

GYAN VIGYAN SARITA: शिक्षा

A non-remunerative, non-commercial and non-political initiative to Democratize Education as a Personal Social Responsibility (PSR)

7th Quarterly e-Bulletin, 1st April '18; Second Year of Publication



Special Issue: World Earth Day and Remembering Stephen Hawking



A person who suffered a rare motor neuron disease called Amyotrophic Lateral Sclerosis (ALS), since age of 21 years predicted few years to live, braved life to keep the death away for 55 years. He became a star cosmologist while living and shall remain for ever a guiding star in cosmos even after his death on 14th March '2-18

Mother does not discriminate between her children, rich or poor, physically fit or special, bright or dull, beautiful or ugly, fair or dark.

She cares for all her children equally well.

Let us awaken to take care of our mother and the supreme mother, the Mother Earth, which is ailing, yet supporting our living to the extent it can.

It is our personal and social responsibility to live everyday as World Earth Day and just not on 22nd April.



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Here, N= No of Hours of Monthly

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to

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We start with what is available in ground;
Aim at best Grooming for Competence Building
Unprivileged;
Welcome better and more economical, but functionally
suitable for IOMS, setup to reach Unprivileged Students
: Spiritually Democratize Education.



Learning Centre
With Projector Display
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... start, without loosing time, with whatever is available.



संपादकीय

पृथ्वी दिवस (Earth Day)

22 अप्रैल का दिन हर वर्ष पृथ्वीदिवस के रूप में मनाया जाता है। इसकी शुरुआत वर्ष 1970 में हुयी थी। इस दिन को मनाने के पीछे उद्देश्य है कि हम पृथ्वी के पर्यावरण की सुरक्षा के प्रति जागरूक बनें। जेराल्ड नेल्सन एक अमेरिकी सीनेटर थे। उन्होंने पर्यावरण सुरक्षा को राष्ट्रीय एजेंडा में शिक्षा के रूप में जोड़ने के प्रयास के तौर पर इस दिन को मनाने का सुझाव दिया था। आज विश्व के करीब 192 देश इस दिन को मनाते हैं।

22 अप्रैल वह दिन है, जब उत्तरी गोलार्द्ध में वसंत और दक्षिणी गोलार्द्ध में पतझड़ का मौसम होता है। संयुक्त राष्ट्र में पृथ्वी दिवस हर वर्ष 20 मार्च एक्विनाक्स (Equinox) के दिन मनाया जाता है। एक्विनाक्स वह समय होता है जब दिन और रात बराबर होते हैं। खगोल विज्ञान के अनुसार एक्विनाक्स उस समय को कहते हैं, जब सूर्य का केंद्र, पृथ्वी की भूमध्य रेखा के ठीक ऊपर होता है। यह समय सामान्यतया 20 मार्च और 23 सितंबर को आता है।

पृथ्वी दिवस को मनाते समय हमें अपने पर्यावरण के दुश्मनों को पहचानना चाहिये और उनसे पर्यावरण को बचाने का प्रयास करना चाहिये। पर्यावरण को सबसे अधिक नुकसान तेल के रिसाव, प्रदूषण फैलाने वाली फैक्टरियों के धुंये, और उनसे पैदा होने वाले कचरे, उर्जा संयंत्रों के मलवे, कच्चे मलजल, कीटनाशक, जंगलों की कटान, और वन्यजीवों के विलुप्तीकरण से होता है।

पृथ्वी दिवस वह पवित्र दिन है जो सभी राष्ट्रीय सीमाओं को पार करता है फिर भी सभी भौगोलिक सीमाओं को अपने आप में समाये हुये रहता है। सभी पहाड़, महासागर, और समय की सीमायें इसमें शामिल हैं। यह पूरी दुनिया के लोगों को एक गूंज के द्वारा बांध देता है। यह प्राकृतिक संतुलन को बनाये रखने के लिये समर्पित है। यह पूरे ब्रह्माण्ड में तकनीक, समय-मापन, और तुरंत संचार को कायम रखता है।

यह दिन किसी विशेष व्यक्ति के जीवन का दिन नहीं है। यह पृथ्वी की संरक्षा से जुड़ा है। इस दिन को किसी व्यक्ति विशेष से नहीं जोड़ना चाहिये। हर दिन तो बहुत सारे अच्छे, बुरे लोग जन्म लेते ही हैं। पृथ्वी पर बेहतर भविष्य के लिये हम यह दिन मनाते हैं। युद्ध-विरोधी होना, और जीव-जंतुओं की रक्षा करना इस दिन के कार्यक्रमलाप का एक भाग हो सकता है।

वर्तमान जानकारी के अनुसार पृथ्वी एक मात्र ऐसा ग्रह है, जहां जीवन दिखायी दे रहा है। इस जीवन की सुरक्षा करना हमारा कर्तव्य है। यह कार्य हम प्राकृतिक संपदा की रक्षा से कर सकते हैं। जीवन को खुशहाल बनाने के लिये पर्यावरण को नुकसान नहीं होने देना चाहिये। उद्योगों का बढ़ना पर्यावरण की कीमत पर नहीं होना चाहिये, अन्यथा जीवन पृथ्वी से समाप्त हो जायेगा। ध्यान रहे, औद्योगिक घराने, प्राकृतिक संसाधनों का दुरुपयोग करते हैं। वे धन कमाने के चक्कर में कभी भी पर्यावरण सुरक्षा का ध्यान नहीं रखते हैं। वैसे भी धन कमाने वाले लोग किसी देश, जाति, संप्रदाय अथवा संस्कृति से जुड़े नहीं होते हैं। वे केवल एक ही विचार पालते हैं, और वह होता है-धन एकत्र करना। धन एकत्र करने से किसी का कितना नुकसान होता है, वे इसकी चिंता नहीं करते हैं।

प्लास्टिक का उत्पादन और उपयोग इसी का परिणाम है। सभी जानते हैं कि प्लास्टिक बहुत नुकसानदायी है, पर अभी भी इसके उत्पादन को रोक नहीं गया है और न ही लोगों ने इसके प्रयोग को खत्म करने का साहस दिखाया है। व्यापारी वर्ग यह सोचता है कि उसके जीवन-काल में तो उसके कारनामों से कोई बहुत नुकसान उसका होना नहीं है, तो भविष्य में जो आयेगा, वह सोचेगा। यही सोच पृथ्वी पर निवास योग्य रहने की स्थिति को कमजोर करती जायेगी, हमारे प्राकृतिक संसाधन कम होते जायेंगे, और फिर हम धीरे-धीरे समाप्त हो जायेंगे।

जो लोग इस दिन को मनाते हैं, वे जानवरों और पौधों के जीवन को इंगित करने के लिये हरे और नीले रंग का इस्तेमाल कर पृथ्वी को बनाते हैं। उनका प्रयास होता है कि वे ग्रीन हाउस प्रभाव और ग्लोबल वार्मिंग को दिखाकर बतायें कि प्राकृतिक पुनर्चक्रण पृथ्वी से समाप्त नहीं होना चाहिये। फल, फूल, पेड़, कीड़े, मकोड़े, सब हमारे पर्यावरण के लिये उपयोगी हैं। हमें नहीं भूलना चाहिये कि प्रकृति से मिले ये सब हमारे लिये तब तक उपयोगी रहेंगे, जबतक हम इस पृथ्वी पर जीवित रहना चाहेंगे।

हमें इस दिन जरूरी स्थानों पर नये पौधों को रोपना चाहिये। पेड़ों पर पक्षियों के लिये घोंसला बनाना चाहिये। पेड़, पौधों, और जीव-जंतुओं का पर्यावरण संरक्षा में योगदान पर चर्चा कर लोगों को जागरूक करना चाहिये। प्लास्टिक थैलों के इस्तेमाल को रोकने के लिये कहना चाहिये। पुराने सामानों को पुनर्चक्रण के माध्यम से पुनः उपयोग करने के प्रति खुद सजग होना चाहिये और अपने आस-पड़ोस को शिक्षित करना चाहिये। सड़क, और पार्कों आदि से गंदगी दूर करनी चाहिये।

अबतक मनाये गये विगत वर्षों के पृथ्वी दिवस के महत्वपूर्ण थीम रहे हैं-जल अद्भुत विश्व, हरे शहर, धरती को संगठित करना, कैसे आप आसपास रहते हैं, कृपया पेड़ लगायें, धरती के प्रति दयालु बनें, आदि आदि। इस वर्ष का थीम है-(End Plastic Pollution) प्लास्टिक प्रदूषण का खात्मा।

अगर हम कभी भी असमय जलवायु परिवर्तन को रोक सकें, भूमि, जल और दूसरे संसाधनों को संरक्षित कर सकें, जानवरों की पीड़ा को घटा सकें, वह दिन ही पृथ्वी दिवस हो सकता है। अगर ऐसा होता रहा तो यह ग्रह सुरक्षित रहेगा और हमेशा हमेशा के लिये मनुष्यों के रहने लायक बना रहेगा।

हमें कोशिश करनी चाहिये कि हम कैसे पृथ्वी के उत्तरी ध्रुव की ठोस वर्ष को कई किलोमीटर तक पिघल कर पहुंचने से रोकें, और सूर्य की पराबैंगनी किरणों को रोकने के लिये बनी हमारी ओजोन परत में कहीं छेद न हो जाये ऐसा हमेशा प्रयत्न करें।

जिस प्रकार हमारी मां, हमें जन्म देकर हर प्रकार से हमारा पालन-पोषण करती है, हमें बड़ा करती है, ठीक उसी प्रकार यह धरती भी हमें अपने से पैदा फल, फूल, अन्न, जल, वायु आदि देकर हमें जीवित रखती है। यही कारण है कि हम धरती को मां का दर्जा देते हैं। धरती पर देवता भी जन्म लेने को आतुर रहते हैं क्योंकि यहां का वातावरण रंग-बिरंगा है, चारों ओर हरियाली है, कहीं चीं चीं करती चिड़ियां हैं, तो कहीं कल-कल करती नदियां हैं, कहीं वनों में उछलते-कूदते जानवर हैं, तो कहीं मस्ती में नाचते मोर हैं।

पृथ्वी के जन्म के बारे में कहा जाता है कि स्वर्ग के बाद ईश्वर ने पृथ्वी बनाया है। वैज्ञानिकों का मानना है कि बिग बैंग परिकल्पना के आधार पर पृथ्वी का जन्म हुआ।

कुछ लोगों का मानना है कि पृथ्वी का जन्म आकाश में बिखरे छोटे-छोटे अणुओं के आपस में इकट्ठा होकर ठोस टुकड़ों में बन जाने से हुआ है। कुछ का मानना है कि आकाश में घूमती चमकदार निहारिकाओं से निकलने वाली पट्टियों के ठोस होकर अलग अलग टुकड़ों में बंट जाने से पृथ्वी का जन्म हुआ है। कुछ लोग पृथ्वी का जन्म चुम्बकीय परिकल्पना के आधार पर मानते हैं। उनके अनुसार आकाश में बादलों के रूप में अनेक परमाणु छाये हुये थे, जब सूर्य उसमें से होकर निकला तब उसके चुम्बकीय प्रभाव से ये अणु एकत्रित होकर संगठित हो गये और ग्रह बन गये। पृथ्वी, उनमें से ही एक है।

अभी हाल में इंग्लैंड के विख्यात वैज्ञानिक स्टीफेन हाकिंग की मृत्यु हुयी है। यह एक संयोग है कि स्टीफेन हाकिंग का जन्म 8 जनवरी 1942 को हुआ। ठीक 300 साल पहले 8 जनवरी को ही इटली के खगोल वैज्ञानिक गैलीलियो का जन्म हुआ था। स्टीफेन हाकिंग को स्कूल में बचपन में सभी "आइंस्टीन" नाम से ही पुकारते थे, और स्टीफेन हाकिंग की मृत्यु 14 मार्च 2018 को हुयी जबकि 14 मार्च 1879 जर्मनी के मशहूर वैज्ञानिक आइंस्टीन का जन्मदिन है।

स्टीफेन हाकिंग ने कहा था -कि हम अपनी लालच और मूर्खता के कारण खुद को नष्ट करने के खतरे में हैं। हम इस छोटे, तेजी से

प्रदूषित हो रहे, और भीड़ से भरे ग्रह पर अपनी और अंदर की तरफ देखते भर नहीं रह सकते।

वर्ष में केवल एक दिन पृथ्वी दिवस मना लेने से, हमारी पृथ्वी सुरक्षित नहीं रहेगी। हमें नित्य प्रति जागकर यह सोचना होगा कि हम

कैसे इसे संरक्षित और सुरक्षित रख सकते हैं। ज्ञान विज्ञान सरिता परिवार की तरफ से सभी पाठकों को पृथ्वी दिवस की शुभकामनाएँ, इस आशा के साथ कि सभी अपनी-अपनी क्षमतानुसार पृथ्वी के वातावरण को सुरक्षित रखने का प्रयास करेंगे और मनुष्य-जीवन को पृथ्वी पर खुशहाल बनाये रखने के लिये सदैव प्रयत्नशील रहेंगे।

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OUR MENTORING PHILOSOPHY: Mentoring is not teaching, neither tuition nor coaching. It is an activity driven by passion, and commerce has no place in it. In this effort is to caution students that -

- This place is not where they will be taught how to score marks and get higher ranks, but to conceptualize and visualize subject matter in their real life so that it becomes intuitive.
- This place is not to aim at solutions but inculcate competence to analyze a problem and evolve solution.
- This place does not extend selective and personalized attention, rather an opportunity to become a part of which is focused on learning and problem solving ability collectively.
- This place provides an opportunity to find students above and below one's own level of learning. Thus students develop not in isolation but learn from better ones and associate in problem solving to those who need help. This group dynamics while create a team spirit, an essential attribute of personality, while one learns more by teaching others.
- This place has strategically chosen Online Mentoring, so that those who are unprivileged can gather at one point and those who can facilitate learning of such students by creating, necessary IT setup. Aseparate **Mentor's Manual** is being developed to support the cause.

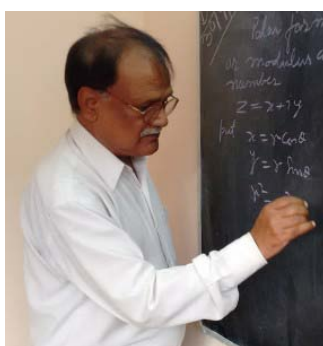
We are implementing this philosophy through **Online Mentoring**

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हमारापंचवर्षीयप्रवास



Start: June-2012



April-2015



June-2016.....

पारम्परिक शैक्षणिक मार्दर्शन से प्रारम्भ कर आज हम तकनीकी-विकास के सहारे मूलभूत प्रासंगिकता को आगे बढ़ने में संलग्न हैं...

यह प्रयास अपने सामाजिक कर्तव्य के प्रति सहजविनीत आग्रह है; कृपया इस पर विचार करें.

An Appeal: Gyan Vigyan Sarita

A Non-organizational Initiative of a Small Set of Co-passionate Persons

Philosophy: Personal Social Responsibility (PSR)

Objective: Groom competence to Compete among unprivileged children from 9th-12th in Maths and Physics, leading to IIT-JEE.

Financial Model: Zero-&-Fund-Zero-Asset (ZFZA). It calls for promoters and facilitators to provide infrastructure for use to the extent they feel it is neither abused nor there is a breach of trust. And, reimbursement of operational expenses to the participators

Operation:

- a. **Mode:** Online since July'16, using Google Hangouts, a free we-conferencing S/w, with connectivity upto 15 nodes.
- b. **Participation:** Voluntary and Non-remunerative, Non-Commercial and Non-Political

Involvement:

- a. **As Promoter –**
 - i. Initiate a Learning Center,
 - ii. Sponsor a Mentor who is willing to join on certain terms,
 - iii. sponsor cost of operation and up-gradation of infrastructure to voluntary mentors,
 - iv. Sponsor Website.
- b. **As Facilitator –**
 - i. Provide space and infrastructure for **Online Mentoring Sessions (OMS)**, which is generally available, with a marginal add-on,
 - ii. Garner support of elite persons to act as coordinators at a Learning Centre.
- c. **As Participant –**
 - i. As a Mentor,
 - ii. As Coordinator,
 - iii. As Editor and or contributor of thought provoking articles for e-Bulletin, which are relevant to the initiative, and make it more purposeful and reachable to the target audience.
 - iv. As author of Chapters for Mentors' Manual, being uploaded as a Free Web Resource,
 - v. Anything else that you feel can add value to the mission and make it more purposeful.

- vi. *Anything else that you consider to make this initiative to become more effective.*

Background: The initiative had its offing in May'12, when its coordinator, a power engineer by profession, soon after submission of Ph.D. Thesis in April'12, at IIT Roorkee, at the age of 61 years, decided to mentor unprivileged students.

SARTHAK PRAYASH, a Ghaziabad based NGO, warmly accepted the proposition and created a facility to mentor students from 8+ to prepare in mathematics and physics and prepare them for engineering entrance tests. They warmly reciprocated and created a class room.

Experience in this selfless social work were used to navigate across without losing focus. He was associated with SUBODH FOUNDATION from Sept'15 to Sept'16 during which he published a monthly e-Bulletin **SUBODH-पत्रिका** to create visibility across persons who could make a difference.

In Sept'16, post transition, the mission has been continued as a non-organizational entity **Gyan Vigyan Sarita**, with a set of Four persons, including retired **Prof. SB Dhar**, Alumnus-IIT Kanpur, a middle aged **Shri Shailendra Parolkar**, Alumnus-IIT Kharagpur, settled at Texas, US and **Smt. Kumud Bala**, Retired Principal, Govt. School Haryana. Earlier, they were complementing the OMS. While, the initiative survived transition, a website: <http://gyanvigyan sarita.in> has been launched. It contains under its **Menu: Publication > e-Bulletins**, and **>Mentors' Manual**. You may like to read them.

Actions Requested: May please like to ponder upon this initiative. **Queries, if any, are heartily welcome.** We would welcome your collective complementing in any of the areas listed at **Involvement**, above, to make the mission more purposeful and reachable to target children.



Coordinator's Views

Environment: Personal Social Responsibility (PSR)

Environment on the Mother Earth that gives us an opportunity to read, write, think, act and live-on has not been like this. Existence of universe is a matter of guess and there are different theories on it right from mythology, to Charles Darwin's Theory of Evolution, and theory of genes and transformation. Despite, it is scientifically believed that universe is result of a big-bang of a mammoth fire ball which has taken billions of years to cool down and evolve into present form of lives. Earth is just a splinter of it. Thomas Robert Malthus has propounded a theory of population balance on earth which stipulates that natural calamities play a role to balance population commensurate to its capacity to population. But, the whole effort of human endeavour, since beginning, in general, and science and technology was to evolve alternatives and remedies to live in hostile conditions on this earth. As a result light is available in nights, water in deserts, canals feeding water to barren field. Going forward today our mother earth is a global village where we are strongly connected to every other person. It is a different matter that elite persons want to remain ignorant about their personal responsibility to perpetuate the gift of mother-earth despite everything worst it has undergone to descending generations. Such persons if use their potential to perpetuate growth with coexistence it would turn into वसुधैवकुटुम्बकम् (Vasudhaiva Kutumbakam- which means world is one family).

Environment is generally construed as fertile land, greenery, fresh air, potable water and sunlight available on earth to live on called पंचतत्त्व (Panch Tatva- which means five elements that constitute life). Environment on earth has never been static, it has been ever changing and shall keep doing so. Life once takes birth it needs food, water air and light till it exits. It is the survival instinct which compels life on the earth to manipulate nature to suit it. More life grows in number and quality, more is its demand on nature. It is only the collective wisdom which enables human race to choose a course, where manipulation of nature is limited to survival needs, without jeopardising existence of other lives, which is called ecology. In pursuit of one life if any other extinct it causes a natural imbalance. This has created increasing awareness across the world and people are getting organized in the form of various forums viz. Wild life protection, birds protection, reviving river, etc. It is only human race that can do it, being most intelligent creation of GOD, despite being insignificant in proportion to the other forms life on earth.

Why are these forum mushrooming? Is it a new business opportunity? Or a sensible enlightenment? If it is the earlier, then, Alhas! God Save the Earth!. But, if it is latter, then obvious question comes up is, it just an act or a thought process. The epitome of such initiatives is in the thought process. And thought process is influenced by everything that goes to contribute to manmade environments; primarily they are sociological, economic and educational environment, each of them have many offshoots.

Sociological environment is most important about realization and reins for coexistence. Like nature,

social environment has also undergone drastic changes right from predator stage to present times. Diversity in levels of affordability and affluence across different societies is clearly visible in the sociological environment. As a society grows larger, more are interdependencies and more are the complexities. These diversities compound stress-&-strain of survival needs which has a deep influence on environment. People aspiring for power to rule influence political environment; it is by way of their means and methods used to acquire power. Hunger of theologists to increase their following and believes influences religious and/or secular environment. People aspiring for wealth influence economic environment and thus environment of business and trade keeps changing. Every successful politician, religious priest and rich person is a game changer to become what he is. Yet none has been everlasting, immortal. The missing factor in pursuit of these so called successful persons is sense of perpetuating existence; all of them are competing against others for immediate gains.

It is seen that theologists do not hesitate to incite religious sentiments if their following is in danger, for whatever may be the reason, whosoever may be on wrong foot, and whatever may be the consequence. If it were not so, then this ever growing society would not have witnessed communal rifts, riots and wars. Likewise, political system has grown from feudalism to so called sovereign democracies, but every political party leaves no stone unturned to come into power, irrespective of scar-marks that they left behind on minds of people in the form of disintegration and lack of mutual trust in their polity. Yet, every politician, be it in power or otherwise, cries foul on accusation by their opponents, calling it politicising issues. This is

the only edge they can use to counter allegations. This is also true in trans-countries and rampant in global politics to gain supremacy. In pursuit of becoming economic or business power immediate gain is most important, whether it leads to ravaging ripe crops, uprooting a civilization, or destroying forests, hills and river banks etc. It is seen that around every high profile society there are slums and garbage dumps. Distance and size between them increases with the gap between their statures. This is the most visible and forces to think upon a question, Why is it so? It is easier and cost effective to throw the garbage, with a total disregard to plight of poor persons and environment which clears it. Why are these elite persons required to be forced to carry a cotton bag, segregate domestic waste right at the point of its generation? These activities neither involve additional effort nor time nor cost. It is sheer a lack of sensitivity towards not only their social responsibility but a lack of wisdom to see the endangered future of their most beloved descendents. This gives rise to another question – are these educated accomplished elites are really educated or just literate?

Root of all this insensitivity towards the society in particular and nature in general is in ill-education. Education which equips a person with bolstering vocabulary might attract for them all that which matters in materialistic glamorous world. It is seen that elite persons and their children are impressive at discourses of human right, values and environment. The other side of their life is shadowy. It is seen to be below their dignity to live in an environment-friendly. If at all they do it, it is in the form of a luxury in farm houses or resorts which they only can afford for a change. It is the social order which empowers such persons to behave so, when they occupy responsible positions. Such a society deserves nothing better than frauds, tyranny, conflicts and disintegration.

Political-social-economic issues and challenges are closely intertwined and highly complex. All practices in these domains are leading to survival of the fittest, smartest and most cunning, yet necessarily not competent.

All thinkers, philosophers (not theologians), scientists must have been idiots to be unaware of their well being, like most of these accomplished politicians, theologians and businessman. This belief is based on the fact that they were working selflessly in pursuit of truth in an environment of selfish persons. It it were

not so, then there must be something different in their making.

In pedagogy of Socrate's School of Thoughts, the first in known history of scholars, dialectical methods were in practice to draw out ideas and underlying presumptions. In this method, the whole concept of education is to evolve a thought process which promotes to analyse and question the observations, determine commonalities in observations so as to evolve theories, explore alternatives or remedies, generalize them for any situation, select among available options the one which is feasible, economical and sustainable.

Education is not a commodity, with a price tag, available off-the-shelf or with delivery schedule. It is a long and persistent process of inculcating competence without shortcuts. Unless a person has grown into this pedagogy it is an over optimism to expect tolerance even within family basic unit of a society. Expecting from such persons sensitivity to environment is day dreaming.

An elite if fails to outreach with a right advice for the larger good is the professional dishonesty. Likewise, an action to justify wrong actions taken by anyone in the vested interests is intellectual dishonesty. Further, remaining complacent under a safe roof despite injustice being done to others is moral dishonesty. Such dishonesties are white collar crimes and it is just a matter of awakening and it is believed that none of the elite persons would like to endanger either self or family by perpetuating it.

It is, therefore, an urgent necessity to get awakened to address education at its basics and not just building statistics. This is where accomplished elite persons can take a step forward to come out of their protective shells so as to reach out to deprived ones with a sense of PSR. Once this process starts it will lead to build inter- and intra-society competition of social harmony, coexistence and well being This is a very small trigger once it starts, it is bound to grow like a chain reaction with more and more persons joining the stream, a big Social Reform Through Education for coexistence, essence of preserving nature, Environment on the Mother Earth.

It is quite relevant to recall a quote of Albert Einstein ***“Every day I remind myself that my inner and outer life are based on the labors of other men, living and dead, and that I must exert myself in order to give in the same measure as I have received and am still receiving.”***

पर्यावरण !

निरंजन धुलेकर

अग्नि , जल , नभ , धरती और वायु के पांच तत्वों में समाहित और इन्हीं से संचालित सम्पूर्ण ब्रह्मांड !

हजारों समुद्रों की रेत में मात्र एक कण के समान उस ब्रह्मांड में ये हमारी पृथ्वी , ईश्वर का अद्भुत वरदान !

और, इस पृथ्वी की गोद यानी कि पर्यावरण में लाखों वर्ष पहले पनपी प्राणी , वनस्पति की प्रजातियाँ और मानव सभ्यता !!

अद्वितीय लीला उस अदृश्य महा शक्तिमान की .. पहले चुगगा बनाया फिर प्राणी को लाया ।

ये चुगगा ही तो पर्यावरण है ... इन्हीं पंच भूतों का विभिन्न रूपों में परिवर्तन , श्वाश, पेय और खाद्य के रूप में , हर जीवित प्राणी और वनस्पतियों का जीवन स्रोत !

एक की विष्टा दूसरे का भोजन ..अनंत चक्र .. जीवन से मृत्यु तक ही नहीं उसके पार भी ..जब तक ये शरीर फिर से पंचभूत के मूल रूप में नहीं आ जाता ।

सर्वप्रथम प्राणवायु , तदोपरान्त जीवन दायी जल और सबसे अंत में भोजन ,...इसी क्रम में मानव , प्राणी, पशु , पक्षी और वनस्पतियाँ ईश्वर से प्राणरक्षा का वरदान मांगती हैं ।

वायु प्रदूषित ,जल भी दुर्गंध और प्राणघातक तत्वों से संक्रमित और भोजन विष समान लवणों से परिपूर्ण होने पर जीवन कब तक जीवित रहेगा !

मृत्यु निश्चित है , परंतु पृथ्वी पर जो सामूहिक इह लीला समाप्त करने या आत्महत्या की ओर प्रेरित करते ये दूषित पंच भूत क्या मानव निर्मित नहीं !?

अत्यधिक और अव्यवस्थित दोहन , स्वार्थ से परिपूर्ण उपयोग , और क्षति के प्रति असंवेदनशीलता ने आज मनुष्य के सामने अकाल मृत्यु का द्वार ला खड़ा किया ।

वनस्पति जगत, इन पांच भूतों ही नहीं ,बल्कि मानव को निरोगी रखने के भी रहस्य, अपने में छुपाए हैं , और हम इसी वनस्पतियों को बड़ी निर्दयता से काट कर स्वयं के मृत्यु दंड पत्र पर हस्ताक्षर कर रहे हैं ।

वनस्पतियों ने ही मनुष्य को आदम से मानव बनाया और यही वनस्पतियाँ अब लुप्त हो कर मानवजाति को पाषाण युग की तरफ जाने का संकेत कर रही हैं ।

हैं मानव, सावधान , तू और सिर्फ तू ही , नभचर ,पृथ्वीचर और समस्त जलचरों की लाखों योनियों के काल कवलित होने का दोषी है ।

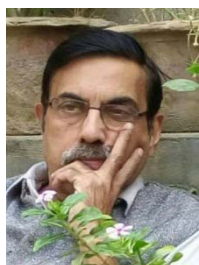
परंतु तुझे मुख्य दंड की घोषणा के पूर्व ,ईश्वर ने भूल सुधार का एक अवसर दिया है , सिर्फ एक उपाय ,जितने मनुष्य जन्म लें हर एक के नाम पर एक घने छायादार वृक्ष का पौधा भी भूमि की कोख से जन्म ले !

बस तू इतना ही कर की ... इस पौधे को उतना ही प्यार ,दुलार , पोषण ,संरक्षण प्रदान कर जितना स्वयं के शिशु को करेगा , करना ही पड़ेगा ,और कोई विकल्प है भी नहीं ।

ये पौधे कालांतर में हमे फिर से प्राणवायु , जल और भोजन के स्रोत बनेंगे और आने वाली पीढ़ियों को जीवन प्रदान करेंगे ।

इस पर्यावरण के छाते को सदैव अपने और आने वाले समय के लिए मजबूती से पृथ्वी पर बनाए रखना ही होगा ।

शुभम भवतु ।



The author is retired banker, and graduate in G.B. Pant University of Agriculture and Technology, Pantnagar, and Master Degree in Sociology. He has experience of working numerous NGOs connected with micro-financing. He was associated programs on agriculture credit and priority sector financing. Doordahrdan and Akashwani, Lucknow. He is a social thinker and writer. His poems, short stories and articles find space in various newspapers and magazines. **He is Fourth (new) pillar of the Gyan Vigyan Sarita – a Sociologist.**

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GROWING WITH CONCEPTS

Concepts of an expert are not like a static foundation of a huge structure; rather it is like blood flowing in a vibrant mind.

*During growing into an expert, each one must have used best of the books available on subject and received guidance of best of the teachers. Authors might have had limitations to take every concept thread bare from first principle and so also must be the constraint of teacher while mentoring a class with a diversity of inquisitiveness and focus. As a result, there are instances when on a certain concept a discomfort remains. The only remedy is to live with the conceptual problem and continue to visualize it thread bare till it goes to bottom of heart and that is an **ingenious illustration**.*

In this column an effort is being made to take one topic on Mathematics, Physics and Chemistry in each e-Bulletin and provide its illustration from First Principle. We invite all experts in these subjects to please mail us their ingenious illustrations and it would be our pleasure to include it in the column.

We hope this repository of ingenious illustrations, built over a period of time, would be helpful to ignite minds of children, particularly to aspiring unprivileged students, that we target in this initiative, and in general to all, as a free educational web resource.

This e-Bulletin covers – a) [Mathematics](#), b) [Physics](#), c) [Chemistry](#) and d) English Grammar. This is just a beginning in this direction. These articles are not replacement of text books and reference books. These books provide a large number of solved examples, problems and objective questions, necessary to make the concepts intuitive, a journey of educational enlightenment.

Looking forward, these articles are being integrated into Mentors' Manual. After completion of series of such articles on Physics it is contemplated to come up representative problems from contemporary text books and Question papers from various competitive examinations and a guide to their solutions in a structured manner, as a dynamic exercise to catalyse the conceptual thought process.

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अंदाज ए बयां

बंदी है, कि हरी झंडी ?

समीर लाल 'समीर'

दिल्ली के मच्छर भी अगर बस मलेरिया के कारक हों तो फिर दिल्ली में रहने का क्या फायदा ? मलेरिया तो गली गली, गाँव गाँव की बात है . दिल्ली में रहने की ठसक अलग होती है . ग्रेजुएट गाँव में पटवारी बनता है और १२ वीं पास दिल्ली में मंत्री , वो भी ऐसा वैसा नहीं - शिक्षा मंत्री. इसी सम्मान का ध्यान रखते हुए दिल्ली के मच्छर भी मलेरिया नहीं, डेंगू देकर जाते हैं.

एक फिल्म में नाना पाटेकर को कहते सुना था कि एक मच्छर आदमी को हिजड़ा बना देता है. तब ताली बजाकर मच्छर मारे जाते थे. अब एक मच्छर आदमी को घर बैठे बेडमिन्टन की प्रेक्टिस करा देता है. आजकल जिसे देखो रिकेट से मच्छर मारता दिखता है. ताली बजाने का काम अब मंच से भाषण देते हुए जनता को चिढ़ाने के लिए किया जाता है अपने आप को सफल बताने के लिए. हालांकि ताली बजाकर मच्छर ही मार रहे होते हैं, इससे बड़ा तो कोई काम दिखता नहीं जो किया हो.

दिल्ली में चाहे जो भी दे दो उसका विरोध होता ही है फिर वो चाहे आरक्षण हो या अनुदान. अतः डेंगू जैसा मच्छरों के द्वारा प्रदूत इस समस्यायुक्त जीवन की मुक्ति का सुगम मार्ग भी विरोध का सामना करने लगा . सारे बाबा आजकल मुक्ति के सुगम मार्ग पर ही प्रवचन दे दे कर पूरे देश को लूट रहे हैं . सब को धन मोह से मुक्त करा कर अपना खजाना भर रहे हैं . उसी जीवन से मुक्ति का मार्ग जब यह बेचारे दिल्ली के मच्छर प्रदूत करते हैं तो उन्हें मार डालने के उपाय पर चर्चा होती है . उनके नाम पर राजनिती होती है. दिल्ली सरकार कहती है कि दिल्ली में गंदगी की जिम्मेदार नगर महापालिका है जो हमारी पार्टी की नहीं है, जिसमें यह मच्छर पैदा होते हैं . फिर हमारे अंडर में दिल्ली पुलिस भी नहीं है कि हम इन मच्छरों को गिरफ्तार

कर सकें. केन्द्र सरकार इन मच्छरों को संरक्षण दे रही है ताकि हम बदनाम हो जायें.

सुझाव आया कि दिल्ली में फॉग मशीन से धुँआ करवा कर इन मच्छरों को मरवा दिया जाये . मच्छर हैं कोइ गाय तो हैं नहीं कि इनको मारना धर्म विरोधी बात हो जाये . मगर जो फॉग मशीन नें धुँआ छोड़ा वो दिल्ली के वातावरण में ऑलरेडी घुले गाड़ियों के धुँए से कम जहरीला सा साबित हुआ और मच्छर तो मानो खुश होकर खुली हवा में दुगुनी गति से साँस लेने लगे . उन्हें इन्तजार रहने लगा कि कब फॉग वाली गाड़ी आये और उन्हें बेहतर आबो हवा मिले.

किसी ज्ञानी ने सलाह दी कि ये ऐसे न मानेंगे .इनको मार कर क्यूँ हत्या का पाप लेना सर पर .इनकी नसबंदी करा दो..जैसे जैसे मरते जायेंगे ..कम होते जायेंगे और धीरे धीरे खत्म हो जायेंगे . फिर पुराने नसबंदी के आंकड़े निकाले गये. उस पर आधारित शोध पत्र को जांचा गया और पाया गया कि भारत की जनसंख्या की वृद्धि में जितना नसबंदी का योगदान रहा है, उतना तो आयुर्वेदिक शिलाजीत का भी नहीं रहा . इमरजेंसी में जबरन नसबन्दी के बाद एकाएक भारत की जनसंख्या में जो बढ़ोतरी हुई वो कई कम आबादी वाले देशों को नसबन्दी के लिए प्रेरित करने के लिए पर्याप्त है. ये ठीक वैसा ही है जैसे जब जब भी सरकार ने भ्रष्टाचार को रोकने के लिए कड़क कदम उठाये हैं, भ्रष्टाचार एकाएक बढ़ता चला जाता है . मानो कड़क कदम न हों..फर्टीलाइजर हो..कि भ्रष्टाचार की फसल लहलहा उठी.

दरअसल बंदी शब्द ही हमारे देश में कमाल करता है. नशाबंदी वाले प्रदेशों में शराब की धड़ाधड़ बिक्री, नोटबंदी के बाद हजारों करोड़ के घोटालों का आंकड़ा, नसबंदी के बाद

आबादी की वृद्धि, यहाँ तक कि नाकाबंदी को धता बताकर विदेश निकल लेने की आजादी में सुलभता..मानो बंदी न हो कर हरी झंडी हो. बंदी का रिकार्ड देखते हुए तो लगता है कि भारत में एक बार ईमानदारी पर पाबंदी लगा कर देखना चाहिये. कौन जाने भ्रष्टाचार बंद हो ही जाये.

फिर तय पाया कि इन मच्छरों को सम्मेलन बुलाकर इनको समझाईश दी जाये कि दिल्ली की जनता तुम्हारी दुश्मन नहीं हैं . उनके साथ मिल जुल कर प्रेमपूर्वक रहो .अगर तुमको खून ही पीना है तो तुम्हारे लिए सरकार ब्लड बैंक के दरवाजे खोल देगी . वो खून तो यूँ भी जरूरतमंदों तक कभी पहुँच ही नहीं पाता और अगर पहुँच भी जाये तो पीना तो तुमको ही है. तुम लोग सीधे ही पी लेना. समझाईश देने के लिए पेशकश करने वाले बाबा श्री ने बताया कि वे मच्छरों को आर्ट ऑफ बिना काटे लिविंग सिखायेंगे और

इसके लिए जमुना किनारे मच्छरों का महा सम्मेलन बुलवाया जायेगा . पिछले इंसानी सम्मेलन का कचरा अब तक वहाँ पसरा है जो मच्छरों के लिए मुफीद माहौल रहेगा.

पिछले इंसानी सम्मेलन का जिक्र आते ही सरकार सतर्क हो गई और फिर नये सिरे से बदनामी न हो जाये ऐन चुनाव के पहले, इस हेतु यह पेशकश भी दर किनार कर दी गई.

एकाएक इस ताजी सलाह पर सरकार गंभीरता से विचार कर रही है कि इन मच्छरों को बैंकों से तगड़ा लोन दिलवा दो ..ये खुद ही विदेश भाग जायेंगे.

फिर न मच्छर रहेंगे..न डेंगू.

सरकार इन मच्छरों का पासपोर्ट कैंसल कर अपने हाथ झाड़ लेगी...फिर विदेश वाले अपनी देखें.



लोकप्रिय चिट्ठाकार समीर लाल व्यवसाय से चार्टर्ड एकाउंटेंट हैं। आजकल वे कैनैडा में रहते हैं। उन्होंने कहानी लिखना पाँचवीं कक्षा में ही शुरू कर दिया था। कविता और व्यंग्य रचना के धनी समीर रतलाम में जन्मे और उनकी आरम्भिक शिक्षा -दीक्षा जबलपुर में हुई। आप कविता, गज़ल, व्यंग्य, कहानी, लघु कथा आदि अनेकों विधाओं में दखल रखते हैं। भारत के अलावा कनाडा और अमेरिका में मंच से कई बार अपनी प्रस्तुति कर चुके हैं। आपका ब्लॉग "उड़नतश्तरी" हिन्दी ब्लॉगजगत में एक लोकप्रिय नाम है। इन्हें अनेक सम्मानों से नवाजा जा चुका है, जैसे कि "तरकश स्वर्णकलम", सर्वश्रेष्ठ उदीयमान ब्लॉगर , इन्डी ब्लॉगर , विश्व का सर्वाधिक लोकप्रिय हिन्दी ब्लॉग, वाशिंगटन हिन्दी समिति द्वारा साहित्य गौरव सम्मान एवं कवि सम्मेलनों के मंच का एक जाना पहचाना नाम हैं। प्रकाशन : काव्य संग्रह - बिखरे मोती, उपन्यासिका - देख लूँ तो चलूँ, प्रकाशन में - कथा संग्रह: द साईड मिरर।

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श्री समीर लाल ' समीर ', एक अनुभवी एवं उत्कृष्ट लेखक, ने इस पत्रिका को अपनी लेखिनी से गौरवान्वित किया है। **ज्ञान विज्ञान सरिता -शिक्षा** का संपादक-मंडल आपका और आपकी लेखिनी, जो गंभीर विषयों की व्यंगात्मक प्रस्तुति है, का हृदय से स्वागत करते हुए एक नया स्तंभ **"अंदाज ए बयां"** आरंभ करता है। आपकी रचनाओं का आगामी अंकों के इस स्तम्भ में कृपया इंतज़ार करें।

मार्केटिंग इज़ द किंग!!

समीर लाल 'समीर'

धरा दिवस हर वर्ष अप्रैल २२ को मनाया जाता है . दिवस विशेष पर प्रयास एवं प्रार्थना इस हेतु होती है कि धरा को ज्यादा समय तक कैसे बचा कर रखा जाये?

हम ही अपने फायदे के लिए साल भर इसका अति तक दोहन करके इसकी हालत ऐसी जर्जर कर रहे हैं और फिर साल के एक दिन प्रार्थना करते हैं कि किसी तरह बची रहे . मानो धरा न हो गई हो फेसबुक का पन्ना हो . साल भर माँ बाप की कोई कद्र और परवाह न की मगर मातृ दिवस और पितृ दिवस पर ऐसा उन्माद भरा उत्सव कि माँ बाप भी सोचने को मजबूर हो जायें कि आज जरूर कुछ ज्यादा पी ली है वरना बेटा ऐसा तो न था.

अच्छा है कि मातृ दिवस और पितृ दिवस पर हर बरस नई नई थीम नहीं आती कि इस साल उन्होंने खाना खिलाया , इसलिए उनको सादर नमन . अगले बरस इसलिए नमन कि उन्होंने पढ़ाया, उसके अगले बरस इसलिए कि उन्होंने घर में रखा....बरस दर बरस थीम बदलते बदलते २० /२५ सालों में आऊट ऑफ थीम ही हो जाये बंदा और फिर उनकी वही हालत जो बुढ़ापे में सच में कर डालते हैं वो ही मातृ दिवस और पितृ दिवस पर भी हो जाये और वो वृद्धा आश्रम में इन्तजार करते एक दिन गुजर जायें.

मगर धरा दिवस की विशेषता है कि हर बरस एक नई थीम होती है. किसी साल पर्यावरण मित्रता की बात होती है . फिर किसी साल ग्लोबल वार्मिंग की . इस बरस २०१८ में प्लास्टिक से हो रहे पर्यावरण के नुकसान की बात है . बात जागरूकता फैलाने की ही है . उम्मीद कर रहा हूँ इस बरस इस हेतु २२ अप्रैल के सेमिनार में जो मूमेन्टो , लोगो, पेम्पलेट एवं अन्य मटेरियल का किट दिया जायेगा वो

प्लास्टिक के बैग में नहीं होगा . यह मात्र एक उम्मीद है वरना तो विश्व हिन्दी दिवस में सम्मिलित होने और सृजनात्मक योगदान का प्रशस्ति पत्र भी अंग्रेजी में प्राप्त हुआ था.

सारे देश धरा दिवस पर रात ८:३० से ९:३० बजे तक बिजली बंद रखने की अपील करते हैं और लोग अपने घरों और दफ्तरों की बत्तियाँ बंद रखकर इस दिवस के प्रति अपनी श्रद्धा, समर्पण एवं समर्थन का प्रदर्शन करते हैं.

मेरे एक मित्र का पिछले साल भारत से फोन आया था . उसे जब मैंने इस हेतु प्रेरित किया तो वह अति उत्साहित हो चला. कहने लगा कि निश्चित ही वह और उसके साथी इस दिवस पर संपूर्ण जागरूकता फैलायेंगे और योगदान करेंगे . उत्तर प्रदेश के उस बड़े शहर में एक आंदोलन सी लहर फैला दी कि २२ अप्रैल , २०१७ को सारे शहरवासी रात ८:३० से ९:३० बजे तक बिजली बंद रख कर अपना समर्थन प्रदर्शित करेंगे. मगर भारत तो भारत है और उस पर से उत्तर प्रदेश !! जो २२ अप्रैल की सुबह से उसके शहर की बिजली गई तो २३ अप्रैल की सुबह ही लौटी . जो है ही नहीं, जो चल ही नहीं रहा है , उसे बंद क्या करते ? बेचारे अपना सा मूँह लेकर रह गये . सोचते ही रह गये कि काश ! इन्वर्टर ही चार्ज कर लेने का मौका मिल जाता तो बिजली चालू बंद कर लेते. ये बेचारे सीधे सादे लोग हैं, कोई नेता तो हैं नहीं जो इतनी हैसियत हो कि स्वच्छता अभियान चलाने के लिए साफ सुथरी जगह पर कचरा फेलवा लें ताकि उसे साफ कर स्वच्छता अभियान को सफल घोषित किया जा सके और अखबारों में छापने के लिए सेल्फी निकाली जा सके..

गरीबी हटाने की बजाये हम आदी हो गये हैं गरीब पैदा करने के ताकि गरीबी मिटाने का नारा उठा कर चुनाव जीत सकें. हम आदी हो गये हैं संप्रदायों को बांटने के ताकि उन्हें जोड़ने का आगाज कर हम अपना उल्लु सीधा कर सकें.

हमारी शिक्षा प्रणाली भी इतनी लचर हो गई है कि मास्टर स्कूल में मात्र इसलिए ठीक से नहीं पढ़ाते ताकि बच्चे उसी मास्टर की कोचिंग में आकर कई गुना ज्यादा पैसा देकर ट्यूशन पढ़ें और सफल हों. उनके विज्ञापन और सफलता के परिणाम देखकर लगता है कि क्या यह वही शिक्षक है जो फलां स्कूल में पढ़ाता है? मौके और नजाकत के हिसाब से हम रुप बदलते रहते हैं. वही मास्टर स्कूल में कुछ और एवं कोचिंग में कुछ और. शायद घर पर कुछ और हो ..सच में कितना सही कहा है निदा फ़ाज़ली साहेब ने:

हर आदमी में होते हैं दस बीस आदमी,

जिस को भी देखना हो कई बार देखना..

इस बरस की धरा दिवस की थीम...प्लास्टिक का विरोध एवं उससे हो रहे पर्यावरण के नुकसान के प्रति सजगता. हम , जो सदा से कुर्ता और पजामा फट जाने पर उसका झोला सिलकर सब्जी लेने जाते रहे हैं, उनके द्वारा? प्लास्टिक हमें बाजार ने पकड़ा दी वरना तो हम झोला छाप शुरु से कहलाते आये ही थे . वही झोला छाप इस बरस उस प्लास्टिक का विरोध दर्ज करेंगे, जिसे बाजार ने हमसे कपड़े का झोला छिन कर हमारे हाथों में थमा दिया है.

हम कुल्हड़ में चाय पीकर बड़े हुए पर्यावरण के प्रति जागरुक नागरिक . बाजार के साथ तालमेल बैठते हुए अनजाने में ही कब प्लास्टिक के कप में चाय सुड़कते हुए पोलीथीन में लपेट कर चाय दफ्तर तक लाने लगे, पता ही नहीं चला. कैसी विडंबना है!!

मुझे वह वाकिया याद आ रहा है मेरे शहर का ..जहाँ खबर उड़ी थी कि एक डॉक्टर ने दवा दे देकर एक गैस के मरीज को दिल का रोगी घोषित कर दिया था और फिर दिल्ली के बड़े अस्पताल में ओपन हार्ट सर्जरी के लिए रेफर कर बड़ा कमीशन बना कर बड़े डॉक्टर का दर्जा प्राप्त कर लिया था.

धरा के साथ भी धरा दिवस पर हम कुछ कुछ वैसा ही तो कर रहे हैं और कहला रहे हैं धरा दिवस के जागरुक सिपाही..

कौन जाने कल को हमारा यही दिखावा, हमें धरा सैनिक का नोबल पुरस्कार दिलवा दे. जमाना मार्केटिंग का है, मार्केटिंग सॉलिड हो तो कुछ भी संभव है..

आज अमेरीका के राष्ट्रपति से लेकर भारत के प्रधान मंत्री तक, सब मार्केटिंग का ही तो कमाल है ! समाज सेवा अब आऊट ऑफ सिलेबस है.

मार्केटिंग इज़ द किंग!!

The Road Not Taken

Robert Frost

*TWO roads diverged in a yellow wood,
And sorry I could not travel both
And be one traveler, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;

Though as for that the passing there
Had worn them really about the same,
And both that morning equally lay
In leaves no step had trodden black.
Oh, I kept the first for another day!

Yet knowing how way leads on to way,
I doubted if I should ever come back.
I shall be telling this with a sigh
Somewhere ages and ages hence:

Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.*

- Famous poem of famous poet- Robert Frost, is reproduced

भावानुवाद : अनजान राहें.....

समीर लाल 'समीर'

राह पकड़ मैं चल रहा था, मंज़िल थी बस ध्यान में
देखा तब दो राह को बनते, उस पर्व वन उद्यान में.

एक मैं और सीमा मेरी है, दोनों पर कैसे चल पाऊँगा
किस पर चलूँ उलझन बस इतनी, मंज़िल किस पर पा पाऊँगा.

एक वो जो अल्लहड बाला सी, बना ना सकी कोई पहचान
दूसरी जिस पर थे अंकित, असंख्य कदमों के निशां.

मैंने चुनी वो राह जिस पर, घाँस थी बस हरी हरी
शायद अब तक बहुत थोड़े, जिसने इसकी थाह धरी.

सोचता था फिर कभी, यह दूसरी मैं राह लूँगा
अंतर्मन में जानता था, कहाँ कभी ये अंजाम दूँगा.

चल पड़ा बिन पद चिन्ह की, उस राह का दामन मैं थाम
शायद वो ही फ़ैसला था, जिससे पाया अभिनव मुकाम.

- This translation in 2006, is reproduced

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Woods are lovely dark and deep,

But, I have promises to keep,

Miles to go before I sleep,

Miles to go before I sleep.

- Extract of poem "Stopping by Woods on a Snowy Evening" by Robert Frost

Connecting Dots.....



Sensitive to Personal Social Responsibility (PSR)

We aim at -

- *Connecting accomplished persons to deserving needy*
- *Catalyze human sensitivity among elites to do their bit*
- *Social Reform through education to unprivileged children*

बूँद - बूँद से घट भरे

हम दुआ करते हैं



उठो! बढ़ो! उड़ो! इतना कि क्षितिज दिखे करीब से,
हो सके तो ध्यान रखना तार न टूटे जमीन से,
शकून मिलेगा इतना जब कह सकें गर्व से,
इस धरा से बढ़ते हैं लोग आस्मां तक जमीं से.

पर्यावरण

मृणालिनी घुळे

अभी तो मुझमें बाकी है पानी
पर यह मेहेरबानी कब तक?

कहे धरा की आत्मा
अब तो होश में आओ जरा
अब भी समय है
बंद करो अब मेरा दोहन
मत बनो मेरे क्षरण का कारण

मेरे रजकण ही करते हैं तुम्हारा पोषण
समृद्ध होंगी शैलमालाएं
एवं होंगे वन सघन
तभी रक्षित होगा पर्यावरण
सांस ले सकुंगी मैं
और जीवन रहेगा अक्षुण्ण.

कवियत्री एक सामाजिक चिंतक एवं विचारक हैं। आपकी कविताएँ वर्तमान पर्यवेक्ष्य में बुद्धि-जीवियों को उनके सामाजिक उत्तरदायित्व के प्रति उन्हें चिंतन के लिए प्रेरित करती हैं। आपकी लेखनी प्रादेशिक एवं राष्ट्रीय स्तर पर प्रकाशित है।



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Thirteen Tips to Save Earth

1. **Plant A Tree**
2. **Pick Up Litter**
3. **Bike To Work**
4. **Volunteer At An Earth Day Event In Your Area .**
5. **Buy Local Food**
6. **Unplug Appliances**
8. **Watch Your Water Commit To Purchasing Sustainable Apparel**
10. **Go Paperless**
11. **Write A Letter to leaders to take action on climate change.**
12. **Switch Light Bulbs when not needed**
12. **Skip The Bottled Water**
13. **Start A Compost Food**

Ref: <http://levistrauss.com/unzipped-blog/2015/04/13-ways-you-can-help-save-the-planet-on-earth-day/>

Students' Section

Inability of students to make ontribution for Students' Section is reciprocated with best wishes in their endeavour for excellence and our support to the every possible extent theouh Interactive Online Mentoring (IOMS)

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INVITATION FOR CONTRIBUTION OF ARTICLES

Your contribution in the form of an article, story poem or a narration of real life experience is of immense value to our students, the target audience, and elite readers of this Quarterly monthly e-Bulletin **Gyan-Vigyan Sarita: शिक्षा**, and thus create a visibility of the concerns of this initiative. It gives target students a feel that you care for them, and they are anxiously awaiting to get benefitted by your contributions. We request you to please feel free to send your creation, by **20th of each month** to enable us to incorporate your contribution in next bulletin, subhashjoshi2107@gmail.com.

We will be pleased have your association in taking forward path our plans as under-

- **With the start of Second year of operation, we have reached to 7th Quarterly e-Bulletin Gyan-Vigyan Sarita: शिक्षा. We shall brought out its First Supplement on 1st May'18.**
- **Theme of the 1st Supplement to 7th Quarterly e-Bulletin dt 1st May is National Technology Day cenebrated on 11th May to commemonrate **1st Nuclear Test at Pokharan by India in 1998.****
- **And this cycle of monthly supplement sandwitching consecutive Quarterly e-Bulletin Gyan-Vigyan Sarita: शिक्षा is aimed to continue endlessly**

We believe that this monthly supplements to quarterly periodicity of e-Bulletins shall make it possible for our esteemed contributors to make contribution rich in content, diversity and based on their ground level work and/or experiences.

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Nature is an excellent example of unity in diversity. Atom at its basic constituent level, it comprises particles of different nature. Some of them are of opposite in nature, and experience a strong force of attraction, yet they continue to exist separately and individually; particles of similar nature, having stong force of repulsion continue to exist in vicinity. This has been there since beginning of nature, and shall continue to exist indefinitely. Any unregulated infringement on the other would is disastrous. The secret of coexistence is in respecting others position.

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Answers to Science Quiz : March'18**Kumud Bala**

ANSWERS: 1. (ii) 2. (i) 3. (ii) 4. (iii) 5. (iii) 6. (iii) 7. (i) 8. (i) 9. (ii) 10. (i) 11. (ii)
12. (i) 13. (ii) 14. (iii) 15. (iii)

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Remembering Stephen Hawking

S.B. Mishra

Despite his passing, the words of Stephen Hawking will live on forever and keep inspiring future generations for years to come. Here is a compilation of some of the most inspirational quote of Stephen Hawking:

1. "Look up at the stars and not down at your feet. Try to make sense of what you see, and wonder about what makes the universe exist. Be curious."
2. "However difficult life may seem, there is always something you can do and succeed at. Where there's life, there's hope."
3. "People won't have time for you if you are always angry or complaining."
4. "I believe alien life is quite common in the universe, although intelligent life is less so. Some say it has yet to appear on planet Earth."
5. "My advice to other disabled people would be, concentrate on things your disability doesn't prevent you doing well, and don't regret the things it interferes with. Don't be disabled in spirit as well as physically."
6. "We are just an advanced breed of monkeys on a minor planet of a very average star. But we can understand the Universe. That makes us something very special."
7. "Work gives you meaning and purpose and life is empty without it."
8. "People who boast about their I.Q. are losers."
9. "Quiet people have the loudest minds."
10. "One of the basic rules of the universe is that nothing is perfect. Perfection simply doesn't exist...Without imperfection, neither you nor I would exist"
11. "You cannot understand the glories of the universe without believing there is some Supreme Power behind it."
12. "To confine our attention to terrestrial matters would be to limit the human spirit."
13. "It matters if you just don't give up."
14. "Nothing is better than reading and gaining more and more knowledge."
15. "The universe does not behave according to our pre-conceived ideas. It continues to surprise us."
16. "Mankind's greatest achievements have come about by talking and its greatest failures by not talking. It doesn't have to be like this."
17. "I'm not afraid of death, but I'm in no hurry to die."



Compiler of the quotes retired as Chief Engineer from M.P. Electricity Board. He has to his credit installation, testing, commissioning and operation of first National HVDC project connecting MPEB and APSEB grids between Barsoor, Madhya Pradesh (currently in Chattisgarh State) and Lower Sileru in Andhra Pradesh. With his rich experience in power system, he has contributed in many inland and overseas power projects as a consultant. Currently, he is settled at Jabalpur.

E-mail ID: shantanam2@gmail.com

STATISTICS

Prof. SB DHAR

Statistics is defined as a branch of mathematics that deals with the collection, analysis, interpretation, and presentation of masses of numerical data.

Sir Arthur Lyon Bowley was an English statistician and economist. According to him, "Statistics may be rightly called the science of averages and their estimates."

For 10+2 students, the area of study and its application is limited to the Measure of Central Tendency, and Measure of Dispersion.

Measure of central tendency

It gives an idea about the centre of the data. It mainly consists of Mean, Median, and Mode.

Mean: The statistical mean refers to the mean that is used to derive the central tendency of the data. It is determined by adding all the data points, and then dividing the total by the number of points. The resulting number is called the mean. It is also called average.

The mean has a wide range of applicability in various types of experimentation. It eliminates random errors and helps to derive a more accurate result than a result derived from a single experiment. We use mean to interpret data.

Advantages of Mean:

- (a) If numbers have mean \bar{x} , then $(x_i - \bar{x})$ is the distance from a given number to the mean. The numbers to the left of the mean are balanced by the numbers to the right of the mean. The residuals sum to zero only if a number is a statistical mean.

- (b) Mean is popular in statistics because it includes every item in the data set and it can easily be used with other statistical measurements.

Disadvantage of Mean

Mean is affected by extreme values in the data set and therefore be biased. For example, the average of 0 and 100 shifts to 50.

Formulae for Evaluation of Mean

- (a) If the data are $x_1, x_2, x_3, \dots, x_n$ then mean \bar{x} is evaluated by -

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = \frac{1}{n} \sum_{i=1}^n x_i$$

- (b) If the data $x_1, x_2, x_3, \dots, x_n$ are associated with their corresponding frequencies $f_1, f_2, f_3, \dots, f_n$ then the mean \bar{x} is given by -

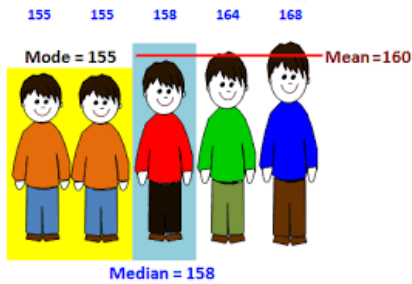
$$\bar{x} = \frac{f_1 x_1 + f_2 x_2 + f_3 x_3 + \dots + f_n x_n}{f_1 + f_2 + \dots + f_n} = \frac{1}{N} \sum_{i=1}^n f_i x_i$$

- (c) If the data $x_1, x_2, x_3, \dots, x_n$ are associated with their corresponding frequencies $f_1, f_2, f_3, \dots, f_n$, and data are big, then the mean \bar{x} is given by

$$\begin{aligned} \bar{x} &= \frac{f_1 d_1 + f_2 d_2 + f_3 d_3 + \dots + f_n d_n}{f_1 + f_2 + \dots + f_n} \\ &= \frac{1}{N} \sum_{i=1}^n f_i d_i, d_i = x_i - a, \end{aligned}$$

Here, a is assumed mean and d_i denotes the deviation of x_i from the assumed mean a .

Median



The median is a simple measure of central tendency.

To find the median, we arrange the data in order from i.e., smallest to largest value. If observations are odd in number, then the Median is the middle value. If observations are even in number, then Median is the average of the two middle values. It is denoted by M.

Formulae for evaluation of Median

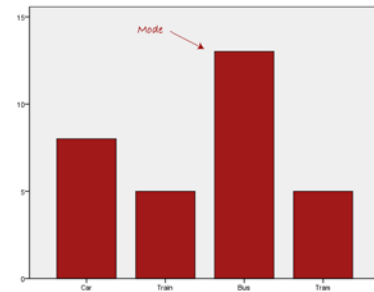
(i) $M = \left(\frac{n+1}{2} \right)^{th}$, if the number of terms is odd.

(ii) $M = \text{mean of } \left(\frac{n}{2} \right)^{th} \text{ and } \left(\frac{n}{2} + 1 \right)^{th}$ if the number of terms is even.

(iii) $M = L + \frac{\frac{N}{2} - F}{f} \times i$, where N= total number of

frequency; F= cumulative frequency before median class; f= frequency of the median class; L= Lower limit of the median class; i=class interval of the median class.

Mode : It is the observation that occurs maximum number of times. Mode helps in identifying the most common or frequent occurrence of a characteristic. Sometime the data have two modes, or three modes or more modes within larger sets of numbers. Such data are called bi-modal, tri-modal or multi-modal as the case may be.



It is given by

$$\text{Mode} = L + \frac{f - f_1}{2f - f_1 - f_2} \times i$$

where,

L = lower limit of Modal class,

f = frequency of the modal class,

f_1 = frequency of the class preceding modal class,

f_2 = frequency of the class following modal class,

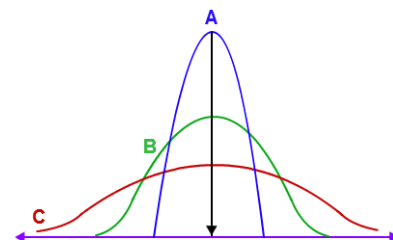
i = class interval of the modal class.

Note: Mode = 3 Median – 2 Mean

Measure of Dispersion

Dispersion is also called variability, scatter, or spread.

It is the extent to which a distribution is stretched or squeezed.



Common examples of **measures of dispersion** are the Range, Mean deviation, Quartile deviation, standard deviation, variance, and inter-quartile

range. It is measured on the basis of the measure of central tendency i.e., mean, median or mode.

Range: The range is the difference between the highest and lowest values within a set of numbers. To calculate range, subtract the smallest number from the largest number in the set. It does not give any idea about the dispersion of data as no central tendency is considered here.

Range = (Maximum value of the data) – (Minimum Value of the data)

Mean Deviation:

(a) Mean deviation=

$$\frac{\text{sum of absolute deviations from mean}}{\text{number of observations}}$$

(b) Mean deviation (about assumed mean a)=

$$\frac{\sum_{i=1}^n |x_i - a|}{n}$$

(c) Mean deviation (in case of grouped data) =

$$\frac{\sum_{i=1}^n f_i |x_i - a|}{N} \text{ where } N = \text{sum of all frequencies.}$$

(d) Mean deviation (about mean \bar{x}) =

$$\frac{\sum_{i=1}^n |x_i - \bar{x}|}{n}$$

(e) In case of grouped data = $\frac{\sum_{i=1}^n f_i |x_i - \bar{x}|}{N}$

(f) Mean deviation (about median M) =

$$\frac{\sum_{i=1}^n |x_i - M|}{n}$$

(g) In case of grouped data = $\frac{\sum_{i=1}^n f_i |x_i - M|}{N}$

Quartile deviation

There are three Quartiles Q_1 , Q_2 , and Q_3 . Second quartile Q_2 is called the Median. Median divided the data in two equal parts. Quartiles divide the data in 4 equal parts.

(a) Q_1 is given by

$$Q_1 = L + \frac{\frac{N}{4} - F}{f} \times i$$

(b) Q_3 is given by

$$Q_3 = L + \frac{\frac{3N}{4} - F}{f} \times i$$

Standard Deviation

It is denoted by σ . It is calculated by the following formulae:

$$(a) \sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2}$$

(b) In case of frequency distribution,

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^n f_i (x_i - \bar{x})^2}$$

(c) A short cut method to avoid calculation of mean

$$\bar{x} \text{ is used } \sigma = \sqrt{\frac{1}{N} \sum_{i=1}^n f_i x_i^2 - \left(\frac{1}{N} \sum_{i=1}^n f_i x_i \right)^2}$$

Note:

(a) Variance= (standard deviation)²

(b) If the series have equal means, the series with lesser standard deviation is more consistent or less scattered.

(c) Coefficient of variance= $\frac{\sigma}{\text{Mean}} \times 100$

- (d) The median does not represent the central tendency of the data in case of very high degree of variability. It means that the mean deviation about median calculated for such series cannot be fully relied upon.
- (e) The mean deviation and the standard deviation have the same units in which the data are given.
- (f) Coefficient of Variance is independent of the units as it is the comparison of the variability of the two series same mean which are measured in different units.
- (g) Adding or Subtracting a positive number to (or from) each observation of a group of data does not affect the variance.
- (h) If each observation is multiplied by a constant say k , then the variance of the resulting observations becomes k^2 times the original variance.



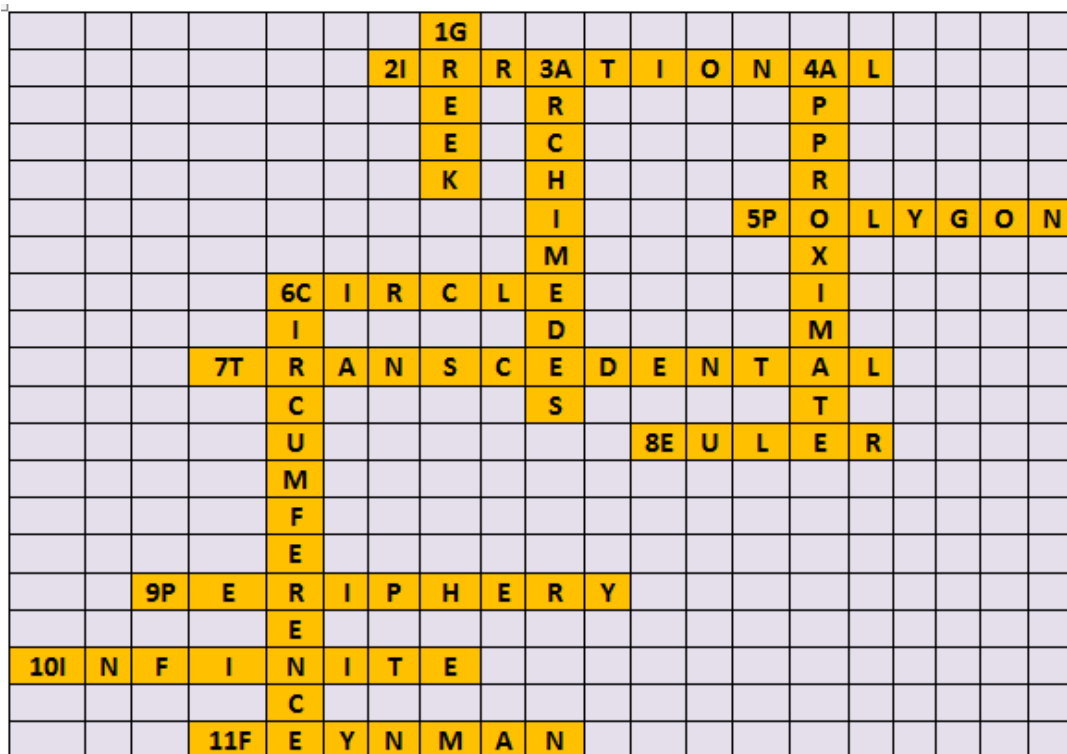
Dr S.B. Dhar, is **Editor of this Quarterly e-Bulletin**. He is an eminent mentor, analyst and connoisseur of Mathematics from IIT for preparing aspirants of Competitive Examinations for Services & Admissions to different streams of study at Undergraduate and Graduate levels using formal methods of teaching shared with technological aids to keep learning at par with escalating standards of scholars and learners. He has authored numerous books of excellence.

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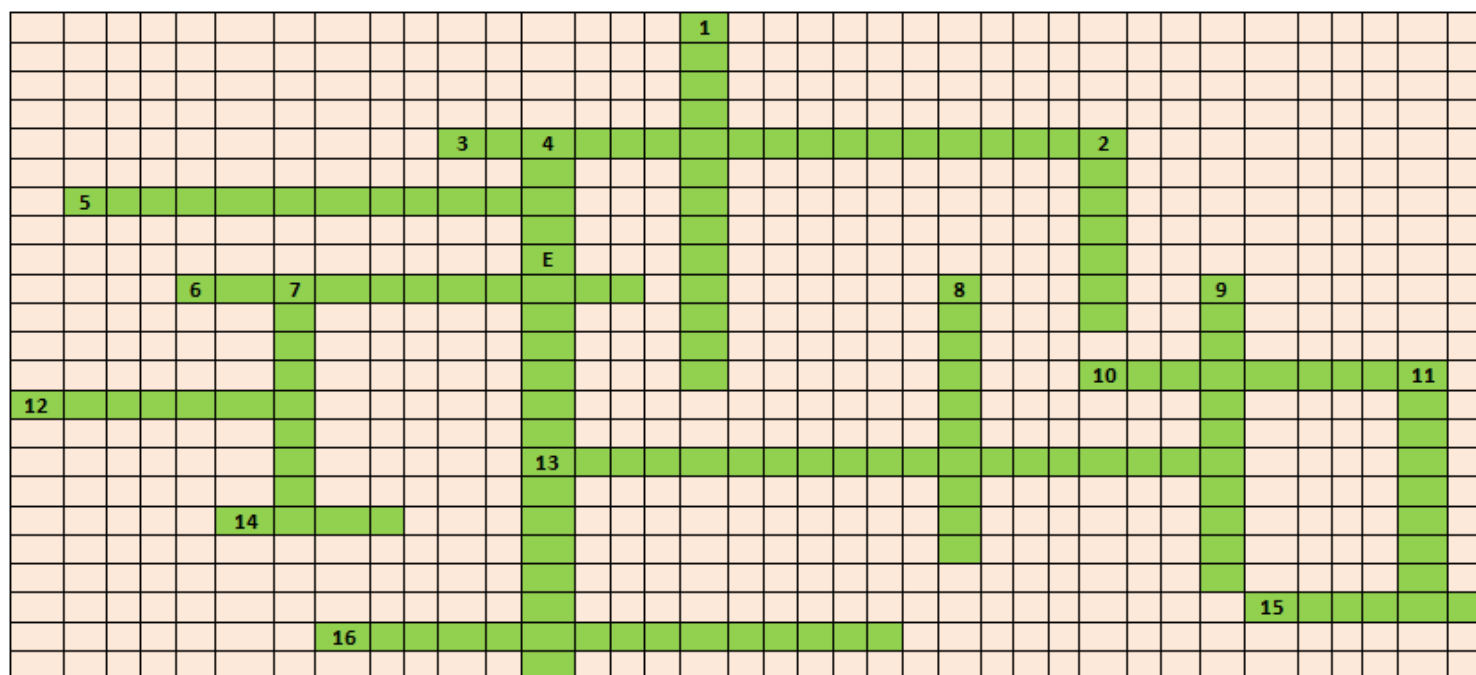
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ANSWER: CROSSWORD PUZZLE March'18: Pi (π)

Prof. S.B. Dhar



—00—

CROSSWORD PUZZLE: Stephen Hawking**Prof. SB Dhar****ACROSS**

- 3 Disease from which Hawking was suffering
- 5 Fellow cosmologist who worked with Hawking
- 6 Daughter of Hawking
- 10 Wife of Hawking
- 12 Hawking was born exactly 300 years after
- 13 Hawking's First book
- 14 Hawking's opinion about concept of Heaven
- 15 Hawking started his University Education at
- 16 BBC included Hawking in the list of 100

DOWN

- 1 Developer of Equalizer for Hawking
- 2 Hawking was born in
- 4 Theory revised by Hawking in 2014
- 7 Hawking's Field of study at Cambridge
- 8 Prize won by Hawking's essay
- 9 Hawking stated about Aliens
- 11 Computer program for Hawking's speech

Growing with Concepts : Physics

Modern Physics: Part V – Nuclear Physics and Allied

*Study of atomic structure in previous sections was confined to arrangement of electrons around nucleus with a simple premise that each atom at its centre has a concentrated +ve core as experimentally demonstrated by Rutherford; it was elaborated in section Atomic Structure. This core is called **Nucleus**, which has +ve charges with heavy mass called **Protons** and electrically neutral particles of mass almost equal to that of proton and is called **Neutron**. Discovery of properties of nucleus and energy contained in it revolutionized the course of technology in Twentieth Century. This adds thrill to knowing nuclear physics, more closely.*

Properties of Nucleus: Protons and Neutrons present in nucleus are called **Nucleons**. Let A be the number of **Nucleons** in an atom then radius of the spherical nucleus is $R = R_0 A^{\frac{1}{3}}$, here, $R_0 = 1.2 \times 10^{-15} \text{ m} = 1.2 \text{ fm}$, an experimentally determined constant, and A is number of nucleons in the nucleus. A is also called Mass Number being nearest whole number of mass of nucleus measured to be $1u = 1.660538782 (83) \times 10^{-27} \text{ kg/u.}$, called in unified atomic mass unit (u). This is the rest mass of the nucleus. This makes a beginning of elaboration properties of Nucleus.

Nuclear Density: Radius of nucleus and mass of nucleons, defined above, leads to defining its density of nucleus is

$$\rho = \frac{Au}{\frac{4}{3}\pi R^3} = \frac{A \times 1.660538782 (83) \times 10^{-27}}{\frac{4}{3}\pi \left(R_0 A^{\frac{1}{3}}\right)^3} = \frac{3A \times 1.660538782 (83) \times 10^{-27}}{4\pi R_0^3 A} = \frac{3 \times 1.660538782 (83) \times 10^{-27}}{4\pi (1.2 \times 10^{-15})^3} = 2.3 \times 10^{17} \text{ kg/m}^3. \text{ The}$$

density of nucleus is independent of atom and is constant.

Nuclides and Isotopes: Building blocks of atom are Neutron, Proton and Electron and with their respective masses $m_n = 1.008665 \text{ u}$, $m_p = 1.007276 \text{ u}$, and $m_e = 0.000548580$. Number of nucleons in an atom are related by an equation $A = Z + N$, here, Z is **atomic number** equal to number of protons, N is **neutron number** equal to number of neutrons, and A is **mass number**. Nucleus with a specific combination of protons and neutrons is called **Nuclide**. Chemical properties of an atom is determined by number of electrons and in turn Z , but physical properties of an atom is determined by composition of nuclide as under. Notation of nuclide composition in use is ${}^A_Z\text{El}$, where El is element, while A and Z are the usual notations. Since, Z determine chemical properties and thus identify element El and, therefore, nuclide is also represented as ${}^A\text{El}$. Nuclides with same Z but different N are called **Isotopes** and thus have different atomic masses. Example of isotopes are ${}^{35}\text{Cl}$ and ${}^{37}\text{Cl}$ are respectively “Chlorine-35” and “Chlorine-37” and ${}^{235}\text{U}$ and ${}^{238}\text{U}$ are respectively “Uranium-235” and “Uranium-238”. Likewise, there are many isotopes listed in references. While, **Isobars** are atoms with A but different Z and have different chemical properties. As an example ${}^{40}_{18}\text{Ar}$ and ${}^{40}_{20}\text{Ca}$ are atoms Argon ($Z = 18$, $N = 22$) and Calcium ($Z = 20$, $N = 20$) atoms Likewise, different atoms with same number of neutron are called **Isotones** e.g. ${}^{37}_{17}\text{Cl}$ and ${}^{39}_{19}\text{K}$ are atoms Chlorine ($Z = 17$, $N = 20$) and Potassium ($Z = 19$, $N = 20$).

Nuclear Spins and Magnetic Moments: Protons and Electrons obey Pauli Exclusion principle in the same way as that of electron. They way also spin like electrons and accordingly spin angular momentum \bar{s} of nucleon is

$$S = \sqrt{\frac{1}{2}\left(\frac{1}{2} + 1\right)} \hbar = \sqrt{\frac{3}{4}} \hbar \text{ and } z\text{-component is } S_z = \pm \frac{1}{2} \hbar. \text{ In addition orbital angular momentum may be associated with motion on nucleons within nucleus and is quantized in manner similar to that of electrons. Thus total}$$

angular momentum \vec{J} of the nucleus is vector sum of individual spin momentum and orbital momentum of all nucleons having magnitude $J = \sqrt{j(j+1)}\hbar$. The z-component is $J_z = m_j \hbar$, here, $m_j = -j, -j+1, 1, \dots, j-1, j$. Value of j depends upon total number of nucleons; if it is an even number then j is an integer else in the case j is an odd number it is a half-integer. In case of a nuclide having $Z = N$, or even values Z and N of then $J = 0$. This leads to an inference that pairing of particles with opposite spin plays an important role in structure of the nucleus. Combination of orbital and spin angular momentum of all nucleons is called **nuclear spin**.

Like electrons, nuclear angular momentum intrinsically forms electric current and is associated with magnetic moment. Thus magnitude of z-component of electron is equal to $\mu_B \approx |s_z|_{\text{electron}}$. Likewise, in nuclear magnetic moment, called nuclear magneton is $\mu_B = \frac{e\hbar}{2m_p}$ a natural unit of magnetic moment. Here, m_p is the mass of proton. Since proton is 1836 time massive as compared to electron and hence, nuclear magneton is smaller to Bohr's magneton in inverse proportion. It is further found that $|\mu_{sz}|_{\text{proton}} = 2.7928 \mu_B$, and not equal to μ_B . Whereas, for neutron which is electrically neutral $|\mu_{sz}|_{\text{neutron}} = 1.9130 \mu_B$. Further, proton, bearing +ve charge, spin magnetic moment $\vec{\mu}$ is parallel and in the direction of spin angular momentum \vec{S} , but for neutron which is electrically neutral vectors $\vec{\mu}$ and \vec{S} are opposite. These anomalies are attributed to fact that proton and neutron are not fundamental particles, as being treated so far, rather they comprise of quarks, which is outside domain of this manual. Nevertheless, inquisitive readers may welcome through [CONTACT US](#). Magnetic moment of entire nucleus is typically a few nuclear magnetons which in presence of magnetic field \vec{B} leads to an interaction energy $U = -\vec{\mu} \cdot \vec{B} = -\mu_z B$. This is the principle behind Nuclear Magnetic Resonance and MRI.

Nuclear Forces and Energy: Nature nuclear forces despite extensive exploration and uses is still a mystery, Nevertheless, the understanding of mechanics and electrostatics is undisputed from the fact that particles having repulsive forces gain energy when brought closer and whereas particles with attractive forces loose energy in similar situation. These forces are of inverse proportion of square of distance from a point charge or a mass. But, disintegration of nucleus with release of energy prompt there must be some third kind of forces between nucleons be it proton, neutrons or both having a short range of the order of 1 Fermi = 10^{-15}m . Such forces are called nuclear forces. In all this analysis Einstein's mass-energy equivalence $E = mc^2$ holds true and it leads to $c^2 = 931.5 \text{ MeV/u}$. Therefore, here, understanding of nuclear forces is preceded to that of nuclear energy.

Forces binding neutron and proton inside nucleus are example of nuclear interaction and are called **nuclear forces**. Characteristics of nuclear forces are: **a)** It is independent of charge of nucleons such that neutron-neutron, neutron-proton, proton-proton binding is all the same, **b)** Nuclear forces are present over a range of nuclear dimension i.e. Fermi and in this range it is stronger than electrical forces that makes nucleus stable. Moreover, short range of nuclear forces restrains nucleus to grow indefinitely, and **c)** constant density of nucleus and almost constant binding energy per nucleon exhibit that a nuclide interacts with those in its immediate neighborhood and not with other nucleons in the nucleus. This makes nuclear forces different from electrical gravitational forces and are 50 to 60 times stronger than the latter. This limitation of range of nuclear force is called saturation and is analogous to covalent bond, and **d)** nuclear forces lead to pairing of protons or neutrons with opposite spins, and in turn pairing of pair i viz. proton-proton pair pairing with neutron-neutron pair. This makes α -particle nucleus of ${}^4_2\text{He}$ an exceptionally stable nucleus. Complex analysis of nucleus has been attempted with different models, most common of these are: **i) Liquid-drop Model**, and **ii) Shell Model**.

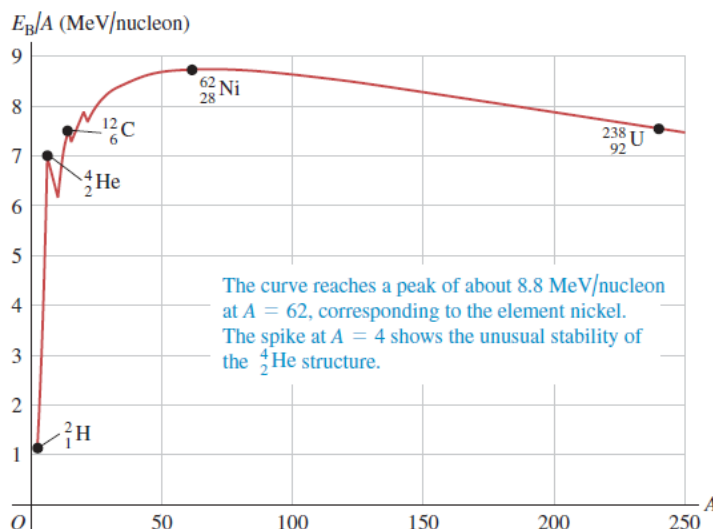
Liquid-drop Model of Nuclear Forces: This was proposed by George Gamow in 1928. Is based on observation that all nuclei have nearly same density. Taking an analogy between nucleon with that of liquid drop

holding its molecules in short range with the inter-molecular interaction and surface-tensions effects. This observation is extrapolated to determine total binding energy as under –

1. Nuclear forces on an individual nucleon saturates with few of its immediate neighbours. This makes binding energy $= C_1 A$ i.e. proportional to the number of nucleons (A), where C_1 is experimentally determined proportionality constant.
2. Nucleons on the surface of nucleus have no outer nucleons and hence less tightly bound as compared to those inside the nucleus. This gives rise to a (-)ve energy term proportional to surface area $= 4\pi R^2$, R is radius of nucleus such that $R \propto A^{\frac{1}{3}}$. This introduces another term in binding energy is $= -C_2 A^{\frac{2}{3}}$, where C_2 is another experimentally determined proportionality constant.
3. Every proton out of Z experiences a repulsive force with remaining $(Z - 1)$ protons and hence potential energy of each proton, as derived in electrostatics is proportional to $Z(Z - 1)$ and inversely proportional to its radius R . Accordingly, a correction term caused by electro-static potential energy is $= C_3 \frac{Z(Z-1)}{A^{\frac{1}{3}}}$.
4. Like any other body, nucleus is stable in lowest energy state and hence it must have a balance between energies associated with protons and neutrons. It implies that N is close to Z for small A and N is greater than Z , but not $N \gg Z$, for large A , it needs a negative energy term corresponding to $|N - Z|$. Since, $N = A - Z$, the best agreement has been on a term $\propto -\frac{(A-2Z)^2}{R} = -C_4 \frac{(A-2Z)^2}{A^{\frac{1}{3}}}$.
5. Last, but not the least pairing of nucleon, as discussed above, it leads to positive binding energy if both N and Z are even and negative binding energy if either of N and Z or both are odd or N is zero. The best fit term is $= \pm C_5 A^{-\frac{4}{3}}$.

Thus total binding energy of a nucleus is $E_B = C_1 A - C_2 A^{\frac{2}{3}} + C_3 \frac{Z(Z-1)}{A^{\frac{1}{3}}} - C_4 \frac{(A-2Z)^2}{A^{\frac{1}{3}}} \pm C_5 A^{-\frac{4}{3}}$. The values of constants chosen to make it best to binding energy of various nucleus are : $C_1 = 16.75 \text{ MeV}$, $C_2 = 17.80 \text{ MeV}$, $C_3 = 0.7100 \text{ MeV}$, $C_4 = 23.69 \text{ MeV}$ and $C_5 = 39 \text{ MeV}$.

Shell Model of Forces: This model considers nucleons occupying positions and spins in shells as per ventral-field approximation for electrons in atomic structure. Each nucleon is considered to be moving in a potential, an averaged out effect of all other nucleons. This model despite disagreement, finds space for consideration due to: **a)** Potential energy function for nuclear forces is for protons and neutrons, **b)** for protons an additional energy function is associated due to electrical repulsion, **c)** in principle protons and neutrons moving in such a potential shall satisfy Schrödinger wave equation, **d)** on the lines of spherical symmetry in distribution of electrons in an atom, concept of filled shells and sub-shells can be applied to relate stability of nucleus, **e)** in atomic physics for stable arrangements of electrons values of $Z = 2, 10, 18, 36, 54$ and 86 , atomic numbers of noble gases, **f)** a comparable effect is observed in structure of nuclear, but with different numbers. This difference in numbers is attributed to difference in potential energy function of the nucleus and interaction of nuclear spin-orbit is much stronger than in atoms. It is found that when number of neutrons and protons are



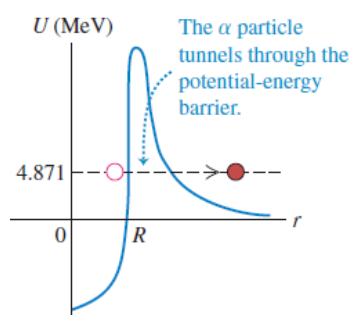
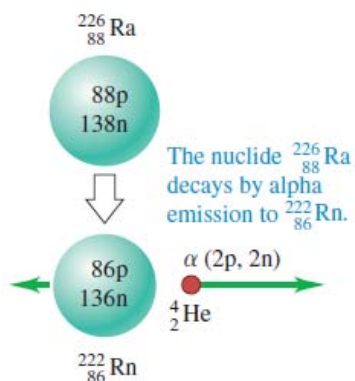
equal i.e. $Z = 2, 8, 20, 28, 50, 82$, or 126 , the resulting nucleus are unusually stable, as shown in the figure, and these number are called **magic numbers**.

As per energy balance equation energy must be added to individual proton and neutron to separate them and, therefore, total rest energy of separated nucleon must be greater rest energy (E_0) of the nucleus. Accordingly, binding energy of nucleons is represented by $E_B = (ZM_H + Nm_n - \frac{A}{Z}M)c^2$. It indicates that rest mass of nucleons is greater than mass of the nucleus by $\frac{E_B}{c^2}$ and is called as **mass defect**. It is to be noted that in this energy balance equation M_H is used instead of mass of proton (m_p) which leads to Z protons combined to Z electrons i.e. a Z number of neutral ${}^1_1\text{H}$ atoms so as to account for Z electrons in the neutral atom.

Nuclear Stability and Radio Activity: As nucleus grows or there is imbalance in the nucleons $N \neq Z$ grows, atoms tends to become unstable and this instability leads emission of particles and radiation till atom becomes stable. The ratio $\frac{N}{Z}$ increases nuclides tends to become unstable at a value of the ratio about 1.6, as shown in the Segre Chart plotted on $Z - N$ plane. In the chart it is also seen from the chart that nuclides with $A > 209$ or $Z > 83$ are stable. These emissions are in stages depending upon size of atom before it reduces to a stable nuclide. Decay of nuclide is identified as **Alpha (α)Decay, Beta (β)Decay and Gamma (γ) Decay** and are being elaborated discretely.

Alpha (α)Decay: It comprises of emission of α -particles by the decaying nuclide. These α -particles are nothing but ${}^4_2\text{He}$ nuclide of Helium atom. Since, it comprises of Two protons and thus changes $Z \rightarrow Z - 2$ and the residual mass $A \rightarrow A - 4$ and the result is a different, lighter and relatively less unstable atom.

Energy and mass equivalence during α -Decay are being analyzed taking example of Radium (${}^{226}_{88}\text{Ra}$).

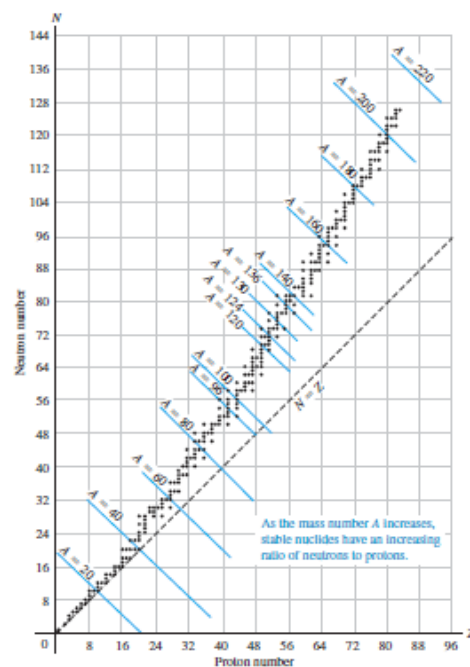


It is to be noted that ${}^4_2\text{He}$ is under influence

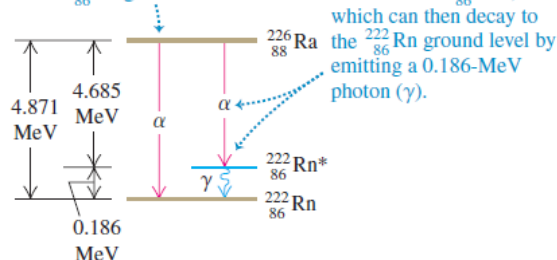
of attractive nuclear forces and therefore, before emission, it has (-) ve potential energy. Nevertheless, probability of crossing potential barrier as tunneling effect has been elaborated earlier in atomic structure. The decaying ${}^4_2\text{He}$, in will cross the potential barrier of 4.871 Mev with a definite is about $1.52 \times 10^7 \text{ m/s}$ and is $\approx 0.95c$, in relativistic range

Velocity of 1.52×10^7 is experimentally determined based on curvature of its path in a magnetic field. Thus, kinetic energy ($\frac{1}{2}mv^2$) particle is

$K = \frac{1}{2}(6.64 \times 10^{-27})(1.52 \times 10^7)^2 = 7.87 \times 10^{-13} \text{ J} = 4.79 \text{ Mev}$, as per Newtonian Mechanics. Considering their charge and mass, they quickly loose energy in collision during its travel. Thus, as a result depth of penetration of these particles is few centimeters in air and in metal small fraction of a millimeter. **This, based on relativistic relationship of mass and energy, leads to an inference that pre-decay mass of an atom is more than mass of the post-decay atom and rest-mass of α -particles.**



${}^{226}_{88}\text{Ra}$ can α -decay directly to the ${}^{222}_{86}\text{Rn}$ ground level ...



An α -particles can directly decay into environment leaving the decayed atom at ground state or impart part of its kinetic energy to the decayed atom causing it to be in an excited state leading to further decay down in the ladder of a stable atom as shown in the diagram.

Beta (β) Decay: This decay is result of process of conversion of Proton \leftrightarrow Neutron, and thus moderating ratio $\frac{N}{Z}$ towards stability. Based on actual conversion **β -Decay** can be either of **a)** beta-minus (β^-), **b)** beta-plus (β^+), **and c)** electron (e) capture. Each of these decays are being elaborated where it shall be noted that during **β -decay** there change in values of N and Z while A of post decay atom remains unchanged such that $A = N_i + Z_i = N_f + Z_f$, here, subscripts i and f initial and final nuclides.

Beta-minus (β^-) Decay: In this decay a neutron decays into a proton, shown by $n \rightarrow p + \beta^- + \bar{\nu}_e = p + e + \bar{\nu}_e$. Here n is neutron, p is proton, β^- is nothing but an electron and $\bar{\nu}_e$ is an **antineutrino**. This decay occurs when ratio $\frac{N}{Z}$ is too high. The $\bar{\nu}_e$ indicates that it has velocity = $0.9995c$, i.e. nearing velocity of light. At nuclide level this can be expressed as ${}^A_ZEl_1 \rightarrow {}^A_{Z+1}El_2 + e + \bar{\nu}_e$. Unlike other particles, antineutrino is having Zero rest mass like photon, it is not having is electrically neutral and has spin quantum number $\pm \frac{1}{2}$. Applying mass-energy equivalence, initial energy equivalent $U_i = [m({}^A_ZEl_1) - Zm_e]c^2$, it corresponds to pre-decay atom, and similarly energy equivalent of post-decay atom $U_f = [m({}^A_{Z+1}El_2) - (Z+1)m_e]c^2$. Thus energy available as a result of nuclear decay is $Q = U_i - U_f$ is shared between particles β^- and $\bar{\nu}_e$ anywhere between Zero to Q . Here, $m({}^A_ZEl_1)$ is atomic mass of El_1 , $m({}^A_{Z+1}El_2)$ is atomic mass of El_2 and m_e is mass of electron.

Beta-minus (β^+) Decay: Those nuclides which have protons in excess than that needed for stability undergo β^+ decay. This decay is similar to that of β^- decay and is expressed by $p \rightarrow n + \beta^+ + \nu_e = n + e^+ + \nu_e$. Here, β^+ is **positron**, an anti particle (e^+) of electron, which has positive charge but in magnitude equal to that of electron, and a mass equal to that of an electron. Collision of an electron and proton destroys both and lead to conversion of energy as per mass-energy equation. And, ν_e is **neutrino** and **antineutrino** are antiparticles of each other. This decay at nuclide level is represented by ${}^A_ZEl_1 \rightarrow {}^A_{Z-1}El_2 + e^+ + \nu_e$. Q value of the decay, similar to that of β^- decay is $U_i - U_f$, where, $U_i = [m({}^A_ZEl_1) - Zm_e]c^2$ and $U_f = [m({}^A_{Z-1}El_2) - (Z-1)m_e]c^2$. Accordingly, $Q = [m({}^A_ZEl_1) - m({}^A_{Z-1}El_2) - 2m_e]c^2$. Here, it is to be noted that in Q the term $2m_e$ occurs because, one proton is converted into neutron and as balance of rest mass $m_n = m_p + m_e$ and in the β^+ decay while $Z \rightarrow Z - 1$, but $N \rightarrow N + 1$.

An isolated proton cannot undergo β^+ decay since $m_n > m_p$ which leads to negative Q value, which is not possible. Nevertheless, an isolated neutron can decay into proton. It is to be noted that β^+ decay can occur whenever the mass of the original neutral atom is at least two electron masses larger than that of the final atom.

Electron (e) Capture: In this decay, there is no particle emission, only neutrino radiation is emitted. An electron in outermost K-shell is absorbed by a proton turning it into a neutron, and decay can be expressed $p + e \rightarrow n + \nu_e$. At nuclide level it is of the form ${}^A_ZEl_1 + e \rightarrow {}^A_{Z-1}El_2 + \nu_e$. Thus, $U_i = [m({}^A_ZEl_1) - Zm_e]c^2$ and $U_f = [m({}^A_{Z-1}El_2) - (Z-1)m_e]c^2$. Accordingly, $Q = [m({}^A_ZEl_1) - m({}^A_{Z-1}El_2)]c^2$ and, in radioactive decay, for Q to be positive a necessary condition for nuclear decay mass of pre-decay atom $[m({}^A_ZEl_1)]$ must be greater than post decay atom $[m({}^A_{Z-1}El_2)]$. Descending of an electron from K-shell into nucleus during electron capture gives rise to X-rays.

Gamma (γ) Decay: Like electron in orbits energy associated with internal motion of nuclides is also quantized. Accordingly nuclides exist from ground state to several excited states. It is seen that energy associated in nuclear decay are of the order of MeV while energy of electrons in orbits is few eV. Thus for all practical purposes in physical and chemical reactions nucleus remains at ground state. Bombardment of nucleus by high energy particles or radioactivity it attains an excited state. Return of excited nuclide to ground state takes place with emission of photons of **γ -rays**. It is to be noted that during γ -decay there is no change in composition of nuclide and hence N and Z remain unchanged so also $A = N + Z$, it is just descending of nuclide from higher energy state to lower energy state.

Law Of Radioactive Decay (LORD), Half life and Average Life: Rate of radioactive decay depends upon composition of nuclide and is different for each atoms and is expressed as **Decay Constant (λ)**. Let, a mass of radioactive substance has N nuclides at a time t . Then as per LORD states that “**rate of decay of nuclides $\left[-\frac{dN(t)}{dt}\right]$ at any time t is proportional to number of radioactive nuclides (N) present in the mass**”. Here (-) sign is indicative of fact that as a result of radioactive decay number of nuclides are reducing. It is mathematically represented as $\left[-\frac{dN(t)}{dt} \propto N\right]$, such that $\left[-\frac{dN(t)}{dt} = \lambda N\right]$. It is a simple problem of integration which leads to $\int_{N_0}^N \frac{dN(t)}{N} = -\lambda \int_0^t dt \rightarrow \log_e \frac{N}{N_0} = -\lambda t$. It can be written as $N = N_0 e^{-\lambda t}$. Here, N_0 is the initial number of nuclides present in the mass at any time $t = 0$, and N is number of residual nuclides after a lapse of time t . Since rate of radioactive decay is called radioactivity (A) and hence at any time t , $-\frac{dN(t)}{dt} = A = \lambda N$. Therefore, LORD can be expressed as $A = A_0 e^{-\lambda t}$. Here, A_0 is the initial radioactivity and A is the radioactivity at time t . The SI unit of radioactivity is **1 Becquerel (1 Bq)** defined as 1 disintegration per second. This unit is named after **Henri Becquerel** who discovered radioactivity in 1896. Nevertheless, considering, huge number involved in disintegration the popular unit is 1 Curie or 1 Ci, in the name of **Maries Curie**.

Half-life, as the name suggests is the time taken to reduce N_0 nuclides to half of it i.e. $\frac{N_0}{2}$. Half-life term is most common in radioactivity. It can be statistically determined for LORD as $\frac{N_0}{2} = N_0 e^{-\lambda t_{0.5}} \rightarrow e^{\lambda t_{0.5}} = 2 \rightarrow t_{0.5} = \frac{\log_e 2}{\lambda} = \frac{0.693}{\lambda}$.

Average Life, is also a statistical inference drawn from the LORD. It is known that any exponential decay takes infinite time for complete decay. Taking a sample of radioactive material having N_0 nuclides, as per LORD, number of nuclides decaying during time $\Delta t = [(t + \Delta t) - t]$ would be $\Delta N = \lambda N \Delta t$. These decaying nuclides have lived for time t , therefore, time-life of decaying nuclides is $\Delta s = \Delta N t = (\lambda N \Delta t) t = \lambda N t \Delta t$. Accordingly, time life of N_0 nuclides is $S = \int_0^\infty \lambda N t dt$. Substituting value of N , using LORD, $S = \lambda N_0 \int_0^\infty t e^{-\lambda t} dt = \lambda N_0 \left[\left[\frac{t e^{-\lambda t}}{-\lambda} \right]_0^\infty - \int_0^\infty \frac{e^{-\lambda t}}{-\lambda} dt \right] = -\lambda N_0 \left[\frac{e^{-\lambda t}}{\lambda^2} \right]_0^\infty = \frac{N_0}{\lambda}$. Therefore, average life of N_0 nuclides is $t_{av} = \frac{S}{N_0} = \frac{1}{\lambda}$. This average life of a mass of nuclides, in terms of its half life, comes to $t_{av} = \frac{1}{\frac{0.693}{t_{0.5}}} = \frac{t_{0.5}}{0.693}$.

Average-life and Half-life being statistical in nature does not predict which nuclide would decay when, rather they only predict behavior of a mass of nuclides.

Nuclear Reactions: Nuclear Decay is a self-actuated process and occurs naturally, but nuclear reaction is an externally actuated and controlled process. Rutherford, demonstrated that bombardment of Nitrogen atoms ^{14}N with α -particles lead to heavier atom Oxygen ^{17}O and is depicted by nuclear reaction $^4_2\text{He} + ^{14}_7\text{N} = ^{17}_8\text{O} + ^1_1\text{H}$. Nuclear reactions are governed by multiple laws viz. conservation of charge, conservation of momentum, conservation of angular momentum, conservation of energy, rest mass and conservation of nuclides. Despite conformance to conservation of nuclides in nuclear reactions, these are non-elastic collision and thus initial mass and final mass of the nuclear reactants are not equal and this is secret of enormous energy associated with nuclear reactions and is explained by mass-energy equivalence. Accordingly, reaction energy (Q) associated in a reaction $A + B \rightarrow C + D$ having rest mass of the reactants are M_A , M_B , M_C and M_D respectively is $Q = (M_A + M_B - M_C - M_D)c^2$. In nuclear reactions when Q is positive, total mass decreases and total kinetic energy increases; such nuclear reactions are called **exoergic reaction**. But, when Q is negative, total mass increases and total kinetic energy decreases and are called **endoergic reaction**. These terms **exoergic** and **endoergic** nuclear-reactions are borrowed from chemistry e.g. exothermic and endothermic reaction.

Taking an example of endoergic reaction where **α -particles** of rest mass m and kinetic energy K collides with a nuclide of mass M and centre of mass of the combined mass attains kinetic energy K_{cm} , which is equal to $K_{cm} = \frac{M}{M+m} K$. Requirement for successful reaction is $K_{cm} > |Q|$ i.e. absolute Q -value of the reaction. Moreover, its kinetic energy must be sufficiently high to penetrate potential energy barrier.

Neutron Absorption: A stable nuclide when bombarded with neutron its absorption forms unstable nuclide and then leads to β^- Decay. This one of the important class of nuclear reaction which has to produce elements, not found in nature, having Z-number as high as 118.

Nuclear Reactions that are most commonly understood and used are a) Fission Reaction and Fusion reaction. These shall be discussed in following paragraphs.

Nuclear Fission: It is decay process an unstable nuclide, called parent nuclide, splits into two parts of comparable A-value, i.e. mass of daughter nuclides. Fission reaction was discovered by Otto Han and Fritz Strassman in 1938 during experiment of bombardment Uranium having 92 protons, that has existed in nature. It has two isotopes of which $^{238}_{92}\text{U}$ is common. The other isotope $^{235}_{92}\text{U}$ is easily split by neutron having kinetic energy less than 1 eV, while splitting of $^{238}_{92}\text{U}$ requires having kinetic energy of the order 1 MeV. This makes $^{235}_{92}\text{U}$ highly unstable and hence uncommon, while $^{238}_{92}\text{U}$ being stable is common.

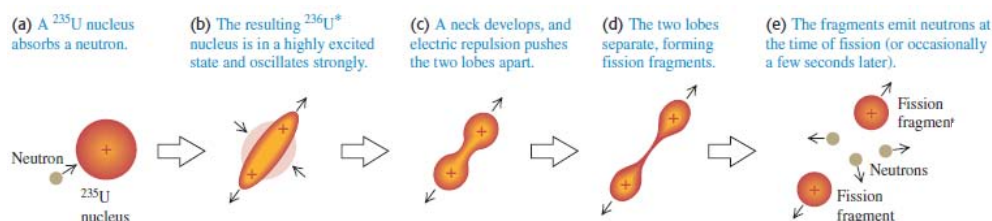
Fission reaction caused by neutron absorption is called **induced fission**. There are nuclides which do not require neutron absorption for initiation and are called **spontaneous fission**. It is $^{235}_{92}\text{U}$ converted to $^{236}_{92}\text{U}^*$ by neutron absorption in a highly excited state and is, therefore, highly prone to spontaneous fission. Fission products of $^{235}_{92}\text{U}$ are more than 100 nuclides of more than 20 elements having mass number (A) predominantly in range 90-100 and 135 to 145.

Fission Reaction: Typical example of the fission reaction are –a) $^{235}_{92}\text{U} + {}^1_0\text{n} \rightarrow ^{236}_{92}\text{U}^* \rightarrow ^{144}_{56}\text{Ba} + ^{89}_{36}\text{Kr} + 3 {}^1_0\text{n}$. and the other is b) $^{235}_{92}\text{U} + {}^1_0\text{n} \rightarrow ^{236}_{92}\text{U}^* \rightarrow ^{140}_{54}\text{Xe} + ^{94}_{38}\text{Kr} + 2 {}^1_0\text{n}$. The asterisk in $^{236}_{92}\text{U}^*$ indicated that this is an excited nuclide. Since, nuclides with A nearing 240 are less tightly bound than those of the middle order having A in the range 90 to 145. This is the reason that kinetic energy of the fission products is very and of the order of 200 MeV as compared to few MeV of α and β particles. Average binding energy per nucleon at $A = 240$ is 7.6 MeV which at $A = 120$ is 8.5 MeV. Rest energy of the nucleus is total rest energy individual nucleon (E_0) minus binding energy of the nucleus (E_B). Thus, increase in binding energy corresponds to decrease in rest energy. The rest energy is converted into kinetic energy of fission products. It is seen that fragments if nuclides have N/Z ratio too high which makes them susceptible to release of neutron and β^- Decay which moderated towards stable nuclide $^{140}_{58}\text{Ce}$ as shown in reaction $^{140}_{54}\text{Xe} \xrightarrow{\beta^-} ^{140}_{55}\text{Cs} \xrightarrow{\beta^-} ^{140}_{56}\text{Ba} \xrightarrow{\beta^-} ^{140}_{57}\text{La} \xrightarrow{\beta^-} ^{140}_{58}\text{Ce}$. d

Liquid drop model of nucleus is helpful in understanding fission reaction. The excess energy of $^{236}_{92}\text{U}^*$ causes excessive vibration in nuclide leading to formation of two lobes connected with a narrow neck. Positive charges in these lobes makes

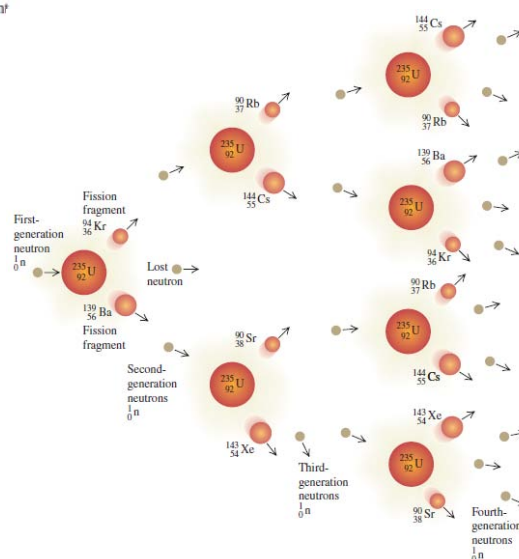
repulsive forces to further narrowing of neck until it is fragmented as shown in the figure.

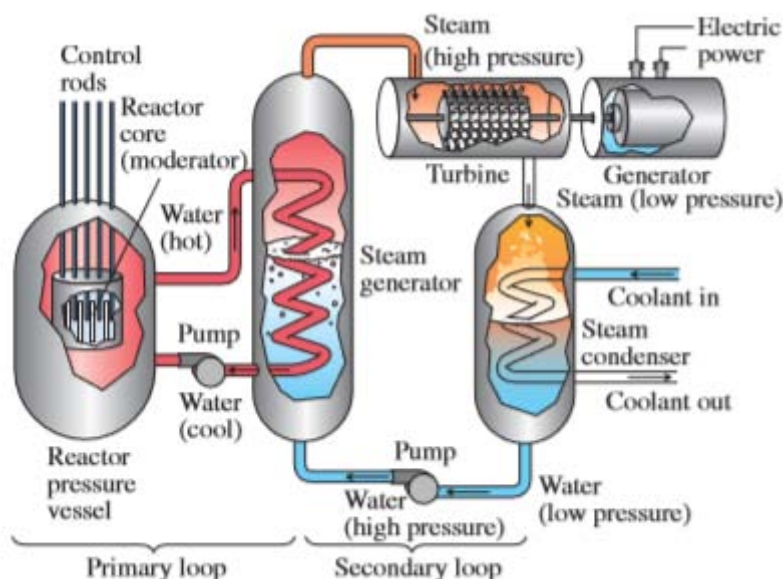
There is a hypothetical potential



energy function of a nuclide, and if it can be excited to energy more than this, fission of nuclide is immediate. In the event of the nuclide being excited less than the potential barrier, fission occurs due to tunneling, but its probability depends upon height and width of the potential barrier.

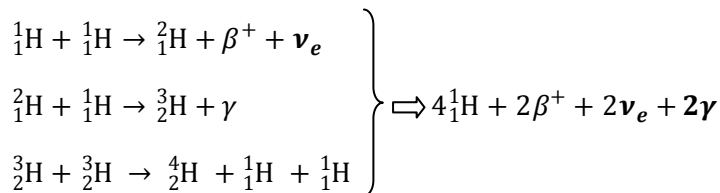
Chain Reaction: Trigger of fission reaction by neutron bombardment of $^{235}_{92}\text{U}$ releases more neutrons, which in-turn trigger more fission as shown in the figure below. Release of energy in fission is enormous and much larger than any chemical reaction. A typical comparison of release of energy in chemical and fission reaction is made. Combustion of Uranium (U) produces Uranium-dioxide (UO_2) which releases 4.5 kJ/g, which is equivalent to 11eV per atom. In contrast to this fission reaction produces 20 MeV per atom, i.e. nearly 20 million times that of chemical reaction. In fission reaction when rate of triggering is controlled then it becomes a reactor and has a great





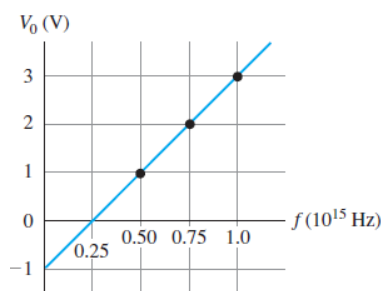
application in peaceful purposes. Otherwise an uncontrolled fission it is explosive and becomes a bomb. Schematic of a nuclear power plant is shown in the figure. Despite, nuclear power plants being deployed for peaceful purposes accidental occurrences of uncontrolled reaction lead to catastrophes. There are many such instances and latest among them is at Fukushima Daiichi Nuclear Plant in Okuma, Japan on 11th March'2011. This was initiated by a natural calamity, primarily Tsunami caused by severe earthquake. This lead to cascaded failure of systems resulting an uncontrolled fusion reaction in the reactors. This is indicative of requirement not only of high precision in performance of equipments but highest degree of reliability, stability and robustness. These requirements are expressed in a famous phrase for "**perfection of nuclear technology**".

Fusion Reaction: Fusion reaction as name suggests is based on fusion of two lighter nuclides, just reverse of fission reaction. The process of fusion involves bringing nuclides of lighter close to each other on nuclear scale i.e. 2 Fermi. At this vicinity the electron clouds of the reacting nuclides are repelled, and so also positively charged nucleus. Therefore, it requires kinetic energy of colliding nuclides about 0.7 MeV. At very high temperature of the order $1.5 \times 10^7 \text{K}$ gases turn into plasma where electrons and protons perform independently Brownian motion bringing protons close in nuclear scale to initiate fusion reaction as shown below. Similar reaction occurs in sun and is a potential source of energy. Yet efforts are being made to accomplish controlled fusion reaction. Fission reaction starts with endoergic process and ends up in exoergic process



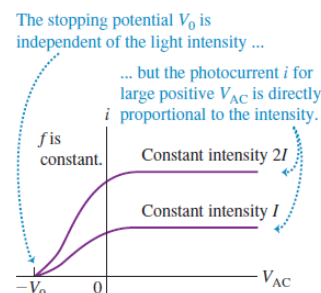
Allied Topics In Modern Physics: Each of the topic in this section has been covered in earlier parts of this series on Modern Physics. Nevertheless, requisite details of these topics on Photo-Electric Effect, X-Rays, and Semiconductors are being brought out to complete the scope of target audience.

Photoelectric Effect: Photoelectric effect and duality of matter was introduced in Part-II of this series of articles on modern physics. Properties of photoelectric are being elaborated. It has been experimentally observed that for a material exposed to a particular radiation is place in electric field

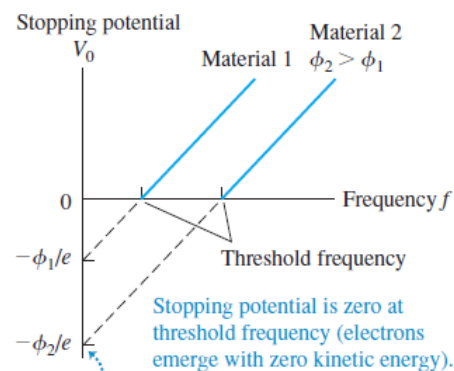


conduction current is established. There are three observations which are used to explain the photoelectric effect and are – a) the conduction current starts increasing at $(-V_0)$ when attains a Maximum value little after a $(+)$ is established with respect to the material exposed to radiation as shown in the figure, b) The magnitude of current increases with increase in intensity of radiation, as long as frequency of radiation remains constant c) Magnitude of V_0 increases with increases Energy of photon has been explained by Einstein as $E = hf$. In general frequency

is also expressed with Greek alphabet ν pronounced as Nu.



Every material, based on its structure, requires specific minimum energy to liberate an electron and it is called **Work Function** (ϕ), and being energy it is expressed in eV. Therefore, energy difference $= hf - \phi = \frac{hc}{\lambda} - \phi$ is the surplus energy with the electron which appears as kinetic energy of the electron. Getting back to electrostatics, this KE can be neutralized by subjecting the electron to a (-)ve voltage such that $eV_0 = \frac{hc}{\lambda} - \phi \rightarrow$ which will hold electron excited by radiation does not leave the material. This $V_0 = \frac{hc}{e} \left(\frac{1}{\lambda} \right) - \frac{\phi}{e}$ is called stopping voltage for a material. In this expression V_0 depends for a material upon wavelength (λ) of radiation, while all other parameters are constant. Typical values of work function for Aluminum is 4.3 eV, Copper is 4.3 eV, Silicon is 4.8 eV and Carbon is 5.0 eV

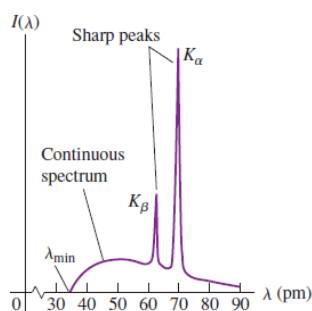


■ For each material,

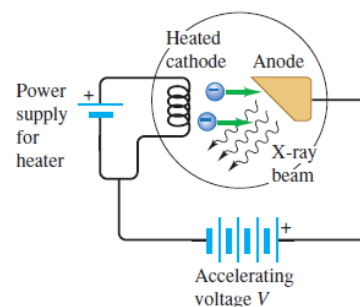
Photoelectric effect has many application right from photo-sensitive devices and controls to solar panels for eco-friendly generation of electricity.

X-Rays : It has been introduced in Part II of Modern Physics, in series of articles in this column. It being further elaborated.

Production of X-ray by impact of accelerated electrons on a metal anode called Coolidge Tube, shown in the figure, known after William Coolidge who in 1913 improvised the Crookes Tube used in experimentation of electrical discharges. It is seen that wavelength (λ) of X-ray emission follows a specific pattern as shown in the graph. Electrons, due to



thermionic emission at cathode, attain kinetic energy $KE = eV$, where V is the potential difference between anode and cathode. This is based on a consideration that electrons emitted by cathode have nominal velocity. This kinetic energy is dissipated in anode in two ways – a) The electron collide with electrons of the anode. In the process, a part of energy is consumed in accelerating the colliding electron and thus increase heat energy of anode and this process continues till it loses its energy to become conduction current. Another part is dissipated in radiation photon, b) kinetic energy is high enough to excite colliding electron of anode to higher orbit with different quantum states.

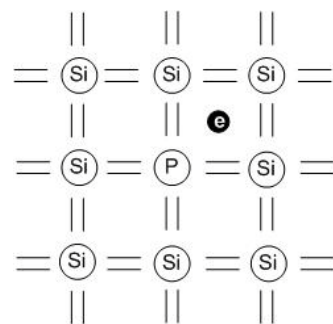


The fraction of kinetic energy converted into photon can be anything in the range $0 < \frac{hc}{\lambda} \leq eV$. Thus minimum wavelength λ_{min} , called **cut-off voltage**, shall correspond to maximum energy of electrons hitting anode i.e. $KE = eV$ or the anode voltage (V). But, intensity of X-ray for a particular V is dependent on thermionic emission of anode, which in turn depends upon temperature of cathode regulated by voltage in cathode circuit. It is to be noted that increase in V leads to increasing reduction of λ_{min} . But, sudden spikes in the curve are explained radiation of excited electron returning to lower orbit such that $\Delta E = \frac{hc}{\lambda} \rightarrow \lambda = \frac{hc}{\Delta E}$. Here, ΔE is the energy difference corresponding to the transition levels. Thus, photons created by transition from Level K to levels L, M and N are characterized as K_α , K_β and K_γ X-rays. Likewise, photons created by transition from Level L to levels M and N are characterized as L_α , and L_β X-rays, and those by transition from level M to N are characterized as M_α X-rays. These ray are since characteristic to atomic structure of material of anode and are therefore called **Characteristic X-rays**. There are two more terms **Hard X-rays** and **Soft X-rays**, which are relative terms. X-rays find application based on its requirement of frequency as much as energy over a wide spectrum.

Morseley's Law: In 1913 Henry Morseley studied X-ray spectral lines in detail and formulated a relationship to determine frequency of spectral lines as $f = 2.48 \times 10^{15} (Z - 1)^2$, where Z is atomic number. It is also expressed as $\sqrt{f} = a(Z - b)$ where a and b are constants, such that $b \approx 1$. Spectral lines predicted by Morseley's law helped in qualitative explanation of spectral lines as per Bohr's Lines.

Bragg's Law: Short wavelengths of X-ray has helped to use its diffraction property to analyze crystal, which forming gratings of 0.1 nm order i.e. at atomic scale such that $2d \sin \theta_n = n\lambda$. Here, n is an integer, and $\theta_1, \theta_2, \theta_3, \dots$ are values of θ corresponding to n , where peak intensity is observed.

Semiconductors : Basic concept of semiconductor was discussed in Part IV of Modern Physics, in series of articles in this series. Semiconductor materials have saturated covalent bonds as shown in the figure. These covalent bonds are separated by conduction band with a small energy gap. Typically for Silicon (Si) most commonly available this energy gap is 1.1 eV., another commonly available semiconductor material is Germanium (Ge) this energy gap is 0.8 eV. In ground state semiconductor materials are insulators. Increase in temperature is good enough for electrons from covalent bonds to jump into conduction band. But, in presence of small quantity of impurity, called **doping**, which is of the order of One part in 10^8 the semiconductor material acquires conducting properties. This has created a revolution in the field of electronics.

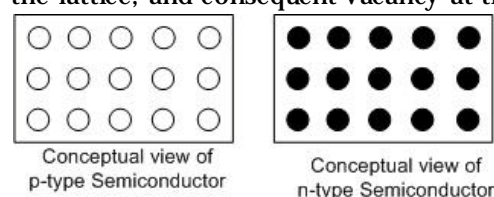


There are two types of doping. Semiconductor material doped with elements having 5 electrons in outermost orbit is called **n-type semiconductor**. Likewise, materials doped with elements having 3 electrons in outermost orbit is called **p-type semiconductor**.

Taking base semiconductor material Silicon ($Z = 14$) which has electron configuration $(1s)^2(2s)^2(2p)^6(3s)^2(3p)^2$, when Phosphorous $Z = 15$ having electron configuration $(1s)^2(2s)^2(2p)^6(3s)^2(3p)^3$ is diffused its Four electrons in 3^{rd} orbit are consumed in covalent bonds. Thus the Fifth electron of outermost orbit becomes free electron having no place in the

lattice of covalent bond. This free electron joins the conduction and is enough to transform conduction property and such doped material is called **n-type semiconductor**. Impurities like Phosphorous which change conduction properties of semiconductor material are called **donor impurities**. There are impurities like Aluminum ($Z = 13$) has electron configuration $(1s)^2(2s)^2(2p)^6(3s)^2(3p)^1$. Three electrons in its outermost orbit creates a vacancy also called

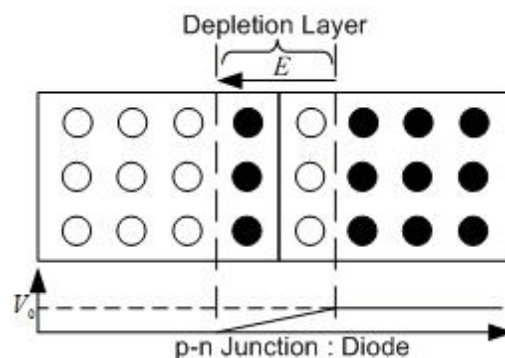
hole (\bar{h}) in covalent bond, which is able to accept an electron from any other covalent bond in the lattice, and consequent vacancy at that position of shift of electron. Eventually, the hole keep moving randomly in the



lattice to add conductivity as a (+) charge, virtually anti-electron. Such material is called **p-type semiconductor** and the impurities capable of creating holes in the lattice are called **acceptor impurities**. It is to be noted that neither of free electrons and or holes present in doped semiconductor disturb balance of electrons and protons. It is just rearrangement of electrons and is internal to the substance. Thus, separately both types of semiconductor remain electrically

neutral. Conceptual representation of both types of semiconductor is shown in figure; hollow circles represent free holes, while filled circles represent free electrons spread around the material.

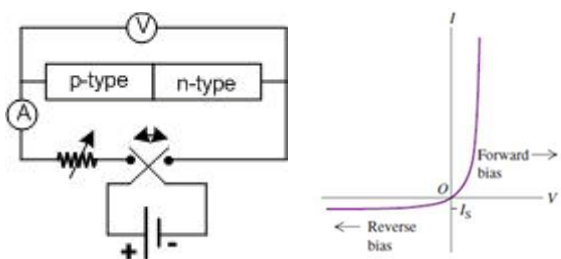
But, a metallic junction, just contact, of p-type and n-type semiconductor is a new world of semiconductor devices. This **p-n junction** called **diode**. Affinity among adjoining electrons and holes of n-type and p-type materials forming junction disturbs electrical balance of the constituent materials. Electrons have more mobility than holes. It is assumed that, x -number of electrons from n-type material move into p-type semiconductor they shall neutralize x -number of holes. As a result, a vacancy of x -number of electrons that is created in n-type material is manifested as x -number of holes. And electron migrating into create surplus of x -number. Despite the overall electrical balance of p-n junctions remains undisturbed. Migration of electron and creation of holes is a continuous process



and thus electric currents established by both the process in opposite directions maintain the balance and overall electrically neutral junction.

Next, obvious question is: what is the depth of penetration of mutual diffusion of free holes and electrons? Migration of electrons having (-)ve charges and holes having conversely (+) charges creates an electric field E in the direction from n-type material to p-type material of a standalone p-n Junction, as shown in the above figure. This standalone state of diode is called **unbiased diode**. The diode when (+)ve potential at p-type material w.r.t. n-type material it is called **forward-biased**, and when n-type material is at (+)ve potential w.r.t. p-type material it is called **reverse-biased**.

Characteristics of Diode: The behavior of diode in forward- and reverse-biased conditions is being elaborated. At this stage reader has had detailed exposure on electrical circuit and hence hereafter its elaboration is being skipped and directly $V - I$ characteristics of diode in adjoining figure is being elaborated.



It is seen that, in forward bias initial increase in current through diode is gradual. This is attributed to gradual cancellation of electric-field caused by depletion layer. Successively, with increase in forward bias width of depletion starts thinning. At $V = V_0$ the depletion layer vanishes, At $V > V_0$ the current steeply rises as diode enters into conduction mode. While, in reverse bias depletion layer keep widening. As a result, in this small current through diode is leakage current. Diodes are available over a

widest range from micro amps to kilo-amps catering from micro electronics to energy systems. Diode is basic semiconductor device, which has grown into multiple forms of diodes, Photoelectric diode, Light emitting Diode, Zener Diode, Schottky Diode, and going forward different kind of semiconductor devices like transistors finding application in analog electronics and digital electronics. It just did not stop at that and found application in integrated circuits, microprocessors and application specific integrated circuits. This yet not the epitome of the field of electronics and communication, race is on for low-power, size-reduction, capability-enhancements, and cost minimization to make technology accessible to poorest of the poor. These statements are just arouse curiosity among readers and further details enter into domain of advanced physics and engineering leading into nano-electronics. Nevertheless, inquisitive readers may welcome through [CONTACT US](#).

Acknowledgement: We acknowledge pictures taken from book University Physics, by Sears and Zemansky [1] in series of articles on Modern Physics, for this Mentors' Manual, a free web-resource in an imitative to democratize education for unprivileged children being pursued with Personal Social Responsibility (PSR) in a non-remunerative, non-commercial and non-political manner.

References:

1. *Sears & Zemansky; University Physics with Modern Physics.*
2. *H.C. Verma; Concepts of Physics, (Vol 1 & 2).*
3. *Resnick, Halliday, Resnick and Krane; Physics (Vol I and II).*

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N.B.: With this article First-cut of all chapters of Physics has been completed. These chapters have been uploaded on [Mentors' Manual](#). These articles are being reviewed and suggestion from esteemed readers wherever available are being incorporated. Revised version of these articles in the form of Chapters will replace respective chapter in [Mentors' Manual](#) as free web-resource.

From next e-Bulletin in this column a series of Questions, Problems both objective and subjective shall be started. These shall be drawn from different sources to give a spectrum verities. It is not a replacement for books and for practice, readers may refer to various text and practice books

Growing with Concepts: Chemistry

PARTIAL COVALENT CHARACTER IN IONIC BONDS (FAJAN'S RULE) AND RESONANCE

Kumud Bala

Although in an ionic compound, the bond is considered to be 100% ionic, actually it has some covalent character also. Thus, just as covalent bond has some ionic character, ionic bonds have some covalent character. This was explained by Fajan as follows:

When a cation approaches an anion, the electron cloud of the anion is attracted towards the cation and hence gets distorted. This distortion of electron cloud of the negative ion by the positive ion is called polarization. The power of the cation to polarize the anion is called its polarizing power and tendency of the anion to get polarized is called its polarizability. The greater is the polarization produced, more is the neutralization of the charges (i.e., charge of the cation by the electron cloud of the anion) and hence the ionic character decreases or the covalent character increases. If there is no polarization, the bond is mainly ionic, if the degree of polarization is small, the bond will be ionic with some covalent character and if the polarization is more, the covalent character becomes predominant. The polarizing power of the cation and the polarizability of the anion and hence the formation of covalent bonds are favoured by the following rules known as Fajan rules.

1. Small size of the cation:- Smaller the size of the cation, greater is its polarizing power. The small cations have high electron density and therefore, they tend to distort or polarize the electron cloud of the anion to greater extent. Therefore, the compounds containing small cations will have more covalent character. For example, LiCl is more covalent than NaCl and KCl.
2. Large size of anion:- Polarization increases with increase in size of anion. This is because the electron cloud on the bigger anion will be held less firmly by its nucleus and, therefore, would be more

easily deformed towards the cation. Thus, larger the anion, the higher will be its polarizability and more will be covalent character in its compounds. Therefore, the anion such as I^{-1} , Br^{-1} , S^{-2} , Se^{-2} , etc. are easily polarizable and have larger tendency to induce covalent character in ionic compounds. Therefore, covalent character of lithium halide follows the order: $LiI > LiBr > LiCl > LiF$ and that is why their melting points are in the order of $LiI(446^{\circ}C) < LiBr(547^{\circ}C) < LiCl(613^{\circ}C) < LiF(870^{\circ}C)$.

3. Large charge on cation or anion:- Larger is the charge on cation greater is polarizing power and larger is the charge on anion greater is its tendency to get polarized. For example, Na^{+} and Ca^{+2} have almost similar ionic radii but $CaCl_2$ has higher covalent character than $NaCl$ because of higher charge on Ca^{+2} ion. Consequently the melting point of $CaCl_2$ is less than that of $NaCl$.

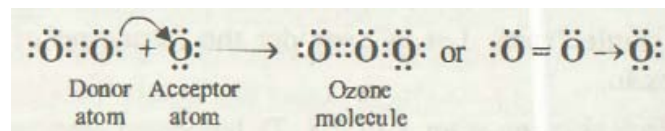
Compound	Radius	Melting points (K)
NaCl	Na^{+} , $0.95A^{\circ}$	1073
$CaCl_2$	Ca^{+2} , $0.99A^{\circ}$	1045

That is why covalent character of the chloride is in the order: $Na^{+}Cl^{-} < Mg^{+2}Cl_2^{-} < Al^{+3}Cl_3^{-}$.

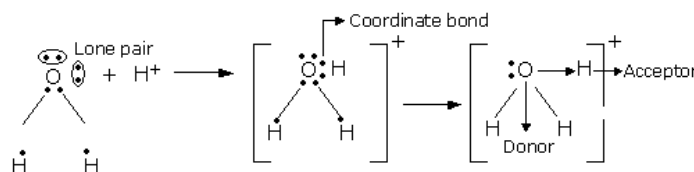
4. Electronic configuration of the cation:- If two cations have same size and charge, then the one with pseudo noble gas configuration (with 18 electrons in the outermost shell) has greater polarizing power than the other with noble gas configuration having 8 electrons in the outermost shell. For example, if we compare the ions of same

size, Na^+ and Cu^+ , Na^+ has eight electrons shell configuration ($2s^2 2p^6$) while Cu^+ has 18 electrons shell configuration ($3s^2 3p^6 3d^{10}$). The Cu^+ ion polarizes the anion more than Na^+ ion. As a result, cuprous chloride (CuCl) is slightly covalent and therefore, insoluble in water whereas NaCl is ionic and highly soluble in water. CuCl has low melting point (705K) as compared to NaCl (1073K), due to its covalent character.

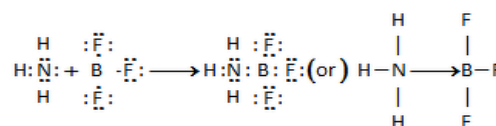
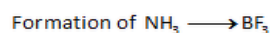
Co-ordinate covalent bond:- So far, we have considered that in a single covalent bond each atom contributes one electron. Perkin (in 1921) suggested another type of covalent bond in which both the electrons are donated by one atom but shared by both the atoms so as to complete their octet. The bond formed is thus called co-ordinate bond or dative bond. Such type of bond is formed between atoms or ions, one of which is deficient in at least two electrons while the other atom has already acquired a stable noble gas configuration or octet. The atom which contributes the electrons is called the donor while the other which only shares the electron pair is known as acceptor. This bond is usually represented by an arrow (\rightarrow) pointing from donor to the acceptor atom. For example,



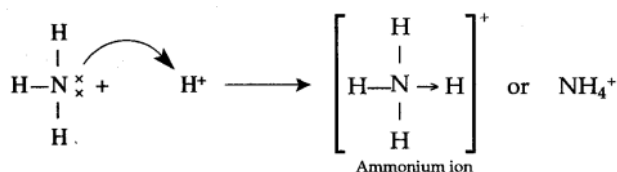
(iii) Hydronium ion (H_3O^+) :- Water has two lone pairs of electrons on oxygen atom while H^+ ion has empty 1s shell. Thus, oxygen atom can easily donate two electrons to H^+ ion.



(iv) Ammonia (NH_3) and boron trifluoride (BF_3) :- These molecules also combine through a co-ordinate bond as shown below:

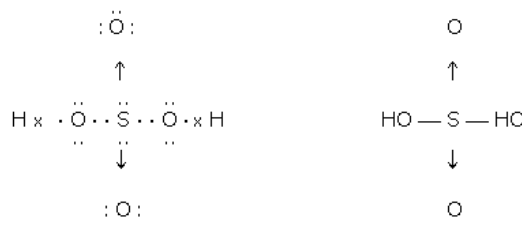


(i) ammonium ion (NH_4^+) :- A hydrogen ion combines with ammonia molecule by a co-ordinate covalent bond to form ammonium ion (NH_4^+)



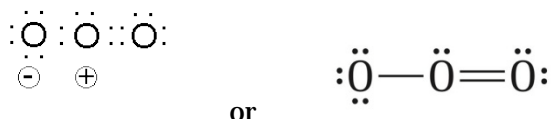
(ii) Ozone molecule (O_3) :- A molecule of oxygen contains two oxygen atoms joined by double covalent bond so that octet of each of the two atoms is complete. Now, if an atom of oxygen having six electrons comes close to oxygen molecule, the new atom may share a lone pair of electron of one of the oxygen atoms of the oxygen molecule. This result is in the formation of a co-ordinate bond.

Sulphuric acid:- Sulphuric acid has also two co-ordinate bonds in its molecule. As given below, the bonds between the sulphur atom and the oxygen atom of two $-\text{OH}$ groups are the normal single bonds, whereas the bonds between sulphur atom and the other two oxygen atoms are co-ordinate bonds.



Resonance:- The phenomenon of resonance was put forward by Heisenberg to explain the properties of certain molecules. It is often observed that a single Lewis structure cannot explain all the properties of the molecule. The molecule is then supposed to have many structures, each of which can explain most of the

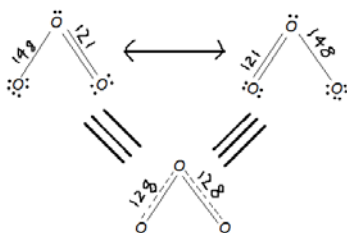
properties of the molecule but none can explain all the properties of the molecule. The actual structure is in between of all these contributing structures and is called resonance hybrid and the different individual structures are called resonating structure or canonical forms. This phenomenon is called resonance. For example, the structure of ozone can be written as



Here each oxygen atom has an octet of electrons. According to this structure, there is one single bond (O-O) and one double bond (O=O) in the molecule. The normal O-O and O=O bond lengths are 148pm and 121pm respectively. According to the structure we would expect two bond lengths in ozone molecule to be unequal. But experimentally it is observed that both the bond lengths are equal (128pm) and the bonds are intermediate between single and double bonds. This means that the above Lewis structure does not account for the observed experimental facts. Hence, an alternate Lewis structure can be written in which the double and single bond are interchanged.



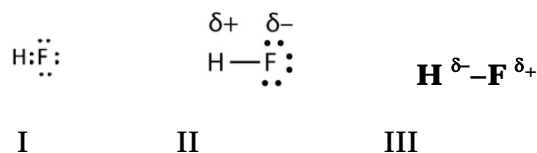
But none of these two structures explain the observed facts. Hence, the actual structure is intermediate between the two Lewis structures and is said to be resonance hybrid. These are represented by drawing double headed arrows between these structures as shown below:



It may be noted that the resonance structures have no real existence. Such structures are only theoretical. In fact, the actual molecule has no pictorial representation. The resonating structures are only a convenient way of picturing a molecule to account for its properties.

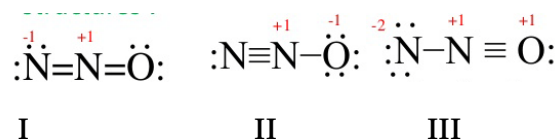
Conditions for writing resonance structures:

- The contributing structures should have same atomic positions. They should differ only in the positions of electrons.
- The contributing structures should have same number of unpaired electrons.
- The contributing structures should have nearly same energy, not differ much in energy. This is an important condition. The individual structures of similar energy contribute equally to the resonance hybrid.
- The structures should be so written that negative charge is present on an electronegative atom and positive charge is present on an electropositive atom. For example, HF, the following three structures are possible:



The structure III is rejected because it has positive charge on electronegative F atom and negative charge on electropositive H atom.

- In a contributing structure, like charges should not be present on adjacent atoms while unlike charges should not be widely separated. For example, N₂O may have the following possible structures:



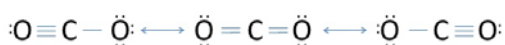
The structure III is ruled out because it has positive charges on adjacent atoms.

Let us discuss some other molecules:

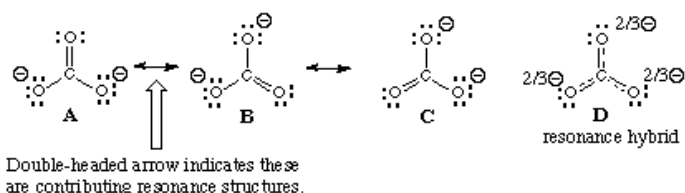
Carbon dioxide molecule:- If CO₂ molecule had only one structure, it should have two carbon to oxygen

double bonds. O=C=O or $\text{:}\ddot{\text{O}}\text{:}::\text{C}::\text{:}\ddot{\text{O}}\text{:}$

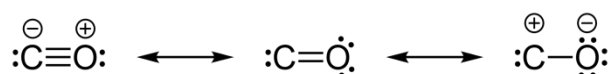
The normal C=O double bond has a bond length of 122pm. However, experimentally, each carbon to oxygen bond length in CO₂ is found to be 115pm which is in between that of C=O double bond (122pm) and C≡O triple bond (110pm). Hence, CO₂ is considered to be a resonance hybrid of the following three canonical forms:



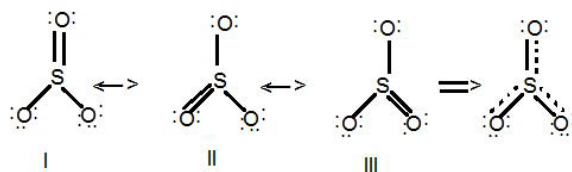
Carbonate ion (CO₃²⁻)- Here again, if only one Lewis structure were considered, there should have been two C-O single bonds and one C=O double bond. However, experimentally, all carbon to oxygen bonds are found to have same bond length which is in between that of C-O single bond and C=O double bond. This can be explained only if carbonate ion has the following resonating structures:



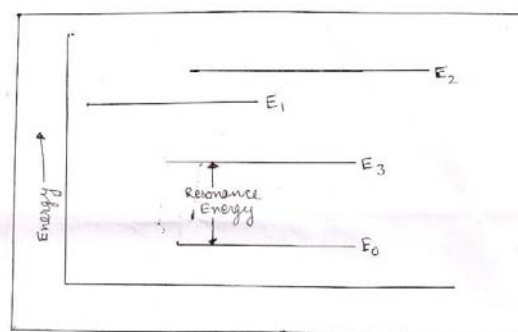
Carbon monoxide:-



Sulphur trioxide:-SO₃



Resonance Energy:- It may be noted that the resonance hybrid is more stable than any of contributing structure. It means the resonance hybrid has lower energy than any of the contributing structures. "The difference in the energy of the resonance hybrid and the most stable contributing structure (having less energy) is called resonance energy."



Characteristics of Resonance:-

- (i) The contributing structures do not have any real existence. They are only imaginary. Only the resonance hybrid has the real existence.
- (ii) Because of resonance, the bond length in a molecule becomes equal, e.g., O-O bond lengths in ozone or C-O bond lengths in CO₂.
- (iii) The resonance hybrid has lower energy and hence greater stability than any of the contributing structures.
- (iv) Greater is the resonance energy; greater is the stability of the molecule.
- (v) Greater is the number of canonical forms especially with nearly same energy, greater is the stability of the molecule.

Some Misconceptions: The following points should be kept in mind:

- (i) The resonating structures have no real existence.
- (ii) It does not mean that the molecule exist for certain fraction of time in one canonical

form and for other fraction of time in another canonical form.

- (iii) There is no equilibrium between the canonical forms like tautomeric forms (keto-enol form) in tautomerism.
- (iv) The real molecule cannot be depicted by a single Lewis structure.

Assignment

- (i) The correct order of stability of the following resonance structures is : (I) $\text{H}_2\text{C}=\text{N}^+=\text{N}^-$; (II) $\text{H}_2\text{C}^+-\text{N}=\text{N}^-$; (III) $\text{H}_2\text{C}^--\text{N}^+=\text{N}$; (IV) $\text{H}_2\text{C}^- - \text{N}=\text{N}^+$
 - (a) $\text{I} > \text{II} > \text{IV} > \text{III}$ (b) $\text{I} > \text{III} > \text{II} > \text{IV}$
 - (c) $\text{II} > \text{I} > \text{III} > \text{IV}$ (d) $\text{III} > \text{I} > \text{IV} > \text{II}$
- (ii) Which of the following is not correct resonating structure for carbon dioxide?
 - (a) $\text{O}=\text{C}=\text{O}$ (b) $-\text{O} - \text{C} \equiv \text{O}^+$
 - (c) $^+\text{O}-\text{C} \equiv \text{O}^+$ (d) $\text{O}^+ \equiv \text{C}-\text{O}^-$

(iii) Which one of the following contains ionic, covalent and co-ordinate bonds?

- (a) NaOH (b) NaCl
- (c) NaCN (d) NaNC

(iv) Which of the following statements is wrong? According to Fajan's rules, the covalent character is favoured by :

- (a) small size of cation
- (b) the cation having 18 electrons shell
- (c) small size of anion
- (d) high charge of cation and anion

(v) NH_3 and BF_3 form adduct readily because they form:

- (a) ionic bond (b) covalent bond
- (c) co-ordinate bond (d) hydrogen bond

(vi) The polarization of electrons in acrolein may be written as:

- (a) $\delta^-\text{CH}_2 = \text{CH} - \delta^+\text{CH}=\text{O}$
- (b) $\delta^+\text{CH}_2 = \text{CH} - \delta^-\text{CH}=\text{O}$
- (c) $\delta^-\text{CH}_2 = \text{CH} - \text{CH}=\text{O}^{\delta+}$
- (d) $\delta^+\text{CH}_2 = \text{CH} - \text{CH}=\text{O}^{\delta-}$

(vii) LiCl is soluble in organic solvent while NaCl is not because:

- (a) Lattice energy of NaCl is less than that of LiCl
- (b) Li^+ ion has higher value of hydration energy than Na^+
- (c) LiCl is more covalent than NaCl
- (d) Li^+ ion has lower value of hydration energy Na^+ .

(c) (ii) (p) (iv) (c) (iv) (p) (iii) (c) (ii) (b) (i):ANSWERS



Author is M.Sc. (Chem.), M.Ed. and Advanced Diploma in German Language (Gold Medallist). She retired as a Principal, Govt. School Haryana, has 3-1/2 years' experience in teaching Chemistry and distance teaching through lectures on Radio and Videos. She has volunteered to complement mentoring of students for Chemistry through Online Web-enabled Classes of this initiative.

e-Mail ID: kumud.bala@yahoo.com

SCIENCE QUIZ- World Earth Day: April'18**Kumud Bala**

1. When is earth day 2018?
(i) April 22 (ii) April 15
(iii) April 20 (iv) April 17
2. Why do we celebrate it?
(i) Support for environmental protection
(ii) Magnificent place
(iii) Blue planet
3. Earth is truly a magnificent place, known as due to its abundance of water.
(i) Red planet (ii) Blue planet
(iii) Gas giant (iv) Asteroid
4. When was the first earth day celebrated?
(i) 22 April 1970 (ii) 22 April 1975
(iii) 22 April 1960 (iv) 22 April 1965
5. Who is considered the founder of earth day?
(i) Gaylord Nelson (ii) Gerald Ford
(iii) Margret Thatcher (iv) George W. Bush
6. What disaster leads to the founding of earth day?
(i) Extinction of American mega fauna
(ii) An oil spill off the coast of California
(iii) The Chernobyl disaster
(iv) An oil spill off the coast of Africa
7. What is theme of earth day's 2018?
(i) Environmental and climate literacy
(ii) End plastic pollution
(iii) Trees for the earth
(iv) Data and technology
8. The earth is the... .. planet from the Sun.
(i) third (ii) second (iii) fourth (iv) fifth
9. The earth is a planet.
(i) gas giant (ii) terrestrial
(iii) jovian (iv) asteroid
10. Earth's atmosphere consists mostly of?
(i) CO₂ and O₂ (ii) O₂ and N₂
(iii) H₂ and He (iv) O₂ and H₂
11. Earth has natural satellites visible to the naked eye? (i) none (ii) four (iii) two (iv) one
12. The earth's diameter is approximately kilometers?
(i) 9655 (ii) 7904 (iii) 12756 (iv) 6542
13. What is the axial tilt of the Earth?
(i) 23.5° (ii) 12.7° (iii) 24.5° (iv) 17.5°
14. Earth rotates in about hours.
(i) 24 (ii) 6 (iii) 12 (iv) 26
15. Earth is moving around the Sun at about 67,000 mph represents speed?
(i) Earth's orbit around the Sun
(ii) Earth's rotation about its axis
(iii) Earth's movement through milky way
16. What is the Earth's true shape?
(i) Sphere (ii) Flat
(iii) Oblate spheroid (iv) Triangle
17. How old is earth?
(i) 4.54 million year (ii) 4.54 billion year
(iii) 6000 year (iv) 8000 year
18. What's the longest mountain chain on the planet?
(i) The everglades
(ii) The mid-ocean ridge
(iii) The Himalayas
19. What is the deepest place in the Ocean?
(i) The Bermuda triangle
(ii) The Mariana trench
(iii) The middle of the Atlantic Ocean
20. Where's the lowest point on land?
(i) Antarctica
(ii) The Dead sea
(iii) Death Valley
21. 134°F (56.7°C) was the hottest temperature ever measured on the earth in
(i) El Azizia, Libya
(ii) The North pole
(iii) Death Valley, California
(iv) The South pole
22. Minus 100° Fahrenheit (-73°C) was the coldest temperature measured on earth in.....
(i) Vostok station, Antarctica
(ii) The North pole
(iii) South pole
(iv) Dead sea
23. The earth's average distance is kilometers from the Sun.
(i) 149,597,000 (ii) 1,495,970,000
(iii) 9,300,000 (iv) 93,000,000

**(Answers to this Science Quiz May'18 shall be provided in
1st Supplement dt 1st May'18 to 7th Quarterly e-Bulletin)**

*Growing with Concepts: English Grammar***Unit-1: Subject and Predicate****S. Swarnalatha**

A sentence is a combination of words that gives a complete meaning or thought. A sentence has a subject and a predicate. It can start with a noun, or noun phrase, pronoun.

The subject of a sentence typically occurs at the beginning of the sentence (position), consists of a noun phrase (form), and indicates the topic of the discussion (meaning).

The predicate follows the subject, starts with a verb indicating an action or state of being, and conveys a thought about the subject.

Look at this sentence.

1. **Rahul is a student.** Rahul is a PROPER NOUN. He / She are pronouns.

Who is a student? Who are we speaking about? We are speaking about Rahul.

Rahul is the subject of the sentence, because the sentence is telling us something about that boy.

Rahul is a student.

What is it telling us about the boy? He is a student. The subject is still Rahul. Here we are getting some more information about our subject, Rahul. Hence this is the predicate in the sentence.

The cat/ran after the rat. The cat (subject) ran after the rat (predicate) ran (verb)

2. Rahul and Raghu are friends.

Rahul and Raghu/ Subject are friends. / Compound Subject There are two nouns in the subject.

3. The light green dress/ is my favourite. The light green dress is Subject.
4. Rahul walked and lost his way in the park. Compound Predicate. More than one verb related to the subject
5. In Imperative sentences Subject is implied. The You is implied.

Sit down . It means you sit down

6. In interrogative sentences.

Have you seen the movie? You is subject. Have and seen the movie Predicate

The light green dress/ is my favourite.

We will look at Types of sentences in our next unit.



Author is a teacher at Ramakrishna Mission School at Vishakhapatnam. She has volunteered to contribute a column Growing With Concepts – English Grammar. Sushri **Sarswathi Tenneti Madam**, A very senior teacher and mentor in English Language has kindly consented to make value addition for enriching this column.

E-mail ID: Swarnalathasingampalli@gmail.com

Theme Song :

PREMISE: *We are pleased to adopt a song“ इतनी शक्ति हमें देना दाता.....”from a old Hindi Movie Do Aankhen Barah Haath दोआँखें बारह हाथ of year 1957, directed by The Late V. Shantaram. The lyrics are by Shri Bharat Vyas, singer Melody Queen Sushri Lata Mangeshkar, and Music Direction by Vasant Desai. It has become a widely accepted inspirational song and/or prayer in many educational institutions and socially inspired initiatives engaged in mentoring of unprivileged children. This newly formed non-organizational initiative, being selflessly operated by a small set of compassionate persons, finds its philosophy in tune with the song and conveys its gratitude to all the eminent persons who brought out the song in a manner that it has attained an epitome of popularity. While working its mission and passion, the group invites one and all to collectively complement in grooming competence to compete among unprivileged children. The song/prayer goes as under -*

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर होना
हम चले नेक रस्ते पे हम से, भूलकर भी कोई भूल होना ॥

दूर अज्ञान के हो अंधेरे, तू हमें ज्ञान की रोशनी दे
हर बुराई से बचते रहें हम, जितनी भी दे भली ज़िन्दगी दे
बैर होना किसी का किसी से, भावना मन में बदले की होना ॥

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर होना
हम चले नेक रस्ते पे हम से, भूलकर भी कोई भूल होना ॥

हमना सोचें हमें क्या मिला है, हम ये सोचे किया क्या है अर्पण
फूल खुशियों के बाँटे सभी को, सबका जीवन ही बन जाए मधुबन
अपनी करुणा का जल तू बहा के, कर दे पावन हर एक मन का कोना ॥

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर होना
हम चले नेक रस्ते पे हम से, भूलकर भी कोई भूल होना ॥



**Together Each Achieves More
(TEAM)**

*Every end, so also end of this e-Bulletin, is a pause for a review, before
Resuming of the journey far beyond ...*