

WHAT IS VAPING?

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YOUNG REVIEWER:



ETHAN
AGE: 15

Vaping is a modern method people use to inhale nicotine and other chemicals. Initially introduced as electronic cigarettes or “e-cigs,” these products were promoted to help reduce the health risks of smoking. Within a few years, e-cigarette manufacturers developed new designs, styles, and flavors, and vaping was born. While most kids do not vape, these sleek products have become more popular and put young people’s health at risk. While the negative health effects of smoking tobacco are well-known, many people think of vaping as harmless. Unfortunately, this is not true. This article will discuss the most important impacts from vaping on the brain, lungs, and other parts of the body.

WHERE THE STORY BEGINS: WHAT IS SMOKING?

Smoking is the action of breathing in the gases and small particles that come from burning a plant called tobacco. The leaves of tobacco are most often rolled into white paper tubes called cigarettes. While it may seem unimaginable now, when cigarettes first became popular

in the 1940's, many people thought that smoking was healthy. We now know that the opposite is true: cigarette smoking causes a lot of health problems—including bronchitis, emphysema (a type of lung inflammation), heart disease, and cancer—making smoking the leading cause of avoidable death around the world. The good news is that decades of public health education, along with new ways to help smokers quit, have decreased the number of people who smoke to the lowest numbers ever seen (14% of adults in the USA in 2018) [1].

For generations, scientists, doctors, and inventors have been looking for technology that could stop the damage to people who smoke cigarettes. It started out with people making “light” or “mild” cigarettes. In 2003, a pharmacist from China invented what we today call electronic cigarettes or e-cigs, by dissolving nicotine and other chemicals in a fluid called “juice” or “e-liquid.” When the juice is heated, the liquid becomes a gas that can be inhaled. The parts of the e-cigarette are shown in Figure 1. He hoped his invention would help people who smoke, but we now know that, just like smoking cigarettes, vaping causes injury to the lungs and other health problems.

HOW DO E-CIGARETTES HURT PEOPLE?

Both cigarette smoke and e-cig vapor are inhaled into the lungs and bring chemicals into the blood, but there are important differences. Smoke comes from the *chemical* reaction that happens when oxygen and a flame mix with the compounds inside the tobacco leaves, like a campfire. Smoke is a mixture of hot gases and small particles. Vapor comes from the *physical* change of a liquid to a gas, like boiling water makes steam. While “vapor” sounds harmless, in this case, the vapor carries dangerous chemicals. Because vapor can be inhaled more deeply than smoke, nicotine and other dissolved chemicals can get further into the body and are absorbed in higher doses.

E-cigarette juice (or e-liquid) contains nicotine, flavoring, and other chemicals in a liquid carrier called propylene glycol or glycerol. When the juice is heated to 400–485°Fahrenheit, it becomes a gas that can be inhaled. Because the liquid is heated to such high temperatures, many chemical reactions occur, and we do not always know what new chemicals will be created. We *do* know that e-cigarette gas can contain **toxins** (poisons) including diacetyl, acrylonitrile, propylene oxide, formaldehyde, and crotonaldehyde, amongst others. These toxins are known to cause cancer and asthma-like inflammation.

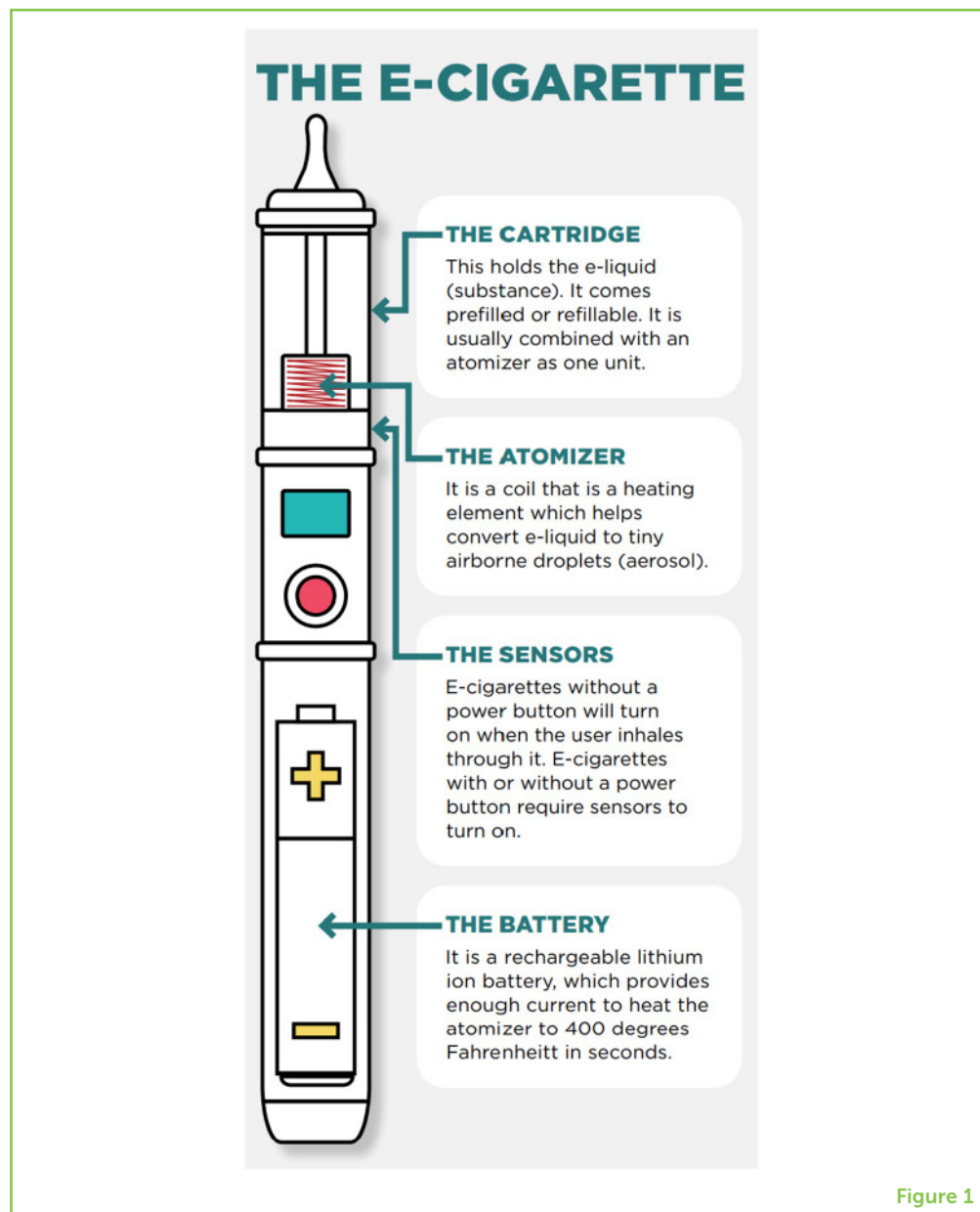
Inside the mouth, immediately after entering the body, gas from the e-cigarette starts its assault. Irritation and damage to the lining of the mouth, nasal passages, and throat can occur with very little exposure. These tissues are also exposed to the cancer-causing chemicals that are carried in the vapor. Once inside the lungs, chemicals from vape

TOXIN

A family of chemicals that cause damage to cells and tissues of the body when they are taken in.

Figure 1

How does an e-cigarette work?
(Image credit: [2]).



gas can cause damaging effects, including increased mucous, airway inflammation, scarring, and in the most severe cases, major problems absorbing oxygen [3].

From 2019–2020, 27 people died from **e-cigarette or vaping-associated lung injury (EVALI)**, many of them young and previously healthy. These people had the most serious form of lung damage from vaping, but many more people who vape have milder forms of lung injury. Sometimes the symptoms—like feeling short of breath quicker than you are used to—are barely noticeable. Some people who vape may think that nothing is wrong at all, but medical tests can still find evidence of lung injury. The good news is that most people’s lungs appear to get better once they quit vaping.

EVALI (OR E-CIGARETTE OR VAPING-ASSOCIATED LUNG INJURY)

The damage to the lung tissues that results in serious breathing problems for some users of vaping devices.

IS THE NICOTINE IN VAPES THE SAME AS THE NICOTINE IN CIGARETTES?

The nicotine in many vape pods is chemically different from the nicotine in tobacco. It has an extra charged particle that allows it to be absorbed through the lungs into the blood more quickly than nicotine from cigarette smoke. Also, the vapor from a vape pen can reach the very small air sacs at the bottoms of the lungs, much deeper than smoke from a cigarette. These two factors together mean that more nicotine is delivered to the brain faster from vaping than from smoking a cigarette. When people vape, they bombard their brains with high concentrations of nicotine, delivered in an instant. The big “nicotine rush” or “buzz” makes vaping even more addictive than smoking cigarettes.

If vaping is not healthier, why did people start doing it? Advertising, misunderstanding of the danger, and addiction to nicotine are all parts of the answer. Companies made cool-looking vapes and then heavily advertised vaping as something fun to do. These same companies claimed that vapes are safe and even healthy! Those claims turned out to be false but, in the meantime, lots of people started vaping and many ended up addicted to nicotine, making it very challenging for them to quit.

WHO IS USING VAPE PENS?

Here’s the scariest part: vape pen use is growing in teenagers and young adults! Because of all the marketing and advertisements that incorrectly told people that vaping was fun and harmless, vape pens became popular with middle- and high-school students over the past 5–10 years. Some people start by vaping “just flavors,” to avoid nicotine. Unfortunately, the flavors and other chemicals in vapes cause lung damage and other health problems. We also know that, sooner or later, most people who start vaping end up switching to e-cigarettes with nicotine in them, and once people start using nicotine, they are likely to become addicted, meaning they lose control over their use of e-cigs and find it hard to quit even when they want to.

VAPING SOUNDS HORRIBLE! WHY DO PEOPLE KEEP DOING IT?

Nicotine is a chemical made by tobacco leaves that looks and acts like a **neurotransmitter** (a normal chemical signal in the brain) called **acetylcholine**. Nicotine is a stimulant, so when it binds to molecules in the brain called **acetylcholine receptors**, it increases brain activity. In low doses, nicotine can help people concentrate, just like the medications that are used to treat attention-deficit/hyperactivity disorder (ADHD). Some people may find it tempting to use nicotine

NEUROTRANSMITTER

Small molecules that act as signals between neuron cells of the brain.

ACETYLCHOLINE

A neurotransmitter sent out from one neuron that excites or activates another neuron.

ACETYLCHOLINE RECEPTOR

A protein switch that sits on neuron outer membranes, that excites the cell when it is turned on by our own acetylcholine or vaped nicotine.

Figure 2

These brain scan images show the activity of brain cells after increasing doses of nicotine are inhaled from regular cigarettes. The images are oriented as if we were looking down on the brain from above. The blue spots show the brain areas where nicotine binds to the acetylcholine receptors on the brain cells. You can see that increasing doses of nicotine clearly acting on cells throughout the brain from front to back. Nicotine impacts many regions and functions of the brain each time it is used (Image credit: [4]).

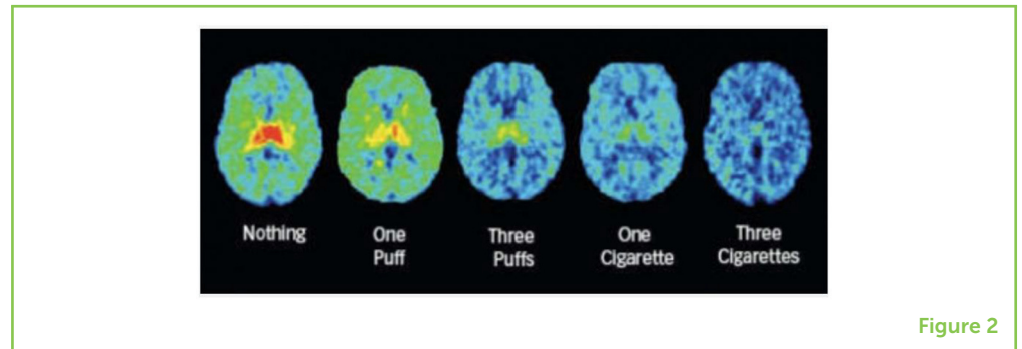


Figure 2

to help them focus better. The problem is that the dose of nicotine from vaping is too high and too short lasting. Figure 2 shows how widely and intensely nicotine can bind to the acetylcholine receptors in the brain. The high level of nicotine found in e-cigs actually makes it *harder* to concentrate. Because nicotine comes and goes so quickly, people who use it repeatedly get withdrawal symptoms. **Withdrawal** is when your brain and body start missing and looking for the powerful chemical they are used to. Symptoms of nicotine withdrawal can include headaches, nausea, and irritability—these symptoms can make it even *harder* to concentrate. While nicotine can make it difficult for *anyone* to concentrate and do well at school, people with ADHD are especially vulnerable because nicotine can make their symptoms worse.

WITHDRAWAL

The unpleasant physical and mental experience that can occur when a person stops using a substance that was acting on the brain.

DOPAMINE

A neurotransmitter that activates neurons in parts of the brain involved in feeling rewards and addiction.

NICOTINE CHANGES OUR BRAINS!

When people use nicotine, they get a rewarding sensation that is similar to the “high” from other drugs, but much briefer. Like other drugs, nicotine boosts the neurotransmitter **dopamine** in certain areas of the brain called reward circuits. Activating reward circuits feels good and reinforces drug use. If use continues, nicotine changes the brain circuits involved in learning, stress, and self-control. When these changes happen, people develop what we call addiction, or loss of control over their use. In other words, even though they want to stop using nicotine, they find it really hard to quit.

Using nicotine can cause some other problems too, especially in teenagers whose brains are still developing. Disturbing acetylcholine receptors when the brain is maturing can change how the brain works. Scientific evidence shows that nicotine interferes with the parts of the brain that are needed for learning throughout life. People who use nicotine as teenagers are also more likely to become depressed when they are adults.

IF SOMEONE OFFERS YOU A VAPE, REMEMBER THIS!

Vaping nicotine is expensive, can damage the lungs and lead to other health problems, and can also cause difficulties with concentration, learning, and mood. The prevalence of vaping has increased among young people because of the myth that e-cigarettes are a safe way to use nicotine. The big burst of nicotine people get from vaping can lead to addiction and problems with brain development.

Quitting nicotine is challenging, especially for people who have become addicted. On the bright side, there are medications that can help treat the discomfort from nicotine withdrawal symptoms and reduce nicotine cravings. If you think you or someone you know has become addicted to nicotine, ask a parent, doctor, or teacher for help. Young people need accurate information about the dangers of vaping so they can make the best decisions about protecting their health. If you have questions, do not trust what you see in an ad or on social media! Ask a parent, teacher, or healthcare professional for accurate information. Together with support from friends, relatives, and professional counselors, we can all help people quit vaping!

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YOUNG REVIEWER



ETHAN, AGE: 15

Hi! My name is Ethan. At my regional science fair, I won Best Junior Project, Best Biology Project, Gold Medal, and a qualification to the Canada-Wide Science Fair, where I achieved a bronze medal. I have also been a finalist at the InspoScience Canada IRIC. Besides, I enjoy debating, having won the title of national champion and second speaker this past year, and public speaking. I am an avid writer, being published for my poems, short stories, and argumentative articles.

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