PSC
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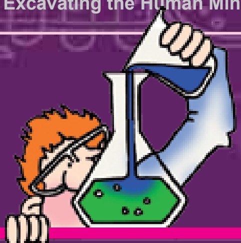
Planetarium Science Center
Science For All!

SPRING 2011

In this edition...



CHEMISTRY; Our Life...

By: Maissa Azab

Having dedicated our careers to promoting and partaking in the noble and fine endeavor that is science communication, we, the PSC Editorial Team, are both required and privileged to communicate all that is science; particularly, science that is entrenched in our everyday lives. In alignment with this overarching mission, it is only appropriate that we consistently join in worldwide scientific celebrations and concerns; hence, our dedication to annual international scientific themes as well as contemporary pressing global issues.

So far, we have discussed Astronomy in celebration of the International Year of Astronomy; Biodiversity in celebration of the International Year of Biodiversity; one of, if not the most alarming global crisis that is Climate Change; the perils facing Human Health today; and last, but by no means least, the most popular topic of Scientists, their discoveries and inventions.

However, nothing so far has been as daunting as the task at hand to us; we, science communicators, who might be of humble scientific background but who play the unique and significant role of transmitting the complicated knowledge of scientists to the general public in layman terms. The task, of course, is to unravel mysteries and miracles of the core science being celebrated this year: Chemistry.

Nevertheless, we plunged with enthusiasm into the challenging task of untangling the cryptic codes of this spectacular science only to be surprised ourselves by a fascinating world of wonders. How surprised we were to discover the spectrum of elements we carry inside our own bodies; to grasp what chemicals do to the soil we inhabit, the air we breathe and the water we drink; to realize the incredible chemistry that goes on inside and around the food we eat from the time it grows on trees, going through its existence in our kitchens, to its journey on our stoves and down our digestive systems.

Naturally, talking about chemistry is not all paved with roses; we are bound to encounter some serious thorns, and we have. The thing to remember though is that if we have been negatively affected by chemicals, it is not really the fault of chemistry itself, but rather the fault of its misuse and exploitation by the greedy and hasty side of human nature; the same nature that has thus far destroyed the world's environment, biodiversity, climate, till the end of it.

Good, bad, or ugly; it is up to you, our dear reader to judge. The important thing is to take the time to read, watch, listen and think; to seek the illusive truth behind the mysterious magic of chemistry; simply, to get informed and make up your own mind.

May we help you a little bit with your quest for truth with what we offer in this "Spring 2011" and the upcoming "Summer 2011" issues, both dedicated to the rich and captivating realm that is chemistry.

CHEMISTRY in Our Daily Life

By: Dr. Boshra M. Awad
Professor of Chemistry, College of Women for Arts, Science and Education, Ain Shams University

Chemistry is the basis for all sciences. It is an exciting experimental science that lets us understand our world and makes our life easier. As you read on, you will see how chemistry is in our everyday life: in our bodies; at home; in the air we breathe, the food we eat, the water we drink, the soap we use; in nature; in our emotions; in every second of our lives, and literally every object we see or touch.

The elements that make the human body

Made up of chemical compounds, most of the human body is made up of water (H_2O), with cells consisting of 65-90% water by weight. Of the human body mass, 99% is made up of just six elements: oxygen, carbon, hydrogen, nitrogen, calcium and phosphorus. The remaining 1%, on the other hand contains, a wide range of elements; such as potassium, sulfur, sodium, magnesium, copper, zinc, selenium, molybdenum, fluorine, chlorine, iodine, manganese, cobalt, iron, among several others.

Antibiotics

Antibiotics are certain chemicals produced by bacteria or fungus that destroy other microorganisms, or hinder their growth. Antibiotics include, among others: penicillin, tetracycline, ampicillin and amoxicillin. As an example, chloramphenicol is an antibiotic that is effective against many disease-causing germs. As it is easily absorbed in the alimentary tract, it is applied orally in cases such as typhoid, cholera, meningitis and pneumonia.

Polymers

Polymers are formed when more than two monomers undergo chemical reactions to unite. From very early times, humans have been using many polymers that are obtained from plants and animals. In modern times, we have been able to make substances that are similar, and with better qualities, with the help of chemistry. Examples of naturally-occurring polymers are cotton (cellulose), starch, silk, rubber and wool. Man-made polymers include plastic, nylon and teflon.

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Silver Lining

By: Maissa Azab
Research: Shahenda Ayman

In Laymen Terms

Silver is classified among precious metals, which are attractive but not very chemically active. As their title indicates, precious metals are not very abundant in the Earth's crust. In fact, silver's abundance in the Earth's crust is estimated to be about 0.1 parts per million. It is also found in seawater, where its abundance is thought to be about 0.01 parts per million.

Used by humans for thousands of years, silver is often found as a free element in nature and can be extracted from its ores fairly easily. Ores rich in silver, however, disappeared long ago due to mining. Today, silver usually comes from ores that contain very small amounts of the metal. The metal is most commonly produced as a by-product of mining for other metals. After the primary metal has been removed, the waste often contains small amounts of silver that are extracted by electrolysis.

Silver is a very inactive metal that does not react with oxygen in the air under normal circumstances. However, it reacts slowly with sulfur compounds in the air; a reaction that produces silver sulfide (Ag_2S), which is a black compound. The tarnish that develops over time on silverware and silver-plated objects is silver sulfide.

The most flexible metal, silver can be drawn into thin wires and hammered into thin sheets. It is soft and white with a shiny surface that reflects light very well. However, silver's most unique property is that it conducts heat and electricity better than any other element.

Electrical and electronic equipment are in fact the second most important use of silver. About 20% of all silver produced is used for this purpose. Silver is actually the most desirable of all metals for electrical equipment as electricity flows through it more easily than it does through any other metal. In most cases, however, metals such as copper or aluminum are used because they are less expensive.

Sometimes, an electrical device is so important that cost is not a consideration. For example, electrical devices on aircrafts, spacecrafts and satellites must work reliably and efficiently; the cost of using silver is not as important as it would be in a home appliance.

About a fifth of all silver produced is used in a variety of other products. It is often used in dental amalgams. Silver amalgams work well for filling decayed teeth because they are non-toxic and do not break down or react with other materials very readily.

Silver Magic

The most important use of silver today, however, is photography. Taking a photograph depends on the simple chemical idea that light can cause electrons to move around.

Pure silver is converted to a compound; silver chloride (AgCl), silver bromide (AgBr) or silver iodide (AgI). In that reaction, while silver combines with chlorine, bromine or iodine to form the compound, each silver atom loses one electron to the other element atom. The silver atom becomes one electron short of what it usually has, becoming a silver ion.

Photographic film is coated with a thin layer of silver ions, which are colorless. When the film is exposed to light, light gives energy to the electrons. Some of these electrons find their way back to silver ions, transforming them back to atoms and silver atoms are not colorless but black. Thus, a photographic film exposed to light turns black at every point where light strikes a silver ion.

In taking a picture, of course, not all of the film gets equal amounts of light. A picture will have areas that get more light than others; some places on the film become very dark, and other places become less dark.

Chemically Speaking

SYMBOL: Ag
ATOMIC NUMBER: 47
ATOMIC MASS: 107.8682
FAMILY: Group 11 (IB) - Transition metal
Chemists classify silver as a transition metal. Transition metals are elements between Groups 2 and 13 in the periodic table. The interesting thing about transition metals is that their valence electrons, or the electrons they use to combine with other elements, are present in more than one shell. This is the reason why they often exhibit several common oxidation states.

Additional steps are necessary to "develop" photographic film or to produce a picture from it but the first step in taking a photograph is changing silver ions back to silver atoms with light.

From Darkness to Light

Correctly processing black-and-white photographs contributes significantly to their longevity. Correctly processed black-and-white silver gelatin films and fiber-base prints, while essentially stable to dry heat and visible light, are nevertheless susceptible to image deterioration when exposed to aggressive chemicals.

Unexposed black-and-white film or paper contains silver salts (silver halides) as the light-sensitive material embedded in a gelatin layer. Silver halides are white, but slowly turn yellow, then brown, and finally black when exposed to light. It is not necessary to expose modern photographic materials to light for a long time: a fraction of a second is usually sufficient for films, and a few seconds is enough for paper prints. Brief exposure creates an invisible "latent image" that can be made visible by treatment in a chemical solution known as "developer".

The five steps of conventional processing of exposed black-and-white film or paper yield photographs are:

Development: During development, exposed silver halides are converted to black elemental silver particles to form the visible picture. Pictures are developed at a specified temperature, usually 20°C.

Stop Bath: Both the choice of the developer and the development time can affect important image characteristics such as contrast. Development is stopped by treating the film or paper for 15–30 seconds in a stop bath, which is usually a 2% solution of acetic acid in water.

Fixing Step: At this point in the process, the film or paper still contains unexposed, and therefore undeveloped, light-sensitive silver halides that must be removed. The fixing and subsequent washing steps are thus crucial for the permanence of developed photographs.

A fixing bath dissolves unexposed silver halides, thereby removing them from the picture. If the fixing is not complete, residual silver halides and other compounds will remain in the film or print, which can cause black and white tones to turn yellow and brown. The washing step will not remove these compounds because they are only soluble in a fresh fixing solution. Therefore, a two-bath fixation is necessary.

Normal fixers with hardening properties work slowly because the hardening of the gelatin causes them to penetrate and diffuse the gelatin layer slowly. Rapid, non-hardening fixers are more efficient, and are washed out of films and papers more quickly. Residual amounts of either type of fixer will damage image stability.

Washing: After the fixing step, residual fixing solution must be removed from photographs. Otherwise, compounds containing sulfur atoms may react with the finely divided image silver to form yellow or brown silver compounds, particularly in the presence of high relative humidity and high temperatures.

Residual fixing salts or hypo are removed by washing films and prints in running water for extended periods of time. The effectiveness of a washing procedure depends on the type of fixer used in processing, the weight of the paper, as well as the temperature, pH (acidity), flow, and salt content of the wash water.

Drying: The last step is air-drying the photograph on a fiberglass screen in a clean, dust-free environment to prevent it from picking up external impurities. Over-drying causes curling.

Post-Processing Treatments: Since the 19th century, the process of toning has been considered an optional treatment step after normal processing is complete. In the toning process, the image-forming silver particles in a photograph react with another metal salt to form silver compounds or alloys. A toning treatment generally increases the permanence of the picture.

Color Kaleidoscope

Color film processing chemistry is different in several major ways:

1. The development step uses reducing chemicals so that exposed silver-halide grains develop to pure silver. An oxidized developer is produced in this reaction; it reacts with chemicals called "couplers" in each of the image-forming layers. This reaction causes the couplers to form a color, and this color varies depending on how the silver-halide grains were spectrally sensitized.
   A different color-forming coupler is used in the red-, green- and blue-sensitive layers. The concealed image in the different layers forms a different colored dye when the film is developed:
   - Red-sensitive layers form a cyan-colored dye.
   - Green-sensitive layers form a magenta-colored dye.
   - Blue-sensitive layers form a yellow-colored dye.
2. The development process is stopped either by washing or with a stop bath.
3. The unexposed silver-halide grains are removed using a fixing solution.
4. The silver that was developed in the first step is removed by bleaching chemicals.
5. The negative image is then washed to remove as much of the chemicals and reaction products as possible. The film strips are then dried.

Unlike black-and-white negatives, the resultant color negatives contain no silver. In addition to being color opposite, the negatives have an orange-yellow hue. They are a color negative in the sense that the more red exposure, the more cyan dye is formed; cyan being a mix of blue and green, or white minus red. Similarly, the green-sensitive image layers contain magenta dye, and the blue-sensitive image layers contain yellow dye. The overall orange hue is the result of masking dyes that help correct imperfections in the overall color reproduction process.

The colors formed in the color negative film are based on the subtractive color formation system. The subtractive system uses one color; cyan, magenta or yellow; to control each primary color. The additive color system uses a combination of red, green and blue to produce a color. Television is an additive system; it uses small dots of red, green and blue phosphor to reproduce a color. In a photograph, the colors are layered on top of each other, so a subtractive color reproduction system is required.

In our last issue, we discussed at length the science and invention behind the development of photography and cinematography; namely, capturing and projecting images as well as recording and emitting sound. However, if it were not for the magic and power of chemistry; a science that is intertwined with almost every single aspect of the life we enjoy today, neither still or motion images, whether black-and-white or colored, would have emerged.

If it were not for chemical research and intervention, we would not have had the incredible gift of grasping memorable moments to cherish forever, and we would have missed the chance of exploring some of the most magnificent arts known to Mankind.

References

www.chemistryexplained.com

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The Zula Patrol
23 Min. Full-dome Show

Stars of the Pharaohs
35 Min. Full-dome Show

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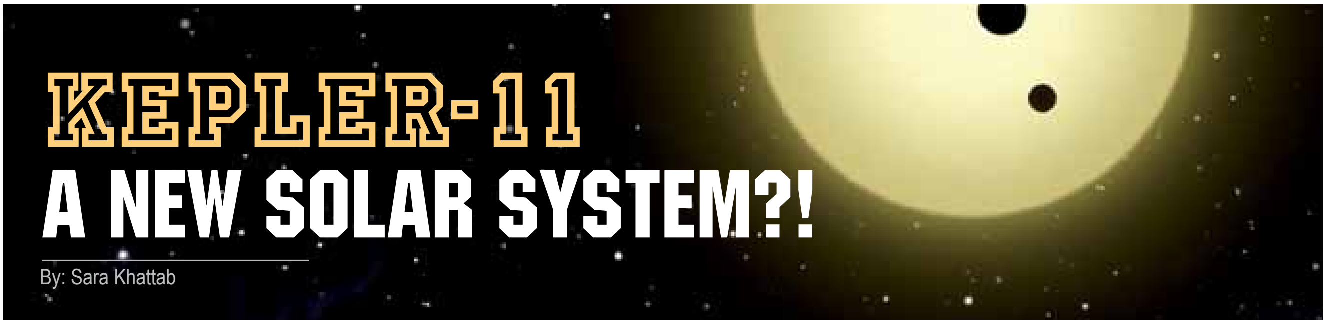
Mystery of the Nile
45 Min. IMAX Show

Oasis in Space
25 Min. Full-dome Show

Stars Show
45 Min. Live Show by the PSC resident astronomer

VISITORS INFO

- For the Planetarium daily schedule and fees, please consult the Center's official website: www.bibalex.org/psc.
- Kindly note that, for technical reasons, the Planetarium maintains the right to cancel or change shows at any time without prior notification.



KEPLER-11
A NEW SOLAR SYSTEM?!

By: Sara Khattab

"*Kepler Spacecraft Discovers Extraordinary New Planetary System,*" reports NASA on 2 February 2011.

Using NASA's Kepler space telescope, scientists discovered a system of six planets that are made of a mix of rock and gases, orbiting a single Sun-like star, Kepler-11, located approximately 2000 light years from Earth.

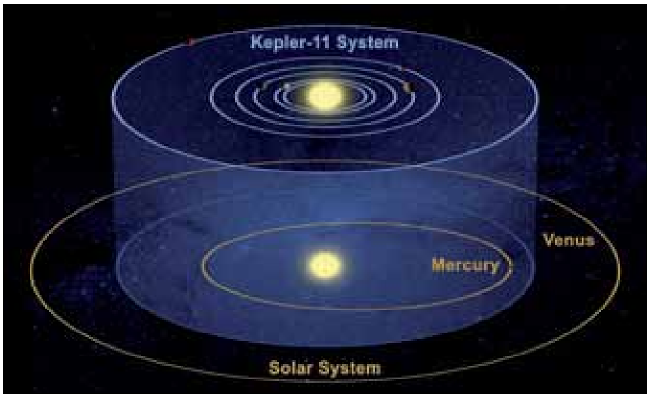
"The Kepler-11 planetary system is amazing," says Jack Lissauer, a planetary scientist and a Kepler science team member. "It is amazingly compact, it is amazingly flat, there is an amazingly large number of big planets orbiting close to their star; we did not know such systems could even exist!"

Our solar system was the only known example of a planetary system until recently, although it was widely believed that other comparable systems existed. "Few stars are known to have more than one transiting planet; Kepler-11 is the first known star to have more than three," said Lissauer; "systems like this are not common."

A planetary system is born when a molecular cloud core collapses to form a star. Protoplanetary disks of gas and dust, in which planets form, surround the newly born star. These disks are seen around most stars that are less than one million years old; few stars more than five million years old also have them.

The Kepler Spacecraft is the first NASA mission capable of detecting Earth-size planets in, or near, the habitable zone, which is the region in a planetary system where liquid water can exist on the surface of the planet orbiting its host star. The Kepler science team is using ground-based telescopes, as well as the Spitzer Space Telescope, to perform follow-up observations on planetary candidates and other objects of interest.

All the planets orbiting Kepler-11 are larger than Earth; the largest are close in size to Uranus and Neptune. The five inner planets are closer to their star than any planet is to our Sun. The innermost planet, Kepler-11b, is ten times closer to its star than Earth to the Sun, while the outermost planet, Kepler-11g, is twice as close to its star than Earth to the Sun.



The planets are mixtures of rock and gases, possibly including water. The rocky material accounts for most of the planets' mass, while the gas takes up most of their volume. The planets Kepler-11d, Kepler-11e and Kepler-11f have a significant amount of light gas, which indicates that at least these three planets formed early in the history of the planetary system, within a few million years.

The Kepler spacecraft will continue conducting science operations until at least November 2012, searching for planets as small as Earth in the habitable zone, where liquid water could exist. Since transits occur about once a year and require three transits for verification, it is predicted to take at least three years to locate and verify an Earth-size planet.

Reference

www.nasa.gov

Heavenly Kaleidoscope

By: Maissa Azab
Idea and Research: Yasser Hussein

Unlike any other science, astronomy is mostly based on observation rather than experimentation. Observing the heavenly sphere, astronomers witness a kaleidoscope of colors, each with a significant meaning.

If you look up into the night sky you may be able to see a few thousand stars from a dark site. So distant, stars appear as points in the sky; most appear white, but a few, such as *Antares* and *Betelgeuse*, have an orange or reddish hue to them, while others such as *Rigel* suggest a bluer color.

The color of a star is primarily an expression of its temperature. A star's behavior is similar to that of a black body radiator; as it gets hotter, its color changes. If it heats up, it first emits radiation in the infrared region; further heating makes it glow a dull reddish color. More heating makes it glow orange, yellow, white and eventually blue. Ultimately if it were hot enough, a black body emits most of its energy in the ultraviolet region.

Although cosmic dust only makes up 1% of the interstellar space mass (ISM), it absorbs and scatters light from stars. Interstellar space is not a perfect vacuum; it comprises cold neutral gas, warm neutral gas and hot ionized plasma. Cosmic dust is made up of small grains of silicates, iron, carbon, frozen water and ammonia ice; hence, light from a distant star is reduced in intensity so that stars appear dimmer.

Termed extinction, this effect is inversely proportional to wavelength so red light is less affected than blue light. More distant stars suffer greater extinction or reduction in brightness than nearby stars. Extinction distant stars thus appear redder than they actually are.

Red giants such as Betelgeuse are not actually that red in color; its actual color is more orange than true red. A small group of stars do, however, appear deep red; these are carbon stars. These ruby-red colored stars have high abundances of carbon molecules in their outer layers that absorb most of the photons in the blue and violet parts of the spectrum. They are collectively referred to as type C.

Stars are classified by their spectra; that is, the elements that they absorb, and their temperature. There are seven main types of stars; in order of decreasing temperature, they are: O, B, A, F, G, K, and M. O and B stars are uncommon but very bright, while M stars are common but dim.

The Hertzsprung-Russell (H-R) Diagram is a graph that plots stars' color; its spectral type or surface temperature versus its luminosity. It shows that there are 3 very different types of stars:

- Most stars, including the Sun, are "main sequence stars" that are fueled by nuclear fusion converting hydrogen into helium. These stars are in the most stable part of their existence, which generally lasts for about 5 billion years. The hotter these stars, the brighter they are.
- As stars begin to die, they become "giants" and "supergiants" with depleted hydrogen supply; their cores contract as their outer layers expand. These stars eventually explode to become planetary nebulae or supernovas, depending on their mass. Further on, they become white dwarfs, neutron stars, or black holes.
- Smaller stars like our Sun eventually become faint "white dwarfs". Having depleted their nuclear fuels, these hot, small and very dense stars are made mostly of carbon. They eventually lose their heat and become cold, dark "black dwarfs".

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Solar Eclipses: When the Sun hides and we seek!

By: Maissa Azab and Ingy Hafez

"*…and the Sun has perished out of heaven, and an evil mist hovers over all,*" Homer, The Odyssey (8th century BCE).

A partial solar eclipse was observed in the skies of Egypt on the morning of Tuesday, 4 January 2011. The eclipse was observed in most of Europe, North Africa and Central Asia. In Alexandria, where the eclipse began at 9:03 am and lasted for 3 hours, the moon covered approximately 55% of the Sun's apparent diameter at greatest eclipse.

The PSC celebrated the event by conducting a public observation on the BA Plaza. About 150 participants attended the event, including school and university students, in addition to BA staff members and the general public. Instruments such as refractor telescopes, a sunspotter and special solar filters allowed safe viewing of the eclipse, where viewers could see the image of the eclipsed Sun projected on screens.

A lecture entitled "Eclipses of the Sun and the Moon" by Senior Astronomy Specialist, Aymen Ibrahem, followed the observation. Using interesting images and illustrations, the lecturer demonstrated intriguing facts on eclipses as well as the nature and characteristics of the Sun and the Moon.

Solar eclipses are among the most magnificent natural phenomena; they occur when the moon passes between Earth and the Sun. The term "eclipse" is derived from the ancient Greek noun ékleipsis (**ἔκλειψις**), which means "the abandonment", "the downfall" or "the darkening of a heavenly body".

Solar eclipses are an extreme rarity within the universe at large; they are seen on Earth due to an accidental combination of circumstances. Many millions of years in the past, the Moon was too close to the Earth to precisely occlude the Sun as it does during eclipses today; and many millions of years in the future, it may be too far away to do so.

It is worth mentioning that on 29 March 2006, Egypt witnessed a total solar eclipse; one of nature's most spectacular phenomena. On that occasion, the eclipse witnessed in Alexandria was partial and lasted about two-and-a-half hours. The totality that lasted almost 4 minutes was visible in the area of Alsaloum where an expedition from the BA; including eminent astronomers from around the globe, a selection of Egyptian astronomy students and PSC staff members; camped to observe the breathtaking event.

Totality is a special, brief opportunity to glimpse the charming solar corona, the outermost layer of the Sun's atmosphere that appears as a pale, diffused glow surrounding the eclipsed Sun. The solar corona cannot be seen in broad daylight, as it is much fainter than the brilliance of the Sun's disc!

A total solar eclipse is a lifetime experience in which the Moon blocks the Sun completely; the air temperature falls; the sky darkens; even stars and planets appear in daytime; animals get confused: in the darkness of totality bats fly and birds sleep! Every year, 2-5 solar eclipses take place somewhere on our planet; but for a given location, several centuries may elapse between two successive total solar eclipses.

Solar eclipses have been observed throughout history, and had a profound impact on early cultures. Ancient eclipse records in China and Babylonia are believed to be over 4000 years ago. Recent research has demonstrated that solar eclipses were depicted in the fascinating mythology of ancient Egypt, and produced evidence that the ancient Egyptians observed solar eclipses over 4500 years ago.

Solar eclipses have been particularly significant to astronomers and historians as they enabled certain historical eras and events to be dated accurately. Astronomers also examined ancient eclipse records to measure the rate of Earth's spin about its axis over the past millenniums. In many ways, the ability to predict eclipses was an outgrowth of the pre-existing need to keep track of time.

References

Partial Solar Eclipse 2011 Report by Aymen Ibrahem
www.bibalex.org/eclipse2006

Further Reading

http://www.bibalex.org/Eclipse2006/TotalEclipses.htm

So You Think You Can Write!

Do you like writing? Are you creative?

Why don't you explore and share your talent with us? Here at the Planetarium Science Center, we welcome and encourage creativity; and the PSC newsletter presents a forum for you to shine.

Our next issue, Summer 2011, is entitled "Chemistry; Our Future". Try your hand at writing and send us an article on the subject or about your experience with science to PSCeditors@bibalex.org no later than 15 May 2011. We will be selecting the most interesting and best written pieces to publish.

A Chemical Saga: From Alchem

By: Ingy Hafez

Long ago, there was a time when knowledge was based on beliefs rather than facts. At that time, a conviction that base metals could be converted into gold and that wisdom could lead to the discovery of the philosophical nature of things prevailed. That conviction, practiced for several millennia in various parts of the world, was known as alchemy. A practical evolution of alchemy is the study of elements to understand their nature and produce new compounds; this evolution is what we know as chemistry.

CHEMISTRY, the etymology of which has been much disputed, is the science of matter and the changes it undergoes. It is the scientific study of the interaction of substances that are composed of atoms made of subatomic particles known as protons, electrons and neutrons. Chemistry is often called "the central science" as it connects the other natural sciences such as astronomy, physics, biology and geology.

It was the mineralogist and humanist George Agricola who first used the words "chymia" instead of the earlier "alchymia". A humanist, Agricola's intention was to purify words and return them to their classical roots, not to make a distinction between the practical science "chymia" and the philosophical science "alchymia"; the modern distinction arose in the early 18th century.

The Pharaonic Kingdom

According to English Egyptologist Wallis Budge, the Arabic word *al-kīmiya* actually means "the Egyptian science", borrowing from the Coptic word for "Egypt", *kēme*, which is in turn derived from the ancient Egyptian *kmt*. The word referred to both the country and the color "black", as Egypt was called the "Black Land".

For Carl Mahn, a German researcher, this theory may be an example of folk etymology. Assuming an Egyptian origin, chemistry is derived from the ancient Egyptian word "khēmia", meaning transmutation of earth. He described it as the science of matter at the atomic to molecular scale, dealing primarily with collections of atoms; such as molecules, crystals and metals.

One of the oldest in history, the ancient Egyptian civilization emerged in pre-history. This highly developed, but static, civilization lasted for over 3000 years, during which it spread its influence far and wide. It is universally agreed that, in technical arts, Egyptian workers pointed the way to the rest of the world, and it is to them that all must turn for the first discovery of those facts that made science possible.

The ancient Egyptians were masters in metallurgy, which is the study of the physical and chemical behavior of metallic elements, and their inter-metallic compounds and mixtures. They achieved a lot with dyes and pigments, including the manufacture of the first synthetic pigment called Egyptian blue, as well as the manufacture of glass. The Egyptians were also ahead of most nations in the research and production of pharmaceuticals, perfumes and cosmetics.

Metallic Arts

Metallurgy was carried on with an elaborate technique and a business that matches modern technologies. The vast quantities of gold, or *nub* in the ancient Egyptian language, amassed by the Pharaohs were the envy of contemporary and later sovereigns. Although much was imported, received by way of tribute or captured in warfare, Egyptian gold mines were also productive.

As early as 3400 BCE, the Egyptians had an intimate knowledge of copper ores, mined in the Eastern Desert between the Nile and the Red Sea. Iron was also known in Egypt from a very early period and came into general use about 800 BCE. The Egyptians called iron "the metal of heaven" or *ba-en-pet*, which indicates that the first specimen employed were of meteoric origin.

Lead, the use of which is not widespread, was among the earliest metals known; samples have been found in graves of pre-dynastic times. A few miles from the Red Sea coast, galena, the natural mineral form of lead sulfide (PbS), is extracted at what is called Gebel Rasas (Mountain of Lead).

Among other non-precious metals, tin was used in the manufacture of bronze, and cobalt was detected as a coloring agent in certain specimens of glass and glaze. Neither metal occur naturally in Egypt; supplies of ore were imported from Persia. Moreover, mercury is stated to have been found in Egyptian tombs from 1500-1600 BCE.

Metallurgy was by no means the only art practiced with success by the ancient Egyptian craftsmen. Glass was almost certainly the invention of the Egyptians, and was produced on a large scale from a very early date.

The Art of Glass

Glass jars, figures and ornaments discovered in ancient Egyptian tombs are evidence of the origins of glass making. Paintings on tomb walls describe the process of glass blowing. The remains of glass furnaces discovered at Tel-El-Amarna illustrate the manufacture of rods, beads, jars and other figures.

Analysis of beautifully patterned Egyptian colored glass artifacts show that they were made of soda-lime glass, composed of about 70% silica (silicon dioxide), 15% soda (sodium oxide), 9% lime (calcium oxide) and much smaller amounts of various other compounds.

The soda lowers the temperature at which silica melts, and the lime stabilizes silica. Soda-lime glass is inexpensive, chemically stable, reasonably hard and extremely workable. It can be re-softened many times if necessary. These qualities make it the most suitable type of glass for manufacturing a wide array of glass products, including light bulbs, windowpanes and bottles, the making of which is not different from that of modern times.

Fashion in the Making

The beginning of the arts of weaving and dyeing are lost in antiquity. A diversity of mummy cloths is evidence of the dyer's skill preserved in many museums. Dyes could be seen on the walls of tombs, temples and other structures that have been protected from weather, and on decorated pottery. Their chemical analysis revealed the materials used for such purposes.

Pigments found in the tomb of Perneb showed what some of the colors were made of. For example, red pigments proved to be made of iron oxide (hematite); yellow consisted of clay containing iron or yellow ochre; blue was finely powdered glass; pale blue was copper carbonate; green was malachite (copper carbonate mineral); black was charcoal or boneblack; and gray was limestone mixed with charcoal.

PART I

my to Chemistry

Mummification

This process, used to preserve the body for the afterlife, relied on desiccation of the tissues to resist decay. It developed from a simple beginning to an elaborate process.

Herodotus says that the body, after removal of the brain and certain internal organs, was covered with natron for 70 days to desiccate the tissues. Chemist Alfred Lucas investigated the use of natron as a dehydrating agent that was used in its dry state. Further work has found the optimum period for desiccation to be 30-40 days.

Lucas also investigated the use of plants and plant products in mummification; he also used molten resin as an embalming agent. Technical improvements during the 19th Dynasty enabled the natural skin color to retain, as seen on the mummy of Ramses II.

Egyptians obviously did not understand the chemistry as we know it, but they were keen observers and experimenters; they knew how to apply certain processes to end up with the required substances. They were among the first practicing chemists. It is appropriate that chemistry derives its name from ancient Egypt, where much of the early development of chemistry took place.

The Greek Side of the Story

According to some, the Arabic *al-kīmiya* or *al-khīmiya* is derived from the late Greek word *khymeia* meaning "the art of alloying metals". According to Carl Mahn, German philologist and researcher, the Greek word *khymeia* originally meant "pouring together", "casting together", "weld" or "alloy".

It was during that time that the roots of alchemy grew. The Greeks of Egypt are regarded as the forefathers of attempts to change valueless metals into metals of greater value, iron into gold being the most famous attempt.

Ancient Greeks developed the idea of the atom. Greek philosophers were the first to theorize about microstructure. The idea that matter is made up of smaller components was not accepted at the beginning; instead, Greeks used states of matter, such as fluid, solid, gas or plasma, as a model of matter.

Anaxagoras was the first Greek to state that matter did not change and coined the term nucleus, which he believed was a different base particle for each substance. Democritus is Greece's foremost atomist who carried atomic theory the farthest. He lived in the golden age of early atomic theory; however, his ideas were mainly improvements on earlier Greek theories.

Aristotle believed that the world could not consist of small particles. On the other hand, he believed there were four basic elements: dryness, wetness, heat and cold, that all worked in different combinations to form all other matter.

The Greeks made several notable contributions to science and helped lay the foundations of several western scientific valuing and investing traditions. Classical Greek culture had a powerful influence on the Roman Empire, which carried a version of it to many parts of the Mediterranean region and Europe.

Mesopotamia: The Land of Rivers

Some researchers believe the actual origin of the word chemistry is the old Persian word *kimiya*, which means gold and the science of transformation of elements.

According to chemistry historian James Partington, "the earliest applications of chemical processes were concerned with the extraction and working of metals and the manufacture of pottery, which were forms of crafts practiced many centuries before the Bronze Age cultures of Egypt and Mesopotamia." So, according to Partington, alchemy came from both Egypt and Mesopotamia.

The Sumerians who inhabited Lower Mesopotamia, the area between the Tigris and Euphrates rivers in modern Iraq, are believed to have developed the world's first urban civilization around 4000 BCE. They are known to use plant drugs, wound washing, plasters and bandaging.

Babylon was the center of two extensive short-lived empires, the earlier of which comprised the whole Mesopotamia, flourishing during the reign of King Hammurabi (1795-1750 BCE). Although destroyed by the Hittites; people of Anatolia or Asia Minor who lived in the Bronze Age, the Babylonian civilization re-emerged and influenced scholarship throughout the known world for centuries.

The early Babylonians studied many fields of science including mathematics, geology and metallurgy, as well as astrology and astronomy. Babylonians understood the methods of manufacturing soap, leather, vinegar, wine and glass and could extract natural plant aromas and animal products, but their comprehension was based on trial and error.

The story of chemistry is a long tale that took history years and years to tell. Taking a journey around the world and throughout the different eras, we unravel the mysteries of this wondrous world. A world we touch in every breath we take; a world we feel in every move we make; a world that engulfs us in every second of every day. In our next issue of the PSC Newsletter, we continue digging into the glorious history of this core science as we plunge into the Islamic Kingdom to see how Muslims contributed to the development of chemistry taking it upon themselves to write one of, if not the most magnanimous chapters in the book of history.

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VISITORS INFO

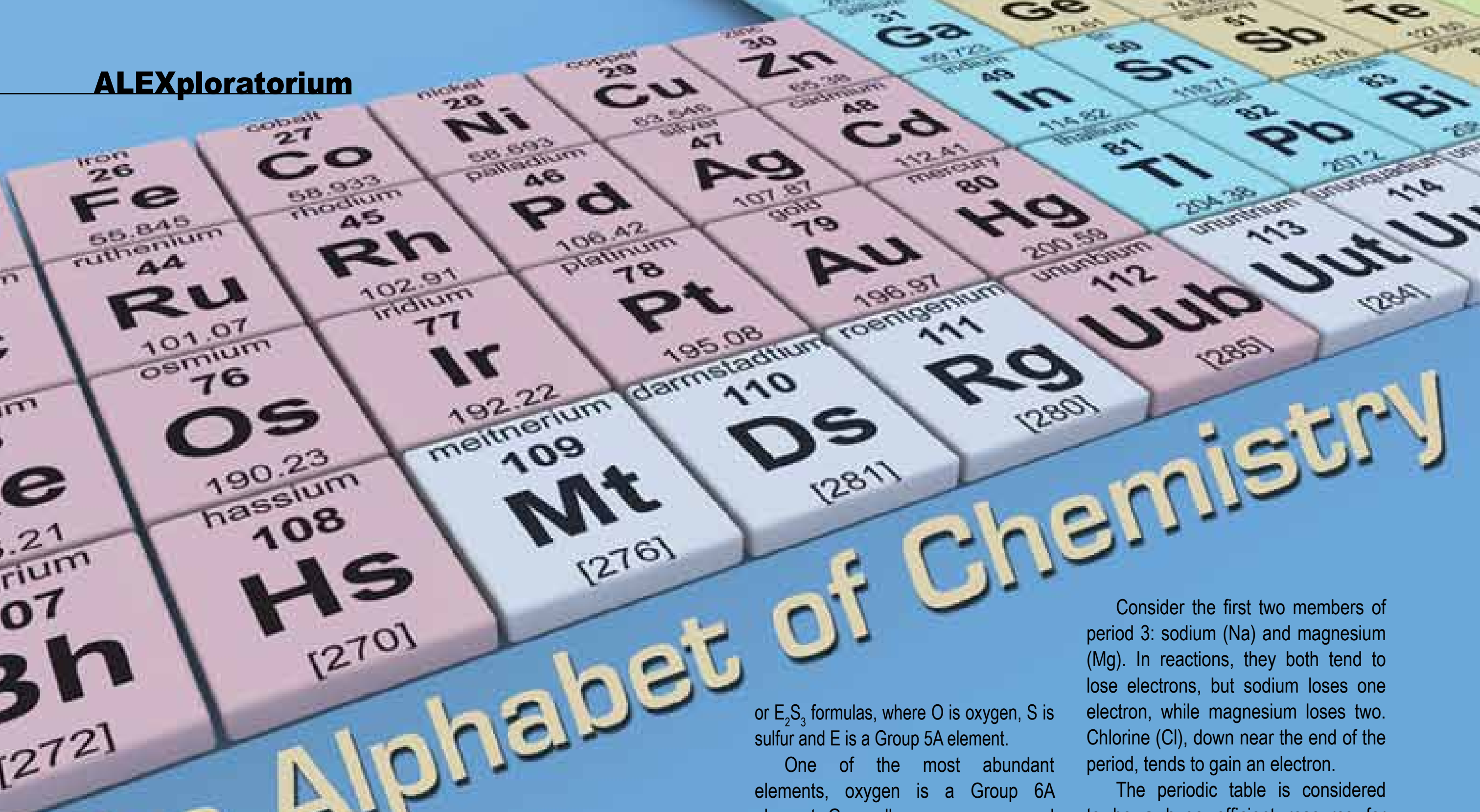
Opening Hours

Saturday to Thursday	[from 10:00 to 15:00]
Friday	[from 16:00 to 18:00]

Guided Tours Schedule

Saturday to Thursday	[10:30 + 11:30 + 12:30 + 13:30 + 14:30]
Friday	[16:45]

- Museum entry fees are included in all Planetarium show tickets.
- For non-audience of the Planetarium, Museum entry fees are 0.50 EGP.
- Museum Tours are free for ticket holders.



The Alphabet of Chemistry

By: Shahenda Ayman

Combinations of 26 letters make up every word in the English language, 28 in the case of Arabic. Similarly, every material in the world is composed of different combinations of about 100 elements that cannot be broken down into simpler substances through ordinary chemistry.

We may never be able to attribute the development of the basic building blocks of writing, the Alphabet, to one single individual. We do know, however, the man who devised the method for classifying the basic building blocks of matter, which we know as the Periodic Table of Elements.

Russian chemist Dmitri Mendeleev (1834 -1907) is the one who, in 1869, proposed that all chemical elements exhibit a “periodicity of properties”. As a result, he tried to organize the chemical elements according to their atomic weights, known to be roughly equal to the number of protons plus neutrons in the nucleus, assuming that the properties of the elements would gradually change as atomic weight increased.

What he found, however, was that the chemical properties of the elements increased gradually and then suddenly changed at distinct steps, or periods as he called them. To account for these repeating trends, Mendeleev grouped the elements in a table that had both rows, or periods, and columns, or groups.

The modern periodic table of elements is based on Mendeleev’s observations. However, instead of being organized by atomic weight, the modern table is arranged by atomic number, which is known as the number of protons inside the nucleus. As one moves from left to right in a row of the periodic table, the properties of the elements gradually change. At the end of each row, a drastic shift occurs in the chemical properties. The next element in order of atomic number is more similar, chemically speaking, to the first element in the row above it; thus a new row begins on the table.

Groups of the periodic table are the eighteen series of elements in columns across the table, each of these groups are special for the common characteristics their constituent elements share. Elements in a given group in the periodic table share many similar chemical properties.

Known as alkali metals, Group 1A elements are never found free in nature; they react with H_2O to form alkaline (basic) solutions. On the other hand, Group 2A elements are known as Alkaline Earth Metals; they react with oxygen in the general formula EO, where O is oxygen and E is a Group 2A element, to form basic solutions.Group 3A elements, known as Metalloids, react to form oxygen compounds with an X_2O_3 formula, where O is oxygen and X is a Group 3A element.

Group 4A includes metals and non-metals, going from non-metals at the top of the column to metals at the bottom. Group 5A elements on the other hand form an oxygen or sulfur compound with E_2O_3 or E_2S_3 formulas, where O is oxygen, S is sulfur and E is a Group 5A element.

One of the most abundant elements, oxygen is a Group 6A element. Generally, oxygen compound formulas within this group are EO_2 and EO_3, where O is oxygen and E is a Group 6A element. Halogens, meaning “salt-forming”, are Group 7A elements; they are all highly reactive and combine violently with alkali metals to form salts. On the contrary, elements of Group 8A are noble gases that are not very reactive.

Transition elements are found in groups 1B, 2B, 3B, 4B, 5B, 6B, 7B, 8B, while Rare Earth Metals are found in Lanthanides series and Actinides series. As for Group 0, it contains inert gases; they are called so because their oxidation number of 0 prevents them from forming compounds readily.

In each period, or horizontal row, the atomic numbers increase from left to right. The periods are numbered 1 through 7 on the left-hand side of the table. Elements that are in the same period have chemical properties that are not all that similar.

Consider the first two members of period 3: sodium (Na) and magnesium (Mg). In reactions, they both tend to lose electrons, but sodium loses one electron, while magnesium loses two. Chlorine (Cl), down near the end of the period, tends to gain an electron.

The periodic table is considered to be a huge efficient resource for scientists, teachers and students among others. The periodic table describes the atomic structure of each element known to Mankind, each with its own unique set of data. By looking at the periodic table, a person can find out how many electrons an element has and how much it weighs. If one is uncertain what a matter is, one can look at the atomic structure of the material, compare it to the information in the periodic table, and identify the material by matching it to the element on the table with the same data. Just like deciphering a code!

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Visitors INFO

Discovery Zone

Opening Hours

Saturday, Sunday, Monday, Wednesday and Thursday: [From 09:00 to 15:30]
Tuesday: [From 08:30 to 12:30]
Friday: [From 15:00 to 17:00]

Guided Tours Schedule

Saturday to Thursday: [9:30 + 11:00 + 12:30 + 14:00]
Friday: [15:00 + 16:00]

Entry Fees

Students EGP 2 Non-students EGP 4

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Show fees

DVD shows:
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3D shows:
Students EGP 2 Non-students EGP 4

NATURE & Human Health

Reported by: Ingy Hafez

Earth's biodiversity, the rich variety of life on our planet, is disappearing at an alarming rate. Grave ecological, sociologic or economic dimensions of this loss gain the most attention. The implication of biodiversity loss on our health, however, is rarely considered.

"How Our Health depends on Nature", a lecture by Dr. Eric Chivian that took place on 30 December 2010, examined the relationship between human health and biodiversity, looking at some case studies of medicines and medical research models derived from Nature, and discussing how ecosystem services sustain all life on Earth, including human life.

The 1985 Peace Nobel Laureate, Dr. Chivian is the Director of the Center for Health and the Global Environment, Harvard Medical School. He has published over 100 publications, among which the much-acclaimed book *Sustaining Life: How Human Health Depends on Biodiversity*, published in June 2008, and of which he gave a copy to the Bibliotheca Alexandrina as a gift.

Dr. Chivian started by telling us about his personal experience, explaining how he fell in love with nature as a child. He told us how he used to lose sense of time when his mother, who worked as a librarian, took him to work with her, and how he used to have what he called the "Cabinet of Curiosities", where he kept fossils and other collections of nature.

He relayed an anecdote that showed how much he cared about the environment and the natural world. It took place on a plane when someone was trying to kill a mole, which is a mammal found in Eurasia and North America. Chivian jumped off his chair to catch it and put it in the vomiting bag distributed inside the plane. He did not care what people thought; all he was concerned about was saving the mole!

Pointing out how "true" nature seems alien and dangerous to many of us, Dr. Chivian explained how disconnected people are from it and unaware of the intimate synchronization that could be found among us. He also shed light on our need to feel and relate to what is happening in the world around us, such as global warming and nuclear wars, and the possible global changes that could occur consequently.

Dr. Chivian's book presents a comprehensive view of how human medicines, biomedical research, the emergence and spread of infectious diseases, and the production of food on land and in the oceans depend on biodiversity.

Referring to pollination of fruit trees as an example, Dr. Chivian speaks of how the interaction of living organisms in nature serves the ecosystem; while their loss results in the opposite. Bees are among the main organisms responsible for tree pollination. Due to biodiversity loss caused by Man's activities, Chinese fruit farmers now have to pay people to pollinate apple trees because there are no longer enough bees to do the job for free.

More alarmingly, it is not just the number of bees that is dwindling rapidly; as a direct result of human activity, species are becoming extinct at a rate 1,000 times greater than the natural average. In the past few decades, 20% of the oceans' coral reefs have been destroyed, with a further 20% badly degraded or under serious threat of collapse; all the while, tropical forests equivalent in size to the UK are cut down every two years. These statistics and the many more just like them impact everyone, for the very simple reason that we will all end up paying the bill.

Moving to endangered organisms and their contribution to medicine, and how individuals can protect biodiversity, Dr. Chivian demonstrated some case studies beginning with polar bears that will be extinct by the end of the century as a result of global warming, which causes the Arctic Sea to melt. Chemicals thrown in the ocean, in addition to the disappearance of seals, on which polar bears feed, are also leading to their starvation and poor health.

The question now is: why are those bears so important? The story is quite interesting. It is a known fact that humans' immobility causes loss of bones, leading to a disease called osteoporosis, where the bone mineral density is reduced. Although polar bears hibernate, they do not lose bones due to the presence of a certain substance in their blood that keeps their bones reconstructing. Thus, bears provide science and scientists a great opportunity to cure such a disease.

An unusual chemical called Taxol, extracted from the bark of the Pacific yew trees present in the United States, has been found useful in the treatment of ovarian cancer and is undergoing testing for other kinds of cancer, such as breast and prostatic cancer. Taxol treats cells that have defects in mitotic spindle(1) assembly, chromosome segregation and cell division.

Taxol is also showing great promise as a possible solution to restenosis, re-clogging of blood vessels, which is the most common cause of failure in angioplasty operations, a procedure that widens a narrowed or obstructed blood vessel, using stents(2). These stents are coated with a slow-release form of Taxol to keep the implanted artery open.

Another example from the marine world is cone snails that live on or near coral reefs. These cone snails are endangered as corals are getting bleached. What makes cone snails so important is that they produce venomous toxins that can work as a source of substances used to relieve severe and chronic pains. Scientists have synthesized "a miraculous drug, a hundred times more effective than morphine, that does not cause tolerance", said Dr. Chivian. Other drugs have also been synthesized to protect nerve and heart cells.

Last, but by no means least, Dr. Chivian referred to the importance of the role of science journalism in communicating what science has to say to the general public. He emphasizes that scientists and educators should train on how to raise awareness of biodiversity, and we can no longer see ourselves as separate from the natural world, nor assume that we will be unharmed by its alteration.

Judging by all that, we find ourselves implicated in a series of crimes against Mother Nature. We are condemned of treason against the environment and ourselves. Ironically, our only salvation lies in the diversity that Mother Nature has already contributed to sustain human's welfare; and the diversity it is still willing to provide if we do not drive it to extinction first.

Glossary

(1) Mitotic Spindle: The fusiform (spindle-like) figure characteristic of a dividing cell, consisting of microtubules, some of which become attached to each chromosome at its centromere (near the middle) and provide the mechanism for chromosomal movement. Also called nuclear spindle.

(2) Stent: An artificial tube inserted into a natural passage in the body to prevent a disease-induced, localized flow constriction.

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The Good The BAD &

By: Lamia Ghoneim

During the era of the industrial revolution and throughout the first half of the 20th century, chemistry and the chemical industry were foreseen by many as the hope and the central science of the future. The potential of chemical products for enriching society and raising the quality of life appeared unlimited. The idea of progress based on scientific and technological advances was widely accepted and the general benefits of science, including industrial chemistry, went largely unquestioned.

Nowadays, however, the tables have been turned. The common perception of chemicals and the chemical industry has shifted towards the negative. Chemicals today are widely regarded as inherently nasty or poisonous; dangerous at the very least. The chemical industry is now under constant attack from environmentalists and the public as a whole. It is blamed for the damage caused to the environment, along with the negative impact this has on our health and our future.

This view is widely spread and promoted by the media, especially the popular press where the word 'chemical' is often preceded by alarming adjectives, even when quite innocent substances are involved, or even those of an entirely natural origin.

The Trial

Between the earlier perception of chemistry as the hope for a better future, and the increasingly negative view the masses hold of it as of late, where does reality lie? If chemistry and the chemical industry were to be put on trial, will the pursuit and application of chemical knowledge be seen as more risky than beneficial?

In order to answer this question, we have to look closely at everything chemistry has touched in our lives. The contributions that chemical products have made to the quality of life, both positive and negative, have to be considered. As to the purpose of giving chemistry a fair trial, we shall begin with the positive.

The Good

For centuries, chemical research and discovery have played a fundamental role in improving the quality and extension of life. In fact, the chemical industry can justly claim to be the most important contributor to the majority of improvements in that regard. To wrap our minds around this notion, let us pause for a moment to consider what a world without chemical products would be like.

Consider first the great variety of products from the chemical industries in common everyday use; for instance, soap, toothpaste, deodorant, shampoo, toothbrushes, shaving products, and other personal care products that play a central role in improving personal hygiene, in addition to the majority of cleaning products found in our homes. Kitchen items such as pots, pans, silverware, plates and cups were all created through chemistry. It also provides materials for clothing, carpets and furnishing; even more importantly, building materials such as cement, steel and glass.

Polymers undoubtedly caused a huge impact on our society. Plastics, nylon, polyester, silicon, PVC, and polycarbonate are chemical products found in every part of our lives. Fuels that we use every day for power, as well as paper, wood products and extracted metals would not have been readily available for us if it were not for the chemical industry.

Without the chemical industry, we would not have such items as computers, silicon chips, CDs, DVDs, iPods, oil to heat our homes, refrigeration units, radios, televisions, batteries, styrofoam, synthetic fabric and dyes, and so much more.

Moreover, we cannot overlook the vast contribution of chemical industries to safeguarding standards for the purity in water supply, as well as maintaining the adequacy, reliability and quality of food supplies. The world's population has been growing geometrically since the 1950's and food supply has more than kept pace on account of chemical products. Agrochemicals such as fertilizers, pesticides, insecticides and herbicides, protect plants and increase yields as well as reduce labor costs in agriculture.

Most prominently, chemical industries have contributed to the rise of public health standards equal to those made by the progress of medical knowledge. They produced new drugs, antibiotics, anesthetics, antiseptics and even surgical tools that have played a crucial role in improving medical treatments and in reducing risks of infection. In some cases, the chances of curing formerly incurable diseases have increased, whilst analgesics have helped reduce pain and suffering. Hospitals have become safer for patients and life expectancy in general has been extended.

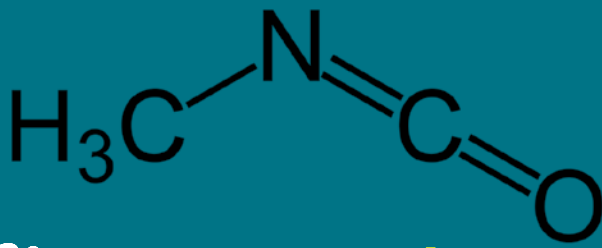
The chemical industry has not only raised our quality of life and indirectly saved millions of lives through providing sufficient food, shelter and medicine for diseases that would have otherwise been considered fatal, but it has made a significant impact on how our society has evolved. It is a major provider of jobs and a creator of wealth; its profits sustain economies and make possible the research and development that lead to new technologies and processes that benefit society.

The Bad

Chemical industries have been and still are responsible for massive environmental damage and pollution; not least the damage caused to the land on which chemical plants are sited. Disposal of chemical by-products at waste-disposal sites of limited capacity has resulted in environmental and health problems of enormous concern. Chemical factories have released hazardous toxins that pollute the air, the water and the soil.

Application of agrochemicals has resulted in the erosion of plant and wildlife habitats in areas given over to intensive agriculture. Moreover, leakage of chemicals from agricultural areas disrupts neighboring terrestrial and aquatic environments. Industrial chemicals and chemicals present in domestic sewage and refuse also endanger the reproductive success of wildlife through the pollution of rivers and marine environments. Not to mention the impact of atmospheric pollution, particularly the devastating effects of sulfur and nitrogen oxides on vegetation when deposited as acid rain. Even more drastically, human-induced global climate change has potentially disastrous consequences for the functioning of ecosystems adapted to different climate conditions.

On the other hand, global ecological effects of CFCs, which are organic compounds used in a variety of everyday products spanning from deodorants to refrigerators, were linked to the destruction of the ozone layer as well as increasing skin cancer.



The Ugly

Moreover, the chemical industry has and still is a prime source of resource depletion; large quantities of natural materials have long been extracted for this purpose. The public fears that finite raw materials and fossil fuels are being used up at an increasing rate that will ultimately deprive future generations of supplies.

On top of all that, the possible risks to human health due to chemical exposure are numerous and frightening. Additionally, the legitimate use of drugs for the medically supervised treatment of diseases has been tainted by the growing misuse of mood altering drugs that cause dependence and may lead to crime, violence, disease or even death.

The Ugly

Perhaps the lowest point in the history of the chemical industry occurred in December 1984, when a faulty tank containing a poisonous chemical called “methyl isocyanate” leaked at a plant in India; an incident famously known as the “Bhopal” disaster. It has resulted in the death of about 20,000 people and the injury of about 570,000 others. The disaster has been causing the region’s human and animal populations severe health problems up till now.

This is by no means the only disaster the chemical industry is responsible for. To name a few, the “Minamata” disaster; the result of dumping mercury compounds in the Minamata Bay in Japan from 1932 to 1968, caused over 3,000 people to suffer various deformities and deaths. More recently, on 21 September 2001 in Toulouse, France, an explosion at the AZF fertilizer factory killed 29 and injured 2,500 in addition to causing extensive structural damage to nearby neighborhoods.

Aside from accidents, there has been a significant increase in the number of people suffering and dying from cancer, which brings growing anxiety about carcinogens in the environment, many of which are related to the chemical industry. Moreover, incidences of reproductive disorders and abnormalities among wildlife and human populations have steadily risen and chemical pollutants are a chief cause.

“At no time in human history have we been exposed to so many chemicals,” warns the ‘Californians for a Healthy and Green Economy (CHANGE)’ organization. “There are an estimated 85,000 chemicals in the stream of commerce, and very little is known about most of them. The health effects of almost half the major industrial chemicals have not been studied at all. Of those that have been studied, approximately 1,400 chemicals with known links to cancer, birth defects, reproductive impacts and other health problems are still in use today.”

These alarming issues have been reviewed repeatedly in recent times and are commonly featured in the media; they are unquestionably frightening. While it is easy to identify problems and consequences, to propose standards and aims, to point our fingers and accuse; it is much more difficult to put effective measures for solving the problems in place.

Through the study of both sides, it is obvious that even though chemistry and the chemical industry have set off detrimental consequences, one cannot possibly agree with the notion that the pursuit and application of chemical knowledge bears risks that outweigh its benefits.

Investigation clearly show that this $3 trillion industry has single-handedly elevated the quality of our lives to unbelievable levels, and the public should acknowledge these facts and take the time to become more informed. Just because something is natural does not automatically make it good; similarly, man-made chemicals should not instinctively be condemned.

Even though the chemical industry is held responsible for its dire faults, we should still have faith that these faults can be corrected, by no other than the industry itself. Chemistry is by definition the transformation of matter. It can therefore be used to remove polluting substances and clean up the environment as well as tackle health issues; solving its own problems.

Long-term, environmentally acceptable solutions to pollution and health problems are not attainable without chemical knowledge. What is more, the sustainable development of our global society in this century can never be achieved without chemical knowledge and research. There is much truth in the saying “chemical problems require chemical solutions.”

Prevention or reduction of negative effects of the industry is best done via source directed measures; that is, strict control of chemical industrial processes. This is the responsibility of national governments as well as the chemical industry itself. In other words, they should stop stalling and start meeting the required standards, as well as study the effects of every chemical we are exposed to; short-term and long-term.

To protect our children and future generations, the world needs a global strategy. Scientists have a responsibility to convey and explain to the public and policy-makers, clearly and without bias, their knowledge and research on the effect of exposure to chemicals.

The coming years will see many new, exciting discoveries in the processes and products of chemistry. Inevitably, the harmful effects of some substances will outweigh their benefits, and their use will have to be limited. Yet, the positive impact of chemistry on society as a whole is beyond doubt.

We hereby sentence chemistry, the chemical industry and anyone who possesses chemical knowledge and understanding to a future of new possibilities; to research and investigation of solutions; and to sustainably developing and making new chemistry.

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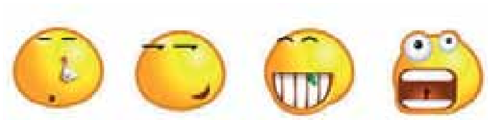

By: Shahenda Ayman

EXCAVATING THE HUMAN MINE

“You are what you eat” is a common saying nowadays, but do you recall munching some molybdenum or snacking on selenium?

The fact is that around 60 chemical elements are found in the human body; what all of them are doing there is still unknown. Roughly 96% of the mass of the human body is made up of just four elements: oxygen, carbon, hydrogen and nitrogen, with a lot of that in the form of water. The remaining 4% is a light example of the periodic table of elements!

Some of the more prominent representatives are called “macronutrients”, whereas those appearing only at the level of parts per million or less are referred to as “micronutrients”. These nutrients perform various functions, including the building of bones and cell structures, regulating the body’s pH, carrying charge and driving chemical reactions.

The United States Food and Drug Administration (FDA) has set a reference daily intake for 12 minerals; calcium, iron, phosphorous, iodine, magnesium, zinc, selenium, copper, manganese, chromium, molybdenum and chloride. Sodium and potassium also have recommended levels, but they are treated separately. Sulfur, on the other hand, is not usually mentioned as a dietary supplement because the body gets plenty of it in proteins.

However, this does not exhaust the list of elements that you need. There are several other elements; such as silicon, boron, nickel, vanadium and lead, that may play a biological role but are not classified as essential. “This may be due to the fact that a biochemical function has not been defined by experimental evidence,” said Victoria Drake from the Linus Pauling Institute at Oregon State University.

A normal diet consists of thousands of compounds. For now, we can only say for certain what 20 or so elements do. Here is a quick rundown, with the percentage of body weight in parentheses.

Oxygen (65%) and **hydrogen** (10%) are predominantly found in water, which makes up about 60% of the body by weight, and without which life is impossible.

Carbon (18%) is synonymous with life. Its central role is due to the fact that it has four bonding sites that allow for the building of long, complex chains of molecules. Carbon bonds can be formed and broken with a modest amount of energy, allowing for the dynamic organic chemistry that goes on in our cells.

Nitrogen (3%) is found in many organic molecules, including the amino acids that make up proteins, and the nucleic acids that make up DNA.

Calcium (1.5%) is the most common mineral in the human body; with nearly all of it found in bones and teeth. Ironically, calcium’s most important role is in bodily functions, such as muscle contraction and protein regulation. In fact, the body will actually pull calcium from bones, causing problems like osteoporosis, if there is not enough of the element in a person’s diet.

Phosphorous (1%) is found predominantly in bone but also in the molecule adenosine triphosphate (ATP), which is able to store and transport chemical energy within cells, providing energy in cells for driving chemical reactions.

Potassium (0.25%) is an important electrolyte; that is, it carries a charge in solution. It helps regulate the heartbeat and is vital for electrical signaling in nerves.

Sulfur (0.25%) is found in two amino acids that are important for giving proteins their shape.

Sodium (0.15%) is another electrolyte that is vital for electrical signaling in nerves; it also regulates the amount of water in the body.

Chlorine (0.15%) is usually found in the body as a negative ion, called chloride; an electrolyte that is important for maintaining a normal balance of fluids.

Magnesium (0.05%) plays an important role in the structure of the skeleton and muscles. It is also necessary in more than 300 essential metabolic reactions.

Iron (0.006%) is a key element in the metabolism of almost all living organisms. It is also found in hemoglobin; the oxygen carrier in red blood cells.

Fluorine (0.0037%) is found in teeth and bones; it prevents tooth decay.

Zinc (0.0032%) is an essential trace element for all forms of life. Several proteins contain structures called “zinc fingers” that help regulate genes. Zinc deficiency has been known to lead to dwarfism in developing countries.

Copper (0.0001%) is important as an electron donor in various biological reactions. Without enough copper, iron will not work properly in the body.

Selenium (0.000019%) is essential for certain enzymes, including several anti oxidants.

Manganese (0.000017%) is essential for certain enzymes, in particular those that protect mitochondria, which is where usable energy is generated inside cells, from dangerous oxidants.

Iodine (0.000016%) is required for making thyroid hormones that regulate the metabolic rate and other cellular functions. Iodine deficiency, which can lead to goiter and brain damage, is a serious health problem throughout much of the world.

Molybdenum (0.000013%) is essential to virtually all life forms. In humans, it is important for transforming sulfur into a usable form.

Chromium (0.0000024%) helps regulate sugar levels by interacting with insulin, but the exact mechanism is still not completely understood.

Cobalt (0.0000021%) is contained in vitamin B12, which is important in protein formation and DNA regulation.

It is important to have a general understanding of the elements because they make up our world. The trends of elements have helped us predict how they behave and how we can manipulate them. Hence, we have to take a deeper look inside our bodies to learn more about the elements that play known and unknown roles in its functions; we will be amazed what we will find!

IT IS ALL IN THE HEAD!

Clarifying the complex structure and the enormous functions of the marvelous creation that is the human body is like revealing the secrets of a mystifying world. Most astonishing of all is the brain; it is the conductor of the conscious and unconscious, known and unknown functions of a human being.

Physically, a human being is born from the mother's womb. However, the birth of character and talent originates from the arcane layers of unconscious and subconscious mind operative in the deeper depths of one's brain. A healthy brain is hence the source of enormous positive potentials.

Slight disordering in the functional regions of the brain disturbs the entire body and mental system. Often, one uses instant remedies of analgesic medicines against complaints like headache. Removal of mental stresses of higher intensity, however, is sought with the help of intoxication, which virtually paralyzes the normal perceptibility of different organs and suppresses the sensitivity of the nervous system towards pain. People get addicted to such "remedies" and eventually lose their physical and mental well-being forever.

Medical experts consider that the limbic system in the human brain can secrete specific neurochemicals, which alleviate the sensation of pain or counter the tension caused by mental stress. Emotions are supposed to trigger the activities of the limbic system. As the sensory nerves carry the sensation of pain to the spinal cord, the efferent receptors of the limbic region in a healthy brain are activated and secrete peptides that serve as natural "pain killers".

Frontline researchers in parapsychology consider that the secretion and concentration of different painkilling hormones like encephalon and endogens, among others, can be regulated by harmonizing the activities of the brain with the help of meditation.

"Emotions are human beings' warning systems as to what is really going on around them. Emotions are our most reliable indicators of how things are going on in our lives. Emotions help keep us on the right track by making sure that we are led by more than the mental/intellectual faculties of thought, perception, reason, and memory," says Dr. Maurice Elias, Professor of Psychology.

Emotions control your thinking, behavior and actions; they affect your physical bodies as much as your body affects your feelings and thinking. People, who ignore, dismiss, repress or just ventilate their emotions, are setting themselves up for physical illness. Emotions that are not released but buried within the body can cause serious illness, including cancer, arthritis, and many types of chronic illnesses.

Negative emotions such as fear, anxiety, negativity, frustration and depression cause chemical reactions in your body that are very different from the chemicals released when you feel positive emotions; such as feeling happy, content, loved or accepted. Literally, thousands of different chemicals participate in brain function and fall into different groups based on their chemical structure, mechanism of action, psychotropic effects, and where they originally came from.

The chemicals that affect the emotional states in the brain consist of three broad types of compounds: **neurotransmitters**, which are chemically derived from single amino acids, the core constituents of proteins; **neuropeptides**, which are small links of amino acids that together form a protein with psychoactive effects; and **hormones**, which are chemicals made in different regions of the body that are released into the blood stream and have psychoactive effects.

Hundreds of different neurotransmitters exist in the brain, and they fall in different groups according to their chemical structure. The biogenic amines are the most understood group of neurotransmitters and include dopamine, serotonin, and norepinephrine.

These three noted biogenic amines are involved in the regulation of mood. Dopamine, for example, is implicated in the brain's natural reward system and, therefore, is seen as pleasure generating. Norepinephrine is linked to the hormone epinephrine, also known as adrenaline. Adrenaline has become associated with all risk-taking activities that cause a "rush". Serotonin was traditionally linked to activities involving sleep, appetite, and reproductive functions, better known in psychiatry as vegetative activities; more recently, it has been implicated in control of mood and anxiety.

Some people become depressed during winter months when days are shorter and darker. The Sun and bright light seem to trigger a response to a brain hormone known as melatonin, which is, in part, responsible for preventing the "blues". Research reveals that two hours of morning Sun is very effective in lifting depression.

It has been discovered that some foods influence the brain's behavior, and the brain's neurotransmitters, which regulate our behavior, can be affected by what we eat. Research is showing that some foods such as bananas and turkey have proteins that help to create serotonin. When the brain produces serotonin, tension is eased. When it produces dopamine or norepinephrine, we tend to think and act more quickly and are generally more alert.

Eating carbohydrates alone seems to have a calming effect, while proteins increase alertness. A balance is achieved when the diet contains a combination of these two nutrients. A turkey sandwich on whole wheat bread is a good combination: the turkey is high in protein and tryptophan, and the whole wheat bread supplies complex carbohydrates.

Most people never heard of serotonin management, or even considered it at all except for medication. Serotonin management amounts to paying attention to the little things that make you feel good and systematically including them in your daily routine. We know, instinctively, that pampering ourselves is a door to a sense of well being, but we may not take time to schedule pleasant surroundings, favorite music or food, or even quality time with loved ones into our daily agenda.

Not just our diet, but our thoughts, our emotions and our behavior, all effect body chemistry. Exercise, for example, produces another chemical known as endorphins, which also helps with depression, anxiety, and sleep. Exercising, watching one's carbohydrate consumption, getting up early and moving, forcing structure on one's life, using meditation and imagery have all proved helpful in keeping one feeling well, relaxed and content.

Collaborative research in neurochemistry, neurophysiology, psychology and other areas of neurosciences has unraveled only a fraction of the unlimited potential of the human brain. The unknown aspects of human consciousness are enormous as compared to what have been deciphered by the modern sciences so far. The real power of the human brain is beyond imagination. One would be amazed to find what an astonishing system exists in this tiny "pocket" of the skull.

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Blue Gold

By: Jailane Salem

Can you imagine your life without water? Of course not, life without water is impossible; we need water to survive.

Water is an essential element in our body, even a slight decrease of water in our bodies can cause us to stop functioning properly, and we can face serious consequences. However, many of us take water (H_2O) for granted, it is readily available to us, but there are many unfortunate souls around the world who do not have access to safe water.

About 1.2 billion people still lack safe drinking water and about 80% of all illnesses in developing countries are water-related such as cholera, dysentery and diarrhea. Simple techniques for treating water at home, such as chlorination[1], filters, and solar disinfection[2], and storing it in safe containers could save a huge number of lives each year.

People living in cities usually obtain their water from public treatment plants. The water is stored in a reservoir and the first step in the water purification process is removal of trash and rubbish. Usually these are large debris; wire mesh is used to capture them. Next, the raw water may be flash-mixed with various chemicals to alter its pH[3], encouraging clumping and settling of smaller suspended solids. After an additional settling stage, the water can be forced through filter beds composed of sand, garnet, and anthracite to remove even smaller particles. The cleared water is then disinfected with chlorine gas or chlorine compounds, ozone, or ultraviolet light, before it is pumped into the distribution system of water mains and storage tanks on its way to our homes.

In developing countries, water treatment companies face many problems, such as the inadequate supply of chemicals, their high price and the insufficient skilled manpower. Some of the chemicals used in conventional water treatment processes for turbidity removal have also been deemed somewhat unsafe such as the widely used aluminum sulfate. There is a fear that ingestion of aluminum ions may induce Alzheimer's disease.

Not only is it dangerous to use aluminum sulfate (alum) and calcium hypochlorite, but it also puts pressure on the nation's financial resources since they are imported, thus making treated water very expensive and beyond the means of most rural people. Due to the importance of water, those who live in rural areas have no choice but to resort to sources such as dams, dug-outs, streams, rivers, and lakes. Water from these sources is usually turbid and contaminated with microorganisms that lead to many diseases including guinea worm and bilharzias.

We know that remote places in Egypt suffer from the unavailability of safe drinking water, and this is due to scarce water treatment plants. The health of farmers and people living in those areas is greatly affected by the lack of safe water, since the water available is contaminated with harmful bacteria and parasites.

In 2003, USAID introduced the use of slow sand filtration water treatment plants to the villages, and funded the construction of these plants. Water from the Nile is filtered using gravel and sand to remove impurities and then chlorinated. The advantages of these plants include high effectiveness of water treatment through removal of turbidity, bacteria and parasites. Due to the manual nature of the operation of these treatment plants, few automation skills are required of the staff, making it easy to manage and maintain. Now farmers in the villages of Tena el Gabal and Gabal el Ter in Minya Governorate are able to obtain safe water and their health has improved. However, many other villages are not as fortunate; hence, a better and easy solution is needed to dramatically improve their quality of life.

But, can a solution that does not need advanced technology or manpower, and will not have us digging too deep into our pockets, exist?

The answer is "yes!" Mother Nature has done it again by providing us with the *Moringa Oleifer*a! This tree is sometimes dubbed "the miracle tree"; it is a vegetable tree that grows in Africa, Central and South America, the Indian subcontinent, and South East Asia. Moringa trees have the capacity to grow rapidly from seeds or cuttings, even in poor, marginal soils; they require little horticultural attention and are resilient to the effects of extended drought. Crushed Moringa seeds clarify and purify water to suit domestic use; it diminishes water pollution and lowers the bacterial concentration in water making it safe for drinking. It is a quick and simple method for cleaning unclean river water.

How does it work?

The seed pods are allowed to dry naturally on the tree prior to harvesting. The seeds are then crushed and sieved using traditional techniques applied in the production of maize flour. For water treatment purposes, approximately 50-150 mg of ground seed will be needed to treat a liter of river water, depending on the quantity of suspended matter.

A small amount of clean water is then mixed with the crushed seed to form a paste. The crushed seed powder joins with the solids in the water and sinks to the bottom; this is an effective natural clarification agent for highly turbid and untreated pathogenic surface water. This treatment also removes 90-99% of bacteria contained in the water, improving drinkability and making the result aesthetically as well as microbiologically more acceptable for human consumption. Using Moringa to purify water replaces chemicals such as aluminum sulfate, which are dangerous to people and the environment, and are expensive.

Water is an essential source of life for all human beings; unfortunately, it is not available in a safe form for everyone. Many ways are available for water treatment, but application varies from one part of the world to another. Innovative thinking and new discoveries in this area are essential for the benefit of all humanity; scientific knowledge and research dedicated to locate natural and cost-effective ways to provide safe water for everyone is indispensable for a better life for all.

Glossary

(1) **Chlorination** is the process of adding chlorine to water as a method of water purification to make it fit for human consumption as drinking water.

(2) **Solar water disinfection** (SODIS) is a method of disinfecting water using only sunlight and plastic PET bottles. It is a free and effective method for decentralized water treatment, usually applied at the household level and is recommended by the WHO as a viable method for household water treatment and safe storage.

(3) **pH** is the measure of the acidity or basicity of an aqueous solution.

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THE TRUTH about Water in the Land of the Nile (I)

By: Lamia Ghoneim

"***Once you drink from the Nile, you will always come back for more***," is a saying that has rung true and firm; until recently, that is.

We have always been taught that Egypt is the land of the Nile. We have been told over and over again how blessed and favored Egypt is to have the Nile flowing through its lands. We grew up believing that water in Egypt is good and plentiful, and that the Nile will keep us sustained and satisfied forever.

Today, if you turn on your tap water, assuming you are lucky enough to have access to running water, the smell and taste of the water may very likely stop you from coming back for more. The Nile that was once an exquisite picture of beauty and the inspiration for countless vivid poems is now polluted beyond recognition.

Many questions circulate nowadays about the safety of the water in Egypt, or even its availability. Many people are wondering what has gone wrong; why the water in the land of the Nile has become of questionable quality; and what must be done to salvage this vital resource for our future and the future of generations to come.

In a humble attempt to answer some of these questions and fears, I shall begin with the root of the problem.

The Sewage System (or the lack of it)

The Nile is the major source of drinking water in Egypt. Tragically, the Nile's water is often below minimum quality standards! A major reason behind this is that only 36.1 % of the Egyptian population is connected to the sewage network where wastewater is treated. A huge amount of untreated wastewater is thus dumped in the Nile!

The amount of water released into the Nile is 3.8 billion m^3 per year, out of which only 35 % is treated properly. According to the Head of the Water Pollution Department at the National Research Center: "Drinking water in Egypt goes through all the necessary purifying procedures. The problem, though, is that the old systems and machinery that do so have not been replaced for decades. We have water networks that lack corresponding sewage systems, which means that sewage is not disposed of properly, eventually getting mixed up with the water network." In other words, the water you drink is potentially polluted with what you flush down the toilet!

Tap Water (or the lack of it)

If you think that everyone in Egypt has water running through their taps, think again. While almost all urban communities are blessed with the modern technology of a municipal water system, many villages and slums are not. Communities without municipal water ranged between 23% and 36% in the year 1996; by 2008, this figure was reduced to around 18%.

The quality of the water that runs through our taps is a whole different story though. In the year 2006, the Parliament's Housing Committee issued a report stating that water in 18 governorates; including Alexandria, Giza and Asyut, is polluted to the degree that it is unsafe to drink. Dr. Habib Ayeb, Vice-President of Sawse (Sakia Association for Water in Society and Environment), reported that 65% of people in Egypt drink polluted water.

According to "The Egypt State of Environment Report of 2008", the four sources of pollution to our water sources are sewage, factories, agricultural drainage and waste. By studying the results of the report and deciphering its chemical codes, I found it affirms that the quality of water from Aswan to Cairo is safe enough to drink; however, with the exception of some areas, including Alexandria! Confused and worried, I decided to take the matter into my own chemical hands.

The Quality of My Water (or the lack of it)

The assessment of water quality or contamination is often achieved through chemical analysis and according to certain International Standards. One of the chemical analysis tests used is the Total Dissolved Solids (TDS) test, which is an indicator test that roughly specifies the general quality of the water. Another general test is the measurement of water pH. I decided to perform these simple tests on tap water in my home in Janaklees, Alexandria.

Given the foul smell and taste of tap water in my house, which were and still are the main motive for my quest, my findings were rather surprising. The TDS level test indicated that water from my tap contains 300 ppm total dissolved solids, which is considered as very acceptable by international standards. The results of the pH test were also good; the water samples tested had an average pH of 7.4, which is well within the range of the acceptable values.

The results could put anyone at ease; however, for a chemical engineer, they failed to do so. In fact, many other, much more complicated, tests are required to assert whether or not water is really safe to drink. The Total Dissolved Solids test does not really detect all dissolved solids; it only detects mobile charged ions but not compounds. Such compounds include sugar, alcohol, organics; including pesticides and their residues; and unionized forms of silica, ammonia, and carbon dioxide. Nor does it detect macroscopic particulates, which are too large to move in the electric fields applied; so, if you see "rusty" looking water from iron oxide particulates, that would not be measured. Moreover, it does not detect anything that makes water look cloudy; neither does it detect bacteria or viruses!

The Solution (or the lack of it)

If you think that drinking bottled water is the better alternative, think again. Setting aside the mighty environmental damage caused by water bottles, when toxic chemicals are released into the atmosphere if they are buried or burnt, buying and drinking bottled water means there is no incentive for the government to clean up the water supply; thereby exposing those who cannot afford bottled water to unclean water.

Avoiding drinking tap water does not mean you are no longer exposed to the dangers of it. Ecologist Dr. Sandra Steingraber notes that "the sense of safety offered by bottled water is a mirage. It turns out that breathing, not drinking, constitutes our main route of exposure to volatile pollutants in tap water; such as solvents, pesticides, and byproducts of water chlorination."

It may seem like we have reached a dead end; but the solution, as I see it, lies in the root of the problem. Through chemical knowledge and research, methods of water treatment can become easier, cheaper, safer and much more effective. By implementation of advanced technology that is effective, as well as safe and environmentally friendly, the future of the Nile can be saved.

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in the Kitchen

By: Noha Rahhal

If the expression "Chemistry in the Kitchen" sounds bizarre to you, think of any meal you have during the day. A meal is made of many different ingredients that might seem impossible to blend together. But they do; they "react" with one another to bring about the most delicious foods. As you take the first bite of a meal, you know whether it is too salty, sour or even perfect. That is because your taste buds "react" to the food you take in. When you finish your meal, you clean up. Whether you wash your hands or wash the dish you were using, you use soap. Once again, this cleansing is nothing but another "reaction".

Molecular Gastronomy…Huh?

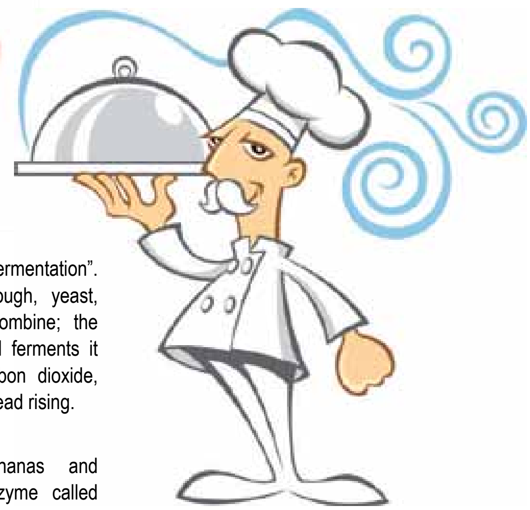
The reaction between food ingredients is not just a funny hypothesis. Your kitchen is a laboratory of a special nature where food ingredients are the chemical substances, bowls and pans are containers to mix those ingredients together, and devices to control the measurements of each ingredient or "substance" and the temperature of the reactions.

You might be surprised to know that there is a discipline dedicated specifically to the study of the physical and chemical processes that occur while cooking; it is called "Molecular Gastronomy". This discipline investigates the chemical reasons behind the transformation of ingredients, as well as the social, artistic and technical aspects of culinary and gastronomic phenomena in general.

The term was coined in 1992 by Hungarian physicist; Nicholas Kurti, and French physical chemist; Hervé This. Areas explored by molecular gastronomy include, among several others: how ingredients change by different cooking methods; how cooking methods affect the flavor and texture of food ingredients; how the senses play roles in our appreciation of food; and the mechanisms of aroma release and the perception of taste and flavor.

Among the many examples of processes explored by molecular gastronomy is "caramelization". When sautéing meat, the goal is to develop a deep brown crust that gives meat its distinctive taste, which is a hallmark of French cooking. Caramelization is the result of heat breaking down proteins into simple sugars giving the food a slightly sweet and complex taste.

Another example is "fermentation". When making bread, dough, yeast, sugar, salt and water combine; the yeast eats the sugar and ferments it creating alcohol and carbon dioxide, which is responsible for bread rising.



Changing Color

Apples, pears, bananas and potatoes contain an enzyme called polyphenol oxidase, which reacts with oxygen; an oxidation reaction that causes browning when the fruit is cut or bruised.

The reaction can be slowed or prevented by inactivating the enzyme through various methods: with heat, meaning cooking; by reducing the pH on the surface of the fruit by adding lemon juice or another acid; by reducing the amount of available oxygen by putting cut fruit under water or vacuum packing it; or by adding certain preservative chemicals like sulfur dioxide. On the other hand, using cutlery that has some corrosion can increase the rate and amount of the browning by making more iron salts available for the reaction.

In another case, plunging asparagus into boiling water causes the cells to pop, resulting in a brighter green color. Longer cooking, however, causes the plant's cell walls to shrink and release acid, which results in an unappetizing shade of grey.

One more example can be seen when you put chopped red cabbage into a hot pan; heat breaks down the red anthocyanine pigment, changing it from acid to alkaline and causing the color to change. If you add some vinegar to increase the acidity, the cabbage becomes red again; baking soda will change it back to blue.

Much More than Sensors

Chemical reactions are not exclusive to the process of cooking and bringing different ingredients together. There is a different kind of reactions that takes place inside our bodies, beginning from our mouths the instant we let food in.

Thousands of tiny taste buds exist in our tongues; there are five types of them to detect the different flavors needed for survival. They are tiny nerve endings that allow us to perceive different tastes, transmitting messages to the brain by chemical reactions. In other words, our taste buds "react" with foods then send signals along our nerves to our brains to decide whether we continue eating or not.

The five types of flavor-detecting taste buds are sweet, sour, salt, bitter and umami, which has only recently been recognized as a separate taste sensation. Umami is the taste of mono sodium glutamate (MSG) found in tomatoes, parmesan cheese and soy sauce, etc.

Taste-bud nerve endings conduct signals through ion channels or G-protein[1] coupled receptors, depending on the type of chemical being detected. Saltiness is perceived when ions; including sodium, magnesium, potassium, and often calcium; are present in the saliva or on the tongue. The receptors respond more strongly to sodium, making it seem saltier. Sour, on the other hand, is perceived when acidic compounds activate hydrogen ion channels, depolarizing[2] the gustatory cells. This allows the two tastes to be different, though the signals are relayed in a similar manner.

The flavors of sweet and bitter are relayed by G-protein coupled signaling. Sweetness is a response to sugars and other molecules, including aldehydes, ketones, and the amino acids glycine, alanine, and serine. The bitter sensation has been found to have a genetic component; some people taste certain foods as bitter, broccoli for example, while others do not. This may explain why it was the last to be added to the list by the Greek philosopher Democritus.

French Chef; Escoffier, became famous in the 1800s for creating dishes that tasted like none of the four taste sensations; the new taste came from his use of veal stock. Asian cooking uses this same flavoring as a fundamental taste in their dishes. It was the Japanese Chemist; Kikunae Ikeda, who found out the key chemical behind this flavor; glutamic acid, which activates G-protein coupled signaling and is often found in fermented or aged foods. The name given by Ikeda a hundred years ago was umami, which is Japanese for "yummy" or "delicious". In 2002, scientists found that there is indeed a fifth taste bud, one that senses L-glutamate; they gave the flavor the official name of umami.

The Chemistry Inside

Chemical reactions do not only take place inside our mouths. As a matter of fact, within each of our bodies, there is a whole series of chemical reactions that occur along the process of digestion. Those reactions are often referred to as "Metabolism; they are necessary for maintaining life. Metabolism is usually divided into two categories: catabolism breaks down organic matter, for example to harvest energy in cellular respiration; while anabolism uses energy to construct components of cells such as proteins and nucleic acids.

The chemical reactions of metabolism are organized into metabolic pathways, in which one chemical is transformed through a series of steps into another chemical, by a sequence of enzymes. Enzymes are crucial to metabolism because they allow organisms to drive desirable reactions that require energy and will not occur by themselves, by coupling them to spontaneous reactions that release energy. Enzymes act as catalysts, allowing these reactions to proceed quickly and efficiently.

The metabolism of an organism determines which substances are nutritious and which are poisonous. For example, some prokaryotes use hydrogen sulfide as a nutrient, yet this gas is poisonous to animals. The speed of metabolism, or the metabolic rate, also influences how much food an organism requires.

TRY IT YOURSELF

Try tasting some ice cream while closing your eyes and stroking a piece of velvet cloth; the ice cream will taste creamier than before! But if you rub your hand over a piece of fine sandpaper while taking another spoonful, the ice cream will seem to become gritty.

Soap and Detergents: Secret Magic

Who does not use soap and detergents in kitchens? We all do. Soap is simply potassium or sodium fatty acids produced from the hydrolysis of fats in chemical reactions known as "Saponification".

Soap has a magnificent power to remove dirt due to its ability to act as an emulsifying agent. An emulsifier is capable of dispersing one liquid into another immiscible liquid. This means that while oil, which attracts dirt, does not naturally mix with water, soap can suspend oil/dirt in such a way that it can be removed. Detergents and soaps are used for cleaning because pure water cannot remove oily, organic soiling.

Detergents were developed in response to the shortage of animal and vegetable fats used to make soap during World Wars I and II. Detergents are primarily surfactants, which could be produced easily from petrochemicals. Surfactants lower the surface tension of water, essentially making it "wetter" so that it is less likely to stick to itself and more likely to interact with oil and grease.

DO IT YOURSELF

WARNING: If you are a school student, ask a parent or a teacher to do it with you.

Materials

- Ventilated work area
- Molds/glass baking dishes
- Wooden spoon
- Gloves
- 4 kg Suet (animal fat)
- 350 g lye[3]
- 750 ml Water
- 500 ml Lemon juice
- 7.5 ml Fragrance

Steps

1. Cut the fat into chunks, placing it into the large pot; cover it, then heat it on medium heat until it melts. Stir occasionally.
2. Cool the fat to below the boiling point of water. Add a volume of water equal to that of the fat. Bring the mixture to a boil. Cover and remove from heat. Let it sit overnight.
3. Remove the fat from the pot. Discard non-fat slime by scraping it off of the bottom of the fat and any liquid.
4. Measure 2.75 kg rendered fat. Cut the fat into tennis-ball size chunks and place into a large bowl.
5. Set up all of your materials. Ventilate the area or work outside; put on safety gear and open all containers.
6. Pour the water into a large glass or ceramic bowl (not metal). Carefully pour the lye into the bowl and mix the water and lye with the wooden spoon.
7. The reaction between water and lye gives off heat and vapors that you should avoid breathing. The spoon will be somewhat degraded by the lye.
8. Once the lye is dissolved by the water, start adding the chunks of fat, a bit at a time. Keep stirring until the fat melts. If necessary, add heat (put on a low burner with ventilation).
9. Stir in the lemon juice and fragrance oil (optional). Once the soap is well-mixed, pour it into molds. If you use glass baking dishes for molds, you can cut the soap into bars after it has become firmer (not hard).
10. The soap will harden in about an hour.
11. You may wrap the finished soap in clean cotton rags. It can be stored for 36- months in a cool, well-ventilated location.
12. Wear gloves when washing your equipment, as there may be some unreacted lye remaining. Wash in very hot water to help melt away the residue.

Glossary

(1) **G-proteins** are guanine nucleotide-binding proteins that are a family of proteins involved in transmitting chemical signals outside the cell, and causing changes inside the cell.

(2) In biology, **depolarization** is a change in a cell's membrane potential, making it more positive, or less negative. In neurons and some other cells, a large enough depolarization may result in an action potential.

(3) **Lye** is a corrosive alkaline substance, commonly sodium hydroxide (NaOH, also known as "caustic soda") or historically potassium hydroxide (KOH, from hydrated potash).

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TRUE COLORS

By: Shahenda Ayman

Chemistry is the science of matter and the changes it undergoes. The science of matter is also addressed by physics, but while physics takes a more general and fundamental approach, chemistry is more specialized, being concerned with the composition, behavior or reaction of matter, as well as the changes it undergoes during chemical reactions.

Everything around us is related somehow to chemistry. There are chemical reactions inside our bodies, in our food, and there are also reactions that happen between our bodies and the clothes we wear. It is, therefore, not surprising that the colors that we see around us are mainly a result of chemical reactions. But have you ever thought of colors and how they exist? Are they a gift from Mother Nature or is it chemistry?

DYES VS. PIGMENTS

Color results from the way colorants interact with light. Dyes and pigments are colorants; substances that impart color to a material. The major difference between dyes and pigments is solubility or the tendency to dissolve in a liquid, especially water.

Dyes are usually soluble, or can be made to be soluble in water. Once a dye is dissolved in water, the material to be dyed can be immersed in the dye solution. As the material soaks up the dye and dries, it develops a color. If the material then retains that color after being washed, the dye is said to be colorfast.

Pigments, on the other hand, are generally not soluble in water, oil, or other common solvents. To be applied to a material, they are first ground into a fine powder and thoroughly mixed with some liquid, called the dispersing agent or vehicle. The pigment-dispersing agent mixture is then spread on the material to be colored. As the dispersing agent dries out, the pigment is held in place on the material.

In most cases, dyes are used for coloring textiles, paper, and other substances, while pigments are used for coloring paints, inks, cosmetics, and plastics.

Many dyes can be obtained from natural sources; such as plants, animals, and minerals. In fact, humans have known about and used natural dyes since the dawn of civilization. Red iron oxide, for example, has long been used to color cloth and pottery and to decorate the human body. Today, T-shirts dyed with naturally occurring iron oxide, known as red dirt, are popular among tourists on Hawaii's island of Kauai. Red dirt imparts a brilliant orange-red color to cloth that is almost impossible to wash out. Other natural dyes include sepia, obtained from cuttlefish.

Some natural dyes are expensive to produce, difficult to obtain, or hard to use. Royal purple got its name because it comes only from the tropical murex snail. So many snails were needed to produce even the smallest amount of dye that only royalty could afford to use it. The dye known as indigo, obtained from the Indigofera plant, imparts a beautiful blue color to material, but it is insoluble in water. It must first be converted to a different "reduced" chemical form that is yellow and is soluble in water. Once attached to a material and exposed to air, the yellow form of indigo is converted back (oxidized) to its original blue form.

A revolution in colorant history occurred in 1856, when, by accident, English chemist William Perkin (1838–1907) discovered a way to manufacture a dye in the laboratory. That dye, mauve, was produced from materials found in common coal tar. Perkin's discovery showed chemists that dyes and pigments could be produced synthetically, which means that humans can produce it in a lab.

Today, the vast majority of dyes and pigments are produced synthetically. These products are easier and less expensive. In addition, their colors are more consistent from batch to batch than the various samples of natural colorants.

Mordant dyeing involves the use of a chemical that combines with the dye to form an insoluble compound. In the mordant process, the mordant is first applied to the fabric. After the mordant has dried, the dye is added. The dye sticks to the mordant, and the fabric is able to take on the color of the dye, forming an insoluble bond.

Pigments are applied to a surface as a mixture that always consists of at least two parts, the pigment itself and the vehicle, and usually many more components. The purpose of the vehicle in this mixture is to carry the pigment onto the surface, much as motor vehicles carry people and goods. A thinner is often needed because many vehicles are thick, viscous materials that are difficult to apply with a brush.

For example, a thinner such as turpentine is often added to a given mixture to make it easier to apply. One of the simplest paints that you imagine, then, might consist of red iron oxide, linseed oil, which is the vehicle, and turpentine, which is the thinner.

After the pigment/vehicle/thinner mixture has been applied to a surface, two changes occur. First, the thinner evaporates leaving the pigment/vehicle mixture evenly spread on the surface. Next, the vehicle slowly undergoes a chemical change, known as oxidation that converts it from a thick liquid to a solid. Since the pigment particles are trapped in the hardened vehicle, a thin tough skin of colored material becomes attached to the surface.

Nearly every industry uses colorants in one way or another. About 7,000 different dyes and pigments exist and new ones are patented every year. Dyes are used extensively in textile and paper industries. Leather and wood are also colored with dyes, so are petroleum-based products; such as waxes, lubricating oils, polishes, and gasoline. On the other hand, plastics, resins, and rubber products are usually colored by pigments.

Food is often colored with natural or synthetic dyes that have been approved by a federal agency and proven safe for human consumption. Dyes are also used to stain biological samples, fur, and hair.

SEASONAL CHANGES

Every fall we hope for beautiful shades of oranges, yellows, reds and purples to send ripples of color through the landscape. Some years we have a great show of fall colors, but other years we do not. The intensity of fall color can vary quite a bit from year to year.

Have you ever wondered exactly what happens to cause these beautiful colors? Chemical processes in trees that occur this time of the year cause the leaves to change color. Let's first take a look at what happens in the leaf structure during the spring and summer.

Leaves of trees during summer are factories producing sugar from carbon dioxide and water by the action of light on chlorophyll; a process known as photosynthesis. Water and nutrients flow from the roots, through the branches, and into the leaves. The sugars produced by photosynthesis flow from the leaves to other parts of the tree, where some of the chemical energy is used for growth and some is stored.

Chlorophyll is a green pigment that masks other colors during the growing season. It absorbs red and blue light from the sunlight that falls on leaves. Therefore, the light reflected by the leaves is diminished in red and blue and appears green.

Xanthophyll is a yellow pigment and carotene is an orange pigment. For example, squash have yellow xanthophyll pigments and carrots have orange carotene pigments. However, we do not see these colors during the spring and summer because chlorophyll hides them.

On the other hand, Anthocyanin is a pigment that produces reds and purples in many types of trees; it is responsible for the red skin of ripe apples and the purple of ripe grapes. Anthocyanins are formed by a reaction between sugars and certain proteins in cell juice. This reaction does not occur until the concentration of sugar in the juice is quite high. It also requires light; this is why apples often appear red on the side facing the Sun and green on the shaded side.

The shortening days and cool nights of autumn trigger changes in the tree as leaves stop making food. One of these changes is the growth of a corky membrane between the branch and the leaf stem, which interferes with the flow of nutrients into the leaf. Because the nutrient flow is interrupted, the production of chlorophyll in the leaf declines, and the green color of the leaf fades. If the leaf contains carotene, as do the leaves of birch and hickory, it will change from green to bright yellow. Chemical changes occur to produce even more vivid colors in the fall.

The range and intensity of autumn colors is greatly influenced by the weather. Low temperatures destroy chlorophyll, and if they stay above freezing, they promote the formation of anthocyanins. Bright sunshine also destroys chlorophyll and enhances anthocyanin production. Dry weather, by increasing sugar concentration in leaf juice, also increases the amount of anthocyanin. So the brightest autumn colors are produced when dry, sunny days are followed by cool, dry nights.

The right combination of tree species and likely weather conditions produce the most spectacular displays; that is why fall is a truly beautiful time of the year.

It is clear that the science of chemistry is like the sea; as we swim deeper we unravel amazing, almost magical, secrets. As we analyze things that surround us, we end up realizing that it is all connected to chemistry one way or another. This only highlights the importance of this core science that shapes everything in our life. It is, therefore, not another detached academic science; it is the essence of our life and the heart of our universe. If there is no chemistry, there is no life at all.

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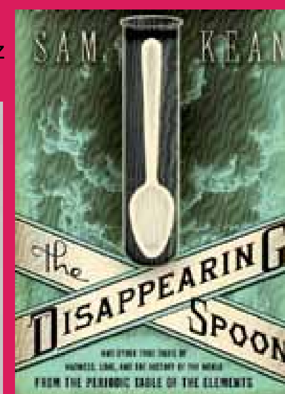
CHECK THIS OUT!

THE DISAPPEARING SPOON:

And Other True Tales of Madness, Love and the History of the World from the Periodic Table of the Elements

By: Sam Kean
PSC Report: Ingy Hafez



"***From the Big Bang to the end of time, it is all in The Disappearing Spoon***".

Periodic Table is one of Man's crowning scientific achievements. It is a treasure trove of stories of passion, adventure, betrayal and obsession. Sam Kean, science writer and current correspondent for *Science* magazine, puts it like this: "The history of the periodic table is the history of the characters who shaped it."

The infectious tales and astounding details in *The Disappearing Spoon* follow carbon, neon, silicon and gold as they play out their parts in human history, finance, mythology, war, arts, poison and the lives of the scientists who discovered them. It narrates stories of people and personalities; of discoveries that were searched for over many years and those that accidentally fell into place; of friendships and partnerships and rivalries.

Sam Kean commences the book with a story of his own childhood play with a ball of mercury. His book goes well beyond the opening anecdote to provide a lively and edifying history of the elements.

Going through the book, we learn that Marie Curie used to provoke jealousy in her colleagues' wives when she invited them into closets to see her glow-in-the-dark experiments, and that Meriwether Lewis and William Clark, sent by President Jefferson to lead the first United States expedition to the Pacific Coast, swallowed mercury capsules across the country and their campsites are still detectable by the poison in the ground. We also know why Gandhi hated iodine, why the Japanese killed Godzilla with missiles made of cadmium, and why tellurium led to the most bizarre gold rush in history!

Kean's book is described to have the structure of a Christmas tree. The trunk is a history of the classification of the elements, an effort that begins in the 19th century. The ornaments on this Christmas tree are the people and personalities behind the chemistry and physics.

The Disappearing Spoon: And Other True Tales of Madness, Love and the History of the World from the Periodic Table of the Elements provides an adventurous, far-ranging survey that offers great good fun. With this Christmas tree come plenty of gifts; some of them even glow in the dark.

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AND
THE NOBEL GOES TO...
MILESTONE NOBEL PRIZES IN CHEMISTRY

By: Sara Khattab

Alfred Nobel; Swedish chemist, engineer, innovator and manufacturer of weapons, invented dynamite, which he thought would end all wars. In 1895, Alfred Nobel wrote his last will, leaving much of his wealth to the establishment of the Nobel Prize. He wanted the profit from his invention used in rewarding people whose work most benefited humanity.

Since 1901, the Nobel Prize has been honoring men and women from all corners of the globe for outstanding achievements in physics, chemistry, medicine, literature, and for work in peace.

Chemistry was the most important science for Alfred Nobel's own work. The development of his inventions, as well as the industrial processes he employed, were based on chemical knowledge. Chemistry was the second prize area that Nobel mentioned in his will. The Nobel Prize in Chemistry has been awarded 102 times to 160 Nobel Laureates between 1901 and 2010.

The First and Last

The first Nobel Prize in Chemistry was awarded to **Jacobus Henricus Van't Hoff** for his discovery of the laws of chemical dynamics and osmotic pressure in solutions. Van't Hoff has been regarded as one of the founders of the new branch of chemistry, which is physical chemistry.

Osmotic pressure is the pressure that needs to be applied to a solution to prevent the inward flow of water across a semi-permeable membrane. The phenomenon of osmotic pressure arises from the tendency of a pure solvent to move through a semi-permeable membrane and into a solution containing a solute to which the membrane is impermeable. This process is of vital importance in biology as the cell's membrane is selective towards many of the solutes found in living organisms.

Van't Hoff's work showed that most dissolved chemical compounds give an osmotic pressure equal to the gas pressure they would have exerted in the absence of the solvent. An apparent exception was aqueous solutions of electrolytes; acids, bases and their salts.

The last Nobel Prize in Chemistry, so far, was awarded in 2010 to **Richard F. Heck** and **Ei chi Negishi** from the United States of America, and **Akira Suzuki** from Japan jointly for the development of palladium catalyzed couplings in organic synthesis. This chemical tool has vastly improved the possibilities for chemists to create sophisticated chemicals, for example carbon-based molecules as complex as those created by nature itself. Palladium-catalyzed cross coupling is used in research worldwide, as well as the commercial production of pharmaceuticals and molecules used in the electronics industry.

Two-Time Chemistry Nobel Laureate

British biochemist **Fredrick Sanger** was the only Nobel Laureate who has been awarded the Nobel Prize in chemistry twice, in 1958 and 1980. He was first awarded the prize for developing techniques to sequence proteins and for determining the amino acid sequence of insulin. His work confirmed that the functions of proteins depended on the sequence of amino acid residues in a polypeptide chain and it confirmed that every molecule of a protein had the same amino acid sequence.

In 1980, Sanger shared half of the prize with **Walter Gilbert** for their contributions to the determination of base sequences in nucleic acids. They developed different methods to determine the exact sequence of the nucleotide building blocks in DNA. The other half of the prize was awarded to **Paul Berg** for his fundamental studies of the biochemistry of nucleic acids, with particular regard to recombinant-DNA. He was the first investigator to construct a recombinant DNA molecule; a molecule containing parts DNA from different species. His pioneering experiment resulted in the development of a new technology, often called genetic engineering.

The investigations of Berg, Gilbert and Sanger introduced a detailed insight into the chemical basis of the genetic machinery in living organisms. Sequence investigations with the methods of Gilbert and Sanger together with the recombinant-DNA technique made excellent tools for continued investigations of the structure and function of the genetic material.

Individuals and organizations awarded a Nobel Prize are called Nobel Laureates. The word laureate refers to being signified by the laurel wreath. In Greek mythology, the god Apollo is represented wearing a laurel wreath on his head. Laurel wreaths were awarded to special people; such as competition winners. It was also used in Ancient Rome; Roman emperors are often shown wearing laurel wreaths. Till this day, laurel wreaths are used to show that someone has done something special.

Women Laureates

Women have been winning Nobel Prizes but in very small numbers compared to their male colleagues. In chemistry, only four women have been awarded so far.

Marie Curie

Marie Curie, both physicist and chemist, was famous for her work on radioactivity. She was the first woman to win a Nobel Prize, and she was the only to win the award in two different fields; physics and chemistry. In 1911, she was awarded in recognition of her services to the advancement of chemistry by the discovery of the elements radium and polonium, by the isolation of radium and the study of the nature and compounds of this remarkable element.

Irène Joliot-Curie

Daughter of Pierre and Marie Curie, Irène Joliot-Curie shared the Nobel Prize in 1935 with her husband Frédéric Joliot for their synthesis of new radioactive elements. Building on the work of her parents who had isolated naturally occurring radioactive elements, Irene realized the alchemist's dream of turning one element into another; creating radioactive nitrogen from boron and then radioactive isotopes of phosphorus from aluminium and silicon from magnesium.

The Curies are the most successful, and certainly the most famous, "Nobel Prize family". Husband and wife Pierre and Marie Curie were awarded the Nobel Prize in Physics in 1903. Marie went on to become the first person to ever win two Nobel Prizes when she was awarded the Nobel Prize in Chemistry in 1911. Their daughter; Irène Joliot-Curie, continued the Nobel family legacy by receiving the 1935 Nobel Prize in Chemistry, together with her husband; Frédéric Joliot.

Dorothy Crowfoot Hodgkin

The third woman to be awarded the Nobel Prize in chemistry was Dorothy Crowfoot Hodgkin, in 1964, for advancing the technique of X-ray crystallography. She used X-rays to find the structural layouts of atoms and the overall molecular shape of over 100 molecules including: penicillin, vitamin B-12, vitamin D, and insulin.

Ada E. Yonath

In 2009, Ada E. Yonath received the Nobel Prize in chemistry along with Venkatraman Ramakrishnan and Thomas A. Steitz for their studies on the structure and function of the ribosome. Through X-ray crystallography, Yonath, Ramakrishnan and Steitz succeeded in mapping the locations of the hundreds of thousands of atoms in the giant molecular complexes inside the cells known as ribosome. The ribosome research was later used to develop new antibiotics, where some antibiotics work by gumming up the ribosomes of bacteria, allowing those bacteria to be stopped at no danger to their host.

The Youngest and the Oldest

To date, the youngest Nobel Laureate in Chemistry is **Frédéric Joliot**, who was 35 years old when he was awarded the Prize in 1935, together with his wife. On the other hand, the oldest Chemistry Nobel Laureate until now is **John B. Fenn**, who was 85 years old when he was awarded the prize in 2002 jointly with Koichi Tanaka, for their development of soft desorption ionization methods for mass spectrometric analyses of biological macromolecules.

Forced To Decline

Offended by the 1935 Nobel Peace Prize being awarded to Carl Von Ossietzky; a German writer who opposed him, Adolf Hitler forbade three German Nobel Laureates from receiving the Nobel Prize. They were later allowed to receive the Nobel Prize Diploma and Medal, but not the prize amount.

Two of these Laureates were awarded the Nobel Prize in Chemistry. **Richard Kuhn** received it in 1938 for his work in carotenoids and vitamins. The second Laureate was **Adolf Butenandt,** in 1939, for his work on sex hormones. This research lead to the discovery of estrone and other primary female sex hormones.

Failure to Launch

Nobel Prizes in Chemistry have been awarded throughout 110 years now. However, it was not awarded on eight occasions: 1916, 1917, 1919, 1924, 1933, 1940, 1941 and 1942.

As described in Nobel's will, the prize is to be awarded to "the persons who have made the most important chemical discovery or improvement". If none of the works under consideration is found to be of the importance indicated in the will, the prize money shall be reserved until the following year. If, even then, the prize cannot be awarded, the amount shall be added to the Foundation's restricted funds.

Ahmed Zewail

Ahmed Zewail was born on 26 February 1946 in Damanhour and was raised in Disuq. As a boy, it was clear that his inclinations were toward the physical sciences; "mathematics, mechanics, and chemistry were among the fields that gave me special satisfaction," says Zewail.

Zewail graduated with the highest honors from the Faculty of Science, Alexandria University. Using spectroscopy and developing the understanding of how and why the spectra of certain molecules change with solvents, he received his Masters in Science. Zewail moved to the United States to complete his PhD at the University of Pennsylvania. After some post-doctoral work at University of California, he was awarded a faculty appointment at Caltech where he has remained since. In 2009, President Barack Obama appointed him to the President's Council of Advisors of the White House, and in November of the same year, he was named the first US Science Envoy to the Middle East.

The 1999's laureate in chemistry was rewarded for his pioneering investigation of fundamental chemical reactions, using ultra-short laser flashes, on very short time scale; short enough to analyze transition states in selected chemical reactions. He studied atoms and molecules in "slow motion" during a reaction and saw what actually happens when chemical bonds break and new ones are created. This reward made Ahmed Zewail the third Egyptian to receive the Nobel Prize, following Egyptian President Anwar Elsadat in 1978, and Naguib Mahfouz in 1988.

Zewail performed a series of experiments that led to the birth of the research area called Femtochemistry. This involves using a high-speed camera to image molecules in the actual course of chemical reactions and trying to capture pictures of them just in the transition state. The camera was based on new laser technology with light flashes of some tens of femtoseconds. The time it takes for the atoms in a molecule to perform one vibration is typically 10-100 fs. That chemical reactions should take place on the same time scale as when the atoms oscillate in the molecules may be compared to two trapeze artists "reacting" with each other on the same time scale as that on which their trapezes swing back and forth.

The contribution for which Zewail received the Nobel Prize meant that we had reached the end of the road: no chemical reactions take place faster than this. With femtosecond spectroscopy we could, for the first time, observe in "slow motion" what happens as the reaction barrier is crossed and understand the mechanistic background to Arrhenius' formula for temperature dependence and to the formulae for which Van't Hoff was awarded his Nobel Prize.

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PSC TRIBUTE

By: Lamia Ghoneim

SAMIRA MOUSSA; *THE UNFULFILLED DREAM* (3 MARCH 1917 – 5 AUGUST 1952)

“**The spokesperson for the Egyptian Embassy in Washington reported today that Samira Moussa; an Egyptian student who has recently completed her studies at the American Oakridge University in Tennessee, has been killed in a car accident.**” —Al-Misri newspaper, 19 August 1952

That was the short statement announcing the tragic death of Egyptian nuclear scientist; Dr. Samira Moussa, at the young age of 35, and with it announcing the death of a dream.

Samira’s wish was to make Egypt and the world a better place, and to provide peace to the Arab World. She strongly believed in the nuclear power for peace advocacy; her opinion was that in order for any country to effectively promote peace, it should be able to speak from a position of power. Moreover, Samira thrived to provide relief for cancer patients as a result of her mother’s agonizing battle with cancer that eventually killed her; “My wish is that through the use of atomic energy, cancer treatment would be within the reach of the masses just as aspirin is.”

Those were her words and her aspirations. Her life begun with hopes and dreams, but ended in tragedy and mystery.

The Bright Beginning

Her story began almost 100 years ago; Samira was born in a time when prevalent traditions did not favor women’s education. A diamond in the rough, she grew up in the village of Sinbu Al-Kubra in Egypt’s Al-Gharbiyah Governorate. Her father; Hajj Moussa Ali, was her first hero who supported her against all odds.

The atmosphere she grew up in was revolutionary; she witnessed the 1919 revolution for independence and the movement for freedom of education for women on all levels. Samira grew up to become a patriotic young woman who prided herself on her Egyptian and Arab identity. She developed qualities of perseverance and determination to follow her dreams. These qualities, accompanied by her exceptional intelligence and talent, led her to excel in her pursuit for a higher education.

The Promising Journey

To give his children a better education, Hajj Moussa moved with his family to Cairo. Throughout her school years, Samira showed exceptional excellence in education becoming the first female student to top the country’s secondary school certificate examination in 1935.

Samira insisted on joining the Faculty of Sciences, Cairo University, where, in 1939, she obtained a BSc in radiology with First Class Honors after researching the effects of X-ray radiation on various materials.

Her enthusiasm and intelligence claimed the attention of her professor, Dr. Ali Musharafa, the first Egyptian Dean of the Faculty who became her second hero. Supported by her Professor, Samira obtained a Masters degree in Science, again coming first in her class. She was then appointed lecturer at the Faculty owing to Musharafa’s efforts who fought for her appointment when it was very difficult for Egyptians to hold positions in the British dominated university.

Samira, who did her thesis on gas thermal convection, was sent by the Faculty to Britain to further her studies in nuclear radiation. She later obtained her PhD in radiology and the effect of X-ray radiation on various materials. Having completed her thesis within two years, she spent a third doing extensive research, which was when she came about her greatest innovation.

She discovered an extremely valuable formula that allows the fragmentation of the atoms of cheap metals; such as copper, paving the way for the production of a cheap nuclear bomb from materials accessible to all nations. The possession of such nuclear technology would have empowered Arab nations immensely; unfortunately, her research was never documented in Egypt.

In her attempt to give the Arab World leverage in the wake of the American bombing of Hiroshima and Nagasaki, in 1948, Samira founded the Atomic Energy Commission and sent students abroad to specialize in nuclear science. She also organized the Atomic Energy for Peace conference hosted by the Faculty of Sciences.

In 1951, she received a scholarship from the Fulbright Atomic Program for Research at Saint Louis University in Missouri. In recognition of her pioneering nuclear research, she was given access to secret US atomic facilities. This raised vehement debate in the US Academic and Scientific circles since Samira was the first “alien” to have access to such facilities.

During her stay in the US, she received several offers to remain but she decided to return to Egypt. In her last letter to her father she wrote: “I have been able to visit nuclear plants in America, and when I come back to Egypt, I will be of great service to my country and will be able to serve the cause of peace.”

The Fateful Ending

As fate would have it, she was never allowed to return to Egypt as she planned. A few days before she intended to return, she was invited to visit a nuclear plant in California and a car was sent for her. On the way across a high cliff road, another car suddenly appeared and pushed her car off the cliff; she died soon after on 5 August 1952. The driver, who managed to escape, was never found. Investigations revealed that the plant she was going to visit never actually invited her.

Samira’s mysterious death and the sudden closure of her case led many to believe that her death was not accidental, especially that around the same decade two Egyptian nuclear scientists were killed in Europe.

The Disappointing Indifference

Historic documents are filled with the names of many prominent Egyptian women who were well acknowledged and admired: great rulers such as Cleopatra; outstanding pioneers such as Nabaweya Moussa; incredible talents such as Umm Kalthoum; and many more names that are engraved in our memories.

Books were written about them, movies were made in their honor and tribute was paid to them throughout the years. Samira Moussa, on the other hand, did not receive much attention. The name of this exceptionally brilliant Egyptian woman, who was the first female nuclear scientist in the Arab World, is only recognized by few, and even those may not be familiar with the details of her short but exceedingly eventful and thrilling life story.

For a woman who had accomplished so much by the time she was 35, indifference to her memory is unacceptable. We hereby pay humble tribute to Samira Moussa; an outstanding woman and scientist who could have become the first Egyptian Nobel Laureate, had she lived long enough to receive that superior recognition.

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GREEN CHEMISTRY

By: Jailane Salem

Day in and day out we hear of the perils of global warming; we are surrounded by news of this issue in newspapers, on television and the internet. Industrial advancements have improved the quality of our lives by leaps and bounds. This however, came at too high a cost for the environment. The Earth's resources have been consumed by us without a thought to the disruption we are causing to the ecological system.

Fertile lands have been ruined, habitats have been destroyed, and environmental systems have been changed beyond recognition. Pollution has abounded in all corners of the Earth. Many people have despaired of the escalating situation, but some are taking positive steps in remedying the wrongs, the most recent example is the summit that was held in Cancun, Mexico. However, delegates of countries are not the only people playing an important role in bringing about change. Many scientists are trying to find practical and efficient solutions, and their contribution is crucial.

Chemistry helps scientists discover alternatives to substances that are harmful to the environment and health. To that effect, a relatively new field called "green chemistry" has been developed to focus on chemical research and engineering that targets the design of products and processes to minimize the use and generation of hazardous substances.

An important issue to be considered nowadays is the reduction in the use of energy, whether at home, at school, at malls, at factories and so on. Green chemistry helps design chemical products that are efficient in the sense that they would need less energy when used and synthetic methods could be conducted at ambient temperatures and pressure.

Disasters, such as aquatic life perishing, occur frequently when chemical hazards are dumped into rivers and seas. The principles of green chemistry are to avoid such occurrences by developing processes that prevent industrial waste, rather than treat it or clean it up after it is formed.

When products are being manufactured, synthetic methods should be designed to maximize the incorporation of all materials used in the process. This will help decrease the amount of left-over substances. Even better, synthetic methodologies are being designed to use and generate substances that have little or no toxicity to human health and the environment.

It is generally believed that there is an island of plastic waste the size of Mongolia floating in the Pacific Ocean, which leads to great harm to marine life and birds. This is due to the fact that plastic materials are non-biodegradable. Therefore, an important issue that green chemists work on is the production of chemical products that are designed to slowly break down and degrade in the environment without leading to any disturbance to natural cycles.

We all have used foam cups, but we usually do not pause to question how this material came to be. Polystyrene foam is a common material used in packing and food transportation; when we buy a television set for example, we usually receive it protected by foam molds that are made of this substance. More than 300 million kilograms are produced each year in the United States alone. Traditionally, CFC and other ozone-depleting chemicals were used in the production process of the foam sheets, presenting a serious environmental hazard.

An example of green chemistry at work can be found in Dow Chemical, an American company, which in 1996 created a better solution for polystyrene foam production. Scientists discovered that supercritical carbon dioxide works as well as a blowing agent, without the need for hazardous substances, allowing the polystyrene to be more easily recycled. The CO_2 used in the process is reused from other industries, so the net carbon released from the process is zero.

The Nobel Prize Committee recognized the importance of green chemistry in 2005 by awarding Yves Chauvin, Robert H. Grubbs, and Richard R. Schrock the Nobel Prize in Chemistry for "the development of the metathesis method in organic synthesis." The Nobel Prize Committee stated: "This represents a great step forward for 'green chemistry', reducing potentially hazardous waste through smarter production. Metathesis is an example of how important basic science has been applied for the benefit of man, society and the environment."

Chemists are now researching new methods that are more sustainable and environmentally friendly. Examples include the production of plastic materials using natural sources such as plants, which are biodegradable, and the creation of lightweight plastic composites that help reduce car and airplane fuel consumption. Major research in the field of chemistry is vital for the necessary development that will allow mankind to lead a comfortable life in harmony with nature. In the 21st Century, our biggest challenge is to salvage what remains of our ailing Earth, heal and persevere in protecting it.

Continued from page 1

In big polymers, hundreds of different units may be joined in different ways. The form, hardness, strength, heat-endurance and elasticity of a polymer can be changed by incorporating alterations in the constituents of the polymer and in the way in which these units are connected. For example, by heating natural rubber with sulfur, we obtain a stronger form of rubber. This happens when the polymers contained in natural rubber become new polymers with the addition of sulfur.

Examples of chemistry in the daily life are endless; to name a few more: cement, a mixture of silicates and aluminates; glass, a mixture of silicates; water purification and desalination; pharmaceutical; agrochemicals such as fertilizers, insecticides, fungicides, weed killers and germicides.

Soap

There are substances that can be dissolved in water, such as salt; and others that cannot, such as oil. Water and oil do not mix, so if we try to clean an oily stain from cloth or from the skin, water is not enough. So, we use soap, which is formed by molecules with a "head", which likes water (hydrophilic), and a long chain that hates it (hydrophobic).

When soap is added to the water, the long hydrophobic chains of its molecules join the oil particles, while the hydrophilic heads go into the water. An emulsion of oil in water is then formed; this means that the oil particles become suspended in the water and are liberated from the cloth. With the rinsing, the emulsion is removed.

Onions that make us cry

Inside the onion cells there are some chemical compounds that contain sulfur. When an onion is cut, the cells break and those compounds suffer a chemical reaction and they are transformed into more volatile sulfured compounds that are released into the air.

These sulfured compounds react with the moisture in the eyes forming sulfuric acid, which produces a burning sensation. Nerve endings in the eye are very sensitive; they pick up on this irritation. The brain reacts by telling tear ducts to produce more water to dilute the irritating acid. So you cry to protect your eyes from the acid.

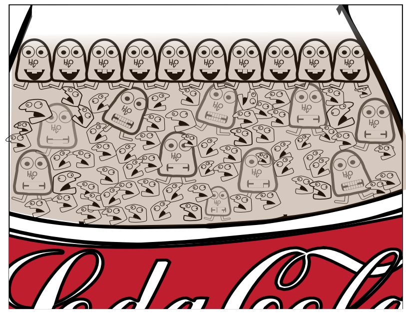
There are some tricks to make onion-dicing less problematic:

- Chop the onion under cold water. The volatile sulfured compounds will be released but then they react with the water, instead of reaching your eyes.
- Freeze the onion for 10 minutes before cutting it. The cold temperature of the onion will slow down the chemical reaction which forms the volatile sulfured compounds.

Invasion of the Mentos Monster!

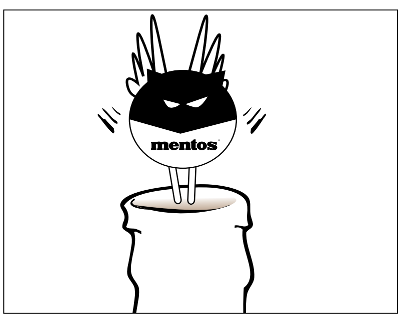
H2O: Water molecules

CO2: Carbon Dioxide

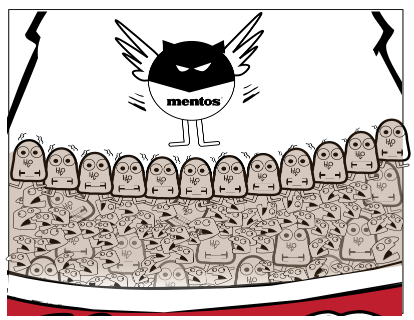


CO2: Let us out! We have the same rights as water molecules.

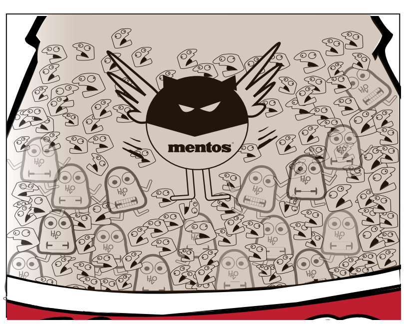
H2O: No one is going anywhere; this is the law of Nature.



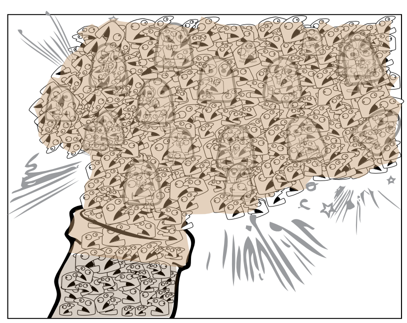
CO2: Do you see that? Is it Super Man?!



H2O: No, that's the Mentos Monster. Oh my God!



H2O: What is happening? HELP!



CO2: Finally, we are FREE! YEAAAAY!!!

Illustrations: Maha Sherin

Dialogue: Ingy Hafez

Phenomenon

Soda drinks consist of mainly water, sugar or diet sweetener, flavoring, preservatives and carbon dioxide gas. Water molecules strongly attract each other, forming a tight mesh around each bubble of carbon dioxide gas called "Hydrogen bond", creating "surface tension" and preventing the gas from expanding and forming more bubbles.

Mentos contain gelatin and gum Arabic and their surface is full of tiny pits that work as "nucleation sites". When Mentos is dropped in the soda, gelatin and gum Arabic dissolve breaking the bonds of water molecules, allowing the gas bubbles to escape and allowing more to form, especially around "nucleation sites".

When all this gas is released, it literally pushes all of the liquid up and out of the bottle in an incredible soda blast. Also, Mentos is heavy and sinks to the bottom, displacing even more liquid up and out of the bottle.

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