Control of cell number during neural development

1. Controlling the number of precursor cells
2. Controlling the number of cell division before differentiation
3. Controlling the number of survival neurons
   - programmed cell death (late phase of development)

Fundamental Neuroscience
Fig. 17.3

Formation of CNS
Progenitors cells of the nervous system arise from the neurectoderm.

Vertebrate-Dorsal part of the ectoderm
Invertebrate-Ventral part of the ectoderm

Not all of the cells in the cluster become neuroblasts.
    Notch mutant (a neurogenic mutation) -produce too many neuroblasts.

Cell-cell interactions define the number and pattern of neuroblasts.
    Lateral Inhibition (inhibitory cell-cell interaction)
    All cells in the cluster is competent to become a neuroblast.
    Laser ablation of Nb- An epidermoblast becomes a Nb.
Delta-Notch signal and the cell fate

Delta (Dl) from a neighbor cell

⇒

Notch (N) activation

⇒

Translocation of Suppressor of Hairless, Su(H), to the nucleus

⇒

Expression of E(spl)-C

⇒

Supression of Achaete-Scute complex (AS-C)

⇒

Delta expression

⇒

Dermoblast

Migration and Instructive signals for differentiation progenitor cells

- glucocorticoid
- FGF, NGF?

Adrenal chromaffin cells
sympathetic neurons

FIGURE 4. Developmental origin of the sympathoadrenal lineage. (A) Schematic cross section through the trunk region of a rat embryo. Initially multipotential neural crest cells migrate ventrally and laterally from the apex of the neural tube, beginning around E9.5–E10 in the rat. The kidney-shaped structures lateral to the neural tube are somites. Some of the crest cells stop migrating near the dorsal aorta, where they aggregate to form sympathetic ganglia, whereas others continue migrating ventrally to invade the developing adrenal gland primordium. (B) Schematic illustration of the bipotential sympathoadrenal progenitor and its choice of cell fates. Cell types are not shown to relative scale.
Growth factors control cell diversification
Birth and migration of neurons in the CNS

Neuroscience, Sinauer Assoc. p.392
Purves et. Al.
### Main subdivisions of embryonic CNS and their adult forms

<table>
<thead>
<tr>
<th>Early stage</th>
<th>Late stage</th>
<th>Major derivatives in adult brain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Forebrain</td>
<td>1a. Telencephalon</td>
<td>Cerebral cortex, basal ganglia olfactory bulb</td>
</tr>
<tr>
<td></td>
<td>1b. Diencephalon</td>
<td>Thalamus, hypothalamus, retina optic nerves and tracts</td>
</tr>
<tr>
<td>3. Hindbrain</td>
<td>3a. Metencephalon</td>
<td>Pons, cerebellum</td>
</tr>
<tr>
<td></td>
<td>3b. Myelencephalon</td>
<td>Medulla</td>
</tr>
<tr>
<td>4. Spinal cord</td>
<td>4. Spinal cord</td>
<td>Spinal cord</td>
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