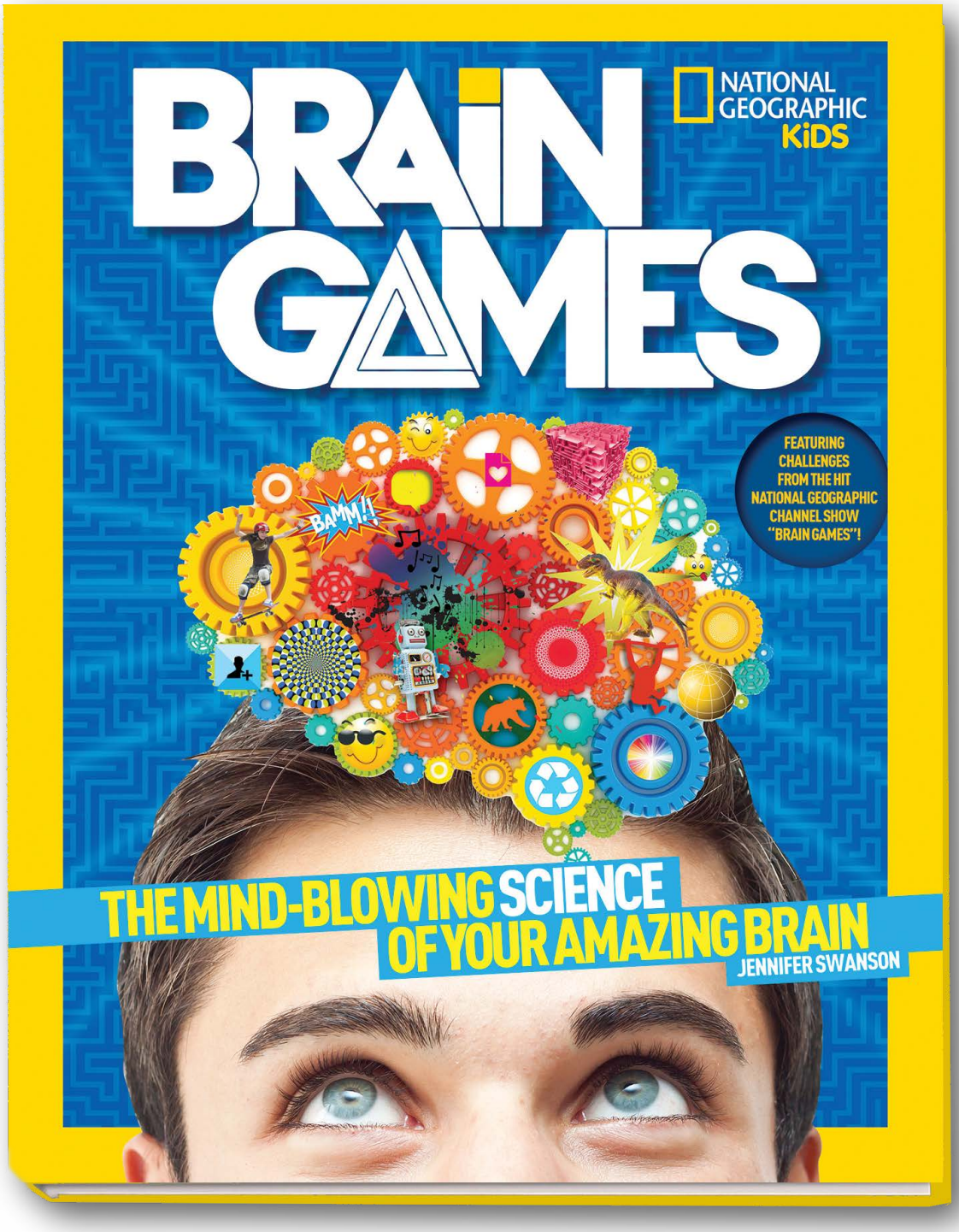
NATIONAL GEOGRAPHIC EDUCATOR'S GUIDE

NEXT GENERATION SCIENCE STANDARDS



NATIONAL GEOGRAPHIC KIDS

GRADE 3

LS3.A: INHERITANCE OF TRAITS Many characteristics of organisms are inherited from their parents. (3-LS3-1) Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3- LS3-2)

WHAT IS MEMORY?

Read aloud chapter 2, "Down Memory Lane." As you read, pause to discuss relationships among the text, photos, diagrams, and illustrations, as well as complete the challenge sections.

After reading, lead the class in a discussion on memory and learning. It is ok if students refer back to the chapter for answers, but express responses in their words.

- How would you describe or define memory?
- What part of your brain is responsible for storing memories?
- Explain the 3-step process to creating memories.
- While many functions of the brain are with us when we are born, others are created as we learn. Explain how learning actually changes the physical map of your brain.

NEURON PATHWAYS FOR MEMORY AND LEARNING

Activity 1: Demonstrate the Complexitiy of Neuron Patterns.

To further demonstrate complexity of neuron patterns and learning, give each student a piece of paper and instruct them to draw 10 dots down the left-hand side of the paper. Then draw 10 more dots down the right-hand side of the paper.

These dots represent neurons. Assume that each neuron makes connections with the 10 dots on the other side of the paper when new input is received.

Read aloud from the "What Exactly Is Happening?" sections of Chapter 2.

Each time a student hears new information, they are to say "pause" and connect the top left dot with a dot on the right while repeating the new information they just heard, thus creating a pathway.

Once the left dot has connected with each of the right dots, move onto the next left dot as seen in the diagram.

Soon the web of pathways will become very complicated. But this is a simplification. In actuality, each of your brain's neurons may make thousands of connections with other neurons.

Explain how learning actually changes the physical map of your brain.

SHORT-TERM VERSUS LONG-TERM MEMORY

There are two types of memory, one that is called short-term memory that helps you remember information from the last day or two, and one called long-term memory that helps you remember things that happened a long time ago. For example, ask students the following two questions:

- What did you have for breakfast this morning?
- What did you have for breakfast four days ago?

(Short Term Memory vs Long Term Memory Continued)

They probably answer the first question fairly easily, but struggle with the second question.

Revisit the two challenges regarding memory on pages 32 and 33. Remember, your short-term memory can only hold about seven things at one time. Have students share their results.

• How did the pictures help you remember?

Now, let's take it one step further. The best way to learn something is to try and associate what you want to learn with something that you already have in your brain.

Activity 2: The Grocery List Challenge.

Objective: You need to go to the grocery store to buy a few items, but you do not have a piece of paper or a pen. You are going to have to remember what to buy.

Here is your grocery list: Bread Bananas Milk

How will you ever remember these items? You can associate each item with something you know very well.

Generate a list of places that the students know very well (for example: their house, their bedroom, the school playground, the classroom, etc.).

Pick one place on the list and have one child describe it for the class.

Now let's try to associate each one of these grocery items to the place that was described. For example, let's use the school playground.

Lead students through the following visualization:

Imagine that you are on the school playground and you are walking toward the slide. Look how tall the slide is. Maybe it shines in the sunlight. Think of a pool slide and how fast you would slide down if the slide were wet. So open up a carton of milk and spill it down the slide. Try it out! Imagine how it feels.

Now, let's take our wet bottoms and head toward the swings. Sit down and start swinging. And while you swing I want you to eat some bananas and make your silliest monkey noises. Hear how the monkey sounds echo in the blue sky.

OK. Enough of that. Now, let's head to the basketball hoop. What should we do? Feel that soft squishy loaf in your hand. Give it a little squeeze. And, let's lob that loaf of bread right into a slam dunk! Well done.

Now check in with the students to see if they remember the three grocery items.

• What item do you associate with the slide?

• What about the swings?

• And what about the basketball hoop?

• How did we use our long-term memories and senses in this exercise?

For an extra challenge, ask the students to remember the three items one week later. They should be able to remember them very easily!

For Further Fun!

Now that we know that our brains learn best when information is linked to the senses and long-term memory, assign small groups of students one of the "What Exactly Is Happening?" sections of *Brain Games.*

Each group will be responsible for teaching the information in their assigned section to the rest of the class in a way that will best help students retain the new information.

GRADE 4

LS1.D: INFORMATION PROCESSING Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)

HOW DOES YOUR BRAIN TURN YOUR SENSES INTO THOUGHTS?

After reading, lead the class in a discussion on the brain and senses. It is ok if students refer back to the chapter for answers, but express responses in their words.

- What is a thought?
- Describe how thoughts travel through your brain.
- Do you think you are more left-brained or right-brained? Why?
- Why does your brain create shortcuts?
- How do the senses aid the brain in processing information and keeping us safe?

THE NEURAL NETWORK

To illustrate how information travels through the neural network through the brain, have all the students stand at their seats. Each student will represent a neuron.

Take hold of the hand of the student closer to you. This is the start of the neural network. That student will then continue the chain by reaching out and holding the hand of the person closest to him/her. That student will then hold the hand of the person closest to him/her while continuing to hold hands with the person in front.

To further illustrate, each time a student takes another student's hand, he or she should wiggle his or her body to mimic the message that goes through the neuron. The chain continues until all students in the class are holding hands.

SEEING IS BELIEVING

Here are a few activities that explain how our eyes and brains work together to allow you to see what is around you.

Activity 1: "X Marks the Blind-Spot".

- Cut long strips of paper.
- Draw an X on the right end and a circle on the left side.
- Students close one eye and stare at the X.
- Can they still see the circle? (They should be able to, in their peripheral vision).
- Then slowly move the paper closer to the face and farther away from the face.
- Is there ever a time when the circle is no longer visible?

Why might that happen?

(Seeing Is Believing continued)

Explanation:

Our eyes are complicated things. There are millions and millions of tiny cells in the eye that take in what we're seeing, then they send a message to our brains. However, to get to the brain, that message needs a pathway—just like we need roads to drive somewhere—the eyes have pathways to get to the brain. These are called nerves.

There are tiny nerves coming out from every tiny little cell. The tiny nerves all come together to one big nerve that goes to the brain. The spot on the eye where the tiny nerves all come together, has no little cells to take in what we're seeing. So we have a blind-spot. If information comes into our eye and goes to that part, we can't see it!

Activity 2: "Two Eyes Are Better Than One".

• Divide the class into pairs. In each pair, one student should hold a small object in his/her hand. Their partner will wear an eye patch or cover one eye.

• Place a target several feet away on the floor. The one-eyed student has to direct the other student to drop the small object onto the target.

Why is it so hard to judge things with only one eye?

Explanation:

We need two eyes to have depth perception. We are created with two eyes so that our eyes can work as a team to see everything. Both eyes send information to the brain, and our brain compares the information to understand everything that is going on. With only one eye, we don't have depth perception—it is very hard for us to judge how close up and far away things are.

By a Hair

How does your brain know when you have heard or smelled something? Believe it or not, it uses hairs!

Everyone has hair in his or her ears and nose and each one of these hairs is connected to a cell beneath the skin. When a sound gets into your ear, it moves the hair, which then alerts the cell and sends a message to your brain. Then your brain tells you what sound it is.

The same thing happens in the nose. When there is a smell in the air, the hair is moved, which then pushes the button and sends a message to your brain that there is a smell. Then your brain tells you what the smell is!

Test that Nose

• Plan a trip outside. The trip could include places around a school. Visit the cafeteria, the library, the main office, a garden, or the playground and write down all the smells you find there. How many can you identify?

• Collect pairs of items that smell and place them in containers that cannot be seen through. Poke holes into the top of the containers. Mix up the containers and try to match the containers that have the same item.

• Noses and brains are supposed to help you find foods that are good to eat. But how well does this system work? Collect at least 10 different items that smell—some should be things that are edible, such as cheese, curry powder, spices, mushrooms or fruits, and some items that are inedible, such as perfume, moth balls, or sawdust. Test students to see if they can pick out things that can be eaten and those that can't.

For Further Fun!

Now that you better understand how our senses, paired with our memory, help us decipher the world around us, let's imagine that you are out for a walk late at night and come upon some danger. Explain how memory and the senses work with our brain to keep us safe.

GRADE 5

PS1.A: STRUCTURE AND PROPERTIES OF MATTER

Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. (5-PS1-1)

WHAT IS WHAT?

Throughout *Brain Games* the various parts of the brain are explained and explored. All of these parts are diagramed in the brain maps on pages 100 and 101. Refer to these pages, as well as their corresponding pages throughout the book for the following.

Having trouble remembering what the frontal lobe or the thalamus are? How ever can you keep all of the terms straight?

Remember, visuals and speaking information aloud (page 33) help your memory better retain. Be creative to help yourself and your fellow classmates recall for a future exam.

- How can you create more effective flash cards?
- Is there a song or jingle you can make up?
- What about linking what you know with what you don't know?
- Maybe an action or gesture can be attached to the terms to help you remember.

Share your learning technique with the class.

MODEL YOUR BRAIN

Activity 1: Model Your Brain.

The outermost part of the brain is called the cerebral cortex which is be divided into four different lobes: the frontal lobe, the parietal lobe, the temporal lobe and the occipital lobe.

Put your two fists together. This represents the two hemispheres of the brain complete with fissures. And guess what? Two fists together are about the size of an individual's brain! Don't worry, brain size in humans is not related to intelligence.

With a partner, label the lobes of the brain model or two fists with a pen or marker.

PUT ON YOUR THINKING CAP

Activity 2: Put On Your Thinking Cap.

For an even better model of the brain, create a papier maché version that you can actually wear!

Start by creating a head form from wire, a balloon, or a bowl to build your cap around. Balling up some newspaper and covering it with masking tape will also work. Use your own head for size and shape so you can wear it.

Then, cut strips of newspaper and mix papier maché paste (2 parts white glue to 1 part water).

Coat the newspaper strips with the paste, and place them one by one on the form.

Let each newspaper layer dry before you add a new layer. Add enough layers to give you a strong structure. When the structure is dry, remove the underlying form.

You can then paint the thinking cap with the lobes of the brain or with the different areas of the cerebral cortex.

PROTECT YOUR BRAIN

Activity 3: Protect Your Brain.

Now that you know that your brain is the most powerful and complex supercomputer ever built, you are going to want to protect it.

Your brain is protected naturally by a hard shell called your skull.

Let's pretend that your head is an egg. You can even draw a little face on Mr. Egghead.

Now, let's place this egg (your brain) into a hard plastic container that represents the skull and seal up the lid.

What would happen to the brain if we shook the skull? What would happen to the egg if this container was dropped?

Shake the egg until it breaks.

If there is only your brain under your skull, each time you bang your head, your brain would splatter like Mr. Egg-head! That means that there must be something else that surrounds the brain.

Take another egg and think of a way to protect the brain so it doesn't break.

Research what protects the brain inside our skull from sudden impacts. (Answer: the cerebrospinal fluid acts like a cushion.) How can you mimic this inside the container?

Try it. Did it work?

Now even though the skull and the cerebrospinal fluid work to protect your brain, it is still very important to wear a helmet when engaging in strenuous activity. Your brain is very important and you should take good care of it.

DESIGN A HELMET

Activity 4: Design A helmet.

This challenge allows students to test out the scientific method for themselves as they problem solve a way to create a helmet that really works! Of course, a little imagination is going to go a long way here, too!

The Scientific Method is an eight-step series that engineers, scientists, and inventors use to problem solve.

Step 1: Ask a Question

Step 2: Do Research

Step 3: Guess an Answer (also called a Hypothesis)

Step 4: Test Your Guess/Hypothesis

Step 5: Did it Work? Could it Be Better? Try Again

Step 6: Draw a Conclusion

Step 7: Write a Written Report of Your Results

Step 8: Retest

After introducing the eight steps to the class,

- Provide the students with several craft items (rulers, paper, cardboard tubing, empty boxes, tape, glue, etc.). Check the recycling for other ideas of materials.

- Each group must create a "helmet" for Mr. Egghead that can protect him from a 5-foot fall.

• Each helmet must:

Hold Mr. Egghead.

Take into consideration what the students already know about the brain, skull, and cerebrospinal fluid.

• The groups must create an eight-page scientific notebook for their helmet and carefully document their use of the scientific method throughout the process of creating their helmet.

Once all helmets have been prototyped, test them out one by one as a class. Did they work? Retest. If they didn't work, head back to the drawing board like a real inventor.

Offer awards to increase the competition.

o Strongest Helmet

o Most Attractive Helmet

o Most Materials Helmet

o Least Materials Helmet

MIDDLE SCHOOL

LS1.D: INFORMATION PROCESSING Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1- 8)

WHAT IS AN EMOTION?

Read aloud Chapter 3, "Emotion Expressway." As you read, pause to discuss relationships among the text, photos, diagrams, and illustrations, as well as complete the challenge sections.

After reading, lead the class in a discussion on emotion. It is ok if students refer back to the chapter for answers, but express responses in their words.

- How would you describe or define emotion?
- In what part of your brain are emotions formed?
- Explain some of the benefits of emotion.
- Give examples of when you have felt the six main emotions and what caused them. How did each emotion feel? How did you react?

NAME THE FEELING

Activity 1: Name the Feeling.

Assign each student one of the six main emotions: happiness, disgust, fear, surprise, anger, and sadness.

Each student will write a detailed story that depicts this emotion in the hopes of making their readers feel the same way. There should be a strong focus on description, as well as utilizing any other senses or evoking memories.

Then, students will read their stories aloud to the class. The rest of the class will be asked the following three questions based on what they heard:

- Name the feeling.
- What's a helpful way to deal with it?
- What's a harmful way to deal with it?

PLAYING WITH YOUR EMOTIONS

Activity 2: Playing With Your Emotions.

Every day we are bombarded with images and sounds that are trying to sell us something. Whether on television, the radio, a billboard, magazines, or the Internet, a marketing company is always trying to make us feel hungry or angry or sad. So, how do the images and sounds in advertisements influence how you feel? You might not even be aware.

While written and spoken language is powerful, it is processed in the cerebral cortex, the "thinking" part of the brain. But images are processed in the same "primitive" part of the brain where strong emotions and instincts are located. This is what advertisers want to access in order to create an impulse in you.

Have students listen only to the sound of a TV advertisement.

- How does it make them feel?
- Do they want to buy the product?

Now show them the same ad with the sound and the images.

- Does it make them feel any different? Why or why not?
- In what ways do they think advertisements encourage "impulse" buying?
- What can they do to control those impulses?

STRESS-FREE CLASSROOM

Activity 3: Stress-free Classroom.

While stress can be motivating and challenge you to work your hardest, it can also cause forgetfulness and panic if not managed correctly.

Divide the class in half and have group 1 research techniques for reducing stress, while group 2 researches how to create a stress-free environment.

Based on their research, group 1 will modify the daily classroom agenda to allow for stress-free learning. Group 2 will be responsible for redesigning the classroom environment to eliminate stress.