Brain Development in Infancy: A Holistic Perspective

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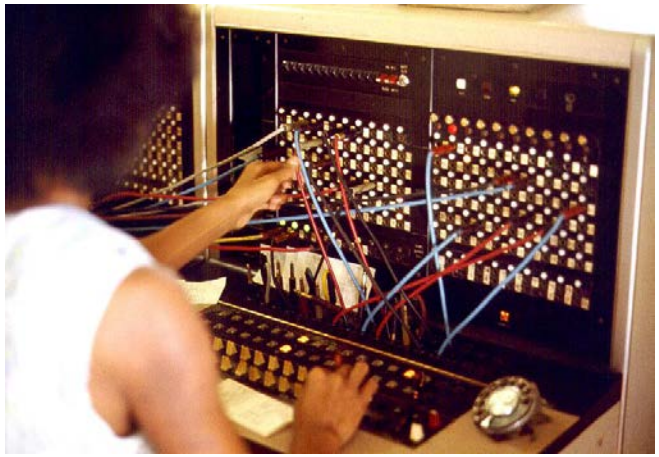
BRAIN FUNCTIONS

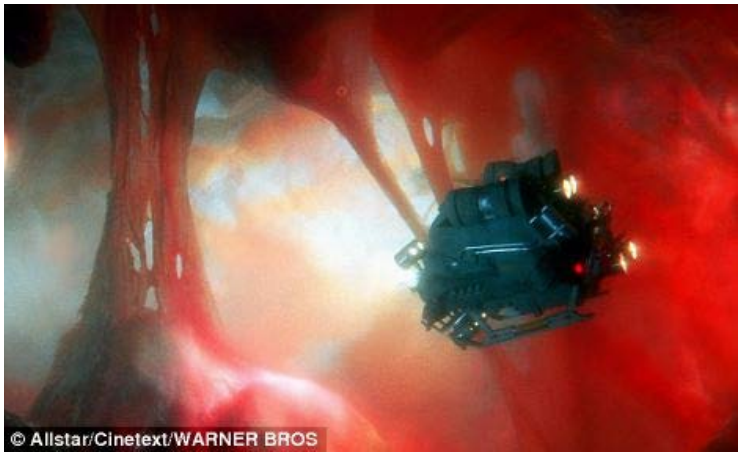
What's normal? How does the brain develop?

How does the brain function?

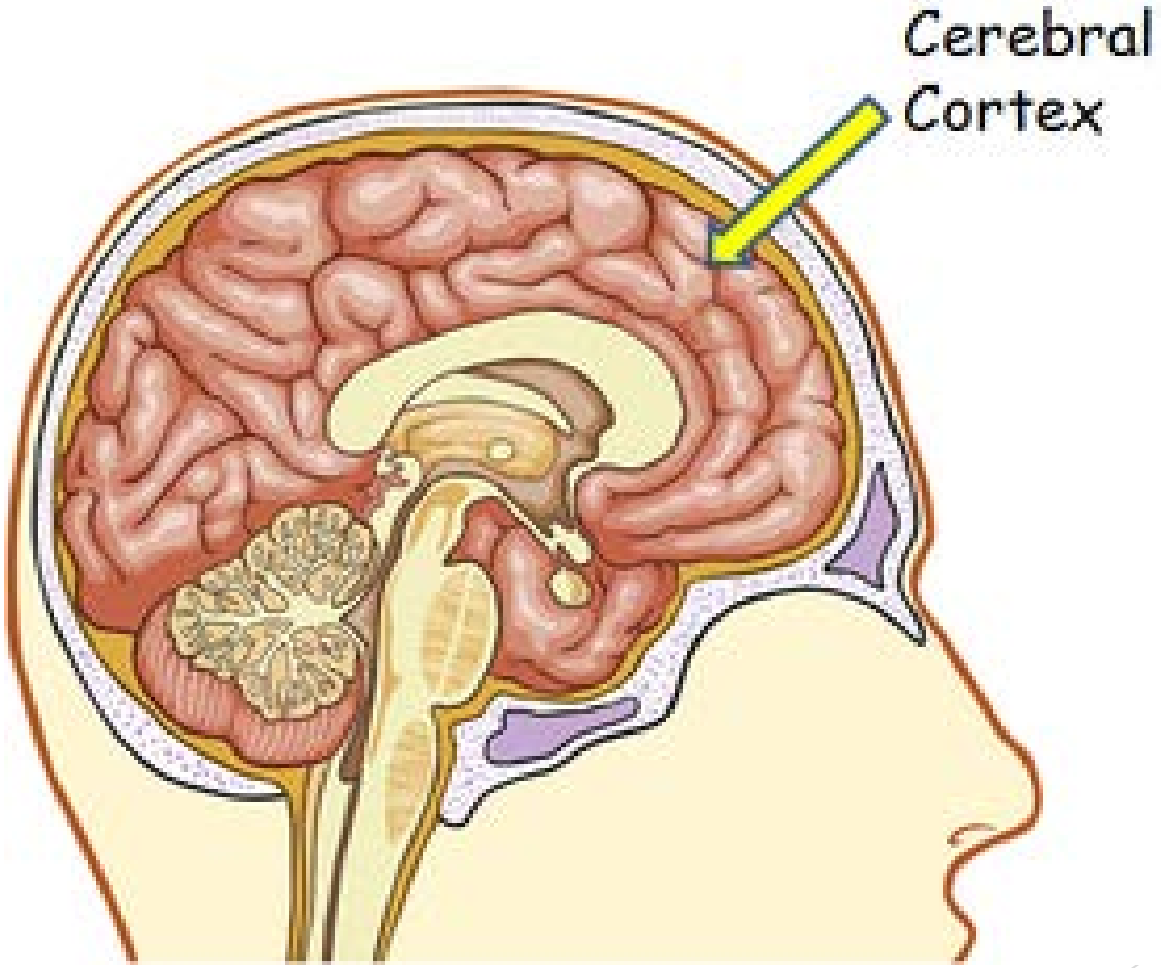
Relay station



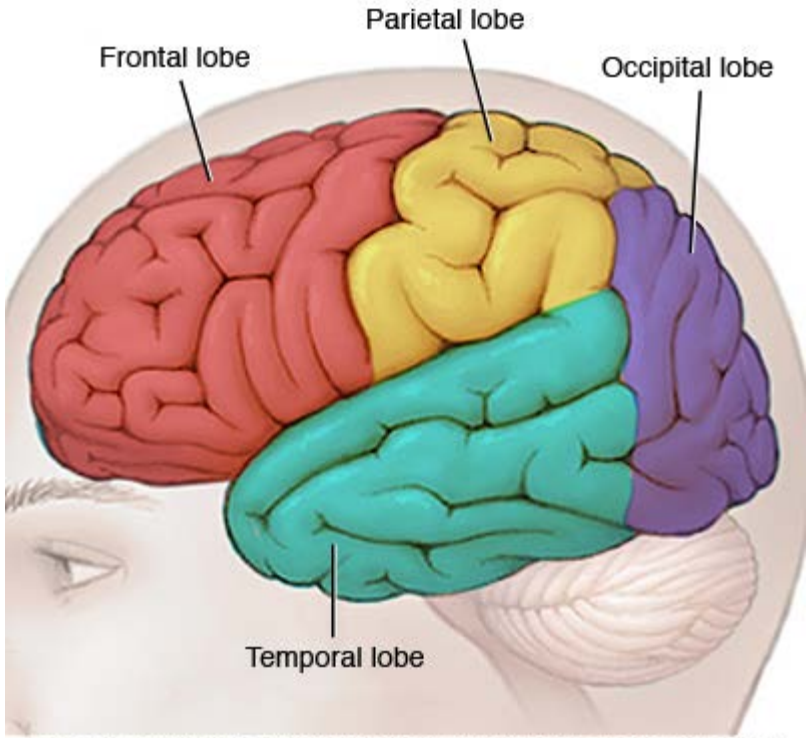
Organs



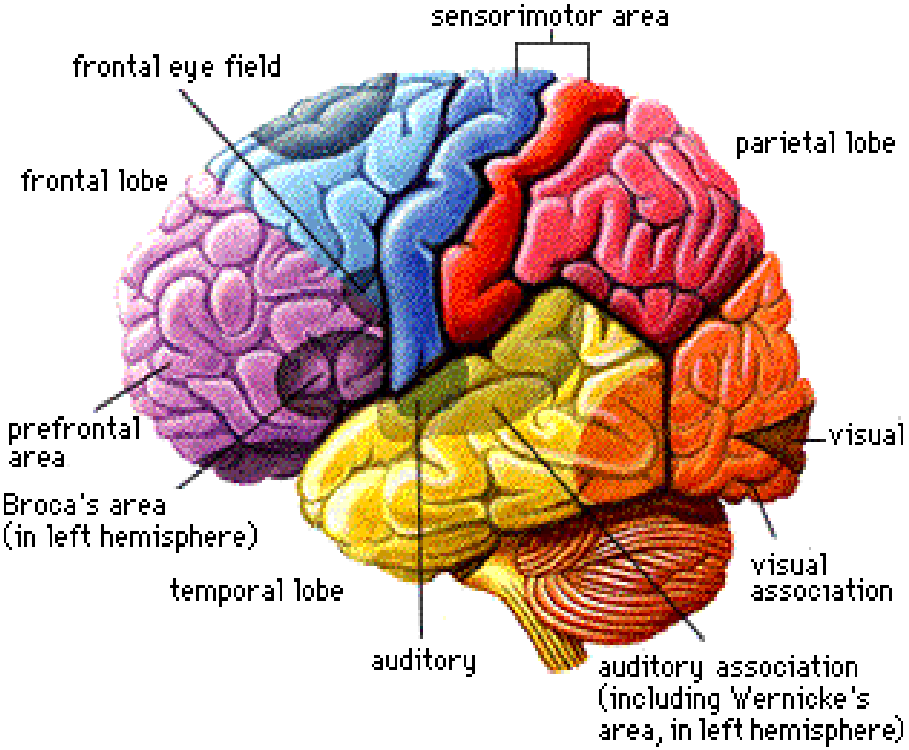
Cerebral Cortex



The Lobes



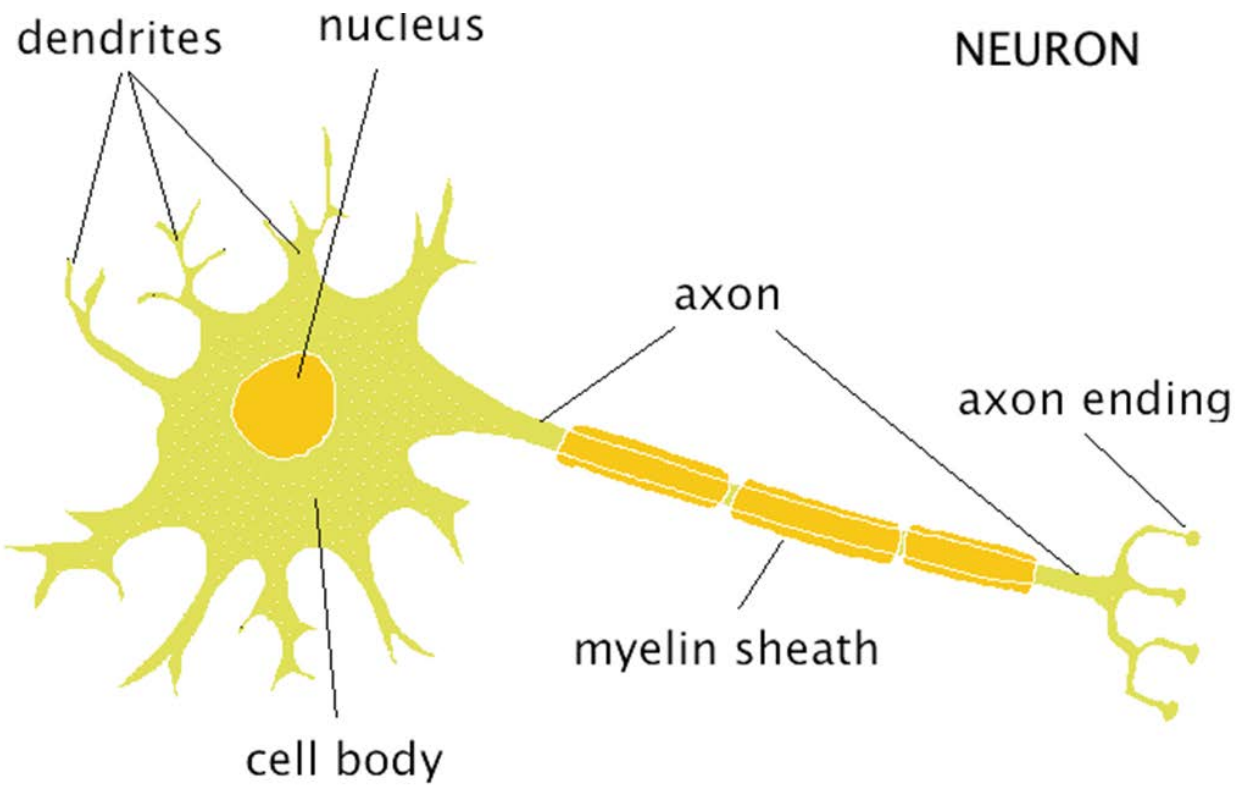
The Brain



http://www.willamette.edu/~gorr/classes/cs449/brain.html

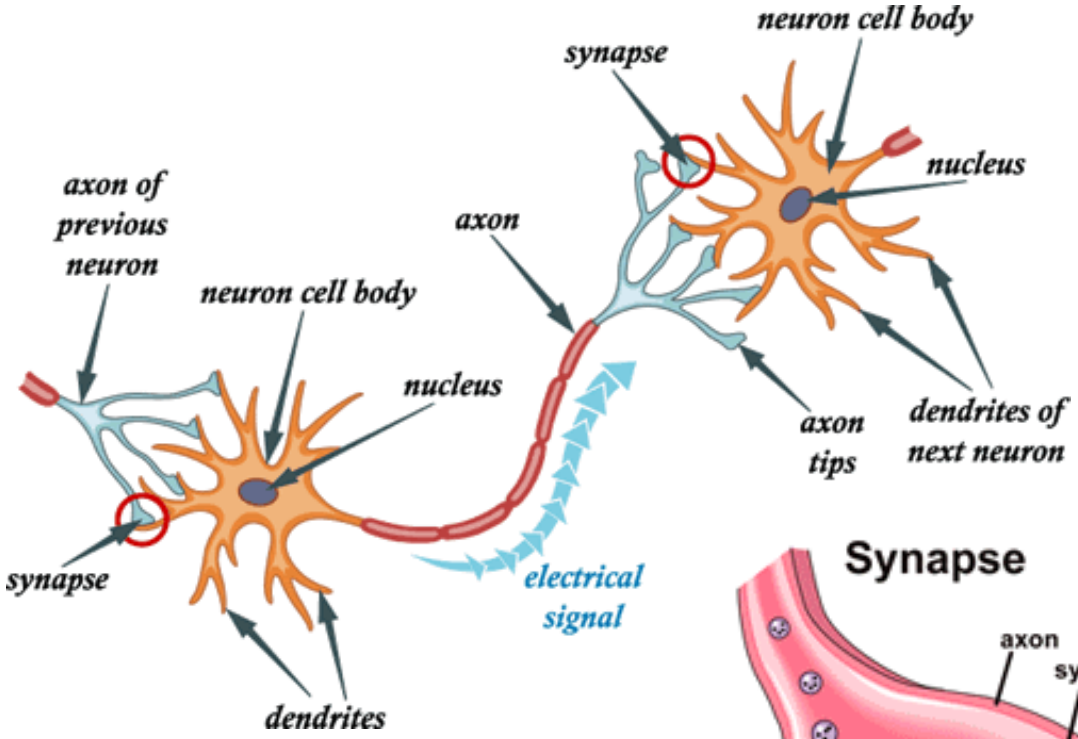
Development of the Brain

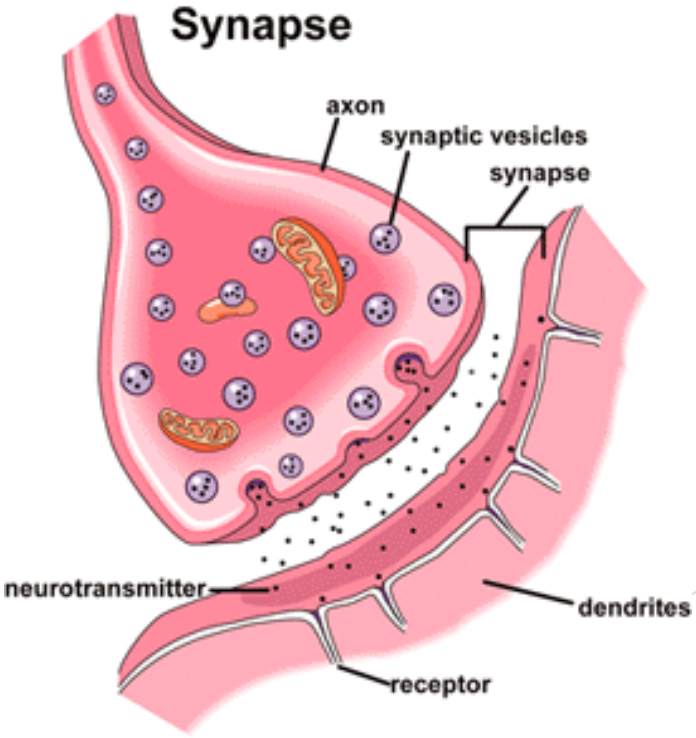
- Wrinkling of the brain
- Frontal lobe not fully developed until late teens/early twenties
- Age 30 – brain begins to shrink due to loss of neurons and reduction of connections b/t neurons
- Cell loss not as extensive as 1st believed
- Some degree of new nerve cells does occur in adult in some regions of the brain

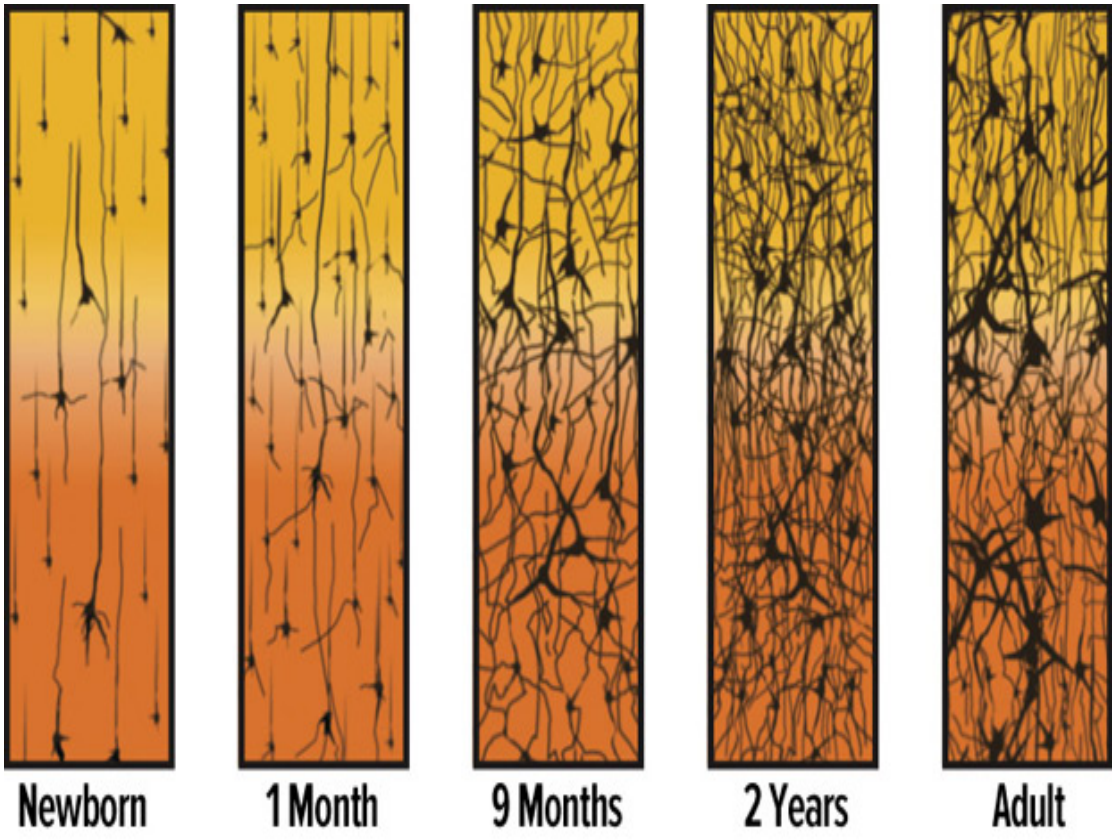


Neurons

Most neurons found in a mature human brain are already present at birth


synapse
neuron cell body
nucleus
axon of previous neuron
axon
neuron cell body
nucleus
axon tips
dendrites of next neuron
synapse
electrical signal
dendrites

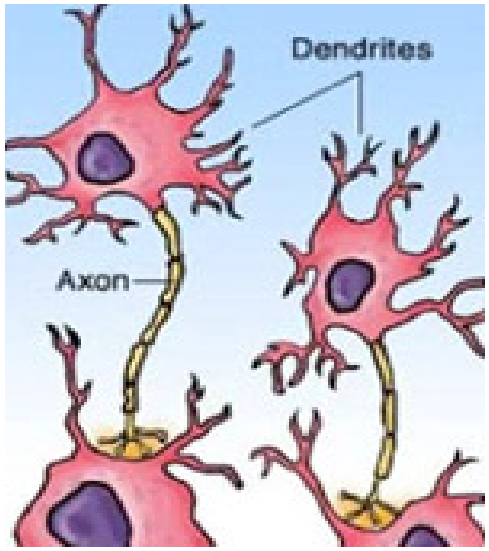

Synapse
axon
synaptic vesicles
synapse
neurotransmitter
dendrites
receptor



Synaptic Pruning

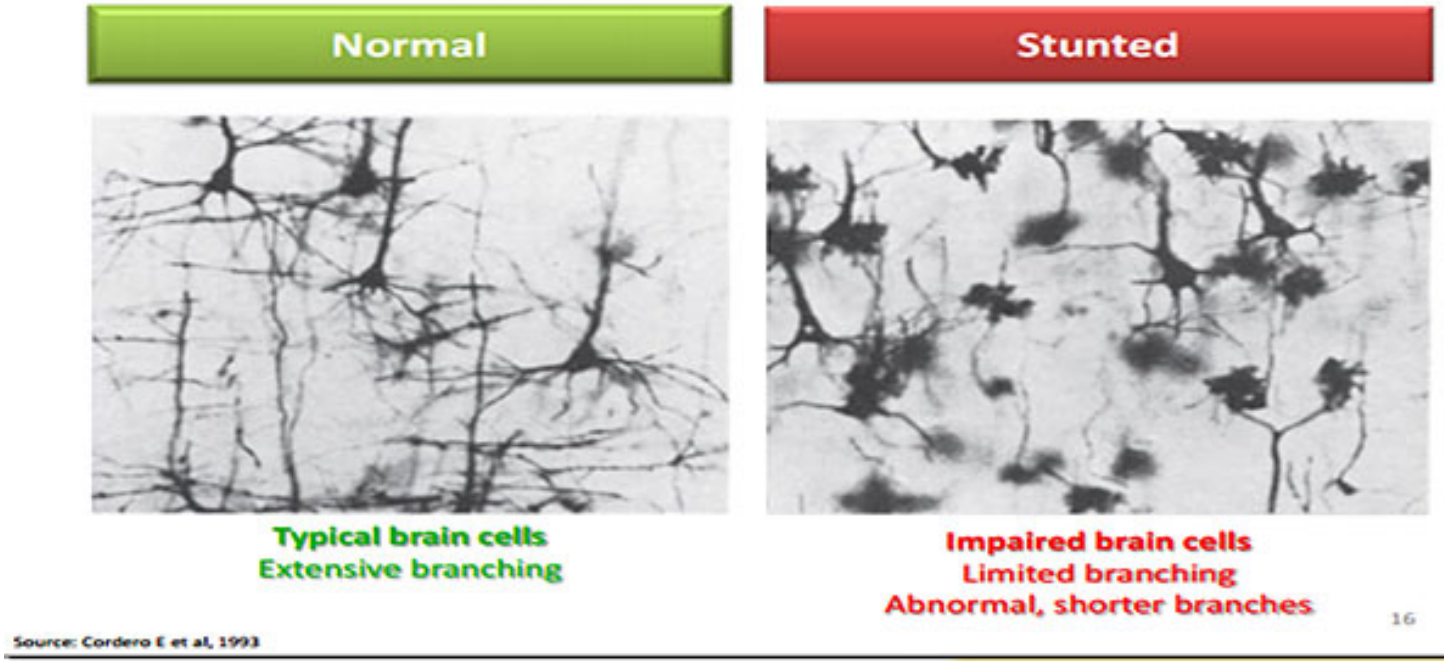
- Number of neurons stays the same but are “immature”
- Significant brain development in cerebral cortex occurs after birth – is due to increase in size of existing cells, growth of new dendrites, and increase in myelination
- Greatest amount of growth occurs w/i 1st two yrs of life, but growth continues into adolescences

Neural Circuits & Connectivity - Is it a Matter of Under-Connectivity?



http://www.whatayear.org/01_08.html

Neural Circuits & Connectivity - Is it a Matter of Under-Connectivity?



http://www.urbanchildinstitute.org/why-0-3/baby-and-brain

Neurotransmitters Involved in Developmental Disabilities

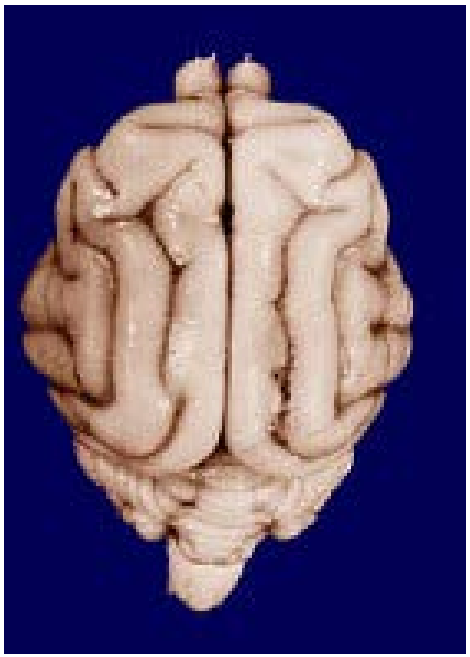
- Norepinephrine – involved in attention
  - Low levels impacts the ability to sustain attention, plan, and organize information
- Dopamine – involved in memory, processing/relaying information, emotional regulation/impulse control
  - Low levels impacts ability to repress urges
  - Involved in motor functions
- Serotonin – involved in emotional regulation
  - Low levels
  - Mood
  - Also related to impulse control and aggression
  - Noise sensitivity
  - Sensory Perception
- Glutamate and GABA
  - Imbalance
  - Low levels of GABA in frontal lobe
  - Abundance of Glutumate – excitatory

Gromisch (2012); Pardo & Eberhart (2007)

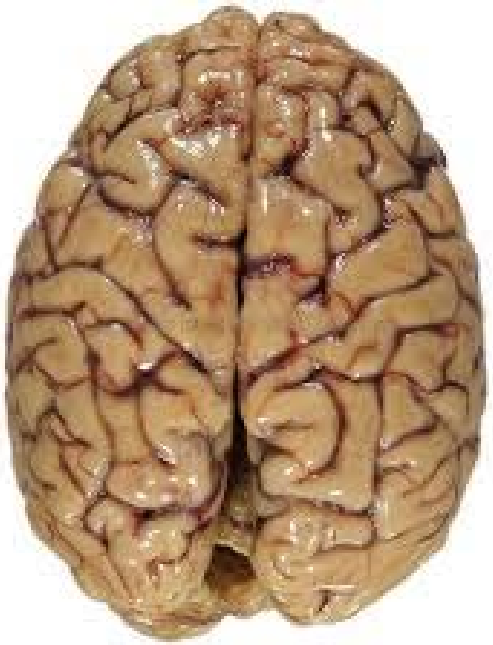
Why do our brains take so long to develop?

What’s the difference?

Cat



Human



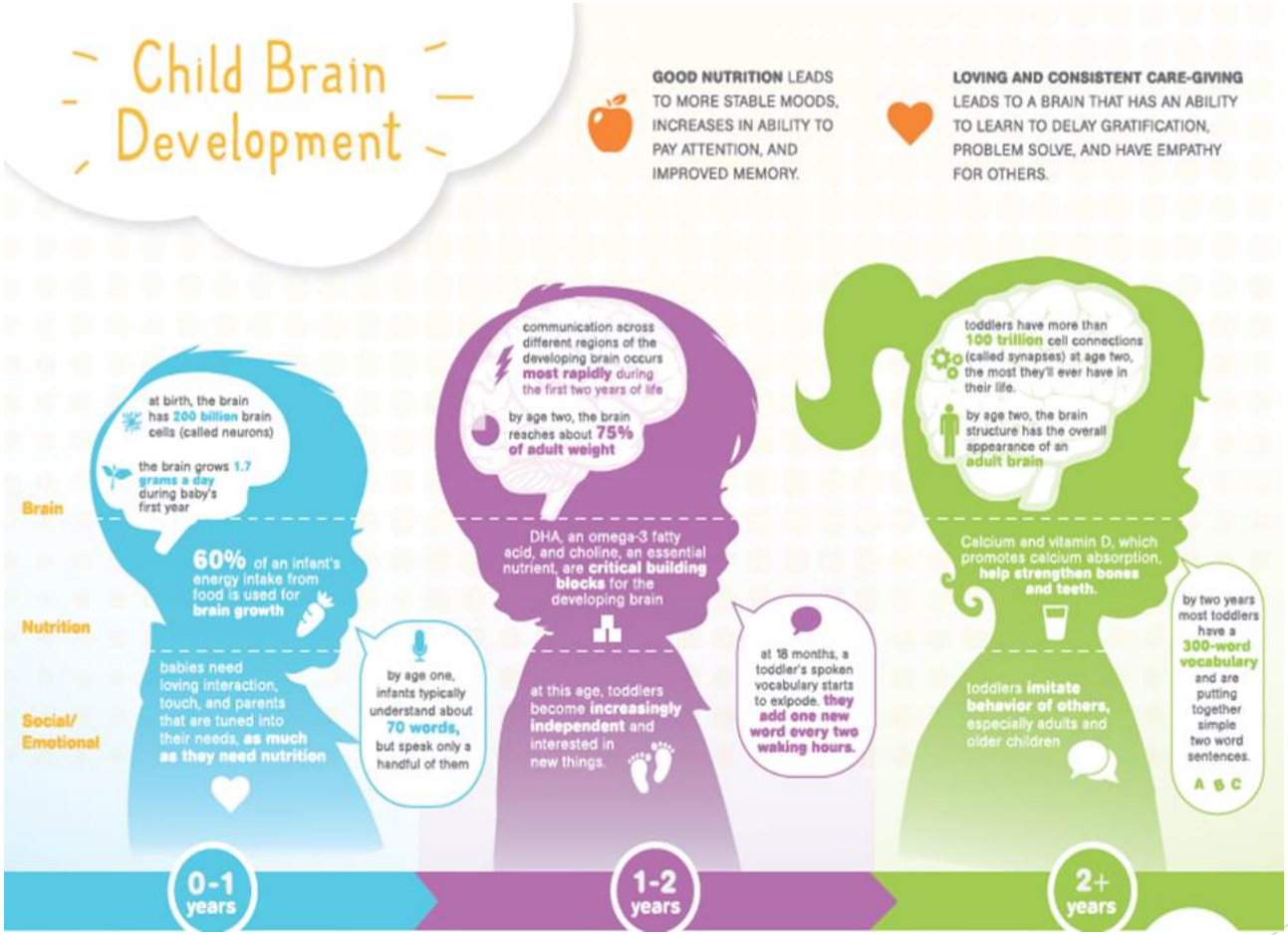
BRAIN SIZE MATTERS

Brain Size Matters

- Early childhood, (1-4yrs of age) is a critical period of brain development
- Head circumference appears normal at birth
- Rapid increase in head circumference growth by 12-months
- Overgrowth in frontal lobe, cerebellum and limbic system
  - 2-4yrs of age
- Enlargement of cerebral volumes (i.e., gray/white matter)
  - Gray matter- cortical thickness
    - Overgrowth seen in early childhood, arrested growth by adolescence
  - White matter – disconnectivity

Hazlett et al., (2005)

Brain Development



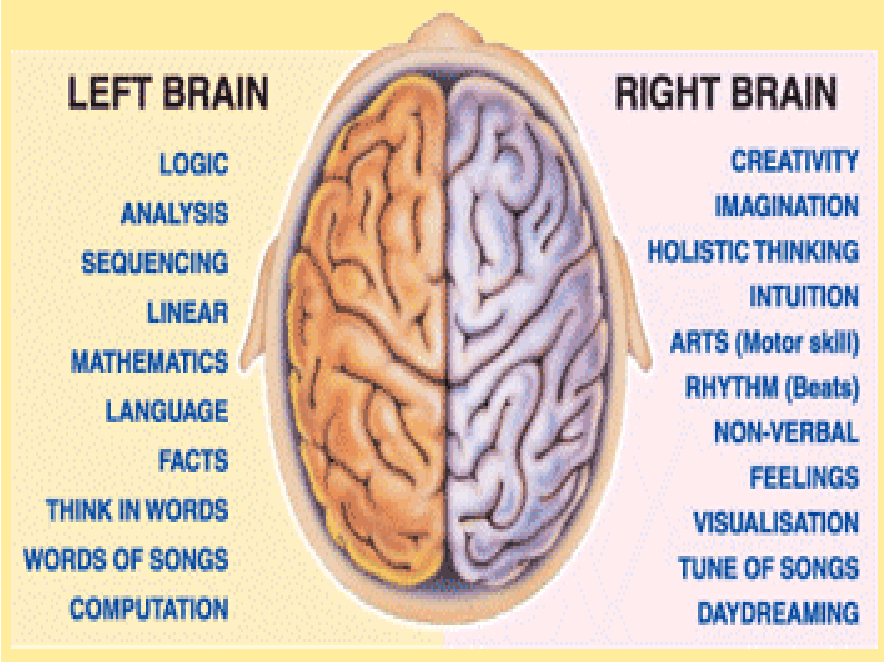
https://jlmadvocacy.files.wordpress.com/2014/10/child-brain-development.png

Brain Size Matters

- Brain Abnormalities seen in Developmental Disorders
- 40% had some abnormality, of which white-matter signal abnormalities, severely dilated Virchow-Robin spaces, and temporal lobe structural abnormalities were the most common
- Microcephaly: 5%-15% = highly predictive of poor outcome
- Macrocephaly: 30% of children with autism- does not strongly correlate with outcome or IQ

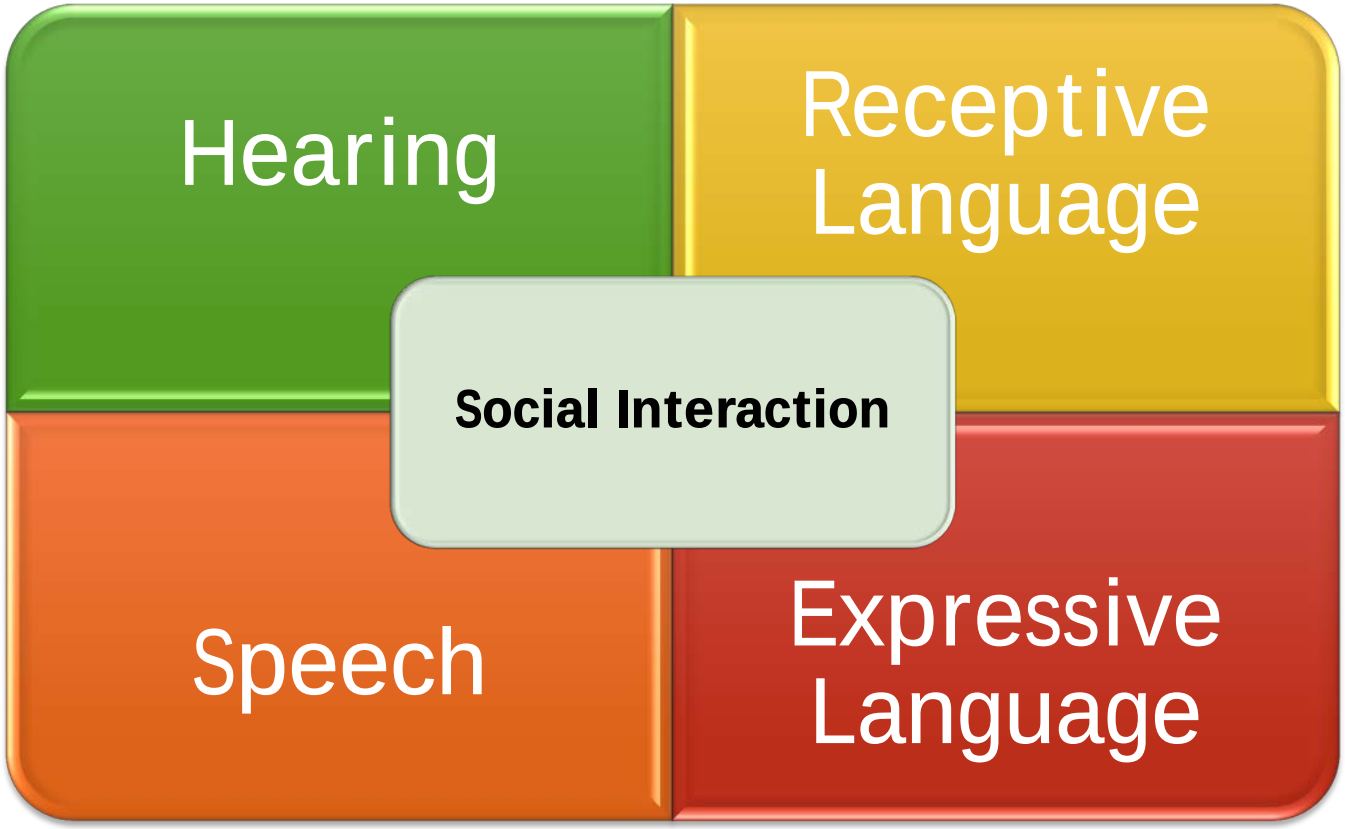
Miles JH, McCathren RB, Stichter J, et al. Autism Spectrum Disorders. 2003 Aug 27 [Updated 2010 Apr 13]. In: Pagon RA, Adam MP, Ardinger HH, et al., editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2016. Available from: http://www.ncbi.nlm.nih.gov/books/NBK1442/

Hemispheric Functions of the Brian

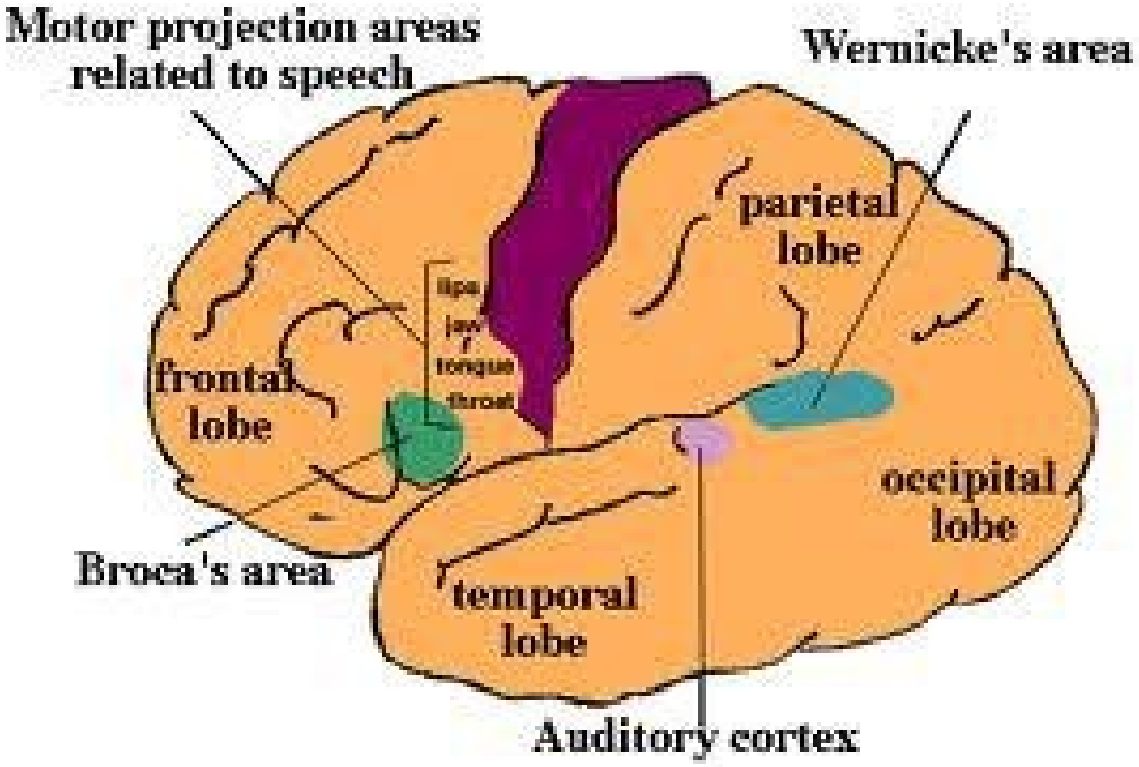


http://pyschologyforallbymichelle.blogspot.com/2010/09/how-our-brians-work.html

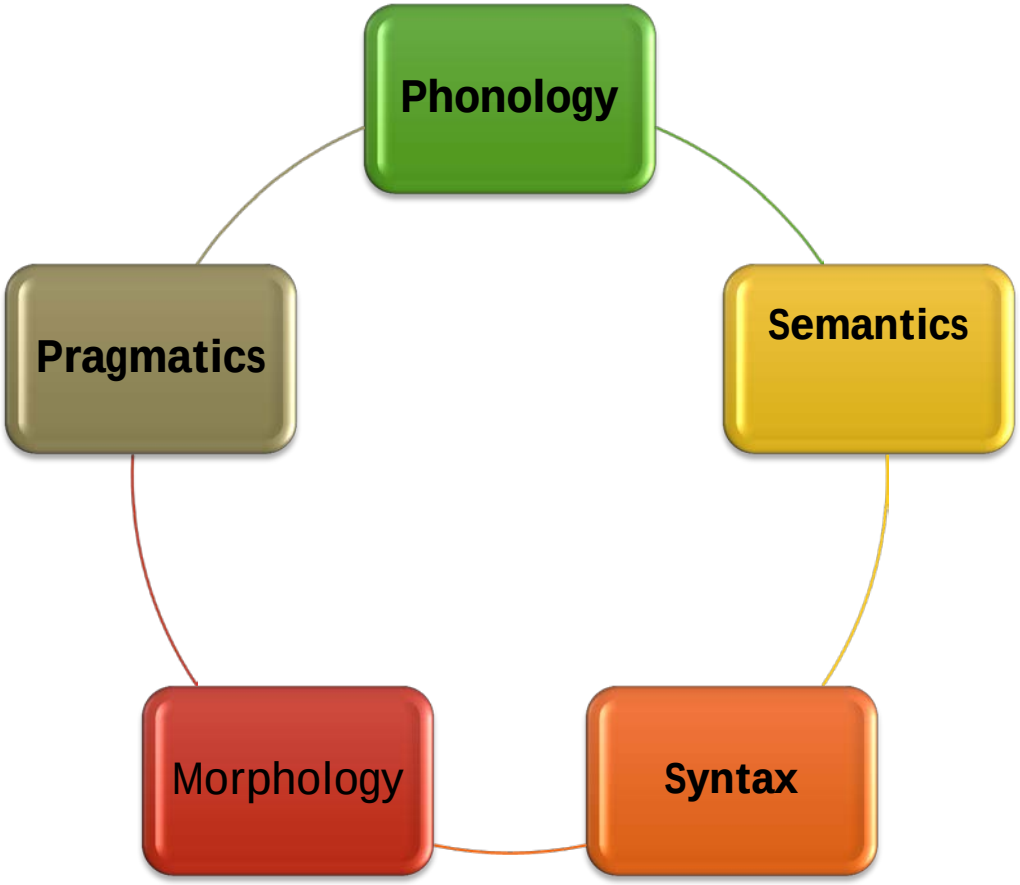
Communication Development



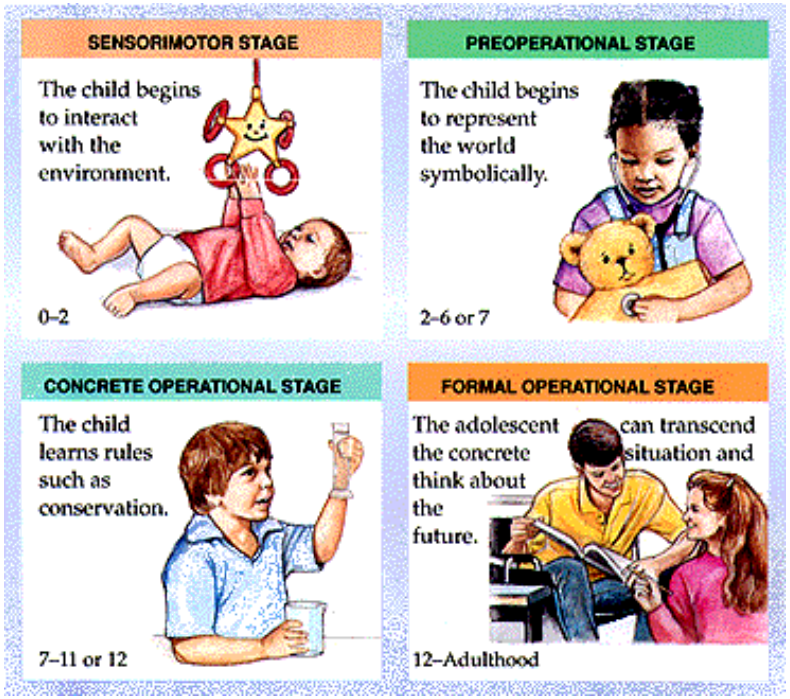
Brain Development: The Seat of Communication



Five Areas of Language



Piaget's Stages of Cognitive Development



https://diyahlaily.wordpress.com/2013/01/07/piagets-theory-about-stages-of-cognitive-development-implication-to-teaching-young-learners/

Milestones

Language

- Points to objects or pictures when named
- Says sentences with two to four words
- Knows names of familiar people and body parts

Cognitive

- Ability to attend to learning task
- Developmentally appropriate attention span ranges

- Age + 1 min (3-6mins)
  - Able to focus his/her attention on one task while being aware of, but not distracted by another's activity.
  - Able to follow age appropriate single or multistep directions independently.
  - Shows interest in age appropriate activities
  - Names common objects
  - Emerging ability in sorting by shape and color

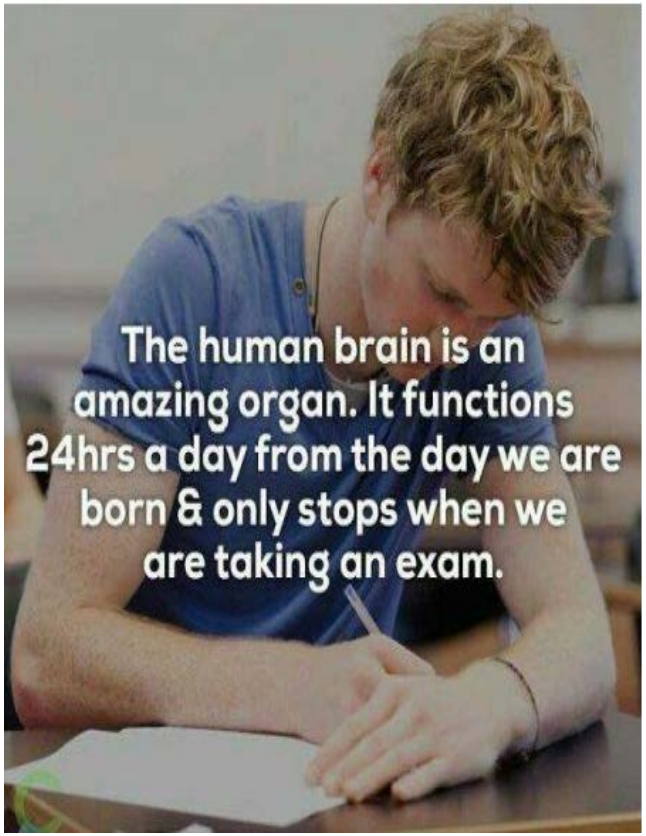
Milestones

- Social-Emotional
  - Greets others/Responds to greetings
  - Initiate social interaction
  - Turn taking
  - Parallel/Cooperative Play
  - Shows concern for others
  - Able to calm self

- Socialization
  - Definition – acquisition of skills through behavior observation of caretakers and peers, and through education

(Spera, 2005)

BRAIN FUNCTION & NEURODEVELOPMENTAL DISORDERS



Prefrontal Cortex & Development Disabilities

- Regulates attention, cognitive control and flexibility, motivation, and emotion
- Hub for Executive Functions
- Projections to other brain regions involved in motor functions and behavior
- Frontal lobe involved with associating rewards with goal-directed behavior.
  - Linked to social orienting deficits

Arnsten & Rubia (2012); Pardo & Eberhart (2007)

Executive Functioning

- Set of mental processes that allow you to manage yourself and resources to engage in goal directed behavior.
- Processes include
  - Shifting
  - Initiating
  - Inhibition
  - Working Memory
  - Planning/Organizing
  - Emotional Regulation
  - Self-Monitoring
- In DD Flexibility and Planning/Organizing are where most difficulties exist

Cooper-Kahn & Dietzel (2008)

Emotions

Self-control

Self & Emotional-Regulation

- Involves Orbitofrontal Cortex and projections to Limbic System (emotional brain)
  - Orbitofrontal cortex – regulation of emotional response to reward and punishment
  - Serotonin primary neurotransmitter in this area
  - DLPFC is involved in the regulation of arousal by receiving info from other areas of the PFC in order to direct attention and memory and to create an action plan

Arnsten & Rubia (2012); Dennis (2010)

Self & Emotional-Regulation

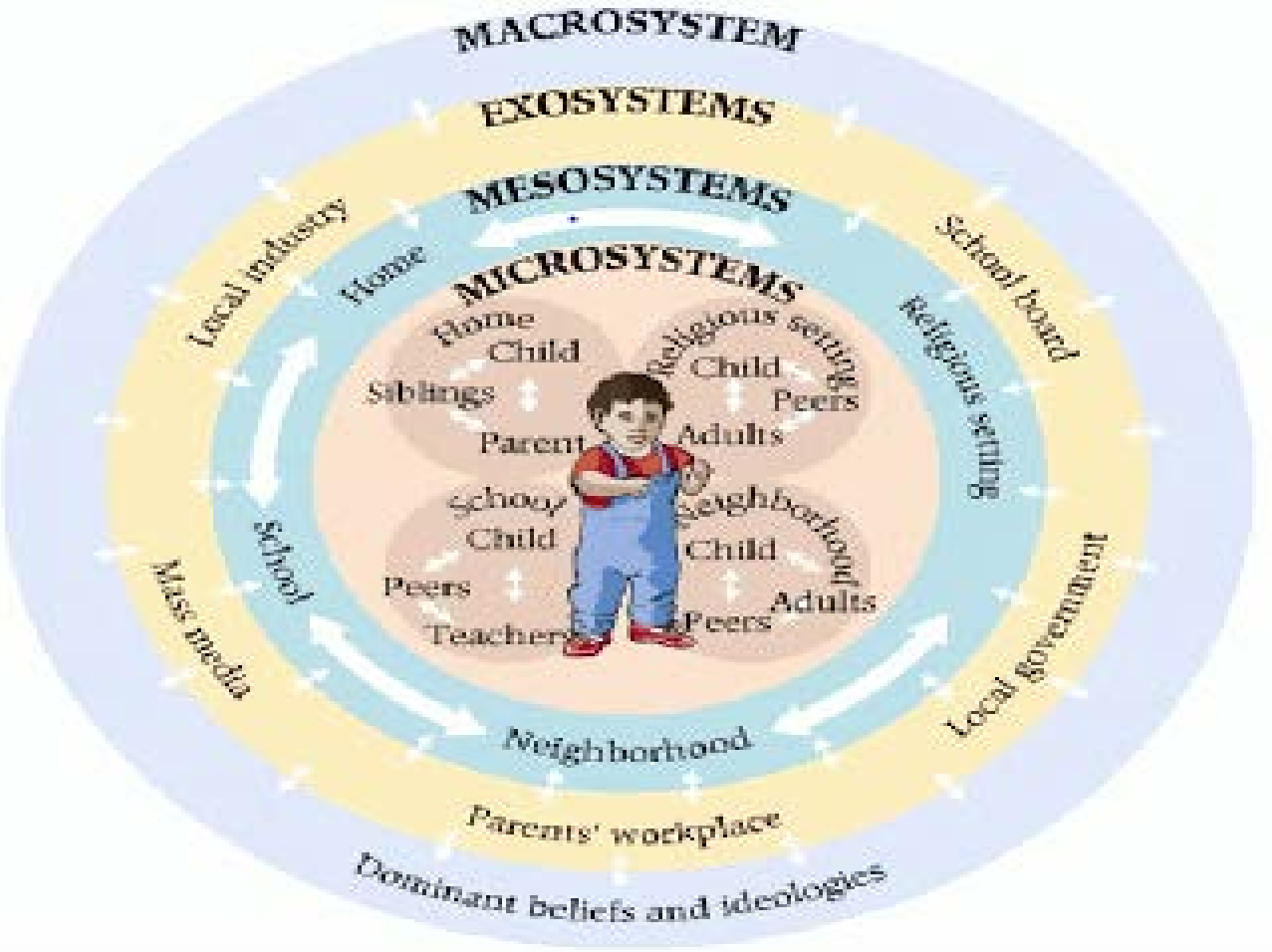
- Define by Barkley (2012) as an self-directed action to produce a change in behavior in order to change an outcome or consequence or attain a goal.
- Behavioral
  - Self-monitoring
  - Intrinsic motivation – unable to induce self-directed motivation for tasks with little payoff.
    - Need immediate reinforcement
- Body – able to monitor and regulate sensory input to regulate output.
- Mind
  - Cognitive Flexibility

Barkley (2012); Etkin, Egner & Kalisch (2011); Barkley (2003)

Self & Emotional Regulation

- Reappraisal – highlights integration of cognition and emotions
  - Adapt to situations and environments
  - In Autism- reappraisal process is impaired because child is not attending to environmental cues resulting in a subjective rather than objective response to event

Contributing Factors: An Ecological Perspective



THE ROLE OF ATTACHMENT IN BRAIN DEVELOPMENT

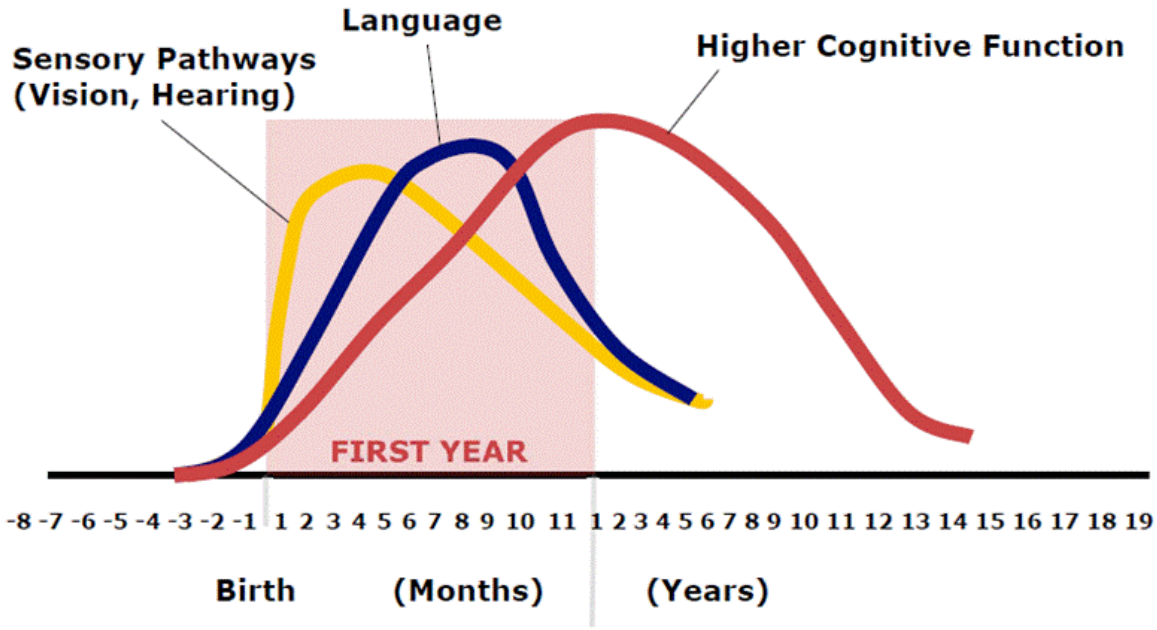
First two years of life is critical in the development of attachment

Center on the Developing Child
HARVARD UNIVERSITY

Human Brain Development

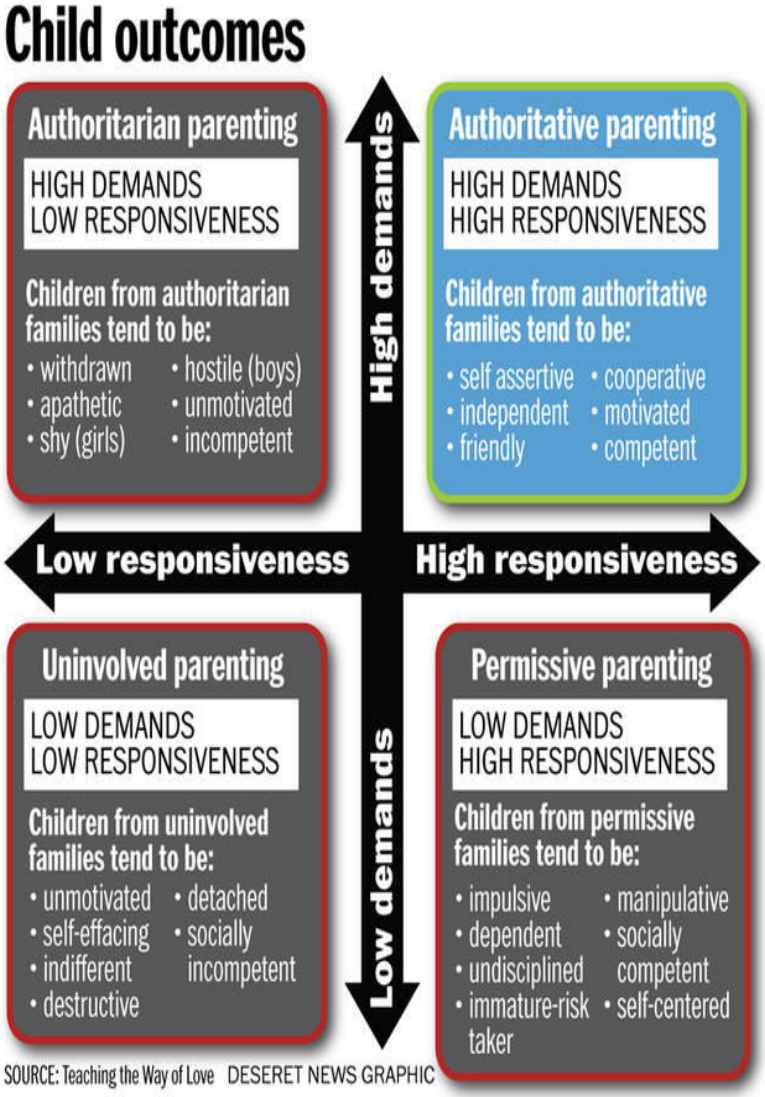
Synapse Formation Dependent on Early Experiences

(700 per second in the early years)



Source: C. Nelson (2000)

Factors that Contribute to Neurodevelopmental Disorders



http://img.deseretnews.com/images/article/graphic/1186587/1186587.jpg

Influence of Parenting and Attachment Styles on Development

Social Learning Theory suggests that people learn by observing other people and attempting to copy their behaviors.

Parents are a social mirror

- Development of Cognitive Schemas
  - Automatic negative thoughts

How we see the world

- External locus of control
- Internal locus of control

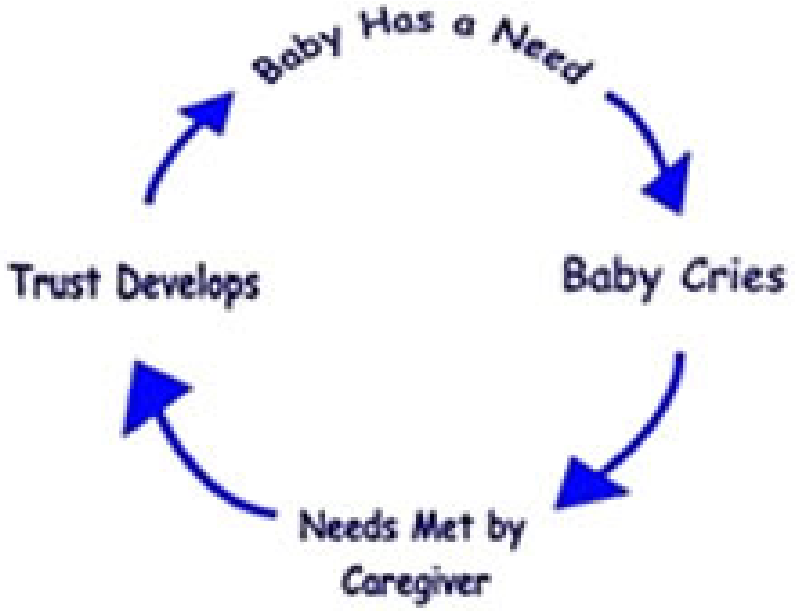
Still Face Experiment- Dr. Edward Tronick

Attachment Patterns

- Secure Attachment
  - Responsive
  - Consistent
  - Positive
  - Needs are met
- Insecure Attachment (avoidant, resistant, disorganized)
  - Inconsistent
  - Abusive
  - neglectful
  - Frustration
  - Needs are not met

Attachment Cycle

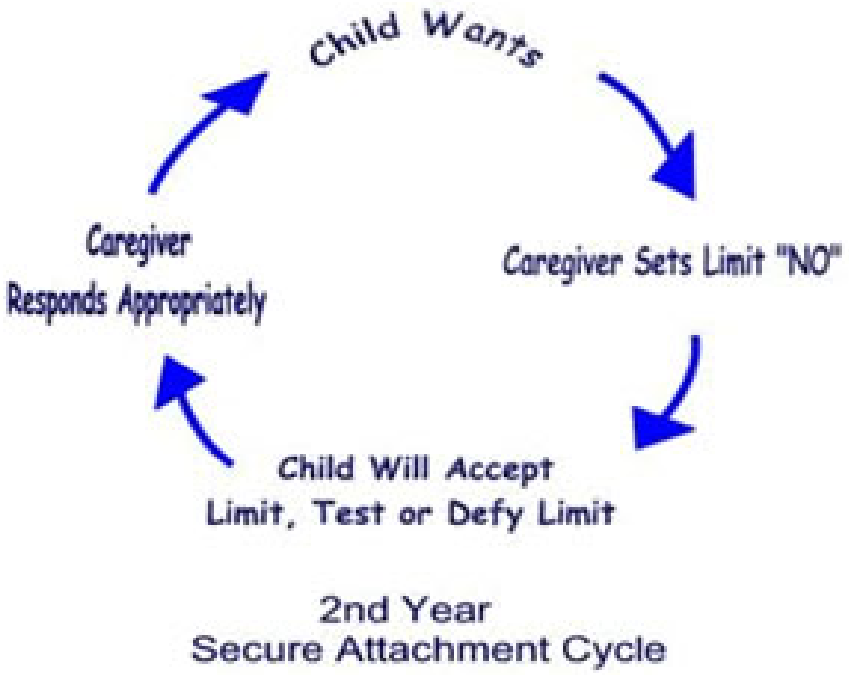
- Healthy Attachment



Healthy Attachment Cycle

Continuation of the Secure Attachment

- 2nd Year



Attachment Cycle Con't

- Disturbed Attachment

Disturbed Attachment Cycle

Signs of Attachment Difficulties

- Sensitivity to rejection and to disruptions in the normally attuned connection between mother and child.
- Avoiding comfort when the child's feelings are hurt, although the child will turn to the parent for comfort when physically hurt.
- Difficulty discussing angry feelings or hurt feelings.
- Over valuing looks, appearances, and clothes.
- Sleep disturbances. Not wanting to sleep alone.
- Precocious independence. A level of independence that is more frequently seen in slightly older children.
- Reticence and anxiety about changes.
- Picking a scabs and sores.

Why do children develop maladaptive attachment patterns?

- Parent's childhood attachment influences their attachment to their child
- Parents who were abused, neglected or abandoned in childhood are more likely to abuse or neglect their children
- Maternal depression is linked to quality of attachment to child
- Temperament of Child

Mills & Allan (1992)

THE ROLE OF ATTACHMENT IN DEVELOPMENTAL, LEARNING, AND BEHAVIORAL PROBLEMS

Effects of Adaptive attachment patterns

- Nurturance
  - Strong growth in brain regions involved in:
    - Learning
    - Memory
    - Stress Response

Belden, Harms, Tillman& Barch (2016)

Effects of Maladaptive attachment patterns

- Children with poor early attachments to parent/caregiver have poor peer and school relations
- Low self-esteem and self-image
- Social and behavior problems
- Develop aggressive behaviors by age 5
- Aggression is linked to later pathology in boys

Mills & Allan (1992);Gauthier et al. (2004)

Effects of maladaptive attachment patterns across development

AGE/STAGE	PARENT'S BEHAVIOR	CHILD'S BEHAVIOR	LATER CONSEQUENCES If Stage Does Not Go Well
Preschool	1. Bonding & attachment behaviors can help with the transition (wooing, cuddling, holding, gazing, feeding).	Magical thinking.	1. Difficulty/ inability to play. 2. Learning problems in school. 3. Shame based identity and magical thinking.

http://www.center4familydevelop.com/phaseschilddevadopt.pdf

Effects of maladaptive attachment patterns across development

AGE/STAGE	PARENT'S BEHAVIOR	CHILD'S BEHAVIOR	LATER CONSEQUENCES If Stage Does Not Go Well
Elementary School	1. Identify current and past positive relationships. 2. Support child's achievements. 3. Build on logical skills and use these to help child cognitively understand past and present.	Development of concrete operational thinking. Empathy develops. Peers become more important. Adaptive Grief Reaction experienced by most adopted children.	• Social skills deficits. • Poor peer relationships. • Acting out during adolescence. • Somatization • Dysthymia and depression. • Eating disorders.

http://www.center4familydevelop.com/phaseschilddevadopt.pdf

Effects of maladaptive attachment patterns across development

AGE/STAGE	PARENT'S BEHAVIOR	CHILD'S BEHAVIOR	LATER CONSEQUENCES If Stage Does Not Go Well
Adolescence	1. Creating a holding environment. 2. Facilitating independence & responsibility. 3. Friend, coach, and mentor.	1. Developing an independent sense of identity. 2. Separation & individuation issues. 3. Development of abstract thinking (formal operations).	1. Anti-social behaviors. 2. Poor relationships. 3. Difficulty finding and keeping employment. 4. Depression.

http://www.center4familydevelop.com/phaseschilddevadopt.pdf

The Role of Attachment in Developmental, Learning, and Behavioral Problems

- Externalizing behaviors
  - Aggression
- Common Disorders
  - Conduct Disorder
  - Oppositional Defiance Disorder
- Internalizing behaviors
  - Withdrawal
- Common Disorders
  - Depression
  - Anxiety

Behavioral and Social-Emotional Intelligence

- Emotional Intelligence – ability to discriminate, label, and recognize emotions to guide our thoughts and actions.
- Executive Functioning
  - Regulation of Attention, Behavior, Emotions
  - Cognitive Flexibility
  - Planning and Organization
  - Memory
  - Shifting

Behavioral and Social-Emotional Intelligence

- External Behaviors
  - Aggression
  - Oppositional Defiance Disorder (ODD)
  - Hyperactivity
- Internalizing
  - Depression
  - Anxiety
- Social Skills
  - Stages of Play
  - Social Pragmatics/Social Communication

Neurodevelopmental Disorders

- DSM V Classification of NDD
  - NDD are classified as…..
- Intellectual Disability
- Global Developmental Delay
- Speech/Language Disorder
- Attention Deficit/Hyperactivity Disorder
- Developmental Coordination Disorder

Diagnostic and statistical manual of mental disorders: DSM-5. (2013). Washington, D.C.: American Psychiatric Association.

Developmental Disabilities

- Categorized as a group of severe chronic conditions due to mental or physical impairments that have a significant impact on an individual's social, occupational and psychological functioning in activities of daily living such as language, mobility, learning, self-help, and independent living.
- Developmental disabilities are diagnosed from birth – 22years of
- Persists throughout the lifespan.

http://www.cdc.gov/NCBDDD/actearly/facts.html.

Prevalence of Developmental Disabilities

Current Prevalence of DDs

- 1 in 6 or 15% of individuals age 3-17 have a developmental disorder
- Of 17% (1.8million) in the prevalence of DD from 1997-2008
- Males were twice as likely to have a diagnosis of DD than females
  - Higher prevalence rates of ADHD,
  - Autism,
  - Learning disabilities

Prevalence rates (1997-2008)

- Learning Disability - 7.66%;
- ADHD- 6.69%;
- Other DD-3.65%;
- Autism was 0.47%

Prevalence rates from 2006-2008

- Autism - 289.5%;
- ADHD - 33.0%; and,
- Hearing loss **decreased** 30.9%

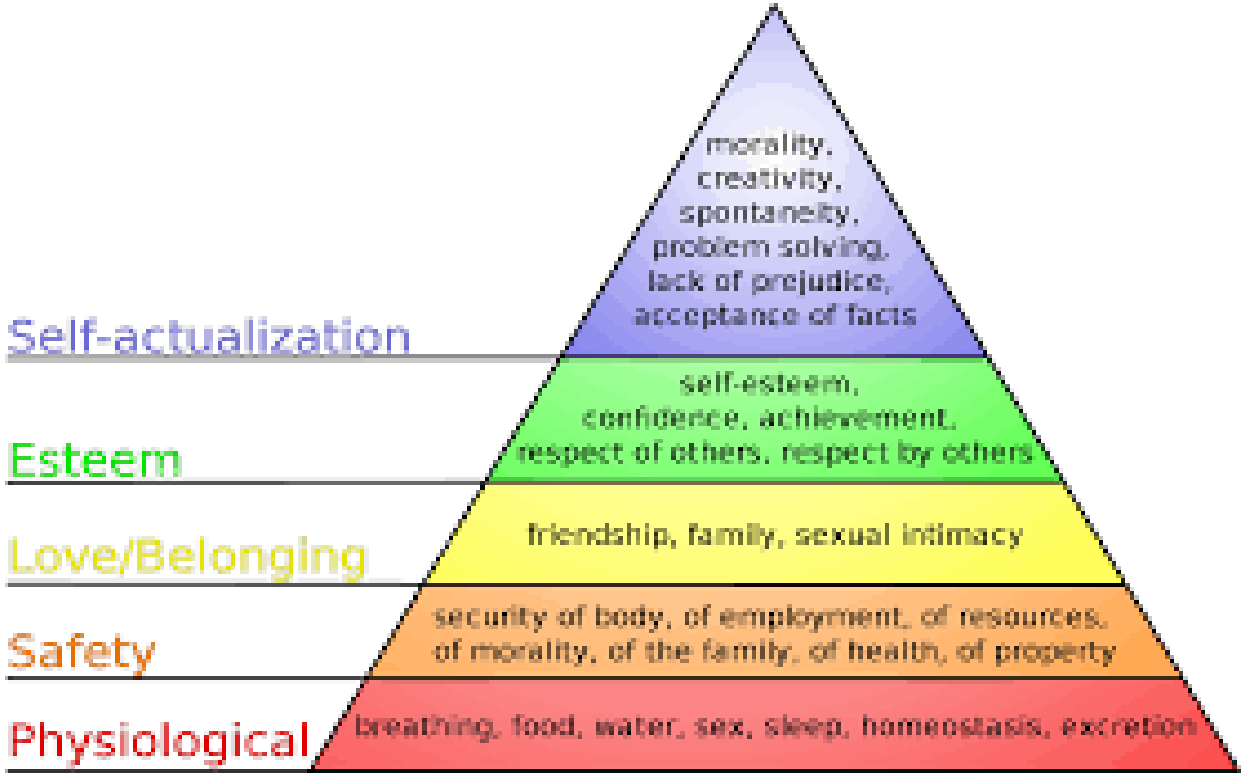
http://www.cdc.gov/NCBDDD/actearly/facts.html

Development and IDEA Classifications

1. DD
2. Autism
3. Deaf-Blindness
4. Deafness
5. Emotional Disturbance;
6. Hearing Impairment (HOH)
7. Intellectual Disability
8. Multiple Disabilities
9. Orthopedic Impairment
10. Other Health Impairment;
11. Specific Learning Disability
12. Speech or Language Impairment
13. Traumatic Brain Injury
14. Visual Impairment (including blindness).

http://idea.ed.gov/explore/view/p/,root,regs,300,A,300%252E8

What We Can Do

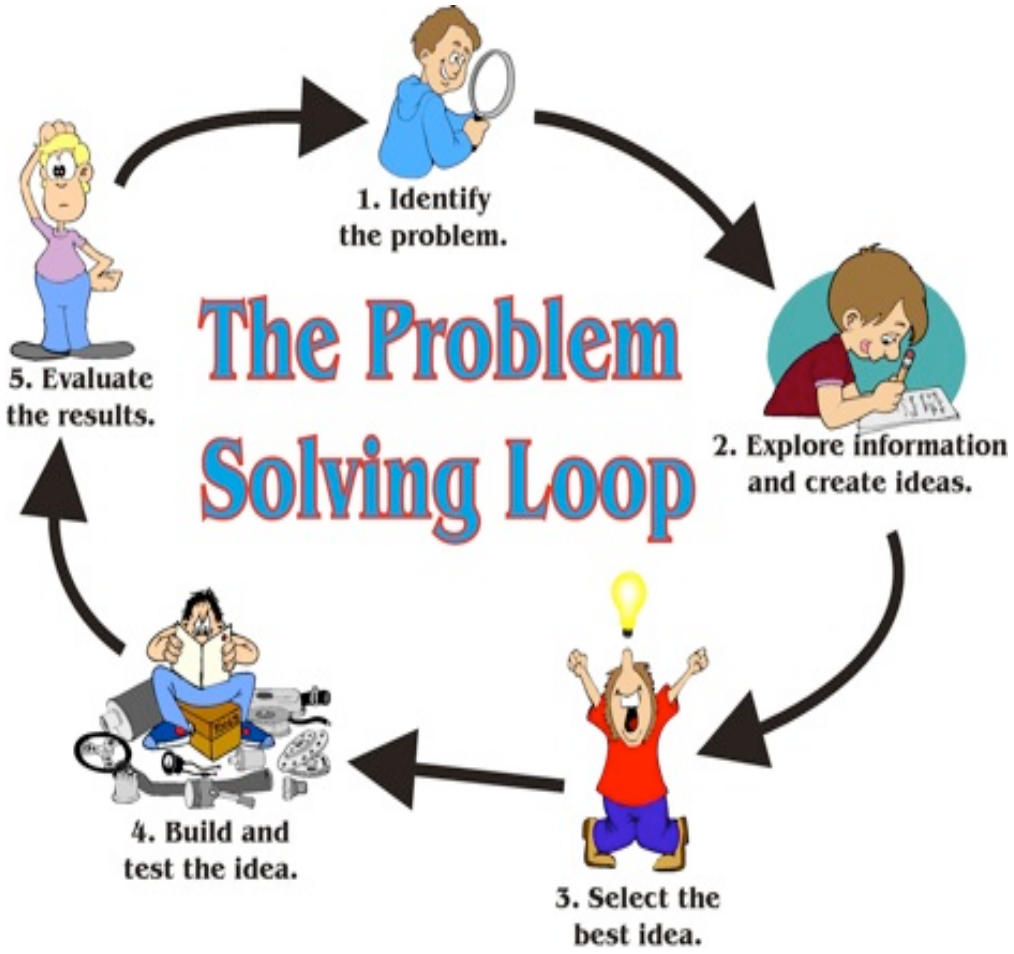


Maslow's Hierarchy of Needs

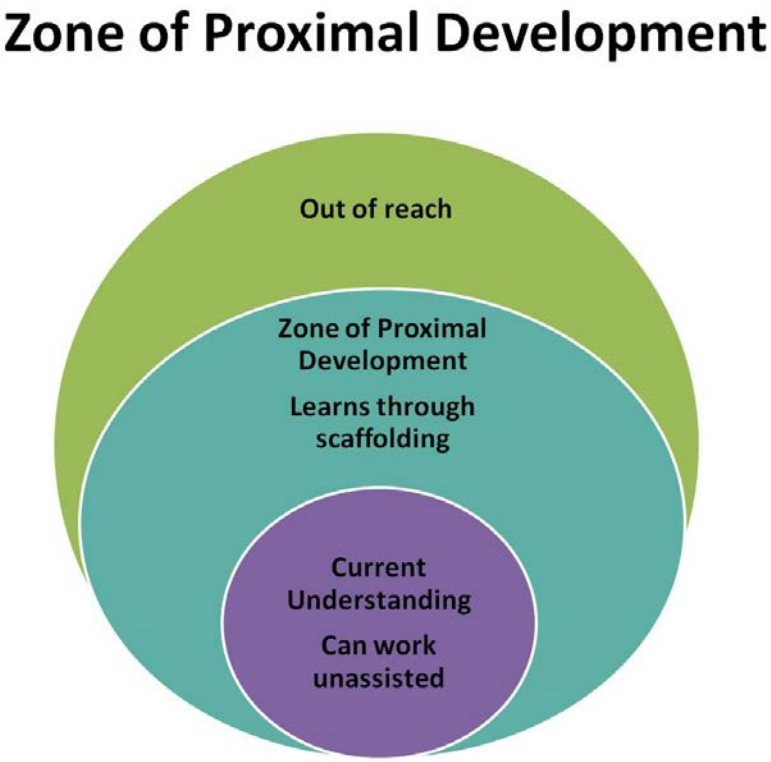
What We Can Do

- Sleep
- Nutrition
- Play
- Nurturing
- Effects of Medication
- Our Own Health

Tiered System

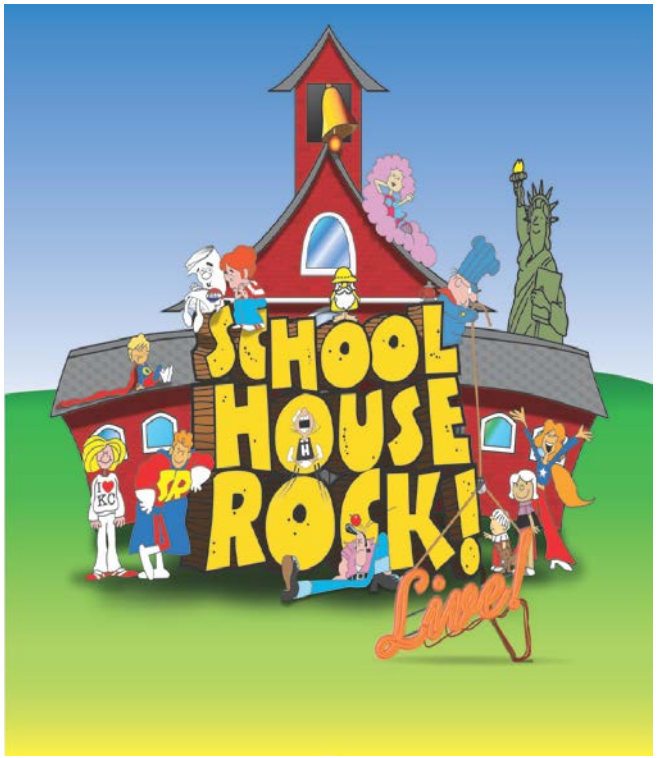


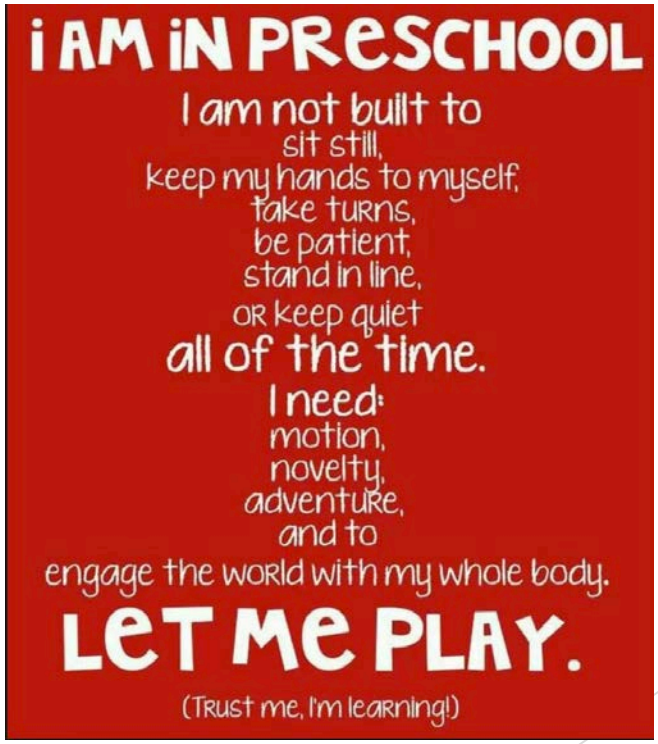
What We Can Do



http://21stcenteducators.blogspot.com/2015/09/zone-of-proximal-development.html

What Can We Do





u46earlychildhood.blogspot.com; http://olathetheatre.org/schoolhouse-rock-live-kicks-off-octa-season/

What We Can Do

Parenting Tips

- **Discipline**
  - **Time out –(children 2-7)**
  - **Child sits in a chair for the duration of time equal to age (i.e. 3-year-old sits for 3mins)**
  - **Child must comply with or complete the task after time out.**
- **Active ignoring**
  - **Ignore behavior you want to decrease**
- **Specific praise & immediate/variable reinforcement**
- **First-then**
- **Time markers & warnings**
- **Two choices**
- **Routines**

What Can We Do

- **Parenting Tips**
  - **•Ensure behavior is not life-threatening**
  - **•Removal of privileges**
  - **•Set reasonable time limit**
  - **•Be consistent in discipline technique**
  - **•Read 123 Magic by Tom Phelan**

Behavioral and Social-Emotional Test Measurements

Objective Rating Scales

- Behavior Assessment Scale for Children (BASC)
- Conners – ADHD
- Behavior Rating Inventory of Executive Functioning (BRIEF)
- Adaptive Behavior Scale (ABAS)
- Gilliam Autism Rating Scale (GARS)
- Childhood Autism Rating Scale (CARS)

Projective Measures (Emotional Functioning)

- House-Tree-Person, Kinetic Family Drawing
- Children Apperception Test (CAT), Thematic Apperception Test (TAT)
- Rorschach

Common Preschool Speech & Language Measures

Language & Vocabulary

- Preschool Language Scales, 5th Edition (PLS-5)
- Clinical Evaluations of Language Fundamentals, 2nd Edition (CELF-P2)
- Peabody Picture Vocabulary Test, 4th Edition (PPVT-4)
- Expressive Vocabulary Test, 2nd Edition (EVT-2)
- Receptive One Word Picture Vocabulary Test, 4th Edition (ROWPVT-4)
- Expressive One Word Picture Vocabulary Test, 4th Edition (EOWPVT-4)

Articulation & Phonology

- Clinical Assessment of Articulation and Phonology, 2nd Edition (CAAP-2)
- Goldman Fristoe Test of Articulation, 3rd Edition (GFTA-3)
- Oral Mechanism Examination

Positives of Early Identification

- Brain rewiring
- Brain plasticity
- Research suggests that the integration of school and social programs that focus on the developmental needs of children is optimal for long term academic achievement and improvement in student's overall behavior.

Perils of Misidentification

- Incorrect services, overly restrictive services
- Pigeon-holed – miss the array
- Medical concerns overlooked
  - Seizures
  - Mental health
  - Psychotropic meds
  - Metabolic - none of 62 persons with PKU who were diagnosed and treated early met diagnostic criteria for autism, whereas two of 35 (5.7%) persons with PKU who were diagnosed late fulfilled the diagnostic criteria for ASD

Miles, J. H. (2011). Autism spectrum disorders—A genetics review. Genetics in Medicine, 13, 278-294. doi:10.1097/GIM.0b013e3181ff67ba

Resources

- Explanation of Categories Under IDEA: http://www.parentcenterhub.org/wp-content/uploads/repo_items/gr3.pd
- Speech-Language Resources: http://www.asha.org
- Understanding the Effects of Maltreatment on Brain Development https://www.childwelfare.gov/pubPDFs/brain_development.pdf

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- www.center4familydevelop.com
- https://jlmadvocacy.files.wordpress.com/2014/10/child-brain-development.png
- **https://www.u46earlychildhood.blogspot.com**

Thank you!

- Questions