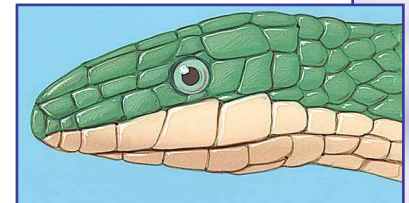
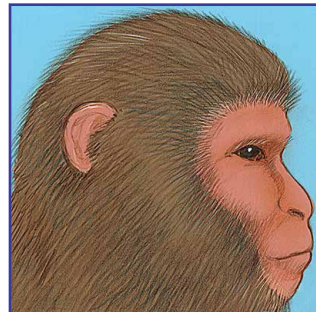
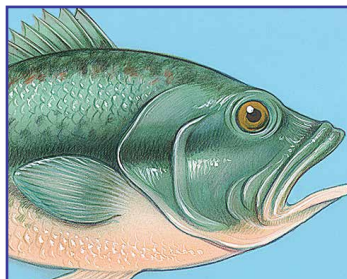
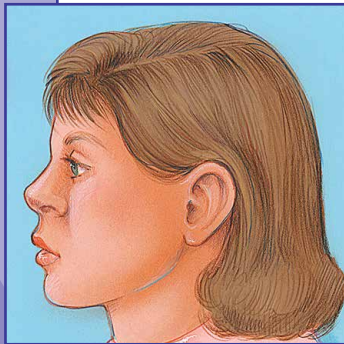


EXPLORATIONS

The Brain Match Game

In what ways do these brains look alike? In what ways are they different? Match each animal to its brain.



See Answers to the "The Brain Match Game" on page 3.



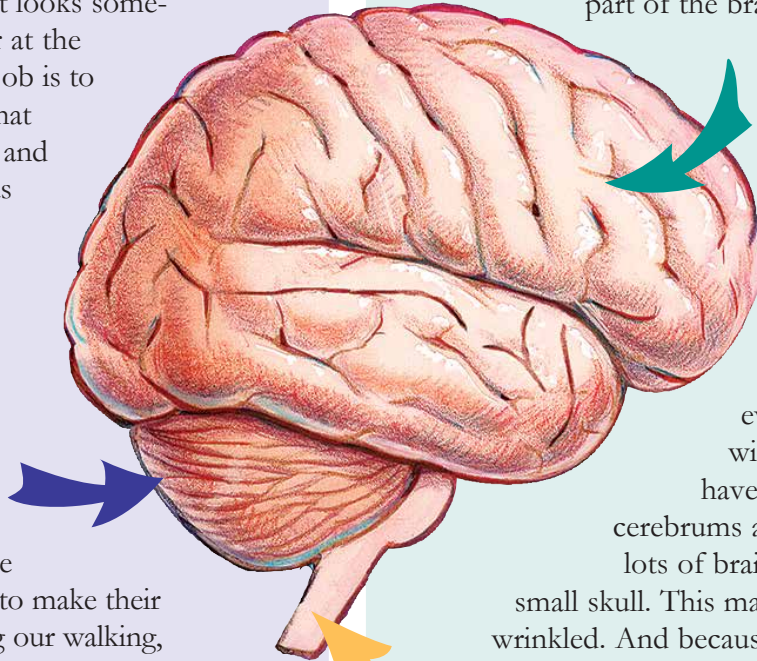
MATTER OF FACT!

The brain is the most complex and specialized organ of the body. Some people refer to the brain as “gray matter.” This actually refers to the outer layers of the cerebrum—the thinking part of the brain—and to parts of the spinal cord. In a living brain, these layers are more pinkish than gray. The brain is the command center of the body. It is enclosed within the skull dome or **cranium** (KRAY-nee-um), the bony shell which protects it. The brain is further protected by a cushion of **fluid** and is covered by thin but tough membranes called the **meninges** (me-NIN-jeez).

One way to think about the structure of the brain is to divide it into three parts: the **cerebellum**, the **cerebrum** and the **brainstem**.



The **cerebellum** (ser-uh-BEL-um) is about the size of a tennis ball in humans. It looks something like a little cauliflower at the back of the brain. Its main job is to coordinate our muscles so that our movements are smooth and even. Something as simple as picking up a cup is really a complex maneuver. The cerebellum helps our muscles know how much to contract so that we don't crush the cup. Have you ever noticed how babies seem clumsy when they begin to walk? That's because their cerebellums are just beginning to learn how to make their legs work well. Coordinating our walking, reaching, balancing, throwing and catching are some of the cerebellum's important jobs. Animals that hunt need well-developed cerebellums so they can move as quickly and skillfully as their prey. Which animal do you think has a more developed cerebellum—the hawk or the field mouse?



The **cerebrum** (suh-RE-brum) is the largest part of the brain in humans. It looks like a huge shelled walnut with a right half and a left half. This wrinkled mass sits below the top of the skull. It is in charge of speaking, seeing, hearing, writing, remembering and even dreaming. Animals with backbones normally have cerebrums, but not all cerebrums are alike! Humans have lots of brain matter stuffed into a small skull. This makes our cerebrum very wrinkled. And because of all those wrinkles, we can do lots of things other animals can't do. Have you ever seen an animal design a car or program a computer? Because the human cerebrum is different from that of other animals, we can create and use complex machines in our everyday lives.

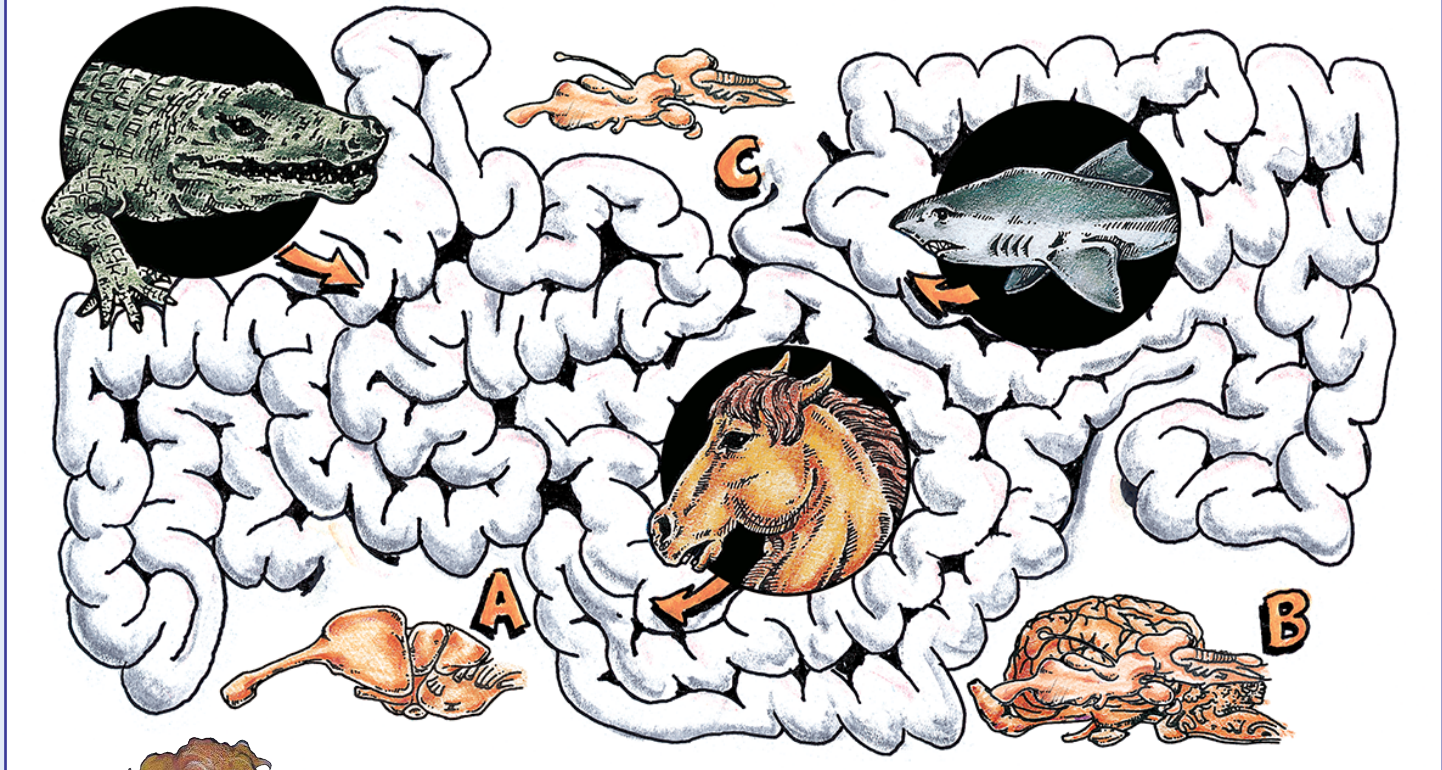
The **brainstem** looks just like its name suggests—a stem. It connects the rest of the brain to the spinal cord. Thanks to our brainstems, we don't have to spend time telling our lungs to breathe, our hearts to beat, or our stomachs to digest—it's all automatic! Brainstems in humans and animals eliminate the need to stop and think about every body activity. The brainstem also controls the “fight or flight” response. For example, when an animal is in danger, it usually will either run away or fight. The brainstem enables the animal to react by telling the muscles to run more quickly, kick harder or breathe faster.



A-Mazing Brains

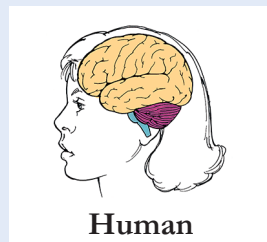
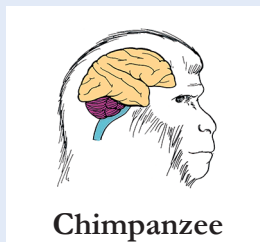
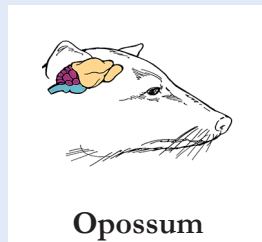
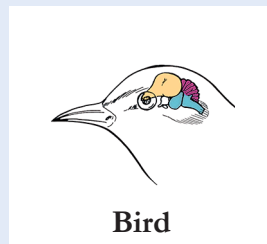
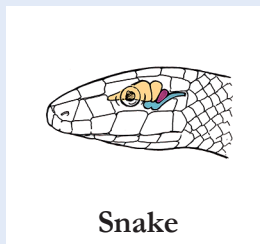
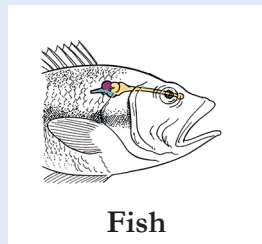
Try this brain-matching maze. Can you predict which brains go with the alligator, the horse and the shark? Find the brain which goes with each animal by tracing the twisted pathways from end to end. When you have matched each one with its brain, turn to the bottom of page 8 to check your matchups.

BRAIN FLASH
 The human brain contains about 100 billion individual nerve cells (neurons). This is comparable to the number of stars in the Milky Way.



Answers to “The Brain Match Game”

- How many did you match correctly?
- After reading “Matter of Fact!” and examining the answers, what do you notice about the brainstems? How are they alike?
- What differences are there among the animals’ cerebrums? How are they different?



EGG-HEADS

"I need a helmet to protect me. Can you design one that will keep me from breaking if I fall? Accidents are the leading cause of injury to kids. Head injuries are especially bad news. Wearing a helmet when bicycling, skateboarding or rollerblading is really using your head!"



BRAIN FLASH

Helmets reduce the risk of brain injury by 85%!

Get your family involved and see how many different types of helmets each of you can make. Remember, the helmet should keep the egg from cracking when it falls. Here are the directions.

1. Get a chicken egg. Don't boil it.
2. Use a marker or pen to draw a face carefully on your egg. Include the eyes, nose and mouth.
3. Look around your house for helmet material. Try things like newspaper, tissue paper, bubble wrap, styrofoam packing peanuts, plastic or paper cups, play-dough, clay, old boxes, etc.
4. Make a helmet that lets your egg "face" see and breathe. You can use tape or play-dough to secure the helmet. Don't cover the eyes or nose.

5. **Important:** Lay several sheets of newspaper on the ground or floor where you are going to test your helmet. If your egg breaks, newspaper will make it easy to clean up.
6. Now test your helmets. Roll the helmeted egg off the kitchen counter or table onto the newspaper. It should be at least three feet to the floor.
7. Does your egg in its helmet crack when it hits the floor? If so, try again with another egg to design a better helmet.

CONGRATULATIONS to all the helmet "egg-sperts!"

CEREBRAL MATTER CHATTER

I need my brain, my precious brain,
my own cerebral matter.
So when I bike, my helmet's on
as down the street I clatter.
'Cause if I fall, I want to know
my cranium won't shatter;
Or even worse, I'd hate to see
cerebral matter splatter!

Did You Know?

Fifty million Americans are affected each year by diseases or injuries that involve the brain. In addition to those suffering from brain disease and injury, as many as 1 in 4 Americans suffer from a mental disorder each year. Perhaps you know someone who has had a head injury or a stroke? Maybe you know someone with epilepsy, MS (multiple sclerosis), Alzheimer's disease, or a drug or alcohol problem? Because so many people are affected by diseases or disabilities of the nervous system, Congress passed a public law which made January 1, 1990 the beginning of ten years of attention to and research on the brain. The ten years were named *The Decade of the Brain*. Research on the brain is part of **neuroscience**, the study of the nervous system.





Knead A Brain?

Follow this recipe to make a model of the human brain with all its wrinkles and folds. When finished, this recipe should weigh about two pounds. This is about one pound less than the average weight of an adult human brain.

- 2 cups water
- 2 cups flour
- 4 teaspoons cream of tartar
- 1/4 cup vegetable oil
- 1 cup salt
- red food coloring



You also can have fun by forming the cerebrum, cerebellum and brain stem of one of the animals on the front cover!

TOP VIEW



SIDE VIEW



- Step 1** Mix together 2 cups of water, 2 cups of flour and 4 teaspoons cream of tartar in a large bowl or in a blender. Mix until the lumps disappear.
- Step 2** Add 1/4 cup of vegetable oil to the flour and water mixture.
- Step 3** Put this mixture in a saucepan and add 1 cup of salt. Stir and cook over low heat until the mixture becomes lumpy.
- Step 4** Pour mixture out and let it cool. Then knead the doughy mixture and form into the shape of a brain. Use the drawings of the human brain to the left to make your own model with the three parts—brainstem, cerebellum and cerebrum.
- Step 5** If you are making a human brain, be sure to form the wrinkles on top. Use a spoon to make the deep grooves in the cerebrum. These grooves are called sulci (SUL-kye). The tops of the folds are known as gyri (JYE-rye) For realistic blood vessels, you can squirt red food coloring into the wrinkles on top.

This “brain dough” will keep for several months in an air-tight container in the refrigerator.

A Weighty Subject

The average adult human brain weighs about 3 pounds, or 1,400 grams. How heavy is that?

1. Find three items, either at home or at the grocery store, that you think might weigh about three pounds. How much do you think each item weighs? List the items and record your predictions about their weights below.

ITEM	PREDICTED WEIGHT
_____	_____
_____	_____
_____	_____

2. Weigh the items. List the items again and record their actual weights below.

ITEM	ACTUAL WEIGHT
_____	_____
_____	_____
_____	_____

Just the Facts

Intelligence in people is not the result of differences in the numbers of neurons, kinds of wrinkles or the sizes of brains. In fact, all human brains look about alike. Instead, each person's individual skills and talents are related to the connections among neurons within the brain.



CONSIDER THIS...

1. Pick up the item that weighs closest to 3 pounds. Consider that a human brain is just about this heavy. Is the item about the same size as a brain?
2. If not, what can you find that is more like the brain in size, even though it may be heavier or lighter? Have you found anything that you think is like a human brain in both size and weight?

BRAIN FLASH

The brain of a baby weighs only about one pound. It grows to almost its full adult size by age three.



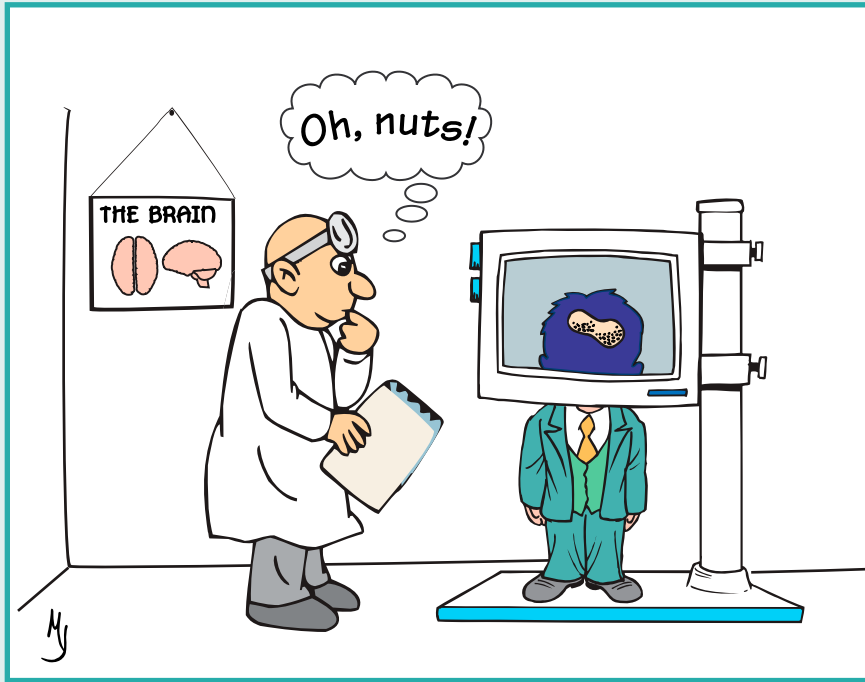
BRAIN FLASH

Did you know that tribes in New Guinea used to prepare and eat the body parts of deceased family members? The brain was reserved as a special gift for women in the family. Unfortunately, it was often a deadly gift!

The women got a disease of the central nervous system called kuru (KOO-roo), or "shaking disease," which caused their death.

Kuru is similar to "mad cow disease," a very rare illness that affects the brains of cattle.

Brain Busters!



© Baylor College of Medicine

Some people think the crinkly cerebrum of a human brain looks like the two halves of a walnut. The wrinkles and folds allow more brain surface to fit within the space of the skull. Why is it important to have more surface area?

Brain cells that are responsible for thinking, sensing and learning are located in a thin layer on the surface of the cerebrum. In other words, when comparing one kind of animal to another, more wrinkles means greater intelligence!

Why do you think the doctor in the cartoon looks so puzzled?

Careers for NeuroExplorers: Teaching

Did you ever wonder about something you've seen or heard? Asking questions is an important part of being a good student and a good scientist. Let's meet a modern neuro-explorer who is a teacher and helps others to find the answers.

Neuro-Explorer: Robert Thalman, Ph.D.
Associate Professor of Cell Biology
Baylor College of Medicine
Houston, Texas

Dr. Thalman, what do you do?

I teach medical school students, who are learning to be doctors, about the brain and how it works. All future doctors need to know about the brain and the nervous system. I also do research on a part of the brain called the hippocampus (hip-o-KAM-pus). I try to find out how

different cells in the hippocampus communicate with each other.

What do you find the most fun or most interesting about your work?



Teaching is exciting because my students really become interested in the nervous system when we do experiments in the lab. Once I've got their interest, they want to learn what they can from books. As a teacher, I can pass on my love of science to others.

What advice do you have for future scientists?

Science is the very best job for a curious person. You get to ask questions and then figure out the answers. So, when you get interested in something, try to find out more about it. Go to the library, ask others who know more than you do, and remember to use your own eyes, ears and brain.

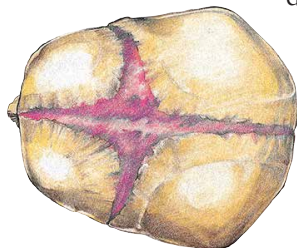
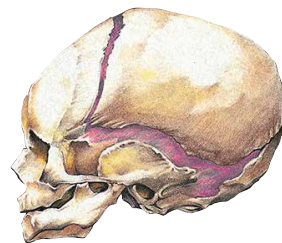


YOUR COLOSSAL CRANIUM



Your brain is made of soft tissue, which can be bruised or torn. The skull serves as a protective case to help keep the brain from being damaged.

Imagine how an egg yolk floats inside an eggshell. The brain also is floating in fluid called the **cerebrospinal** (suh-ree-bro-SPI-nal) **fluid**. The **cranium** is the domed part of the skull that covers the brain. You also have facial bones which provide a frame for your eyes, nose and mouth. The front portion of the skull is a honeycomb of bone and air spaces (**sinuses**) that act like an “air bag” for the brain and help absorb the force of a blow.



Did you know that when you were born your cranium was not solid? Babies have “soft spots,” or **fontanelles** (fon-tuh-NELZ), on the top of their heads where the bones of the cranium have not yet joined together. A baby’s cranium needs room to grow. Usually, by the time you are about two years old, the last of the fontanelles have been filled in.

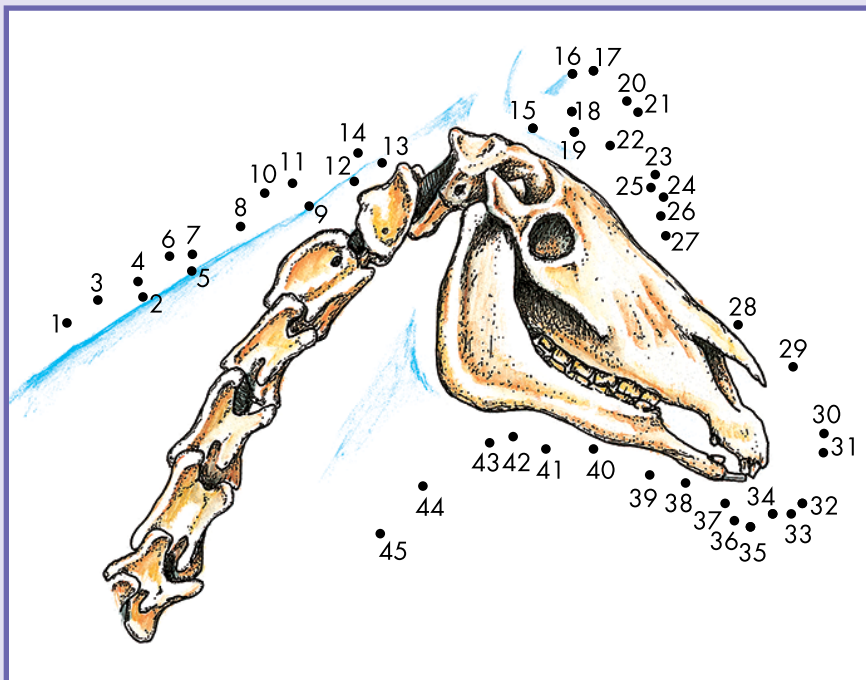
The places where the soft spots grow together form jagged lines called **sutures** (SOO-churz). They fit together like the pieces of a jigsaw puzzle. The sutures do not begin to fuse solidly together until you are around 25 years old. This allows the skull to expand as the brain slowly grows to maturity. After age 25, the sutures gradually turn to solid bone. Then you might say that a person can truly be called a “bonehead”!

Animals have craniums for the same reason as humans—to protect their brains. In the puzzle at the right, try to guess which animal’s bones are pictured. To find the answer, connect the dots.

BRAIN FLASH

Did you know that the human brain is about the consistency warm oatmeal, or custard, or butter at room temperature? This important organ is very delicate and needs protection.

- Answers to “Amazing Brains” from page 3.
- a. Alligator
 - b. Horse
 - c. Shark



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