Cogs 17: Section

Tricia Ngoon

7.11.17

Slides found here

Slides at: tinyurl.com/s1cogs17

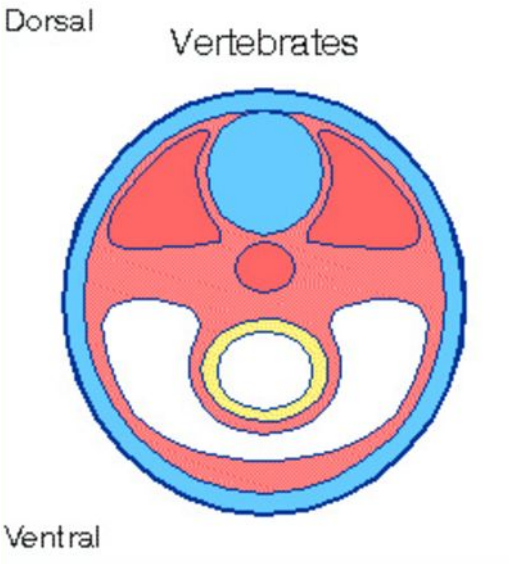
Outline

- Brain Development
- Brain Study Techniques
- Midterm Review

Neural Development

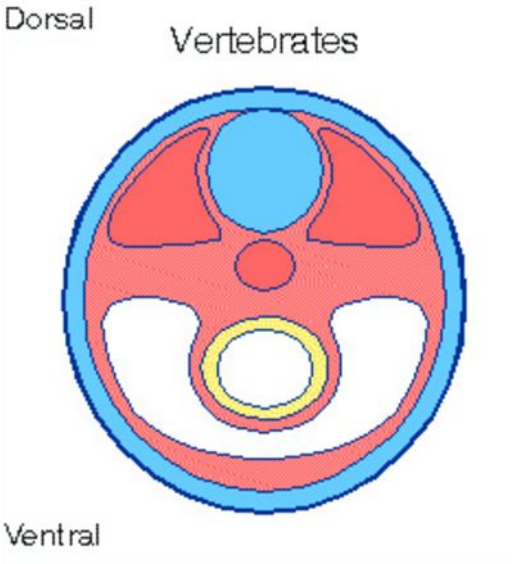
The Germ Layers

- Inner layer =
- Middle layer =
- Outer layer =



The Germ Layers

- Inner layer = **Endoderm (organs, glands)**
- Middle layer = **Mesoderm (bones, muscles, blood vessels)**
- Outer layer = **Ectoderm (nervous system, skin)**



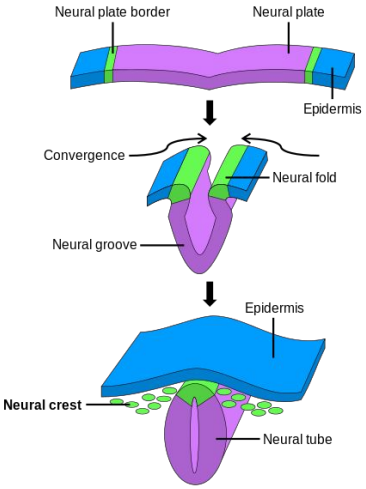
How is the neural tube formed?

How is the neural tube formed?

- Dorsal ectoderm thickens and hardens into **neural plate**
- Edges of plate form ridges (**neural folds**) that converge until they fuse
- Once neural folds have fused, they form **neural tube**

**Spina bifida occurs when...

Neural folds fail to fuse



Which part of the neural tube becomes what?

- Rostral end -
- Caudal end -
- Neural crest -
- Hollow center -

Which part of the neural tube becomes what?

- Rostral end - **brain**
- Caudal end - **spinal cord**
- Neural crest - **PNS**
- Hollow center - **ventricles**

What do these terms mean?

- Proliferation -
- Migration -
- Differentiation -

What do these terms mean?

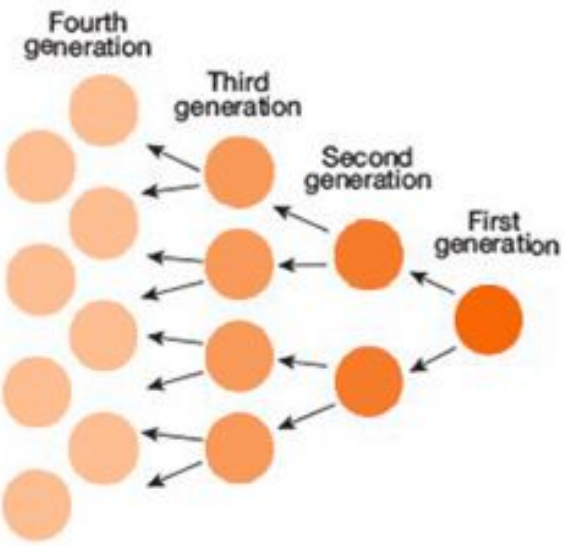
- Proliferation - **growth of new cells (neurons and glia cells)**
- Migration - **movement of cells from place of origin to later position**
- Differentiation - **cells differ in structure and function**

Describe proliferation

- Symmetrical division -
- Asymmetrical division -

Describe proliferation

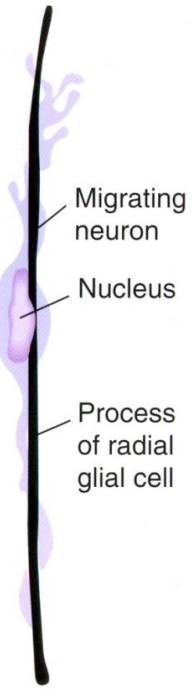
- Symmetrical division - stem cell produces **2 identical offspring** to increase **ventricular zone**
- Asymmetrical division - produces **1 identical stem cell and 1 neuron**



Describe cell migration

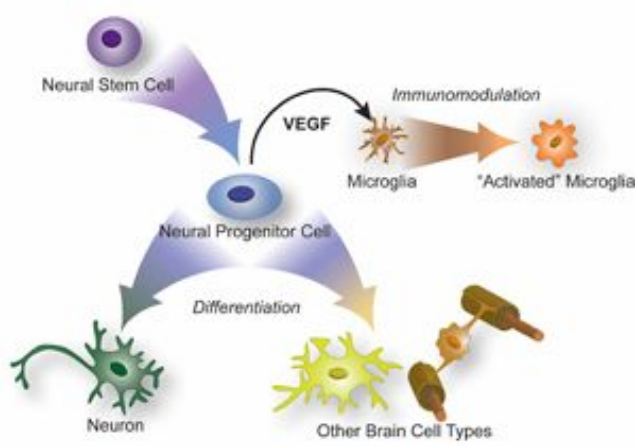
Describe cell migration

- Cells migrate when they accumulate in Ventricular Zone
- Some neurons migrate by “crawling” along radial glia fibers
- Some neurons migrate by following chemical trails



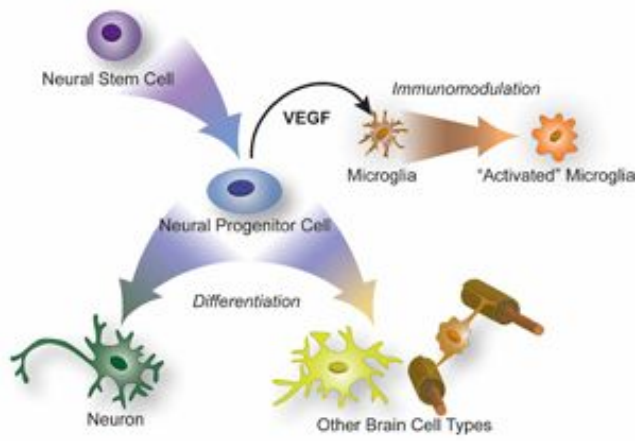
What are the 2 factors that affect cell differentiation?

- Cell autonomous -
- Induction -



What are the 2 factors that affect cell differentiation?

- Cell autonomous - **genetic**
- Induction - **environmental**



Describe how each of these aids synaptogenesis

- Growth cones

- Guidepost cells

Describe how each of these aids synaptogenesis

- Growth cones **are the end of a growing axon with many Filopodia that detect chemical gradients**

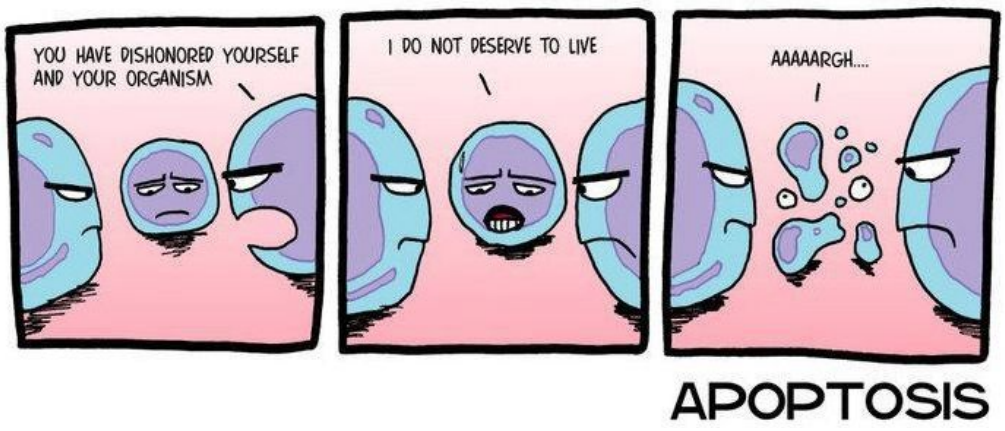
- Guidepost cells **direct axons to the target cell by releasing neurotrophins**

What is apoptosis?

What is apoptosis?

Apoptosis: A tragic affair

Programmed cell death



What does the phrase “cells that fire together, wire together” mean?

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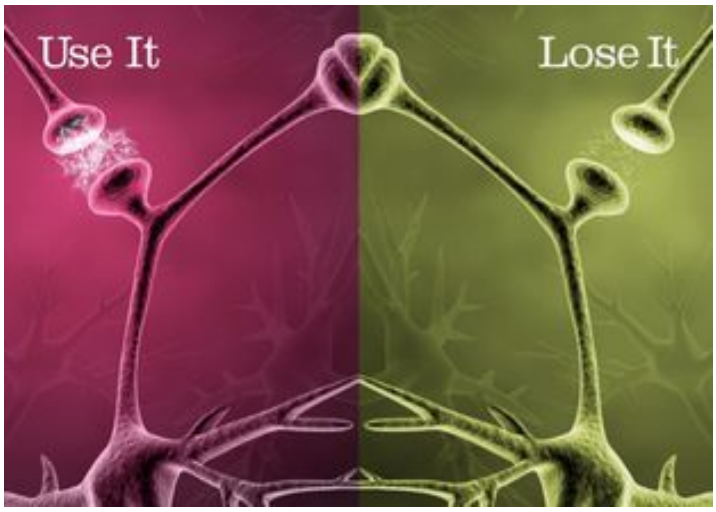

- Competitive process
- **Co-activated cells are strengthened**

Brain Study Techniques

Invasive or Non-invasive?

- Staining
- Lesions
- Electrical stimulation
- Single-cell recording
- EEG
- MEG
- MRI
- fMRI
- CAT
- PET

Invasive or Non-invasive?

- Staining **-Invasive**
- Lesions **-Invasive**
- Electrical stimulation **-Invasive**
- Single-cell recording **-Invasive**
- EEG **-Non-Invasive**
- MEG **-Non-Invasive**
- MRI **-Non-Invasive**
- fMRI **-Non-Invasive**
- CAT **-Non-Invasive**
- PET **-Invasive**

Functional or Structural?

- Staining
- Lesions
- Electrical stimulation
- Single-cell recording
- EEG
- MEG
- MRI
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Functional or Structural?

- Staining **-Structural**
- Lesions **-Functional**
- Electrical stimulation **-Functional**
- Single-cell recording **-Functional**
- EEG **-Functional**
- MEG **-Functional**
- MRI **-Structural**
- fMRI **-Functional**
- CAT **-Structural**
- PET **-Functional**

Good or Bad Temporal/Spatial Resolution?

- Staining
- Lesions
- Electrical stimulation
- Single-cell recording
- EEG
- MEG
- MRI
- fMRI
- CAT
- PET

Good or Bad Temporal/Spatial Resolution?

- Staining **-No temporal, Good spatial**
- Lesions **-No temporal, Good spatial**
- Electrical stimulation **-No temporal, Good spatial**
- Single-cell recording **-Good temporal, Good spatial**
- EEG **-Good temporal, Poor spatial**
- MEG **-Good temporal, Good spatial**
- MRI **-Poor temporal, Best spatial**
- fMRI **-Poor temporal, Very good spatial**
- CAT **-No temporal, Ok spatial**
- PET **-Poor temporal, Good spatial**

What are the 3 stains in cell staining?

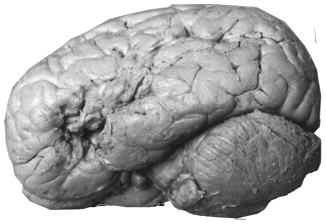
- Entire neuron, small number of cells -
- Myelinated axons -
- Somas, large number of cells -

What are the 3 stains in cell staining?

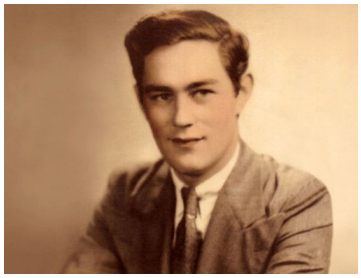
- Entire neuron, small number of cells - **Golgi**
- Myelinated axons - **Weigert**
- Somas, large number of cells - **Nissl**

Describe one patient that is known for their brain lesion?

Describe one patient that is known for their brain lesion?



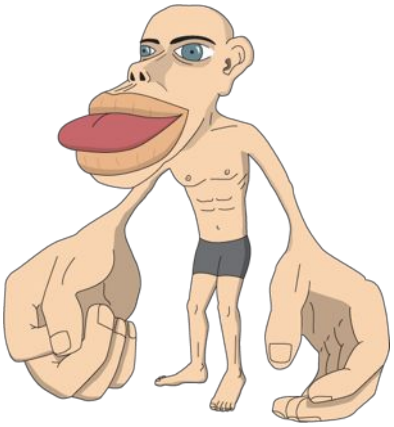
"Tan"



H.M.

Phineas Gage

What is this and how was this discovered?



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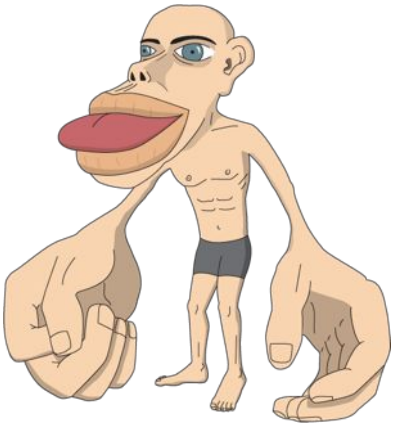
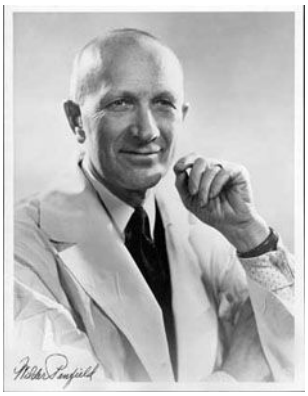
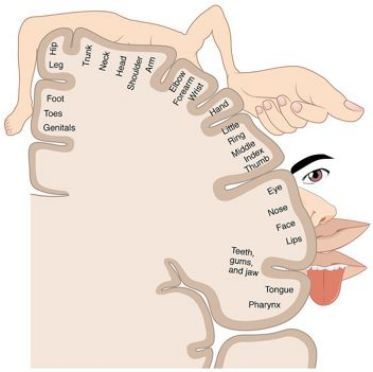


Homunculus



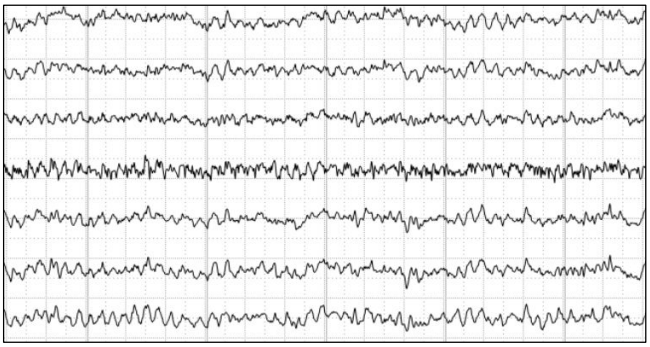


Wilder Penfield, electrical stimulation

Which technique records electrical activity in the brain?

Which technique records electrical activity in the brain?

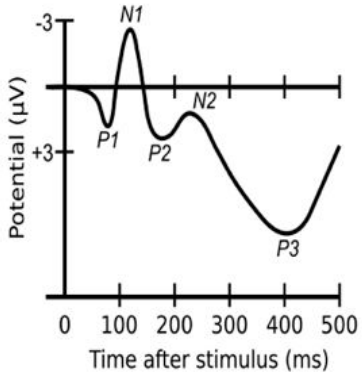
Electroencephalography (EEG)



What is an ERP?

What is an ERP?

- **Event-related potential - The time-locked average of many EEG trials to factor out other brain activity and focus on a particular response.**



What is the difference between EEG and MEG?

- EEG - Electric field created by neurons is detected on _____ of the cortex. These fields are _____ to the cortex.

- MEG - Electric field created by neurons is detected on _____ of the cortex. These fields are _____ to the cortex.

What is the difference between EEG and MEG?

- EEG - Electric field created by neurons is detected on **gyri** of the cortex. These fields are **perpendicular** to the cortex.

- MEG - Electric field created by neurons is detected on **sulci** of the cortex. These fields are **parallel** to the cortex.

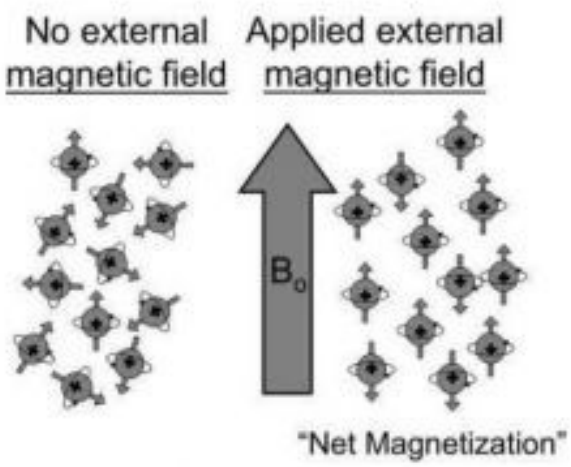
How does MRI work?

- Radio waves

- Magnetic waves

How does MRI work?

- Radio waves **pulse to make hydrogen protons gyrate in body fluid**
- Magnetic waves **align** those protons

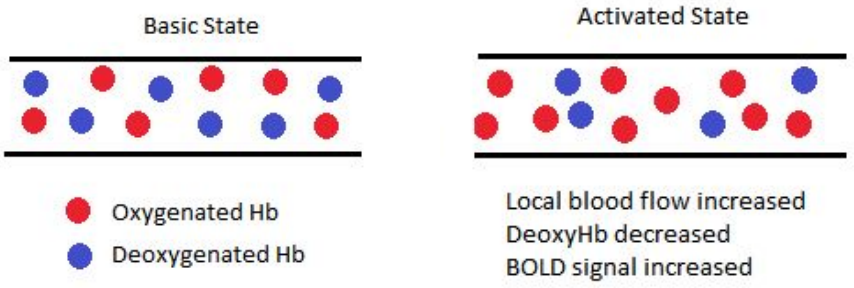


What is the BOLD signal and why is it used in fMRI?

- BOLD signal =
- Used in fMRI because...

What is the BOLD signal and why is it used in fMRI?

- BOLD signal = **Blood Oygen Level-Dependent signal**
- **Active** parts of brain require more **oxygenated blood**, and the **difference in oxygenated and deoxygenated blood** leads to increased BOLD signal



Review

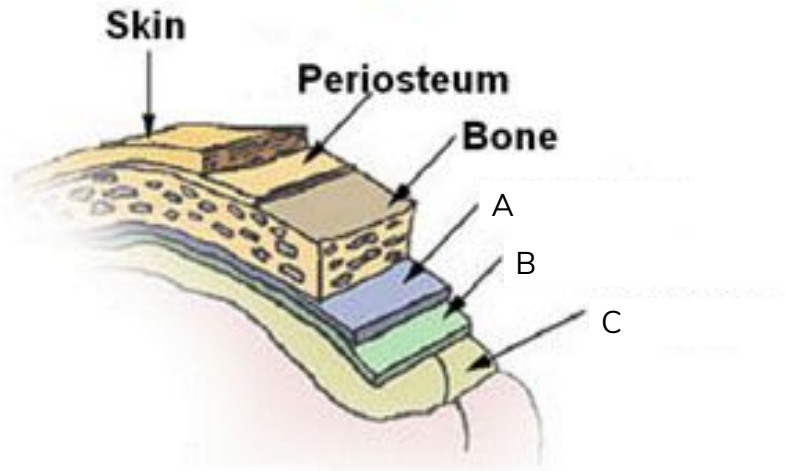
What do these anatomical terms mean?

- Dorsal =
- Ventral =
- Rostral/Anterior =
- Caudal/Posterior =
- Superior =
- Inferior =
- Lateral =
- Medial =

What do these anatomical terms mean?

- Dorsal = **Back of body, top of head**
- Ventral = **Stomach, bottom of head**
- Rostral/Anterior = **Toward front end**
- Caudal/Posterior = **Toward rear end**
- Superior = **Above**
- Inferior = **Below**
- Lateral = **Away from midline**
- Medial = **Toward midline**

Name the meninges



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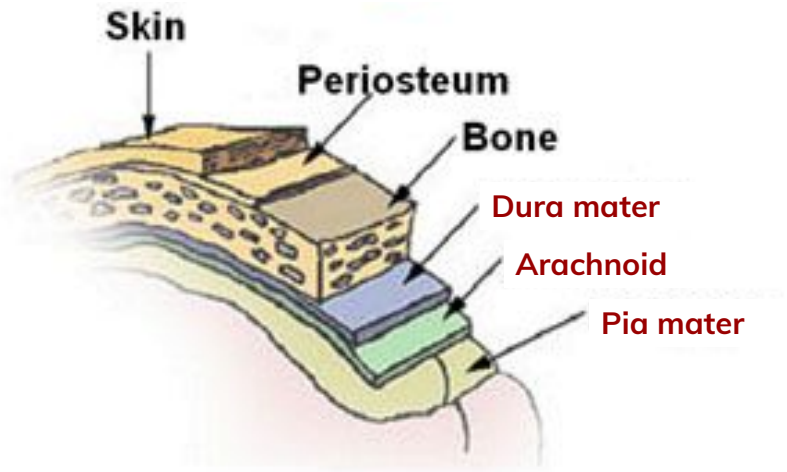


What are the different parts of the PNS?

What are the different parts of the PNS?

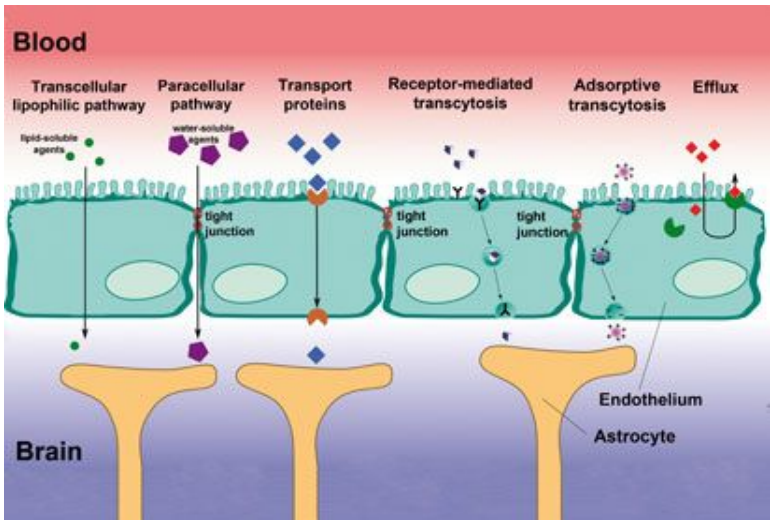
Autonomic nervous system

- Assesses and maintains body's internal environment
- Involuntary
- Sympathetic NS - "fight or flight"
- Parasympathetic NS - "rest and digest"

Somatic nervous system

- Maintains body's interaction with external environment
- Voluntary control of body movements

What is the purpose of the BBB and what can pass through?



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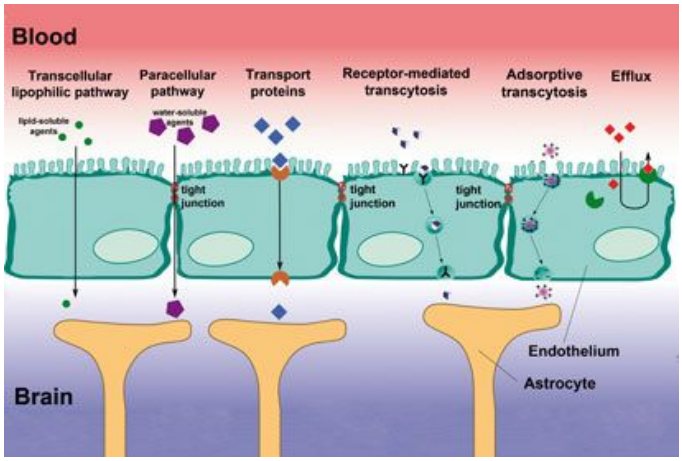
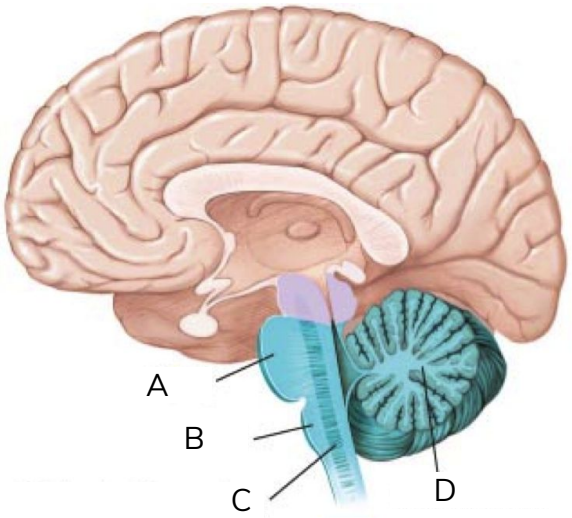


- BBB **controls what can enter brain from bloodstream**
- **Lipid-soluble agents** can easily pass through
- Other molecules can pass through in other methods

What are these hindbrain parts and their functions?



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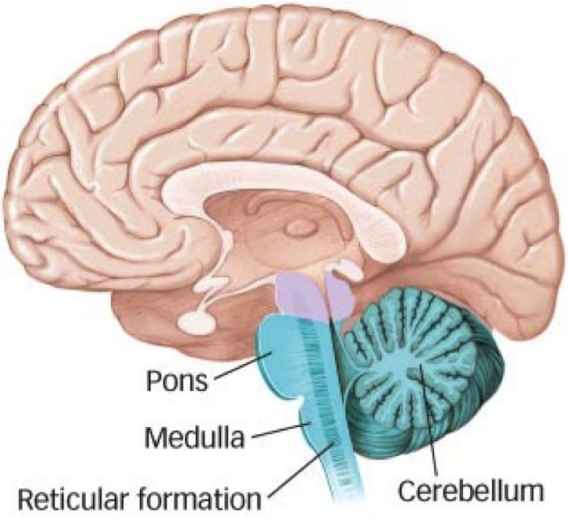
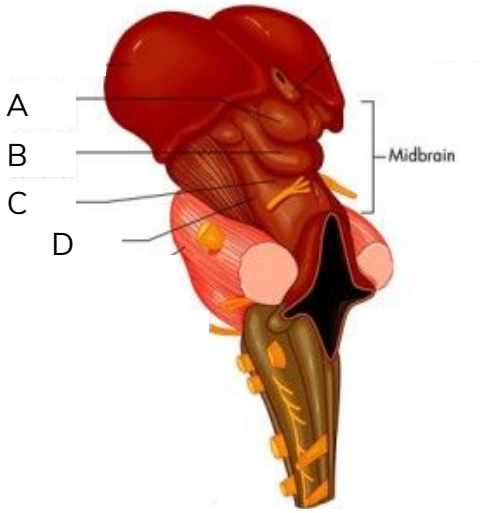
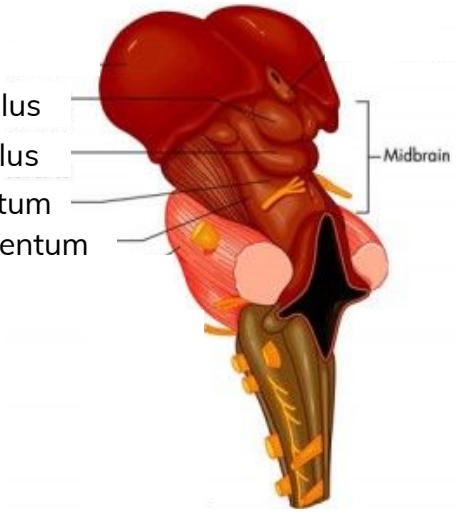


A. **Pons** - sensory roles, aids in sleep
B. **Medulla** - controls vital reflexes
C. **Reticular Formation** - network of cells involved in arousal
D. **Cerebellum** - movement coordination

What are these midbrain structures and their functions?

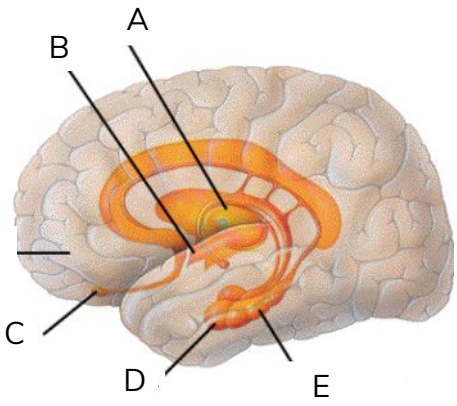


What are these midbrain structures and their functions?

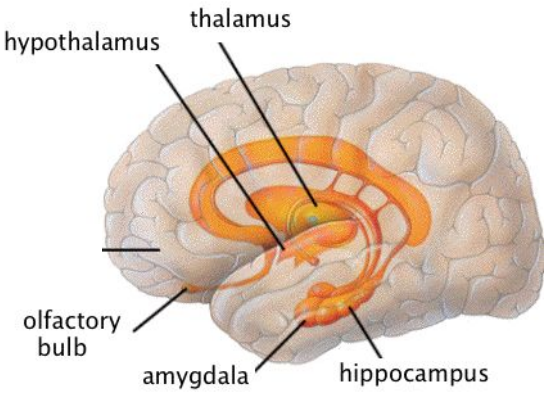


A. **Superior Colliculus** - visual motion
B. **Inferior Colliculus** - auditory motion
C. **Tectum** - consists of colliculi
D. **Tegmentum** - motor pathways

What are these forebrain parts and functions?

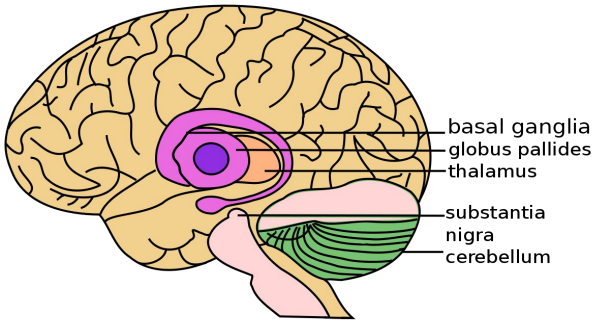


What are these forebrain parts and functions?



A. **Thalamus** - the sensory and motor "relay center"
B. **Hypothalamus** - oversees the 4 Fs (feeding, fighting, fleeing, and sex)
C. **Olfactory bulb** - receives smell info
D. **Amygdala** - emotional expression
E. **Hippocampus** - formation of new memories

What is the role of the basal ganglia?



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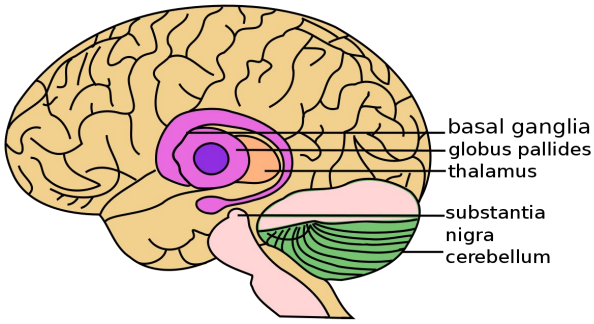
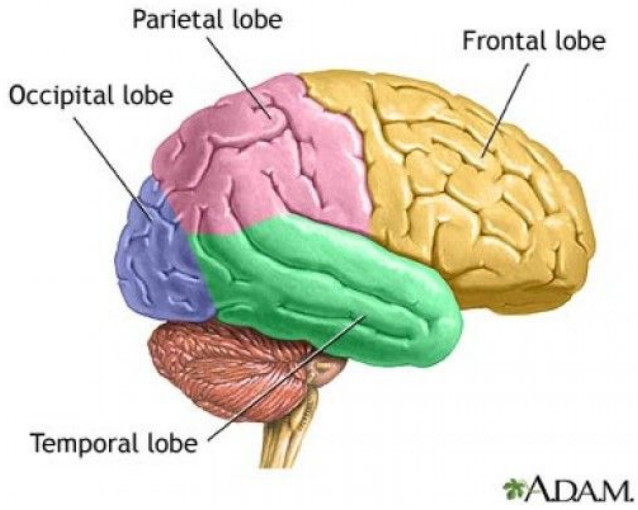


- **Organization of movement sequences**
- Affected in Parkinson's

Describe the main roles of each lobe



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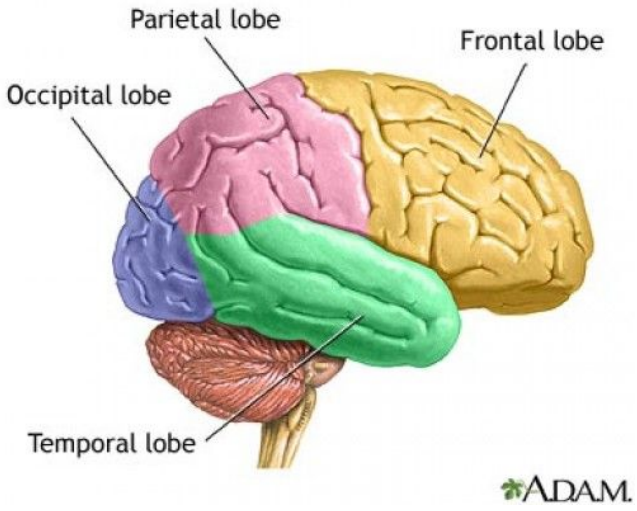
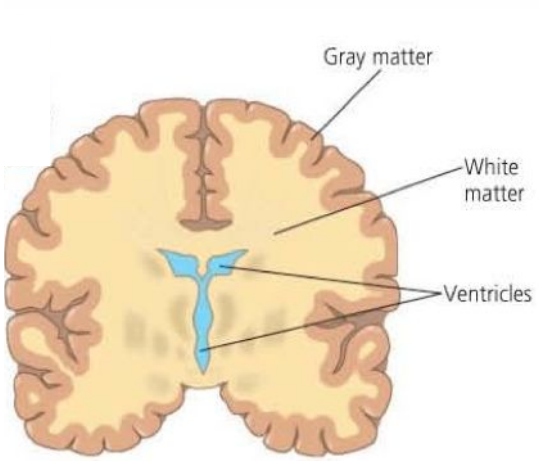


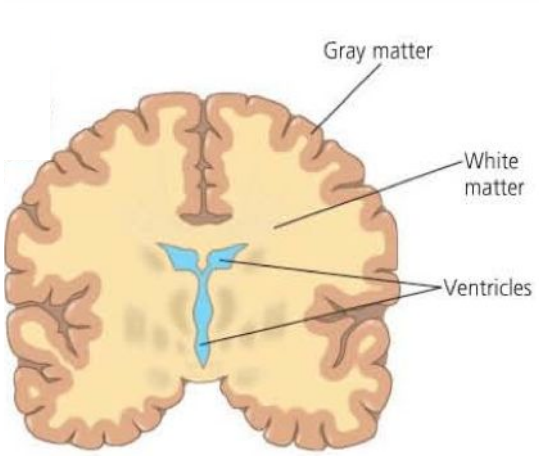
- **Frontal lobe** - higher order thinking, motor control, working memory
- **Parietal lobe** - Somatosentory and visuo-spatial mapping
- **Temporal lobe** - auditory processing, memory
- **Occipital lobe** - visual processing

What are each of these?



- Gray matter -
- White matter -
- Ventricles -

What are each of these?



- Gray matter - **somas and synapses**
- White matter - **myelinated axons**
- Ventricles - **hollow chambers that produce CSF**

What is the difference between the dorsal and ventral visual pathways?

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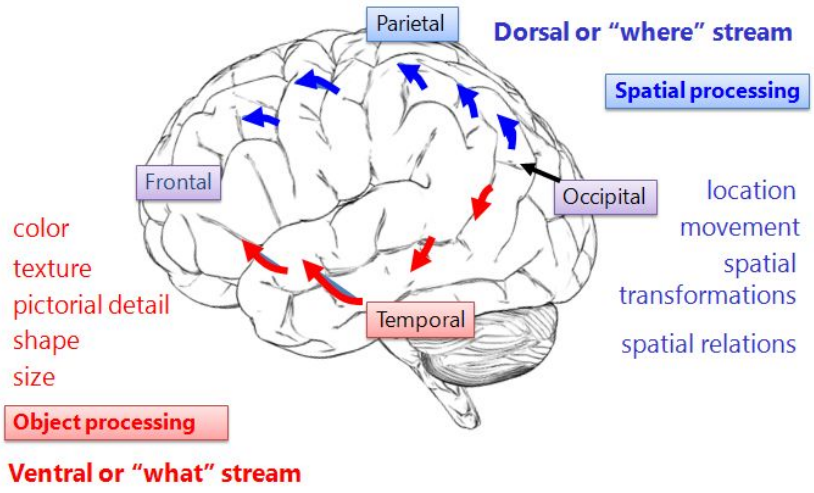
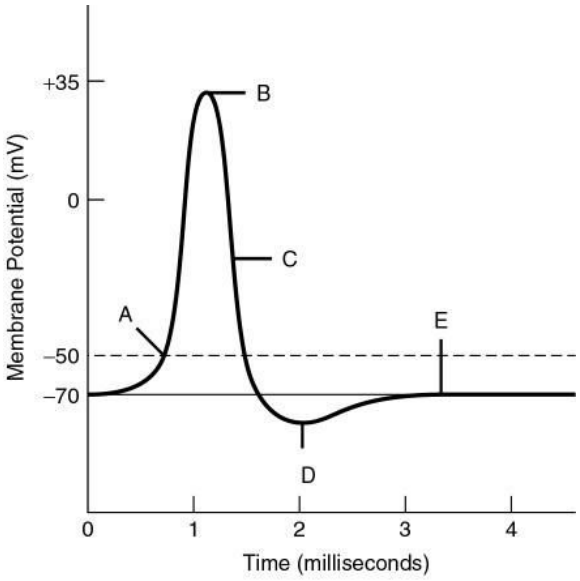


Label and describe the steps of an action potential



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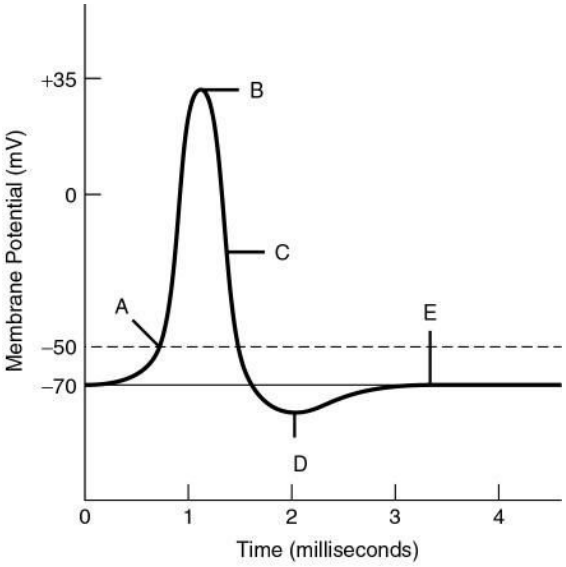
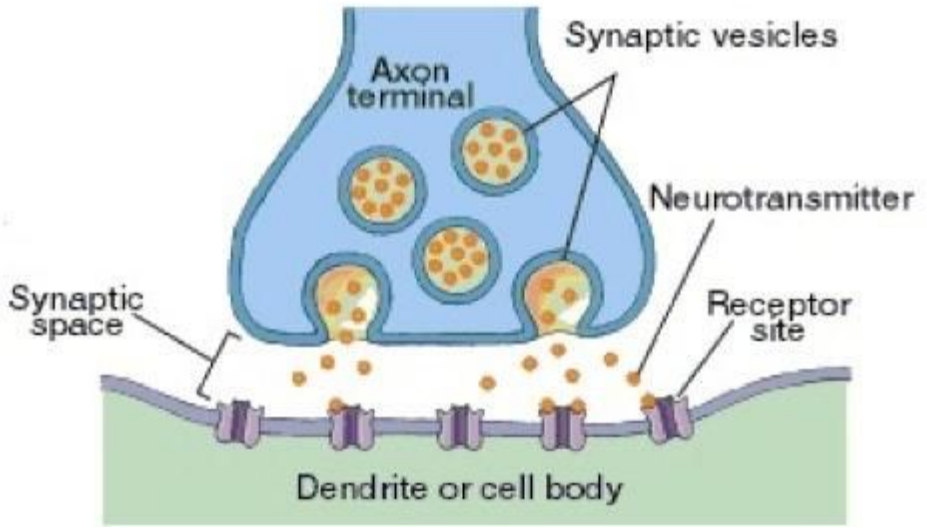


A. **Threshold -** Na+ enters cell
B. **Action potential peak**
C. **Repolarization -** K+ leaves cell
D. **Hyperpolarization**
E. **Restoring the resting potential**
   - Sodium-Potassium Pump

How are NTs transferred between neurons?



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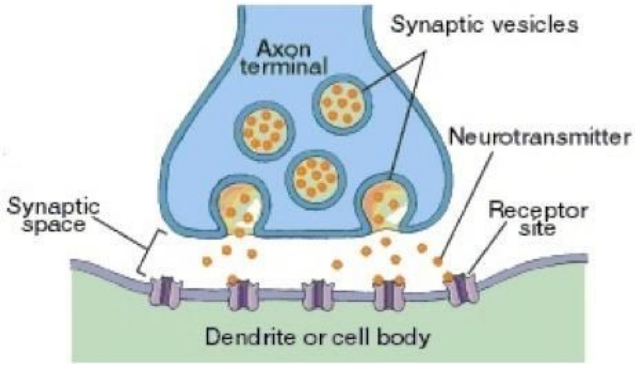

- **Ca++** gates open when depolarization reaches presynaptic terminal
- **Exocytosis** - release of NT from vesicles in presynaptic cell into **synaptic cleft**
- NT binds to r**eceptor sites** on the dendrites or soma of **postsynaptic cell**

How do NTs affect the postsynaptic cell?

- EPSP -
- IPSP -
- Temporal summation -
- Spatial summation -
- Ionotropic mechanism -
- Metabotropic mechanism -

How do NTs affect the postsynaptic cell?

- EPSP - **Excitatory Post-Synaptic Potential increases likelihood of cell releasing NT**
- IPSP - **Inhibitory Post-Synaptic Potential decreases likelihood of cell releasing NT**
- Temporal summation - **Repeated stimulation in rapid succession**
- Spatial summation - **multiple cells converge on a single cell simultaneously**
- Ionotropic mechanism - **directly affects ion gate**
- Metabotropic mechanism - **triggers second messnger, which binds to G-protein to open ion gate**

What are the main roles of these NTs?

- Acetylcholine - **arousal, learning**
- GABA - **inhibitory, regulates anxiety**
- Glutamate - **excitatory, learning, perception**
- Serotonin - **sleep, mood regulation**
- Dopamine - **reward, reinforcement**
- Norepinephrine/noradrenaline - **arousal, attention**
- Substance P - **pain**
- Endorphins - **counteracts substance P**
- Hormones - **regulatory molecules** (i.e. testosterone, estrogen, oxycotin, etc.)

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What's the difference between agonists and antagonists?

- Agonist -
- Antagonist -

What's the difference between agonists and antagonists?

- Agonist - agonist increases effect of NT
- Antagonist - antagonist decreases effect of NT