Navi Mumbai Science Foundation

EdUREKA

Education for Spirit of Science

Volume 4, Issue: No. 3 **July-December 2022**

STORY OF BATTERY

Navi Mumbai Science Foundation

[Regn. No.: Maha/2592/10/ (Thane)
BPT Regn. No. F/24093/Thane]

Navi Mumbai Science Foundation
EdUREKA
Education for Spirit of Science

July-December 2022

Volume 4, Issue: No. 3

****

Editor-in-Chief: **Dr. P. K. Joshi**

Reach me: pkkjoshi@gmail.com / 9969000848

Editorial Board

- Dr. A. M. Bhagwat
- Dr. A. K. Rajarajan
- Dr. D. A. R. Babu
- Dr. K. P. Muthe
- Dr. Shashibhal Pandey
- Shri M. P. Bellary
- Dr. V. Dalvi

Published by:

Navi Mumbai Science Foundation

[Regn. No.: Maha/2592/10/ (Thane),
BPT Regn. No. F/24093/Thane]

Address

B-51, Gitanjali, Plot No.52, Sector-17,
Vashi, Navi Mumbai-400703.

Webpage

www.navimumbaisciencefoundation.org

Email: edureka.nmsf@gmail.com

Contact No.: 022-27891475

****

This is a quarterly e-magazine published by Navi Mumbai Science Foundation, a society engaged in spreading science education and scientific temperament among students of Navi Mumbai region for the last one decade. The magazine will mainly cover activities and articles on science education useful to students, teachers & society at large.

Contents .....

1. **From Editor's Desk** 1
2. **The path which led to the invention of batteries.** 2
3. **Experiential learning** 4
4. **My learning experience at Resource Generation Camps.** 6
5. **Education tomorrow!!!!** 7
6. **Forthcoming issue** 10

Views expressed in the magazine are from authors and editor may not agree with it.

To receive the copy of E-magazine, send your mail id to edureka.nmsf@gmail.com

From Editor's Desk!!....

Editor's Corner

Dear Readers, students and teachers, we continue with our endeavor to bring articles to you which will give you a different perspective to things that you already know or introduce you to new concepts.

We bring to you articles from perspective of history of science, which is very important to understand the chronology of discoveries and inventions. There are many such perspectives which people have, which may be different from our authors and contributors. I invite all such writers, who may be students, teachers, scientists or even those who adore science and its beauty, to contribute their perspectives so that it tinkers curiosity among the young readers of this magazine.

This time we also bring an article on how programs, where teachers share their experiences, help teachers to evolve their teaching methods, which in turn helps in clarifying the concepts of students of science.

The path which led to the invention of batteries.

The path of discoveries and even inventions are not at all straight forward and simple, as they seem after the discovery. In the earlier issues we had seen how the measurement of speed of light, for the first time, seems so straight forward to understand. But for people who had never walked that path and are the pioneers, it is a very difficult task.

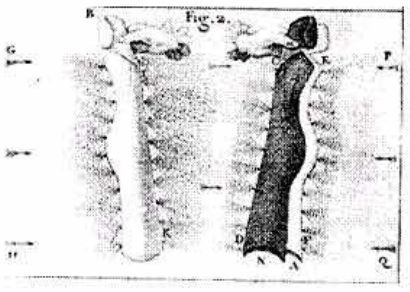
Same is the story in every field. Very recently, I visited the museum of Himalayan Institute of Mountaineering. It has exhibits in 3D, which lay out the Himalayan route taken to Mount Everest from its camps (I am not calling base camps purposely) at lower altitudes.

In the month of May 1953, Tenzing and Hillary did not just wake up and walk up to the Mount Everest. Several people had probably tried and failed, but even in their "failures" they had started sketching out the "best" path to reach the summit. It is an interesting history which one should read to see how this "best approach" was sketched out for Tenzing and Hillary, by those "failed" attempts. I am putting the word "failed attempts" in quotation mark because we have a very narrow definition in society of "failure" and "success". But this is not the right forum to discuss it today.

Now, the path to Everest is very clearly sketched out and I have heard from some Mountaineers, that it has now become almost like a tourist spot, in comparison to the days of challenges in the decades of 1950 and 1960. The reason for such a statement is because the "Best route", "Base camps" are all pre-determined. The "best approach" is pre-determined and must have by now been optimized.

Same is the story with science and its discoveries. We use batteries at every minute of our life. But how did the concept get developed? The path taken by the humans (collective effort) was not straight forward. But nevertheless, in this particular case it started in a hilarious way.

Robert Symmer (1707-1763)was a clerk in United Kingdom and used to wear white silk socks and black woolen socks. There are varying stories in the literature, but for around 2 decades he demonstrated how socks of same colour repelled each other but those of opposite colour attracted each other. I am sure there were people, for whom colour was the cause of these repulsions and attractions. But it was a logical explanation for few based on observation but not substantiated by any experiments. This is how scientific explanations begin.



A diagrammatic representation, believed to show *Symmer's electrified socks*
(courtesy *G. Bonera, Dipartimento di Fisica 'A.Volta' Università di Pavia*)

About quarter century later, in 1786, Luigi Galvani, placed headless frogs on a table with a wire connected. The legs of the headless frogs twitched whenever there was lightening during a thunderstorm. In those days there were static electricity generators. Galvani noticed same effect on the frogs, when a static electricity generator was cranked up, in the vicinity. However, there was no impact seen with variation of distance between the generators and the frogs. If the nerves were connected to glass, then there was no reaction to sparks. Hence, the first conclusion was that this was a naturally occurring phenomenon called " animal electricity"

He held the frog legs by hand so that its feet touched a silver box, he held a piece of metal in other hand and touched it to the silver box and the legs twitched. As soon as the legs twitched, the circuit, as we now know it, broke and the legs relaxed. Upon legs getting relaxed, they came down to touch the silver box, to be twitched again. These dancing legs were quite an attraction and a "magic" of those times.

His final conclusion, published as “Commentary on the effect of electricity on muscular motion” frog’s muscle was like a Leyden jar, storing and discharging electricity.

Enter Alessandro Volta.

Initially Volta, from University of Pavia, believed in what Galvani said. But he decided to explore further into the theory and he touched the back of the frog with a strip of metal and leg with a coin, and connected the metal to coin. Legs twitched.

BUT ONLY IF THE METAL AND COIN WERE OF DIFFERENT MATERIAL.

Thus, both were out to prove other wrong, when they were saying the same thing. Thus, Volta believed that every cell had a potential energy (can be called biological energy in those days). This is same as what we now understand as the source of energy in electrochemical cells.

For Volta the legs of frog were like a needle indicating the bi-metallic source of energy

Since Galvani was reluctant to intervene in the controversy with Volta, he trusted his nephew, Giovanni Aldini, to act as the main defender of the theory of animal electricity.

It is now possible to duplicate this energy outside a biological cell. So he replaced the legs of headless frogs with paper which were soaked in water which had high concentration of salt and detect the flow of charge (or electricity) {does this sentence read better}. This was the beginning of Galvanic cell, consisting of different metal electrodes separated by solution called electrolyte. The difference between the potential at two different electrodes resulting into what we now know as the electromotive force, emf. And if one uses identical electrodes, one will get no emf.

It is an irony that discover of such a powerful effect, died in poverty.

By

P.K. Joshi

EXPERIENTIAL LEARNING

Are teacher training programs useful for school (science) teachers? I want to share my experience of a program recently attended by me.

I attended a workshop specifically designed for strengthening the experimental culture in science education. To make certain concepts clear and easy to understand hands on activities, demonstrations and performance of experiments which are essential to introduce science in the classroom teaching. This program was organized by Vigyan Bharati in collaboration with Madhya Pradesh Science and Technology Center, Bhopal.

This was a three-day training program to raise the teacher trainers in the field of experimentation.

I got the opportunity to participate in this national level program and I would like to share my experience as a participant of this teacher training program.

The training program was conducted for three days where all the sessions were either dealing with experiments or demonstrating how to teach with activity and activities with the low-cost materials or the materials available at the premises. The program is appropriately titled “EXPERIENTIAL LEARNING”. The aim of this program was to train the trainers who were the participants. They are expected to interact with teachers in their own area and train more such trainers.

The first day was spent understanding several measuring instruments like digital balance, multimeters, thermometers, microscope etc. which are required for elementary experiments in science. Experiments related to optics like formation of images with different optical devices, internal reflection, removal of parallax, etc. were performed by us and concepts like image formation, seeing real images, pinhole camera were seen in totality.

Fruitful discussions related to intensity of the images, rainbow formation, potential difference, electric current, resistance, internal resistance, Emf, center of gravity, center of mass, reflex action of a human body etc. helped us to understand many basic concepts. we performed some electrical experiments with bread board and multimeter. Several concepts of wave formation, phase changes etc. were demonstrated and discussed with live equipment. We received valuable guidance and opportunity to learn from a very good team of resource people. They made all difficult concepts so simple that it was a jaw dropping experience for all of us.

This physics session was followed by concept of titration, uses of indicator, presence of salts in samples of water collected from different sources in a story form. We enjoyed all chemistry experiments and learned how to note the observations correctly. All the chemistry sessions very interesting and colorful.

At night we discussed many concepts of astronomy with skit enacting and interesting games, we were provided valuable information about many astronomical events happening in the sky.

Some aspects of science were shown with connection to writing of poetry.

Several very elementary but important Biology experiments were discussed. Experiment to measure the size of animal population was very interesting. It was a total new idea for all of us. Discussion on conducting experiments; equipment and independence from traditional equipment was also discussed.

Experiments teach multiple concepts in a single interaction. For example, carrying out a simple experiment of measuring focal length of convex lens, one can learn the concept of optical axis, alignment of objects (object pin, lens, image pin, etc.), measurement of length, co-ordinate axis system, linearization of equation, graph drawing, etc. Or while carrying out a titration experiment, one can learn (some or all) concept of molarity, concentration, measurement of mass and volume, measurement of pH, neutralization, how to handle burette/pipette/syringes, mixing of liquids, etc.

This program is also designed in a way that the participants are required to carry this torch to the schools of their area and introduce this concept of training the trainers and concept of experiments.

We all were wishing that this program should not come to an end so fast. Each one of us was very happy and contented to take away good knowledge and information from all renowned professors.

I wish more and more workshops should be conducted frequently for teachers to develop interest and skill in teaching using experiments and simple hands-on activities in the classroom.

By

Mrs Urvashi Korde
Faculty of physics
Physics Department, Wilson College, Mumbai

My learning experience at Resource Generation Camps.

The aim of this article is to share my experiences as a teacher of Physics who, in addition to being a +2 level teacher for 36 years have worked for activities/ movements like IAPT and Olympiad programs. At the onset I wish to make it clear to the readers that this in neither an attempt to boast about my work in these fronts nor to attempt to give any advice to the others. It is merely an attempt to share my experience of how such activities were instrumental in my evolution as a teacher. The esteemed readers can find her/his own moral of the story and put it in application not only as teachers but also as learners.

You are all aware that Homi Bhabha Centre for Science Education is the nodal agency for all the Olympiads in India. The first screening is done by IAPT under the title NSE. It is conducted for all basic science subjects – physics, chemistry, biology and astronomy & astrophysics. Thanks to my teacher – mentor, Prof R. M. Dharkar, who, as chief coordinator of this examination, had moved around and got most of his students involved in these activities. I was involved with the resource generation and assessment of this examination first with physics and then with the junior science part.

However, in the present article I shall focus on my experience with International Junior Science Olympiad (IJSO) for students under the age of 16. IJSO is different from other senior Olympiads in two aspects. One, the syllabus is a science syllabus, NOT separated into Physics, Chemistry and Biology. Here I would like to mention that it is NOT simply a physical binding of the three books into a single book, but an integrated approach in real sense at the very topic level. Two, the experimental event is a group event which encourages collaboration/ co-ordination among the group at this young age group. Again, it is NOT, three students simply doing the same experiment but a real attempt to encourage team work and collaboration during the experimental activity. A distinction must be drawn here from the pairing or grouping of students in regular laboratory work.

These aspects of IJSO will be highlighted in the article(s) that follow.

Personally, I was invited, to join this group of teachers of IJSO, due to my earlier involvement with NSE, senior Physics Olympiad.

The purpose of the invitation was to design good quality questions (which we shall deal in a separate article), good quality experiments, paper corrections and moderation, grading of students, selection of students, training them for the international event and finally some of us being the guides at the international event for our students.

It will be a good idea to describe the event itself in some detail.

IJSO is an event for the students, under the age of 16, held in December every year at different locations of the world. Currently there are more than 50 countries who are regular participants in the event every year. The event consists of 3 exams, viz. Multiple Choice Questions (MCQ) for 30 marks, Theory/Long questions, which are numerical and conceptual in nature, 30 marks, and finally the experimental task, which is a group event, (40 marks). The marks obtained by the group are added as individual marks to each of the participant of that group. For further details you can visit the site www.ijsoweb.org.

The first stage of exam was conducted by Indian Association for Physics Teachers, IAPT under the title National Standard Examination for Junior Science or NSEJS, across the country at over 1000 centers, and more than 50,000 students (few years ago) appear for this exam, towards the end of November every year, on a Sunday. Interested reader needs to update self, with the recent changes in timings, if any.

From this exam, around 300 to 350 students are chosen to appear for the second-round exam conducted by HBCSE-TIFR, titled Indian National Junior Science Olympiad (INJSO) towards the end of January of the subsequent year. This examination is conducted at around 15 centers spread out across the country. Around 35 students were selected for an Orientation-Cum Selection Camp (OCSC) held at HBCSE in the month of May every year.

At this camp, students were introduced to good quality of lecture sessions and high-quality elementary experiments (some of them are listed on the site: https://www.tifr.res.in/~pkjoshi/articles/articles.html). At the end of the camp a team of six students were selected who went through another 8 days of training at HBCSE, before their departure to the event in December. This Pre-Departure Camp (PDC) was held to train the students for the event at the international level.

And finally, a group of three teachers, one each of Physics, Chemistry and Biology, were selected to lead six students to the international event. These articles are not about the events described above, but about the activities which went behind the scenes in meetings of teachers to conduct these events (needed).

Teachers from various schools, colleges, Universities, and scientists from research institutes were involved in developing lectures, exam papers for these events described in the earlier sections. The group of teachers, scientists, called as Resource Persons (RPs) were also responsible to grade these exam papers and declare the results. RPs were also responsible for the experimental sections.

It is to be noted here that most of the teachers/ scientists involved as RPs were involved in both experimental and theoretical work.

By
Pradip Dasgupta
M.Sc. Dip. H. Ed. B. Ed.
Retd Teacher,
Siddharth College of Art, Science & Commerce

EDUCATION TOMORROW!!!

Post-pandemic period gives us an opportunity to re-imagine what schools and schooling are for and advocate for a re-schooled society in which our investment in schools builds and develops society. Today's learners are digital natives. They are accustomed to getting information and meeting their needs with a click of a button in a user-friendly, personal and customizable way. Students want their learning experience to meet their interests, time constraints and academic needs.

Learners are even more technologically savvy, demanding, confident and focused. Contrary to the old-school traditions housed in English, math, social studies and science, we'll need to redesign curricula and courses to reflect the skills mandated by emerging economies and technologies. Skills such as coding, design, sustainability and financial literacy will have to be integrated and taught in the classroom.

Schools will have to offer more ways for students to gain real-world experience that is applicable to their future careers. Schools should provide opportunities for students and include internship programs in companies. Rather than limiting students inside a classroom, schools can create more opportunities for students to gain useful technical skills through real-world application.

The world has already witnessed that the concept of 9-5 jobs in the office is also decreasing as people get an enormous scope for earning by sitting at their home and working online. As the world has witnessed a lot of technological changes, many things have changed since then. The email has replaced letters and WhatsApp and Facebook have almost substituted human interaction.

Blended learning, flipped classrooms and BYOD (Bring Your Own Device) for learning. Personalised learning at one's own pace and speed. And the teacher would now be the mentor, clarifier and the problem solving specialist. Examination patterns will change completely with increased use of online quizzes, group projects, and group discussions. It's not very far when we will see students from all over the world attending the same classes, and interacting with each other. No one will have to miss out on an education, and students are much more likely to enjoy learning as a result.

At the rate at which technology is progressing Students entering school today will find themselves two decades from now in occupations that do not exist today. We had never imagined about flipkart, Amazon, Uber, swiggy, even google or Facebook two decades back. Coding today is catching fire ! Anyone nowadays can learn to code and in future create his/her own website or even his/her own business. Educational institutions must not only focus on their day to day operations but also shape their vision on how they will better use technology for enhancing the learning process. Today's students have an entirely different world view to previous generations, having grown up in a world full of choice and limitless options. They have high expectations, demanding fast, easy access to content wherever they are.

The new free tool ChatGPT looks very harmless to us now, but very soon it is going to reshape our society as well as our economy drastically!! ChatGPT can create movie outlines, write entire codes and solve coding problems, write entire books, songs, poems, scripts within minutes thereby hampering the creativity of an individual. An ideal example is our smartphones that each one of us carries. Earlier when we used the landlines or the not so smart mobile phones we could remember atleast a few

important fone numbers as per our priorities. But now with everything digitally available on our fingertips we don't even remember the phone numbers of our loved ones either. The unrestricted use and development of Artificial Intelligence pose a significant risk to the existence of humanity.

Gamification has added a more creative, dynamic and innovative element to learning. These activities have the potential to turn an otherwise routine teaching learning process into an imaginative activity that will motivate students to work harder and provide teachers with valuable insight into student performance. Video-sharing websites, such as YouTube, also offer an array of educational videos which students are relying on for doubt solving and learning.

Students of today need deeper cognitive skills in priority areas such as creativity and problem solving, social-emotional skills such as relationship building, self-awareness, and self-recognition since they not only support academic learning

but also promote well-being. To meet these needs, technology can play an increasingly critical, role in how students learn and how educators support them.

In country like India with such huge population even if teachers and schools believe in the power of personalized learning and are motivated to individualize instruction, it is not always clear how to do so for hundreds or thousands of students. One-on-one mentoring is a highly effective way to personalize learning, for instance, but it is not a feasible for working with large student populations when the focus is more on time bound syllabus completion and assessments. Instead schools can rely on systems that are technology-enabled and student- driven, which is a very powerful way to provide personalized learning at large scale.

We did not blink an eyelid when we moved into the cashless society or paperless money interns of debit and credit cards. Similarly In the near future say around 10 years from now robots will be introduced into the classrooms. These robots will not only teach fixed contents, but will also be equipped with a response function that answers various questions made by students.

More emphasis should be given to physical education and mental health of the students in the coming years. The amount of junk food consumption and digital exposure will lead to obesity amongst the Youth. In today's world, many of us rely on social media platforms such as Facebook, Twitter, Snapchat, YouTube, and Instagram to find and connect with each other. We fail to understand that we human beings are social creatures. We need the companionship of others to thrive in life, and the strength of our connections has a huge impact on our mental health and happiness. Being socially connected to others can ease stress, anxiety, and depression, boost self-worth, provide comfort and joy, prevent loneliness, which social media cannot

compensate. Hence mental health of kids are a matter of great concern in the near future.

In today's times we don't use technology, we love technology. If future generations are to remember us more with gratitude than sorrow, we must achieve more than just the miracles of technology. We must also leave them a glimpse of the world as it was created, not just as it looked when we got through with it. It has become appallingly obvious that our technology has exceeded our humanity.

No matter how advanced technologies are, teachers are still the best educators !!!

Dr. Ushavati Shetty

B.Sc(Botany), M.Sc(Cytogenetic & Plant Breeding), PhD (Aerobiology), BEd, TEIS(Teachers Education in International Studies), Psychology, DSM(Diploma in School Leadership & Management)

Forthcoming events of NMSF

~~~~~~

1. Homi Bhabha Bal Vaigyanik Competition-2023" Guidance Sessions, Starting in the first week of June, 2023. For further details, visit NMSF website (www.navimumbaisciencefoundation.org) around 3rd week of April, 2023.

DON'T MISS IT

Coming up in Next issue (January-March 2023)

1. More about experiments
2. Student's corner
3. Teacher's page
4. Activity question AND MUCH MORE……

DO YOU HAVE ANY INTERESTING EDUCATIONAL STORY TO TELL? JUST SEND YOUR STORY TO US AT edureka.nmsf@gmail.com for putting in EduREKA.
~~~~~~