CHEM 101 PROJECTS

Introduction to Chemistry

Section G

Bellevue Community College

Instructor: Jennie K. Mayer

Fall 2005

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The Mixture of Money

by David Alford

Millions of Americans today make purchases and conduct transactions. Passing back and forth over the counter, coins are a large part of everyday life. But how many people know what their money is truly made of? Most currency being made today are composed of alloys, combinations of metals. These alloys are used for several reasons, including cost, durability, and even convenience. In addition, alloys determine other features of coins as well.

A good example of alloys being used in money is the penny. “[It] was first made of pure copper…In 1837 [,however,] the mint added zinc and tin to the mix” [1]. Since then, the penny’s composition has changed many times. In 1982, for instance, the penny changed from being 95 percent copper and 5 percent zinc to 97.6 percent zinc and only 2.4 percent copper [2].

When this switch occurred, most of the characteristics of the penny changed. “The mass of [the old] penny was 3.1 grams…, but a penny [made] after 1982 weighs 2.5 grams” [3]. At first, this may seem odd since zinc is heavier than copper. The reason for the apparent contradiction is that copper is denser than zinc. Copper’s density is 8.96 grams per cubic centimeter, while the density of zinc is only 7.13 grams per cubic centimeter [4]. Increasing the amount of zinc, and decreasing the amount of copper, significantly reduced the penny’s mass.

Yet, in all this, the size and shape remained identical. Due to the copper coating, the coin’s appearance also was unchanged (save that the date was enlarged on some of the coins).

The main reason behind the 1982 switch in alloys was cost. “A zinc penny costs 6/10 cent to manufacture, compared to 8/10 cent for the old copper coin” [2], “[resulting] in over $830,000,000 in material cost savings to the United States Government” [5]. By altering the alloy, much money was saved.

Another reason alloys are used is for durability. The United States Mint stopped putting silver in common currency in 1964. Today only a handful of different coins are made from silver. Most of these are un-circulated (they have never been released into circulation). However, even these coins are not pure silver. Even though they are consider silver coins, they actually have some copper mixed in. The silver state quarters made in 1999 are ten percent copper [6]. These silver-copper alloys are called “coin silver” [7].

Why do they mix in the copper? Unlike the 1982 penny, it’s not because of cost. It’s because of durability. Precious metals, like silver or gold, are not very strong. If minted pure, they would be much more prone to damage such as scuffing, denting, or even chipping.

A third reason for using alloys in coins is simply convenience. In 1943, World War II was taking its toll on, among other things, the U.S.’s copper supply. The Mint decided to substitute steel for the copper in the pennies. “The copper released was enough to meet the combined needs of two cruisers, two destroyers, 1242 flying fortresses, 120 field guns and 120 howitzers; or enough for one and one-quarter million shells for our big field guns” [8]. In 1944, the Mint swapped the steel out for a new alloy, obtained from old bullet shells [8]. These alloys and others were simply available at the time, and therefore used.

These are only some of the reasons alloys are used in coins. It’s not surprising that the application of chemistry to the minting of currency has resulted in several benefits. Of course, not many people would guess that there is more copper in silver state quarters then in regular ones [6]. One could never test this fact without studying their composition. So the next time you are at the checkout counter, think for a moment of what those coins, stamped with “In God We Trust”, are made of.

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Roles of serotonin in the human body and correcting chemical imbalances

by Veronica Bibikova

Civilized man has long pondered the bottomless pit of mystery that is the human brain. It is only as recently as the late 20th century that advancing technology has allowed scientists to peer into the complex marvel of machinery that houses grand consciousness; the mind; the ego; the self. With the expansion of scientific knowledge, fields such as neuroscience, medicine, psychotherapy and pharmacology have advanced far enough into the (truly) final frontier to offer humanity in the next century an unsurpassed advantage to those preceding it.

In the present era, unlike any other since the beginning of time, most of us have received enough exposure to science to be well familiar with the neuron, or nerve cell; "the basic building block of the nervous system". (1) The brain houses around 100 billion neurons of various types, and many more glial cells supporting them, which make up roughly 90% of the cells of the brain. (2) Communication between the several types of neurons present in brain tissue facilitates all cognitive and physiological functions, and occurs through a process called the neural synapse.

Neurons, the cell components of the peripheral and central nervous systems, communicate through neural "firing", or electrical signaling, between the axon terminal (message carrying extension) of one neuron and the dendrite (message receptor) of another. Separating the two lies the synaptic cleft, or the neural "Grand Canyon", a junction which the neural impulse cannot cross alone, and therefore an appropriate neurotransmitter (chemical messenger) is released by the sending neuron to bind at receptor site and relay the message across the gap. (Since it is in the hypothalamus that basic body drives as well as certain aspects of emotion are governed, several major neurotransmitters are concentrated in this area of the brain.) (1)

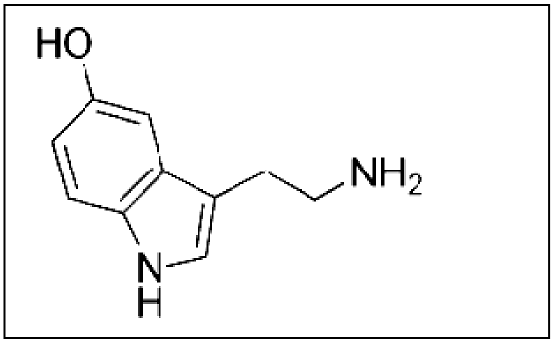
One such neurotransmitter, a vital chemical messenger, is **serotonin**, or **5-Hydroxy-tryptamine**, with the chemical formula $\mathbf{N_2OC_{10}H_{12}}$. (5) The bulk of the molecular mass of the single serotonin molecule, 176 g/mol, is attributed to carbon, which makes up 68% of the overall. (5)

Contrary to chemical function, the name serotonin refers to a vasoconstrictor (blood vessel constrictor) component in the blood, and was named as such in 1948 when the molecule was first isolated. (7) The name 5-Hydroxy-tryptamine, or 5-HT, has now been adopted in the field of pharmacology, and accurately describes neurotransmitter structure. (5)

Serotonin is comprised of a 6-carbon benzene rings and a five-membered pyrrole ring (indole functional group), an amino group (NH_2), and a hydroxyl group (OH), a functional group which characterizes an alcohol molecule. (13, 15, 6, 4) A benzene ring is an organic chemical compound in which a varying number of carbon atoms bond to three other atoms to secure their octet electron configuration; two other carbons and a hydrogen atom. (Hydrocarbon) (3) A pyrrole is a five hydrocarbon ring containing nitrogen.

In the human body, serotonin is synthesized from one of 20 common amino-acids of genetic coding; tryptophan (abbreviated Trp), codon *UGG*, and having the chemical formula $C_{11}H_{12}N_2O_2$. (11) Trp serves as a "precursor" for serotonin, as well as melatonin, the primary neurohormone involved in regulation of the sleep cycle, and LSD, a hallucinogen that mimics the effects of serotonin in neural synapses. (11, 5) Manufactured from the amino-acid trytophan, serotonin is a tryptamine ,(3-(2-aminoethyl)indole).(13)

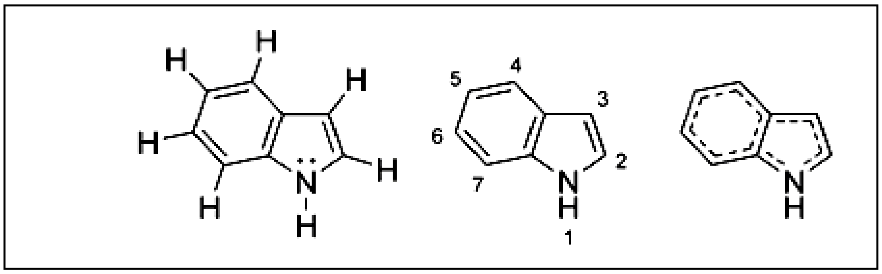
The functional group (dictating chemical properties, bonding trends and active sites in the body) of both Trp and it's derivative, serotonin (5-HT), is the organic compound indole. (5, 11, 13) Named for the word indigo, a blue plant-derived pigment, and widely abundant in nature, indole is characterized by it's two ring structure. (15) At the molecular level, indole is a hexagonal benzene ring (six-membered hydrocarbon) bonded to a pentagonal pyrrole, (5-membered hydrocarbon containing nitrogen), a "heterocyclic organic compound". (4, 15) The carbons within indole, and consequently serotonin, are joined with both single and double bonds.



SEROTONIN (**5-Hydroxy-tryptamine**) (5)

Serotonin is synthesized at multiple sites within the body, including the gastrointestinal tract. In the medulla oblongata, pons and midbrain (located atop the spinal chord), serotonin is produced in the Raphe Nuclei, which are small, dense bundles of neural tissue. (9) The Pineal Gland, however, located deep within the hypothalamus, is accredited with having the capacity to produce over 3000 ng of serotonin, making it by far the largest synthesizer of serotonin in the body. (14) Only 5 to 10 mg of serotonin are present within the average adult body at any given time, with 90% concentrated in the intestinal tract and the rest circulating in blood platelets and in the brain. (7)

Serotonin, aside from regulating mood, affects multiple other behaviors and body systems, since axons of serotonergic (serotonin generating) neurons extend into various sections of the brain. (9) Mediating neural impulses, serotonin is directly involved in the control of “appetite, sleep, memory and learning, temperature regulation, mood, behavior, cardiovascular function, muscle contraction, endocrine regulation and depression.” (7) Interestingly enough, 5-HT also functions as an irritant, found in scorpion venom and wasp stings. (7) The injection of pure serotonin into the blood stream results in the onset of symptoms associated with both, such as nausea, gasping and pain. (7)



INDOLE (15)

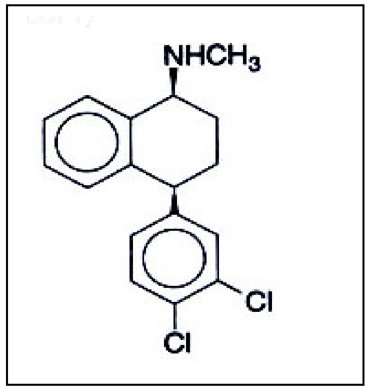
In the synthesis of serotonin from tryptophan, tryptophan hydroxylase, an enzyme catalyzing the reaction, bonds a hydroxyl group (OH) to Trp's benzene ring at carbon 5, creating an intermediate product, 5-hydroxytryptophan. A carboxyl (COOH) group is then removed from the intermediate by decarboxylase, a second enzyme and amino acid, leaving 5-hydroxytryptamine; 5-HT; serotonin. (8) In the body, foods such as bananas, milk and turkey (think post-Thanksgiving dinner happy and sleepy), as well as fatty fish, such as salmon, which contain high quantities of omega-3 fatty acids, promote the above reaction by keeping levels of Trp at optimum level. (Complex carbohydrates and vitamin C also aid in serotonin production.) (8)

A deficiency in Trp levels can significantly impair serotonin production and promote the onset of depression, as well as disturbing a wide variety of psychological & physiological functions, such as sleep, concentration and appetite. Not surprisingly, a plethora of psychiatric disorders are characterized in whole or in part by the systematic imbalance of serotonin, with bipolar disorder and major depressive disorder correlated most closely. It is also important to note that although increasing consumption of Trp rich foods is often beneficial in the treatment of mild/ seasonal depression, clinical depressive disorder is rooted firmly in biological factors, and therefore requires mediation with psychotropic drugs as a first plan of treatment. (10)

One such psychotropic agent (brain chemistry altering substance), is Sertraline, an antidepressant of the SSRI (Selective Serotonin Re-uptake Inhibitor) class, otherwise identified by it's popular brand name, Zoloft. For clinically depressed patients, who characteristically exhibit below-normal levels of serotonin in neurological synapses, (which is below 5-10 mg for an adult individual in the overall body system including brain, blood and gastrointestinal tract), an SSRI such as Zoloft, taken daily for a period of three to six weeks, will begin to inhibit the re-absorption of serotonin after neural firing. (Serotonin is thought to be minimized when re-uptake occurs too quickly after a synapse, or in too-large quantities.) (16)

Three benzene rings, (two containing all double bonded carbon atoms), two chlorine atoms and a methyl-amine ($NHCH_3$) group comprise the sertraline molecule. The methyl group (methylene, CH_3) does not exist alone in nature (due to carbon's incomplete valence orbitals), but as a component of many organic substances, such as methyl alcohol, methyl ether and methyl amine, as in the sertraline molecule. (18) (Interestingly, the methyl-amine group is also characteristic of both the drugs methadone and ecstasy.)

ZOLOFT (Sertraline) (17)



Zoloft and other drugs like it are deemed “selective” because they are highly specialized to bond only at the serotonin receptor site, ignoring all other enzymes and neurotransmitters in the body. (16) (How and when an enzyme/neurotransmitter bonds is determined by it’s molecular shape, which, in turn, is reliant on functional groups and structure of the molecule.) Only the re-uptake of serotonin is effected, resulting in a higher concentration of 5-HT at the synapse for longer periods, better neural communication and elevated mood.

As the quantity of diagnosed cases of mental disorders per year has increased steadily in the past three decades (beginning at about the same time the Cambrian explosion of psychotropic drugs occurred in the mid 1970’s), awareness and tolerance of mental afflictions has also increased. While this is perhaps due to the increased media sponsorship by pharmaceutical companies selling newly developed drugs each year, which in turn is probably positively correlated to the expanding the realm of known disorders of various types, for the individual truly in need of medication therapy, such as cases of schizophrenia and depression (flaws in chemistry not in character), mediation with psychotropic drugs is a new lease on life.

Having the scientific knowledge and tools to correct faulty wiring problems in the brain, and enabling the mentally disordered to experience life with the same functional biological framework as non-afflicted individuals is a tremendous and wonderful leap in the treatment of diseases that have been around since the dawn of man. Previously attributed to demonic possession and unorthodox religious following, the mentally ill were previously subjected throughout history to “treatments” which include but are not limited to; burning at the stake, castration, and “therapeutic” bleeding, as well as the disturbingly recent lobotomy (a severing of the connective tissue between the left and right brain hemispheres, performed in the early 1950’s to the early 1960’s).

Due to the expanding range of scientific understanding, such that of roles neurotransmitters including serotonin, dopamine, norepinephrine and GABA play in the body, among many others, we now have the capability to treat bipolar disorder in the same manner we treat heart disease. The headway made in the medical field in the span of a century is both baffling and mesmerizing when one stops to consider what the norm has been for all the time that we have inhabited the planet. In terms of contribution to our civilization, if nothing but penicillin (and maybe soap) had come out of the 20th century that in itself would be deserving of applause. However, for Zoloft alone, nothing short of fireworks would be appropriate.

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What is Teflon?

by Janice Chae

The chemical that I wanted to focus on was Teflon. It made me want to know what was so unique about it. Teflon is used in many cleaning products as well as products for the use in the kitchen such as cookware and utensils. I always thought that Teflon was just a stronger element put into the bathroom products to make it clean faster. The reason why is because I always wanted to know what it did because I have a toilet cleaner that said it has Teflon in it. Since there are many different name brand bathroom products advertised, I got interested in what Teflon could do for my toilet. It made my toilet cleaner and stay cleaner longer than the other toilet cleaner I had. Teflon is a plastic that is very smooth and does not react chemically with other substances. It is used in industry and as a surface for cooking pans so that food does not stick to the pan. [1]

Chemical compounds that are in Teflon contain carbon and fluorine. Since carbon and fluorine are both non-metals, I can see how Teflon comes into a liquid form. There are probably other additives in the cleaning product such as the smell and color, but the formula for Teflon still stays the same. In the picture given in my notes, it shows that the carbon and fluorine are jointed together all the way around. The formal term for Teflon is tetraflouroethylene or polytetrafluroethylene. According to my learning so far, I only know the prefixes of “poly” and “tetra.”

I was surprised how the chemist who discovered Teflon used the term “tetra.” Normally, people never really hear those prefixes except for chemists, biologists, scientists, etc. Since “tetra” means four, then that probably explains the fluorine part of Teflon. “Tetrafluro” means four F atoms on a two carbon repeating unit. Carbon has four openings in its atom which the fluorine filled those four spots. So the bonding between carbon and fluorine are equal. Fluorine has a -1 charge, which has one hole in its atom and that one hole bonds itself to the four holes atom carbon.

Visual of the formula:

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  F F F
R-C-C-C-R        "R" means repeating
  F F F
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Where you can find Teflon in the kitchen is if you have non-stick coated pots and pans. Teflon is also used for cookware to prevent food from sticking onto the pots and pans. It makes a layer onto the pan so the heat won't even be able to break apart the Teflon particles. There were some issues on Teflon coated cookware though. It talked about how cookware with Teflon constructed too much heat onto the pots and pans which overheated the pots and pans which made it to crack the cookware just a little bit. Also, workers and/or chemists that breathed fumes from heated Teflon were getting sick. It might not be for all people, but for some the chemicals in Teflon aren't good for their body. But overall, Teflon is useful for cookware because of the non-stick affect while cooking which makes it easier to clean. But all cookware also tend to wear down after a very long period of use. It's also the same for bathroom products that have Teflon in them.

As for bathroom products, Teflon is added to bathroom products for its power to clean and coat the toilet to prevent the toilet from building up dirt faster. Taking Clorox bleach with Teflon for example, there are some products for the shower and toilet. There were many questions asked about whether the Teflon would make the shower surface slippery. The answer to that frequently asked question was no. [2]. The reason being is that since showers are normally slippery, Teflon doesn't make it more slippery. Even though Teflon is known for being one of the most slippery products there are, it's basically just a coating which lasts for quite a while, just like waxing a car. Teflon isn't visible so that's another advantage of having it with some bathroom cleaners. The Teflon doesn't stay on forever. It washes away approximately about ten times before to clean again with products with Teflon. The reason why is because of the experiment I did while cleaning my dirty toilet. It's hard to remember how many times the toilet was used and flushed, so my calculations could be wrong on how long the Teflon will stay on.

The history of Teflon was that it was made by chemist named DuPont. DuPont's studies originated at the Jackson Laboratory in New Jersey. [3]. DuPont's name became real famous as towards his product Teflon. It was started to use it on cookware and cleaning products. Now Teflon has even gotten further into using it for automobiles and even electronics. This chemist had invented something useful to the society that I assume that almost every person has a household item that contains Teflon and just not know it. The invention of Teflon was described as an experiment done that was uncalled for and had made a very useful product. [3].

The main reason why I wanted to focus on the topic of Teflon is to find out what it did to my toilet while I used that cleaning product that had that stuff in it. At first I just bought it because it seemed to sound that if it had Teflon, an extra ingredient to the cleaning product, that it would make it more clean and stay cleaner longer. Now I know that Teflon is something that has been around for a long time and is very useful, not only for cleaning products, but for cookware and other things as well. Teflon is a well-made product by DuPont and is down in history for the positive outcomes that came out of his research and discovery of it.

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How Televisions Work

by Kevin Chau

Television has advanced over decades of science and technology. Cathode Ray Tube technology or CRT started the boom in TV. New technologies were introduced as time advanced. We currently have more than three different technologies; CRT, LCD, Plasma, and Projection. Television and display screens have changed human life greatly. The lifestyle has also changed as well, we watch TV at least once a day, and having a visual display is much better than having just sound.

The most common television screen in most houses is a CRT [1]. CRT stands for cathode ray tube. In a CRT display, there really is a long funnel-like tube. In this kind of display, the cathode is a filament that is heated inside a vacuum tube made of glass. When a cathode is heated, a ray of electrons flow off the cathode, and is accelerated by a positive anode. The actual image is produced on a screen coated with phosphor; this is near the front of the glass, and the phosphor glows when struck with an electron beam. Magnetic fields are created to curve the path of travel of the beam. Steering coils are placed at the end of the vacuum, creating magnetic fields within the tube. The beam will react by moving up and down, left and right, thus creating a full screen image [1].

Plasma screens were the biggest transition to thin screens. Plasma screens went up to sixty inches in size, but remained less than half a foot thin. Plasma screens use a gas composed of free flowing ions and electrons called plasma. When an electrical connection is established through the gas, the plasma will emit light, similar to a fluorescent light tube. A plasma screen is made up of many small pixels; each pixel is colored red, green, or blue. All of the pixels are filled with gas, and put in grid of electrodes. When a certain pixel needs to be lit up, the “computer” within the screen, will send an electrical charge down the grid. The pixels are located in places such as A1, B6, C9, etc. Plasma screens had both negatives and positives. When they were first released, they would often cost up to $20,000 depending on size. But plasma screens were very thin; they could be hung on walls like works of art, and were very convenient when compared to a conventional tube display. Because the technology is similar to fluorescent tubes, the gas will eventually get dimmer as the hours of use increase. [2]

LCD or liquid crystal display screens have none of the issues that plasma had. The dimming is non existent and brightness is no longer an issue. The functionality of a liquid crystal display is similar to a plasma display. Instead of having gas filled pixels, light tubes are placed in the back of the display, lighting up the whole screen. There is an array of colored pixels, and behind each pixel is a liquid crystal substance. When there is no current flowing through the liquid crystal substance, it will remain closed and block light from passing into the screen. But when there is an electrical current, the substance will bend and twist to allow the light to pass through. Similar to a plasma display, all pixels are placed in an electrical grid. [3]

Chemistry plays a rather large role in each technology. The first technology, the CRT, shoots electron beams. Electrons were discovered in the late 1800’s by a man named JJ Thomson. He was investigating cathode rays, which he discovered that these rays were composed of particles much smaller than atoms. Plasma displays are filled with a gas that ionizes when the computer sends an electrical current. When ionized, the gas will excite the phosphor within the pixel, thus emitting light. [4]

Humans rely heavily in digital displays for everyday life. These displays are everywhere we go. From our homes, to the workplace, school, out in public, as well as airports; these displays display information that allow us to get through the day easier. For example: when you go to an airport, there are always screens that show the time of each flight. If these screens did not exist, travelers would crowd the lines to information booths, slowing other travelers in the process. In the home, people use computers to catch up on world events, as well as spend some time communicating using technology. Entertainment has also been affected, before video had arrived, everyone gathered around the radio, and listened. Now, the radio has been replaced by the television, and home entertainment has never remained the same. The TV brings families together to watch moving images. If all of this technology was suddenly removed, we would not have cell phones, computers, calculators, TVs, and other technology oriented device. Without those products, we would not have as advanced buildings, cars, and even good schools. All of those are created using technology, screens allow engineers to design and test newly invented objects before they hit the real world.

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X-rays

by Peyman Derogari

The world of technology gives us the advantage of having healthier life and knowledge about things around us. If someone feels pain somewhere in his or her body such as chest, hand, or back, the person needs to know what causes the pain. In most cases, the doctor will take an x-ray from the part of the body that has pain to see what the problem is. Different kinds of x-rays help doctors to observe within the body and find the problem. To understand x-rays, we need to consider the history of x-rays and its explanation, and how it works in different fields, as well as the risks for humans.

X-ray discovery has an interesting history. As with all discovered things in the world, one day someone discovered x-rays for the first time. Mr. Wilhelm Conrad Roentgen (1845-1923) was a German physicist who discovered x-rays by accident on November 1895[1]. He was working with his assistant in the lab and studying a Crookes tube operating at high voltage in a dark room. While he was testing it for other purposes, suddenly he saw the "fluorescence –glowing- of a piece of barium platinocyanide" located on the other side of the room.[2] In December 1895 he took his wife to his laboratory and made an x-ray of her hand. They saw her hand's bones and her wedding ring in the x-ray. Then Roentgen explained his discovery to other scientists in the medical field in Wurzburg city. After a couple months the x-ray technique was used by scientists to take an x-ray of a tooth and to find bullets' location in wounded soldiers in the Italian-Ethiopian battle. [3]Because Roentgen didn't know what kind of rays were going through the object, he called them x-rays.[4] The letter x represents the unknown in science.

Explanation of x-rays can help us to know them better. The most interesting property of the x-ray is the ability to penetrate ordinary matter. They are one of the most useful

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forms of energy. Their main uses have been in the field of medicine. X-rays are a kind of electromagnetic radiation that can go through objects because they have high energy and very short wavelengths. Electromagnetic radiation consists of gamma rays, x-rays, ultraviolet rays, visible light, infrared rays, and radio waves. X-rays have speed of 3.0 * 10^8 meter per second, same as all other electromagnetic waves like light or radio waves. X-rays are electrically neutral and can't be deflected by electrical or magnetic fields. In addition, they can ionize gases indirectly by removing electrons from atoms[5]. One characteristic of light is the wavelength. Wavelength is the distance between adjacent wave crests. The distances between crests are very short in x-rays, and they are able to go through objects like human tissue.

Rays are different in energy because of their wavelength. If the wavelengths are short, it means that the energy is high, and if the wavelengths are long, then amount of energy is low. Electromagnetic radiation has a wavelength between 10^-16 m (gamma rays) and 10^6 m (radio waves). For instance, for visible light, red light has the longest wavelength of 750 nanometers (nm) and violet light has the shortest wavelength of 400nm.[6] Gamma rays are produced by a sun or star and have the shortest wavelength. X-rays have the next longest wavelengths after gamma-rays. The wavelength of an x-ray is between 10^-9m and 10^-11m.Thus, x-rays have high energy and can go through objects such as papers, flesh, clothes, and wood.

Roentgen also showed x-rays can go through objects depending on their density. X-rays are stopped by bones in the human body. Because x-rays can't go through bones, the image on the x-ray photograph will be white to show the shape of bones. Other parts that allow x-rays through, such as air in the lungs, will be black on the film. And soft tissues become shades of gray.

X-rays can create an image on a photographic plate. This technique has been used in the medical field since 1896.[1]In addition, recently, sensitive-x-ray imaging can produce images that show much more detail in tissue structure. The x-ray machine for this purpose is very big and needs a large place. Today, these new machines aren't in

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[5] The Fundamentals of X-ray and Radium Physics by Joseph Selman Published in Illinois. USA 1972 (Fifth edition) page: 146-9,157-8
[6] Introductory Chemistry by Nivaldo J.Tro 2003 New Jersey-Page279

use by hospitals because of their big size. However, the machines may be constructed in smaller size in the future, or the hospitals could have enough space to have them. [7]

It is not easy to see atoms. Even new microscopes are not able to make atoms visible. Atoms are very small. And a variety of light have wavelengths much longer than atoms which make it impossible to see atoms. As mentioned above x-rays are a kind of electromagnetic radiation that can be in very short wavelength, so they are able to make the atoms visible. [8]

X-rays are also used in industry, the medical field, and at the airport. For instance x-ray machines are useful in airports to look for the materials that are not allowed to pass through the check point or be carried inside the airplane. X-rays go through the bag that the passenger carries and show if there are any unlawful items in the bag. Imagine how much time and effort is required to search each bag. For example, in Oklahoma City airport, one security worker found something questionable in an x-ray machine. After searching the bag, they found a device consisting of a carbon dioxide cartridge filled with gun powder that could be exploded when connected with a power source. [9]Using this technology is advantageous, but employees would be harmed if they were exposed to x-rays. According to most sources, x-rays damage tissues in the human body.

High energy in x-rays, gamma rays, and ultraviolet rays can destroy or change molecules inside our body. An overdose of x-rays may cause cancer or skin burn. However, the doctors can use gamma rays or x-rays to destroy cancer tumors. Doctors use the radiation therapy to treat patients. Doctors direct rays inside the tumor to damage the molecules that carry genetic information which make the cells grow. [10]

Scientists use x-rays more as the technology grows to make life easier. Roentgen dedicated his discovery to the world and it has been used in many fields. In the future preferable x-ray technology will be used in the medical field. Although there are some risks of using x-rays, we are not exposed to the x-rays often, so the benefit of using x-

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[7] (Science Service, incorporated-Aug 20, 2005-x ray excels-Washington DC.) accessed on 10/19/05

[8] http://www.stolaf.edu/people/hansonr/mo/x-ray.html last access: 10/20/05

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[10] Introductory Chemistry by Nivaldo J.Tro 2003 New Jersey-Page 282

rays usually outweighs the cost. In the situations that doctors have no alternative way to treat cancer they use radiation therapy to treat patients.

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Allotropes of Carbon: Synthetic Diamonds

by Ami Endicott

Carbon is in every living thing and consequently is the most abundant element in the world. Graphite is carbon, commonly used in pencil lead. Diamonds are made of carbon and are, not only aesthetic, but also used as coating for cutting tools. Carbon is also used to make steel, art supplies, medicine, and control rods for nuclear reactors, among other things[1]. "There are four known allotropes of carbon: amorphous, graphite, diamond and fullerene. A new (fifth) allotrope of carbon was recently found. It is a spongy solid that is extremely lightweight and, unusually, attracted to magnets. The inventors of this new form of carbon -- a magnetic carbon nanofoam-- say it could may someday find medical applications" [1].

Carbon has three main allotropes, graphite, diamond, and fullerenes. Graphite is soft and fragile because it is a carbon atom that is bonded with another three carbon atom. Graphite is made up of these carbon layers that are weakly bonded to each other by free electrons which allows the layers to slide [2,5]. Diamonds are the hardest known material. They are made of one carbon atom bonded with another four carbon atoms. This eliminates the layer of free electrons and because of that the structure is extremely strong because no atoms are allowed to move in the tetrahedral arrangement[2,5]. Fullerenes, also called buckminsterfullerenes or "bucky balls", are circularly bonded. They were created in 1990 by hitting graphite with powerful lasers in an electrical arc [3].

Diamonds and synthetic diamonds are chemically identical, because they are both made of carbon [6]. The only difference between them is the quality of the diamond and the structure. Natural Diamonds have an octahedral structure while some synthetic diamonds (by Genesis) form a cubic structure which can be detected by UV light[5,6].

Natural diamonds have been around for thousands of years but in the late 1772, their structure was finally discovered. Antoine Lavoisier found a way to burn diamond by heating a diamond, sealed from air by clay, over 1500°C and dropping it into liquid oxygen. The diamond would burn completely and all that is left is CO_2 gas. Lavoisier realized that diamonds were really made of pure carbon [5].

The synthetic diamond is a very recent development in the scientific field. During WWI there was a need for diamond tipped cutting tools. The GE Company in 1951 attempted to use a combination of temperature and pressure to create a diamond from graphite. The succeeded in creating poor quality diamonds in 1955 [4]. Some Russians attempted the same experiment and were slightly more successful. They sold their equipment and plans to a new company Genesis. This process is known as High pressure high temperature or HPHT. Very recently a new company, Apollo, has come up with a revolutionary process of creating diamonds cheaper, clearer, and with less energy than that of Genesis; this process is known as chemical vapor deposition (CVD).

The manufacturing of synthetic diamonds is highly competitive. The HPHT process was first developed in Russia and sold to an American company Genesis. It uses a 8,000 lb machine that uses hydraulics and electricity to press and heat the core of the ceramic growth camber containing the diamond seed at the bottom and the graphite and metal solvent troilite on top [6]. Pressure is increased on the growth chamber by forcing oil into the top layer of the sphere. This creates pressure against the steel anvils and the pressure goes though the anvils onto the growth chamber to create 58,000 atmospheres. When the electricity is turned on the temperature rises to 2300F and the temperature melts the troilite around the diamond [4]. The metal precipitates the carbon out, it rains down on the diamond seed where it crystallizes onto the seed [5]. Using this system a flawed three carat stone can be made in a few days by recreating conditions 100 miles under the earth [6].

The CVD process of making diamonds is extremely recent. In 1996, Linares, after numerous tests, found the exact combination of temperature, gas composition, and pressure or the “sweet spot”. In his cylindrical machine, diamond chips are placed on a pedestal and the chamber is depressurized to $1/10^{th}$ of an atmosphere. Hydrogen and natural gas (CH_4) is injected into the chamber. It is heated with a microwave beam to 1800F. The electrons are separated from the nuclei and form plasma cloud. The free carbon in the cloud precipitates out and is deposited on the diamond chips. The diamond chips become mini-bricks that grow 1/2mm per day. The CVC produces flawless white diamonds [6].

In early production of synthetic diamonds there were many problems. Early machines didn't reliably produce diamonds. This was solved by controlling the settings of the machines and upgrading to more precise ones [6]. The metal solvent used to create the diamond left nitrogen residue in the diamond, discoloring it. Heating the diamond for a longer time solved that problem [5]. The GE Company came up with another solution by developing what they called a nitrogen "getter". It was aluminum and attracted the nitrogen away from the diamond [5]. In the beginning many scientists were unable to grow a single crystal and the development of the CVD process solved this and all other problems [6].

Gem companies such as De Beers became very concerned by the growing synthetic diamond industry. They began to look for ways to tell the synthetics from the natural diamonds to retain their monopoly. The original way to detect a fake was a microscope. It could detect the metal inclusions of poorly made diamonds, but as synthetics were being perfected, this method no longer worked [5]. De Beers then developed DiamondView which uses UV light to detect the fake. The light would shine through the diamond and when it was turned off the fake diamond would glow because of its cubic structure [6]. This also became ineffective because the CVD method produces synthetic diamonds with an octagonal structure just like that of a natural diamond. Sellers of synthetic diamonds are required to state whether they are natural or synthetic, but with the improvements made on the synthesizing process by Apollo, many are not. De Beers and other diamond sellers have resorted to marketing, hoping to keep their edge on the diamond market. As time goes on who knows what the future will hold for the diamond industry [5].

Diamonds are said to be the dream material of the future. They could be installed in any electronic devise instead of silicon chips. They would allow computers to run faster, they could be used to create powerful lasers, cell phones could fit in watches, there would be iPods that would not only hold 10,000 songs, but 10,000 movies [4]. Diamonds are also used as a tough coating for tools so they can cut, but if they are produced cheaply, diamonds could be used as protective coatings for everyday things such as cars. The pioneering scientists who are trying to achieve this sometimes resort to producing gem quality diamonds for sale to fund their research [5]. Though there are many practical uses for synthetic diamonds, the most widely known use is for jewelry. More synthetic diamond companies are trying to grow flawless diamonds for sale to the public.

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The Chemistry of Coca-Cola

by Alana Ewing

Do you like pop? What's your favorite kind? How about Coca-Cola? Have you ever wondered how it was made? Well I have. I have also always wondered how they kept it carbonated and what was involved in making it. So I am here to tell you what I have learned and hopefully it will answer some of the questions you have had about pop of all kinds even if you don't like Coke.

Coca-Cola was first sold as a soft drink in "1886 by Doctor John Pemberton a pharmacist from Atlanta, Georgia. Coca-Cola was advertised as a tonic until 1905 and contained extracts of cocaine as well as kola nut which is loaded with caffeine. By the late 1980s Coca-Cola was the most popular fountain drink. Sales continued to increase and between 1890 and 1900 sales of the syrup increased 4000%". [1] Coca-Cola soon became very popular in the US and through out the world its popularity grew. In "1982 Diet Coke was created as a sugar-free equivalent for Coca-Cola". [2] In "1985 they tried to change the formula of coke and create the New Coke. It didn't work out though people thought that changing the formula of coke was like rewriting the constitution". [3]

Though the exact ingredients of Coca-Cola are top secret, I was able to find some of the main ingredients. They are: "citrate caffeine, citric acid, vanilla extract, lime juice, flavoring, sugar, F.E. Coco, water and caramel sufficient". [4] This list of ingredients is supposedly the original recipe. The current recipe is locked in a bank in security vault in a bank in Atlanta, Georgia it is known by only two Coca-Cola employees at any one time. The ingredients in which it was named after was coca leaves from South America and the flavoring was made of kola (cola) nuts which also caffeinated the drink. As we all know carbonated water also is an important ingredient. Carbonated water "occurs when carbon dioxide is dissolved in water the reaction is written as:

$$H_2O + CO_2 \leftrightarrow H_2CO_3\text{". [5]}$$

Carbonation can be found in other drinks also from carbonated water to the head of beer and champagne. Carbonation is also found in "nature like when yeast ferments but this is called conditioning when it happens in nature instead of carbonation which describes artificial processes". [5] Coke is also pretty acidic. It has a "pH level of 2.5". [3] People believed that it would eat the enamel off of teeth but test were done that proved otherwise.

Bottling of coke began in 1899. But the bottles didn't start out plastic like they are today they were glass and they were first bottled in Biedenharn bottles. "By 1909 there were already almost 380 bottling plants open. By 1920 over 1,000 bottling plants and bottlers were in existence". [6] Coke was "first put in cans in 1960 but back then they were in steel cans as apposed to the aluminum" [7] ones we see now days. Though the can was being sold bottles were still the big sellers.

Coke has made a great impact on the world in so may was. It started out as a tonic to "cure numerous diseases, including morphine addiction, dyspepsia, neurasthenia, headache, and impotence" [3]. Now a days it sponsors many sports teams and events such as the "Olympics, NASCAR, Major League Baseball, the National Football and Hockey Leagues, and the National Basketball Association". [3] It also has been a refreshing and thirst quenching drink that is very popular through out the world.

Coca-Cola has been around for almost 120 years and it is going strong. In all that time their original formula has only slightly changed due to advances in technology, prices and product demand. It is amazing that something so simple can be so important to American society along with many others I'm sure. It's a household name through out the world.

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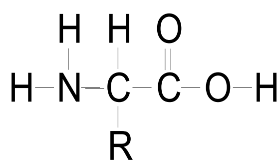
The Amino Acid Phenylalanine and its Relationship to Aspartame

by Rhys Fuentes

Amino acids are the subunits or building blocks of proteins. Proteins are composed of long chains of amino acids called peptides. Bonds between amino acids are called peptide bonds. An amino acid has two main components. The first component remains constant in every amino acid and is made from a single hydrogen atom, an amine group (-NH_2) and a carboxyl group (-COOH) attached via covalent bonds to a central carbon. The second component varies for each amino acid, and is called the side chain or R group; this side chain is also covalently bonded to the central carbon atom. See the amino acid structure below. [1, 2, 3, 4] Amino acids have a name, a three-letter code name, and a one-letter code name. [3, 4] For example, the simplest amino acid has a hydrogen atom as a side chain; it's called glycine; its three-code name is Gly, and its one-letter code name is G.



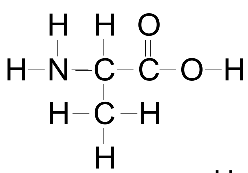
amino acid structure

Amino acids are usually classified according to the chemical and structural properties of their side chains. Amino acids are commonly classified as aliphatic, cyclic, aromatic, acidic, basic, hydroxyl, or sulfur containing. [3, 4] Due to the side chains, amino acids may be polar or non-polar, hydrophobic or hydrophilic, positively charged or negatively charged or neutral in charge. [3, 4] The side chains are ultimately responsible for how proteins fold to reach their final structural form, and how proteins function and interact in biochemical reactions. [1, 2, 3, 4]

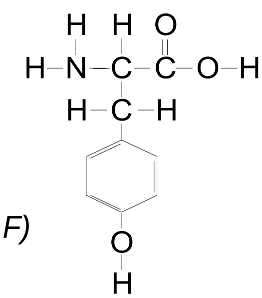
Amino acids and proteins are very important and very necessary in biological reactions. All enzymes found in bacteria, plants, and animals are made from proteins. Enzymes allow chemical reactions to occur inside and outside living cells that would normally not occur due to temperature, pressure, or concentration limitations of the chemical reactions. [2] In addition to enzyme activity, proteins function in "structural support, signaling, shape changes, transport, movement, and defense against diseases". [2]

There are over two dozen different amino acids [5], but only twenty amino acids are used in protein synthesis: alanine, arginine, asparagine, aspartic acid, cysteine, glutamic acid, glutamine, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tryptophan, tyrosine, and valine. [1, 2, 3, 4] The human body cannot synthesize ten of the amino acids [4], so these amino acids are called essential amino acids and must supplied in the food humans eat. One essential amino acid is called phenylalanine; it's an aromatic (ring structure), very hydrophobic, neutral-in-charge amino acid. [3, 4, 6]

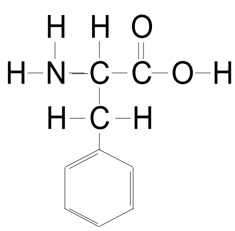
Phenylalanine is a derivative of the amino acid alanine [4, 6], which has a methyl group ($-CH_3$) side chain. In phenylalanine, a phenyl group is substituted for one of the hydrogens in the methyl group. The amino acid tyrosine is made from phenylalanine. The structures for alanine, phenyalanine, and tyrosine are shown below. [1, 2, 3, 4] Tyrosine, in turn, can be converted into dopamine, norepinephrine and epinephrine, all very important neurotransmitters. [6, 7]



alanine (ala, A)



tyrosine (try, Y)



phenylalanine (phe, F)

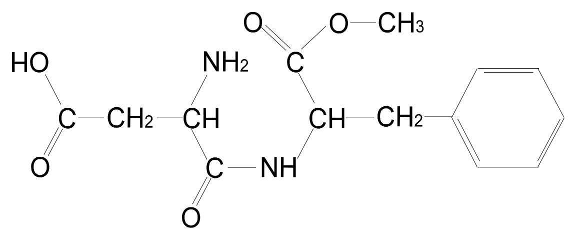
Some people have a genetic disorder called phenylketonuria (PKU), which is the inability to breakdown phenylalanine; essentially, they lack the enzyme to convert phenylalanine into tyrosine. [7, 8, 10, 11, 12, 13] All products containing aspartame carry warning labels for PKU patients. [6, 11, 14] As an aside, PKU can cause severe, irreversible mental retardation if not treated before three weeks of age. Newborns in the US are tested for PKU during the first two to three days after birth. [8, 10, 13]

Phenylalanine exists in two forms, the *L*- and *D*- forms, which are mirror images of each other (enantiomers). [6, 8] The *L*- form is the levorotary or left-handed form, while the *D*-form is the dextrorotary or right-handed from. [5] *L*-phenylalanine is the natural form found in animal and vegetable proteins, while the *D*-form is man-made. [6]

L-phenyalanine and a synthetic combination of the *D*- and *L*- forms called DL-phenylalanine (DLPA) are used as nutritional supplements. [6, 7, 8] *L*-phenylalanine has been used in studies to treat chronic pain and Parkinson's disease. [7, 8] It has been used as part of the treatment for depression and vitiligo (in conjunction with UVA irradiation or sunlight). [7, 8] Vitiligo is the loss of pigment resulting in white patches in the skin. A common use of phenylalanine is in the artificial sweetener aspartame, which is found in foods such as soft drinks and gum. [6, 9, 10, 11, 12, 13, 14, 15]

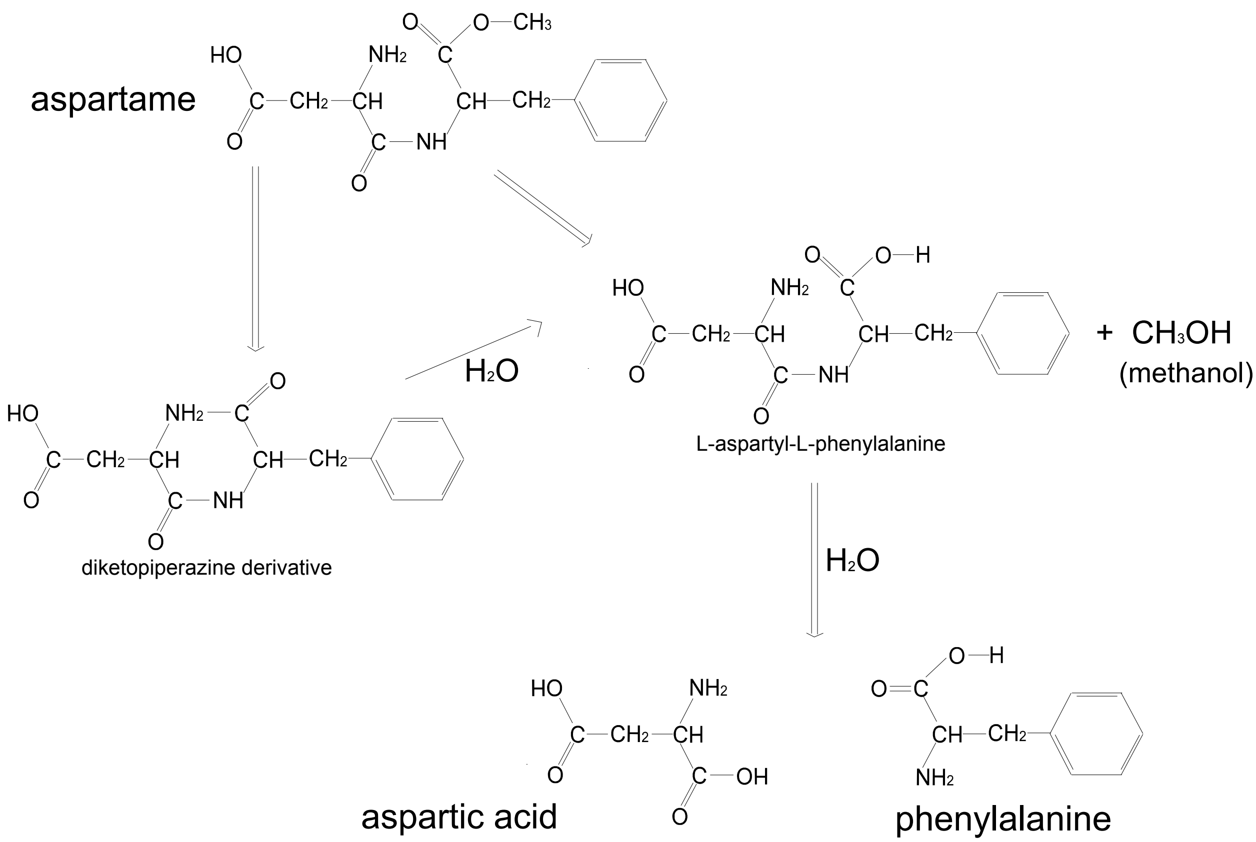
Aspartame is an artifical, non-caloric sweetner. It's made from two amino acids, aspartic acid and phenylalanine. [11, 12, 13, 14, 15] The structure for aspartame is shown below. [11, 12] Aspartame is a white, odorless powder, and is about 200 times sweeter than table sugar. It is marketed under several brand names, such as NutraSweet®, Equal®, Canderel®, and Spoonful®. [9, 11, 12, 14, 15]

aspartame



Aspartame was discovered in 1965 by chemist working for the G.D. Searle company. [11, 12, 14] The chemist was working on treatments for gastric ulcers, and accidentally spilled aspartylphenylalanine methyl ester (aspartame) on his hands. When he licked his fingers to pick up some paper, he noticed a sweet taste. [11, 12] The sweetener was given Food and Drug Administration (FDA) approval in 1974, but was suspended following an appeal on the grounds that the substance was toxic and cancerous. It was re-approved in 1981 for use in solid foods, in 1983 for soft drinks, and in 1996 as a general sweetener. [11, 12, 14] Today the sweetener is used in more than 6,000 products worldwide. [12, 14, 15] Despite many studies conducted by national and international organizations validating its safety and the establishment of an Acceptable Daily Intake (ADI) value by the FDA and an international committee of experts [10, 11, 12, 13, 14, 15], its health risks are still a concern to some people.

Aspartame is very stable in the dry state and is fairly stable in frozen products. Aspartame cannot be used in cooked or sterilized foods because in liquid form, it looses its sweetness and, more importantly, it partially breaks down when the temperature is greater than 30°C. [12, 14] The breakdown products of aspartame include aspartic acid, phenylalanine, and methanol. [11, 12, 13, 14, 15] See the structures below. [12]



The safety issues concerning aspartame involve: possible toxicity from methanol, which can be metabolized into formic acid and formaldehyde (formaldehyde is considered a carcinogen); elevated concentrations of phenylalanine and aspartic acid in the blood, which may result in increased concentration of these amino acids in the brains, which may be alter neurotransmitter concentrations; and, possible links to epilepsy, brain tumors, and cancer. [9, 10, 11, 12, 13, 14, 15] Simply put, health risks to elevated phenylalanine concentrations in the brain, and, links to epilepsy, brain tumors and cancer have not been proven. [10, 11, 12, 13, 14, 15] In regards to methanol, the body has a mechanism for filtering out small amounts of methanol. [11, 14] Twenty-four grams of methanol is considered lethal, and aspartame contains only milligram amounts of methanol. [11, 12, 14, 15] In addition to aspartame, other naturally occurring foods, such fruit and vegetable juices contain methanol [11, 12, 13, 14, 15]

The FDA's ADI is set at 50mg/kg, which is approximately 100 times less that levels considered toxic. [9, 12, 13, 14] In order to reach the ADI for aspartame, a 150-pound adult would have to consume more than twenty 12-ounce diet sodas or 97 packets of NutraSweet per day. [9, 12, 14] A new FDA-approved sweetener called Neotame, is a derivative of aspartame. Neotame has a structure that prevents the peptide bond between aspartic acid and phenylalanine from breaking, making it safer for PKU patients. [11, 14]

Most scientists are very confident in aspartame's safety. [11, 12, 13, 14, 15]. "Other experts remain cautiously optimistic...Aspartame appears to be safe, but should be retested" [9] since becoming a general sweetener in 1996. Investigations conducted by the Centers for Disease Control and Prevention (CDC), "the principal agency in the United States government for protecting the health and safety of all Americans", show no evidence of health risk from aspartame. [13]

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What's the Rave with Trans Fat?

by Nina Kenner

From McDonald's famous fries to the loveable round shape of Oreos, Trans Fat has found its way into our food. What is it about Trans Fat that is making headlines and arousing FDA's concern?

Trans Fat, also known as trans-fatty acids, is created through hydrogenation. Hydrogenation is a process where hydrogen is added to vegetable oil. The purpose of the process is for longer preservation of the product or of "shelf life" [3]. What happens is the occurrence of a chemical reaction where hydrogen adds to a double or triple bond to connect two atoms in the structure of the molecule [1]. The process results in edible fats from out of liquid fats due to hardening from the reaction. The FDA's definition for Trans Fat is "all unsaturated fatty acids that contain one or more isolated (i.e., nonconjugated) double bonds in a *trans* configuration" [2].

Fatty acids are carboxylic acids with hydrocarbon chains that can be quite long with 10-30 carbons; usually they are in the range of 12-18. The general principle is that vegetable oils contain more unsaturated fatty acids whereas animal fats contain more saturated fats. Unsaturated, or alkene, also means that there are one or more double bonds between carbons [4]. When hydrogen is added to an alkene it results in a saturated fatty acid. Unsaturated fatty acids are found to be in liquid form while saturated fatty acids are solids [2].

Usually, acids with few carbons are polar. The hydrocarbon chain in an alkane chain (saturated) is non-polar and acts as a counter, which results in the molecule as a whole to be non-polar. Saturated fats also have higher melting points than unsaturated fatty acids. This is due to the molecular geometry between the two groups of fatty acids. Saturated fats have a linear structure which allows the acid molecules to have closer intermolecular interactions. Because unsaturated fatty acids have bonds between every carbon that is occupied by hydrogen, resulting in bends of the molecule's structure. This in turn gives unsaturated fats a lower melting point because of weaker intermolecular interactions [4].

In general, fat is a source of energy and is a necessity for growth, development and maintaining good health when used in moderation. It also assists the body in the intake of carotenoids and vitamins A, D, E and K [3].

So what is the fuss over Trans Fat? Trans fatty acids raises low density lipoprotein, or LDL cholesterol. It is also known as the “bad” cholesterol. When the LDL cholesterol is raised, this in turn increases the chances for coronary heart disease or CHD. Saturated fat and dietary cholesterol also have the same dire effects when overtaken. It is known that Americans take in 4 to 5 times as much saturated fat in their diet compared to Trans Fat. The National Heart, Lung, and Blood Institute of the National Institutes of Health Study show that more than 12.5 million Americans have CHD, which is the leading cause of death in the United States. Because of CHD, more than 500,000 people die each year. Because of these statistics and dangers of Trans Fat, the FDA passed the requirement for Trans Fat to be listed starting January 1, 2006. If Dietary Supplements contain Trans Fat that is 0.05 g or higher, it is required that the manufacturers list the amount on the Nutrition Facts panel [3].

Trans Fat can be found in vegetable shortenings, margarine, cookies and crackers, baked goods and deep-fried foods [2]. To maintain a healthy diet, consumers should check the nutrition facts panel and make sure that they are not taking in too much saturated fat, Trans Fat and cholesterol. People can also choose alternative fats such as monounsaturated and poly unsaturated fats, which does not raise the LDL cholesterol and also have benefits to the body. You can find monounsaturated fats in olive and canola oils. Polyunsaturated fats can be found in fish, nuts, sunflower oil, corn oil and soybean oil. Choosing vegetable oils and soft margarines can be a healthy choice; these oils and soft margarines are low on saturated fat, Trans Fat and cholesterol in comparison to animal fats, hard margarines and solid shortenings. Fish in comparison to meat, have low levels of saturated fat, and most types of fish provide omega-3 fatty acids. And the last tips are choosing to eat lean meats, asking about the foods when dining and watching calories. All these will help you have a better and healthier diet [3].

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Biodiesel as a fuel

by Michael Labaz

Biodiesel is a relatively new fuel (the word biodiesel isn't even included yet in Microsoft Word 2003). Its official definition according to the National Biodiesel Board is: "a domestic, renewable fuel for diesel engines derived from natural oils like soybean oil, and which meets the specifications of ASTM D 6751."[1] The main reason for creating it is protecting our planet (and therefore ourselves and our children) from pollutants. It is created from soy, cooking and any vegetable oil by a process called transesterification (a smart word that can be broken down to separation of glycerin from oil).

It has to be said that even though biodiesel is an environment friendly fuel it still pollutes the air even though the numbers are a lot different as compared to those of a traditional diesel. Some of the scientists were concerned that biodiesel when used for fueling cars produces a greater amount of NOx (nitrogen oxides) and it appeared that if biodiesel is made out of used cooking oil this is not a problem. But since it is a relatively new fuel it is still under the research even though it has been approved by the EPA (Environmental Protection Agency) and scientists are still looking for ways to reduce nitrogen oxide in air pollution by biodiesel that's produced from an oil other than cooking. It still remains to be the only alternative fuel approved by EPA. The amounts of the pollutants that we are concerned about the most (those that are regulated) are greatly lowered when pure biodiesel is used. The numbers are the following: Total Unburned Hydrocarbons are lowered by 67%, Carbon Monoxide by 48%, Particulate Matter by 47% (according to EPA particulate matter is "dust, dirt, soot, smoke, and liquid droplets") but NOx is higher by 10% (if it is not made out of cooking oil).

Concerning the cost of biodiesel it is not really cheaper than diesel and in some cases even exceeds it. Also since it is an alternative fuel it becomes a threat to the oil companies since no oil other than soy, vegetable or cook is used in its production. It was estimated that switching to biodiesel would create 10% drop in our oil economy. However on the other hand it would benefit our economy (or rather secure our economy) because it would make US less dependent on foreign oil. One of the sources suggests: “there are more than 4 billion gallons of waste cooking oil produced annually in the U.S.; enough to replace 10% of fuel expenditures.”[2] Also it would create a little shift favorable to our farmers since there would be a greater demand for their products. Another thing that should be kept in mind is that creating biodiesel from products that are not organically grown could dramatically change the picture because all the pollutants used on the farms could be the same if not worse threat to the environment. Biodiesel is a not the fuel that is taken from under the ground and therefore will not eventually be used up. Technically, biodiesel could be produced forever since the products used are renewable.

A car doesn’t not need any modifications in order to run on biodiesel but drivers for some reason prefer mixing it with diesel instead of using it by itself which increases lubricity (lubricity prolongs life of an engine and could even increase car’s performance) and replaces traditional additives. Maybe it’s because they don’t “trust” this relatively new fuel even though it “is safer to use than petroleum diesel - it has a flash point of 300° F (vs. 125° F for diesel).”[3] This means that biodiesel is less flammable and there is less chances that your car will blow up if your tank is filled up with it. Also it “reduces the classic diesel engine "knocking" noise.”[4] Those of you who had diesel cars know what it sometimes means for ears to listen to the engine for hours in a row. Another good thing for the environment is that degrades 4 times faster than regular petroleum diesel which means that in case of a spill it is not as dangerous. But on the other hand it is kind of worse for storing it since the period of time can’t be as long as in case of traditional fuel.

If you want to buy biodiesel it could be found at the following location:
Chevron 1607 145th Place SE Bellevue, WA 98007. If you want to buy it from any other location please make sure that the company you are buying from is registered under the BQ-9000 (it’s a fuel quality government program). Also it is recommended to change the fuel filter after the first usage of biodiesel. Due to its cleaning properties it will wash away all the bad stuff and your filter will become dirty but this will benefit you later.

Personally, if I had a diesel car I probably would switch to biodiesel since it would be better for me and the environment.

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ADHD…A Modern Mystery

by Bridget Maloney

ADHD is a behavioral disorder affecting the hyperness and attentiveness of a person (1). It can affect everyone from children to adults (1). I'm sure you all have noticed the kids in class that are hyper, can't sit still, and have trouble paying attention. These are usually the people that have ADHD. Scientists do this day are not sure what exactly causes this disorder (1). There is no permanent cure for ADHD, but there are a few methods of treatment to help ease the symptoms (1)(3). ADHD is a complexing disorder that affects a large percent of the adult and adolescent population (1). There are many questions that society is asking, and I am here to educate you on just exactly what this disorder is and its treatments so you can eventually formulate your own educated questions.

As I mentioned earlier ADHD is a mental disorder affecting the hyperness and attentiveness of a person. (1) This hyperness and lack of attentiveness is a result of imbalanced levels of the two neurotransmitters, dopamine and norepinephrine (3). In case you don't know what neurotransmitters are, they are chemicals in the brain that transmit information from different areas of the nervous system to the brain (2). So in short they are what tells owe that's hot, or someone is talking to you pay attention. When there is an imbalance there is a problem with the communication and information being relayed it results in problems like ADD, Alzheimer's, depression, and also ADHD. As I mentioned earlier the two different types of neurotransmitters that ADHD affects are dopamine and norepinephrine (3), Dopamine is a neurotransmitter in the nervous system that affects heart rate and blood pressure, memory, attention, and problem solving (4). Memory, attention, problem solving, these are all problem areas for people with ADHD (4). Dopamines chemical formula is $(C6H3)(OH)2-CH2-CH2-NH2$ (4). The other neurotransmitter is norepinephrine, which is also in the nervous system (5). Norepinephrine affects attention, impulsiveness, and flight or fight response, which as well are problem areas for people diagnosed with this disorder (5). Its chemical formula is $C8H11NO3$ (3)

There is no answer for what exactly causes these imbalances that result in ADHD (5). However doctors do believe that these imbalances may be a result of genetics, they could be inherited (1)(3) So if your parents have ADHD, perhaps you might have it as well. Alcohol and drug abuse during pregnancy is another possibility of what may cause ADHD (1)(3). Also toxins in the environment, like lead, are another likelihood (1). So now that we know what ADHD is, and what are the possible causes of it, what are the typical symptoms of this disorder?

When someone has ADHD they are easily distracted, not able to concentrate for long periods of time, restless, and take longer than normal to complete tasks (1). There are no medications to cure ADHD, but there are medications to help control and ease the symptoms (1). There are stimulants, which help a person focus attention by increasing norepinephrine or dopamines, and also stimulating areas of the brain. (1) (3) By stimulating, I mean, this drug gets the parts of the brain more alive in order for it to be easier for them to accept the chemicals also known as neurotransmitters. Since there is a problem with the chemicals relaying information between different parts of the nervous system and brain, these drugs stimulate the chemicals allowing them to transmit these messages (2). The neurotransmitters, if they are slow, then they are sped up and visa versa. A balanced level is what is trying to be made here. Some of these stimulants are Adderall, Concerta, Ritalin, Metadate, and Dexadrine (1). Earlier I mentioned non-stimulants as another method of treatment. Non-stimulants works on the neurotransmitters by increasing the amount of norepinephrine and dopamine as apposed to stimulating (1). This medication actually increases the amount of neurotransmitters in the nervous system (1). There is only one form of this medication and it is called Strattera (1). Along with medication, psychological and behavioral counseling prove to be most efficient and effective (1). This is an alternative method but it still helps. The same neurotransmitters, dopamine and norepinephrine, that effect ADHD also effect depression (1). So some doctors use antidepressants in order to increase neurotransmitters like the non-stimulant medications (1). These are sometimes used alone, and are sometimes used along with other ADD and ADHD medications (1). ADHH is not treated the best it can be with antidepressants but is good for someone who has both ADHD and suffers from depression (1). There are many ways to treat ADHD. Some work with best with other methods while some work alone. While there may be many options, there still is no cure for ADHD (1).

In conclusion ADHD is a chemical imbalance that involves unbalanced levels of dopamine's and norepinephrine, neurotransmitters that affect the nervous system and a persons brain (1). Doctors are not sure what causes ADHD, but heredity and environment are some of the possibilities (1)(3). ADHD is not curable but it can only be treated by stimulants, non-stimulants, antidepressants, and counseling (1). These medications help ease the symptoms of anxiety, attentiveness, hyperness, impulse, etc. by stimulating areas of the brain and/or by increasing neurotransmitters, although they do not cure the problem (1). We still do not know what exactly causes this disorder (1). Even to doctors what exactly goes on in the brain of someone who has ADHD is somewhat unknown and vague. We know a lot, but we don't know everything that we need to know in order to help people with this disorder. There are many unanswered questions not just for you and I but also for doctors and chemists that will only further our future knowledge of this disorder, hopefully leading to a cure.

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Recycle

by Han Nguyen

Recycling is the process of transforming the old and waste materials to new and usable products. Recycling programs were introduced in 1890's in New York City. Recycling benefits are to save energy, conserve natural resources, reduce air and water pollution by decreasing carbon dioxide emissions, protect the environment and save landfill space, decrease the costs and more importantly to protect people's health. The process of recycling is separated into steps. First, the reusable materials are collected, then cleaned, ink or any chemicals are removed. After that, the materials are shredded, or crushed. They manufacture the mixture materials into new products. The last step is to sell the new products to consumers. Many everyday materials and suppliers can be recycled which include paper, cardboard, aluminum, glass and plastic.

The first step of recycling paper is sorting into different types: newsprint, typing and computer paper, or magazines. Then the ink is removed by soaking. The paper is shredded into small pieces. The next step is to add water to the paper pulp, and some chemicals also are added. The paper and water mixture is pressed by the rollers and flattened into sheets. These sheets are then dried by furnaces with hot air. The final step is to cut the sheets into difference sizes to sell. Paper is made of cellulose fibers. That's why paper is indefinitely recyclable because the fibers will degrade over time. One ton of recycled paper can save seventeen trees, three cubic yards of landfill and seven thousand gallons of water. Making recycled paper uses 64% less energy and 58% of less water compared to making a new paper. Every Sunday, America wastes 90% of newspapers which wastes 500,000 trees. [1,2,3]

The cardboard needs to be flatted first. To remove the fibers, the cardboard is soaked. Chemicals are also added to remove metal or ink contaminants. The pulped cardboard mixture is then pressed into cardboard. This wet cardboard is dried by the furnaces. One ton of recycled cardboard saves nine cubic yards of landfill space. It also reduces carbon dioxide emissions by 850 pounds per year. [4,5]

Recycled aluminum is different from recycled paper or cardboard. After processing the aluminum, trucks carry them to smelting plants, then shred into bales. The next step is to remove the paint by putting them into the de-lacquering oven, then also transfer it to the furnace to remove dirt or chemical contaminants. After that process, the workers heat up the hot shredded aluminum in 1400 ^{0}F (650 ^{0}C). When the cans melt, they pour it into molds. The molten aluminum is cooled in the rectangular ingots, and then sent to the mills to roll into sheets. Twenty cans of recycled material use with the same energy to make one new can. Recycling a can will save energy to run a television for three hours. It also saves 10 cubic yards of landfill space. [2,6]

The first step of recycled glass is to separate the glass into different colors. This glass needs to be washed. It's crushed into small pieces. These glass pieces are melted in the furnace under high temperature and poured into the mold. This molded glass will become new bottles and jars after they are cool. Glass recycling decreases 20% air pollution and 50% water pollution. Energy from recycled bottle can run a 100 watts light bulb for 4 hours. Unlike paper, glass can be recycled many times and it never wears out. [5,7]

Plastic is collected in large qualities. These plastics are sorted and separated. After that, the plastics are melted with high temperature, and then manufactured into new products. There are two types of plastics: polyethylene plastics and polymers plastics. Polyethylene plastics have HPDE (high density) such as milk and water bottles, detergent bottles and toys; LPDE(low density) includes wrapping films and grocery bags. There are four types of polymer plastics: polyvinyl chloride (V), polystyrene (PS), polypropylene (PP) and polyethylene terephthalate (PETE). Pipe, meat wrap and cooking oil bottles are plastic made of polyvinyl chloride (V), polystyrene (PS) such as in coffee cups, polypropylene (PP) is in syrup bottles, yogurt tubs and diapers and polyethylene terephthalate (PETE) is in soft drink bottles and medicine containers. American people use 2,500,000 plastic bottles per hour. However, plastic garbage kills 1,000,000 sea creatures each year. [2,7]

The amount of earth pollution is increased each day. Our damaged atmosphere will affect a lot of aspects of life such as environment, economic, natural resources and health care. We as individuals should help to protect the environment that we live in. Therefore, recycle is the right method to prevent this dangerous situation happen to our world.

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Octane

by Kevin Steere

Everyone who has pumped gasoline at a gas station has seen the numbers next to the different grades of gas. The numbers may say something like 87, 89, or 92. We all know that 87, being the lower number is the cheapest grade and 92, the highest number is the premium grade. However, many of us do not know exactly why. The numbers next to the grades of gasoline represent the minimum rating of octane in that particular grade of fuel. Octane is a hydrocarbon product of crude oil.

Every time you drive your car, you are putting your engine through many series of events called cycles. In most cars a cycle consists of four events. These four events are called strokes. A stroke is when one of the pistons in your engine moves either up or down and your crank shaft moves half of a revolution. The first stroke that your engine goes through is called an intake stroke. In this stroke your intake valve is open and the piston moves down in the cylinder to create a vacuum. This vacuum sucks the gasoline and air into the cylinder. Once the piston reaches the bottom of that stroke it begins the second stroke called the compression stroke. In this stroke the piston moves upward compressing the air and gasoline. Once the piston reaches the top of the cylinder (Top Dead Center) the spark plug ignites and the gasoline explodes. The explosion sends the piston downward on the third stroke called a combustion stroke. The fourth and final stroke is called an exhaust stroke. In this stroke the exhaust valve opens and the piston moves upward pushing out the exhaust. This whole process is called a cycle and your engine repeats this time and time again. (2)

The part of an engines cycle where octane comes into play is the compression stroke. The amount of air that your engine compresses in a compression stroke is called a compression ratio. The ratio measures the amount of air in a cylinder at the bottom of the compression stroke and compares it to the amount of air at the top of the compression stroke. Most gasoline cars have a ratio of about 8/1.

When oil refineries refine crude oil, the product is many hydrocarbon chains. (1) These chains can be separated to make gases such as propane, butane, and many others. Gasoline is made up of two main products that come from crude oil. The biggest part of gasoline is octane. (4) Octane is a hydrocarbon made up of eight carbon atoms and eighteen hydrogen atoms. (3) Octane is used in gasoline because it handles compression extremely well. The other main part of gasoline is often heptane. Heptane is made up of seven carbon atoms and sixteen hydrogen atoms. (1) The atoms in heptane, as well as octane share electrons in a covalent bond. Heptane does not handle compression very well. When you combine octane with heptane you get gasoline with a certain octane rating. This rating of gas can only withstand a certain amount of pressure before it will spontaneously combust. Therefore, gasoline with a rating of 87 octane can withstand less pressure than gasoline with a rating of 92 octane.

Spontaneous combustion is known in the car world as knocking. When a car knocks it is generally because the gasoline that is being used has too low a level of octane. When the car reaches its compression stroke it creates a pressure too high for that particular mixture of octane and heptane. The gasoline reacts to the pressure by exploding. This is bad because the full potential of the gasoline is not being used; energy is lost and it can cause damage to the motor. To correct this problem one must run a higher grade of gasoline with more octane. The more octane your gas has the better it can handle the compression of your car. However, running a premium grade of gas is not always as efficient for some cars. Most cars can run efficiently with a lower grade of gasoline because their compression level does not exceed its octane rating. Running better gas would simply cost more without improving the cars performance.

When you run a higher octane level in your car you may notice that you get better gas mileage. This is because the gasoline ignites only when it is supposed to. The explosion is more precise and your car runs more efficiently. This is often the case in higher performance vehicles that have more compression.

Octane is very important in the mechanical world because its serves as a main ingredient for gasoline. If we didn’t have octane, our vehicles would not run efficiently and a simple task such as driving to school would be much more difficult. Until the world discovers an alternative fuel, octane will play a key role in our lives. If we hadn’t discovered octane, than the world may not be where it is today.

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TNT "EXPLOSIVE"

by Brandon Urban

When most people hear the word TNT they think of that Ac/Dc song they listened to while growing up, but it is so much more then a song from the mid 70's. Without TNT's explosive capabilities life and the expansion of explosives might not be the same. TNT's full name is trinitrotoluene. Much can be said about TNT from its discovery to its effects, and also how it coincides with the chemistry world.

TNT was first made in 1863 by a German chemist named Joseph Wilbrand, but its potential was not seen for several years, this was mainly because it was difficult to detonate and because it was on the lower end of powerful compared to other explosives. Although its advantages, however, are that it could be safely melted by using plain steam or eve hot water and easily poured molten product into shell cases. It was also so insensitive that, for example, in 1910 it was exempted from the British 1875 Explosives Act from actually being considered as an explosive for the purposes of manufacture storage (http://en.wikipedia.org/wiki/Trinitrotoluene). Later on in its days TNT posed a great threat during the First World War due to its versatility when exploding.

One very interesting thing I discovered was how TNT is manufactured: Trinitrotoluene is prepared from toluene, which is readily available from coal tar (a faction of oil, which can be separated by fractional distillation). Toluene is mixed with nitric and sulphuric acids so that electrophilic substitution of NO_2 groups, commonly known as nitration, can occur. The mono-substituted product is formed first and then with increased reaction temperatures and acid concentrations the di-substituted and then the tri-substituted products are formed. The last step is often carried out with free SO_3 in the mixture too. (http://www.chm.bris.ac.uk/webprojects2001/moorcraft/TNT.htm)

It is an important explosive, since it can very quickly change from a solid into hot expanding gases. Two moles of solid TNT almost instantly changes to 15 moles of hot gases plus some powdered carbon, which gives a dark sooty appearance during the explosion. TNT is explosive for two reasons. First, it contains the elements carbon, oxygen, and nitrogen, which means that when the material burns it produces highly stable substances with strong bonds, so releasing a great deal of energy. This is a common feature of most explosives; they invariably consist of many nitrogen or oxygen containing groups, attached to a small, constricted backbone. However, explosives like TNT, actually have less potential energy than gasoline, but it is the high velocity at which this energy is released that produces the blase pressure. This high speed reaction is called detonation. TNT's detonation speed is 6,940 m/s compared to pantane's 1,680 m/s in air. (The Chemistry Of Explosives by Jacqueline Akhavan.)

The second fact that makes TNT so explosive is that it is chemically unstable, the nitro-groups are so closely packed together that hey experience a great deal of strain from the neighboring groups. Due to this it doesn't take much irritation forces to break some of the weaker strained bonds in TNT. In a study typically one gram of TNT produces somewhere around 1 litre of gas, this in turn is a 1000% increase in volume.(The Chemistry of Explosives by Jacquline Akhavan). TNT is also used as a weapon, due to its low melting temperature in some cases which allows it to be quickly put into ammunition shells.

There was a lot to be learned about this compound and maybe more unknowns but to remember that TNT is not just some song. It is a very unique explosive which has both helped people and caused great devastation but without it things could be different. It is a substance that will not be forgotten not only because it goes “boom” but because of the versatility of the explosive, but mainly because of the “boom.”

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Fireworks

by Danny Waldon

Everyone likes to see a good fireworks show. Almost every American saw at least one fireworks show or made a little one in their own backyard on holidays like the 4^{th} of July or New Year's Day [1]. There are numerous types of fireworks that are used, from simple sparklers, to roman candles, to the big explosive devices they use at big parties and celebrations. But, not that many people know how fireworks actually work. They don't know the components to making a firework, why they don't give off the same colored lights, or why the explosions themselves have a range of shapes and designs.

The basic components of something like a sparkler require a fuel source; an oxidizer, iron or some other steel, and a binder [1]. Firecrackers need something very different. Mostly they are made of gun powder, which is the fuel source of most fireworks used [1]. "Gunpowder consists of 75% Potassium Nitrate (KNO3), 15% Charcoal (a carbon source), and 10% Sulfur. This fuel is tightly packed into the casing, a thick cardboard or paper rolled up tube, forming the propellant-core of the rocket in a typical length of width or diameter ratio of 7:1" [2]. The container is usually paper that's pasted and a string that's formed into a cylinder. The stars are really spheres, cubes, or cylinders of a sparkling-like composition. The bursting charge is a "firecracker-like" charge at the shell's center. As for the fuse, it gives a time delay as to when the shell will explode [1].

As to what the colors of each firework should be, they can range to basically all of the colors we normally see in a rainbow. "For red, Strontium chloride (SrCl2) is used. Calcium chloride (CaCl2) give off an orange color. For yellow, a sodium D-line atomic emission is needed. Barium chloride (BaCl2) releases green. And finally, for a blue light, Copper (I) chloride (CuCl) is used" [3]. If you look more closely at the compounds, you'll notice that most of them consist of an alkaline-earth metal joined with chlorine.

There are two different types of emitters that give of light: black body radiation and gas phase emitters [3]. The black body radiation is highly used, because it can absorb and release all forms of radiation frequencies [3]. The gas phase emitters are a little more tricky. To get different colors, the chemical properties mentioned above are needed [3]. Unfortunately, making fireworks isn't as easy as it sounds. A fuel-oxidizing system is needed to generate the atoms being emitted at a sufficiently high temperature [3]. Pyrotechnic compositions are required are required to create and evaporate these atoms into an intense flame [3]. To make a firework give off red light, Strontium carbonate (SrCO3) and Potassium perchlorate are used to help produce the (SrCl2) mentioned above. The decomposition equation for Potassium perchlorate is (KClO4 → K+ + Cl- + 2 O2) [3]. While red colored lights are quite easy to release, blue light is far more difficult. That's because the Copper (I) chloride needed to release the blue colored light is very fragile. "it can be used with metallic fuels only with difficulty. Consequently, blue stars are never very bright" [3].

Fireworks can come in many shapes, sizes, and forms. A sparkler is just a stick with a lighted tip that releases tiny streams of light. Roman candles can shoot off different colored comets every 2-3 seconds. But, for the big explosions at parties and celebrations, they give off different exploding shapes. They are: palms, round shells, ringed shells, willows, roundels, chrysanthemums, pistils, marooned shells, and serpentines [1].

Now you're probably wondering what any of this technical stuff applies to in real life. Well, it's a good way to teach someone how to blow stuff up. To be more serious, all this information and more are vital if you plan to actually build and set off fireworks and/or rockets in your own garage. If you ever hear a kid ask what makes fireworks give off all the different colors, you can tell them that it involves chemistry and chemical compounds.

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Stem Cells

by Cassidy Werner

Stem cells are unspecialized cells with the ability to divide indefinitely, eventually differentiating into different cell types [1, 2, 3]. Originally discovered in mouse embryos over twenty years ago, the relentless research of dedicated scientists has recently led to experimental cell-based surgeries that may hold the key to curing a myriad of disorders including Parkinson's and diabetes [2, 4]. Embryonic stem cells (taken from a three to five day old embryo called a blastocyst) especially have shown promising results. Despite their seemingly limitless medical potential, many oppose stem cell research, claiming it to be immoral and unjust [5]. Research hurdles and moral implications notwithstanding, stem cells may prove to be the miracle cure of many human ailments.

There are two types of stem cells, adult (sometimes called somatic) stem cells and embryonic stem cells. Both have the ability to go from being an unspecialized cell to a specialized cell (a cell with a specific function, for example, a nerve cell), and to divide into other cells [1, 3]. However, there are key differences. Adult stem cells are developed later than embryonic stem cells, found scattered throughout tissue in the body, and generally are activated when that tissue is damaged or diseased [1]. For example, stem cells in bone marrow may advance marrow transplant surgery [2]. However, these cells tend to differentiate into a limited number of cells, and do not produce as many [1]. It is also thought that somatic stem cells may actually be the cause of some diseases, though more research is needed to confirm this [3]. Embryonic stem cells, on the other hand, are harvested from the inner cell mass of a blastocyst produced in an in-vitro clinic [2]. These show greater medical potential than somatic stem cells because of their ability to divide into greater numbers, and to differentiate into any type of cell ("pluripotent" cells) [2].

Learning to grow, identify, and harvest these cells without causing them to randomly differentiate took time [1]. Today, stem cells are grown in a special culture medium, a sort of "nutrient broth" that allows the cells to grow; it is thought that as research advances, changes in the culture medium could result in a specific type of cell (changing the surface and concentration of stem cells may also prove useful) [1]. The culture medium is often preceded by a layer of mouse stem cells, which give the growing cells something to attach themselves to [1]. (There is a movement to stop usage of mouse cells, as the fear of a cell-based therapy recipient's body rejecting the stem cells is enough without having to worry about mouse viruses making their way into humans [1, 2].) Scientists also use a variety of tests to identify stem cells at the end of the growth process. The most efficient and widely-used method is the usage of molecular surface markers, or "fluorescence" [1]. Each type of cell is coated with different kinds specialized proteins called "receptors" that are able to bond with different types of "signaling molecules" [1]. Normally used for communication within the body, scientists have taken advantage of the receptors by attaching "tags" to their signaling molecules [1]. When exposed to certain energy sources, these tags emit a specific color and brightness of light [1]. (There are many types of tags that may be bonded to any signaling molecule [1].) By marking cells with these tagged signaling molecules, researchers are able to determine whether or not their stem cells have differentiated. (These tags can also be used for harvesting; when passed through a light sources and an electric field, charged fluorescent tags become negatively charged and non-fluorescent become positively charged, allowing scientists to separate the cells [1].)

Many opinions exist on what chemicals to use for differentiation and which sort of cell offers the most potential. (For example, some scientists continue to line their culture dishes with mouse stem cells despite concern over possible virus exchange.) Scientists have only worked with organic chemicals so far, but research is being done into inorganic chemicals ("liquid-crystalline-based materials") that may serve as a way to control the shape of the stem cell's growth surface [2]. It has been shown that when surrounded by a certain type of cell (for example, a nerve cell), stem cells will turn into that specific type [1]. (Some scientists even use "embryoid bodies", or clumps of cells, to randomly differentiate their cells.) Scientists not wanting to rely on already specialized cells often inject genes to guide the cells one way or another [1]. Identifying the genes that will activate the differentiation process is extremely difficult, however, and much more research is needed before anything can be considered definitive. There is also some debate over the ability somatic stem cells to overcome their general trend and turn into any type of cell (plasticity), which would result in decreased chances of rejection in cell-based therapies- this requires a greater time and research investment [1].

The debate over the morality of stem cell research still rages. Those against it feel that by harvesting embryonic stem cells from a blastocyst, a potential life is being destroyed. These groups, mostly religious or highly conservative, put this embryonic stem cell research in the same category as abortion [5]. Confusion over therapeutic cloning and reproductive cloning also causes (unnecessary) debate, as people confuse a blastocyst with a much more advanced embryo. (This debate may eventually end, as Harvard University researches have found a way to "reset" somatic stem cells using embryonic stem cells [6]. Their goal is eventually be able to reset these cells without using embryonic stem cells to do so.) Pro-stem cell groups feel that the potential benefits far outweigh the moral implications of harvesting embryonic stem cells. These groups have become more prominent, with the allocation of funds specifically for stem cell research in California and continuous University studies.

Stem cells, assuming they reach their full potential, will eventually be able to treat everything from Parkinson's to hair loss. For example, heart patients will not need invasive surgery; instead, cardiovascular cells will be injected into the damaged area and eventually reconstruct the artery [3]. Parkinson's patients will receive nerve cells, improving mobility (this has already been done with mice afflicted with a similar disorder) [1]. Drug research will also be facilitated as recreated stem cells replace living human subjects in drug tests [3]. Similarly, stem cells may offer a better understanding of how to treat and/or prevent birth defects and cancer by studying the cause of mutations in their genetic code [1, 3].

Stem cells, with their ability to self reproduce and differentiate, have amazing medical potential. Future research will be targeted first at neurological and immunodeficiency disorders, then at heart disease, and finally towards drug development and disease study [3].While many hurdles remain on both the research and ethics front, the future for stem cells looks bright.

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Oxygen and Ozone

by Liu Yang (Nancy)

There are so many allotropes on earth. For instance, graphite and diamond are a couple of allotropes, they varies greatly in their physical quality and chemical quality. But, both of them are composed of carbon. Today, I am going to introduce a couple of allotropes: they are oxygen and ozone.

Oxygen is not strange to us because it exists everywhere. Oxygen is one of the most essential elements for all of life on the earth. Oxygen has no color and smell; it can barely dissolve in water (30 milliliter of Oxygen dissolves in about 1 liter water). The density of oxygen is 1.429 g/ L, which is a little bit more than air. In normal atmosphere pressure, the mass of pure oxygen is 1.4g/L. Oxygen transforms into sky-blue liquid in the condition of -183 centigrade. At -218 centigrade, it can even turn into some kinds of solid that looks like snowflake. In general, oxygen contributes about 20.99% of air. (1, 2,)

As a strong oxidizer, oxygen reacts with carbon, phosphorus, sulphur and many other elements. It can be also applied in a great many of fields in our life. In the first place, human and most of the life-forms can not live without oxygen, the airmen, divers and climbers take air tanks with them so that they are able to work in anoxic condition. In the next place, from the burning of candle to the flying of rocket, oxygen plays a role to support combustion. Also, oxygen is important to many industries like steel-making. (1,)

In comparison with oxygen, ozone is not encountered most by people. Ozone is a type of blue fishy inartificial gas on earth. Ozone is very unstable on chemistry, it decomposes into oxygen easily. The air contains of little part of ozone. It does exist mainly in 10-15 kilometers high atmosphere and it is widely known as the ozonosphere by people. The specifications of ozone are various: sterilization, deodorization, discoloring things and so on. (4,) In the year of 1785, Germans found that the electromotor gives out peculiar smell when it works. In 1840, German scientist, Scobey made certain that this is O3 and named it “OZONE”. (3, 5,)

From then on, scientists of Europe firstly researched into the specifications and functions of ozone. The function of sterilization was introduced into industry. A beef-producing firm in Sweden used ozone for beef-storage, from 1870 this way of beef-storage continued to use until today. (5,)

In 19th century, people realized that ozone could have strong oxygenation with timber, straw, starch, plant pigment, fat, vegetable tallow and alcohol. In 1868, de·Gebeth obtained the first patent of ozone application, that is, oxygenating coal tar for dope and oil paint production. In 1873, European used ozone for sugar producing and flax blanching. Ozone made great contribution to the producing technologies of many industries in the latest 100 years. Water purifying, chemical oxygenation, food storage and medical care are the four main fields of ozone applications, researches in these four fields have reached a very high level. IOA (International Ozone Association), which was set up in Canada in 1973 is a worldwide association for ozone technology development. This association holds conference for international ozone technologies intercourse every two years. IOA has branches in most of the developed countries. (3, .5, 6)

After World War II, ozone technologies developed rapidly. Since Germany built up the first ozone using water purifying factory in 1902, there were thousands of water purifying factories set up in Europe, America, Canada and Japan. American built these kinds of factories in 1970 for the first time, using it mainly to deal with life sewage. In industry applications, ozone is used in chemistry, oil, paper, weave, pharmacy, flavor and food industries. Europe took ozone for milk, meat, and cheese and egg storage. Eighty percent of cold store in American equipped with ozone creator in last years of 1930’s. After World War II, ozone using also spreads into the manufacturing and transportation of food industry. (3, 5, 6)

In medical applications, ozone can disinfect sickroom, operating room, medical instruments. Doctors can use ozone for dentistry (operations and keeping asepsis).

Drinking ozone water helping in treat gynecology diseases, using of ozone gas injection can cure varicosity. (3, 5,)

Finally, the ozonosphere absorbs almost all of the ultraviolet radiation from sun, keeping lives on earth from injury. However, human-beings gave off too much pollution in these years. (For instance, exhaust gas). Ozonosphere is heavily destroyed by these exhaust gas, especially the ozonosphere for the two Poles and Everest. We worry a lot about it because human are not able to withstand ultraviolet radiation directly without the filtration of ozonosphere. (6)

Although allotropes have same fundamental element but their attributes are various depend on their component and their structure. Some allotropes are familiar to people but some are not. All in all, allotropes are important to mankind and other life on earth. We should learn to know the way to use and to keep them in the balance condition.

That is all about my discussion about this couple of allotrope, oxygen and ozone.

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