells and describe their functions.

Think! Trace the path of a reflex.

ACTIVITY OBJECTIVES
Compare the sensitivity of various parts of the arm, hand, and neck.
Draw an inference from a set of observations.
Predict an outcome from a trend in data.

1 FOCUSING THE LESSON

Vocabulary Write the Words to Know on the chalkboard and pronounce them. Remind students that they already know the term nerve cell, and ask a volunteer to tell its meaning. (A cell that can receive and send messages) Explain that sensory refers to the senses, motor refers to movement, and connecting refers to the making of connections. Help students think of meanings for the new terms sensory nerve cells, motor nerve cells, and connecting nerve cells.

Choose from the following warm-up exercises.
Getting Started Have students try the activity. Discuss other automatic reactions that students have experienced. (Jerking a hand away from a hot object, blinking, coughing)

Warm-up Activity Have students tell all the activities that take place in their bodies while they sit quietly. Have them hypothesize which activities are automatic. (Heartbeat, breathing, swallowing)

2 DEVELOPING THE LESSON

TEACHING/GUIDED LEARNING
What actions does the nervous system control?

Have students read the two paragraphs in this section. Ask: What does involuntary mean? (Not one's choice) Point out to students that the question is also an involuntary action. When they eat lunch or run a race, they do not have to direct their stomachs to digest the meal or tell their hearts to beat faster.

These actions help to keep you alive. If you had to think about making your heart beat or your lungs breathe, you would not be able to do other things.

2. Actions of the Nervous System

Getting Started Cross your legs at the knees. With the edge of your hand, firmly tap the top leg just below the knee. What happens? Think about the part of the nervous system that might control this action.

The leg kicks forward. What actions does the nervous system control?

When you tap your knee with your hand, your leg jerks forward automatically. Many of the actions controlled by the nervous system happen without your thinking about it. Actions that are controlled without having to think about them are involuntary actions. The activities of the heart and lungs are involuntary actions. Why is it important that heartbeat and breathing be controlled automatically?

Teacher Options

READING STRATEGY
Before the students have read the lesson, have them read the Lesson-Directed Questions (LDQs) and picture captions. After each LDQ, ask for volunteers to predict answers. Ask students if the picture captions help them answer the LDQs. Instruct students to be aware of the LDQs as they read the lesson.
Now think about actions that you decide to do. You might decide to pick up a pencil or open a book. Actions that are controlled by thinking about them are voluntary actions. Like involuntary actions, voluntary actions are controlled by the nervous system. The actions of the muscles of your skeletal system are voluntary. Some of these voluntary actions are shown here.

**How does the nervous system control actions?**

As you learned, nerve cells carry messages that control the actions of the body. Nerve cells can be divided into three groups.

The first group is the sensory nerve cells. **Sensory nerve cells** are nerve cells that carry messages to the spinal cord and brain. Some sensory nerve cells pick up messages from inside your body. Many others pick up messages from outside your body. These sensory nerve cells are found in the sense organs—your eyes, ears, nose, tongue, and skin. For example, sensory nerve cells in your skin pick up messages about heat, cold, pain, and pressure.

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**Elicit from students that voluntary actions are actions that are controlled by thinking about them. Refer students to the pictures. Ask them to identify the parts of the body over which they have active control. (Muscles in the legs, arms, face, neck, torso)**

**CHECK FOR UNDERSTANDING**

Ask: What actions does the nervous system control? (The nervous system controls involuntary actions such as heartbeat and breathing and the voluntary actions of the skeletal muscles.) **Why is the knee jerk an involuntary action?** (It happens without thinking about it.)

**TEACHING/GUIDED LEARNING**

How does the nervous system control actions?

> Emphasize that nerve cells can be divided into three groups. Ask: What is the job of a sensory nerve cell? (To carry messages from inside or outside the body to the spinal cord and brain)

Explain that nervous system messages are actually bits of information.

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**HEALTH-SCIENCE CONNECTION**

Have students record all the activities they did during one hour of a day. Examples are swimming, eating, and laughing. Then ask them to categorize the activities. Have them make a chart with the headings: **Involuntary Actions** and **Voluntary Actions**. Tell them to record each activity in the appropriate column. Have them determine which kinds of actions can help them build a stronger, healthier body. (Voluntary actions, such as swimming, running, and playing sports, that build stronger muscles, lungs, and hearts)

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**ACTIVITY**

Use the following MIST™ chapter to help students raise interesting questions about patterns of growth that occur in humans.

- **MIST™ 5**
  - Living and Growing
  - "Getting Taller"
  - Side 1, Chapter 13

Use the following MIST™ chapter to help students raise interesting questions about the importance of using the five senses.

- **MIST™ 3**
  - The Senses
  - "Making Sense of It"
  - Side 1, Chapter 03

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Tell students that the numbered steps in the picture on pages 522 and 523 explain how the three kinds of nerve cells work together. Ask: **What is the job of the motor nerve cell?** (Carries messages away from the brain and spinal cord to parts of the body) **What is the effect of messages carried by motor nerve cells?** (Messages of motor nerve cells cause muscles to move.) **What is the job of a connecting nerve cell?** (Connects sensory nerve cells with motor nerve cells)

Have one group of students write a four-step description of how the three kinds of nerve cells work together for the sense of smell, for example, when cookies are baking. Have another group do the same for the sense of touch, for example, when an ant is crawling on their arms. Have the groups exchange descriptions and compare them with the one for hearing in the picture.

The second group of nerve cells is the motor nerve cells. **Motor nerve cells** are nerve cells that carry messages away from the brain and spinal cord. Many motor nerve cells carry messages that make your muscles move.

The third group of nerve cells is the connecting nerve cells. **Connecting nerve cells** are nerve cells that connect sensory nerve cells with motor nerve cells. Connecting nerve cells are found within the brain and spinal cord. Look at the drawing to see how the three kinds of nerve cells work together.

Sometimes messages take shortcuts. They may travel from sensory to motor nerve cells.

**Teacher Options**

**LIMITED ENGLISH PROFICIENCY**

Have students try to think of as many reflex actions as they can. Write their responses on the chalkboard. Then discuss what would happen if these reflexes were not automatic. Ask students what function they wish were part of a reflex action. Ask them to write a story two or three paragraphs long, in which they show how this reflex would work and what advantage it would have. Ask students to use the vocabulary they learned in the textbook whenever possible. Allow students to invent the spelling of difficult words. Have volunteers share their stories with the class. Display their stories on the bulletin board in the classroom.
without going to the brain. Suppose, for example, that you touch something hot. Without thinking about it, you pull your hand away quickly. The muscles in your hand act before your brain gets the message about what is happening.

Now think about what happened when you tapped your knee. Remember that your leg moved forward automatically. Both of these actions are examples of reflexes (REE fleks ihz).

A reflex is a quick, automatic action. Because reflexes are very fast, they help protect the body from harm. How does pulling away quickly from something hot protect your hand?

This action helps prevent your skin from getting burned.

RETEACHING A Different Modality (Kinesthetic) Provide students with materials to make their own models of reflexes. Give them three different-colored pipe cleaners, colored twine, or telephone wire, and a large sheet of white drawing paper. Tell students first to draw an outline of a human. Then ask them to label the spinal cord and the brain. Direct students to show how a message travels from sensory nerve cells to connecting nerve cells to motor nerve cells by using a certain color pipe cleaner, twine, or wire for each type of nerve cell. Challenge students to show the path of a particular message, such as a loud noise or a bitter taste, along the path of nerve cells that they have created.
1. When the girl touches the sharp thorn, sensory nerve cells receive the pain message. These nerve cells carry the message to the spinal cord.

2. Connecting nerve cells in the spinal cord carry the message to motor nerve cells.

3. The motor nerve cells carry the message to muscles in the hand.

4. The girl pulls her hand away.

The drawing shows what happens during a reflex. Follow the path of the message as you read.

Notice that the path of the reflex message is short, because it does not include the brain. So reflexes take less time than other actions. A reflex may happen in as little as 1/100 second.

**Lesson Review**

1. Involuntary actions—actions that are controlled without having to think about them; voluntary actions—actions that are controlled by thinking about them. **OBJECTIVE A**

2. Sensory nerve cells carry messages to the spinal cord and brain. Motor nerve cells carry messages away from the brain and spinal cord. Connecting nerve cells connect sensory nerve cells with motor nerve cells. **OBJECTIVE B**

**Think!** Sensory nerve cells receive the message and carry it to the spinal cord; connecting nerve cells in the spinal cord carry the message to motor nerve cells; motor nerve cells carry the message to leg muscles.

**LESSON SUMMARY**

Ask: What actions does the nervous system control? (Voluntary and involuntary actions as well as reflex actions, by means of sensory, motor, and connecting nerve cells)

**LESSON CONNECTION**

Life Science to Physical Science The nervous system may be compared with a telephone network: The telephone wires are like nerves and the central switchboard is like the brain.

- Call on students to trace the events of a reflex by reading the numbered statements.

**CHECK FOR UNDERSTANDING**

Ask: How does the nervous system control actions? (Sensory nerve cells carry messages from inside or outside the body to the spinal cord and brain. Motor nerve cells carry messages away from the brain and spinal cord to all parts of the body, causing muscles to move. Connecting nerve cells connect sensory and motor nerve cells.)

Have students work in pairs to observe the pupil reflex. Have one student close or cover his or her eyes for one minute and then open them. Have the other student observe how pupils quickly react to light by becoming smaller.

Assign the Lesson Review. The answers follow.

**LESSON REVIEW** (Practice)

1. Involuntary actions—actions that are controlled without having to think about them; voluntary actions—actions that are controlled by thinking about them. **OBJECTIVE A**

2. Sensory nerve cells carry messages to the spinal cord and brain. Motor nerve cells carry messages away from the brain and spinal cord. Connecting nerve cells connect sensory nerve cells with motor nerve cells. **OBJECTIVE B**

**Questions Students Ask**

How do we breathe without thinking about it? The nerve cells in the brain associated with the lungs are pacemaker neurons. From time to time these cells will stimulate themselves if no other signals come in. So, you do not consciously have to think about breathing. Your lungs are somewhat like a self-inflating balloon. Such a balloon would automatically inflate after if deflated to a certain size. So, too, your lungs inflate periodically even though you do not consciously tell yourself to inhale and exhale.

Assign part C, page 128, of the Student Resource Book.
Explore

OBJECTIVES
• Compare the sensitivity of various parts of the arm, hand, and neck.
• Draw an inference from a set of observations.
• Predict an outcome from a trend in data.

TIME ALLOTMENT
30-35 minutes

PREPARATION
Prepare a sample table.

Safety Reminders: Have students pick up materials when finished and clean up spills immediately. Caution students against pushing too hard when testing with paper clips. Warn them to keep paper clips away from eyes.

GUIDING THE ACTIVITY
- Review with students the three types of nerve cells—sensory, motor, and connecting cells—and their functions. Have them identify the types of nerve cells they are using during this activity. (All three types)
- Show the students how to open the paper clip and adjust it so that the two ends are adjacent to each other.
- After some data are collected in step D, have the students try to predict the next value before they actually measure it.

Answers to Writing and Sharing Results and Conclusions
1. Answers will vary.
2. The nerve cells are closest together on the body part where there was the shortest distance felt between the points of the clip. This is inferred because two nerve cells sensed the location of the clip at those two points.

For additional support material for this activity, see page 519b.

<table>
<thead>
<tr>
<th>SKILL TRACE: PREDICTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predict an outcome from a trend in data</td>
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<tr>
<td>Introduce</td>
</tr>
<tr>
<td>p. 313</td>
</tr>
<tr>
<td>Skill Master</td>
</tr>
<tr>
<td>p. 333</td>
</tr>
</tbody>
</table>

Materials
- paper clip - metric ruler

Procedure
A. Open a paper clip and bend it into a U shape. Bring the ends together until they touch.
B. Prepare a table like the one shown.

<table>
<thead>
<tr>
<th>Body Part</th>
<th>Distance between points</th>
<th>Number of points felt</th>
</tr>
</thead>
<tbody>
<tr>
<td>wrist</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>fingertip</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>0</td>
</tr>
</tbody>
</table>

C. Work with a partner. While your partner's eyes are closed, gently touch the inside of his or her wrist with the points of the paper clip. Ask whether your partner feels one point or two. Record this number in the table.
D. Move the points 0.5 cm apart and repeat step C. Next open the points by 1.0 cm and then by 1.5 cm. Repeat step C for each amount.
E. Repeat steps C and D for the following body parts: fingertip, back of hand, back of neck.

Writing and Sharing Results and Conclusions
1. For each body part tested, what was the smallest distance between the points when both were first felt?
2. Of the body parts tested, where are nerve cells closest together? How do you know?

ART-SCIENCE CONNECTION
Have students create a class bulletin board of collages of voluntary and involuntary actions such as smiling, running, or breathing. Guide them to use photographs, illustrations, and original art to show different actions. Challenge students to label each action, identifying which type it is.
REFLEXES HELP YOU STAY ALIVE

They control important body organs.

**Figure B** Reflexes control your heartbeat.

1. What happens to your heartbeat if you are excited?
   It gets faster.

2. What happens to your heartbeat if you are asleep?
   It gets slower.

They protect you from injury.

**Figure D** When you trip, your hands move automatically to protect your face.

**Figure E** When dust gets in your eyes you tear, and your eyelids flutter—automatically.

3. What part of your body do you seem to protect first automatically?
   the head

4. How does this reflex protect you?
   protects the eyes from harmful substances; prevents you from hitting your head
COMPLETING SENTENCES

Choose the correct word or term for each statement. Write your choice in the spaces provided.

1. Reflexes are ___________.
   inborn learned, inborn

2. You __________ control reflexes.
   cannot can, cannot

3. Reflexes __________ planned.
   are not are, are not

4. Reflexes __________ happen by themselves.
   do do, do not

5. You __________ know that most reflexes are happening.
   do not do, do not

6. Reflex responses are carried out by ___________. (Careful, this one is tricky.)
   muscles nerves, muscles

7. Most reflexes are very __________.
   fast slow, fast

8. A reflex always happens __________.
   the same way the same way, in different ways

9. Reading __________ a reflex.
   is, is not

10. Blinking when something enters your eye __________ a reflex.
    is, is not

WORD SCRAMBLE

Below are several scrambled words you have used in this Lesson. Unscramble the words and write your answers in the spaces provided.

1. PONSESER __________ response
2. XERFEL __________ reflex
3. NAIP __________ pain
4. NORBNI __________ inborn
5. SULUMITS __________ stimulus