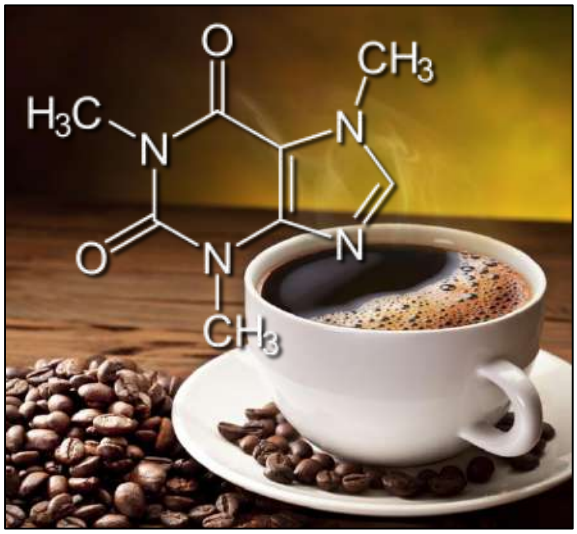
THE CURIOUS CASE OF CAFFEINE

(1) Imagine a world where 90% of the people around you use a white powdery substance daily in order to alter their mental and emotional state. You don't have to imagine this world, it is the one that currently surrounds you now! Caffeine, in its pure form, is a bitter, white powdery substance that is scientifically called 1,3,7-trimethylpurine-2,6-dione with a chemical formula of $C_8H_{10}N_4O_2$. It is most famously found in coffee but it is also consumed in tea, sodas, energy drinks and chocolate.

(2) Caffeine is the world's most widely consumed psychoactive drug. Psychoactive means that it changes how your brain functions. In the case of caffeine, the main mental changes involve increased mental alertness, greater focus and better thought processing, as well as a feeling of added energy and wakefulness. Besides the mental effects, caffeine also has body effects like increased heart rate and blood pressure and short-term increases in stamina and endurance.

(3) Due to these effects, caffeine has been used as a daily energy booster for coffee and tea drinkers for centuries. It has also been used by students to help them stay alert and awake to cram for exams and by truck drivers to drive long hours throughout the night. Because caffeine also temporarily boosts energy, it can be mixed in with other street drugs to enhance the stimulating effects of the drugs. It can also be found in weight loss pills which make claims that the caffeine can suppress appetite and increase caloric burning.

(4) Caffeine's effects are due to many factors but one major one is that caffeine binds to the adenosine receptors found in the neurons of the brain. Normally the brain produces a chemical called adenosine which binds to adenosine receptors and causes neurons to decrease their activity and this causes a feeling of drowsiness. When present, caffeine binds to adenosine receptors and blocks the ability of adenosine to bind and act. This prevents the neurons from slowing down and even causes them to increase their activity. This promotes a feeling of wakefulness and mental alertness.



(5) There is a secondary effect to this rapid neuronal activity. The pituitary gland in your brain senses the increased activity and thinks that your body is undergoing a stressful situation. This causes the pituitary to release a hormone called adrenocorticotropic hormone (ACTH) which triggers the adrenal glands to produce a hormone called adrenaline.

(6) Adrenaline initiates the body's "fight or flight" response which prepares you to handle a stressful situation. Imagine if you were confronted with an angry bear, your body will have to get ready to either "fight" or run away ("flight"). For either response, your body needs to be prepared in the same way. As adrenaline floods your body, your heart will beat faster, your blood pressure will increase, you will breathe faster to deliver more oxygen to your muscles and the flow of blood will be redirected to your muscles to prepare you to spring into action. This is why caffeine users feel a rush of energy. The caffeine tricks the body into preparing for a stressful situation even if someone's just preparing to start their day.

(7) Despite the energy boosting effects of caffeine, the average caffeine drinker isn't possessed with an abnormal amount of energy. The reason for this is because regular drinkers develop a tolerance for the effects of caffeine. After continued use, the normal dose of caffeine doesn't produce the added stimulating effects it once did. This is because the body

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constantly tries to adjust to the increased caffeine intake in order to bring you back to normal. There are different mechanisms that might produce this normalization. Some studies show that in response to increased caffeine intake, your brain creates more adenosine receptors to compensate.

(8) For regular coffee drinkers who have developed a tolerance, the absence of caffeine produces withdrawal symptoms like fatigue, irritability and headaches. The only way to prevent this is to consume caffeine again. Thus the cycle of caffeine addiction can begin. In addition, caffeine's addictive properties may also be related to those of cocaine and heroin. All three drugs cause dopamine to increase in the brain. Dopamine activates your brain's pleasure centers and makes you feel good which reinforces caffeine use.

(9) Though caffeine is generally considered safe, people can overdose if too much is consumed. One cup of coffee contains 75mg-150mg of caffeine so it would take 60-130 cups of coffee to kill a person as the toxic lethal dose is 10g or greater. Though it is unlikely that a person would kill themselves by drinking coffee, the abuse of powdered caffeine supplements can produce lethal effects with just a tablespoon. There have been cases of death associated with this type of misuse.

Article Questions

1) In the chart below, list the mental and physical effects that caffeine has on the body.

Mental Effects	Physical Effects

2) How does caffeine help the brain feel more alert?

3) What is the "fight or flight" response and how does caffeine trigger this response?

4) If caffeine is supposed to boost energy, why do regular coffee drinkers seem like they have only normal amounts of energy instead of enormous amounts of energy?

5) Explain two reasons why caffeine can become an addictive habit.