Brain Development
Infancy and Early Childhood
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Quiz
- You were born with a predetermined number of brain cells which continually die off through your life.
- The number of brain cells a person has, determines how much the person knows

Brain Facts
- The adult brain weighs only 3 pounds and is the size of a grapefruit.
  - 78% water
  - 10% fat
  - 8% protein

  - It is so soft, you can cut it with a butter knife

Brain Development
- 15 days gestation
  - brain development begins
- Ectoderm
  - Outer layer of cells that will mostly be skin
- 16-20 days-
  - Neural plate forms
- 21-22 days-
  - Neural tube forms
    - Forebrain, Midbrain, Hindbrain

- http://faculty.washington.edu/chudler/dev.html

Prenatal Brain Development
- During prenatal development, 250,000 neurons are added to the brain every minute
  - 50,000 cells are added every second. Scheibel

  - Brain stem develops first, then hindbrain, then midbrain.

Prenatal Brain Development
- Growth and development of the brain are genetically determined
  - Environmental factors will however, play a role from the time of conception (Scheibel, 2002).
The Infant Brain

- 25% of its eventual adult size
  - About 3 pounds

- Already has 100 billion neurons
  - This is twice as many as we need!
  - There are 5-10X as many glial cells

- The most developed region is the brain stem.

- **Synaptogenesis**
  - Formation of synaptic connections during development and their modification by experience are important steps in the wiring of the brain.

**Synaptic connections**

**Brain Anatomy 101**

**Crash Course 😊**

- Two kinds of brain cells
  - **Glial cells**
    - The glue of the brain
    - Makes up 90% of our brain cells
      - Transport nutrients.
      - Substance used for myelination
      - Cleans debris from synapses
  - **Neurons**
    - The brain's workers
    - They have a body!!

**Neurons**
- Dendrites
- Axon
- Cell Body
- Synapse

**Myelinization**
- **Myelin**
  - Fatty substance that insulate axons
  - Increases conduction of nerve impulses from 10-100 times as rapidly as would occur along a non-myelinated axon.

A newborn's neurons lack dendrites, synaptic connections and myelin sheath needed for conducting impulses.
**Synaptogenesis**

**Dendrites**
As dendrite branches multiply, they provide an increasing surface area for (synaptic terminals) from other neurons.

The larger the number of neuronal connections, the higher the possibilities for neural, and therefore, cognitive activity.

**Axons**
Variety of lengths, depending on the “skill” or “activity”

- Imagine the length of those in the lower spinal cord of the center for the “Lakers”

**Pruning**
- Unnecessary connections are eliminated in order to create a more efficient system

- Growth and Pruning is dependent on experience
  - Each time a neural pathway is used, it strengthens
  - It becomes strong enough to be immune to pruning

**Critical Periods of Brain Development**

- There are windows of opportunity
- The most optimal times for specific brain systems to develop

**Myelinization**
- Process has a time table
  - 1-3 months
    - Faster for the sensory tract than motor tract
  - 3-6 months
    - Myelinization of cerebral cortex takes place
  - Last...
    - Prefrontal lobes (executive functions, intentions, future planning) go into adulthood
      - (Scheibel)

**1-3 months**
- Neural connections increase to over 100 trillion
  - Daily verbal interactions
  - Daily physical interactions
  - Routines
    - Feeding, bathing, diaper changes, playing, holding....
3-4 months
- Fine tuning
  - **Parietal**
    - Object recognition
    - Eye-hand coordination
  - **Temporal**
    - Hearing
    - Language
  - **Visual cortex**
    - Focusing for clearer images

6-7 months
- Neural connections develop for sound recognition in the native language
  - Do you want your bottle? Becomes...
    - Do/ you/ want/your/bottle?
      - Wernicke’s Area of Language comprehension
      - Auditory cortex
      - Broca’s Area

8-9 months
- Hippocampus becomes fully developed
  - Memories
  - Emotions

12 months
- Brain consumes twice as much energy as the adult brain
- Prefrontal cortex develops synapses at a rapid rate
  - Forethought and logic

18 months
- Neural connections have increased and strengthened
  - Information transfer is efficient
  - Language explosion takes place
  - Full cortex is involved in language development
  - Toddlers can learn up to 12 words a day (fast mapping)

One Year of Age
- Has a greater density of synaptic connections than the adult brain
  - The smarter we are the more synaptic connections we have.

2 years of age
- Fully wired brains
  - Greater maturity in motor areas
    - Physical ability exceeds common sense
What can we do?

- Shape the environment
  - Attachment
  - Novelty
  - Activity
  - Nutrition

Studies

- Marian Diamond (1998)
  - University of California, Berkeley
    - Studied brain development in rats (40 yrs)
      - Impoverished
        - Food, water, cage
      - Enriched
        - Food, water, cage, toys, wheels, trails and climbing blocks
    - Rats in enriched environments had more dendritic connections, dendrites were also thicker

- William Greenough
  - University of Illinois
    - Same experiment
      - Rats in Rat Disney Land had 25% more connections
      - In four days, dendrite growth was evident as was dendrite death.

- Diamond (1985)
  - Baby rats and mature rats
    - Mature rats dominated and wouldn’t let the baby rats play
      - Only the mature rats grew dendrites
    - It isn’t enough for them to be in the enriched environments, they have to actively interact with it...

- What do we do in our classrooms?

Sprenger, M.1999. Learning and Memory. The Brain in Action. Association for Supervision and Curriculum Development
Craig Ramey, University of Alabama

- Experimental and Control Groups of children 6 months of age
  - Followed for 12 years
  - Experimental
    - Playmates, good nutrition, learning and play opportunities
  - Control
    - Stayed within inner-city impoverished environments

  **Significantly higher IQs in experimental group 12 years later**
  Sprenger, M. 1999. Learning and Memory. The Brain in Action. Association for Supervision and Curriculum Development

IQs of nursing home residents

- People in nursing homes have significantly lower IQs than those waiting to be admitted to nursing homes.

- IQs changed significantly after 6 months in the nursing home.

  Sprenger, M. 1999. Learning and Memory. The Brain in Action. Association for Supervision and Curriculum Development

**Activity**

- Crawl Time
- Studies show impact of motor stimulation on reading, writing, attention
  - 1960
    - 2-year-old had spent an average of 200 hours in a car.
  - Today
    - 2-year-old has spent an estimated 500 hours in a car seat.


**The Visual Brain**

- “Children need a flood of information, a banquet, a feast.” Martha Pierson, Baylor College of Medicine (1996)
- Television is 2 dimensional
- The Brain needs depth
  - Some researchers believe television should be banned for children under 8 years of age.

**Healthy Environments**

- Muddy synapses
- Sleep, Food, Water
  - Dehydration
    - We are thirsty because of a drop in water content in our blood
    - When water drops, salt concentration increases which increases the release of fluid from cells
This raises blood pressure and stress levels
Within 5 minutes of drinking water, there is a decline in corticoids and ACTH (stress hormones)

**Nutrition affects development**

What did we eat?
- 65% of nutrition came from fruits, vegetables, nuts, legumes, and honey

What do we eat now?
- 17% of our nutrition comes from fruits, vegetables, nuts, legumes and honey.

- Modern diet it made up of cereals, grains, milk, dairy products, sugar, fats and alcohol.

**Animal Fat**
- Stunts cell growth
- Promotes poor dendrite growth
- Creates brain short circuits
- Dries up neurotransmitters
- Starves cerebral tissue
  - Impairs learning

**Omega-6**
- Inflammatory affect on neurons
- It lights a fire throughout the brain
- Foods with Omega-6
  - Processed foods
  - Vegetable oils (corn, safflower, sunflower)
  - Pastries and baked goods

**Omega-3 Fats (fish)**
Mackerel, herring, sardines, salmon, white tuna, swordfish, haddock
- Keep cells soft and flexible
- Improves memory
- Regulate serotonin levels
- Is ADD an Omega-3 deficiency?
- Is Dyslexia an Omega-3 deficiency?

**Glucose**
- The Smart Drug (Blood Sugar)
  - Energy
  - Good mood
  - Concentration
  - Memory
Vitamins

Can they raise the IQ?

“It’s not that vitamins increase intelligence. It’s that a poor diet lowers performance on intelligence tests”

Vitamin C

- The brain saver
- The smart pill
- It can directly influence electrical impulses, the synthesis of and release of neurotransmitters

  - citrus fruits, broccoli, tomatoes, melons, dark green leafy vegetables, cabbage, strawberries, potatoes

Thiamin

- Is known to control mood

- Overall brain improvement
  - Study on children
    - Increase in reaction time, intelligence, visual acuity and memory

  - pork, organ meats, legumes, nuts, whole grains, enriched cereal

Where do we go from here?

References


Website: