

## Summary for developmental plasticity

### normal adult V1

- . rough balance between cells driven by L and R (above/below L4)
- . alternating L and R OD columns with equal width
- . L and R LGN axons terminate in distinct territories in Layer 4

### newborn V1

- . no ocular dominance column
- . LGN axon terminals branch extensively, fibers from two eyes overlap

### V1 of MD animal

- . physiological change: OD shifts toward the non-deprived eye
- . Anatomical change: deprived eye columns shrink, open eye columns expand
- . LGN axon terminals from the open eye take over more area

## Summary for developmental plasticity

- mechanism of segregation
  - TTX , no segregation (**complete lack of activity**)
  - BD (binocular deprivation), normal OD (**weaker but balanced input from both eyes**)
- activity-dependent competition
  - three-eyed frog experiment (**competition leads to segregation**)

## Adult cortical plasticity

early development

- critical period

adulthood

- although certain properties (such as OD) are fixed, a large range of other properties is mutable.
- within certain limits, the functional properties of neurons and the organization of cortex are dynamic
- lesion-induced adult cortical reorganization
  - somatosensory cortex
  - primary auditory cortex

Reference

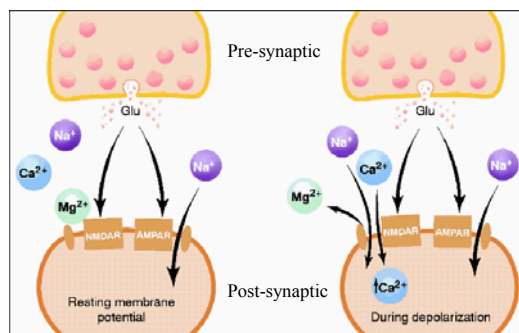
Buonomano DV, Merzenich MM. Cortical plasticity: from synapses to maps. *Annu. Rev. Neurosci.* (1998) 21:149-186

## Molecular mechanism of cortical plasticity

### 1. NMDA receptor - coincidence detector

- ligand dependent (requires binding of Glu)
- voltage dependent (requires depolarization of the postsynaptic cell to remove  $Mg^{2+}$  from the channel pore)

Pre and post fires asynchronously      Pre and post fires synchronously

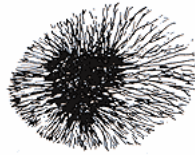


trigger LTP, strengthen synapse

## Molecular mechanism of cortical plasticity

### 2. Neurotrophins

First neurotrophin, NGF (nerve growth factor), is discovered by Rita Levi-Montalcini, winner of the 1986 Nobel Prize



Criteria for neurotrophins to function as molecular signals in synaptic plasticity:

- 1) expressed in the right places and at the right times
- 2) expression and secretion are activity-dependent
- 3) regulate aspects of neuronal function

## Summary

- adult cortical plasticity
  - lesion induced changes in cortical map
    - somatosensory cortex area 3b
    - primary auditory cortex
- cellular mechanism of cortical plasticity
  - Hebb's hypothesis
    - developmental plasticity
    - adult cortical plasticity
- Molecular mechanisms of cortical plasticity
  - NMDA receptor
    - coincidence detector
    - block NMDA receptor, block segregation of OD columns
  - neurotrophins
    - signaling molecules in synaptic plasticity