UNIT 3 GUIDE – 10/14/2019
SASHA WALD
MS. REEP AP PSYCHOLOGY

MODULE 9 – Biological Psychology and Neurotransmission

Biology, Behavior and Mind	– Early 1800s, Franz Gall proposed *phrenology*, studying bumps on your skull, could reveal mental abilities/character traits
	  – popularity faed, but it focused attention on "*localization of function*", the idea that various brain regions have particular functions
	– **Biological psychologists** make discoveries about how biology and the mind interact:
	  – the body is composed of cells
	  – nerve cells conduct electricity/talk to one another by sending chemical messages across a small gap
	  – specific brain systems serve specific functions
	  – we integrate information processed in these systems to construct sight, sound, meaning, memory, pain and passion
	  – our adaptive brain is wired by our experience
	– We are *biopsychosocial* systems

Neural Communication	– **Neurons** are the building block of our neural info system
	– Each has a cell body and branching fibers
	  – bushy **dendrite** fibers receive info, conducting it towards the cell body
	  – the **axon** fiber passes the message through terminal branches to other neurons, muscles or glands
	– Axons are encased in a **myelin sheath**, fatty tissue which speeds their impulses – degeneration of the sheath can result in *multiple sclerosis* (loss of muscle control)
	– Neurons transmit a message when stimulated by senses or by chemical signals from other neurons – they fire an impulse (**action potential**), an electrical charge which travels the axon
	  – may travel at 2–180 mph
	– The fluid outside an axon's membrane is positive, while the interior has negatively charged ions (this is called the resting potential)
	– The axon's surface is selectively permeable – when the neuron fires, the first part of the axon opens its gates and allows positive Na ions (sodium) into the cell
	  – that axon section is now *depolarized*, causing another axon channel to open, then another, etc…
	– During the **refractory period**, positive Na+ ions are pumped out to allow the neuron to reset
	– Most signals to neurons are *excitatory*, others are *inhibitory*. If excitatory signals exceed inhibitory signals by a minimum intensity (**threshold**) then an action potential is triggered. It's an **all-or-none** response
	– Sir Charles Sherrington (1857–1952) named the **synapse**, the meeting point between neurons, which has a tiny *synaptic gap*
	– When action potentials reach the synapse, they trigger the release of **neurotransmitters**, chemical messengers, which bind to receptor sites on the receiving neuron

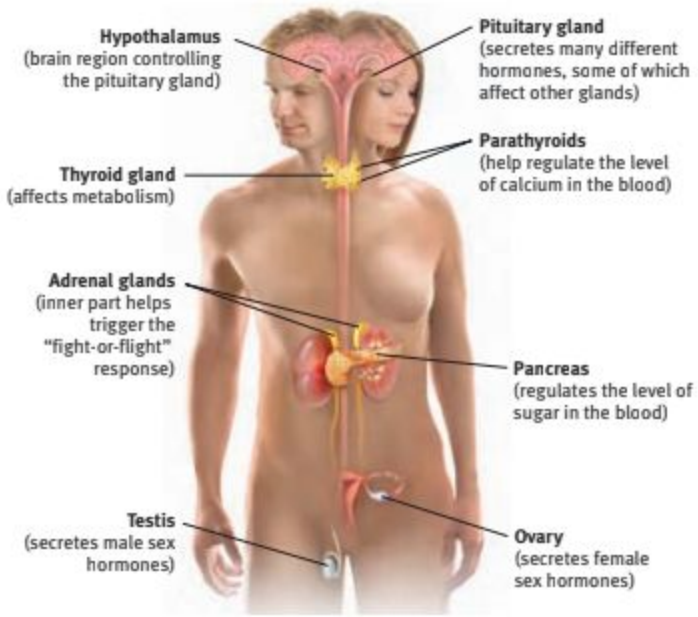
	- In **reuptake,** the sending neuron reabsorbs extra neurotransmitters - *Acetylcholine (ACh)* plays a role in learning and memory, and is used at every junction between motor neurons/skeletal muscles - it causes muscles to contract (anesthesia blocks it) - The body produces its own opiates, called **endorphins**, which explain things like "runner's high", painkilling through acupuncture, and not feeling a severe injury - When flooded with opiate drugs (ex heroin) the brain may stop producing natural opiates - Drugs affect the brain at synapses, by exciting or inhibiting neurons' firing - **Agonist** molecules like opiate drugs imitate neurotransmitters, binding to receptors and mimicking their effects - **Antagonist** molecules bind to receptors, blocking neurotransmitter's functioning - they're enough like the original neurotransmitter to bind to the receptor, but not enough to stimulate it

Neurotransmitter	Function	Examples of Malfunctions
Acetylcholine (ACh)	Enables muscle action, learning, and memory.	With Alzheimer's disease, ACh-producing neurons deteriorate.
Dopamine	Influences movement, learning, attention, and emotion.	Oversupply linked to schizophrenia. Undersupply linked to tremors and decreased mobility in Parkinson's disease.
Serotonin	Affects mood, hunger, sleep, and arousal.	Undersupply linked to depression. Some antidepressant drugs raise serotonin levels.
Norepinephrine	Helps control alertness and arousal.	Undersupply can depress mood.
GABA (gamma-aminobutyric acid)	A major inhibitory neurotransmitter.	Undersupply linked to seizures, tremors, and insomnia.
Glutamate	A major excitatory neurotransmitter; involved in memory.	Oversupply can overstimulate the brain, producing migraines or seizures (which is why some people avoid MSG, monosodium glutamate, in food).

MODULE 10 - The Nervous and Endocrine Systems

The Nervous System	- The **central nervous system** is the brain and spinal cord, the body's decision maker - The **peripheral nervous system** gathers info and transmits decisions to other body parts - **Nerves**, bundles of axons, link the CNS with the body's sensory receptors, muscles and glands - **Sensory neurons** carry messages from tissues to the CNS - **Motor neurons** carry instructions from the CNS to muscles and glands - Info is processed via **interneurons**, where most complexity resides - The **somatic nervous system** enables voluntary control of skeletal muscles - The **autonomic nervous system** has two important functions: - the **sympathetic nervous system** expends energy and arouses you - it accelerates heartbeat/blood pressure, slows digestion, raises blood sugar, cools you with perspiration - the **parasympathetic nervous system** produces the opposite effect - The brain has about 40 billion neurons, and 400 trillion synapses

	- Neurons in the brain are clustered into groups called *neural networks* - Learning strengthens connections between neurons - The spinal cord is a "two-way information highway" connecting the PNS and brain - **Reflexes** are our automatic responses to stimuli - a spinal reflex pathway has one sensory neuron and one motor neuron, often communicating through an interneuron - If the spinal cord is severed, you lose sensation and <u>voluntary</u> movement below the damage

The Endocrine System	- The **endocrine system**'s glands secrete **hormones**, chemical messengers which affect other tissues, including the brain
	- Some hormones are chemically identical to neurotransmitters, but the systems differ
	  - The nervous system is much faster (fraction of second vs second)
	  - Endocrine messages have longer lasting effects
	- The **adrenal glands** on the kidneys release epinephrine and norepinephrine to increase heart rate, blood pressure and blood sugar (fight/flight response)
	- The **pituitary gland**, controlled by the *hypothalamus* releases many hormones
	  - growth hormone stimulates physical development
	  - oxytocin enables birth contractions, milk flow in nursing, orgasm, pair bonding and trust
	  - influences the release of hormones by other endocrine glands (it's like a master gland) - triggers sex glands to release sex hormones, and adrenal glands to flow body w/ the stress hormone cortisol
	 

MODULE 11 - Studying the Brain, and Older Brain Structures

The Tools of Discovery: Having Our Head	- Scientists can selectively **lesion** (destroy) small groups of brain cells, and also *stimulate* various brain parts to note the effect - An **electroencephalogram (EEG)** reads electrical activity in your neurons that

Examined	sweeps waves across the surface of the brain - A **CT (Computed tomography) scan** takes x-ray photos that can reveal brain damage - A **PET (Positron emission tomography) scan** shows each brain area's consumption of radioactive glucose, showing which areas are most active during a certain activity - An **MRI (Magnetic resonance imaging)** puts someones head into a strong magnetic field, aligning atoms of brain molecules, then disorienting them with radio-wave pulses, causing them to emit signals providing a detailed photo of soft tissues - An **fMRI (Functional MRI)** reveals function as well as structure by comparing MRI scans taken <1 second apart, showing how specific areas activate through increased blood flow

Older Brain Structures	- The **brainstem** begins at the top of the spine, starting with a slight swelling called the **medulla**, which controls heartbeat and breathing
	  - it handles unconscious tasks that keep us alive
	- Above the medulla is the *pons*, which helps coordinate movement
	- The brainstem is where most nerves from each side of the brain connect with the opposite side
	- The **thalamus**, atop the brainstem, is two egg shaped structures which are the sensory control center
	  - It receives info from all senses except smell, and routes that info to higher brain regions
	  - directs some of the higher brain's replies to the medulla and cerebellum
	- Inside the brainstem is the **reticular formation**, which filters incoming stimuli and relays important info to other brain areas and enables arousal
	- The **cerebellum** extends from the back of the brainstem and has two halves
	  - enables nonverbal learning/memory, judgement of time, moderation of emotions and discriminating sounds/textures
	  - coordinates voluntary movement w/ assistance from poms
	- Between old and new brain areas if the **limbic system**, containing the amgala, hypothalamus and hippocampus
	  - the **hippocampus** processes conscious memories
	- The **amygdala**, two small neural clusters, is linked to aggression and fear, including the perception of these emotions and the processing of emotional memories
	  - there is, however, neural activity in many levels when we act with fear or aggression
	- The **hypothalamus** is just below the thalamus, and it influences hunger, thirst, body temperature and sexual behavior to maintain homeostasis
	  - it secretes hormones which trigger the pituitary to influence other glands to release their hormones
	  - it contains *reward centers* like the *nucleus accumbens* which are associated with the pleasures of eating, drinking and sex
	  - a dopamine-increasing drug cn be used to associate experiences with pleasant feelings
	  - addictive disorders may stum from malfunctions in normal brain systems for pleasure and well-being

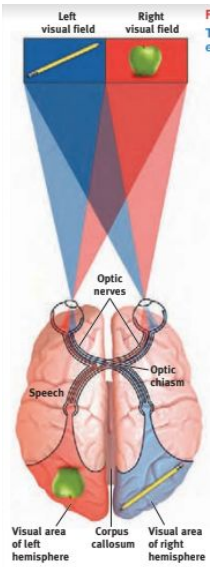
Structure of the Cortex	- Supporting our nerve cells are 9x as many **glial cells**, which provide nutrients and insulating myelin, guide neural connections, mop up ions and neurotransmitters
	  - they may play a role in learning and thinking
	- Each hemisphere's has four *lobes*, separated by *fissures*
	  - There are **frontal, parietal, occipital** and **temporal** lobes

Functions of the Cortex	- Gustav Fristch and Eduard Hitzig discovered the **motor cortex** at the back of the frontal lobe
	  - stimulating the motor cortex causes movement on the opposite side of the body
	  - body areas with the most precise control have larger areas of cortical space
	  - *cognitive neural prosthetics* are used with those who've suffered paralysis or amputation
	- At the front of the parietal lobes, behind the motor cortex, is the **somatosensory** cortex, which receives information from skin senses and movement of body parts
	  - more sensitive regions take up more of the cortex
	- The visual cortex is in your occipital lobes, the auditory cortex is in the temporal lobes
	- In the brain's **association areas**, neurons are busy with higher mental functions
	  - electrically probing these areas makes no observable response, so they can't be neatly mapped
	  - they interpret, integrate and act on sensory info, linking it with stored memories
	- The *prefrontal cortex* in the forward part of the frontal lobes enables judgement, planning and processing of new memories
	  - frontal lobe damage alters personality and inhibition (ex Phineas Gage)
	- In the parietal lobes, association areas enable mathematical and spatial reasoning
	- In the underside of the right temporal lobe, association areas help us recognize faces
	- Damage to Broca's area disrupts speaking, and Wenicke's area disrupts understanding
	- Our mental experiences arise from coordinated brain activity

The Brain's Plasticity	- Brains are sculpted by both genes and experiences
	- **Plasticity** is the brain's ability to modify itself after damage
	  - severed neurons usually don't regenerate, and some brain functions are preassigned to specific areas
	  - *some* of the neural tissue can *reorganize* in response to damage
	- Plasticity can occur after serious damage, especially in young children and when induced by therapy
	- In those who are blind/deaf, unused brain areas are made available for other things like Braille (touch in the visual cortex) or enhanced peripheral vision since the temporal lobe has no stimulation from hearing and instead processes visual signals
	  - this may also occur if disease or damage frees up ceratin areas - tumors or amputations for example
	- **Neurogenesis** is when the brain produces new brain cells, baby neurons

	- this can be stimulated by exercise, sleep and lack of stress

MODULE 13 - Brain Hemisphere Organization and the Biology of Consciousness

Our Divided Brain	- The **corpus callosum** is a wide band of axon fibers that connects the two hemispheres and carries messages between them - Patients with **split brains** are usually normal, but without a corpus callosum, the left/right sides of the brain don't transmit data  - When info is sent to one hemisphere, it can be quizzed completely individually - If the left visual field sees a pencil and the right an apple, the left hand would point to a pencil or pick up a pencil with their left hand (controlled by right brain) but the person would say apple (controlled by left brain) - People with split brains can simultaneously copy different figures - The left brain will create theories to explain the right side's behavior - *Perceptual* tasks are related to the right brain, while intellectual ones are related to the left brain - The left hemisphere literally interprets language, and the right makes inferences, helps modulate speech to clear up meaning, and helps orchestrate our sense of self
The Biology of Consciousness	- Today, science explores the biology of **consciousness**, which helps us act on long-term interests as opposed to short-term pleasure/pain avoidance, and helps to anticipate how we seem to others - **Cognitive neuroscience** is the study of brain activity linked to mental processes - Even in a motionless body, the brain and mind may still be active - Based on cortical activation patterns, scientists can, in a limited way, read your mind - Much of our brain work occurs out of sight in an unconscious, automatic function - researchers call this **dual processing** (we know more than we know we know) - Vision is a dual-processing system - our *visual perception track* lets us recognize things and plan future actions, while our *visual action track* guides moment-to-moment movements - these tracks are in different brain areas, so one can be damaged while the other remains intact - Running on "auto-pilot" allows our consciousness to monitor our system and deal with new challenges

MODULE 14 - Behavior Genetics:Predicting Individual Differences

Genes: Our Codes for Life	- **Behavior geneticists** study our differences and weigh the effects/interplay of heredity and **environment** - Each person has 46 **chromosomes** (23 per parent), each of which is a coiled

	chain of **DNA**
	- **Genes** are small segments of the DNA, of which each person has 20-25,000
	  - they can be active or inactive, and may be turned on by environmental events
	  - they provide code to create *protein molecules*, the body's building blocks
	- Researchers of the Human **genome** have discovered the common sequence of human DNA.

Twin and Adoption Studies	- **Identical twins** develop when one fertilized egg splits in two, and they're genetically identical
	  - they have the same genes, but not necessarily the same number of copies of those genes (one could be more at risk for a disease)
	  - they may be different if they didn't share a placenta in the womb
	- **Fraternal twins** develop when two eggs are fertilized, and they're only as similar as brothers and sisters
	- Identical twins are much more similar than fraternal twins, genetically and psychologically
	- Adoption creates two groups: *genetic* and *experimental relatives* - we can then ask whether adopted children are more like biological or adopted parents
	- People who grew up together, whether or not they're blood related, do not much resemble one another in personality, and adoptees are usually more similar to biological parents
	- Most adopted children thrive because adopted parents are much more carefully screened (obviously)

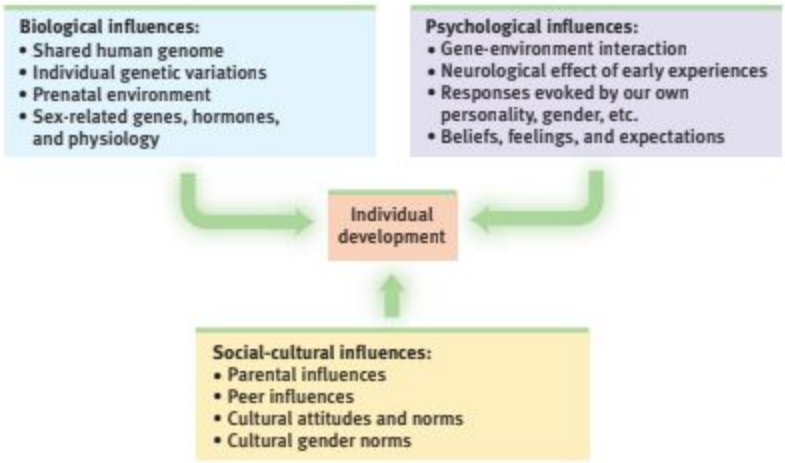
The New Frontier: Molecular Genetics	- **Molecular genetics** seeks to identify *specific genes* influencing behavior - Medical personnel can give would-be parents a report on how their fetus's genes may affect their behavior
Heritability	- Behavior geneticists can estimate the **heritability** of a trait using twin and adoption studies, the extent to which variation of a trait among individuals can be attributed to their differing genes - If all environments became more similar, heritability would increase because differences due to environment would decrease - Heritable individual differences don't imply heritable group differences – putting people in a new social context can change their aggressiveness

Gene-Environment Interaction	- Our most important behavioral hallmark is our enormous adaptive capacity
	- Genes are *self-regulating*, and react to different contexts
	- Genes and experience are both important, and they **interact**.
	  - environments trigger gene activity, and genetically influenced traits evoke responses in others
	- **Epigenetics** studies the molecular mechanisms by which environments trigger genetic expression
	  - environmental factors like diet, drugs and stress can affect the epigenetic molecules that regulate gene expression

MODULE 15

Natural Selection and Adaptation	- **Evolutionary psychologists** focus on what makes us alike, and use the principle of natural selection to understand the roots of behavior and mental

	processes - organisms' varied offspring compete for survival - certain biological/behavioral variations increase reproductive and survival chances in a certain environment - surviving organisms are more likely to pass on their genes - over time, populations change - **Mutations**, random errors in gene replication, produce sometimes advantageous variations - Our adaptive flexibility contributes to our *fitness* - our ability to survive and reproduce
Evolutionary Success Helps Explain Similarities	- Shared human traits were shaped by natural selection acting over the course of human evolution - Our shared human *genome* is our common genetic profile - 95% of genetic variation exists *within* populations - Across cultures, we tend to share a "universal moral compass" which has survived from a past when direct harm-doing was punished (train problem - kill 1 person to save 10?) - Our natural dispositions are often mismatched with out current junk-food and climate change filled environment - Darwin's theory lives on in the *second Darwinian revolution*: applying evolutionary principles to Psychology
An Evolutionary Explanation of Human Sexuality	- With few exceptions, men are more likely than females to initiate sexual activity - Men have a lower threshold for perceiving warm responses as a sexual come-on - Women send their genes on by pairing wisely, men by pairing widely, thus our approaches to sex are respectively more rational and more recreational - Men prefer women who appear to be fertile, and who are at a good age for childbearing, while women are attracted to men who seem mature, bold and affluent
Reflections on Nature and Nurture	- When there is variation, natural selection and heredity, there is evolution - Differences initiated by nature may be amplified by nurture - for example, culture magnifies the gender difference, encouraging males to be macho and females to be gentle - Gender rules are increasingly converging, as brute strength becomes increasingly irrelevant - We are the products of both genes and environments (biopsychosocial approach to individual development)

	 Biological influences: • Shared human genome • Individual genetic variations • Prenatal environment • Sex-related genes, hormones, and physiology Psychological influences: • Gene-environment interaction • Neurological effect of early experiences • Responses evoked by our own personality, gender, etc. • Beliefs, feelings, and expectations Individual development Social-cultural influences: • Parental influences • Peer influences • Cultural attitudes and norms • Cultural gender norms