Biological Bases of Behavior: The Brain

Chapter 3

AP Psychology

Neuroscience:Chapter Objectives:

- **By the end of this chapter, I will be able to:**

- **Identify basic processes and systems in the biological bases of behavior, including parts of the neuron and the process of transmission of a signal between neurons.**
- **Discuss the influence of drugs on neurotransmitters (e.g., reuptake mechanisms).**
- **Discuss the effect of the endocrine system on behavior.**
- **Describe the nervous system and its subdivisions and functions:**

— central and peripheral nervous systems;

— major brain regions, lobes, and cortical areas;

— brain lateralization and hemispheric specialization.

- **Recount historic and contemporary research strategies and technologies that support research (e.g., case studies, split-brain research, imaging techniques).**
- **Discuss psychology's abiding interest in how heredity, environment, and evolution work together to shape behavior.**
- **Predict how traits and behavior can be selected for their adaptive value.**
- **Identify key contributors (e.g., Paul Broca, Charles Darwin, Michael Gazzaniga, Roger Sperry, Carl Wernicke).**

Lesson One: Objectives

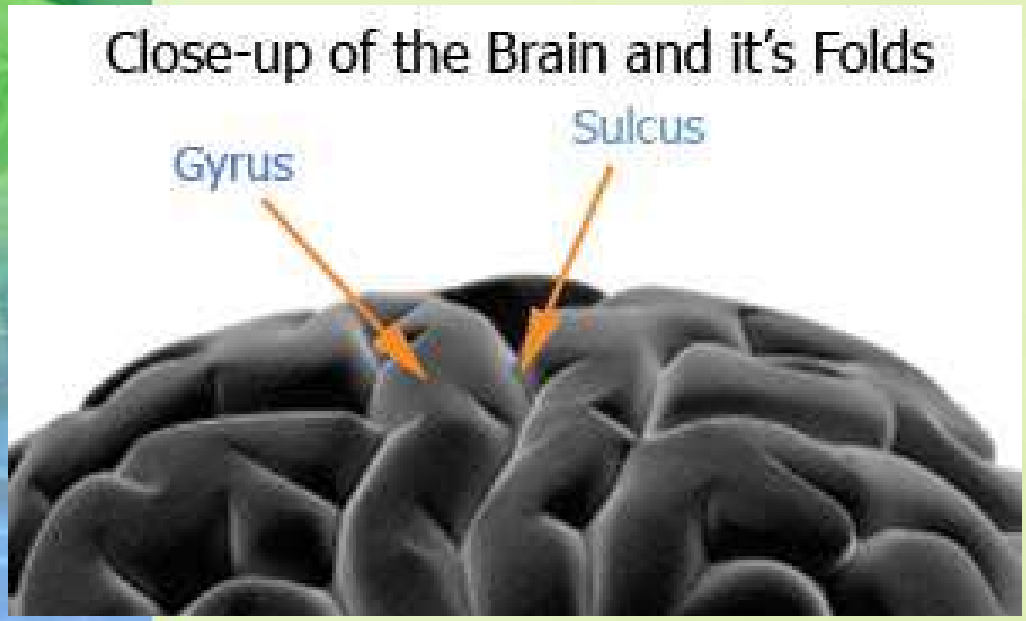
- **By the end of this lesson, I will be able to:**
- **1. Identify key contributors to brain research both historical and present day.**
- **2. Recount historic and contemporary research strategies and technologies that support research (e.g., case studies, split-brain research, imaging techniques).**

Introduction:

- **The mature brain weighs about 3 lbs and contains about 1 trillion cells.**
- **It has the consistency of firm Jell-O.**
- **Your brain is fueled by sugar (glucose).**
- **This is why when you are hungry, you may have trouble thinking (your blood glucose levels are low).**

Your brain doesn't look like this inside!

The Brain:

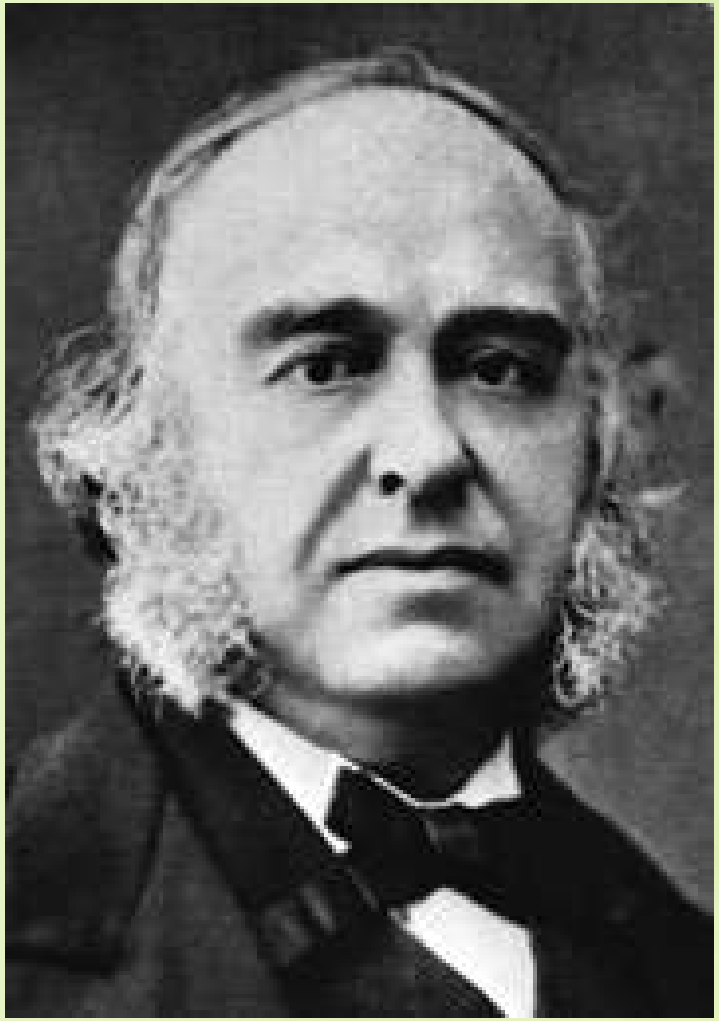


- **<u>Gyri</u> – Peaks of your brain**
- **<u>Sulci</u> – Valleys of your brain**
- **Deeper valleys are called fissures**

Techniques to learn about brain and neural functioning:

- **The brain has only been studied for about 150 yrs.**
- **Phineas Gage (1848) was one of the first case studies**
- **The relationship between the frontal lobe and emotion began here.**

Broca's Area:

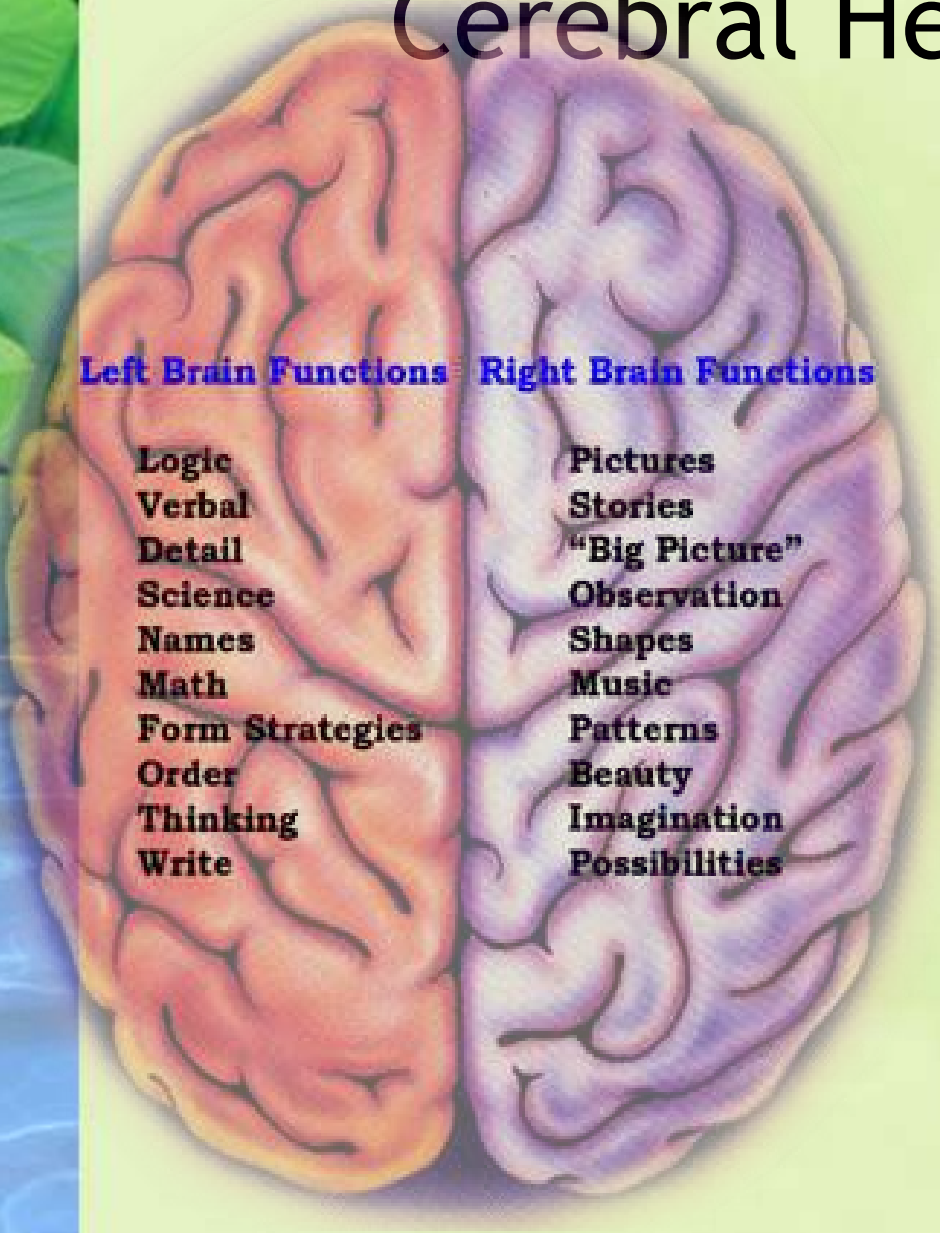


- **In 1861, Paul Broca performed an autopsy on a patient who couldn't speak.**
- **He had no mouth or vocal chord damage and could still understand language.**
- **The patient showed deterioration of the left frontal lobe (Broca's area).**
- **Expressive Aphasia – loss of ability to speak**
- **This can happen after a stroke**

Wernicke's Area:

- **Carl Wernicke later studied a similar concept in the left temporal lobe.**
- **Destruction or deterioration of this area led to…..**
- **<u>Receptive Aphasia</u> – loss ability to comprehend written and spoken language**

Cerebral Hemispheres:



- **The <u>left</u> side of your brain is responsible for verbal, mathematical, and analytical functioning.**
- **The <u>right</u> side of your brain is responsible for spatial, musical, and holistic functioning (face recognition)**
- **They found this out by performing surgery on patients that suffered from seizures.**
- **Split brain patients have the <u>corpus callosum</u> cut so that the seizures cannot continue**

Damage to the brain:

- **Gunshot wounds, tumors, strokes, and other diseases can destroy brain tissue.**
- **The ability to identify Lesions – precise destruction of brain tissue allowed for more understanding of the brain.**
- **Surgical removal, cutting of neural connections, or destruction by chemical applications have all yielded important results.**
- **Including this…….**

Analyzing Brain Function:

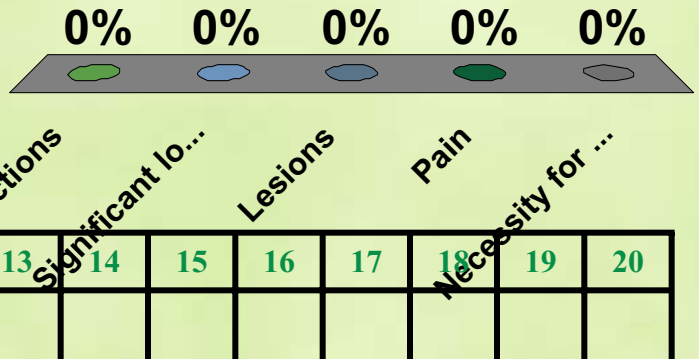
- **CAT (CT) (Computerized axial tomography)- X-ray imaging that allows for 2D slices to show the extent of a lesion.**
- **MRI (Magnetic resonance imaging) – Shows snapshot structure of the brain, but doesn't show the brain functioning)**
- **EEG (Electroencephalogram) – Traces brain's electrical activity with electrodes on scalp "brain waves."**
- **PET – (Positron emission tomography) – A radioactively tagged glucose is injected into the brain and imaging shows metabolic brain activity.**
- **FMRI (Functional MRI)- Shows the brain at work in high resolution "real time"**

Lesson Two Objectives:

- **By the end of this lesson, I will be able to:**
- **1. Discuss the effect of the endocrine system on behavior.**
- **2. Describe the nervous system and its subdivisions and functions:**
- **— central and peripheral nervous systems;**
- **— major brain regions, lobes, and cortical areas;**
- **— brain lateralization and hemispheric specialization.**

Gunshot wounds, tumors, and strokes all result in_____, which can be viewed to study the extent in which the brain is damaged:

1. **Infections**
2. **Significant loss of function**
3. **Lesions**
4. **Pain**
5. **Necessity for surgery**



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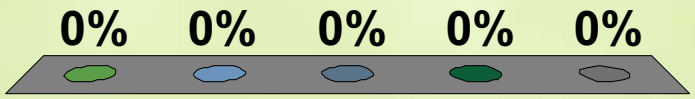
Paul Broca found that the loss of the ability to speak intelligibly is associated with damage to a region of the brain in the:

1. **Thalamus**
2. **Right parietal lobe**
3. **Right occipital lobe**
4. **Left temporal lobe**
5. **Left frontal lobe**



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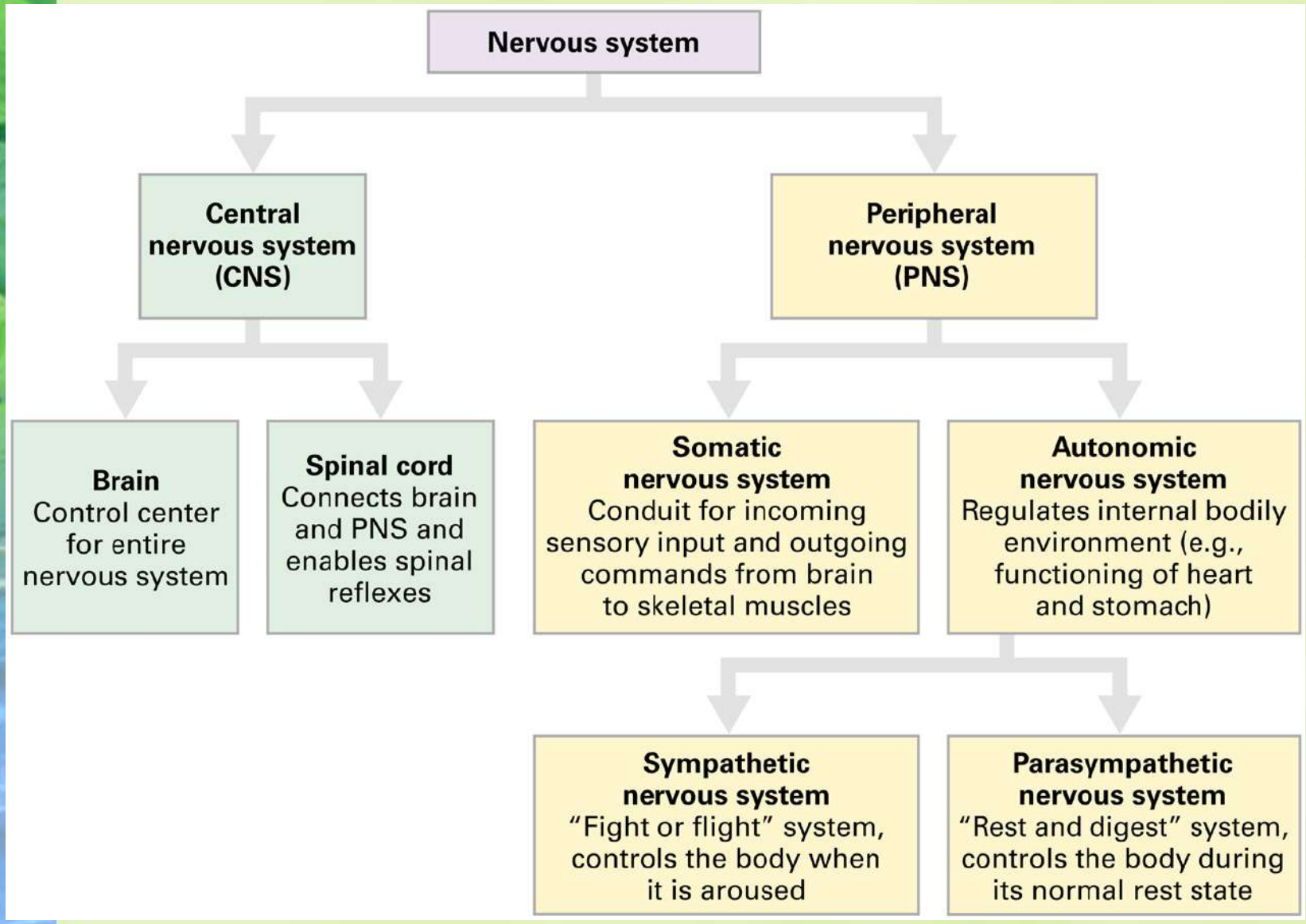
Thalamus
Right parietal...
Right occipita...
Left temporal ...
Left frontal l...

Nervous System - Introduction

- **Where does thought come from?**
- **What allows my body to hit a baseball?**
- **Your brain works along with your Nervous System to accomplish these tasks.**


Nervous system
Central nervous system (CNS)
Peripheral nervous system (PNS)
Brain
Control center for entire nervous system
Spinal cord
Connects brain and PNS and enables spinal reflexes
Somatic nervous system
Conduit for incoming sensory input and outgoing commands from brain to skeletal muscles
Autonomic nervous system
Regulates internal bodily environment (e.g., functioning of heart and stomach)
Sympathetic nervous system
"Fight or flight" system, controls the body when it is aroused
Parasympathetic nervous system
"Rest and digest" system, controls the body during its normal rest state

Central Nervous System:

The Band *Spinal Tap*

- **Consists of brain and spinal cord**
- **<u>Brain</u> – the control center**
- **<u>Spinal cord</u> – provides the simple spinal reflexes (without direction from the brain) – touching a hot stove.**

Peripheral Nervous System:

- **Peripheral Nervous System – Responsible for carrying out sensory information (changes in external or internal environment)**
- **Autonomic – Stimulates involuntary muscles. (heart)**
- **Somatic – Stimulates voluntary muscles. (skeletal muscles)**

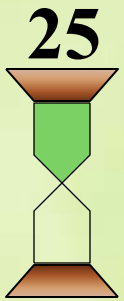
Sympathetic/Parasympathetic Nervous Systems

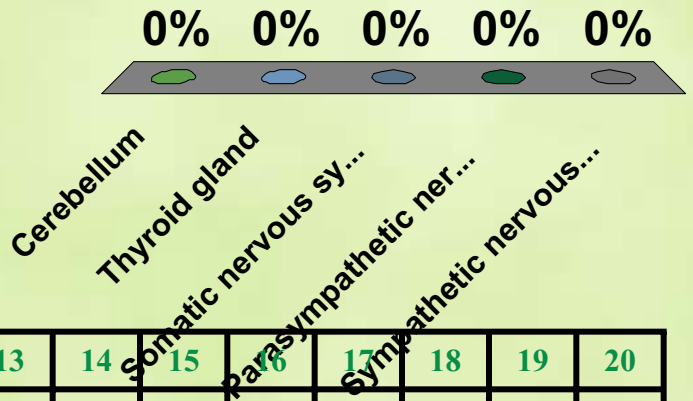
- **Sympathetic Nervous System – Responses that help body deal with stress (heart rate, tears, dilating of pupils)**
- **Prepares you for stressful experience**
- **Parasympathetic Nervous System – Calms your body following sympathetic stimulation (salivation, peristalsis)**
- **Calms you down after a stressful experience**
- **Both are subdivisions of the Autonomic Nervous System**

Sympathetic nervous system		Parasympathetic nervous system
Dilates pupils		Contracts pupils
Speeds heart rate		Slows heart rate
Speeds breathing		Slows breathing
Inhibits digestion		Stimulates digestion
Produces sweaty palms		Dries palms

Of the following, the effect of adrenaline on the body is most similar to the effect of the:

1. **Cerebellum**
2. **Thyroid gland**
3. **Somatic nervous system**
4. **Parasympathetic nervous system**
5. **Sympathetic nervous system**





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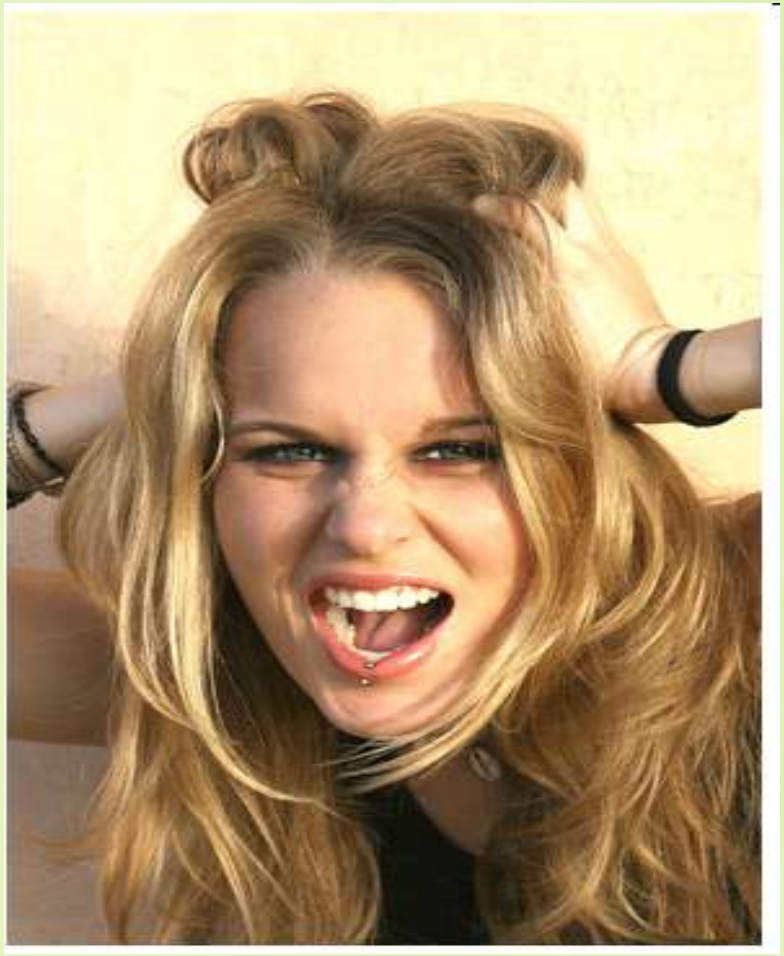
The Endocrine Glandular System



- **Not part of the nervous system**
- **Works with the autonomic nervous system in responding to stress**
- **Plays a role in basic behaviors and bodily functions such as eating, metabolism, reproduction, and growth**
- **Endocrine glands secret hormones, which are chemicals carried by the bloodstream to target sites throughout the body**

The Endocrine System:

- **Pineal Gland – Produces melatonin (regulates circadian rhythms) – SAD / Sleep wake cycle.**
- **Pituitary Gland – "Master Gland" – Associated with secretion of HGH and is involved with most other glands.**
- **Adrenal Glands – Cortisol – stress hormone – prepares body for "fight or flight"**
- **Pancreas – Regulates blood sugar – imbalances result in diabetes and hypoglycemia.**
- **Thyroid Gland – Regulates the body's metabolism.**

Which of the following glands interact(s) most directly with all of the others to help regulate body processes?

1. **Pituitary**
2. **Adrenals**
3. **Parathyroids**
4. **Thyroid**
5. **Ovaries**

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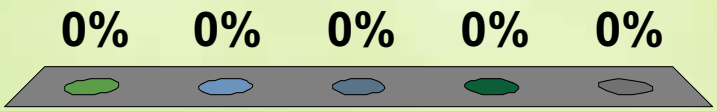

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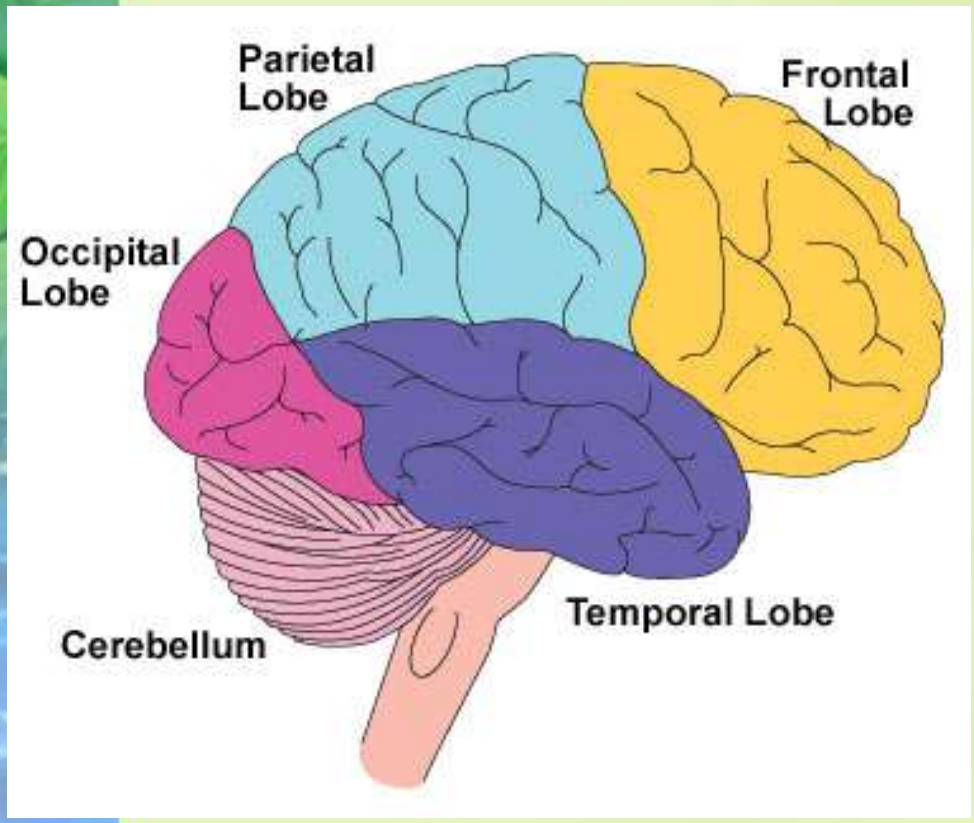
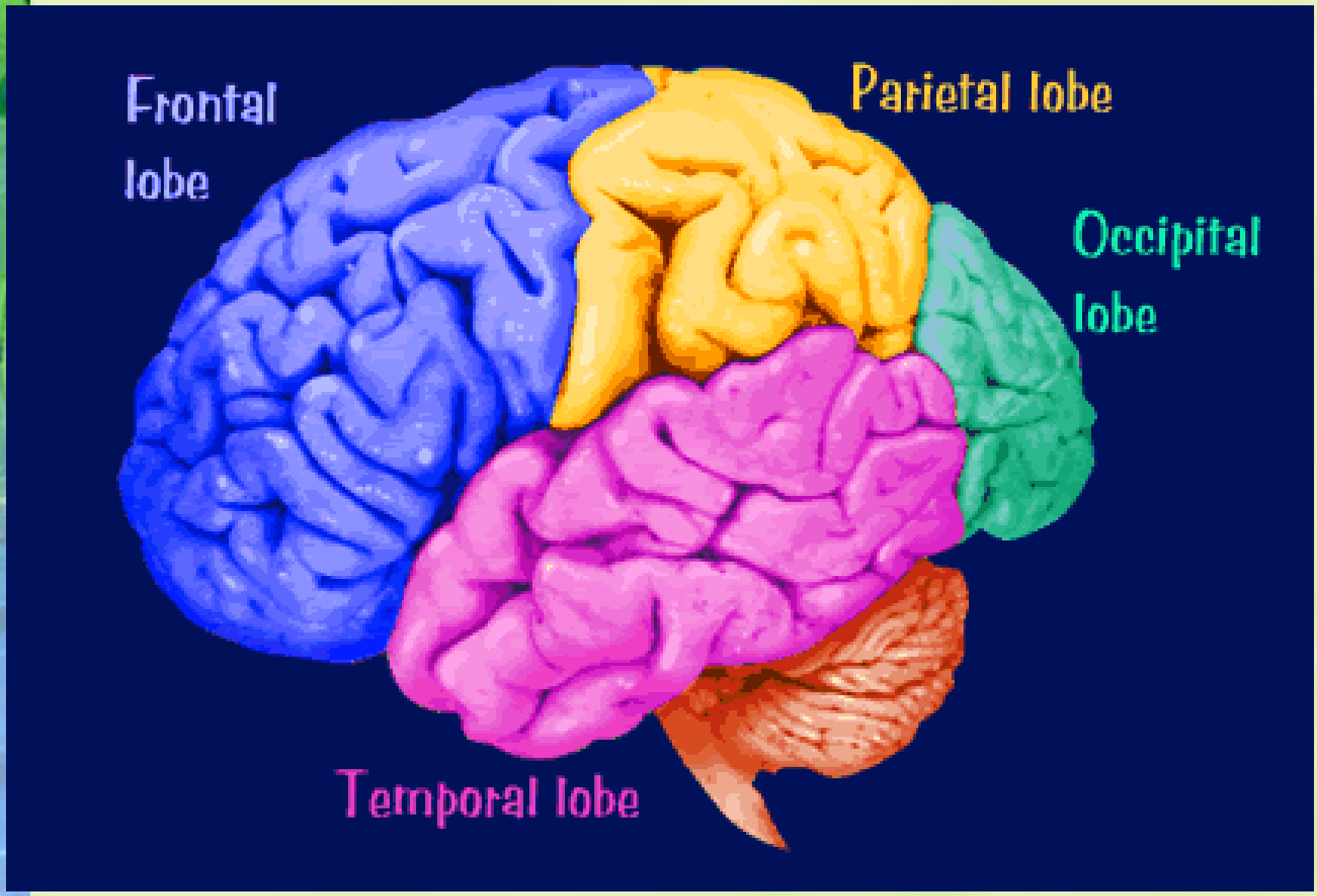
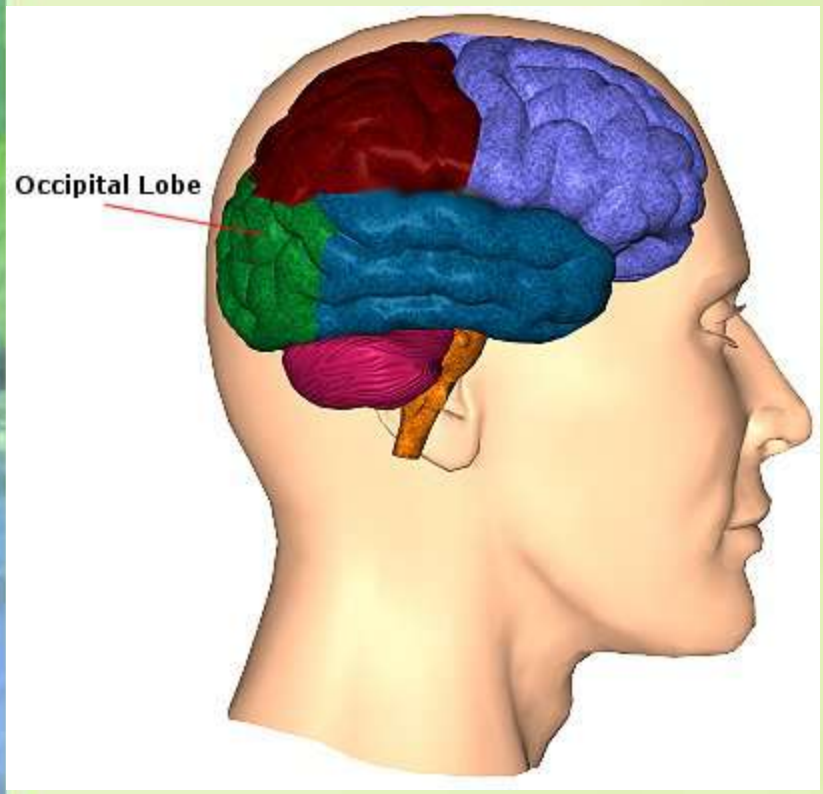
The Four Lobes of the Brain:



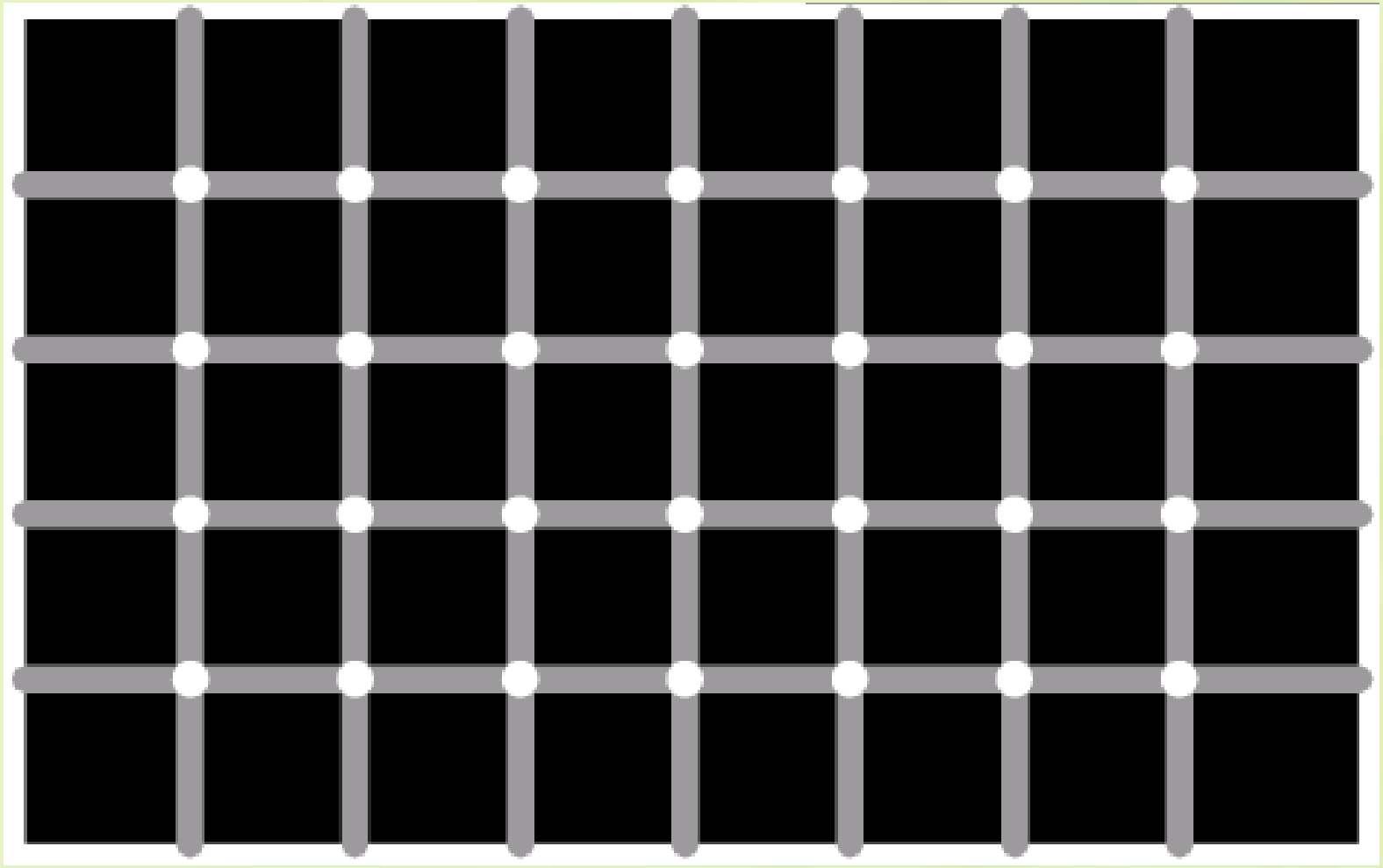
- **<u>Learning Target</u>: Describe the major brain regions, lobes, and cortical areas**
- **Today we will be conducting an activity for each of the lobes of the brain.**
- **<u>Important</u> – Each lobe is responsible for certain functions, but can adapt if there is damage.**
- **Frontal Lobe**
- **Parietal Lobe**
- **Temporal Lobe**
- **Occipital Lobe**


Frontal lobe
Parietal lobe
Occipital lobe
Temporal lobe

Occipital Lobe



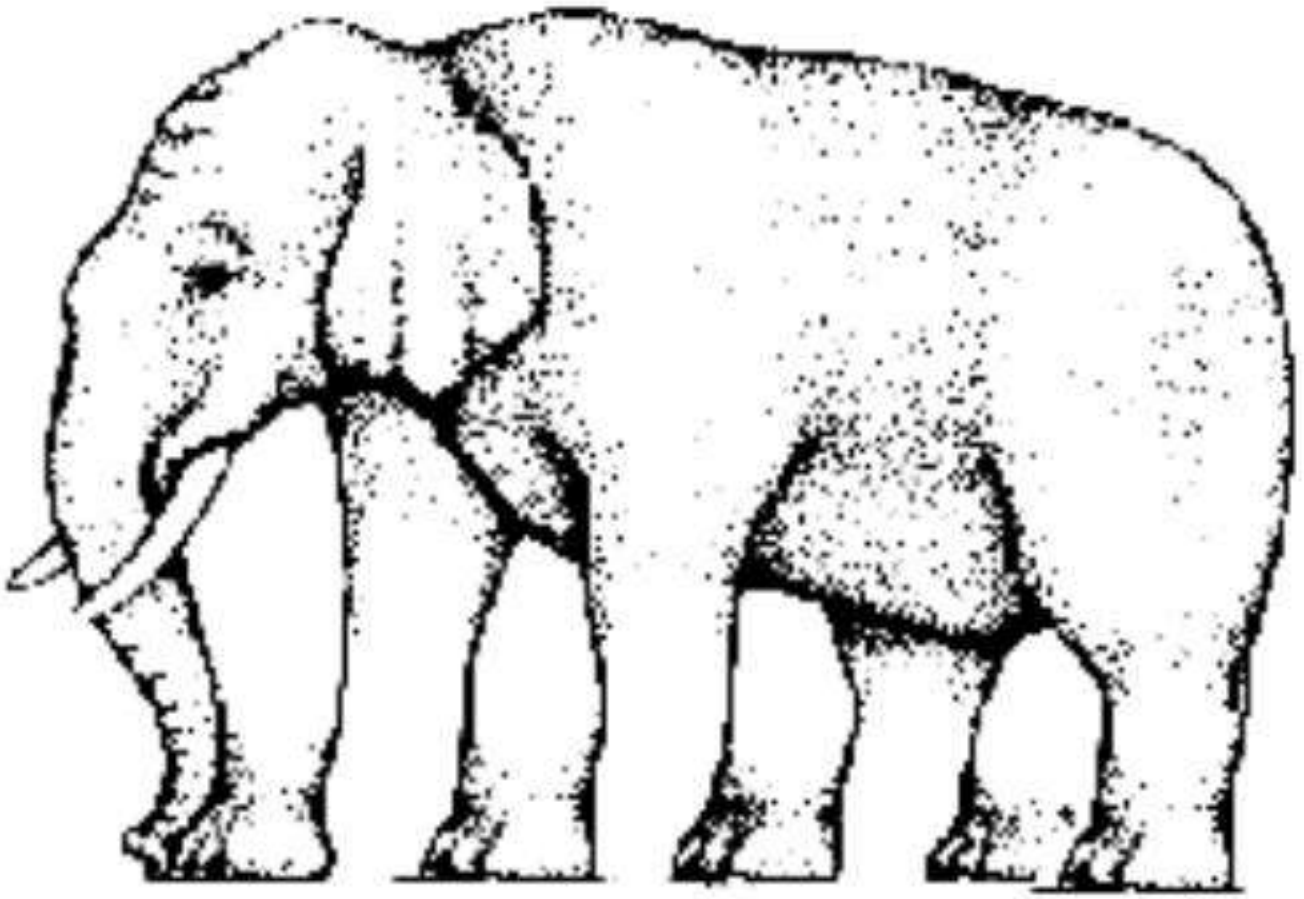
- **Processes visual information**
- **Left half of visual field is processed in right occipital lobe**
- **Right half is processed in left occipital lobe**
- **Damage to lobe:**
- **1. Loss of vision**
- **2. Field Cut**
- **Activity – Optical Illusions**



Read This!

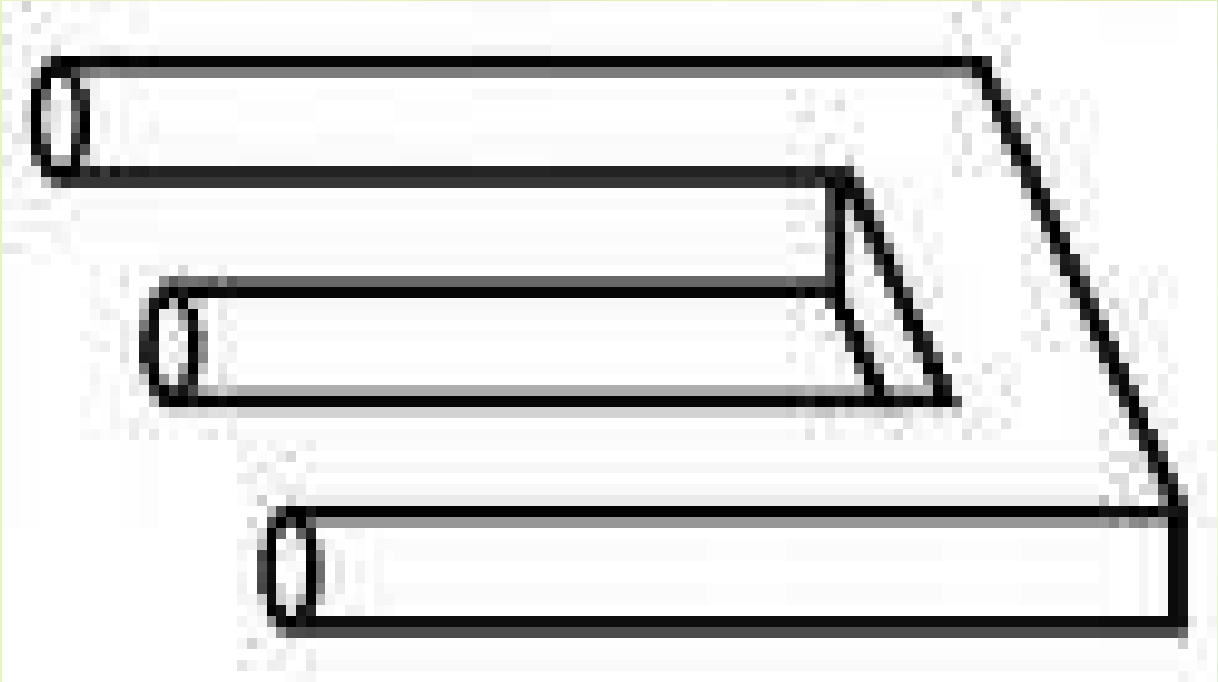
THE PWEOR OF THE HMUAN MNID

Aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoatnt tihng is taht the frist and lsat ltteer be in the rghit pclae. The rset can be a taotl mses and you can sitll raed it wouthit porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.



How many legs does this elephant have?

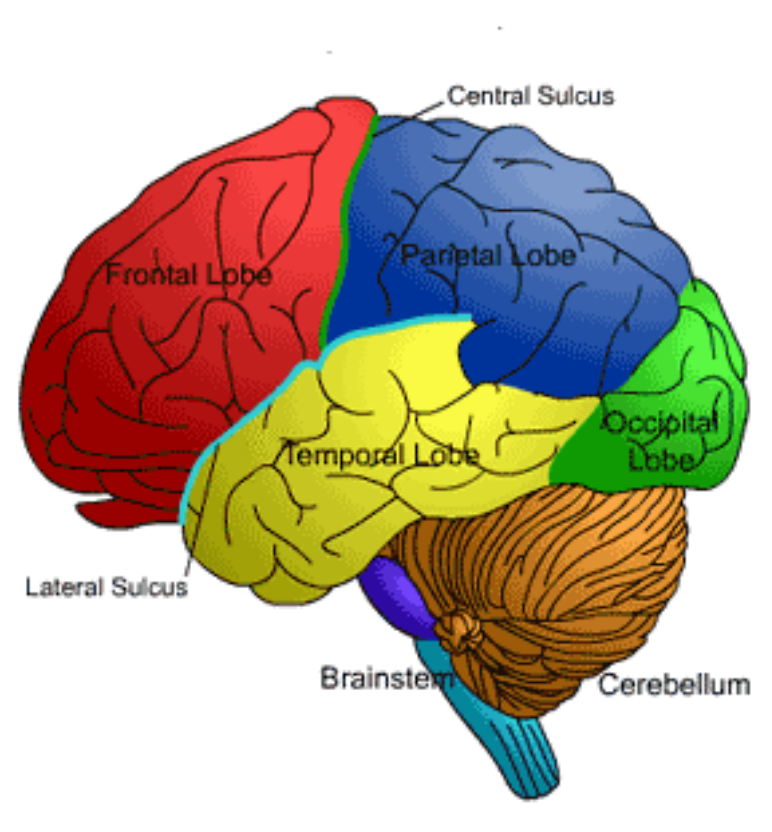
Try to Draw This:



Parietal Lobe

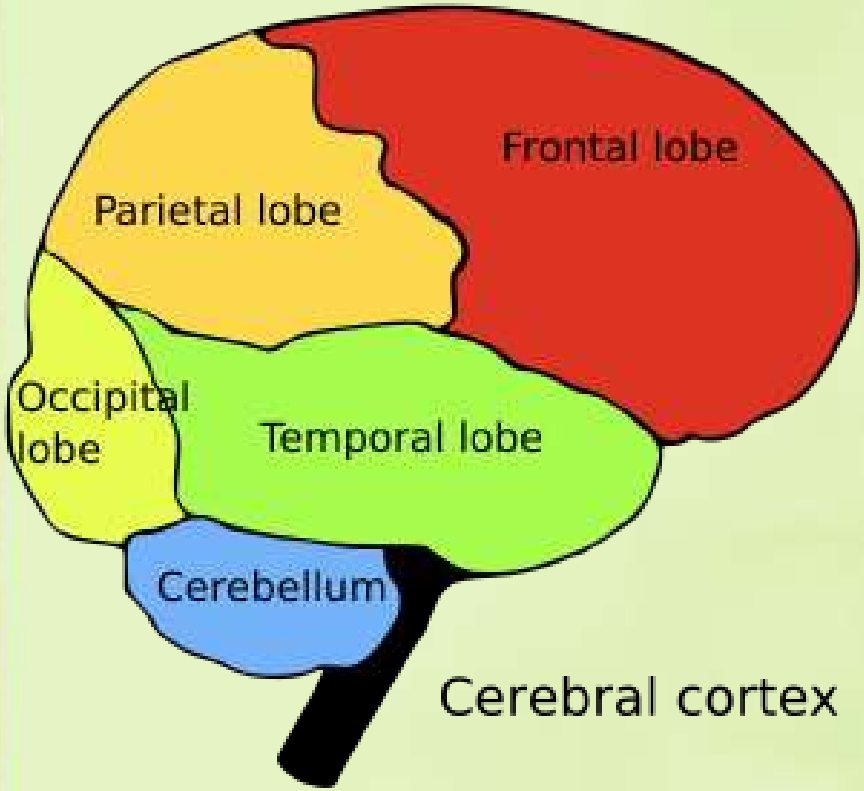
- **Responsible for touch sensations**
- **Also responsible for spatial awareness**
- **Damage to parietal lobe:**
- **1. Difficulty with sensory functions (sensitivity or decreased sensitivity to pain)**
- **<u>Activity</u> – "The Box of Mystery"**

Temporal Lobe



- **Responsible for hearing**
- **Right temporal lobe is responsible for understanding music / tonality**
- **Damage to temporal lobe:**
- **1. Difficulty with rhythm**
- **2. Difficulty picking out different sounds, instruments, feelings**
- **<u>Activity</u> – How does this song make you feel?**

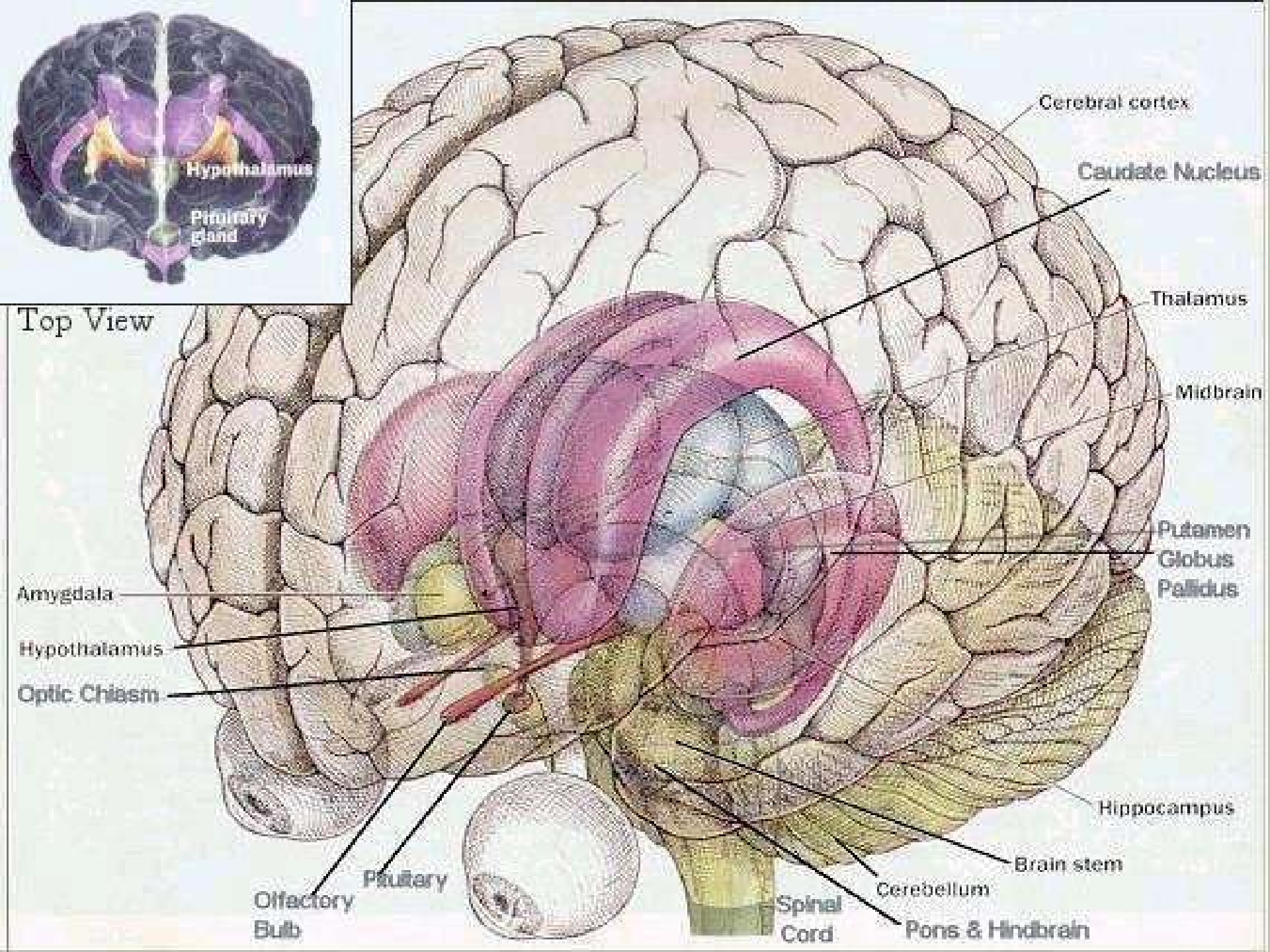
Frontal Lobe



- **Initiates movements of skeletal muscles**
- **Moral and thought center for the brain**
- **Damage to the frontal lobe –**
- **1. difficulty speaking**
- **2. difficulty with decision making**
- **<u>Activity</u> – The Heinz dilemma**

Lesson Three: Objectives:

- **By the end of this lesson, I will be able to:**
- **1. Identify basic processes and systems in the biological bases of behavior, including parts of the neuron and the process of transmission of a signal between neurons.**


Hypothalamus
Pituitary gland
Top View
Cerebral cortex
Caudate Nucleus
Thalamus
Midbrain
Putamen
Globus Pallidus
Amygdala
Hypothalamus
Optic Chiasm
Hippocampus
Brain stem
Cerebellum
Pituitary
Olfactory Bulb
Spinal Cord
Pons & Hindbrain

Cerebral Cortex:

- **The <u>cerebral cortex</u> receives and processes sensory information and directs movement.**
- **It also helps with higher order thinking, planning, and judgment.**
- **It is the largest section of your brain.**

Amygdala

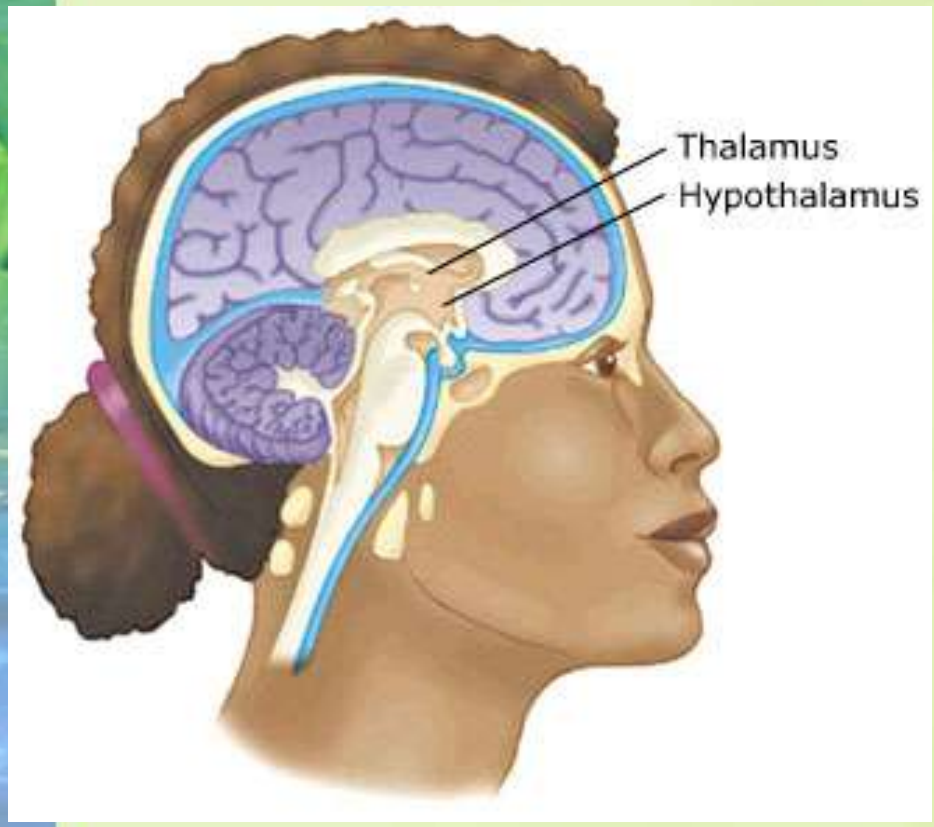
- **The word amygdala is Latin for almond, and that's what this area looks like.**
- **Scientists believe that the amygdala influences:**
- **1. Fear**
- **2. Aggression**

The Amygdala and the teen brain:

The Cerebellum's Balancing Act

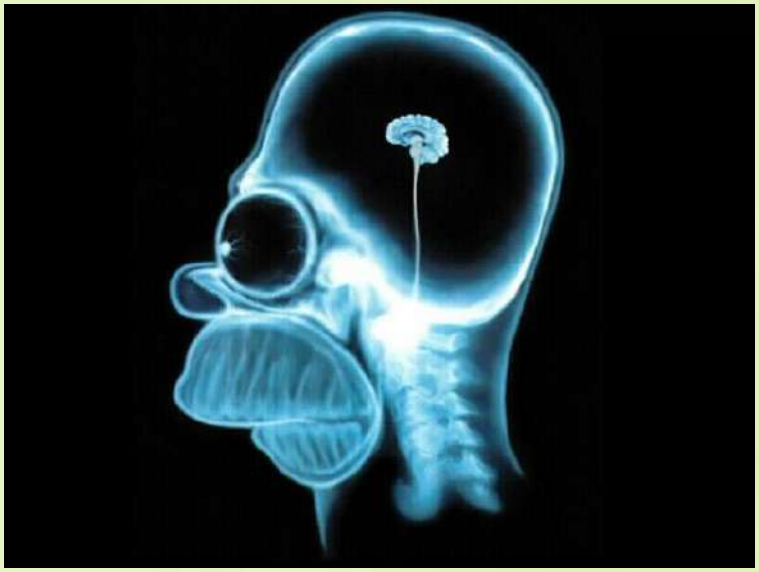
- **The cerebellum works with the inner ear (vestibular system) to help you maintain your balance**
- **It controls:**
- **1. Motor functioning**
- **2. Balance**

Hypothalamus:



- **The hypothalamus is like your brain's inner thermostat.**
- **The hypothalamus is also responsible for:**
- **1. Heart rate**
- **2. appetite drives – thirst, hunger, sexual desire)**
- **3. Determines biological rhythms (menstrual cycle)**

Hippocampus



- **The hippocampus is most associated with memory.**
- **Enables formation of long-term memories:**
- **Memory retention is best reinforced through long periods of sleep.**

The part of the brain most closely associated maintaining balance and the coordination of complex sequences of movements is the:

1. **Hypothalamus**
2. **Thalamus**
3. **Pons**
4. **Medulla**
5. **Cerebellum**

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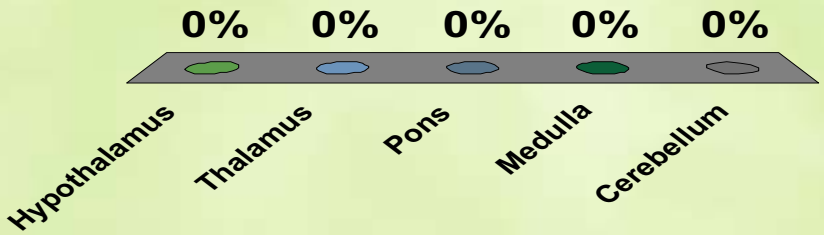

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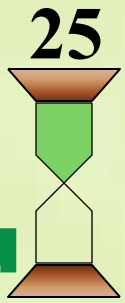
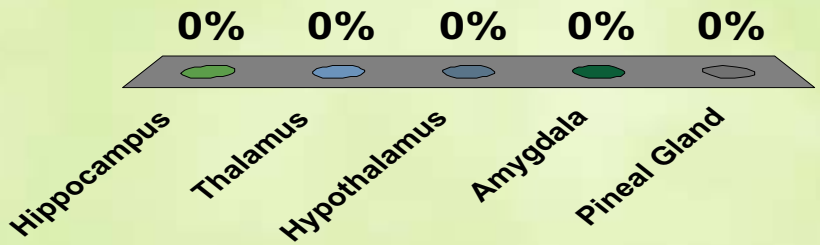
Medulla (Oblongata)

- **Responsible for maintaining vital body functions, such as breathing and heart rate**
- **It also is responsible for:**
- **1. coughing,**
- **2. gagging,**
- **3. swallowing**
- **4. vomiting.**

A severely overweight rat would most likely result from lesioning of the:

1. **Hippocampus**
2. **Thalamus**
3. **Hypothalamus**
4. **Amygdala**
5. **Pineal Gland**





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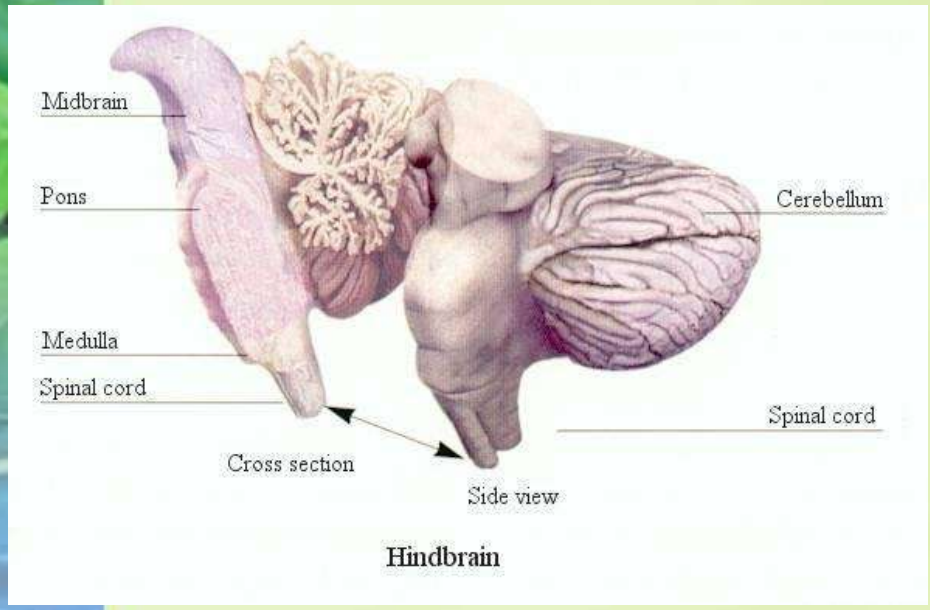
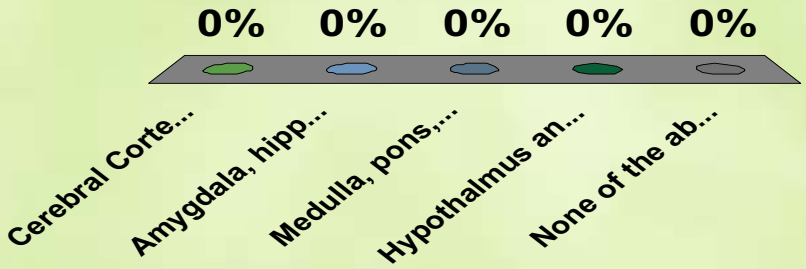
Pons



- **The pons main function is to be a bridge between the medulla and the cerebellum.**
- **It also regulates your arousal and wakefulness states.**

More than half of the volume of the human brain is composed of the:

1. **Cerebral Cortex**
2. **Amygdala, hippocampus, and pituitary gland**
3. **Medulla, pons, and cerebellum**
4. **Hypothalmus and thalamus**
5. **None of the above**



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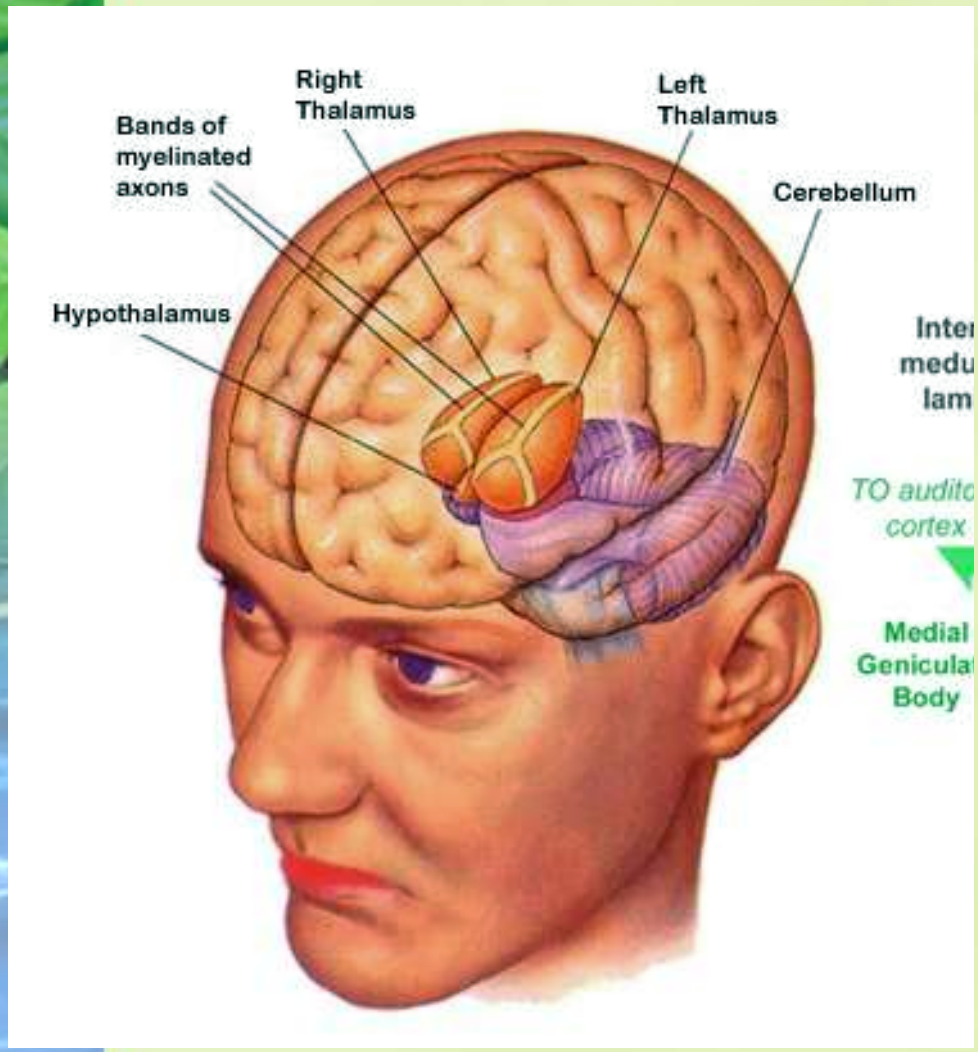
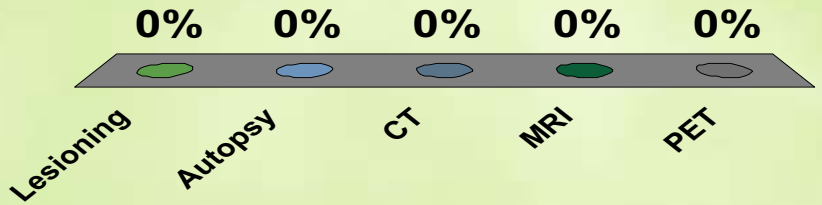
Thalamus:



- **The <u>Thalamus</u> acts as a relay station for sensory pathways.**
- **<u>It carries:</u>**
- **1. Visual information**
- **2. Auditory information**
- **3. Taste information**

Scientists are able to see changes in the brain as it processes information by means of:

1. **Lesioning**
2. **Autopsy**
3. **CT**
4. **MRI**
5. **PET**



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While trying to head the ball, Jill had a concussion in tonight's soccer game. What type of scan will the doctor's most likely use in order to see if she has any damage to her brain?

30

1. PET
2. MRI
3. EEG
4. FMRI
5. CAT

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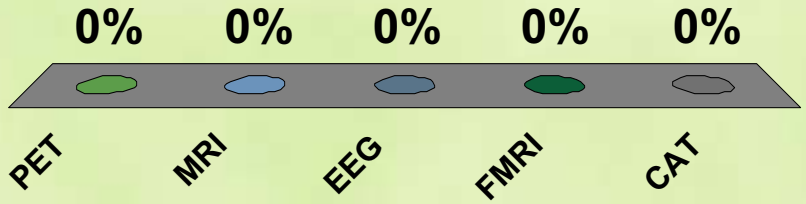

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Lesson Four: Objectives:

- **<u>By the end of this lesson you will be able to:</u>**
- **1. Identify what techniques were used to handle any brain abnormalities**
- **2. Discuss the difference between surgeries done across cultures.**
- **3. Discuss the implications of collision sports on the brain**

Turn and Talk: Discussion

- **1. What surprised you most about this women's experience?**
- **2. Were you surprised at how different she was after she had the stroke?**
- **3. Do you think she can be as successful as she was before the stroke?**

Historical Causes and Treatments:

- **Perceived Causes**
  - **movements of sun or moon**
    - **lunacy--full moon**
  - **evil spirits**
- **Ancient Treatments**
  - **exorcism, caged like animals, beaten, burned, castrated, mutilated, blood replaced with animal's blood, trepanation.**

Trepanation:

- **Trepanation was used to alleviate people from their “problems.”**
- **A hole was bored, punched, or cut into the skull.**
- **They have found burial sites with hundreds of these skulls with holes in similar locations.**

Primitive Brain Surgery:

- **Just a warning: This is an extremely graphic video of a real life trepanation.**
- **This is not for the faint of heart.**
- **http://video.google.com/videoplay?docid=-6362503783013786677&hl=en**

Turn and Talk: Discussion

- **1. What is your overall reaction to this video?**
- **2. Did it seem that those involved in the process were disturbed by this process? Why?**
- **3. How do you think the people in this tribe view their "medicine man?"**
- **4. Do you think the surgery actually works or do you think it is a self-fulfilling prophecy?**
- **5. Do you think that these types of surgeries should be curtailed? Why?**

A Blow to the Head:

- **60 Minutes Clip**

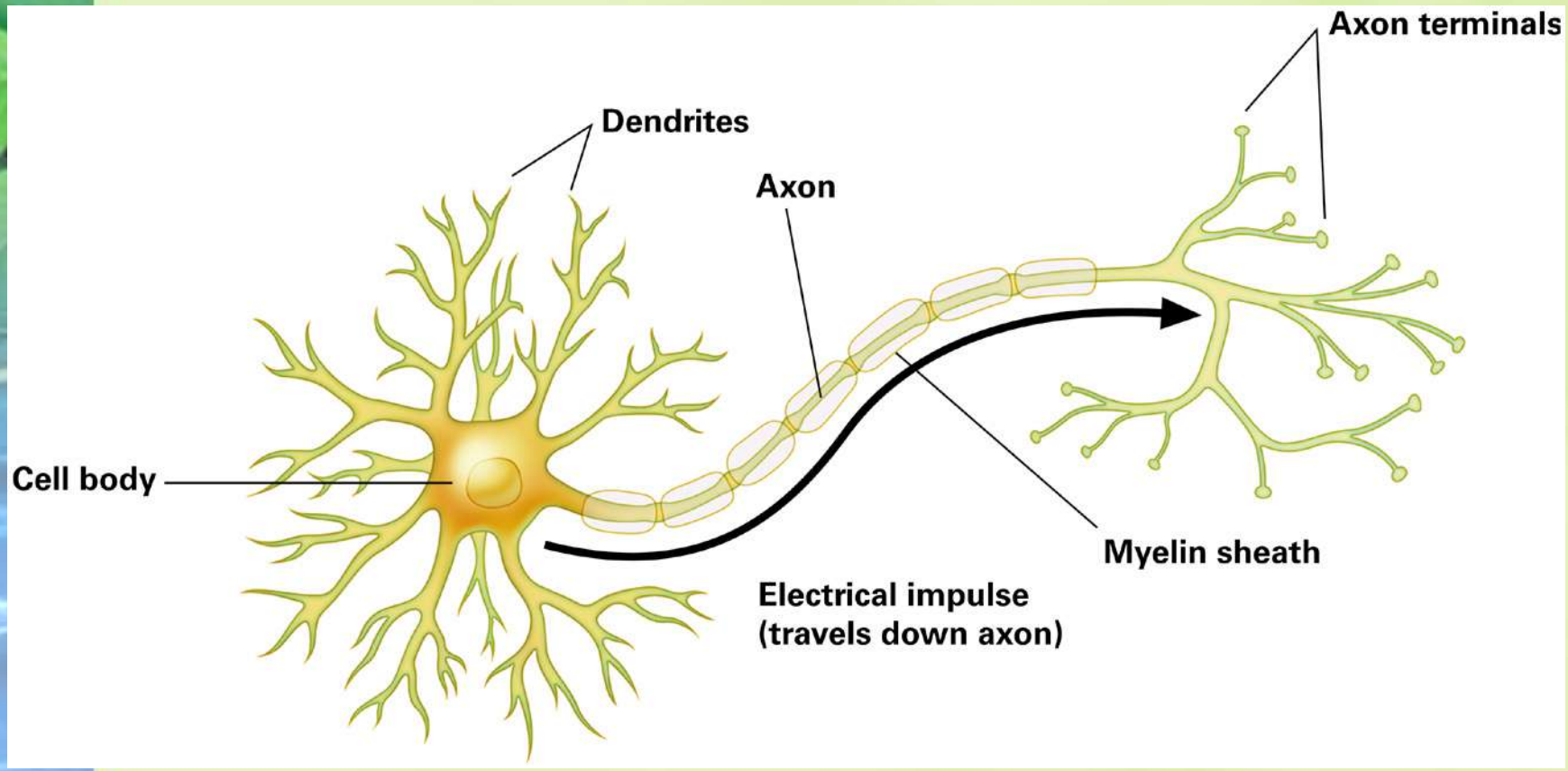
Turn and Talk: Discussion

- **1. Knowing what we do about collision sports, do you think you'll see less people playing them?**
- **2. Why is it that parents allow children to play collision sports at such a young age?**
- **3. If you were a parent and know what you know about the brain, would you allow your child to play collision sports?**

Lesson Five: Objectives

- **By the end of this lesson, I will be able to:**
- **1. • Identify basic processes and systems in the biological bases of behavior, including parts of the neuron and the process of transmission of a signal between neurons.**

The Structure of a Neuron

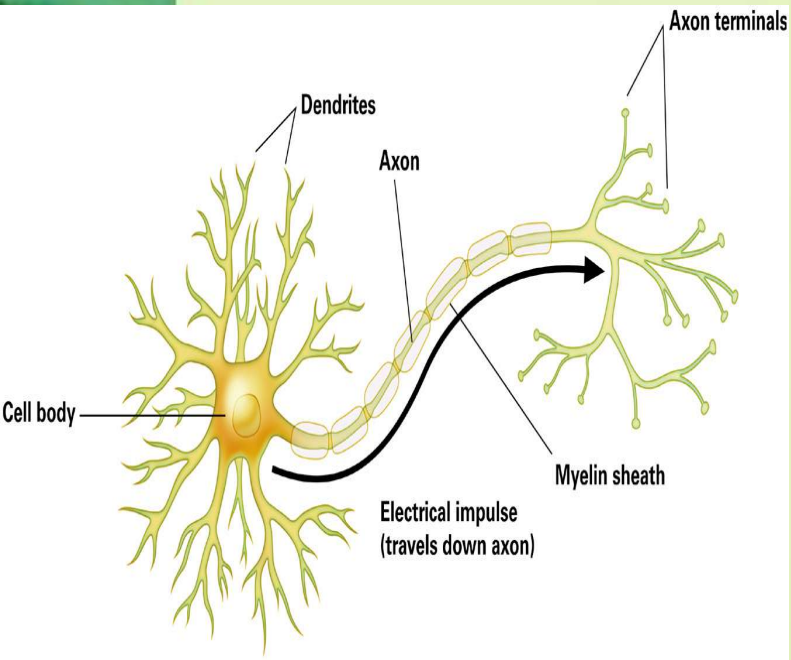


The Neuron

Tesla Roadster – 0-60 in 3.9 seconds…it's all electric.

- **<u>Neuron</u> – brain cell that receives and transmits *electrical* signals throughout the nervous system.**
- **Neurons control:**
- **1. muscle movement,**
- **2. digestion**
- **3. engage us in thinking, dreaming, and remembering.**

The Structure of a Neuron



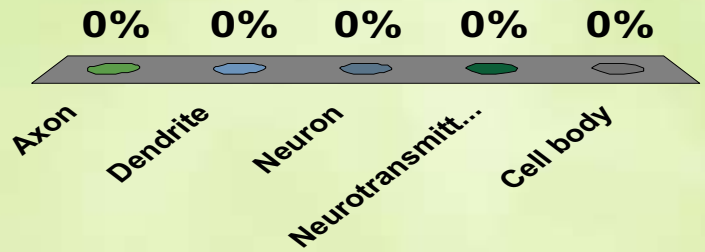
- **Dendrites are the fibers that project out of the cell body, receiving information from other neurons (communicator)**
- **The cell body (soma) contains the nucleus of the cell and other biological machinery to keep the cell alive (home base)**
- **The axon transmits messages through the neuron (the highway)**
- **The axon terminals (terminal buttons) are at the end of the axon and send messages to a different neuron (the operator)**

Structure of Neuron:

- **Myelin Sheath – Allows the electrical message to be sent smoothly from axon to axon.**
- **Deterioration of the myelin sheath leads to Multiple Sclerosis**
- **MS's hallmark is very slow muscle movement (The message cannot travel quickly because the Myelin is damaged)**

This is a brain cell that receives and transmits electrical signals throughout the nervous system.

1. **Axon**
2. **Dendrite**
3. **Neuron**
4. **Neurotransmitter**
5. **Cell body**



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More Types of Neurons:

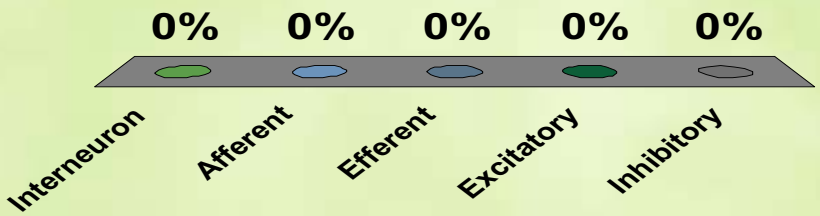
- **<u>Afferent</u> – Send signal to your brain (you have an itch) - BUMP**
- **<u>Interneuron</u> – Process signal in brain (neurons are trying to organize what's going on) - SET**
- **<u>Efferent</u> – Send signal back to it's origin. (you itch) - SPIKE**

Within-Neuron Communication

- **Information from the dendrites is either:**
- **1. excitatory - (telling the neuron to generate an electrical impulse) or**
- **2. inhibitory - (telling the neuron not to generate an electrical impulse)**
- **Note: The impulse must be strong enough for a message to be sent.**

Which type of neuron is the first to react to a signal of pain?

1. **Interneuron**
2. **Afferent**
3. **Efferent**
4. **Excitatory**
5. **Inhibitory**



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Onto Action Potential:

- **<u>Action Potential Steps</u>**
- **There are several steps that happen when the brain is sent a signal of pain.**
- **We are going to go through each of these steps today.**

When the dendrites tell the neuron to generate an electrical impulse, it is called:

1. **Inhibitory**
2. **Ancillary**
3. **Excitatory**
4. **All or nothing impulse**
5. **An impulse**

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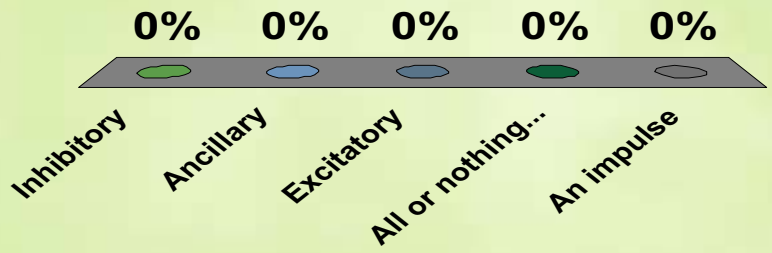

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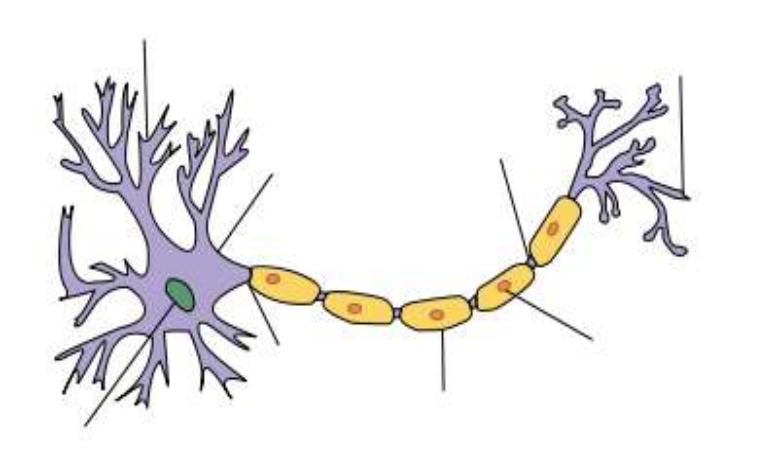
Step #1 – Axon Membrane: Chemical Gates.



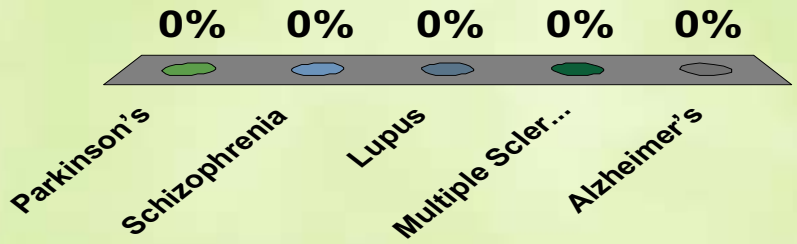
- **Batteries have protective coating.**
- **So do axons.**
- **<u>Axon</u> – long tube filled with and surrounded by fluid.**
- **Deterioration of myelin sheath = MS**
- **<u>Chemical Gates</u> – can open to allow electrically charged particles to enter. They can also close to keep electrically charged particles out.**
- **The axon's electrically charged particles are the key to making it a living battery. (negative charge)**

Step #2 – Ions: Charged Particles

- **The fluid inside and outside the axon contains ions.**
- **<u>Ions</u> – Chemical particles that have electrical charges.**
- **<u>Ions follow two rules</u>.**
- **1. Opposite charges attract**
- **2. Like charges repel**
- **<u>Ions work just like a battery</u>: A battery has both positive and negative ends.**

What disease does degeneration of the myelin sheath contribute to?

1. **Parkinson's**
2. **Schizophrenia**
3. **Lupus**
4. **Multiple Sclerosis**
5. **Alzheimer's**



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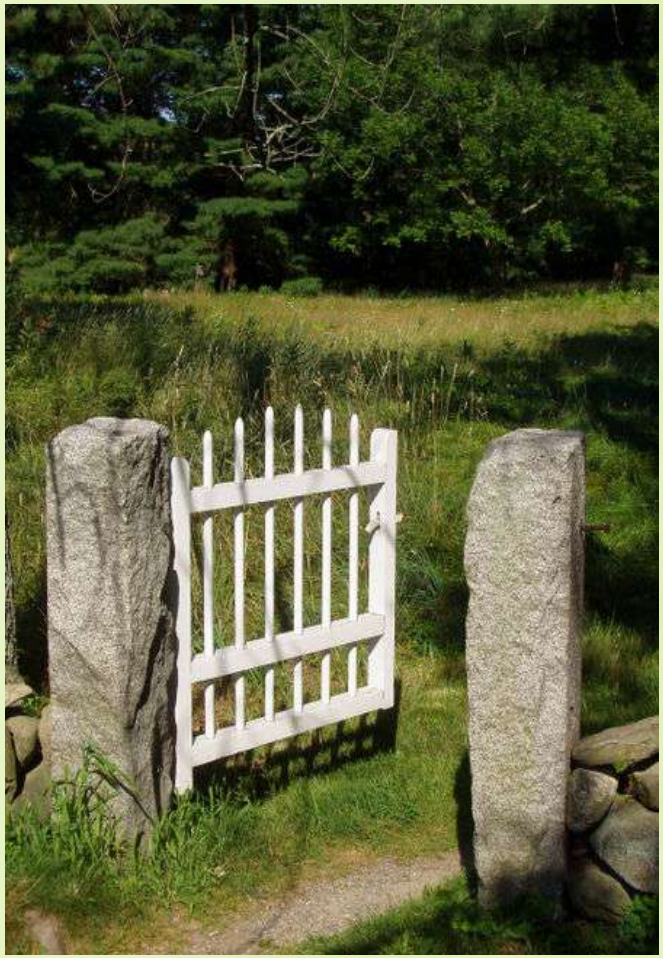
Step #3 – Resting State: Charged Battery

- **<u>Resting State</u> – The axon has a charge (potential), but is not used yet.**
- **It acts like a battery just sitting there waiting to be drawn upon for power.**
- **There tend to be more negatively charged ions, which create the holding charge.**

Step #4 – Action Potential: Sending Information



- **When we step on a tack, and our neurons get excited, a few things will happen.**
- **First, the axon's chemical gates will open.**
- **All of the positively charged ions will rush inside the gates to find the negatively charged ions that they like so much.**
- **This process is called Action Potential.**

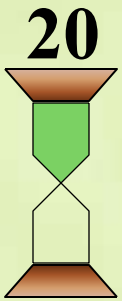
Step #5 – Sending Information

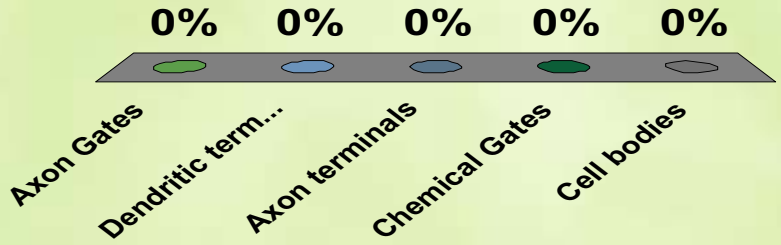
Isuzu Impulse - 1986- 1991

- **Action Potential is more like a fast-burning fuse than a gunshot.**
- **The axon has numerous action potentials that move down the axon. – not just one.**
- **Nerve impulse – series of separate action potentials that take place.**

These open to allow some electrically charged particles to enter the axons and keep some electrically charged out:

1. **Axon Gates**
2. **Dendritic terminals**
3. **Axon terminals**
4. **Chemical Gates**
5. **Cell bodies**





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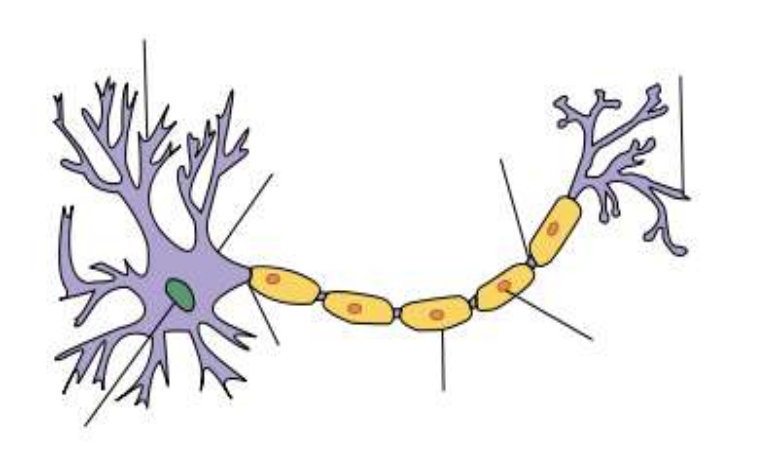
Step #6 – All-or-None Law

- **The impulse is an "all or nothing" event, meaning that there either is or is not an electrical impulse**
- **Only if the impulse is strong enough will there be a message sent.**

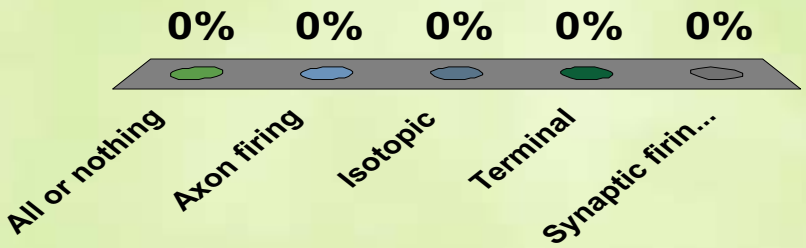
Step #7 – Nerve Impulse



- **If there are 6 action potentials, they will go in order until they reach the end of the axon.**
- **Then they will retreat back to their resting state, awaiting another chance to be in action.**
- **You'll notice gaps in the <u>myelin sheath</u>.**
- **This is where the axon's gates open and the action potential takes place each time.**

The principle that neurons either fire or they don't is called the:

1. **All or nothing**
2. **Axon firing**
3. **Isotopic**
4. **Terminal**
5. **Synaptic firing**



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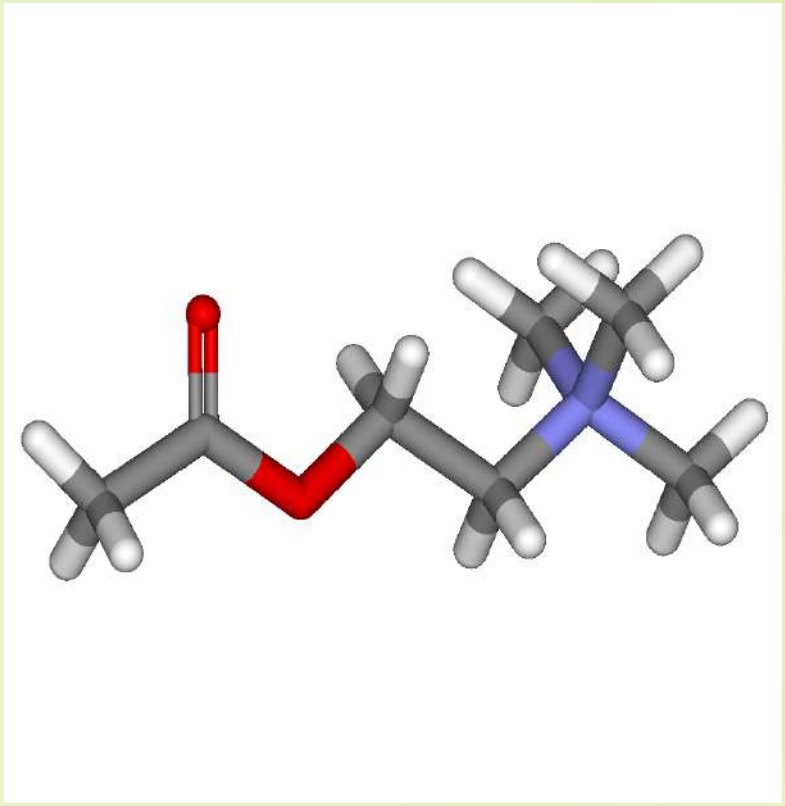
Step #8 – Terminal Buttons and Neurotransmitters



- **Once the nerve impulse reaches the end of the axon, they run into the terminal buttons**
- **The terminal buttons then release their neurotransmitters.**
- **These neurotransmitters will then cross the synapse and either excite or inhibit the function of neighboring organs (heart), muscles, or cell bodies.**

Lesson Six: Objectives:

- **By the end of this lesson, I will be able to:**
- **1. Discuss the influence of drugs on neurotransmitters (e.g., reuptake mechanisms).**

What Are We Talking About Today?

- **Axon terminals contain**
- **<u>neurotransmitters</u>**
  - **specialize in transmitting information between neurons**
  - **Examples: Dopamine, GABA, Endorphins, Serotonin**

Neurotransmitters, Drugs, and Poisons

Key terms:

Agonists

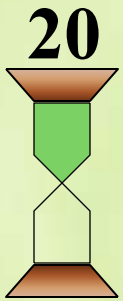
Drugs and poisons that **increase** the activity of one or more neurotransmitters

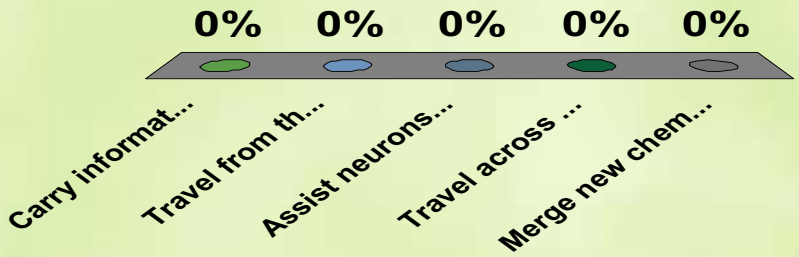
Antagonists

Drugs and poisons that **decrease** the activity of one or more neurotransmitters

Your brain is involved in every perception, thought, and emotion, as are its neurons and their neurotransmitters. Neurotransmitters are chemical messengers that:

1. **Carry information primarily in the endocrine system**
2. **Travel from the cell body along the axon and create an action potential**
3. **Assist neurons by providing physical support, nutrition, and waste removal**
4. **Travel across the synapse and affect adjoining neurons**
5. **Merge new chemical messages with old ones**





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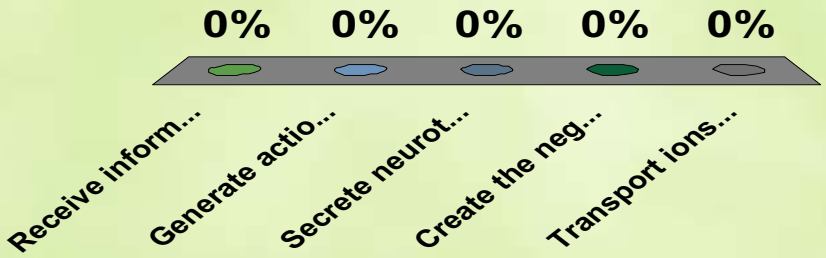
One Key Term to Know:

- **<u>Re-uptake</u> –After a neurotransmitter has been used, it needs to find it's way back to the <u>axon terminal</u> where it came from so that it can be used at another time.**
- **Many of the neurotransmitters we will be talking about can be affected by certain drugs (cocaine, curare, etc.) so this process is either slowed, increased, or doesn't happen at all.**

A neuron without terminal buttons would be unable to:

1. **Receive information from neighboring neurons**
2. **Generate action potential**
3. **Secrete neurotransmitters to other neurons**
4. **Create the negative charge necessary for action potential**
5. **Transport ions across the cell membrane**



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Neurotransmitters

1. Acetylcholine (ACh)
2. Dopamine
3. Serotonin
4. GABA
5. Endorphins

Acetylcholine (ACh)

- **Acetylcholine is involved in learning, memory, and muscle movement**
- **Curare is an antagonist that paralyzes the body by occupying the receptor sites for ACh, thereby preventing ACh from getting in and carrying its message to a neuron**
- **People with Alzheimer's often have trouble with Ach transmission.**

Dopamine

John Nash has extremely high dopamine levels.

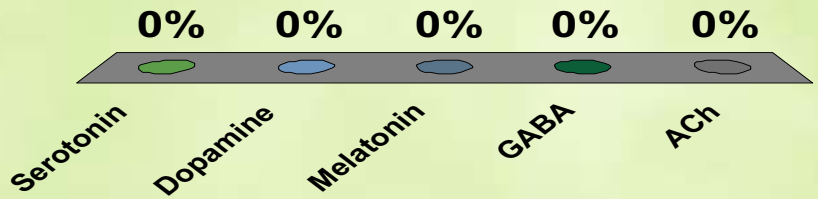
- **Dopamine impacts our arousal and mood states, thought processes, and physical movement (works with your hypothalamus)**
- **If re-uptake doesn't happen and the dopamine was not removed, the neuron would be continually activated and cause extreme over arousal. (skitz)**
- **Low levels = Parkinson's high levels = Schizophrenia**
- **In this interview Michael J. Fox talks about his battle with Parkinson's.**

Endorphins

- **<u>Endorphins</u> are a group of neurotransmitters that are involved in:**
- **1. pain perception**
- **2. pain relief**
- **<u>Morphine</u> and <u>heroin</u> are agonists that bind to receptor sites, thereby increasing endorphin activity**

Miguel has been diagnosed with schizophrenia. His psychologist believes that Miguel's hallucinations and perceptual distortions may in part be caused by excessive amounts of the neurotransmitter:

1. **Serotonin**
2. **Dopamine**
3. **Melatonin**
4. **GABA**
5. **ACh**



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Serotonin

- **Serotonin is a neurotransmitter involved in arousal and mood, and plays a major role in mood disorders such as depression**
- **Some anti-depressant drugs such as Prozac, Paxil help regulate the amount of serotonin that is being released**

Jenny has just finished an Ironman Triathlon and seems to be very happy and elated. One cause of her feelings may be due to abnormally high levels of chemical substances in her brain called:

1. **Acetylcholine**
2. **Serotonin**
3. **Endorphins**
4. **Dopamine**
5. **GABA**

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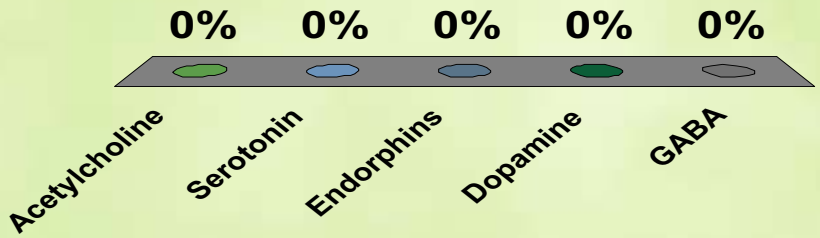

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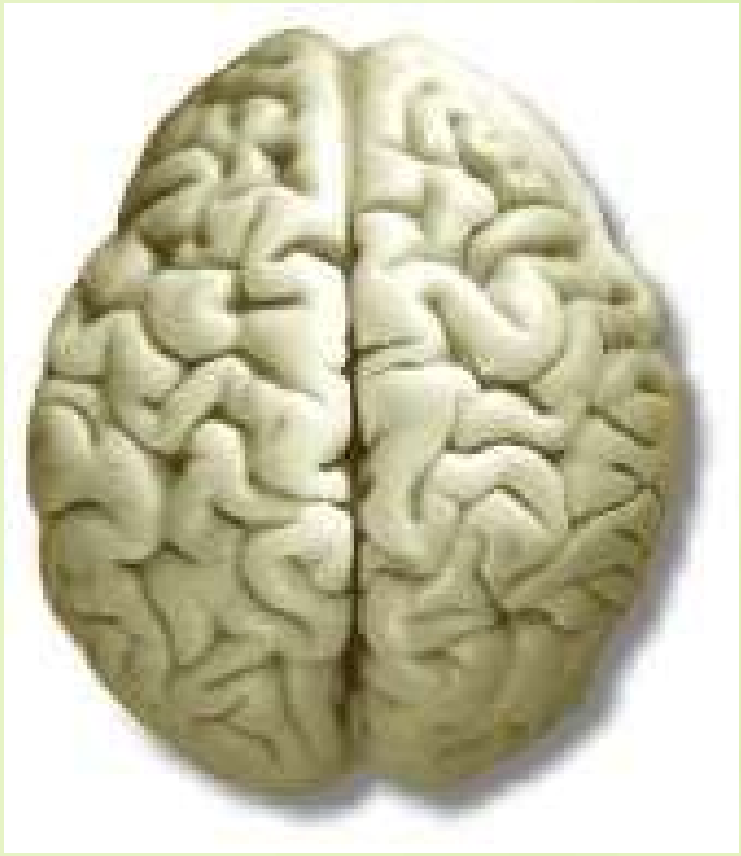
GABA: Gamma-aminobutyric acid



- **GABA is the main inhibitory neurotransmitter in the nervous system**
- **Anti-anxiety drugs are agonists for GABA**
- **Lack of GABA may contribute to epileptic seizures**