

# The bio-cognitive basis of learning

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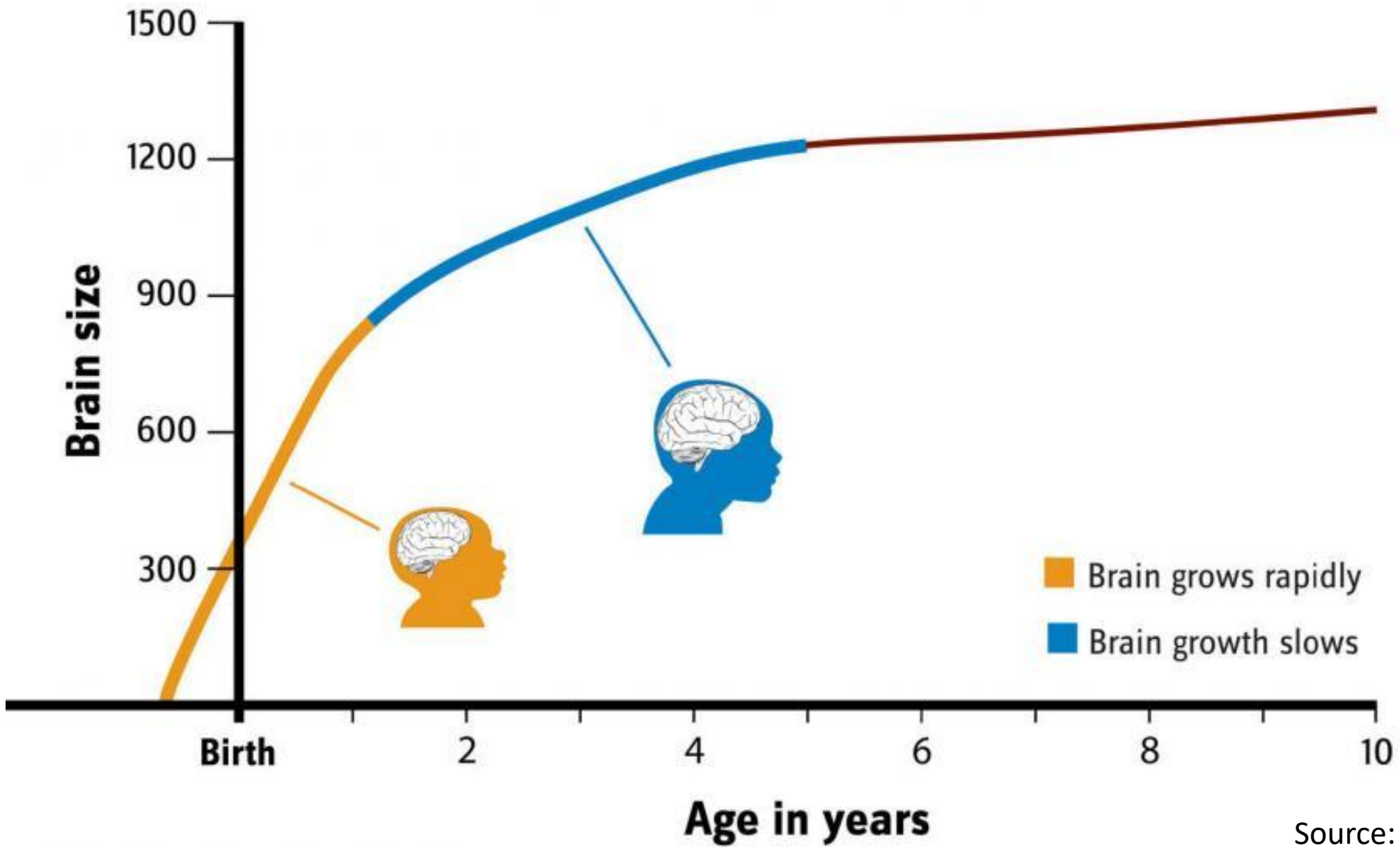
# Overview

- Brain development
- Using modern cognitive approaches to understand the brain-learning nexus
- Linking research to learning and teaching
- Q and A

“The brain is a wonderful organ. It starts working the moment you get up in the morning, and does not stop until you get into the office”

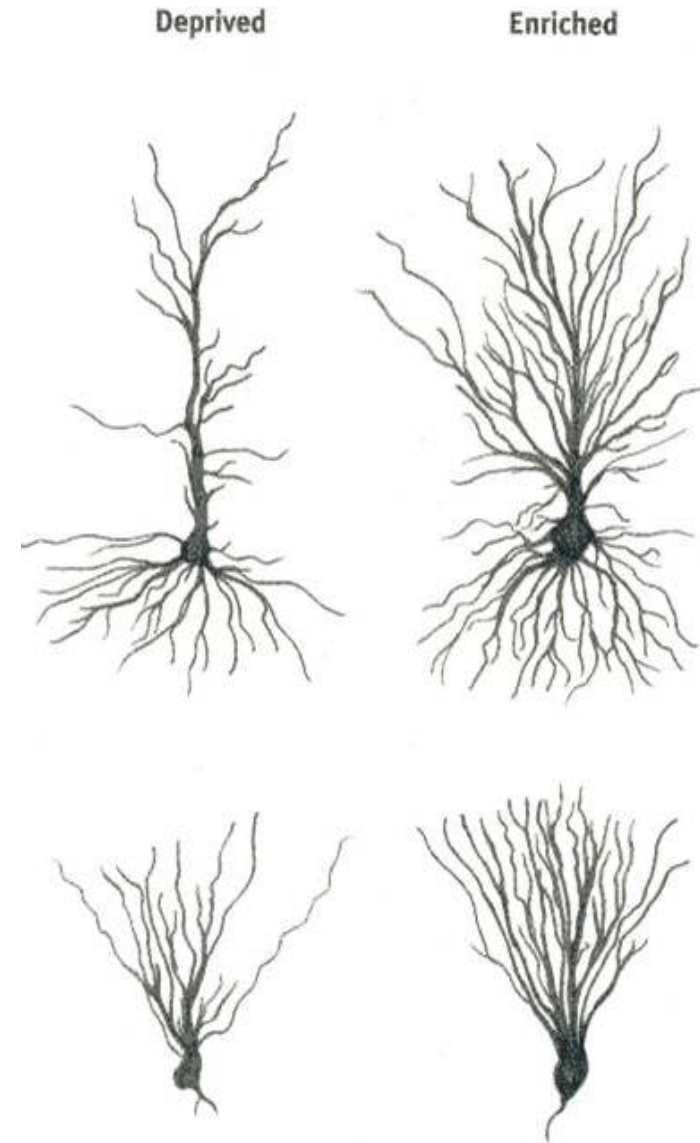
- Robert Frost





Source: Smithsonian Museum

# Synaptic growth and pruning







Frontal lobe  
development takes  
much longer

# Traditional stage-based approach

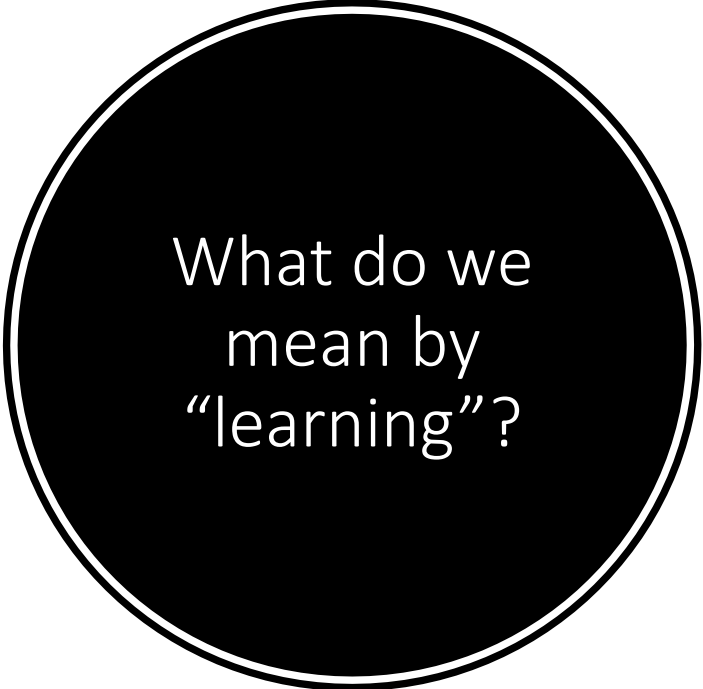
- Ages 2-7: Preoperational
  - Egocentrism- perspective taking
  - Centration- tendency to have attention captured by striking features of objects
- Ages 7-11: Concrete operations
  - Actions performed in the mind that give rise to logical thinking
  - Can replace physical action with mental action
- Ages 11 onwards: Formal operations
  - Growing capacity for abstract reasoning
  - Growing capacity for hypothetical thinking



There is no one-to-one correspondence between  
brain development and developmental  
milestones

No wonder there is disagreement on how to  
conceptualise how thought changes from infancy  
to adulthood!

However, there are age-related differences that  
are cognitively based



What do we  
mean by  
“learning”?



Behaviourist  
approaches

Cognitive constructivist  
approach

Learning as  
the result of  
mental  
construction

- Draws on experience of the world  
...to make sense of the world  
...in order to build understanding

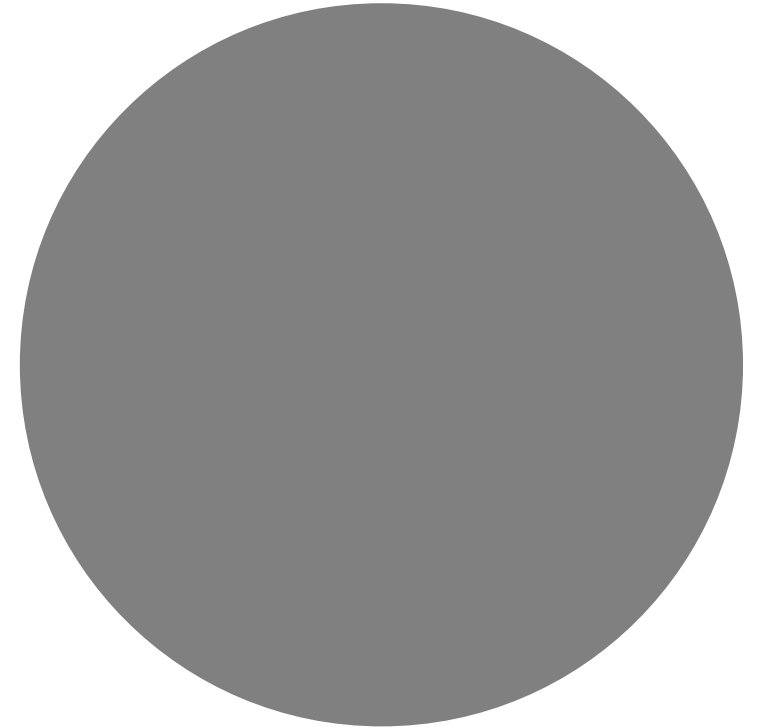
# The learning equation



# What do we know about children's cognitive development?

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Bjorklund & Causey



1. Cognitive development occurs as a result of internal and external factors

These factors are dynamic

There are reciprocal interactions between factors

2. Cognitive development occurs within a social context



Cultural influences



Social relationships



### 3. Cognitive development involves both stability and plasticity over time

**Stability:** the extent to which children maintain their relative rank order over time

**Plasticity:** the extent to which cognitive patterns can be shaped by experience

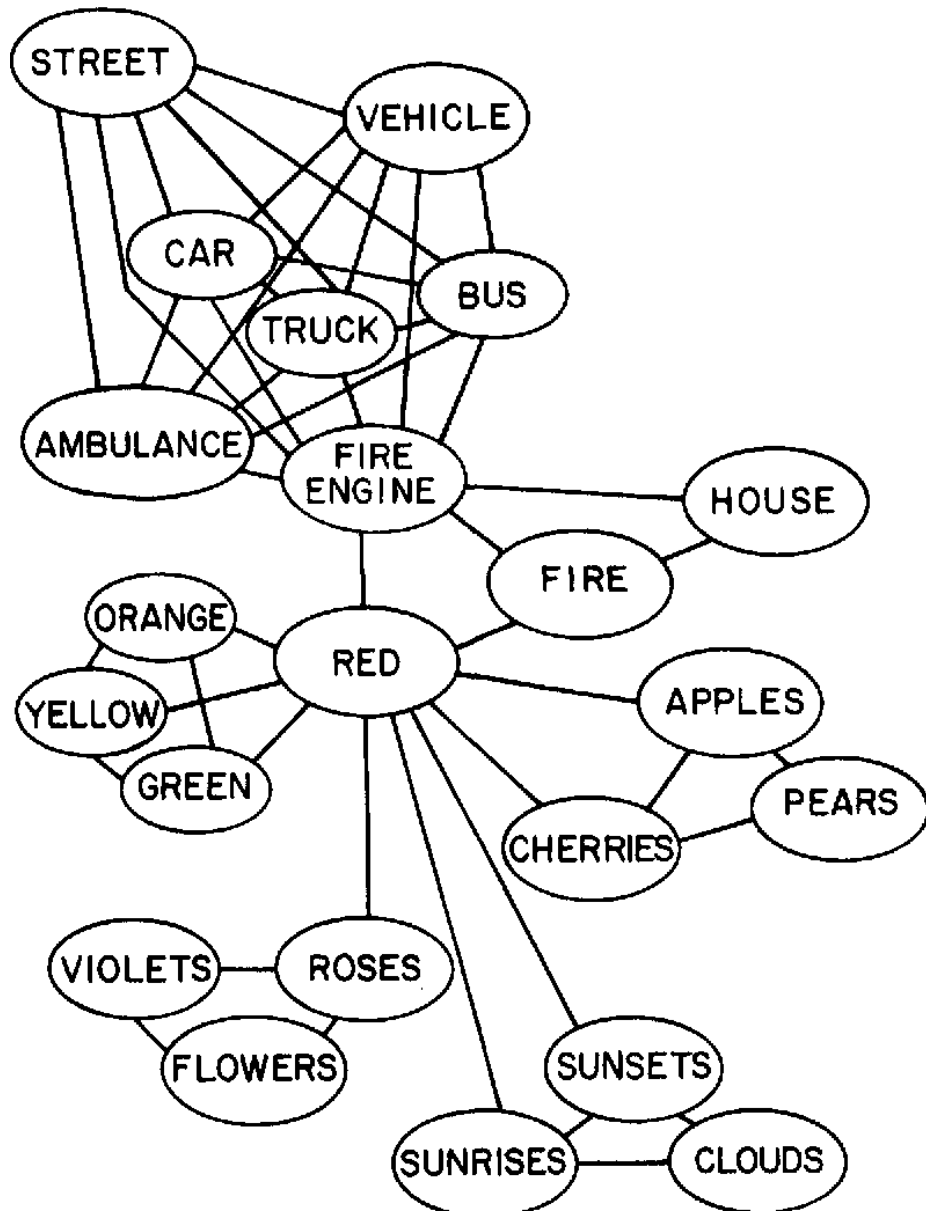
4. Cognitive development involves changes in the way information is represented



Language



Concepts



- Network models of memory
- Spreading activation
- Scaffolding and memory “hooks”

5. Children develop increasing intentional control over their behaviour and cognition

Different uses of strategies, problem solving

Executive function

6. Cognitive development involves changes in both domain-general and domain-specific abilities

A child's thinking is influenced by factors that influence all aspects of thinking

Different aspects of thinking are influenced in different ways

# The learning equation



# Active Versus Passive Teaching Styles: An Empirical Study of Student Learning Outcomes

*Norbert Michel, John James Cater III, Otmar Varela*

DOI: 10.1080/10645570802355562

# A Short Review of School Field Trips: Key Findings from the Past and Implications for the Future

*by Jennifer DeWitt<sup>1</sup> and Martin Storksdieck<sup>2</sup>*

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# Exploring mobile learning in the Third Space

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Questions?

Fun fact

How much genetic material do humans share with bananas?

