

# Brain size is not correlated with intelligence...

## It's all in the "wiring".

### Telencephalon

#### Cerebrum (telencephalon)

1. The largest region of the brain
2. "*hollow*" = two lateral ventricles
  - septum pellucidum separates the chambers
3. Surface features:
  - a. elevated ridges = gyri (surface area)
  - b. cleft-like depressions = sulci
  - c. deep grooves = fissures
4. Two hemispheres:
  - a. left side = language, reading, writing, speaking, logic
  - b. right side = sensory information, spatial relationships
  - c. corpus callosum connects the two hemispheres
  - d. hemispheres divided into lobes by deep fissures:
    - i.e., frontal, parietal, temporal, occipital lobes.
5. Cerebral FUNCTIONS:
  - a. conscious thought processes
  - b. intellectual functions
  - c. memory storage and processing
  - d. involuntary regulation of somatic motor patterns

# Telencephalon - cortical mapping

**Lobes:** frontal, parietal, temporal, occipital

**'Brodmann's areas':** map of 47 functional regions

## **Prefrontal cortex:**

1. emotion, motivation, behavioral regulation
2. sense of time, reasoning
3. "pre-frontal" lobotomy

**Frontal lobe:** includes **Speech center** (Broca's area):

- coordinate breathing/vocalization for speech
- **Pre-central gyrus**  
= **primary motor cortex aka: motor homunculus**

## **Parietal lobe:**

1. Central sulcus - prominent sulcus
2. Post-central gyrus  
- primary sensory cortex: **aka:** sensory homunculus

**Temporal lobe:** includes auditory cortex

**Occipital lobe:** includes visual cortex

## Diencephalon

**The diencephalon is a 'box' with a:**

1. roof (epithalamus),
2. walls (thalamus)
3. floor (hypothalamus)
4. chamber = third ventricle

**Epithalamus** (pineal gland)

- pineal gland secretes melatonin (sleep patterns)

**Thalamus**

- relay/processing center for sensory information

**Hypothalamus**

1. controls thirst, appetite, body temperature
2. coordinates the ANS
3. coordinates endocrine system
4. secretes hormones
  - a. oxytocin (uterus, prostate)
  - b. antidiuretic hormone (ADH) (kidneys)
5. integrates sensory & motor commands related to emotion (conscious & unconscious)
6. pituitary gland lies beneath the hypothalamus
  - a. suspended by infundibulum
  - b. supported within sella turcica of the sphenoid

## **Mesencephalon**

1. corpora quadrigemina processes visual & auditory data
  - a. superior colliculi - vision
  - b. inferior colliculi - hearing
2. red nucleus - maintains muscle tone & posture
3. substantia nigra - neurotransmitter dopamine
  - a. drop in dopamine causes increased muscle tone
  - b. Parkinson's disease - tremors in muscles
4. cerebral peduncles - supports the cerebrum

## **Metencephalon**

### **Cerebellum (post. portion of metencephalon)**

1. coordinates postural/skeletal muscles of body
2. programming of repetitive movements (subconscious)
3. two hemispheres, vermis
4. folia - folds of cerebellar cortex (increased SA)
5. arbor vitae - grey/white matter
6. purkinje cells - highly branched cells in cerebellar cortex
7. cerebellar peduncles - links cerebellum to brainstem

### **Pons (anterior portion of metencephalon)**

1. 4 important CN's (V, VI, VII, VIII)
2. respiratory center (fine tuning)
3. connects cerebellar hemispheres with brainstem

## **Cerebellum games...**

The right hand is hard-wired to the right foot.  
The connection is very difficult to avoid

1. make clockwise circles with your right foot.
  2. draw the number "6" in the air with your right hand.
- = Your foot should change direction

## Myelencephalon

### Medulla oblongata

1. transition from brain to spinal cord
2. 5 important CN's (VIII, IX, X, XI, XII)
3. site of autonomic centers for visceral functions:  
*cardiovascular, respiratory, digestive systems*
4. @ foramen magnum = damage can lead to death
5. fourth ventricle within pons + medulla oblongata

### Grey and White Matter

Grey: neuron bodies @ cortex of cerebrum & cerebellum

Grey: noncortical concentrations cells = nuclei

White: represents axonal processes (myelinated)

1. sub-cortical in cerebrum and cerebellum
2. axons running in 3 principle directions
  - a. association fibers btw. gyri w/in a hemisphere
  - b. commisural fibers btw. gyri of opp. hemispheres
  - c. projection fibers ascend/descend to CNS

### Limbic system

1. includes many nuclei spread through brain  
= functional rather than anatomical grouping of nuclei
2. links conscious thought w/ ANS f(x)'s of brainstem  
= behavior & emotional states: thirst, hunger, sex....
3. learning and the storage/recall of long-term memory

**Synesthesia**—typically a hereditary neurological condition  
- common among artists and poets (& drug users)

Brain sees an object: shape, motion, color, texture  
- with very little info on how it puts them back together

Sensory cross-wiring in the brain  
= hyper-connectivity within the limbic system  
= brain-imaging technology (PET/MRI scanning)

***Result...***

- people see letters/numbers in color
- hear music/speech in color
- taste shapes, smell sounds, etc....

**Alzheimers Disease**—neurological condition  
- genetic mutations +/- environmental factors  
- substantial decrease in cortical neurons (frontal lobes)  
- substantial decrease in volume of gyri (= large sulci)

Senility—75 % senile dementia is Alzheimer's-related  
- deterioration of organizational / focus tasks  
- memory loss (short-term followed by long-term)

# Meninges

## Three layers:

1. Dura mater - thick, fibrous, outermost layer
  - a. epidural space btw dura mater & vertebral canal
  - b. target for an "epidural block"
  - c. becomes the endosteum of the braincase
2. Arachnoid - thin, intermediate layer
  - a. subarachnoid space btw arachnoid & pia mater
  - b. blood vessels supported by arachnoid trabeculae
  - c. subarachnoid space filled with CSF
  - d. targetted site for a "spinal tap"
3. Pia mater - vascular, innermost layer, adheres to gyri
  - a. pia mater is firmly attached to the spinal cord
  - b. blood vessels form network on surface of cord

**Meningitis** - inflammation of meninges (bacteria, viruses).

## **Elaborations of the Dura mater:**

1. Falx cerebri - runs between cerebral hemispheres  
- anchored anteriorly to crista galli of the ethmoid
2. Falx cerebelli - runs between cerebellar hemispheres
3. Tentorium cerebelli - runs btw cerebrum & cerebellum
4. Diaphragma sellae - encloses the pituitary gland
5. Dural sinuses: delamination of dura mater  
- forms cavity for venous blood  
- outermost layer = endosteum
6. Spinal meninges are continuations of cerebral meninges

## **Blood-Brain Barrier**

1. Neural tissue must be isolated from the general blood circulation because circulating hormones/chemicals may have disruptive effects on neuron function (e.g. alcohol)
2. Astrocytes (neuroglia) & endothelial cells that enclose capillaries in the CNS have a very restricted permeability  
= control of chemical exchange btw brain & blood

## **Exceptions to Blood-Brain Barrier**

1. Capillaries in hypothalamus & epithalamus are permeable to permit diffusion of their hormones into the general circulation
2. Capillaries of the choroid plexus are permeable (secretion of CSF) and are very important filters/barriers between the brain and general circulation

## **Cerebral Spinal Fluid (CSF)**

1. produced by choroid plexus
  - a. capillary beds in each ventricle
  - b. refined filtrate of the blood
2. circulates through:
  - a. ventricles, central canal
  - b. subarachnoid space
3. recovered by archnoid granulations @ sagittal sinus
4. transports nutrients and removes waste products
5. cushions neural tissue - "floats" the brain