COGS 17 Week 4

Spring 2024, A03

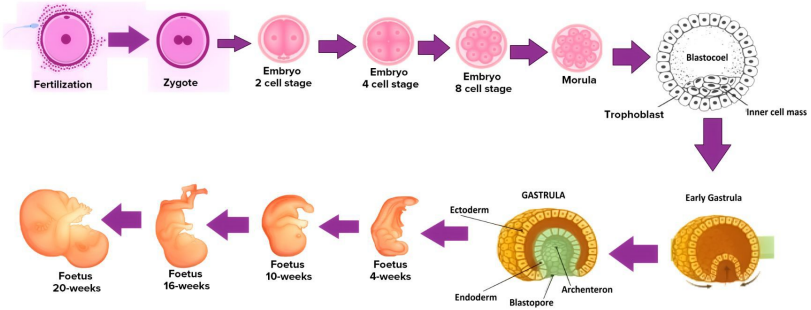
Slides Adapted From Previous Quarter

By: Jason Chen

Announcement

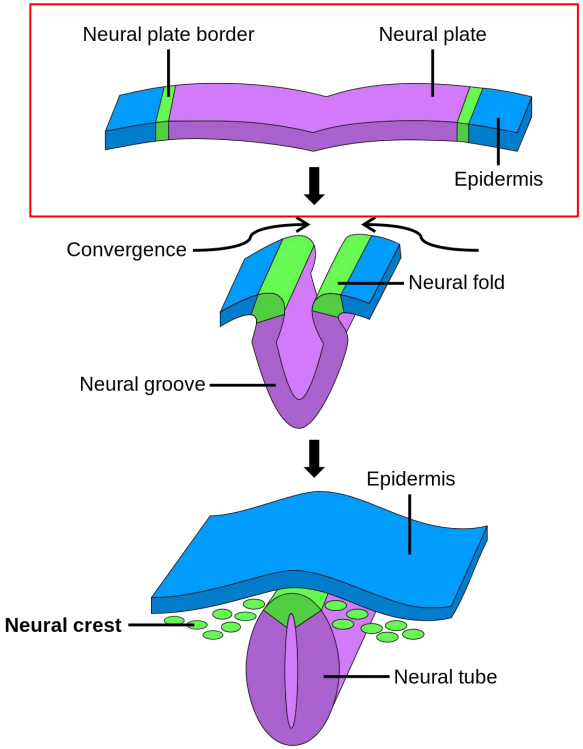
- Midterm On Apr 23, 2024 (Tomorrow) 3:30 - 4:50 pm
- 23 Questions, most of them require multiple responses
- 80 Minutes to complete
- One attempt
- You can revisit and change answers
- If you prefer in-person exam, PETER 108 will be available

Embryonic Development



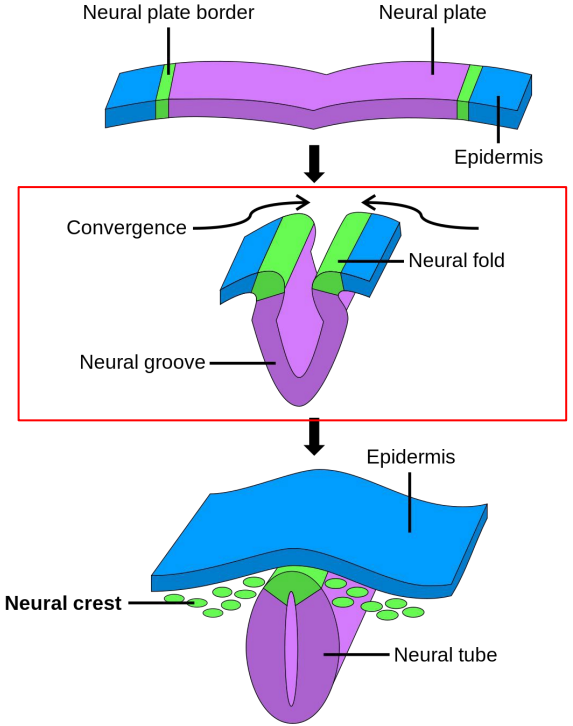
- A new embryo develops **three cell layers**: Ectoderm (outer layer, becomes **nervous system & skin**), Mesoderm (middle layer, becomes **bones, muscles, blood vessels**), endoderm (inner layer, becomes **organs, glands**)

Embryonic Development



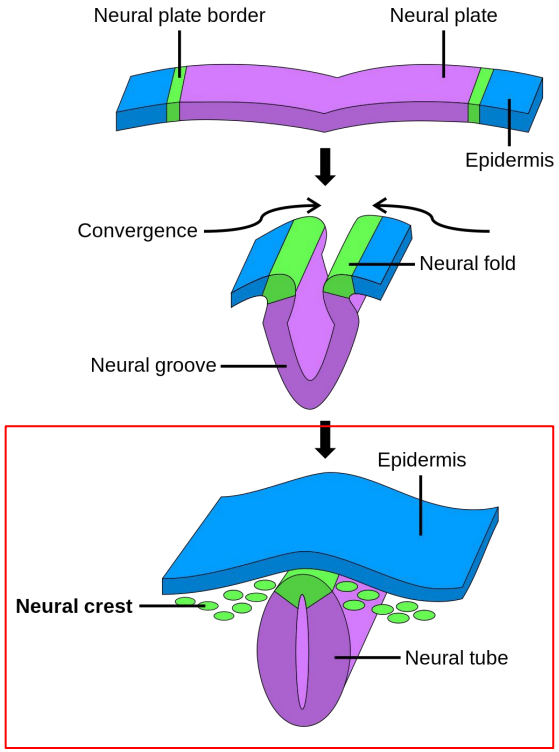
- Over first 2 weeks, embryo changes from a sphere of cells to an elongated “worm”, still **3 layered**
- Then dorsal Ectoderm begins to thicken and forms hard **Neural Plate**

Embryonic Development



- Edges of plate form ridges (Neural Folds) that curl toward each other along a longitudinal line

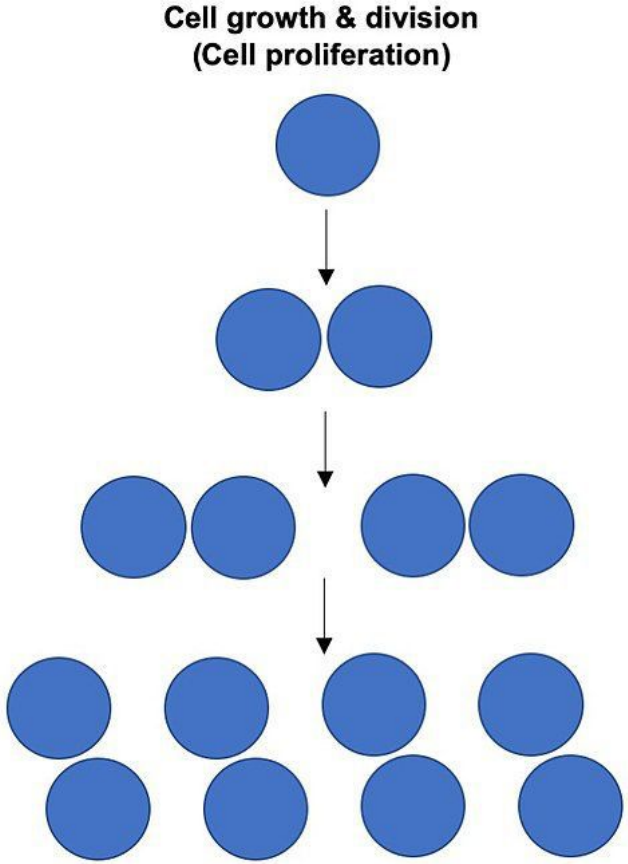
Embryonic Development



- By week 4, edges of Neural Folds have fused, forming **Neural Tube** lined with Ectoderm, embedded in Mesoderm
- Spina Bifida - Neural fold failed to fuse
- **Rostral end** of Neural Tube >> **Brain**
- **Caudal end** >> **Spinal Cord**
- **Surface** of ridges (Neural Crest) >> **Ganglia of ANS & Peripheral Neurons & Glia**

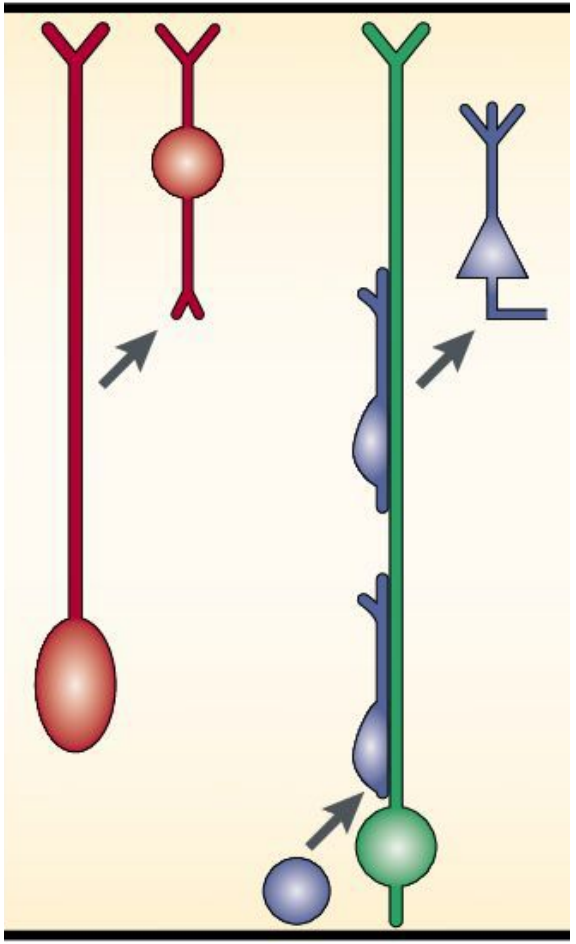
Proliferation

- Growth of new cells
- Stem Cells: Ectodermal cells that line the inside of the Neural Tube
  - give rise to neurons first through **Symmetrical Division**
  - ~Week 7, shift to **Asymmetrical Division**, producing **one stem cell + one neuron**
- Stem cells stay to divide, neurons start to **migrate**

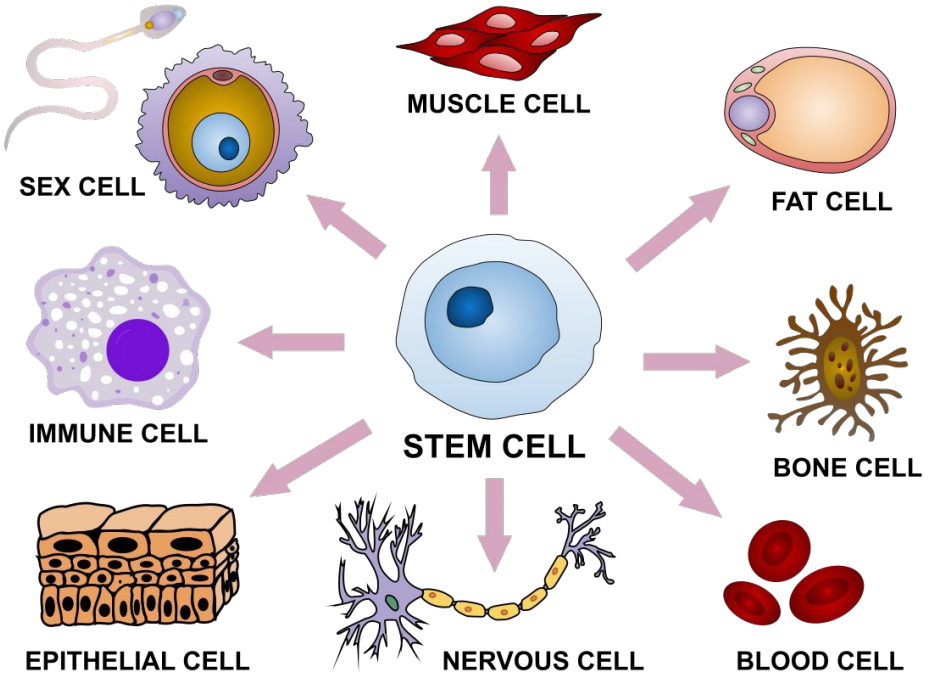


Migration

- Some Neurons migrate by “crawling” along **Radial Glia fibers**, often aided by **Glycoproteins**
- Other Neurons may migrate by following **chemical trails** laid down by **Glia Cells** or by **other Neurons**



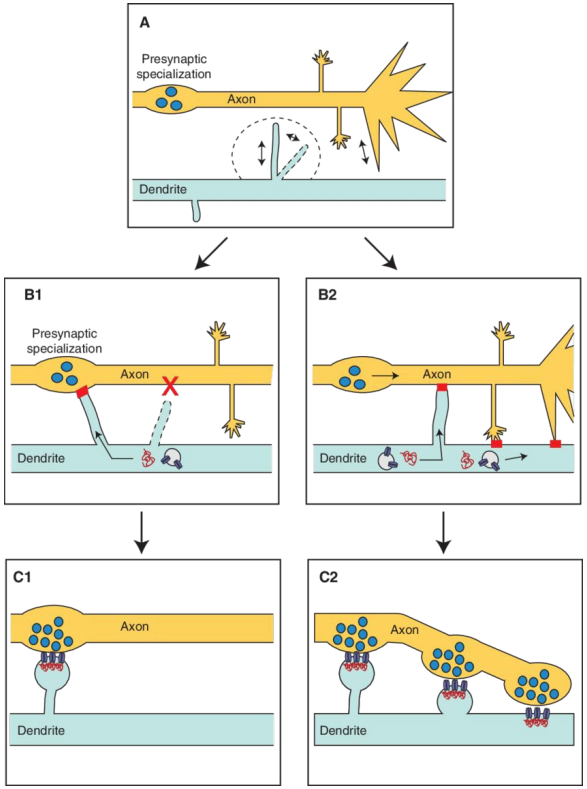
Differentiation



- **Transition** of a cell from one cell type to another

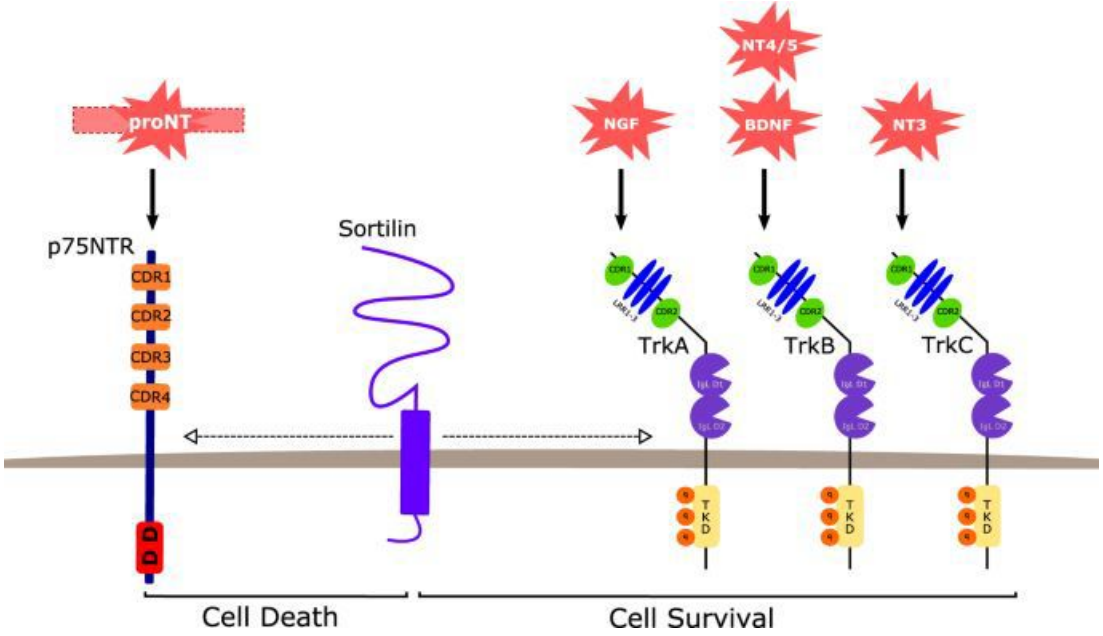
- Per Cell-Autonomous (**genetic**) and Induction (**chemical influences from local environments**) factors

Synaptogenesis



- Developing junctions (Synapses) between cells
- After migration, Neurons grow Axons first and Dendrites later
- **Growth Cone** at end of elongating axon has many **Filopodia** that detect surrounding **chemical gradients**
- Some Axons are directed by **Guidepost Cells**
- Others depend on **Chemical Trails** produced by Glia cells or other migrating Neurons/Axons

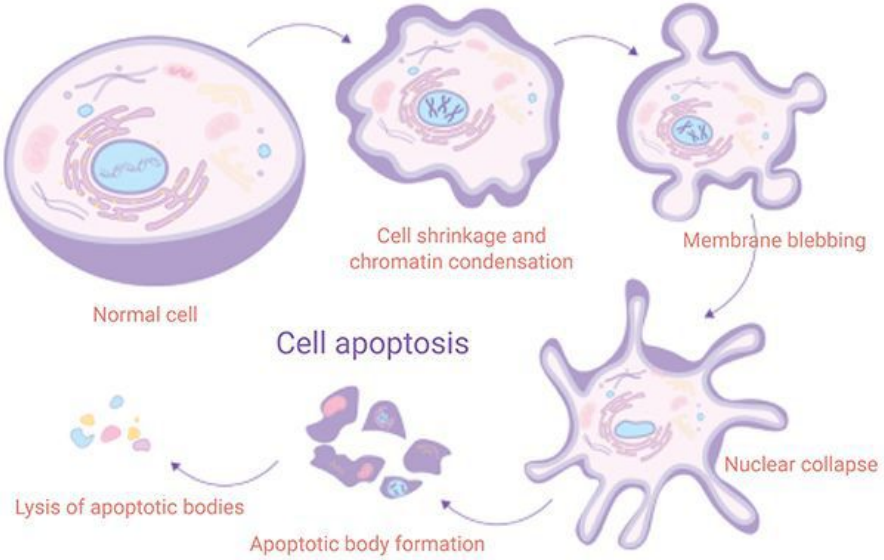
Neurotrophins



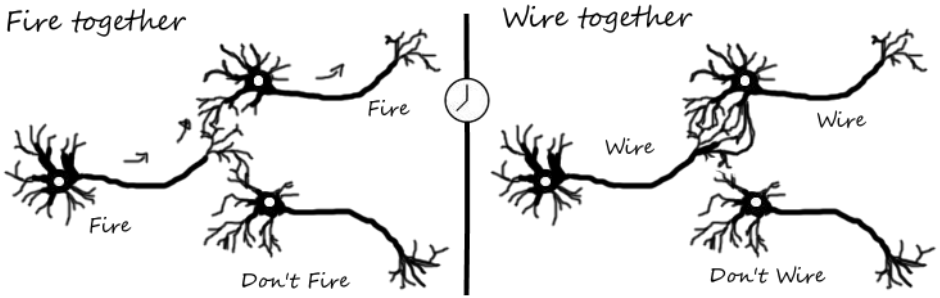
- Chemicals that attract/repel and promote survival and activity of Neurons

Apoptosis (Programmed Cell Death)

- Triggered by **suicide genes**
- As cells compete for connections, those who **do not have connections** die off
- Post-development, most remaining **Stem Cells** also die by the **activation of their suicide genes**

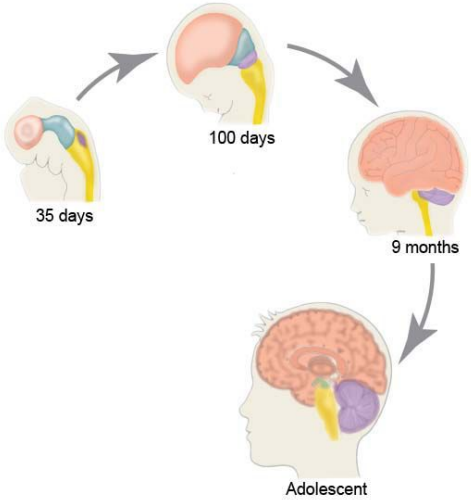


Cells that Fire Together, Wire Together



- Patterns of **co-activity** often determine outcome of competition
- Adjacent Presynaptic cells tend to correlate their bursts of activity, so tend to develop connections to adjacent targets

Further Development

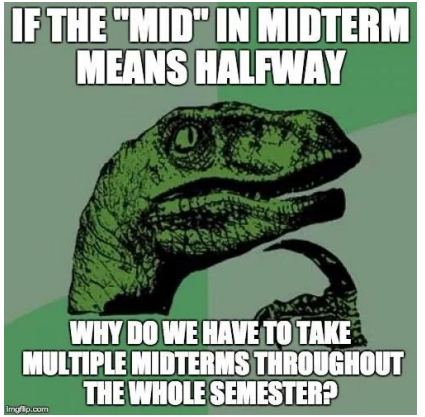


- Brain Growth
- Dendritic branching
- Further Synaptogenesis
- Myelination in neurons

Problem Set for Today (Midterm 1 Review)

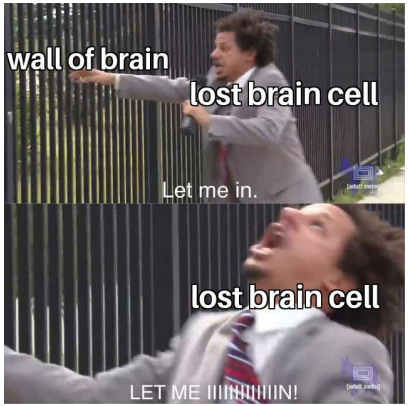
- Link: https://docs.google.com/document/d/1twqvPLN-zhmFigpvCnIB2FhTs_yCT6ARGlANHv9Oqpo/edit?usp=sharing


"I'M FREE AFTER MIDTERM SEASON."
BUT IT'S ALWAYS MIDTERMS SEASON.


IF THE "MID" IN MIDTERM MEANS HALFWAY
WHY DO WE HAVE TO TAKE MULTIPLE MIDTERMS THROUGHOUT THE WHOLE SEMESTER?

GOOD LUCK!


YOU GET A MIDTERM!
2004
AND YOU GET A MIDTERM!
AND YOU GET A MIDTERM!
EVERYONE GETS A MIDTERM!


wall of brain
lost brain cell
Let me in.
lost brain cell
LET ME IIIIIIIIIIIIN!

Questions?

Office Hours: Mon 5-6 pm

To get the section slides: https://github.com/JasonC1217/COGS17-A03-Sp24

OR: