The Nervous System

"How you know when to

STOP

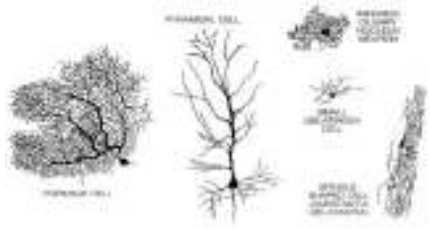
doing something stupid."

Or

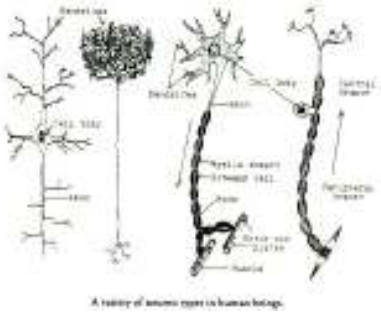
"Keep doing something pleasurable"

Complexity of the Brain

The brain contains approximately 100 billion nerve cells, or neurons, and 10 – 50 times more supporting cells, or glia.

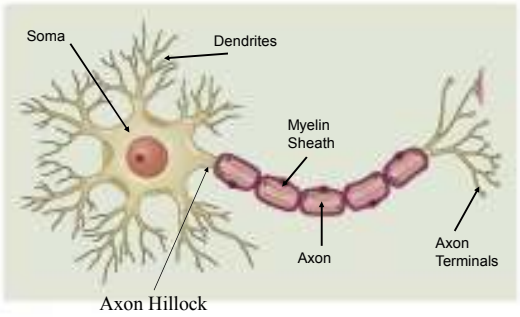


Different Types of Neurons



The Neuron

- Dendrites – receive CHEMICAL info
- Soma (cell body) – contains nucleus, cytoplasm, organelles
- Axon Hillock
- Axon – transmits ELECTRICAL info
- Myelin sheath – covers the axon to increase transmission speed (cause of sensory and motor disturbances in multiple sclerosis)
- Axon terminals (housing Vesicles. Aka terminal buttons) transmit CHEMICAL info.



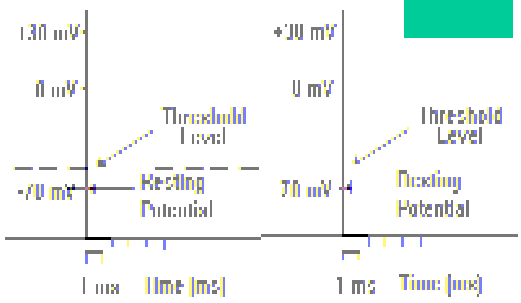
Its all Electrical

- Resting Potential (polarized at -70 millivolts compared to outside the cell) + Action Potential {aka stimulus} (depolarizes and area of the cell with 110 millivolts) = +40 millivolts allowing + charged sodium ions to enter cell. When a critical mass of sodium is amassed and it triggers an electrical circuit in the axon to fire.

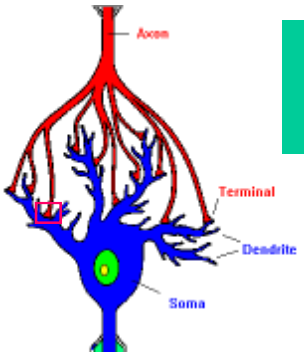
Its all electrical

- Once the strength of the signal reaches a certain Threshold Level (say 5,000 of the 10,000 connecting axons say "yes") the axon hillock sends a message down its length. It travels from 2 millimeters to 3 feet (depending on the axon length) where it becomes chemical again.

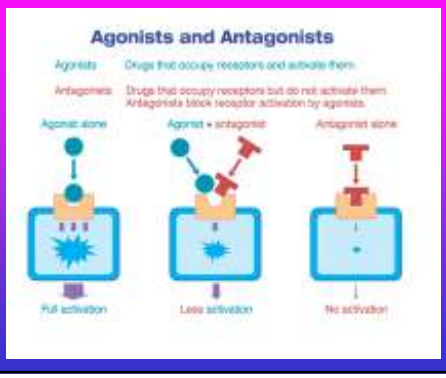
Action Potentials



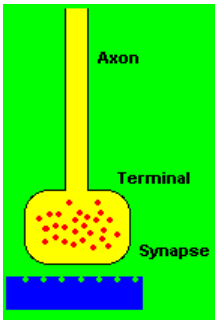
The Synapse



Neuropharmacology



The Synapse



- Now its all CHEMICAL
- Axon terminal releases neurotransmitters
- Neurotransmitters cross the synapse and bind to receptors on another neuron
- Neurotransmitters released, taken up again by first neuron (Re-Uptake), or they flushed out of the system (blood stream, urine)

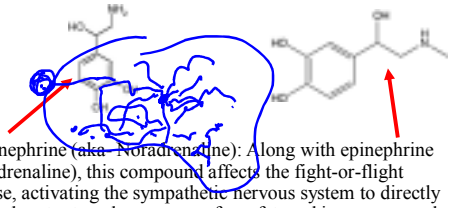
Neurotransmitters (≈ 100)

- Acetylcholine – Excitatory to muscles and memories. Controls movement (respiratory paralysis)
- Dopamine – Inhibitory to involuntary muscles, learning and memory. Deals with motivation, pleasure (schizophrenia, Parkinson's)
- Serotonin – Inhibitory to emotional arousal. Controls mood, sleep, appetite, anxiety (depression, obsessive-compulsive disorder, panic disorder.
- Endorphins: Inhibitory to pain.

Disorders associated with having too much or too little neurotransmitter

Neurotransmitter	Amount of Neurotransmitter	Associated Psychological Disorders
dopamine	too much	schizophrenia
	too little	Parkinson's disease
serotonin	too little	depression obsessive compulsive disorder
norepinephrine	too little	depression
acetylcholine	too little	Alzheimer's disease

Neurotransmitters (cont/)



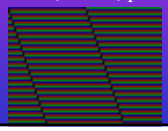
- Norepinephrine (aka- Noradrenaline): Along with epinephrine (aka- adrenaline), this compound affects the fight-or-flight response, activating the sympathetic nervous system to directly increase heart rate, release energy from fat, and increase muscle readiness.
- Glutamate a neurotransmitter involved in Long Term Potentiation (LTP), which is vital to memory formation

Why is this so important?

- Imbalances cause: Schizophrenia, Major Depression, and a host of other mental illnesses

Reuptake Inhibitors

- Prevent reuptake of neurotransmitters from the synapse
- MAO Inhibitors
- Tricyclics
- Selective serotonin reuptake inhibitors
- Example: Prozac
  - Treats depression, OCD, panic disorder



Downers
Benzodiazepines

Speed
Amphetamines

So why not just

- Take this drug to make you happy
- Take this drug make you stronger
- Take this drug to end stress
- Take this drug to enhance your …

Heroin
Increases
Gaba which
Reduces
Dopamine
release

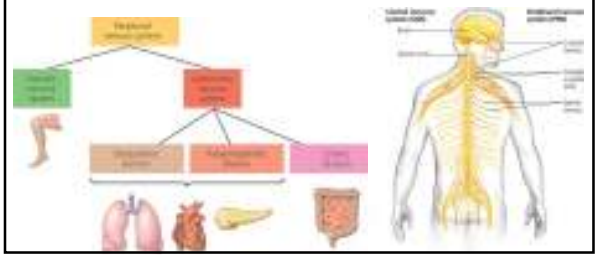
Cocaine
blocks
Dopamine
Re-uptake,
Keeping it
Exciting
Pleasure
centers

The LESS Cl (chlorine) the greater the excitement

So What's
The big deal?

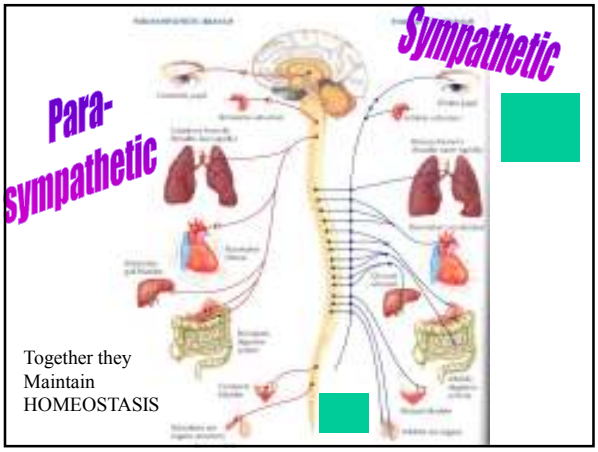
The Nervous System is ÷ into

- Central Nervous System (CNS) = brain & spinal cords
- Peripheral Nervous System (PNS) = outside of CNS; made up of *cranial* nerves, *spinal* nerves, and *ganglia*



Peripheral Nervous System is ÷ into:

- **Somatic Nervous System** – carries signals to and from skeletal muscles, mainly in response to *external* stimuli; ***voluntary*** because it's subject to conscious control
  - (not much skeletal muscles activity is actually controlled by *reflexes* mediated by the spinal cord or the brainstem)
- **Autonomic Nervous System** – regulates the *internal* environment by controlling smooth and cardiac muscles and the organs of the digestive, cardiovascular, excretory, and endocrine systems; generally ***involuntary***
  - **Autonomic Nervous System is further** ÷ into:
    - Parasympathetic
    - Sympathetic



The functions of the spinal cord

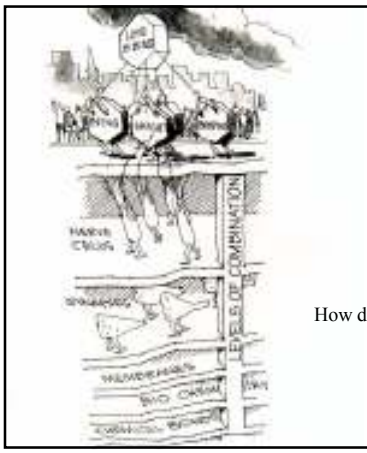
- Passing information to and from the brain: linking the peripheral nervous system to the brain.
- controlling simple reflexes

Reflex Controlled in the Spinal Cord

Complexity of the Brain

"…One of the most awe-inspiring mysteries of brain science is how neuronal activity within circuits gives rise to behavior, and even consciousness…"

Mental Health: A Report of the Surgeon General



THE Endocrine System

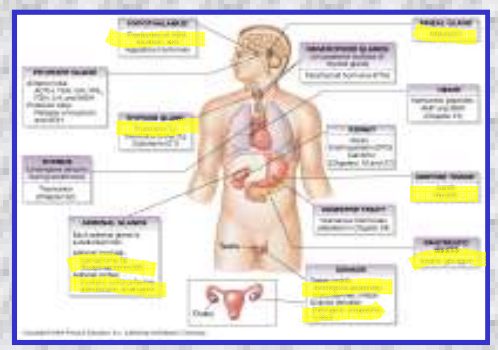
How do you make a hormone?

The Brain as a GLAND (also)

- Cortex sends hormones and or signals to the Hypothalamus
- Hypothalamus send hormones to the Pituitary Gland
- The Pituitary sends hormones to the other glands
  - Pancreas
  - Liver
  - Heart (rarely, but does function as gland at times)
  - Thyroid
  - Etc.

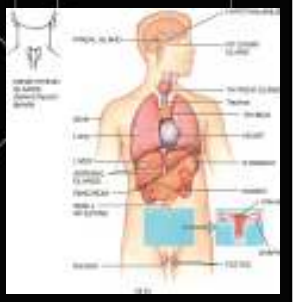
Endocrine System

The Hormones of the Endocrine System



Endocrine System

- **Major homeostatic control system with nervous system.**
- **Effects mediated by hormones**
  - **Responses slower and longer lasting than nervous system**
  - **Influence much broader**
    - **Regulates virtually all types of cells**
- **Consists of**
  - **endocrine glands**
  - **several organs containing endocrine tissue**



- Ductless glands that secrete hormones
  - –Hypothalamus secretes hormones that tell the pituitary gland what to do

Ductless Glands Continued

–Pituitary secretes

- growth hormones
- Prolactin (milk)
- ADH (urine output, & paternal instincts)
- Oxytocin (maternal instincts & labor)

Pituitary continued

- Gonadotropins:
  - stimulate growth of external sex organs
  - Amount helps determine how "male" or "female" one becomes.
  - Problems can arise such as hermaphrodism

STILL MORE

- Pancreas: secretes:
  - Insulin to regulate blood sugar levels
- Thyroid secretes:
  - thyroxin which controls metabolism

AND MORE

- Adrenal gland secretes:
  - cortical steroids which creates energy, builds muscles
  - adrenaline which raises blood pressure, acts as a powerful neurotransmitter, and helps cope with stress

AND MORE

- Testes secrete testosterone which:
  - builds muscle mass
  - creates beards and deeper voices
  - May be tied to aggressiveness

NO MORE

- Ovaries produce estrogen, progesterone, and little bit of testosterone. Estrogen determines
  - breast and hip size (the amount of fat)
  - on its menstrual cycle it increases the amount until an ovum is produced, then it stops, and…