

Unit 6 Notes: Biology and Behavior

The Nervous System

- the *nervous system* is divided into two parts
 - the *central nervous system* refers to the brain and the spinal cord
 - the *peripheral nervous system* refers to the neural pathways going to and coming from the central nervous system
- *sensory* (or *afferent*) *neurons* relay information from the sense receptors to the spinal cord and brain
- *motor* (or *efferent*) *neurons* relay information from the central nervous system to the muscles

- *reflex arcs* allow behavior responses without processing by the higher-order levels of the brain--these are essential for survival and allow for rapid motor responses

- the peripheral nervous system can be divided into two systems
 - the *somatic nervous system* is in charge of voluntary skeletal muscles
 - the *autonomic nervous system* is in charge of predominantly involuntary smooth and cardiac muscle activity
 - this is important for heart functioning and digestion

- the autonomic nervous system can be divided into two systems
 - the *parasympathetic nervous system* is in charge of the body at rest (slowing down biological processes) and in digestion of food
 - the *sympathetic nervous system* kicks in during times of stress, fear or rage--it controls our “fight or flight” behaviors

(insert diagram of the neuron here)

- the *dendrites* receive incoming information
- the cell body, which contains the nucleus, is called the *soma*--it is the living part of the neuron
- the *axon* is the long fiber over which outgoing messages travel The *axon terminal buttons* are the transmitters, sending information on to the next neuron
- the space between neurons is the *synaptic gap*
- the *synapse* is made up of the axon terminal buttons of one neuron, the synaptic gap, and the dendrites of the next neuron

- there are several *neurotransmitters* or chemicals released by the synaptic vesicles that travel across the synaptic gap and affect adjacent neurons
- some of these are
 - *dopamine* which inhibitory neurochemical involved in Parkinson's Disease and schizophrenia
 - *serotonin* which is an inhibitory neurochemical involved in obsessive-compulsive disorder (OCD) as well as sleeping, arousal, eating, mood and depression

- *acetylcholine* which is an excitatory neurochemical involved in Alzheimer's Disease
- *norepinephrine* which is an inhibitory neurochemical, involved in arousal, wakefulness, learning, memory, depression and mania

Old Methods of Brain Study

- there are several methods of brain study which have been conducted in the past, with new, computerized studies rendering more accurate information
- old methods of brain study include:
 - *direct stimulation* (or microelectrode method): part of the brain is stimulated to see its effect
 - *evoked potential*: part of the brain is monitored to see if external stimuli change its functioning
 - *lesioning* (or *ablation*): severing or cutting parts of the brain
 - *EEG*: measures brain wave activity--frequently used in dream research

New Methods of Brain Study

- new methods of brain study include:
 - *MRI* : magnetic fields from radio waves
 - *PET* : positron emission tomography, uses radioactive material, good for metabolic activity of the brain
 - *CT* : uses X-rays to look at soft tissue
 - *SPECT* : single photon emission computerized axial tomography, traces blood flow in the brain
 - *SQUID* : super conducting quantum interference device, senses tiny changes in the brain's magnetic fields and represents them in 3-D, deals with electrical impulses from neural firing

(insert diagram of the brain with parts identified here)

The Three Brains

- the brain can be divided into three brains--forebrain, midbrain and hindbrain
- the forebrain includes:
 - *hypothalamus*: controls hunger, thirst, sexual behavior, body temperature and motivation
 - *thalamus*: the relay center for sense receptors
 - *cerebral cortex*: higher-order thinking and language
 - *corpus callosum*: band of fibers that connects the two hemispheres
- the midbrain includes:
 - *reticular formation* (not on diagram): the alert system of the brain
- the hindbrain includes:
 - *cerebellum*: controls balance, fine movement and muscle tone
 - *pons*: the sleep-wake cycle
 - *medulla*: controls breathing, heart rate and blood pressure

- the *brainstem*--the midbrain and hindbrain combined that are typically considered the most primitive part of the brain
- *phylogeny*--the study of the evolutionary development of humans
- also listed on the diagram is the *limbic system* which includes:
 - the *amygdala* is responsible for some aspects of memory as well as aggressive and defensive behaviors
 - the *hippocampus* is also responsible for memory and preservation
 - the *septum* regulates aggression, pleasure and sexual arousal
- removal of the hippocampus has resulted in significant problems with memory
 - *anterograde amnesia*--this is the inability to develop new memories while older memories remain intact
 - *retrograde amnesia*--memory loss just prior to a traumatic event or brain injury

(insert diagram of the lobes here)

The Four Lobes

- the brain can also be divided into four lobes:
 - the *frontal lobe* is responsible for psychomotor behavior; it is responsible for initiative, planning, abstraction, expression, expressive speech, and aggression
 - *Broca's brain*, involved in expressive speech, is in the left frontal lobe
 - the *temporal lobe* processes hearing and receptive speech;
 - *Wernicke's area*, involved in receptive speech, is in the left temporal lobe
 - the *occipital lobe* (sometimes called the *striate cortex*) is responsible for visual information
 - the *parietal lobe* processes some speech and somatosensory information from sense receptors in the skin, muscles and joints

The Two Hemispheres

- the brain can also be divided into two hemispheres with predominant functions in each hemisphere
- hemispheres are joined by the corpus collosum
- they are
 - asymmetrical (not the same size or same purposes)
 - predominantly *contralateral* (processes cross to opposite side of the body)
 - some aspects of behavior are *ipsilateral* (same side of the body)
 - set up so information crosses at the corpus collosum

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| <ul style="list-style-type: none"> • the left hemisphere... is verbal is mathematical is analytical is concrete considers extremes of things is non-emotional deals with the present | <ul style="list-style-type: none"> the right hemisphere... is pictorial is abstract is preverbal sees the big picture has spatial ability is creative is musical is emotional deals with the past and future |
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The Endocrine System

- the *endocrine system* in the body is a communication system that releases hormones through the bloodstream to various parts of the body
- the *thyroid gland* is responsible for metabolic activity and is located in the front of the neck; it releases the hormone *thyroxin*
- the *pituitary gland* works in conjunction with the hypothalamus and is located on the underside of the brain; it regulates the activities of the endocrine system and releases the largest number of the body's hormones
- the *adrenal glands* release *adrenaline* or epinephrine in response to fear or other emotionally-charged situations
- the *sex glands* work in conjunction with the pituitary gland
 - the *testes* are the male sex glands
 - secondary sex traits in males are governed by *androgens*
 - the *ovaries* are the female sex glands
 - secondary sex traits in females are governed by *estrogen* and *progesterone*

Behavioral Genetics

- *traits* are defined as behavioral and physical characteristics
- *genes* are the biological material that cause traits to be passed on from one generation to the next
 - *recessive genes* are less likely to be passed on
 - *dominant genes* are more likely to be passed on
- at conception, both the male and female contribute sets of 23 chromosomes each
 - while the mother always passes on an X chromosome to determine the gender of the fetus; if the father passes on an X chromosome the fetus is genetically female and if he passes on a Y chromosome the fetus is genetically male
- genetic disorders can also occur during development:
 - *Down's syndrome*, which is linked to mental retardation, is caused by an extra 21st chromosome
 - *Huntington's Chorea*, which typically occurs after the age of 40, is a debilitating genetic disorder that involves involuntary movements and progressive dementia
- genetics encompasses one side of the ongoing *nature versus nurture* debate, with environmental arguments being offered by the opposing side