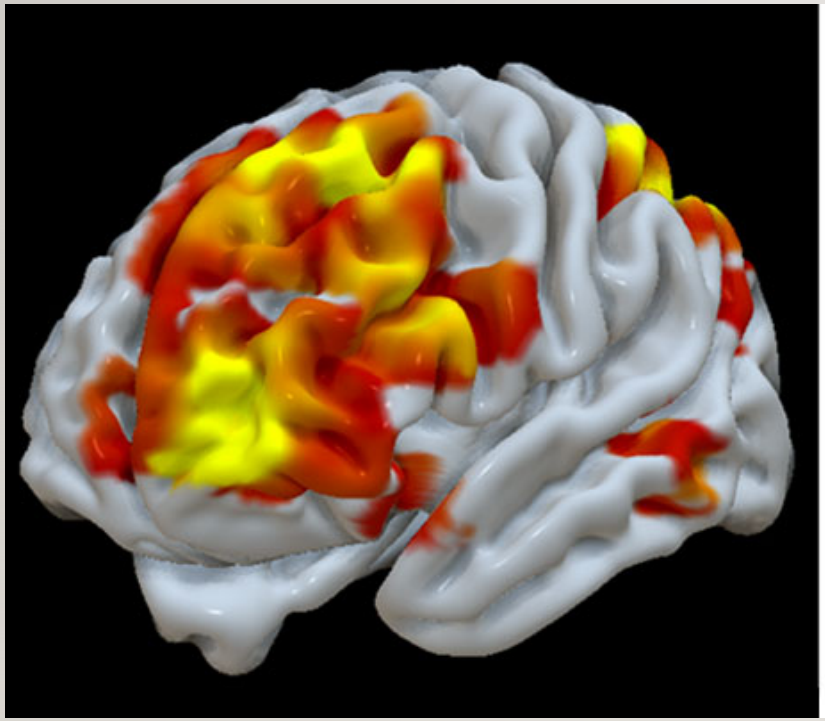
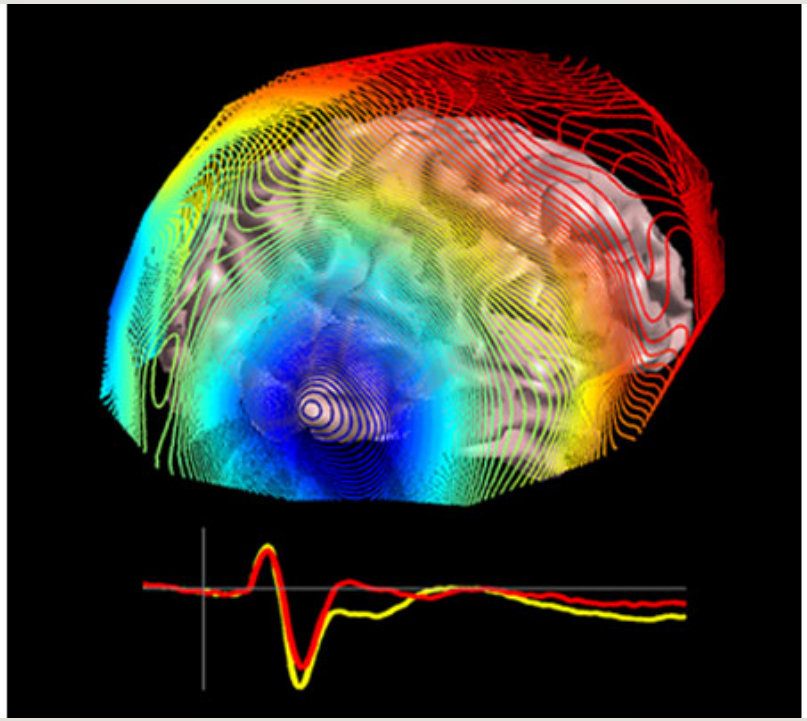
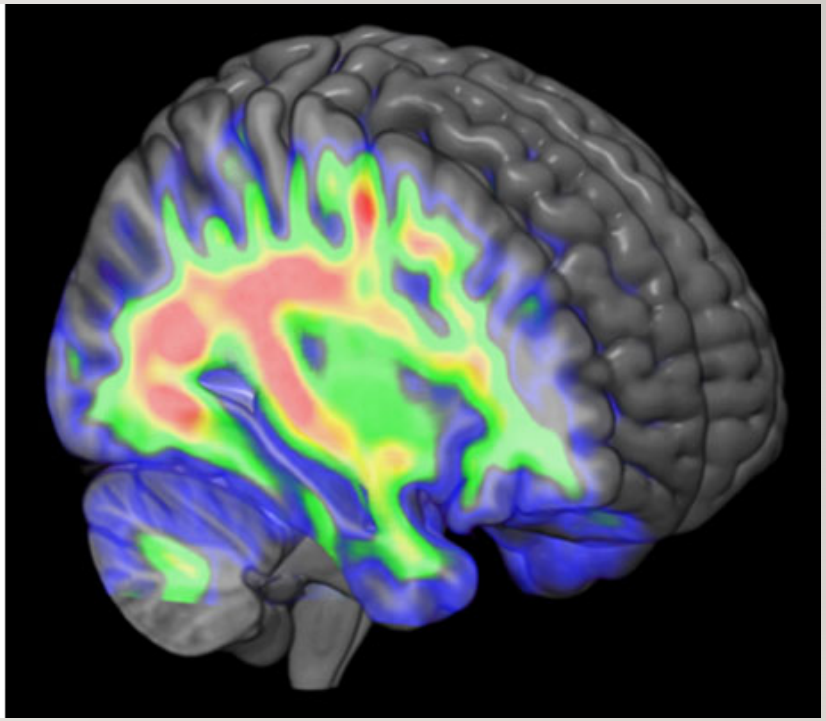
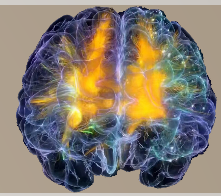






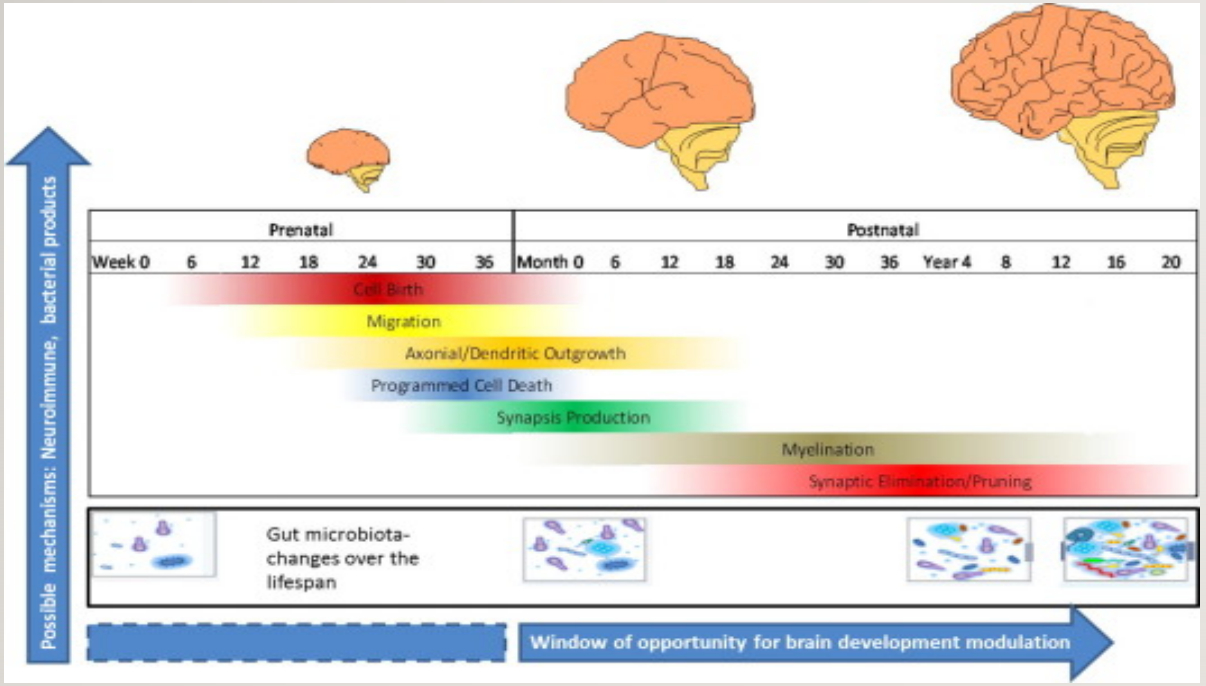
COGNITIVE NEUROSCIENCE

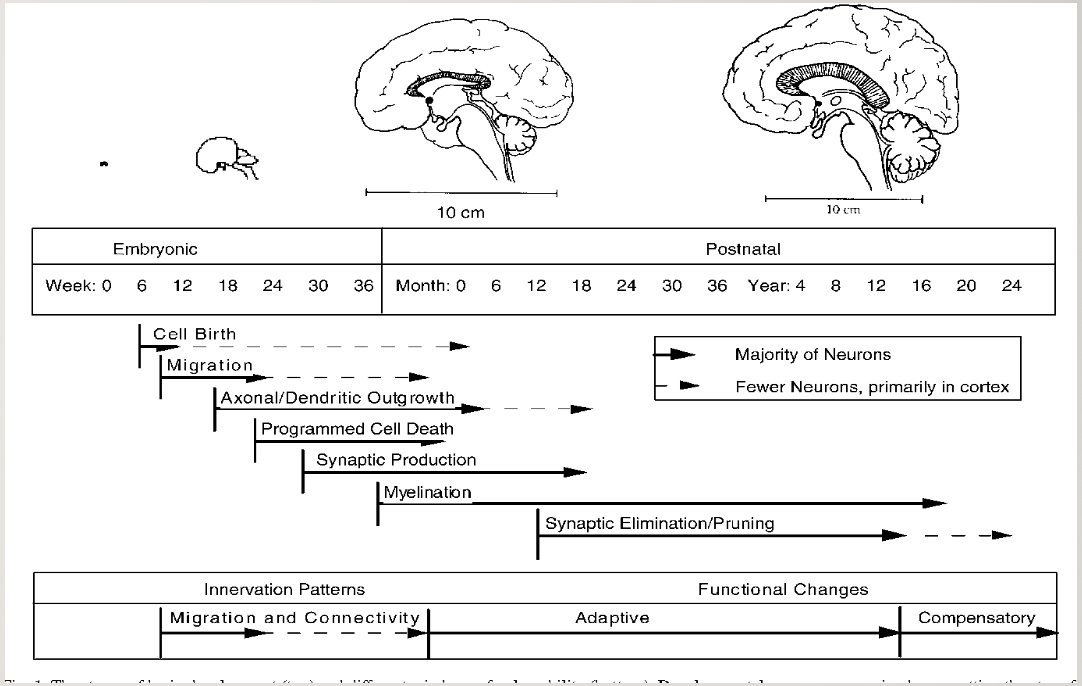
By YAN Zhixiong Ph.D

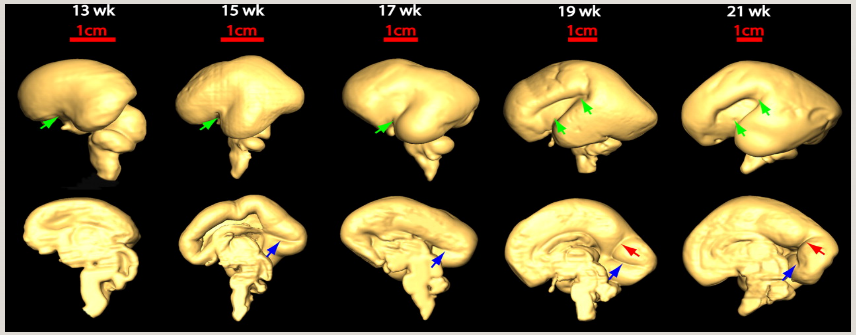


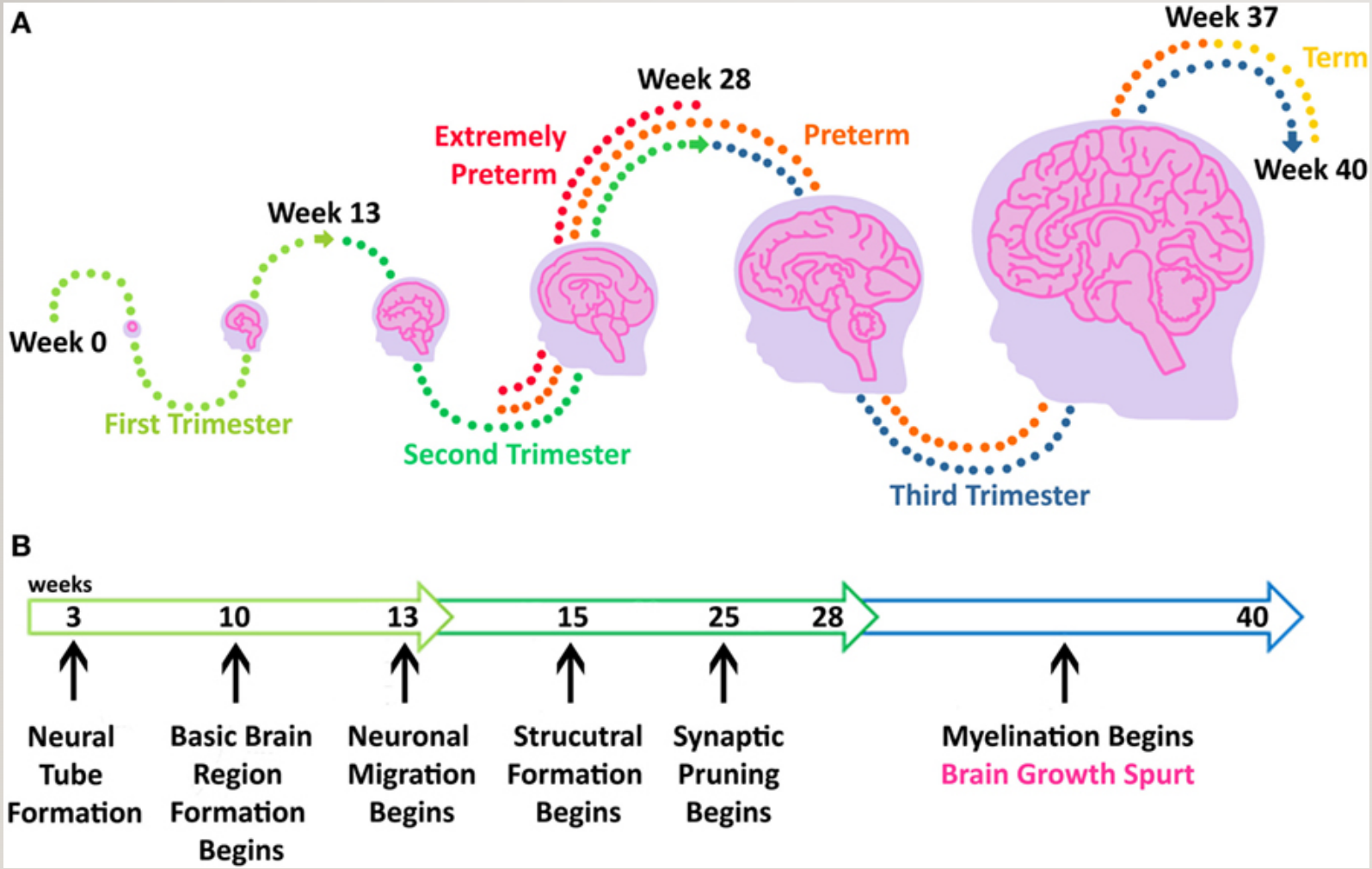
BRAIN DEVELOPMENT

BRAIN DEVELOPMENT








A
Week 37
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Preterm
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Week 40
Week 13
Week 0
First Trimester
Second Trimester
Third Trimester
B
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3
10
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15
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28
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Neural
Tube
Formation
Basic Brain
Region
Formation
Begins
Neuronal
Migration
Begins
Strucutral
Formation
Begins
Synaptic
Pruning
Begins
Myelination Begins
Brain Growth Spurt

Brain Development—How you can help your child learn and grow.

Frontal Lobe—Concrete Thinking (3 to 12 years)

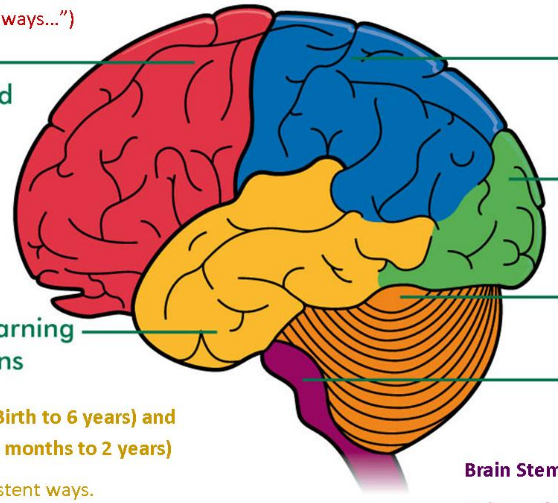
Have me sort and categorize objects.
Encourage problem-solving. Let me be frustrated sometimes as I figure something out.
Help me notice patterns. ("When you do X, this always happens." "After we do Y, we always...")

Parietal Lobe—Language (Birth to 6 years)

Talk to me, sing to me, read to me.
Listen to me and respond.
Read the same stories or sing the same songs over and over so I learn to memorize.

Parietal Lobe—Touch (Birth to 6 years)

Touch me—hug me, hold my hand, massage me.
Give me lots of objects to manipulate.
Let me explore the world hands-on—pulling, pushing, pouring, picking up, dropping, turning, twisting, opening, and closing.



Prefrontal Cortex—Judgment (12—22 years)

Give me choices (when I'm calm... I can't make choices when I'm stressed or upset).
Talk to me about plans.
Help me break down big tasks into little steps.

Occipital Lobe (Birth to 2 years)

Surround me with interesting things to look at.
Play games where I follow things with my eyes.
Make sure I have plenty of outdoor time to develop distance vision.

Cerebellum (Birth to 1 year)

Let me move—a LOT.
Take me to playgrounds and swimming pools..
Dance with me. Let me wiggle, roll, and jump.
Let me take some "risks" while I learn to move.

Temporal Lobe (Birth to 6 years) and Limbic System (8 months to 2 years)

Respond in consistent ways.
Show me unconditional love.
Experience joy with me.
Talk to me about my emotions. Give me the vocabulary to understand how I feel.

Brain Stem (Birth)

Help me feel emotionally and physically safe.

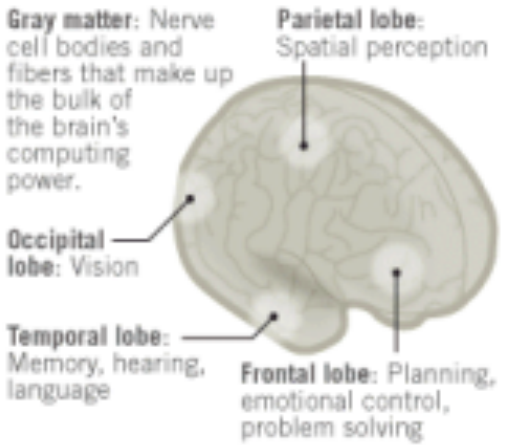
If I am frightened or stressed, my brain goes into survival mode (brain stem function), and the rest of my brain can't grow and develop. When I feel safe, I can learn.

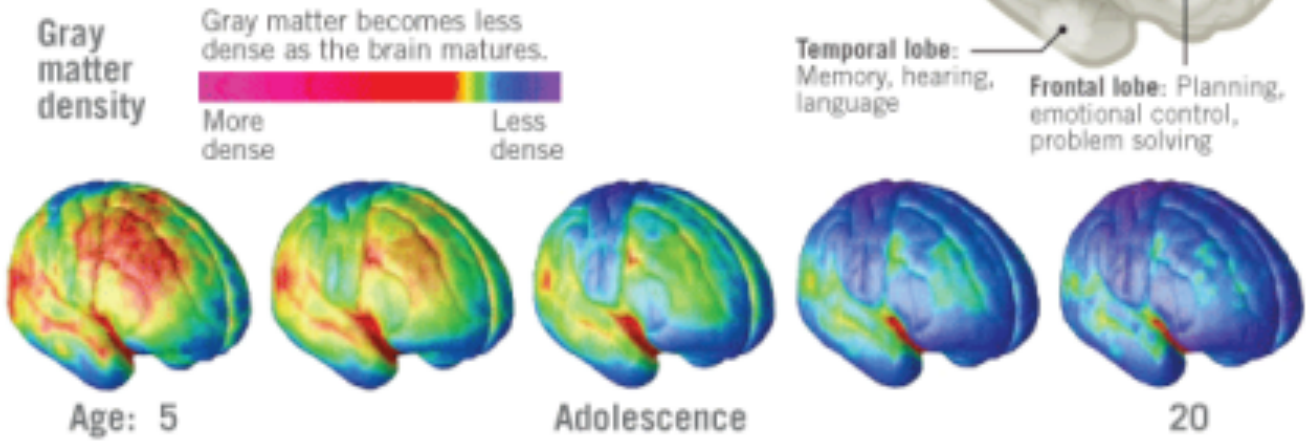
Note: Timeframe given is the "sensitive period" when that part of the brain is growing and developing the most. The brain grows and changes throughout our lifetimes.

Illustration: Macmillan Cancer Support 2012

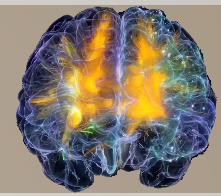
Growing a Grown-up Brain

Scientists have long thought that the human brain was formed in early childhood. But by scanning children's brains with an MRI year after year, they discovered that the brain undergoes radical changes in adolescence. Excess gray matter is pruned out, making brain connections more specialized and efficient. The parts of the brain that control physical movement, vision, and the senses mature first, while the regions in the front that control higher thinking don't finish the pruning process until the early 20s.



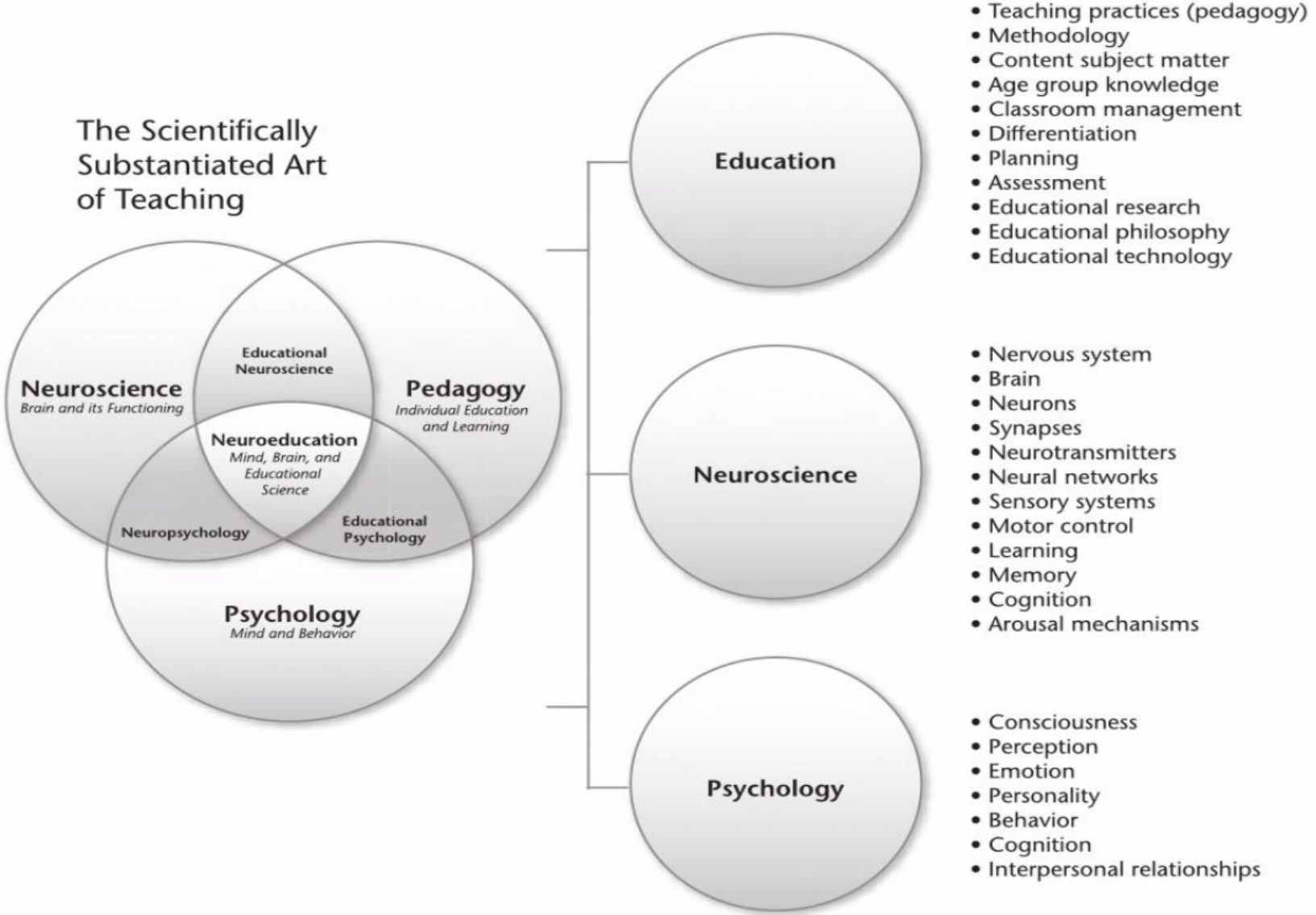


Source: "Dynamic mapping of human cortical development during childhood through early adulthood," Nitin Gogtay et al., *Proceedings of the National Academy of Sciences*, May 25, 2004; California Institute of Technology



Mind, brain and education (MBE)

FIGURE PREFACE.2
Core Knowledge in Mind, Brain, and Education Science



A example of MBE

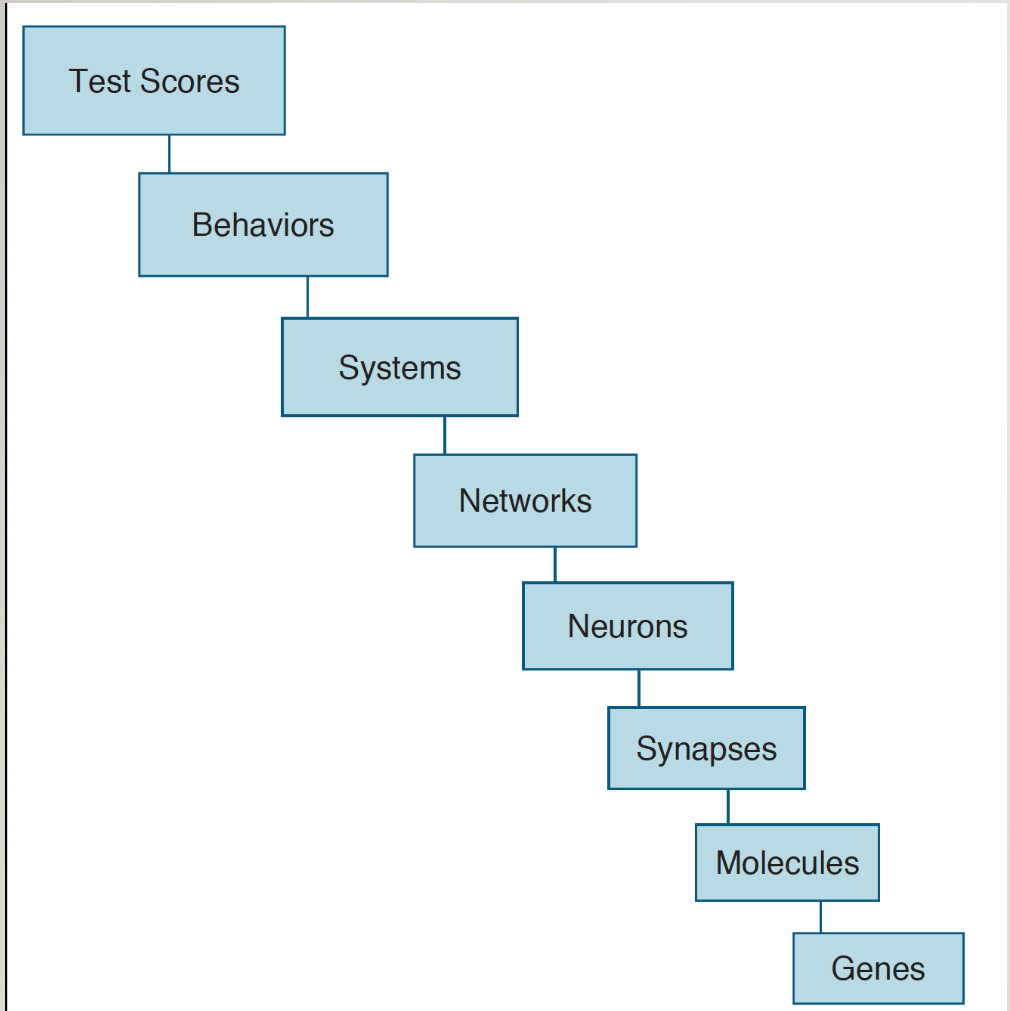


Figure 1. An illustration of the idea of multiple levels of analysis in multiple contexts in both teaching and research in a science of mind, brain, education and learning. Both non-reductionistic translation across levels and each level of analysis itself contribute to an integrated understanding. As a hypothetical example, a student's poor product (test score) might be explicable by inattentive behaviors in the classroom involving attentional systems, particular neural networks and specific neurons in the brain, which can be better understood with additional knowledge about levels of neurotransmitters such as dopamine at crucial synaptic junctions, which can be related both to the classroom environment and to the student's genome. Practitioner-researchers in a science of learning will be multilingual constituents able to integrate and use information across multiple levels of analysis.

Table I. Comparing education and cognitive neuroscience research

	Traditional education research	Traditional cognitive neuroscience research
Goals	Evaluate and improve educational material, methods and pedagogy	Uncover relationships between mind and brain
Methods	Increasing, although not exclusive, emphasis on fully randomized, controlled trials	Noninvasive brain imaging, behavioral and psychophysical measures
	Standardized measures	Experimenter-designed experimental and control tasks
Sample	Increasing pressure to use large sample sizes (100s) ensuring random sampling across a diverse population	Small sample sizes (10–20) owing to constraints of methods and expenses
		Often little demographic information on samples
Setting	Classroom, school, district, or other education setting	Highly controlled laboratory setting
	High ecological validity	Low ecological validity
	Large number of extraneous variables	Small number of extraneous variables

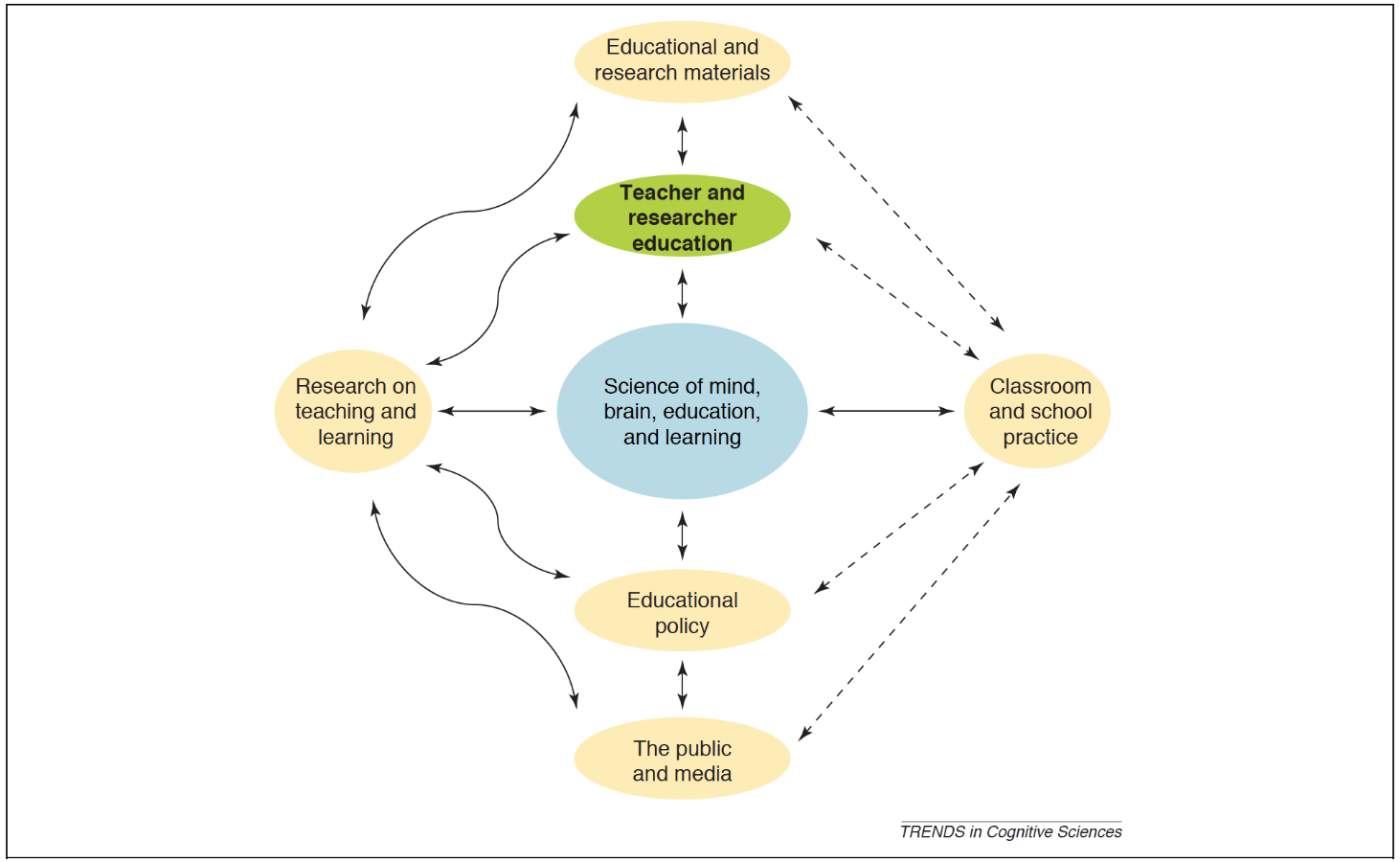
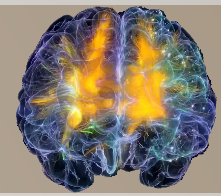


Figure 2. An interdisciplinary science of mind, brain, education and learning will be constructed based on mutual dialogue between researchers of teaching and learning (including but not limited to laboratory, school, classroom and cognitive neuroscience researchers) and educationalists (including but not limited to classroom teachers, aides, specialists and school administrators), amongst other influences. We focus on teacher and researcher education as key to this process of construction; individuals educated within an integrated, multidisciplinary approach will be best suited to build meaningful bridges between the fields of education and cognitive neuroscience. We also focus on research on teaching and learning at different levels and in multiple contexts. Note that all arrows are bidirectional and that some connections are currently more direct (straight, dashed lines) whereas other bridges are less defined (curved, solid lines). Adapted from [47] with permission from the National Academy of Sciences.



The end!