go to school

unit six

Human Body Detectives Go to School Elementary Curriculum

The Brain

Based on the Fifth Case in The HBD Series, *Brainiacs*

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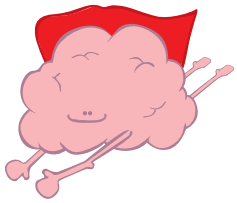

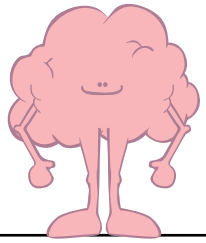

The Brain

INSTRUCTIONAL OBJECTIVES

The student will understand all about the brain: anatomy, physiology, and brain health.

LONG RANGE OBJECTIVES

With a basic understanding of how their brain functions, students will make healthy food and lifestyle choices.

SUGGESTED GRADES: 3 to 5

MATERIALS

- HBD: *Brainiacs*: An Imaginative Journey Through the Nervous System (book)
- Manila file folders (standard size)
- HBD downloadable stickers for this unit
- HBD downloadable worksheets for this unit
- Black Sharpie® pen
- Crayons and markers
- Glue stick, paper for the brain self-portrait and hats
- OPTIONAL: scissors, paper, tape, hole punch, string or yarn, modeling clay, beads
- OPTIONAL: Avery Labels #5164 & #5260

OVERVIEW OF LESSONS

Lesson 1: Introduction to the brain; HBD: *Brainiacs*; brain anatomy: hemispheres, lobes, matter, cortexes
Lesson 2: What are neurons?
Lesson 3: What are other nerves in the body?
Lesson 4: Feeding and protecting your brain; review; Q & A; conclusion

*During each lesson in this unit students will work on their own **Brain Self-Portrait Diagram** and/or **Brain Ha**t. At the conclusion of Lesson 4, the diagram or artwork will be complete and students will be able to take it home.

LESSON 1
INTRODUCTION TO THE BRAIN

INSTRUCTIONAL OBJECTIVES

The student will understand the functions of the brain anatomy: hemispheres, lobes, matter, and cortexes.

! **Teacher's note:** This lesson may be divided into two classes. Consider reading the story and having the students set up their case folders and fill out the **Know, Want to Know, Learned** page the day before the unit begins.

MATERIALS

- Downloadable HBD **Know, Want to Know**, **Learned** page
- HBD: *Brainiacs* (storybook)
- HBD Case File Folder (manila folder)
- HBD downloadable stickers (Avery #5260) for this unit's Brain Case File
- Black Sharpie® pens
- Pre-cut paper from large roll, large enough to trace students' heads OR a smaller 14" x 22" poster board for brain self-portrait
- Crayons and markers
- **Your Brain Hat handout**: computer printer and heavier computer stock paper, scissors, hole punch, tape
- Downloadable HBD **Left or Right Brain Thinker handout**
- Optional Homework: **Label Your Brain handout**

OVERVIEW OF CONTENT

- Introduction: anatomy of the brain
- Read aloud HBD: *Brainiacs*
- Create Human Body Detectives Case File Folders
- Discuss brain anatomy and physiology: hemisphere, matter, cortexes and lobes Activity Sheets:
- **Left or Right Brain Thinker** and **Label Your Brain** Handouts
- Begin work on Brain System Self-Portraits and/or Brain Hats

INSTRUCTIONS

1) **Have students fill out the Know, Want to Know, Learned page**. Encourage them to write down what they know about the brain followed by what they want to know about it. They will fill out the "Learned" section once the unit is completed.

2) **Hand out a manila folder to each student.** Also hand out brain case file stickers to label the file. Have students affix stickers to the file tab and write their names in a corner on the front of the folder. Tell students that they are going to be Human Body Detectives like Merrin and Pearl and that they will fill their files with important information during their investigation of the brain.

3) **Announce that you will read HBD: *Brainiacs*.** Two girls, Merrin and Pearl, enter someone's brain. "Let's find out whose it is and what happens!" Read HBD: *Brainiacs* aloud. When finished, briefly discuss the story. "What was the most exciting part for you?"

4) **Understanding the Brain**

* **Ask the students:** Is the brain just a container for thinking and/or storing facts and memories? Or does the brain have other purposes?

What is the brain? What does it do?

- It is an organ
- Living computer: lets you think and dream
- Master communicator: it accepts messages from your eyes, ears, taste buds, and skin
- Gateway between the body and the mind
- Controls body temperature, blood pressure and breathing
- It allows you to walk, talk, stand or sit; basically controls everything we do (the boss)

The brain is a small organ approximately the size of a grapefruit, a small head of cauliflower, or a softball, and it weighs about 3 pounds. It has the consistency of Jell-O, therefore, sticking your fingers through it, is possible (a good reason why we have our hard skulls).

5) **Brain Main Parts**

! **Teacher's note:** The brain hat shows the exact location of all the parts listed.

Cerebrum

The biggest part of the brain is the cerebrum; it is the brains of the brain! The cerebrum looks like a walnut and is located on the outer part of the brain.

The cerebrum is not only the thinking part of the brain, but it is also responsible for understanding language, memories, emotions, body temperature, eating and sleeping. Thoughts happen in the cerebrum.

The cerebrum is divided into two equal halves: the right and left hemispheres. The right hemisphere controls the left side of the body and the left hemisphere controls the right side. For example, if you kick a ball with your right foot and point with your right hand, then your left hemisphere is in control.

The two hemispheres are divided by a thick bundle of nerves called the corpus collosum.

Each hemisphere has specialized roles. Research has indicated that the right hemisphere helps us think about music, colors, and shapes. The left hemisphere helps us with math, logic, and speech.

Activity (handout, Right or Left Brain Thinker): This will take a few moments and provide a fun discussion. You may want to do it at the end of class.

Cerebral Cortex

The outermost layer of the cerebrum is the cerebral cortex. It is divided into four main lobes: frontal, occipital, parietal and temporal.

These lobes have specific functions:

- frontal controls motor functions, decision making, problem solving and memory
- occipital controls vision and color recognition
- parietal receives sensory information from the body, like sensations from the skin—touch, heat, cold, pain. It processes the information and puts words into thoughts
- temporal controls language, hearing, memory and emotions

Brain trivia: The Broca's area is found in the frontal lobe of the left hemisphere and is responsible for producing language and speech.

Ask the students: What would happen if the Broca's area gets damaged? People with damage to this area of the brain are able to understand what people are saying but are not able to the form words.

Two examples of cerebral cortexes:

Primary motor cortex:
This cortex is part of the temporal lobe and regulates or executes movement.

Primary sensory cortex
This cortex is part of the parietal lobe and processes sensory information that comes from the body.

Brain trivia: Deep inside the right and left hemispheres are the structures: thalamus and the hypothalamus. The thalamus receives the first messages from the sensory stimuli like pain, pressure, and temperature, via sensory neurons (we will learn about this later). The hypothalamus, about the size of a bean, helps keep body temperature at about 98.6°F, no matter how cold or hot it is outside the body. The hypothalamus will also make you feel hungry, thirsty, sleepy, afraid or happy.

Cerebellum

The cerebellum is at the back of the brain, below the cerebrum and is about the size of a pear. It may be a lot smaller than the cerebrum, but it has many important jobs like controlling balance, movement, posture and coordination. Next time you are riding your bike, give thanks to your cerebellum!

Brain trivia: In Latin, "cerebellum" translates to "little brain."

Brain Stem

The brain stem sits beneath the bottom of the brain just above the neck and connects the brain to the spinal cord. It is approximately three inches long and as thick as your thumb.

We have voluntary muscles and involuntary muscles in our bodies.

- **Voluntary muscles** are ones that you control. For example, when you want to run you tell your leg muscles to move.
- Our **involuntary muscles** are working all the time, automatically. Examples of these involuntary muscles are our heart, lungs, and stomach muscles for digestion.

The brain stem is in charge of all the functions of these involuntary muscles to help circulate our blood, let us breathe, and digest our food.

The brain stem is also known as the body's secretary since it sorts through millions of messages that the body and brain are sending back and forth.

Brain trivia: The brain stem helps us breathe, eat and sleep.

The Limbic System

The limbic system is located on top of the brain stem and has structures involved with connecting emotions and senses (for example; remembering the smell of baking cookies) to memories.

The **amygdala** and **hippocampus** are important structures within the limbic system and play roles in memory: forming, organizing and storing.

The almond shaped structure located in the temporal lobe of the brain is called the amygdala; it's main function so to process emotions. Once emotions are processed, the amygdala is responsible in deciding what emotional memory is important enough to be stored and then decides where that memory will be stored in the brain.

The horseshow shaped hippocampus (one half of the horseshoe is on the left side and the other on the right side of the brain) has an important job of determining where in the brain long-term memory storage needs to be and then retrieving the memory when needed.

Brain trivia: Any damage to these areas of the brain may result in an inability to form new memories.

Spinal Cord

The big questions are: how is the body connected to the brain, and how does the brain know what to tell the body to do? The spinal cord and its nerves put it all together. The spinal cord is an extension of the brain that runs down our backs and is protected by spinal bones (vertebrae). Inside the spinal cord are long bundles of nerves, which allow safe passages of messages between the brain and body.

Central Nervous System and Periphery Nervous System

The nervous system is made up of the brain, spinal cord and neurons. The system is responsible for sending, receiving and understanding information from all parts of the body.

- Central nervous system, or the command center: brain and the spinal cord
- Periphery nervous system contains nerves/neurons that are outside the brain and spinal cord and its main function is to connect the CNS to the rest of the body.

Teacher's Note: Neurons are nerve cells that help transmit the information throughout the body. There are four basic parts of a neuron: the dendrites, the cell body (soma), the axon and the axon terminal. (We will go into further detail on this later.)

Gray and White Matter

The central nervous system has two kinds of neural tissue: gray matter and white matter.

- **Gray matter** houses cell bodies and dendrites of a neuron; its' mission is to pass along the information and making sure it gets to where it needs to go.
- **White matter** is responsible for a speedy communication delivery on the axons. It makes sure information is continually passed on from neuron to neuron, quickly! White matter is white due to the fatty layer of the mylinated sheath and is on the axons.

6) Brain Self-Portraits and/or Brain Hat Art

- Have each student find a partner. Hand each student the large paper and a dark colored Sharpie®, or a 14" x 22" poster board, then have each student draw their brain on the paper. Instruct them to do five angles: front, back, top and both sides. Let them know that over the next few lessons, they will be adding elements—hemispheres, lobes, etc.—of their brains to their self-portraits, so instruct them to leave room around each image.
- Follow the directions on the Brain Hat handout.

7) Conclusion

Review what the students have learned about the brain to this point. Answer students' questions about today's lesson and then let them know that next time they will learn about the different functions of the brain.

End the class with a joke:

What did the right hemisphere say to the left hemisphere
when they could not agree on anything?
Let's split.

Optional Homework

Label Your Brain
Activity: Right or Left Brain Thinker

LESSON 2:
FUNCTIONS OF THE BRAIN

INSTRUCTIONAL OBJECTIVES
Students will understand how neurons work.

MATERIALS
- Students' own HBD case file folders
- Downloadable HBD: How to Make a Neuron with Pipe Cleaners
- Downloadable HBD: Cloze Notes: How Neurons Communicate
- Downloadable HBD: Label Your Neuron
- Downloadable HBD: Crossword Puzzle
- Downloadable HBD: Flow Chart for Neuron Communication
- Downloadable HBD: Afferent and Efferent Pathways
- Optional: Clay, play dough, recyclables, pipe cleaners, beads or food to build a neuron

OVERVIEW OF CONTENT
- Introduction to what neurons are and what they do in the body.
- Activity Sheets:
  - Label Your Neuron (fill out during class)
  - Cloze Notes: How Neurons Communicate (fill out during class)
  - Review: Flow Chart for Neuron Communication
  - Crossword Puzzle, Build a Neuron with Pipe Cleaners
  - Work on Brain Self-Portraits and/or Brain Hats

INSTRUCTIONS
Activity: Hand out the downloadable **HBD: Label Your Neuron** page. Either during the lesson or after the lesson, have the students complete the sheet. They can then place it in their case file folder. If time allows, let students create pipe cleaner neuron art to enhance the teachings.

Begin today's lesson with a quote and discuss.

"*Men ought to know that from the brain, and from the brain only, arise our pleasures, joy, laughter and jests, as well as our sorrows, pains, griefs, and tears.*"
Hippocrates (about 400 B.C.)

1) **What is a Neuron?**
*side note: impulse, nerve impulse and message will be used interchangeably

Cells of the nervous system are called nerve cells or neurons. Your brain is made of approximately 100 billion nerve cells/ neurons. They gather and transmit messages to and from the brain, to other nerve cells, to muscles and to gland cells so you can walk, talk, blink and move your hand away from a hot stove. Neurons are basically the working units of the brain. In fact, neurons have an amazing ability to transmit messages up to several feet and at lightning speeds (up to 200 miles per hour).

There are three types of neurons that carry the nerve impulses in different directions:

- Sensory or afferent neurons: these nerve cells transmit signals from sensory neurons TOWARD the central nervous system (the brain and the spinal cord) (asking the brain what to do with the sensory stimuli)
- Motor or efferent neurons: these nerves transmit signals AWAY from the central nervous system to the muscles and glands (with messages telling the muscles what to do)
- Interneurons: these neurons send information BETWEEN sensory and motor neurons and are located in the central nervous system

The four basic parts of a neuron:

- **Cell body** or **soma**. Inside the cell body is the nucleus, the control center. The nucleus keeps the cell alive and healthy. If the cell body dies, the neuron dies.
- **Axon**. This long, cable-like projection of the cell body—which looks like a link of sausages—has the important job of carrying the message or nerve impulse. Most neuron axons are covered with a white fat layer called a myelin sheath. This sheath protects the axon, and helps transmit the impulses at a faster speed with the help of the Nodes of Ranvier, which helps carry the impulse. These mylinated neurons are found in the sensory and motor neurons. Non-mylinated neurons are found in the brain and spinal cord.
- **Dendrites** or **nerve endings**. Dendrites are branch-like projections of the cell body. Dendrites can be located on one or both ends of a cell. Their main function is to receive and pass messages from other nerve cells.
- **Axon terminals**. Axon terminals are located at the endings of the axon. Axon terminals separate neuron from neuron. This small separation between the axon terminals is called a synapse.

Activity: Ask the students to hold their arms out and spread their fingers. Inform them that their hands represent the cell body or soma, their fingers represent dendrites bringing information to the cell body, and their arm represents the axon taking information away from the cell body.

Interesting facts!

- The longest neuron in your body runs from your big toe to the base of your spine. It is over a meter long
- The longest axon of a neuron is around 15 feet long and is found in giraffes

2) How Neurons Communicate

Activity: Hand out the downloadable **HBD Cloze Notes: How Neurons Communicate** page. Instruct the students to fill in the blanks as they listen to the lesson. They can then place the completed worksheets in their case file folders.

Neurons communicate through a chain of sequences, also referred to as an electrochemical process. This process begins when a sensory receptor – like a button being pressed to activate- on the body is activated by a stimulus, like light, sound, temperature, pain, etc. With the help of neurons, the message is sent to the brain to get a response on what to do.

The Chain of Sequences

- A sensory stimulus occurs (light, pain, heat, cold, sound, temperature) in the periphery nervous system of the body.

Ask the Students: What are some specific stimuli? (hot stove, cold ice)

- The stimulus is received by the sensory receptor in the periphery nervous system of the body when it feels or senses the stimulus. A sensory nerve cell/neuron is alerted (the neuron gets " fired up") and a nerve impulse is generated and begins its quick journey to the brain (periphery nervous system: TOWARDS the brain (central nervous system) via a sensory neuron) to inform the brain about what is happening and to get a reply on what to do.
- A dendrite receives the nerve impulse/message and sends information down the axon, away from the cell body and toward the brain.

- As the impulse/message travels along the axon, it moves quickly with the aid of the fatty mylinated sheath and their nodes of Ranvier. The impulse will hop or jump from one node to another, which allows for quick transmission.
- When an impulse/message reaches the end of a dendrite or axon terminal and meets the synapse, it will trigger the release of neurotransmitters, which will carry the message to the next neuron's dendrite.

Brain trivia: The mylinated sheath is made of specialized cells called glia or neuroglia. The glia cells have many jobs: to transport nutrients to the neurons, to clean up brain debris (remove unwanted things from the brain), aid in myelin formation, and keep the neurons supported. The glia cells are vital to maintaining a functional nervous system.

Brain trivia: Neurons do not touch each other directly; there is a small gap between neurons called, synapses (see axon terminals above).

Brain trivia: Due to these synapses, messages cannot travel from neuron to neuron. In order to relay the message, neurotransmitters aid the impulse to leap to the next neuron.

- The impulse enters the Central Nervous System (brain and spinal cord).
- Review: The impulse is brought to the brain's primary sensory cortex for interpretation and final decision making on what needs to happen next.
- When a decision is determined, the impulse will pass from a sensory neuron via an interneuron, a motor neuron in the primary motor cortex.
- The motor neuron will transmit the message to a muscle where a response will occur (like moving your hand away from a hot stove).

Review Activity: Hand out the downloadable Flow Chart for Neuron Communication page. Review the chain of events and then have them place their completed worksheets in their case file folders. (This also can be given out before this section for students do fill in while you are talking).

Teacher's note: For the students who want to dive deeper into the subject, ask them to research resting and action potentials.

3) **Have the students take out their case file folders and finish their work on their Cloze Notes, Flow Chart for Neuron Communication and Label Your Neuron handouts.**
They can store the completed worksheets in their folders.

4) **Have each student roll out their Brain Self-Portrait and/or work on their Brain Hat.** If time allows, create neurons with pipe cleaners.

5) **Conclusion**
Review what the students have learned about the brain up to this point. Answer students' questions about today's lesson and then let them know that next time they will be learning about other nerves in the body.

End the class with a joke:
Why do neurons like text?
They like to send and receive lots of information.

Optional Homework
Build a Neuron with Pipe Cleaners (if not done in class)
Crossword Puzzle

LESSON 3:
WHAT ARE CRANIAL AND SPINAL NERVES?

INSTRUCTIONAL OBJECTIVES
Students will know more about cranial nerves and spinal nerves.

MATERIALS
- Students' own HBD case file folders
- Downloadable HBD: Cranial Nerves Chart
- Downloadable HBD Lab: Test Your Cranial Nerves
- Downloadable: HBD: Brain Search
- Downloadable: Snellen Eye Chart - click here.

OVERVIEW OF CONTENT
- Introduction to what the cranial and spinal nerves are
- Activity sheets: Brain Search
- Work on Brain Self-Portraits and/or Brain Hat

INSTRUCTIONS
Begin today's lesson with a quote and discuss:
"To repeat what others have said, requires education; to challenge it, requires brains."
Mary Pettibone Poole (from A Glass Eye at a Keyhole, 1938)

1) **Cranial and Spinal Nerves:**
Your nervous system controls and coordinates every function of your body, allowing you to move and function in your everyday life.

! **Teacher's Note:** This is a good time to review the functions of the nervous system

- **Cranial nerves** are found in the brain stem and they are responsible for the signals to the brain.
- **Spinal nerves** exit between individual spinal vertebrae and go to the various parts of your body to help you move.

Cranial Nerves

The cranial nerves are 12 pairs of nerves that extend from the bottom, or inferior, part of the brain. These nerves vary in function: some bring information from the sense organs to the brain, others control muscles and, lastly, a few cranial nerves are connected to glands and organs like the lungs and heart.

Cranial nerves are identified by roman numerals I through XII.

Roman Numeral	Name	Function
I	Olfactory nerve	Smell
II	Optic nerve	Vision
III	Oculomotor nerve	Eye movement
IV	Trochlear nerve	Eye movement
V	Trigeminal nerve	Touch, pain
VI	Abducens nerve	Eye movement
VII	Facial nerve	Taste (front 2/3 of tongue)
VIII	Vestibulocochlear nerve	Hearing and balance
IX	Glossopharyngeal nerve	Taste (front 1/3 of tongue)
X	Vagus nerve	sensory, motor and autonomic functions
XI	Spinal accessory nerve	Controls muscles in head movement
XII	Hypoglossal nerve	Controls muscles of the tongue

Cranial nerve trivia mnemonic:
Oh **O**nce **O**ne **T**akes **T**he **A**natomy **F**inal **A** **G**ood **V**acation **S**eems **H**eavenly

The **bold letters** stand for:
olfactory, optic, oculomotor, trochlear, trigeminal, abducens, facial, vestibulocochlear, glossopharyngeal, vagus, spinal accessory, hypoglossal

Ask the students: Can they make up their own mnemonic?

2) **Spinal Nerves**
There are 31 pairs of spinal nerves that extend from the left and right sides of the spinal cord. The spinal nerves are mixed nerves, meaning that they carry both sensory and motor signals between the spinal cord and different areas in the body.

Teacher's note: If you have done the **Osteoblasts to the Rescue**: An Imaginative Journey Through the Skeletal System book and curriculum, please refer back and discuss/review the backbone/spine.

The 31 spinal nerves are split into 5 groups named for the 5 regions of the vertebral spinal column. The spinal nerves provide innervation – supplies areas of the body with nerves - to body areas below the neck as opposed to the cranial nerves, which carry impulses only to the head and neck.

- 8 pairs of cervical nerves (supply/innervate the head, face, ear, eye, shoulders, neck and more)
- 12 pairs of thoracic nerves (supply/innervate arms, hands, stomach, liver, esophagus, lungs, kidneys and more)
- 5 pairs of lumbar nerves (supply/innervate the large intestine, bladder, lower extremities i.e., legs, feet)
- 5 pairs of sacral nerves (supply/innervate hip bones, tail bone)
- 1 pair of coccygeal nerves (supply/innervate hip bones, tail bone)

3) **Have the students take out their case file folders.** Hand out the **Cranial Nerves Chart**. Have students partner up and do the **Test Your Cranial Nerves** lab. When finished, have the students store the handouts in their case file folders.

4) **Have each student roll out their Brain Self-Portrait and/or work on their Brain Hat.**

5) **Conclusion**
Review what the students have learned about the brain and nervous system to this point. Answer students' questions about today's lesson and then let them know that next time they will be learning about nourishing their brain.

End the class with a joke:
What works even after it is fired?
A neuron.

Optional Homework
Finish their **Test Your Cranial Nerves** and the **Brain Search**

LESSON 4
HOW TO NOURISH YOUR BRAIN

INSTRUCTIONAL OBJECTIVES
Students will understand the importance of eating healthy foods and exercising to keep their brains healthy.

MATERIALS
- Students' own HBD case file folders
- Downloadable Food for Brain handout
- Instructions for Lab: Brain Lab: One Handed Dressing

OVERVIEW OF CONTENT
- Introduction to the brain needs for nourishment from foods and protection from accidents
- Activity sheets: Food for Brain chart and Brain Lab: One Handed Dressing
- Finish Brain Self-Portraits and/or Brain Hat

INSTRUCTIONS
Begin today's lesson with a quote and discuss:

"*My own brain is to me the most unaccountable of machinery—always buzzing, humming, soaring, roaring, diving, and then buried in mud. And why? What's this passion for?*"
Virginia Woolf

1) **Why is it Important to Feed your Brain?**
The brain is very busy receiving, processing and sending messages. Like all organs in the body, the brain needs to be properly nourished.

! **Teacher's Note:** This is another good time to review the functions of the brain and nervous system.

2) Feed Your Brain

A) Fats

The brain is 60% fat, which helps maintain flexibility, transmit and receive information and provides energy and aids in maintaining cells within the brain. The right or good fats will protect you from disease; however, the wrong or bad fats may create disease.

Ask the students: which fats would be good and how they will help their brains.

Sources of good fats
Salmon, halibut, nuts, seeds, extra virgin olive oil, coconut oil, avocados

Not so good fats
Processed foods, packaged foods like baked goods, cookies and crackers

B) Protein

Proteins do many wonderful things in the body, but the important job it has for the brain is to help form/make neurotransmitters.

Brain trivia: When an impulse/message reaches the end of a dendrite or axon terminal and meets the synapse, it will trigger the release of neurotransmitters, which will carry the message to the next neuron's dendrite.

Sources of good proteins
Nuts, seeds, chicken, fish, meats

Not-so-good proteins
Deep-fried battered proteins: chicken nuggets, fish sticks

Teacher's note: Remind the students of the benefits of eating organic, free-range meats (ones that are not processed)

C) Carbohydrates

Carbohydrates are the main source of energy for the brain.

Good (complex) carbohydrates
Meals and snacks must contain complex carbohydrates: whole grains (for example; brown rice instead of white rice), colorful vegetables and beans.

Not-so-good (simple) carbohydrates (not recommended)
Simple carbohydrates foods: white bread, white potatoes, white sugar, which is void of nutrients and fiber.

Teacher's note: if you have done the nutrition lesson, please refer to the lesson on simple and complex carbohydrates.

D) **Water**

Water is essential for optimal brain health and is necessary to maintain neurotransmitter health, increase circulation to remove waste that the body doesn't need and, most importantly, keep the brain from overheating.

Teacher's note: Discuss dehydration with the students. Talk to students if they have ever felt dehydrated and what it felt like: did it feel good? Ask them about how they keep themselves hydrated. Remind them that there best choices are water, infused water with lemons and oranges, and herbal teas versus sports drinks that contain sugar and food coloring and fruit juices (contain sugar and sometimes coloring).

Teacher's note: Muscles quickly become fatigues when not enough water/fluids are present in the body cells. Before exercising, it is best to begin hydration 2 hours beforehand and take some sips of water during exercise to avoid any fatigue.

E) **Nutrients**

Lots of different healthy foods provide valuable nutrients that the brain needs in order to function at its best.

B Vitamins: produce energy for the brain, and aid in making neurotransmitters.
Food sources: whole grains and dark leafy greens

Zinc: Zinc is needed to make dendrites and to repair cells. Zinc also helps with memory (hippocampus)!
Food sources: nuts and seeds

Calcium: Calcium is essential for nerve transmission.
Food sources: dark leafy greens, yogurt, salmon, broccoli, almonds

Teacher's note: Remind the students the importance of eating a variety of whole colorful foods to obtain an array of nutrients that can help the health of their brains. Children respond well to challenges (especially if there are incentives and rewards). Have the students record their lunches for a week and see who colors up their lunch the most in one week.

Teacher's note: Ask the students: How do you color up your plate?
Make a list: adding fruit to cereal, lettuce, cucumbers, tomatoes to sandwiches, raw vegetables with dips like hummus.

Activity: Hand out the Food for Your Brain handout. Review the handout and let the students fill in the section, How do you eat these foods?

3) **Protect your Brain**

Ask the students: What are your favorite exercises? How can you protect your brain while doing them?

Protect your Head! Wear a helmet when you ride your bike or do any other activities that, if an accident occurs, may cause harm to your brain (like falling off your bike or skate board).

Activity: This is a good time to do the Brain Lab: Using One Hand to Dress.

4) **Have each student finish his or her Brain Self-Portrait and/or Brain Hat.** Display in the classroom or have them add it to their case file folders. Finish filling out the **What I Learned** Worksheet.

5) **Conclusion**
Briefly review this lesson, followed by all aspects of the four lessons from the brain unit. Answer students' questions. Hand out **Case Solved stickers** for them to affix to the front of their case file folders.

End the class with a joke:
Why was the neuron sent to the principal's office?
It has trouble controlling its impulses!

go to school

Dr. Heather Manley, ND, is a practicing physician who received her medical degree in 2001 from National College of Naturopathic Medicine in Portland, Oregon. She is also the award-winning author of the **Human Body Detectives** book and curriculum series.

A contributing writer to Dandelion Moms, Organic Eats magazine, Parents Canada, and KIWI magazine, Dr. Heather was inspired to write the **Human Body Detectives** stories when she went on a search for books about healthy eating tips for parents and kids and couldn't find what she was looking for. She wanted to provide a fun and engaging resource that would teach kids about how their bodies work and what foods best feed them. And the HBDs were born.

The **Human Body Detectives** series won Moms' Choice Award and is also a Parent Tested, Parent Approved winner. Dr. Heather has been named to the Top 50 Mompreneurs Bloggers List on both **Babble**, **VoiceBoks** and **blogtrepreneur**.

Dr. Heather lives and practices on the Big Island of Hawaii, where her focus is on preventative healthcare for families and providing a resource for families to learn more about preventative health care so that they can be confident and proactive in their everyday health. She lives with her husband and her two daughters, with whom she based her stories' characters, Merrin and Pearl.

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