Unit 2: Biopsychology

The Nervous System

Vocabulary

Central Nervous System (CNS)
Spinal Cord
Reflexes
Peripheral Nervous System (PNS)
Neurons
Action Potential
Threshold
Synapse
Neurotransmitters
Somatic Nervous System (SNS)
Autonomic Nervous System (ANS)
Sympathetic
Parasympathetic

Biopsychology

A branch of psychology concerned with the links between biology and behaviour.

Can be used to understand sleep patterns, dreams, depression, hunger, stress, disease, etc.

The Nervous System

The nerves of the ***peripheral nervous system (PNS)*** conduct information from the body to the ***central nervous system (CNS)*** and back allowing the body and brain to communicate.

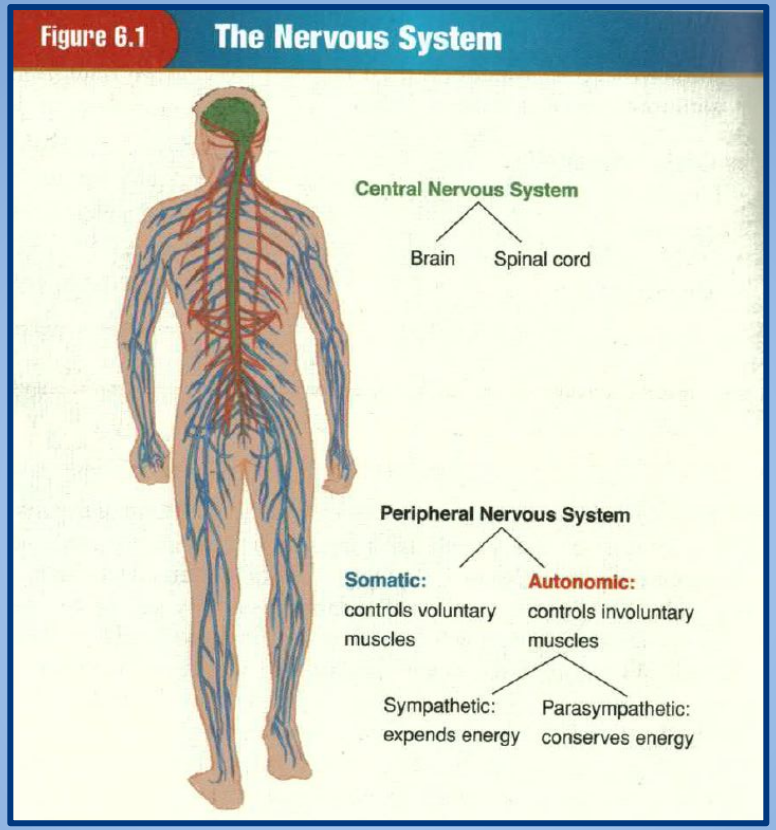


Figure 6.1 - The Nervous System

The Central Nervous System

The Brain

- Thinking, feeling, and acting
- Roughly 400 trillion synapses
- Neurons cluster into working groups called neural networks

The Spinal Cord

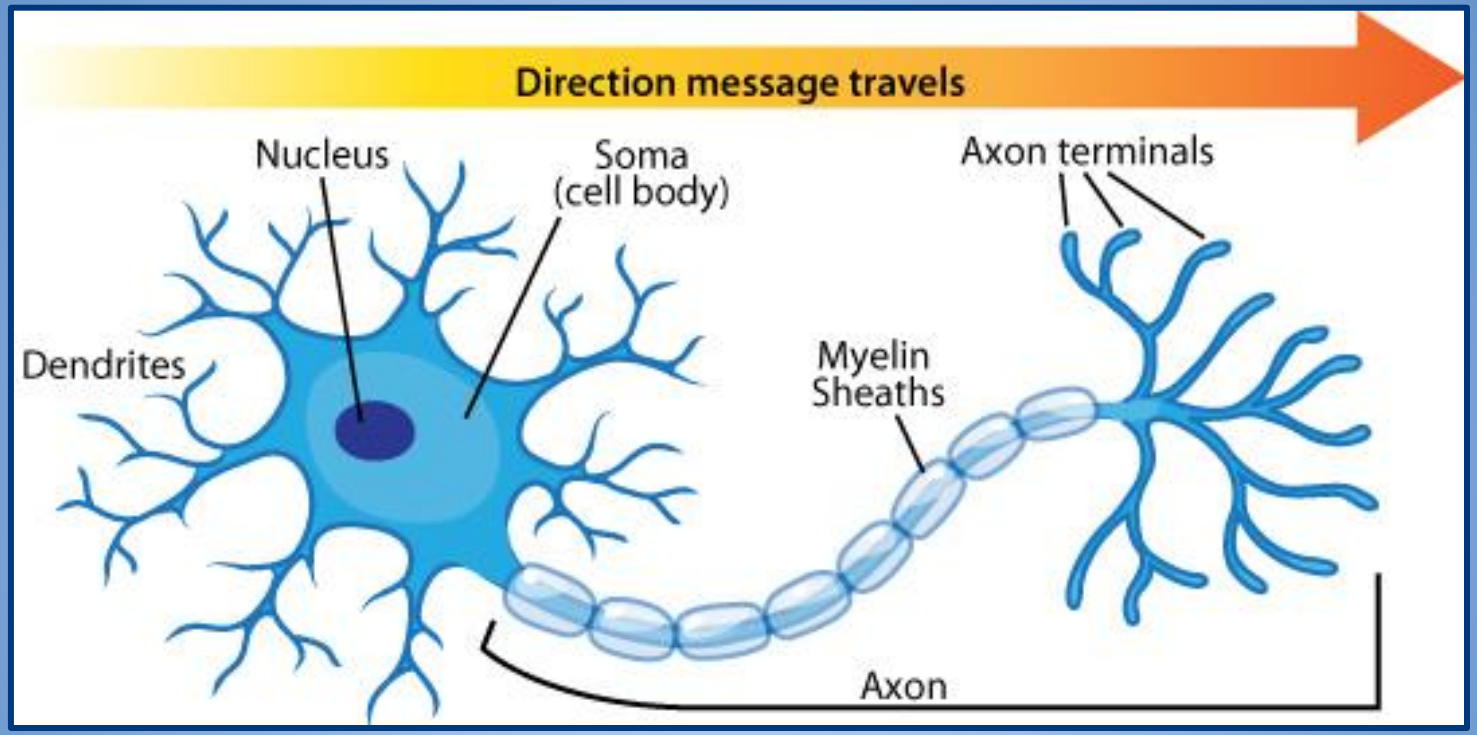
- Connects the CNS to the PNS
- Information highway

Reflexes are simple autonomic responses to sensory stimulus that occur through the spinal cord, skipping the brain.

Neurons

Messages to and from the brain travel along the nerves which are made up of strings of long, thin cells called ***neurons***.

Neurons are made up of four basic parts: dendrites, the cell body, an axon, and axon terminals.



Anatomy of a Neuron

Anatomy of a Neuron

- **Dendrite** - the branching extensions that receive messages and conduct impulses toward the cell body.
- **Axon** - the extension of a neuron through which messages pass, can be several feet in length.
- **Axon Terminals** - branched end of a neuron, connects to the dendrites of the next neuron.
- **Myelin Sheath** - layer of fatty tissue encasing the fibers, leads to faster transmission of impulses.
- **Cell Body** - control of the neuron cell, contains nucleus.

Your Turn to Draw

You will have 1 minute to look at the picture. Then you will draw and label a neuron cell.

Communication of Neurons

Action Potential: a neural impulse, a brief electrical charge that travels down an axon.

This is done by our senses or when triggered by chemical signals from a neighboring neuron.

Threshold: level of stimulation required to trigger a neural impulse.

It is an **all or none** response. If stimulation reaches the threshold, the neuron will fire.

Communication of Neurons

Synapse: the gap that exists between neurons.

A neuron transmits its impulses to another neuron across the ***synapse*** by releasing chemicals known as ***neurotransmitters***.

ex) dopamine, endorphin, acetylcholine

Neurotransmitters

- Different neurotransmitters are used in different parts of the brain and have different effects on behaviour and emotions.

Some Neurotransmitters and Their Functions

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.	Excess dopamine receptor activity is linked to schizophrenia. Starved of dopamine, the brain produces the tremors and decreased mobility of Parkinson's disease.
Serotonin	Affects mood, hunger, sleep, and arousal.	Undersupply linked to depression. Prozac and some other 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 brain, producing migraines or seizures (which is why some people avoid MSG, monosodium glutamate, in food).

Voluntary and Involuntary Activities

Somatic Nervous System: the part of the PNS that controls voluntary activities (ex. moving your hand to wave).

Autonomic Nervous System: the part of the PNS that controls involuntary activities (ex. heartbeat, stomach activity).

Voluntary and Involuntary Activities

The autonomic nervous system has two parts:

- the ***sympathetic nervous system*** prepares the body for dealing with emergencies.
- the ***parasympathetic nervous system*** works to conserve energy and enhance the body's ability to recover from strenuous activity.

Receptors are constantly receiving messages and alerting the autonomic nervous system to respond.

Peripheral nervous system

Central nervous system

Nervous system

Peripheral

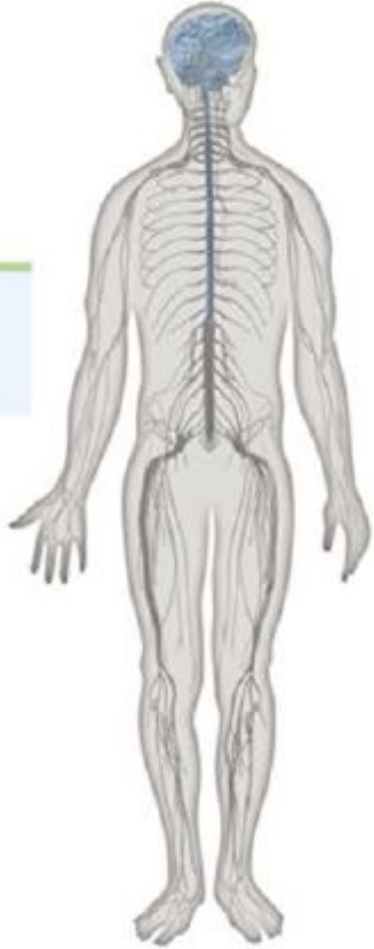
Central (brain and spinal cord)

Autonomic (controls self-regulated action of internal organs and glands)

Somatic (controls voluntary movements of skeletal muscles)

Sympathetic (arousing)

Parasympathetic (calming)



Unit 2: Biopsychology

The Brain

Vocabulary

Hindbrain
Midbrain
Forebrain
Lobes
EEG
CT
PET
MRI

Cerebellum
Corpus Callosum
Pons
Spinal Cord
Medulla
Thalamus
Hypothalamus

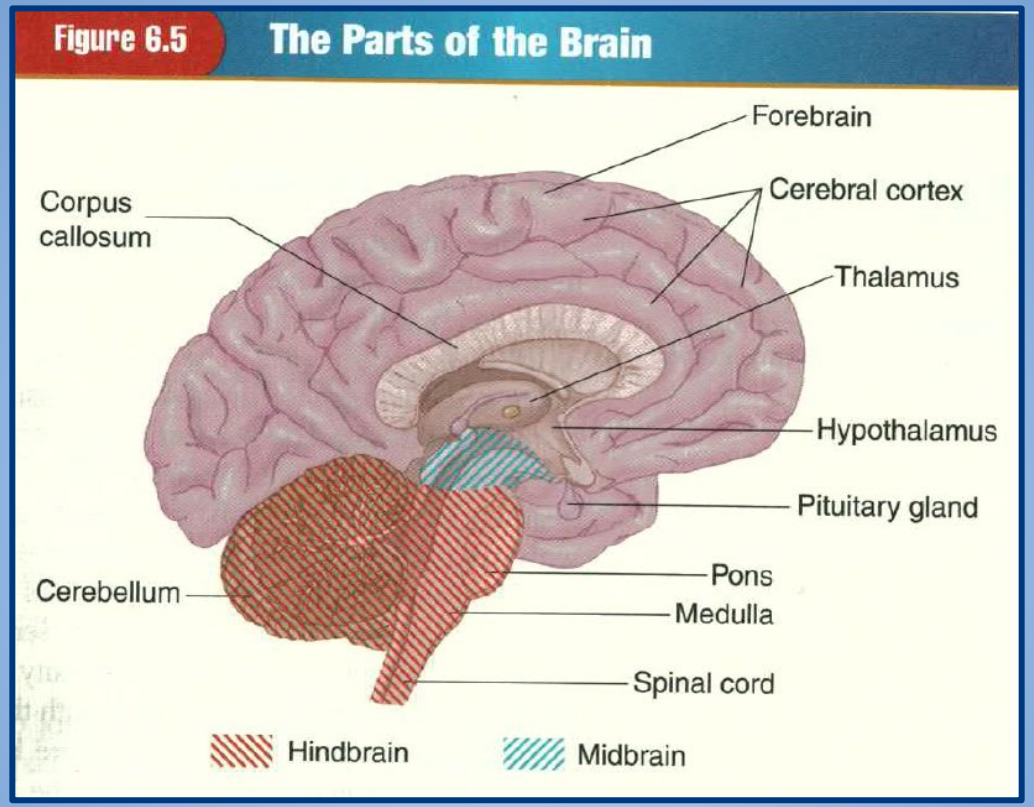


Figure 6.5 - The Three Brains

The Hindbrain

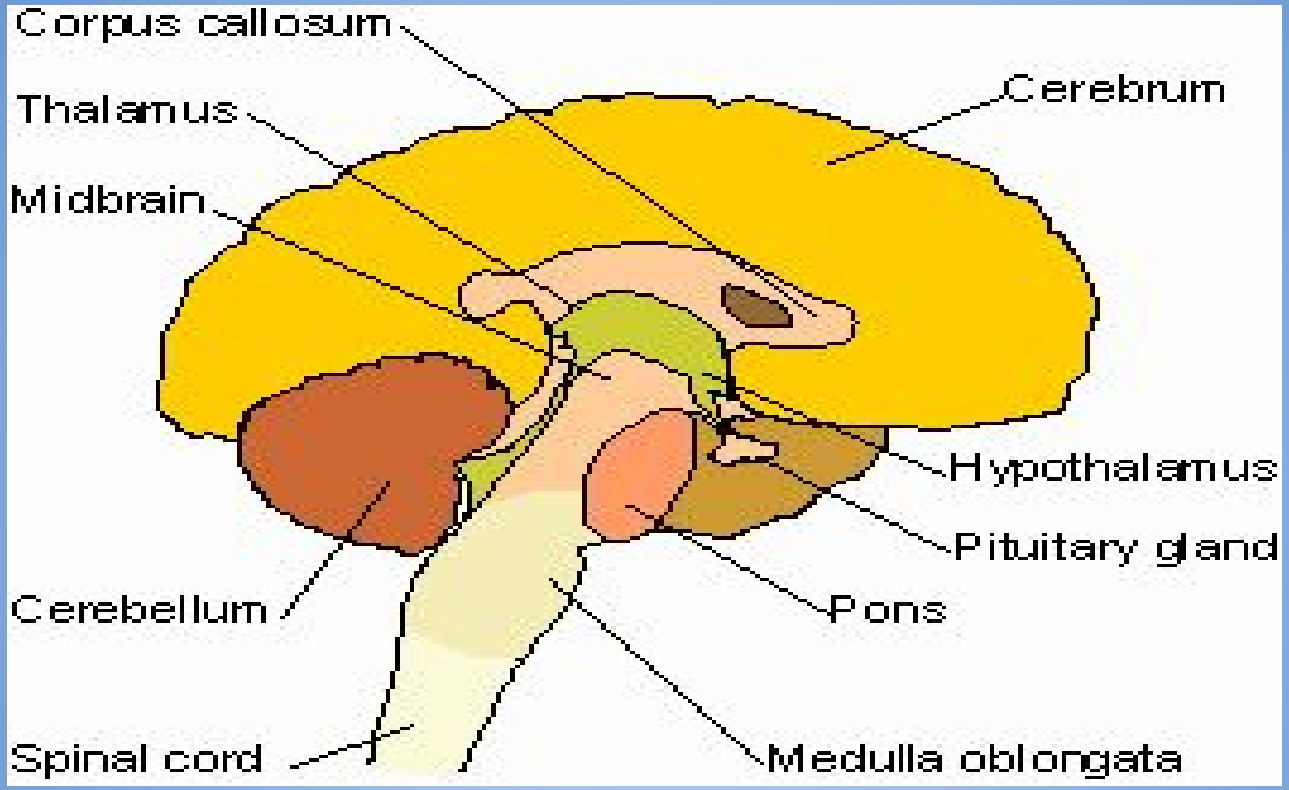
- Located at the rear base of the skull
- Responsible for basic life processes
- Includes:
  - ***Medulla***: controls breathing, HR, and other reflexes
  - ***Pons:*** bridge between the brain and spinal cord
  - ***Cerebellum:*** controls posture, balance, and voluntary movement

The Midbrain

- Small part of the brain above the pons
- Arouses the brain, integrates sensory information and relays it up to the forebrain.

The Forebrain

- Houses the higher thinking processes
- Structures of the forebrain include:
  - ***Cerebral Cortex and Cerebrum:*** surround the brainstem and hindbrain.
  - ***Thalamus:*** integrates sensory input
  - ***Hypothalamus:*** controls involuntary functions such as hunger, thirst, and reactions to temperature
  - ***Limbic System:*** regulates emotions and motivation



Major Structures of the Brain

Lobes of the Brain

The ***cerebrum*** is made up of two hemispheres connected by a band of fibers called the ***corpus callosum***.

Each hemisphere has grooves that mark different ***lobes***.

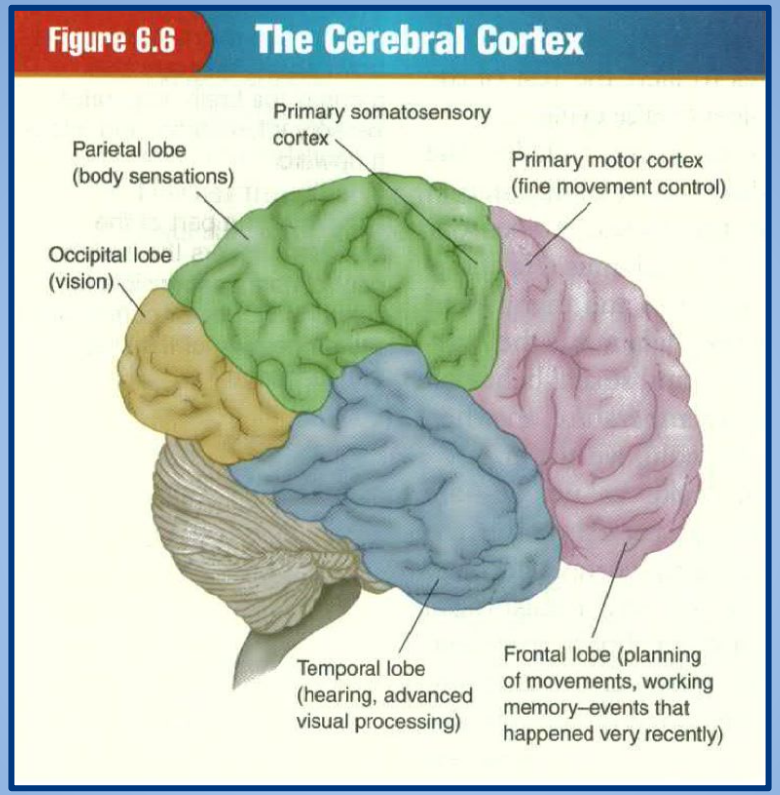


Figure 6.6 - The Lobes of the Brain

The Occipital Lobe

- At the back of the head
- Includes the cortical area, where most visual signals are sent and visual processing is begun. This area is called the *primary visual cortex*.

The Parietal Lobe

- The **parietal lobe** is forward of the occipital lobe. It includes the area that registers the sense of touch called the *primary somatosensory cortex*.

The Temporal Lobe

- ▫The **temporal lobe** (meaning near the temples) lies below the parietal lobe.
- ▫Near the top, the temporal lobe contains an area devoted to auditory processing, called the *primary auditory cortex*. Impairment to this part of the brain can damage a person's comprehension of speech and language ability.

The Frontal Lobe

- ▫The **frontal lobe** is the largest in lobe in the human brain. It contains the principal areas that control the movement of muscles called the *primary motor cortex*.

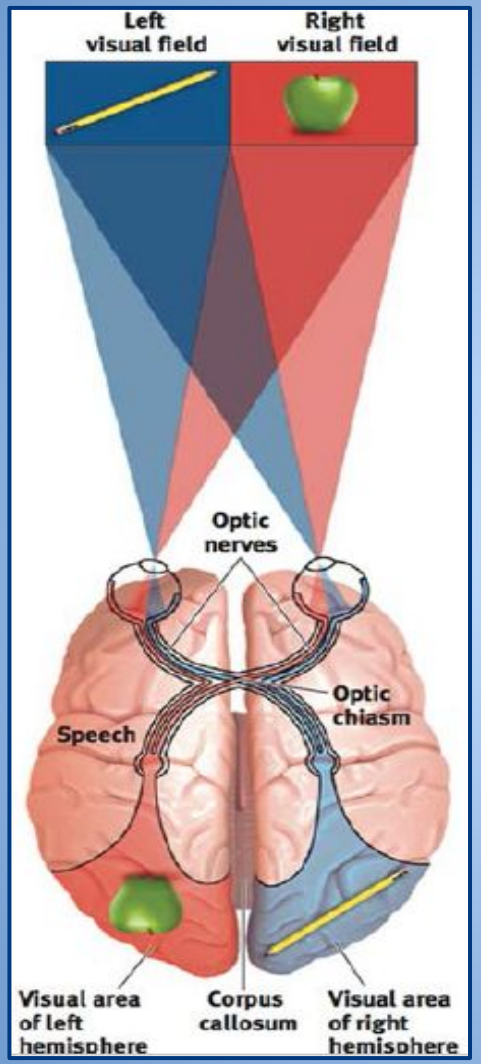
The Frontal Lobe

- The amount of motor cortex allocated to the control of a body part depends not on the part's size but on the diversity and precision of its movements. ***Therefore more of the cortex is given to parts we have fine control over*, such as fingers, lips, and the tongue.** Less of the cortex is devoted to larger parts that make crude movements, such as the thighs and shoulders.

Left and Right Hemispheres

Though each hemisphere has distinct properties, the two sides communicate and help each other via the ***corpus callosum***.

Each hemisphere is connected to the opposite half of the body -- the left hemisphere controls the right side of the body.



Right Brain

- visual and spatial relations
- recognizing patterns
- creativity and intuition

Left Brain

- speech
- mathematics and logic
- critical thinking

Activity: Mr. Split Brainy

The **Split Brain Experiments Game** is based on the 1981 Nobel Prize in Physiology that was awarded for discoveries surrounding differences in the left and right hemispheres of the brain.

http://www.nobelprize.org/educational/medicine/split-brain/

The Brain's Plasticity

Our brain is extremely moldable. It is able to modify and heal itself after trauma.

ex) pianists have more developed auditory centers.

Plasticity - the brain's ability to change, especially during childhood, by reorganizing after damage or by building new pathways based on experience.

The Girl with Half a Brain

How Psychologists Study the Brain

Separate into 5 groups, each group will be assigned one method scientists use to study the brain:

- Recording
- Stimulation
- Lesions
- Accidents
- Images

Groups will then be rearranged so that a representative from each category is present to share their group's information.

How Psychologists Study the Brain

Read the section on your research method in the textbook, pages 165-168. You must record and share the following information:

- What is it?
- How does it work?
- What kind of equipment is used?
- What has this method taught us about the brain?
- Anything else of interest/importance

The Endocrine System

- The major way the brain communicates with the body is through the nervous system.
- However, the body has a second communication system that is also important to behaviour.

Types of Neurotransmitters

NEUROTRANSMITTER	FUNCTION	RESULTS IF UNDERSUPPLIED OR OVERSUPPLIED
Acetylcholine	Excitatory at synapses involved with movement and memory	Paralysis, Alzheimer's disease (undersupply)
Norepinephrine	Involved with memory and learning	Depression (undersupply)
Serotonin	Governs sleep, appetite, and temperature	Depression (undersupply)
Endorphin	Inhibits pain	None
Dopamine	Involved with learning, emotional arousal, and movement	Schizophrenia (oversupply), and Parkinson's disease (undersupply)

The Endocrine System

- The ***endocrine system*** consists of glands that secrete chemicals into the bloodstream that help control bodily functioning. The messengers in this system are called ***hormones***.
- Hormones are the chemical substances released by the endocrine glands.

The Endocrine System

- In a way endocrine glands are like chemical synapses with distant receptors. Once released, the hormonal transmitters diffuse through the bloodstream and bind to special receptors on distant target cells. There are some 30 different hormones in the human body. Some have specific target cells while other have a great many cells throughout the body.

The Endocrine System

- Some hormones are released in response to changing conditions in the body and act to regulate those conditions such as digestion in the stomach and intestines, regulating blood pressures and releasing insulin.

The Endocrine System

- Much of the endocrine system is controlled by the nervous system through the hypothalamus and its neighbour the ***pituitary gland***. The pituitary gland releases a great variety of hormones that fan out around the body, stimulating actions in the other endocrine gland.

Unit 2: Biopsychology

Heredity and Environment

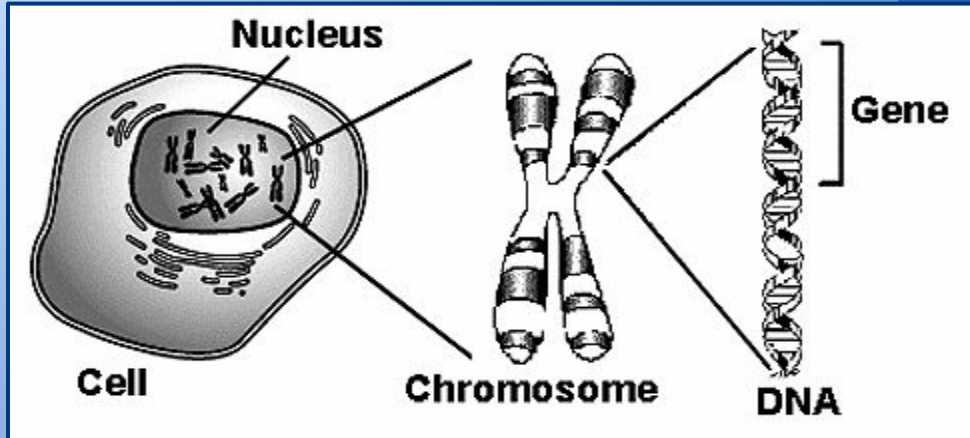
Crash Course Genetics

Humans have 46 chromosomes in each of their cells. 23 from their father, 23 from their mother.

Chromosome: threadlike structures made of DNA molecules that contain genes.

DNA: complex molecule containing the genetic information that makes up chromosomes

Genes: units of heredity that make up chromosomes (segments of a DNA strand) that can be active or inactive.



The BIG Question

Nature vs. Nurture

What has a bigger influence on our behaviour, our genes or our environment?

Twin and Adoption Studies

- To study this question researchers would have to either control the home environment and vary heredity, OR control heredity and vary the home environment
- Ethical?.....No. Case studies are the best option.

Identical Twins

- Develop from a single fertilized egg that splits in two, creating two genetically identical people. Natural human clones!
- Ideal for studying the effects of different environments on behaviour because their heredity is automatically controlled.

Nature vs. Nurture - Twin Studies

Twins Growing Up Apart

Twin Studies

Adoption

- Are adopted children more like their biological parents that gave them their genes, or their adoptive parents who contributed the home environment?

Adoption

- Studies show that personality is not affected by one's environment.
- Certain personality traits, like extraversion and agreeableness, likely have some biological connections.
- Universally family environment DOES influence children's attitudes, values, manners, faith and politics.

Why are children from the same family so different? Discuss.

Heritability

The proportion of variation among individuals that we can attribute to genes.

ie.) The likelihood a person might inherit a gene

Keep in mind, this does not allow us to predict the outcome that gene might have on personality or behaviour.

Only the extent to which differences among people are attributable to genes.

ex) Boys Raised in a Barrel

- Mark Twain jokingly proposed raising boys in barrels, feeding them through a hole, until the age of 12.
- If we were to actually do this the boys would all emerge with lower than normal IQ scores.
- BUT, given their equal environments, the differences in their scores would only be explained by their heredity.
- This would tell us the ***heritability*** of IQ.

So which is it?

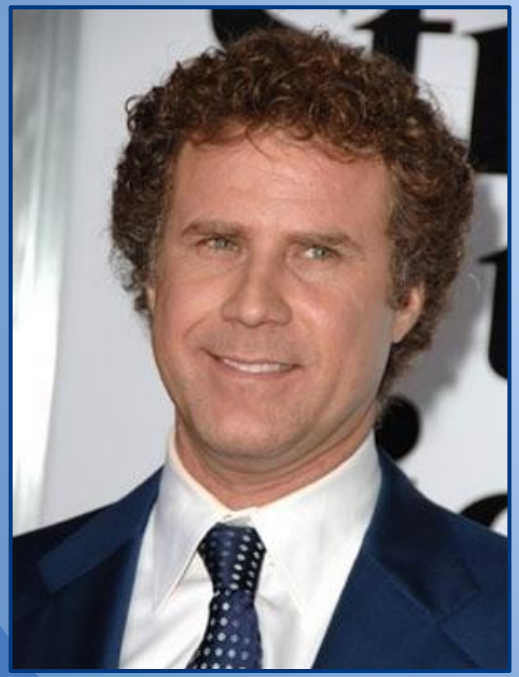
- Genes and experience are both important. They **interact** to make us who we are.
- Environmental factors can trigger gene activity.
  ex) heart disease, diabetes
- Yet, our environment can only take us so far.
  ex) ‘genetic ceiling’ in athletics

Both!

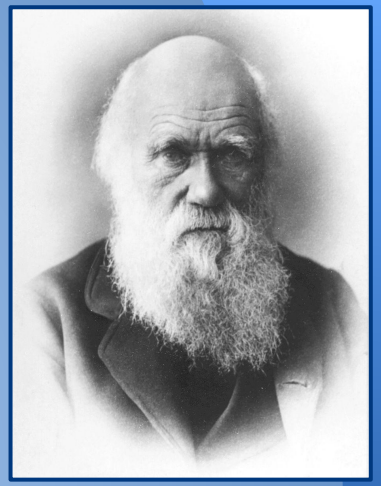
- From conception onward, we are the product of a cascade of interactions between our genetic predispositions (NATURE) and our surrounding environments (NURTURE).

- Our genes affect how people react to AND influence us.

Example of Gene-Environment Interaction



Evolutionary Psychology

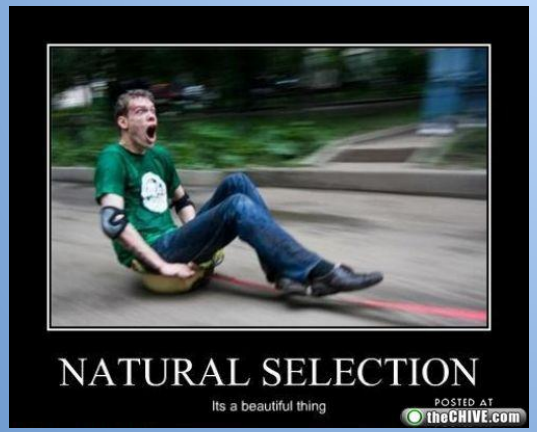


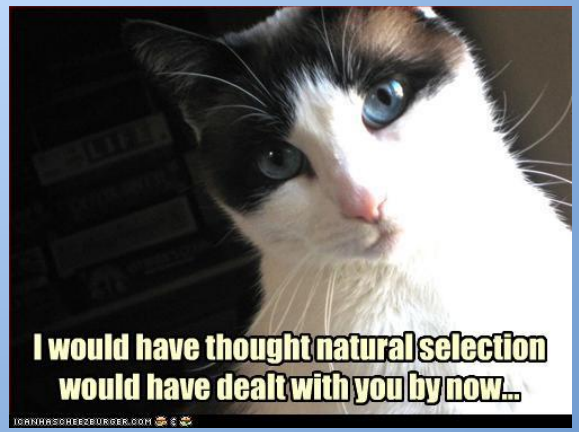
The study of the evolution of behaviour and the mind, using principles of natural selection.

Natural Selection: the principle that, among the range of inherited trait variations, those that lead to increased reproduction and survival will most likely be passed on to succeeding generations.

What does that mean?

- Organisms' varied offspring compete for survival.
- Certain biological and behavioural variations increase an organism's' chances for survival and reproduction in a particular environment.

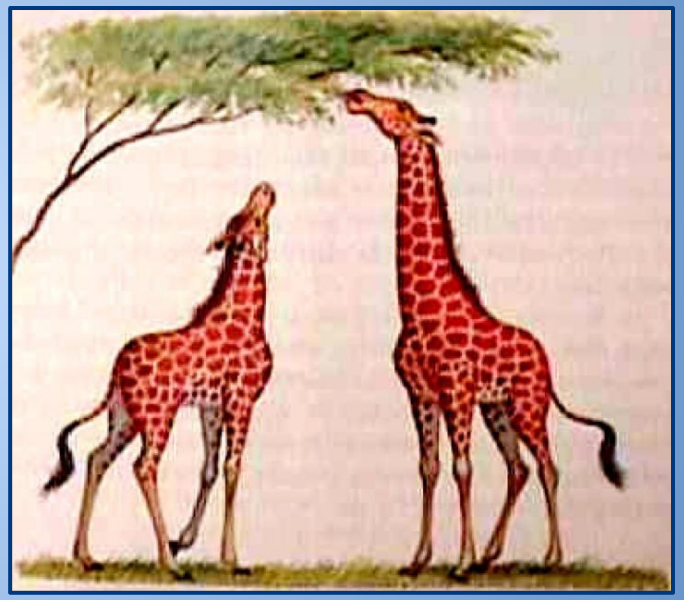




Adapt to Survive

Mutations: random errors in gene replication that leads to change

Over time, nature will select advantageous variations from among mutations allowing humans to adapt to environmental conditions.



Outdated Tendencies

- Genetic traits which helped our ancestors survive may harm us today

Explain this example:

Evolution and Psychology

The application of Darwin's research on natural selection has allowed psychologists to address questions such as:

a. Why do infants fear strangers about the time when they become mobile?
b. Why do so many people have phobias about spiders, snakes and heights than about more dangerous threats like car accidents and guns?
c. Why are biological fathers less likely than unrelated boyfriends or stepfathers to abuse the children they live with?
d. Why do humans share some universal moral ideas?

Discuss!