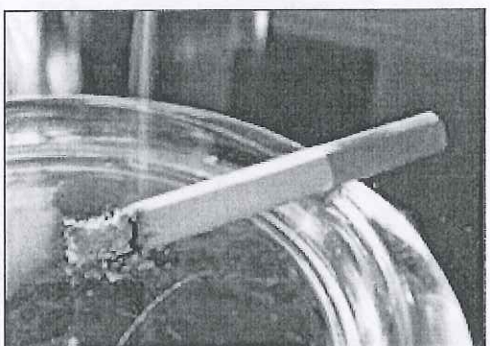
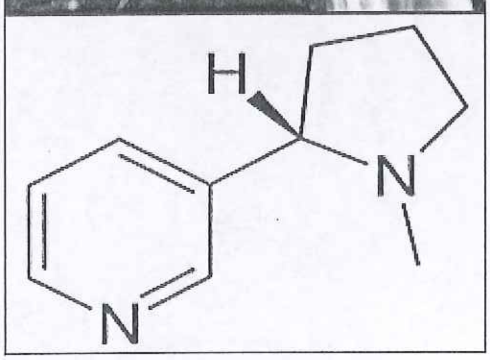
Tobacco

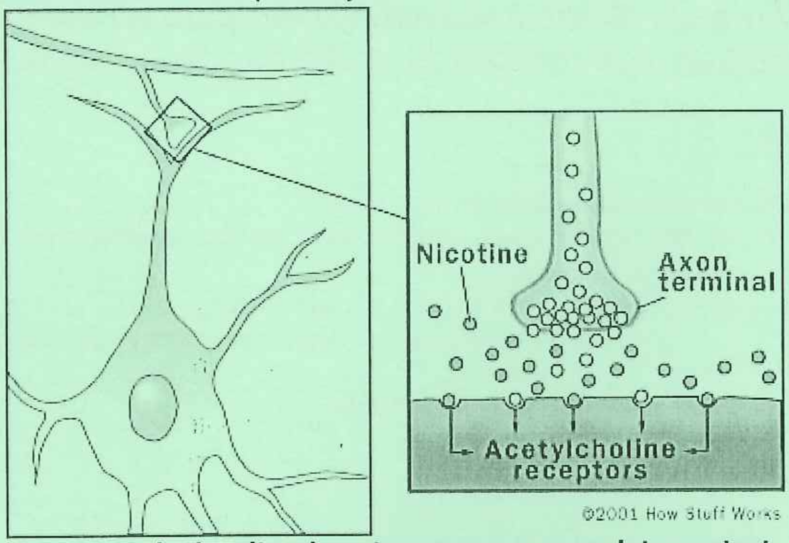
The phrase "tobacco products" refers to numerous different tobacco-based items, including cigarettes, cigars, smokeless tobacco (such as snuff), bidis, Kreteks, and loose-leaf tobacco. Nicotine is the primary addictive toxin found in tobacco; it is a colorless liquid that turns brown when burned and is found in all kinds of tobacco products. It is known to be highly addictive in smaller doses (1-2mg) and can kill the average person in larger quantities. Tobacco products are used among all demographic populations, but approximately 80% of adult smokers (of whom there were 46.5 million in the United States in 2004) started smoking before the age of 18; every day, nearly 4000 youths under the age of 18 try their first cigarette. Among other effects, nicotine stimulates dopamine production in the brain and can cause the user to feel slightly euphoric. However, tobacco use accounts for about one third of all cancer deaths in the United States and is the single most preventable cause of premature deaths. In Indiana it is illegal for anyone under the age of 18 to purchase or accept tobacco for personal use. It is also illegal to knowingly sell tobacco to a person under the age of 18. Violators of these laws are guilty of a Class C misdemeanor.

Pictures

- 
- 

Nicotine and the Brain (http://health.howstuffworks.com/nicotine4.htm)

Your brain is the key player in nicotine's action. Like a computer, your brain processes, stores and uses information. In a computer, information travels in the form of electricity moving through wires; information transfer is a binary process, with switches being either "on" or "off." In your brain, **neurons** are the cells that transfer and integrate information. Each neuron has thousands of inputs from other neurons throughout the brain. Each of these signals is included in the calculation of whether or not the neuron will pass the signal it receives on to other neurons in the pathway.

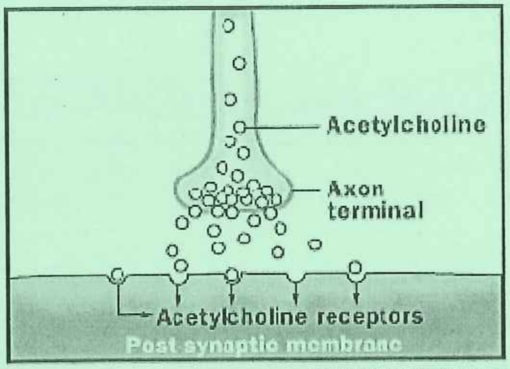


A synapse is the site where two neurons come into contact. The presynaptic neuron releases a neurotransmitter, which binds to receptors on the postsynaptic cell. This allows signals to be transmitted from neuron to neuron in the brain.

While signals are conducted through individual neurons as electric current, communication between neurons is mediated by chemical messengers, called **neurotransmitters**. Neurotransmitters traverse the physical space between two neurons and bind to special protein receptors on the postsynaptic cell. Once bound, these receptors set in motion physiological changes within the neuron that allow it to send the signal on down the line.

Each neurotransmitter has its own specific family of receptors. Nicotine works by docking to a subset of receptors that bind the neurotransmitter **acetylcholine**. Acetylcholine is the neurotransmitter that (depending on what region of the brain a neuron is in):

- Delivers signals from your brain to your muscles
- Controls basic functions like your energy level, the beating of your heart and how you breathe
- Acts as a "traffic cop" overseeing the flow of information in your brain
- Plays a role in learning and memory



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Acetylcholine is released from one neuron and binds to receptors on adjacent neurons.

Like acetylcholine, nicotine leads to a burst of receptor activity. However, unlike acetylcholine, nicotine is not regulated by your body. While neurons typically release small amounts of acetylcholine in a regulated manner, nicotine activates cholinergic neurons (which mainly use acetylcholine to communicate to other neurons) in many different regions throughout your brain simultaneously. This stimulation leads to:

- **Increased release of acetylcholine** from the neurons, leading to heightened activity in cholinergic pathways throughout your brain. This cholinergic activity calls your body and brain to action, and this is the wake-up call that many smokers use to re-energize themselves throughout the day. Through these pathways, nicotine improves your reaction time and your ability to pay attention, making you feel like you can work better.
- **Stimulation of cholinergic neurons** promotes the release of the neurotransmitter dopamine in the **reward pathways** of your brain. This neural circuitry is supposed to reinforce behaviors that are essential to your survival, like eating when you're hungry. Stimulating neurons in these areas of the brain brings on pleasant, happy feelings that encourage you to do these things again and again. When drugs like cocaine or nicotine activate the reward pathways, it reinforces your desire to use them again because you feel so at peace and happy afterwards.
- **Release of glutamate**, a neurotransmitter involved in learning and memory - Glutamate enhances the connections between sets of neurons. These stronger connections may be the physical basis of what we know as memory. When you use nicotine, glutamate may create a **memory loop** of the good feelings you get and further drive the desire to use nicotine.

Nicotine also increases the level of other neurotransmitters and chemicals that modulate how your brain works. For example, your brain makes more **endorphins** in response to nicotine. Endorphins are small proteins that are often called the body's natural pain killer. It turns out that the chemical structure of endorphins is very similar to that of heavy-duty synthetic painkillers like morphine. Endorphins can lead to feelings of euphoria also. If you're familiar with the runner's high that kicks in during a rigorous race, you've experienced the "endorphin rush." This outpouring of chemicals gives you a mental edge to finish the race while temporarily masking the nagging pains you might otherwise feel.

Nicotine (http://www.drugabuse.gov/MOM/TG/momtg-nicotine.html)

Background

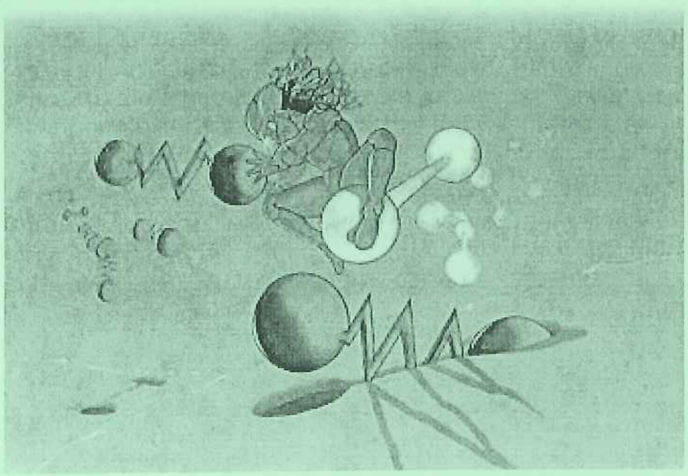
Tobacco, which comes primarily from the plant nicotiana tabacum, has been used for centuries. It can be smoked, chewed, or sniffed. The first description of addiction to tobacco is contained in a report from the New World in which Spanish soldiers said that they could not stop smoking.

When nicotine was isolated from tobacco leaves in 1828, scientists began studying its effects in the brain and body. This research eventually showed that, although tobacco contains thousands of chemicals, the main ingredient that acts in the brain and produces addiction is nicotine. More recent research has shown that the addiction produced by nicotine is extremely powerful and is at least as strong as addictions to other drugs such as heroin and cocaine.

Some of the effects of nicotine include changes in respiration and blood pressure, constriction of arteries, and increased alertness. Many of these effects are produced through its action on both the central and peripheral nervous system.

Mechanism of Action

Nicotine readily enters the body. When tobacco is smoked, nicotine enters the bloodstream through the lungs. When it is sniffed or chewed, nicotine passes through the mucous membranes of the mouth or nose to enter the bloodstream. Nicotine can also enter the bloodstream by passing through the skin. Regardless of how nicotine reaches the bloodstream, once there, it is distributed throughout the body and brain where it activates specific types of receptors known as cholinergic receptors.



Cholinergic receptors are present in many brain structures, as well as in muscles, adrenal glands, the heart, and other body organs. These receptors are normally activated by the neurotransmitter acetylcholine, which is produced in the brain, and by neurons in the peripheral nervous system. Acetylcholine and its receptors are involved in many activities, including respiration, maintenance of heart rate, memory, alertness, and muscle movement.

Because the chemical structure of nicotine is similar to that of acetylcholine's, it is also able to activate cholinergic receptors. But unlike acetylcholine, when nicotine enters the brain and activates cholinergic receptors, it can disrupt the normal functioning of the brain.

Regular nicotine use causes changes in both the number of cholinergic receptors and the sensitivity of these receptors to nicotine and acetylcholine. Some of these changes may be responsible for the development of tolerance to nicotine. Once tolerance has developed, a nicotine user must regularly supply the brain with nicotine in order to maintain normal brain functioning. If nicotine levels drop, the nicotine user will begin to feel uncomfortable withdrawal symptoms.

Recently, research has shown that nicotine also stimulates the release of the neurotransmitter dopamine in the brain's pleasure circuit. Using microdialysis, a technique that allows minute quantities of neurotransmitters to be measured in precise brain areas, researchers have discovered that nicotine causes an increase in the release of dopamine in the nucleus accumbens. This release of dopamine is similar to that seen for other drugs of abuse, such as heroin and cocaine, and is thought to underlie the pleasurable sensations experienced by many smokers.

Other research is providing even more clues as to how nicotine may exert its effects in the brain. Cholinergic receptors are relatively large structures that consist of several components known as subunits. One of these subunits, the ß (beta) subunit, has recently been implicated as having a role in nicotine addiction. Using highly sophisticated bioengineering technologies, scientists were able to produce a new strain of mice in which the gene that produces the ß subunit was missing. Without the gene for the ß subunit, these mice, which are known as "knockout" mice because a particular gene has been knocked out, were unable to produce any ß subunits. What researchers found when they examined these knockout mice was that in contrast to mice who had an intact receptor, mice without the ß subunit would not self- administer nicotine. These studies demonstrate that the ß subunit plays a critical role in mediating the pleasurable effects of nicotine. The results also provide scientists with valuable new information about how nicotine acts in the brain, information that may eventually lead to better treatments for nicotine addiction.

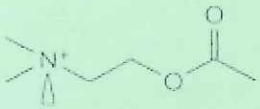
However nicotine may not be the only psychoactive ingredient in tobacco. Using advanced brain imaging technology, it is possible to actually see what tobacco smoking is doing to the brain of an awake and behaving human being. Using one type of brain imaging, positron emission tomography (PET), scientists discovered that cigarette smoking causes a dramatic decrease in the levels of an important enzyme that breaks down dopamine.

The decrease in this enzyme, known as monoamine-oxidase-A (MAO-A), results in an increase in dopamine levels. Importantly, this particular effect is not caused by nicotine but by some additional, unknown compound in cigarette smoke. Nicotine itself does not alter MAO-A levels; it affects dopamine through other mechanisms. Thus, there may be multiple routes by which smoking alters the neurotransmitter dopamine to ultimately produce feelings of pleasure and reward.

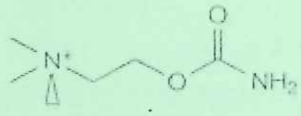
That nicotine is a highly addictive drug can clearly be seen when one considers the vast number of people who continue to use tobacco products despite their well known harmful and even lethal effects. In fact, at least 90% of smokers would like to quit, but each year fewer than 10% who try are actually successful. But, while nicotine may produce addiction to tobacco products, it is the thousands of other chemicals in tobacco that are responsible for its many adverse health effects.

Smoking either cigarettes or cigars can cause respiratory problems, lung cancer, emphysema, heart problems, and peripheral vascular disease. In fact, smoking is the largest preventable cause of premature death and disability. Cigarette smoking kills at least 400,000 people in the United States each year and makes countless others ill, including those who are exposed to secondhand smoke. The use of smokeless tobacco is also associated with serious health problems.

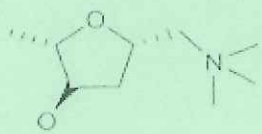
Chewing tobacco can cause cancers of the oral cavity, pharynx, larynx, and esophagus. It also causes damage to gums that may lead to the loss of teeth. Although popular among sports figures, smokeless tobacco can also reduce physical performance.



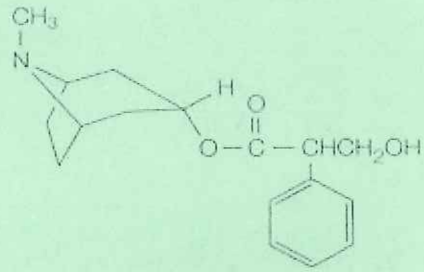
Acetylcholine



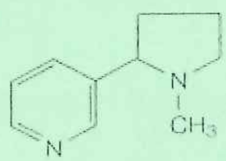
Carbachol



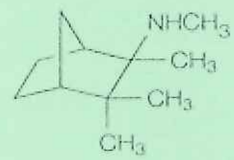
Muscarine



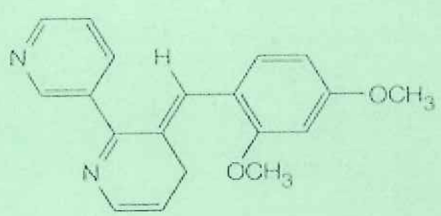
Atropine



Nicotine



Mecamylamine



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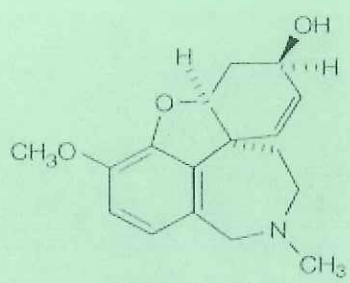

Galantamine

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