

Education and the Brain

- James S. McDonnell Foundation
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Education and the Brain

Infants' brains undergo rapid synapse formation.

From 3 -10 years, children's brains have more synapses than at any other time in their lives.

Early experience causes synapses to form or protects them from elimination at puberty.

The time of rapid growth and/or high connectivity is the critical period in development, the optimal learning period.

Enriched environments are most important and beneficial during the critical period.

Ideas from Neuroscience

- **Synaptogenesis** -- in infancy the brain forms synapses in excess of adult levels.
- **Critical periods** -- normal development of neural systems requires specific experiential input at specific times.
- **Pruning at Puberty** -- at sexual maturity synapses are pruned back to adult levels.
- **Enriched environments** increase synaptic connections.

Synaptogenesis

- 1. What behaviors emerge during this time of rapid synapse growth?**
- 2. How do these behaviors change as synapse numbers peak and then decrease?**
- 3. Shouldn't we try to increase this growth by providing more stimulation to babies?**
- 4. What is the relevance of this phenomenon to formal school instruction?**

Critical Periods

- 1. What is a critical period?**
- 2. How are they identified?**
- 3. How extensively do we understand the neural basis of critical periods?**
- 4. Are critical periods “windows” that open/slam shut?**
- 5. Does the amount of stimulation matter?**
- 6. What is the benefit of critical periods?**

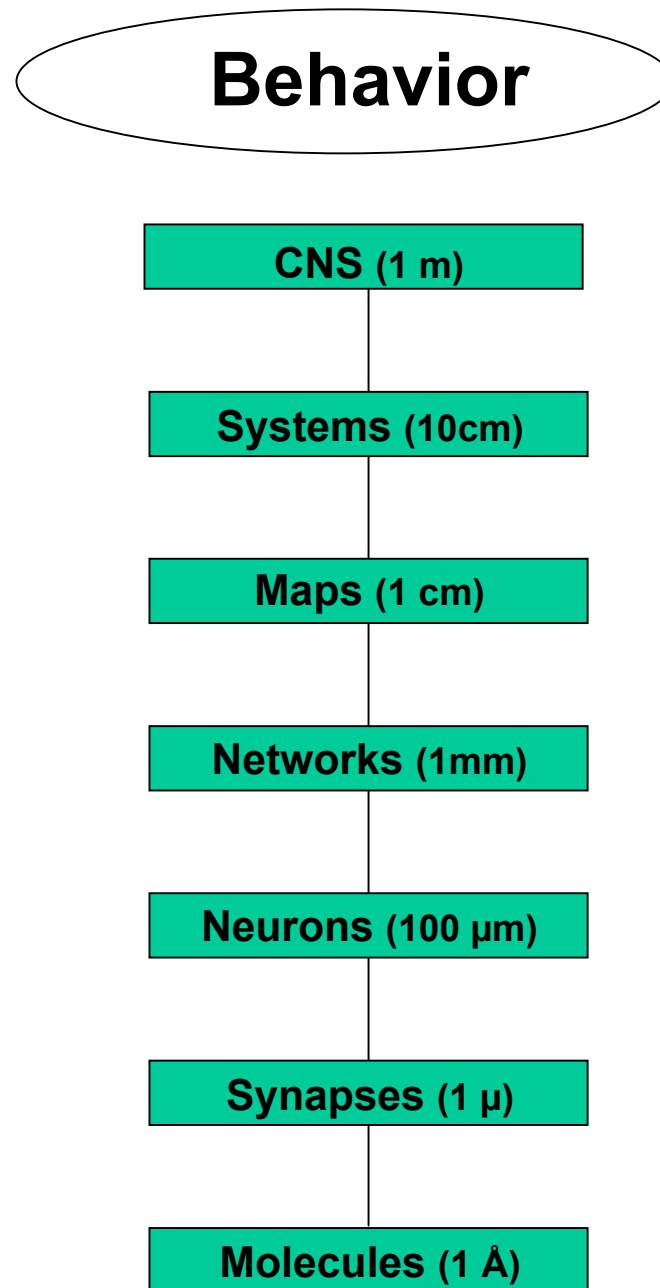
Enriched Environments

- 1. What is an enriched environment?**
- 2. What happens to animals raised in complex environments?**
- 3. Are the effects of complex environments “critical period” effects?**
- 4. Do we think that same kind of neural processes underlie both kinds of effects?**
- 5. Why might there be such differences?**

Pruning at Puberty

- 1. What happens to synapses at puberty?**
- 2. What is the functional and behavioral significance of the pruning?**
- 3. How does previous experience affect the extent of the pruning?**
- 4. Should we engage in intensive “synapse conservation” programs prior to pruning?**
- 5. But, aren't more synapses better than fewer?**

The Brain: Levels of Study



Education-Mind-Brain

- **Educators are looking at the wrong level.**
- **We cannot yet link gross behaviors with brain structures (synapses or hemispheres).**
- **Cognitive analyses can link education (behavior) to systems neuroscience.**
- **Cognitive analyses are already helpful for improving educational practice.**

Education-Mind-Brain

The links between cognitive and educational research are much tighter than the link between neuroscience and education.

The links between cognitive science and neuroscience are already strong, growing It is obvious that those interested in describing the functions of neural systems have been heavily dependent upon psychology.

(Susan Chipman, Three Perspectives on Learning, in *Mind, Brain, and Education*, 1986, p. 215)

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