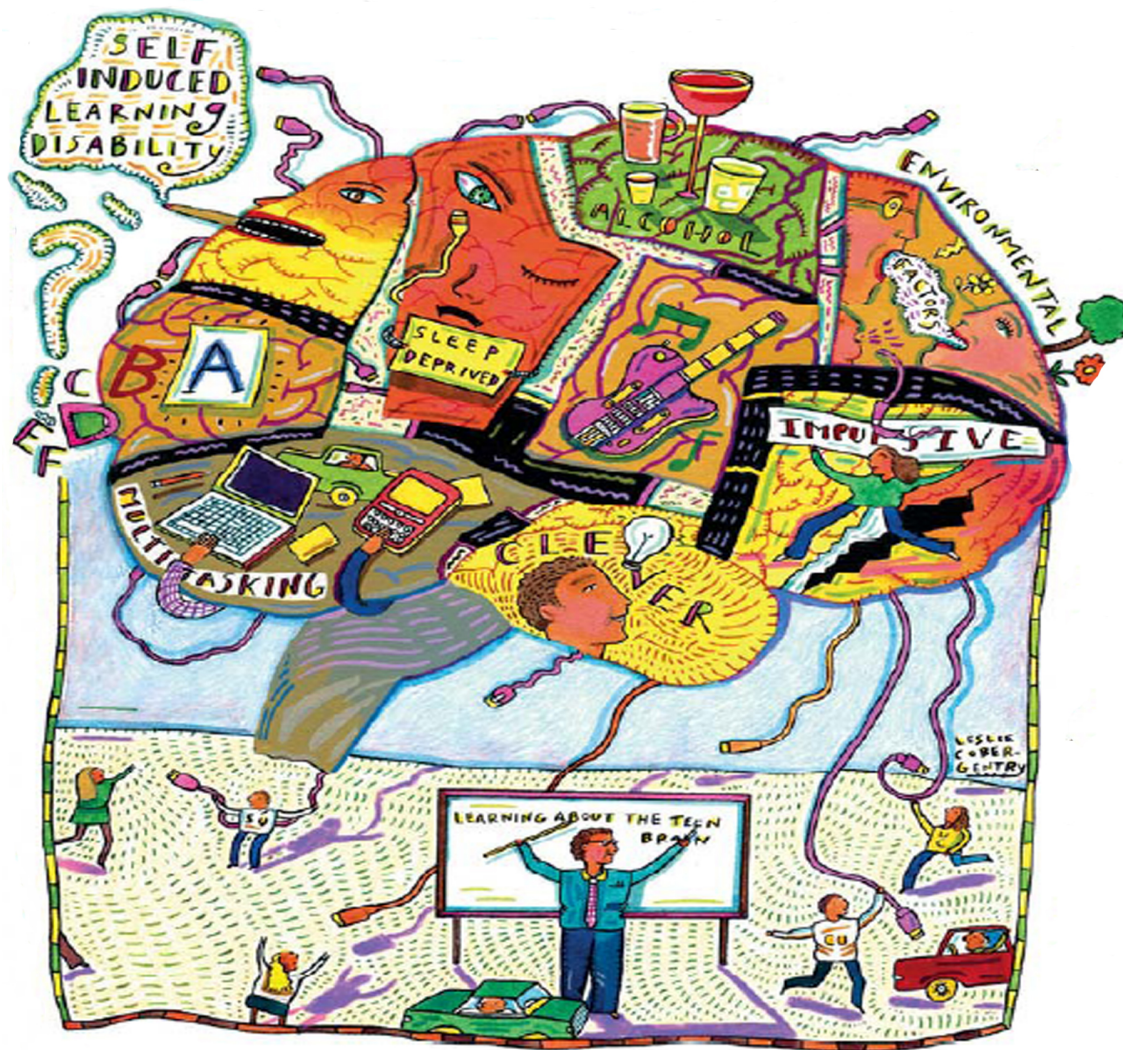


Adolescent Brain Development



Key Issues About Substance Abuse and Mental Health

Can you count the dolphins?



Children 10 and under (pre-puberty)
only see the dolphins

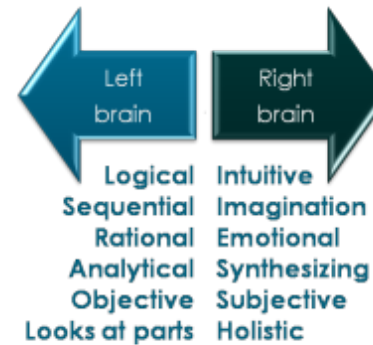


The brain is the very basis of who you are, what you experience and what you can and will exchange with the world around you.

- Its not that you see, it determines *what you see*,
- And hear,
- And feel,
- And taste,
- And smell
- And think,
- And know,
- And do....

Reductionism

Parts
Structured
Rational
Prove it!
Hierarchy
Categories
Separate
Future/past
Precise
Static
Male
Nosy
Separate notes
Mechanic



Holism

Whole
Creative
Intuitive
Open mind
Synergy
Individuals
Connected
Now
Chaotic
Dynamic
Female
Selfcorrecting
Harmony
Organic



All of each of us is experienced through

1. An infinite number of complex electro-chemical exchanges
2. Occurring across trillions of neural connections
3. At incredible rates of speed
4. Involving structures and processes that are physically and chemically *fragile*
5. What separates us from other species is our capacity for language- the basis of *reflective awareness*.



Critical Neural Structures and Processes

Handout

Adolescent Brain Development

Tortoise and the Hare

The **cerebral cortex (Cerebrum)**, the region of the brain for **reasoning, planning and inhibition** develops at a slow, steady pace through age 25. The **limbic system, areas that engage stimulation, emotion and hormones** develop in “bursts”. In essence, the management operations in the cortex struggle to “keep up” with intensities.





Pruning

Use It or Lose It



There are 2 significant periods of rapid growth in neural **gray matter (neurons)**: infancy to 2 years, *toddlerhood* and 11-12 years of age, *toddlerhood part 2*.

Following each of these periods of **gray matter** expansion are periods of *neural pruning* wherein gray matter volume and the number of synapses (connections) is reduced as a function of **USE**. Preserved axons become wrapped in myelin. **Myelinated** axons are referred to as **white matter**. Myelin raises the efficacy of connections.

Long Term Potentiation is the process by which retained synapses are strengthened as a function of repetitive use.

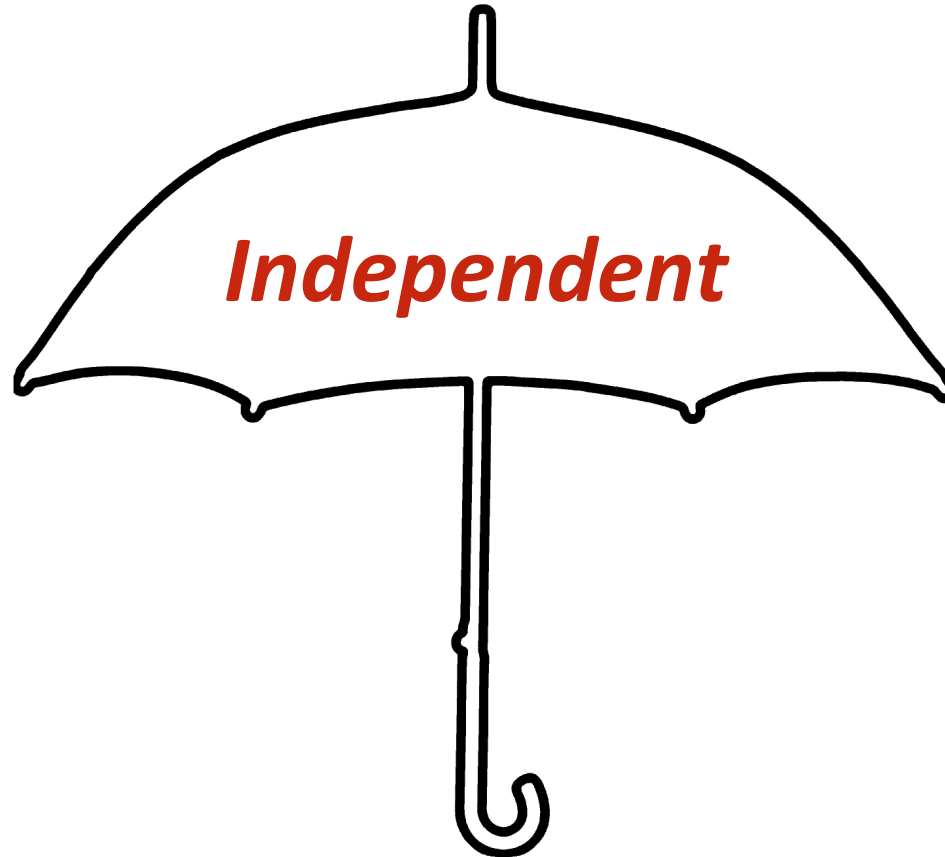
Learning = Skill Development = Brain Change
The brain is *constantly* changing



Adolescent Brain Change

1. Retention vs. pruning of neurons *as a function of use*
- 2. Myelination** of axons of retained neurons
3. Increase and strengthening of synapses (LTP) of retained neurons

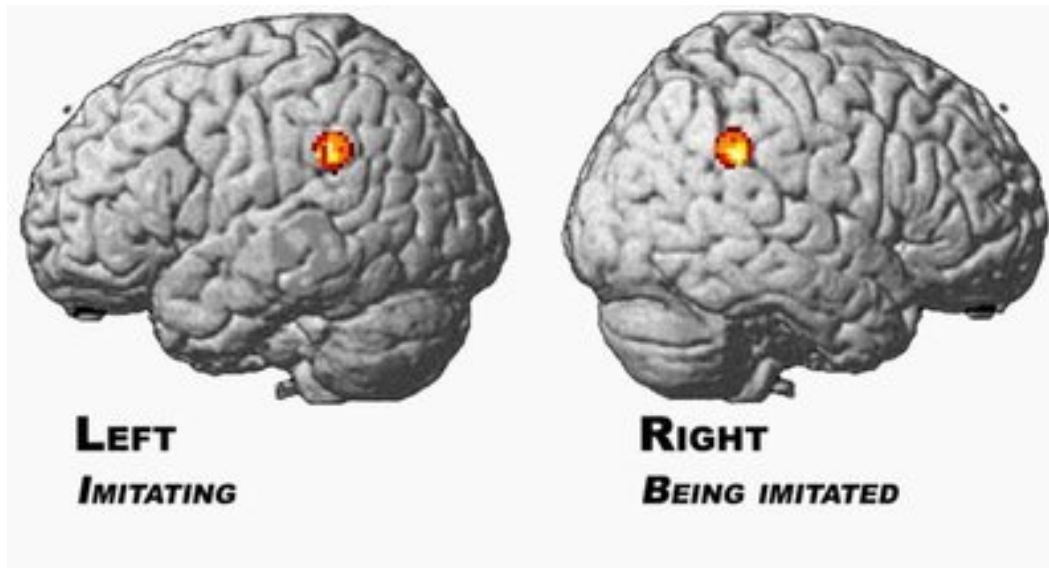
Adolescent Development = *Becoming* Functionally



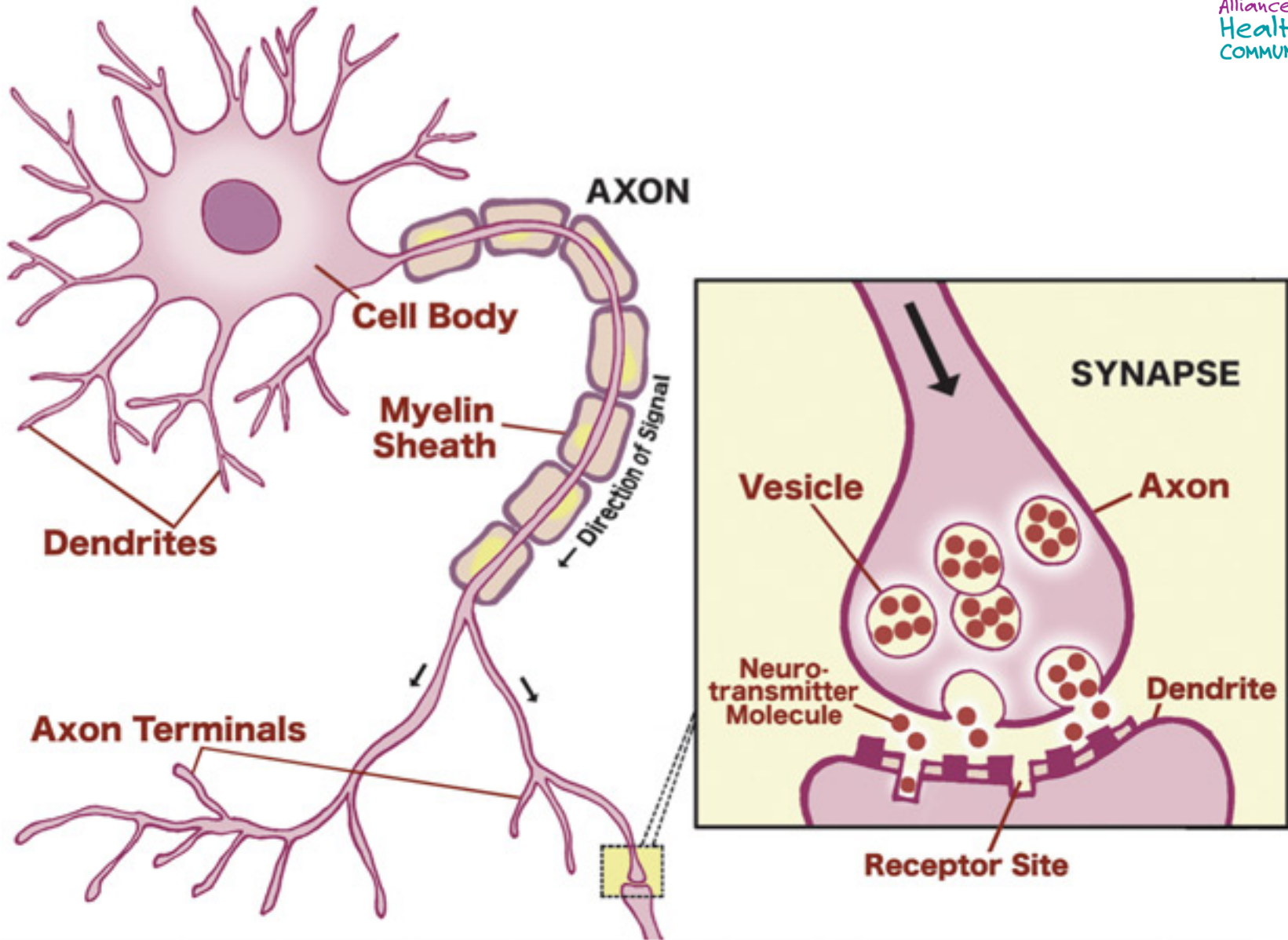
Regarding what skills?

Learning happens continuously through

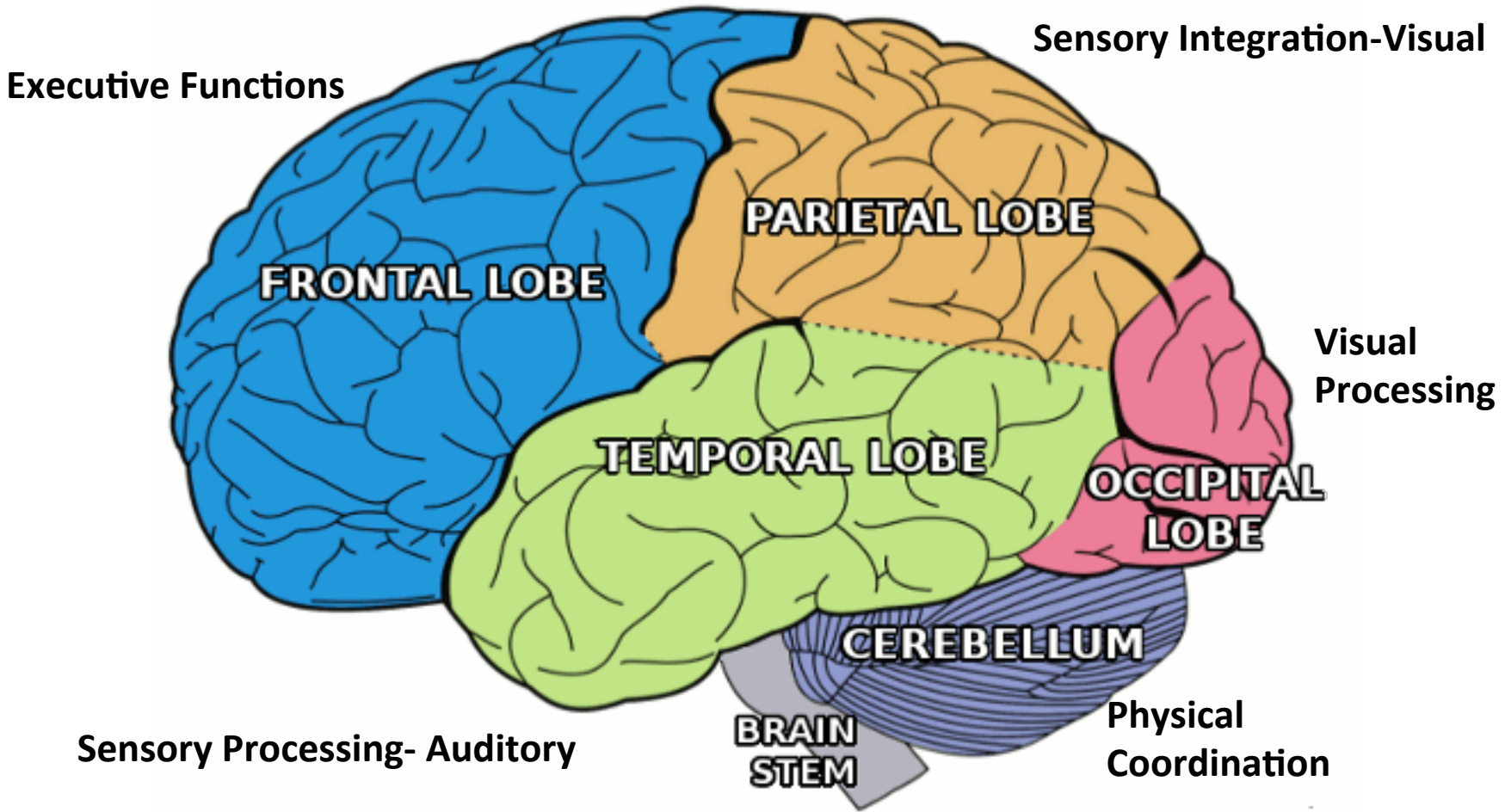
1. “**Empathic imitation**” involving mirror neurons (some debate)
2. Sustained, **effective participation** in surrounding culture
3. Internal dopamine reward/reinforcement systems



Structure of Typical Neuron



Outer Lobes of the Cerebrum



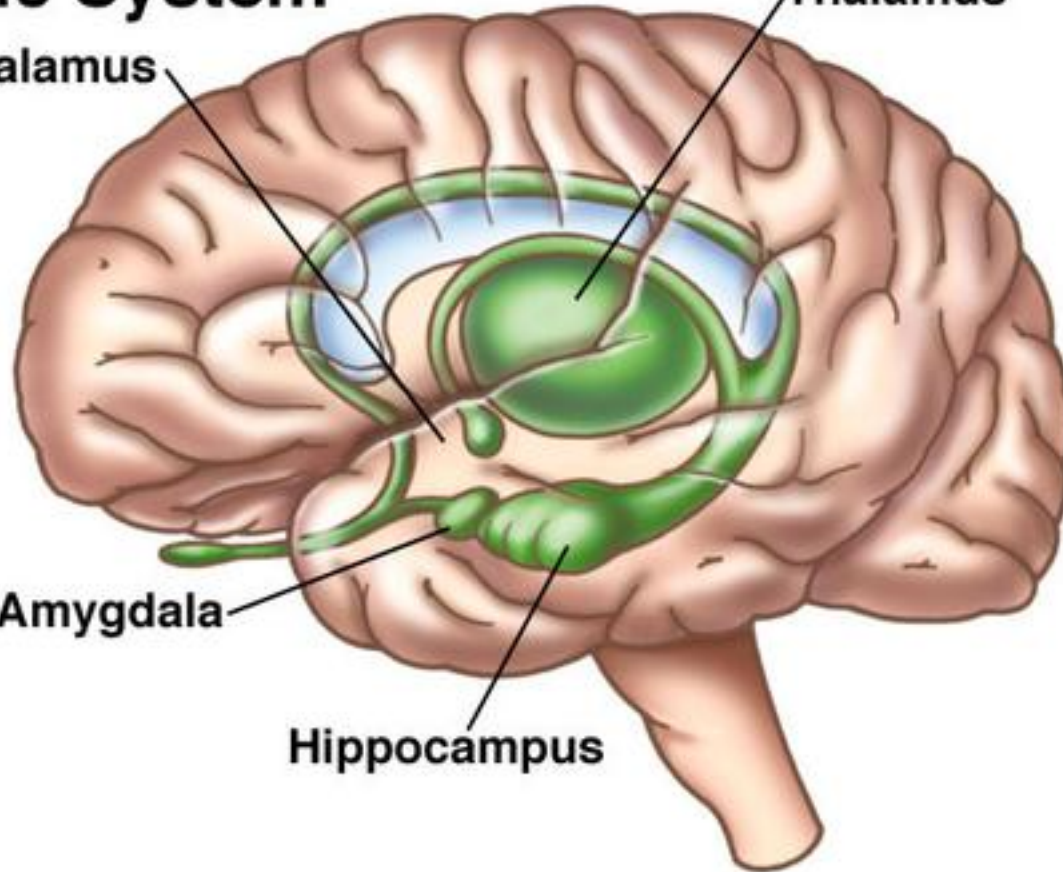
Limbic System

Hypothalamus

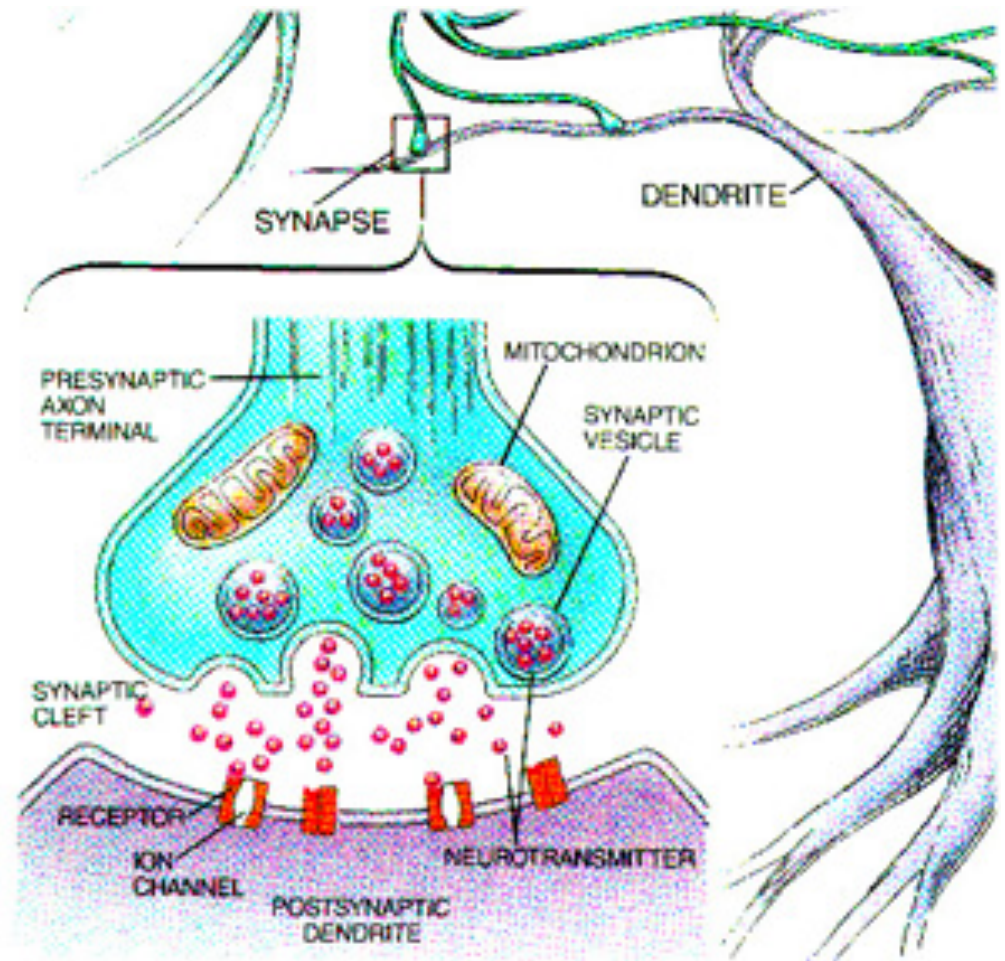
Thalamus

Amygdala

Hippocampus



Synapse Structural Details



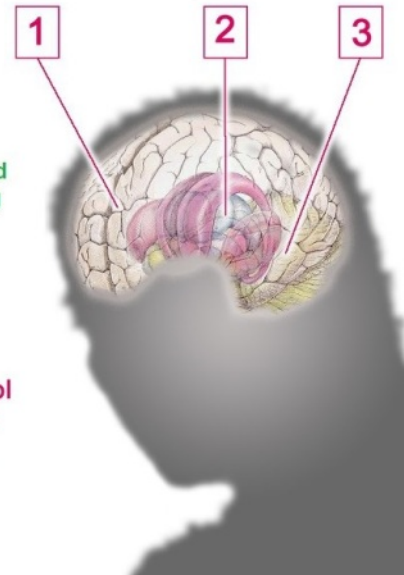
Neurotransmission
happens here →

Alcohol- So What's the Big Deal?



How Alcohol Attacks The Brain ?

1. First, alcohol affects the forebrain and **assaults Motor Coordination and Decision Making**
2. Then, alcohol knocks out the midbrain, and you **lose control over emotions and increase chances of a blackout.**

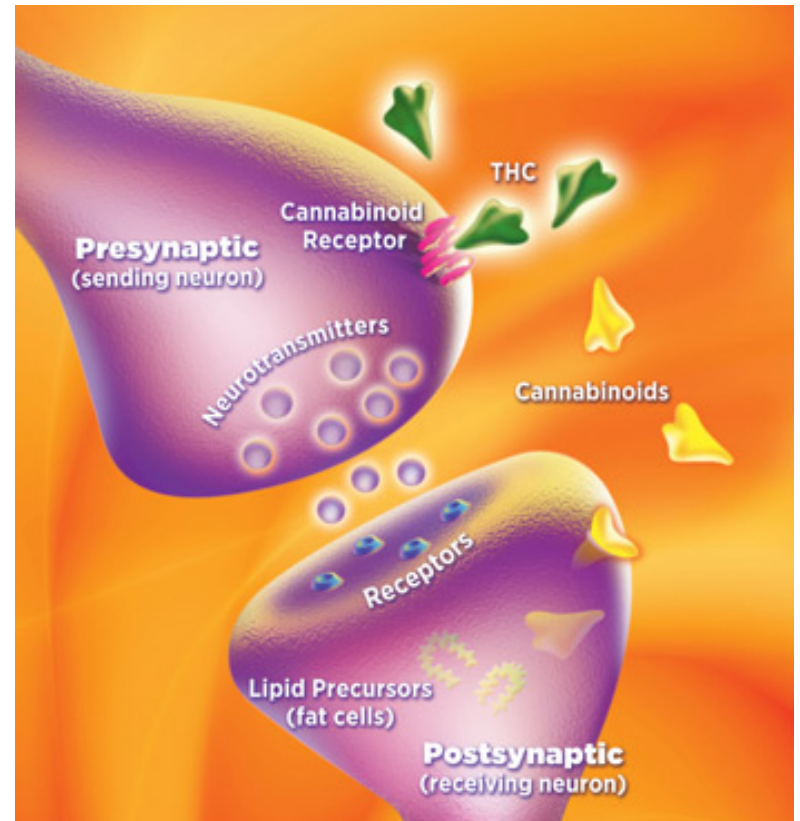
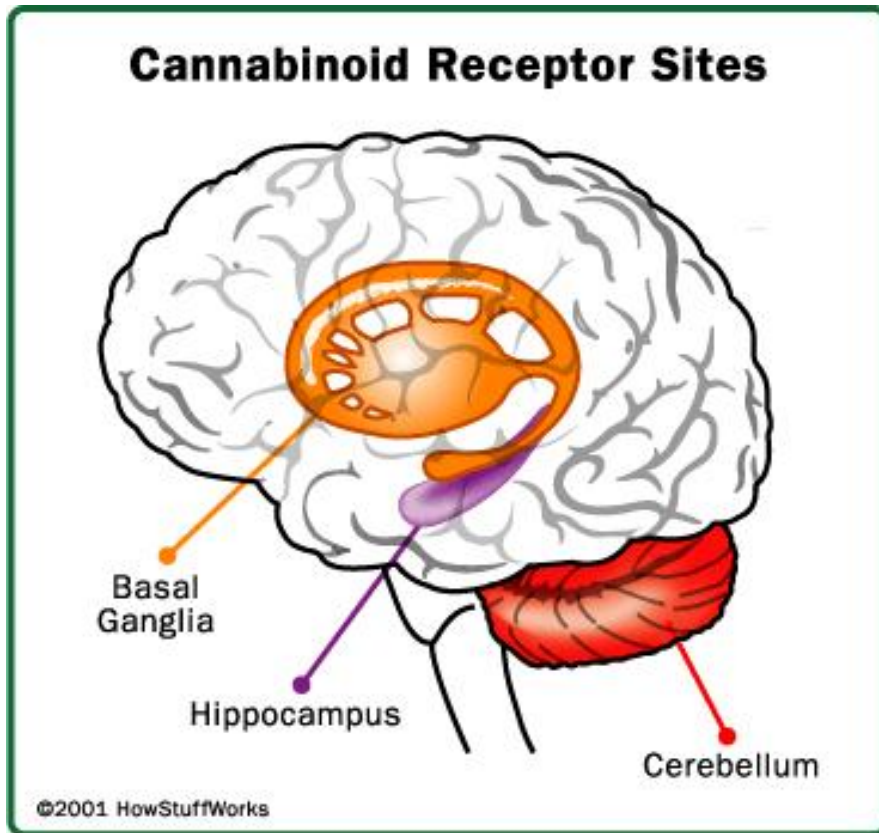


3. Finally, alcohol batters the brainstem as it **affects heart rate, body temperature, appetite and consciousness**, a dangerous and potentially fatal condition.

Science says.....

1. **Adolescent binge drinking** has been shown to reduce myelination in the prefrontal cortex correlating to diminished capacities for cognitive and behavioral control that may last a lifetime.
2. **Alcohol use** has been shown to impair Long Term Potentiation (LTP)
3. **Heavy marijuana use in adolescence (6+ joints daily)** has been correlated with diminished myelination in neural circuits of the cerebrum (frontal, parietal and temporal regions).
4. **Heavy, chronic marijuana use** correlates strongly to lower volumes of gray matter in orbitofrontal cortex (social/emotional control).
 - Evidence suggests that the brain's plasticity capacities (adaptation) become engaged to increase OFC connectivity as ***compensatory device*** for decreased gray matter volume.
5. **Marijuana use** has been shown to increase both manic and depressive symptoms in Bi-polar disorder as well as symptoms in schizophrenia.

Let's Talk about Pot and the Brain



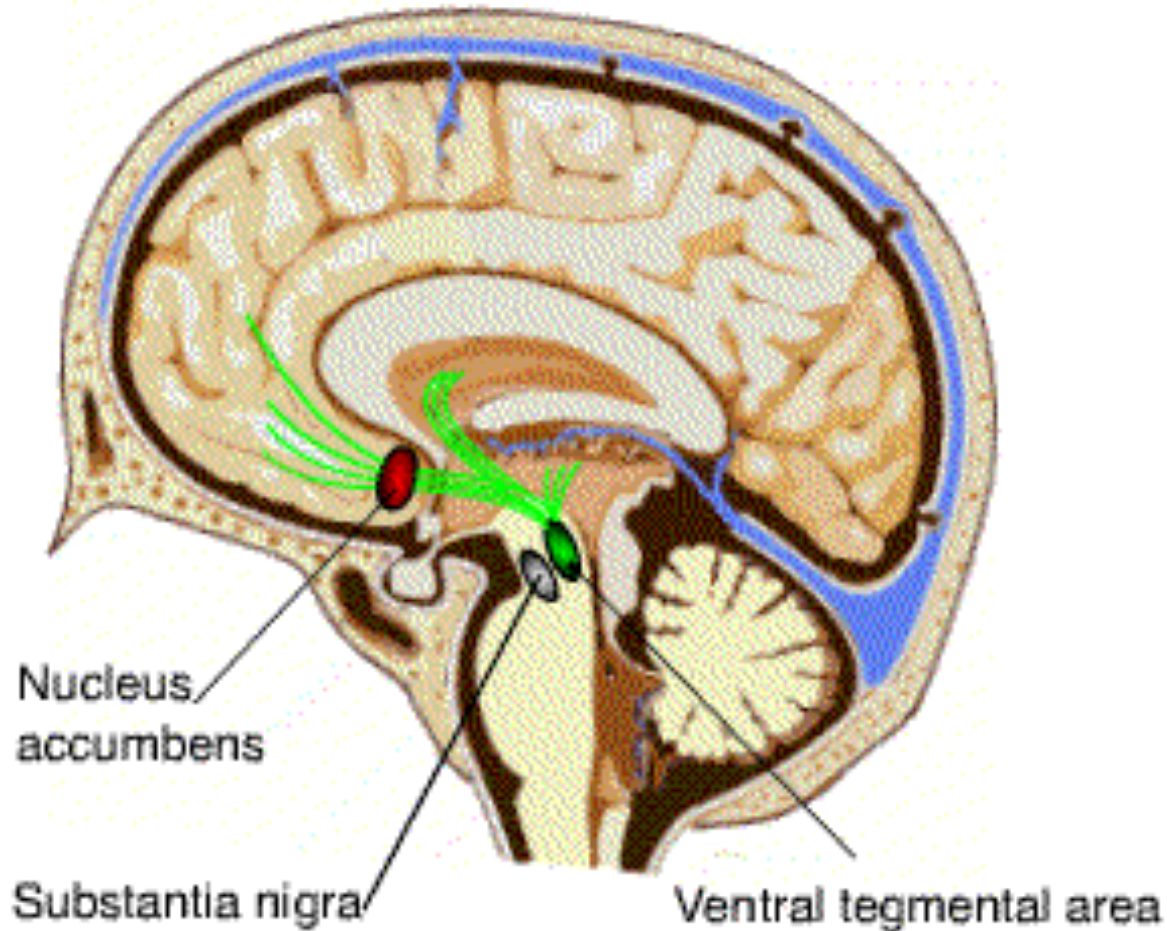
**Sites prominent in DA reward and reinforcement systems-
a.k.a, motivational processes**



- 1. Endocannabinoids and exocannabinoids** are of similar but NOT identical chemical structures
 - Endo means from “within”: endocannabinoids, i.e. anandamide, are produced within neurons from lipids (fats) and serve to limit the transfer of neurotransmitters (e.g., dopamine) between neurons
 - THC is a cannabinoid (exocannabinoid) that acts on endocannabinoid receptor sites causing dysregulation in neurotransmitter release.
- 2. Over time, **THC changes how endocannabinoids work**** in these brain areas which can lead to problems with memory, addiction and mental health.

Dopamine Pleasure-Reward Pathway

Integral in Motivation: Survival and Learning



Neurotransmission, Pain Relief, Reward and Reinforcement

Chronic use of *drugs of abuse* can cause permanent alterations in the neurotransmitter release and uptake process

1. Heroin (and pharmaceutical opiates) stimulate many more receptor sites than are normally involved in the endorphin (natural opiates) release-uptake process, resulting in a massive amplification of opioid receptor activity



2. Amphetamines and cocaine hijack DA reward system.

- **Reward** (an outcome that feels good)
- **Reinforcement** (an outcome that increases the likelihood of repeating the behavior that produced it)
 - **Reward and Reinforcement are different** and mediated by different biological processes
- Amphetamines and cocaine stimulate the release of DA.
- Cocaine blocks DA reuptake as well.
- Both drugs result in **saturation of DA receptor sites far beyond natural reward.**
- This results in **salience**- contextual aspects of drug use, i.e. internal/external cues become **triggers**- leading to an **acquired OCD (*Sham Reward*)** which may not be fully reversible.
- Continued use is function of irresistible urge to perform behavior triggered by environmental or internal cues.

