Review of Key Concepts and Terms (Unit 1A)

Biological Bases of Behavior

Important but NOT TESTABLE vs. New this year(24-25), TESTABLE; add to your notes

The structures of human biological systems and their functions influence our behavior and mental processes. Some psychologists study behaviors and mental processes from a biological perspective. This includes an examination of the influence that the interaction between human biology and our environment has on behavior and mental processes. This is a recurring topic throughout the course that will be used to explain many psychological phenomena. The biological perspective also provides insight into the causes of and treatments for psychological disorders. There is a complex interaction between a person's biology and their behavior and mental processes. Heredity and environment play a role, as do variations in a person's consciousness.

Topic 2.1: Interaction of Heredity and Environment

Learning Target 2.A

Discuss psychology's abiding interest in how heredity, environment, and evolution work together to shape behavior.

An important aspect of the study of psychology is the interplay among genetic, environmental, and evolutionary influences. Complex human traits, such as intelligence, aggression, altruism (selfless concern for others), and personality, are influenced by all of these factors.

For instance, psychologists attempt to determine how an individual's level of aggression is impacted by inheritance and exposure to violence, as well as why aggressive tendencies were naturally selected.

Behavioral genetics attempts to integrate the influences of heredity, environment, and evolution in terms of their effect on human behavior

Every human cell contains 46 chromosomes in 23 pairs. The genetic material that makes up chromosomes is DNA. Certain segments of DNA control the production of specific proteins that control some human traits. These discrete segments are called genes

Genes can be dominant or recessive. If we inherit two recessive genes for a particular trait, that trait will be expressed. In any other combination of genes, the dominant trait is expressed.

A **genotype** comprises all of the possible combinations of genes. The **phenotype** is the observable result.

Psychological researchers investigate how different combinations of genes create tendencies for physical and behavioral traits.

Our gender is determined by our 23rd pair of chromosomes. Men have an X and Y chromosome and women have two X chromosomes. Usually a man will contribute either an X chromosome (resulting in a girl) or a Y (resulting in a boy)

Since identical twins (called **monozygotic twins** since they develop from one fertilized egg) share all the same genetic material, researchers study them in order to examine the influence of genes on human traits.

Heritability is the degree of variance among individuals that can be attributed to genetic variations. Many physical and psychological characteristics are inherited. However, genes do not determine everything about us. Environmentality is the degree to which a trait's expression is caused by the environment in which an organism lives.

Today, the debate is no longer nature versus nurture, but rather nature and nurture working together; our psychological makeup is largely the result of the interaction of the two forces.

Learning Target 2.B

Identify key research contributions of scientists in the area of heredity and environment.

Charles Darwin

- British naturalist
- Theory of evolution / natural selection
    - Given a range of possible inherited trait variations, those traits that lead to increased reproduction and survival of the species are most likely to be passed down to generations that follow.
    - **Adaptation** is the process by which an organism or species becomes better suited for life in its environment
    - **Adaptive traits** are the specific traits that make the organism or species better suited
- Ideas of "natural selection" continue to influence the modern evolutionary perspective

Learning Target 2.C

Predict how traits and behavior can be selected for their adaptive value.

Based on the ideas of **natural selection** – the principle that, among the range of inherited trait variations, those contributing to ***reproduction and survival*** will most likely be passed on to succeeding generations.

- Certain biological and behavioral variations increase organism's reproductive and survival chances in their particular environment
- Offspring that survive are more likely to pass their genes to ensuing generations
- Thus, over time, population characteristics may change
- Some genetic variations arise from mutations (random errors in gene replication), others from new gene combinations at conception
- Examples of adaptive traits (common in cultures throughout the world)
    - Nausea of pregnant women, especially after eating bitter or strongly flavored food

- Human mate preferences - men seek out many partners with the goal to procreate as much as possible; women are more likely to have fewer partners with the goal of finding a suitable mate with good genes

Topic 2.2: The Endocrine System

Learning Target 2.D

Discuss the effect of the endocrine system on behavior.

The endocrine system consists of ductless glands, which secrete ***hormones***, or chemical messengers into the bloodstream. The endocrine system uses these hormones to control and coordinate functions, including growth, metabolism, reproduction, and stress responses. Transported by the bloodstream throughout the body, hormones are capable of influencing behavior in a **SLOW** fashion over minutes, hours, or weeks, instead of the nervous system's fast milliseconds. Though hormones circulate throughout the bloodstream, only certain types of cells respond to each hormone in the same way neurotransmitters fit into only certain receptor sites. The central nervous system exerts control over the endocrine system through the activity of the ***hypothalamus***, a limbic system structure that releases hormones that trigger action by the pituitary gland.

Gland/Location	Hormone	Function	Dysregulation
Pituitary Gland "Master Gland" Forebrain structure below the hypothalamus	Growth Prolactin Oxytocin storage Various hormones that stimulate other glands	The pituitary gland regulates growth, breast milk production, childbirth, bonding, and communicates to other glands to release hormones	Extremes in height
Pineal Gland Forebrain structure	Melatonin	The pineal gland regulates seasonal and sleep cycles. Melatonin concentrations fluctuate daily with higher levels at night causing drowsiness.	Seasonal Affective Disorder (SAD)
Thyroid and Parathyroid Glands Throat	Thyroxine Calcitonin Parathyrin	The thyroid controls metabolism or the rate at which glucose is converted to energy. Together the parathyroid glands regulate calcium levels in the blood.	Hypothyroidism (underactive gland) Hyperthyroidism (overactive gland)
Adrenal Glands Above kidneys	Cortisol Epinephrine (Adrenaline) Norepinephrine (Noradrenaline)	The adrenal glands are controlled by the sympathetic nervous system's flight-or-fight reaction, which increases heart rate, blood pressure, and glucose levels to respond to a threat.	Excessive sympathetic nervous system activity can compromise the immune system.
Pancreas Close to the stomach	Insulin Glucagon	The pancreas regulates sugar metabolism	Diabetes Low blood sugar

Gonads Testes Ovaries	Androgens, including testosterone Estrogen Progesterone	The gonads allow for sexual reproduction	Reproductive difficulties Higher levels of testosterone are correlated with increased aggression.

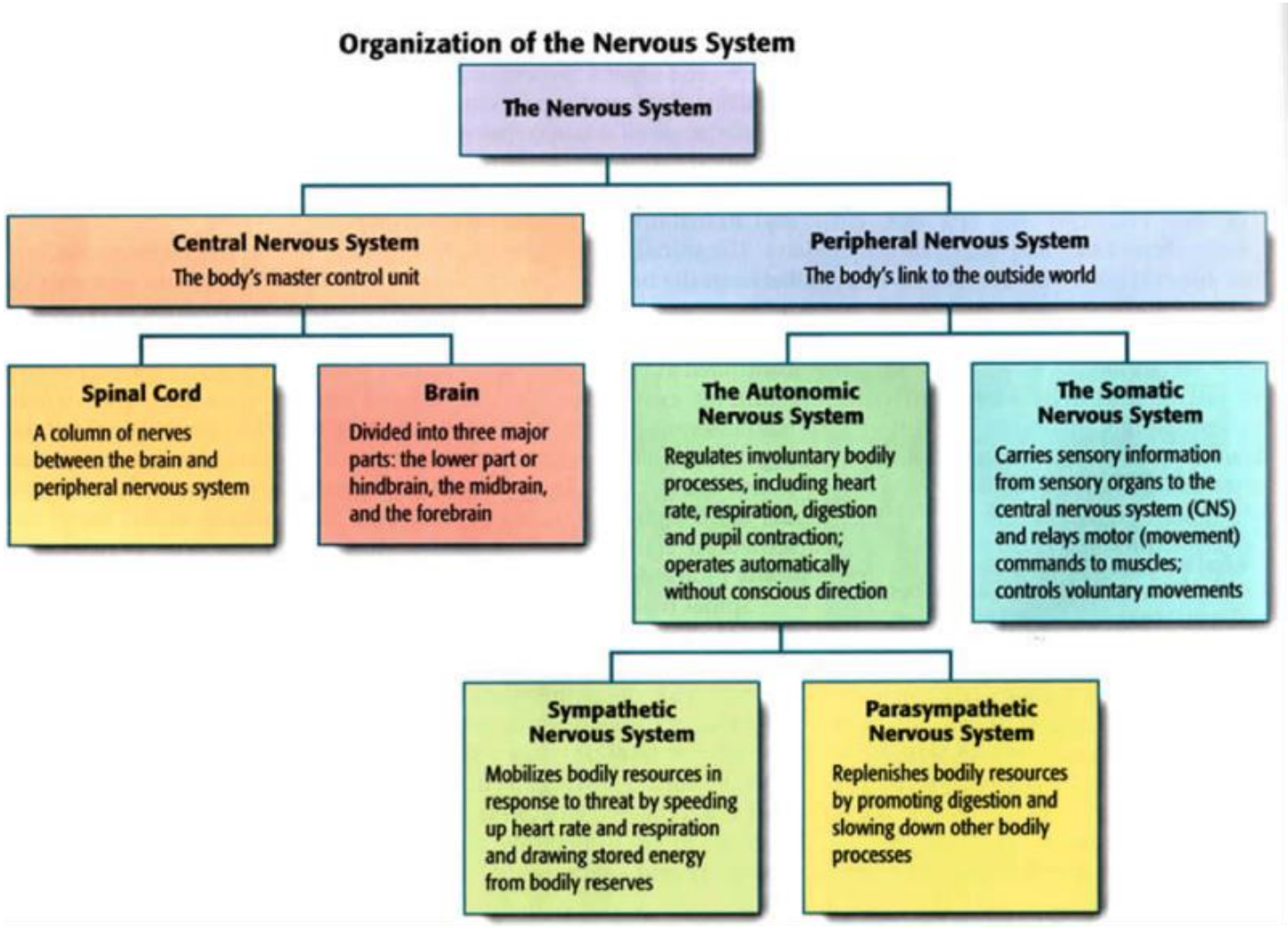
See also for hormones: leptin, ghrelin

Topic 2.3: Overview of the Nervous System and the Neuron

Learning Target 2.E

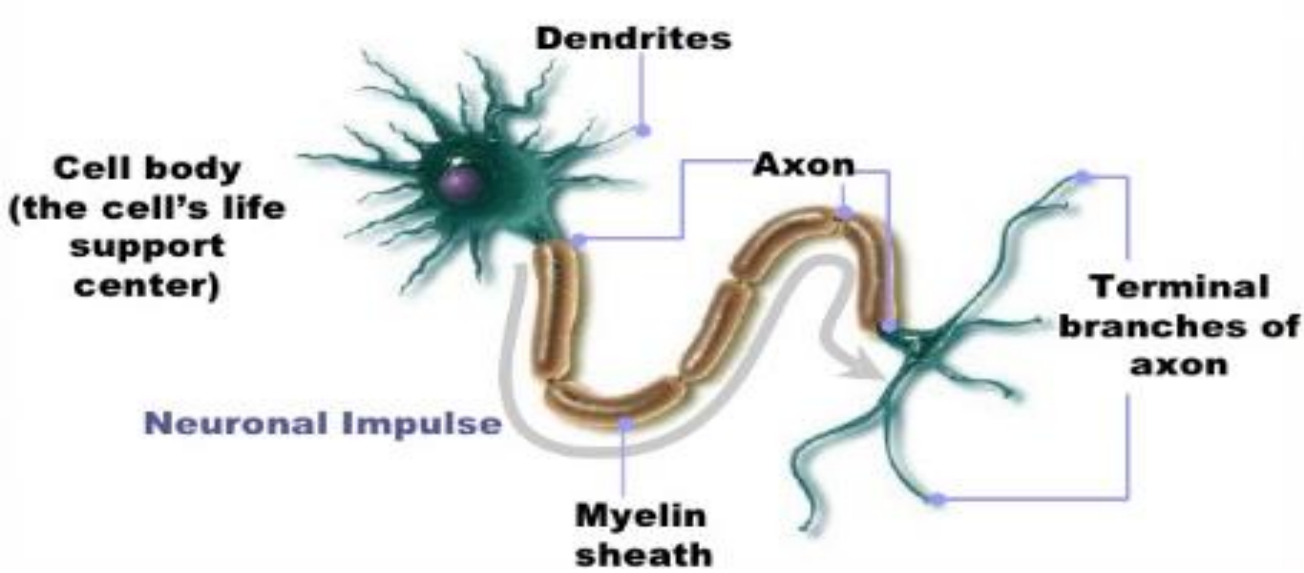
Describe the nervous system and its subdivisions and functions.

The human nervous system manages and directs all the voluntary and involuntary actions that we make, as well as our thoughts.



Learning Target 2.F

Identify basic processes and systems in the biological bases of behavior, including parts of the neuron.



Neuron	Location	Function
Cell Body (Soma)	Center of the Neuron	Contains the nucleus and produces energy for the neuron
Nucleus	Center of the cell body	Contains the genetic information of the neuron in the form of DNA
Dendrites	Branches extending from the cell body	Receive chemical messages via neurotransmitters from other neurons and transports them to the cell body of the neuron
Axon	A long tube-like extension attached to the cell body	Sends the electrical message (ACTION POTENTIAL) away from the cell body of the neuron
Myelin Sheath	Insulating layer of fat cells surrounding the axon of some neurons	Fatty substance produced by glial cells that provides insulation and increases the SPEED of the electrical message (action potential) * Deterioration of the myelin sheath leads to the loss of muscle control associated with the neurological disease **multiple sclerosis (MS)**
Nodes of Ranvier	Regularly spaced gaps in the myelin sheath along the axon	Enables ion exchange resulting in the electrical message (action potential) jumping across gaps in what is called ***saltatory conduction***.
Terminal Buttons (Terminal Buds / Axon Terminal)	Small knoblike structures at the end of the axon	Contains neurotransmitters in vesicles (sacs) to be released across the synapse.
Synaptic Vesicles	Tiny sacs located in the terminal buttons	Responsible for storing and releasing neurotransmitters
Synapse (Synaptic Cleft/Gap)	Extremely narrow space between the terminal button of the sending neuron and the receptor site of the receiving dendrite	Location of neurotransmission No physical contact between neurons
Receptor Sites	Ends of the dendrites on the postsynaptic neuron	Areas on the dendrite that receive neurotransmitters to initiate cell firing

		Receptor sites are specifically designed for particular neurotransmitters

Neural Diversity

Neurons come in many shapes and sizes. They also have a variety of functions.

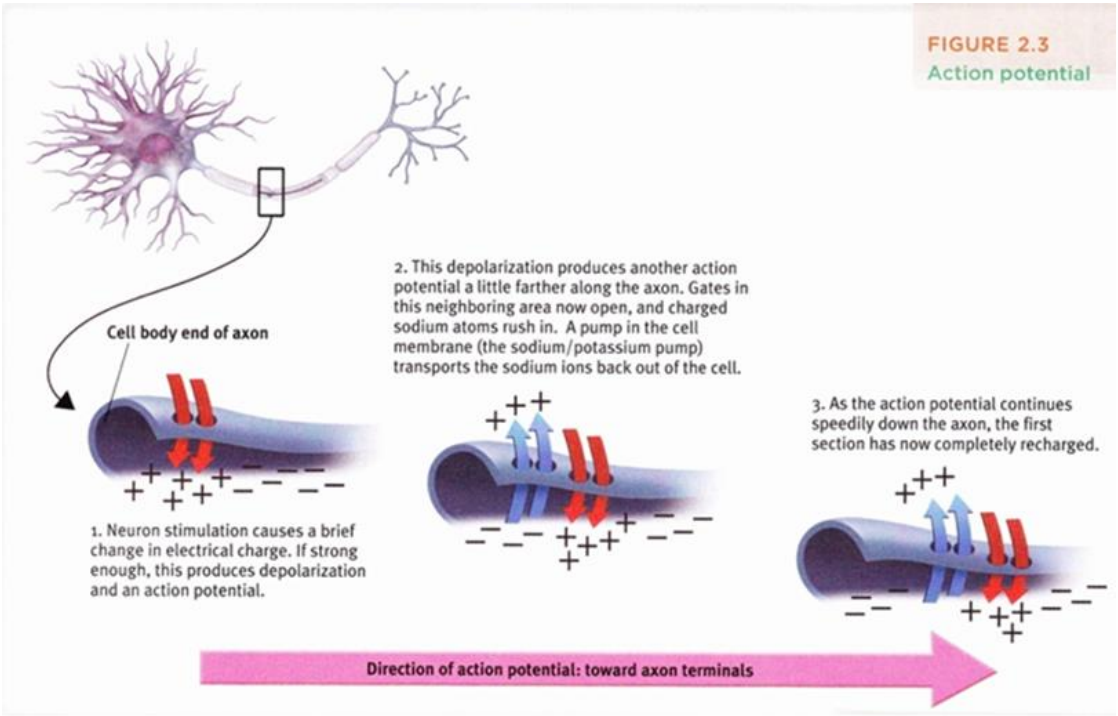
- **Sensory Neurons** (also known as *Afferent Neurons*) take input received through sensory receptors throughout the body, such as in the skin, eyes, nose, ears, and tongue, and pass it on toward the brain and spinal cord to initiate a response.
- **Motor Neurons** (also known as *Efferent Neurons*) transmit signals from the brain to our muscles and other organs.
- **Interneurons** are relay neurons, or connectors, allowing for information to pass between neurons.

Topic 2.4: Neural Firing

Learning Target 2.G

Identify basic process of transmission of a signal between neurons.

Exclude: sodium-potassium pump



Steps of a Neural Impulse

Resting Potential (Polarization)	While the neuron is waiting for a message, the fluid-filled interior of the axon has a negative charge and the fluid exterior has a positive charge • Charged particles or ions are located on the inside (Potassium - K^+) and outside (Sodium - Na^+) of the axon membrane.

Threshold	When the neuron is stimulated by pressure, heat, light, or chemical messages, the electrical charge inside the exon can reach a tipping point (slightly more positive than the resting potential) known as the threshold.
All-or-None Principle	Once threshold has been reached, the neuron fires completely, regardless of how strong the stimulus was.
Action Potential (Depolarization)	Depolarization occurs during the action potential when the interior of the axon changes to a less negative charge. The firing process of the neuron begins when the axon allows certain ions through its semi-permeable membrane, making the interior of the axon become less negative. ● Sodium (Na^+) ions move to the inside of the ion ● Potassium (K^+) ions move to the outside of the ion
Repolarization	During this period the sodium-potassium pump returns the ions to their original positions on the inside and outside of the axon, reestablishing the resting potential.
Refractory Period	While repolarization is occurring, the neuron cannot fire because it is resetting itself to its original resting potential state.

Topic 2.5: Influence of Drugs on Neural Firing

Learning Target 2.H

Discuss the influence of drugs on neurotransmitters.

Excitatory Neurotransmitters are chemicals that when released from the terminal buttons excite connecting neurons and cause them to fire.

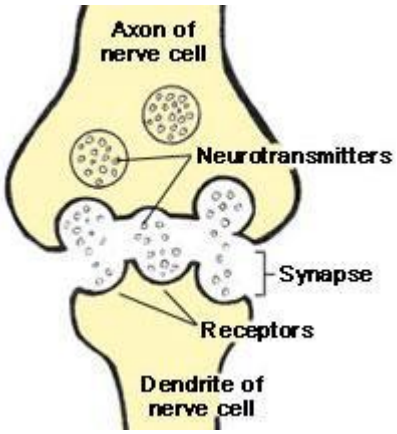
Inhibitory Neurotransmitters are chemicals that when released from the terminal buttons inhibit (prevent) the next neurons from firing.

Neurotransmitters			
	Function	**Lack**	**Excess**
Dopamine	Pleasure, reward, voluntary movement, learning, and attention ● Certain dopamine pathways are involved in drug addiction.	Parkinson's disease	Schizophrenia
Acetylcholine (AcH)	Memory and movement	Alzheimer's disease Paralysis Myasthenia gravis	Muscle convulsions
Serotonin	Mood, appetite, and sleep	Depression Feeding and eating disorders Sleep-wake disorders Aggression	
Norepinephrine	Mood and sleep	Depression	Anxiety
Glutamate	Memory and learning Major excitatory neurotransmitter		Migraines and seizures

GABA	Relaxation and sleep Major inhibitory neurotransmitter	Anxiety disorders Seizures Insomnia	
Endorphins	Inhibits pain signals	Lower pain thresholds Use of heroin and other opiates leads to decreased production of endorphins	Higher pain threshold Runner's high

See also for neurotransmitters: substance P

Reuptake: neurotransmitters are reabsorbed by the presynaptic neuron



Agonists: drugs that work by either blocking reuptake or mimicking the natural neurotransmitters by fitting into receptor sites on the postsynaptic neuron.

- Example: ***Xanax*** is an anti-anxiety medication – the drug molecules fit into receptor sites for the inhibitory neurotransmitter GABA and excite the cell
- **SSRIs** (Selective Serotonin Reuptake Inhibitors): function as agonists by delaying the reuptake of serotonin, allowing the neurotransmitters more opportunity to stimulate the postsynaptic neuron (Example: ***Prozac*** is a drug used to treat depression)

Antagonists: drugs that work by occupying receptor sites on the postsynaptic neuron and block the impact of neurotransmitters.

- Individuals with schizophrenia have too much dopamine, and antipsychotic medications act as dopamine antagonists to block the receptor sites and prevent cell excitement

Topic 2.6: The Brain

Learning Target 2.I

Describe the nervous system and its subdivisions and functions in the brain. Examples: major brain regions, lobes, cortical areas, brain lateralization and hemispheric specialization

The human brain consists of three major divisions/regions: the hindbrain, the midbrain, and the forebrain.

Hindbrain

"Primitive" part of the brain; coordinates basic bodily functions

	Functions	*Helpful Hint*
Brainstem *Base of the brain at the top of the spinal cord*	• Automatic survival functions • Sends and receives information	Severe damage to the brainstem would result in death.

Cerebellum *Behind the brainstem underneath the brain*	• Balance and coordination • Fine motor movements • Procedural memory	Cerebellum literally means "little brain" and looks like a miniature brain attached to the brain stem.
Pons *Above the medulla on the brainstem and below the thalamus*	• Sleep and arousal • Dreams • Facial expressions	Imagine the pons as a pillow (sleep) located to the top of the bed (brainstem)
Medulla **(Medulla Oblongata)** *Below the pons on the brain stem*	• Survival functions (heartbeat, breathing, and digestion) • Reflexes (sneezing, coughing, vomiting, and swallowing)	"I ♡ my medulla!"

Midbrain

Very small in humans; coordinates simple movements with sensory information

	Functions	*Helpful Hint*
Reticular Formation **(Reticular Activating System)** *Network of nerves running vertically through the brainstem and extending to the thalamus*	• Arousal to stimuli • Sleep • Attentiveness • Filters incoming stimuli and relays important information to the thalamus	Damage to the reticular formation results in a coma.
Basal Ganglia *Midbrain and forebrain*	• Smooth voluntary body movements	Cell damage to dopamine-producing neurons in the basal ganglia disrupts movement for individuals with Parkinson's disease.

Forebrain

Sophisticated part of the human brain; allows for complex thought and behaviors unique to humans

	Functions	*Helpful Hint*
Thalamus *Two connected egg-shaped structures located at the top of the brainstem*	• Filters and relays sensory information ***except for smell*** to the appropriate parts of the cerebral cortex	Think of the thalamus as the banker in Monopoly that manages all the money (incoming sensory information) and distributes the money to the players (specific brain areas responsible for that type of information)
Limbic System *Bagel-shaped group of structures between the brainstem and the cerebral cortex*	• Learning • Memory • Emotion • Basic drives	To help identify the three parts, thinks of the mnemonic HAH: **H**ippocampus, **A**mygdala, and **H**ypothalamus
Hippocampus *Limbic system structure surrounding the thalamus*	• Explicit memory formation • Learning	Imagine the hippocampus as a college campus where students make a lot of memories and learn a lot of things.

Amygdala *Limbic system structure at the end of each arm of the hippocampus*	• Emotions (especially fear and aggression)	Imagine scary hands/fingers located at the end of each arm of the hippocampus. This hint helps identify the amygdala's function (fear and aggression) and location (almond shaped structures at the end of each arm of the hippocampus.
Hypothalamus *Limbic system structure below the thalamus*	• Maintenance functions (eating, drinking, body temperature, and sex) • Controls the autonomic nervous system • Controls the endocrine system by influencing the pituitary gland	To help identify four of the significant hypothalamus functions, think of the four F's: Fighting, Fleeing, Feeding, and Fornicating
Nucleus Accumbens *Region of the forebrain near the limbic system*	• Pleasure or reward circuit • Associated with drug dependency	The nucleus accumbens is rich in dopamine, which is associated with pleasure
Suprachiasmatic Nucleus (SCN) *Small region within the hypothalamus*	• Regulation of circadian rhythm • Regulation of sleep cycle	The suprachiasmatic nucleus controls the pineal gland
Corpus Callosum *Bundle of neurons connecting the two cerebral hemispheres*	• Relays information between the two hemispheres	Think of the corpus callosum ***calling*** the other hemisphere to communicate messages.

STUDY TIP:
Be able to differentiate between the following…

- The **hypothalamus** regulates internal body temperature.
- The **parietal lobes** are where the perception of temperature on the skin occurs.

The Cerebral Cortex and Lobes

The largest and most developed area of the brain, the **cerebrum**, refers to most of the brain except for the brainstem and cerebellum and is comprised of two separate layers. The internal layer of the cerebrum is made up of the axons of neurons and glial cells and is called ***white matter***. The one-fourth-inch thick wrinkled outer layer is called the **cerebral cortex** and is made up of the cell bodies of neurons called ***gray matter***. The cerebral cortex is responsible for sophisticated thinking and learning in humans. Any portion of the cerebral cortex that is not devoted to motor or sensory functions is known as an **association area**.

The rather large cerebral cortex in humans, which would be approximately the size of a newspaper if it were stretched out flat, is folded upon itself to fit within the skull. The ridges along the surface of the cortex are referred to as **gyri**, and the valleys on the surface are called **sulci**. The two halves of the brain are referred to as the left and right hemispheres. Especially deep or pronounced grooves on the cerebral cortex in each hemisphere are called **fissures**. Several deep fissures divide the cerebral cortex into four regions or lobes: the **frontal lobes** (located behind the forehead), the **parietal lobes** (located directly behind the frontal lobes), the **temporal lobes** (located above the ears), and the **occipital lobes** (located at the back of the cortex).

Frontal Lobe Higher-level thinking; Reasoning; Planning; Judgment; Impulse Control		
	Location	*Function*
Prefrontal Cortex	*Association area located in front of the motor strip in the frontal lobes*	• Controls conscious thoughts and actions • Working memory • Short-term and long-term planning
Broca's Area	*Front of the LEFT frontal lobe*	• Controls the facial muscle movements required for speech production
Primary Motor Cortex	*Rear of the frontal lobes, parallel to the sensory cortex (extending from ear to ear like a headband)*	• Controls voluntary movement • Left motor cortex controls movement on the right side of the body • Right motor cortex controls movement on the left side of the body

Parietal Lobes Receives sensory information about the somatic senses of touch, pain, and temperature; Spatial abilities		
	Location	*Functions*
Primary Somatosensory Cortex	*Front of the parietal lobes, parallel to the motor cortex (extending from ear to ear like a headband)*	• Sensory input is received for touch and body position • Left sensory cortex controls sensation for the right side of the body • Right sensory cortex controls sensation for the left side of the body

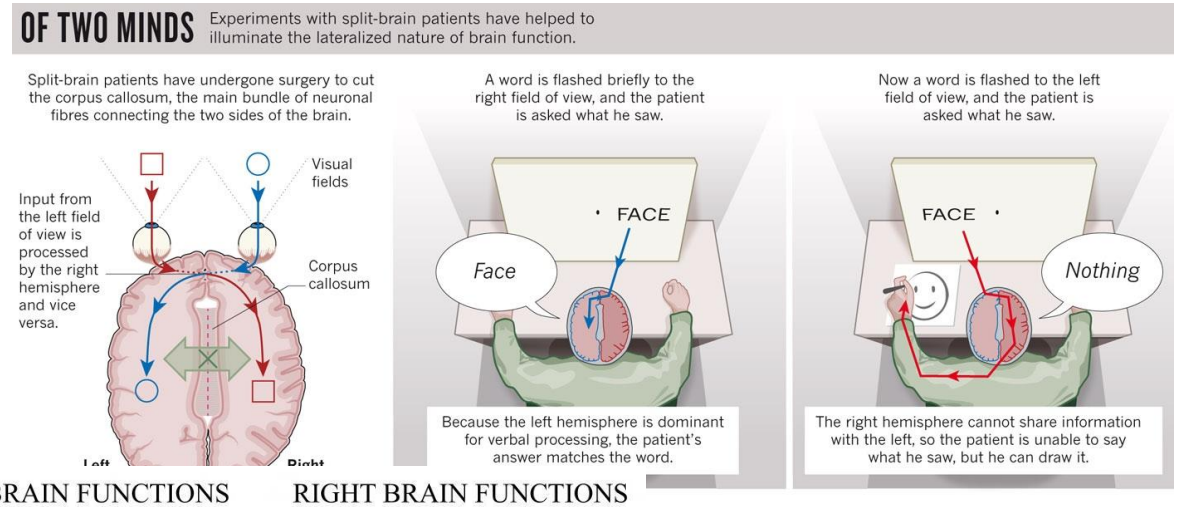
Occipital Lobes Visual processing		
	Location	*Functions*
Primary Visual Cortex	*Bottom area of the occipital lobes*	• Information from the left visual field goes to the right side of each eye and is interpreted by the right visual cortex • Information from the right visual field goes to the left side of each eye and is interpreted by the left visual cortex

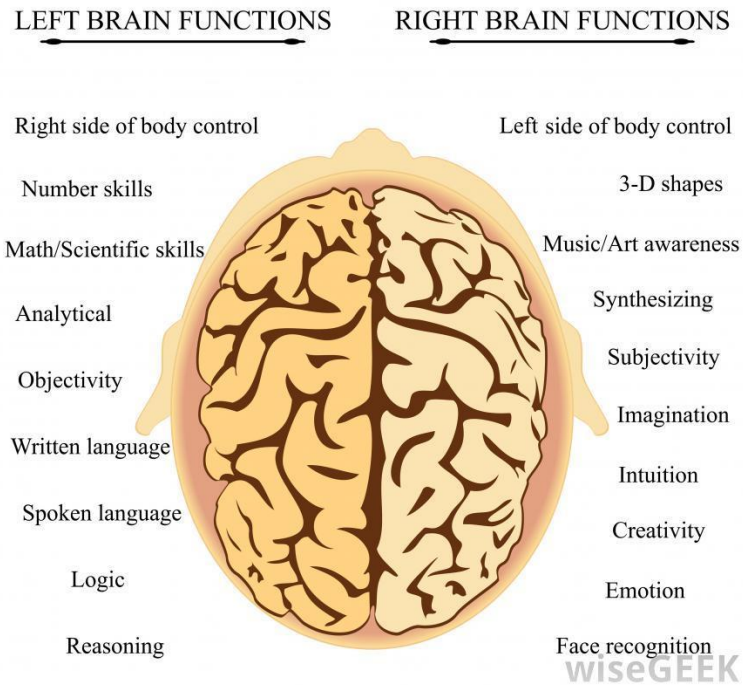
Temporal Lobes Auditory processing (hearing); Olfactory (smell); Recognition of faces		
	Location	*Functions*
Primary Auditory Cortex	*Upper area of the temporal lobes*	• Processes most auditory information from the opposite ear
Wernicke's Area	*Top of the LEFT temporal lobe*	• Responsible for language comprehension • Creates meaningful statements

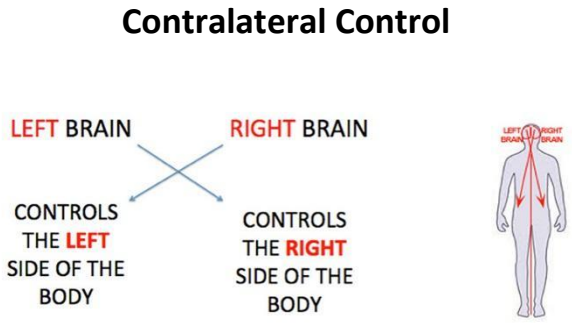
Specific functions controlled by each half of the cerebral cortex have been identified in what is referred to as lateralization (hemispheric specialization)

- Much of what we know about lateralization is the result of research with **split-brain patients** whose corpus callosum was severed to treat severe ***epilepsy*** that did not respond to medications and other treatments.
    - Key researchers
        - **Roger Sperry**
        - **Michael Gazzaniga**
    - Split brain patients do not display differences in intelligence or personality, but the lateralized functions of each hemisphere can be observed in specific laboratory experiments

- If a word is flashed to the left visual field (received by the right side of each eye), this information is sent by the optic nerve to the right hemisphere. Normally this information would then cross the corpus callosum to the left hemisphere where language exists.
    - Because these connections have been cut, the split-brain patient will be unable to say the word aloud. However, the nerves of the right motor cortex cross under the medulla and will allow the split-brain individual to use his or her left hand to select the object that was viewed.
- If a word is flashed to the right visual field (received by the left side of each eye), the information will be sent to the left hemisphere and the split-brain patient will be able to pronounce the word because the left hemisphere is in charge of language.







Learning Target 2.J

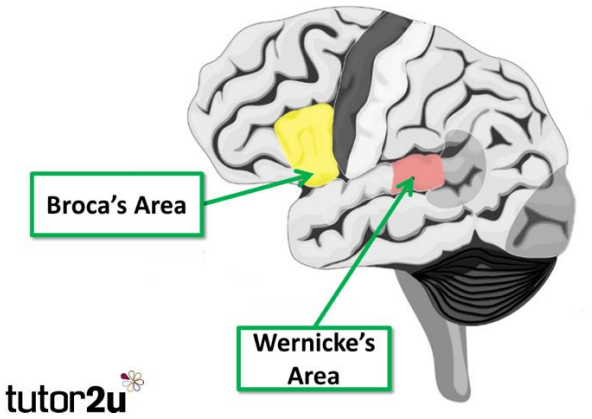
Identify the contributions of key researchers to the study of the brain.

Paul Broca

- 1861
- Performed an autopsy on the brain of a patient, nicknamed Tan, who had lost the capacity to speak although his mouth and his vocal cords weren't damaged, and he could still understand language.
- Tan's brain showed deterioration of part of the frontal lobe of the left cerebral hemisphere (Broca's Area), as did the brains of several similar cases.
- This caused a loss of the ability to speak (**expressive aphasia**)

Carl Wernicke

- 1874
- Related nerve diseases to specific areas of the brain
- Discovered structure in the left temporal lobe that controls language comprehension (Wernicke's Area)
- This caused a loss of the ability to comprehend written and spoken language (**receptive aphasia**)
    - Speak in garbled sentences and poor speech comprehension



Topic 2.7: Tools for Examining Brain Structure and Function

Learning Target 2.K

Recount historic and contemporary research strategies and technologies that support research.

Early brain research typically involved reviewing case studies of individuals who had suffered brain damage. Advances in biological psychology have been developing rapidly due to the technological improvements achieved with modern brain scanning equipment, which allow for noninvasive examination of both healthy and damaged brains. Psychologists use four main techniques to study the brain's functions:

Accidents (Case Studies)	• War, accident, or stroke victims • Phineas Gage (metal rod through the head) = frontal lobes regulate emotion and the ability to play future events • Tan (Broca's aphasia) = problems in speech production resulting from a lesion in the left frontal lobe
Lesions	• Involves the removal of a portion of an organism's brain; often on animals o Removing the lateral portion of the hypothalamus in a rat will cause it to stop eating but removing the ventromedial portion will cause it to overeat • Researchers observe behavioral changes to determine the function of specific areas of the brain; has helped scientists localize brain region responsibilities

	• Often used on humans to remove and stop the spread of brain tumors
Direct Stimulation	• Opposite of lesioning • Researchers electrically stimulate the brain; often on animals • Stimulating the amygdala of mice will result in an aggressive reaction • The use of electrical stimulation has helped surgeons understand the potential results of removing specific areas of the brain during tumor removal
Brain Imaging	• Enable psychologists to look inside the human brain to identify either the structure or function of various brain parts • *See chart below and on the next page*

Brain Imaging Techniques

Scan	Definition	Purpose	Advantages/Disadvantages
EEG	Electroencephalogram measures electrical activity of the neurons below the electrodes placed on the scalp. The EEG is often used to show brain wave patterns of electrical activity during sleep stages and seizures.	Function	**Advantages** • Noninvasive • Abnormal patterns indicate neurological disorders **Disadvantages** • Difficult to determine which specific brain areas are producing the electrical activity
PET	Positron emission tomography involves the injection of a small harmless amount of radioactive material, such as glucose (sugar), into the bloodstream. The PET scan indicates areas of the brain active during cognitive tasks by tracking specific structures using the radioactive material as fuel, resulting in a color coded image	Function	**Advantages** • Allows investigation of mental illness and neurological problems, including Alzheimer's disease and epilepsy • Allows investigation of specific types of neurotransmitters and drugs **Disadvantages** • Exposure to low levels of radioactive material • Difficult to pinpoint the exact location of brain activity
CT Scan (CAT)	Computerized axial tomography creates advanced and specific X-rays of the brain. When the individual is in the machine the X-ray tube rotates around the body taking a series of X-rays. The CT scan is often used to locate tumors and brain damage resulting from blood clots and strokes.	Structure	**Advantages** • Can view large brain abnormalities • Significantly more sensitive than traditional X-ray imaging **Disadvantages** • Involves radiation • Incapable of locating small brain abnormalities
MRI	The magnetic resonance imaging technique uses strong magnetic fields that cause different molecules to vibrate at different frequencies, which produces detailed images of slices of brain tissue.	Structure	**Advantages** • Generates images of brain structures with greater clarity than the CT scan • No exposure to radiation or radioactive materials **Disadvantages** • Cannot be used on an individual with a metallic implant including a pacemaker or surgical pin • Individual is required to remain still for an extended period of time in a confined space
fMRI	The functional magnetic resonance imaging technique uses magnetic fields to produce images of the brain and tracks real-time brain activity by	Structure and Function	**Advantages** • No exposure to radioactive materials like during a PET scan, allowing researchers to conduct multiple scans on the same individual

	measuring blood flow carrying oxygen to active brain tissue.		• Ability to pinpoint and track mental processes that occur over seconds as opposed to minutes, such as thinking about an object **Disadvantages** • Cannot be used on an individual with a metallic implant including a pacemaker or surgical pin • Although no harmful consequences have been identified, the long-term impact of exposure to powerful magnets is unknown

Learning Target 2.L

Identify the contributions of key researchers to the development of tools for examining the brain

Roger Sperry

- 1968
- Used split brain surgery to successfully treat patients with severe epilepsy
    - Split brain surgery means the corpus callosum has been severed (the large band of white matter that connects the two hemispheres of the brain)
        - One of the most confusing and challenging parts for most students when learning Sperry's study is the idea of contralateralization. The brain is composed of two hemispheres. Most stimuli (sound is more complex) is processed contralaterally. This means that if stimuli enters on the left, for example, the left hand, it is processed in the right hemisphere and vice versa.
        - For the most part, language is processed in the left hemisphere.
- The aim of Sperry (1968) was to show the independent streams of conscious awareness possessed by each hemisphere and to show how each hemisphere has its own memories.

Topic 2.8: The Adaptable Brain

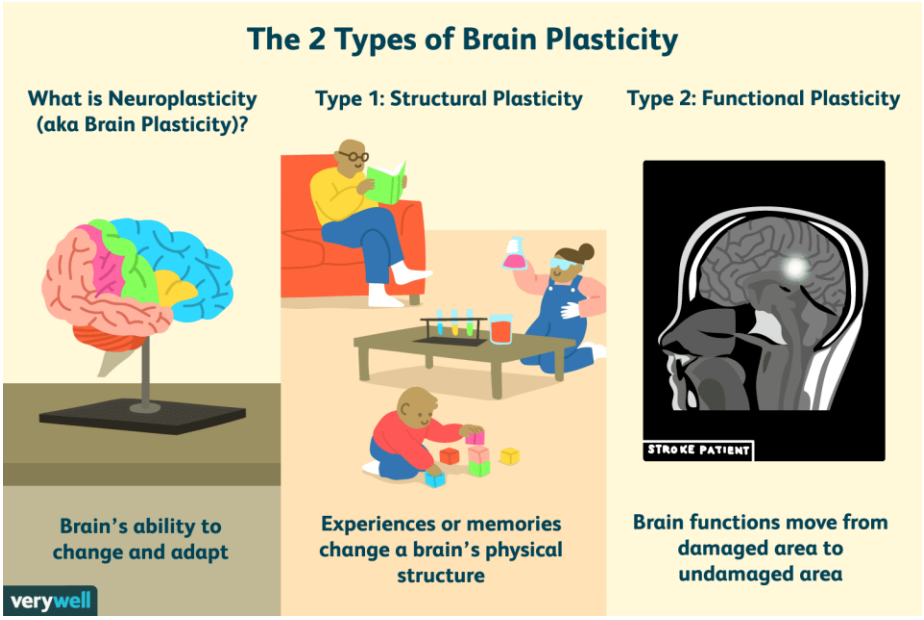
Learning Target 2.M

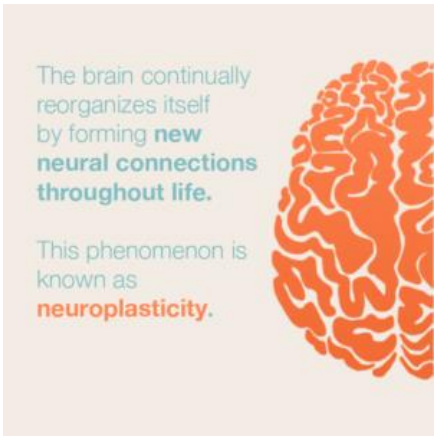
Discuss the role of neuroplasticity in traumatic brain injury.

One of the most amazing abilities of the human brain is the capacity it has for adaptation or plasticity which allows the brain to be able to modify itself as an adaptation to experience or repair itself after damage.

For example, if a particular area in the brain is damaged, nearby areas can learn to assume the functions of the regions that were destroyed **by developing new connections between dendrites.**

- **DEFINITION: Neuroplasticity**: The brain's ability to reorganize itself by forming new neural connections throughout life. **Neuroplasticity** allows the neurons (nerve cells) in the brain to compensate for injury and disease and to adjust their activities in response to new situations or to changes in their environment.





Learning Target 2.N

Identify the contributions of key researchers to the study of neuroplasticity.

Michael Gazzaniga

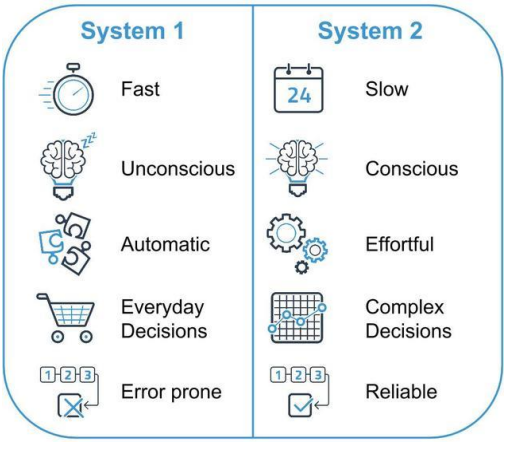
- Director of the SAGE Center for the Study of the Mind at UC Santa Barbara
- Studies the neural basis of mind with primary responsibility for initiating human split-brain research to understand functional lateralization

Learning Target 2.O

Describe various states of consciousness and their impact on behavior.

Consciousness is our state of awareness of our existence, sensations, thoughts, and environments. We are conscious to the degree that we are aware of what is going on both inside and outside our bodies.

Our conscious awareness is one part of the **dual processing** that goes on in our two-track minds.



Levels of Human Consciousness

Conscious Awareness	All the ideas in your immediate awareness, such as your thoughts, feelings, senses

Nonconscious	Biological functions occurring without your awareness, such as respiration and digestion
Preconscious	Items we can access from long-term memory; stored information about yourself or your environment that you are not currently aware or thinking of but can easily call to mind when asked
Subconscious	Hidden memories that influence behavior despite no clear memory of them; information you have been exposed to be cannot recall; mere exposure effect (also known as the familiarity principle) - if you have a memory of a dog barking loudly and charging at you at age three, you may not recall your terror/fear, but you are still not likely to buy a product advertised with a barking dog
Unconscious	From the psychoanalytic perspective (Sigmund Freud), hidden memories that influence behavior but can never be known to the conscious mind; Freud characterized these as conflicts between competing parts of our personalities (the id, superego, and ego) that influence our attitudes and actions

Learning Target 2.P

Identify the major psychoactive drug categories and classify specific drugs, including their psychological and physiological effects.

A Guide to Selected Psychoactive Drugs

Drug	Type	Pleasurable Effects	Adverse Effects
Alcohol	Depressant	Initial high followed by relaxation and disinhibition	Depression, memory loss, organ damage, impaired reactions
Heroin	Depressant	Rush of euphoria, relief from pain	Depressed physiology, agonizing withdrawal
Caffeine	Stimulant	Increased alertness and wakefulness	Anxiety, restlessness, and insomnia in high doses; uncomfortable withdrawal
Methamphetamine	Stimulant	Euphoria, alertness, energy	Irritability, insomnia, hypertension, seizures
Cocaine	Stimulant	Rush of euphoria, confidence, energy	Cardiovascular stress, suspiciousness, depressive crash
Nicotine	Stimulant	Arousal and relaxation, sense of well-being	Heart disease, cancer
Ecstasy (MDMA)	Stimulant; mild hallucinogen	Emotional elevation, disinhibition	Dehydration, overheating, depressed mood, impaired cognitive and immune functioning
Marijuana	Mild hallucinogen	Enhanced sensation, relief of pain, distortion of time, relaxation	Impaired learning and memory, increased risk of psychological disorders, lung damage from smoke

Learning Target 2.Q

Discuss drug dependence, addiction, tolerance, and withdrawal.

Psychoactive drugs: a chemical substance that alters a perceptions and moods.

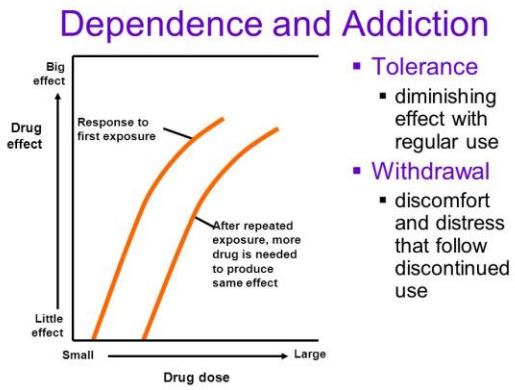
Tolerance: the diminishing effect of a drug after repeated use that requires the user to take larger and larger does before experiencing the drug's effect.

Withdrawal: the discomfort and distress that follow the discontinued use of a drug.

Physical dependence: a physiological need for a drug, marked by unpleasant withdrawal symptoms when the drug is no longer taken.

Psychological dependence: a psychological need to use a drug, such as to relieve negative emotions.

Addiction: compulsive drug craving and use, despite adverse consequences.



Drug addiction is a chronic, relapsing behavioral disorder

- ✓ First: It causes **physical dependence**. Body builds **tolerance** for the drug requiring addict to take more and more to get the same effect. Followed by unpleasant **withdrawal symptoms**
- ✓ Second: Emphasis on behavior because of compulsive nature of addiction i.e. **cravings**.
- ✓ It is a chronic relapsing disorder with periods of **remissions** and **relapsing**

Learning Target 2.R

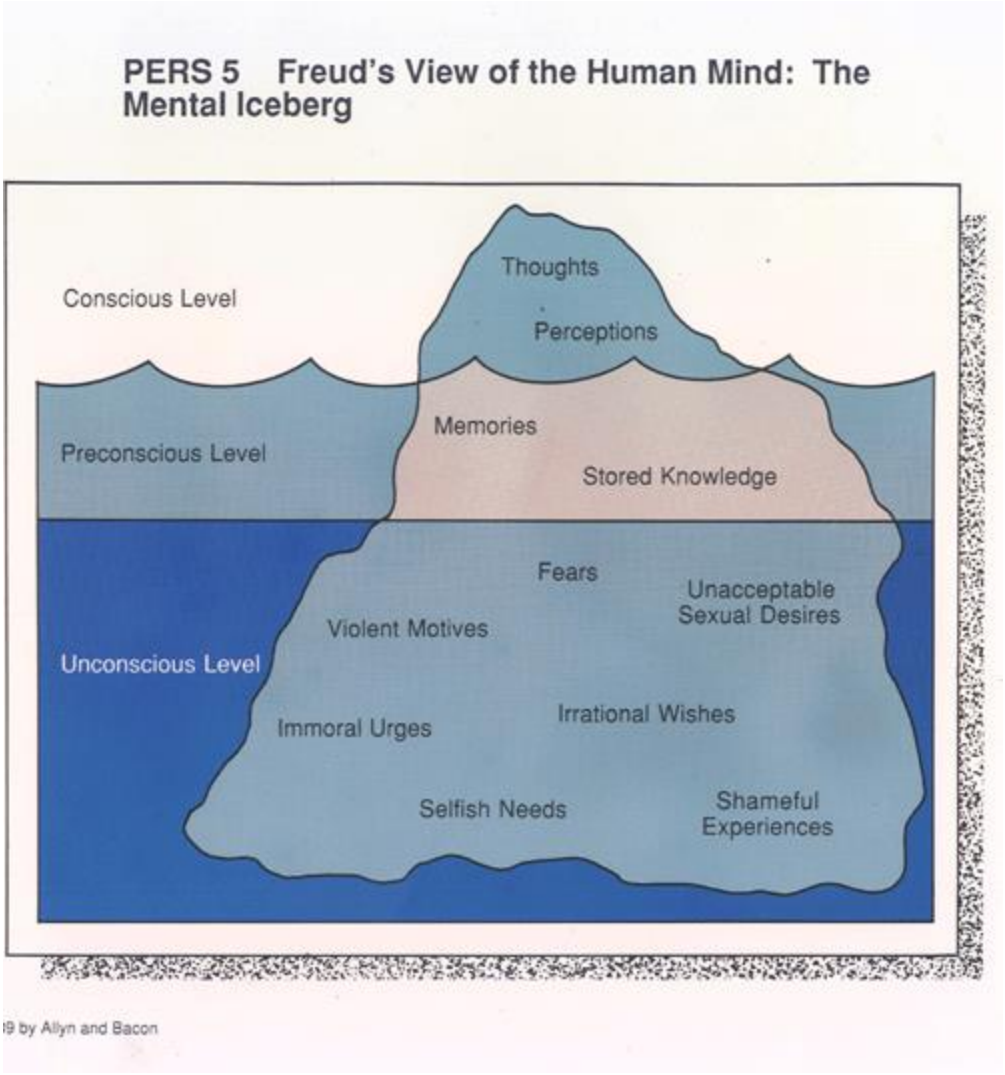
Identify the contributions of major figures in consciousness research.

William James

- One of the initial scholars who described consciousness as a flow
- "Stream of Consciousness" - a constantly moving stream of thoughts, feelings, and emotion
  - Cannot be divided up for analysis; always changing
  - Purpose is to aid the individual in adapting to the environment

Sigmund Freud

- Focused on the unconscious causes of behavior and personality information; founded psychoanalysis
- Wrote *The Interpretation of Dreams*. Believed dreams are "the royal road to the unconscious." Said there were two levels of dreams: manifest and latent.
  - Manifest: the remembered storyline of a dream
  - Latent: the underlying meaning of a dream
- Wish-Fulfillment Dream Theory
  - Dreams provide a "psychic safety valve" - expressing otherwise unacceptable feelings



Topic 2.9: Sleeping and Dreaming

Learning Target 2.S

Discuss aspects of sleep and dreaming.

Biological Rhythms: the periodic physiological fluctuations our bodies go through.

Annual cycles: cycles that occur in our bodies on a yearly basis, such as SAD (Seasonal Affective Disorder – becoming depressed during the winter), or birds flying south for the winter and bears hibernating.

28-day cycles: cycles that occur every month. Ex. a woman's menstrual cycle.

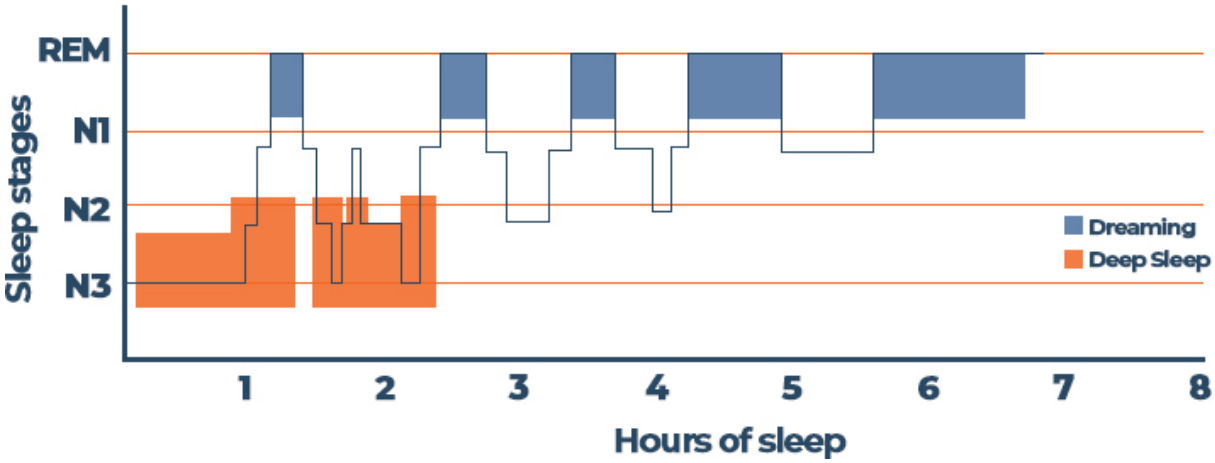
Circadian rhythm: the biological clock; regular bodily rhythms that occur on a 24-hour cycle, such as body temperature or wakefulness.

Suprachiasmatic nucleus (SCN): a pair of grain-of-rice –sized cell clusters in the hypothalamus that helps in waking up a person when it is activated by light-sensitive retinal proteins. It works with the pineal gland.

Melatonin: a sleep-inducing hormone. The SCN causes the brain's pineal gland to decrease its production of melatonin in the morning or to increase it in the evening.

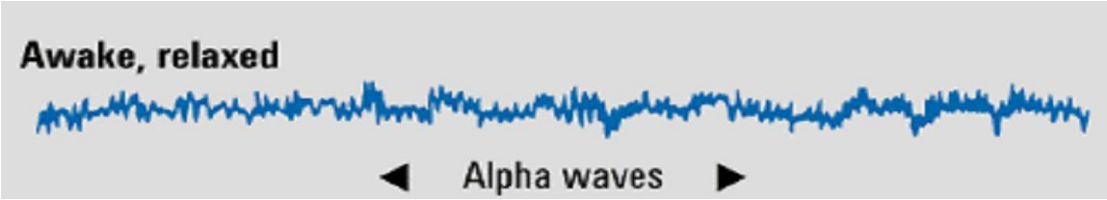
Adenosine: a neurotransmitter that causes drowsiness and the slowing of nerve cells. Caffeine is an antagonist that blocks the transmission of adenosine keeping us awake.

Sleep: a periodic, natural loss of consciousness. Throughout the night, the body experiences many sleep cycles, each one lasting around 90 minutes. Each cycle has 4 stages (N1, N2, N3, and, REM)



Beta waves: waves of someone who is wide awake.

Alpha waves: the relatively slow brain waves of a relaxed, awake state.



NREM-1: the first stage that lasts about 5 minutes, emit theta waves, may experience hallucinations and **hypnagogic** sensations (feelings of floating or falling).

> **Hallucinations:** false sensory experiences, such as seeing something in the absence of an external visual stimulus.

NREM-2: the second stage that lasts for about 20 minutes, clearly asleep and experience **sleep spindles** (random bursts of activity).

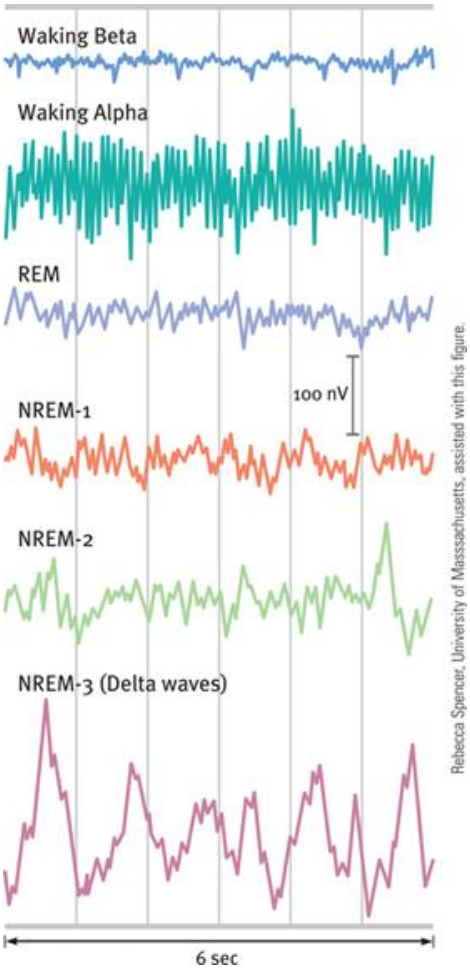
NREM-3: the deepest stage of sleep in which it is hard to wake, lasts for about 30 minutes, emission of delta waves, sleep walking, bed wetting, etc. occur during this stage.

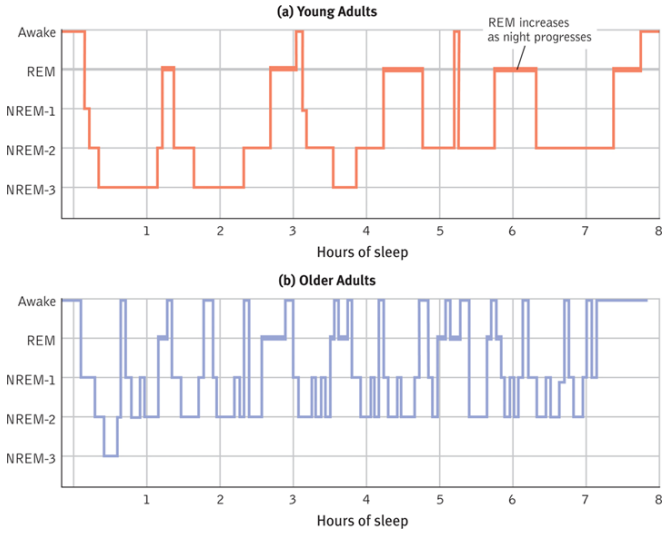
> **Delta waves:** the larger, slow brain waves associated with deep sleep.

REM sleep: rapid eye movement sleep; a recurring sleep stage during which vivid dreams commonly occur. Also known as **paradoxical sleep** because the muscles are relaxed (except for minor twitches) but other body systems are active.

NREM sleep: non-rapid eye movement sleep; encompasses all sleep stages except for REM sleep.

REM rebound: the tendency for REM sleep to increase following REM sleep deprivation (created by repeated awakenings during REM sleep).





Stage	Wave Name	Wave Characteristics	Characteristics or Common Behaviors of This Stage
Awake But Relaxed	Alpha	High frequency	Alert and aware but crossing slowly into the first stage of sleep
NREM-1	Theta	Slower frequency than alpha	Fantastic images resembling **hallucinations** **Hypnagogic sensations** such as the jerk of a limb or feeling of falling Sensations from the environment filter in to the images
NREM-2	N/A	**Sleep spindles** – rapid bursts of rhythmic brain-wave activity	Could be awakened without much difficulty but now clearly asleep
NREM-3	Delta	Slower frequency waves that last about 30 minutes	Harder to wake – **deepest level of NREM sleep** Lasts about 30 minutes
REM	N/A	Waves become rapid and saw-toothed like those of NREM-1	Heart rate rises, breathing becomes rapid and irregular, eyes dart, **dreaming** occurs

Sleep Disorders

- **Insomnia:** a sleep disorder in which a person has recurring problems in falling or staying asleep.
- **Narcolepsy:** a sleep disorder characterized by uncontrollable sleep attacks. These attacks are usually caused by excitement. The sufferer may lapse directly into REM sleep, often at inopportune times.
- **Sleep apnea:** a sleep disorder characterized by temporary cessations of breathing during sleep and repeated momentary awakenings. Sleep apnea is associated with obesity. It is suggested that people lose weight to help curb the sleep apnea. Wearing an air pump while sleeping helps also.
- **Night terrors:** a sleep disorder characterized by high arousal and an appearance of being terrified; unlike nightmares, night terrors occur during Stage 4 sleep, within two or three hours of falling asleep, and are seldom remembered.
- **Somnambulism:** aka sleepwalking
- **REM sleep behavior disorder:** parasomnia involving the physical acting out of dreams

SLEEP DEPRIVATION

EFFECTS

Lack of sleep is a health issue that deserves your attention and your doctor's help. Not getting enough sleep—due to insomnia or a sleep disorder such as obstructive sleep apnea, or simply because you're keeping late hours—can affect your mood, memory and health in far-reaching and surprising ways, says Johns Hopkins sleep researcher Patrick Finan, Ph.D. Sleep deprivation can also affect your judgment so that you don't notice its effects.

SAFETY

6,000
FATAL CAR CRASHES CAUSED BY DROWSY DRIVING EACH YEAR

1 IN 25
ADULTS WHO'VE FALLEN ASLEEP AT THE WHEEL IN THE PAST MONTH

WEIGHT

MORE CRAVINGS FOR SWEET, SALTY & STARCHY FOOD

↑ Higher levels of the **hunger hormone** ghrelin

↓ Lower levels of the **appetite-control hormone** leptin

50% HIGHER RISK FOR OBESITY IF YOU GET LESS THAN 5 HOURS OF SLEEP NIGHTLY

BRAIN EFFECTS

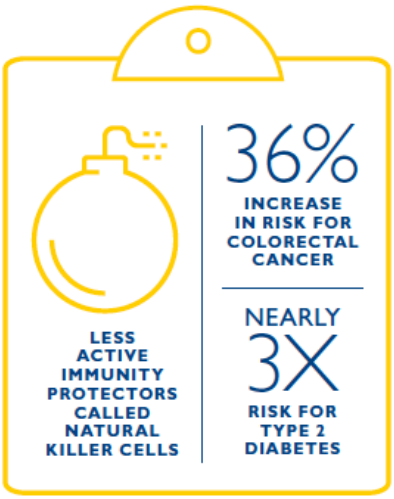
33%
INCREASE IN DEMENTIA RISK

GREATER RISK FOR:

- Depression
- Irritability
- Anxiety
- Forgetfulness
- Fuzzy thinking

3-5 YEARS
HOW MUCH SLEEP DEPRIVATION CAN AGE YOUR BRAIN

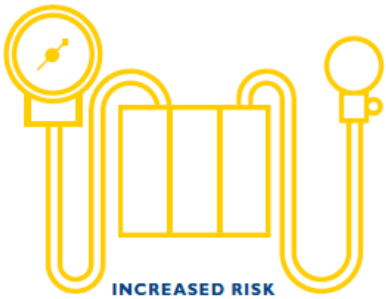
HEALTH



36%
INCREASE IN RISK FOR COLORECTAL CANCER

LESS ACTIVE IMMUNITY PROTECTORS CALLED NATURAL KILLER CELLS

NEARLY 3X
RISK FOR TYPE 2 DIABETES



INCREASED RISK OF HIGH BLOOD PRESSURE

48%
INCREASE IN DEVELOPING HEART DISEASE

3X
MORE LIKELY TO CATCH A COLD

Dreams: a sequence of images, emotions, and thoughts passing through a sleeping person's mind during REM sleep.

Lucid dreams: a dream in which one is aware that one is dreaming.

Manifest content: the remembered story line of a dream (according to Sigmund Freud).

Latent content: the underlying meaning of a dream (according to Sigmund Freud).

DREAM THEORIES

Theory	Explanation	Critical Considerations
Freud's wish-fulfillment	Dreams provide a "psychic safety valve"—expressing otherwise unacceptable feelings; contain manifest (remembered) content and a deeper layer of latent content—a hidden meaning.	Lacks any scientific support; dreams may be interpreted in many different ways.
Information-processing	Dreams help us sort out the day's events and consolidate our memories.	But why do we sometimes dream about things we have not experienced?
Physiological function	Regular brain stimulation from REM sleep may help develop and preserve neural pathways.	This may be true, but it does not explain why we experience *meaningful* dreams.
Activation-synthesis	REM sleep triggers neural activity that evokes random visual memories, which our sleeping brain weaves into stories.	The individual's brain is weaving the stories, which still tells us something about the dreamer.
Cognitive development	Dream content reflects dreamers' cognitive development—their knowledge and understanding.	Does not address the neuroscience of dreams.