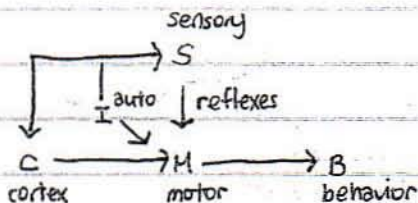


parietal lobe - contains major somatosensory region

temporal lobe - important in hearing, language

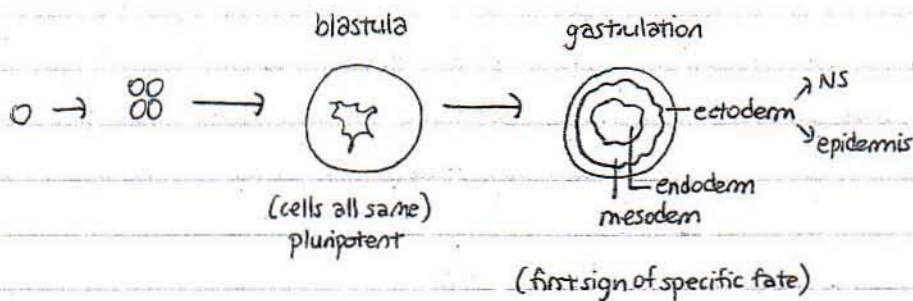


neural tube → forebrain, midbrain, hindbrain, spinal cord → medulla, pons, cerebellum, cerebral hemispheres

25 days

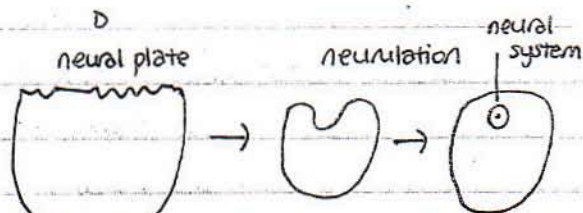
40 days

100 days

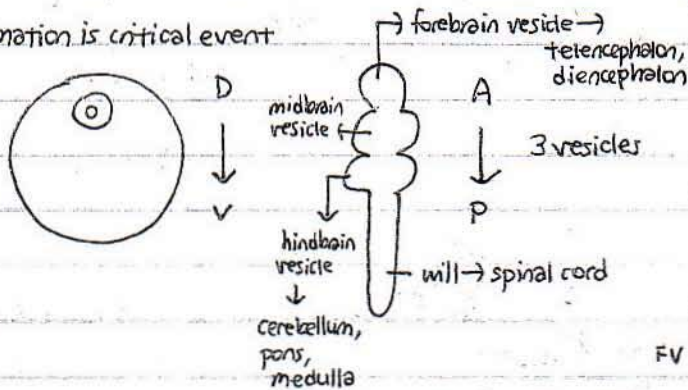


ectoderm: flattens on dorsal side, round still on ventral

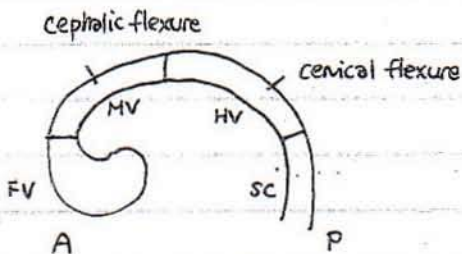
↳ forms grooved neural plate



- axis formation is critical event



(vary in timecourse by organism)



- forebrain vesicle splits → cerebral hemispheres, diencephalon

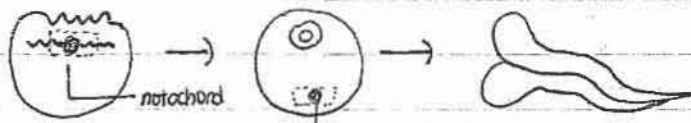
pons → rhombomeres → cranial nerve
 cerebral cortex → prosomeres



1920's: Spemann + Mangold : transplanted regions to other regions

- looked in neurts

- taking mesoderm w/ notochord, transplanting, → 2 NS



mesoderm forms notochord (runs down A→P axis)

transplanted from mesoderm (Spemann's organizer)

transplanted right after gastrulation

(notochord later forms from this mesoderm)

induces

- if take earlier, SO becomes forebrain structures

if take later, induces more caudal structures

- pathways by which cells can communicate : 6 pathways (fundamental)

- all have same principles (need signal from one cell, receptor on other)

(pathway from receptor → nucleus → changes in gene expression)

* 1. TGFβ

- BMPs, activin, DPP all components of this

↳ in invertebrates

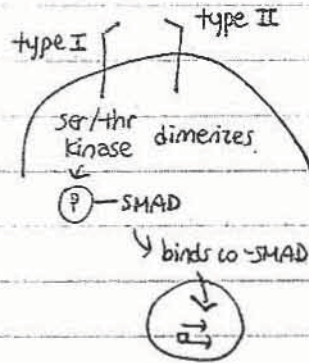
- 2 classes of Rs (Type I, Type II)

- many different R isoforms, many ligands

- critical role in breast cancer, wound repair

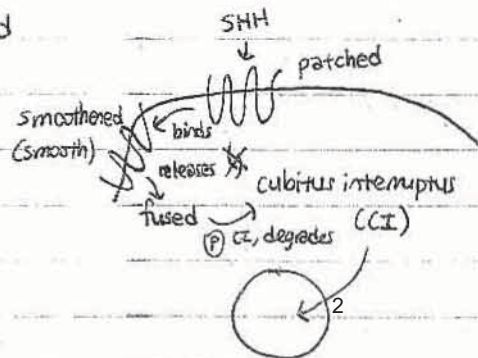
3 amino acids: side chains can be phos.

- OH ser
- CH₂-OH thr
- OH tyr



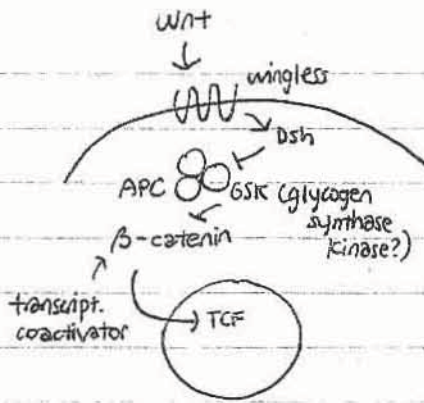
(formation of neural epithelium, also dorsal cell fates in spinal cord)

* 2. Hedgehog - Patched



- critical in basal cell carcinoma, early brain disease

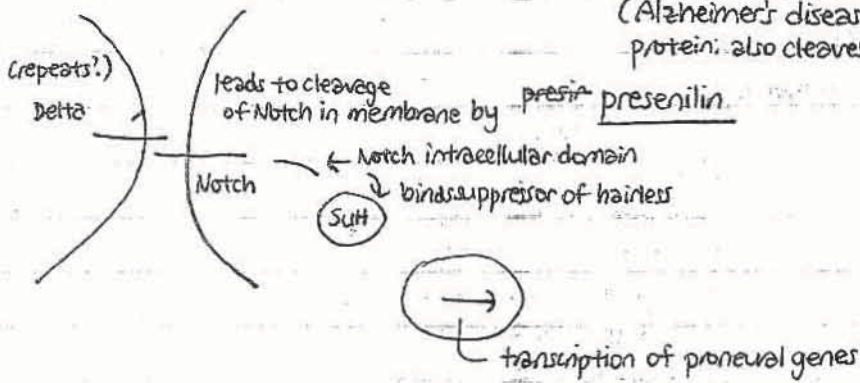
3. Wingless



all so far can work short or long range (diffusible)

4. Notch / Delta

- local pathway, requires cells next to each other

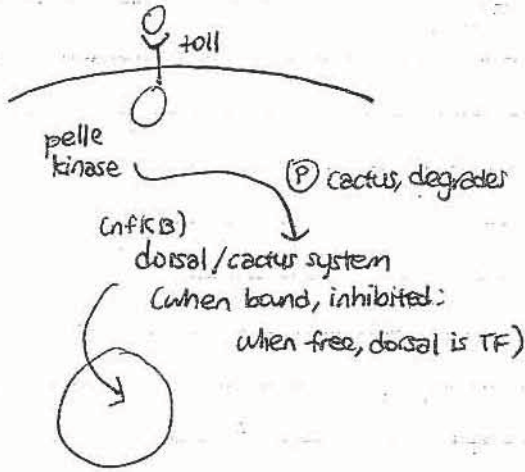


5. Receptor Tyrosine Kinase

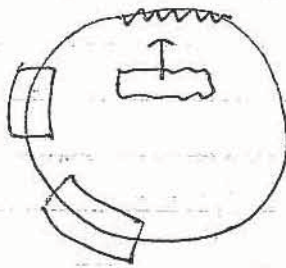
- common in cancer
- uses small secreted ^{6 proteins} molecules, eg Ras
- kill vascular flow in tumors?



6. Toll/NFkB



Spemann's organizer
(mesodermal region)



if take cells from anywhere, become neurons in culture (need to give another signal to get epidermis)

SO keeps BMPs from working (to get neural cells): secretes follistatin

chordin } bind & deactivate BMPs
noggin }

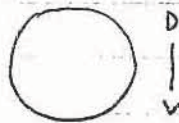
↳ BMP4 (high everywhere except neural ectoderm)

if add BMP4, → epidermal cells

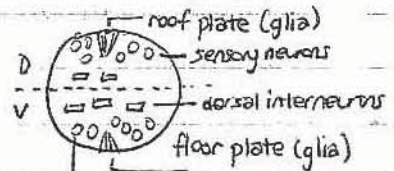
neural plate



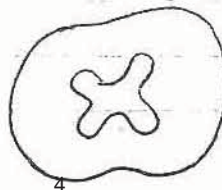
neural tube

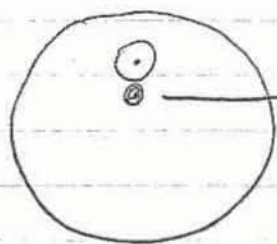


need to establish D-V, A-P axes



in spinal cord,





mesodermal notochord: induces floor plate, motor neuron formation (SHH pathway)

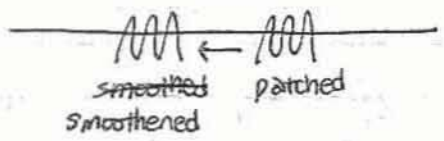
↓ glial

↳ notochord secretes high [SHH] → floor plate
diffuses lower [SHH] → motor neurons
very low [SHH] → ventral interneurons

(different Rs w/ different SHH affinity, turn on different TFs)

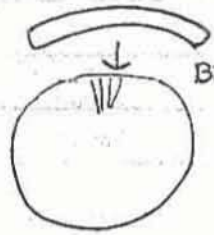
morphogen: different pathways induced by different conc.

- if put notochord in dorsal region, get ventral cell fates
- if take away notochord, get all dorsal structures (from dorsal signals diffusing)

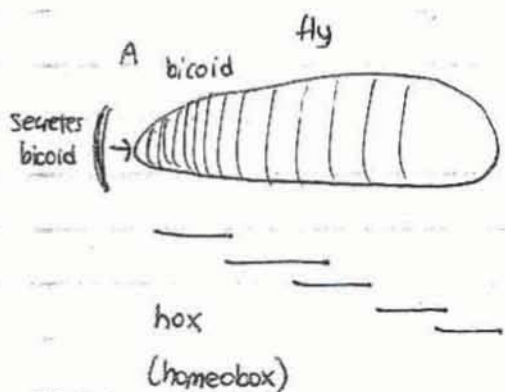


dominant
if make ~~dominant~~ smooth, turn cells into motor neurons
if mutate patched, get dorsal structures

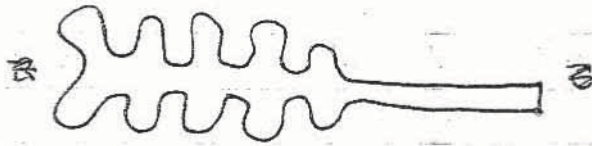
- still get dorsal structures (SHH not necessary here)
- but if take away dorsal epidermis above it, don't get dorsal structures



↓ glial
BMPs turn on roof plate → BMPs sensory neurons dorsal interneurons



bicoid turns on hox genes at different conc.
- different combinations of hox genes give segments
- in vertebrates, also conc. of morphogens (BMPs inhibited as go ~~far~~ forward)



inhibit

BMPs for forebrain



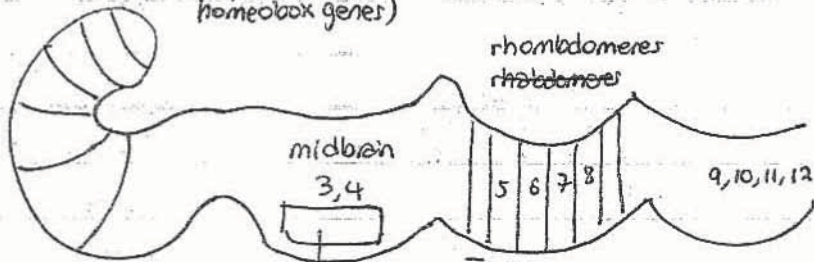
noggin
chordin
follistatin

baseline fate
forms midbrain

FGF

retinoic acid
(signal formation
of posterior structures)

morphogens secreted to do this
prosomeres (different patterns of
homeobox genes)



substantia nigra

(if remove SHH,
remove this)

if delete hox
genes, can convert
1 rhombomere to
other (turn 1 nerve into another)

different combinations
of hox genes give different
rhombomere identities

- know:
1. SHH pathway
 2. know BMPs (dorsal fates) pathways

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7.29J / 9.09J Cellular Neurobiology
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