Brain Resource Creation Workshop: Chapter 8 - Adult and Aging Brain

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The Adult Brain

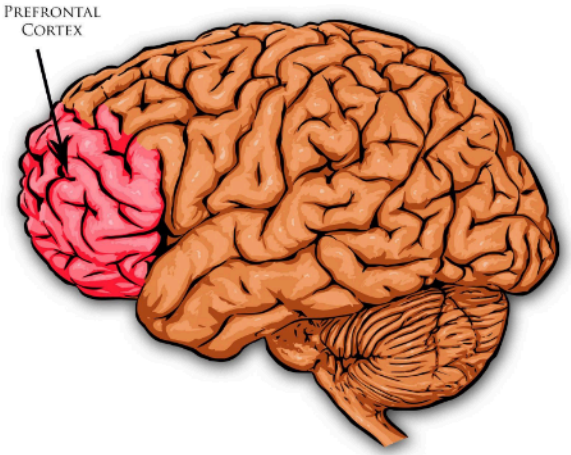
Transition from Childhood to adulthood:

- Gray matter decreases meaning that excess neurons and synapses are reduced
- Some brain regions become stronger
- White matter increases meaning that more nerve tracts are becoming wrapped in myelin
    - Age 40 is usually the maximum age for the highest amount of white matter
    - Distant separated areas of brain connect and execute a function together

The Adult Brain

Prefrontal Cortex (PFC):

- The anterior area of the frontal lobe
- Involved in higher, advanced level functions
  - Problem solving, decision making, etc.
- Prevents immediate impulses to incite more proper responses
- More cognitive control means a less emotionally based decision-making process (unlike adolescents)



The Adult Brain

Intelligence:

- Peaks between ages 25-60
- Fluid intelligence: problem solving and pattern identification abilities
  - Peaks at approximately age 30
- Crystallized intelligence: factual knowledge and memorization
  - Peaks at approximately age 50

What is Aging?

Aging:

- Defined as the long process that is determined by the strength of a person's physical and neurological health
  - Increases risk of disease like dementia which harms daily functions
- Normal aging: comprised of decline in memory and cognitive functions
  - Becomes a separate disease process in brains that are aging

What is Aging?

Aging:

- Aging is inevitable, dementia and disability aren't
- Variety of aging processes cause shape changes in...
  - Brain structure, chemistry, midlife functions
- Healthy Aging: support cognitive health throughout life through nutrition

How the Brain Changes

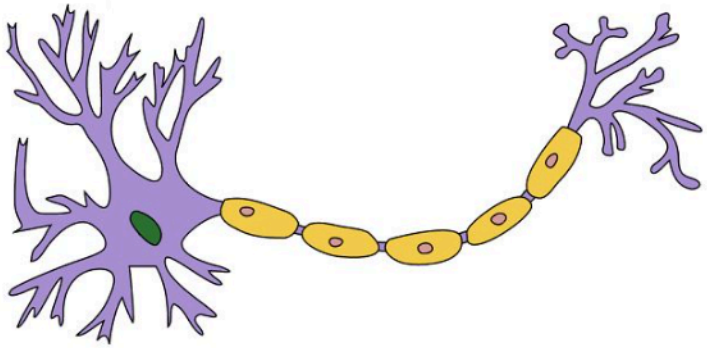
Cognitive Changes:

- Working memory: capability of holding a mode of information and manipulating it
  - For example: phone number is stated as you dial
- Working memory depends on processing new information quickly
  - Not stored knowledge
- Selective attention: brain focuses on the stimulus and filters distractions
- Divided Attention: multitask
  - For example: holding conversations while driving

How the Brain Changes

Structural Changes:

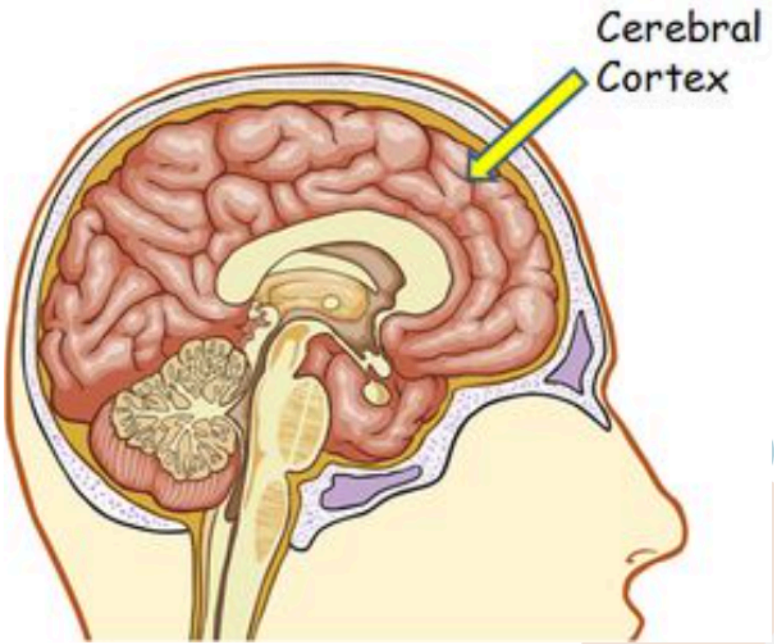
- Prefrontal cortex, cerebellum, and hippocampus decrease in volume with age
  - Large masses of volume in midlife
- Individual neurons are changed, causing a lowering of volume
- Caused by neuron shrinking during adulthood, reduction of dendrites complexity, and myelin loss



How the Brain Changes

Structural Changes:

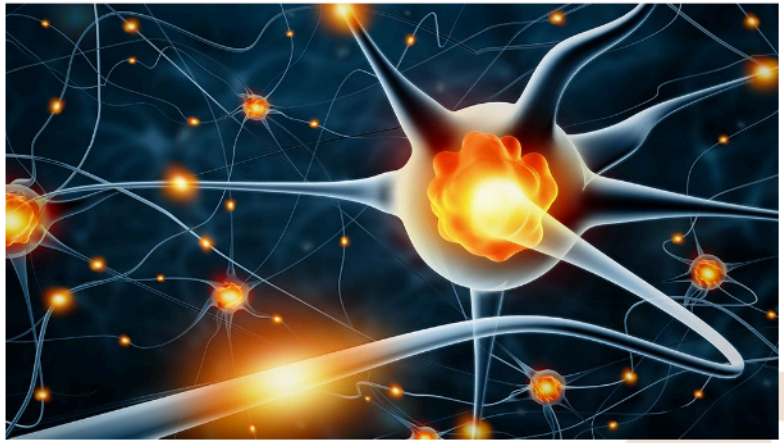
- Cerebral cortex, the outside brain layer that has neuron cell bodies, thins as one gets older
- Cortical Thinning: similar pattern to volume loss
  - Thinning pronounced in frontal lobes and partially in temporal lobes
- "Last in, first out" theory: last parts of brain to develop are first to deteriorate



How the Brain Changes

Neuronal Changes:

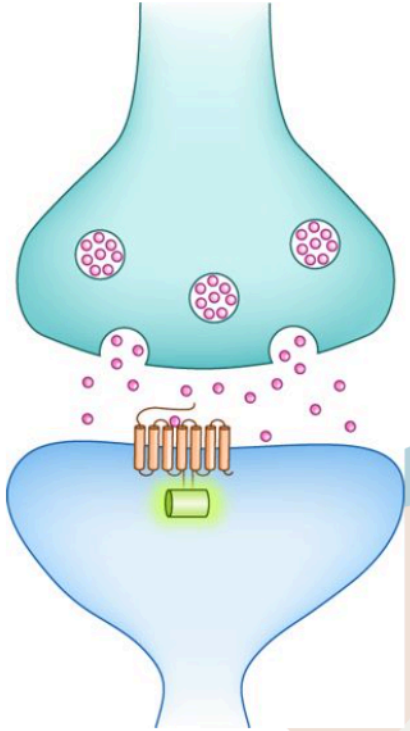
- In the prefrontal cortex and hippocampus...
  - Dendrites shrink with age and their branches lose complexity
  - Loss of dendritic spines (receives chemical signals)
- Thin spines: small, slender structures that the aging process targets
  - Loss of thin spines with dendrites could impede communication
- Neurogenesis, neuron formation, declines with age



How the Brain Changes

Chemical Changes:

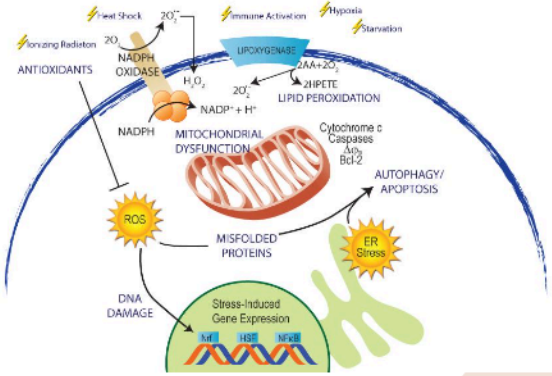
- Number of neurotransmitters declines with age
- Less receptors bind to neurotransmitters because less dopamine is synthesized
- Serotonin may decline with age



Why does the brain age?

Oxidative Stress and DNA Damage:

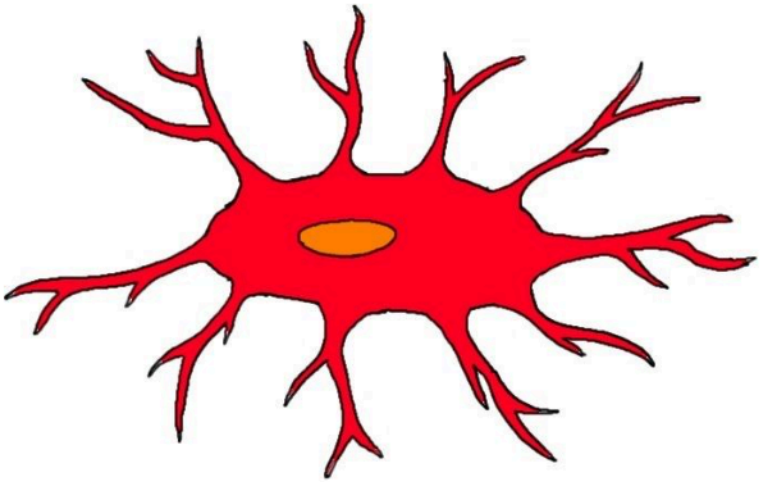
- Mitochondria: carries out chemical reactions in cell that provide energy
  - Metabolic reactions can make harmful products -> Free Radicals
  - Could destroy fats, DNA, and proteins
- Body defense mechanisms that neutralize free radicals declines as one age
  - Vulnerability to oxidative damage increases
- Alzheimer's disease increases oxidative damage within the brain



Why does the brain age?

Immune Dysfunction:

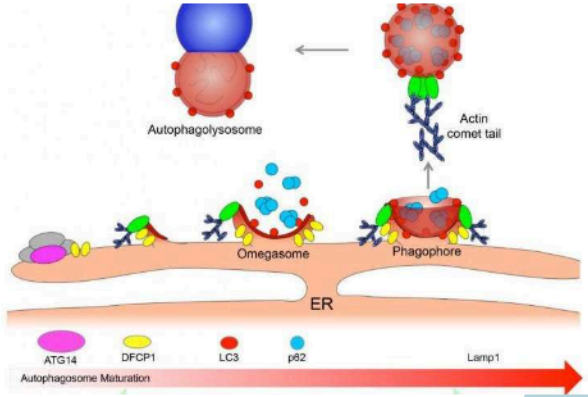
- Microglia (immune cells): defend against pathogens, clean up cellular debris, maintain snypases
- Responses are protective but could be harmful if prolonged
- Microglia becomes more reactive with age
    - Greater brain inflammatory response
    - Damping production of anti-inflammatory molecules



Why does the brain age?

Impaired Protein Recycling:

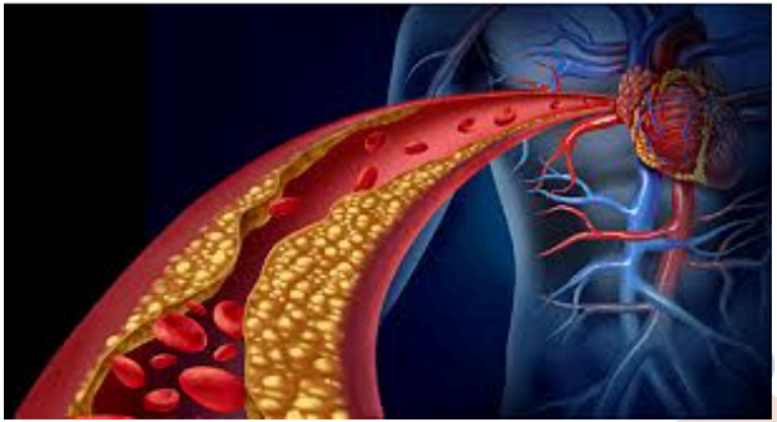
- Buildup of protein can cause cellular degeneration
- Damaged molecules can build up in cells
  - Because neurons are not replaced by cells often, unlike; bone marrow, intestinal lining, and hair follicles
- Cellular machinery in breakdown and recycling declines with age
  - Waste removal systems are less efficient



Healthy Aging

Diet and Exercise:

- To reduce cardiovascular risk factors linked to cognitive damage
  - Eat diet rich in veggies, meats, and grains
  - Prevents high blood pressure and high LDL cholesterol levels
- Caloric restriction linked to better cognitive health
- Increased physical activity could
  - Slow progression of Alzheimer's disease and dementia
  - Reduce cortical thinning and decrease hippocampal shrinking



Healthy Aging

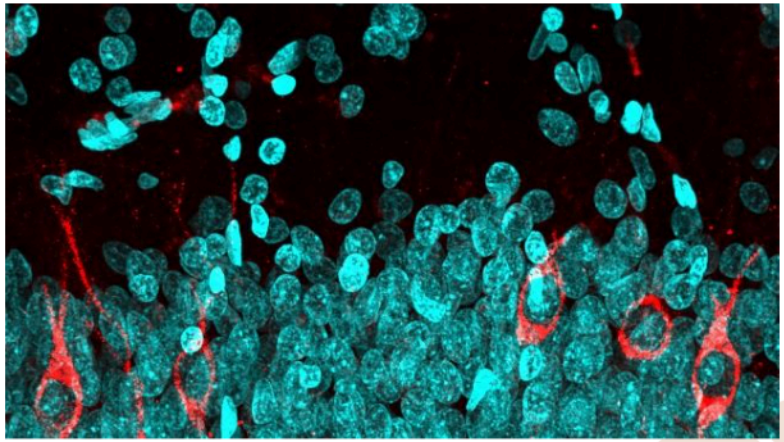
Benefits of exercise:

- Exercise helps improve neuroplasticity: brain's ability to make connections between neurons
- Increases neurogenesis, or forming new neurons
- Improves blood flow and neurotrophic production factors
    - Supports the growth of new neurons and synapses

Healthy Aging

Mental Stimulation and Social Networks:

- Cognitive stimulation improves neuroplasticity
  - Amplifies neurogenesis and significant neurotrophic factors
- Stimulating cognitive activities leads to lower rates of cognitive decline
- Active social lives lead to cognitive benefits



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We hope you enjoyed the workshop!

Any questions?

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