Brain Development and Substance Use

Brain health means taking care of your brain so it can work its best and support your overall well-being, including your physical, mental, spiritual, emotional, and social health. Using substances while your brain is still developing can significantly impact brain health and overall well-being. This is because substances influence how the brain develops, adapts, and functions over time. Brain health matters at every stage of life, from before birth to older adulthood. It is especially important during childhood and adolescence because the brain is still growing, adapting, and developing.

Visit our **Brain Health** infographic to learn about how to protect your brain. https://decyde.ca/educational-materials/#mental-health

Limbic system

"The emotion and reward network"

Made up of many brain areas (including the hippocampus and amygdala). Develops quickly during adolescence and helps control emotions, rewards, and risk-taking, making youth more sensitive to the effect of substances.

Prefrontal cortex

"The decision-maker"

Helps with decision-making, judgement, and impulse control. It continues developing until about age 25, making youth more vulnerable to risky decision-making and substance-related harm.

Cerebral cortex

"The thinking centre"

The outer most layer of the brain. Helps with thinking, learning, memory, decision-making, movement, and processing information from the senses.

Corpus Callosum

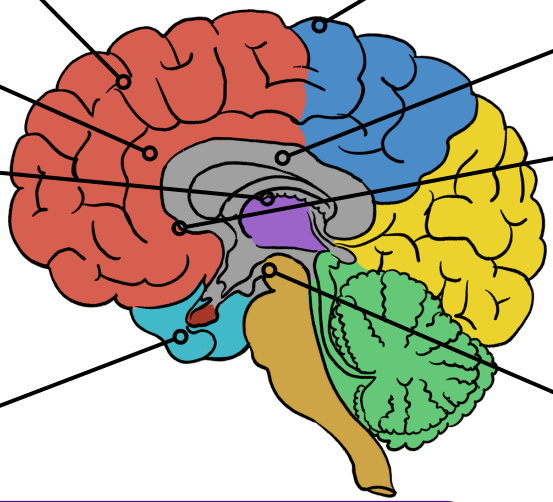
"The brain bridge"

Connects the right and left sides of the brain so they can communicate. It continues growing during adolescence leading to better communication and coordination between brain regions.

Hippocampus

"The memory maker"

Helps form new memories and supports learning. Cannabis, alcohol, and stimulants can disrupt memory formation and make learning more difficult.



Nucleus Accumbens

"The reinforcement centre"

Helps the brain experience reward and pleasure. Many substances overstimulate this area by increasing dopamine, reinforcing substance use and increasing the risk of addiction.

Amygdala

"The emotion alarm"

Helps process emotions like fear, stress, and cravings. Alcohol, opioids, and stimulants can alter emotional responses and increase cravings triggered by stress and other cues.

Ventral Tegmental Area (VTA)

"The dopamine messenger"

Produces and releases dopamine, a "feel-good" chemical involved in motivation, learning and reward. Nicotine, opioids, stimulants, and alcohol increase dopamine signaling, reinforcing substance use.

Fun Fact! Your brain can "rewire" itself! Every time you learn something new, practice a skill, or build a healthy habit, your brain strengthens connections and creates new pathways. This is known as **neuroplasticity**.

The Role of Neurotransmitters and Substances

Neurotransmitters are chemical messengers that help the brain cells send signals to each other. Substances can disrupt these signals by changing how neurotransmitters work in the brain. This can affect feelings, thoughts, decision-making, and behaviours.

Serotonin

"The mood regulator." Helps manage mood, emotions, sleep, and behaviour.

Some substances can temporarily cause an increase in serotonin, creating euphoria and relaxation. Long-term substance use can deplete serotonin and alter mood regulation.

Glutamate

"The learning signal." Helps with learning and memory.

Substance use can disrupt glutamate, a brain chemical involved in learning and memory. Over time, this can strengthen cravings, make substance-related triggers harder to ignore, and increase the chance of returning to use.

Dopamine

"The reward signal." Helps the brain recognize rewards.

Substances can cause a big rise in dopamine, creating rewarding feelings and reinforcing use. Over time, the brain may become less responsive to dopamine, increasing cravings and reducing enjoyment of everyday activities.

GABA

"The brakes." Helps slow brain activity and regulate behaviour.

Substances can increase GABA and slow brain activity, causing relaxation or drowsiness. Over time, the brain adapts, leading to tolerance. Stopping substances suddenly may cause anxiety, sleep issues, tremors, or seizures.

Norepinephrine

"The alert system." Helps control attention, stress, and arousal.

Certain substances can briefly increase norepinephrine, causing greater energy and alertness. Long-term substance use can disrupt it, contributing to low mood, anxiety, stress, and cravings.

Brain Development and Substance Use

How can substances impact the developing brain?

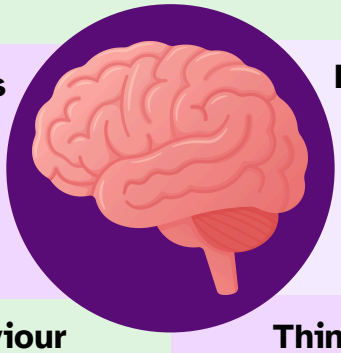
Higher Risk of Addiction

The developing brain is more sensitive to the rewarding effects of substances, which may increase the risk of developing a substance use disorder when using substances repeatedly.

Stopping substances suddenly may lead to harmful effects, such as withdrawal. For more information on how to safely reduce substance use visit: https://decyde.ca/support-resources/

Brain & Gene Changes

Substance use can influence how certain genes are expressed, which may affect the way the brain develops and how brain cells communicate.



Brain Structure & Connections

Repeated substance use can change the structure and connections between brain cells, making it harder for different parts of the brain to work together effectively.

Mood & Behaviour

Changes in the brain can influence emotions, motivation, impulse control, and behaviour. This can affect school, relationships, and everyday choices.

Thinking, Learning & Memory

Substance use can affect attention, learning, memory, problem-solving, and decision-making, especially when the brain is still developing during adolescence.

Why Youth Are More Vulnerable to Substance Use

The brain develops from back to front, with the prefrontal cortex being one of the last areas to fully mature. The brain continues to develop until about age 25 and adapts throughout life. During a person's youth, brain systems involved in reward and motivation develop earlier than those responsible for judgment, impulse control, and decision-making. This can make adolescents more vulnerable to risk-taking and the effects of substances, which can further disrupt these developing brain systems.

Learn more about the effect of specific substances on the brain: https://decyde.ca/educational-materials/#mental-health

Some factors can increase the risk of harmful effects on the brain, including:

- Starting substance use at a **younger age**
- Using substances **more frequently or in larger amounts**
- Using **more than one substance** at the same time

These factors can also increase the risk of developing a substance use disorder and other negative health and social effects later in life, such as difficulty maintaining relationships and employment.

Empowering Youth to DECYDE

MEMORIAL UNIVERSITY

For more information visit us at: **www.decyde.ca**

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