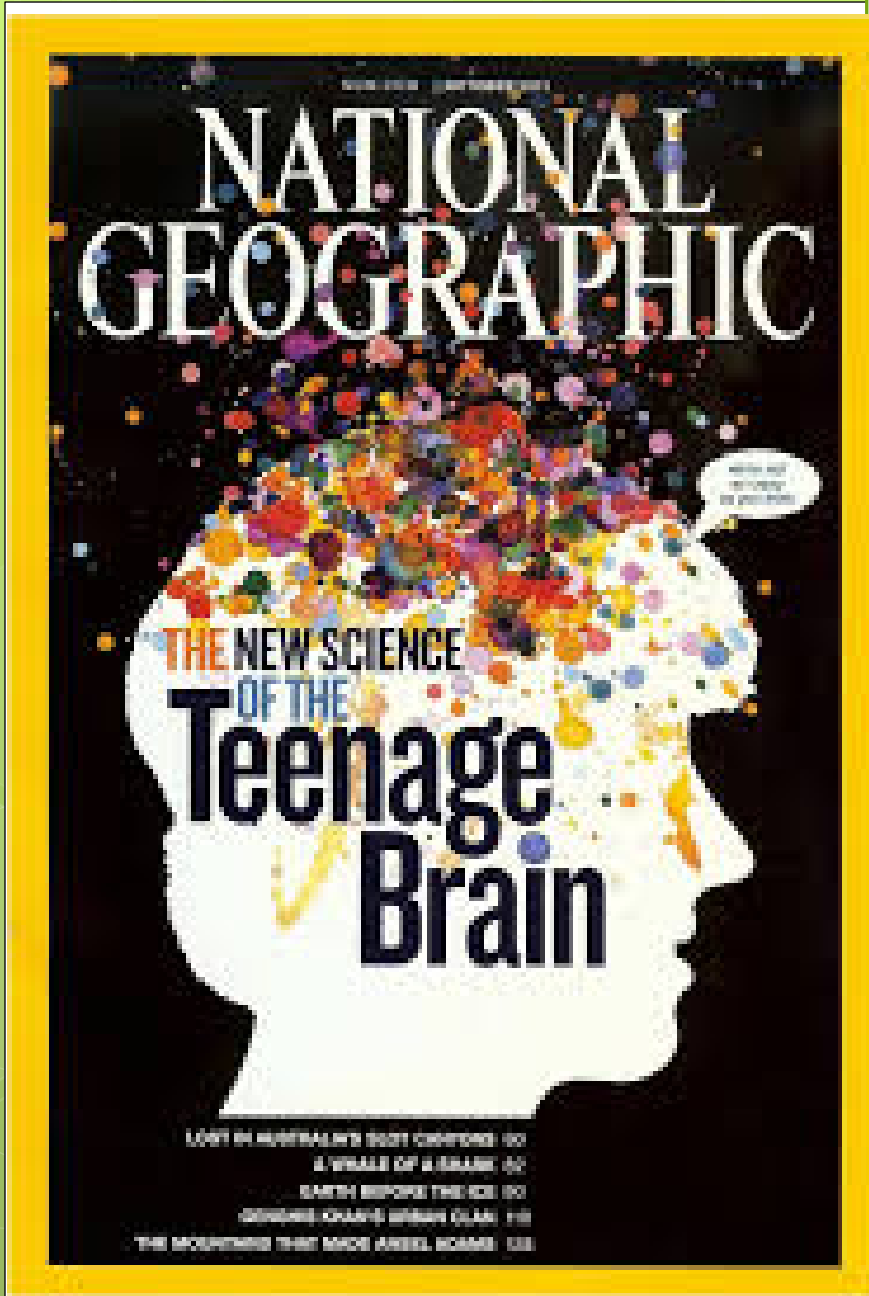




# Adolescent Brain Development

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## Learning Objectives:

What is typical adolescent brain development

How is brain development related to substance use

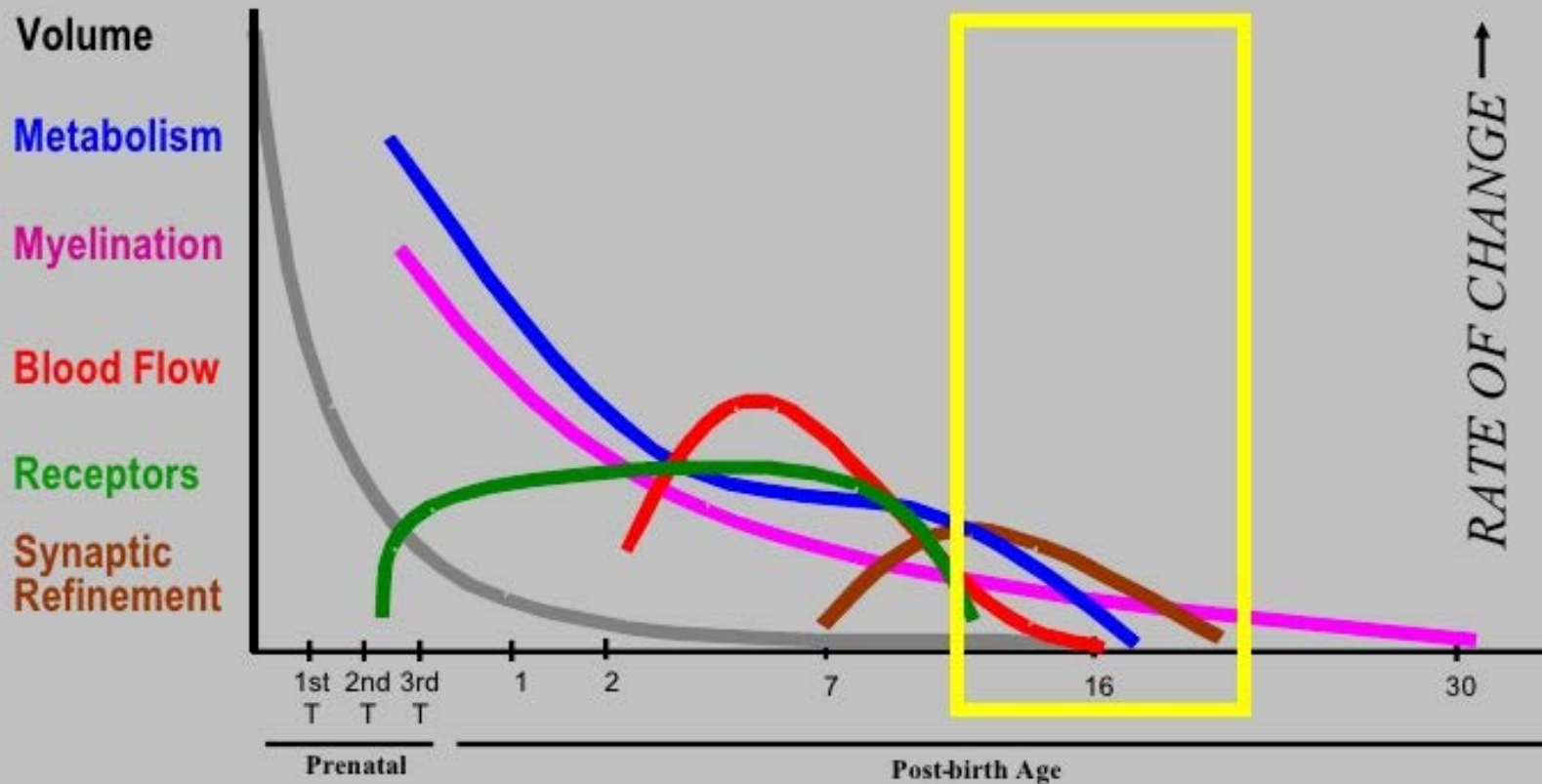
How does substance use affect brain development

# The Teen Brain is in a Constant State of Development

And some areas of the brain mature faster than others. The areas of your brain associated with reward, motivation, and impulsivity matures early.

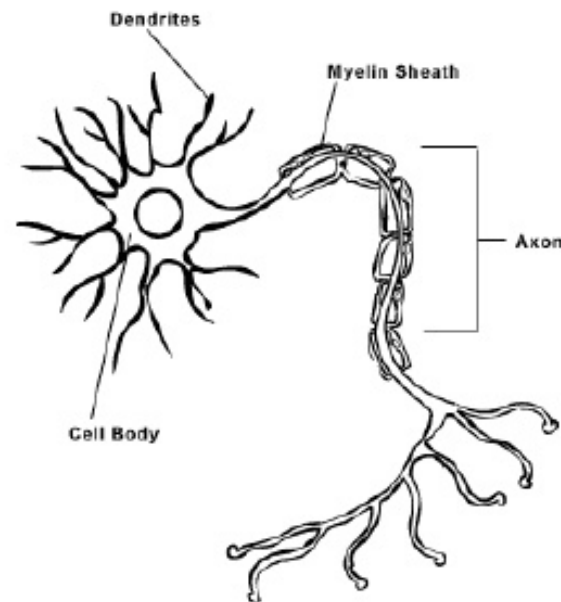
Photo credit (CC 2.0): [Daniel Flower](#)

# Brain Development



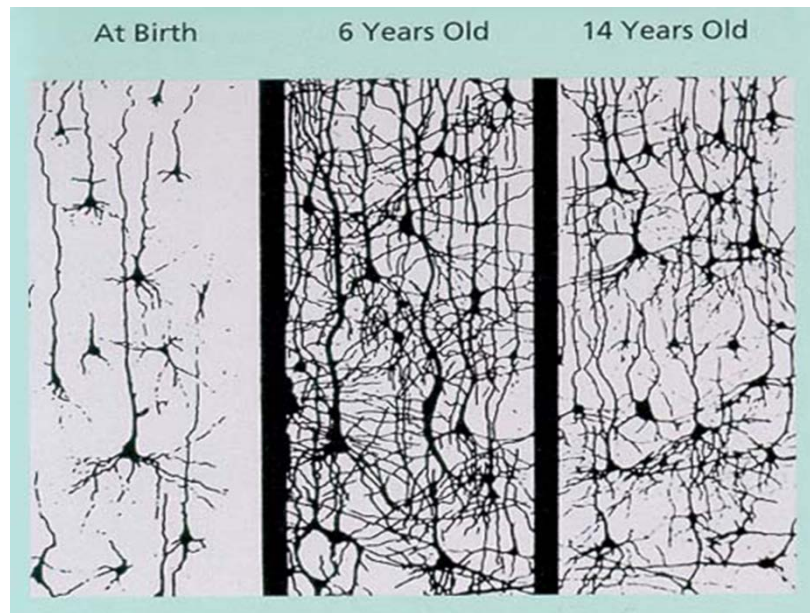
# Teen Brain Under Construction

- **Myelination:** Thickening of myelin sheath around neural connections increases the efficiency of those connections
- **Pruning:** Removing unneeded connections the brain has formed
- **Use it or lose it:** The connections that are most frequently used become more efficient, the connections that are not get removed



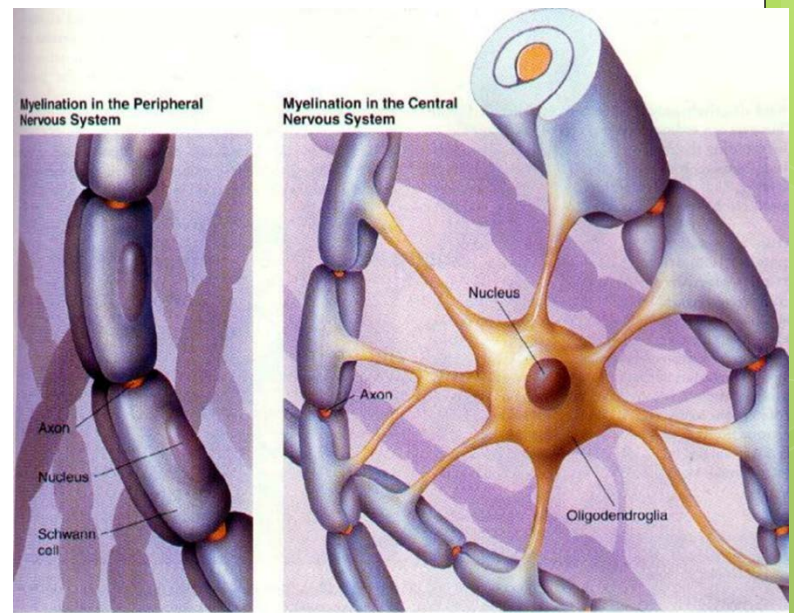


Through Adolescence the brain continues moving from a network of grassy paths to super highways



### Step 1. Synaptic Pruning

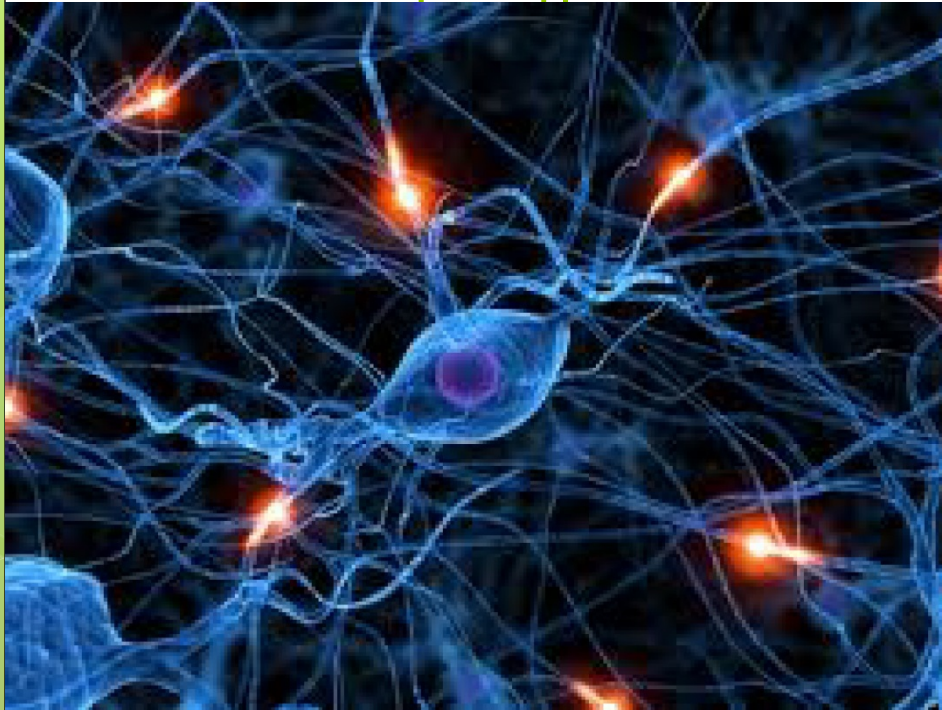
Process: Use it or Lost it.  
Goal: Increase Brain Efficiency



### Step 2. Myelination of Neurons

Process: Insulation & Protection  
Goal: Increase Brain Speed

Synapses are the places where  
between neurons.

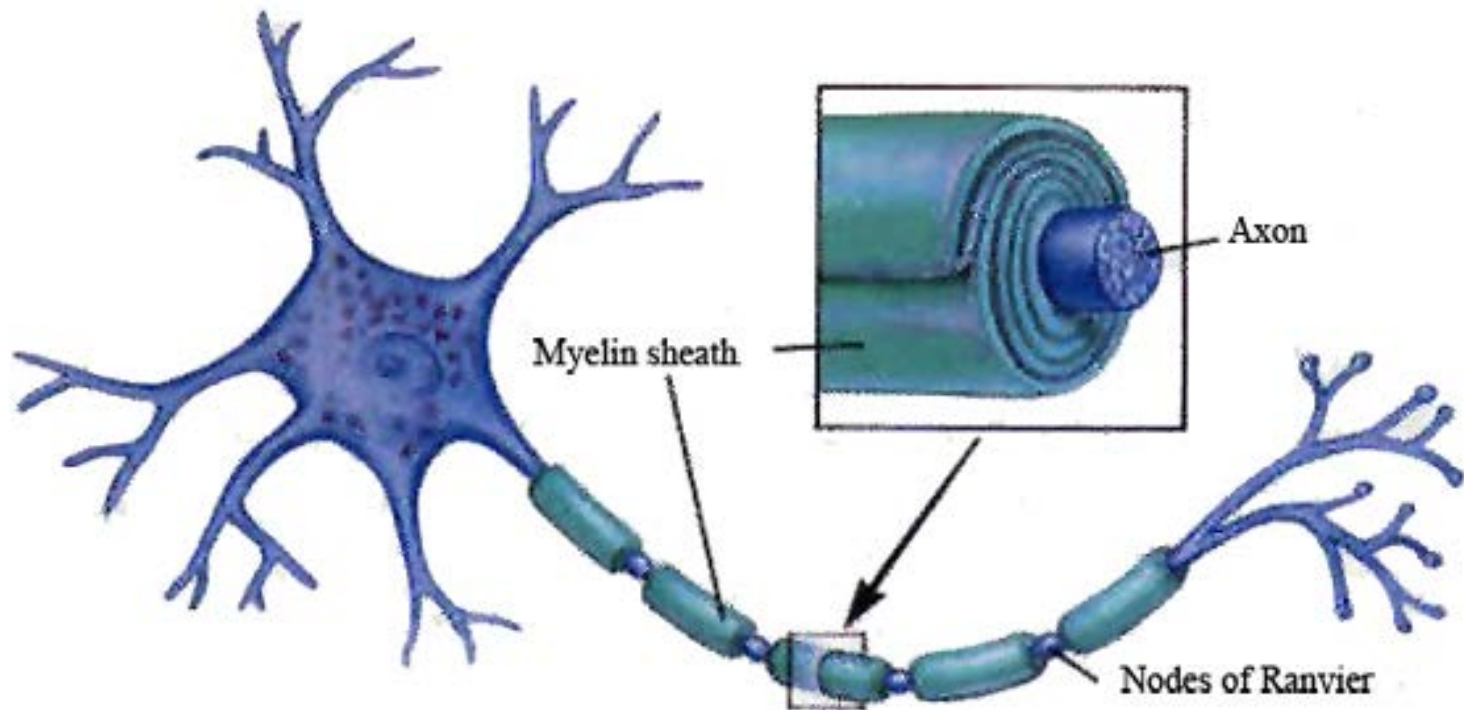


Communication signals an important relationship between neurons and brain structures that should be preserved.

Disruptions in communication can lead to disruptions in form and function of the nervous system.



# NEURONS THAT SURVIVE SYNAPTIC PRUNING GET MYELINATED.



Myelin acts like the insulation around an electrical wire: it offers protection and speeds up the transmission of the signal between cells.



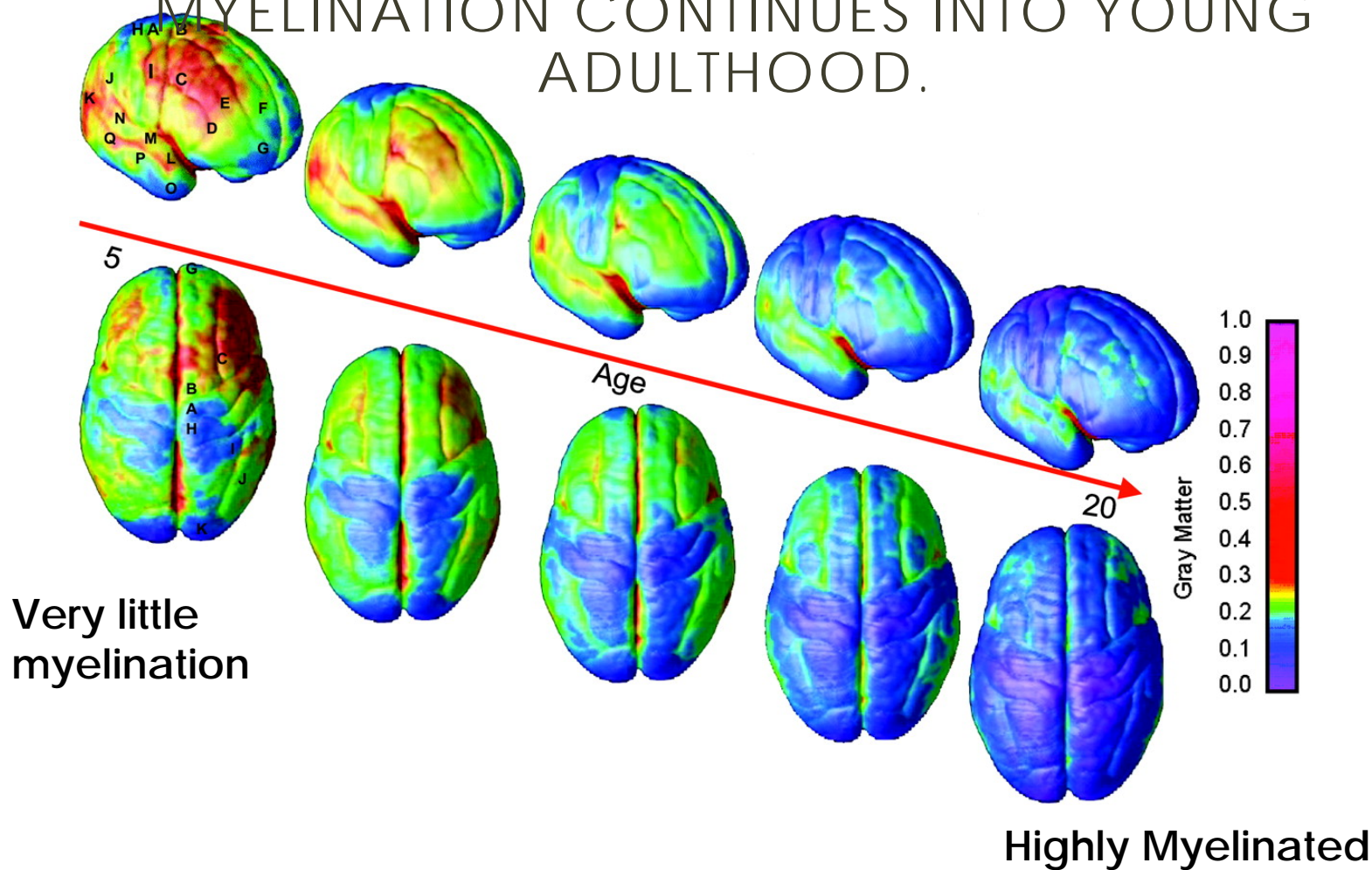
# Adult Vs. Teen Brain



- Most of the activity in the adult brain is in the frontal lobe
  - Thinking, reasoning, planning
- Most of the activity in the teen brain is focused in the center
  - Pleasure reward center

# BRAIN DEVELOPMENT DOESN'T HAPPEN ALL AT ONCE:

STRENGTHENING CONNECTIONS THROUGH MYELINATION CONTINUES INTO YOUNG ADULTHOOD.



## ATTENTION: Are you listening?

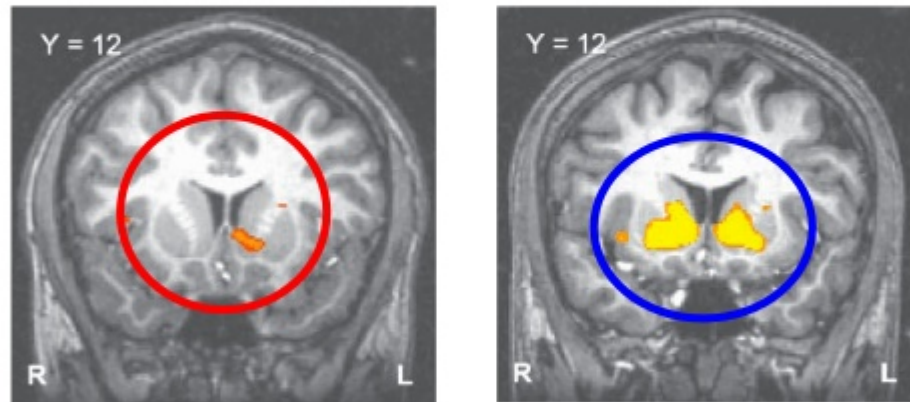


Many cognitive abilities (including the control of attention) rely on the proper functioning of a part of the brain called the **prefrontal cortex**.

BUT... the **prefrontal cortex** undergoes massive structural changes during adolescence, and it is one of the last brain areas to mature completely!

## MOTIVATION: Adults vs. Teens

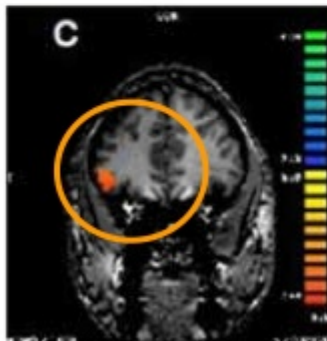
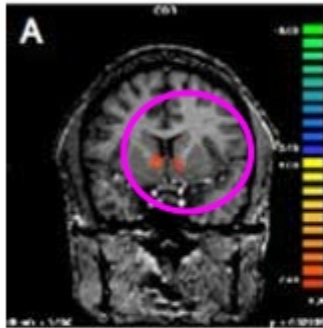
One study looked at the differences in motivation between adults and teenagers. The researchers compared the brain activation of adults and teenagers while they were performing the same task for a reward.



Compared to **adults**, **teenagers** under-use the brain circuits that are involved in motivation!



## RISK-TAKING: The neural basis for “What the heck were you thinking?!”



Galvan et al. (2006)

- When teenagers and adults are faced with potential rewards, their brains respond **VERY** differently.
- In teenagers, the maturing “reward” systems (photo A) are disproportionately active relative to later maturing “control” systems (photo C).
- This biases their actions toward immediate gain rather than long-term gain. This just might underlie some of the risk-taking behaviours that occur during adolescence!

## Risk and Reward



It's **not** that teens are stupid, or have no control over their own brain. Studies have shown that teens **know** when they are engaging in risky behavior (like unprotected sex, drinking, or drugs). However they are more likely to think that the benefits of those behaviors outweigh any potential harm.

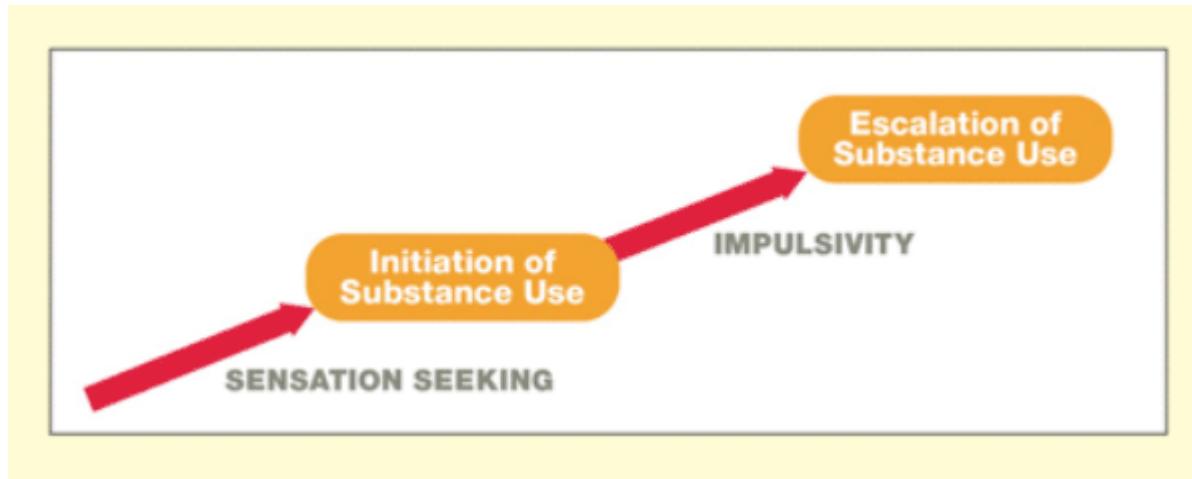
## **What does this mean for me??**



**Most teenagers are more likely to do their homework for a \$5 reward TONIGHT than for a \$50 reward next week!**







## **Sensation Seeking Promotes Initiation of Substance Use, While Impulsivity Contributes to Its Escalation**

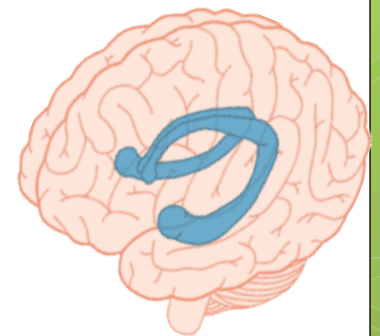
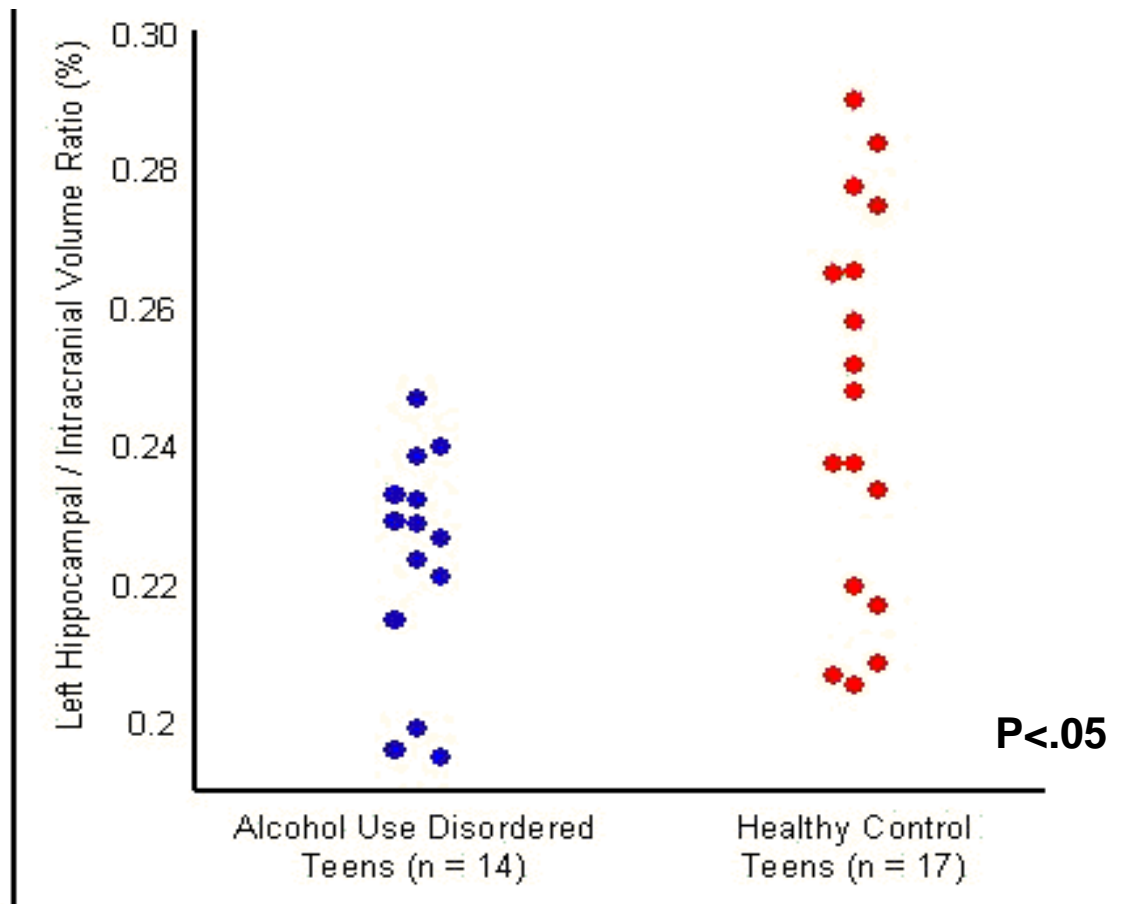
Young teens highly motivated to seek novel/ intense sensations are more likely to initiate use of alcohol, marijuana, or tobacco

Teens already using substances, more impulsive teens are more likely to escalate use

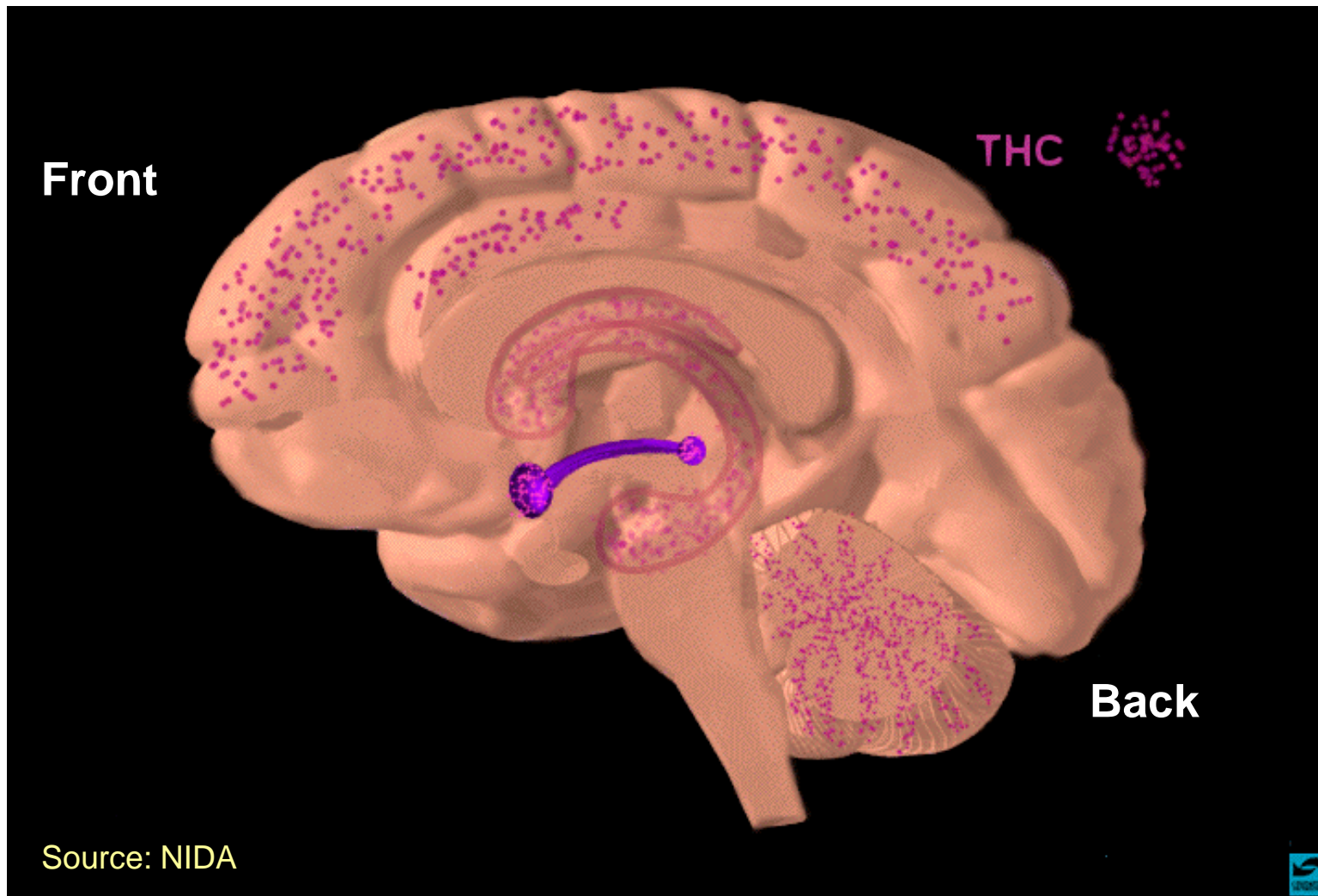
<https://www.drugabuse.gov/news-events/nida-notes/2016/05/sensation-seeking-promotes-initiation-impulsivity-promotes-escalation-substance-use>

# Alcohol Use and Small Hippocampus; *memory, learning, & sleep regulation*

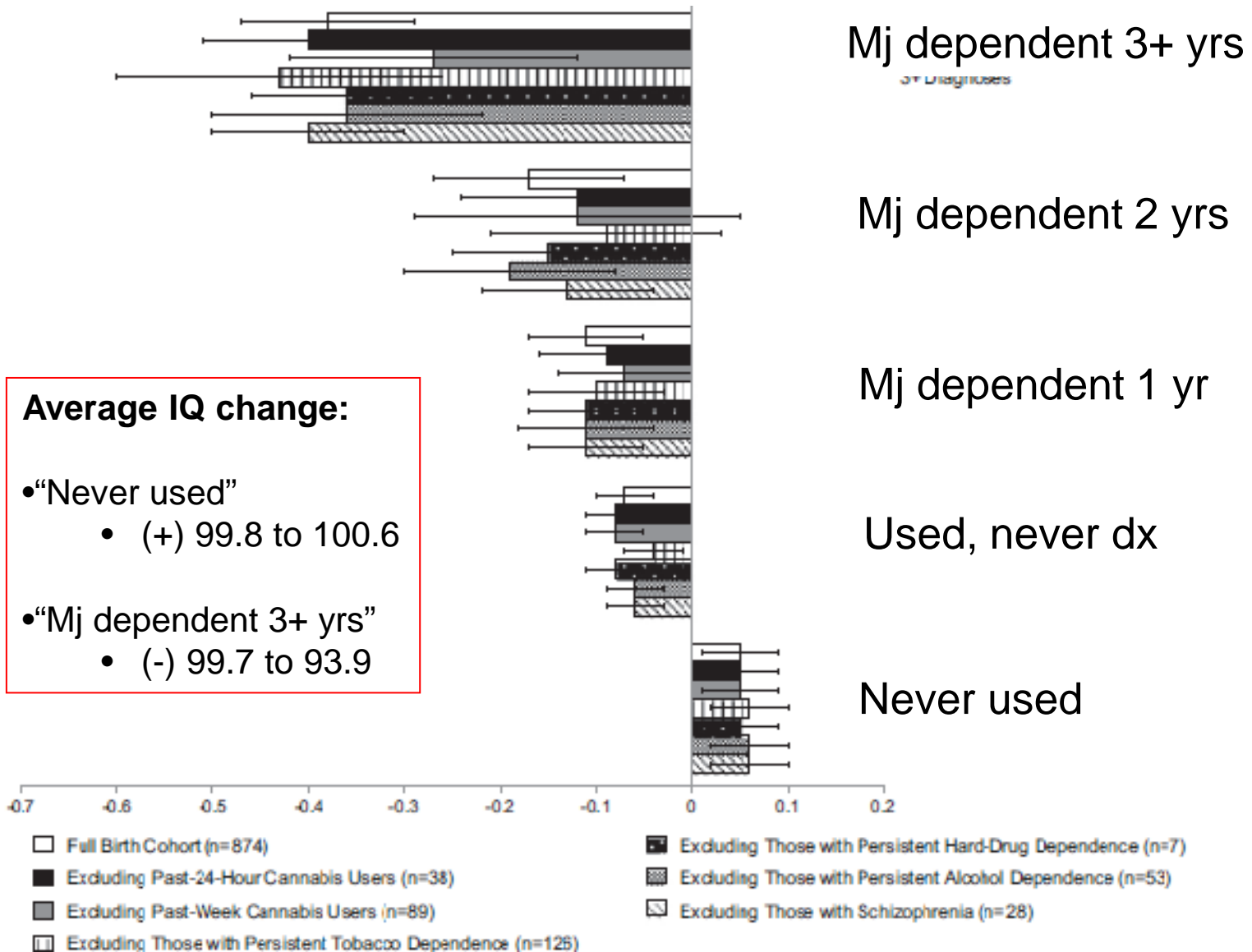
HIPPOCAMPUS SIZE (VOLUME)



# Marijuana binds to cannabinoid receptors



# Adolescent Marijuana use & adult IQ





# National Institutes on Drug Abuse/ Alcohol Abuse and Alcoholism

- Adolescent Brain Cognitive Development (ABCD) Study
- 13 grants to research institutions around the country
- 10,000 9 -10yr olds, followed through the period of highest risk for substance use and other mental health disorders
  - What is the impact of use on the structure and function of the developing brain?
  - What are the brain pathways that link adolescent substance use and risk for mental illnesses?
  - What impact does substance use have on physical health, psychological development, information processing, learning and memory, academic achievement, social development, and other behaviors?

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