

Positional information generated by a morphogen gradient, instruct the stem cells to adapt different lineages.

Development of the spinal cord

- Group of motor neurons are found in the ventral horn of the spinal cord, tracing of MN identify different classes.
- Within the spinal cord, there are also local inhibitory interneurons which causes reciprocal inhibition of agonist-antagonist contractions.
- Central pattern generators: rhythmic motor activity such walking, breathing.
- Dorsal mesodermal structure notochord induce the neural tube (structure made up of stem cells)

In the adult spinal cord, the neurons are separated in layers called Rexed's laminae.

- Notochord will induce floorplate, act as an organising center. **Grafting experiment of notochord induce on neural tube**
- Floorplate also induce motor neurons, act as an organising center. **Also supported by grafting experiment.**

Sonic hedgehog (Shh) signalling: Mutant in Drosophila have inverted hairs, looks like hedgehog, gene named hedgehog. Shh in vertebrates.

- Notochord secrete Shh, induce floorplate, which also secrete Shh. **Shown through ISH.**
- Notochord + floorplate establish a gradient of Shh ventrodorsally, induce different neuron subtypes based is Shh exceed threshold concentration
- Shh promote expression of Class II transcription factors, while inhibit expression of Class I transcriptional factors
 - Within the ventrodorsal axis, class I and class II TF also exhibit mutual inhibition.
 - Example: Nkx2.2 expressed ventrally. Nkx2.2 I—I Pax6 (class I) dorsally
 - Example: Nkx6.1 expressed ventrally. Nkx6.1 I—I Dbx2 (class I) dorsally
 - Stem cells within the neural tube interpret the class I and II transcription factor combinations and adopt different fates, undergo lineage restriction, express different markers.
 - Neural stem cells undergoes a transcription factor signalling cascade, giving rise to post-mitotic neurons away from the ventricular zone.

BMP, Wnt signalling:

- Dorsal BMP and Wnt induce formation of neural crest cells
 - Neural crest cells are stem cells, which migrate to different areas, exposed to different inducing factors.
 - Neural crest cells are differentially induced to undergo different lineage restrictions, giving rise to different post-mitotic cell types in different regions of the embryo.
 - NCCs migrate to anterior part of the somite becomes dorsal root ganglions
 - NCCs migrate away from the spinal cord can be induced by ganglions to become schwann cells.
- BMP and Wnt create a dorsoventral gradient, induce cell fates in the neural tube as well, similar to Shh mechanism.