* **Neural and Hormonal Systems**  
    
  Psychology and Biology
* Everything psychological is simultaneously biological.
  + To think, feel or act without a body would be like running without legs.  
    -We are bio-psycho-social systems. To understand our behavior, we need to study how biological, psychological and social systems interact.
* The human brain is the most complex system, natural or man made, in the world.
  + About 3 lbs.  
    About the size of a grapefruit  
    Pinkish/gray in color  
    About 100 billion nerve cells  
    At a loss rate of 200,000 per day during our adult lives we still end up with over 98% of or brain cells.
* **Biopsychology:** The specialty in psychology that studies the interaction of biology, behavior and mental processes.  
  -The mind thinking about the mind.

some biological psychologists call themselves behavioral neuroscientists, neuropsychologists, behavior geneticists, physiological psychologists, or biopsychologists

* **Neuroscience** is a newer field of study in psychology focusing on the brain and our behavior.
* **Innate Abilities**

We are born with certain **innate** abilities, or things we are already programmed to do. But, there are things we must learn.   
-**Evolution** is the gradual process of biological change that occurs in a species as it adapts to its environment.

* A Wrongheaded Theory

-The study of the human brain has been a winding road. Plato was the first to correctly locate the mind in the spherical head.   
-Since the early 1800s we have come a long ways when a German physician developed the theory of phrenology.  
-Phrenology claimed that bumps on the skull could reveal our mental abilities and character traits. Ex. Mark Twain story

* **The Role of Evolution**

-Evolution has fundamentally shaped psychology because it favors genetic variations that produce adaptive behavior.  
-The evolutionary process is the link between genetics and behavior.

* **Natural Selection**

-Natural selection says those individuals best adapted to the environment are more likely to flourish and reproduce; those that are poorly adapted will tend to leave fewer progeny, and their line may die out.  
-For those individuals whose ancestors had accumulated new traits that allowed them to survive,   
  
Owl butterfly example  
<http://youtu.be/dR_BFmDMRaI>

* There are two main misconceptions about evolution and evolutionary psychology.

**1. Darwin said humans come from monkeys.**  
 In reality he suggests that we had a common ancestor millions of years ago.

**2. Behavior can alter heredity.**  
 People didn’t start growing bigger brains so they could communicate with language, but people who had bigger brains and could communicate had an easier time surviving. As a result, a bigger brain became a dominate trait in humans.

* **Evolution as an Accepted Theory…**

-The majority of sciences recognize evolution as a valid theory for more than a century.  
-Psychology has been slow to accept evolutionary psychology as a psychological theory.  
-Some psychologists say it puts too much emphasis on *nature* (biological) and not enough on *nurture* (learning).

* **Genetics and Inheritance**

-Psychologists agree that genetics play a role in our basic makeup including our temperament, tendency for fears and certain behavior patterns.  
-Our genetic inheritance is broken into two categories: *genotype* and *phenotype*.

* **Genotype and Phenotype**

**Genotype:** An organism’s genetic makeup.  
 -The blueprint for what an organism is.  
**Phenotype:** An organism’s physical characteristics.  
 -This includes the chemistry and “wiring” in our brains.

* **Heredity and the Environment**

-One important thing to remember about heredity is that it never acts alone.  
-Heredity always acts in a partnership with the environment, which includes biological influences like nutrition, disease, and stress.

* **Chromosomes, Genes and DNA**

Every cell in the body carries a complete set of biological instructions for building the organism. We have 23 pairs of chromosomes.  
 -Each chromosome consists of a long tightly coiled chain of DNA. This DNA holds our unique genetic characteristics.

* **Genes**

**Genes:** A segment of chromosome that encodes the directions for the inherited physical and mental characteristics of an organism.  
-Genes are the “words” that make up the organism’s instruction manual.

* **Chromosomes**

***Chromosomes:*** Threadlike structures consisting mostly of DNA, along which the genes are organized.  
-Chromosomes are like a string of words in a coded sentence. They also act as “punctuation,” detailing how and when each gene is to be expressed.

* **Sex Chromosomes  
  -**The two chromosomes responsible for determining a person’s biological sex are represented as either “XX” for femaleness or “XY” for maleness.  **-**From your mother, you inherit an “X,” essentially leaving your father’s contribution to determine your biological sex, depending on if you inherit and “X” or a “Y.”
* **Why You Don’t Look Exactly Like Your Siblings  
  -**It is important to remember that you are not exact replicas of your parents.  **-**You and your siblings probably look similar, but not exactly the same. This is because what you inherit from your parents is a random shuffling of genes. **-**This random shuffling and variation is what Darwin viewed as the raw material for evolution and genetic differences.
* **DNA Re-explained**<http://www.khanacademy.org/video/dna?playlist=Biology>
* **A Debate for the Future  
  -**This could be a touchy subject, so do not take any arguments personal!

-With some degree of certainty, parents can pick the sex of their child. Within the next 25-30 years, it is expected that parents will be able to pick the components of their child like a Subway sandwich line, adding and deleting certain physical and mental characteristics.   
 -Is this a good idea?

* **How Your Body Communicates**

Internally, your body has two communication systems. One works quickly, your nervous system, and one works slowly, your endocrine system.

* Content Objective  
  **Neuron**, **Dendrite, Axon**, **Synapse**, **Myelin Sheath**, **Terminal Buttons**, **Neurotransmitter**, **Absolute threshold, Action potential, All-or-none principle**, **Plasticity**, **Reflex**, **Neural pathway**, **Agonist**, **Antagonist**
  + Language Objective  
    **First, second, then, next**   
    **Initially**   
    **Subsequently**   
    **Simultaneously**
* **Stress and Happiness  
  -**These two systems do not just work in cooperation during stressful situations like a car accident, but also in happier situations, such as when you earn an unexpected “A,” or “fall in love.” **-**Why Study Them **-**These two systems are the biological foundations for all of our thoughts, emotions and behaviors.  **-**When one of these two systems falters, the result can be a multitude of effects on the brain and mental functions, some mild and some life altering.
* **Neurons: Our Building Blocks**

-Neurons are cells specialized to receive, process and transmit information to other cells.  
-Bundles of neurons are called nerves.

* **3 Types of Neurons**While neurons can be different sizes and shapes, they all share a similar structure and function in a similar way.  **-**Neurons are broken into three categories based on their location and function: **-Sensory Neurons  
   -Motor Neurons  
   -Interneurons**
* **A neuron exists to perform 3 tasks:**1.) Receive information from the neurons that feed it.  
  2.) Carry information down its length.  
  3.) Pass the information on to the next neuron.
* **Sensory Neurons  
  -***Sensory neurons,* or *afferent neurons*, act like one-way streets that carry traffic from the sense organs ***toward*** the brain.The sensory neurons communicate all of your sensory experience to the brain, including vision, hearing, taste, touch, smell, pain and balance.
* **Motor Neurons  
  -***Motor neurons,* or *efferent neurons*, form the one-way routes that transport messages ***away*** from the brain to the muscles, organs and glands.
* **Interneurons**Sensory and motor neurons do not communicate directly with each other. Instead, they rely on a middle-man.  **-***Interneurons*, which make up the majority of our neurons, relay messages from sensory neurons to other interneurons or motor neurons in complex pathways.
* What a Neuron Looks Like
* **How Neurons Work  
  -**The **dendrite**, or “receiver” part of the neuron, which accepts most of the incoming messages. **-**Consists of finely branched fibers. **-**Selectively permeable **-**Dendrites complete their job by passing the incoming message on to the central part of the neuron called the ***soma***.  **-**The soma, or ***cell body***, contains the cell’s nucleus and life-support machinery. **-**The function of the soma is to assess all messages the cell receives and pass on the appropriate information, at the appropriate time.  **-**When the soma decides to pass-on a message, it sends the message down the **axon**.  **-**The axon is a single, larger “transmitter” fiber that extends from the soma. **-**This is a one way street
* **Axon**The **axon** is the extension of the neuron through which the neural impulses are sent. **-**Axons speak, dendrites listen. **-**In some neurons, like those of the brain, the axons are very short. In others, like those in the leg, they can reach 3 feet long.
* **Action Potential  
  -**Information travels along the axon in the form of an electrical charge called the **action potential**.  **-**The action potential is the “fire” signal of the neuron and causes neurotransmitters to be released by the terminal buttons.
* **Myelin Sheath  
  -**The myelin sheath protects the axon and the electric signal that it is carrying much like the orange plastic coating does on an electrical cord. **-**The myelin sheath is made up of Schwann cells, which is just a specific type of glial cells
* **Nodes of Ranvier  
  -**The Nodes of Ranvier are the microscopic spaces between the myelin cells that cover the axon. These spaces are important because they keep the action potential going through the long axon. **-**Without the spaces, the charge might lose its intensity before reaching the end of the cell. **-**Think of the nodes as the turbo button in a race car game
* **Action Potential and Resting Potential  
  -**The axon gets its energy from charged chemicals called ions. In its normal state, the ions have a small negative charge called **resting potential**.  **-**This negative balance can be easily upset, however. When the cell becomes excited, it triggers the **action potential**, which reverses the charge and causes the electrical signal to race along the axon.
* **Absolute Threshold  
  -**The neuron is a mini decision maker. It receives info from thousands of other neurons-some excitatory (like pushing the gas pedal). Others are inhibitory (like pushing the breaks).  **-**If the excitatory signals, minus the inhibitory signals exceed a minimum intensity, called the ***absolute threshold***, then action potential is realized or crossed. **-**Think of it as a class vote: if the excitatory people with their hands up outnumber the inhibitory people with their hands down, the vote passes.
* **Refractory Period  
  -**Each action potential is followed by a brief recharging period known as the refractory period. **-**After the refectory period, the neuron is capable of another action potential.  **-**Much like waiting for the flash to recharge on a disposable camera before you can take another picture.
* **All or Nothing  
  -**Once the action potential is released, there is no going back. The axon either “fires” or it does not. This process is called the **all-or-none principal**.
  + How do we detect a gentle touch from a slap? A strong stimulus, like a slap, can trigger more neurons to fire, more often, but not any stronger.  
     -Squeezing a trigger harder wont make the bullet go faster.
* **Depolarization  
  -Depolarization** is the initial movement of the action potential where the action passes from the resting potential in the cell body into the action potential in the axon.
* **How Cells Connect  
  -**Neurons do not actually touch each other to pass on information. The gap between neurons is called the **synapse**.  **-**The synapse acts as an electrical insulator, preventing an electrical charge from racing to the next cell.-To pass across the synaptic gap, or synaptic cleft, an electrical message must go through a change in the **terminal buttons**.   
  -This change is called **synaptic transmission**, and the electrical charge is turned into a chemical message that flows easily across the synaptic cleft.  
  -In the terminal buttons are small sacs called **synaptic vesicles**. These vesicles contain **neurotransmitters** which are chemicals used in neural communication.  
  -When the action potential reaches the vesicles, they are ruptured and the transmitters spill out. If they have the right fit, the transmitters fit into the receptors like a key into a lock.
* **Reuptake  
  -**Cells are very efficient. Neurotransmitters that are not absorbed by the connecting dendrite are reabsorbed by the sending neuron in a process called *reuptake.* **-**SSRI (Selective seratonin reuptake inhibitor) example
* **Some Neurotransmitters and Their Functions**
* **Acetylcholine (ACh)**  
  -Involved in memory and muscle activity  
  -Causes muscle contraction  
  - Lack – Alzheimer’s  
   Curare – blocks Ach receptors – paralyzed  
  Botulin – Botox – paralyzes underlying face muscles   
   Black widow – flood of Ach - contractions
* **Endorphins**  
  -“morphine within”   
  -natural, opiate-like neurotransmitters  
   linked to pain control and pleasure
* **Dopamine**  
  -An excitatory transmitter  
  -Excess – Schizophrenia  
  - Deprived – Parkinsons - tremors
* **Serotonin**  
  -Enhances mood, eating, sleep, and sexual behavior  
  -Lack – depression – Prozac –blocks reuptake
* **Norephidrine**   
  Alertness and arousal  
   Lack – depressed moods
* **GABA – gamma aminobutyric acid**  
   Inhibiting neurotransmitter  
   Lack – seizures, tremors, insomnia
* **Agonist** - molecules mimic neurotransmitters  
  -Morphine – mimics actions of endorphins  
  -Stimulates brain areas involved in mood and pain sensations
* **Antagonists** - similar enough to fit in receptor site and block neurotransmitter action  
  Curare – paralyzes by blocking Ach receptors
* The chemicals that our bodies produce work as agonists (excite) and antagonists (inhibit). They do this by *amplifying* or *mimicking* the sensation of pleasure **(agonist),** or *blocking* the absorption of our neurotransmitters **(antagonist).**  
   -Agonist-opiates mimic the high produced naturally  
   -Antagonist-botulin blocks ACh (enables muscle action)
* **The Blood-Brain Barrier**   
  -Allows brain to fence out undesirable chemicals   
  -zParkinson’s – dopamine cannot pass the blood-brain barrier – L-dopa can and is converted to dopamine by the brain
* **Glial Cells**Amongst the vast number of neurons are glial cells. These cells bind the neurons together and help provide insulating covering for the axon.  **-**They act as glue to hold cells together, facilitate communication and potentially play a role in intelligence. **-**Einstein: myth was a bigger brain, truth was more glial cells!
* Content Objective   
  **Brain stem, Medulla, Pons, Reticular formation, Thalamus, Cerebellum, Cerebral Cortex, Limbic system, Hippocampus, Hypothalmus, Cerebral cortex, Brain lobes, Central nervous system, Peripheral nervous system, Autonomic nervous system, Sympathetic nervous system, Parasympathetic nervous system, Glial cells, Reflex, Plasticity**
  + Language Objective  
    **If….then  
    As a result of…  
    One reason for…**  
    **Which in turn…**  
    **Accordingly…**
* **How Does a Neuron Work?**
* **Interneurons**CNS neurons that internally communicate and intervene between the sensory inputs and motor outputs.
* **Sensory Neurons**- *afferent neurons*   
  -Neurons that carry incoming information from the PNS to the central nervous system and the brain. Also known as afferent neurons.  
  -Motor Neurons- *efferent neurons*   
  -Neurons that carry outgoing information from the CNS to muscles and glands. Also known as efferent neurons.
* **Structures of the Nervous System**The nervous system has 2 major components: **-Central Nervous System (CNS)  
   -Peripheral Nervous System (PNS).**
* **The CNS  
  -**The Central Nervous System includes the brain and the spinal cord.   
  -They are so important to the human body that they are encased in bone for protection-  
   -Support for evolutionary psychologists
* **The Peripheral Nervous System  
  -**The Peripheral Nervous System contains all of the nerves which feed into the brain and spinal cord. **-**Sensory and motor neurons that connect the CNS with the rest of the body
* **Somatic Nervous System**  
  The division of the peripheral nervous system that controls the body’s skeletal muscles-voluntary movements
* **Autonomic Nervous System**   
  -The part of the *peripheral nervous system* that controls the glands and the muscles of the internal organs (such as the heart)   
   -**Sympathetic Nervous System**   
   -The division of the *autonomic nervous system* that arouses the body, mobilizing its energy in stressful situations   
   -**Parasympathetic Nervous System**   
   -The division of the *autonomic nervous system* that calms the body, conserving its energy
* **Sympathetic and Parasympathetic  
  -**The *sympathetic* and *parasympathetic* nervous systems together make an *opponent process system*-opponent systems work in opposition of each other to create a *homeostatic* balance. **-**Sympathetic causes the body to rise to the challenge it faces.  **-**Parasympathetic causes the body calm after the challenge.   
  The result is a balanced state in the body
* **Reflexes**Our automatic response to stimuli are***reflexes***.A simple spinal reflex pathway is composed of a single sensory neuron and a single motor neuron, connected through the spine with an inter neuron.This type of response does not involve the brain, and is often why we feel our body move before we feel the stimuli **-**A warm, headless body could demonstrate a reflex like that produced when hitting the patellar tendon with a hammer.
* **The Endocrine System  
  -**The endocrine system is the body’s chemical messenger system, that relies on hormones. **-**Hormones travel through the bloodstream and affect other tissues. When they act on the brain they they influence our interest in sex, food and aggression. **-**Major glands: endocrine glands: pituitary, thyroid, parathyroid, adrenals, pancreas, ovaries, and testes. **-**Endocrine “messages” tend to work slow, but outlast the effects of neural messages.
* **Working with Other Systems  
  -**The nervous system directs endocrine secretions, which then affects the nervous system. **-**Under ***normal*** (unaroused) conditions, the endocrine system works in parallel with the ***parasympathetic*** nervous system to sustain our basic body processes. **-**In ***crisis***, the endocrine system shifts into a new mode to support the ***sympathetic*** nervous system….it releases epinephrine (adrenalin). **-**Triggers the “fight or flight” response
* **The Master Gland**-While the body has a many glands which are important, the most important glad is the **pituitary gland**.  **-**Controls all of the responses of the endocrine system
* **The Brain**
* Neurons cluster into work groups called **neural networks**.  
   -Neurons work with those close by to ensure short, fast connections.  
   -Learning occurs as feedback strengthens connections.  
   -*Neurons that fire together wire together.*
* For creatures with more complex brains, there are three levels. Creatures with complex brains all share a similar stalk, the **brain stem**.  
   -The brain stem is the part of the brain with the longest ancestry  
   - Even the most simple creatures have this part of the brain  
  On top of the brain stem, in more evolved creatures, are the *limbic system* and the *cerebral cortex.*
* The **brain stem** is made up of four regions: the *medulla*, the *pons*, the *reticular formation* and the *thalamus*.
* The **medulla** is the bulge low in the brain stem. It regulates basic body functions including breathing, blood pressure and heart rate.  
  -The medulla operates on autopilot without our conscious awareness, like most of our brainstem.
* **The Pons  
  -**The pons is an even larger bulge that sits just above the medulla. **-**The pons helps relay signals to the cerebellum that deal with movement as well as sleep, respiration, swallowing, bladder control, hearing, equilibrium, taste, eye movement, facial expressions, facial sensation and posture.Pons is Latin for bridge, a fitting name since it acts as a “bridge” which connect the brain stem to the cerebellum.
* **The Reticular Formation  
  -**The reticular formation is a pencil shaped bundle of nerve cells that forms the brain stem’s core. **-**One job of the reticular formation is to keep the brain awake and alert. **-**Also is responsible for monitoring incoming sensory messages.
* **The Thalamus**A pair of egg shaped structures at the very top of the brain stem near the center of the brain.  
  The thalamus is like the central processing chip of a computer and directs all incoming and outgoing sensory and motor traffic. **-**With the exception of smell
* **The Cerebellum  
  -**Sometimes called the “little brain,” the cerebellum sits at the back of the brain stem and looks like a miniature version of our brain.  
  -The cerebellum enables one type of nonverbal learning and memory. It helps judge time, regulate our emotions and discriminate sounds and textures.  
   -Actions we perform without consciously thinking about-walking, dancing, or drinking from a cup.
* **Limbic System  
  -**The limbic system is the middle layer of brain that wraps around the thalamus. Together, the limbic system and the thalamus give humans/mammals the capability for emotions and memory **-**The layers of the limbic system not only processes memories and regulate emotions, it is also involved in feelings of pleasure, pain, fear and rage. **-**Cat experiments, brain lesions  **-**Expands on the more basic functions of the brain stem.
* **Hippocampus**One of the two most important parts of the limbic system is the hippocampus.  **-**Technically there are two hippocampi and their job is to connect your present with your past memories.
* **Amygdala  
  -**The second part of the limbic system that is important is the amygdala. Like the hippocampi, the amygdalas’ job relates to memory and emotion. **-**It also seems to play the largest role in dealing with feelings of pleasure.
* **Hypothalamus  
  -**A third part of the limbic system is the hypothalamus. It’s function is to analyze the blood flow in your body. **-**Specifically regulates body temperature, fluid levels and nutrients. **-**When it detects an imbalance, it tells the body how to respond.-The hypothalamus is organized into neural clusters that influence different things: hunger, thirst, body temperature and sexual behavior.  
  -The hypothalamus has “reward centers.”   
   -In a series of experiments with rats they inserted electrodes on these reward centers. Rats were given access to a pedal that would stimulate their own reward centers. Rats would hit the pedal up to 7,000 times per year until they passed out. They would even cross an electrified floor to hit the pedal that a starving rat would not cross to reach food.   
   -Addictive disorders could stem from *reward deficiency syndrome*-leads people to crave whatever provides that missing pleasure re relieves negative feelings.
* **Cerebral Cortex  
  -**When you look at a human brain, the majority of what you see is the cerebral cortex.  **-**The cerebral cortex is a thin layer of interconnected neural cells. It is the brains ultimate control and information-processing center. **-**The larger cortex of mammals offers increased capacities for learning and thinking, enabling them to be more adaptable.  **-**The wrinkles of the brain are made by fissures and folds called Gyri.

**Frontal and Parietal Lobes  
Frontal Lobes:** Portion of the cerebral cortex just behind the forehead. **-**Involves the motor cortex. **-**Involved in making plans and judgment.  **Parietal Lobes:** Portion of the cerebral cortex at the top of the head. **-**Used for general processing, especially mathematical reasoning.

***Motor Cortex:*** Area of the brain at the back of the frontal lobe. **-**In charge of the movement of your body parts. **-**The motor cortex on the right side of your brain controls the movement of the left side of your body, and vice versa.

* + ***Demo: move your right hand in a circular motion. Now move your foot in the same direction. Easy?***
    - ***Try moving your foot in the opposite direction. Much harder.***
    - ***Try moving your left foot in the opposite direction. Why is it easier?***  
       ***Sensory Cortex:*** At the front of the parietal ***lobe***.  
      -Experiences and processes body touch and movement sensations.  
      The sensory cortex on the right side of your brain controls the sensation of the left side of your body, and vice versa.
    - The Motor Cortex and the Somatosensory Cortex
* **The Motor Cortex**  
  -**The areas requiring precise control occupy the greatest amount of cortical space.**
* **Temporal Lobes:** The temporal lobe is involved in auditory processing.   
  -It is also heavily involved in semantics both in speech and vision.   
  -The temporal lobe contains the hippocampus and is therefore involved in memory formation as well.   
  **Occipital Lobes:** Portion of the cerebral cortex just at the back the brain   
   -Responsible for visual functions
* **Association Areas  
  -**These are areas of the cerebral cortex that are not involved in primary motor/sensory functions but are involved in higher level mental functioning: learning, thinking, memory and speaking. **-**Damage to an association area can have a wide range of consequences from changes in personality, to removing a person’s inhibitions.Phineas Gage was a railroad worker in the mid 1800s. After a work accident blew a steel rod through Gage’s head, entering the left cheek and exiting the top of his skull, people were amazed that he was immediately able to sit up and speak, eventually returning to work. The once affable, soft spoken Gage, however, had become irritable, profane and dishonest. While his mental abilities and memories were intact, his personality was greatly changed.
* **Aphasia  
  -**Damage to any one of several cortical areas can cause *aphasia*, or an impaired use of language. **-**When you read words aloud, the words (1) register in the visual area, (2) are relayed to a second area, the angular gyrus, which transforms them into an auditory code that is (3) received and understood in Werneicke’s area and (4) sent to Broca’s area, which (5) controls the motor cortex as it creates the pronounced word. Depending on which link in the chain is damaged, a different form of aphasia occurs. **-Plasticity**
* Your brain has the ability to modify itself after some types of damage. This usually takes the form of reorganization.  
  -Blindness or deafness leaves areas of the brain free to be used for other cognitive tasks.  
  -Plasticity means the nervous system, and especially the brain, has the ability to adapt or modify itself as the result of *experience*.  
   While *neurogenesis*, forming of new neurons each day, does happen, your brain cells do not usually regenerate.
* Plasticity Video
* <http://www.learner.org/vod/vod_window.html?pid=2380>
* <http://www.youtube.com/watch?v=TSu9HGnlMV0>

**Broca’s area and Wernicke’s area**

* **Broca and Wernicke**
* **Broca’s Area:** Located in the left frontal lobe.  
   -Is involved with expressive language.  
   -Damage to this area results in difficulty with spoken language.  
   -Area directs muscle movements important to speech production.
* **Wernicke’s Area:** Located in the temporal lobe.  
   -Controls receptive language (understands what someone else says.)
* **Damage to Broca’s Area  
  -**When a person experiences brain damage in Broca’s area, the result is often times expressed in difficulty with speech.  **-**Common in stroke patients
* **Divided Brains  
  -**Evidence has suggested that each hemisphere of the brain serves different functions. This *lateralization*, is apparent after brain damage. **-**In the recent past, patients who had severe cases of epilepsy would sometimes be treated with a procedure they called the “split brain.”
* **The Split Brain Procedure  
  -**For these patients, life changed very little on the service, with the exception of far fewer seizures. Put under certain circumstances, however, the side effects were very clear.
* **Myth of the “Two Brains”  
  -**There is no activity to which only one hemisphere makes a contribution. **-**Logic is not confined to the left hemisphere. **-**There is no evidence that either creativity or intuition is an exclusive property of the right hemisphere. **-**It is impossible to educate one hemisphere at a time. **-**There is no evidence that people are “right brained” or “left brained.”
* **Differences in the Hemispheres  
  -**What studies about the brain do reveal is that the left hemisphere is more active when a person deliberates over decisions. **-**The right hemisphere understand simple requests, easily perceives objects and is more engaged when quick, intuitive responses are needed.  **-**The right hemisphere is is also more active when copying drawings, recognizing faces and perceiving emotions.
* **Which one is happier?  
  -**Stare at the center of one face, then the other. Does one appear happier? **-**Most people say the face on the right does. Researchers think this is because the right hemisphere, more skilled at emotion, receives information from the left half of each face.
* **Techniques for Studying Human Brain Function and Structure**
* **EEG (*Electroencephalography*)  
  Technique:** Multiple electrodes are pasted to outside of head **What it shows:** A single line that charts the summated electrical fields resulting from the activity of billions of neurons **Advantages** Detects very rapid changes in electrical activity, allowing analysis of stages of cognitive activity **Disadvantages** Provides poor spatial resolution of source of electrical activity
  + **PET (*Positron Emission Tomography*)  
    SPECT (*Single Photon Emission Computed Tomography*)  
    Technique:** Positrons and photons are emissions from radioactive substances **What it shows:** An image of the amount and localization of any molecules that can be injected in radioactive form, such as neurotransmitters, drugs, tracers for blood flow or glucose use (which indicates specific changes in neuronal activity) **Advantages** Allows functional and biochemical studies;   
     Provides visual image corresponding to anatomy  
    **Disadvantages** Requires exposure to low levels of radioactivity;  
     Provides spatial resolution better than that of EEG, but poorer than that of MRI  
     Cannot follow rapid changes (faster than 30 seconds)
* **MRI (*Magnetic Resonance Imaging*)  
  Technique:** Exposes the brain to magnetic field and measures radio   
  frequency waves **What it shows:** Traditional MRI provides high resolution image of brain anatomy, and newer functional images of changes in blood flow (which indicate specific changes in neuronal activity) **Advantages of MRI:** Requires no exposure to radioactivityProvides high spatial resolution of anatomical details (<1 mm)Provides high temporal resolution (<1/10 of a second)
* **fMRI-Functional MRI  
  -**It can reveal the brain’s functioning as well as structure. **-**a technique for determining which parts of the brain are activated by different types of physical sensation or activity, such as sight, sound or the movement of a subject's fingers.  **-** This "brain mapping" is achieved by setting up an advanced MRI scanner in a special way so that the increased blood flow to the activated areas of the brain shows up on Functional MRI scans.
* **MEG (*Magnetoencephalography*)  
  What it shows:** Detects the magnetic fields produced by electrical currents in neuronsDetects and localizes brain activity, usually combined with structural image from MRI **Advantages:** Detects very rapid changes in electrical activity, allowing analysis of stages of cognitive activity**.** Allows millimeter resolution of electrical activity for surface sources such as cerebral cortex **Disadvantages:** Poor spatial resolution of brain activity in structures below cortexEquipment is very expensive
* Combining a PET Scan and an   
  Magnetic Resonance Imaging
* Brain Surgery Violinist
  + [https://www.youtube.com/watch?v=T3QQOQAILZw#action=share](https://www.youtube.com/watch?v=T3QQOQAILZw)