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MSG

PG.6

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PG.15

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The Truth About Manmade Global Warming PG.10

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GENETICALLY MODIFIED ORGANISMS:
A QUESTION OF ETHICS

BY MARCI ROSENBERG AND CONNIE LIU

Every earthly organism has its good and bad points. Even bacteria, which are the infamous source of countless fatal illnesses, contain valuable traits that have the potential to avail mankind. The idea of harvesting only the benefits of these organisms has given rise to a new field of science involving genetically modified organisms. GMOs, as they are called, allow scientists to build the "perfect microbial machine," which combines the best capabilities of each organism into one super organism. The positive impacts of this technology are astounding and innumerable. If allowed to progress, genetically modified organisms could revolutionize all areas of science.

Although the idealistic concept seems perfect, GMOs have been the subject of intense ethical debate, mostly due to the problems involved in its implementation. Take the example of the asphalt-eating bacteria, an aide to construction workers and builders. At first glance, it appears only as a beneficial organism. This microbe, however, also has the potential to cause significant damage to roads, such as aggravating already present road cracks.

Furthermore, when scientists create GMOs, they are not simply engineering a static individual that, once produced, will stay in a certain form until death. Rather, they are engineering organisms that have the capability to mutate, to alter in genetic structure. In fact, there is the possibility that the super paint-eating or rubber-degrading strains of the asphalt-eating bacteria may undergo mutations that will allow them to attack houses, cars, and machinery causing unstoppable devastation to society.

Another problem occurs when scientists engineer microorganisms to degrade xenobiotic compounds man-made compounds that linger hazardously in the environment. A GMO that efficiently removes these dangerous compounds from the environment appears to be a must-have. However, this process, one that would take many hundreds of years in nature, is actually problematic when dealt with by GMOs. Since these xenobiotic compounds are toxic, the GMO, itself, is often killed in the degradation process. This causes increased health problems because the intermediary by-product is highly hazardous. A well-known example of this is the anaerobic biotransformation of trichloroethylene. Scientists found that GMOs only have the ability to transform trichloroethylene to vinyl chloride before being killed by the toxicity of the vinyl chloride. Thus, in trying to rid trichloroethylene, vinyl chloride, a known carcinogen and an even more dangerous toxin is formed and left undegradable in the environment. After realizing this, GMOs stopped being used in the degradation of trichloroethylene; however, this lesson learned poses a important argument

GRAPHIC BY OLGA BATALOV

that shows the risks of GMO implementation.

DNA transfer between altered and non-altered organisms is another rare, but dangerous possibility. DNA transfer can occur between natural bacteria via viruses to bacteria of other species and genera, an action that, as suggested by the name, transfers genetic material from one species to another. This is a rare occurrence, but if it were to happen with a GMO, there would be negative consequences because of unexpected changes in the genetic sequencing of previously stable species. A strain of sweet potato whitefly (Bemisia tabaci) that turned into a super bug around 1991, destroyed around 200 million Californian crops that year. Additionally, single-gene changes that occur through these gene transfers can make a previously non-pathogenic organism pathogenic. A grape pathogen with limited range became a pathogen with wide-range because of a single-gene transfer. Houseflies and anopheline mosquitoes also developed resistance to certain insecticides because of a singe-gene transfer.

But besides technical problems, there are also socioeconomic effects involved with introducing GMOs to society. The Bovine Growth Hormone (BGH), for example, is a genetically modified hormone, which increases milk production in cattle by around forty percent. Because this growth hormone increases milk production, it also decreases the number of dairy farmers necessary. In essence, hardworking human labor will be outsourced to million of microorganisms. The economy will be most damaged in a country where a large percentage of the populations depends on the one process that GMOs might dominate. In Ghana, for example, over twenty percent of the work force is in cocoa production. With the use of GMOs and simple carbohydrates, synthetic alternatives to cocoa, coffee, and tea can be easily produced, taking away the jobs and livelihoods of people around the world.

But then again, to the consumer or to the country in famine, these changes might be more advantageous than problematic. Genetically modified foods can relieve the prevailing malnutrition issue, particularly that of third world countries. Children and adults alike are severely suffering from malnutrition and anorexia because of the lack of nourishing foods. This concern can be solved easily by utilizing GMO technology. Golden rice is one example of a GMO that has been successfully incorporated in societies dependent on rice. The plain rice that many people rely on as their staple diet does not have an adequate amount of nutrients. Because of the lack of Vitamin A in rice, Vitamin A deficiency is a primary cause of blindness in these countries. Golden rice, developed by researchers at the Swiss Federal Institute of Technology Institute for Plant Sciences, contains an unusually high content of vitamin A, among other nutrients.

Scientists also are developing a process to reduce costs of producing medicines and vaccines by developing edible vaccines in tomatoes and potatoes. Through this new development, it will be easier to ship, store, and administer these new vaccines to people in third world countries. These new advancements would also drastically decrease prices of generic medications prescribed by doctors and make them more readily available to financially-challenged individuals in the United States.

Along with alleviating hunger, GMOs can be produced with desired traits such as drought resistance, disease prevention, herbicide tolerance, and more; in addition, due to modern technological advancements, plants can be grown virtually anywhere. Millions of people would be saved from the fatal grasp of anorexia or malnutrition; moreover, we would boost the survival rate of babies in third world countries.

In the end, it is difficult to decide whether further research and implementation of GMOs should be performed. They are perfect in so many ways: cheap, effective, (in most cases) harmless: to the key to resolving many problems that plague society today. Yet, at the same time, there are risks to releasing GMOs, making their debut in society linked to questions of ethics. GMOs are an ideal solution to many of the world's problems, but only in ideal circumstances. Do we risk harms like that of the asphalt-eating bacteria, the biotransformation of trichloroethylene, or the sweet potato whitefly super bug while we strive to make GMOs practical? The noble task of relieving famine may be at hand with the aid of genetically modified foods, but can we endure the potential consequences? There are no clear answers to these questions now, but questions never stopped the progress of science, and the enormous potential of genetically modified organisms is just too momentous to contain.

WHAT IS A GMO?

BY ELORA LOPEZ

GMO stands for Genetically Modified Organism. A GMO is any organism, be it a plant, animal, or bacteria, whose genetic sequence has been changed from its natural state. Sometimes these changes come from the addition of DNA from one species into another species' genetic code. This newly combined DNA strand is called recombinant DNA. The organism that has DNA made from two different species is referred to as a transgenic organism, whereas the GMO that is made up of DNA from only one species is a cisgenic organism. The first transgenic organism was created in 1973, when an E. coli bacterium was genetically modified to express a Salmonella gene.

This genetic alteration can be done in several different ways. In the case of transgenic organisms, there are two main methods that are used to add a section one organism's genetic code to another. In some cases, the DNA section that is to be inserted is attached to a virus, and the virus transfers the section to the desired destination. This way, the two sections of genetic code can be combined. DNA can also be physically be inserted by use of a gene gun, also called a biolistic particle delivery system. The gun inserts a heavy metal coated with the DNA that is to be transferred into the other organism's genetic code.

There is now a myriad of different GMOs being produced in the world, all with very different applications. The human protein antithrombin III has been injected into the milk-producing genes of goats, the result being that the goats produce the protein in their milk, and so it can be collected and given as medicine to those that have an antithrombin III deficiency.

Though GMOs have already endured numerous scientific breakthroughs its implementation is still awaiting approval from those with ethical concerns.

GRAPHIC BY JESSICA ZENG

The application of GMOs poses a risk. Though asphalt-eating bacteria can be of great potential, it also may be detrimental, widening cracks in roads.

THE SECRET OF THE SECRET INGREDIENT:

PHOTOS BY LING JING

This cup of Maruchan instant noodles, bought at Torrey Pines High School, contains more than 50% of an average person's daily sodium allowance. The presence of MSG contributes significantly to the high level of sodium.

As the bell sounds, signaling the commencement of the few treasured minutes of lunch, students flock to lunch lines and emerge with steaming cups of Ramen noodles. Unbeknownst to them, however, a certain molecule is interacting with their taste buds as they are gulping down the savory, warm soup. This notorious substance is monosodium glutamate, more commonly known as MSG. The MSG in the students' scrumptious and inexpensive cup of noodles produces a delectable flavor, but also acts as a poison.

MSG, or Aji-no-moto, as it is called in Japan, was isolated from a type of seaweed by Kikunae Ikeda in 1908. Since its development, a major MSG industry has evolved, and MSG has become an essential component in processed, dried, and canned foods, certain cultural cuisines (most notably Chinese food and American fast foods), and of course, the famed and adored Ramen noodles.

As a flavor enhancer, MSG changes the sensitivity of taste buds and stimulates electric signals to the brain, thus intensifying pleasing sensations. MSG is not a flavoring in itself, but rather targets glutamate receptors in the mouth to create the unami taste, a recent add-on to the traditional four tastes of sweet, salty, bitter, and sour. (Unami describes the flavors common in foods such as meat, cheese, and mushrooms.) In a sense, MSG tricks the brain into thinking the food being eaten tastes good.

With the stimulation of taste buds, a series of detrimental events take place. To give a definition shouldering some indication of its effects, monosodium glutamate is the sodium salt of glutamic acid, a non-essential amino acid, an amino acid that the body sufficiently manufactures. MSG is also described as processed free glutamic acid, or glutamic acid that is not a component of a protein. Unlike L-glutamic acid, the naturally occurring variant of glutamic acid that is found in proteins and acts as a neurotransmitter, free glutamate does not have peptide linkages; as a result, the body does not digest it properly but instead quickly absorbs it into the bloodstream. This rapid absorption causes glutamate level to be multiplied eight to ten times its usual level. This excess is toxic and leads to severe implications for the nervous system.

Though astrocytes, helper neurons, can moderate glutamate level, lack of glucose renders them ineffective while simultaneously increasing the toxicity of glutamate one hundred-fold. Thus, astrocytes are not always present to help the body recover. Another defense mechanism, the blood brain barrier, regulates transportation of glutamate to prevent it from spreading, but is not developed in children, is worn with age, disease, and injury, and does not include the vital hypothalamus or pituitary gland in its protection. Ultimately, there exists no foolproof, impeccable defense against excess glutamate. Consequently, to people without adequate defenses, to those who are MSG-sensitive, MSG consumption can be extremely problematic. More than 100 million people in the world today suffer from MSG-sensitivity.

MSG can also insidiously affect the health of those who are not MSG sensitive. In carefully moderated concentrations and amounts, MSG shows no significant implications. However, excessive consumption can lead to or exacerbate long-term health problems including chronic headaches, asthma, heart problems, mood swings, depression, and paranoia. MSG is also involved in retinal degeneration, or breakdown of cells composing the retina, which extends to damage to dendrites (filaments on neurons that receive signals from other neurons). MSG, simply put, kills brain cells, acting as an excitotoxin and neurotoxin by instigating neuron degeneration and death through overstimulation of glutamate receptors.

Recently, attention has been called to the deleterious effects of MSG, sparking an ingredient-naming movement in which companies market MSG under alternate names on food labels. Worst of all, the Food and Drug Administration (FDA) allows and is in fact the driving force behind this flurry of renaming. Decomposed proteins and glutamic acid produced by bacteria that have been refined to be 99% pure glutamic acid must be recorded as monosodium glutamate. If the artificially synthesized glutamic acid is refined to be less than 98% pure glutamic acid, the ingredient name becomes hydrolyzed vegetable protein. HVP can be particularly harmful because it also contains other amino acids, such as aspartic acid and L-cysteine, which also contribute to neuron death. Finally, if amino acids are combined, a third type of MSG is yielded and dubbed natural flavoring. Other names for MSG that have been approved by the FDA are accent, Chinese seasoning, glutavene, subu, Kombu extract, and mei-jing.

No matter what name it is disguised under, however, MSG will always have the same pernicious effects. Fortunately, the public is now much more aware of the health implications of MSG than it was a few decades ago, but MSG is still used extensively in packaged foods and restaurant dishes. Those with MSG sensitivity who ingest the substance or normal people who unknowingly devour large amounts of the flavor-enhancing molecule will be plagued with severe and significant health conditions, which can lead to death if left untreated. Thus, though students may relax and enjoy a filling, tasty lunch of ramen noodles, the secret ingredient scattered within the soup will ensure that the pleasure is only temporary.

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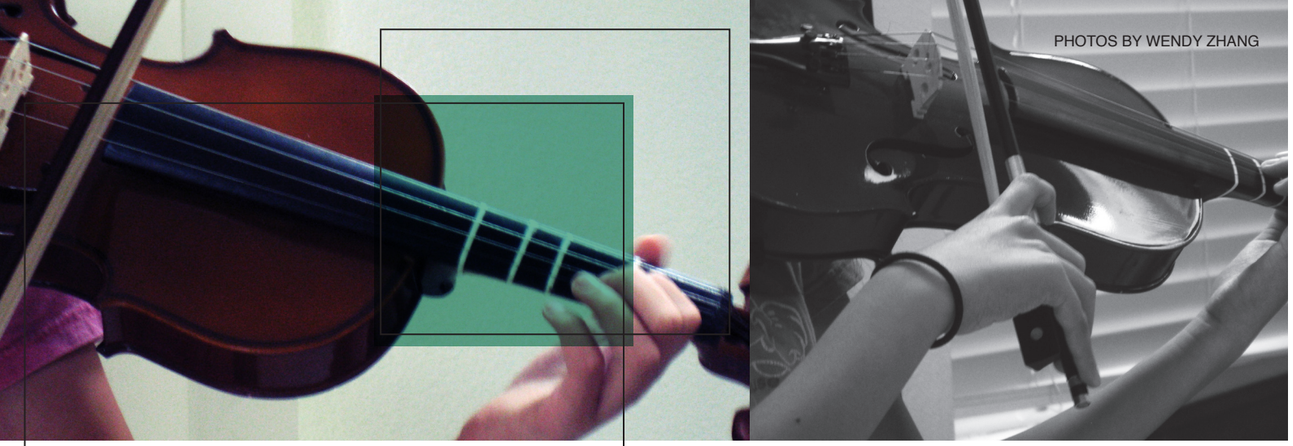
PHOTOS BY WENDY ZHANG

QUANTIFYING QUALITY: VIOLIN SOUND ANALYSIS

BY NATHAN MANOHAR EDITED BY ALICE FANG

An exquisite violin is easily identified by the trained ear. In fact, even untrained ears can spot a good violin upon a mere glance at the price tag: the greatest instruments of seventeenth century Italian luthiers are priced in the millions, while a cheap but playable violin can be bought for less than a hundred dollars. The difference in quality is undeniable, for the perfection behind the making of a Stradivarius – deemed the greatest of all violins – is not easily attained.

We tried to determine the quantitative differences between various violins, ranging greatly in price and sound quality. For each violin, open strings were recorded and a Fourier transform was used to generate the spectrogram and determine the percent of sound in each harmonic. The three highest quality instruments tested were the Stradivarius, Schleske, and Marcello Villa violins. The cheapest and poorest quality violin tested was the eBay violin.

First, we must examine sound waves to achieve an understanding of violin tone. As sound travels, air molecules compress and expand. When sound waves reach the ear, eardrums vibrate and through the series of processes that follow, a nerve impulse is sent to the brain and sound is "heard." The height of a sound wave (called amplitude) is related to the volume and amount of compression and rarefaction, or decrease in density, of the air molecules, so a louder sound has larger amplitude. Another essential element of a sound wave is its frequency, the number of times the sound wave cycle repeats in one second, measured in Hertz. For example, A, the note to which an orchestra tunes, has a wave cycle that repeats 440 times in one second. The frequency of the wave is known musically as pitch. Higher pitches have higher frequencies.

The most basic sound wave resembles a sine graph and has one pure frequency (figure 1a). The complex sounds of instruments, however, contain an infinite mixture of sine and cosine waves (figure 1b). This means that not one, but infinite frequencies, are sounded when a note is played. The reason we hear one pitch and not chaos is because each frequency has a different amplitude, and the main pitch we hear (the fundamental frequency) has the greatest amplitude. The other frequencies involved, called harmonic overtones, peak in amplitude at integer multiples of the fundamental on the graph. When a note is played on the violin, the listener identifies the fundamental frequency as the pitch, but also hears the frequencies of the overtones. These overtones give sound complexity and allow for the differentiation of similar sounds. Different instruments, for example, have different strengths in each harmonic. This is how a trumpet can be distinguished from a flute by ear. This is also how two different violins, even when both are playing the same note, can be distinguished from each other.

Thus, in order to compare two violins, we must analyze the strength of its various frequency components, which can be done through a Fourier transform. Essentially, the Fourier transform breaks a complex wave into its sine and cosine components to determine the specific amplitude of each frequency. A spectrogram represents this graphically with time on the horizontal axis, frequency on the vertical axis, and amplitude on 3rd axis (often represented by color).

A variety of violins sounding open A (440 Hz) were recorded and compared to each other and to a computer-generated A. On the spectrograms, the computer-generated note A had only one line because it is one pure frequency. The A on the violins, however, had many frequencies—overtones. From the spectrograms, it was noted that as the harmonic overtones on the violin become higher, its strengths also become weaker. The strength of the harmonics varies depending on the violin. The higher quality violins had similar wave patterns and had more strength in the fundamental note. Using the Fourier transform, it was shown that these violins (namely, the Stradivarius (Figure 2), Schleske, and Marcello Villa) had approximately 92, 70, and 82 percent of the sound in the fundamental, respectively. Meanwhile, the Fourier transform revealed that the eBay violin had only 46 percent of the sound in the fundamental for the A string (Figure 3). The huge gap between the high quality and low quality instruments is most likely a reason why some instruments are deemed "high quality" and others are not.

It must be noted that greater strength in the fundamental harmonic is not always favorable. The computer-generated sine-wave A has 100 percent of sound in the fundamental; however, this pure frequency is incomparable to the violins. Nonetheless, the fact that the eBay violin had only 46% in the fundamental compared to the 92% in the Stradivarius does show that purity of a sound is one factor in determining the quality of violin. Evidently, more research is needed to determine the extent that purity of sound (percent of fundamental) plays in the perception of quality. However, the percentage of sound in the fundamental may have been altered the quality of recording as well. A higher quality recording system may have picked up sounds in higher harmonics with more precision.

Moreover, the highest quality violins tested had higher relative strengths of the fourth harmonic. The Stradivarius had 4.2% of the total sound in the fourth harmonic, while the Schleske and Marcello Villa violins had 15.1% and 9.0% of the sound in the fourth harmonic, respectively. Most of the other harmonics had relatively low strengths, with a thousandth or hundredth percent of the total sound in the high quality instruments. In the lower quality violins, no significant correlation could be made between the strengths of the various harmonics, with certain harmonics having a higher strength in some instruments and not in others. The "randomness" of the distribution of the strength of the harmonics in the lower quality violins probably contributes to their poor tone.

By scientifically analyzing the tones produced by the various violins, we were able to find numerous differences between the high and low-quality instruments. The hope is through examining the basis of violin sound, instruments of Stradivarius quality may be one day be replicated with ease and be accessible to musicians around the world.

Full original lab report can be viewed at www.falconium.org.

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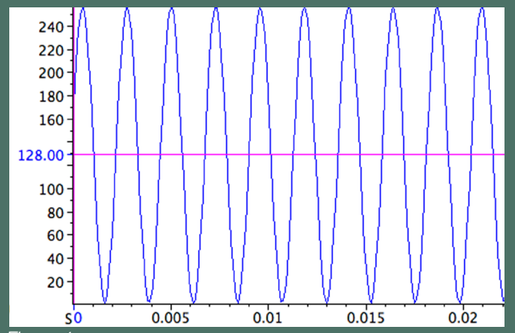


Figure 1a

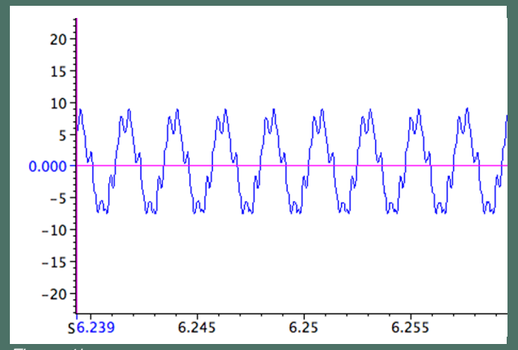


Figure 1b

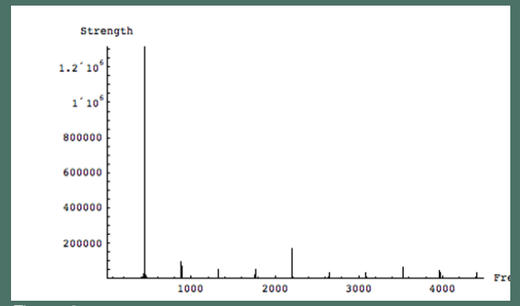


Figure 2

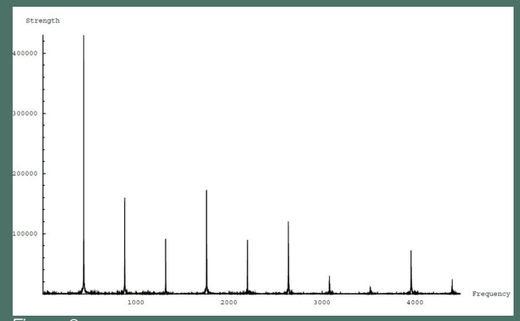
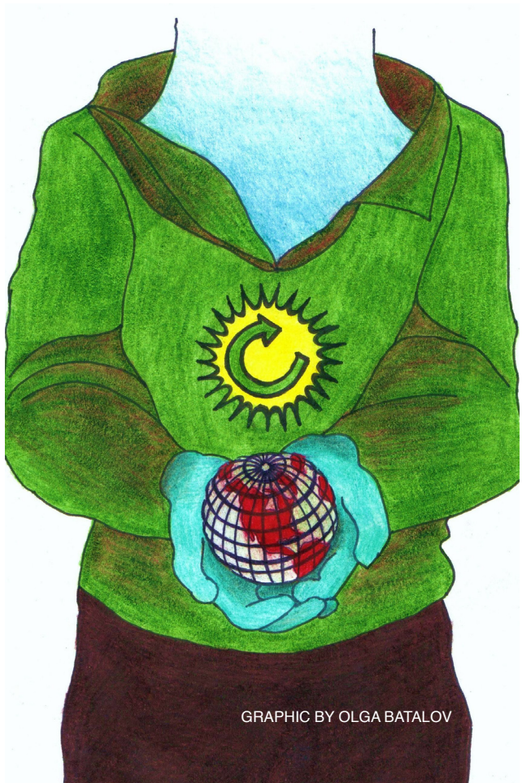


Figure 3

The Truth about MANMADE Global Warming

BY REBECCA SU AND NOOR AL-ALUSI



GRAPHIC BY OLGA BATALOV

The phrase "global warming" immediately inspires images of deadly greenhouse gases and pollution darkening the skies, not to mention polar bears scrabbling to stay afloat atop melting glaciers. Supposedly, humans are largely responsible for this environmental crisis by generating record levels of greenhouse gases through industrial activity. Politicians and scientists around the world are convinced that manmade global warming has put us on the brink of catastrophe. However, is it really fair to attribute all the effects of global warming to human pollution? Although there is copious research to substantiate the claim that humans are to blame, a growing number of scientists argue that these widely accepted facts about global warming are still no more than budding theories. An increasing amount of evidence actually suggests that natural cycles could be the root of climate change.

Before we look at how skeptics explain the planet's trend of warming temperatures, let us analyze the accepted theory of how the climate works. The Earth maintains its balance in temperature by absorbing solar energy through ultraviolet and visible light and emitting heat in the form of infrared radiation. There are many variables that influence this energy balance and thus affect the global temperatures, including cyclic changes in the sun's brightness; particulates from oceans, volcanoes, and manmade air pollution; and fluctuating levels of heat-trapping greenhouse gases in the atmosphere.

One of the most common arguments in support of manmade global warming is that high levels of carbon dioxide emissions from humans have resulted in a worldwide increase in temperature. The empirical evidence from the Intergovernmental Panel on Climate Change (IPCC) suggests that the amount of carbon dioxide has increased since the Industrial Revolution due to the widespread burning of coal and other fossil fuels, and that global temperatures have been warming since 1970. The IPCC has found that atmospheric CO_2 has increased from about 280 years and maintains that this accounts for the current warming trend. Although human industrial activity does influence CO_2 emissions, rising CO_2 levels in the atmosphere are not the main culprits of warming global temperatures. Upon examining trends from the past 240,000 years, scientists have discovered that, surprisingly, the inverse may hold true: a surge in global temperature leads to a hike in CO_2 levels. Those scientists hypothesize that this is due to the Earth's oceans, which hold a great deal of the planet's CO2. Since water has a larger capacity for dissolved gas at colder temperatures, warmer temperatures will cause the oceans to release CO¬2 into the atmosphere, just as soda loses its fizz on a hot day.

Moreover, a significant discrepancy in the pattern between temperature and CO_2 could disprove the greenhouse effect theory: scientists from the Japan Society of Energy and Resources (JSER) found that the warming trend abruptly stopped in 2001 and has not continued for the past eight years: however, CO_2 emissions have continued to increase. This irregular relationship between temperature and CO_2 levels suggests that a buildup of manmade carbon emissions may have little or no effect upon global climate at all: instead, the global temperature rises and falls on its own accord.

Additionally, although temperature fluctuations on Earth seem to be a cause for alarm, they are not unusual at all. According to Denis Avery and Fred Singer of the National Center for Policy Analysis (NCPA) and the Nongovernmental International Panel on Climate Change (NIPCC), such changes are a part of the planet's regular warming and cooling cycles, which have existed for eons. Each cycle lasts for approximately 1500 years, consisting of alternating ice ages and relatively warmer "interglacials." Our current warming trend may simply be a recovery from a recent Little Ice Age that lasted from approximately 1400 to 1800. Since the warming began in 1850, we may experience temperature increases for several more centuries, regardless of human efforts to curb greenhouse gas emissions.

The main factor causing these temperature cycles may not be human activity, but the sun. The Earth is constantly bombarded with solar cosmic rays, which are high-energy charged particles (usually atomic nuclei and similar subatomic particles) that travel near the speed of light. When cosmic rays enter the atmosphere, they strike air molecules and ionize them, causing them to clump together into particles called cloud condensation nuclei (CCN), or "cloud seeds". The CCN are sites at which surrounding water vapor can come together and condense into droplets, eventually forming a cloud. Since clouds reflect solar radiation and heat, they have an overall cooling effect on the planet. Recent studies have shown that there is a direct relationship between the amount of cloud coverage and cosmic rays that enter the atmosphere. Meanwhile, the sun also creates a "solar wind" consisting of charged particles that shields Earth from these cooling cosmic rays and thus increases the temperature of the planet. The cyclical nature of the sun's activity ultimately determines the extent to which Earth is affected by cosmic rays and solar winds. In fact, Earth's warming and cooling trends closely reflect patterns of solar variation.

But why are the reports of global warming so conflicting? Temperatures and other factors are so variable that such facts can be selectively chosen to defend any conclusion. For instance, the NIPCC claims that the IPCC solidifies its stance that fossil fuels cause global warming by simply publishing only data that supports its position. Similarly, the IPCC argues that the NIPCC is only defending its perspective on global warming because the organization is funded by the oil and gas industry.

These new theories about global climate patterns and detailed analyses of past trends, despite the controversy that surrounds them, are salient and plausible reminders that the ideas surrounding manmade global warming have yet to become conclusive facts. Politics, science, personal sentiments, and media have all become deeply tangled in this controversial debate. More research must be conducted before a decisive correlation can be claimed. In the meantime, it is vital that we continue enacting measures to protect and preserve our planet.

This article was published in the interest of fostering debate and sharing alternative viewpoints. The opinions expressed herein are those of the authors and do not represent the views of the Falconium Science Journal or Torrey Pines HIgh School.

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EXAMINING IODINE VALUE IN FATS

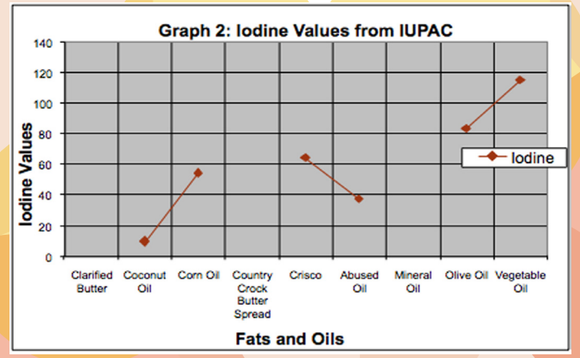
BY MAKANA KRULCE

Fats are one of America's most wanted criminals, making daily headlines and responsible for an entire movement of food chemistry research. Coveted food products on the market are adorned with appealing "low fat" or "fat free" labels. The American mind is straitjacketed into believing that the words "fats" and "oils" are expletives, while nutritionists struggle to explain the differences between saturated, monounsaturated, polyunsaturated, and trans fats. However, the differences between these substances are not embodied in the simple description of "good fats are liquid and bad fats are solid"; instead, the chemistry behind lipids must be considered.

Iodine value is often used to explain chemical differences in oils and fats. The iodine value of a fat or oil is the amount of iodine that can be infused in 100 grams of fat during the halogenation process. Halogens commonly used are iodine (I_2), bromine (Br_2), and chlorine (Cl_2); in this experiment, iodine was used. The general procedure for an iodine value experiment is as follows: First, the fat or oil is dissolved in a solvent, usually chloroform. Then, a halogen mixture of iodine and bromine in glacial acetic acid is added. The halogens attach themselves to the double bonds in the fatty acid chain, and require roughly one hour in the dark for this process. Next, the excess halogens that did not attach to the fat molecules are combined with potassium iodide (KI). This reaction produces pure iodine. A simple iodine-starch reaction follows, the products of which are titrated against a sodium thiosulfate solution to determine the amount of iodine left over. Because the halogens attach themselves to the double bonds, the more iodine found after the reaction, the fewer double bonds there are in the lipid.

However, these reactions involve a dangerous Hanus solution (a mixture of glacial acetic acid and halogens), a chloroform solvent, a large amount of fat (100g) and a long reaction time, all of which are limited by a school laboratory. A school-compatible version of this lab attempted to produce the same relative results in regards to the double bonds of specific fats, but with safer procedures and fewer resources.

The first change made to the procedure was the elimination of chloroform solvent, which is very dangerous and prohibited from school. The most readily available organic solvent that is similar in structure is hexane, which was used instead. Like chloroform, hexane is nonpolar, which means that it easily dissolves oils, which are also nonpolar. However, this proved inadequate with solid fats



such as butter and margarine. The hexane was simply not strong enough to dissolve the solid fats, so the fats had to be melted before the experiment began. Fats were melted over a warm hotplate for about a minute before the chemical reaction, which allowed for easier testing.

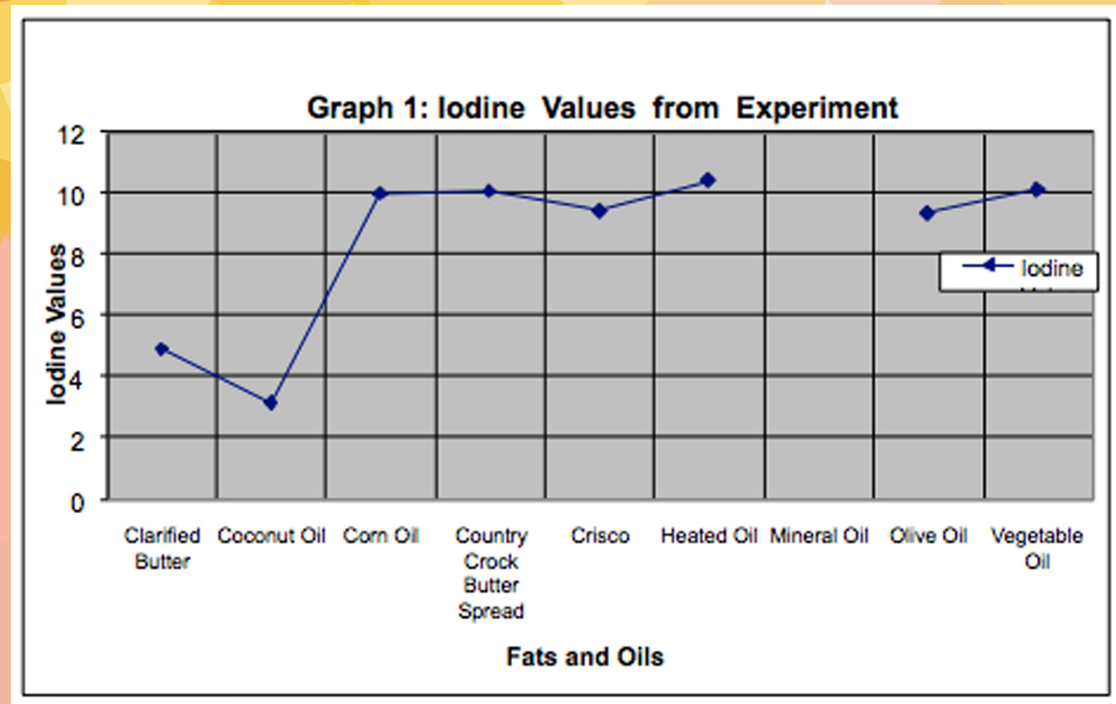
The procedure originally calls for 100 g of the oil or fat, but all measurements were cut down to only about 0.1 g of fat per trial. This was due to the lack of readily available Hanus 0osolution and the inaccessibility of large amounts of oil or fat. As a result, the entire procedure was cut down, increasing the likelihood of experimental error. Small amounts of chemicals were used with the titration and reaction, which affected the overall interpretation of the results. The results were more difficult to compare to the universal iodine numbers because the amounts of titration solutions used were much smaller. As a result, the values were compared to graphs to see relative trends instead of exact numbers.

Additionally, the procedure originally called for an hour of reaction time to allow the halogens to interact with the double bonds, but this was cut down to only half an hour. This could have affected the amount of halogens absorbed by the fatty acids, because the molecules had a smaller opportunity to combine. However, in combination with the proportionately smaller amounts of chemicals, results were not as far off as previously hypothesized.

Despite these experimental errors, the lab was ultimately successful. By comparing the known iodine values to the experimental values from the lab, it was found that the values were relatively consistent. For example, altered experiments found that corn oil had a higher iodine number than coconut oil, which was supported by theoretical data. The same was true for olive oil and vegetable oil. Experimental results showed that olive oil has a smaller iodine number than vegetable oil, which is consistent with IUPAC's data. There was a discrepancy with the Crisco and the heated oil, but this can be accounted for. The theoretical values that were entered for the Crisco and heated oil were not the real values for these substances. No values for Crisco and the exact heated oil that was used are given by IUPAC. In place of these values, hydrogenated fish oil and heated oil are noted, respectively. It was expected that the values would be consistent, due to similarities between the oil, but it has been decided since that these values should not have been compared to the experimental values, because the substances are not similar enough. Other than this discrepancy, the experimental values appear to be relatively similar to the theoretical values from IUPAC.

The IUPAC iodine values of the fats tested in the revised procedure were plotted on a graph and compared to the graph of the experimental data. It was found that the results were relatively the same. Because the revised procedure saw a decrease in the total amount chemicals used, the values were obviously much less than the IUPAC values, but the curve was very similar overall.

Understanding differences between fats, which can be relayed by data such as iodine value, is essential for educating the public on the health risks and benefits of these substances. With knowledge of the properties of different lipids, scientists can better inform and aid the public with its dietary choices, contributing to generally healthier eating practices.



A FEW WORDS ON INNOVATION

BY ALBERT CHEN

What shall I write for my essay (or Falconium article, may it be)? I look at my blank word document and begin to type. I have my subject! My word document! No, it is the written language, which can capture ideas and thoughts. And my computer, which stores my writing and allows me to edit. More broadly, my subject is innovation, the creation of a new idea or method. The written language, weapons, mathematics, and printing are among the greatest innovations of all time. They have stood through periods of war and of peace and prevailed timelessly as inevitable components of society.

Innovations can come many ways and from many sources; they may come accidentally or through necessity. Companies innovate by improving products and services to meet society's demands and keep up with competitors. For those in business, innovation is critical to maintaining revenue and keeping customers satisfied. Scientists and engineers also innovate, whether in searching for a novel cure for a disease or creating a new gadget that will ease the flow of everyday life. Creative new products are constantly being designed. Here are some examples.

The Surge Protector

But not just any surge protector. In light of today's conservation efforts, Belkin, a consumer electronics corporation, has created a surge protector that goes beyond merely protecting devices from voltage spikes: Belkin's surge protector saves energy and money as well. Belkin innovators knew that even when electronic devices are powered off, they still suck precious energy. After scratching their heads for some time, they invented a surge protector with the extra feature of cutting off power from select electronic devices in order to eliminate waste of standby energy. Belkin's surge protector meets the need to conserve while serving the surge protector's traditional role.

Insulin and Diabetes

For people with diabetes, insulin providing devices are an integral part of daily life. Insulin must be inserted in the bloodstream in order to maintain stable blood glucose levels. The primitive needle and syringe method was one of the first ways this was accomplished. However, scientists soon recognized the need for a discreet yet effective insulin-delivering pump. After all, poking yourself with a needle to monitor glucose level, and then poking yourself a few more times to actually get insulin in your body isn't the most pleasant thing to deliberately do every day. Thanks to their efforts, there are now customizable external insulin pumps that deliver insulin based on a daily routine and can sense changes in blood glucose levels. This greatly improves the quality of life for diabetics. Current research shows an in-development intranasal spray may also show some promise.

Those Nasty Mosquitoes

Innovation doesn't always come from the big companies and scientists. Anyone can innovate. For an elementary school science fair project in Taiwan, one student and his teacher devised a method to capture mosquitoes. By using an empty soda bottle, paper, tape, water, yeast, and cane sugar, the student was able to make a trap that caught 1,400 mosquitoes over the course of a few weeks. No more mosquito problem.

GRAPHIC BY JESSICA ZENG

As you might have realized, innovation can come from anyone, and it can be practical or just cool. Visit www.falconium.org/innovation to keep updated on innovation news. Our world is always in need of innovators.

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¿ an ode to the question ?

BY JOE DRISCOLL

It is the nature of the human mind to thirst for knowledge, to understand how events in this universe occur. I do not know why humans behave so irrationally. After all, Mother Nature is a fickle lover, unwilling to throw herself at the casual curious spirit. She must be courted lovingly, given body and soul for years before doing the same. And even then she does so sparingly. Too much work for too little a prize, if you ask me. Yet mankind pursues her to the ends of the earth, hanging on her every word in hopes that one day her lips might slip, revealing all to those worshiping her. Perhaps it is hardwired into our DNA; a salmon cannot help but swim upstream despite its ultimate demise. Or maybe we are fooled by our own ignorance, thinking that the answers we discover will fix all the problems we possess. But I like to think that we woo Mother Nature because we know that we will never have her. We like this challenge of impossible nature. We enjoy the fact that we are ultimately doomed to fail. Never will we know all that there is to know, and that excites us to a greater degree than any softly spoken secrets Nature feels willing to part with us. It is the challenge, the insurmountable odds that tell us we will never know everything - that we will never truly understand life - to which we defiantly call out.

The brief existence of one man cannot hope to see him learn all knowledge of the Universe, but that does not stop him from trying. And in this colossal effort to achieve the impossible, man has created the mathematics and sciences, tools for its posterity so that people in their lifetimes may reach a tiny bit farther than their forebears ever could. And it is these tools that we must use to greatest extent. Not for ourselves - even the youngest among us has no hope of understanding a trillionth of all there is - but for our children's children. For the generations that will base their imaginations and theories on the ideas ours has yet to define. So that one day, after infinitely many lifetimes and countless generations, man will walk upon this Earth with such knowledge that he will have satisfied all curiosity, ridden all questions. Then, finally, mankind will be lifted from this curse of wonder. No longer will he search in vain for answers that will not be discovered until his grandchildren are gone from the earth. Then man will finally be at peace.

Some may fanaticize of this time, wishing themselves in this paradise full of answers. I, however, am not one of these. Peace has never been my strong suit. I am drawn to adventures full of difficulties and misfortune. Much like love, the quest for answers is full of hazards. It throws you to the ground, beats you to an inch of your life, and steals all your money. But also like love, I would rather experience a hell twice as gruesome than be denied of that quest. What ecstasy can be found in finding patterns no one else knew existed! What euphoria exists in boldly going where no human being has gone before! The delight of using math and science to discover answers no creature has ever laid eyes on is something indescribable. Even simply increasing my own knowledge, better understanding how a plane is able to glide across the clouds, amuses me to no end. And guessing… using the imagination to try and explain the laws of the universe; Coming up with multiple hypotheses, each one appearing as correct as the next; Eliminating one after the other slowly and thoughtfully; Constantly molding this explanation, correcting its faults through years of experience until I am sure I am right; Then one fine morning waking up and discovering that I was absolutely and totally wrong. What greater adventure is this?

Man throws himself into his questions, regardless of the paucity of answers, because in doing so he proves himself worthy of living. By questioning he finds adventures. By imagining he experiences courage. And by believing, regardless if all he believes turns out to be wrong, he lives his life.

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