PSYC 200 Lecture 3
Jan 13 2016

The Human Brain

we study the brain because it enables behaviour
has three characters: integration sophistication and adaptability
"you don't see with your eyes, you see with your brain"
integration: brain structure are constantly competing and cooperating with one another, a big machine of commands
sophistication: the brain is significantly more complex than any of the most sophisticated computers, nothing on earth that is man made that can match gods creation, generating billions of connections, too complex to know everything about the brain
adaptability: the brain is constantly changing, everything you remember something new connections are made

the nervous system
CNS (central nervous system): encompasses brain and spinal cord
Peripheral Nervous System (PNS): everything outside of the brain and spinal cord, serves all of the limbs and organs
Sensory component (afferent): carry info from limbs and organs towards the spinal cord and up into brain, afferent means info is flowing towards CNS
motor pathway (efferent): convey info from brain and spinal cord out towards limbs and organs, efferent means info is flowing away from CNS (efferent=exits), two divisions to motor pathway: autonomic nervous system and somatic nervous system
Autonomic nervous system: involuntary, signals flow from CNS to cardiac muscles, smooth muscles, glands, controls heartbeat, digestive system and organs (you don't think of controlling them, it is just happening). it has two divisions: sympathetic nervous system and parasympathetic nervous system
Somatic nervous system: voluntary, signals flow from CNS to skeletal muscles
sympathetic nervous system becomes active when we are active, it is like accelerator for organs
parasympathetic nervous system: turned on when we are resting and not active, it helps us store energy sources for later use, both divisions cannot be on at the same time

principal components of the nervous system
two major classes of cells: neurons and glia cells
neurons are the functional unit of the nervous system, they are responsible for thoughts, actions, feelings, 10-100 billion neurons in our brain, they don't function independently but form neuronetworks (give rise to human behaviour)
no single neuron is used for a specific behaviour, it is all part of a larger network
glia cells: "nerve glue", provide physical and metabolic support to neurons, they help out, for every one neuron there are 50 glia cells

how do neurons share information? they use electrochemical processes (electrical and chemical signals)
how does it receive info? dendrites are short branches that protrude from the cell body, neurons receive signals from neighbouring neuron and convey info to the cell body
a single neutron can receive up to 2000 other neurons through its dendritic contacts (branches connecting)
soma: nucleus is contained in soma, it contains all of the neurones genetic information, it is

located within the 23 pairs of chromosome found in the cell nucleus, chromosomes are made of genes, genes are made of DNA

DNA only does one thing: directs protein synthesis, 98% of human body is protein

neurons integrate info to other cells, passes on information

more excitatory than inhibitory makes soma fire signals

axon: carries signal away from the cell body after neuron fires it, only one axon per neutron

action potential: electric signal, the signal will make it to axon terminal made up of axon branches, tips of the branches have knobs, once signal reaches knobs it is converted from electrical signal to chemical signal, signal is carried by neurotransmitters

types of neurons
sensory: convey info from organs to brain
motor: convey info from brain to organs
interneurons: form connections with neighbouring neurons, between motor and sensory neurons (they don't directly communicate with each other), motor neuron can communicate with sensory neutron through interneurons

multiple sclerosis: first thing to go is your legs because the signals becomes too weak too reach the bottom of your feet

Glial cells: fill in the spaces between neutrons, they hold the neurons in place, they are the source of myelin, not only does myelin help keep the strength of a signal to remain constant and strong, it also insulates the signal and prevents the signals from neighbouring axons from getting mixed up, another important function is that it helps regulate the extracellular chemical content (regulate the amount of neurotransmitters that are free in the extracellular space), another function is that it helps regulate extracellular ionic content (regulates sodium, potassium, another function is that it provides nourishment for the neurons, it also helps remove waste from the neurons

glia cells help form the blood brain barrier (BBB)

when ingesting RED BULL (main ingredients are taurine and caffeine), the taurine doesn't cross the blood brain barrier because brain doesn't need any extra coming from the outside

communication between neurons
resting membrane potential: neutron at rest, it has a built up source of potential energy (RMP), there is a difference of voltage across the neutron membrane, it possesses a negative resting membrane potential, inside of neutron is more negative relative to outside of neutron, imbalance of charges, cell cannot fire off an electrical signal

ion distribution at rest: A- is the negative charge produced by structures inside the cell (i.e. golgi apparatus)
two types of ions are trying to make their way across the membrane: sodium and potassium
more sodium outside of cell so it has tendency to go into cell to regulate concentration but it can't traverse membrane, potassium can't regulate its concentration either because it can't go through membrane

when ions move across membrane, they generate electrical current

generating an action potential
by stepping on thumb tack (pin), it will cause channels on sensory neurons to open up, allowing sodium into cell membrane, sodium then depolarizes the membrane (generator potential, membrane potential goes from -65mV to -62mV), membrane potential will reach a threshold like a positive value (+45mV, takes about one millisecond to happen), this generates an action potential

to bring potential back to negative, you need to remove potassium from the cell, voltage is back to -65mV, this is called re-polarization

depolarization of the cell during the action potential is caused by the influx of sodium ions (coming in) across the membrane and re-polarization is caused bt the efflux of potassium ions (going out) (what is basic principle of action potential? this is a test question)

the propagation of the action potential down the axon
you have excitatory signals coming in to the cell so that it will trigger an action potential at the axon hillock, action potential travels to gaps called nodes where the action potential becomes refreshed/regenerated so that it stays strong all the way down the axon
myelin speeds things up, makes process more efficient

the synapse
the end is the point of the contact with another neutron and is called the synapse, it is where synaptic transmission takes place, it involves neurotransmitters. the pre-synaptic region (1) is where the action potential arrives and it is converted to a chemical substance (neurotransmitter). the postsynaptic region (2) is where the neurotransmitter goes after being released by presynaptic region and crossing a space called the synaptic cleft (3), it then attaches itself on the postsynaptic region and trigger some sort of action depending on excitatory or inhibitory neurotransmitter