A LOOK AT THE BRAIN

The brain fills up most of the head and weighs about 1.5 kg (~3 pounds). The brain needs lots of blood. It receives 35 liters of blood every hour! The blood brings oxygen and sugar to the brain and carries away waste products and carbon dioxide. The brain uses more energy than any other organ of the body, consuming 40% of the oxygen and sugar taken in.

The large blood vessels branch off into smaller and smaller vessels, down to the microscopic vessels called capillaries. The capillaries form a fine network all through the brain, making sure that every cell gets nourishment.

The brain looks wrinkled and folded. There is a good reason for this. The surface layer, the cortex, of the brain is larger than it appears. If it was peeled off the brain and laid out flat, it would cover an area about the size of a kitchen table. Imagine the cortex as the tablecloth that has been crumpled up to fit inside a head. The more wrinkles there are, the more brain cortex there is. In general, an animal’s intelligence can be judged by how wrinkly the brain is. Wrinkles are a better guideline for intelligence than size.

Inside the skull, the brain is surrounded by a layer of watery fluid, cerebrospinal fluid, which cushions and protects it from bumps and bangs. Without this fluid, injury would be risked every time someone went out to play. After the fluid ‘bathes’ the brain, it flows down the middle of the spinal column bathing all the spinal nerves. Eventually, the fluid exits at the bottom of the spinal cord and is reabsorbed by other body tissues. The brain is constantly making new fluid at the rate of about a spoonful every hour.

There are three main sections of the brain. The largest section, the top part, is called the cerebrum (sah-REE-brum). This is the part of that is thought of as the ‘real’ brain. This is where thinking and feeling take place. It is also the part that commands muscles to move and processes information from the eyes and ears.

The wrinkly blob under the cerebrum is called the cerebellum (sare-eh-BELL-um). It’s almost like a separate brain. It’s name means “little brain.” This
part of the brain is in charge of coordinating balance and movement. Without it, people would fall over when trying to walk. It’s needed to do things like throwing a ball or shooting a target. It is the fastest growing part of the brain and reaches adult size by the time a child is two years old.

The stem-like thing sticking out of the bottom is called the **brain stem**. It performs bodily functions that are often taken for granted, such as breathing and the beating of the heart.

In the diagram, the cortex (which doesn’t look so wrinkly in this picture) is about as thick as a piece of corrugated cardboard. This is where thinking takes place. The cortex is sometimes called “grey matter” because it looks light grey in color. Underneath the grey matter, is a thick section called “white matter.”

The center of the brain is a confusing place. There are all sorts of blobs and weird shapes. It’s even more complicated than this picture. It has been simplified as much as possible without leaving out any important parts. There are connecting tissues, empty spaces, and a few other small parts that have difficult Latin names and serve mainly as helpers for these main parts.

The cerebellum and the parts of the cerebrum: frontal, motor, sensory, parietal, occipital, and temporal lobes can be seen. The left temporal lobe is sort of peeking out from behind the cerebrum. The right temporal lobe, the one that would have been in front, had to be removed in order to see the middle of the brain.
The sideways ‘C-shaped’ thing in the middle, the **corpus callosum**, is a connecting bridge between the right and left sides of the brain. The cerebrum is in two halves, connected to each other by the corpus callosum. It is believed that a thicker corpus callosum creates a better connection between the two hemispheres. It is the "firm body" that joins the two halves of the cerebrum, and lets each half know what the other half is doing.

Lurking above (and sort of on the outside of) the corpus callosum is the **cingulate gyrus** (SING-gew-late JIE-rus). It is actually part of the cerebrum, but it is attached to the **limbic system** (the inner parts). It may help relay information from the inner parts of the brain out to the cerebrum, as well as helping to control emotional responses. Scientists are still trying to figure out what else it does.

The brain stem has been divided into three pieces: the **medulla oblongata**, the **pons**, and the **mid-brain**. The medulla oblongata is the center for the control of breathing, blood pressure, and the beating of the heart. The medulla keeps these systems running even when someone is asleep. The actions of sneezing, coughing (the uncontrolled kind), and vomiting are also controlled in the medulla. Some cough medicines (suppressants) act on the medulla, dulling it a bit, giving some relief from the urge to cough.

The pons controls the waking and sleeping cycles. Even if there is no alarm clock, a person will still eventually wake up, thanks to the pons. It also acts as a connector between the cerebellum and the cerebrum and so may help with balance and posture.

The mid-brain is sort of a crossroads for nerve pathways. It helps direct in-coming signals and routes them to the correct area of the cerebrum. It also seems to have a function in swallowing and salivation reflexes.

The very center of the inner brain is called the limbic system and is probably the hardest to understand.
**BRAIN ANATOMY: The parts explained**

**AMYGDALA:** The amygdala (ah-MIG-dahl-ah) is the center for emotion, especially strong ones such as fear and anger. It turns on the bodily functions that are related to these emotions, like increased heart rate and sweating. This emotional center just happens to be at the tip of the part that controls memory, which is possibly why the strongest memories are things that were felt so strongly about by someone.

**HIPPOCAMPUS:** This is the Latin word for sea horse. Apparently, someone in the early history of brain research thought this part looked a bit like the body shape of a sea horse. Probably what is now called the fornix was included as part of the hippocampus. That whole entire "C" shape almost looks like a sea horse. (Some serious imagination may be needed!) Since those early days, most of the C has been given the name fornix, which is Latin for a "vaulted arch," like in a cathedral ceiling. (Okay, so the fornix doesn't look exactly like a vaulted arch, but at least it resembles one more than the hippocampus looks like a sea horse!) The hippocampus and the fornix are part of the memory system. They let new things be compared to old ones that are already in memory. The hippocampus is sort of like a librarian, finding a place to put new books (memories) and pulling out old ones when they're needed.

**FORNIX:** This is a connector piece that connects the hippocampus, the hypothalamus, and amygdala. The little bump at the end, which is called the mammillary body, seems to have a role in emotions such as happiness and excitement.

**HYPOTHALAMUS:** The word "hypo" means "under," so the hypothalamus is located under the thalamus. Although this part is very small, it has lots of important jobs! It keeps body temperature and blood pressure constant, makes a person feel hungry or thirsty, helps sort out emotions coming from the amygdala, manufactures chemicals that control growth, and sends chemical messages down to the pituitary gland telling it when to release its chemicals. Think of the hypothalamus as the body's balance regulator that lets other organs know when there is too much or too little of something.

**THALAMUS:** This part remains somewhat of a mystery to scientists. but it seems to be in charge of sorting out all the signals coming from the limbic system and then sending them to the parts of the cerebrum they should go to.

**FRONTAL LOBE:** Located in the front of the head, behind the forehead (thus its name), this is the area of the brain that is thought of when someone thinks of the "brain." The frontal lobe is where decisions are made and mental calculations are done. When critical thinking games, like chess, are played the frontal lobe gets a workout. The frontal lobe is responsible for monitoring behavior and learning social skills that are needed in order to get along with other people. The famous example of Phineas Gage shows how damage to the frontal lobe can result in a change of personality. Before the accident Phineas was responsible, polite, and good with people. After the accident he was irresponsible, rude, and terrible with people.

**MOTOR CORTEX:** Right next to the frontal lobe is the thin strip of cortex that sends signals to your muscles telling them to move (or to stop moving). The frontal lobe thinks of the chess move, then sends a
signal to the motor cortex, which in turn sends a signal to the muscles in the arm and hand, causing them to pick up the chess piece and move it to another square.

**SENSORY CORTEX:** This thin strip is connected to all parts of the body and receives messages about things that are felt. If a sudden pain in the wrist is experienced, the pain sensation is received in the brain by the sensory cortex. The sensory cortex can relay this information on to the frontal lobe so that why your wrist hurts can be figured out and steps to fix whatever is causing the pain can be taken. The sensory cortex has two sides, each one matching up to one side of the body. So the signals from the right wrist go to a different area than the signals from the left wrist. Some parts of the body, such as the fingertips and face, get a much larger section of the cortex devoted to them. These parts need more sensitivity than parts such as the back or the legs.

**PARietal lobe.** This area of the brain (pronounced: par-EYE-it-al) is a mysterious one. Scientists still don’t know everything the parietal lobe does. Its main job seems to be keeping track of where the body is and what it is doing. If the eyes are closed, what the arms are doing can still be determined. The hands can be brought together without looking. This is the parietal lobe working.

It also seems to keep track of all the objects in the environment, and "knows which end is up." For example, the end of a pencil that is used for writing is known, even if the pencil is upside down. This may seem a bit obvious, or even silly, but this function of the brain is very important. The parietal lobe takes input signals from body parts and keeps track of them all, making sense of it all and relaying this information to the frontal lobe. The parietal lobe works with the cerebellum and the inner ears to give a sense of balance.

**OCCipital lobe:** This area (pronounced ock-SIP-it-al), located at the back of the head, is where the input from the eyes gets processed. It may seem strange, but the nerves from the eyes travel all the way to the back of the brain. Not only that, but the nerves from the eyes cross over in the middle so that the left eye connects to the right side of the brain and the right eye connects to the left side of the brain. To further complicate things, the images arrive at the occipital lobe upside down! The occipital lobe has to make sense out of all the upside-down images that come from the eyes. It turns everything right side up and figures out what is being looking at. The eyes only do half the job of seeing. The occipital lobe has to finish the job.
TEMPORAL LOBE: This area is on the side of the head, sort of behind the ears and the temples. (The temples are the sides of the forehead.) The temporal lobe is in charge of the ears and nose. The ability to speak and to understand speech is located in the temporal lobe. When someone talks, the temporal lobe is used to construct a sentence that makes sense. Then the temporal lobe tells the motor cortex to tell the muscles in the mouth and throat to make the sounds. The sense of smell and the memory of smells are also located in the temporal lobe. The temporal lobe is very close to the inner part of the brain where memories are stored.

THE EMPTY SPACE: This space is not really empty; it is filled with cerebrospinal fluid. Fluid-filled spaces in the brain are called ventricles. Scientists think these pockets of fluid help to cushion and protect the brain, as well as “floating” the brain, to take pressure off the spinal cord. Also, the fluid nourishes the cells of the inner brain.

OLFACTORY BULB Although it might sound like a light bulb factory, it is really the nerve that brings in smelling sensations from the nose. The nose hooks up to the brain very close to the place where memories are stored, the hippocampus. Some scientists think this is why a smell is never forgotten. The odor sensations are then sent to the temporal lobe where the brain determines what kind of smell it is.

PITUITARY GLAND The pituitary (pit-TU-it-ty-ary) gland produces chemicals that make a person grow and mature from a child into an adult.

The Brain Song:
I woke up Monday morning, just like I always do;
Without my PONS to get me up, I’d sleep the whole day through.
My faithful old MEDULLA had worked all through the night,
To keep my heart and lungs working right.
Oh, my brain stem works so hard,
It does so many things I disregard (oh, how very boring)
Thinking about my CEREBELLUM is a snore,
Without it, though, my head would hit the floor.

I jumped up out of bed, then, and dressed without a fuss;
I was getting signals from my HYPOTHALAMUS.
I went out to the kitchen for cereal and a bowl,
But what a sight for my OCCIPITAL!
Pans and dishes filled the sink.
My TEMPORAL LOBE could smell the garbage stink (oh, how very awful)
Thinking about the chores that waited for me there
Was more than my poor FRONTAL LOBE could bear!

I fled that great disaster using MOTOR CORTEX nerves,
I hurried over forks and crumbs and Friday night’s hors d’oeuvres.
My FRONTAL LOBE decided to take me out the door,
But I really wish I’d seen that apple core!
As I gazed up at the ceiling,
My TEMPORAL LOBE could “hear the birdies sing” (oh, how very lovely)
Thinking I’d made my poor PARIETAL go lame,
My LIMBIC SYSTEM felt a sense of shame.

Oh, my HIPPOCAMPUS would make sure
The memory of this day would long endure (oh, how very poignant)
Thinking I’d better get some help with my hygiene,
I dialed 1-800-42-GET-IT-CLEAN!
Directions: Use the text to complete the puzzle.

ACROSS
1) This lobe is your vision center
2) This “firm body” connects the right and left sides of your cerebrum
3) This lobe is where you make decisions
4) This pea-sized gland controls your growth
5) This is the center for strong emotion, especially fear and anger
6) This is the correct name for empty spaces in the brain
7) This small part has many jobs, including telling you when to eat and drink
8) This is the bottom of your brain stem, and it controls your breathing and heart beat

DOWN
1) This part was named after the sea horse, and is important for storing memories
2) This is a layer of the cerebrum and sits right on top of the corpus callosum
3) This is the relay center where signals from the senses are sorted out and relayed on to the cerebrum
4) This is the connector piece between the amygdala and the hypothalamus
5) This is the part of the brain stem that controls your waking and sleeping cycle
6) This lobe processes information from the ears and nose
Directions: Color the brain parts with the colors listed. Be sure to color in the boxes next to each part to create the legend. DO NOT LABEL PARTS.