Caffeine and Adenosine:

Why do so many people consume so much caffeine?

Why does caffeine wake you up?

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As adenosine is created in the brain, it binds to adenosine receptors. The binding of adenosine causes drowsiness by slowing down nerve cell activity. In the brain, adenosine binding also causes blood vessels to dilate (presumably to let more oxygen in during sleep). To a nerve cell, caffeine looks like adenosine. Caffeine therefore binds to the adenosine receptor. However, it doesn't slow down the cell's activity like adenosine would. The cell cannot "see" adenosine anymore because caffeine is taking up all the receptors adenosine binds to. So instead of slowing down because of the adenosine level, the cells speed up. You can see that caffeine also causes the brain's blood vessels to constrict, because it blocks adenosine's ability to open them up. This effect is why some headache medicines like Anacin contain caffeine -- if you have a vascular headache, the caffeine will close down the blood vessels and relieve it.
So now you have **increased neuron firing** in the brain. The pituitary gland sees all of the activity and thinks some sort of emergency must be occurring, so it releases hormones that tell the adrenal glands to produce adrenaline (epinephrine).

Adrenaline is the "fight or flight" hormone, and it has a number of effects on your body:
1) Your pupils dilate.
2) Your breathing tubes open up (this is why people suffering from severe asthma attacks are sometimes injected with epinephrine).
3) Your heart beats faster.
4) Your blood vessels on the surface constrict to slow blood flow from cuts and also to increase blood flow to muscles.
5) Blood pressure rises.
6) Blood flow to the stomach slows.
7) The liver releases sugar into the bloodstream for extra energy.
8) Muscles tighten up, ready for action. This explains why, after consuming a big cup of coffee or a caffeine soda, your hands get cold, your muscles tense up, you feel excited and you can feel your heart beat increasing.

Caffeine also increases dopamine levels in the same way that amphetamines do (heroine & cocaine also manipulate dopamine levels by slowing down the rate of dopamine re-uptake).
Dopamine is a neurotransmitter that, in certain parts of the brain, activates the pleasure center. Obviously, caffeine's effect is much lower than heroin's, but it is the same mechanism. It is suspected that the dopamine connection is part of caffeine addiction. So you can see why your body might like caffeine in the short term, especially if you are low on sleep and need to remain active. Caffeine blocks adenosine reception so you feel alert. It injects adrenaline into the system to give you a boost. And it manipulates dopamine production to make you feel good.

The problem with caffeine is the longer-term effects, which tend to spiral. For example, once the adrenaline wears off, you face fatigue and depression. So what are you going to do? You take more caffeine to get the adrenaline going again. As you might imagine, having your body in a state of emergency all day long isn't very healthy, and it also makes you jumpy and irritable. The most important long-term problem is the effect that caffeine has on **sleep**. Adenosine reception is important to sleep, and especially to deep sleep. The half-life of caffeine in your body is about 6 hours. That means that if you consume a big cup of coffee with 200 mg of caffeine in it at 3:00 PM, by 9:00 PM about 100 mg of that caffeine is still in your system. You may be able to fall asleep, but your body probably will miss out on the benefits of deep sleep. That deficit adds up fast. The next day you feel worse, so you need caffeine as soon as you get out of bed. The cycle continues day after day.

This is why 90% of Americans consume caffeine every day. Once you get in the cycle, you have to keep taking the drug. Even worse, if you try to stop taking caffeine, you get very tired and depressed and you get a terrible, splitting headache as blood vessels in the brain dilate. These negative effects force you to run back to caffeine even if you want to stop. If you are interested in breaking the caffeine cycle in your life, read the book ***Caffeine Blues*** (especially Chapter 10).
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