PSC
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newsletter
4th year | 4th edition
Planetarium Science Center
Science For All!
SUMMER 2011

In this edition...

Chemistry; Our Future...

By: Maissa Azab

The Future… What a surreal notion? For centuries, Mankind has fantasized about the future, seeing wonders and miracles becoming a reality in it. We have all read the novels and watched the movies foretelling future humans dressed in fantastical bright costumes, living in floating cities and riding flying vehicles to work. We have also seen future humans travelling through space to distant planets and galaxies as simply as we travel from continent to continent today.

Come to think of it, the fact that we do fly from continent to continent today has also once been a fantastical futuristic vision. So, does that mean that, one day, space travel would be as mundane as air traveling is today?

Who knows? But, is this our most pressing fantasy today? Sure, space exploration in itself is a treasure trove of information about the universe we inhabit and its evolution. Not to mention, it is also becoming more pressing to discover planets that are similar to Earth where human-like life could exist; sort of a plan B in case we fail to rescue our ailing Earth. But, what about plan A? What about saving Earth, our one and only home as far as we can tell?

The truth is that Earth and its inhabitants are indeed facing challenges of exponential scale. Tragically, some of the most disturbing of those are the outcome of Mankind's exploration and discovery. It is truly disgraceful that so many marvelous scientific breakthroughs that have made the quality of our lives so much better, in the most part, have been exploited in such ways that their toll has left our planet depleted, putting all its inhabitants in mortal danger.

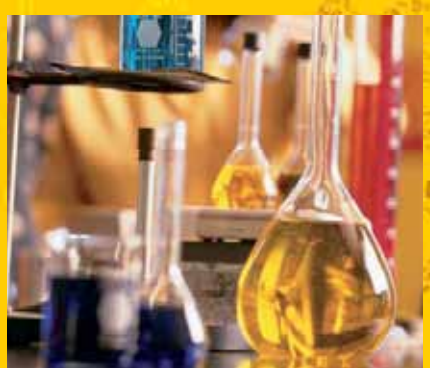
Today, we face heavy challenges with an exploding population that is nothing short from devouring the planet's resources and therefore its chances of any kind of future. We are consequentially facing critical challenges to secure clean air, safe water, healthy food, dependable medicine, sustainable energy, eco-friendly products or advanced materials.

On top of all that, Mother Nature is truly angry with us now and with each passing year we do not rise to fend the Earth and the lives that swim, float, crawl, run or fly on it, her wrath alarmingly rises. Despite all the progress humans have increasingly made in recent years, the calamities that have recently been befalling various parts of the world are also increasingly devastating.

It is about time we channel all our fantasizing genius into a future that is not just charming to dream about, but that is, in fact, tangibly possible and sustainable for future generations still to come.

Now, more than ever, we need to deploy all our resources' arsenal into this battle for the future. And what is more powerful than the always-magical science of chemistry? A double-edge science, it is intrinsic in all aspects of our life and in everything that surrounds us. More importantly, it has the supremacy, if used correctly, to blow a fresh breath into our lungs, water the thirsty, feed the hungry, heal the sick, save lives, and power the world for generations and generations.

It is the nick of time. There is no more time to lose on idle fantasies. Now is the time to bring the fantasies that really matter to life.



6th Science Centre World Congress
4 - 8 September 2011
Cape Town, South Africa
Science Across Cultures

6TH SCIENCE CENTER WORLD CONGRESS (6SCWC)

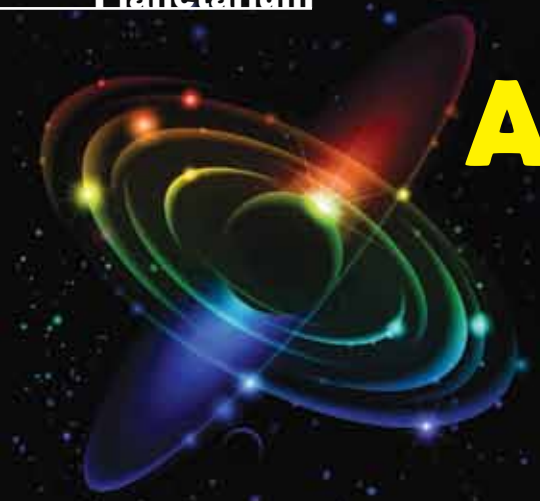
The 6th Science Center World Congress (6SCWC) will be held in Cape Town, South Africa, 4-8 September 2011. Congress developments are really getting underway!

Hosted by the Cape Town Science Center, the Southern African Association of Science and Technology Centers, and the North Africa and Middle East Science Centers Network, the 6SCWC is aimed at senior decision-makers from all over the world in the science center, education and museum fields, as well as developers of new science centers and science museums in Africa and other developing regions. Staff from universities, government departments, corporate foundations, traditional museums, educational NGOs and CBOs are also invited to attend.

The 6SCWC International Program Committee has been hard at work planning the 6SCWC program. Sixty sessions, involving more than 216 delegates as conveners and speakers, have been accepted into the sessions program. There are also exciting, interactive demonstrations planned during lunches and tea breaks, as well as Science Café sessions in the mornings.

Please visit the 6SCWC website (www.6scwc.org/sessions.php) for the program, and join our mailing list at (www.6scwc.org/contact.php) to receive notification of the announcement of the final program.

For additional information and registration, please visit the 6SCWC website at: www.6scwc.org



An Astrochemical Account...

By: Maissa Azab
and Sara Khattab

Astrochemistry is the area of study where astronomy and chemistry overlap; it is the study of the nature, behavior, and history of molecules and materials in the various astronomical environments. The most important tool in this area of study is spectroscopy, which is the use of telescopes to measure the absorption and emission of light from molecules and atoms in various environments. The abundance of elements, chemical composition, and temperatures can be deduced from astronomical observations when compared to laboratory measurements.

The Stuff of Stars...

The commonsense view that dominated science for centuries was that elements do not emerge from anywhere; the consensus was that the lifetime of every element coincides with the lifetime of the Universe, and that they are neither created nor destroyed. By 1939, German and American scientists had proved that the Sun and other stars heated themselves by fusing hydrogen together to form helium, a process that releases an outsized amount of energy compared to the atoms' tiny size. As telescopes improved, data proved that most young stars contain only hydrogen and helium, while older stars stew with dozens of elements.

Desperate to maintain high temperatures, stars lacking hydrogen begin to burn and fuse helium in their cores. Pretty soon significant amounts of lithium, boron, beryllium, and especially carbon accumulate inside stars. However, burning helium releases less energy than burning hydrogen, so stars run through their helium in a few hundred million years. Some small stars even "die" at this point, creating molten masses of carbon known as "white dwarfs".

Heavier stars fight on, crushing carbon into six more elements, up to magnesium, which buys them a few hundred years. A few more stars perish then, but the biggest, hottest stars burn those elements too over a few million years. This is nothing less than the evolution of elements; iron is the final stage of a star's natural evolution because fusing anything to iron's 26 protons costs energy.

Elements heavier than iron emerge ready-made from "mini big bangs". After burning through elements, such as magnesium and silicon, extremely massive stars burn down to iron cores in about one Earth day. Suddenly, lacking the energy to keep their full volume, burned out stars implode under their own immense gravity, collapsing thousands of miles in just seconds. In their cores, they even crush protons and electrons together to form neutrons, until little but neutrons remain there.

Rebounding from this collapse, they explode outward; for one month, a supernova stretches millions of miles and shines brighter than a billion stars. Billions and billions of particles collide so many times per second creating new elements; every natural combination of element and isotope spews forth from this particle blizzard. One such explosion precipitated our Solar System.

Down to Earth...

About 4.6 billion years ago, a supernova sent a sonic boom through a flat cloud of space dust about fifteen billion miles wide, the remains of at least two previous stars. The dense center of the cloud boiled up into the Sun, and planetary bodies began to aggregate and bundle together. The most impressive planets, the gas giants, formed when a stellar wind blew lighter elements outward toward the fringes. Among those giants, the gassiest is Jupiter, which for various reasons is a fantastic camp for elements, where they can live in forms never imagined on Earth.

When the Solar System began to come together, the gas giants formed first, in as little as a million years; while the heavy elements congregated in a celestial belt roughly centered on the Earth's orbit and remained quiet for millions of years more. When the Earth and its neighbors were finally spun into molten globes, those elements blended more or less uniformly inside them and dense iron sank to the core inside each planet. When Earth cooled and solidified enough to make churning difficult, clusters of elements spread far enough that, except in a few notorious cases, no one country monopolizes their supply.

Reasonable people might ask how scientists have the foggiest idea how the Earth was formed. Basically, they analyzed the amount and placement of common and rare elements in the Earth's crust and deduced how they could have reached where they are. For example, the common elements lead and uranium fixed the birth-date of the planet through a series of almost insanely meticulous experiments done by a graduate student, Clair Patterson, in Chicago during the 1950s using meteor bits.

A Matter of Life...

For decades, astronomers have debated whether the molecules of life were formed in the depths of space, or evolved amidst the violent volcanic eruptions and severe lighting storms that raged on the young Earth. The idea that primitive life on Earth may have been seeded by a comet or asteroid impact is controversial. Since it was suggested more than forty years ago; however, increasingly complex organic molecules have been discovered in space.

The first discovery of amino acids, the building blocks of life, was during 1994 when scientists found glycine in a meteorite. Finding amino acids in this meteorite suggests that there is more than one way to make amino acids in space, which increases the chance for finding life elsewhere in the universe.

The discovery of glycine, which is the simplest among all the 20 amino acids, is the first step in establishing the crucial link between amino acids in space and the emergence of life in the Solar System, or indeed, elsewhere in the galaxy. The molecular spectra seen in interstellar gas clouds closely matches those found in comets and meteorites, and comparing them could in principle allow astronomers, or exobiologists, to trace the origin of the Earth's early chemistry to its parent gas cloud.

Embedded in meteorites and Moon rocks, some amino acids may have been first created in interstellar space, and then froze in meteors that bombarded the Earth during its early history. In hopes of unmasking more evidence, astronomers are searching for amino acids in the cold, molecular gas found in some regions of our own Milky Way galaxy.

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Spacesuit Chemistry!

By: Sara Khattab

Something as fragile as a human being entering the realm of the outer space requires a material that is lightweight yet durable enough to protect astronauts as they explore the universe. Luckily, the space age has coincided with the age of plastics; chemistry has created just the materials that make remote worlds and the harshest environments more accessible, making exploration possible.

Plastics are typically polymers[1] of high molecular mass, and may contain other substances to improve performance and/or reduce production costs. They are resistant to chemicals; thus, they can be used to store many types of substances or withstand harsh environments. Monomers[2] of plastic are either natural or synthetic organic compounds.

Today's spacesuits rely on up to ten different polymers to protect space crafters from temperatures ranging from -156.6ºC to 176.6ºC; the helmet and visor are made of protective polycarbonate layers. On the space station, plastics provide cleaner air, purer water, and more effective sanitation than ever. Water purification and recycling depend on medical-grade fluoropolymer tubing and membranes as well as iodinated polystyrene beads to recover 85-95% of waste water and make it drinkable.

NASA's Pathfinder used polymers in its mission to Mars where robotic vehicles were landed using airbags made of tough aramid fiber[3]. Pathfinder's ablative coating was made of silicon plastic, and the parachute was made of polyester. The rover's wheels used plastic bearings and its solar panels were made of plastic composites; even the bright golden cover that protects the rover is made from polymide[4].

Some visionaries see spacesuit technologies as the blueprint for a new era of sustainable housing where buildings generate energy depending on windows and construction materials made from recycled plastics.

Glossary

1. **Polymer:** a large molecule composed of repeated molecular units that are usually joined by covalent bonds. Most plastics are man-made polymers, while proteins are natural polymers made up of amino acids.
2. **Monomer:** an atom or a small molecule that may bind chemically to other monomers to form a polymer. The term monomer refers to the organic molecules which form synthetic polymers.
3. **Aramid fibers:** a class of heat-resistant and strong synthetic fibers. They are used in aerospace and military applications, for ballistic rated body armor fabric and ballistic composites, in bicycle tires, and as an asbestos substitute.
4. **Polymide:** a polymer containing monomers of amides joined by peptide bonds. They can occur both naturally and artificially. Polyamides are commonly used in textiles, automotives, carpet and sportswear due to their extreme durability and strength.

¡Telescopes!

By: Sara Khattab

Many people enjoy watching the night sky, and some enjoy watching the day sky as well to observe the solar eclipses and sunspots. Using binoculars and portable telescopes, amateur astronomers or stargazers contribute to astronomy by monitoring variable stars, tracking asteroids, and discovering transient objects, such as comets, though scientific research is not their main goal. Amateur astronomy is usually associated with viewing the night sky when most celestial objects and events are visible.

A long time ago, stargazers learned the basics of the night sky with pencils, star charts and lots of patience with their telescopes. Progress in science is often linked to development of new technologies, so scientists and engineers are continually exploring new techniques to improve their ability to collect and analyze the stars.

Now, high-tech equipment and smart phone apps are making the task a lot less daunting for beginners. New point-and-shoot telescopes require only the push of a button to go into action. Just push the button and the device gets its own bearings, aligning itself with the stars above so it can tell you the name of the star or comet seen in the eyepiece.

These automated telescopes that can find celestial objects with no help from humans are not new, they had motors to drive them, allowing built-in processing and databases. Users of some older telescopes can choose any star or planet from the menu on the hand controller, re-centering the eyepiece over the chosen object. But even these telescopes need to be set properly and some people are defeated by the process.

Nowadays, amateur stargazers are trying to find a way to collect data via low-cost technology like smart phone applications. Smart phones, with their cameras and abundant processing power, offer novel features that telescopes cannot. United Soft Media offers applications for iPhone and iPads that identify bright stars or planets seen in the night sky. They can simulate a ride on a spacecraft taking the users on a tour of distant planets.

These applications can lead to more telescope sales. For those who want to meld the benefits of telescopes with smart phones, a simple adapter, which connects an iPhone directly onto the telescope eyepiece is available. With that, users can take snapshots of Saturn, the Moon, Jupiter and other bright objects via the telescope.

Dr. Chris Lintott, director of citizen science at the Adler Planetarium in Chicago, believes that the availability of beginners' tools like apps and self-aligning telescopes will help drive interest in astronomy.

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AVAILABLE SHOWS

The Zula Patrol
23 Min. Full-dome Show

Stars of the Pharaohs
35 Min. Full-dome Show

Seven Wonders
30 Min. Full-dome Show

Oasis in Space
25 Min. Full-dome Show

Mystery of the Nile
45 Min. IMAX Show

Cosmic Voyage
35 Min. IMAX 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.

A Chemical Saga: The Islamic Su

By: Ingy Hafez

After the fall of the Roman Empire, the focus of alchemical development moved to the Arab Empire and the Islamic civilization. The Islamic world was a melting pot for alchemy, where Muslim philosophers made great contributions.

Arabs appeared in history during the 7th century; by then, alchemy had gone a long path. A century after Prophet Muhammad passed away, the Islamic Empire had extended from the Atlantic Ocean in the West, to Central Asia in the East. Islam transferred primitive tribes from the darkness of ignorance to the light of knowledge, making Muslims the most advanced civilization of that time.

The Islamic civilization gave rise to many centers of culture and science, and yielded great scientists and philosophers. There were remarkable breakthroughs in technology, as well as investment in economic infrastructure, such as irrigation systems and canals.

Islamic Chemistry

In many ways, Muslim chemistry rose in the same manner as it did in Mesopotamia, with the difference that the Arabs were more careful in their larger number of experiments, made careful notes of their laboratory results, and developed their laboratory apparatus to a high point of perfection; hence, the actual impact of Arabs on the application of the scientific method in chemistry surfaced.

Although Muslims were portrayed as mere transmitters of Greek wisdom, the truth was not exactly as it seems. It is true that they translated many books and writings of the ancients; however, they soon realized that, in the field of chemistry, the ancients dealt primarily with speculation and mystery. Muslims, on the other hand, were among the first to develop the scientific method and apply it in their research extensively. In historian Briffault's book, *Making of Humanity*, he states: "Investigation, accumulation of positive knowledge, minute methods of science and prolonged observation were alien to Greek temperament. These were introduced to Europe by the Arabs. European science owes its existence to the Arabs".

Muslims were not alchemists, but rather the world's first "true" chemists. They produced a variety of compounds useful for the development and advancement of science, culture, industry, and civilization. They invented and perfected the processes of distillation, sublimation, crystallization, oxidation, and precipitation; and they discovered the process of calcination applied to reduce substances to a powdered form.

Muslims pursued chemical and alchemical ideas with enthusiasm and success. The great number of modern chemical words derived from Arabic (alcohol, alkali, alchemy, zircon, elixir, natron, and more) indicates how important that period was in the history of chemistry. They also originated the synthesis of numerous crucial substances that are essential to the development of chemical sciences. Among many other achievements, the acid-base principal of chemistry was entirely their development, along with the pH scale.

As industrial chemists, Muslims applied advanced techniques for extracting minerals and metals. They perfected glass-making and introduced the technology for coloring it with metal oxides. They invented crystal-making, introduced steel-making, produced dyes, as well as a variety of plasters, glazes and other building compounds.

Muslims also perfected the production of paper. Though the Chinese produced paper, it was done through a tedious process requiring silk. It was the Muslims who instituted chemically-aided paper production. Millions upon millions of books were published wherever this invention existed. Following that, Europeans became accustomed to the luxury of imported paper from the Muslim world. The mass production of affordable books by Europeans was only possible after the replacement of parchment and silk paper with this new paper.

Muslims writings and books strongly stimulated the development of European chemistry, and their books were taught in many European schools for many centuries. After the Crusades, Europeans' thirst for knowledge grew wild and many books were translated into European languages. Slowly, the Western world acquired the knowledge of Muslims and began its Renaissance.

Carved in History

Jabir ibn Hayyan (721-815)

Jabir ibn Hayyan, father of chemistry, was an Islamic thinker to whom a large number of alchemical, practical, and philosophical works were attributed; more importantly, he laid the foundations of modern chemistry. Many of his works were translated and distributed throughout the learning centers of Medieval Europe.

Ibn Hayyan's contributions to chemistry are numerous. He proclaimed the importance of experimentation. "The first essential in chemistry," he declared, "is that you should perform practical work and conduct experiments, for he who performs not practical work nor makes experiments will never attain the least degree of mastery".

He applied his chemical knowledge to the improvement of various manufacturing processes, such as producing steel and other metals, preventing rust, engraving gold, dyeing and waterproofing cloth, tanning leather, and the chemical analysis of pigments and other substances.

Ibn Hayyan's works paved the way for most of other Islamic chemists, including al-Razi, Tughrai and al-Iraqi. His books strongly influenced the Medieval European alchemists, and justified their search for the method by which base metals could be transformed into gold, providing a new source of important and practical chemical knowledge.

Al-Kindi (c. 801–873)

Known to the West as Alkindus, al-Kindi was an Iraqi polymath known for his efforts in introducing Greek and Hellenistic philosophy to the Arab world. He was a pioneer in chemistry, medicine, music theory, physics, psychology, and the philosophy of science.

Al-Kindi was the first to oppose the practice of alchemy, centuries before ibn Khaldun. He exposed the falseness of the myth that base metals could be transformed into precious metals. He distinguished alchemy from chemistry. He wrote two treatises on the denial of alchemy: "Warning against the Deceptions of the Alchemists and Refutation of the Claim of Those Who Claim the Artificial Fabrication of Gold and Silver".

Al-Kindi was also in tune with the chemical laboratory in his book *Kitab kimiya' al-'itr* (The Chemistry of Perfume) that contained more than 100 recipes for fragrant oils, salves, aromatic waters, and substitutes or imitations of costly drugs.

Al-Kindi is also noted for his experiments on botanical and chemical work, such as *A Treatise on the Artificial Production of Foodstuffs without their Elements*, which describes the same experiment with a different range of material.

Al-Razi (866-925)

Following the death of ibn Hayyan, nearly a century elapsed before Persian chemist and physician Abu Bakr Muhammad ibn Zakariyya al-Razi, also known to the West as Rhazes, followed Jabir's great example successfully.

It was after al-Razi's first visit to Baghdad that he actually took up the study of medicine. He showed such skill in the subject that he wrote no fewer than one-hundred medical books. On alchemy, in addition to his *Book of Secrets*, he wrote about a dozen other books, two of which were contradictions to works by other authors.

PART II

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Al-Razi is considered of exceptional importance in the history of chemistry. In his books, we find a systematic classification of carefully observed and verified facts regarding chemical substances, reactions and apparatus. In his book *Sirr al-asrar*, (Secret of the Secrets), we find a list of these categorized substances and their sub-categories. To these natural substances, al-Razi mentions a certain number of artificially obtained substances as well.

His persistence on promoting research work in the laboratory brought its fruits in pharmacy. He gives a list of the apparatus used in chemistry, divided into two classes: instruments used for melting metals, and those used for the manipulation of substances generally. He provides the same kind of information included nowadays in manuals of laboratory arts.

From a general study of his chemical works, al-Razi should be accepted as one of the most remarkable seekers of knowledge that the world has ever seen; not only unique and unequaled in his time, but without a peer until modern science dawned in Europe with Galileo and Robert Boyle.

Later on in Islamic History

Abu'l-Qasim of Iraq

Abu'l-Qasim lived during the 13th century, and has left us several books that indicate the trend of alchemical thought and practice in Islam. In his time, the contrast between the two intellectual worlds, the European and Islamic, could not be better exemplified than by Abu'l-Qasim and his contemporary Roger Bacon; one of the earliest European advocates of the modern scientific method inspired by the works of Plato and Aristotle.

The driving force of Islam started to weaken, while the new motivation that Arab learning had given Europe had resulted in a scientific renaissance, which was to reach its full development not long afterwards. Abu'l-Qasim's views were those of his predecessors, of three or four centuries earlier. He was a good experimentalist and a comparatively logical thinker; however, his general views often represented a traditional movement.

Al-Jildaki (?-1342)

Al-Jildaki is known for his extensive knowledge of Muslim chemical literature. He produced very little original contribution to the history of Islamic alchemy as most of his books were commentaries on the works of earlier writers. For example, his great *End of the Search* is a commentary upon Abu'l-Qasim's book *Knowledge Acquired Concerning the Cultivation of Gold*. It was customary that he cited lengthy quotations from many significant authors, thus making his books a rich storehouse of information on Muslim chemistry.

Al-Tughra'i (1063-1121)

Sadly, few works of Al-Tughra'i survive; however, later scholars highly praised his work, especially as a theorist, and he certainly passed on much of the European knowledge of ancient alchemy. He was the most important alchemist since ibn Hayyan; his style became perfect, but his books can only be read by those who are already advanced in the great art. In his *Kitab Masabih al-Hikma wa Mafatih al-Rahma* (The Lamps of Knowledge and the Keys of Mercy), Tughra'i states the teaching of the Ancients.

Al-Majriti (?-1007)

In Andalusia, scholars in all domains, including alchemy, flourished. One of those was al-Majriti who lived in Madrid. He assimilated Muslim sciences in the Arab Orient, where he seems to have had close contact with the originators of the famous *Encyclopedia of the Brethren of Purity**, of which he brought to Spain a new edition.

Until the time of ibn Hayyan, chemistry was void. Thanks to the efforts of the two Muslim chemical geniuses ibn Hayyan and al-Razi, chemistry first began to take shape as a true science. Chemistry, in the work of the great chemists from ibn Hayyan to the time of ibn Sina, was concerned mainly not so much with alchemy but with concrete technical matters such as the development of tools, and the preparation and study of reactions.

There is no doubt that the work of Islamic scholars provided the framework for the development of chemistry. They preserved knowledge from other parts of the world and significantly added to it. Their work was kept alight, and they ensured the flame of knowledge be passed on to enlighten the whole world.

Glossary

* The Brethren of Purity were a secret society of Muslim philosophers in Iraq in the 10th century. Their teachings and philosophy are explained in the "Encyclopedia of the Brethren of Purity"; a giant compendium of 52 epistles that greatly influenced later encyclopedias.

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VISITORS INFO

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

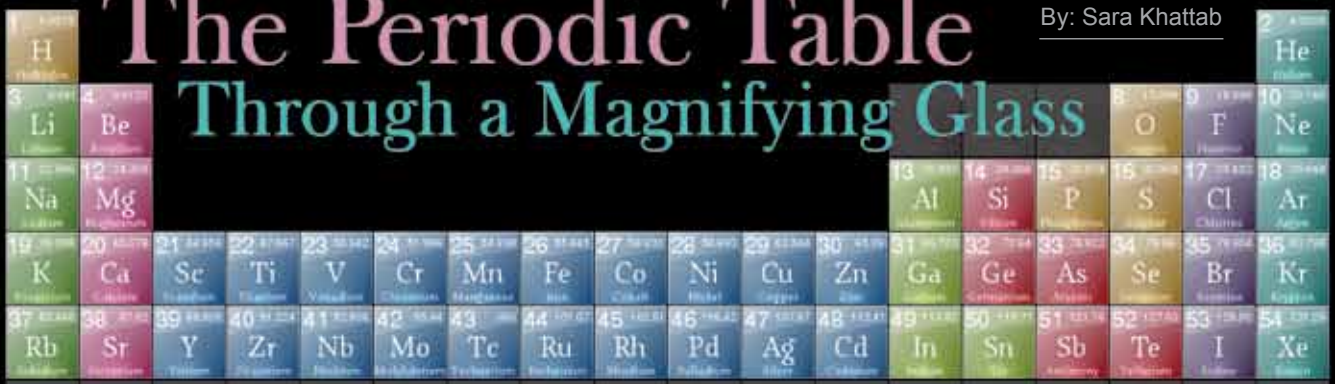
Guided Tours Schedule

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 Periodic Table
Through a Magnifying Glass

By: Sara Khattab



"It took scientists 2200 years, from Greece in 400 BCE to Europe in 1800, to grasp what elements really are, because most are too changeable," says Sam Kean in his tantalizing book *The Disappearing Spoon*.

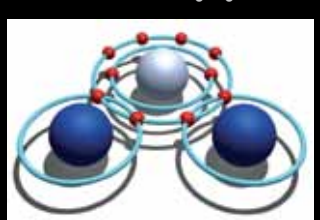
Categorizing and looking for patterns in matter started in ancient times. In Aristotle's time, water, fire, earth and air were considered the basis for everything. Over time, many observations and experiments, in addition to the discovery of new elements, led to the scientific classification system of elements based on common characteristics and behaviors known as the periodic table.

At the time Mendeleev arranged the elements in his periodic table, there were 63 elements known. The first element in the periodic table is hydrogen for it is the simplest element with a single electron orbiting one proton and no neutrons. Hydrogen can bond with other elements to form compounds; the most prominent example is when two hydrogen atoms bond with one oxygen atom to form H_2O, or water. On the other hand, the last element to be added to the periodic table was ununoctium, also known as eka-radon or element 18; it has the temporary element symbol Uuo. Ununoctium has the highest atomic number and highest atomic mass of all discovered elements.

Out of the 118 elements on the periodic table now, only 92 elements are found naturally, some of which can only be created from other natural elements by radioactive decay(1). The remaining elements are synthetic elements produced with the help of humans, mostly in particle accelerators. The first element to be produced synthetically was technetium with the atomic number 43; every form of it is radioactive. Many of technetium's properties were predicted by Mendeleev before the element was discovered.

One of the rarest elements in the world, francium was the last element discovered in nature and not by synthesis. It results from the breakdown and decay of actinium, and has an extremely short half-life; a matter of minutes. Outside the laboratory, francium is extremely rare; scientists estimate there are no more than a few ounces of it in existence on Earth at any given time. Francium has been used for research purposes in the fields of biology and atomic structure.

By mass, oxygen is the third most abundant element in the universe after hydrogen and helium, and the most abundant in the Earth's crust making up almost half of the crust's mass. It is a highly reactive non-metallic element that forms compounds with almost all other elements. Free oxygen is too chemically reactive to appear on Earth without the photosynthetic action of living organisms, which use the energy of sunlight to produce elemental oxygen from water. Because it comprises most of water's mass, oxygen comprises most of the mass of living organisms.



There are a total of 38 different types of transition metals between groups 3 and 12 on the periodic table. These metals are ductile, malleable and are good conductors of heat and electricity. Some of the most abundant transition metals include copper, cobalt, iron, and nickel; other less abundant types include scandium and niobium. Iron, cobalt and nickel are the only transition metals that can produce a magnetic field.

On the other hand, there are seven elements in the periodic table that have the properties of both metals and non-metals. These elements are classified as metalloids; they are boron, silicon, germanium, arsenic, antimony, tellurium, and polonium. Some metalloids, such as silicon and germanium, are semi-conductors, which makes metalloids useful in computers and calculators.

Noble gases, also known as inert gases, are a group of chemical elements with very similar properties under standard conditions; they are all odorless, colorless, with very low chemical reactivity. The six noble gases are helium, neon, argon, krypton, xenon, and the radioactive radon. The discovery of the noble gases aided in the development of a general understanding of atomic structure. Noble gases have several important applications in industries such as lighting, welding, and space exploration.

'Noble' indeed, helium, or element two, has exactly the number of electrons it needs to fill its only shell. This 'closed' configuration gives it tremendous independence because it does not need to interact with other atoms to share or steal electrons to be satisfied. The same configuration extends down the 18th column. Scientists might have figured out what elements are much sooner had they known about helium, which has never reacted with another substance and has never been anything but a pure element.*

One column to the west sits the most energetic and reactive gases on the periodic table, the halogens.* These are five non-metallic elements found in group 17 of the periodic table. The term "halogen" means "salt-former" and compounds containing halogens are called "salts". Halogens exist, at room temperature, in all three states of matter: solid (iodine and astatine), liquid (bromine), and gas (fluorine and chlorine).

If the table is a map, then to the east of the noble gases sits column one; even more violent elements known as alkali metals. Despite being normal metals in some ways, instead of rusting or corroding, alkalis can spontaneously combust in air or water. They also form an alliance of interests with halogen gases.*

The periodic table with its thrilling history and stunning phenomena is truly an eternally fertile ground for scientific discovery, so let us continue gazing through the magnifying glass and reflecting on what we see.

Glossary

(1) Radioactive Decay is the spontaneous breakdown of an atomic nucleus resulting in the release of energy and matter from the nucleus. There are three types of radioactive decay are called Alpha Decay, Beta Decay and Gamma Decay. You can learn more by visiting: http://www.ndt-ed.org/EducationResources/HighSchool/Radiography/radioactivedecay.htm

References

(*): quoted from *The Disappearing Spoon* by Sam Kean
chemistry.about.com
www.ehow.com
www.chemicalelements.com
www.ndt-ed.org
en.wikipedia.org

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

Listen and Discover

- For the list of available shows and the schedule, please consult the Center's official website: www.bibalex.org/psc.
- For reservation, please contact the PSC Administrator one week before the desired date.

Show fees

DVD shows:
Students EGP 1
Non-students EGP 2

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

By: Shahenda Ayman

BigShot
the Hands-on Camera!

What could be cooler for an aspiring scientist or engineer, or anyone for that matter, than a hands-on project to work with and learn about electronics and optics firsthand? How about one where each student ends up with his or her own digital camera?

Professor Shree Nayar of the Computer Vision Laboratory at Columbia University and his team have come up with a prototype for the BigShot digital camera, which is primarily educational and targets schoolchildren, but could be a potential hit with a large group of adults as well.

The main parts of the camera include a gearbox, a lens wheel, a flash, a circuit board, a battery and a dynamo. As it does not have a Liquid Crystal Display Screen (LCD), it does not need too much power to take a photo; the battery is only needed to use the flash. Otherwise, you can use a hand crank(1) connected to the dynamo via the gearbox to generate the necessary power to capture a shot.

The camera looks a bit like a science experiment, which is the point. The back cover is transparent, providing a view of the gadget's gearbox, dynamo, processor chip and circuits, enabling young users to better understand the relationships among the different components. The front cover of the plastic prototype comes in colors inspired by M&M candy!

Packaged as a kit of parts, BigShot teaches scientific and engineering principles along the way to assembly. Not only do children have fun building a useful object from scratch, but as they manipulate the lenses, gears and dynamo, they learn about optics, mechanics and energy. Nayar and several of his Columbia graduate students designed a website that offers lucid tutorials in each concept.

Once BigShot is put together, it functions like any other digital camera, even better than many, in that it features multiple lenses situated on a wheel. The wheel rotates to produce not only a standard perspective but also panoramic views via a wide-angle lens, and 3D images via a stereo lens. Energy produced by turning the hand crank powers the camera when its battery runs out of charge, and BigShot's single-LED flash can be used to teach semiconductor technology.

BigShot is a great way to get children interested in the world of technology and gives them a camera of their own that they can proudly show off.

Glossary

(1) A crank is any of several types of arms or levers for imparting rotary or oscillatory motion to a rotating shaft, one end of the crank being fixed to the shaft and the other end receiving reciprocating motion from a hand.

References

www.photographyblog.com
www.scientificamerican.com

The Homo Sapiens Report:
The Future of Humanity
A Lecture by: Dr. Michael Wadleigh

Reported by: Ingy Hafez

Homo Sapiens, Latin for "wise man" or "knowing man", is the species that you and all other living human beings on this planet belong to. "A Homo Sapien is the organism that can know what is true, right and lasting", says Dr. Michael Wadleigh.

According to Dr. Wadleigh, the challenges facing humans cannot be solved just by moving to renewable energy sources. Within a few decades, humans would have no resources to rely on. We thus have to analyze possible future problems, as well as contemplate potential solutions and decisions that need to be taken. To that effect, Dr. Wadleigh's highly visual presentation at the Library of Alexandria, on 3 March 2011, had a broad look at the complex issues mankind will be facing over the next century.

Oscar winning film director and co-founder of The Homo Sapiens Foundation, part of the UNESCO's Education for Sustainable Development, Dr. Wadleigh is an expert in popularizing difficult information with special emphasis on global sustainable development. In his lecture "The Homo Sapiens Report: The Future of Humanity", he focused mostly on global issues, with a special part about Egypt. "I hope the Egyptian people would consider some of the points I raise in this lecture while developing a new constitution for their country," he told the audience.

Dr. Wadleigh joins hands with prominent figures in advocating for the concept of sustainable development for humanity as the most important subject of the 21st century. This means that science should play a crucial role in any solution to the crises that humanity encounters. He emphasized how crucial the next forty years will be with respect to the interaction of all human institutions and disciplines; science, arts, politics, business, psychology and the environment; in addition to the interaction with our planet's natural resources, without which nothing is possible for humanity.

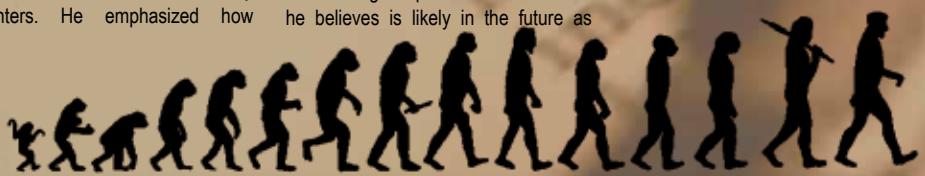
Through his report, Dr. Wadleigh presented data in an accessible and appealing fashion, comparing the growing rate of product development to the exploitation of our finite natural resources. It was a kind of narrative of human history, where data complemented drawings, inspired by the visual imagery of sci-fi films; such as the world's most famous movie "Avatar".

The lecture also tackled the rapid changes taking place around the globe, including the financial and ecological resources crises; as well as the social, political and economic volatility in North Africa and elsewhere. Dr. Wadleigh discussed unusual, novel, as well as desirable "alternative futures", which all countries should find important.

When talking about Egypt, Dr. Wadleigh explains a scenario that he believes is likely in the future as resources deplete and people have little to exchange with one another. "When building a new Egypt, think about being in a spaceship, solving problems as if nothing else is coming in from the outside world," he says.

To demonstrate the possibilities of change, Dr. Wadleigh is working on a documentary film about Egypt from 1970 until 2050. In cooperation with the Bibliotheca Alexandrina, he will be collecting images, footage and data on the past forty years to show how Egypt has changed and to make future projections for the coming forty years.

"We need to return to the basics; the real needs and causes of happiness," he said. Many consumer values are created and sustained through advertising by attaching meanings to specific products. By achieving sustained developmental goals and standards of living, in addition to defining the basic needs of food and shelter, health and education, people derive happiness and fulfillment from human interaction and the ability to reason and create instead.



The Workshop

Creativity is a talent we are born with; yet, it needs practice to blossom and stay vibrant. Through a unique diversity of hands-on activities, the PSC encourages children to explore their creativity and find out how to use it in their life; all the while enriching their knowledge. In our workshops, students are able to interact with each other and with the world around them in an exciting and entertaining manner; they are guaranteed to have a blast!

Dancing with Colors

Colors are all around us; they make our world beautiful in many ways, and they certainly stimulate children's imagination. In this workshop, children will learn some interesting facts about colors and discover what they can do with them.

- Target age: 4–6 years

ABC Science

The workshop involves different simple and entertaining experiments, using simple everyday and recycled materials that could be found around at home. The experiments will cover the digestive system, acid and base reactions, and batteries.

- Target age: 6–8 years

Use Your Five Senses

In this workshop, children will be involved in activities and experiments on sensory experiences to explore the human five senses. They will be able to identify, compare, classify and investigate the world around them.

- Target age group: 6–8 years

Kids City

Kids City is a place for fun learning, offering students a unique and exciting experience. It includes a hospital, a factory, a police station, a nature park, and shops; children are encouraged to explore the different roles in our community.

- Target age: 6–8 years

The Science of Art

Children will discover the science behind art crafts and learn how to make use of everything in their life, especially everyday waste. The workshop includes activities such as making papyrus using modern paper and coffee, and making artistic pieces using regular cardboard boxes.

- Target age: 6–8 years

Do it Yourself (1): Cosmetics

In this workshop, not only will children learn how to prepare their own perfumes and bath fizzers using natural products, they will also experiment with different ingredients and learn the chemistry behind the prepared compounds.

- Target age: 6–8 years

Legendary Egypt: part I & II

In the first part, children learn the mummification process using a human model, know the chemical materials used during the process and make a canopy jars. In the second part, children will make a tomb model and discover the ancient Egyptian chemical elements as well as the different types of dyes.

- Target age: 6–11 years

The Chemistry behind Everyday Products

Chemistry exists in everything we put our hands on during the day. Children will learn how different everyday applications and products; such as shampoo, photocopiers, printers, among others; work and relate to chemistry.

- Target age: 9–11 years

Sugar

There is more to sugar than the sweet white substance we add to our food and drinks. Children will discover the kinds of sugar, and distinguish the difference between simple unilateral sugar and complicated bilateral sugar, among other interesting facts.

- Target age: 9–11 years

Do it Yourself (2): Remedies

In this workshop, children will learn how to prepare herbal remedies; such as syrups, infusions, creams or ointments; using natural products and different techniques. They will also learn the chemistry behind those remedies.

- Target age: 9–11 years

Everyday Changes

Though we might not notice, chemical reactions are all around us, and chemical changes occur all the time in our daily life. Children will make orange soda, experiment with cucumbers and pickles, and make cheese from milk, among a variety of other activities.

- Target age: 9–11 years

Espionage

The life of a secret agent is unmasked in this workshop! Children will follow their footsteps and try out their gadgets to analyze fingerprints, decipher secret codes, among many other exciting things that all involve science.

- Target age: 9–11 years

Geologist for a Day

Much more than naming rocks and digging up fossilized bones, geologists unravel Earth's story. Children become geologists for a day to learn how the dynamic forces that shape the Earth work, and use this knowledge to predict their effects on Mankind.

- Target age: 9–11 years

Forensic Science

Like detectives, participants will collect and analyze evidence to discover suspects through identifying fingerprint patterns, tool marks and shoe prints, as well as using hairs and fibers as evidence, and examining blood samples.

- Target age: 12–16 years

The Science behind Balls

There is an actual science behind balls; what they are made of, how high they can bounce, and why certain balls are used in certain sports. In this workshop, participants learn many interesting facts about the science of balls.

- Target age: 12–16 years

Nanotechnology

The aim of this workshop is to introduce nanotechnology to young people through a brief history of its presence in nature and hands-on activities that stimulate the imagination.

- Target age: 12–16 years

Chemistry Magic

Chemistry is magical and full of secrets. This workshop aims to introduce important scientific concepts to young people through a number of interesting and intriguing hands-on experiments in the form of a magic show.

- Target age: 12–16 years

Making the World a Better Place Using Chemistry

This workshop aims to emphasize the benefits of understanding and applying chemistry in dealing with the environment. It focuses on the significant role of chemistry in making our impact on the environment more friendly.

- Target age: 12–16 years

Analyze This

Spectroscopy is a technique that uses the interaction between matter and radiated energy to perform analysis. Through a range of practical activities, potential future scientists will be inspired. Among topics covered are: water and food analysis, the physics of light and color and chemical equilibrium.

- Target age: 12–16 years

Do it Yourself (3): Toys

Participants will learn how to prepare their own bouncing balls and gel creatures. They will also experiment with different ingredients and learn the chemistry behind making toys and the polymers used.

- Target age: 12–16 years

Le Genie des Pyramides (Pyramid Construction)

Since the time they were built, about 5,000 years ago, the means by which the Egyptian Pyramids were constructed remain an enigma. This workshop aims to demonstrate a method proposed by Mr. Pierre Crozat, a French architect.

- Target age: 12–16 years

Programs & Events

New Programs

Creativity

Creativity is the freest form of self-expression. The ability to be creative can reflect and nurture children's emotional health. This program offers children the perfect opportunity to have fun, while exploring their creative side and developing their social skills, by exposing them to a variety of stimulating activities.

- Target age: 6–11 years

The Little Parliament

One day, today's children and youth will be old enough to vote to select our country's leaders. At the PSC, they get to experience the process through a mock presidential election, part of "The Little Parliament" Program. They will be able to challenge their political knowledge and learn more about seemingly complicated political terms, as well as experience being presidential candidates, and try to win over friends to vote for them.

- Target age: 6–16 years

Teamwork Seminar

Teamwork divides effort, and multiplies success. This program fosters teamwork by engaging participants in activities that require them to work together. The activities could be physical, others may require mental abilities. Fun activities; such as sports or games; will allow team members to relax and enjoy working together.

- Target age: 9–16 years

The Starting Point

This program is designed to introduce children and youth to the Periodic Table of Elements in an interactive and simple way. Participants will discover the history of the Periodic Table, its characteristics and evolution, from 1869 until now.

- Target age: 12–16 years

Young Scientists

This program aims at enhancing participant's awareness of the scientific method of thinking, and prepare them to introduce their ideas. The program comprises a series of scientific lectures and workshops, as well as soft skills trainings: team building, creative thinking, presentation skills and decision-making. Participants with required potential will be directed to participate in Intel-BASEF 2012.

- Target age: 12–16 years

Photography (Part 2)

Photography is the process and art of creating still or moving pictures by recording radiation on a sensitive medium; such as a photographic film, or an electronic sensor. This program assists participants in learning the art of photography and its purposes.

- Target age: 12–16 years

Ongoing Programs

Chess Club

In cooperation with the Egyptian Chess Federation, this program aims to develop and sharpen children skills. Chess is an exercise for the mind; it develops valuable mental abilities such as concentration, critical thinking, pattern recognition, strategic planning, creativity, analysis, synthesis, and evaluation, to name a few. Chess is a highly effective tool for teaching problem-solving and abstract reasoning through analyzing situations by focusing on important factors and eliminating distractions.

- Target age: 6–16 years
- Program duration: 3 months
- Number of sessions/week: Twice
- Session duration: 2 hrs
- Fees (following interview): EGP 150
- For additional information and registration, please contact the PSC Administrator.

Super Science Show

Introducing a new form of science learning that is pure entertainment; this is a dynamic and highly motivational activity that involves children in a variety of amusing and interesting hands-on scientific experiments that stimulate enthusiasm.

- Target age: 6–12 years
- Show duration: one hour.
- Show fees within the BA: EGP 100/group
- Show fees outside the BA: EGP 300/group
- For reservations, please contact the PSC Administrator at least one week prior to the deadline.

Outreach Programs

Science Club

An ambitious outreach project, the Science Club program has been adopted by the PSC to add the hands-on concept to science learning within the formal education framework. It aims to establish scientific corners in different schools, and train teachers to apply innovative communication methods. The program aspires to stimulate curiosity, interest and enjoyment in science, in addition to enhancing experimental abilities and developing investigative skills.

- Target age: 6–13 years
- Free-of-charge
- Participation is for schools only. For additional information and registration, please contact the PSC Administrator.

Lectures

The Importance of Chemistry and Scientists

Understanding chemistry helps you understand the world around you; since everything we touch, taste or smell is related to it. Chemistry is not only for scientists; it is for everyone, everywhere. When studying chemistry, we understand how things work. If we know some chemistry, we can make wise choices about everyday products that we use.

- Target age: 9–12 years

The Future of Nanotechnology Application

Nanotechnology has numerous applications in our lives, most of which come as a surprise, for it represents the core of things that surround us every day. Our wrinkle-free fabrics, LCD screens and skin care products, are all part of the applications of nanotechnology that make our lives better.

- Target age: 12–16 years

Time Management

Time management refers to the development of processes and tools that increase efficiency and productivity. When we think of time management, we tend to think of minimizing wasted time so we have more time to do more things. Therefore, time management is often thought of, or presented as a set of time management skills; the theory is that once we master time management skills, we will be more organized, efficient, and happier.

- Target age: 12–16 years

UNLEASH YOUR IMAGINATION

By: Sara Khattab

Every year, the PSC organizes the Intel Bibliotheca Alexandrina Science and Engineering Fair (Intel BASEF), in collaboration with Intel Co., targeting promising school students, 14-18 years of age, from Alexandria and neighboring Governorates. As usual, the competition, held this year, 13-15 March, aimed to train eager young participants in researching, innovating, competing and winning in a wide variety of science and engineering fields.

Eighty-nine students, 41 girls and 48 boys, competed with enthusiasm and zest, introducing their creative abilities, scientific thinking skills, and innovative ideas to the judges and the encouraging audience. This year, 62 projects were presented, mainly in the "Engineering: Electrical and Mechanical" category, which recorded the highest participation with 19 projects. Forty-five students presented their projects individually while the rest worked in teams presenting 17 team projects.

The first grand award went to Mohamed Magdy in the Engineering: Electrical and Mechanical category for his project "Cars Controller by Satellite (Car Protector)". The goal of the project is to protect cars from theft by connecting them to computers; it is divided into four parts: detecting theft; sending a signal to a receiver at the owner's house; tracking the vehicle by GPS and reporting its location to the police; stopping the vehicle by disabling the fuel pump and closing the windows and doors so the thief cannot escape.

Ahmed Hassan received the second grand award in the Animal Sciences category for his project "The Miracle of Living by Termites". The project aims to demonstrate how the ecological niche of termite colonies can be used to produce clean energy at low cost. He makes use of the fact that termites feed on waste paper, particularly cardboard, the digestion of which results in the production of hydrogen gas, which is one of the best clean fuels.

The third grand award winner was Sara M. Samir for her project "Do You Know Your Memory?" in the Behavioral and Social Science category; it tackles the possibilities of false memory, and how one's memory weakens over time but can improve if effectively used.

The Research, Development & Innovation Program (RDI) has supported the grand award winners with their needs to participate and compete in the International Science and Engineering Fair (ISEF) in the United States of America, 8-13 May.

All participants exerted their utmost efforts in their projects, and prizes were awarded for the best in each category to around 20 students. In the Chemistry category, Aya Magdy Elsaqa received the first place award for her project entitled "Using Chemical Reaction as an Energy Source for the Heat Pump". Whereas the second place award went to Mennat Allah Ali Abdou for her project "Magic Paper", and the third place award went to Massoud Gaber Ibrahim for his project "Anti-bacteria Fan".

The winning projects in the Medicine and Health Sciences category tackled important issues; the first place award winners, Bahaa Hisham and Mazen Aladdin, studied the effect of the biological clock on some diseases such as cancer and hypertension in their project "How to Increase Your Health Stock by Adjusting Your Clock?" Whereas the second place winner, Rana Adam, prepared an experiment to discuss the use of natural oils in the treatment of some allergies in her project "The Effect of Eucalyptus on Bronchial Asthma".

One of the interesting and promising projects is Aya Ali Ibrahim's winning project entitled "Planting One Million Acres in the Western Sahara" in the Environmental Sciences category, which aims to relieve the pressure on the High Dam. Another interesting project is Nourhan Soliman's "Women Harassment", which received the second place award in the Behavioral and Social Sciences category, and discussed the main reasons for the problem and the possible solutions.

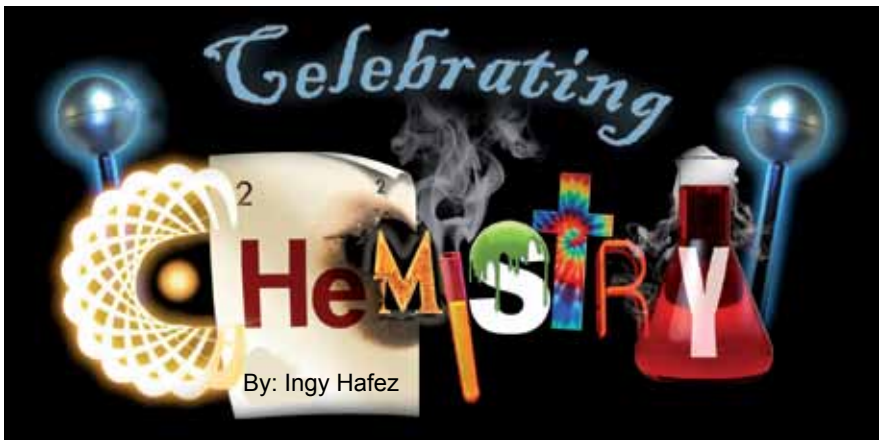
On the other hand, special awards went to underage participants, who presented 13 projects, to encourage them to keep on track. The Best Idea Award went to Mostafa A. Sayed in the Animal Sciences category for his project "How Do Humans Harm Predator Animals?". The Best Effort Award went to Adel Elkasrawy in the Engineering: Materials and Bioengineering Category for his project "Helper 5000", while the Best Team Award went to Mohtadi and Muhannad Ihab Barakat in the Engineering: Electrical and Mechanical category for their project "A useful use for children's crying".

SUDOKU

Chemistry

		Ni				Ag		
	Mn	Au					Ni	
Cu	Fe		Sn					Mn
		Mn		Fe				
			Ni	Ti		Sn		
						Ni		Ag
Fe				Zn	Ti		Ag	
	Ti					Fe		Au
		Ag			Cu		Zn	

IYC 2011:



Learn, Think, Live Chemistry!

Mankind's understanding of the material nature of our world is grounded in our knowledge of chemistry. All known matter is composed of chemical elements or compounds that are made from chemical elements; similarly, all living processes are controlled by chemical reactions.

The International Year of Chemistry (IYC 2011) is a worldwide celebration of the achievements of chemistry and its contributions to the well-being of humankind. Under the unifying theme "Chemistry—Our Life, Our Future", the year-long celebration offers a range of interactive, entertaining and educational activities for all ages. Activities; such as lectures, exhibits, and hands-on experiments, will explore how chemical research is critical for solving our most vexing global problems involving food, water, health, energy, transportation, and more. The Year of Chemistry is intended to reach across the globe with opportunities for public participation at the local, regional, national, and international levels.

IYC 2011 events will emphasize that chemistry is a creative science essential for sustainability and the improvement of our way of life. The goals of IYC 2011 are to increase the public appreciation of chemistry in meeting world needs, to encourage interest in chemistry among young people, and to generate enthusiasm for the creative future of chemistry.

The year 2011 coincides with the 100th anniversary of the Nobel Prize awarded to Madame Marie Curie—an opportunity to celebrate the contributions of women to science. The year will also be the 100th anniversary of the founding of the International Association of Chemical Societies, providing a chance to highlight the benefits of international scientific collaboration.

The idea for an international year was first discussed in 2006, during the meeting of the International Union of Pure and Applied Chemistry (IUPAC) Executive Committee. The IYC 2011 is an initiative of IUPAC and of UNESCO; the United Nations Educational, Scientific, and Cultural Organization. It involves chemical societies, academies, and institutions worldwide, and relies on individual initiatives to organize local and regional activities.

IYC 2011 in Egypt

Under the umbrella of the IYC 2011, the PSC is planning to conduct a variety of activities including the "Everyday Changes", "Chemistry Magic", "Chemistry Behind Candy", "Invisible Ink" and "Color Up Your Life" workshops; the "Nanotechnology" workshop and program; the "Science Club" ongoing outreach program; the "Super Chemistry Show"; the annual "Science Festivity" event, under the overarching theme of "Science and Scientists"; the "Science Olympiad" competition 2011; the "Arab Environment Day", with emphasis on the relation between chemistry and the environment; as well as the "Women in Science 2011: Marie Curie" conference and exhibition.

We invite you to become part of the IYC 2011; whether you are a student, a teacher, a university professor, a chemist, a researcher, or just someone with an interest in chemistry. The success of the IYC will depend on individual initiatives organized around the world. Visit the IYC 2011 website at www.chemistry2011.org to propose your own ideas, and join us in making the world a better place.

Reference

www.chemistry2011.org

CHEM-MYSTERY!

By: Sara and Yosr Elshaarawi
House of English School

Dear young leaders, we are addressing you today in recognition of the International Year of Chemistry 2011 to celebrate its achievements and contributions to the well-being of humankind.

Thousands of unseen, yet significant, reactions happen every instant everywhere! These inescapable, naturally occurring events all fall under the superdome of Chemistry.

The IYC 2011 is an opportunity to explore and improve the essence of this substantial science, by acting in recognition of such a valuable occasion. This can be done by boosting the public gratitude and perception of chemistry, especially by endorsing the interest and enthusiasm of youth for an innovative future in chemistry.

Being sixteen-year-old science fair participants, we have participated indirectly in promoting Green Chemistry, using chemical reactions to reduce the enhanced greenhouse gas effect. We suggested a scientific research proposal to transform the carbon dioxide captured from power plants into a useful product; carbonic acid. The occurrence of such a chemical reaction would decrease one of the main greenhouse gases and transform it into a useful product, which can be sold and used industrially, providing an alternative eco-friendly profit to power plants. Such ideas involving chemistry studies and references are surely to have a positive effect as a contribution to decreasing global warming effect; hence, participating in saving the environment.

Just like many teens of our age, we have found special interests that help us set our future goals. Though only sixteen, we have already had the luck to get exposed to several worldwide events that have motivated us. We have participated in local and international competitions and science fairs; the best, yet most challenging, part of which has always been the responsibility of representing our country. The essence of such experiences can be sensed when we meet foreign colleagues and see the impressed smiles on their faces.

Despite being twins, each one of us shows an individual interest in different fields. However, whatever path we take, we hope to make our family, community and country proud. We hope that 2011 will be a start of further chemistry recognition and wider awareness of its immense achievements.

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

By: Lamia Ghoneim

Are We Heading towards Water Wars?!

On 28 February 2011, while we were occupied with the momentous political events taking place in Egypt, Burundi seized the opportunity to officially join fellow upstream countries in signing a new Cooperative Framework Agreement on sharing the Nile water, becoming the sixth country to join an alternative Nile Basin Initiative (NBI); hence, allowing the pact to come forth without Egypt's approval on account that two-thirds of riparian countries[1] have signed the pact.

Ethiopia, Kenya, Rwanda, Tanzania and Uganda previously signed the agreement, leaving out Democratic Republic Congo, Egypt and Sudan. This new agreement is destined to provide Egypt with less access to the Nile water than had been previously allocated, by allowing upstream countries to establish irrigation and hydro-electric projects such as dams without Egypt's prior consent.

If this agreement comes into action, our already water stressed country may be deprived of its current water rights, exposing 85 million Egyptians who depend on the Nile in more than 90% of their water needs to dangers of drought, thirst and water wars.

Conflicts and Escalating Tensions

Tensions in the Nile Basin between upstream and downstream countries have long been a key diplomatic issue for Egypt. The core dispute between Egypt and upstream countries is the 1929 Nile Water Agreement that binds all nine riparian countries, which was brokered by the British during the Colonial Era. Egypt was then given "property rule", meaning the right to veto the establishment of any projects along the river to protect its natural and historical rights over the Nile.

The Agreement was later extended in 1959, allocating Egypt 55.5 billion cubic meters a year, i.e. 87% of the Nile water; and Sudan 18.5 billion cubic meters a year; the remaining Nile water was allocated to the upstream countries. At that time, none of the riparian countries opposed the Agreement, even following their independence. It was acknowledged that the Nile is Egypt's historic right, based on prior use. More importantly, unlike the Nile Basin countries where billions of cubic meters of rain falls, be it on the equatorial or Ethiopian Plateau, Egypt hardly has any rain and is completely dependent upon the Nile for its water needs.

More recently though, upstream countries led by Kenya, Tanzania and Uganda demanded the renegotiation of the treaties "granting Egypt the major share of the Nile water" under the pretext that these treaties are outdated and were signed during colonialism, and claiming that climate change has made it difficult to rely on rain-fed agriculture.

Redlines and Existential Worries

During recent negotiations, Egypt and Sudan were unable to reach an agreement with upstream countries seeking a new Nile sharing assertion. The two countries maintained that downstream countries must approve any water use by upstream countries that could reduce their guaranteed quotas of water and threaten their existence. "Should political and diplomatic negotiations and international arbitration fail, a situation could arise in which the only remaining option would be the use of military force," said Ahmed Abul-Wafa, Professor of International Law, echoing an earlier statement by former UN Secretary-General Boutros Boutros-Ghali to the effect that "the next war in our region will be over the waters of the Nile, not politics".

Following Burundi's signing of the new agreement, Egyptian Minister of Water Resources and Irrigation declared the agreement violated agreed upon procedures and does not relieve Member States of their commitments to agreements with Egypt. He stressed that Egypt welcomes any cooperation in any development projects in the Nile Basin countries on condition that it does not affect its water share. Moreover, the Prime Minister Essam Sharaf headed a delegation in a visit to Northern and Southern Sudan on 20 March to discuss the current situation and the best course of action and solutions for the Nile Basin conflict.

Nevertheless, the present situation looms alarmingly with Ethiopia currently going forward with the construction of new dams that are bound to affect our share of the Nile water. Ironically, millions of Egyptians already suffer from water shortage, with many officials asserting that Egypt would not survive without its 87% share of the Nile water, and pointing out serious water shortages that are expected to hit the country in the coming five years.

Setting aside the complicated politics of the situation, and whether or not we manage to preserve our share of the Nile water, the real question is: How will we manage the expected water shortages bound to hit us either way; be it today or in five years? With our country's rapidly escalating population, and the ultimately limited supply of the river Nile, how will we survive? If we happen to lose part of our share of the Nile water, is it a doomsday scenario? Or is there a way out?

Alternatives and Scientific Solutions

Water resources in Egypt are represented with the quota from the Nile water; the limited amount of rainfall on coastal areas; the shallow and renewable groundwater reservoirs in the Nile Valley, the Nile Delta and the coastal strip; and the deep, mostly non-renewable, groundwater in the Eastern Desert, the Western Desert and Sinai. The non-traditional water resources include reuse of drainage and wastewater, and desalination of seawater and brackish groundwater.

As a Chemical Engineer, I lean towards chemistry coming to the rescue, this time in the form of desalination. Desalination refers to the processes that remove excess salt and other minerals from water, thereby converting saltwater to freshwater. With the water need rapidly increasing, the available supply of freshwater resources will soon be unable to meet the demand, which brings up the desalination alternative.

Actually, water desalination is an indispensable industry for many countries, and it must be investigated as a solution for water scarcity in Egypt. Currently, it is practiced on a small scale such as in the Red Sea coastal area to supply tourist villages and resorts with adequate domestic water. Establishing more desalination plants along the Red Sea and Mediterranean would eliminate the cost of water transport from the Nile to the coasts, as well as conserve the Nile water. In fact, Egypt has about 2,400 km of shorelines on both the Red Sea and the Mediterranean, in addition to a substantial amount of brackish groundwater and

annual agricultural drainage that can be used as a sustainable water resource in many parts in Egypt.

The water desalination industry should top the agenda of developing non-conventional water resources, especially since desalination technologies have developed substantially with the development of Reverse Osmosis (RO) technology that led to significant reductions in the cost of desalination, and increased the quality of the water produced. The RO process basically removes large molecules and ions, typically from seawater or brackish water, by the application of pressure on water on one side of a selective "membrane" or filter. The end result is that the large molecules, ions and pollutants are retained on the pressurized side of the membrane and the purified and now freshwater passes to the other side.

Yet, in spite of recent developments and technologies, the energy cost of water desalination is still high, which is the main limitation for its large scale use in Egypt. However, new research and studies reveal actual breakthroughs in the use of renewable energy; namely, solar energy; to be harnessed for operating high compression pumps needed for modular Reverse Osmosis systems. This method is ideal for water desalination in Egypt, since Egypt has great potential of brackish water wells, and immense amounts of solar radiation in remote areas where future integrated development projects are located and are in dire need of a water resource.

Cooperation and Effective Utilization

Aside from enhancing the use of non-conventional water resources, another important strategy is the effective utilization of the Nile water, which can only be achieved through negotiating and promoting cooperation between the Nile Basin countries.

"The Nile can provide water for all the countries that depend on it, what we use is very little compared to what there is. Yet, in order to tap this potential there must be far better management of the water, particularly around the equatorial lakes, where water losses are huge. Plants consume more than is lost through natural evaporation," stated Ibrahim Nasreddin, Cairo University's Institute of African Studies.

Projects such as the Jonglei Canal have been designed to combat such water losses, but unfortunately the conflict in Sudan brought the project to a standstill. Egypt and Sudan originally agreed to construct the Jonglei Canal, as an attempt to make full use of the river Nile. Due to the Sudd Swamp, the water from the southwestern tributaries (the Bahr el-Ghazal system) does not reach the main river and is lost through evaporation and transpiration. Hydro geologists thus proposed digging a canal east of the Sudd to divert water from the Bahr al-Jabal above the Sudd to a point farther down the White Nile, bypassing the swamps and carrying the White Nile's water directly to the main channel of the River.

The primary objective of the project was to ensure the flow of 4.7 billion cubic meters of water annually, to be equally distributed between Egypt and Sudan, amounting to an increase of 5-7% of Egypt's current Nile water share; and to provide a model for similar effective-utilization initiatives in other areas. With the future of our share of the Nile is uncertain, resuming work in this project is imperative, especially now that peace has been restored in Sudan.

Conservation and Efficient Management

Water conservation is another strategy that can effectively limit future water shortages. With the rapidly growing population and the expected increase in domestic water consumption, public awareness campaigns are essential to help the public become more informed about the importance and necessity of water conservation, and could serve to reduce domestic water use significantly. However, the domestic sector is not the main water-consuming sector; it is the agricultural sector that consumes about 85% of the Nile water, and it is the sector where water conservation and overall water use efficiency is vital.

Improvement of the irrigation system and increasing the reliability of irrigation water supply would serve the need to meet the water demand more efficiently and effectively. Implementing more efficient—though more expensive—irrigation methods such as drip irrigation instead of the prevailing method of surface irrigation would save precious water and in the long-term would prove to be more economic and much more ecologically aware.

Speaking of water conservation brings to mind the amount of drainage water wasted annually, and which could otherwise be treated and reused in irrigation. Studies show that average water discharged annually to the Sea is 12.5 billion cubic meters per year, while the volume of drainage water officially reused for irrigation has increased from 2.8bcm/y in 1985, to 5.2bcm/y in 2000, and is expected to reach 8.3bcm/y by 2017. Even though Egypt has already made a number of leading steps towards the reuse of drainage water, there is still a long way ahead and work should be intensified in this field.

Finally and most imperatively, we have to seriously limit the pollution of the Nile water, which is considered among the most serious factors contributing to water shortage.

These were only a few of the potential "ways out" that could save us from the dangers of drought, thirst and water wars. Cooperation and negotiations between our country and other Nile Basin Countries is the only combat we need to face; and the weapons of our choice should be science, technology and the unrelenting efforts of sensible politicians and bright scientists.

Glossary

(1) Riparian Countries are countries related to or located on the banks of a certain river or stream.

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Chemistry of the Future: Green Chemistry

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The Concept

Green chemistry, also known as sustainable chemistry, is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, and use. Whereas environmental chemistry is the chemistry of the natural environment, and of pollutant chemicals in nature, green chemistry seeks to reduce and prevent pollution at its source.

The use and production of these chemicals may involve reduced waste products, non-toxic components, and improved efficiency. As a chemical philosophy, green chemistry applies to organic chemistry, inorganic chemistry, biochemistry, analytical chemistry, and even physical chemistry. While green chemistry seems to focus on industrial applications, it does apply to any chemistry choice. Click chemistry is often cited as a style of chemical synthesis that is consistent with the goals of green chemistry.

Moreover, renewable resources; such as biomass, carbon dioxide, nanoscience, solar energy and waste utilization; can be made increasingly viable technologically and economically through green chemistry.

Why do we need green chemistry?

- Chemistry is undeniably a prominent part of our daily lives.
- Chemical developments also bring new environmental problems and harmful unexpected side effects, which result in the need for 'greener' chemical products.
- Green chemistry looks at pollution prevention on the molecular scale and supports the invention of more environmentally friendly chemical processes that reduce or even eliminate the generation of hazardous substances.

There is some debate as to whether green chemistry includes a consideration of economics, but by definition, if green chemistry is not applied, it cannot accomplish the reduction in the "use or generation of hazardous substances".

Twelve Principles

Green chemistry is a highly effective approach to pollution prevention because it applies innovative scientific solutions to real-world environmental situations. The Twelve Principles of Green Chemistry, originally published by Paul Anastas and John Warner in *Green Chemistry: Theory and Practice* (Oxford University Press: New York, 1998), provide a road map for chemists to implement green chemistry:

1. **Prevention;** it is better to prevent waste than to treat or clean it up after it has been created.
2. **Atom Economy;** synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. **Less Hazardous Chemical Syntheses;** wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. **Designing Safer Chemicals;** chemical products should be designed to effect their desired function while minimizing their toxicity.
5. **Safer Solvents and Auxiliaries;** the use of auxiliary substances; such as solvents, separation agents, etc.; should be made unnecessary wherever possible and innocuous when used.
6. **Design for Energy Efficiency;** energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. **Use of Renewable Feedstocks;** a raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. **Reduce Derivatives;** unnecessary derivatization; which is the use of blocking groups, protection/de-protection, temporary modification of physical/chemical processes; should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.
9. **Catalysis;** catalytic reagents, as selective as possible, are superior to stoichiometric reagents.
10. **Design for Degradation;** chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.
11. **Real-time analysis for Pollution Prevention;** analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. **Inherently Safer Chemistry for Accident Prevention;** substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.

It can be concluded that Green chemistry is NOT a solution to all environmental problems, BUT the most fundamental approach to preventing pollution.

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Going Green Is Gold!

By: Jailane Salem

As each day passes by, the importance of taking care of our one and only Earth becomes even more apparent. The loud cries of environmentalists are being echoed from all corners of the globe, and it seems as though people are starting to listen and heed their warning. Industries are trying to improve themselves and becoming greener, while markets are offering more and more green products. Science is heavily involved in making this transition to eco-friendly technology, and chemistry is leading the way.

The Power Struggle

One aspect of making our lives comfortable is having appliances and products that help us communicate, move from one place to another, take care of our health and so on. Before reaching us, these products are made and assembled in factories. Factories, in turn, need energy to run. Since the industrial revolution, factories have relied on fuels that release green gas emissions; carbon dioxide, methane, and nitrous oxide. This has been one of the major causes of the problems we are facing now.

The solution to rectify this sorry situation is to make the whole industrial process greener from start to finish. Sustainable thinking, thus, should not be limited to the 'end product'; instead, each stage in its life cycle should be considered. This presents an opportunity to apply new chemistry methods and technologies to improve overall sustainability. To that end, industries should make it their priority to create and secure environmentally sustainable energy supplies, and improve the efficiency of power generation, transmission and use. Chemistry can help raise smart and sustainable solutions, especially in areas such as energy production and storage, as well as conservation.

The making of solar cells, for example, is an expensive process that requires a lot of energy. Chemistry is essential to improve and optimize the manufacturing processes to make it more commercially feasible, as well as more environmentally friendly to produce. There are great opportunities for a more versatile 'second generation' of solar cells, which chemists are currently helping to develop; thin-films of semiconducting materials can coat surfaces offering a more adaptable way to convert the Sun's energy into electricity. 'Third generation' solar cells promise to deliver even more versatile thin-film technology, using materials such as novel plastics and organic photovoltaics. Moreover, inspiration can be drawn from nature; for example, chemists can try to find ways to mimic photosynthesis, and thereby take advantage of biological methods to harvest and store the Sun's energy.

The Green Substitute

Leading companies have started jumping on the eco-friendly bandwagon. Most recently, the giant soda making company PepsiCo Inc. unveiled a new bottle made entirely of plant material that it says reduces bottles' carbon footprint. The bottle is made from switch grass, pine bark, corn husks and other materials. Pepsi also plans to use other food materials; such as orange peels, oat hulls, potato scraps, and other leftovers from its food business; hence, applying the green chemistry principle of reusing end products instead of dumping them as waste.

On the other hand, we are constantly surrounded by electronics and during the past decades the problem of electronic waste has increased. Informal processing of electronic waste in developing countries is a major problem and causes serious health and pollution problems. Even recycling and disposal of electronic waste involves a significant risk to workers and communities. Great care must be taken to avoid unsafe exposure in recycling operations and leakage of material such as heavy metals from landfills and incinerator ashes.

Some electronic scrap components, such as CRTs (Cathode Ray Tube), contain contaminants such as lead, cadmium, beryllium and mercury. This is why it is extremely important that electronic producers become more aware of the impact of their product on the environment, and to become more involved in researching alternative ways and materials to make their product.

Samsung is being environmentally conscious by taking serious steps to cater to the growing needs of greener products. The company has recently launched an environment friendly mobile handset that is called the Reclaim; 80% of it is made of recyclable material with corn and other bio-materials used in making the outer casing and other parts. Moreover, soy-ink is used to create the images and text on the box and the warranty card. Finally, the charger consumes less power than standard, and has an indication LED to show full charging and the time to unplug the charger.

Chores Made Green

When washing our dishes we always use degreasers that help the process and make it quick and efficient, especially when tackling stubborn grease. However, many chemicals used in those products are harmful to us and to the environment. But never fear; green chemistry is here in the form of chemicals made from plant material, which means they are completely biodegradable so there is no risk of toxic traces being left behind. Moreover, when using those degreasers, there is no need to worry about inhaling dangerous fumes while working.

These degreasers also work more effectively than many chemical-based cleaning solutions, as they use a unique technology known as micro-blasting. It penetrates the grease at a molecular level, breaking it down into very small particles; these are then coated to ensure they do not re-adhere to each other or to the cleaned surface.

Can you imagine doing a load of laundry without soap or detergent? Well, whoever created The Enviro-Friendly Laundry Ball thought certainly, yes! This ball naturally and gently cleans laundry without the use of harsh or allergy causing chemicals. It harnesses the power of water to do all the cleaning. The ball works through ionization, which is breaking down the hydrogen molecules of the water to increase molecular movement. This gives water a high penetration capacity and improves its washing properties. The laundry ball weakens dirt's adherence to fabric so it is easily removed without detergent; and according to laboratory testing, the bleaching and anti-bacterial abilities are better with the laundry ball.

One never changes one's lifestyle on a whim; it must be by a conscious decision in order for it to last. One needs to commit to a greener way of life, and consciously make choices that will present as little harm as possible to Mother Nature. "We do not inherit the Earth from our ancestors; we borrow it from our children," is a wise saying; it is indeed imperative to look ahead to preserve the gift that is our home; Earth.

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By: Shahenda Ayman

Forever YOUNG!

Every woman is obsessed with her appearance; she always wants to look pretty and stay young. Wrinkles are her worst enemy and nightmare. As a result, the global market for skincare and cosmetics exceeded 53 billion dollars in 2002, and the number of new products brought to the market continues to expand exponentially. Cosmetic chemists are always looking for interesting and exotic ingredients that improve skin's appearance and health.

Wrinkles are mostly associated with aging. As we age, the cells of our skin become thinner and lose elasticity because of the decreased levels of collagen production in our body. Moreover, the fat cells just under the outer layer of our skin, which make the skin look supple, get smaller and lose their ability to fill out whatever gaps created by the damage that occurs in the inner layers of our skin with age. Hence, the skin sags, becomes dry and develops wrinkles.

On the other hand, spending too much time under the Sun with minimal or no protection at all causes the skin to be vulnerable to ultraviolet radiation. Sunlight causes the outer layer of the skin, the epidermis, to become thinner, and encourages the overproduction of melanin, which eventually leads to skin cancer. Continued exposure to sunlight also causes the collagen in our skin to break down more rapidly.

Getting wrinkles is a natural process; it is something we cannot avoid, and it starts happening in our twenties and thirties. Thankfully, there are affordable and effective ways to hold back the formation of wrinkles and keep our skin looking younger for a longer time.

The Secret of Young Skin

Hyaluronic acid is a miracle agent that promises a lasting youthful look. It occurs naturally in the deeper layers of our skin, the dermis. It helps keep skin smooth and "plump" through its ability to hold up to 1,000 times its weight in water. It also supports the formation and maintenance of collagen.

The ability of hyaluronic acid to bind water in large quantities, thereby acting as filler, makes it attractive for the beauty industry. The modeling of lips or padding of sunken scars is most often carried out by injecting hyaluronic acid under the skin. The skin, hence, regains its volume, becoming firmer, and wrinkles are reduced. Unfortunately, this treatment does not renew aging skin; it inflates it temporarily.

The Fountain of Youth

The cosmetic industry promotes a large number of different substances in skin creams that are advertized to give customers eternally youthful looks. The abbreviation Q10, contained in revitalizing creams, depicts a substance that can smooth out wrinkles.

When oxygen in cells is not completely converted to water, the so-called free radicals are formed. These particles are very reactive and cause chain reactions that can harm the cell, causing aging of the skin. Q10, also known as ubiquinone, is a vitamin-like antioxidant, synthesized in the body and present in every cell; it plays a role in the production of energy. It also plays a role in the renewal of skin, fighting free radicals that damage skin cells; thus, delaying premature aging. It also improves the absorption of various vitamins by skin cells, as well as the natural cellular exchange and building of collagen in the skin.

As the concentration of Q10 decreases with age, radicals produced by stress can no longer be degraded; skin aging is the result. With anti-oxidant skin creams one tries to counteract this problem; Q10 creams help skin cells get an energy boost to fight back against environmental influences, and neutralize free radicals.

Not only creams, but Q10 food supplements are entering the rejuvenation market. The co-enzyme can be taken in the form of capsules, through which an increase in the concentration effect of Q10 in the body was proven. If you have a balanced diet, the Q10 concentration in the body is sufficient without the need of supplements. Oily fish; preferably mackerel or sardines, nuts, legumes, sunflower seeds, or the flesh of organs like that of liver represent an adequate source of Q10.

Seven Natural Ways to Cleanse Your Body

How you feel is linked to your body's ability to deal with toxins. Even given the best conditions, your body has plenty of work to do like digesting the fats, proteins, and carbohydrates in your diet. Add to that the impact of leading a stressful and/or deskbound life, breathing polluted air, etc, and the result is that your body is taking in more toxins than it can expel.

Toxins have various means of entering your body; they can get into your system by way of food, water, or even air. As they amass in your body, you detect their manifestation in your skin, your energy level, your susceptibility to illness, etc. To put a stop to the damage these toxins cause, detoxification is necessary.

The human body has the capacity to detoxify itself, but, because of pollutants and other factors that our body comes across every day, this natural ability sometimes becomes inactive. Unless you do something to eliminate toxins from your body, they will accumulate in the tissues over time, eventually leading to great damage. The good news is you can make small, everyday changes that will dramatically improve your health and wellbeing by enhancing your body's natural process of detoxification. Here are some tips to get you started:

1. **Avoid smoking and caffeinated beverages;** they are loaded with harmful chemical substances that may damage internal organs in the long process.
2. **Drink plenty of water;** the kidneys cannot perform adequately without sufficient water intake. Kidneys remove waste such as uric acid, urea, and lactic acid.
3. **Eat lots of fruits, whole grains**, **vegetables and foods high in fibers;** these are excellent for flushing toxic residues out of the body.
4. **Increase the intake of foods like beetroot, berries, broccoli, red grapes, spinach, and carrot;** these foods contain antioxidants that fight free-radical attacks and inflammation, protecting the immune system and body cells.
5. **Increase the intake of spices;** they are excellent for the purposes of drawing toxins out of the body and leaving you feeling more energetic and healthier.
6. **Eat plenty of raw garlic;** it fights infection and disease, and, unlike antibiotics, does not harm our body's beneficial intestinal flora.
7. **Take enough rest;** exercise and sleep well. Exercise like walking and jogging are best recommended to maintain strong stamina and boost energy levels.

Mother Nature has all the keys to staying young and healthy. It is ridiculous that people spend so much money on plastic surgeries and medicines while all what we need is around us. You do not need products or supplements to obtain good health; a healthy diet can protect us from many diseases and save our money.

Black, Brown, Red, or Yellow!

What on Earth would we do if hair dye was taken away from us? It is a wondrous substance that helps cover grey hair and keep us looking young. It gives us that extra boost in our appearance, which goes hand in hand with developing our personalities and the way we interact with others.

Hair coloring is very popular today, with over 75% of women coloring their hair and a growing percentage of men following suit. How does hair color work? It is the result of a series of chemical reactions between hair molecules, pigments, as well as peroxide and ammonia, if present.

What's in a Hair?

Hair is mainly keratin, the same protein found in skin and fingernails. The natural color of hair depends on the ratio and quantities of two other proteins, eumelanin, responsible for brown to black hair shades, and phaeomelanin; responsible for golden blond, ginger and red colors. The absence of either type of melanin produces white/gray hair.

Bleach is used to lighten hair. It oxidizes melanin molecules in hair, removing the color in an irreversible chemical reaction; the melanin remains present, but the oxidized molecules become colorless. However, bleached hair tends to have a pale yellow tint; yellow is the natural color of keratin. Moreover, bleach reacts more readily with the dark eumelanin pigment than with phaeomelanin, so some gold or red residual color may remain after lightening.

Color Me This!

Up until the 19th century, the only dyes available were those prepared from natural sources; by combining various plant extracts, it was possible to create a fairly extensive range of colors. Indigo, for example, could be mixed with henna to give varying shades of brown.

Other substances that have been used for dyeing hair or wigs are rock alum, black sulfur, honey, in addition to lead, quicklime, salt, or silver nitrate in rose water. Another early method of coloring hair was to apply powders made of wheat starch, powder of potato starch combined with chalk, burnt alabaster, colorants, burnt sienna or umber.

Many different plant extracts were used for hair dye in Europe and Asia before the advent of modern dyes. An extract of the flowers of the chamomile plant was long used to lighten hair, and it is still used in many modern hair preparations. Other dyes were produced from walnut leaves or nut husks, and from the galls, a species of oak trees. Some of these plant-derived dyes were mixed with metals, such as copper and iron, to produce more lasting or richer shades.

Hair Coloring Made Possible

The outer layer of the hair shaft, its cuticle, must be opened before permanent color can be deposited into the hair. Once the cuticle is open, the dye reacts with the inner portion of the hair, the cortex, to deposit or remove the color. Most permanent hair colors use a two-step process, usually occurring simultaneously; first removing the original color of the hair, then depositing a new color.

Ammonia is the alkaline chemical that opens the cuticle and allows the hair color to penetrate the cortex. It also acts as a catalyst when the permanent hair color comes together with the peroxide, which is used as the developer or oxidizing agent that removes pre-existing color.

Peroxide breaks chemical bonds in the hair, releasing sulfur, which accounts for the characteristic odor of hair color. As the melanin is decolorized, a new permanent color is bonded to the hair cortex. Various types of alcohols and conditioners may also be present in hair color. The conditioners close the cuticle after coloring to seal in and protect the new color.

The Dye Revolution

The late 19th century saw the introduction of hydrogen peroxide as an efficient hair lightener; thus, ushering in the experimentation of chemical compounds to produce a synthetic dye. The first chemical compound developed was pyrogallol, used since 1845, in combination with henna, to dye hair brown.

The 1880s saw the introduction of amino dyes of which p-phenylenediamine was the earliest. Before being applied to the hair, it is mixed with caustic soda, sodium carbonate, or ammonia. Hydrogen peroxide was then applied, which then brought out the color.

In 1950, Clairol was the pioneer of the one-step hair dye, which made the process of hair dyeing much easier; the time-consuming shampoo and pre-lightening steps could be eliminated.

But what do modern hair dyes contain? They generally contain dyes, modifiers, antioxidants, alkalizers, soaps, ammonia, wetting agents, a plethora of different fragrance, and a mixture of other compounds used to impart different qualities to hair depending on hair type, color and texture. Metal oxides, can also be added as pigment.

Resorcinol is a commonly used modifier, used to bring out the tone of color or set the dye. The dye is prevented from oxidizing with air by means of an antioxidant such as sodium sulfite. Dyes work most efficiently in an alkaline composition so alkalizers, such as ammonium hydroxide, are added.

Added to these basic chemicals, will be a variety of chemicals to give a certain dye solution certain qualities suitable for different hair types. There are various types of hair dyes on the market, such as temporary hair colors and semi permanent dyes, which penetrate into the hair shaft but wash out of the hair after 5-10 shampoos.

The next time you reach for that bottle of dye or sit patiently in the hairdressing salon, as the smells of the chemicals waft around your nose, you can reflect on the long journey of those dyes and what a boring world it would be without them.

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By: Lamia Ghoneim

The Lost Renaissance

Many countries, including Egypt, are embracing nuclear power as an alternative source of energy. With oil prices on the rise and pollution from burning fossil fuels causing global warming and taking its toll on our planet, most countries are looking for a green sustainable source of energy that holds promise for a better future. Whether or not nuclear energy holds that promise has been a matter of an ongoing flaming debate for years now; with proponents arguing that it is the only viable and efficient sustainable energy source and opponents insisting that it possesses too many threats to humanity and the environment.

Despite the controversy, the last decade has witnessed a revival of the nuclear power industry; a nuclear renaissance, as it was often called. However, this year the heated debate has taken a huge turn when a massive earthquake in Japan caused significant damage to one of the country's nuclear power plants. Just like that, the nuclear renaissance may be gone for good.

A Nation's Crisis Fuels Nuclear Fear

It all started on 11 March 2011. First, Japan was shaken violently by a massive earthquake; the most powerful to hit the country to date. Following in its wake, a tsunami smashed what the earthquake had not destroyed. In the path of both stood the Fukushima nuclear power plant on the Pacific Coast, north of Tokyo. The twofold catastrophe knocked out power needed to maintain safe cooling levels for the plant's multiple nuclear reactors. Despite heroic emergency efforts, temperatures in the reactor cores rose to dangerous levels.

Since then, hydrogen explosions and fires at the plant have released radiation into the atmosphere. With cooling pumps out of order, workers struggled to keep the reactors cool using seawater, which requires venting radioactive steam. Soon after, they were forced to dump considerable amounts of contaminated water into the ocean to make room for storage containers holding water that is even more radioactive.

Japanese officials evacuated a 20-kilometer zone around Fukushima. Nearly half a million people had to leave their homes. Japanese Prime Minister Naoto Kan pleaded for calm, but warned that radiation had already spread from the crippled reactors and there was a very high risk of further leakage. Engineers admitted that it could take months and further heroic efforts to stabilize the damaged reactor and perhaps years to clear up the toxic mess left behind.

The crisis has led to substantial amounts of radiation leaking into the atmosphere, ground and sea in the world's second worst nuclear crisis since the 1986 meltdown at Chernobyl in the former Soviet Union. What is more, it could lead to the "decease" of nuclear energy, as quoted by post crisis headlines around the globe.

Japan's nuclear disaster has unleashed anti-nuclear passions all over, putting governments on the defensive and undermining the nuclear power industry's recent renaissance as the clean energy of the future. The scale of the alarm has been quite remarkable; it has spread worldwide and voices everywhere have risen demanding the abandonment of nuclear energy. Panic is mounting and public outcries to shut down nuclear power stations around the world are on the rise that some governments have actually listened.

Weighing Risks; Keeping Fears into Perspective

In a world endangered by climate change and pollution, before governments are forced to take drastic measures and abandon nuclear energy entirely, it is vitally important to keep fears in perspective and weigh all energy choices.

If we abandon nuclear energy, the most likely alternative energy source is fossil fuel. Other clean renewable sources such as wind or solar, still much more expensive and much less efficient than nuclear energy, are at least decades away from the scalability needed to power a significant share of a modern industrial society's energy requirements.

Comparing the risks of burning fossil fuel to the risks of using nuclear power is relatively easy. The sole fatal nuclear power accident of the last 40 years was the Chernobyl accident, during which a complete meltdown occurred and directly killed 31 people. It is important to recognize that even during a complete meltdown the reactor cores will never detonate like a nuclear bomb. By comparison, the Paul Scherrer Institute calculates that, from 1969 to 2000, more than 35,000 people died in severe accidents in the oil and coal supply chain; 11,000 in China alone. The rate of direct fatalities per unit of energy production is 18 times worse for oil than it is for nuclear power.

Even if we count all the premature deaths plausibly related to Chernobyl—4,000 according to the World Health Organization—that number is dwarfed by the death rate from burning fossil fuels. The 2008 Environmental Outlook of the Organization for Economic Co-operation and Development (OECD) calculates that fine-particle outdoor air pollution caused nearly 1 million premature deaths in the year 2000, and 30 percent of this was energy-related. It would take 500 Chernobyl incidents to match that level of annual killing.

Lessons Learned

Nevertheless, we cannot ignore what has happened in Japan. Precisely because nuclear accidents are so rare, we have to study them intensely. Each one tells us what to fix in the next generation of power plants. While the international nuclear power industry says it is strongly focused on safety, the events at Japan's Fukushima facility raise concerns that existing nuclear plants must be updated.

Nuclear plants built on seismic lands must be constantly monitored and safety precautions must be updated. Fortunately, unlike older models similar to the Fukushima power plant, new-generation models do not rely on electrical power for their cooling systems but instead are fitted with large tanks of water operating by gravity in the event of a crisis.

It is not very apparent yet what toll this emergency will take on the people of Japan and on the environment. However, it is apparent that we should not allow what might have been a once-in-a-lifetime confluence of historic natural disasters dictate the fate of nuclear energy around the world.

By all means, let us have a robust debate about the future of nuclear energy. Let us hear all the arguments for it and against it. Let us also keep things in perspective while we do so. Let us not lose the nuclear renaissance for good.

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By: Ingy Hafez

Sustainable Energy… What Is It All About?!

Sustainable energy is the provision of energy that meets the needs of the present without compromising the ability of future generations to meet their needs. Sustainable energy sources are most often regarded as including all renewable energy sources, such as hydroelectricity, solar energy, wind energy, wave power, geothermal energy, bioenergy, and tidal power. It usually also includes technologies of low environmental impact that improve energy efficiency.

Sustainable energy is about using energy wisely, and using energy generated from clean sources and clean technologies. Being energy-efficient will reduce our household and business energy bills, reduce the amount of energy we need to produce in the first place, as well as cut energy-related greenhouse pollution.

Until the past ten or twenty years, sustainable energy was thought of in terms of availability in relativity to the rate of use. Today, in the context of sustainable development, other aspects are equally important, including environmental effects and the question of wastes, even if they have no environmental effect. Safety is also an issue, as well as the broad and indefinite aspect of maximizing the options available to future generations.

On Our Way to Sustainability?!

Harnessing renewable energy such as wind and solar is an appropriate first consideration in sustainable development because, apart from constructing the plant, there is no depletion of mineral resources and no direct air or water pollution. In contrast to a few decades ago, we now have the technology to access these sources on a significant scale for electricity.

Controlling these "free" sources is not the only option. Renewable sources other than hydro are disperse, alternating and unreliable by nature. The fact that we seek the Sun for our summer holidays proves its low intensity; similarly, bad weather and nighttime underline its short-term unreliability. These two aspects offer a technological challenge. It requires collecting energy at a peak density of about 1 kilowatt (kW) per square meter when the Sun is shining to satisfy a quite different kind of electricity demand that requires a relatively continuous supply.

The implementation of renewable energy technology, essential for reducing our dependency on polluting fossil fuels and reducing CO_2 emissions to slow the rate of global warming, is thus only part of the solution.

A number of factors are indisputable; the world's population will continue to grow and energy demand is likely to increase even faster. The key question is how we generate that electricity. Today, worldwide, 64% is from fossil fuels, 16% from nuclear fission and 19% from hydro, with very little from other renewables. There is no prospect that we can do without any of these.

To meet the increasing global demand for energy, while reducing the risk of damage to the environment, it is important that countries find new types of energy; while developing and expanding existing sources that are more sustainable than fossil fuels. It also requires industry and domestic users of energy use it more efficiently and stop wasting it.

What Can We Do?

With energy consumption rising, it is important that industry, transportation and consumers in their homes use energy more efficiently. We can all help by making changes in our lifestyles and our houses by:

- Walking, cycling or using public transport;
- Using smaller more energy-efficient cars;
- Reducing the number of aircraft journeys;
- Switching off lights, power sockets, phone chargers and TVs when not in use;
- Using energy-efficient light-bulbs and rechargeable batteries;
- Recycling and reusing plastics and oil-based products;
- Insulating house roofs, using double-glazing and more efficient heating systems; and,
- Considering introducing solar panels.

Other than that, renewable energy products utilize the Earth's natural resources that can be used to generate energy, which is sustainable and reusable. Current energy consumption levels cannot be sustained from the normal supply of gas and oil, therefore alternative sources need to be identified. Renewable energy systems combined with traditional heating equipment can address this issue and reduce carbon emissions along the way. These renewable energy products are healthier, safer and cost-effective.

Heat Pumps

Heat pumps, in simple terms, convert free natural resources into usable energy. A heat pump can use the air, water or ground heat energy, and via a heat exchanger, deliver it to the heating appliance.

Ground source heat, a series of underground pipes filled with a heat transfer liquid, are connected to the heat emitter. These pipe systems use the solar store in the ground, which is rechargeable via the Sun. Wet soils offer the optimum efficiencies.

This system is the easiest heat pump system to install, as it requires no ground work and a small site area, hence savings in installation cost.

Solar Systems

A professionally sized solar energy system can provide a significant percentage of a building's annual hot water requirement at zero cost to the user. Solar can be used on even the haziest or cloudiest of days but are more efficient during summer. Correct orientation and inclination will improve efficiencies. For example, a south facing solar panel at the correct angle will acquire the most out of the solar system. Solar panels are linked to solar cylinders, which can store and use hot water on demand.

Normal systems consist of a panel, a pumping system and a hot water tank. A liquid passes through the solar panel, which is heated via the Sun, and heat is transferred to the water tank.

Biomass Boilers

Biomass refers to living and recently dead biological material that can be used as fuel. Most commonly, biomass refers to plant matter, such as wood in pellet or chipped form; or energy crops such as Miscanthus, but may also include biodegradable wastes that can be burnt as fuel. It excludes organic material that has been transformed by geological processes into substances such as coal or petroleum. Biomass systems typically consist of a store, a feed and a boiler for burning fuels providing the heat source.

Rainwater Harvesting

Rainwater harvesting is the collection and storage of rain from roofs or from a surface catchment for future use. The water is generally stored in rainwater tanks or directed into mechanisms which recharge groundwater. Rainwater harvesting can provide supplemental water, increase soil moisture levels for urban greenery, and increase the groundwater table through artificial recharge. It can also mitigate urban flooding. Rainwater systems are usually easy to install. They usually comprise a pumping system and a piping system combined with a filter.

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Nanotechnology

By: Sara Khattab

Our future!

There is more to the nano world than meets the eye. Nanotechnology is the study of manipulating matter on an atomic and molecular scale, and it may become the most influential force in the world. Generally, nanotechnology deals with structures of a size between 1 and 100 nanometers; it involves developing materials or devices with at least one dimension within that size. This technology may end world hunger, increase the speed of memory chips, or modify the human body, to name a few.

Nanotechnology has a number of interesting potential applications in areas such as health, environment and energy, among many others. An area of nanotechnology application that holds great promise for Mankind is medicine. The biological and medical research communities have exploited the unique properties of nanomaterials for various applications; nanomedicine is the medical application of nanotechnology. Nanomedicine seeks to deliver a valuable set of research tools and clinically useful devices in the near future.

Nanoparticles have unusual properties that can improve drug delivery; whereas larger particles would be cleared from the body, nanoparticles are absorbed by the cells due to their size. Drug delivery systems, lipid- or polymer-based nanoparticles, hence can be designed to improve the pharmacological and therapeutic properties of drugs because many diseases depend upon processes within the cell and can only be impeded by drugs that make their way into the cell. A drug may lead to tissue damage, but with drug delivery, regulated drug release can eliminate the problem.

Using drugs and surgery, doctors can only encourage tissues to repair themselves; on the other hand, synthetic polymeric materials have the potential to grow and multiply human cells. About ten years ago, scientists discovered the important influence nanostructures had on the way a line of cells would develop. In the case of human skin cells, re-implantation of the tissue can be performed once a sufficient amount of skin is obtained by growing it on a polymeric material surface.

Nanostructures have the ability to influence the behavior of organic cells; different kinds of cells can grow better and faster depending on the type of polymer surface. Using one type of polymer material or another will help grow different types of muscles, nerves, or cells adapted to a human heart, bone or any other part of the human body. Polymeric materials could also be used for designing entire artificial implants; indeed, many types of implants are already being made out of polymer materials, such as heart valves and blood vessels.

The National Cancer Institute created the "Alliance for Nanotechnology in Cancer" in the hope that investments in this branch of nanomedicine could lead to breakthroughs in terms of detecting, diagnosing and treating various forms of cancer. Things behave differently at the nanoscale; an excellent example is the fact that gold, which looks yellow at our "normal" scale, actually reflects red light at the nanoscale. This has resulted in the design of experimental systems that kill cancerous cells with normal visible light, but leave normal cells unharmed.

Nanotechnology also has a significant impact on several aspects of food science; from how food is grown, to how it is packaged. Companies are developing nanomaterials that will make a difference, not only in the taste of food, but also in food safety, and the health benefits that food delivers. One of the applications of nanotechnology in food is "green packaging" using nanofibers made from lobster shells or organic corn, which are both antimicrobial and biodegradable. Moreover, nanoparticles are being developed to deliver vitamins or other nutrients in food and beverages without affecting taste or appearance. These nanoparticles actually encapsulate the nutrients and carry them through the stomach into the bloodstream.

Over the past few decades, the fields of science and engineering have been seeking to develop new and improved types of energy technologies that have the capability of improving life all over the world. Nanotechnology could be harnessed to consume extremely low amounts of energy, making it a vital alternative to current methods of supplying power. Manufacturing improvements by reducing materials and process rates, energy saving, and enhanced renewable energy sources are the most advanced nanotechnology projects related to energy.

A reduction of energy consumption can be reached by better insulation systems, through the use of more efficient lighting or combustion systems, and the use of lighter and stronger material bulbs that only convert approximately 5% of the electrical energy into light. Nanotechnological approaches, such as light-emitting diodes could lead to a strong reduction of energy consumption for illumination.

Not only that, but nanotechnology could also help increase light conversion efficiency using nanostructures. Organic solar cells, most likely available from 2009 onwards, are thin film, flexible cells, based on inexpensive nanoparticles and polymers that will replace expensive old generation silicon-based brittle solar cells. These are easily manufactured on a continuous roll process, and their flexibility means increased application in the automotive industry such as sun-roofs. Increased flexibility means, of course, increased usage, at increased efficiencies, which in turn translates into increased sustainable energy generation.

Further applications which require actual manipulation or arrangement of nanoscale components await further research. Though technologies branded with the term "nano" are sometimes little related to, and fall far short of the most ambitious and transformative technological goals of the sort in molecular manufacturing proposals, the term still connotes such ideas. Ironically, this new nanotechnology, literally the smallest scale known to science, a billionth of a meter, can potentially solve some of the biggest challenges facing the Earth and its inhabitants.

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By: Noha Rahhal

A Virus under the Microscope

In our last issue, we had a look at the chemical processes that take place from cooking a meal, eating and digesting food, to washing up afterwards. On that occasion, we unraveled an intimately relevant facet of chemistry to our daily life. Now, let us explore a different, equally intimate; albeit much more dangerous; aspect of chemistry in our life. We will have an overview of the chemical structure of viruses; how they are enabled to perform their malicious functions; and the reactions that our immunity system perform to combat them.

A Nasty Little Organism

Originally, the term "Virus" comes from a Latin word that refers to poison and other noxious substances. According to Wikipedia, the Free Encyclopedia, a virus is a "small infectious agent that can replicate only inside the living cells of organisms". Viruses are of various different types, but they all infect all kinds of organisms and they all have exactly the same anatomical structure.

Although viruses attack living organisms, there is a great controversy about whether to regard them as living organisms or not. Viruses have been described as "organisms at the edge of life" due to the fact that they possess genes but not a cellular structure as any other living organism. Surprisingly, viruses evolve by natural selection and have the ability to reproduce by creating multiple copies of themselves in no time. This reproducing feature is what makes viruses invincible.

A graphic mimic of how a typical virus looks like under a microscope shows that the virus consists of nucleic acid, either DNA or RNA, and a protein coat that envelops that nucleic acid. Since a virus does not constitute naturally of a cell, it does not have its own metabolism. Thus, it needs another host cell so that it can reproduce and perform its functions. Viruses also cannot synthesize proteins as they lack ribosomes, which are vital for transforming RNA that exists in any virus to proteins that are vital for the reproducing process. Moreover, viruses can neither generate nor store energy, so they have to derive their energy along with other metabolic functions from the host cell.

Viral Arts

Viruses differ in types, but they also differ in their composition. Nevertheless, they all pass through the same phases when attacking a cell, or when looking for a host to reproduce. There are six main stages in a virus's lifecycle:

1. **Attachment:** This first stage, in a virus's lifecycle, is when a virus attaches itself to a receptor living cell. For a virus to infect a host cell, that cell must have receptors for the virus on its surface and also be capable of supporting viral replication. These host cell receptors are normal surface molecules involved in routine cellular function, but since a portion of a molecule on the viral surface resembles the chemical shape of the body's molecule that would normally bind to the receptor, the virus is able to attach to the host cell's surface.
2. **Penetration:** In this phase, the Virion, which, according to theFreeDictionary.com, is "a complete viral particle, consisting of RNA or DNA surrounded by a protein shell and constituting the infective form of a virus", enters the host cell either through endocytosis(1) or membrane fusion.
3. **Un-coating:** During this phase, the whole viral capsid is removed. This phase leads to the release of the viral genomic nucleic acid from the protein coat.
4. **Replication:** This phase involves the multiplication of the genome and the synthesis of the viral messenger RNA (mRNA). The viral genome directs the host cell's metabolic machinery (ribosomes, tRNA, nutrients, energy, enzymes) to synthesize viral enzymes and viral parts. The viral genome has to both replicate itself and become transcribed into viral mRNA molecules. The viral mRNA can then be translated by the host cell's ribosomes into viral structural components and enzymes need for replication and assembly of the virus.
5. **Self-Assembly:** This is all about the self-assembly of the virus particles. Usually, some modifications in the protein created take place. Amidst that stage, the viruses mature.
6. **Lyses:** This can be regarded as the most devastating and horrific stage for the host cell. This is because during that phase, the virus is released from the host cell by bursting the cell membrane and cell wall leading to the destruction of the host cell.

Combating a Virus

A virus can be weakened or inactivated to stimulate the immunity system. Weakened viruses can still reproduce, but not as fast as natural viruses normally do; that is the main point of creating several vaccines to combat or "inactivate" the viruses and prevent them from moving along with their lifecycles.

Vaccines are made of the same constituents that exist in a virus. When a vaccine is synthesized to weaken a particular virus, it reproduces itself fewer than 20 times, whereas a normal virus can reproduce itself hundreds or even thousands of times. Thus, a vaccine virus does not lead to causing diseases; on the contrary, it produces "memory B cells" when replicating, which protects cells from further infection by viruses of the same type in the future. The weakening vaccines provide cells with an everlasting immunity; however, it cannot be given to people who suffer from weakened immunity systems.

Some other vaccines are made for the purpose of inactivating a virus. This is simply attained through the presence of a chemical that immediately kills the virus. However, several doses of that type of vaccines are needed to combat the virus to ensure everlasting immunity.

However, life is not always that simple. Even vaccines can prove to be inactive when attempting to combat or inactivate viruses because they always change their composition. Once they are exposed to a certain medication, they change their whole structure. Thus, there is a need to keep the industry of vaccines and medications in a constant state of updating and innovation to keep pace with this changing nature of viruses.

Vaccine production is a long series of interrelated stages. The process starts with the generation of the antigen, which is "a substance when introduced into the body stimulates the production of an antibody". An antigen is usually generated in yeast, bacteria or cell cultures. Recombinant proteins derived from viruses can be generated too; however, they need many modifications including ultrafiltration to inactivate some viruses. Eventually, vaccines are finalized by adding preservatives to allow the use of multi-dose vials and stabilizers to increase the vaccine's life, or adjuvants to enhance the immunity response of the antigen.

All through, chemical reactions occur: between a virus and a cell, between a vaccine and a certain virus, and in laboratories to acquire those vaccines. This last process is studied and explored by a field of chemistry known as "Medicinal Chemistry". Medicinal Chemistry is all about the application of chemical research techniques to the synthesis of pharmaceuticals. It is directed towards the innovation and discovery of drugs and their development.

Although viruses cannot be viewed as living organisms in the truest sense, they affect other living organisms leading to their destruction in some cases all because they contain chemical constituents that "react" with those that exist inside the cells of living organisms. Chemistry is, once again, the keyword when we look at phenomena that occur to our bodies and take place all around us in nature.

Glossary

(1) Endocytosis is a process whereby cells absorb material (molecules such as proteins) from the outside by engulfing it with their cell membrane.

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By: Lamia Ghoneim

Chemistry against CRIME

As nighttime descended on the quiet neighborhood, the silence was shattered by the loud barks of an agitated dog; its fur and paws matted with blood. The dog led the Crime Scene Investigation (CSI) team down a dim tree-shaded pathway, where they found the body of a woman lying at the foot of some steps, in a pool of blood.

Dressed in a heavy winter coat, no injuries were visible on the woman's body except for a single gunshot wound on her temple. The contents of the woman's purse scattered on the stairs around her; but no cell phone or wallet were in sight, indicating the possibility of a mugging. Ten feet from her body lay a man's Timex *watch with a broken 8" wristband; the time on its screen marked 9:32.*

The crime scene was cordoned off and thoroughly inspected by the CSI team. Samples and potential evidence were collected and preserved.

Sounds familiar? The previous scene might be the opening scene of an episode of *Law & Order* or *CSI*, but it may also be a scene from real life. Over the past decade, television programs focusing on solving crimes have consistently topped popularity charts all over the world. Viewers seem to be captivated by the crime-solving tools that law enforcement officers have at their disposal and the skills they possess.

Indeed, Crime Scene Investigation has come a long way from the days of Sherlock Holmes to modern times, as Forensic Science joined the scene. Today, investigators have an amazing array of chemicals and devices with which to examine the minutest evidence that no criminal can hope to escape from a crime scene without leaving behind at least some detectable evidence.

One of the most important contributors to the forensic scientist's investigative arsenal has been the science of chemistry.

Fingerprint Magic

The CSI team brought out their chemical kits, and mysterious gaseous fumes were released. Under the light of the UV lamp and just like magic, fingerprints were exposed on the victim's clothes, on top of the stairs, and all over the crime scene.

We have all seen these magic fumes on TV, but apparently they are real; not at all a product of magic. In fact, they are a product of chemical labs where various chemicals that are used to reveal invisible fingerprints are created. Over the past half century, a number of improvements in the way fingerprints are analyzed and identified have been made, many resulting from the use of chemical reactions.

In many crime labs, there are four kinds of chemical reagents used to expose invisible, or latent, fingerprints. They are cyanoacrylate, silver nitrate, iodine, and ninhydrin. Perhaps you know cyanoacrylate by its trade name: Super Glue; the same product you purchase at any superstore. When cyanoacrylate is heated or mixed with sodium hydroxide (NaOH), it releases fumes that interact with the amino acids in the fingerprint residues found on an object, thus making a white print.

After exposure to cyanoacrylate, the fingerprints can then be captured on film as is or treated with a fluorescent pigment that sticks to the fingerprint. The fingerprint then fluoresces, or glows, under a laser or ultraviolet light source.

In this method, an object suspected to have latent fingerprints is exposed to the fumes inside a gadget known as a fuming chamber. The end result is that the fumed fingerprints are now hard and stable as one would expect from Super Glue. Instead of setting up a fuming chamber at the scene of a crime, CSI technicians often use a handheld wand-shaped tool that heats up a small cartridge of cyanoacrylate mixed together with fluorescent pigment. This tool then releases gases in close proximity of the latent prints, allowing the technician to fix and dye the fingerprint simultaneously.

When CSI technicians apply silver nitrate—a chemical ingredient found in black-and-white photographic film—to a latent fingerprint, the chloride found in fingerprint residue interacts with it to form another compound called silver chloride. This new compound reveals a black or reddish-brown fingerprint in the presence of ultraviolet light.

The third chemical used to reveal latent fingerprints is iodine. When heated up, crystalline iodine releases iodine fumes into a fuming chamber, where the iodine interacts with the oils found in the latent print, thus producing a brownish colored fingerprint. Unfortunately, this kind of print has a tendency to fade rather quickly. Therefore, it must be captured on film right away or fixed by spraying it with a "fixing solution" made of water and starch. This fixing solution allows the print to last for weeks or even months.

The fourth kind of chemical reagent used to reveal latent fingerprints is ninhydrin. When an object suspected of containing latent fingerprints is sprayed with a solution of ninhydrin, it may take several hours for the fingerprints to show up because ninhydrin reacts very slowly with the oils in the fingerprint. However, heating up the object can reduce the reaction time and the resulting fingerprint will be a purple/blue print.

The collected fingerprints were matched with those of the victim's and persons of interest in the case, including previous suspects in similar robbery and assault cases. However, fingerprints alone cannot solve the case; they are only one step in the CSI investigation.

Invisible Blood Show Yourself

After collecting the fingerprints, the CSI team put on their sunglasses and started liberally spraying the crime scene area with a special solution, instantly creating an eerie blue glow that shone in the darkness of the night. A trail of glowing shoeprints from the entrance of the property leading towards the body was revealed. Inside the house, the trail continued until it reached the doorway of a room that appeared to be an office or a study of some sort. Once inside, the team sprayed the special solution again; only this time, the blue glow appeared all over the carpet, as well as on the floorboards underneath it.

All of us who are fans of forensic TV shows have seen the CSI hero, in obligatory sunglasses of course, dim the lights and spray the "magical" substance over the carpet, dramatically revealing the blood splatter of poor victims. How do they do that, you may wonder?

The "central" chemical in this drama is "luminol" ($C_8H_7O_3N_3$), a powdery compound made up of nitrogen, hydrogen, oxygen and carbon. The investigator

mixes the luminol powder with a liquid containing hydrogen peroxide (H_2O_2), and other chemicals, and pours the liquid into a simple spray bottle. The hydrogen peroxide and the luminol are actually the principal players in the chemical reaction, but in order to produce a strong glow, they need a catalyst, in this case the iron in the victim's blood.

To perform a luminol test, the CSI team simply sprays the mixture wherever they think blood might be. If hemoglobin and the luminol mixture come in contact, the iron in the hemoglobin accelerates a reaction between the hydrogen peroxide and the luminol. The luminol loses nitrogen and hydrogen atoms and gains oxygen atoms, resulting in a compound known as 3-aminophthalate. The reaction leaves the 3-aminophthalate in an energized state. The excited electrons quickly fall back to a lower energy level, emitting the extra energy as a light photon. With iron accelerating the process, the light is bright enough to see in a dark room.

If luminol reveals apparent blood traces, investigators will photograph the crime scene to record the pattern.

The team detected no signs of forced entry of the property, neither were there any signs of a struggle inside. The pattern of blood discovered by luminol indicated that the murder took place inside the office where the victim was shot and immediately collapsed on the carpet; she was then carried outside by a suspect, most likely a man who wears size 10 shoes, signified by the trail of bloody shoeprints uncovered by luminol.

The perpetrator tried to wash all traces of blood from the house, but luminol managed to detect the minutest amount of blood that remained. Upon these revelations, the detectives deduced that the murder was not likely the result of a simple mugging as primarily suspected. They construed that the murderer engaged in foul play and tampering with the evidence, in order to give the crime the appearance of an assaulted robbery, when in fact it was not.

Based on fingerprints, shoeprints, the broken watch and other circumstantial evidence, the detectives now had a prime suspect: the husband. They requested a warrant for his arrest.

Gunshot Residue Stuck on You

The investigators used a filtered vacuum device to collect trace evidence from the carpet in the office and from the victim's clothes and purse. A few items, including the recovered Timex *watch, were collected and tested for gunshot residue.*

We often hear about "Gunshot Residue (GSR)" sticking to the hands of the killer and ultimately exposing him; but what exactly is it and how is it detected?

The answer is through simple chemistry. When a firearm is discharged, an assortment of vapors and particulate material are expelled in the area around the firearm. These products of firearm discharge can be collectively referred to as Gunshot Residues (GSR) and are used to estimate firing distances, identify bullet holes, and most importantly, to determine whether or not a person has discharged a firearm. The residue may settle on the hands, sleeves, face and other part of the shooter, as well as any other object or person within the residue fallout radius.

Through various techniques, this residue may be detected and used as powerful evidence. Laboratory examination of GSR under a Scanning Electron Microscope (SEM) is considered the most reliable method. Adhesive tapes are applied to a person's hands and then placed under an SEM, which the technician uses to locate and identify specific residue particles and their composition.

Another method for GSR detection is through chemical analysis methods that detect byproducts of the burning of primer and gun powder. These byproducts include the metals: lead, antimony, and barium. CSIs obtain GSR residue by swabbing the suspect›s hands, arms, and clothing with a moist Q-tip or filter paper. The Q-tip or filter paper is then treated with a solution of "diphenylamine", a chemical that interacts with these metals by producing a color change. The test is positive if the color blue is produced.

The tests performed concluded the presence of GSR on the Timex *watch that the investigators believed to be owned by the husband. Upon this evidence, an arrest warrant was immediately issued and following his arrest, the CSI team swabbed the suspect's hands, face and clothes for trace evidence.*

And Chemistry Solves the Case

Thorough scientific testing led the CSI team to conclude that the husband has recently fired a shotgun, and although the clothes he was wearing had no trace of blood, his shoes did. The shoeprints also matched those detected by the CSI team in the scene of the crime, and although he denied that the broken watch was his, his fingerprints were on its wristband.

Faced by the compelling evidence against him, the man confessed to murdering his wife. He claimed she refused to help him through his money troubles even though she was very rich; he was facing bankruptcy and jail and she still refused to loan him the money. He saw no way out but to murder her to inherit her money; he thought he could get away with it by staging the murder to appear like a mugging that occurred outside their house, when in fact he had called his wife into his office upon her arrival and shot her in cold blood.

It did not help that he lost his watch on the scene, but in any case he did not stand a chance, not with the CSI's weapon: chemistry against crime.

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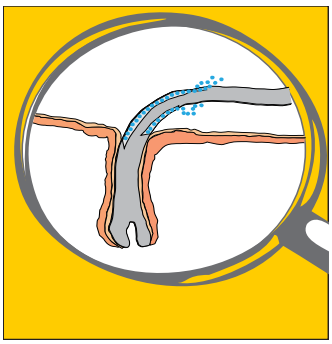
DYE HARD!

NH_3
H_2O_2
Dye

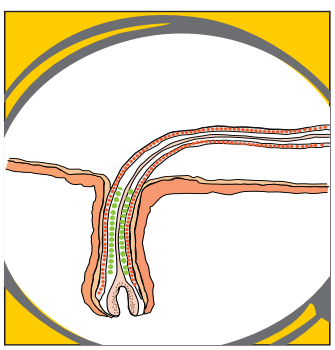
Woman: I wish I could turn back time and get my hair color back. *sniff* *sniff*

Fairy: Don't cry! The Hair Dye Fairy is here to make your wish come true.

Fairy: Now, what are the magic words? Oh, yes!
BIBBIDI-BOBBIDI-BOO



NH_3: Hair cuticle, hair cuticle; open up...
BIBBIDI-BOBBIDI-BOO



H_2O_2: Let us in; we are bringing in the magic dye!
BIBBIDI-BOBBIDI-BOO

Woman: Wooooowwwww! It worked! I love it!
Thank you Hair Dye Fairy!

Illustrations: Maha Sherin

Phenomenon

Hair dye mainly contains ammonia (NH_3), hydrogen peroxide (H_2O_2) and dye molecules. First, the ammonia opens up the hair cuticle, allowing the hydrogen peroxide and colorant to penetrate into the hair cortex. Hydrogen peroxide reacts with, or oxidizes, the remaining melanin in the hair, making it colorless. The small dye molecules then penetrate the hair cortex where they deposit, increase in size and become trapped, creating a new overall hair color.

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