Volume 15, 2015-16

The Chemical Society
Miranda House
University of Delhi

Chemistry Department 2015-16

III year

Row 1 (sitting) (L to R): Sushmita, Yashvi, Vibha, Sahar, Chitranshi,Preeti

Row 2 (L to R):Poonam, Manisha, Kritika,Diksha, Shipra, Rohini, Reshma, Vaishali, Nikita, NehaAbbasi, Khushboo, Komal, Mitali, Gunjan, Chinky.

Row 3(L to R): Sonam, SakshiSharma, Monika Kumari, Kalpana, Roshni, Jyoti, PriyaYadav

Row 4 (L to R): Monica, Parsanta, Divya, Suman, Ankita, Samriddhi, Alishpreet, Nachiketa, Kajol

II Year

Row 1 (sitting) (L to R): Ritu, Ruby,Punisha,Deepti, DivyaRai,Neha,Komal,NehaRani

Row 2 (L to R): Nancy, Monica, Divya Bhatt, Shilpi, Meenakshi, Kirti, Manisha, Kharun, Prabha, Rashmi, Smriti, Preeti Choudhary, Harsha, Ayushi, Bharti, Anshika

Row 3 (L to R): Mamta, Anita, Suman, Surbhi, Raksha, Shaileyee, Ipshita, Preeti, Neerja, Meenu

Row 4 (L to R): Nidhi, Anandita, Yashika, Phroyia, Vaishali, Alisha, Ritu, Shilpa

Row 5 (L to R): Priya, Sonia, Nikita, Shruti, Manisha, Ishita, Sweety, Mahima, Kriti, Sapna, Shivani, Sonika, Pragati, Sapna

I YEAR

Sitting: Row 1 (L to R): Deeksha, Aditi Arora, Amishi, Ruchi Gupta, Priya, Sukriti, Sanskriti, Ekta, Ekta Sangwan,Kanchan Bharadwaj, Harshita, Priyanshi

Row 2 (L to R): Shelly, Simran, Meghna, Meena, Shiva, Jahanvi, Peehu, Taruna, Khushboo

Standing:

Row 1 (L to R): Megha, Arpita Saggar, Monika, Kavita, Swati Jain, Samridhi Bajaj, Himanshi

Row 2 (L to R): Rimjhim, DivyaMahajan, Yashi, Isha, Sajal, AnkitaKumari, JyotiMunjal, Aashi, Goldi, Nisha, Anju, Alka, HimanshiSoni, Anamika, Shubhangi, Neehar

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FRONT COVER

The Chemistree at *Pratikriya 2016*

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Dear Readers,

Rasayanika, The Chemical Society of Miranda House has had an eventful and fruitful year. Whether it was the inaugural lecture of the Society or the Green Chemistry seminars or the DSKC internship, our members actively participated in all. The year 2015-16 started off with a very informative inaugural lecture. Other major events were the Departmental trip to Dehradun and *Pratikriya*, the annual Chemistry fest, which had enormous participation from not only Miranda but also from other colleges. Despite the fact that we have been busy throughout the year, we still found time to excel both academically as well as creatively. Among other distinctions earned by Chemistry students, Nitasha was elected the Students' Union President 2015-16 and Sakshi Sharma, the NSS President for 2015-16, won the Golden Jubilee Award for Science. Chemistry students also exhibited their concern about environmental issues by contributing hugely to the efforts of *MH-Vatavaran*, the college Environment Society, under the guidance of several teachers of the Chemistry Department as well as the office bearers Shipra, Rohini, Ayushi and Divya, all Chemistry students. *Rasayanika* is also proud of Jyoti Agarwal of III Year, who has been selected with full fee waiver to pursue M.Ed. in Environmental Education in Lynchburg College, Virginia, USA. This became possible due to Jyoti's high degree of motivation and a Memorandum of Understanding signed between Lynchburg College and Miranda House.

On behalf of the entire Society I would like to thank Dr. Bani Roy. Without her guidance, this publication would not have been possible.

I would also like to thank all my teachers for their guidance throughout the year and my friends for their creative articles and their input. In the words of Patrick Süskind: "Talent means nothing, while experience, acquired in humility and with hard work, means everything." So keep working hard and never give up.

Dipshi Singh
President, Rasayanika
2015-16

Rasayanika: the Chemical Society

Annual Report 2015-16

Around thirty Chemistry students, including a few students from Daulat Ram College, Zakir Hussain College and Jaypee University worked on summer projects in June-July 2015 in the DS Kothari Centre for Research and Innovation in Science Education in Miranda House. Six Chemistry faculty members were involved as mentors in various interesting projects, which included Natural Indicators, Sunscreen Lotions, Antioxidant Activity of Fruit Juices, Caffeine in Soft Drinks etc.

Rasayanika, the departmental society, was inaugurated with the talk *Quasicrystals: the 2011 Nobel Prize in Chemistry*, which was delivered by Prof Rajesh Prasad of IIT Delhi. With this lecture, the Add-on Certificate Course *Green Chemistry and Environment* was also launched for the academic session 2015-16. The other invited speakers during the session were: Dr Koustubh Sharma from Snow Leopard Trust; Dr. Pravin P. Ingole from IIT Delhi; Dr Sumit Sharma from Ohio State University; Dr Sushmita Mohapatra from Bhartiya Vidyapeeth College of Engineering, Delhi; Dr Fawzia Tarannum from TERI University and Dr Jeetender Chugh from IISER Pune.

A Bridge Course was conducted for B.Sc (H) Chemistry CBCS students on *Safety in the Chemistry Laboratory* in October. Faculty training workshops *Computational Methods in Drug Discovery* and *Computational Chemistry and Bioinformatics* were organised by Chemistry teachers of Miranda House in April and August 2015 respectively. An educational excursion for students was undertaken in October to the Forest Research Institute in Dehradun. The group was accompanied by two teachers and two non-teaching staff members. Some Chemistry students and two teachers attended the Global Biotechnology Summit organised by the Department of Biotechnology at Vigyan Bhawan on 5-6 February 2016. A group of Chemistry students accompanied by five teachers attended Sir Venkataraman (Venki) Ramakrishnan's talk organised by the British Council in the KK Birla Auditorium on 8 January 2016. Seven Chemistry students were invited participants in the NDTV Agenda episode anchored by Sunetra Chodhury regarding the World Culture Festival in March 2016. Two of them asked questions which were appreciated by the audience.

Chemistry students are active in various cultural societies of the college. The posts of President of NSS and President and Vice President of MH-Vatavaran were held by Chemistry students in 2015-16. Chemistry students got a number of prizes in Tempest 2016. These included two prizes each in Book Cover Designing and Slogan Writing and one prize in Film-based Quiz. On Founder's Day 2016, Chemistry students received several awards and honours including Best Volunteer, MH-Vatavaran and the highly prestigious Golden Jubilee Award for Science.

The highlight of *Pratikriya 2016,* the annual inter-college Chemistry Festival held on 15 March 2016 was an interactive panel discussion on *What after Chemistry Honours in Miranda House?* Invited Miranda House Chemistry alumnae spoke about their college days and their career paths, emphasising the fact that their training in Chemistry received at Miranda House had stood them in good stead whatever their chosen field after graduation. The panellists were Marilyn D. Milton, Professor, Department of Chemistry, University of Delhi; Sindhu Jain Bhattacharya, Contributing Editor CNBC-TV18; Sonia Gandhi, Scientist, DRDO; Urvana Menon, Programme Officer WWF-India; Arpita Kulshrestha, Advocate and Anu Kadyan, Research Scholar IIT Delhi. Students enjoyed the reminiscences of the visitors and derived inspiration for their own future careers from the interesting stories of struggle and success narrated by the panellists. Some students also made high quality presentations on

scientific topics. Some of the panellists stayed back to judge the scientific posters displayed by the students. *Prayog* the lab work competition and the Chemical Crossword also generated enthusiastic participation. Overall, it was a day-long celebration of Chemistry that struck a chord with the students.

List of prize winners in various competitive events of *Pratikriya 2016*

***Eureka!* The Paper Presentation** *First Prize*	Sagarika	Daulat Ram College
Second Prize	Raksha Jain & Ipshita	Miranda House
Scientific Poster Presentation *First Prize* *Second Prize*	 Deeksha & Priyanka Ritu & Mahima	 Miranda House Miranda House
Prayog *First Prize* *Second Prize*	 Aashi Raksha Jain	 Kirori Mal College Miranda House
Chemiscellany *First Prize* *Second Prize*	 Preeti & Rashmi Aditi & Megha	 Miranda House Miranda House

Information received about placements for higher studies for the outgoing batch of 2015-16:

Deepshi Singh	M.Sc. Chemistry, IIT Roorkee
Jyoti Aggarwal	Masters in Environment Education, Lynchburg College, USA
Chitranshi Sharma, Kajol Tonk, Priti Pilania, Priya Yadav, Rohini Aggarwal	M.Sc. Chemistry, IIT Delhi
Geetika Dhanda	Integrated Ph.D. JNCASR, Bangalore
Reshma Kumari, Sakshi Mehta, Susmita Baruah	M.Sc. Chemistry, IIT Guwahati
Yashvi Paniya	M.Sc Chemistry, IISER, Bhopal
Chinky Kochar, Diksha Malik, Divya Yadav, Gunjan, Khushboo, Kritika Singh, Manisha Kumari, Monika Kumari, Meenakshi Yadav, Purvika, Sonia Verma, Vibha Saini, Swati Khurana	M.Sc. Chemistry, University of Delhi

Alishpreet Kaur, Vice President

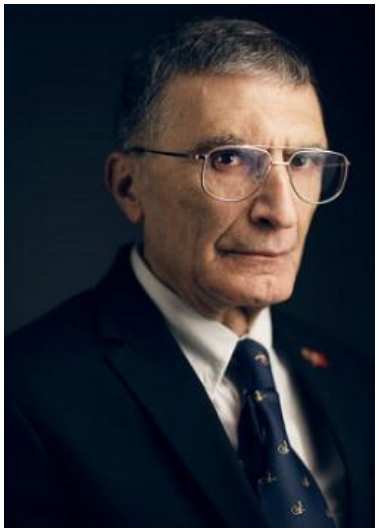
NOBEL PRIZE IN CHEMISTRY 2015

A Review

The Nobel Prize in Chemistry 2015 was awarded jointly to
Tomas Lindahl
Francis Crick Institute and Clare Hall Laboratory, Hertfordshire, UK
Paul Modrich
Howard Hughes Medical Institute and Duke University School of Medicine, Durham, NC, USA
Aziz Sancar
University of North Carolina, Chapel Hill, NC, USA
"for mechanistic studies of DNA repair"

Tomas Lindahl

Paul Modrich



Aziz Sancar

Nobel Prize in Chemistry 2015

DNA repair – providing chemical stability for life – from one cell to another, from one generation to the next. The genetic information that governs how human beings are shaped has flowed through our bodies for hundreds of thousands of years. It is constantly subjected to assaults from the environment, yet it remains surprisingly intact. Tomas Lindahl, Paul Modrich and Aziz Sancar were awarded the Nobel Prize in Chemistry 2015 for having mapped and explained how the cell repairs its DNA and safeguards the genetic information. The foundation of who you are was created when 23 chromosomes from a sperm combined with 23 chromosomes from an egg. Together, they formed the original version of your genome, your genetic material. All the genetic information required to create you was present in that fusion. If someone had pulled out the DNA molecules from this first cell and laid them in a row, it would have been two metres long. When the fertilised egg subsequently divided, the DNA molecules were copied and the daughter cell also obtained a full set of chromosomes. After that, the cells divided again; two became four, four became eight. After the first week you consisted of 128 cells, each one with its own set of genetic material. The total length of your DNA began to approach 300 metres. Today – many, many billions of cell divisions later – your DNA could stretch all the way to the sun and back, around 250 times. Even though your genetic material has been copied so many times, the most recent copy is remarkably similar to the original that was once created in the fertilised egg. This is where

life's molecules display their greatness, because from a chemical perspective this ought to be impossible. All chemical processes are prone to random errors. Additionally, your DNA is subjected on a daily basis to damaging radiation and reactive molecules. In fact, you ought to have been a chemical chaos long before you even developed into a foetus. Your DNA is monitored by a swarm of proteins Our DNA remains astonishingly intact, year after year, due to a host of molecular repair mechanisms: a swarm of proteins that monitor the genes. They continually proof-read the genome and repair any damage that has occurred. The Nobel Prize in Chemistry 2015 is awarded to Tomas Lindahl, Paul Modrich and Aziz Sancar for having mapped these fundamental processes at the molecular level. Their systematic work has made a decisive contribution to the understanding of how the living cell functions, as well as providing knowledge about the molecular causes of several hereditary diseases and about mechanisms behind both cancer development and aging. Tomas Lindahl, Paul Modrich and Aziz Sancar have, independently of each other, mapped several processes for DNA repair that are relevant to humans. The story begins with Tomas Lindahl, born in the same country as Alfred Nobel. Life exists – so DNA must be repairable "How stable is DNA, really?", Tomas Lindahl started wondering towards the end of the 1960s. At the time, the scientific community believed that the DNA molecule – the foundation of all life – was extremely resilient; anything else was simply out of the question. Evolution does require mutations, but only a limited number per generation. If genetic information were too unstable no multi-cellular organisms would exist. During his postdoc at Princeton University, USA, Tomas Lindahl worked on the RNA molecule, a molecular cousin to DNA. It did not go well. In his experiment he had to heat RNA, but this inevitably led to the molecules' rapid degradation. It was well known that RNA was more sensitive than DNA, but if RNA was destroyed so quickly when subjected to heat, could DNA molecules really be stable for a lifetime? This question took hold in Lindahl's mind. It would be a few years before he began to look for an answer to that question, and by then he had moved back to Sweden and Karolinska Institutet in Stockholm. Some straightforward experiments proved that his suspicions were correct: DNA underwent a slow but noticeable decay. Lindahl estimated that there were thousands of potentially devastating injuries to the genome every day, a frequency that was clearly incompatible with human existence on Earth. His conclusion was that there must be molecular systems for repairing all these DNA defects and, with this idea, Tomas Lindahl opened the door on an entirely new field of research. Special enzymes remove damage in DNA Using bacterial DNA which, just like human DNA, consists of nucleotides with the bases adenine, guanine, cytosine, and thymine, Tomas Lindahl began to look for repair enzymes. One chemical weakness in DNA is that cytosine easily loses an amino group, which can lead to the alteration of genetic information. In DNA's double helix, cytosine always pairs with guanine, but when the amino group disappears, the damaged remains tend to pair with adenine. Therefore, if this defect is allowed to persist, a mutation will occur the next time DNA is replicated. Lindahl realised that the cell must have some protection against this, and was able to identify a bacterial enzyme that removes damaged remains of cytosines from DNA. In 1974, he published his findings. Tomas Lindahl puts together the pieces of base excision repair This was the start of 35 years of successful work, during which Tomas Lindahl has found and examined many of the proteins in the cell's toolbox for DNA repair. In the beginning of the 1980s, a relationship took him to Great Britain, where he took up a position at the Imperial Cancer Research Fund in London. In 1986, he became director of the newly founded Clare Hall Laboratory, subsequently known for its scientific creativity. Bit by bit, Lindahl pieced together a molecular image of how *base excision repair* functions, a process in which *glycosylases,* enzymes similar to the one he had found in 1974, are the first step in the DNA repair process. Base excision repair also occurs in human beings and, in 1996, Tomas Lindahl managed to recreate the human repair process *in vitro.* The decisive

factor for Tomas Lindahl was the realisation that DNA inevitably undergoes change, even when the molecule is located in the cell's protective environment. However, it had long been known that DNA can be damaged by environmental assaults such as UV radiation. The mechanism used by the majority of cells to repair UV damage, *nucleotide excision repair,* was mapped by Aziz Sancar, born in Savur, Turkey, and professionally active in the USA.

Biochemistry preferable to life as a doctor Aziz Sancar's fascination with life's molecules developed while he was studying for a medical degree in Istanbul. After graduating, he worked for a few years as phycisian in the Turkish countryside, but in 1973 he decided to study biochemistry. His interest was piqued by one phenomenon in particular: when bacteria are exposed to deadly doses of UV radiation, they can suddenly recover if they are illuminated with visible blue light. Sancar was curious about this almost magical effect; how did it function chemically?

Claud Rupert, an American, had studied this phenomenon and Aziz Sancar joined his laboratory at the University of Texas in Dallas, USA. In 1976, using that time's blunt tools for molecular biology, he succeeded in cloning the gene for the enzyme that repairs UV-damaged DNA, *photolyase,* and also in getting bacteria to over-produce the enzyme. This work became a doctoral dissertation, but people were hardly impressed; three applications for postdoc positions resulted in as many rejections. His studies of photolyase had to be shelved. In order to continue working on DNA repair, Aziz Sancar took up a position as laboratory technician at the Yale University School of Medicine, a leading institution in the field. Here he started the work that would eventually result in the Nobel Prize in Chemistry.

Aziz Sancar - investigating how cells repair UV damage By then it was clear that bacteria have two systems for repairing UV damage: in addition to light-dependent photolyase, a second system that functions in the dark had been discovered. Aziz Sancar's new colleagues at Yale had studied this dark system since the mid-1960s, using three UV-sensitive strains of bacteria that carried three different genetic mutations: *uvrA, uvrB* and *uvrC.* As in his previous studies of photolyase, Sancar began investigating the molecular machinery of the dark system. Within a few years he had managed to identify, isolate and characterise the enzymes coded by the genes *uvrA, uvrB* and *uvrC.* In ground-breaking *in vitro* experiments he showed that these enzymes can identify a UV-damage, then making two incisions in the DNA strand, one on each side of the damaged part. A fragment of 12-13 nucleotides, including the injury, is then removed. Base excision repair C A A G T T C A A G T T C A G A G T T G C A A G T T C A A G T T U G 1 2 3 4 5 C GU GC Base excision repairs DNA when a base of a nucleotide is damaged, for example cytosine. Cytosine can easily lose an amino group, forming a base called uracil. An enzyme, glycosylase, discovers the defect and excises the base of uracil. Another couple of enzymes remove the rest of the nucleotide from the DNA strand. Uracil cannot form a base pair with guanine. DNA polymerase fills in the gap and the DNA strand is sealed by DNA ligase.

Similar mechanisms for UV damage repair in humans and bacteria Aziz Sancar's ability to generate knowledge about the molecular details of the process changed the entire research field. He published his findings in 1983. His achievements led to an offer of an associate professorship in biochemistry at the University of North Carolina at Chapel Hill. There, and with the same precision, he mapped the next stages of nucleotide excision repair. In parallel with other researchers, including Tomas Lindahl, Sancar investigated nucleotide excision repair in humans. The molecular machinery that excises UV damage from human DNA is more complex than its bacterial counterpart but, in chemical terms, nucleotide excision repair functions similarly in all organisms. So, what happened to Sancar's initial interest in

photolyase? Well, he eventually returned to this enzyme, uncovering the mechanism responsible for reviving the bacteria. In addition, he helped to demonstrate that a human equivalent to photolyase helps us set the circadian clock. Time to turn to the work of Paul Modrich. He also began with a vague idea about a repair mechanism, which he then chiselled out in elegant molecular detail.

It pays off to learn about "DNA stuff" Paul Modrich grew up in a small town in northern New Mexico, USA. The diversity of the expansive landscape spurred his interest in nature, but one day his father, a biology teacher, said: "You should learn about this DNA stuff." This was in 1963, the year after James Watson and Francis Crick had been awarded the Nobel Prize for discovering the structure of DNA. A few years later, that "DNA stuff" really became central to Paul Modrich's life. Early in his research career, as doctoral student at Stanford, during his postdoc at Harvard, and as an assistant professor at Duke University, he examined a series of enzymes that affect DNA: *DNA ligase, DNA polymerase* and the 1 UV radiation 3 4 2 Nucleotide excision repair Nucleotide excision repairs DNA-injuries caused by UV radiation or carcinogenic substances like those found in cigarette smoke. UV radiation can make two thymines bind to each other incorrectly. The enzyme exinuclease finds the damage and cuts the DNA strand. Twelve nucleotides are removed. DNA polymerase fills in the resulting gap. DNA ligase seals the DNA strand. Now the injury has been dealt with.

A few years later, that "DNA stuff" really became central to Paul Modrich's life. Early in his research career, as doctoral student at Stanford, during his postdoc at Harvard, and as an assistant professor at Duke University, he examined a series of enzymes that affect DNA: *DNA ligase, DNA polymerase* and the restriction enzyme *Eco RI*. When he subsequently, towards the end of the 1970s, shifted his attention to the enzyme *Dam methylase* he stumbled over another piece of "DNA stuff" that would come to occupy him for a large part of his scientific career.

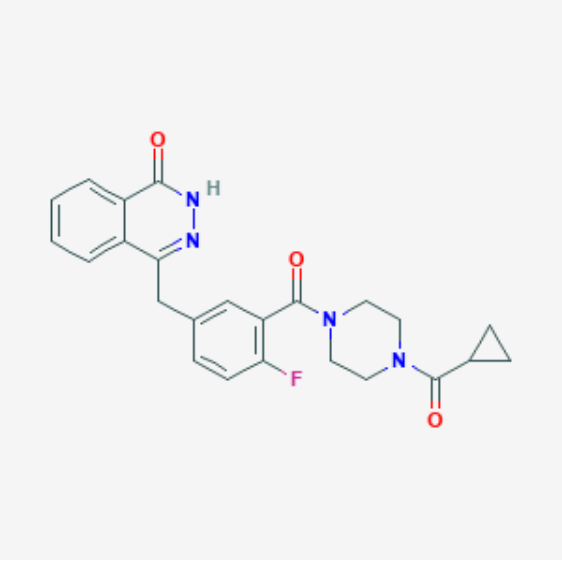
Interweaving two strands of research Dam methylase couples methyl groups to DNA. Paul Modrich showed that these methyl groups could function as signposts, helping a particular restriction enzyme to cut the DNA strand at the correct location. However, only a few years earlier, Matthew Meselson, a molecular biologist at Harvard University, had suggested a different signalling function for the methyl groups on DNA. Using some molecular biology artistry, Meselson had constructed a bacterial virus with several occurrences of mismatching bases in the DNA. For instance, A could be placed opposite C, instead of T. When he let these viruses infect bacteria, the bacteria corrected the mismatches. No one knew why the bacteria had developed this function, but in 1976 Meselson speculated, among other things, that it could be a repair mechanism that corrected the faulty matches that sometimes occur when DNA is replicated. If that was the case, Meselson continued, perhaps the methyl groups on the DNA helped the bacteria identify which strand to use as template during correction. As the new DNA strand, the faulty replica, was still unmethylated, maybe that was how it could be identified and corrected? Here – in the methylation of DNA – Paul Modrich's and Matthew Meselson's paths crossed. Working together, they created a virus with a number of mismatches in its DNA. This time, Modrich's dam methylase was also used to add methyl groups to one of the DNA strands. When these viruses infected bacteria, the bacteria consistently corrected the DNA strand that lacked methyl groups. Modrich and Meselson's conclusion was that DNA *mismatch repair* is a natural process that corrects mismatches that occur when DNA is copied, recognising the defect strand by its unmethylated state.

Paul Modrich – illustrating DNA mismatch repair For Paul Modrich, this discovery kick-started a decade of systematic work, cloning and mapping one enzyme after the other in the

mismatch repair process. Towards the end of the 1980s, he was able to recreate the complex molecular repair mechanism *in vitro* and study it in great detail. This work was published in 1989. Paul Modrich, just like Tomas Lindahl and Aziz Sancar, has also studied the human version of the repair system. Today we know that all but one out of a thousand errors that occur when the human genome is copied, are corrected by mismatch repair. However, in human mismatch repair, we still do not know for sure how the original strand is identified. DNA methylation has other functions in our genome to that of bacteria, so something else must govern which strand gets corrected – and exactly what remains to be clarified.

Defects in the repair systems cause cancer. Besides base excision repair, nucleotide excision repair, and mismatch repair, there are several other mechanisms that maintain our DNA. Every day, they fix thousands of occurrences of DNA damage caused by the sun, cigarette smoke or other genotoxic substances; they continuously counteract spontaneous alterations to DNA and, for each cell division, mismatch repair corrects some thousand mismatches. Our genome would collapse without these repair mechanisms. If just one component fails, the genetic information changes rapidly and the risk of cancer increases. Congenital damage to the nucleotide excision repair process causes the disease *xeroderma pigmentosum;* individuals who suffer from this disease are extremely sensitive to UV radiation and develop skin cancer after exposure to the sun. Defects in DNA mismatch repair increase the risk of developing hereditary colon cancer, for instance. In fact, in many forms of cancer, one or more of these repair systems have been entirely or partially switched off. This makes the cancer cells' DNA unstable, which is one reason why cancer cells often mutate and become resistant to chemotherapy. At the same time, these sick cells are even more dependent on the repair systems that are still functioning; without these, their DNA will become too damaged and the cells will die. Researchers are attempting to utilise this weakness in the development of new cancer drugs. Inhibiting a remaining repair system allows them to slow down or completely stop the growth of the cancer. One example of a pharmaceutical that inhibits a repair system in cancer cells is *olaparib.* In conclusion, the basic research carried out by the 2015 Nobel Laureates in Chemistry has not only deepened our knowledge of how we function, but could also lead to the development of lifesaving treatments. Or, in the words of Paul Modrich: "That is why curiosity-based research is so important. You never know where it is going to lead… A little luck helps, too."

Source: http://www.nobelprize.org/nobel_prizes/chemistry/laureates/2015/



ABSTRACTS OF PAPERS PRESENTED IN *PRATIKRIYA 2016*

Advances in Green Chemistry

Kriti Kapil
Miranda House

Green Chemistry, also called sustainable chemistry, is an area of chemistry and chemical engineering focused on the design of products and processes that minimize the use and generation of hazardous substances. Green chemistry focuses on technological approaches to preventing pollution and reducing consumption of nonrenewable resources. The concept of greening chemistry is a relatively new idea which developed in the business and regulatory communities as a natural evolution. In our efforts to improve crop protection, commercial products and medicines, we have been causing unintended harm to our planet and humans.

Green Chemistry can help us to develop chemical processes and earth-friendly products that will prevent pollution in the first place. Through the practice of green chemistry, we can create alternatives to the hazardous substances we use as our source materials. We can design chemical processes that reduce waste and reduce demand on diminishing resources. We can employ processes that use smaller amounts of energy. We can do all of this and still maintain economic growth and opportunities while providing affordable products and services to a growing world population.

This is a field open for innovation, new ideas, and revolutionary progress. This is the future of Chemistry. The presentation will capture a brief outline on the recent advances made in the field of Green Chemistry and the future prospects of this gloriously emerging branch of Science.

Anticancer Drugs

Prashant Sharma
Ramjas College

Cancer is the unregulated growth of cells. The paper looks at various causes of cancer and the effect on the cell cycle. It also examines which anticancer drug is acting on which part of the cell cycle (cell cycle specific drugs & nonspecific drugs) and classification of anticancer drugs on the basis of structure and their mode of action with various examples.

An overview is also given of platinum based anticancer drugs (Cisplatin, Carboplatin, Oxaplatin) their side effects and their mechanism of action, ruthenium based anticancer drugs, their uptake in the body and advantage over other drugs (NAMI-A, KP1019), their uses and side effects, also osmium complexes, gallium complexes and various toxicities of these drugs.

Bioremediation

Aditi Arora, Samriddhi Bajaj
Miranda House

Bioremediation is a waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site. Technologies can be generally classified as *in situ* or *ex situ*. Some examples of bioremediation are phytoremediation, bioleaching, bioreactor, composting and rhizofiltration.

Bioremediation may occur on its own (natural attenuation or intrinsic bioremediation) or may only effectively occur through the addition of fertilizers, oxygen, etc., that help encourage the growth of the pollution-eating microbes within the medium (biostimulation).

Microorganisms used to perform the function of bioremediation are known as **bioremediators**.

However, not all contaminants are easily treated by bioremediation using microorganisms. For example, heavy metals such as cadmium and lead are not readily absorbed or captured by microorganisms. A recent experiment, however, suggests that fish bones have some success absorbing lead from contaminated soil. Bone char has been shown to bioremediate small amounts of cadmium, copper, and zinc. Phytoremediation is useful in these circumstances because natural plants or transgenic plants are able to bioaccumulate these toxins in their above-ground parts, which are then harvested for removal.

Mycoremediation is a form of bioremediation in which fungi are used to decontaminate the area. The term *mycoremediation* refers specifically to the use of fungal mycelia in bioremediation. There are a number of cost/efficiency advantages to bioremediation, which can be employed in areas that are inaccessible without excavation. For example, hydrocarbon (specifically, petrol spills) or certain chlorinated solvents may contaminate groundwater, and introducing the appropriate electron acceptor or electron donor amendment, as appropriate, may significantly reduce contaminant concentrations after a long time allowing for acclimation. This is typically much less expensive than excavation followed by disposal elsewhere, incineration or other *ex situ* treatment strategies, and reduces or eliminates the need for "pump and treat", a practice common at sites where hydrocarbons have contaminated clean groundwater.

The process of bioremediation can be monitored indirectly by measuring the *Oxidation Reduction Potential* or redox in soil and groundwater, together with pH, temperature, oxygen content, electron acceptor/donor concentrations and concentrations of breakdown products (e.g. carbon dioxide).

Bio-Remediation

Nancy Suri, Divya Bhatt
Miranda House

The term ‘bioremediation’ covers a wide range of engineered systems which utilizes micro-organisms to degrade, detoxify and immobilize organic contaminants. It is the use of living organisms (e.g., bacteria) to clean up oil spills or remove other pollutants from soil, water, and wastewater. It relies largely on the enzymatic activities of living organisms, usually microbes, to catalyze the destruction of pollutants or their transformation to less harmful forms.

There are sites which are filled with waste organic materials and bacteria, fungi, protists and other microorganism keep on breaking down the organic matter to decompose the waste. If such environment is filled with oil spill, some organism would die while some would survive. Bioremediation works by providing these organisms different materials like fertilizer, oxygen, and other condition to survive. This would help to break the organic pollutant at a faster rate.

This process uses no chemicals and it allows waste to be recycled. It allows for contamination to be treated, neutralized or removed and then produces a waste product itself that is more easily disposed of. In some cases, there is no need for disposal at all.

There are 9 types of bio-remediation techniques *viz*. Phytoremediation, Bioventing, Bioleaching, Landfarming, Bioreactor, Composting, Bioaugmentation, Rhizofiltration and Biostimulation –each using different methods to remove different type of contaminants.

Bioremediation is a promising approach for environment because of its permanence and potentially low cost compared to other technologies. It is one of the most cost effective and safe solutions we currently have for managing contaminated waste.

Green Chemistry

Mohika Banga
Maitreyi College

The paper first introduces and explains the term Green Chemistry. It goes on to state and elaborate the twelve principles of Green Chemistry. The goals of Green Chemistry are explained. Some examples and uses of green chemistry in everyday life are discussed. New research in the field of Green Chemistry is then presented.

Green and Ecofriendly Synthesis of Silver Nanoparticles

Raksha Jain, Ipshita Majumdar
Miranda House

Metallic nanoparticles have been extensively investigated due to their unique size-dependent properties which make them ideal for numerous applications including optical/chemical sensors, electronic devices, and catalysts. These nanoparticles exhibit unique physical, chemical and biological properties due to their high surface-to-volume ratio. In this work, the synthesis of stable silver nanoparticles by the bioreduction method is investigated.The synthesis of nanoparticles is the buzzword in modern nanotechnology. The synthesis of nanoparticles using plant extracts is currently under fruitful exploitation and has opened avenues to fight microbes and prevent diseases using atomic scale tailoring of materials. Aqueous extracts of spices such as clove, cinnamon, cumin, black pepper and fennel seeds are used as reducing and stabilizing agents for preparation of silver nanoparticles. These green silver nanoparticles can then be used for various applications including the preparation of water purification devices.

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Plants to Purify Indoor Air

Sagarika Taneja
Daulat Ram College

Indoor Air Pollution is the second highest killer in India (directly or indirectly). US EPA (Environmental Protection Agency) estimates that indoor air is 10 times worse than ambient air. The brain utilizes 20% of the body's oxygen supply; hence pure air is essential for good health. There are approximately 200 different kinds of VOCs (volatile organic compounds) in our atmosphere, which are biggest air pollutants. Levels of common organic pollutants are 2 to 5 times higher inside homes than outside. Right kinds of toxin removing plants like Mother-in-law's Tongue (*Sansevieria trifasciata*) and Money Plant (*Epipremnum aureum*) can help in keeping the air clean by adsorbing the particulate matter – even PM2.5 which is the most dangerous pollutant. WHO recommends maximum limit of PM2.5 to be 10µg/m^3 whereas its level is approximately 350µg/m^3. Large scale promotion of keeping such plants indoors can help in keeping air pollution under control. A combination of such plants can act like air purifiers and require low maintenance.

CHEMISTRY ADVANCEMENTS THAT SCULPTED THE MODERN WORLD

Did you know that the discovery of a way to make ammonia was the single most important reason for the world's population explosion from 1.6 billion in 1900 to 7 billion today? Or that polythene, the world's most common plastic, was accidentally invented twice?

The chances are you didn't, as chemistry tends to get overlooked compared to the other sciences. Not a single chemist made it into *Science magazine*'s **Top 50 Science stars** on Twitter. Chemistry news just don't get the same coverage as the physics projects, even when the project was all about landing a chemistry lab on a comet.

So the **Royal Society of Chemistry** decided to look into what people really think of chemistry, chemists and chemicals. It turns out most people just don't have a good idea of what it is chemists do, or how chemistry contributes to the modern world.

This is a real shame, because the world as we know it wouldn't exist without chemistry. Here are the top three chemistry inventions that make the world we live in.

1. Penicillin

There's a good chance that penicillin has saved your life. Without it, a prick from a thorn or sore throat can easily turn fatal. **Alexander Fleming** generally gets the credit for penicillin when, in 1928, he famously observed how a mould growing on his Petri dishes suppressed the growth of nearby bacteria.

But, despite his best efforts, he failed to extract any usable penicillin. In 1939 Australian pharmacologist **Howard Florey** and his team of chemists figured out a way of purifying penicillin in useable quantities.

Full-scale production of penicillin took off in 1944 when the chemical engineer **Margaret Hutchinson Rousseau** took Florey's Heath Robinson-esque design and converted it into a full-scale production plant.

2. The Haber-Bosch process

Nitrogen plays a critical role in the biochemistry of every living thing. It is also the most common gas in our atmosphere. But nitrogen gas doesn't like reacting with very much, which means that plants and animals can't extract it from the air. Consequently a major limiting factor in agriculture has been the availability of nitrogen.

In 1910, German chemists **Fritz Haber** and **Carl Bosch** changed all this when they combined atmospheric nitrogen and hydrogen into ammonia. This in turn can be used as crop fertilizer, eventually filtering up the food chain to us.

Today about 80% of the nitrogen in our bodies comes from the Haber-Bosch process, making this single chemical reaction probably the most important factor in the population explosion of the past 100 years.

3. Polythene

Most common plastic objects, from water pipes to food packaging and hardhats, are forms of polythene. The 88m tons of the stuff that is made each year is the result of two accidental discoveries.

The first occurred in 1898 when German chemist **Hans von Pechmann**, while investigating something quite different, noticed a waxy substance at the bottom of his tubes. Along with his colleagues he discovered that it was made up of very long molecular chains which they termed polymethylene.

Then in 1933 an entirely different method for making the plastic was discovered by chemists at the now defunct chemical company **ICI**. They were working on high-pressure reactions and noticed the same waxy substance as **von Pechmann**. At first they failed to reproduce the effect until they noticed that in the original reaction oxygen had leaked into the system.

Two years later **ICI** had turned this serendipitous discovery into a practical method for producing the common plastic that's almost certainly within easy reach of you now.

Source:http://blogs.discovermagazine.com/crux/2015/06/02/chemistry-breakthroughs/#.Vyn88lIwBXV

Sushmita Baruah
Chemistry Honours III Year

SIR VENKATRAMAN RAMAKRISHNAN'S LECTURE

A Report

The globally known Nobel laureate and structural biologist, Sir Venkatraman Ramakrishnan delivered a lecture as a part of the GREAT TALK series organized by British Council at K. K. Birla Auditorium on 8 January 2016. The GREAT TALK series aims to motivate young Indian students to plan their careers effectively by interacting with British citizens who are leaders in their chosen fields. A group of students from the Departments of Botany and Chemistry, Miranda House, accompanied by Dr. Bani Roy and Dr. Mallika Pathak attended the lecture.

In his talk titled *On Nobody's Word: Evidence and Modern Science*, Sir Venki, as he is popularly known as, explored some examples of errors made by scientists as well as examples of irrational beliefs that persist. Sir Venki was recently elected President of the Royal Society and began his lecture by appreciating the motto of the Society *Nullis in verba*, which translates to "Take nobody's word for it". The apt motto is an expression of the determination of Fellows to withstand the domination of authority and to verify all statements by an appeal to facts determined by experiment.

His fascinating talk progressed into the importance of removing a bias to perfectly dissect a problem scientifically. He debunked many so called scientific theories such as cold fusion, stork effect and other explanations with barren logic given by esteemed scientists and quacks alike. As his talk progressed, he elaborated on the importance of realizing what bad science is. Dr. Venki quoted a passage written by Ben Goldacre on how science has always been self-correcting in nature.

The field of science has undergone some rather drastic evolution over the past centuries. Misguided fields such as alchemy and astrology have slowly but surely progressed into advanced fields of modern chemistry and astronomy. Rationality over the ages has been on a relative progression. Astrologers, alchemists and "healers" that were once considered as mystical practitioners of science are now mostly debunked as charlatans and pseudo-scientists. This testifies to the fact that science in itself is self-correcting and works in spite of the scientists that create it.

To illustrate, Sir Venki cited the cold fusion theory. Hypothesized by Martin Fleischmann and Stanley Pons in 1989, the theory was later proved inaccurate. Another satisfying answer was given by him to make the audience understand that no one is immune to confirmation bias. Sir Venki shared the example of Linus Pauling's recommendation of Vitamin C (ascorbic acid) as a treatment to common cold and cancer. Till date, Vitamin C tablets are regarded as a sure measure to get rid of the cold. However, this delusional recommendation has been proven false by a series of studies conducted by National Institute of Health. This exemplifies that humans by nature have a fondness for bias. This is not only restricted to the common man's bias towards an opinion by a scientist of great stature but also that of the scientists themselves. Linus Pauling was had already been awarded the Nobel Prize and had earned a formidable reputation around the globe. Even when he gave opinions in fields outside his expertise, they were taken as facts without a thought. In summary, not everything that sounds scientific can be deemed as science.

Amongst many other interesting bits, one crucial facet of his talk was on the need to differentiate fields that can make a logical progress and from those that will ultimately stagnate. For example, Ayurveda and homoeopathy should not be treated in the same way.

Ayurveda is a system of traditional medicine that is quite different from homoeopathy. Many of the Ayurveda remedies may be quite worth exploring. The Nobel Prize for medicine in 2015 went to a Youyou Tu, Chinese doctor who explored Chinese traditional medicine and put it to scientific test and isolated the active ingredient, in this case artemisinin,that has revolutionized the treatment of drug-resistant malaria. He believes that Ayurveda needs to put its recipes to the scientific test. In science, it is not bad to be wrong but it is bad to deliberately falsify.

Dr. Venki Ramakrishnan's talk was incredibly illuminating for us students who are prone to confirmation bias because a great chunk of our knowledge in the present day is based on facts gleaned from the Internet that may not be supported with valid tests. Sir Venki's smooth and interactive style of oration was reminiscent of the talk he had given at Miranda House in December 2013. His talk was indeed a brilliant amalgamation of brevity, eloquence and wit, a much needed combination to instill scientific curiosity in the students.

Ninadini Sharma
Botany Honours III Year 2015-16

GLOBAL BIOTECHNOLOGY SUMMIT 2016

Celebrating Biotechnology: "Destination India"

A Global Biotechnology Summit with the theme *Destination India* was held on 5-6 February 2016 at Vigyan Bhawan, New Delhi. The two-day summit organized by the Department of Biotechnology, Ministry of Science and Technology, Government of India, brought together nearly 1500 participants to discuss opportunities, collaborate and prepare a joint action plan for achieving the target of 100 billion US dollars for the Biotech sector by 2020. The summit, organized on the occasion of the 30th Foundation Day of Department of Biotechnology (DBT), was attended by more than 1500 participants including eminent scientists from national and international, public and private sector institutions and organizations, delegations from state governments and delegations from other countries with DBT partners, students, research fellows, biotech start-up entrepreneurs, policy makers, civil society and so on. Also present on the occasion were the former secretaries of DBT.

Dr. Harsh Vardhan, Hon'ble Minister of Science and Technology and Earth Sciences, was the Chief Guest for the occasion. Guests of honour were Shri Radha Mohan Singh, Minister of Agriculture and Farmers' Welfare, Smt. Nirmala Sitharaman, Minister of State (independent charge), Ministry of Commerce and Industry and Shri Y.S. Chowdhary, Minister of State, Ministry of Science and Technology. The event started with the welcome address by Prof. K. Vijay Raghavan, Secretary, DBT. The basic theme of his address can be summed up by saying that India should not fall behind in biotechnology sector.

Special addresses were given by the guests of honour. All three guests of honour talked about India being ready to be a global Biotech Destination and said that this sector will grow and contribute to the economy. The mega-event showcased India's biotechnology strength and capacity to attract investors and other key partners to invest in the biotech sector in India. The summit was a well-planned follow-up to the Hon'ble Prime Minister's call for 'Make In India' to encourage the start-up ecosystem which has a potential for scale-up.

There were key plenary talks by Prof. Ada E. Yonath, Nobel Laureate, Weizmann Institute of Science, Israel and Prof. Maria Leptin, EMBO- Excellence in Life Sciences, Heidelberg, Germany.

The summit focused on the priority themes- Make in India, Start-up India, Nurturing Bio entrepreneurship, Skill India, Biotech Opportunities, Action for Swachh Bharat and Swasth Bharat, Biotechnology Cooperation, Biotechnology Innovation for Inclusive Development and Biotechnology and Society.

"Steered under the leadership of brilliant minds over the years, biotechnology in India has crossed significant milestones. With the experience of 30 years, DBT's endeavour will be to further improve our processes and culture so that we expand our reach and depth effectively," said Prof. Vijay Raghavan, Secretary, DBT.

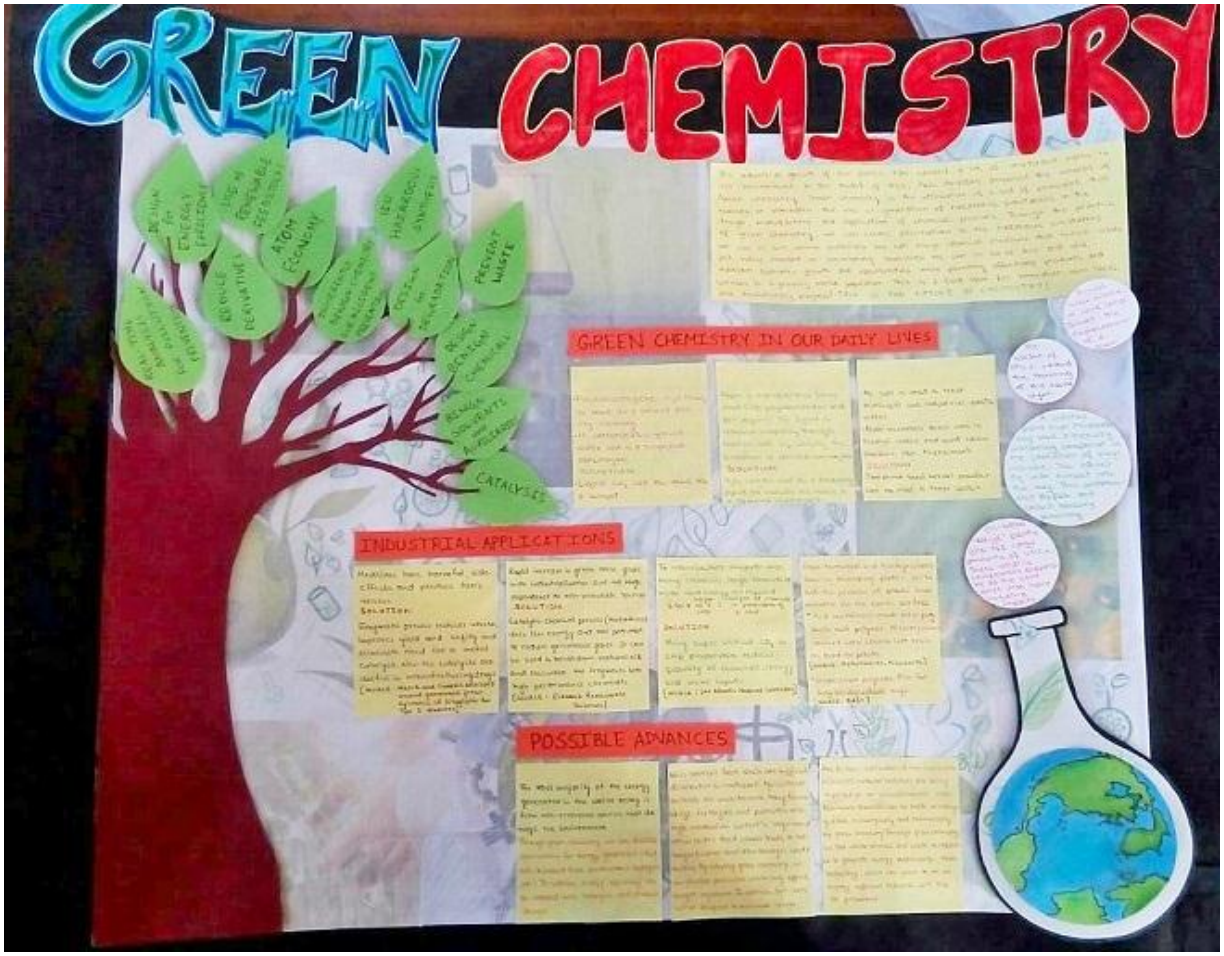
Plenary talks and panel discussions helped the participants to understand how the goals of the biotech strategy have been aligned with the policies of State Governments and the joint action plan. It showed the path to exciting opportunities for students and researchers by giving them an exposure to the best experts in the field. Our Principal, Dr. Pratibha Jolly, was one of the speakers in the Skill India session. Dr. Jolly impressed everyone with her well-chosen words as she always does.

The event was a great learning experience for all of us. We sincerely thank our department teachers for giving us the opportunity to be a part of this session.

P.S. The place and the food were really great.

Nancy Suri

Chemistry Honours II Year



EDUCATIONAL TOUR TO MUSSOORIE, DEHRADUN, DHANAULTI AND HARIDWAR

The Departments of Chemistry and Botany of Miranda House organised an educational trip of three days and four nights (31 Oct- 3 Nov 2015 to Mussoorie, Dehradun, Dhanaulti and Haridwar. There were 18 students of Botany and 30 students of Chemistry along with four teachers (two from Botany and two from Chemistry) and senior laboratory staff members (two each from Botany and Chemistry).

The group checked into the hotel in Mussoorie and left immediately to visit the beautiful Kempty falls. In the evening a trip to Gun Hill point was undertaken by ropeway. The next day, the group left for Dhanaulti to visit Eco Park and Surkanda Devi Temple. The temple was situated on a hill top with three kilometres of trekking. The Eco Park was full of biodiversity of plants.

On the third day, Sahastradhara in Dehradun, which is famous for its sulphur water reserves, was the attraction. Many students collected the sulphur water which is known for its medicinal properties. They also collected many mosses and algae specimens from Sahastradhara.

The next destination was the Forest Research Institute (FRI). It had a massive imposing facade with lush green surroundings. The museum was well-stocked and the staff explained about plant history and various plant species. Then Botanical Gardens were also beautiful where students were informed about different plants and their benefits. Later that evening, the group visited Haridwar and departed for Delhi. It was a memorable and enjoyable experience for all.

CHEMISTRY JOKES

Q: What do you get when you mix sulphur, tungsten and silver?
A: SWAG

Q: Why did the acid go to the gym?
A: To become a buffer solution.

Q: Why did the noble gas cry?
A: Because all his friends argon.

Q: Why did Chlorine's sisters Boron and Carbon lock her in the closet?
A: Because she was too attractive.

Q: Anyone know any jokes about sodium?
A: Na

Q: If H2O is water, what is H2O4?
A: Drinking, bathing, washing, swimming.....

Compiled by
Jyoti Aggarwal
Chemistry Honours III Year

BELIEVE IN MAGIC?

I am going down this lane once more which I traversed for three long years.

Well, this is a short description of my life at Miranda!

Going back to the year 2013 when we were in that rat race of securing a seat in the North Campus. Little did we know what it was like to be in a college, but we were certain about the place we wished to be in! Amazing, isn't it. Though we knew nothing about what it is like being away from home and taking care of our own self, still we were excited about this new phase.

Discussing with our special school friends that 'bunch of ideas', struggling with our wardrobe and planning to have an enjoyable college life, seeing my juniors getting excited reminds me of that feeling!

Parents' talk – "I wish you clear the cut-off of MIRANDA HOUSE''

When you questioned them, they had that big bundle of reasons with them, ending with that favourite mummy dialogue – "When you'll become a parent you will understand this."

To start with why MIRANDA?

We all get that parent's idea, isn't it? If someone asks "Why had you taken this decision to be in an all girls' college." Answering this question now makes me feel proud of my decision which I had taken three years ago!

Being in a co-ed education system for my entire school life was not an easy task for me. You reading this may be thinking about your happy childhood days. Mind you, not everyone's school life is that happy! Things at times are grey! I had lost that confidence to interact with people, to be in a group, to stand up for my ideas. I had started fearing people. Miranda was the escape from that. It was that gateway to my solitude.

And that is how this journey began.

Turning back now, I have transformed myself to the person I was deep down, but was hidden somewhere. I know past happenings do help us, for the better always. To all the readers reading this, my friends, it is tough I know, but it will work, just be true to yourself, and never be a wrongdoer! It pays! It surely does!

Enough of sentiments!

My Departmental Society – RASAYANIKA.

How I gained a bunch of friends and that happiness of being allotted Lab 3. Surely my Department people can relate to this!

Room 151 has that talent of hosting our best alumni.

Room 145 where we have spent hours with our teachers. Those benches have recorded all our deeds – our career discussions, our graphical debates, our sentimental personal talks, our anxious moments completing files and most memorable – seating in a set pattern before the internal exams! Sorry teachers but yes we plan!

But somewhere deep down we know these tricks won't work because there is some inbuilt system in teachers, it detects it.

This Department and people I came across here have somewhere or the other helped me gather that strength to bring that "ME" back.

Who says studying in an all girls' college is a difficult task?

We all know how fine we are made here. Where there is no such ideology of us being a second gender, which somewhere does continue to prevail in our society. We are the only one here, responsible for our own selves!

Miranda was and always be the right choice!

A fair journey!

A road worth traversing!

Riya Gupta
Chemistry Honours III Year

CHEMISTRY DEPARTMENT AWARDS

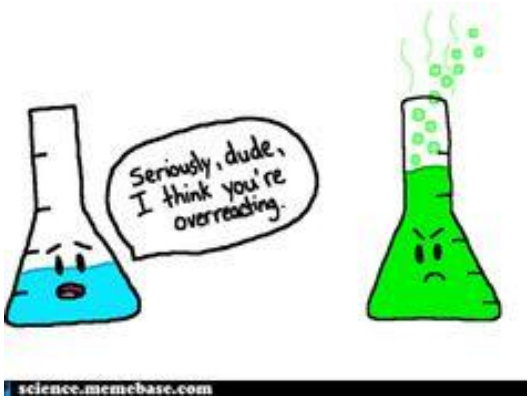
In addition to the college awards for academic and all-round excellence, Chemistry students are eligible for some Departmental wards as well. These are:

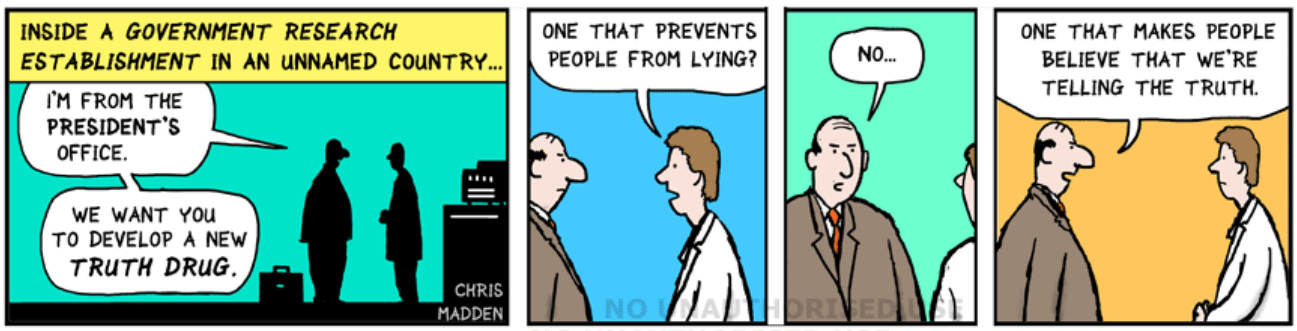
Anita Tandon Award for Highest Marks in Organic Chemistry I Year: is given to a I Year student who has scored the highest marks in Organic Chemistry (university examination + internal assessment) in Semester I. If two students have the same marks in the Theory paper, the Practical marks are added to break the tie.

Laxmichand Dayawanti Award for Academic Excellence II Year: is given to a II Year student who has shown academic excellence, excellence in co-curricular/extra-curricular activities and good attendance record.

Naunit Ram Ahuja Award for Academic Excellence II Year: is given to a II Year student on the basis of academic merit and financial need.

GK Dhingra Award for Highest Marks in Organic Chemistry Semester III + Semester IV: is given on the basis of the highest marks in Organic Chemistry (university examination + internal assessment) Semester III + Semester IV. If two students have the same marks in the Theory paper, the Practical marks are added to break the tie.





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Faculty, Chemistry Department 2015-16

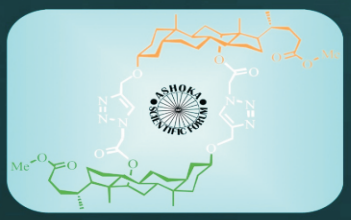
Front Row: Dr. Deepti Rawat, Ms. Anita Kumari, Dr. Anshika Lumb, Dr. Mallika Pathak, Dr. Malti Sharma, Dr. Poonam

Back Row: Dr. Smriti S. Bhatia, Dr. Amrita T. Sheikh, Dr. Sharda M. Sonkar, Dr. Bani Roy, Dr. Adarsh Gulati, Ms. Nutan Rani, Dr. Madhulika J. Verma

Non-Teaching Staff, 2015-16

Row 1 L to R: Shri Harkesh, Shri Sunil Kumar, Shri Sunil Kumar, Shri Vijay Kumar, Shri Rajmal Mandhotra, Shri Guari Shankar, Shri Shashi Mohan, Shri Sanjeev Kumar

Row 2 L to R: Shri Raghav Shah, Shri S.K. Bhandari, Shri R.B. Bhanwal, Shri R.S. Saklani, Shri S.D. Rana, Shri Ravi Kumar, Shri Jaswant Singh, Shri Mahesh Singh



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