Marijuana's Effect on the Brain

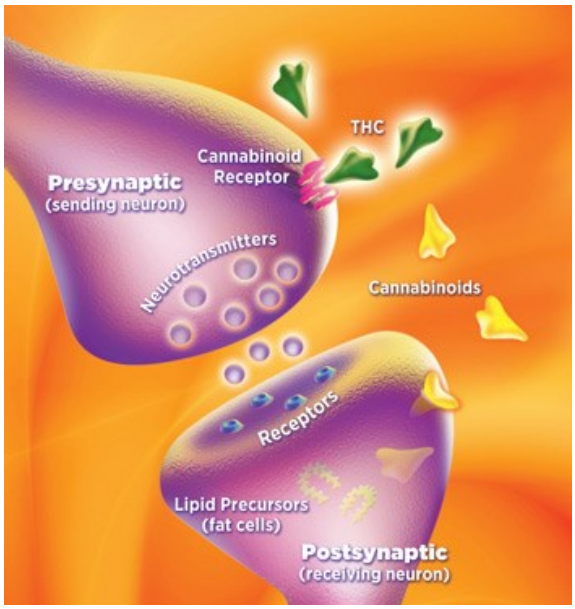
- Tetrahydrocannabinol (THC) is the active ingredient in marijuana.
- THC binds to the endocannabinoid (EC) system in the brain, which affects how a person feels, moves, and reacts.
- Over time THC can change how the EC system works, which can lead to problems with memory, addiction, and mental health.

After several decades of research, scientists studying the effects of marijuana have made several important discoveries. Not only did they identify the active ingredient in marijuana, they also discovered where and how it works in the brain - via a system they called the **endocannabinoid (EC) system.** The EC system - named after the marijuana plant *Cannabis sativa* and its active ingredient delta-9-tetrahydrocannabinol (THC) - is a unique communications system in the brain and body that affects many important functions, including how a person feels, moves, and reacts.

The natural chemicals produced by the body that interact within the EC system are called cannabinoids, and like THC, they interact with receptors to regulate these important body functions. So what makes the EC system unique and how does THC's impact on this system affect a person's memory, risk for accidents, and even addiction?

How Cannabinoids Work Differently From Other Neurotransmitters

Brain cells (neurons) communicate with each other and with the rest of the body by sending chemical "messages". These messages help coordinate and regulate everything we feel, think, and do. Typically, the chemicals (called **neurotransmitters**) are released from a neuron (a presynaptic cell), travel across a small gap (the synapse), and then attach to specific receptors located on a nearby neuron (postsynaptic cell). This spurs the receiving neuron into action, triggering a set of events that allows the message to be passed along.



The EC system communicates its messages in a different way because it works "backward." When the postsynaptic neuron is activated, cannabinoids are made "on demand" from lipid precursors (fat cells) already present in the neuron. Cannabinoids are then released from that cell and travel **backward** to the presynaptic neuron, where they attach to cannabinoid receptors.

Wheeler | CONNECTICUT Clearinghouse
a program of the Connecticut Center for Prevention, Wellness and Recovery

800.232.4424 (phone)
860.793.9813 (fax)
www.ctclearinghouse.org

A Library and Resource Center on Alcohol, Tobacco, Other Drugs, Mental Health and Wellness

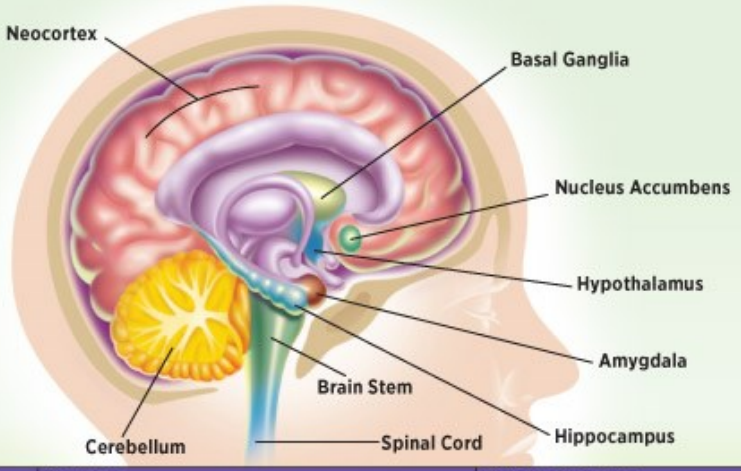
Why is This Important?

Since cannabinoids act on presynaptic cells, they can control what happens next when these cells are activated. In general, cannabinoids function like a "dimmer switch" for presynaptic neurons, limiting the amount of neurotransmitter (e.g., dopamine) that gets released, which in turn affects how messages are sent, received, and processed by the cell.

How Does THC Affect the EC System and Behavior?

When a person uses marijuana, THC overwhelms the EC system, quickly attaching to cannabinoid receptors throughout the brain and body. This interferes with the ability of natural cannabinoids to do their job of fine-tuning communication between neurons, which can throw the entire system off balance.

Because cannabinoid receptors are in so many parts of the brain and body, the effects of THC are wide-ranging: it can slow down a person's reaction time (which can impair driving or athletic skills), disrupt the ability to remember things that just happened, cause anxiety, and affect judgment. THC also affects parts of the brain that make a person feel good—this is what gives people the feeling of being "high". Over time, THC can change how the EC system works in these brain areas, which can lead to problems with memory, addiction, and mental health.



Brain Structure	Regulates	THC Effect on User
Amygdala	emotions, fear, anxiety	panic/paranoia
Basal Ganglia	planning/starting a movement	slowed reaction time
Brain Stem	information between brain and spinal column	antinausea effects
Cerebellum	motor coordination, balance	impaired coordination
Hippocampus	learning new information	impaired memory
Hypothalamus	eating, sexual behavior	increased appetite
Neocortex	complex thinking, feeling, and movement	altered thinking, judgment, and sensation
Nucleus Accumbens	motivation and reward	euphoria (feeling good)
Spinal Cord	transmission of information between body and brain	altered pain sensitivity

The brain structures illustrated above all contain high numbers of CB receptors

Connecticut Resources

Department of Mental Health and Addiction Services
www.ct.gov/dmhas

National Resources

Substance Abuse and Mental Health Services Administration
www.samhsa.gov
1.800.662.HELP (4357)

National Institute on Drug Abuse
www.drugabuse.gov

dmhas