Mendeleev Madeover

A MONOGRAPHIC MEMOIR

COMMEMORATING INTERNATIONAL YEAR OF THE
PERIODIC TABLE OF CHEMICAL ELEMENTS (IYPT2019)

Organised by:
Birla Industrial & Technological Museum
(National Council of Science Museums)
Ministry of Culture, Govt. of India

In association with:
Royal Society of Chemistry
(Eastern India Section)

TEAM MONOGRAPHIC MEMOIR

EVENT MENTORING:
Shri A. D. Chowdhury &
Shri V. S. Ramachandran

CONTEST CO-ORDINATING:
Shri T. K. Sengupta &
Ms. A. Ghose

MEMOIR EDITING:
Ms. A. Ghose

ILLUSTRATION & DESIGNING:
iKnowHow
samik@iknowhow.co.in
9836125275

MEMOIR PUBLISHING:
Mr. G. Seal

CONTENTS

MESSAGE 1

INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY

IUPAC

The International Union of Pure and Applied Chemistry (IUPAC) is pleased to recognize the efforts of Birla Industrial & Technological Museum in celebrating the International Year of the Periodic Table of Chemical Elements (IYPT2019). Your conception of the 'Mendeleev Madeover' Visual Interpretation Contest is an important achievement. We congratulate all the participants for sharing your passion about chemistry and wish you the very best.

Sincerely,

DR. LYNN M. SOBY
Executive Director, IUPAC

MESSAGE

The Eastern India Section of the Royal Society of Chemistry, as one of the many overseas sections of the parent body always tries to fulfill its avowed aim of advancement of science and practice of chemistry. It has got the pleasure in collaborating with Birla Industrial & Technological Museum in organizing **Mendeleev Madeover – Visual Interpretation Contest** for the school students to be organized since September 2019. Mendeleev's periodic table which consisted of different elements arranged regularly in rows and columns can be considered as a landmark in the annals of Chemical Sciences. It was very useful in predicting new elements in the vacant position with its properties which were yet to be discovered. Since different branches of science can no longer be separated in water-tight compartments the Periodic Table can also have important implications in the development of biological sciences also. It is particularly relevant since we are celebrating 150 years of Mendeleev Periodic Table. We wish this event a great success.

PROF. ASISH DE
Honorary Secretary
Royal Society of Chemistry
(Eastern India Section)

MESSAGE

On the occasion of the International Year of the Periodic Table 2019, attempts are being taken to impart to the young school students the significance of Mendeleev's Periodic Table. Birla Industrial and Technological Museum, Kolkata has taken a sincere endeavor in this respect throughout the year. The vertical Periodic Table that the students prepared knowing the representative elements present in the everyday objects in the occasion of a workshop called 'Periodic Picnic' on May 6, 2019, came out as a product of an academic game. The participating students were excited to do the job. As a follow-up endeavour, the Mendeleev Madeover Visual Interpretation Contest allowed more students to indulge in re-interpreting the table, but more importantly understand the nuances involved in such an exercise. I believe that these sorts of activities involving the students will stimulate them to love chemistry and should encourage them to take chemistry as their future career which is the need of the society. Look forward to these future chemists.

PROF. (DR.) NITIN CHATTOPADHYAY
F.A.Sc., F.N.A.Sc.
Department of Chemistry,
Jadavpur University

INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY

14 August, 2019

The Director
Birla Industrial & Technological Museum
19 A, Gurusaday Road
Kolkata-700019
West Bengal
India

Dear Director,

Congratulations! The International Union of Pure and Applied Chemistry (IUPAC), in collaboration with eleven Chemistry Nobel Laureates, is pleased to honor the Birla Industrial & Technological Museum, in recognition of the International Year of the Periodic Table of Chemical Elements (IYPT2019), as one of the winners of the IUPAC Periodic Table Challenge Nobelium Contest. We thank you for sharing your passion and creativity about chemistry with the world community and wish you the very best.

As a Nobelium Contest Laureate, we invite you to share your experience through social media and your institution. In addition, we would like to encourage you to take and post photos with your new Periodic Table to inspire others in joining this celebration!

If you have any additional questions, would like to volunteer with IUPAC, or provide any additional information, please reach out at periodictable100@iupac.org or visit our website at www.iupac.org/100.

Sincerely,

Lynn M. Soby

Dr. Lynn M. Soby
Executive Director

cc: Dr. Juris Meija, IUPAC100 Co-chairs

IUPAC Secretariat P.O. Box 13757 Research Triangle Park, North Carolina 27709 USA
T+1 919 485 8700 secretariat@iupac.org www.iupac.org

Award letter for BITM's Periodic Picnic Workshop

KNOW THE ELEMENTS THAT PUSH THE PERIODIC TABLE PAST ITS LIMITS

2

The year 2019 marks 150th anniversary of one of the most significant breakthroughs in science, the creation of a tool that allows us to make sense of the basic ingredients of our universe, and that still fuels research and innovation today: **the Periodic Table of Chemical Elements**.

There were about 60 known elements when Mendeleev completed his work on "The experience of a system of elements based on their atomic weight and chemical similarity" on 1 March 1869.

In 1869, Dmitri Mendeleev realized that when organizing the known elements by atomic weight, certain types of elements occurred regularly. This system indicated that there is a link between the structure of an element and its properties, and showed gaps between known elements, allowing Mendeleev to predict the existence of elements that were still unknown.

Mendeleev's periodic table of elements, a system that some call "chemistry's roadmap", has grown and developed over the years. However, its original discovery is still known as one of the most significant achievements in science and is integral to science and technology today. The United Nations Educational, Scientific, and Cultural Organization attributes the table as a "common language" for scientists, allowing for seamless communication and referencing.communication and referencing.

In the 1940s, the search for elements beyond uranium led to the discoveries of the neutron-induced fission of uranium and of eleven trans-uranium radioelements, belonging to the actinide series. The best-known of the actinide elements is plutonium. The element 93 (neptunium) was discovered in 1939 by the scientists at the University of California, Berkeley. Two years later, the element 94 (plutonium) was discovered by the same team. Plutonium was used in atom bomb dropped on Nagasaki in August 1945 and the discovery of plutonium remained a military secret until after World War Two. For decades, the key US research centre for new elements research was at Berkeley, California and thus the elements 95, 97 and 98 are called americium, berkelium and californium. The elements 99 and 100 are named after two pioneers of nuclear science: einsteinium for Albert Einstein and fermium for Enrico Fermi.

Between 1940 and 1974, more than a dozen new elements beyond element 92 (uranium) were discovered. This series of achievements culminated in 1974 with the creation of element 106, which was named seaborgium to honor Nobel Laureate Glenn Seaborg (1912-99), who played a key role in many of these discoveries at the laboratory.

On 30th December 2015, **the International Union of Pure and Applied Chemistry (IUPAC)** confirmed the discovery of four new chemical elements (Nihonium, Nh, 113), (Moscovium, Mc, 115), (Tennessine, Ts, 117) and (Oganesson, Og, 118), all of which had been created in labs and it means the seventh row of the periodic table is finally complete. But when elements 119 or 120 are made, they will start a whole new row.

No one knows how much longer the table can be extended by the creation of new elements. Some suspect there is no limit. Others say there may be a point beyond which atoms cannot get any heavier: such enormous atoms would be completely unstable, instantly disintegrating in a flurry of radioactivity. So even if there is no end to the periodic table, there may be strange stuff awaiting us in its furthest reaches. Whether we will ever explore these extreme elements is another matter entirely.

Elements are the fundamental building blocks of chemistry. An element is essentially a substance that only contains one kind of atom. So making a new element means making a new kind of atom. Each element is assigned a number which specifies how many protons the atom contains.

Of course, if elements with higher atomic numbers are discovered, then an additional row will be added to the table. Today 118 elements have been identified, of which the first 94 occur naturally on Earth and the remaining 24 are synthetic.

A Russian-American team at the Joint Institute for Nuclear Research in Dubna, Oak Ridge National Laboratory in Tennessee and Lawrence Livermore National Laboratory in California discovered elements 115 (moscovium (Mc)), 117 (tennessine (Ts)) and 118 (oganesson (Og)), while Japanese researchers were credited for discovering element 113 (nihonium (Nh)). All four elements are not found in nature, and were synthetically created in laboratories. Until now, these elements had temporary names and symbols on the periodic table as their existence was hard to prove. Since they decay extremely quickly, scientists found it difficult to reproduce them more than once.

The periodic table of the elements is slowly getting bigger. Efforts to find the next elements, 119 and 120, are underway. All elements with more than 104 protons are labelled as "superheavy," and are part of a vast, totally unknown land that scientists are trying to uncover.

When making new superheavy elements, scientists are engaged in a battle against the laws of nature: In elements with low atomic weight, protons and neutrons stick together because the strong nuclear force pulls them together. But when more and more protons are packed into a nucleus, the strong nuclear force starts to lose out to another force, the Coulomb force. This force causes particles of the same charge to push each other apart. Most superheavy nuclei undergo nuclear fission within milliseconds, splintering into lighter elements, or they spit out a few alpha particles—made of two protons and two neutrons—at first and then split apart.

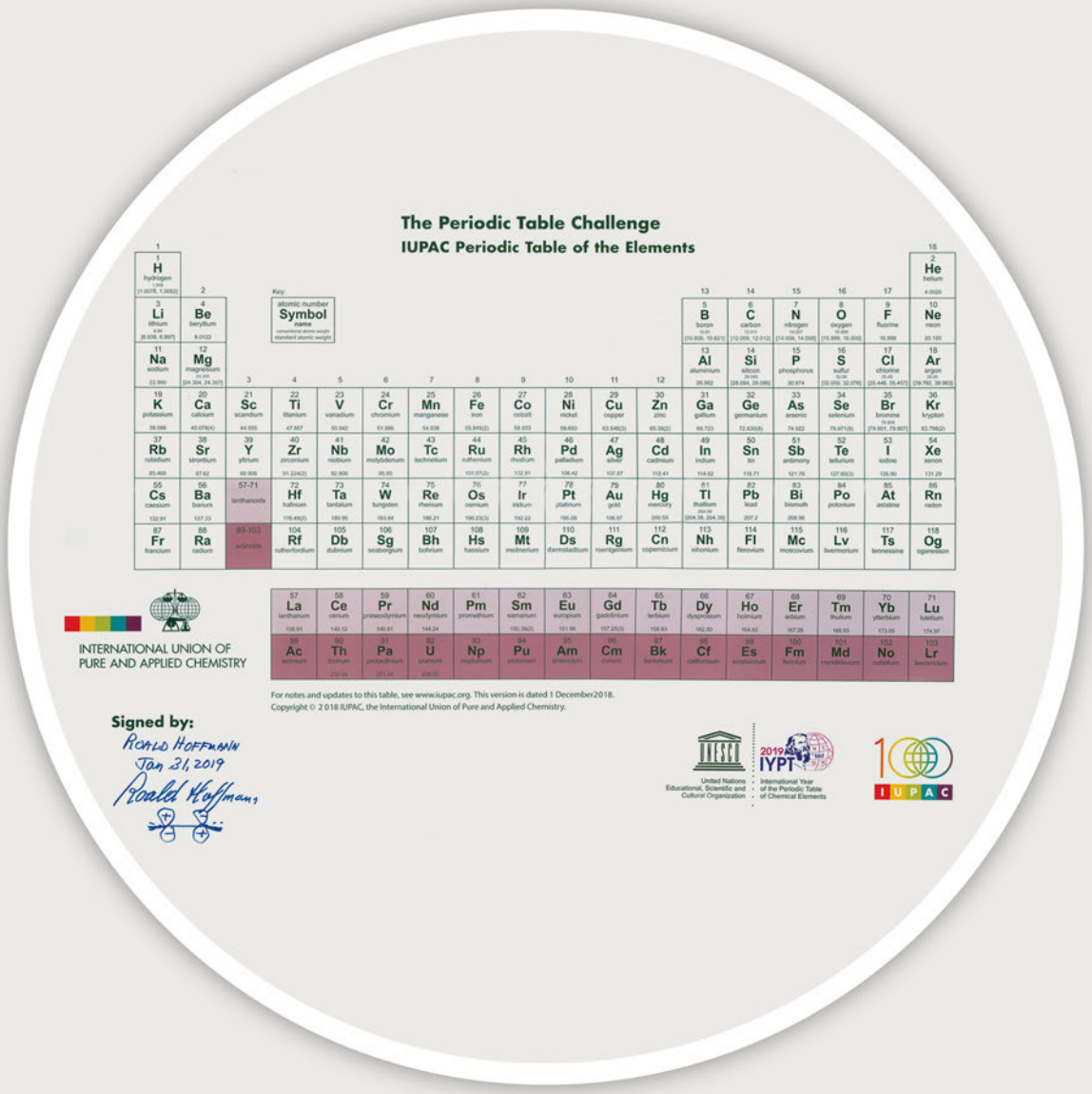
Russian scientists Yuri Oganessian proved that there may exist an 'island of stability' where very heavy elements would not be unstable. This would change the trend of decreasing stability after Uranium. At what number of protons and neutrons, this island of stability will be found, has seen different predictions from scientists across the world.

Scientists want to create such never-before-seen atoms to test how far the periodic table goes, to satisfy curiosity about the forces that hold atoms together and to understand what bizarre chemistry might occur with these extreme atoms.

Richard Feynman predicted that element 137 would be the last one. But nobody really knows where the table will end. Calculations of the table's end are based on the theory of relativity. When nuclei get larger, more protons in the nucleus mean more force pulling electrons in, so the electrons traveling around them have to go faster and faster, reaching speeds that are a substantial fraction of the speed of light. At these speeds, the electrons become "relativistic," and the atoms behave differently from what is expected based on their position in the table. Eventually, calculations predict that the electrons would have to travel faster than light, which is impossible. On this basis, some scientists predict that the end may be element 170, since this may be the point at which there are enough protons to ask the electrons to do the impossible.

It's been 150 years since Russian chemist Dmitri Mendeleev created his periodic table. Yet we still cannot answer the question: "Which is the heaviest element that can exist?"

A. D. CHOUDHURY, Director General, National Council of Science Museums



Periodic Table of Chemical Elements, signed by 1981 Chemistry Nobel Laureate Roald Hoffman, awarded to Birla Industrial & Technological Museum by the International Union of Pure & Applied Chemistry (IUPAC) for being one of the Summer Winners of the Periodic Table Challenge Nobelium Contest, with their workshop, the 'Periodic Picnic' under Service & Education Category in July 2019

BITM'S TRIBUTE TO MENDELEEV

The year 2019 marks the 100th anniversary of International Union for Pure and Applied Chemistry (IUPAC) and also the 150th anniversary of the development of the Periodic Law of the Elements. To celebrate these anniversaries, IUPAC was hosting an online, global challenge about the Periodic Table of the Elements. With thousands of players from 120 countries, this online challenge was aimed at a global audience of young students, encouraging them to become part of a global community that is excited about chemistry. We decided to test our endeavours on this commemorative year and accepted IUPAC's Periodic Table Challenge.

Congratulations!

You have successfully met the IUPAC Periodic Table Challenge!
You may now move on to the Nobelium Contest!

This certificate is awarded to:

Birla Industrial & Technological Museum

Kolkata, India

by

THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

Lynn M. Soby
Executive Director, IUPAC

IUPAC

July 04, 2019
Date Awarded

Silver

79
Au
Gold

Earlier in May, during its 60th Anniversary celebrations, Birla Industrial & Technological Museum (BITM), Kolkata, had developed a workshop on the Periodic Table of Chemical Elements – the Periodic Picnic. It featured the joint participation of academicians and the students, where experts from various fields helped in identifying signature elements in everyday objects, while delving into the finer, less discussed but cardinal properties of the Groups/ Periods they belonged to. Around 220 students, from 11 schools ultimately built up a Spiral Periodic Table with the elements of the Groups/Periods being discussed. This was repeated during Teacher Workshops on two occasions, with 74 teachers and every time, the novel way of manifesting the quirks and perks of the hundred odd elements that make us all, proved to be a show-stealer. We entered this Workshop format under the Service & Education Category of IUPAC's Challenge, aptly titled the Nobelium Contest.

This Contest shared our passion and creativity about chemistry globally by highlighting the role of the Periodic Table in a creative manner. The entry was shared online and put up for vote for People's Choice and also judged by the IUPAC panel of experts based on three broad categories: creativity, commitment, and impact. Summer winners of the Nobelium Contest were announced in sync with the actual 100th anniversary of IUPAC on 28th July 2019. *BITM's Periodic Picnic had won the People's Choice Award in the Nobelium Contest.*

As the Nobelium Laureates, we had to keep the ball rolling. The final form of the participant-assembled Element Tree, originally inspired from Fernando Dufour's 3D form of the Periodic Table, is featured today as a welcome exhibit in the BITM premises in this commemorative year. It was now that we began to consider launching a chemistry-themed competition for student community. It was to be a visual interpretation contest, aiming to reach secondary and high school students across Kolkata. It was to be an opportunity for students to engage hands on with the periodic table in general and elements in particular, develop a deeper understanding of key principles of chemistry, and foster an appreciation of the wider impact of chemical sciences throughout life and society. The Royal Society of Chemistry (Eastern India Section) joined us in this initiative and we introduced the Mendeleev Madeover Contest in September.

Across the two months, we received scores of submissions and were excited by the queries from the contestants. We were overwhelmed by their imaginations and far-sightedness – so much so that they managed to make the juror's job more difficult. We had promised to publish the best submissions, but found it difficult to eliminate any. Beyond just entertaining us, the tales of the periodic table, as told by our chemistry enthusiasts, provided a way of understanding elements that had never appeared in textbooks or lab manuals. Scientists regard the periodic table as an anthropological marvel—the history of our species written in a compact and elegant script. For us at BITM, the Mendeleev Madeover Maestros are the ones to watch out for in the coming years. With their ability to think out-of-the-box without compromising on core chemistry, they are our modern day Mendeleevs!

V. S. RAMACHANDRAN, Director, Birla Industrial & Technological Museum


A Third Dimension in Periodic Table
পর্যায় সারণী থেকে পর্যায় শঙ্কু
Mn
Manganese

COMING OF AGE 4

The periodic table is hard to beat. On a Friday, one hundred and fifty years ago, a Siberian chemist, in a desperate attempt to meet the publisher's deadline, sent out a manuscript that aimed to bring order to the building blocks of the material world. It contained an outline of the periodic table - 'Suggested System of the Elements' - humble origins from which descended the charts that adorn our galleries and millions of classrooms the world over. A symbol of completeness, it dispersed the chemical haze of the 63 elements discovered till that day, as its successors do today for the 118 elements - in forms as varied as elephants, cupcakes and cereals! But let's not forget the basics.

Mendeleev's periodic table, not the first, but the best - didn't appear 'complete' and out of 'nowhere'. Like all things worth celebrating, it had a troubled beginning. As Philip Ball warns, "It was the most comprehensive ordering of the building blocks of matter and unwittingly, it pointed the way to the underlying quantum rules that govern the composition and properties of atoms. It helped unite chemistry and physics and revealed a deep aspect of nature's design. Just don't try to pretend that it arrived in a dream." Mendeleev never made the dream claim himself. It had come from a colleague, 40 years later. "The sources are too iffy ", says historian of science Micheal Gordin at Princeton University. Mendeleev himself emphasized that his discovery "was the product of insight and chemical knowledge", not a dream discovery as we would have liked to believe.

ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ,

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

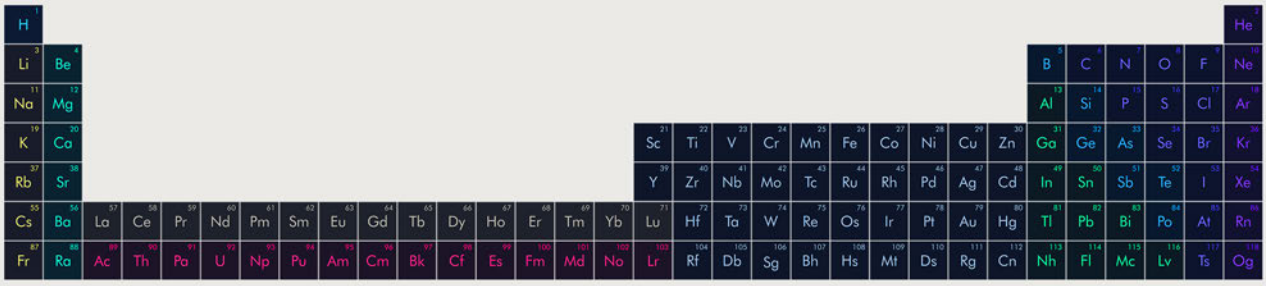
			Ti=50	Zr= 90	?=180.
			V=51	Nb= 94	Ta=182.
			Cr=52	Mo= 96	W=186.
			Mn=55	Rh=104,4	Pt=197,1.
			Fe=56	Ru=104,4	Ir=198.
			Ni=Co=59	Pd=106,6	Os=199.
H=1			Cu=63,4	Ag=108	Hg=200.
	Be= 9,4	Mg=24	Zn=65,2	Cd=112	
	B=11	Al=27,3	?=68	Ur=116	Au=197?
	C=12	Si=28	?=70	Sn=118	
	N=14	P=31	As=75	Sb=122	Bi=210?
	O=16	S=32	Se=79,4	Te=128?	
	F=19	Cl=35,5	Br=80	I=127	
Li=7	Na=23	K=39	Rb=85,4	Cs=133	Tl=204.
		Ca=40	Sr=87,6	Ba=137	Pb=207.
		?=45	Ce=92		
		?Er=56	La=94		
		?Yt=60	Di=95		
		?In=75,6	Th=118?		

Д. Менделѣевъ

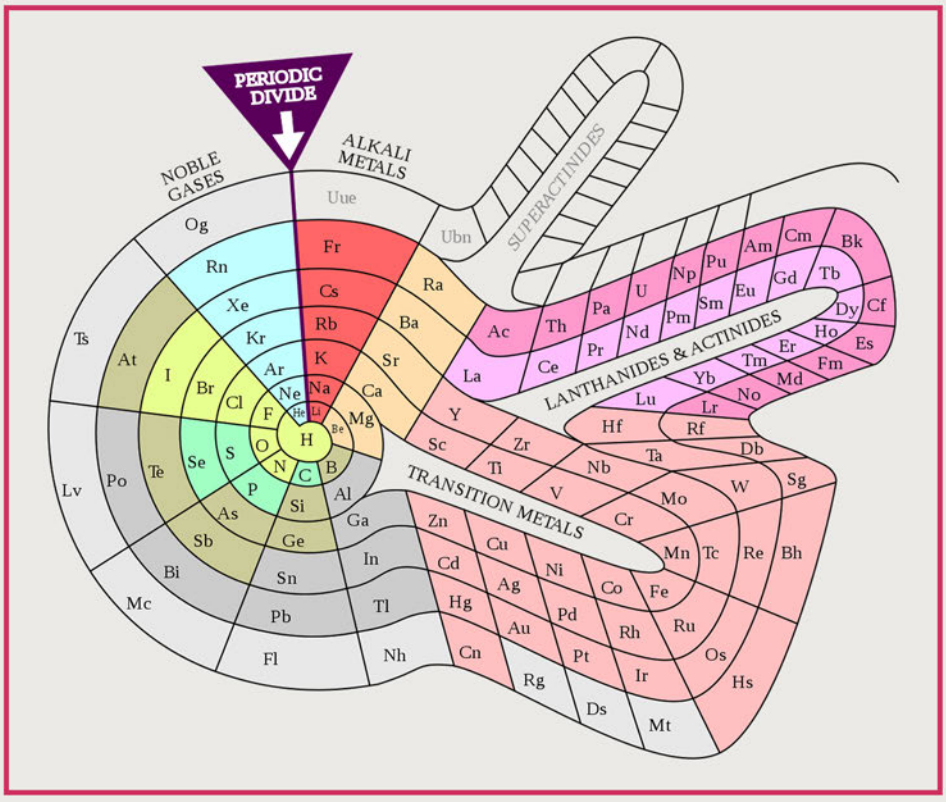
Mendeleev's Suggested System of the Elements

GOING LONG

SOME CHEMISTS THINK THE PERIODIC TABLE SHOULD BE EXTENDED TO 32 COLUMNS TO ALLOW THE ATOMIC NUMBERS, OR THE NUMBER OF PROTONS IN THE NUCLEUS, TO RUN IN AN UNINTERRUPTED SEQUENCE



The pattern of reality as we know it, is also far from the truth. Arguments over elements that don't quite 'fit' continue to rage, as do arguments about how the table is best 'laid out'. "Just as notes can be arranged in various ways to produce music, so the essence of the relationships between the elements could be depicted differently", says Joshua Howgego. Should we then start over? Go spiral - as suggested by Theodor Benfey, which allows the f-block to bulge outwards? Go long - as argued by Eric Scerri, making the table not 18 but 32 columns, allowing the atomic numbers to run in an uninterrupted sequence? Go one dimension up - adopt Fernando Dufour's 3D Periodic System, more like a Christmas Tree with elements radiating from the trunk in circles that get larger close to the bottom? Our quixotic quest for the perfect Table is a story in progress. Today we know a lot about the elements, but do we know enough?



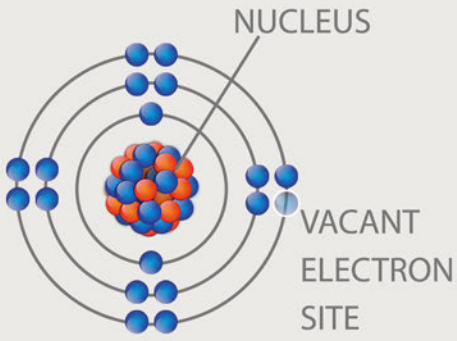
The Periodic Table is certainly unfinished - it continues to be extended by the synthesis of new elements. Eric Scerri believes, “At present, the periodic table appears to be absolutely complete for the first time - and probably the last time - in the foreseeable future. The official recognition of elements 113, 115, 117 and 118 a few years ago has meant that the seventh period in the table has no remaining gaps. But the current completeness is something of an illusion. There are active efforts to synthesize elements 119 and 120, and once this feat is achieved, a new period of 50 elements will need to be opened up”. But going along the axis of increasing atomic number and decreasing stability, we might be tempted to wonder - who lies at the very end of the table? Some argue for 137, other, more detailed calculations point to 172 or even 173. How the periodic table morphs to accomodate these exotic elements is what should keep us watching it closely.

EXTREME MATTER

SUPERHEAVY ELEMENTS MIGHT BREAK THE RULES OF THE PERIODIC TABLE

RULE TAKERS

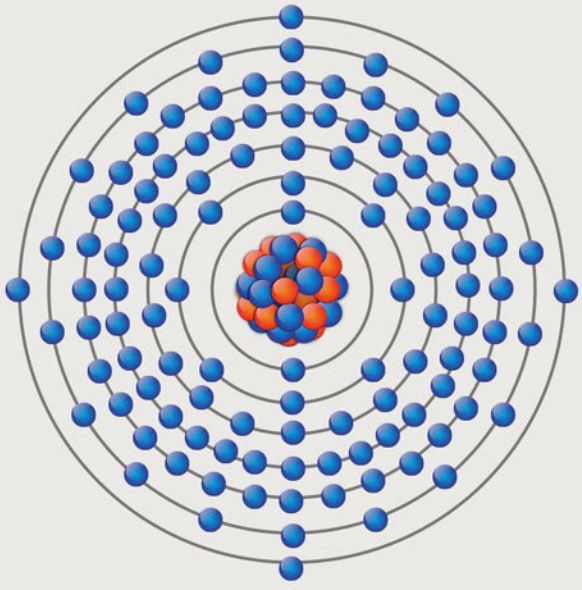
For most elements, it is the arrangement of electrons that largely determines their properties. Those with a vacancy in their outer shell tend to be reactive. Elements in the same column of the periodic table have similar arrangements and therefore similar properties.



CHLORINE

RULE BREAKERS

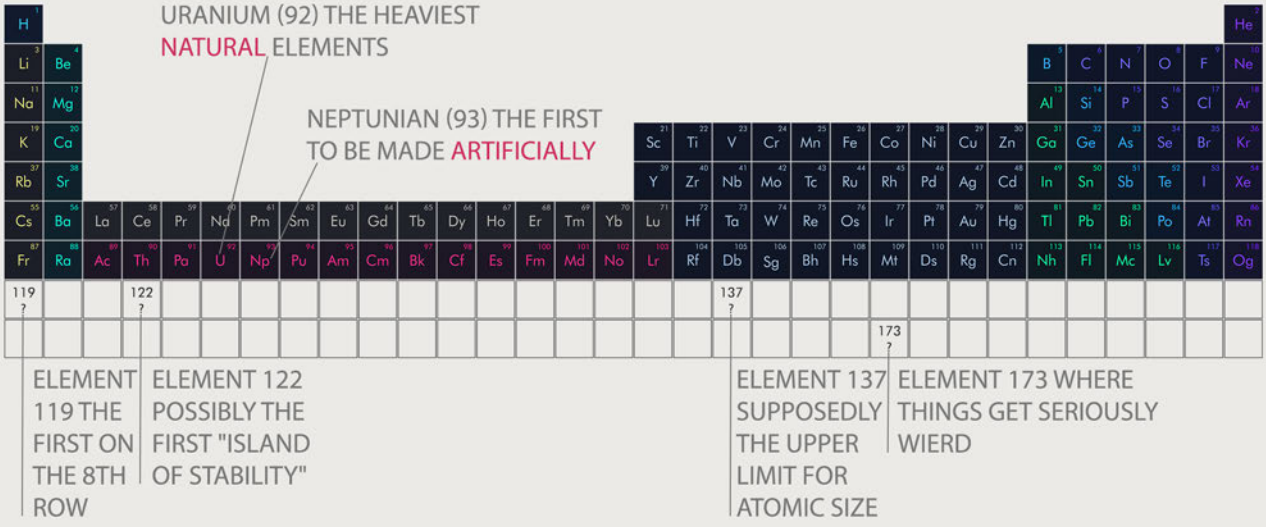
Superheavy elements may buck these trends. Their electrons move so fast that they gain mass and so orbit more tightly, squeezing the atom's size. This may change their properties, so they align with those above them in the column.



FLEROVIUM

THE OUTER LIMITS OF CHEMISTRY

FOUR NEW ELEMENTS COMPLETE THE SEVENTH ROW OF THE PERIODIC TABLE

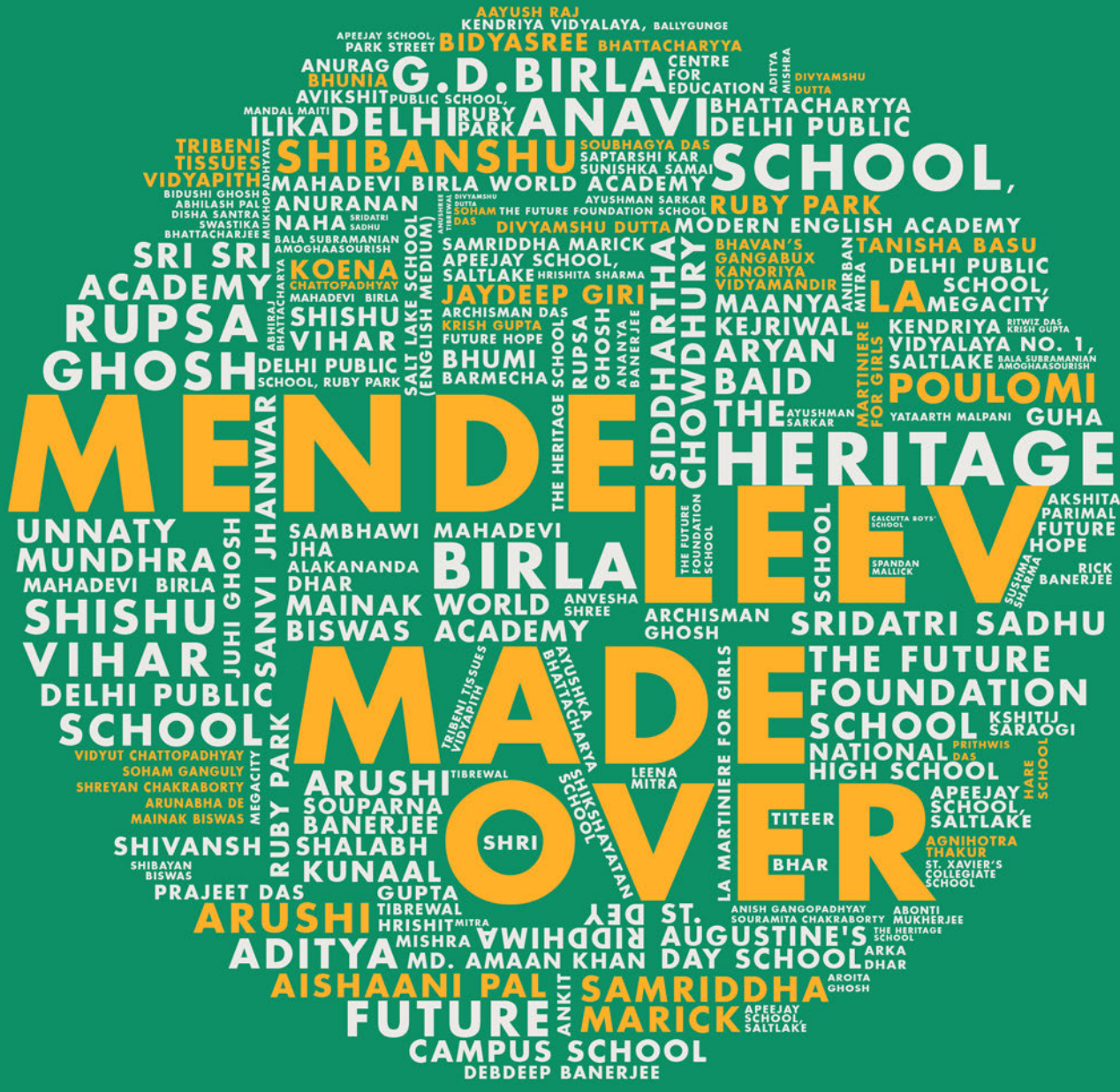


150 years on, the story of the most beautiful table in science is far from being finished. Participants of the Mendeleev Madeover Contest shared with us their imaginations and beliefs for bringing order to chaos – much like Mendeleev had done. There's strange stuff waiting for us at the farthest ends of the periodic table. Enclosed within the covers of this booklet are the stories that the next generation of Periodic Tablers decided to tell. Will their ideas stand the test of time and come of age as Mendeleev's did? We sure hope so!

ADITI GHOSE,
Contest Co-ordinator & Education Assistant, Birla Industrial & Technological Museum

5

MENDELEEV MADEOVER MAESTROS


MENDELEV
MADE
OVER
AAYUSH RAJ
KENDRIYA VIDYALAYA, BALLYGUNGE
APEEJAY SCHOOL, PARK STREET
BIDYASREE BHATTACHARYYA
ANURAG BHUNIA
G.D.BIRLA CENTRE FOR EDUCATION
ADITYA MISHRA
DIVYAMSHU DUTTA
AVIKSHIT PUBLIC SCHOOL,
MANDAL MAITI
ILIKA DELHI RUBY PARK ANAVI
BHATTACHARYYA DELHI PUBLIC
TRIBENI TISSUES VIDYAPITH
SHIBANSHU
SOUBHAGYA DAS
SAPTARSHI KAR
SUNISHKA SAMAI
SCHOOL,
BIDUSHI GHOSH
ABHILASH PAL
DISHA SANTRA
SWASTIKA BHATTACHARJEE
MUKHOPADHYAYA
MAHADEVI BIRLA WORLD ACADEMY
ANURANAN NAHA
SRIDATRI SADHU
ANUSHREE SHAW
DIVYAMSHU DUTTA
SOHAM DAS
THE FUTURE FOUNDATION SCHOOL
AYUSHMAN SARKAR
RUBY PARK
DIVYAMSHU DUTTA
MODERN ENGLISH ACADEMY
BALA SUBRAMANIAN AMOGHAASOURISH
SRI SRI ACADEMY
KOENA CHATTOPADHYAY
SAMRIDDHA MARICK
APEEJAY SCHOOL, SALTLAKE
HRISHITA SHARMA
BHAVAN'S GANGABUX KANORIYA VIDYAMANDIR
ANIRBAN MITRA
TANISHA BASU
DELHI PUBLIC SCHOOL, MEGACITY
MAHADEVI BIRLA
JAYDEEP GIRI
ARCHISMAN DAS
KRISH GUPTA
FUTURE HOPE
MAANYA KEJRIWAL
ARYAN BAID
KENDRIYA VIDYALAYA NO. 1, SALTLAKE
RITWIZ DAS KRISH GUPTA
BALA SUBRAMANIAN AMOGHAASOURISH
RUPSA GHOSH
ABHIRAJ BHATTACHARYA
SHISHU VIHAR
BHUMI BARMECHA
DELHI PUBLIC SCHOOL, RUBY PARK
SALT LAKE SCHOOL (ENGLISH MEDIUM)
THE HERITAGE SCHOOL
RUPSA GHOSH
ANANYA BANERJEE
SIDDHARTHA CHOWDHURY
MARTINIERE FOR GIRLS
POULOMI
THE AYUSHMAN SARKAR
YATAARTH MALPANI
GUHA
HERITAGE
AKSHITA PARIMAL FUTURE HOPE
CALCUTTA BOYS' SCHOOL
SPANDAN MALLICK
SUSHMA SHARMA
RICK BANERJEE
UNNATY MUNDHRA
MAHADEVI BIRLA
SHISHU VIHAR
JUHI GHOSH
SANVI JHANWAR
DELHI PUBLIC SCHOOL
VIDYUT CHATTOPADHYAY
SOHAM GANGULY
SHREYAN CHAKRABORTY
ARUNABHA DE
MAINAK BISWAS
MEGACITY
RUBY PARK
SAMBHAWI JHA
ALAKANANDA DHAR
MAINAK BISWAS
MAHADEVI BIRLA WORLD ACADEMY
ANVESHA SHREE
THE FUTURE FOUNDATION SCHOOL
LEEV
SCHOOL
ARCHISMAN GHOSH
SRIDATRI SADHU
TRIBENI TISSUES VIDYAPITH
AYUSHKA BHATTACHARYA
THE FUTURE FOUNDATION SCHOOL
KSHITIJ SARAOGI
NATIONAL HIGH SCHOOL
PRITHWIS DAS
HARE SCHOOL
LA MARTINIERE FOR GIRLS
ARUSHI SOUPARNA BANERJEE
TIBREWAL
SHIKSHAYATAN SCHOOL
LEENA MITRA
SHIVANSH SHALABH KUNAAL
SHRI
TITEER
BHAR
APEEJAY SCHOOL, SALTLAKE
AGNIHOTRA THAKUR
ST. XAVIER'S COLLEGIATE SCHOOL
SHIBAYAN BISWAS
PRAJEET DAS
GUPTA
ARUSHI
TIBREWAL
HRISHIT MITRA
ANISH GANGOPADHYAY
SOURAMITA CHAKRABORTY
ABONTI MUKHERJEE
THE HERITAGE SCHOOL
ST. DEY AUGUSTINE'S DAY SCHOOL
ADITYA
MISHRA
RIDDHIMA
MD. AMAAN KHAN
ARKA DHAR
AISHAANI PAL
SAMRIDDHA MARICK
AROITA GHOSH
FUTURE CAMPUS SCHOOL
ANKIT
APEEJAY SCHOOL, SALTLAKE
DEBDEEP BANERJEE

LEFT TO RIGHT: PROFESSOR (DR.) NITIN CHATTOPADHYAY, DR. MRINAL KANTI PODDAR, DR. MUKUL KUMAR BASU & PROF. ARUP KUMAR DAS

6 JURY

Prof. (Dr.) Nitin Chattopadhyay

Professor Chattopadhyay specializes in Photochemistry, Biophysical Chemistry, Surface Chemistry, Fluorescence Sensing, Polymer Photophysics. He teaches in the Department of Chemistry, Jadavpur University. He is Fellow of the Indian Academy of Sciences (FASc), National Academy of Sciences India (FNASc) and West Bengal Academy of Science and Technology (FAScT). He is a recipient of the Bronze Medal of Chemical Research Society of India. He also received Prof. S C Ameta Award (2019) from the Indian Chemical Society and Prof. S R Mohanty Memorial Award (2018) from the Orissa Chemical Society. He has been endowed with Shiksha Ratna Award from the Government of West Bengal (2019). He has been in the Editorial Boards of a number of international journals like Biophysical Chemistry, Journal of Photochemistry Photobiology B: Biology, Heliyon, Journal of Luminescence, Journal of Colloid and Interface Science, Journal of Chemical Sciences.

e-mail: nitin.chattopadhyay@yahoo.com

Dr. Mrinal Kanti Poddar

Dr. Poddar (an Emeritus Medical Scientist, Jadavpur University & Emeritus Professor, University of Calcutta) is a renowned biochemist and neurochemist. Fellow of the Royal Society of Chemistry, Emeritus member of the International Society of Neurochemistry, U. K., Member, International Brain Research Organization, Paris, International Society for Neurochemistry, U. K., Federation of European Neuroscience Societies, Society for Neuroscience, U.S.A., Asia Pacific Society for Neurochemistry (Japan), Indian Academy of Neuroscience, India, Neurochemistry Society of India and many more. His achievements include inventions in traditional medicine (he is the recipient of Gananath Sen Memorial Gold Medal award for his works on Traditional Medicine), received fellowship of IBRO (International Brain Research Organization)/ UNESCO (Paris). He has the expertise in neurochemical, neurotoxicological, pharmacological, and behavioural research, mode of action of psychopharmacologic drugs and their interactions, neurobiochemical and neuropharmacological mechanism of thermoregulation under different environmental temperatures, neuroimmune regulation in relation to nutritional status of diet, endogenous biomolecule and aging. Dr. Poddar has been the President of Prof. J. J. Ghosh Foundation, the Vice-President of the executive body of the Indian Academy of Neuroscience, India (Kolkata Chapter), and also the Vice-President of the executive body of the Royal Society of Chemistry (Eastern India Section). He is a member of Editorial Board of different scientific journals.

e-mail: mrinalkp@yahoo.com

Dr. Mukul Kumar Basu

Dr. Basu is a Former Emeritus Scientist, Director Grade Scientist & Head of Bio-membrane Division at Indian Institute of Chemical Biology, Kolkata. He is a Fellow of Royal Society of Chemistry, London; West Bengal Academy of Science & Technology, Kolkata; National Academy of Sciences, India; Indian Academy of Sciences, Bangalore, India. His research interest includes Host-parasite interactions, Structure function of biomembrane and model membrane, Drug targeting at specific sites using different vesicular delivery modes and Surface properties of membrane systems. He had been felicitated as Scientist of Merit' by Science Association of Bengal for outstanding activities in the field of scientific research and development on National Science Day (February 28) in 1995. He has also been felicitated by Institution of Chemists (India) for delivering H. K. Sen Memorial Award lecture on Site Specific Drug Delivery in 2008.

e-mail: mukulkbasu@gmail.com

Prof. Arup Kumar Das

Having worked in some of the reputed advertising agencies in Kolkata and Delhi, Prof. Das was a full time lecturer at the 'College of Design' under Burdwan University. He has participated in many prestigious 'Biennales' like 6th Beijing International Art Biennale, 1st International Biennial Print Lalit Kala Academy, New Delhi, 9th International Biennial of Print Art at Bharat Bhavan, Bhopal, Madhya Pradesh,18th Asian Art Biennale, Bangladesh to name a few. Having received a number of honorary awards and merits, he has showcased his works regularly in several group shows. With a number of articles in reputed journals, he is intrigued by the cultural history of Kolkata and its allied regions. Presently he is In-charge of the Graphic Design/ Applied Art Department, Government College of Art and Craft, Kolkata.

e-mail: arupdasart@gmail.com / arupkumardasart@yahoo.in

ELEMENTS IN MEMORY OF PEOPLE 7

PROF. (DR.) SYAMAL CHAKRABARTI
DEPT. OF CHEMISTRY, UNIVERSITY OF CALCUTTA

Different objects, natural or man-made, are often named in memory of people that we observe in the history of civilisation. Chemical elements are also not the exception. Russian scientist Dmitri Mendeleev submitted a table of 63 elements in1869 known as Mendeleev's Periodic table. None of the elements in his table were named in memory of people. Most of them were connected with mythology. All of us know now-a-days, Mendeleev's Periodic table is a brilliant piece of work in science which may be compared with Newton's Principia or Darwin's theory of evolution. Mendeleev breathed his last in 1907 but he had been deprived from having a Nobel Prize introduced in 1901. In 1879, after ten years of Mendeleev's Periodic table the first chemical element named after a person was Samarium. In fact, Samarium was discovered in 1879. The element got its name after Vassili Samarsky-Bykhovets(1803-1870) who was a Russian mining engineer and the chief of Russian Mining Engineering Corps between 1845 and 1861. The mineral samarskite and chemical element Samarium are named after him. He was the first person whose name was given to a chemical element. Vassili was born in a noble family and got military engineering education. He served in a military position in different capacities. He was promoted to the rank of captain in 1834 and colonel in 1845. The next year he became the Chief of Staff of the Corps of Mining Engineers and remained in that position until 1861. During this period, he was also a teacher at Saint Petersburg Mining Institute and became a member of the scientific council. He took a three months sabbatical leave in 1862 to attend an international scientific exhibition in London. Vassili himself was not involved in the studies of samarskite and samarium. But he granted access to mineral samples from the Urals to the German mineralogists working in this area. The symbol for samarium is 'Sm' and its atomic number is 62.

The second element which was named after a person is Gadolinium. This element of atomic number 64 and with a symbol 'Gd' was extracted from the mineral gadolinite.

Johan Gadolin (1760-1852) was born in Finland (that time a part of Sweden). He first studied mathematics and finally studied chemistry. In 1779, Gadolin joined Uppsala University and in 1785 as an extraordinary professor at Abo. He was elected a member of the Royal Swedish Academy of Sciences in 1790. Gadolin was one of the first chemists who gave laboratory exercises to his students. It is to be noted that Gadolinium was separated by Jean Charles Galissard de Marignac(1817-1894), a Swiss chemist who first worked in famous Liebig's laboratory, then in a porcelain factory and finally as a professor of chemistry in the academy of Geneva. Thus we see that like the previous one, the second element was also named after a scientist who was not the discoverer of the same. The discoverer was Marignac but not Gadolin.

An element was discovered in 1944 which was named after a known explorer, financier, navigator and cartographer **Amerigo Vespucci** (1454-1512). The name of the element is Americium with atomic number 95. He was born in Italy and died in Spain. He demonstrated that Brazil and West Indies were not Asia's eastern outskirts as earlier stated by Columbus. It is a separate, unexplored land mass that was named after him America in 1507. In that way, Amerigo Vespucci is memorised after the name of a country as well as after the name of a chemical element. However, Americium was first produced by Glenn T. Seaborg and his co-workers at the metallurgical laboratory of the University of Chicago when they were working under Manhattan project. The discovery was kept secret and released to the public in 1945. Seaborg leaked the result on the U.S. radio show for children five days before the official presentation at an American Chemical Society meeting. Its amount was in micrograms but identified through radio activity. In addition to Americium, another element was discovered by the same reaction. That was Curium named after two great French scientists Marie Curie and Pierre Curie. Both of them were Nobel winners and Madame Curie got Nobel Prize twice. To our dear teenagers, they do not require any further introduction. Though Glenn Seaborg and his associates were the discoverers of Americium and Curium, the element of atomic number 96 got its name after the scientists who worked with different radioactive elements such as Polonium, Radium etc. People called Curium as the first intentionally synthesized element which was isolated and identified in 1944.

Then we had the discovery of another new element of atomic number 97 in 1949 which got its name after the Irish Philosopher **George Berkeley** (1685-1753). Its name is Berkelium. This element was also synthesized by Glenn Seaborg and his co-workers in the University of California, Berkeley. Though George Berkeley was not a scientist, we like to write few words about him. He was also known as Bishop Berkeley. Berkeley was an idealistic philosopher. He has written a number of books in favour of idealism. His ideals were against the 'free-thinkers' e.g. secularists, sceptics, agnostics, atheists etc. - in short, anyone who doubted the truths of Christian religion. His book 'Analyst' was a direct attack on calculus, a prime branch of mathematics. In Indian context, we can recapitulate a very important episode. When Iswarchandra Vidyasagar was the Principal of Calcutta Sanskrit College, Dr. J. R. Ballantyne was the Principal of Sanskrit College, Varanasi. Ballantyne suggested introducing a Berkeley's book for the students of Sanskrit College, Calcutta. The book propagates idealist philosophy. Vidyasagar rejected Ballantyne's suggestion because he used to prefer materialistic philosophy over idealistic one. It is known to everyone that the materialistic philosophy is more close to science than the idealistic philosophy. How the scientists accepted the suggestion to name an element after a person against materialistic outlook may have other great stories not known to us.

The next element we have after the name of **Albert Einstein** (1879-1955), known as Einsteinium. It was discovered in 1952. Einstein is one of the great scientists of all times. He was a declared pacifist. Thus it is a matter of disappointment that an elemental component of the debris of the first hydrogen bomb explosion in 1952 was named after Albert Einstein.

One good thing about Einsteinium is that it was used to synthesize, for the first time, only 17 atoms of a new element in 1955 known as Mendelevium, named after the great founder of periodic table Dmitri Mendeleev.

Mendeleev

However, before the discovery of Mendelevium in 1955, we got another element in 1952 in addition to Einsteinium. That element was named Fermium after the name of Italian scientist Enrico Fermi (1901-1954). Fermi got Nobel Prize in 1938 for his claim that after the bombardment of thorium and uranium with slow neutrons, he created new elements. But later it has been proved that the new elements were not really new, they were the nuclear fission products. Fermium has atomic number 100 and like Einsteinium also found in the debris of the first hydrogen bomb explosion in 1952.

Just little before, we mentioned about an element called Mendelevium. Before 1955, nobody thought to name any element after the creator of the periodic table. From the time of Samarium, it took a long 75 years. Some people are saying that when the whole periodic table is named after Mendeleev, it is immaterial whether the name of any element is after him or not.

We remembered **Alfred Nobel** (1833-1896 by naming element number 102 as Nobelium in 1958. Nobel was a Swedish chemist, engineer, inventor, businessman and a philanthropist. Nobel was the inventor of dynamite and had a total of 355 patents. However, he is most famous for the Will to establish Nobel Prizes.

Ernest Lawrence (1901-1958) got Nobel Prize in physics in 1939 for inventing cyclotron. This instrument is used for preparing many artificial radioactive elements. An element of atomic number 103 was synthesized by the scientists of Lawrence Berkeley National Laboratory. They proposed its name as 'Lawrencium' with symbol as 'Lr'. The element was named in 1961. In the year 1964, another element of atomic number 104 was named after the name of great nuclear physicist **Ernest Rutherford** (1871-1937). Like so many elements, it is not found in nature. Rutherfordium can be synthesized in the laboratory. This Nobel Winner British physicist considered to be the greatest experimentalist since Michael Faraday. It is interesting to note that Rutherford received Nobel Prize in Chemistry but not in Physics. In fact he is considered to be more of a physicist than a chemist.

In the year 1974, the element of atomic number 106 was assigned as Seaborgium after the name **Glenn T. Seaborg** (1912-1999). It was a rare honour that the nomenclature took place when Seaborg was 62 years old. Seaborg got Nobel Prize in Chemistry in 1951. He was the principal co-discoverer of ten elements plutonium, americium, curium, berkelium, californium, einsteinium, fermium, mendelevium, nobelium and seaborgium. He held very high positions in science and technology division of USA. He was also a prolific author. He was once listed in the Guinness Book of World Records as the person with the longest entry in Who's Who in America.

In 1981, the element 107 was named after the Danish Nobel Winner **Niels Bohr** (1885-1962) as Bohrium. It is highly radioactive and has its half-life 61 one seconds only. It was reported by two teams. Bohrium was first reported in 1976 by a Soviet research team and then by a German research group in 1981. In the history of naming elements, there are debates and difference in opinions. We do not like to discuss that long story over here.

Lise Meitner (1878-1968) was famous for one of the discoverers of nuclear fission. She was born in Vienna and died in Cambridge. Meitner was the first woman to become a full professor of Physics in Germany. She lost her academic positions during Nazi period as she was a Jew. She fled to Sweden, settled there and became a Swedish citizen. Out of three scientists Otto Hahn, Otto Frisch and Lise Meitner, only Hahn was awarded the Nobel Prize in Chemistry in 1944 for nuclear fission. Several scientists and journalists have called her exclusion 'unjust'. Records say, she was nominated 19 times for Nobel Prize in chemistry between 1924 and 1947 and 29 times for Nobel Prizes in physics between 1937 and 1965. The chemical element 109 has been named Meitnerium in 1992.

Wilhelm Rontgen (1845-1923), the inventor of X-ray got the first Nobel Prize in 1901. In the year 1994, element number 111 has been named under his name.

In the year 1996, we went back to a scientist who had to suffer from religious orthodoxy. His name is known to everybody. He is **Nicolaus Copernicus** (1473-1543), a revolutionary scientist from Poland. This outstanding astronomer proposed a model for the Universe, known as Heliocentric model, keeping Sun rather than Earth at the centre of the Universe. Element number 112 is kept after his name as Copernicium.

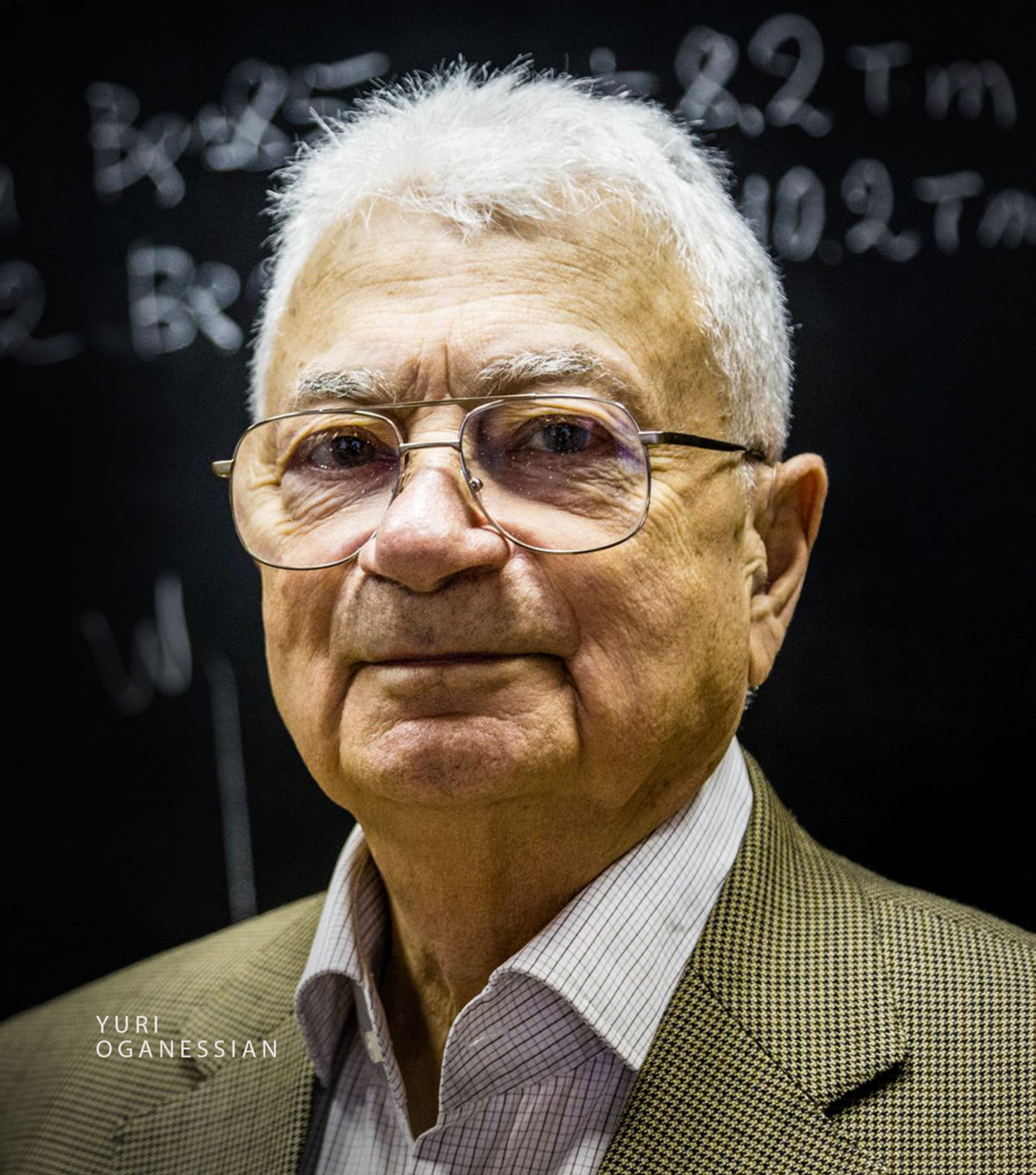
Georgy Flyorov (1913-1990) is a Russian scientist who is known for his discovery of spontaneous fission. He wrote a letter to Joseph Stalin during the time of World War II to adopt atomic bomb research. In 2012, element 114 was named as Flerovium. The element is extremely radioactive. The most stable isotope has the half-life around 1.9 seconds. The question has not yet been solved whether Flerovium behaves more like metal or a noble gas.

After a long gap of so many years, an element was again named after someone who was a landowner in the early days of California. His name was **Robert Livermore** (1799-1858). The 116th element in the periodic table was named as Livermorium in the year 2000. In fact, he donated lands where the Lawrence Livermore National Laboratory was founded.

The last naming is with the last element so far discovered. The element is Oganesson(Og) bearing the name of the Russian scientist **Yuri Oganessian** (1933-). Yuri Oganessian is considered a leading researcher in superheavy chemical elements. He succeeded Georgy Flyorov as director of the Flerov Laboratory of Nuclear Reactions. After Seaborgium, the heaviest element on the periodic table is named after him. It is second time that an element was named after a living scientist. Georgy Flyorov told about him which is stated below:

'A remarkable physicist and experimentalist…his work is characterised by originality, an ability to approach a problem from an unexpected side, and to achieve an ultimate result.'

The naming of elements started with the name of a Russian scientist in 1879 and presently ended also with the name of a Russian scientist. Let us wait for the future to see what happens next.


YURI
OGANESSIAN

MIDDLE SCHOOL 8
LEVEL WINNERS

THEME: EVERYDAY ELEMENTS
AIM: COMPARE OBSERVABLE EVERYDAY MATERIALS OR CHEMICAL CHANGES SEEN IN THEM

First Prize

NAME	Rupsa Ghosh
STANDARD	Class-VII
SCHOOL	Delhi Public School, Ruby Park
PROJECT FORMAT	Presentation

MENDELEEV MADEOVER MAESTRO STATEMENT:

This project is based on Mendeleev's periodic table. It gives you a vivid description about five elements of the periodic table. They are – Nitrogen, Carbon, Magnesium, Chlorine and Sodium. The usage and reactions of the elements are provided.

PRAISE FROM THE JURORS:

Highlighting the perks and quirks of our regularly encountered elements – from the humble salt at the breakfast table to the pencil lead at school, from the major part of the air that keeps us living to the occasional fireworks that keep us celebrating and even the antiseptic that helps to heal a wound when accidents strike – this Maestro covered pretty much a lot of our Everyday Elements and made us re-discover their roles, reputations and reactions!


Nitrogen
78%
Oxygen
20.9%
Argon
0.90%
Other gases
0.17%
Carbon dioxide
0.03%
Savlon
Antiseptic Cream
Cetrimide, Chlorhexidine Digluconate

Second Prize

NAME	Siddhartha Chowdhury
STANDARD	Class-VII
SCHOOL	Modern English Academy
PROJECT FORMAT	Sketch

MENDELEEV MADEOVER MAESTRO STATEMENT:

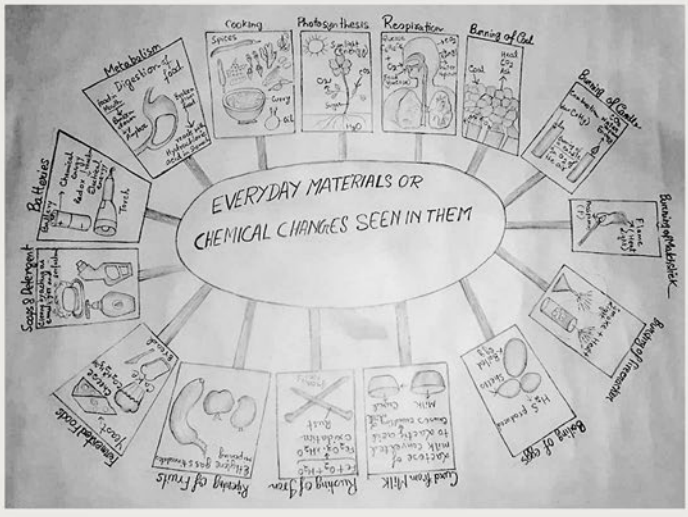
Sketches denoting everyday reactions involving:

1. Respiration (aerobic): Oxygen inhaled reacts with digested food to release carbon dioxide, water and energy.
2. Fermentation: Anaerobic respiration by yeast produces ethanol, carbon dioxide, other chemicals that make cheese, bread.
3. Photosynthesis: Carbon dioxide, water in presence of sunlight, chlorophyll changes into glucose,food and oxygen.
4. Digestion: Amylase enzyme in our saliva breakdown food into simpler substances. Hydrochloric acid inside stomach further breaks it down.
5. Rusting: Changes colour of iron to reddish brown (hydrated ferric oxide)
6. Burning of:
    i. Coal: Converts chemical energy in coal in presence of oxygen, heat to carbondioxide, ash, light and heat.
    ii. Fuel: Liquefied petroleum gas burns to produce energy (heat and light).
    iii. Candle: Hydrocarbon + Oxygen+Heat=> Carbon Dioxide+ Water Vapour + Heat, Light
    iv. Matchstick: Phosphorus + Oxygen+Heat=> Phosphorus pentoxide + Heat, Light
7. Cooking: Spices are mixed in right proportion. Temperature, time is adjusted to bring chemical change. During hard boiling of egg, hydrogen sulphide is produced.

8. Food preservation: In pickles, jams- lactic acid, vinegar alters pH and changes the food's texture, taste, flavour.
9. Ripening of fruits: Ethylene gas stimulate ripening enzymes which catalyse reactions to change. properties, colour of fruit.
10. Formation of curd: Lactobacillus bacteria, in warm conditions, convert lactose of milk into lactic acid and causes milk to curdle.
11. Soaps, detergents: Soap emulsifies in contact with water, detergents lower the surface tension of water, interact with oils and rinse them away.
12. Fire crackers: A fire cracker explodes, produces heat, light, sound, various colours e.g. magnesium (brilliant white light), strontium (crimson light), barium (green light).
13. Batteries: Torch batteries store chemical energy which is converted to electrical energy.
14. Medicines: Release chemicals in our body which are absorbed by liver, flows with blood to different organs where chemical reactions take place to cure the disease.

PRAISE FROM THE JURORS:

The hand-drawn pencil sketches, around the theme of the topic – Everyday Elements, encompass, quite literally, the reactions of atoms that keep us going. Whether it's powering our systems or our devices, cooking of food in our woks or our stomachs, the reactions in our vicinity can be used as a boon and as a bane. Juxtaposing them in one single shot, the sketch celebrates the chemical changes observed daily, but this time, more mindfully.



Third Prize

NAME	Bidyasree Bhattacharyya
STANDARD	Class-VII
SCHOOL	G. D. Birla Centre for Education
PROJECT FORMAT	Presentation

MENDELEEV MADEOVER MAESTRO STATEMENT:

We are living in a vast world of different elements. In our life we find the application of different useful elements. We also come across different chemical reactions of different common elements around us. In my project I have chosen following selected elements which are very common and important in our daily life.

In this presentation metals chosen are:-
a. Iron, b. Copper, c. Aluminium, d. Gold

Non metals chosen are:-
a. Oxygen, b. Nitrogen, c. Carbon, d. Ozone

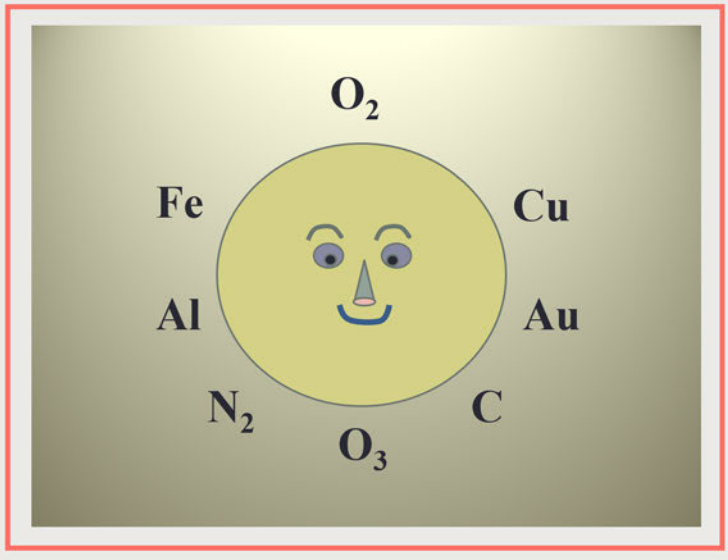
1. Iron: - Rusting, one of the most common chemical reaction of iron has been presented.
2. Copper: - Chemical reaction of copper to form copper(II) oxide has been mentioned. Important applications of copper have also been presented.
3. Aluminium: - One of the most important chemical reactions of aluminium which is the formation of aluminium oxide has been mentioned in the presentation.
4. Gold: - Chemical inertness of gold has been mentioned.
5. Oxygen: - Importance of oxygen in various fields of our life has been mentioned briefly.

6. Nitrogen: - Importance of nitrogen in protein synthesis has been explained in the presentation.
7. Carbon: - Immense importance of carbon, its allotrope has been explained briefly. Role of carbon in pollution has also been mentioned
8. Ozone: - Role of ozone in ozonosphere as well as depletion of ozone layer has been mentioned briefly.

Relevant practical applications have been mentioned briefly almost for all above mentioned elements. Thus in this endeavor I have tried my best to make the overall presentation in such a manner that anybody can understand very easily importance of different elements along with their selected chemical properties in everyday life. Related diagrams have been attached which will also make the presentation more meaningful.

PRAISE FROM THE JURORS:

Dealing with the ordinary as well as the exotics with equal ease, this presentation highlighted the elements we know are important today, as well as those that we are taught to be essential for tomorrow – not just for us, but for the planet as well. Kudos for thought spared for elements inside the earth, on it, over and beyond it too. Everyday elements they might be, but nonetheless they are everywhere and exciting too!



PERIODIC TABLE

IN THE CONTEXT OF SCIENTIFIC EXPLORATION

DR. (PROF.) MAITREE BHATTACHARYYA
DIRECTOR, JAGADIS BOSE NATIONAL SCIENCE TALENT SEARCH

The periodic table provides us with lots of valuable information, which is not only important tools for the chemists, but as well for physicists and definitely for biologists too. When we were school students, I would often memorize facts about periodic table element arrangement without understanding the importance of the elements themselves. But now we know, moving across the periodic table leads to an increase in the number of protons, whereas moving down along the group, the number of electron shells increase. This pattern is so consistent that predicting the properties of elements based on their relative position in the table, is obvious, and this understanding has contributed significantly towards the extended and quality human life in twentieth century.

Nature has selected several metals from the periodic table for specific functions. Understanding the implications of selective choice of metals from the periodic table for the biological processes can help design more effective drugs. Metallodrugs are potential tools for unique mechanisms of drug action based on the choice of the metal, their oxidation state, the varieties and number of coordinated ligands and the coordination geometry. To exploit the potential of metallodrugs, it is absolutely essential to understand the mechanisms of the coordination complex and its components, the metal and the ligand(s), once the metal-ligand complex enters the body. Metallodrugs for the treatment of cardiovascular diseases focus on the regulation of nitric oxide (NO) and dioxygen (O2) in the blood vessels. There is significant recent progress in identifying new target sites and elucidating the mechanisms of action of anticancer, anti-microbial, anti-viral, anti-parasitic, anti-inflammatory, and anti-neurodegenerative agents, which finally results into designing metal-based diagnostic agents.

9

It is also possible to use genomics to understand medical conditions related to them the metals such as Fe, Cu, Zn, but for other metals it is not yet clear, how, or if, genomes code for these elements. Genomes do not code for the elements themselves, but it is observed for particular chemical forms (e.g. vitamin B12 for cobalt) in several cases. Genomic codes for metals actually indicate codes for proteins, and proteins are highly selective for particular metal ions. It is also known that Platinum, Gadolinium and Technetium, are widely known in inorganic medicinal chemistry, which can make use of non-essential as well as essential elements for the design of drugs and diagnostic agents. We see, that, a range of new target sites are being proposed for metallodrugs but there is still much progress to be made on target-site validation. Tailoring the design of metallodrugs to treat specific diseases, like cancer, or cardiovascular diseases are likely to be a major part of future personalized medicine, which will include genomic and proteomic profiling of individuals. We focus especially on the interactions of the metallodrugs with proposed target sites, including DNA and proteins. Despite the fact that successful clinical platinum anticancer drugs have DNA as their major target, in recent times DNA is not being considered to be a favoured target site. This is partly because DNA is also likely to be attacked in normal healthy cells as well as in cancer cells. However, downstream processing of platinated DNA can differ in normal and cancer cells, so differential cytotoxicity can still be achieved. Moreover, it is becoming evident that anticancer drugs which target a single protein or enzyme are not always successful, since cells readily become resistant to such drugs and utilise alternative metabolic pathways.

The exploration of the medical periodic table poses exciting challenges for chemical and medicinal researchers. Specifically, inorganic compounds, and metal complexes, offer mechanisms of drug action that can be quite distinct from those of organic drugs. About 13 metal ions are essential for mammalian life, which can be used in therapy. But, it must be mentioned, that, not only essential metals can be used, but also nonessential metals, and consequently a strategy might be particularly important for fighting bacteria which are becoming increasingly resistant to organic drugs. Also radionuclides with suitable ligands offer targeted agents both for diagnosis and therapy. The ligands can play critical roles in the activity of all metallodrugs and diagnostic agents. We have tried to focus here particularly on the discovery of new targets for metallodrugs. In the contemporary world, an understanding of targets and mechanisms of action is essential if a drug is to receive approval for clinical use. Such understanding will eventually become important when patients can be screened on a personal-medicine basis (pharmacogenomic strategy) for the optimum drug to treat their disease progression. There are signs that rapid progress is currently being made, aided by advances in metal analysis and especially speciation techniques, and by the methods of modern molecular biology (proteomics and genomics), which can be fruitfully applied to the identification of target sites and understanding of metabolic pathway.

We can also discuss about a few metals, which have crucial roles in determining therapeutic strategy. The effect of lithium was eventually proven in human clinical trials and lithium became an important medicine in psychiatric therapy. Despite the widespread use of lithium around the world since its discovery, its mechanism of action is not known yet. One theory suggests that lithium helps regulating the internal clock system, while the other opinion is, that it affects the interneuron signal transmission process. The actual mechanism is perhaps a combination of multiple functions.

Nevertheless, this kind of drug is perhaps most unlikely to come out from today's systematic drug discovery approach. Recent studies are showing that vanadium may be effective in treating diabetes. It has been reported that the daily administration of 100-200 mg of vanadyl sulfate (VOSO4) to diabetic patients resulted in lowered blood sugar levels. It is quite astonishing that a simple metal salt shows equivalent medicinal effect to that of peptidic insulin composed of 51 amino acids. If the absorption could be further improved (by organometallic complexation) and the toxicity problem could be solved, practical use would be wonderful. On the other hand, there is also a drug that makes use of strontium. Strontium-89 is a radioactive isotope that emits a beta ray with the half-life of 50.5 days, and it can be used as a medicine that alleviates the severe pains associated with metastatic bone cancer. It is strange that a radioactive isotope of strontium has both cancer-inducing and pain-relieving properties, but this is an example of the unique relationships between human body and radioactivity, and also between human body and drugs. The X-ray radiocontrast agent is barium sulfate, which is insoluble in water thus not absorbed by the digestive system though non-toxic. And because barium is a large element with atomic number 56 it effectively scatters X-ray, providing the visualization of the stomach and the intestines in white color after drinking the chalky liquid. As Barium is also inexpensive, it will likely continue to be used for years to come. Moreover, its user-friendliness has been improved in recent years by reducing the dose and improving the taste. Gold complexes such as sodium aurothiomalate and auranofin are great examples of pharmaceutically used organometallic complexes. In auranofin, the thiosugar and the phosphine bind to the gold atom, making the molecule look like a catalyst of chemical reaction. These complexes are used as a medication of rheumatoid arthritis and the mechanism of action is considered to involve accumulation in the joint fluids, preventing collagen decomposition, and binding and neutralizing inflammation causing substances.

Radiation therapy is an important cancer treatment along with chemotherapy and surgery. The most famous type is probably gamma ray irradiation by radioactive cobalt-60. Cobalt-60 is formed from cobalt-59, its stable isotope, by neutron activation in a nuclear reactor. Cobalt-60 emits a beta ray with the half-life of 5.27 years to become nickel-60, then emits two gamma rays which attacks the cancer cells.The type of nuclei that can be used for radiation therapy is specified by the law and it includes a wide range of nuclei from tritium to radon-226. The list includes even artificial elements such as technetium and notorious ones of late such as iodine and cesium. Ideally, radiation therapy targets only malignant cells and keeps healthy cells intact, but in reality simple irradiation cannot be completely cell-specific. Therefore, there are therapies in which a small radiation source is delivered to the affected tissue to treat it from inside.

The newest weapon of radiation therapy is a combination with antibody which works with higher efficacy. For example, the adduct of a radioactive element such as yttrium-90 with an antibody was developed as a chemotherapeutic for lymphatic cancer. The drug utilizes the ability of antibodies to recognize the protein expressed on the surface of cancer cells, which reduces the chance of affecting untargeted areas of the body. Antibody technology is advancing fast and further development of this therapy in close future can be expected. We, are employing all sorts of chemical elements to defend ourselves in the war against our biggest health threats, like cancer. For this reason, a number of different approaches of drug development are being taken. Accordingly, we look forward to see unusual elements utilized in future which will be instrumental in initiating therapies based on innovative medical (and chemical) concepts.

Early medicines were the product of accidental discovery of a plant or microbial extract and trial testing of similar compounds to find the most effective version. Today, tools of modern chemistry purification and analysis techniques, being empowered with cutting edge techniques like spectroscopy and crystallography researchers map the structures of modern medicines, mimic their functions and tailor drugs to individual needs—making medical wonders regular events to render quality life to the human society. Thus discovery and utilization of new metals and elements have their meaningful roles to correlate the diseases and new therapeutic exploration. Here lies the importance of the International Year of the Periodic Table of Chemical Elements.

HIGH SCHOOL LEVEL WINNERS 10

THEME: ALTERNATIVE PERIODIC TABLE
AIM: DEVISE ALTERNATIVE METHODS OF REPRESENTATION OF MENDELEEV'S PERIODIC TABLE

First Prize

NAME	Abonti Mukherjee
STANDARD	Class-XI
SCHOOL	The Heritage School
PROJECT FORMAT	Animation

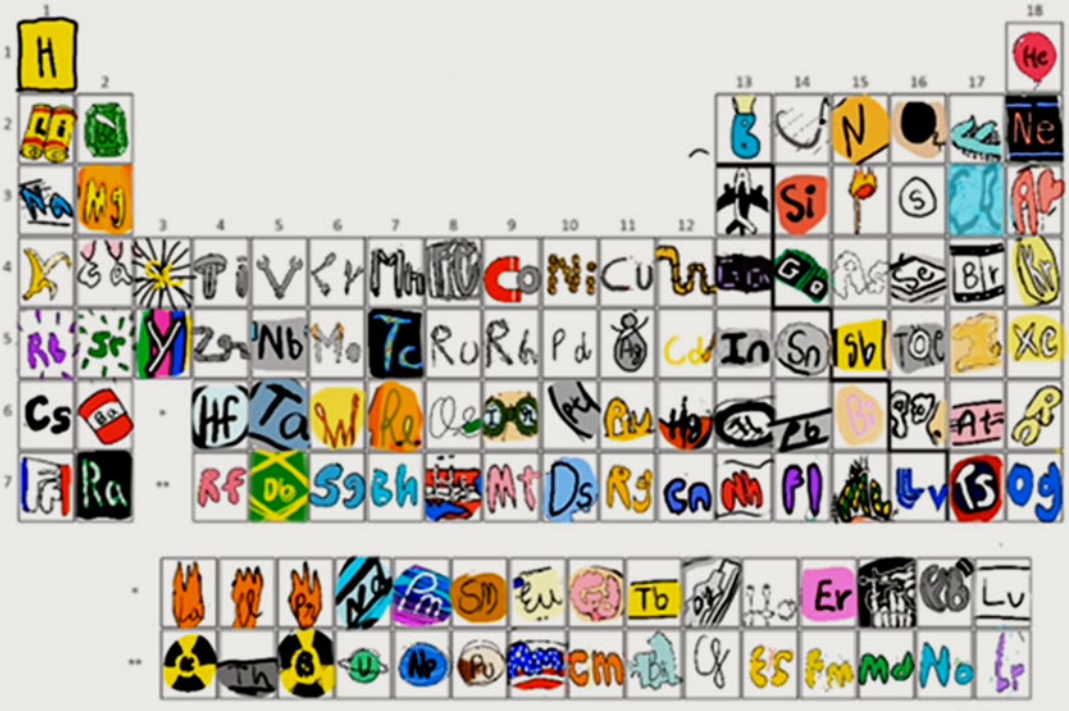
MENDELEEV MADEOVER MAESTRO STATEMENT:

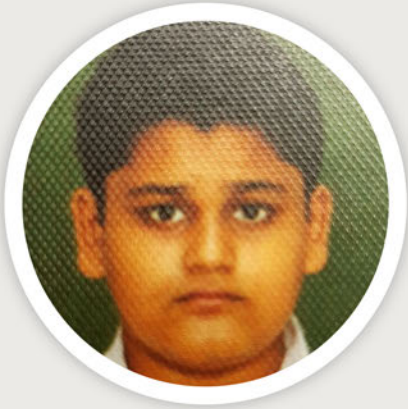
In the given work I have animated the elements of the whole period table. The entire table consisting of 118 elements has been animated keeping in mind their everyday uses and associations. For instance, Helium gas is used in balloons, Moscovium is named after Moscow and Mendelevium is named after the Russian chemist Dimitri Mendeleev. Simple, 2D animation with flat colour is used and the App FlipaClip has been used. All the elements feature In a particular way mostly in the shape/use in which they have been portrayed like Carbon in the shape of the pencil lead, Fluorine in association of its use in tooth paste etc. I have chosen to associate few of these elements with their discoverer's name or place of origin as some of these elements are either radioactive or their uses have not been discovered like Mendelevium or Fermium. The animation helps to draw the attention of the audience/ user in new ways as the minimum movement helps to engage them with an otherwise non interactive table which is static.

Movement always helps to captivate the audience and there is also a small scenario built around the element like the lungs are inhaling the Oxygen, the plane descends which is made out of aluminium et al. In these times of more and more interactive communication and classroom teaching environment, a dynamic period table can definitely redefine the interest of the students back to the study of chemistry in a fun and engaging way. Sources used are Google Images, YouTube reference videos, images of periodic table from the Internet.

PRAISE FROM THE JURORS:

When talking about chemistry is made as fun as doodling on a page, we realize that our job has been done! Addressing the importance of each and every element in the table and re-interpreting them in the iconic arrangement itself, the animations give the chemical symbols a life of their own. More than mere letters and numbers now, elements in this Periodic Table show their true characters and make things happen. It was hard to resist playing them on a loop!





Second Prize

NAME	Kunaal Gupta
STANDARD	Class-X
SCHOOL	Delhi Public School, Ruby Park
PROJECT FORMAT	Sketch

MENDELEEV MADEOVER MAESTRO STATEMENT:

SATELLITE MODEL OF PERIODIC TABLE CONSTRUCTION: The periodic table is made into a structure that sort of represents the solar system with almost complete circles (in place of orbit).The hydrogen is at the center. The lanthanides and actinides are made in orbit surrounding the elements.

ADVANTAGES:

i. The model provides a strategic position to hydrogen so that it can be included in Group 1 (alkali metals) and Group 17 (halogens).
ii. Elements in a line form a Group (same as modern periodic table) and each orbit is a Period.
iii. All the periodic trends are followed: atomic number increases clockwise, atomic size increases and ionization energy decreases down the period, etc. [There is a gap left between Group 18 and Group 1 so that there is no dip in atomic number when going clockwise. Between elements 57 (La) and 70 (Yb); 89 (Ac) and102 (No)].
iv. The table is simple, systematic and easy way for remembering the properties of various elements as it is based on the electronic configuration.
v. The model successfully represents lanthanides and actinides in the main body.

vi. It is seen that the properties of lutetium and lawrencium are more similar to that of yttrium and scandium as compared to lanthanum and actinium. Thus lutetium and lawrencium are placed in the same line as scandium and yttrium and the lanthanides and actinides start after barium and radium respectively. Also lanthanum and actinium are placed exceptionally close to lutetium and lawrencium because of their electronic configuration.

POTENTIAL ADVANTAGE:

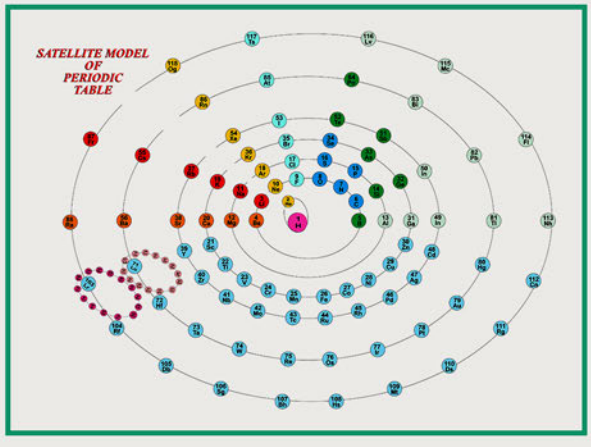
The isotopes of an element can be depicted by making a sub-orbit around i.e. the element will act like earth while the isotope(s) will become like moon orbiting it thus overcoming the disadvantage of position of isotope.

CONCLUSION:

The satellite model is an approach to modify the periodic table by keeping the base properties same and trying to overcoming the disadvantages.

PRAISE FROM THE JURORS:

We are all made of star-dust. Every element originates somewhere up there. This satellite model of the table, not only pays tribute to their characteristics and inter-relationships but also depicts, in quite a delightful way, their stellar beginnings. By accommodating the lanthanides and actinides in a galaxy of moons, the table tries to address the limitations of the modern form of the periodic table. The central hydrogen atom, resting all disagreements about its position once and for all – a masterstroke perhaps!



Third Prize

NAME	Shibanshu Soubhagya Das
STANDARD	Class-IX
SCHOOL	Kendriya Vidyalaya No. 1, Salt Lake
PROJECT FORMAT	Video Presentation

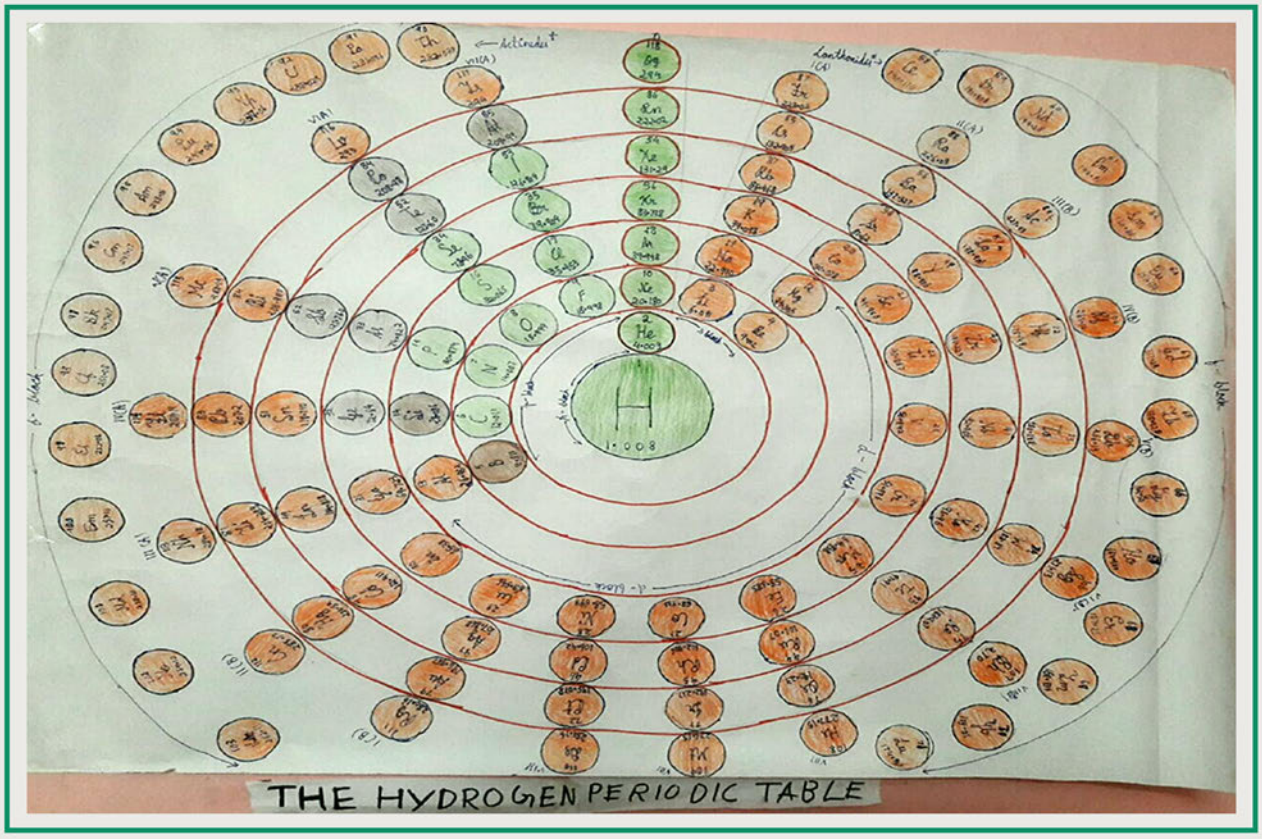
MENDELEEV MADEOVER MAESTRO STATEMENT:

The idea of formulating a nuclear model of the periodic table of all 118 elements in a hubs and spokes model will genuinely help to understand the properties of the elements with more clarity. While arranging the elements, Hydrogen has been considered as the center of the arrangement, as because the Atomic Mass and the Number is near Unit. The seven periods of the original Mendeleev's arrangement have been represented by concentric circles to give a note of atomic orbits. Lanthanides and Actinides have been assigned a position outside of the outer Orbit. Isotopes can be demarked clearly by depicting each of the circle around the original and most stable isotopes. Metals, Non Metals, Metalloids and Nobel Gas have been clearly identified by unique color codes. Taking Noble Gas series being the starting point and moving in the clockwise direction , the properties of the classes of elements have been arranged in a such a way , the atomic number of the elements have been arranged in ascending order , keeping the class of original Mendeleev's Periodic Table intact . 118 elements have been arranged in 13 Group and 7 Periods along with 14 Lanthanides and Actinides each positioned outside the exterior orbit. Any element can be found by atomic number, atomic mass (except Isobar) and class and period (not for f-Block). This Periodic Table can be nomenclature as Hydrogen Periodic Table as because, the properties of the elements have been arranged, taking Hydrogen as Center.

It also bears a close resemblance of the Atomic Model. Hope this arrangement of the elements will give a easier view of the elements.

PRAISE FROM THE JURORS:

Another hydrogen-centered model - but a separate approach altogether. With a bird's eye view of a spiraling periodic table, this Hydrogen Periodic Table offers a fresh perspective. Colour-coding, explaining, detailing - this presentation even delved into its own limitations. With immaculate chemistry being depicted in the spokes of its wheel-like arrangement, this Table is definitely on a roll!



PEROIDIC TABLE
THEN & NOW

11

DR. SEKHAR CHANDRA PAL
TEACHER, SALT LAKE SCHOOL
(ENGLISH MEDIUM)

Periodic table is an **unforgettable feat of bringing order** to an unordered set of elements. Mendeleev followed by Moseley gave the Periodic Law which not only hypothesized properties of some of the already discovered elements but also to predict the properties of elements that were yet to be discovered. The Periodic table acted as a target for the synthesis of the rest of the trans-uranic elements and the field of super-heavy chemical elements.

In this age, even after the discovery of all the Mendeleev-predicted naturally occurring elements, the periodic table still remains **relevant**. It serves as a list of elements for students, newly initiated to the subject, and familiarises them with the concept of atomic number and electronic configuration. Each period of the periodic table matches with the principle quantum number and each block corresponds to the azimuthal quantum number thereby summarizing the electronic configuration of all the elements.

The periodic table of elements presents us with a qualitative understanding of the properties, providing us with **trends** across a period, without out the actual specific data derived from experiments. Properties such as Ionisation Energy and Electronegativity are calculated through extensive process with a margin of error. Other properties like metallic character do not have any experiment in a strict sense. However, even without a strong understanding of the process one can easily understand and utilise them.

Elements having **similar electronic configuration** take part in similar reactions and due to the periodic law fall under the same group. Thus by studying the properties of one element of each group we can know the properties of the entire group. Alkali metals are highly reactive and are usually found as halides as seen in case of sodium. Similarly elements in gr 18 are highly unreactive as seen in case of argon, a gas used to provide inert atmosphere. This feature is also useful for finding alternatives or substitutes to current materials. Iron and cobalt have replaced Ruthenium and Rhodium as cheaper metal catalyst for many reactions. Research on Germanium shows that it possesses more potential as a semiconductor than silicon.

Properties such as boiling point, density and crystal structure are related to the interactions between each atom which in turn is directly related to their electronic configuration. Boiling point and melting point of non-metals like halogens and noble gas increase down the group. It increases down the group due to an increase in electrons down the group. This results in the increases in size of the electron cloud and hence bigger temporary dipoles and bigger induced dipoles form, due to greater movement of electrons making one end of the molecule more delta positive and the other more delta negative, which end up requiring more energy to break down. However the melting point of group 1 and 2 metals decreases down the groups. This occurs due to a decrease in charge density as atomic radius increases and charge stays constant, meaning that the delocalised electrons are further away from the metal cations, leading to weaker electrostatic forces of attraction that require less energy to break down, causing a decrease in melting point.

NOT PERFECT

The periodic table is **not perfect**. Various exceptions, although explainable, arise to many obvious patterns. The periodic trend shown by valency is sparsely followed for heavier elements, especially for lanthanide and actinide series. Atomic size of hafnium and zirconium are nearly equal although belonging to different group. Nitrogen shows more stability compared carbon and oxygen. The new super-heavy elements end up breaking more trends. Oganesson, which should be a noble gas, is predicted to be a solid at room temperature and highly reactive, due to **relativistic effects**. However, even with these shortcomings the periodic table provides a **concise and a clear presentation** of all the elements. It provides a classification which is simple yet efficient and exhaustive. With all its advantages outweighing its faults, it maintains its place as an integral part of the subject, not only for now but for generations to come.

RELATIVISTIC

SPECIAL PRIZE

Praise from the Jurors:

Dodging each challenge like seasoned aces, these interpretations of everyday elements and their arrangements guided both amateurs and professionals smoothly through the labyrinth of chemistry. They began with a spark and ended with a bang – leaving us very little to complain about!

12

NAME	Ayushman Sarkar
STANDARD	Class-VI
SCHOOL	The Future Foundation School
PROJECT FORMAT	Animation

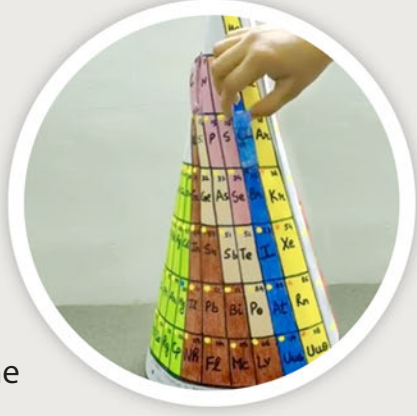
MENDELEEV MADEOVER MAESTRO STATEMENT:

This is an awareness video on global warming and Everyday Elements. The first scene shows the letters of the word 'Element' talk with each other about the compound 'water'. The letters decide to discuss about the elements we see every day. Hydrogen and oxygen combine to form water. The glass we see is made out of sand, which is a mixture of silicon oxide particles and other elements. Much of the Earth's crust is made of silicon. Iron is found everywhere; in form of steel, iron ore, duralumin etc. Steel is used vividly at home. It is an alloy of iron and carbon. It is a very malleable and ductile element. Pipes and old coins were made out of copper. They can bend very easily because copper is also malleable and ductile. Carbon is a black non-metal. It has a lot of forms; ash, smoke, coal, soot etc. It is often used to strengthen metals. Carbon combined with oxygen form Carbon Dioxide and Carbon Monoxide in different proportions. Nickel and Zinc are used in batteries and dry cells. They are excellent mediums to store electrodes. Sodium and chlorine combine to form common salt, a common food product. Chlorine is a yellowish - green poisonous gas. Argon, Neon and other noble gases are used in light bulbs. They do not react with the tungsten filament. Magnesium, Potassium etc. are useful elements in the human body. At the end, the letters tell us about the effects of global warming and make us aware and pledge us to stop this.

NAME	Shivansh Shalabh
STANDARD	Class-IX
SCHOOL	Delhi Public School, Ruby Park
PROJECT FORMAT	Video

MENDELEEV MADEOVER MAESTRO STATEMENT:

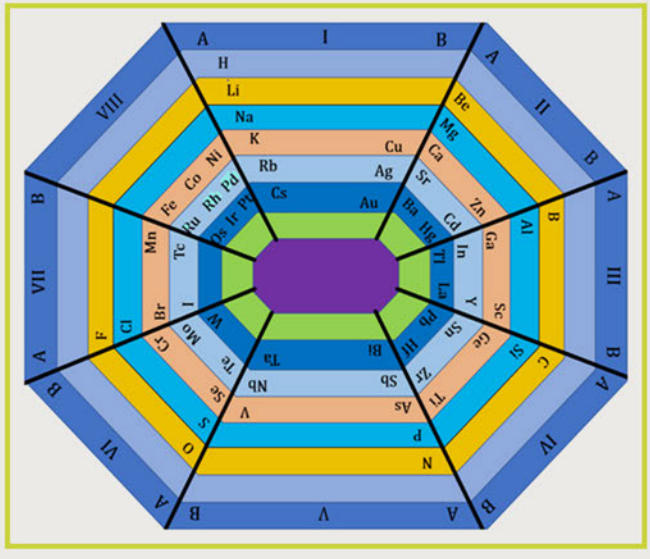
My idea is to represent the Mendeleev's Periodic Table on a Frustum which is a 3-dimensional figure and looks like a cone with sliced top. The name of my Periodic Table is 'Frustum ex Elementis' which is a Latin name and means 'frustum of elements'. The Periodic Table is plotted taking the narrow part as the top. The hydrogen is kept on the top of the Frustum and the lanthanides and actinides series are inserted in the 6th and 7th period respectively. A reference point is provided in order to avoid confusion along with the different colours given to different groups of elements (families). A space for isotopes is also created which is foldable and does not cause distortion of the Periodic Table. The elements are marked with three kind of symbols each representing their physical state i.e. solid, liquid or gas at Standard Temperature and Pressure (STP).There are several advantages of such a representation. Firstly, the periodic trend is followed. Since frustum is a 3-dimensional figure, it is more appealing to students. The lanthanides and actinides series are inserted in the 6th and 7th Period respectively without making Periodic Table look abrupt. The isotopes are also added in the Periodic Table which is a major limitation in the case of Mendeleev`s Periodic Table. The different colours of groups of elements (families) make their individual study easier. Hydrogen which has properties of different groups of elements has been kept on the top of the frustum. The Periodic Table also helps us to know the state of an element at STP.



NAME	Arka Dhar
STANDARD	Class-XI
SCHOOL	Hare School
PROJECT FORMAT	Presentation

MENDELEEV MADEOVER MAESTRO STATEMENT:

I have done the Periodic Table with an octagonal shaped tabular figure having 6 periods and 8 groups with 2 subgroups each except the 8th group. The groups are shown by making a table in each segment of its sides which vividly displays the elements belonging to the same group. The subgroups hold their own elements with similar properties. Now, let's come to the Periods. They are in between each of the concentric octagons (i.e., the gap created in between each octagon). The 1st period is shown by the light blue coloured area followed by 2nd period which is yellow in colour and so on. The middle part of the periodic table has a space which is unfilled. This is the shape that I have exclusively thought for creating the project.



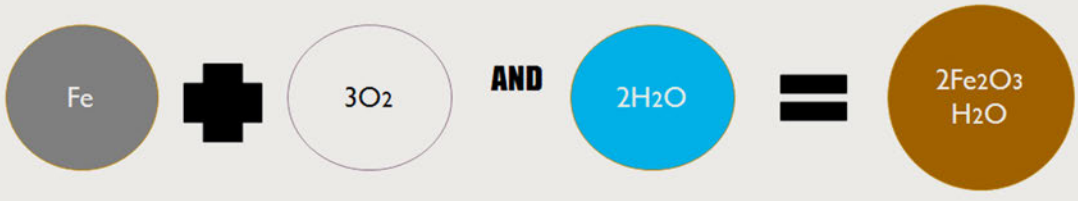
NAME	Abhiraj Bhattacharya
STANDARD	Class-VI
SCHOOL	The Future Foundation School
PROJECT FORMAT	Presentation

MENDELEEV MADEOVER MAESTRO STATEMENT:

This project is to demonstrate the chemical changes seen in some everyday elements. The materials in which the chemical changes are taking place as demonstrated are iron, milk, wood and human beings. It also describes the process through which the materials & living beings undergo certain chemical changes. A few marked differences among a few common related elements like Iron & Copper, Mercury & Bromine are mentioned.

ELEMENTS & CHANGES SEEN IN THEM

"Change is constant". Changes happen all around us, even within us. Most of them are irreversible but some of them are reversible changes. Here are a few examples of irreversible or chemical changes



NAME	Leena Mitra
STANDARD	Class-VIII
SCHOOL	La Martiniere for Girls
PROJECT FORMAT	Video

MENDELEEV MADEOVER MAESTRO STATEMENT:

Burning is an important and essential aspect of our lives. Fuel is burnt for heating, cooking, running vehicles and machines etc. Fireworks contain numerous chemicals. Each chemical component has an important use in the production of fireworks. Aerial shells are launched using gunpowder, a mixture containing 75% potassium nitrate, 15% carbon and 10% sulphur. Gunpowder is used to fuel the fireworks into the air. On lighting the fuse, the mixture reacts and forms nitrogen, carbon dioxide and potassium sulphide. Potassium sulphide is a basic salt. 78% of nitrogen and 0.04% of carbon dioxide are present in the atmosphere. Nitrogen is an incombustible gas that controls the rate of burning. Carbon dioxide is an inorganic oxide of carbon which is a product of respiration. Expanding molecules of the gases explode the shell cover. There are different elements and compounds which produce the various colours in fireworks. For example, elements like iron and copper give the colours yellow and blue respectively. Iron is an abundant metal and copper is found in small quantities in the earth's crust. Both iron and copper are malleable and are used to make commercial articles both in pure and alloy forms. Potassium perchlorate, dextrin and water make up the mixture to coat a stick to make sparklers. Potassium perchlorate is a strong oxidising salt and can be used as an anti-thyroid agent used to treat hyperthyroidism. Dextrin is used as a pyrotechnic binder and fuel for fireworks and sparklers. Flakes of elements like aluminium and magnesium are used for the sparks, as they have a white flame on burning. Often gases like carbon monoxide, nitrogen oxides, hydrocarbons, and sulphur dioxide form due to fireworks. These gases are toxic and can lead to acid rains. However, if displayed with constraint, fireworks are a spectacular and enjoyable sight.

CHEMICAL ELEMENTS: OUR BODY, THEIR HOME 13

PROF. BHUPATI CHAKRABARTI
FORMERLY OF DEPARTMENT OF PHYSICS, CITY COLLEGE,
IMMEDIATE PAST GENERAL SECRETARY,
INDIAN ASSOCIATION OF PHYSICS TEACHERS (IAPT)

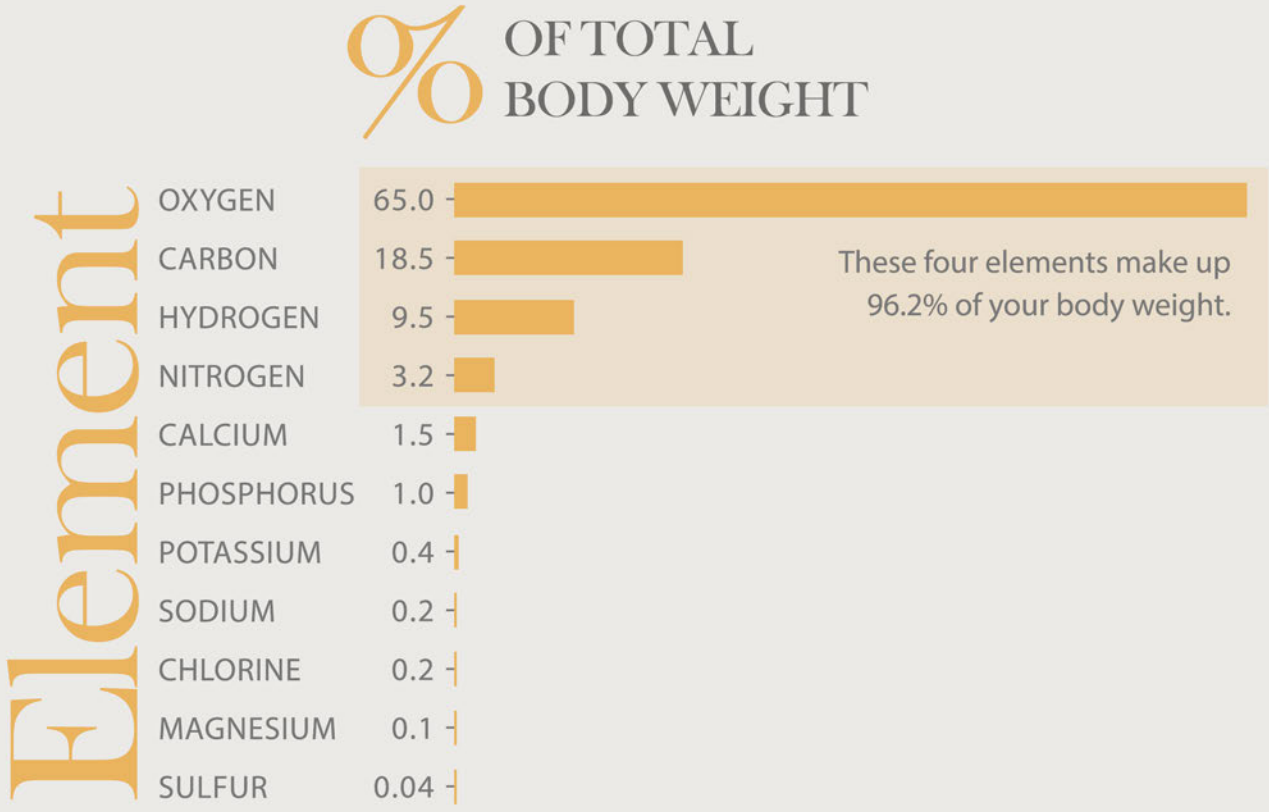
People like Dhiman Mandal are rare these days. Studious, successful and sober, Dhiman had always been obsessed with chemistry. When in class XI, during the 125th birth anniversary celebrations of Mahatma Gandhi, Dhiman came to know that it was also the 125th year of the periodic table of chemical elements. It fascinated him to think that when Gandhi was being born in India, far away in Russia, Dmitri Mendeleev was devising his periodic table of elements. There were only around 60 chemical elements known back then – the other naturally known and artificially synthesized elements were yet unknown, as were their properties. Yet, it was the beginning of a completely new era in Chemistry.

Young boys practice a knack of associating disparate things audaciously. Dhiman's young friends had a knack of associating unrelated things quiet well together. They somehow noticed that his initials matched very well with the Father of the Periodic Table, the Russian chemist Dmitri Mendeleev. Since then, he stopped being a Dhiman and came to be known affectionately, sometimes as Dmitri and at other times as Mendeleev. Dhiman was only too happy to be placed in such an elite bracket.

A few days ago, during the weekend get-together at Spandan's place, Dhiman was greeted by the exclamation, "Here comes a quarter of the periodic table!" Dhiman was flabbergasted, "Do you mind being a little less gibberish and perhaps let me know what is going on?" Spandan was only happy to explain. After all, it's not every day that you get to crack a joke about the periodic table and then explain it to a certain D. Mendeleev! He started, "You see Dmitri, the human body is made up of a lot of chemical elements, all in the form of compounds. 50 – 70% of it is water – a compound of oxygen and hydrogen. Besides, there's a substantial amount of carbon and nitrogen too. The other elements in here amount to around 26 together. So, when you walked into this room today, you brought in 25% of the elements of the Periodic Table. Of course, that was true for all of us too!" Spandan's eyes sparkled, "Gotcha!"

Dhiman was amused, but not Pratyay. He protested, "Get your facts right Spandan – I'm pretty sure that the Periodic Table has roughly 120 elements. So if we carry a mere 26 elements out of those in our body, then how come does it ever add up to a quarter of the periodic table? We are way too short for it." Spandan admitted, "I was only counting the naturally occurring 92 elements of the table, although I am aware that the Periodic Table has 118 named elements today, with places reserved for a few more." Sujoy had become impatient by now. He burst out, "Oh stop it – will you? Spandan got a chance to tell us about a handful of those elusive 26 elements. Dmitri, please tell us about the rest – they sound quite interesting."

Dhiman was excited now, "Spandan's observation is outstanding. Let me just add a few details to his feature. We know for a fact that 96% of our body weight is composed of only four elements – hydrogen, oxygen, nitrogen and carbon. Even though most abundant in the form of water, because of its light weight, hydrogen constitutes less than 10% of our body mass. Then come the next seven elements – calcium, phosphorus, potassium, sodium, chlorine, magnesium and sulphur. The calcium in our bones is legendary – wasn't that the first thing that we were taught in class?"So saying, he fiddles with his mobile phone and lays out a chart for all of us to see.



"We shouldn't ignore the trace elements", Dhiman warns. In correct proportions, they are absolutely necessary for our survival and well-being." "Then you need to enumerate these 15 trace-elements too", pleaded Spandan. Dhiman relented, but with a caveat, "The presence of a handful of these trace elements depends on our geographical location too. For example, the trace elements in the body of an Australian are bound to differ from those of a Siberian. So the list is not exhaustive."

"What is this trace-element you are going on and on about?" interrupted Archisman who was feeling a bit lost by this time. He even expressed a valid concern, "The eleven biggies you just showed us seem to cover 99% of our body mass – do you really believe that we may still have space to accommodate another fifteen of your trace-elements?"

"Why, yes of course", says Dhiman. "Spandan's fifteen elements are absolutely safe! Actually, those elements which constitute less than 0.01% of the body mass are called the trace-elements. These scanty elements amount to another fifteen ones from the Periodic Table. They are found in one part per 10,000 parts of our body – or even less. If we look for them in Archisman's body, they'll amount to less than 10 grams. Archisman, I just rounded-off your weight to a 100 kg, hope you didn't mind!"

Chubby Archisman didn't mind at all. Instead he asked, "Is there any chance that this trace-element list of your's include gold or platinum as well? If yes, then I'd be happy that even without wearing any jewellery, I'd still be carrying 'precious cargo'!"

Dhiman surfs a little more and draws up another list – this time titled 'Trace Elements'. "Though present in minuscule amounts, their presence is essential for our survival. Out of these, we are well aware of the roles of iodine and iron. But Spandan, I have to elaborate a little more for you. Before that, just have a look."

NAME & SYMBOL OF THE ELEMENT				
Boron (B)	Cobalt (Co)	Iodine (I)	Molybdenum (Mb)	Tin (Sn)
Cadmium (Cd)	Copper (Cu)	Iron (Fe)	Selenium (Se)	Vanadium (V)
Chromium (Cr)	Fluorine (F)	Manganese (Mn)	Silicon (Si)	Zinc (Zn)

"What? Iron is a trace-element? No wonder then it is tough building a body that is as strong as iron! I should really stop popping in those iron-tablets from tomorrow", declared Archisman. Pratyay had something else on his mind. "Alas! No gold or silver on the list. But I remember my grandpa had his teeth plated in gold. Surely he had gold in his body, and it wasn't in trace amounts – what say Mendeleev?"

"Yes", exclaimed Dhiman. "That's exactly where I was trying to come. But before I proceed further I must admit that there is a lack of consensus in the scientific community about the exact number of trace elements in human body. However a widely accepted number is fifteen for the trace elements. As it is if 26 of the 92 natural elements found on earth are available in our body, it accounts for more than 28% of the lot. Add to it the suffering I underwent because of fracturing my leg last year…"

"So?", Archisman got a little touchy. "Why bring that up now?" After the accident involving Archisman's bike and Dhiman's leg, Archisman felt a little embarrassed whenever the issue came up. But Dhiman pacified him, "All I wanted to say is that, thanks to the implants provided by the orthopedic surgeons during that episode, the number of elements in my body have certainly increased. Medical implants generally contain metals and metallic-alloys, polymers and ceramics. I was allotted a metal-alloy implant. It contained cobalt and chromium – both of which were already present in my body. It was the titanium and tantalum in the alloy that added up to my body and its element list."

"Oh Dmitri, you ought to be feeling like a King! You are carrying 30% of the naturally occurring elements of the Periodic Table in your body right now!" cheered Pratyay. "So are you", retorted Dhiman. "Weren't you treated for dental ailments a couple of years back? Surely you are flashing some titanium in every smile of yours! Sometimes they use gold alloys for dental implants too. Assuming that, you have a million dollar smile – and quite literally I suppose!"

"Laugh all you can – but I hardly find the idea of carrying around a foreign implant in my body quite pleasant. Besides, can't the trace-elements just all be added surgically, eh, Mendeleev?" asked Sujay. "Yes", continued Dhiman. "Had I opted for ceramic implants, then I would have added aluminium oxide, zirconium oxide or calcium phosphate – namely the elements aluminium and zirconium, with atomic numbers 13 and 40."

“Sounds interesting, those would be present as trace elements – less than 9 gramme of medical grade metal in my 90 kg body I suppose”, Archisman calculated. Manik, from the nearby stall, had brought in piping hot tea by now. “How’s your father doing?” inquired Pratyay. Manik replied that he was recuperating from an angioplasty and resting for a while.

Dhiman sips on his tea and ponders, “ Angioplasty for Manik’s father has introduced stents in his artery – stents made of steel, a special medical grade metallic one, as just mentioned by Archisman. The main element there would be iron. But since it is an alloy of many more elements, it is specially tested for unwarranted reactions with the human body. This ensures that such implants do not do more harm than good to us. Producing medical grade metals is thus a complete challenge in itself.” Dhiman continued and came out with an important input. He said “Moreover nowadays any metallic implant needs to be completely non-magnetic and must be MRI compatible. They must not cause any interference with the very strong magnetic field produced in an MRI machine. After all you just do not known when someone needs to go for an MRI. The medical implant cannot come as a spoilsport in these situations.”

“True Mendeleev, you’ve enlightened us today. I now realize that I should be consuming these trace elements in the supplements that need to keep popping in. They are responsible for running our systems healthily and happily”, said Spandan. Archisman continued, “It’s amazing how a 100 kg person suffers from the imbalance of a few of these crucial trace elements. Only last year my uncle suffered from a nasty sodium-potassium imbalance and behaved quit peculiarly for two whole days. It turns out that it is quite a common problem in aged-people.”

"You're right – sparse they may be, but nonetheless they are essential too", and so saying Dhiman prepares to leave. "When are we meeting up again – just like the trace-elements in his body, Spandan is rarely available nowadays!" Spandan ignores the last bit and urges, "Mendeleev, I have a request for you. Today's discussion brought out the crucial roles of various elements in the human body. But what about other living beings?"

Dhiman responded, "Given the variety of plants, animals, even insects that make up our biodiversity – surely their chemical compositions, the percentage of essential and trace elements – that's sure to have a mind-boggling variation as well."

Pratyay agreed, "Next time Dhiman, you must tell us about these variations in our ecology. Sure we can look it up too, but the interaction and enrichment that we would get from our own Mendeleev is surely a class apart. We'll also make sure that we do our homework and come – that must make your job easier and lead to a more fruitful discussion."

"Spoken like a true friend", exclaimed Archisman, and they all shared a hearty laugh together – the kind that comes with true companionship, which does not remain confined to the sidelines like trace elements do – it comes with a bond that is more elemental in nature.

(Editor's translation of the original Bengali 'Boshot Kore Koyjona',
Jnan-o-Bijnan, vol. 72, no. 9-10, Sep-Oct 2019, p.p. 494-497)

SPECIAL PRIZE
II

Praise from the Jurors:

Singing, talking, sketching, modeling, story-telling – all means were explored to bring out the nuances of everyday chemistry and their implications. At the end of lessons, the air was heady with the aroma of freshly delivered chemistry knowledge, delivered delightfully!

14

NAME	Sridatri Sadhu
STANDARD	Class-VI
SCHOOL	The Future Foundation School
PROJECT FORMAT	Presentation

MENDELEEV MADEOVER MAESTRO STATEMENT:

Chemical change is said to occur when a substance combines with another to form a new substance which is not reversible. When chemical reactions occur, the atoms are rearranged and the reaction is accompanied by an energy change as new products are generated. How do we know that a chemical change has taken place?

i. Change of odor (for example, rotten fruits)
ii. Change of color (for example, silver to reddish-brown when iron rusts)
iii. Change of composition (for example, burning of fireworks)
iv. Light and/or heat given off (for example, burning of wax)
v. Formation of gases, often appearing as bubbles in liquids
vi. Formation of a precipitate (insoluble particles)
vii. The decomposition of organic matter (for example, rotting food)
viii. The change is difficult or impossible to reverse

NAME	Avikshit Mandal Maiti
STANDARD	Class-VII
SCHOOL	Delhi Public School, Ruby Park
PROJECT FORMAT	Presentation

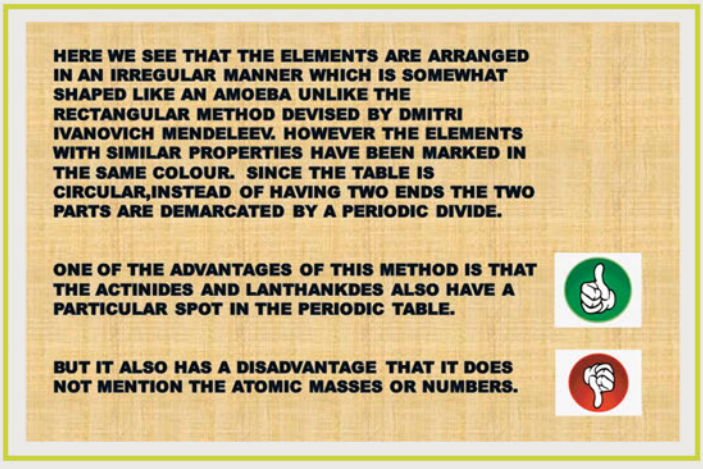
MENDELEEV MADEOVER MAESTRO STATEMENT:

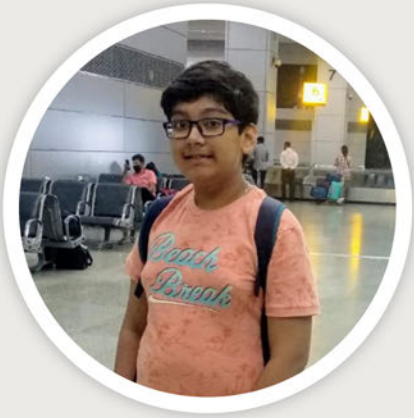
We have noticed many interesting changes around us in our daily life. Some of them are physical changes while some of them are Chemical changes. Few examples of chemical changes that we can see in our daily life are burning of coal, tarnishing of copper, rusting of iron and respiration. In my presentation tried to depict some of these changes and chemical reactions that are happening. One should be inquisitive enough to discover those changes and try to understand various interesting reactions the that are taking place around us.

NAME	Shreyan Chakraborty
STANDARD	Class-IX
SCHOOL	Delhi Public School, Megacity
PROJECT FORMAT	Video

MENDELEEV MADEOVER MAESTRO STATEMENT:

The organization of the periodic table can be used to derive relationships between the various element properties, and also to predict chemical properties and behaviours of undiscovered or newly synthesized elements. Russian chemist Dmitri Mendeleev published the first recognizable periodic table in 1869, developed mainly to illustrate periodic trends of the then-known elements. He also predicted some properties of unidentified elements that were expected to fill gaps within the table. Most of his forecasts proved to be correct. Mendeleev's idea has been slowly expanded and refined with the discovery or synthesis of further new elements and the development of new theoretical models to explain chemical behaviour. The modern periodic table now provides a useful framework for analyzing chemical reactions, and continues to be widely used in chemistry, nuclear physics and other sciences.





NAME	Md. Amaan Khan
STANDARD	Class-VIII
SCHOOL	Delhi Public School, Ruby Park
PROJECT FORMAT	Presentation

MENDELEEV MADEOVER MAESTRO STATEMENT:

The topic given for this project was "everyday Elements". After contemplating on it, I decided to make a little information booklet about the "element" that I chose, that is Selenium. I have prepared this in the form of a power point presentation which highlights some relevant information about the element as well as provides some random tidbits of information regarding it.

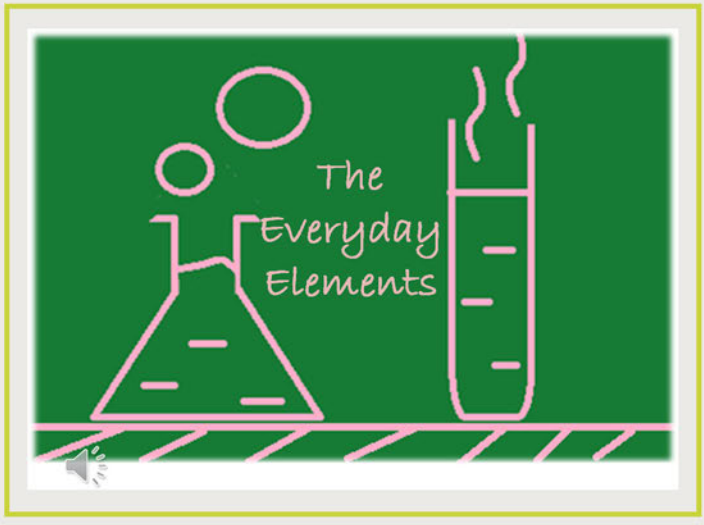
Coming to health , Selenium also makes up an important part of our diet . Our body relies on Selenium for many of its basic functions from reproduction to fighting infection . The amount of selenium intake should ,thus ,be strictly monitored . While too little Selenium can cause serious health issues , due to Selenium deficiency , too much Selenium can also be toxic for the body . It is not produced by the body but is needed for proper Thyroid and immune system functioning . Some foods rich in Selenium are Brazil nuts , Yellowfin Tuna , Ham , Pork , Beef , Turkey , Chicken , Cottage cheese , Eggs ,Brown rice and enriched foods.




NAME	Poulomi Guha
STANDARD	Class-VII
SCHOOL	Apeejay School, Salt Lake
PROJECT FORMAT	Presentation

MENDELEEV MADEOVER MAESTRO STATEMENT:

Oxygen plays a vital role in the uniqueness of the Earth. Another example is titanium which is used in toothpaste we need it every day. People living in villages use copper utensils which turn green after some days this happens because of the chemical reaction of copper and oxygen. Nikita had got a silver earring from her father and she became so fond of it that she started wearing them every day but after some days she noticed that her earring had become blackish and she was offended about it getting spoiled. But scientifically it was formation of argentums oxide. Some elements we use are: Osmium, Bismuth, Mercury, Nickel, Lithium, Neon, Magnesium, Phosphorus, Sodium, Iron, Cobalt, Tungsten, Carbon.



15

Chemistry inspires, influences and indulges the modern economy. Transforming drug discovery, enabling measurement of salts in blood to develop point-of-care device used in hospitals, ambulances and war zones, revolutionizing DNA sequencing, researching nano-coating techniques which protects soldiers, footwear and smartphones, chemistry is the modern day philosopher's stone. Spearheading development of new manufacturing technology to increase industrial productivity and reduce waste, revolutionizing the ability to create and characterize new materials, with applications in batteries, fuel cells and green safety technologies, chemistry contributes to the cause of humanity like none other. Developing quantum dots leading to energy efficient lighting and televisions, enabling zero emission energy production, researching into properties of graphite extending nuclear reactor lives, the contributions of chemistry are affecting the present and future of the world itself.

PROF. (DR.) NITIN CHATTOPADHYAY
DEPARTMENT OF CHEMISTRY,
JADAVPUR UNIVERSITY

PERIODIC TABLE: THE TABLE OF CHEMISTRY

With the expansion of ideas and techniques of discovery of chemical elements and consequently, studies of their physical and chemical properties the concept of some sort of organization of a large number of elements peeped into the minds of the scientists. **The chronological development of such systematic** arrangements, ending at the Modern Periodic Table, involves thoughts and contributions of a large number of chemists. The first of such an effort came from Johann Dobereiner in 1829 (alkali metal and halogen triads). This triggered the gradual formation of an upward cascade consisting of a number of propositions from de Chancourtois, John Newlands, Lothar Meyer and Dmitri Mendeleev (March 06, 1869). Although the tables provided by the last two were very similar, Lothar Meyer made it from the consideration of physical properties of the elements while Mendeleev made it considering the chemical properties.

Moreover, there were some added characteristics of Mendeleev's table like correction of atomic weights of some elements, prediction of elements not discovered till then etc. Eventually, Mendeleev's Periodic Table over ruled the other one. Till that period the periodic behavior of elements were correlated with their 'atomic weight's. The basis was, however, modified to 'atomic number' after the contribution of Henry Moseley (1913). Moseley discovered the isotopes of elements which established that "the properties of the elements varied periodically with atomic number," not atomic weight. The Modern Periodic Table came up compiling the discoveries of scientists like William Ramsey (discovery of noble gases), Marie and Pierre Curie (discovery of radium and polonium), Ernest Rutherford, Antonius van den Broek and so on. Provision of transuranic elements was established after Glenn Seaborg discovered plutonium.

Although development of the Periodic Table was gradual, development of **Mendeleev's table was, in a sense, path breaking**. Hence UNESCO declared 2019 as the International Year of the Periodic Table (IYPT) in celebration of the 150th anniversary of the Mendeleev's Periodic Table. Impact of the Periodic Table is immense in learning chemistry. The importance of the Periodic Table is evident simply from the recognition of the IYPT by the UNESCO. It is impossible to keep in memory the huge information associated with the physical and chemical properties of the large number of chemical elements. Periodic Table makes our life easy. It is actually only the trend of variation of the physical and/or chemical properties of the elements along a period or a group that is significant to understand; and that helps us a lot in getting the wide span of chemistry to a good extent. Variation of the atomic or ionic radii of the elements along a period or a group itself tells a lot about other chemical properties of the elements making the related chemistry easier to the chemists.

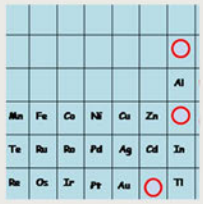
MADEOVERS ... AND MORE!

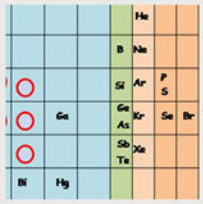
When 80 Maestros compete with each other to makeover Mendeleev's elements and their tabular arrangement, what results is an enviable hall of fame!

In a competition, some selection is mandatory.

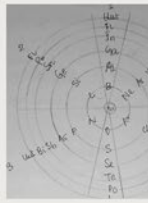
But for us, each of them made it. Period.

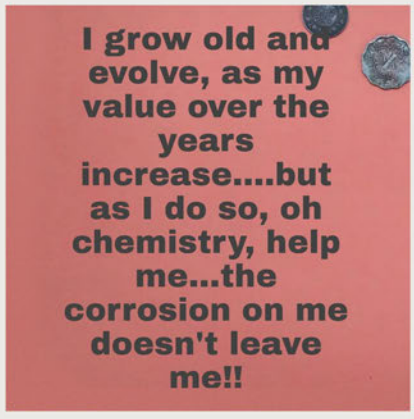
Visit bitm.gov.in/mendeleev to see more.





Solar System Model



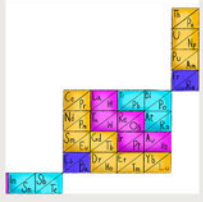


Nuclear Table

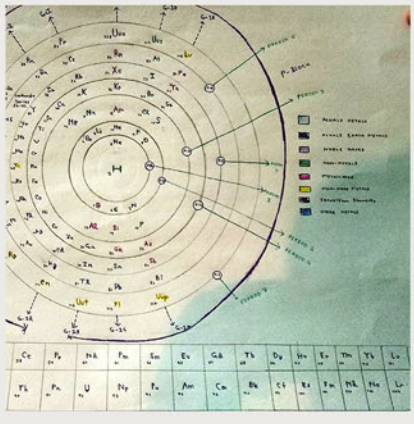
16

... the enzymes in these fruits act as catalysts to speed up the reaction

Protractor Table



... they make our life efficient



Circular Rose

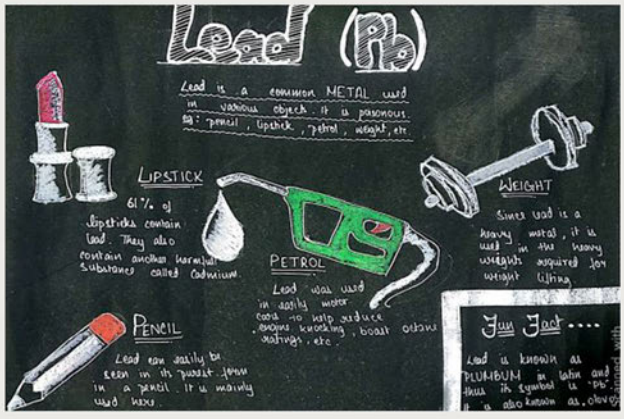
Rust is an iron oxide...

Wedding Cake-cum-Screw Table

... the output is a spongy and bouncy egg

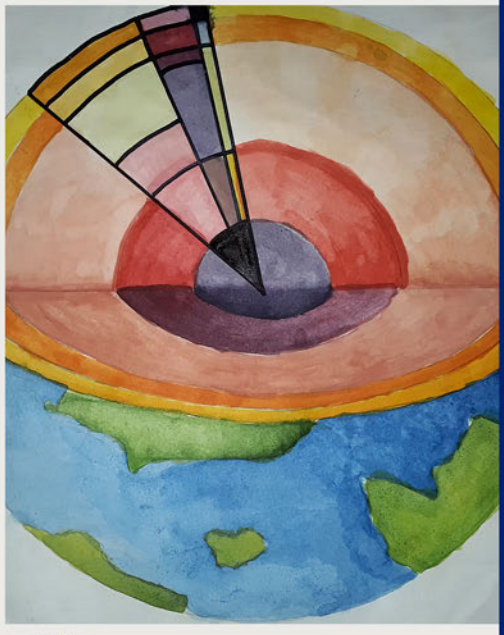
... In today's world, silicon has become our oxygen!

... when oxygen enters the tracheal tubes, it reacts with luciferin in presence of luciferase and produces a cold light



... tea is known as the master of chemical diversity

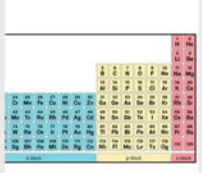
Grey ring around hard-boiled egg?

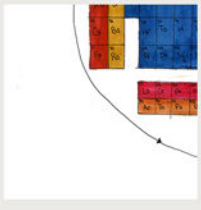


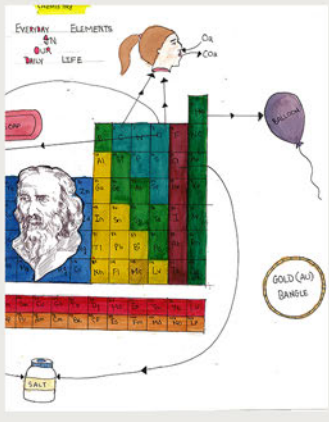
... easier to Remember & Reproduce

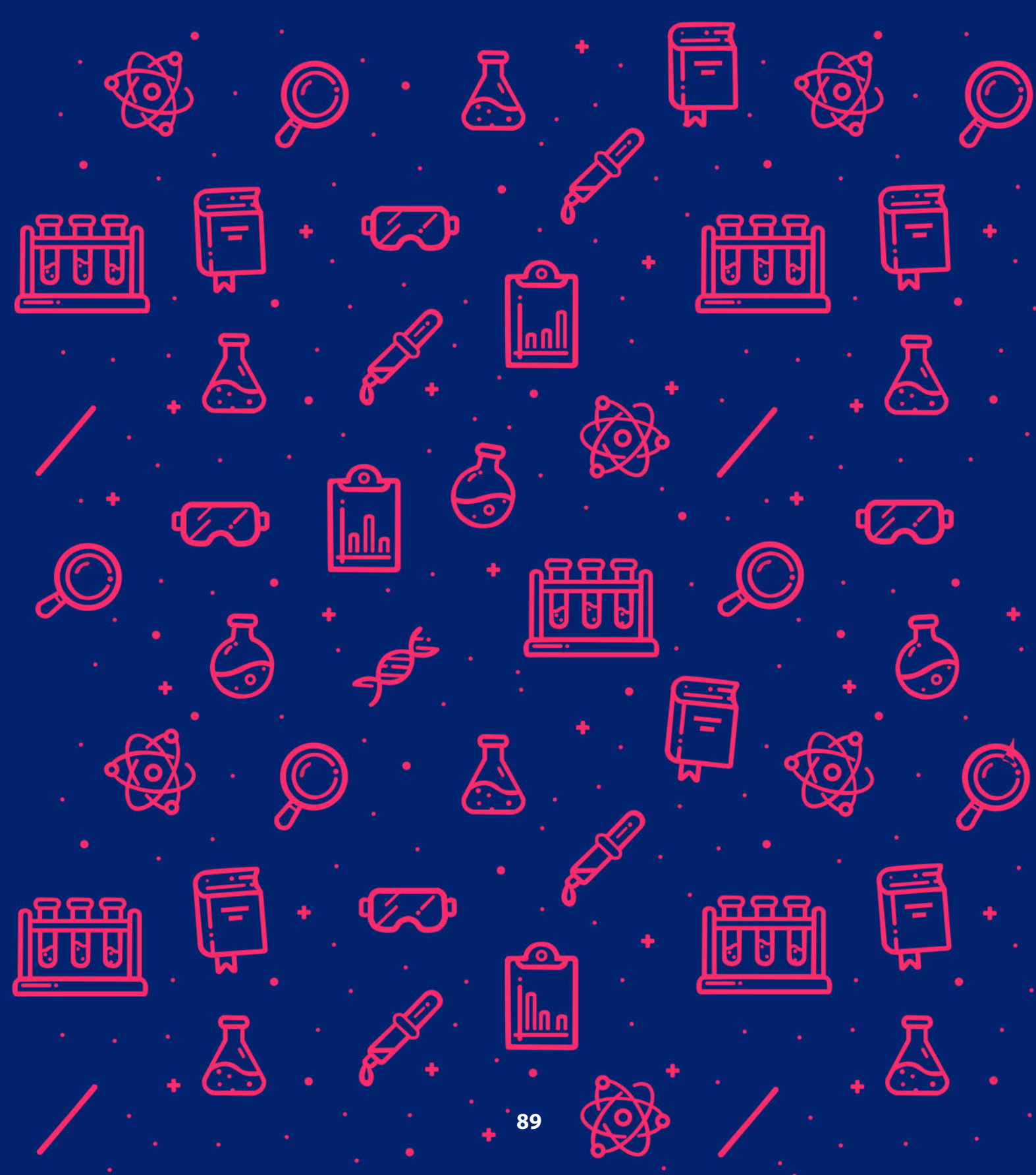
...it has assumed the title 'King of Metals' and the world is in its second century of 'The Age of Aluminium'

... Lactobacillus bacteria is the bacteria responsible for changing milk into curd









ACKNOWLEDGEMENT

BIRLA INDUSTRIAL & TECHNOLOGICAL MUSEUM GRATEFULLY ACKNOWLEDGES:

For contributing articles on various aspects of the Periodic Table of Chemical Elements

Prof. (Dr.) SYAMAL CHAKRABARTI,	Dept. of Chemistry, University of Calcutta
Prof. (Dr.) MAITREE BHATTACHARYA,	Dept. of Biochemistry, University of Calcutta and Director, Jagadis Bose National Science Talent Search
Dr. SEKHAR CHANDRA PAL,	Teacher, Salt Lake School (English Medium)
Prof. BHUPATI CHAKRABORTY,	Formerly of Dept. of Physics, City College, University of Calcutta
Prof. (Dr.) NITIN CHATTOPADHYAY,	Department of Chemistry, Jadavpur University

For providing reference material for the contest, workshops and souvenir

PAUL PARSONS & GAIL DIXON,	The Periodic Table: A Field Guide to the Elements
SAM KEAN,	The Disappearing Spoon
TIM JAMES,	Elemental: How the Periodic Table Can Now Explain (Nearly) Everything
THEODORE GRAY,	The Elements: A Visual Exploration of Every Known Atom in the Universe

www.americanscientist.org
www.bbc.com
www.independent.co.uk
www.iupac.org
www.newscientist.com
www.pinterest.com
www.rsc.org
www.science.org.au
www.scientallis.weebly.com
www.sciencenews.org

17

Mendeleev Madeover

A MONOGRAPHIC MEMOIR

COMMEMORATING INTERNATIONAL YEAR OF THE
PERIODIC TABLE OF CHEMICAL ELEMENTS (IYPT2019)

Organised by:

Birla Industrial & Technological Museum
(National Council of Science Museums)
Ministry of Culture, Govt. of India
19A Gurusaday Road, Kolkata 700019
Phone: +91 33 2287 7241-43, 9477345291, 9477345292, 9477345290
e-mail: director@bitm.gov.in
www.bitm.gov.in

In association with:

Royal Society of Chemistry
(Eastern India Section)
https://www.rsc.org/Membership/Networking/LocalSections/Asia/Indiaeastern.asp