

Grade 5: The Brain and Nervous System

Lesson 1: The Brain & Nervous System

Lesson 2: Brain Connections - Memory, Learning, and the Stress Response

Objectives:

1. Students will identify three major structures of the nervous system. (Brain, spinal cord, nerves)
2. Students will identify three parts of a neuron. (Cell body, dendrites, axon)
3. Students will understand how the nervous system affects memory, learning, and the stress.

Optional:

4. Students will identify four major structures of the brain. (Cerebrum, Cerebellum, Brain stem, cerebral cortex)
5. Students will identify four of the six major divisions of the nervous system. (Central & peripheral; somatic & autonomic; sympathetic & parasympathetic)
6. Students will identify one function of each of the four divisions of the nervous system.

Materials:

Lesson 1:

- Items that can be quietly dropped. Enough for ½ the class. (Examples: soft ball, tennis ball, etc...)
- Drawing paper
- Pencils
- Fruit such as apple, banana, orange. (1 piece of fruit for every 5 students.)
- Poster board
- Material to make Learning Station models (Tape, glue, string, wire, modeling clay, colors, tubes, beads, cardboard)
- Container- any kind
- Notes with the following information written on them...
 - From brain to hand – Pick up container (motor instruction)
 - From hand to brain –The container feels very HOT. (Sensory feedback)
 - From brain to hand – Drop container! (Motor instruction)
- Pins or tape

Lesson 2:

- 2 Teacher Aids, parents or volunteers
- Simple picture to put on the overhead

- Simple story to read
- Parent Letter (**See Figure 1**)
- Article (**See Figure 2**)
- Graphic organizer, Nervous System Activity and The Brain (**See Figure 3**)
- Graphic organizer, Memory and Learning (**See Figure 4**).
- Answer Keys for the graphic organizers are included at the end of the Lesson (**See Figure 5 and Figure 6**)

Children's Literature:

The Brain: Our Nervous System

By Seymour Simon

Activity Summary:

In this lesson students will acquire a basic understanding of the brain and nervous system and how the nervous system functions in memory, learning, and the stress response. Students will use this foundation to develop understanding of brain and nervous system health in their own body.

Background information for the teacher:

Overview

All organs in each body system must work together within that system, and every body system must work together with every other body system for humans to function. The nervous system coordinates each body system within its own system and with the other systems. All movements and sensations as well as thoughts, emotions, and memory are controlled by the nervous system. Since conditions within and without the body are constantly changing, the nervous system monitors changes or stimuli, stores information and/or initiates response impulses throughout affected body systems for action and sensation, emotion, thought, and memory.

What is the Nervous System

The nervous system is made up of the brain, the spinal cord, and a vast network of nerves throughout the whole body.

Master Coordinator

The following excerpt provides an illustration of the complexity of the nervous system activity involved in a simple activity such as reading.

“As you read this page, your nervous system is performing many different tasks, all with split-second timing and the greatest efficiency. It is directing certain muscles to move your eyes from left to right and back again. Your eyes are sending a steady flow of information to your brain. Recognizing the image of each letter, your brain is combining letters into words and sentences. Some of the information you are gathering will be stored in your brain as memories. Meanwhile your brain is recalling some of your old memories to help in understanding new ideas.

At the same time, your nervous system is instructing many of your skeletal muscles to keep you in a sitting position. Other muscles blink your eyes about 25x a minute.

Your nervous system is also receiving back messages about your heart rate, blood pressure, breathing rate, body temperature, digestion of your food . . . Through your nervous system you may realize you are tired or that dinner is cooking. Your brain knows where you are, about what time it is, and whether you are hungry.”

(From *The Human Body* by Ruth Dowling Brunn, M.D., and Bertel Brunn, M.D.)

Organizing the Nervous System

The nervous system is organized in two systems:

1. Central nervous system (CNS) includes the brain and spinal cord.
2. Peripheral nervous system (PNS) includes the cranial nerves and spinal nerves. There are 12 pairs of cranial nerves, and 31 pairs of spinal nerves.

The peripheral nervous system has two divisions:

- a. Somatic nervous system.

The somatic nervous system moderates and mediates the body's relationship to the external environment. Functioning of this part of the nervous system is voluntary and consists of sensory and motor nerves. Sensory nerves *send information to the brain* (central nervous system) from the skin, muscles and sense organs such as the eyes, ears, skin, and nose, etc.

Motor nerves *carry instructions from the brain* back to the muscles.

- b. Autonomic Nervous System (ANS).

The ANS controls the activities of the circulatory, digestive, respiratory, and reproductive systems. These functions are involuntary. The ANS controls smooth muscle (in the hollow organs such as stomach, intestines, etc.) cardiac muscle, and glands.

The ANS itself is divided into two parts: the Sympathetic and Parasympathetic nervous systems.

(1.) The Sympathetic nervous system is responsible for initiating the stress response within the body. This is commonly known as the fight-or-flight response. It prepares the body by increasing the heart rate putting more blood and oxygen throughout the body, decreasing digestive and elimination function, preparing the immune response processes, and many other activities to ensure survival.

(2.) The Parasympathetic response essentially reverses the fight-or-flight response and returns the body to a more normal state.

How the Nervous System Works

Highly specialized cells called neurons are the main functional unit of the nervous system. The brain has more than 10 billion nerve cells. We are born with all the neurons we will ever have.

Neurons have the following structures:

Cell body - Contains the nucleus and other cell structures,

Dendrites - Neuron fibers that carry impulses or signals **to** the cell body. These are the receptors in the nervous system.

Axons - Carry signals **away** from the cell body.

Information travels through many Sensory and motor neurons going to and from the Central Nervous System. When a neuron is stimulated by a sensation such as heat, pressure, pain, color, taste, etc., a small electrical pulse is generated. This travels the length of the neuron. But then the signal has to get across a gap between one neuron and the next. This gap is called the synapse.

The nerve signal or impulse must move across the synapse between the two neurons. It generally moves from the axon of one nerve to the dendrite of another. Chemicals, known as neurotransmitters, act as agents to help make the impulse transfer across the synapse.

Special sites, or receptors, on the dendrite pick up the transferred information from specific neurotransmitters. This sequence is repeated across thousands of neurons transmitting information to the brain and back through the body.

The Reflex Arc is the name for the activity that moves sensory and motor signals through the nervous system.

Linking Up

The spinal cord links the peripheral nervous system and the brain. The cord runs through vertebral column and is protected by the bony vertebrae. The cord itself goes from the brain to about two-thirds of the way down the spine. Branching off from the spinal cord are the nerves.

Big Brain

The brain is soft, wrinkled and moist. The bones of the skull, cerebrospinal fluid and membrane protect and cushion the brain. The brain weighs about 3 pounds.

Three primary structures of the brain are:

Cerebrum-

The largest and uppermost part.

It makes up about 85% of the brain's weight.

This is the "thinking" part of the brain.

Conscious thought, memory (both long and short-term) and reasoning are activities of the cerebrum.

It also controls our voluntary muscle movement.

Brain stem-

It is underneath the cerebrum and in front of the cerebellum

Connects the cerebrum and the spinal cord.

Controls the involuntary muscles that maintain important body functions such as breathing, blood circulation, and food digestion.

Cerebellum-

Found below the posterior part of the cerebrum. The name cerebellum means "little brain".

It coordinates voluntary (i.e., skeletal) muscles, maintains balance and muscle tone.

The cerebrum itself is divided into two hemispheres, right and left. Each hemisphere is divided into four lobes. The left hemisphere is responsible for speech, reading, writing and logical thinking. These are more linear and analytical functions. The right hemisphere controls emotions, creativity, musical and artistic ability. Right-brained activity is related to intuitive, creative and holistic functioning.

The brain tissue that we most commonly think of as being “the brain” with all the folds and fissures is the cerebral cortex. This is a fourth brain structure. This is the ‘grey matter’ of the brain. The cerebral cortex forms the outermost tissue layer on the cerebrum and is the most evolved portion of the brain. This area controls conscious thought, reasoning, and abstract mental functioning.

The brain makes up about 2% of our body weight and uses about 20% of the energy produced by the body.

Connections: Memory and Learning

Although the number of our neurons does not increase after birth, the connections between them do. And it is with these connections that learning and memory happen. When learning, messages repeatedly move over neurons, making connections or pathways between the neurons. As we grow and learn the nerve connections between the right and left sides of the brain grow enabling the two sides to communicate with each other. The brain stores what it has done, learned and experienced in different areas of the cerebral cortex within the cerebrum.

Note to Teacher:

An excellent chart on how brain interacts with other body systems can be found at:

<http://faculty.washington.edu/chudler/organ.html>.

A chart showing the divisions of the nervous system can be found at:

<http://faculty.washington.edu/chudler/nsdivide.html>

Vocabulary:

- Central nervous system
- Peripheral nervous system
- Autonomic nervous system
- Somatic nervous system
- Sympathetic nervous system
- Parasympathetic nervous system
- Voluntary

Involuntary
Neuron
Reflex Arc
Cell body
Dendrite
Axon
Cerebrum
Cerebellum
Brain stem
Cerebral cortex

Lesson 1: The Brain and Nervous System

Engage

Have students work in groups of three to do a quick experiment about reflexes. Each group needs an item that they can quietly drop. The item needs to be small enough to be caught and held with one hand. Items that could be used are a soft ball, an eraser, a shoe, a tennis ball, etc. Each student should have a piece of paper to record their results. A clock with a second hand must be clearly visible to each student group.

In the experiment one student will hold the object in front of the other student. The object will be held at about shoulder height of the second student and at about arm's length away. The second student will have their arms down by their sides. The first student will softly count to five and then let the object go. When they let go they say "drop". The second student must catch the object with their dominant hand. When the student catches the object they must say "catch". The third student watches the time and starts recording when they hear "drop" and stops recording when they hear the word "catch". This is repeated two more times and recorded. Then the object is dropped and the student attempts to catch it with their non-dominant hand. This is done 3 times and recorded. Repeat for the second and third student. Each student should get a turn to drop, catch, and record the time. Find averages.

Have the class discuss their results and the differences, if any, between the dominant and non-dominant hands. Use this simple experiment to introduce the brain and nervous system involvement in eye-hand coordination, reflexes, and left and right sidedness.

Explore

Organize the students to work together in groups of 5. Give each group an apple, orange, banana or a picture of a piece of fruit. Also make sure one student has drawing paper and color pencils.

Ask one student from the group to draw the fruit. Ask the other group members to pay attention to all the activities going on in the drawer's body that helps them draw the fruit and keeps their body working well while they draw the fruit. Have the students take notes on the side of their paper about what they notice. Ask them to notice everything large and small, voluntary and involuntary, that the drawer's body does.

Have each group make a master list of everything the group thought of. Have each group record which body systems are involved.

One student in the group should be the recorder. Another student can present their information to the class.

Possible answers:

- Sensory signals from the eye about fruit color, shape, etc

- Image recognition

- Memory access

- Motor signals to the hand and fingers holding the pencil, to direct the pencil to draw the image

- Motor signals for sitting position remaining upright, leaning on the desk, crossing the legs, etc.

- Heart muscle pumping

- Breathing

- Temperature sense on skin-cold or warm in the room

- Smells they are aware of

- Sounds in the room or outside

- Digestion after lunch, or hunger pangs if before meal break

- Bladder signals or pressure

- Other unconscious body activities such as scratching nose or ear, sneezing, etc.

Have each group's presenter tell the class what they discovered.

Record the answers on the board. Group the responses together according to each body system.

Explain

Ask: What part of our body makes all this happen? What body system controls our body? (Brain and nervous system)

The nervous system is the master coordinator of the body.

The nervous system coordinates each body system within its own system and with all the other systems. All movements and sensation as well as thoughts, emotions, and memory are controlled by the nervous system. Since conditions within and without the body are constantly changing, the nervous system monitors changes or stimuli, stores information and/or initiates response impulses throughout affected body systems for action and sensation, emotion, thought, and memory.

Have the students role play different parts of the nervous system and act out the reflex arc sending and receiving messages from the brain and right hand.

Students play the parts of the:

- Brain,
- Spinal cord (2-3 students),
- Motor Nerves from the spinal cord (2-3 neurons)
- Sensory Nerves to the spinal cord (2-3 neurons)
- Neurotransmitters, and
- Right hand.

For the neurons, use 3 students for each neuron with one student as the cell body, one the axon, and one the dendrite. Arrange the neuron students so that the axon of one neuron stands next to the dendrite of the next neuron. Leave space for one neurotransmitter between each neuron. The spinal cord (which it self is made up of neurons) can either be set up with the 2-3 students being the whole cord (to simplify the activity) or with the three-part neuron assembly.

Note: This activity can be set up with as many neurons as you want depending on if you would like all the students to participate in one experiment. You may want to break the class in half and have the students do the experiment twice.

Have the students make signs with different colored paper that has the name of their part. Wear the signs during the activity.

Explain the parts of the nervous system and their roles in the nervous system activity (What is the nervous system? How the Nervous system works, and Linking up) as you organize the students.

Have three notes pre-written on folded pieces of paper before the “action” begins. These will be the directions for the motor activity and sensory feedback. The notes can give the following directions:

1. From brain to hand – Pick up container (motor instruction)
2. From hand to brain –The container feels very HOT. (Sensory feedback)
3. From brain to hand – Drop container! (Motor instruction)

The activity begins when the brain. The brain gives note #1 to the first spinal cord student. This student passes it to the second spinal cord student, etc. When the note reaches the end of the spinal cord it is passed to the neurotransmitter. The neurotransmitter gives the note to the dendrite who gives it to the cell body who gives it to the axon who gives it to the neurotransmitter, etc. The relay continues through all the motor neurons until it is given to the hand.

The hand picks up the container and *continues to hold it* while notes #2 and 3 are relayed through the sensory neurons, spinal cord and brain and then back to the hand along the motor neurons pathways. It is important that the hand keeps holding the “hot” container while all this is happening to illustrate the correct sequence of neurological activity. The brain responds with motor instructions on note #3. When the note reaches the right hand then it can release the ‘hot’ container.

Extend

Learning Stations about the Brain and Nervous system

Have students work together in groups. Assign topics or have students choose the subject they want to learn more about.

Suggested topics are: parts of the nervous system, parts of a neuron, sensory neurons, motor neurons, how neurons work, what neurotransmitters are, is there only one kind of neurotransmitter, spinal cord, whole body layout of the nervous system.

The assignment for each group is to:

1. Create a model or drawing of their subject.
 - a. Explain its function, what it does,
 - b. Explain its role in a healthy body

- c. Include an information key indicating the different parts and function
2. Decide on a question the group wants to explore or something they want to know more about regarding their subject
 - a. Determine their methods to answer the question (Research in library or on Internet, books or other information in school or at home).
 - b. The steps to be done to acquire that information.
(Note: It may work better if students want to conduct simple experiments for them to do that as part of the Lesson Two, Extend activity.)
 3. Divide the tasks among themselves to complete their Learning Station.

Have each group do research on basic information about their subject: how big is it, how much does it weigh, how long is it, where is it in the body, what is around it, what does it do?

Have them make their models to size or scale. Be sure they show what the scale is. Have each group decide how to make the model and the materials they need. Make materials available for them to choose from: poster board, cardboard, large drawing paper, colors or paint, string, modeling clay, tubes, beads, wire, etc.

Encourage the groups to create a simple experiment to demonstrate how their subject works, to measure and record its activity, and/or to test a question about it. The students can create their own experiment or go online to find suggestions. Two excellent websites for children are given in Web Resources.

A “Nervous System Info Fair” can be sponsored by the class for the parents and school when all the Learning Stations for Lesson One (as well as for the Exercise, Hygiene, and Self-Esteem) are completed. The room could be arranged with student desks put together, the Learning Station posters put up, and students can present their stations and experiments to the public.

Evaluate

Homework: Have the students create a neuron. They may use any materials they would like from home. However, three parts of the neuron must be included and identified.

Lesson 2: Memory, learning, and the stress response

Engage

Have the students engage in a reading activity at their desk.

Pre-arrange to have two people (Teacher's Aide, parent) come into the classroom a few minutes apart. They will each stay for a couple of minutes. Have them each do a few things in the class. For example: open a window, gather some books, post something on the bulletin board, drop something and pick it up, etc.

Have the person who came in first (A) leave the room. Then a minute or two later have the second person (B) leave. After the second person leaves the room ask the students to write down: what they remember about person A (not B) – what he/she looked like, how the person was dressed, and what he/she did while they were in the room. (Note: It is helpful for the teacher to make their own notes about both people while they are in the room to refer to during the discussion.)

Ask the students to share what they remembered. List their recollections on the board. You might begin by asking the students to share their descriptions of what the person looked like and what they were wearing. Ask for specific information about what they did.

Did the students mix up the two people? How are the recollections the same or different? Did students disagree on what they remember?

Ask: Why do we remember different things? Have the students give their ideas.

Now have the students write down what they remember about the second person. List their recollections on the board. Discuss again what recollections are different and the same. Ask if it was more difficult for them to recall information about the second person since it had been a length of time between when they saw the person and when they remembered them. (This is where the teacher's notes can be helpful.)

Have both people (A and B) come back in the room. Compare the student's recollections with what he/she looks like, how they are dressed, and what they did while they were in the room.

Have the students give themselves one point for each thing they remembered and got correct. Remind the students that you are doing an experiment so you need them to be honest about how many they get right for the experiments to work.

Explore

First Experiment:

Put a picture on the overhead. Have the students look at the picture for one minute. Next have each student write down every detail they remember from the picture. Exchange their papers with a friend/neighbor. Put the picture back up on the overhead. Have the friend/neighbor give the student a point for each thing they remembered correctly from the picture.

Next Experiment:

Tell the students you are going to read them a story. Tell them to just relax and enjoy. After completing the following story have the students write down everything they remember from the story.

Exchange papers with a friend/neighbor and read the story again. Have the friend/neighbor give them one point for every answer they wrote down that was correct.

Last Experiment:

Hand out a story. Have each student read the story. Next have each students write down everything they remember from the story. Again, exchange papers with a friend. Have the student read the story and give their friend/neighbor a point for each thing they remembered correctly from the story.

Explain

Graph the information found from the explore portion.

Picture Experiment: Ask: Who got 0-5 answers correct, 6-10, 11-15, 16-20, 21-25, etc...

Graph

Auditory Experiment: Ask: Who got 0-5 answers correct, 6-10, 11-15, 16-20, 21-25, etc... Graph

Reading Experiment: Ask: Who got 0-5 answers correct, 6-10, 11-15, 16-20, 21-25, etc...

Graph

Compare the graphs. Which experiment did most of the students remember the most answers?

What looks like it was the hardest?

Have the students graph their own information. Graph how many they got correct for each activity. Which experiment was easiest for you?

Talk about learning styles. Discuss how people learn differently and this experiment may show how you learn best.

Extend

Using your Brain: Memory and Stress Experiment

Use this simple experiment to illustrate how different kinds of memory and thinking work and how stress can have an impact on thinking.

Step 1: Counting to 100

- Arrange the students so everyone can see a clock with a second hand.
- Have each student count from 1 to 100 as quickly as possible, whispering the numbers softly to themselves.
- Have them record how many seconds it took to count from 1 to 100.

Step 2: Counting backwards from 100

- Repeat the experiment, except this time have students count *backwards* from 100 to 1.
- Remind students to count quietly to themselves, while they watch the clock.
- Have them record the time it took.

Discussion:

- How did the time compare between the first and second experiment?
- Was it harder to count backwards?
- Why? (Most students won't have backwards counting memorized the way they do forwards counting. It takes thinking—and sometimes checking and rechecking to be sure you're saying the correct number.)
- What helped you do the backwards counting? (Some students may visualize a number line, etc...)
- Ask students what conclusions they might draw from this part of the experiment. (Things take longer when you have to think about them. It might be useful to have some things memorized. See what student's volunteer.)

Step 3: The impact of stress on memory

- Divide the class into groups—three students in each group.

- One student will be the counter, one will be the stressor, and the other will be the recorder.
- The task of the counter is to count backwards from 200 to 100.
- The task of the stressor is to sit near the counter (no touching) and say the counter's name over and over again in a low voice.
- The task of the recorder is to record how long it took the counter to count backwards from 200 to 100. The recorder should also record how many times the counter had to stop to think about what number came next. (This can be hard to tell sometimes, but other times the counter will become so distracted that he or she stops completely. Tell the recorder to make a mark on the paper each time the counter stops long enough to be noticeable.)

Discussion

- Have each recorder describe what happened in their team.
- Did the counter have a hard time?
- Why?
- Reflect on the idea that constant interruption is a kind of stress and stress affects your ability to think and concentrate. (Some students may be able to draw the inference that interrupting their parents in the middle of something important might not be the best thing to do.)
- Have a discussion about the findings from the various groups.
- If appropriate, have students brainstorm some of the other things that can cause stress besides being interrupted when you are concentrating. (For example, anxiety about a test, not enough sleep, drinking sodas with caffeine, etc.)

Evaluate

Send home **Figure 1** as homework. Have the students give the test at the top of the page to a parent or adult. Explain to the student that their job is to create a stressful situation while their parent takes the test. The student can say they know all the answers, or explain that the test is really easy, or distract them while they take it. Tell the students to make it stressful for the parent. After the parent finishes the test the student can tell the parent what they were doing and have the student write in the space below the test, what they did to create a stressful situation. Lastly have the student explain three different ways people learn. Have the parent write in the three spaces the three ways their student told them about. Return the homework to class.

Optional Enrichment Activity

Invite a local doctor from the community (or parent/guardian of a student) to come to the Nervous System Info Fair. Have the physician give a short talk about brain health and taking care of your brain.

Advanced Challenge Activity (optional)

Note to Teacher: If you would like to take this a step further do the following activity.

Have the students work individually to read the article on nervous system function, the brain, and memory. (See **Figure 2**) Give each student the two graphic organizers, Nervous System Activity and The Brain (See **Figure 3**), Memory and Learning (See **Figure 4**). Have students complete the blank boxes. Answer Keys are included at the end of the Lesson (See **Figure 5 and Figure 6**).

When all students are finished discuss the results.

Additional Web Resources

Neuroscience for Kids

<http://faculty.washington.edu/chudler/neurok.html>

Kids Health-Kids

www.kidshealth.org/kid/

The Human Brain

<http://yucky.kids.discovery.com/flash/body/pg000135.html>

Missouri Standards:

Health and Physical Education

- I. Function and Interrelationships of Systems
 - A. Body Systems
 - What all Students Should Know
 - 1. Human body systems do not exist in isolation. Their optimal functioning depends upon their interdependence. When system failure occurs in one, it ultimately cause problems for other body systems.

What All Students Should Know

3. The nervous system includes the brain, nerves and spinal cord. It is the communication center for the body, sending and receiving messages, regulating body functions and serving as the control center for the five senses and for emotions, speech, coordination, balance, and learning.

Learning is influenced by the brain's short term and long term memory as well as learning styles and the environment.

4. What All Students Should Be Able To Do

- a. analyze how learning is influenced by their memory, environment, learning styles and learning strategies

Figure 1:

Name: _____

Part 1:

Ask a parent, guardian or adult to answer the following questions.

What are the two parts of the nervous system? 1. _____ 2. _____

What are neurotransmitters? _____

What are the parts of a neuron? _____

What is the difference between motor and sensory nerves? _____

Explain what you did. _____

Part 2:

Explain 3 different ways people learn to a parent. Have the parent write down what they learned.

1. _____

2. _____

3. _____

Return by _____

Figure 2

Organizing the Nervous System

The nervous system has several divisions. There are two main ones:

1. Central nervous system (CNS) includes the brain and spinal cord.
2. Peripheral nervous system (PNS) includes the cranial nerves and spinal nerves.

There are 12 pairs of cranial nerves, and 31 pairs of spinal nerves.

These two parts are what we think of as “the nervous system.” But there is more.

Parts of the Peripheral Nervous System

The peripheral nervous system has two parts also: the Somatic Nervous System and the Autonomic Nervous System. These two systems control all our voluntary muscle movement and all the involuntary movement in muscle, body organs and glands.

Somatic Nervous System

Sensory nerves and motor nerves are important parts of the Somatic Nervous System.

They monitor and control the voluntary movements of muscles.

- The sensory nerves *send information to the brain* in the central nervous system from the skin, muscles and sense organs such as the eyes, ears, skin, and nose, etc.
- The motor nerves *carry instructions from the brain* back to the muscles.

Autonomic Nervous System

The actions of the circulatory, digestive, respiratory, and reproductive systems are controlled by the Autonomic Nervous System. The organs and muscles in these parts of our body work automatically and are involuntary movements. This part of the nervous system controls smooth muscle (in the hollow organs such as stomach, intestines, etc.) cardiac muscle, and glands.

The Autonomic Nervous System also has two parts. They are called the Sympathetic and Parasympathetic Nervous systems.

Sympathetic Nervous System

This system starts the stress response within the body. Stress happens when we are frightened, angry, worried, or feel threatened. It is an important part of the way the body protects us. It is often called the fight-or-flight response.

When we are under stress, the sympathetic nervous system protects the body by increasing the heart rate, putting more blood and oxygen throughout the body, slowing digestion and

waste elimination, activating the immune response, and many other activities that ensure our survival.

Parasympathetic Nervous System

This part of the nervous system reverses the fight-or-flight response and returns the body to a more normal state. This is recovery from stress and is an important job. Being stressed for a long time is very unhealthy for the body. The body needs time to restore itself. Having good nervous system health means having ways to relax, slow down, play, laugh, and be easy.

Big Brains

The brain is soft, wrinkled and moist. The bones of the skull, cerebrospinal fluid and membrane protect and cushion the brain. The brain weighs about 3 pounds.

Three primary structures of the brain are:

- Cerebrum-
 - This is the largest and uppermost part.
 - It makes up about 85% of the brain's weight.
 - This is the "thinking" part of the brain.
 - Conscious thought, memory (both long and short-term) and reasoning are activities of the cerebrum.
 - It also controls our voluntary muscle movement.
- Brain stem-
 - It is underneath the cerebrum and in front of the cerebellum
 - Connects the cerebrum and the spinal cord.
 - Controls the involuntary muscles that maintain important body functions such as breathing, blood circulation, and food digestion.
- Cerebellum-
 - This is found below the posterior part of the cerebrum.
 - The name cerebellum means "little brain".
 - It coordinates voluntary (i.e., skeletal) muscles, maintains balance and muscle tone.

The cerebrum itself is divided into two hemispheres, right and left.

The left hemisphere is responsible for speech, reading, writing and logical thinking. These are more linear and analytical functions.

The right hemisphere controls emotions, creativity, musical and artistic ability. Right-brained activity is related to intuitive, creative and holistic functioning.

- Cerebral Cortex –
 - The brain tissue that we most commonly think of as being "the brain" with all the folds and fissures is the cerebral cortex. This is a fourth brain structure.
 - This is the 'grey matter' of the brain.

The cerebral cortex forms the outermost tissue layer on the cerebrum and is the most evolved portion of the brain.

This area controls conscious thought, reasoning, and abstract mental functioning.

Connections: Memory and Learning

When we are born we have all the neurons we are ever going to have. What increases as we learn and grow are the connections between the neurons. These are called neural pathways. Making neural pathways is how learning and memory happen. Messages repeatedly move over neurons and make connections or pathways between the neurons. As we grow and learn the nerve connections between the right and left sides of the brain grow also. This allows the two sides to communicate with each other. The brain stores what it has done, learned and experienced in different areas of the cerebral cortex.

Figure 3: Nervous System Activity Organizer

The Nervous System is organized in two main systems:	Includes the following parts	Does these jobs		
Central Nervous System (CNS)				
Peripheral Nervous System (PNS)				
	The Peripheral Nervous System has two divisions:	Includes the following parts	Does these jobs	
	Somatic Nervous System			
	Autonomic Nervous System			
		The Autonomic Nervous System has two divisions:	Affects these parts of the body	Does these jobs
		Sympathetic Nervous System		

The Brain, Memory and Learning
Figure 4

Divisions of the brain	Where is it located?	What does it do?
Cerebrum		
Brain Stem		
Cerebellum		
Cerebral Cortex		
Hemispheres of the brain:		
Right		
Left		

Nervous System Activity Organizer

Answer Key

Figure 5

The Nervous System is organized in two main systems:	Includes the following parts -	Does these jobs		
Central Nervous System (CNS)	Brain Spinal cord	Coordinates messages to and from the brain		
Peripheral Nervous System (PNS)	Cranial nerves – 12 pairs Spinal nerves – 31 pairs	Coordinates messages from the body to and from the brain		
	The Peripheral Nervous System has two divisions:	Includes the following parts	Does these jobs	
	Somatic Nervous System	Sensory and motor neurons	Monitors the body's contact with the external environment Coordinates voluntary muscle control	
	Autonomic Nervous System	Sensory and motor neurons	Controls circulatory, digestive, respiratory, and reproductive systems. Monitors and controls involuntary activity.	
		The Autonomic Nervous System has two divisions:	Affects these parts of the body	Does these jobs
		Sympathetic Nervous System	Heart, lungs, stomach, intestines, bladder, rectum, immune response mechanisms	Initiates the stress response (fight or flight)

The Brain, Memory and Learning
Answer Key
Figure 6

Divisions of the brain	Where is it located?	What does it do?
Cerebrum	Uppermost part of the brain, and the largest part	“Thinking” activity happens here. Conscious thought, short and short-term memory, and reasoning. Voluntary muscle movement
Brain Stem	Under the cerebrum and in front of the cerebellum. Connects cerebrum and spinal cord	Controls involuntary muscles. Maintain breath, blood circulation, food digestion.
Cerebellum	Posterior and lower cerebrum.	Coordinates voluntary skeletal muscles, maintains balance and muscle tone
Cerebral Cortex	The brain’s grey matter, outermost portion of the cerebrum	Conscious thought, reasoning, and abstract thinking.
Hemispheres of the brain:		
Right	Cerebrum	Creative, musical, and intuitive mental functioning
Left	Cerebrum	Analytical functions.