

## **Marijuana** ([http://teens.drugabuse.gov/mom/tg\\_mj1.asp](http://teens.drugabuse.gov/mom/tg_mj1.asp))

Marijuana is the dried leaves and flowers of the cannabis plant. Tetrahydrocannabinol (THC) is the main ingredient in marijuana that causes people who use it to experience a calm euphoria. Marijuana changes brain messages that affect sensory perception and coordination. This can cause users to see, hear, and feel stimuli differently and to exhibit slower reflexes

## **Marijuana Mechanism of Action**

THC, the main active ingredient in marijuana, binds to and activates specific receptors, known as cannabinoid receptors. There are many of these receptors in parts of the brain that control memory, thought, concentration, time and depth perception, and coordinated movement.

By activating these receptors, THC interferes with the normal functioning of the cerebellum, the part of the brain most responsible for balance, posture, and coordination of movement. The cerebellum coordinates the muscle movements ordered by the motor cortex. Nerve impulses alert the cerebellum that the motor cortex has directed a part of the body to perform a certain action. Almost instantly, impulses from that part of the body inform the cerebellum as to how the action is being carried out. The cerebellum compares the actual movement with the intended movement and then signals the motor cortex to make any necessary corrections. In this way, the cerebellum ensures that the body moves smoothly and efficiently.

The hippocampus, which is involved with memory formation, also contains many cannabinoid receptors. Studies have suggested that marijuana activates cannabinoid receptors in the hippocampus and affects memory by decreasing the activity of neurons in this area. The effect of marijuana on long-term memory is less certain, but while someone is under the influence of marijuana, short-term memory can be compromised. Further, research studies have shown chronic administration of THC can permanently damage the hippocampus of rats, suggesting that marijuana use can lead to permanent memory impairment.

Marijuana also affects receptors in brain areas and structures responsible for sensory perception. Marijuana interferes with the receiving of sensory messages (for example, touch, sight, hearing, taste, and smell) in the cerebral cortex. Various parts of the body send nerve signals to the thalamus, which then routes these messages to the appropriate areas of the cerebral cortex. An area of the sensory cortex, called the somatosensory cortex, receives messages that it interprets as body sensations such as touch and temperature. The somatosensory cortex lies in the parietal lobe of each hemisphere along the central fissure, which separates the frontal and parietal lobes. Each part of the somatosensory cortex receives and interprets impulses from a specific part of the body. Other specialized areas of the cerebrum receive the sensory impulses related to seeing, hearing, taste, and smell. Impulses from the eyes travel along the optic nerve and then are

relayed to the visual cortex in the occipital lobes. Portions of the temporal lobes receive auditory messages from the ears. The area for taste lies buried in the lateral fissure, which separates the frontal and temporal lobes. The center for smell is on the underside of the frontal lobes. Marijuana activates cannabinoid receptors in these various areas of the cerebrum and results in the brain misinterpreting the nerve impulses from the different sense organs.

For many years, it was known that THC acted on cannabinoid receptors in the brain. It was hypothesized that since the normal brain produces these receptors, there must also be a substance produced by the brain itself that acts on these receptors. Despite years of effort, however, the brain's THC-like substance eluded scientists, and whether or not such a substance existed remained a mystery. Finally, in 1992, scientists discovered a substance produced by the brain that activates the THC receptors and has many of the same physiological effects as THC. The scientists named the substance anandamide, from a Sanskrit word meaning bliss. The discovery of anandamide opened whole new avenues of research. For instance, since the brain produces both anandamide and the cannabinoid receptors to which it binds, it was thought that anandamide must play a role in the normal functioning of the brain. Not only are scientists studying anandamide, but more recently additional cannabinoid molecules and receptors have been discovered. One of these, 2-arachidonoglycerol, is a substance that is similar to anandamide, and has a role in controlling pain. Scientists are now actively investigating the function of anandamide and 2-arachidonoglycerol in the brain. The research will not only help in gaining a greater understanding of how marijuana acts in the brain and why it is abused, but it will also provide new clues about how the healthy brain works.

The discovery of anandamide may also lead to a greater understanding of certain health problems and ultimately to more effective treatments. When made synthetically and given orally, THC can be used to treat nausea associated with chemotherapy and stimulate appetite in AIDS wasting syndrome. Now that the brain's own THC-like substance has been identified, researchers may soon be able to uncover the mechanisms underlying the therapeutic effects of THC. This could then lead to the development of more effective and safer treatments for a variety of conditions.

Recent research in animals has also suggested that long-term use of marijuana (THC) produces some changes in the limbic system that are similar to those that occur after long-term use of other major drugs of abuse such as cocaine, heroin, and alcohol. These changes are most evident during withdrawal from THC. During withdrawal, there are increases in both the levels of a brain chemical involved in stress and certain emotions and the activity of neurons in the amygdala. These same kinds of changes also occur during withdrawal from other drugs of abuse, suggesting that there may be a common factor in the development of drug addiction.

The following activities, when used along with the magazine on marijuana, will help explain to students how these substances change the brain and the body.

## *Drugs and the Brain - Background Information*

**Marijuana BLOCKS "speed up" messages**

The drug marijuana fits partway into the receptor site for the neurotransmitter **ACETYLCHOLINE**.

This blocks the acetylcholine so that it can't get into the receptor site, and no "speed up" messages can get sent.

**Marijuana affects:**

learning  
memory  
social inhibitions  
brain stem  
perception  
vision  
attention

**Marijuana is also called "weed" or "grass".**

When someone uses marijuana, they get red eyes and a dry mouth, and they feel weak and sleepy.

Someone using marijuana may seem silly because the part of the brain that controls social inhibitions is slowed down.

Scientists have found that people who use marijuana for a long time may have trouble remembering and learning because neurons in those parts of the brain are damaged or killed.

When someone is taking marijuana, they will often feel anxious and restless. They are confused and have trouble concentrating.

Someone using marijuana may say that time slows down a lot. They may seem to see colors more intensely, and have trouble telling how far away things are from them or how big things really are.

The drug marijuana can have different effects on different people. There is no way to know ahead of time how one particular person will react to it.

When people smoke marijuana, the smoke also has a lot of chemicals like tar that can cause cancer, especially in their lungs and mouth.

Receptor for the neurotransmitter,  
**ACETYLCHOLINE**

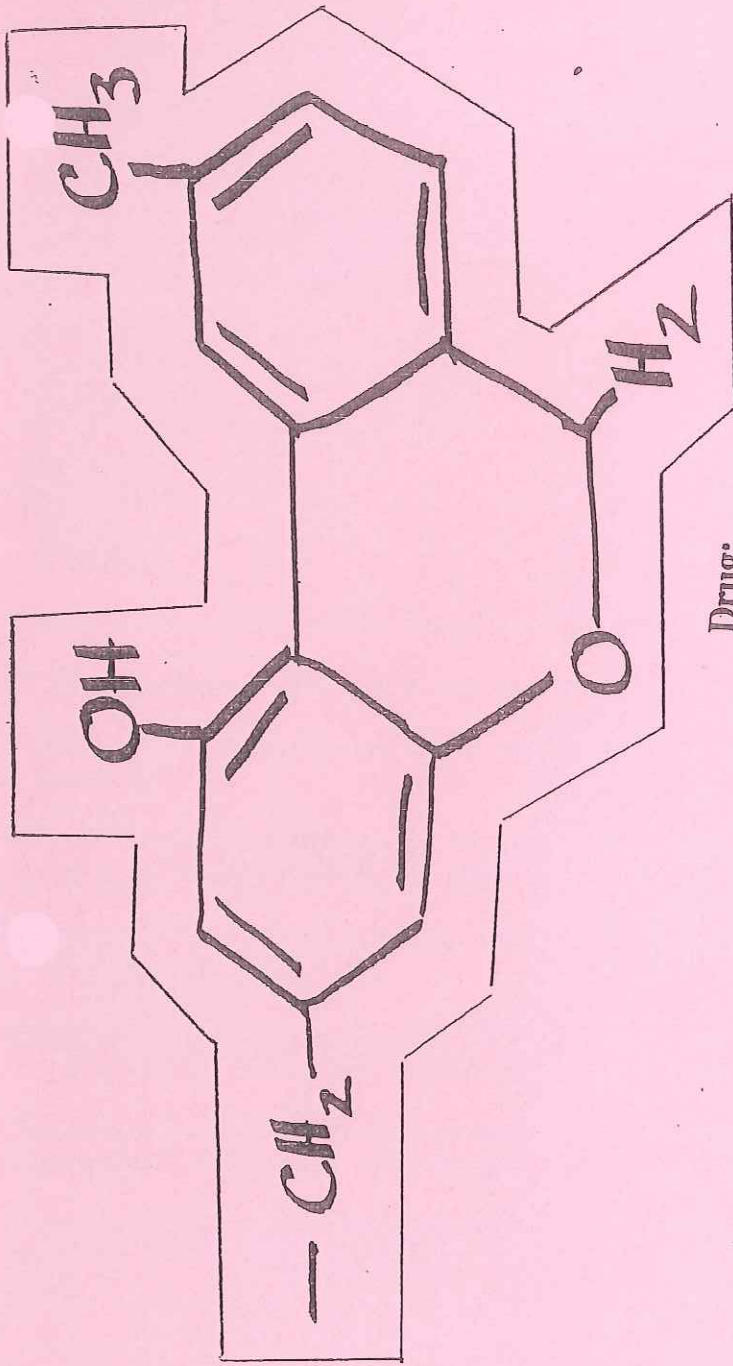
Acetylcholine sends "speed up" messages

Acetylcholine affects:

learning  
memory  
social inhibitions  
brain stem  
perception  
vision  
attention

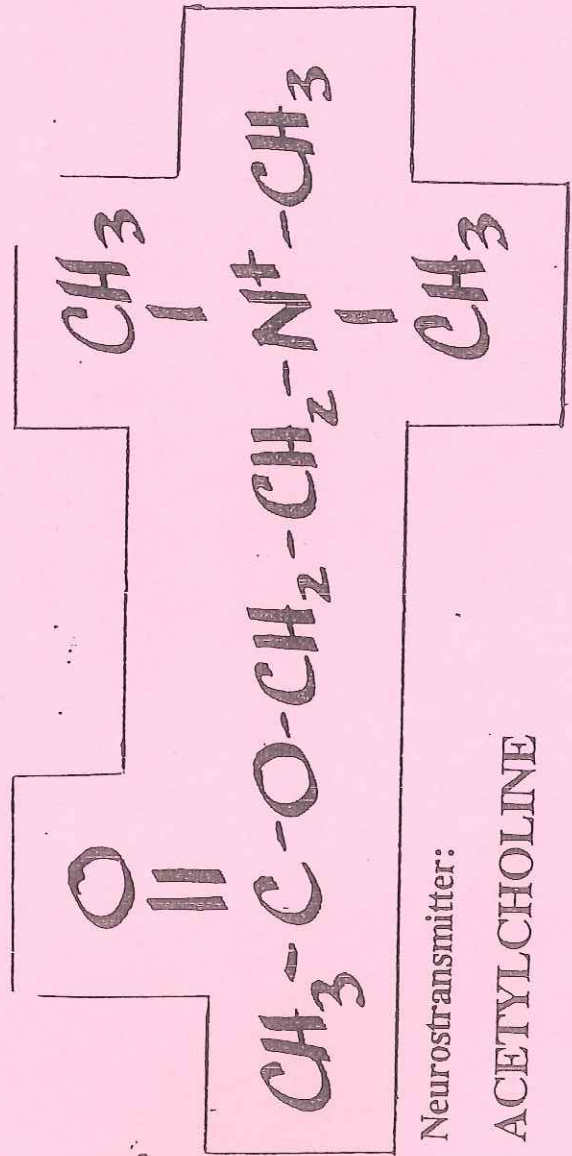
Acetylcholine pathways are associated with learning and memory and with the control of sleep and arousal.

Acetylcholine is also the neurotransmitter that sends messages from nerves to muscles.



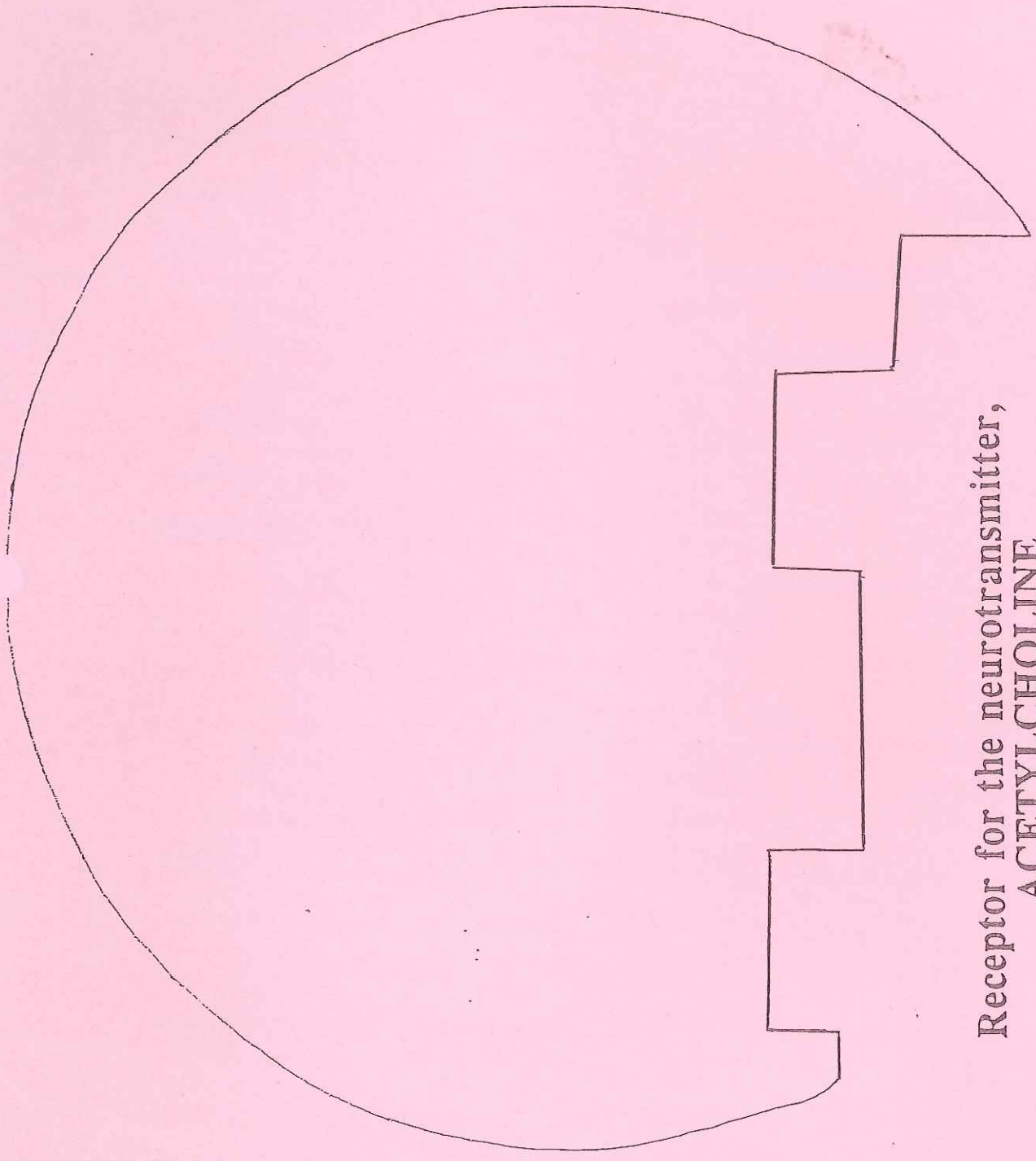
Drug:

MARIJUANA



Neurotransmitter:

ACETYLCHOLINE



Receptor for the neurotransmitter,  
**ACETYLCHOLINE**