The Brain: Part One

**Today's Plan:**
1. giving directions inside your brain
2. meninges and blood vessels
3. the cerebrospinal fluid and the ventricles
4. a development view
5. the forebrain

(mammalian) Brain Diversity
- brains are different shapes and size
- all end with a little "tub"(aka the spinal cord)
- made of two things:
  - Flap- side lobe
  - wrinkles
- brains vary in size and in the number of "folds" on their surface
- brains are remarkably similar in overall structure

Animal Brains (vertebrates)

Brain/Body Weight
linear relationship between body weight and brain weight
- above the line, your brain is bigger than to be expected (the body size)
- below the line, your brain is smaller than the body size
- humans have the biggest brain compared to our body size

Brain Diversity: Different brains... different people
- Einstein's Brain
  - prefrontal cortex (area 9)
    - planning
    - attention
    - working memory
  - parietal lobe (area 39)
    - association cortex
    - language
- more glial cells!
- more sulci (grooves/folds)

1. Giving Directions
- neuraxis
- rostral= anterior
- ventral FRONT
- dorsal BACK
- caudal= posterior
- lateral OUT (eyes or ears? = ears)
• medial IN
• contralateral OPPOSITE
• ipsilateral LEFT

Brain Planes of Section
• three different planes
  ◦ Frontal plane (transverse, coronal)
    ‣ splits front to back
  ◦ Sagittal plane
    ‣ front to back
  ◦ Horizontal plane
    ‣ flat front to back
• Cross section
  ◦ spinal cord

Planes of Section
• gray matter: cell bodies (somas) outside
• white matter: axons (myelin sheaths) inside

Nervous System: Overview
• Two things
  ◦ CNS
    ‣ brain (skull)
    ‣ spinal cord (vertebral column/spine)
  ◦ PNS
    ‣ nerves
    ‣ peripheral ganglia

2. Meninges
• dura(hard) mater: thick, unstretchable, surrounds the brain
• arachnoid(think spider) membrane: soft, spongy
  ◦ sub-arachnoid save filled with Cerebra Spinal Fluid
• Pia(religious) mater: follows brain surface, contains blood vessels

• how do you call a (small) infection of the meninges? a headache/ migraine
• a large one? meningitis

Brain Vasculature
• brain (2% of the body) uses about 20% of oxygen absorbed by the lungs
• contains large network of capillary vessels
• dense: one can tell which group of neurons are active by looking at where blood flows (fMRI: glucose and oxygen-> measures blood flow)
• problems lead to: migraines or strokes(leaking blood vessel)

3. Cerebral Ventricles, image ~3.4
• Cerebro-Spinal Fluid
• lateral ventricles -> 3rd ventricle -> cerebral aqueduct -> fourth ventricle(-> subarachnoid space) -> central canal (right + left)
• CSF produced by the choroid plexus from blood
C.S.F Absorption in the sinuses
- CSF: fully replaced every 6 hours

Hydrocephalus
- disorder of CSF circulation, visual- swelling/large head, at birth
- Occurs in 2/1000 children. mostly congenital, also as a result of meningitis
- tube inserted into the lateral ventricle runs to the abdominal cavity(shunting), value to regulate pressure

CSF Summary
- produced from blood by the chord poleax (all ventricles)
- full replacement every 6 hrs
- flows all around the brain and spinal cord
- reabsorbed into the blood
- ventricles also have a role in development
- carries nutrients and acts like a cushion

4. Neural Migration image 3.6
- on the 18th day... we start as a tube (neutral tube) made of progenitor cells
- by 20 weeks, the brain looks "superficially" like an adult brain
- glial fiber (aka radical glial cells)

Neural Development
- symmetrical cell division (last 7-8 weeks)
  - progenitor cell
    - progenitor cell (x2) -> increase ventricular size
- asymmetrical cell division (last 3 months)
  - progenitor cell
    - progenitor cell -> both great brain tissue
    - brain cells ^
      - radical glial cells (support migration of other cells)
      - neurons + glial cells
- longer divisions stages -> larger brains
- after 5 months: Apoptosis: "suicide" single for progenitor cells (tells them to stop growing and die)
- ventricles produce 2x more neurons than necessary. unused neurons progressively die by apoptosis
  - babies have more neurons than adults

Neural development: new cells in the adult
- there is neurogenesis in the adult brain. in rats: hippocampus (learning and memory) and olfactory bulb (sense of smell)
- new cells are injected with a brown stain. 60 days later shows grow in new cells
- physical exercise increase neurogenesis. stress/depression reduce neurogenesis

Developmental Subdivisions image 3.5
- telencephalon: contive + emotional areas
- diencephalon: early sensory and hormonal
• mesencephalon: motivation, regulation of behavior → midbrain
• mesencephalon: basic motor actions and plans
• myelencephalon: interface with spinal cord → hindbrain
• spinal cord

5. The Forebrain
• = telencephalon + diencephalon
• telencephalon = 2 hemispheres

the 3 Major Fissures: 2 Hemispheres
• fissure = fissures
• sulcus- sulci (folds)
• gyrus- gyri (the "hill" of the wrinkle)
• corpus callosum (right v left)
  ◦ lets your hemispheres talk to each other (i.e. how to clap your hands together)
  ◦ -> contralateral perceptual + motor info flow
• sulk + gyri -> surface x3!
• left side of your brain connect the right side of your body, and the right side of the brain to the least side of your body