Your Amazing Brain

A REALLY FUN Introduction to Neuroscience

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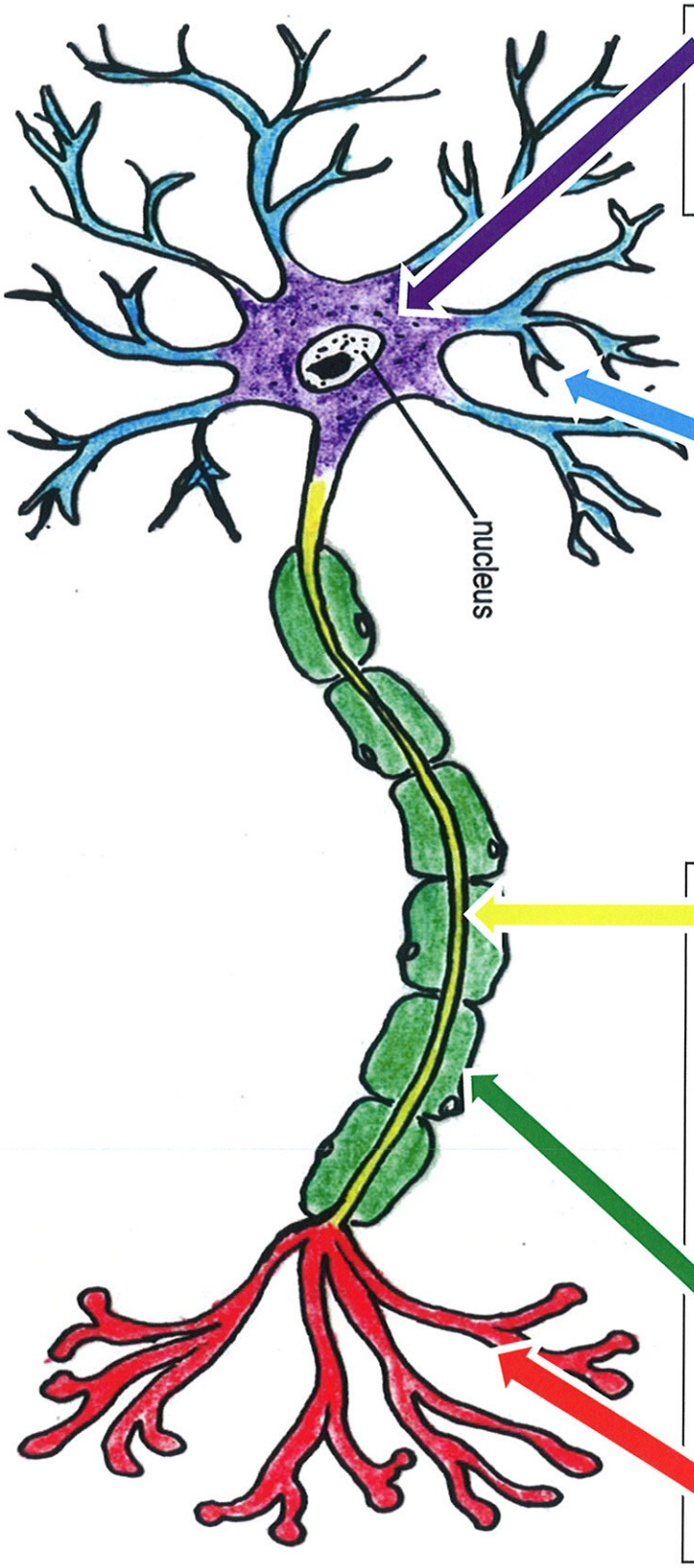
Neurons have 3 major components



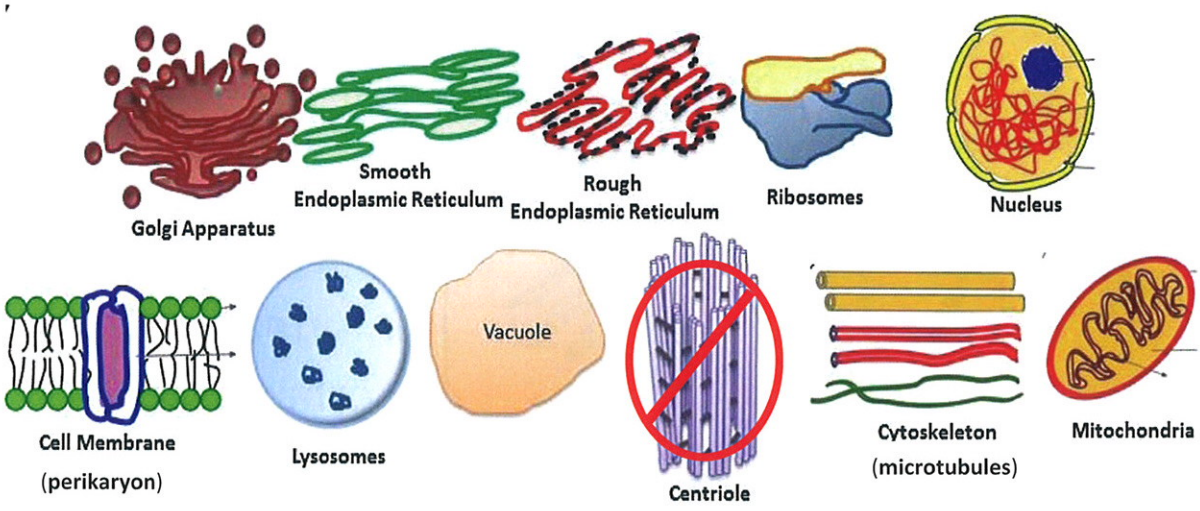
Cell Body Location of **nucleus**, synthesizes proteins, energy

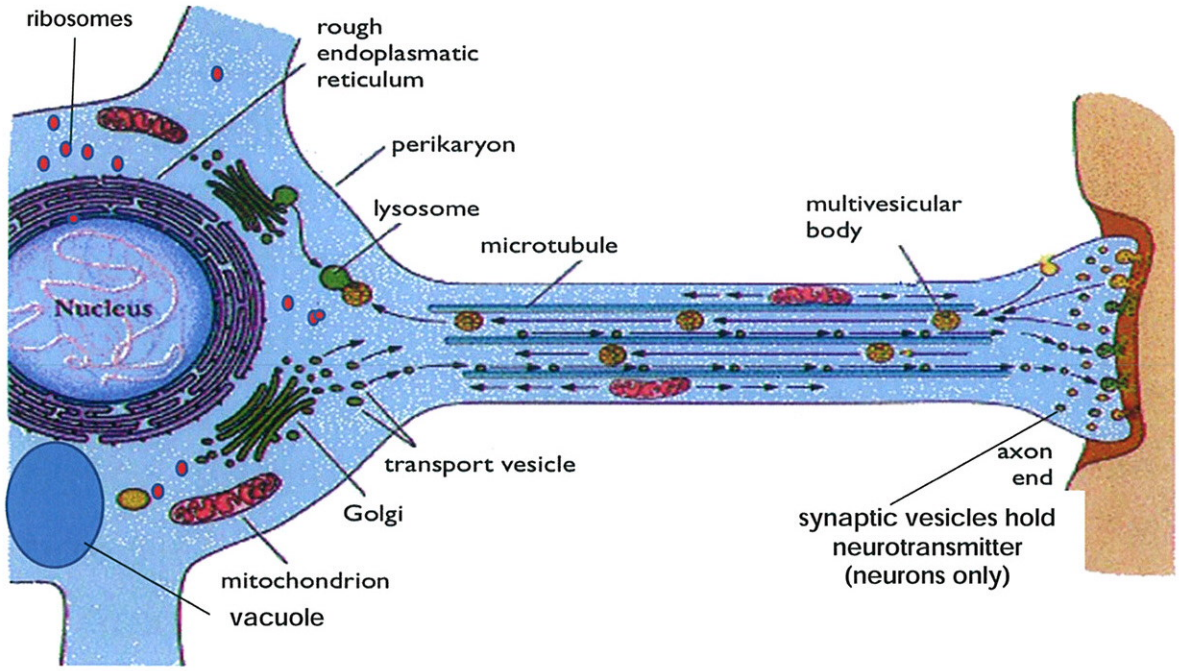
Dendrites Receive information from other neurons

Axon
Sends information to other neurons. Many are surrounded by insulation called **myelin.** The end of the axon branches, called **telodendria.**

Neuron have **most**

of the same components as other cells.



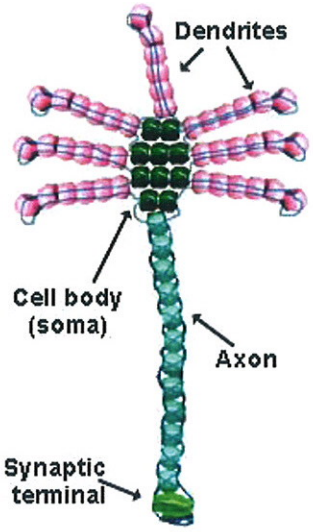


Build Your Own Neuron!

1. On this page, glue a foam rectangle piece as the backing.
2. Glue on the foam cell body and axon.
3. Glue dendrites made out of pipe cleaners or string
4. Add the inner cell parts using pomp oms, sequins, pipe cleaners, and/or paint.
5. Label the parts or create a legend for yourself.

Make a Neuron from Beads

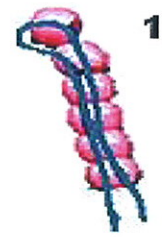
Get out some beads and make a neuron key chain
or make 2 into earrings!



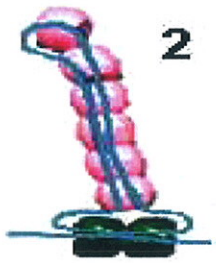
Materials

You will need 4 or 5 different color beads for each part. This neuron with seven dendrites requires 65 beads.

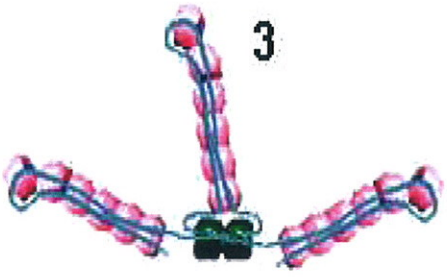
42 beads for the dendrites
10 beads for the cell body
12 beads for the axon
1 bead for the synaptic terminal
1 bead for nucleus (optional)
2 ft. string (yarn, rope, lanyard, flexible wire)



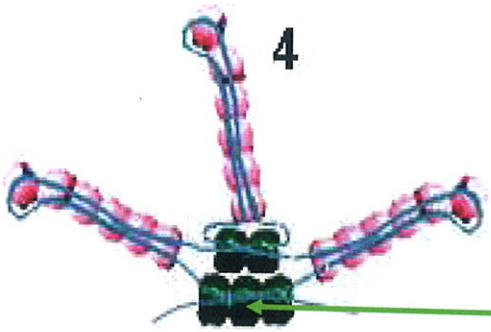
Loop one bead (of the color chosen for the dendrites) through to the mid-point of your piece of wire/string. You now have two pieces of free wire/string. Hold the two pieces together and string 5 beads of the same color through the two pieces together as shown on the diagram.



Separate the two pieces of wire/string. Loop two beads (of the color chosen for the soma), through one piece of string. Loop the second piece of string through both beads in the opposite direction. Pull the strings through in opposite directions and adjust to look like the figure to the left. You now have two separate pieces of string.

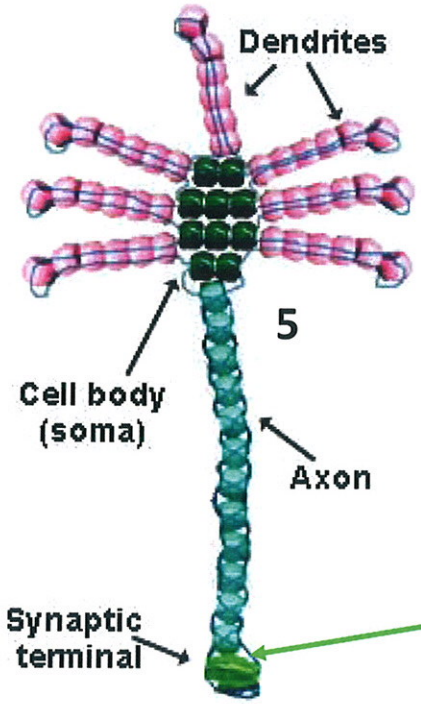


Step 3. Using one piece of string, loop 6 beads of the color chosen for dendrites through to create the 2nd dendrite. Then, loop the same string back through all beads, skipping the last one as shown in the diagram. Repeat this process on the other piece of string to make the 3rd dendrite.



Step 4. To build on to the soma, arrange three beads as shown on the diagram. Loop one string through all beads in one direction. Then, loop the second string through the opposite direction. (The strings will cross inside the beads). If adding a nucleus, use a different color for the middle of the three beads.

***Repeat Step 3 and Step 4 to make the remaining dendrites and complete the soma. Note that the last part of the soma only has two beads.



Step 5. With the beads you have chosen for the axon, position one directly underneath and between the last two beads of the soma. Loop one string through the right hole and the other through the left hole (string criss-crosses in the bead). Repeat with the remaining 11 axon beads, completing the length of the axon. At the end of the axon, add the final bead to indicate the synaptic terminal.

Step 6. Tie the string in a knot to finish your neuron. Attach your key ring or earrings.

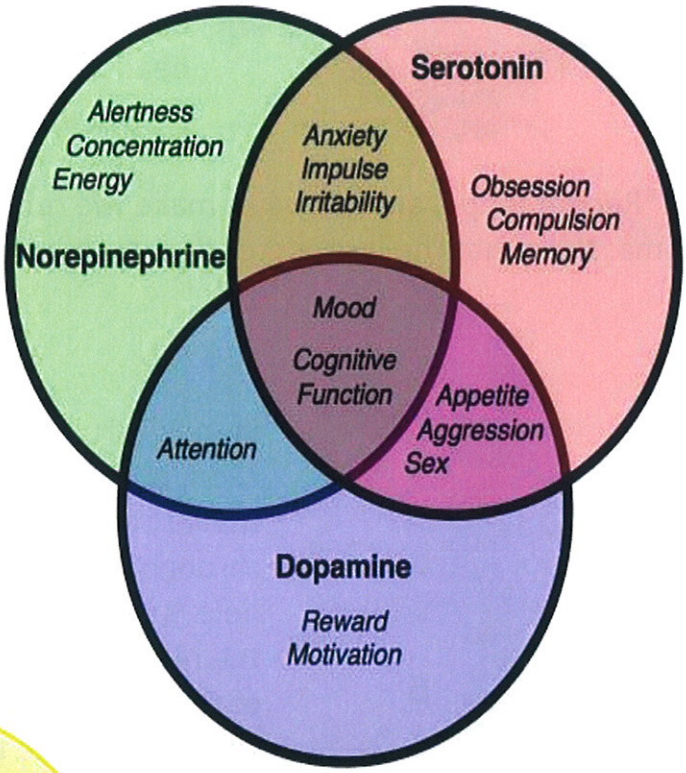
Adapted from: http://faculty.washington.edu/chudler/chmodel.html

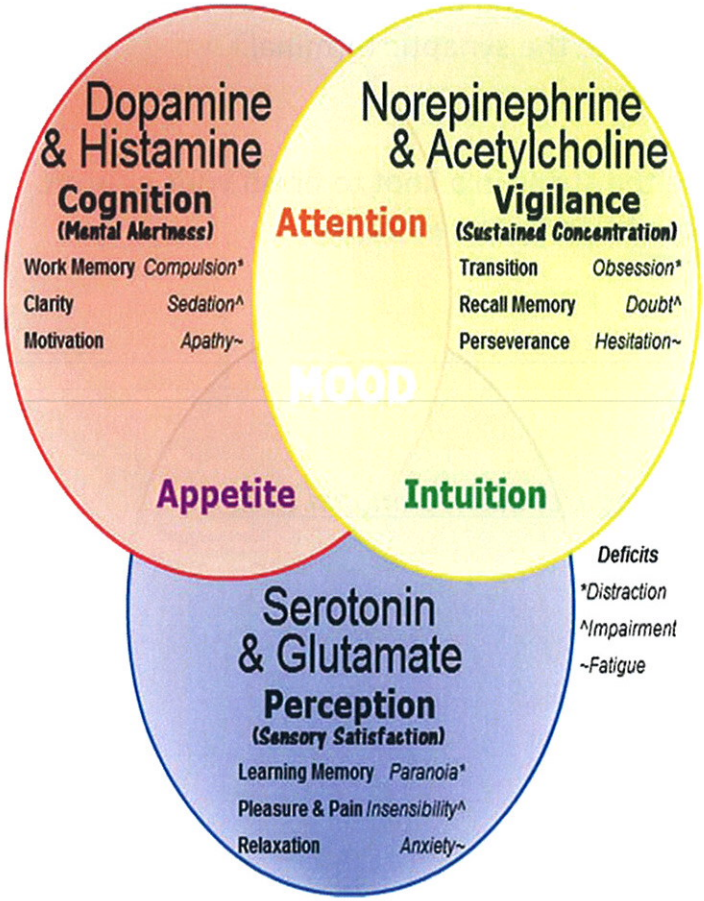
Your Chemical Brain

Neurons communicate when one releases a chemical called neurotransmitter.

This causes a change in electrical charge of the receiving neuron.

Neurons in different brain structures use different neurotransmitters.





Neurotransmitters affect behavior by the location of their neurons.

Several can be important for one behavior.

All drugs that affect behavior, thought, perception, or emotion increase, decrease, or mimic neurotransmitters in the brain.

This game teaches functions of

Seratonin
Dopamine
Acetylcholine
Noradrenaline

ALSO...
Effects of too much
or too little
&
Associated brain structures

How to Play:

- **It is played like Uno, where each player is dealt 5 cards, plus one face up from the deck starting the discard pile.**
- **Each player in turn matches a card in their hand to the neurotransmitter, topic, or effect shown in the discard pile and discards their match.**
- **If the player has no match, they draw a card.**
- **Players holding INHIBITION cards can stop the play of a neurotransmitter.**
- **Players holding EXCITATION cards call the new neurotransmitter and topic. If no one holds an EXCITATION card, players draw one card per turn until one is drawn.**
- **The complete list of neurotransmitters, topics, and effects used in this game appear on the next page.**

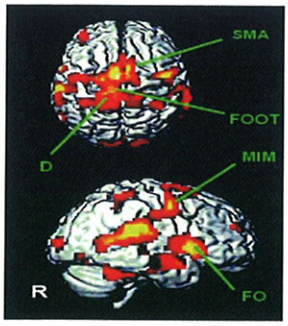
	Acetylcholine	Dopamine	Norepinephrine	Serotonin
Functions	activates sweat glands	movement	fight-or-flight response	Sleep/wake cycle
Functions	goose bumps	pleasure sensation	attention	appetite
Functions	Pupil constriction	addiction	increase heart rate	body weight
Functions	Heart muscle	memory	release of glucose	mood
Functions	breathing	motivation	increase blood to muscles	memory
Functions	Glands	attention	wakefulness	feeding behavior
Functions	Smooth muscles (blood vessels, stomach, bladder, intestines)	problem solving	alertness	internal clock
Functions	activates skeletal muscles	learning		pain perception
Functions	Memory			body temperature
Functions	Sleep cycles			
Structures	Spinal cord motor neuron	Midbrain	Amygdala	Midbrain
Structures	Medulla	Hypothalamus	Cingulate gyrus	Hypothalamus
Structures	Basal forebrain	Nucleus accumbens	Hippocampus	Spinal cord
Structures	Hippocampus	Cortex	Hypothalamus	Hippocampus
Structures			Cortex	Amygdala
Structures			Spinal cord	Cortex
			Thalamus	
			Pons	
Too Much	depression	schizophrenia	Nausea and vomiting	Confusion
Too Much	stomach cramp	repetitive movements	Anxiety	Restlessness
Too Much	Dilation of blood vessels	anxiety	Increased heart rate	Dilated pupils
Too Much	Decrease heart rate	mania	High blood pressure	Changes in blood pressure
Too Much	Paralysis	nausea/vomiting	Panic	Nausea and/or vomiting
Too Much	convulsions			Increased heart rate
Too Much	salivation			Tremor
Too Much	crying			Shivering
Too Much	urination			Goose bumps
				Sweating
				Loss of hunger
Too Little	Memory problems	incoordination	Low energy	Anxiety
Too Little	muscle tremors	depression	Decreased focus	Fatigue
Too Little	Paralysis	ADD and ADHD	Depression	Loss of Concentration
Too Little	Respiratory failure	Lack of emotion	Sleep cycle problems	Memory Problems
Too Little	Hallucinations	Social phobia	Attention Deficit disorder	Depression
Too Little	coma	Lack of enthusiasm		Agitation
Too Little		Chronic boredom		Mania/obsession
Too Little		Fatigue		Mood swings
Too Little		Excessive sleep		Sugar cravings
Too Little				Indifference
Too Little				Excessive worrying
				Insomnia

Your Amazing Brain FACTS

The brain has two halves: the right hemisphere controls the left side of the body and the left hemisphere controls the right side of the body.

The left side of your brain is usually better at problem solving, math, and writing.

The right side of the brain is important for creativity, art, and music.

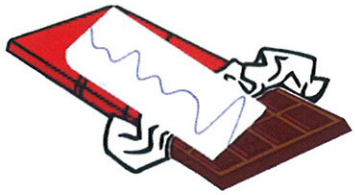


To make a single movement requires at least ten different brain structures.

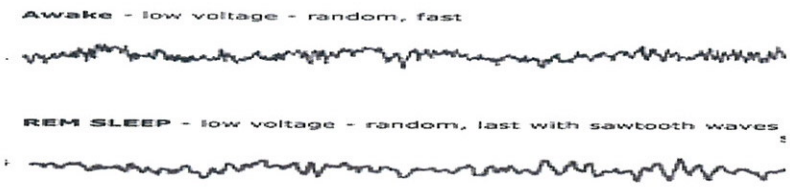
Laughing at a joke requires <u>activity in at least five different areas</u> of the brain plus at least 10 more for movements for laughter.

Brain structure 'hierarchy' goes from back to front, where basic functions like breathing and heart rate are at the back and base but problem solving and creativity are at the front.

The human brain has the same consistency as tofu or soft jello.



The smell of chocolate increases theta brain waves, which trigger relaxation. Theta waves also dominate light sleep.

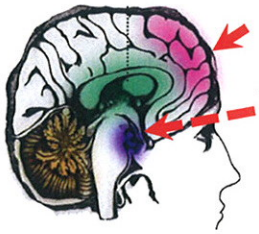


Brain waves during dreaming are similar to brain waves while awake and alert.

"Sphenopalatine ganglioneuralgia" is the scientific word for BRAIN FREEZE. It is caused by freezing and thawing nerves in the roof of the mouth.

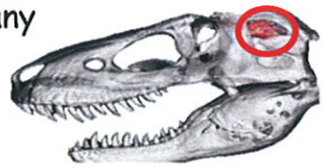
Your brain has an estimated 100 billion cells. It's just an estimate because it would take over 3,000 years to count them all.

Your brain does not mature until you are about 20 years old. One of the last parts to mature is the frontal lobe (responsible for organization, planning, and self-control).



Teens often react with the emotional part of the brain but adults use the reasoning (frontal) parts. This explains why being a teen is like being on an emotional rollercoaster and why their parents are so confused by it!

The front of the human brain is proportionally larger than any other animal's.



Bigger animals don't always have bigger brains. A T-Rex brain was about the size of a couple of walnuts!

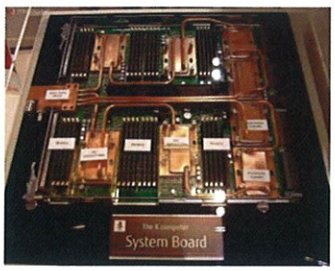
The adult brain weighs about 3 lbs. It is 65% at birth and about 90% of that size by age 5.

The brain undergoes its most drastic changes when you are a baby and a teenager. These changes largely consist of eliminating or thinning unnecessary connections.

New brain connections are created every time you form a memory. You can make new connections your whole life and can definitely teach an old dog new tricks!

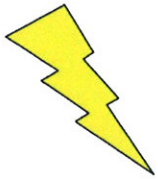
If the brain is damaged, it does not heal and repair itself.

Lack of oxygen in the brain for 5-10 minutes results in permanent brain damage.



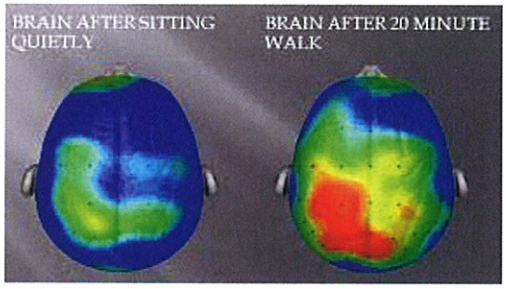
The brain is faster and more powerful than a supercomputer. In 2015, the 4th most powerful supercomputer in the world took 40 minutes to simulate just one second of human brain activity.

Your brain generates enough electricity to power a lightbulb.



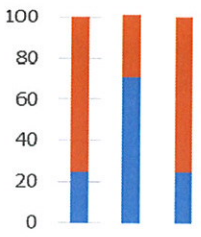
Neuron communication speed can be more than 250 miles per hour. This is a thousand times slower than lightning.

Exercise causes your body to produce a chemical that makes learning easier. So if you're stuck on a homework problem, go out and play a game of soccer, then try the problem again!



The brain is suspended in Cerebrospinal fluid, effectively floating in liquid that acts as both a cushion to physical impact and a barrier to infections.

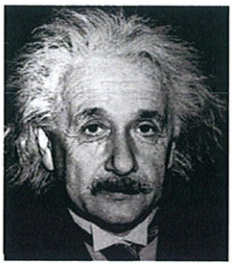
The brain cannot feel pain. Headaches are caused by pain felt in the outer covering of the brain (called meninges), blood vessels, and muscles of the head. The brain is responsible for the feeling of pain in every part of the body except itself.



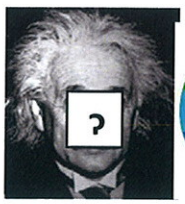
The brain is responsible for all thoughts, behaviors, emotions, memories, sensations, and bodily functions.

Your brain uses 25% of the total oxygen and 70% of the total glucose and 25% of the nutrients in your body. So breathe clean air and eat right!

The pathologist who conducted Einstein's autopsy stole his brain and kept it in a jar for 20 years.



Einstein's brain was smaller than the average adult brain... but the structure for math was larger.

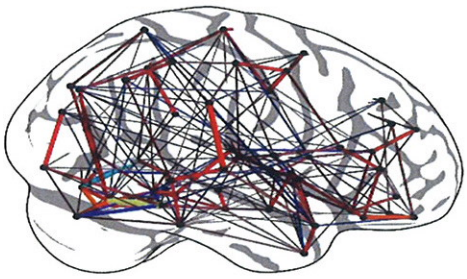


People with *prosopagnosia* cannot recognize familiar faces. People with *associative agnosia* cannot recognize objects. People with *akinetopsia* cannot see movement. People with *achromatopsia* cannot see colors.

Harvard University's Brain and Tissue Resource Centre is a brain bank where over 7,000 human brains are store for research purposes.

Drugs cause physical changes to the brain that over time, results in addiction. Addiction is a chronic disease of the brain.

Marijuana affects memory and thinking areas in the prefrontal cortex.



Brain cells are so interconnected that damage to a small area can affect many other areas and many behaviors.

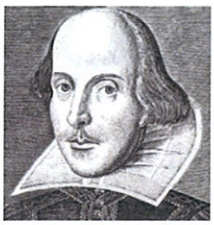
People use all of their brain, all of the time. NOT 10%. Even if it doesn't seem like it.

1 quadrillion is the estimated number of connections in the human brain.

Your neurons create and send more messages than all the phones in the entire world.

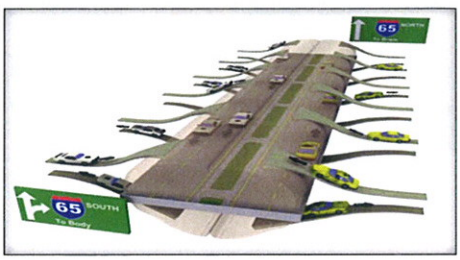
In most people, their first language is in the left hemisphere but their second language is lateralized to the right hemisphere.

Right handers are better at using their left and right hemispheres independently, but left handers are better at using the two sides together.



Different parts of the brain are activated when reading Shakespeare versus reading a textbook.

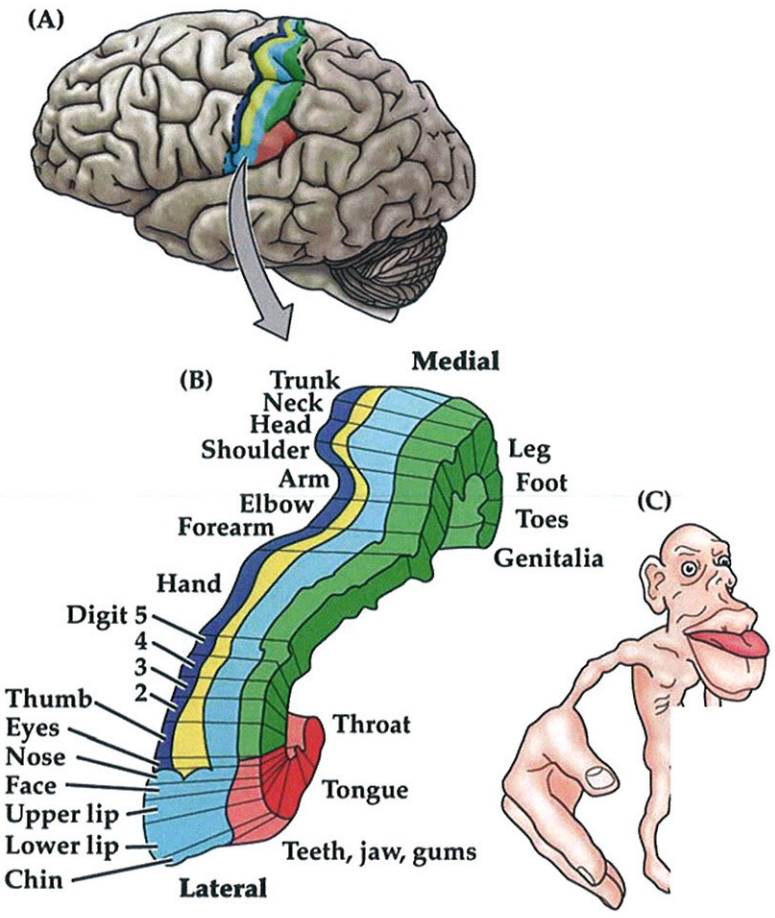
The spinal cord is like a super highway bringing massive amounts of information from the skin, muscles, and organs to the brain, and from the brain to the muscles and organs.



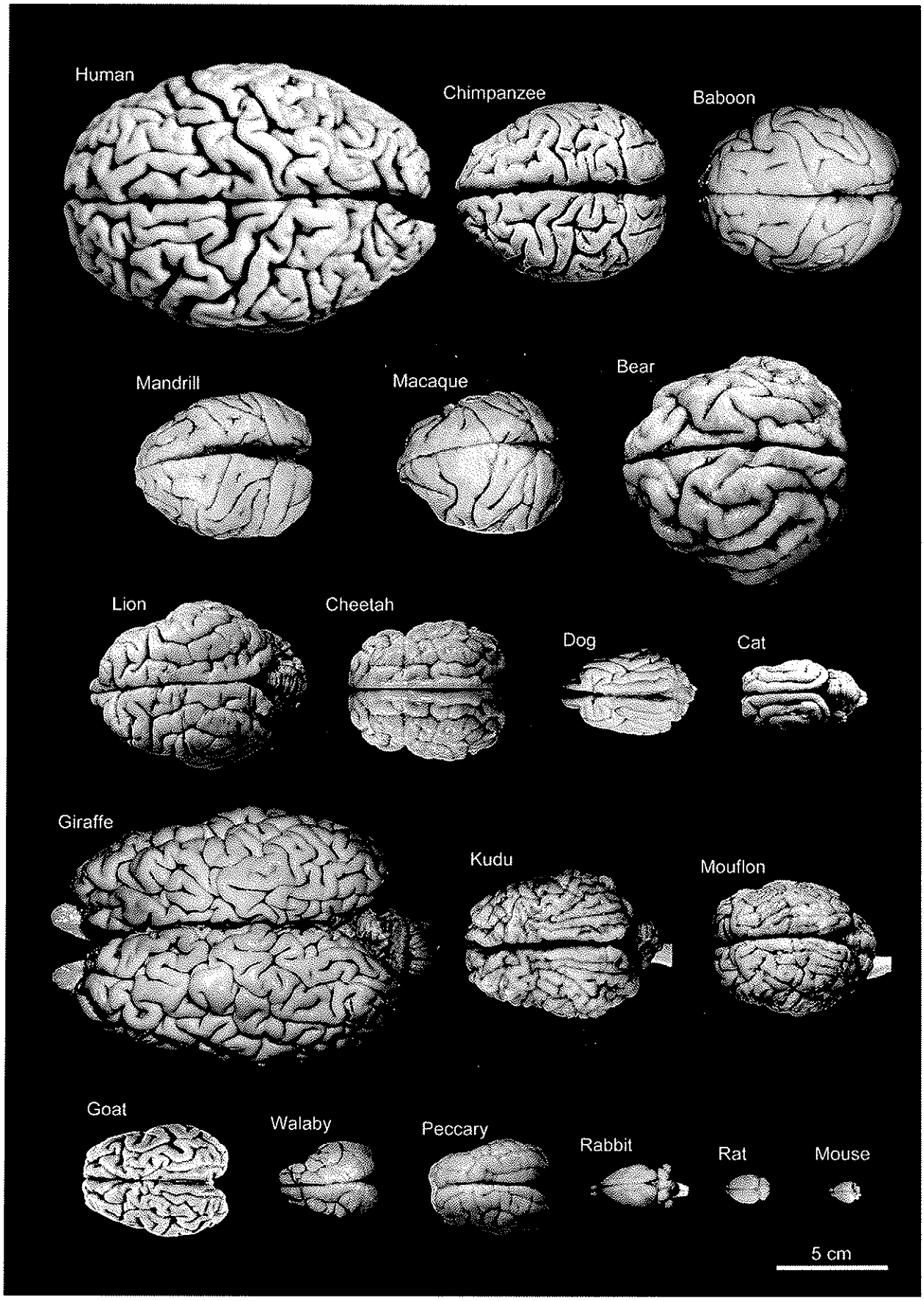
This is called a homunculus.

This is what your brain thinks YOU look like.

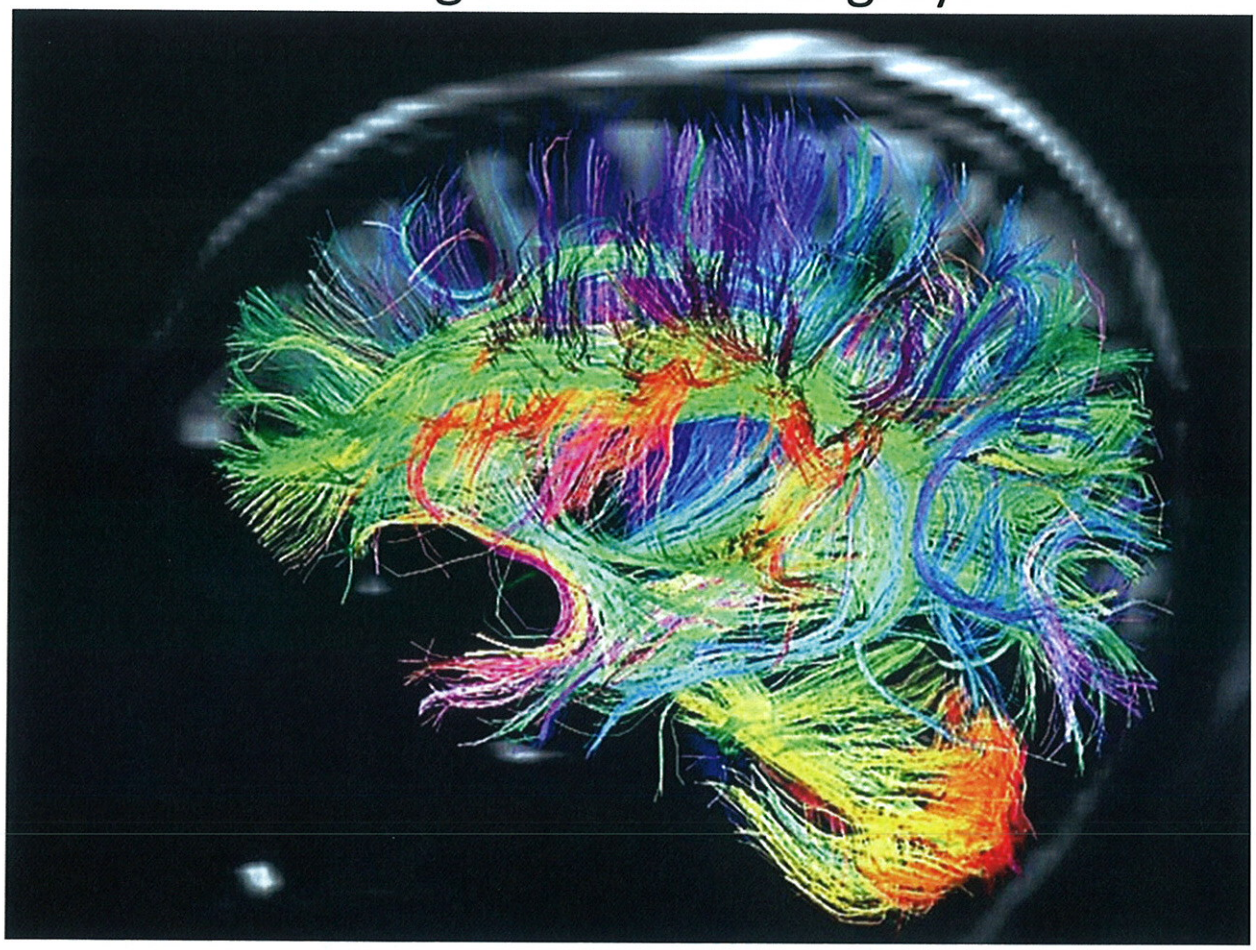
Because more space in the brain is dedicated to hands and face than any other body part.



NEUROSCIENCE 5e, Figure 9.11

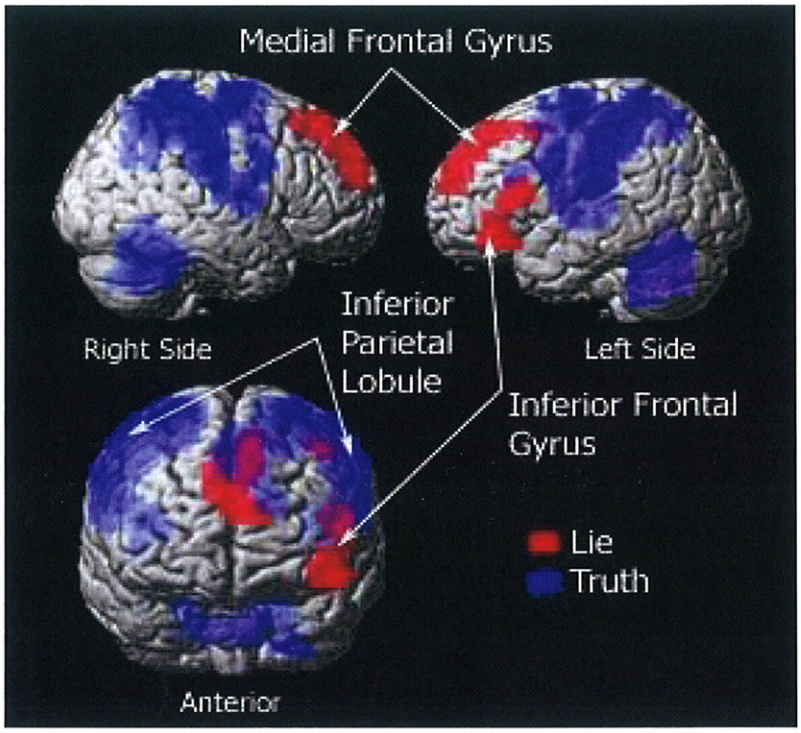

Human
Chimpanzee
Baboon
Mandrill
Macaque
Bear
Lion
Cheetah
Dog
Cat
Giraffe
Kudu
Mouflon
Goat
Walaby
Peccary
Rabbit
Rat
Mouse
5 cm

Scientists are using
<u>diffusion spectrum imaging</u> to map the connections between structures in the brain. Different colors represent directions. Even though your picture is not color, you can distinguish shades of gray.



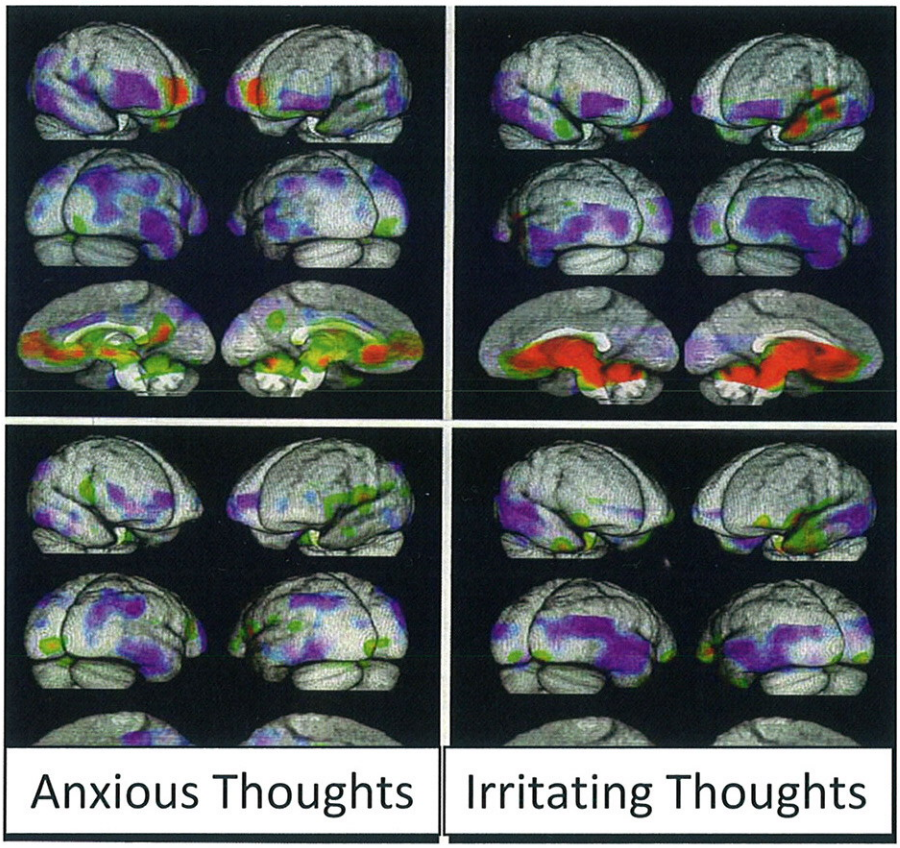
Brain disorders are due to connection problems. When connections are lost, structures cannot communicate.
This causes behavioral, physical, thought, and emotional disorders.

The future of lie detection?



Happy Thoughts

Sad Thoughts



Anxious Thoughts

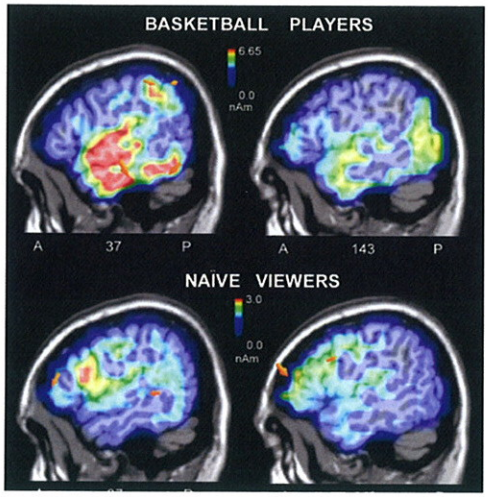
Irritating Thoughts

Emotions generates different patterns of brain activity.

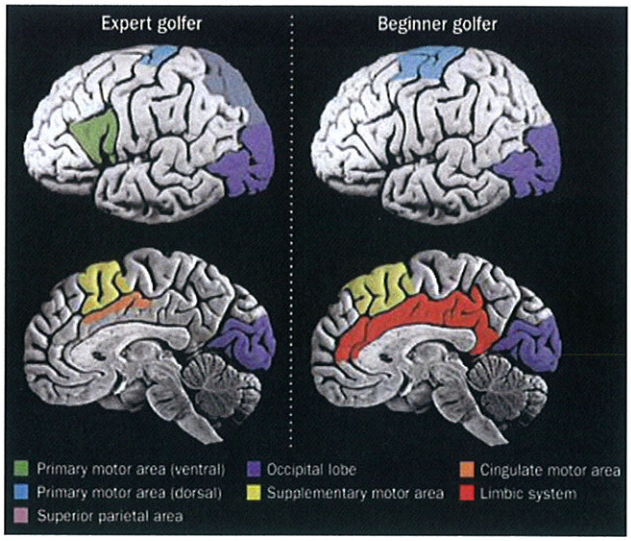
Learning really does change the brain!

These pictures show differences in activity between experts and non-experts.

In Sports…

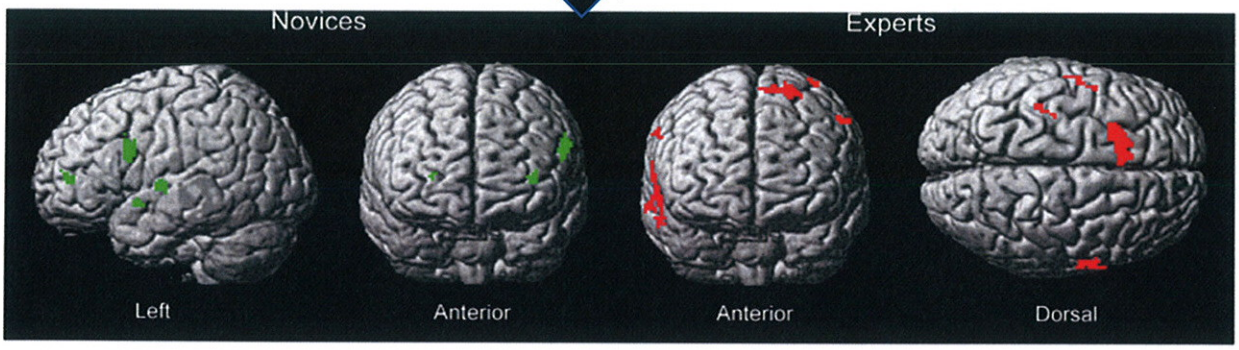


Basketball Players ←



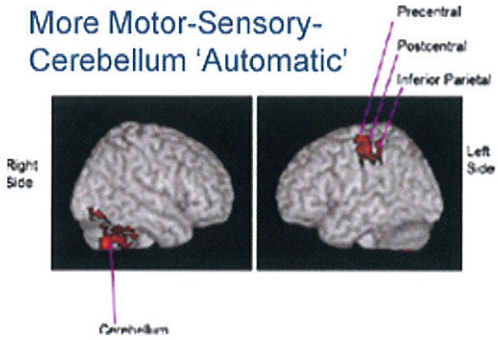
Golfers →

Hockey Players ↓

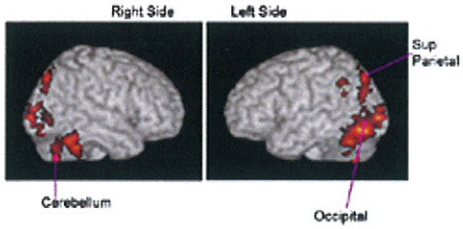


In School.....

More Motor-Sensory-Cerebellum 'Automatic'



Good Writers

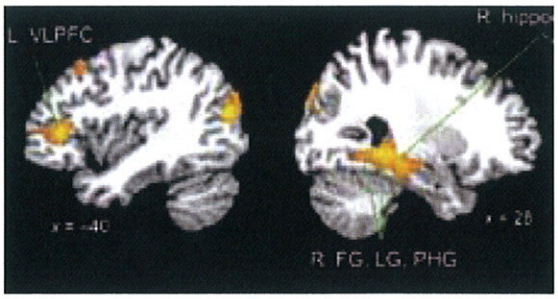


Poor Writers

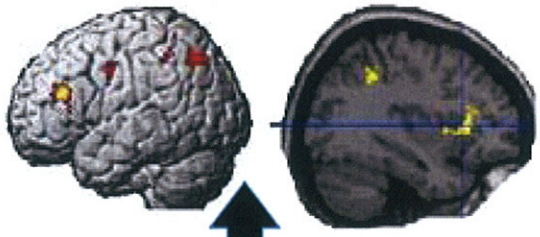
More Visual Monitoring

Writing

Basic Math Facts Retrieval

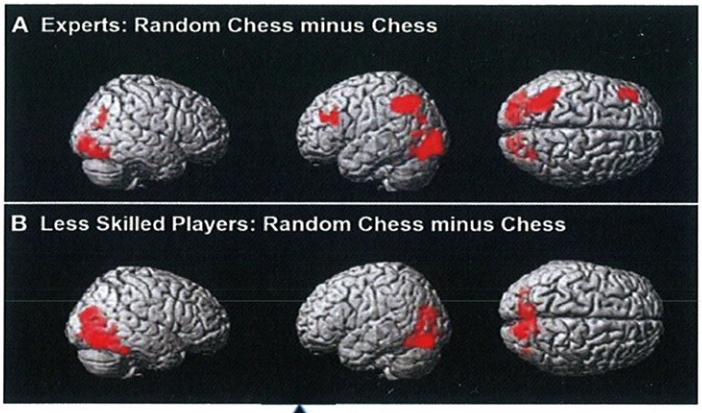


Algebra

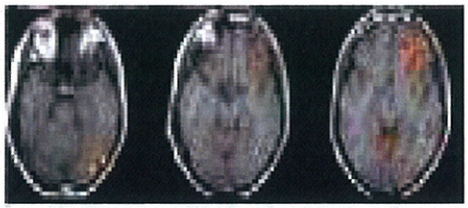


Math

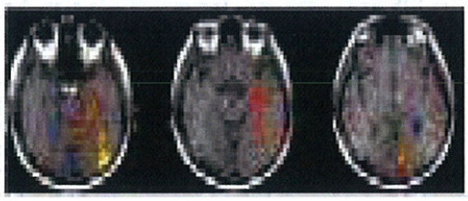
In Hobbies.....



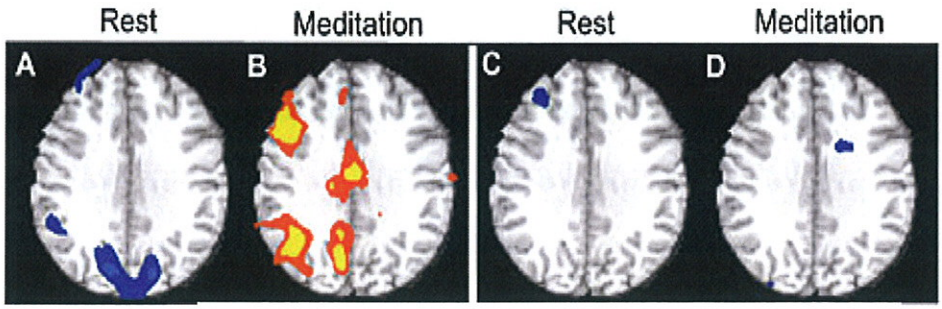
Chess Players



Artists

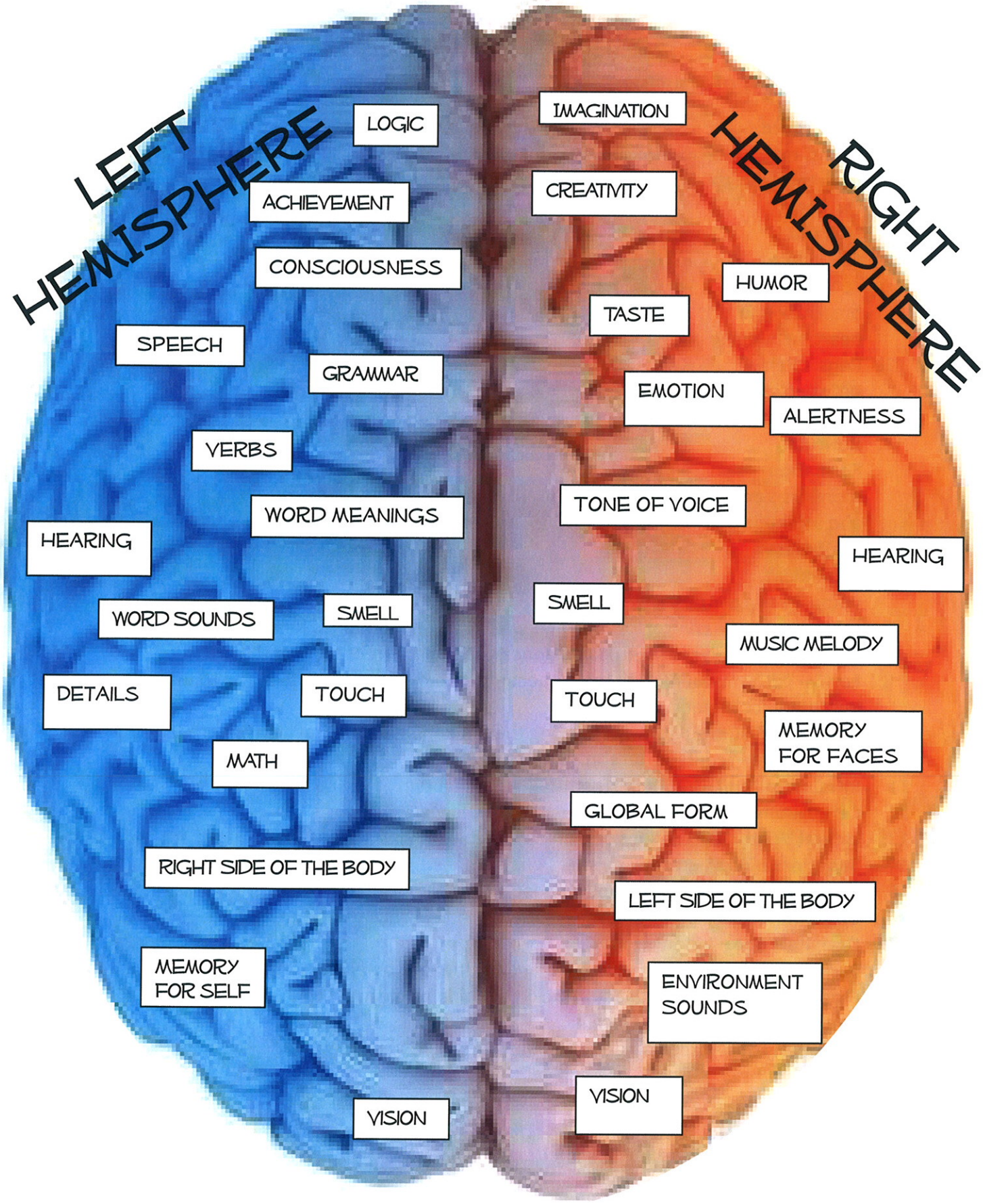


Non-Artists



Experts **Novices**

Two sides of the brain: Independence and Collaboration

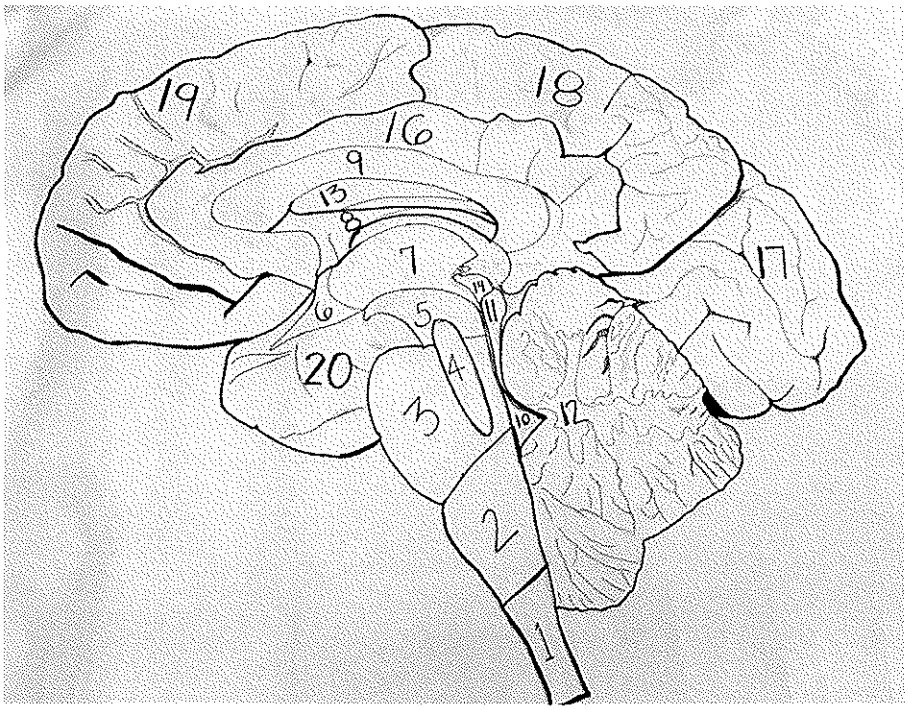


Brain By Numbers

Appreciate the many parts of the brain from three different views

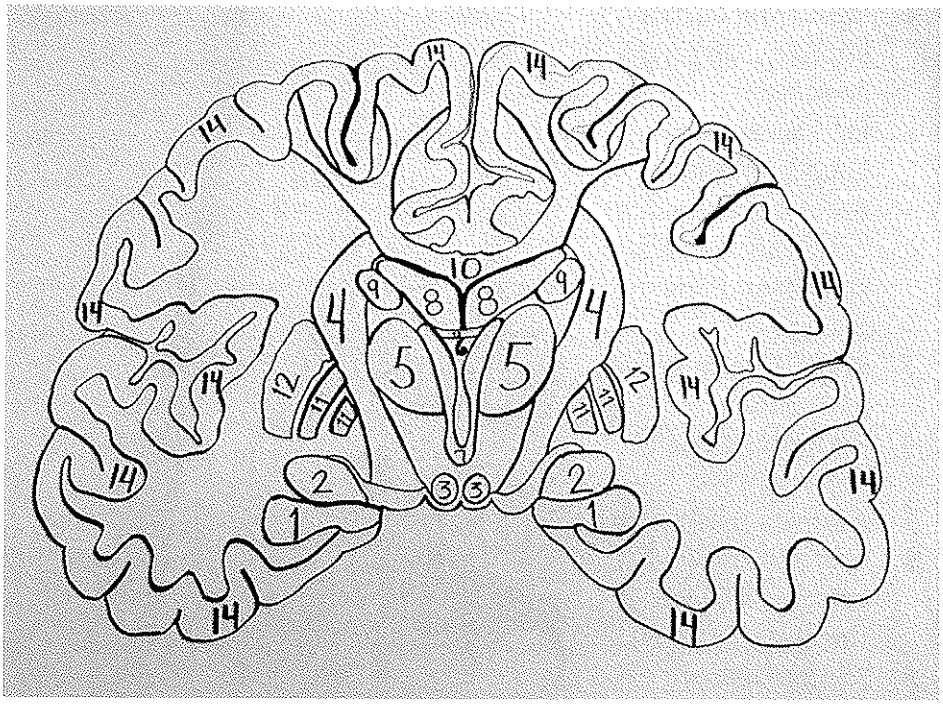
...and this is a short list!

Mid-Sagittal View of Structures



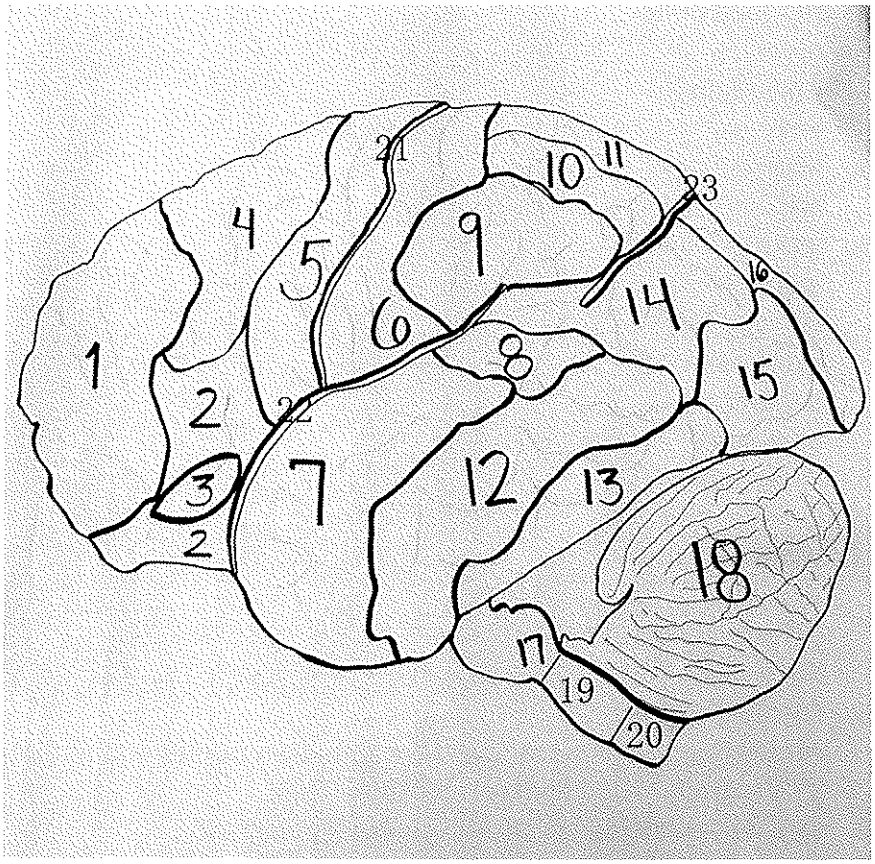
1. **Spinal Cord –** carries messages from the brain to the body
2. **Medulla Oblongata –** controls breathing and heart functioning
3. **Pons –** Relay between spinal cord and brain
4. **Reticular Formation –** monitors sleep and attention
5. **Midbrain –** movement, vision, hearing, arousal
6. **Hypothalamus –** control for food and water intake , hormones for stress response
7. **Thalamus –** receives and sends sensory signals to different parts of the brain
8. **Fornix**- pathway connecting the hippocampus to mammillary bodies and to thalamus important for memory and emotion.
9. **Corpus Callosum –** pathway of linking the left and right cerebral hemispheres
10. **4th Ventricle** – contains cerebrospinal fluid
11. **Inferior Colliculi –** auditory structure in the midbrain
12. **Cerebellum –** coordinates movement and balance
13. **Lateral Ventricle –** contains cerebrospinal fluid (CSF)
14. **Superior Colliculi –** receives visual signals
15. **Pineal Body –** a part of the body's sleep regulation system
16. **Cingulate Gyrus** - important for emotion, problem solving, and creativity
17. **Occipital Lobe –** vision
18. **Parietal Lobe –** sensory information and locations of body parts
19. **Frontal Lobe –**emotion, decision making, problem solving, speech, and memory, personality
20. **Temporal Lobe –**processing auditory information and hearing

Coronal View of Structures



1. **Hippocampus-** memory
2. **Amygdala-** emotion
3. **Mammillary Bodies**- memory
4. **Internal Capsule-** pathway connecting the frontal lobes to thalamus and brainstem
5. **Thalamus-** receives and sends sensory signals to different parts of the brain
6. **Fornix**- pathway connecting the hippocampus to mammillary bodies and to thalamus
7. **3rd Ventricle**- filled with cerebrospinal fluid
8. **Lateral Ventricles** - filled with cerebrospinal fluid
9. **Caudate Nucleus**-movement
10. **Corpus Callosum**- connects left and right sides of the cortex
11. **Globus Pallidus**-movement
12. **Putamen**- movement
13. **Anterior Commissure**- connects the left and right temporal lobes for pain, smell, memory, hearing, and emotion
14. **Cerebral Cortex**-all advanced processing including perception, memory, movement, emotion, thinking, language, reasoning, creativity.

Lateral View of Structures



1. **Prefrontal Cortex**- impulses, emotions, decisions
2. **Inferior Frontal Lobe**- contains Broca's area, and is important for self-control and risk taking.
3. **Broca's Area**- speech production
4. **Premotor Cortex**- important for planning movements
5. **Motor Cortex**- controls muscles of the body
6. **Somatosensory Cortex**-receives information about touch from the body.
7. **Superior Temporal Gyrus**- hearing, language
8. **Wernicke's Area**-part of superior temporal gyrus for language comprehension
9. **Inferior Parietal Gyrus**-language, math, emotion
10. **Medial Parietal Gyrus**-navigation, spatial locations
11. **Superior Parietal Gyrus**- hearing and language comprehension
12. **Medial Temporal Gyrus**- memory, word knowledge
13. **Inferior Temporal Gyrus-** face and object recognition
14. **Medial Occipital Lobe**-vision
15. **Inferior Occipital Lobe**-vision
16. **Superior Occipital Lobe**-vision
17. **Pons–** Relay between spinal cord and brain
18. **Cerebellum**- smooth, coordinated movements
19. **Medulla Oblongata** - controls breathing and heart functioning
20. **Spinal Cord**- pathway for sensory information from the body to the brain and motor commands from the brain to the body.
21. **Central Sulcus**- groove between the frontal lobe and the parietal lobe
22. **Lateral Sulcus**-groove between the temporal and frontal lobes
23. **Parietal-occipital Sulcus**- groove between the parietal lobe and occipital lobe

ABC's of Neuron Disease

A neurology who-done-it game

In the following four pages you will find cases of individuals with one of the following disorders:

Multiple Sclerosis
Alzheimer's Disease
ALS
Parkinsons's Disease

Use the information in the case and place a check mark next to the causes (antecedents), behaviors, and clinical treatments in the table that appears immediately below each case.

Once you've figured out the ABC's, check your answers to determine whether you can properly diagnose the disease.
The answers appear after the cases.

Tiffany, 54, comes to your office complaining of stiff muscles and weakness that started in her hands but is now also in her legs. She says her hands feel clumsy and she has difficulty with activities like buttoning a shirt or using a key. She also noticed some difficulty chewing. During her physical examination she seems alert and aware, showing no mental problems. However, you notice her speech is a little slurry and she has trouble getting up and standing even though she clearly understands the commands to do so. Her muscles also seem to have less mass than is normal. What is her diagnosis, Doctor?

Antecedents **What are causes?**	**Behaviors** **What are symptoms?**	**Clinical** **What are treatments?**	**Diagnosis** **What is the disease?**
☐ Dopamine is an important brain chemical in structures of the brain for movement. ☐ Frontal lobe is important for personality, attention, and logical reasoning ☐ If too many neurons die, brain mass decreases which can cause severe memory, reasoning, and personality problems ☐ Loss of myelin (insulation of axons) in the brain and spinal cord causes weakness, numbness or pain, and vision problems ☐ Motor neurons in the brain and spinal cord control muscles for movement. ☐ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking) ☐ Poor communication from the brain to muscles can cause muscle stiffness, tremors, or spasms ☐ Basal Ganglia structures are important for starting movements and for coordinating the right set of body parts for a movement. ☐ When the body thinks myelin (axon insulation) is a foreign substance, it destroys and replaces the myelin with scar tissue.	☐ Blurry and double vision ☐ Difficulty chewing ☐ Difficulty speaking ☐ Difficulty with automatic movements like smiling, blinking, arm movements ☐ Difficulty understanding language ☐ Forgetfulness ☐ Loss of muscle mass ☐ Muscle spasms ☐ Muscle stiffness ☐ Personality changes: aggression & anger ☐ Problems moving ☐ Problems forming new memories ☐ Shuffling walk with loss of arm swing ☐ Extreme fatigue ☐ Symptoms may come and go ☐ Tremors in hands ☐ Trouble using hands for tasks ☐ Trouble thinking through daily activities ☐ Weakness in arms and legs	☐ **Baclofen** is a drug used to relax muscles and control spasms ☐ **Cholinesterase inhibitors** are drugs used to increase communication between cells ☐ **Corticosteroids** reduce inflammation that occurs from damage to neurons and can slow disease progression ☐ **Levodopa** is a drug that replaces dopamine in the brain ☐ **MAO-B Inhibitors** prolong the effects of dopamine ☐ **Memantine** is a drug that is used to slow neuron death in the brain and increase thinking and memory processes ☐ **Physical therapy** to increase blood circulation to slow muscle loss that occurs from disuse ☐ **Riluzole** is a drug that slows damage to motor neurons and muscle spasms	☐ Alzheimer's Disease ☐ ALS (Amyotrophic Lateral Sclerosis) ☐ MS (Multiple Sclerosis ☐ Parkinson's Disease

Barbara, 37, has experienced sudden problems over the past 2 days. She has blurry and double vision and weakness in her right leg and trouble walking. She also said that she has experienced these things a few times before but then they just went away. She also experiences numbness, and muscle stiffness and spasms in her arms and legs. Her body always feels so tired. Mentally, she mostly feels fine but sometimes finds herself having trouble finding the right words or that she can't think quickly enough to keep up with conversations and completing tasks at work. What is Barbara's diagnosis, Doctor?

Antecedents **What are causes?**	**Behaviors** **What are symptoms?**	**Clinical** **What are treatments?**	**Diagnosis** **What is the disease?**
☐ Dopamine is an important brain chemical in structures of the brain for movement. ☐ Frontal lobe is important for personality, attention, and logical reasoning ☐ If too many neurons die, brain mass decreases which can cause severe memory, reasoning, and personality problems ☐ Loss of myelin (insulation of axons) in the brain and spinal cord causes weakness, numbness or pain, and vision problems ☐ Motor neurons in the brain and spinal cord control muscles for movement. ☐ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking) ☐ Poor communication from the brain to muscles can cause muscle stiffness, tremors, or spasms ☐ Basal Ganglia structures are important for starting movements and for coordinating the right set of body parts for a movement. ☐ When the body thinks myelin (axon insulation) is a foreign substance, it destroys and replaces the myelin with scar tissue.	☐ Blurry and double vision ☐ Difficulty chewing ☐ Difficulty speaking ☐ Difficulty with automatic movements like smiling, blinking, arm movements ☐ Difficulty understanding language ☐ Forgetfulness ☐ Loss of muscle mass ☐ Muscle spasms ☐ Muscle stiffness ☐ Personality changes: aggression & anger ☐ Problems moving ☐ Problems forming new memories ☐ Shuffling walk with loss of arm swing ☐ Extreme fatigue ☐ Symptoms may come and go ☐ Tremors in hands ☐ Trouble using hands for tasks ☐ Trouble thinking through daily activities ☐ Weakness in arms and legs	☐ **Baclofen** is a drug used to relax muscles and control spasms ☐ **Cholinesterase inhibitors** are drugs used to increase communication between cells ☐ **Corticosteroids** reduce inflammation that occurs from damage to neurons and can slow disease progression ☐ **Levodopa** is a drug that replaces dopamine in the brain ☐ **MAO-B Inhibitors** prolong the effects of dopamine ☐ **Memantine** is a drug that is used to slow neuron death in the brain and increase thinking and memory processes ☐ **Physical therapy** to increase blood circulation to slow muscle loss that occurs from disuse ☐ **Riluzole** is a drug that slows damage to motor neurons and muscle spasms	☐ Alzheimer's Disease ☐ ALS (Amyotrophic Lateral Sclerosis) ☐ MS (Multiple Sclerosis ☐ Parkinson's Disease

68 year old Dominick comes to your neurology clinic for increasing episodes of forgetfulness. His sister, Regina, tells you that over the last several years Dominick has had difficulties remembering conversations, appointments, where he places his belongings and his friends' names. Also, a few times he got lost in his own neighborhood where he has lived for the past 20 years and seems confused when doing everyday tasks, like dressing. His personality has become aggressive and he has trouble speaking where he seems unable to find the right words. What is Dominick's diagnosis, Doctor?

Antecedents **What are causes?**	**Behaviors** **What are symptoms?**	**Clinical** **What are treatments?**	**Diagnosis** **What is the disease?**
☐ Dopamine is an important brain chemical in structures of the brain for movement. ☐ Frontal lobe is important for personality, attention, and logical reasoning ☐ If too many neurons die, brain mass decreases which can cause severe memory, reasoning, and personality problems ☐ Loss of myelin (insulation of axons) in the brain and spinal cord can cause weakness, numbness or pain, and vision problems ☐ Motor neurons in the brain and spinal cord control muscles for movement. ☐ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking) ☐ Poor communication from the brain to muscles can cause muscle stiffness, tremors, or spasms ☐ Structures in the brain called the basal ganglia are important for starting movements and for coordinating body parts for a movement. ☐ When the body thinks myelin (axon insulation) is a foreign substance, it destroys and replaces the myelin with scar tissue.	☐ Blurry and double vision ☐ Difficulty speaking ☐ Difficulty smiling & blinking ☐ Difficulty understanding language ☐ Forgetfulness ☐ Muscle atrophy ☐ Muscle spasms ☐ Muscle stiffness ☐ Personality changes: aggression & anger ☐ Problems forming new memories ☐ Shuffling walk with loss of arm swing ☐ Slowed thinking and extreme fatigue ☐ Symptoms may come and go ☐ Tremors in hands ☐ Trouble using hands for tasks ☐ Trouble thinking through daily activities ☐ Weakness in arms and legs	☐ **Baclofen** is a drug used to relax muscles and control spasms ☐ **Cholinesterase inhibitors** are drugs used to increase communication between cells ☐ **Corticosteroids** reduce inflammation that occurs from damage to neurons and can slow disease progression ☐ **Levodopa** is a drug that replaces dopamine in the brain ☐ **MAO-B Inhibitors** prolong the effects of dopamine ☐ **Memantine** is a drug that is used to slow neuron death in the brain and increase thinking and memory processes ☐ **Physical therapy** to increase blood circulation to slow muscle atrophy that occurs from disuse ☐ **Riluzole** is a drug that slows damage to motor neurons and muscle spasms	☐ Alzheimer's Disease ☐ ALS (Amyotrophic Lateral Sclerosis) ☐ MS (Multiple Sclerosis ☐ Parkinson's Disease

Edgar, 62, has been complaining of shaky hands. His wife noticed the problem a year ago when he had trouble signing his name. He has had trouble keeping up with her on walks and she says that he shuffles like a penguin. During examination, you observe slow and stiff shuffling when walking with lack of arm swing. You also notice that Edgar sometimes slurs his words. Over the next few months Edgar develops difficulty smiling and blinking but has no mental or emotional problems. What is Edgar's diagnosis, Doctor?

Antecedents **What are causes?**	**Behaviors** **What are symptoms?**	**Clinical** **What are treatments?**	**Diagnosis** **What is the disease?**
☐ Dopamine is an important brain chemical in structures of the brain for movement. ☐ Frontal lobe is important for personality, attention, and logical reasoning ☐ If too many neurons die, brain mass decreases which can cause severe memory, reasoning, and personality problems ☐ Loss of myelin (insulation of axons) in the brain and spinal cord causes weakness, numbness or pain, and vision problems ☐ Motor neurons in the brain and spinal cord control muscles for movement. ☐ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking) ☐ Poor communication from the brain to muscles can cause muscle stiffness, tremors, or spasms ☐ Basal Ganglia structures are important for starting movements and for coordinating the right set of body parts for a movement. ☐ When the body thinks myelin (axon insulation) is a foreign substance, it destroys and replaces the myelin with scar tissue.	☐ Blurry and double vision ☐ Difficulty chewing ☐ Difficulty speaking ☐ Difficulty with automatic movements like smiling, blinking, arm movements ☐ Difficulty understanding language ☐ Forgetfulness ☐ Loss of muscle mass ☐ Muscle spasms ☐ Muscle stiffness ☐ Personality changes: aggression & anger ☐ Problems moving ☐ Problems forming new memories ☐ Shuffling walk with loss of arm swing ☐ Extreme fatigue ☐ Symptoms may come and go ☐ Tremors in hands ☐ Trouble using hands for tasks ☐ Trouble thinking through daily activities ☐ Weakness in arms and legs	☐ **Baclofen** is a drug used to relax muscles and control spasms ☐ **Cholinesterase inhibitors** are drugs used to increase communication between cells ☐ **Corticosteroids** reduce inflammation that occurs from damage to neurons and can slow disease progression ☐ **Levodopa** is a drug that replaces dopamine in the brain ☐ **MAO-B Inhibitors** prolong the effects of dopamine ☐ **Memantine** is a drug that is used to slow neuron death in the brain and increase thinking and memory processes ☐ **Physical therapy** to increase blood circulation to slow muscle loss that occurs from disuse ☐ **Riluzole** is a drug that slows damage to motor neurons and muscle spasms	☐ Alzheimer's Disease ☐ ALS (Amyotrophic Lateral Sclerosis) ☐ MS (Multiple Sclerosis ☐ Parkinson's Disease

Tiffany

Antecedents
What are causes?

- ✓ Motor neurons in the brain and spinal cord control muscles for movement.
- ✓ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking)
- ✓ Poor communication from the brain to muscles can cause muscle stiffness, tremors, or spasms

Behaviors
What are symptoms?

- ✓ Difficulty chewing
- ✓ Difficulty speaking
- ✓ Loss of muscle mass
- ✓ Muscle spasms
- ✓ Muscle stiffness
- ✓ Problems moving
- ✓ Trouble using hands for tasks
- ✓ Weakness in arms and legs

Clinical
What are treatments?

- ✓ **Baclofen** is a drug used to relax muscles and control spasms
- ✓ **Physical therapy** to increase blood circulation to slow muscle loss that occurs from disuse
- ✓ **Riluzole** is a drug that slows damage to motor neurons and muscle spasms

Diagnosis
What is the disease?

✓ ALS Amyotrophic Lateral Sclerosis

Barbara

Antecedents
What are causes?

- ✓ Loss of myelin (insulation of axons) in the brain and spinal cord causes weakness, numbness or pain, and vision problems
- ✓ Motor neurons in the brain and spinal cord control muscles for movement.
- ✓ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking)
- ✓ Poor communication from the brain to muscles can cause muscle stiffness, tremors, or spasms
- ✓ When the body thinks myelin (axon insulation) is a foreign substance, it destroys and replaces the myelin with scar tissue.

Behaviors
What are symptoms?

- ✓ Blurry and double vision
- ✓ Muscle spasms
- ✓ Muscle stiffness
- ✓ Problems moving
- ✓ Extreme fatigue
- ✓ Symptoms may come and go
- ✓ Trouble using hands for tasks
- ✓ Trouble thinking through daily activities
- ✓ Weakness in arms and legs

Clinical
What are treatments?

- ✓ **Baclofen** is a drug used to relax muscles and control spasms
- ✓ **Corticosteroids** reduce inflammation that occurs from damage to neurons and can slow disease progression
- ✓ **Physical therapy** to increase blood circulation to slow muscle loss that occurs from disuse

Diagnosis
What is the disease?

✓ MS (Multiple Sclerosis)

Dominick

Antecedents
What are causes?

- ☐ Frontal lobe is important for personality, attention, and logical reasoning
- ☐ If too many neurons die, brain mass decreases which can cause severe memory, reasoning, and personality problems
- ☐ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking)

Behaviors
What are symptoms?

- ☐ Difficulty speaking
- ☐ Forgetfulness
- ☐ Personality changes: aggression & anger
- ☐ Problems forming new memories
- ☐ Trouble thinking through daily activities

Clinical
What are treatments?

- ☐ **Cholinesterase inhibitors** are drugs used to increase communication between cells
- ☐ **Memantine** is a drug that is used to slow neuron death in the brain and increase thinking and memory processes

Diagnosis
What is the disease?

- ☐ Alzheimer's Disease

Edgar

Antecedents
What are causes?

- ✓ Dopamine is an important brain chemical in structures of the brain for movement.
- ✓ Motor neurons in the brain and spinal cord control muscles for movement.
- ✓ Good communication between neurons is important for movement, sensory (vision, hearing, touch) and mental processes (memory, emotion, thinking)
- ✓ Poor communication from the brain to muscles can cause muscle stiffness, tremors, or spasms
- ✓ Basal Ganglia structures are important for starting movements and for coordinating the right set of body parts for a movement.

Behaviors
What are symptoms?

- ✓ Difficulty speaking
- ✓ Difficulty with automatic movements like smiling, blinking, arm movements
- ✓ Muscle spasms
- ✓ Muscle stiffness
- ✓ Problems moving
- ✓ Shuffling walk with loss of arm swing
- ✓ Tremors in hands
- ✓ Trouble using hands for tasks

Clinical
What are treatments?

- ✓ **Levodopa** is a drug that replaces dopamine in the brain
- ✓ **MAO-B Inhibitors** prolong the effects of dopamine in the brain

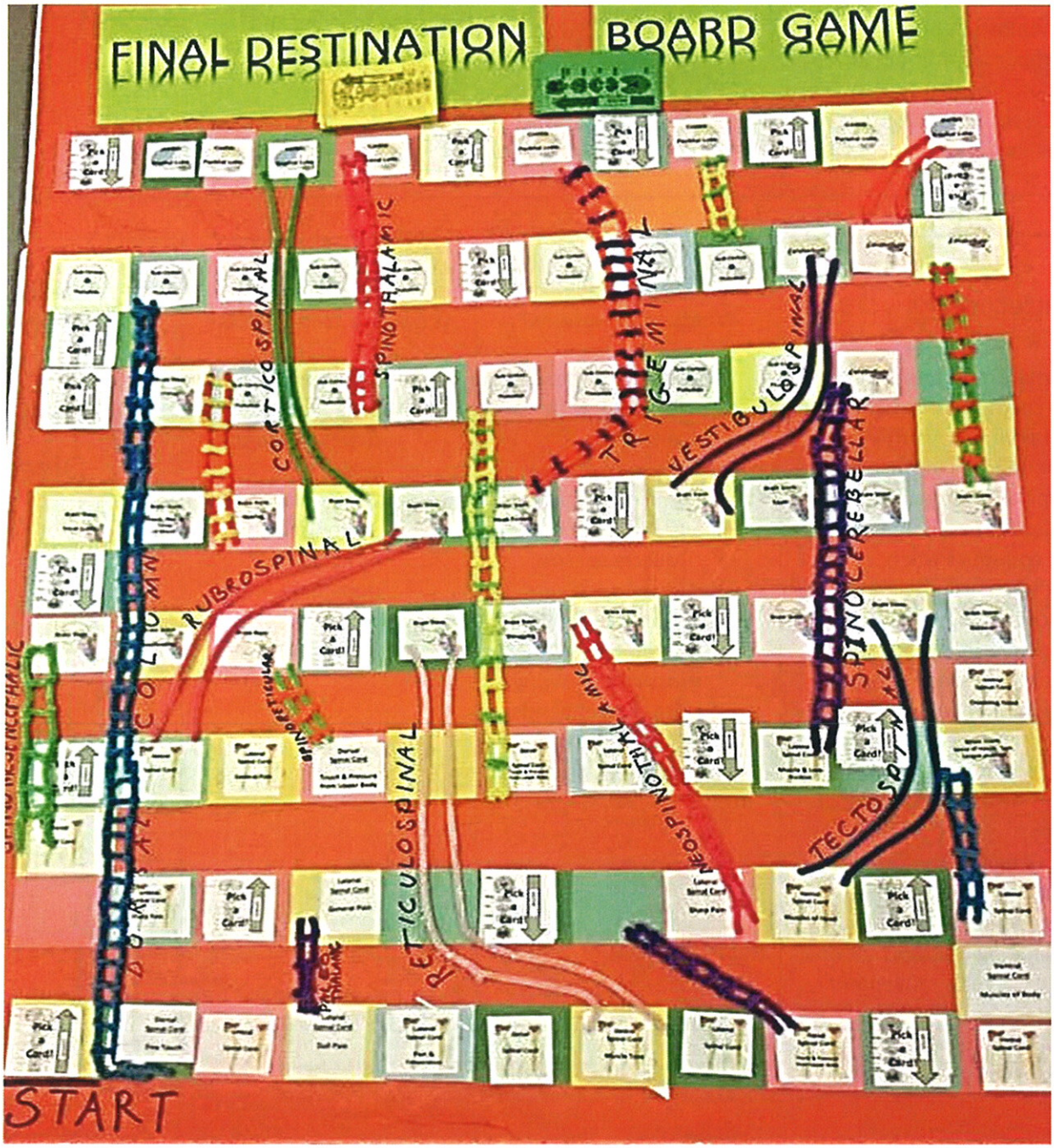
Diagnosis
What is the disease?

- ✓ Parkinson's Disease

Sensory-Motor Chutes & Ladders

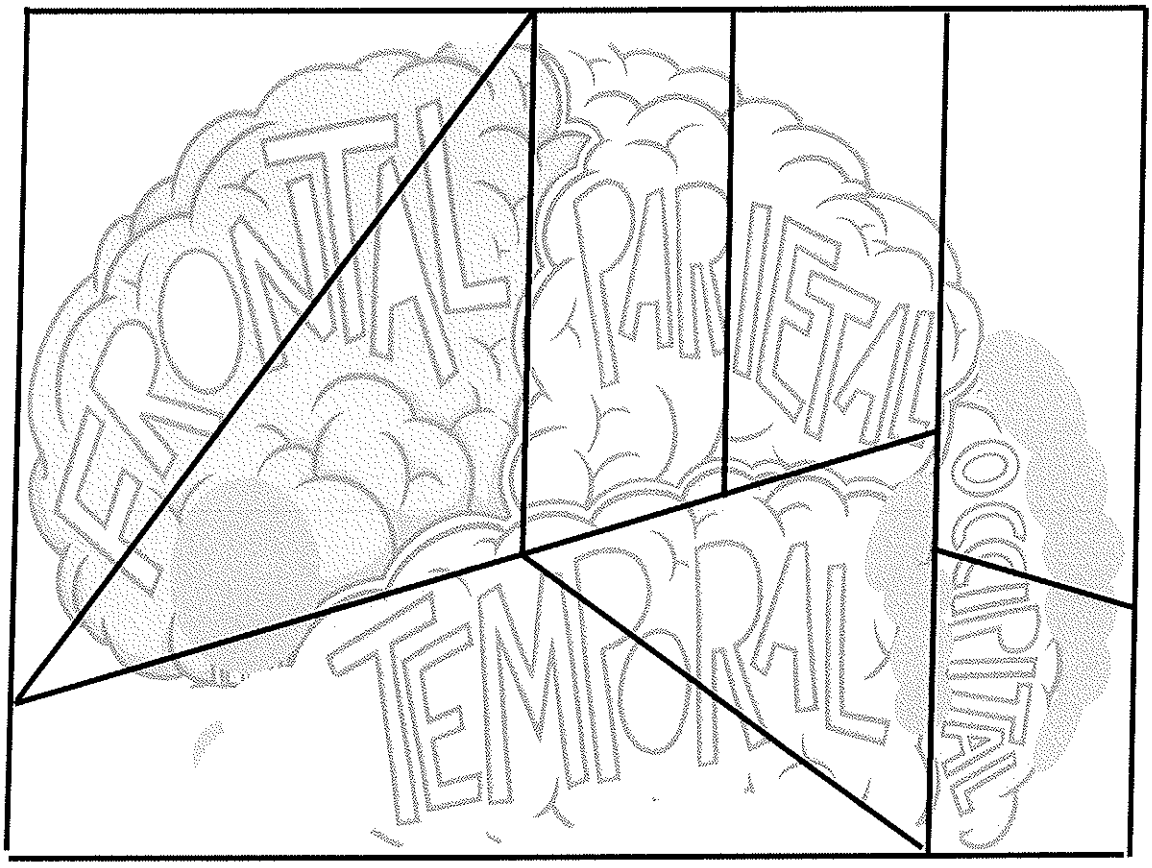
This board game teaches the concepts of ascending (moving up the spinal cord toward the brain) and descending (moving down the spinal cord, away from the brain) pathways for sensory and motor (movement) information. It also teaches the main parts of the nervous system that are involved in different stages of processing information to and from the brain.

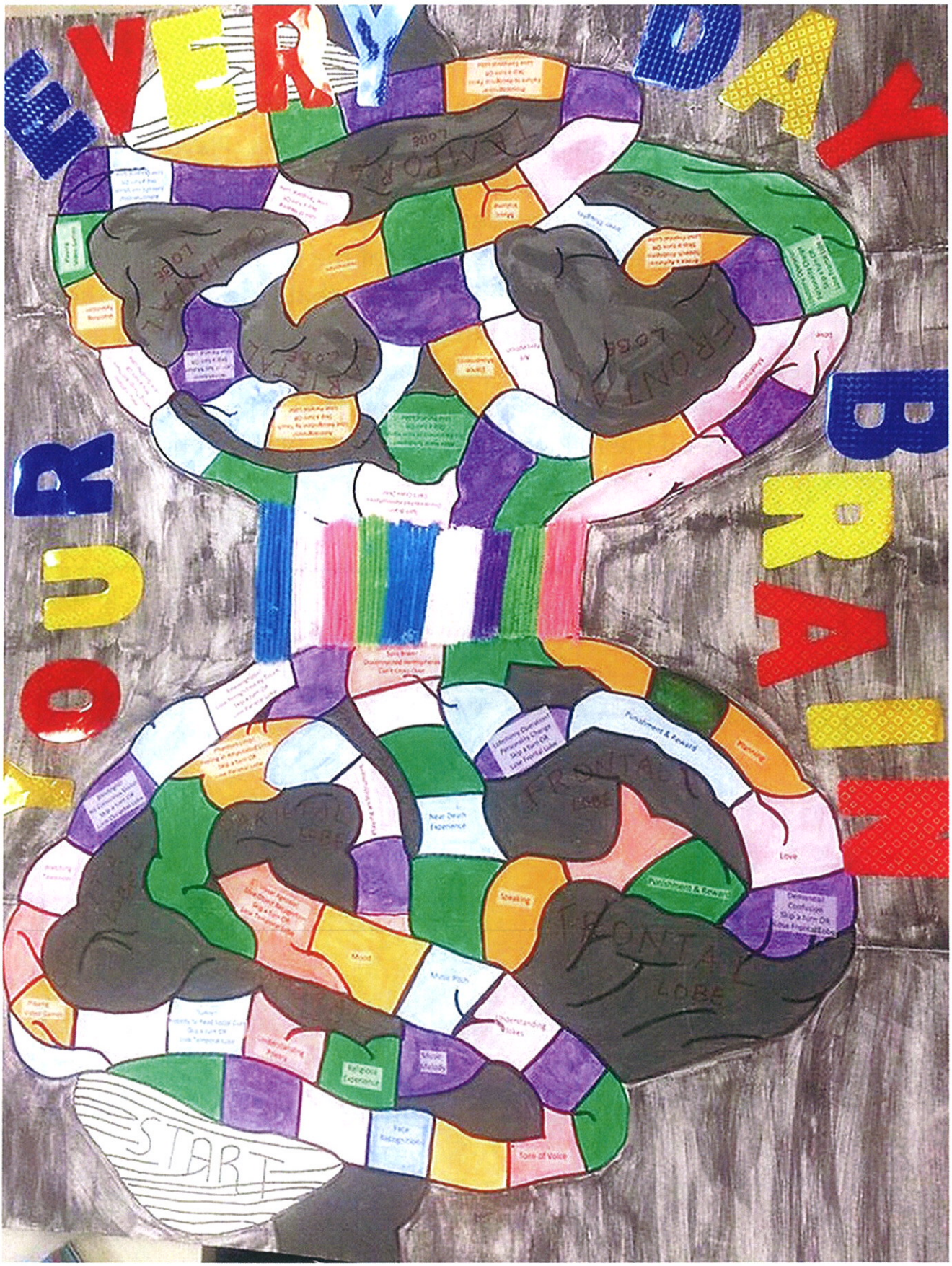
Players can land on a sensory space with a ladder, a motor space with a chute, or pick a card. Cards provide a scenario and tell players to find ladders and chutes based on the pathway names or location in the processing pathway. The game board we created appears below. You can play it at home, you just need some tiny playing pieces.



Your Everyday Brain

In this board game, players learn about regions in the brain for normal functioning and some very unusual disorders. Players move around the board, taking any pathway and can cross the corpus collosum to the other side, if so desired. If they land on a behavior, the can pick up the puzzle piece for that lobe of the brain. If a player lands on a disorder, they return a puzzle pieces for that lobe or lose a turn. The first to complete their brain puzzle wins and glues their puzzle pieces below. Remaining players play until there is only one player left. The last player gets the remaining pieces needed. The game board we created appears on the following page. You can play it at home, you just need some tiny playing pieces.




EVERY DAY
YOUR BRAIN
FRONTAL LOBE
START
Punishment & Reward
Near Death Experience
Love
Speaking
Mood
Mood Pitch
Religious Experience
Tone of Voice

Want to learn more?

Check Out These Websites!

3-D Brain online. http://www.g2conline.org/2022.
Also available as app for Apple and Android.

Inside the Teenage Brain.
http://www.pbs.org/wgbh/pages/frontline/shows/teenbrain/

"Fun Brain Facts for Kids - Interesting Facts about the Human Brain." Fun Brain Facts for Kids - Interesting Facts about the Human Brain. Science Kids, n.d.

Neuroscience for Kids, https://faculty.washington.edu/chudler/introb.html

Drugs, Brains, and Behavior: The Science of Addiction.
http://www.drugabuse.gov/publications/drugs-brains-behavior-science-addiction/drugs-brain.

Neuroscience. https://www.psychologytoday.com/basics/neuroscience.

Your Amazing Brain http://kids.nationalgeographic.com/explore/science/your-amazing-brain/

Brain Games are Bogus http://www.newyorker.com/tech/elements/brain-games-are-bogus

Teen Health http://kidshealth.org/teen/index.jsp?tracking=T_Home

Effects of drug abuse http://teens.drugabuse.gov/educators/nida-teaching-guides/mind-over-matter/teachers-guide/effects-drugs-abuse-brain

Vsauce
What can you do without a brain
https://www.youtube.com/watch?v=3teflb1QNN4
What's Left https://www.youtube.com/watch?v=DU3OdTLuHf0
Brain Stuff https://www.youtube.com/playlist?list=PL234AA06B9CC29BD3