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VIPNET NEWS

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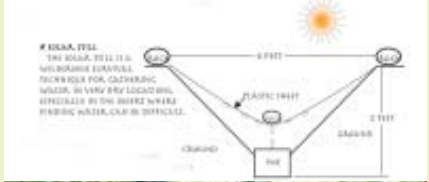
विशेष लेख



एक वैश्विक प्रयोग

पानी : एक रासायनिक विलयन

यह तो हम जानते ही हैं कि इस वर्ष को अंतर्राष्ट्रीय रसायन विज्ञान वर्ष के रूप में मनाया जा रहा है। जिसके उपलक्ष्य में पूरे विश्व में कई संस्थाएं विभिन्न गतिविधियां आयोजित कर रही है। इसी क्रम में आईयूपीएसी और यूनेस्को ने पूरे विश्व के विद्यार्थियों के लिए गतिविधियों का एक सेट तैयार किया है जिसके द्वारा वह यह जान पाएंगे कि रसायन विज्ञान किस प्रकार हमारे दैनिक जीवन में महत्वपूर्ण भूमिका निभाता है। इस प्रयोग का मुख्य पात्र पानी है जो हमारे रोजमर्रा के जीवन में अहम भूमिका निभाता है। 'एक वैश्विक प्रयोग-पानी एक रासायनिक विलयन' पानी के रासायनिक गुणधर्म से परिचय कराने के साथ ही समाज और पर्यावरण में पानी की भूमिका से अवगत कराएगा। इस लेख के माध्यम से इस बारे में जानकारी दी जा रही है कि किस प्रकार आप इस वैश्विक प्रयोग का हिस्सा बन सकते हैं।

पानी एक रासयनिक विलयन

हम जानते ही हैं कि शुद्ध पेयजल मानवीय स्वास्थ्य और उसकी जीविका के लिए सबसे अहम संसाधन है। पानी पृथ्वी पर पाए जाने वाले संसाधनों में सबसे प्रचुर तत्व है। पानी हमारे ग्रह के लगभग 70 प्रतिशत हिस्से को ढके हुए है। इसके अलावा पानी का हमारे शरीर के कुल भार में लगभग 70 प्रतिशत हिस्सा होता है। पानी की गुणवत्ता विभिन्न स्थानों की भौगोलिक स्थिति, मौसम, तापमान और मानवीय प्रभाव के अनुसार एक स्थान से दूसरे स्थान पर भिन्न होती है।

अंतरराष्ट्रीय रसायन विज्ञान वर्ष-2011 के तहत संयुक्त राष्ट्र संघ ने अधिकारिक तौर पर छात्र-छात्राओं के लिए ऐसी परियोजना का प्रस्ताव रखा है जिसके तहत वो स्थानीय स्तर पर उपलब्ध झीलों, नदियों, झरनों, तालाबों और अन्य जलीय संसाधनों के स्थानीय पेयजल स्रोतों का परिक्षण एवं उसका विश्लेषण कर 'ग्लोबल डाटा मैप' को प्रेषित करें। यह प्रयोग 31 दिसम्बर, 2011 तक किया जा सकता है। शिक्षकों, स्काउट नेतृत्व और परिवार इसके लिए अपनी भागीदारी का पंजीयन कराने के साथ ही वहां उपलब्ध प्रयोगों और अपने परिणामों को देख सकते हैं। इसके लिए http://water.chemistry2011.org. वेबसाइट की मदद ली जा सकती है।

इस वेबसाइट पर सभी उम्र के बच्चों के लिए गतिविधियां उपलब्ध हैं। इन गतिविधियों के लिए आवश्यक उपकरण उन्हें अपने स्कूल की प्रयोगशालाओं में या अपने आसपास ही आसानी से मिल जाएंगे। इस परियोजना के द्वारा विद्यार्थी स्थायी जल-प्रबंधन के साथ ही उपभोग के लिए जल का शुद्धिकरण सीख पाएंगे।

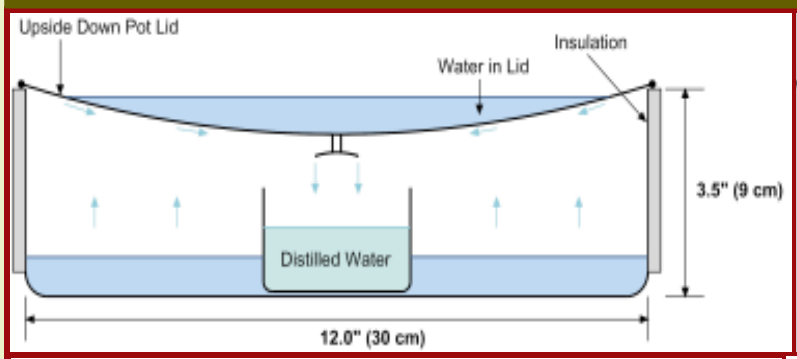
इस प्रकार विश्व भर के बच्चों के प्रयोगों का परिणाम एक वैश्विक प्रयोग के रूप में सामने आएगा जो शायद अब तक का सबसे बड़ा रासायनिक प्रयोग होगा। इन प्रयोगों के परिणाम इलेक्ट्रॉनिक रूप में इंटरऐक्टिव ग्लोबल डाटा मैप के रूप में 2011 के अंत में हम सभी के सामने होंगे। इस प्रकार यह प्रयोग विज्ञान में अंतरराष्ट्रीय सहयोग का एक अच्छा उदाहरण होगा। इस वैश्विक प्रयोग में निम्नांकित चार प्रयोगों के माध्यम से जल की गुणवत्ता के मापन और जल शुद्धिकरण को मापा जा सकेगा।

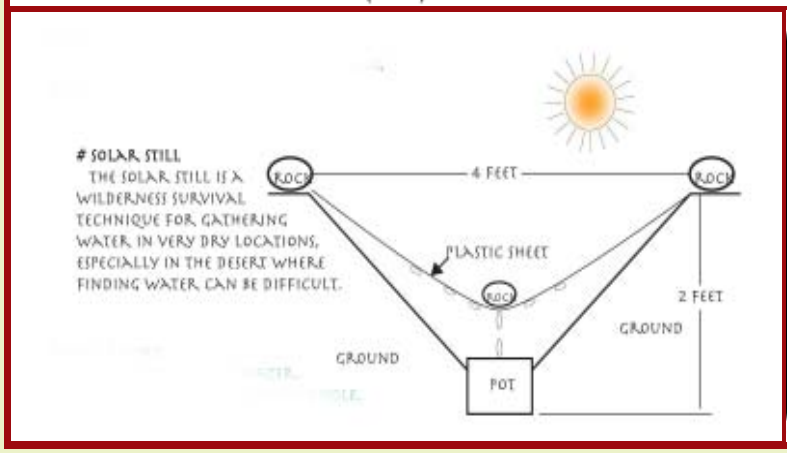
1. **पीएच मापन**: विद्यार्थियों द्वारा सूचक विलयन का उपयोग कर स्थानीय जलीय स्रोतों

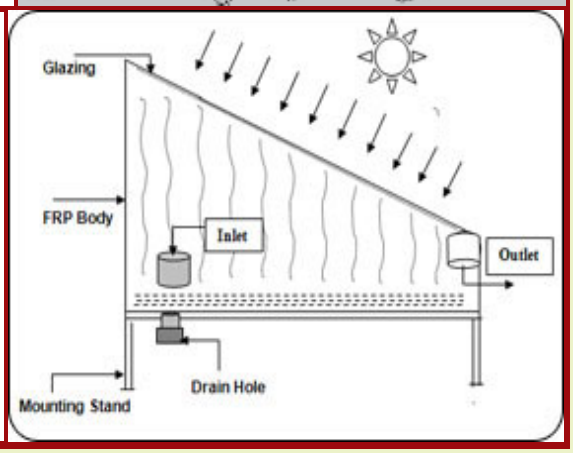
The 'silly' question is the first intimation of some totally new development. ... A.N. Whitehead

इस प्रयोग के अंतर्गत विज्ञान प्रसार द्वारा अगस्त, 2011 के दौरान इलाहबाद में आयोजित एक कार्यशाला से रसायन विज्ञान के शिक्षकों के लिए प्रशिक्षण कार्यक्रमों की शृखंला का शुभारंभ किया है। इस शृखंला में रसायन विज्ञान से संबंधित 'स्वयं करके देखो' गतिविधियां, नूतन प्रयोगों, मिट्टी की जांच की विधियां, खाद्य पदार्थों में मिलावट की जांच, चमत्कारों के नाम पर इस्तेमाल होने वाले रसायनों, जल से संबंधित वैश्विक प्रयोग और रासायनिकी के वर्तमान एवं भावी परिदृश्य की जानकारी दी जाएगी।

विभिन्न प्रकार के सोलर स्टिल







का पीएच मापन (यदि पीएच मीटर उपलब्ध हो तब) कर आंकड़ों को संग्रहण कराना है। इस प्रयोग के लिए विद्यार्थी रंगीन सूचक को अपने स्कूल की लैब से प्राप्त कर सकते हैं या फिर उसे लाल पत्तागोभी या चुकन्दर आदि से बना सकते हैं ताकि वह स्थानीय जलीय स्रोतों का पीएच माप सकें। इस प्रयोग से वह अम्लता संबंधी गुणधर्मों के बारे में जान सकेंगे और उसी समय वह अपने प्रयोग से प्राप्त परिणामों की विश्वसनियता को भी परख सकेंगे। इस प्रकार पूरी कक्षा के संयुक्त परिणाम को वह वैश्विक मैप पर दर्जा करा सकेंगे।

2. लवणता: इस प्रयोग के माध्यम से विद्यार्थी अपने स्थानीय जल स्रोतों की लवणता को माप सकेंगे। लवणता संबंधी गतिविधि छात्रों को दिए गए जल के नमूने की चालकता के मापन के लिए घरेलू या व्यापारिक मीटर का उपयोग करने का अवसर देगी। इस प्रयोग के द्वारा विद्यार्थी लवण के बारे में जानने के साथ ही विलयन में लवण के सांद्रण के बारे में जानेंगे।

3 कीटाणुशोधन: इस प्रयोग के द्वारा विद्यार्थी यह जान पाएंगे कि रसायन विज्ञान किस प्रकार से हमें शुद्ध पेयजल उपलब्ध कराने में मदद कर सकता है। छानना या निस्यन्दन इसी प्रकार की एक प्रक्रिया है। छानने वाली गतिविधि में छात्र घरेलू सामग्री से जल शुद्धिकरण यूनिट बना कर विभिन्न निस्यन्दन प्रदार्थों की दक्षता को माप सकते हैं। इस प्रयोग के साथ जल को उपचारित भी किया जा सकता है। इसके अतिरिक्त विपनेट क्लब अपने स्थानीय जल उपचारित संयत्र की विधि पर शोध करके अपनी रिर्पोट और परिणाम वैश्विक प्रयोग वेबसाइट पर डाल सकते हैं।

सोलर स्टिल का निर्माण: विद्यार्थियों द्वारा घरेलू प्रदार्थों से एक सौलर स्टिल का निर्माण कर उसके द्वारा जल को शुद्ध करने के लिए उपयोगी प्रयोग किया जा सकता है। विद्यार्थियों को सौलर स्टिल से जल को शुद्ध करने के वैकल्पिक प्रयोग को विकसित करने के साथ ही आसवन प्रक्रिया और प्रदार्थ की अवस्था को समझने का अवसर मिलेगा। यह गतिविधि विद्यार्थियों को स्वयं के सोलर स्टिल को अपने अनुसार बनाने का अवसर प्रदान करेगी।

इस वैश्विक प्रयोग में भागीदार बनने के लिए शिक्षकगण यदि चाहे तो वह विद्यार्थियों से सभी गतिविधियों को न कराकर विकल्प के रूप मे केवल एक गतिविधि भी करा सकते हैं। अपने पाठ्यक्रम के अनुसार यदि विद्यार्थी जल का अध्ययन कर रहा है तो ऐसी अवस्था में शिक्षक अपने पाठ्यक्रम में वैश्विक प्रयोग को जोड़ कर उन्हें इस वैश्विक गतिविधि में शामिल होने का अवसर दे सकते हैं।

रासायनिकी एक आधारभूत विज्ञान है जिसने मानव के जीवन में महत्वपूर्ण भूमिका निभाई है। रसायन विज्ञान से हमें पृथ्वी और ब्रह्मांड को जानने में भारी मदद मिली है। हम यह भी जानते हैं कि प्रयोग विज्ञान की आत्मा हैं। इसलिए अंतरराष्ट्रीय रसायन विज्ञान वर्ष-2011 के दौरान पानी के रूप में सभी जगह आसानी से उपलब्ध ऐसा रासायन हमारे पास है जिसके द्वारा हम अपनी गतिविधियों के द्वारा रासायन विज्ञान और वैज्ञानिक विधि को आसानी से समझ सकेंगे। इस बारे में ओर अधिक जानकारी के लिए www.water.chemistry 2011.org बेवसाइट देख सकते हैं।

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Nothing is too wonderful to be true, if it be consistent with the laws of nature and in such things as these, experiment is the best test of such consistency.

Michael Faraday

The more we study the work of Faraday with the perspective of time, the more we are impressed by his unrivalled genius as an experimenter and a natural philosopher. When we consider the magnitude and extent of his discoveries and their influence on the progress of science and industry, there is no honour too great to pay to the memory of Michael Faraday - one of the greatest discoverers of all time.

Ernest Rutherford

MICHAEL FARADAY

One of the Greatest Discoverers of All Time

Michael Faraday was born on September 22, 1791 at Newington, Surrey, England. His father James Faraday was a blacksmith who came from Yorkshire in the north of England. His mother Margarate Hastwell was the daughter of a farmer. Early in 1791 Faraday's parents moved to Newington, which was then a village outside London, where Faraday's father hoped that work would be more plentiful.

The Faradays were members of a sect known as the Sandemanian, which originated in the 1730s in a breakaway from the Scottish Presbyterians (having to do with Church of Calvinistic-protestant origin governed by presbyters or elders). The sect never had more than a few hundred followers. In that sense it was an obscure sect. Its members did not try to spread its message. They believed that those who belonged to their community would naturally find a way to them. The sect demanded total faith and total commitment. The members of the sect organised their daily lives through their literal interpretation of the Bible. The followers of this sect considered themselves as the true followers of the Church and consequently they believed that their salvation was assured. This kind of belief made it easier for them to make peace with the hardship of the present day world. They were not interested in worldly goods and wealth. Faraday's religious belief gave him a strict moral code. Faraday was a devout member of the Sandemanian sect. Faraday's scientific world view was deeply influenced by the message of the Bible. Jim Baggott wrote in New Scientist (1991): "Faraday found no conflict between his religious belief and his activities as a scientist and philosopher. He viewed his discoveries of nature's laws as part of the continual process of 'reading the book of nature', no different in principle from the process of reading the Bible to discover God's laws. A strong sense of the unity of God, and nature pervades Faraday's life and work."

Faraday attended a day school and he received only the most basic education - to read, write and count that is the traditional 'three Rs' of reading, (w)riting and (a)rithmatic. Given his family background nothing much could be expected. The Faradays were desperately poor. When Faraday was thirteen years old he had to find work to help the family finances. In 1804 he was employed running errands for George Riebau, a bookseller and bookbinder. Riebau's shop was located in Blandford Street, close to where the Faradays lived. One of Faraday's main duties as an errand boy was to deliver newspapers to those who used to read newspaper on loan basis and fetch them back to the shop. Riebau was a kind employer. After a year as an errand boy Faraday was taken on by Riebau as an apprentice bookbinder. Faraday learned the trade of book binding well as is evident that in later years he bound many volumes for himself and many of them are still in existence. For most of part of this apprenticeship Faraday lived on Riebau's premises. Thanks to the magnanimity of Riebau, Faraday and also his two other fellow apprentices working at the time got the opportunities to develop their own interest. Faraday not only bound books but he also read them. Among the many books that he read during his apprenticeship, two books had great influence in shaping his future scientific career. This is evident from a letter that he wrote to his friend De La Rive. Faraday wrote :

"There were two that especially helped me, the "Encyclopaedia Britannica" from which I gained my first notions of electricity and Mrs. Marcet's "Conversation on Chemistry", which gave me foundation in that science."

During his period of apprenticeship with Riebau he came in contact with the City Philosophical Society, an organization established by a group of young men interested in self-improvement. The Society organised a series of evening lectures on natural philosophy (the modern day equivalent of science). Faraday became a member of this Society in 1812. Membership cost a

The story of Michael Faraday's life is one of the most romantic stories in the annals of science. It will continue to inspire in countless ways. Faraday rose from a book – binder's apprentice to become one of the greatest scientists of all time. He is acknowledged as one of the greatest thinkers of his time. He was a true pioneer of scientific discoveries. His discoveries have had a spectacular effect on successive scientific and technological developments.

shilling. Faraday's subscription was paid by his brother Robert. For two years Faraday attended lectures on a variety of scientific topics. At the Society Faraday made new friends. Among them were Benjamin Abbott and Edward Magrath. With Abbott he carried on extensive correspondence as an exercise in improving his skill at written communication. Magrath helped him in his grammar, spelling and punctuation. Faraday's interaction with Magrath continued for seven years.

Faraday prepared four bound volumes of his notes taken during the meetings of the Society. Faraday's employer Riebau encouraged him in his attempt to study science. In fact Riebau used to show these volumes to his customers. One of Riebau's young customers (some Mr. Dance) was so much impressed with the Faraday's notes that he borrowed these volumes for the purpose of showing them to his father. Apparently the elder Dance was also impressed as evident by the fact that he sent tickets to Faraday to attend lectures given by Humphrey Davy at the Royal Institution. Faraday attended four lectures at the Royal Institution. He was fascinated by the lectures delivered by Davy. He took careful notes which he wrote up, with accompanying drawings of the experiments demonstrated by Davy and bound. Davy's lectures reinforced Faraday's interest in science he spent seven years serving his apprenticeship with Riebau.

Faraday's apprenticeship with Riebau ended on 7 October 1812, a couple of weeks after his 21st birthday. Faraday was desperately trying to get an employment where he could pursue his interest in science. It was not only difficult but looked impossible to change his profession of bookbinding to science. In any case he had no formal education. But Faraday was determined to pursue his interest in science. He wrote to Sir Joseph Banks, the then President of the Royal Society, asking him how he could become involved in scientific work. However, Banks did not bother to reply. In the meantime Faraday started working as a bookbinder for a Mr. De La Roche. Unlike his earlier employer Mr. De La Roche was a difficult master. Without being discouraged by not receiving a reply from Banks Faraday wrote to Humphrey Davy. He also sent him the notes he had taken at Davy's lectures. Davy not only replied to Faraday but also arranged a meeting. However, nothing much happened. Davy advised Faraday to keep working as a bookbinder saying, "Science is a harsh mistress, and in a pecuniary point of view but poorly rewarding those who devote themselves to her service."

But then in February 1813, an incident happened that turned a bookbinder's apprentice into one of the greatest scientists of all time. One Mr. William Payne who was working as laboratory assistant at the Royal Institution got involved in a public brawl. As a result he was dismissed from his job at the Royal Institution. Davy sent for Faraday and offered him the job.

Faraday was offered the job at a guinea (a former English gold coin, last minted in 1813, equal to 21 shillings) a week with accommodation provided in two rooms at the top of the Royal Institution building. Faraday was yearning for such an offer and so he readily accepted the job though the salary was much less than he was earning as bookbinder. In October 1813 Davy planned to undertake a scientific tour of Europe and he invited Faraday to go along with him as his assistant and secretary. For going with Davy on foreign tour Faraday was required to resign his post at the Royal Institution. However, it was guaranteed that Faraday would get back his job on his return to England. Faraday agreed. Before this tour Faraday had never traveled more than 12 miles from the centre of London. During the tour which lasted for 18 months Faraday had also acted as Davy's part-time valet and servant. Mrs. Davy who was a class-conscious woman and believed in keeping servants firmly in their place, treated Faraday badly. Inspite of inconveniences Faraday enjoyed his trip thoroughly. Faraday maintained a journal in which he recorded his experiences. He got the opportunity to meet the key figures of science. While travelling from laboratory to laboratory across Europe, Faraday got the opportunity to perform experiments and attend lectures and in this process he received the education he had never had. By all means the trip had profound influence on Faraday.

On his return to London, in 1815, Faraday was re-engaged at the Royal Institution as an assistant. His duties mainly involved with chemical experiments in the laboratory. He also began lecturing on chemistry topics at the Philosophical Society. He published his first paper in 1816 on caustic lime from Tuscany. It was sent to Davy by the Duchess of Montrose. The paper was published in 'The Quarterly Journal of Science' of the Royal Institution - the precursor of the Proceedings of the Royal Society. As his chemical capabilities increased, he was given more responsibility. In 1825 he replaced the seriously ailing Davy in his duties directing the laboratory at the Royal Institution. In 1833 he was appointed to the Fullerian Professorship

Faraday's contributions to human society have been outstanding. Physicists and chemists alike look back on Faraday as a worthy pioneer. However, he is best known for his contributions in physics to the understanding of electricity and magnetism. Among his many path- breaking discoveries were induced electricity (1831), electrostatic induction (1838), the relationship between electricity and magnetism (1838) and between electricity and gravity(1851), hydro-electricity (1843) and atmospheric magnetism (1851). Faraday became one of the greatest scientists of all time because of his interest in science, his strong motivation and his remarkable perseverance.

of Chemistry – a special Chair created for him.

Faraday made numerous discoveries both in chemistry and physics. His research work was of highly technical nature. To understand his discoveries satisfactorily one would require a detailed knowledge of chemistry and physics. Among the most important discoveries of Faraday were discovery of benzene, magneto-electric induction, laws of electro-chemical decomposition, the magnetization of light and diamagnetism.

Faraday's early career was notable for its chemical research. His only original book Chemical Manipulation appeared in 1827. He made new chemical compounds. In 1822 he made the first steel alloy. In 1823, Faraday was the first to liquefy a gas, chlorine. In 1825 he discovered benzene (C6H6) while examining the residue collecting in cylinders of illuminating gas. He called the new compound 'bicarburet of hydrogen because he took its formula to be C2H. It was Faraday who synthesised the first chlorocarbons. Faraday was one of the best chemical analysts of his time.

Although Faraday began his scientific career as a chemist, he also became intrigued by the nature of electricity and magnetism which began to be recognized as different aspects of a single phenomenon at the beginning of the 1820s. His life's major work was the series of Experimental Researches on Electricity published over 40 years in Philosophical Transactions in which he announced his many discoveries including electromagnetic induction (1831), the laws of electrolysis (1833), and the rotation of polarised light by magnet (1845).

In 1820 Hans Christian Oersted (1777-1851) had discovered the first link between electricity and magnetism. Oersted found that when a magnetic compass is held near a wire that carries an electric current the needle of the compass (which is a tiny bar magnet) is always deflected to a point at right angles to the wire. The experiment implied that an electric current produces a magnetic force that influences the compass needle.

When Faraday read of Oersted's experiment he like other members of the scientific community became very excited and decided to investigate it on his own. In September 1821 Faraday demonstrated "electromagnetic rotation" by showing that a current-carrying wire could be made to rotate around a fixed magnet. This was the first primitive electric motor. Sixty years after of Faraday's demonstration electric trains were running in Germany, UK and the USA.

Unfortunately this experiment triggered off a rift between Faraday and his mentor Davy that was never healed. Davy thought that Faraday had overheard a discussion between Davy and William Hyde Wollaston (1766-1828). Faraday admitted that he may have gotten a start from the discussion between Davy and Wollaston but his apparatus was substantially different and the effect demonstrated by Faraday was completely different from the effect predicted by Wollaston. History has put its stamp on the originality of Faraday.

After discovering the electromagnetic rotation Faraday wanted to convert magnetism into electricity that is the reverse of what Oersted did–electricity was converted into magnetism. In 1831 Faraday demonstrated that when a magnet is moved past a wire, or pushed into the mount of coil of wire while the magnet is moving it creates an electric current in the wire. This discovery formed the basis of the electricity generator or dynamo, in which electricity is produced by rotating magnets that move swiftly past coils of wire. Faraday found that by combining mechanical motion with magnetism he could produce electric current. He detected the presence of electric current when he moved the coil of wire over the magnet but when he let the magnet just sit motionless inside the coil of wire there was no electric current. This was the principle of electromagnetic induction or the basic principle of electric generator or dynamo. Joseph Henry (1797-1878), an American physicist, had also come up with an excellent demonstration of this idea. However, he never published it. On the other hand, Faraday pursued his work with extraordinary single-mindedness and got the credit for its discovery. Henry had accepted Faraday's originality.

It is said that the then British Prime Minister Sir Robert Peel (1788-1850) after seeing a demonstration of the dynamo effect asked Faraday what use the discovery was. Faraday replied, "I know not, but I wager that one day your government will tax it." Faraday himself did not try to develop the practical applications of his discoveries.

Rather he became deeply interested in understanding how electricity and magnetism are related to each other.

He was a great builder of instruments. Faraday was a great populariser of science. He initiated popular science lectures for children and general audiences at the Royal Institution. Faraday was one of the greatest lecturers of his time. His Christmas lectures for the children at the Royal Institution became legendary. These lectures, Faraday intended, to 'amuse and entertain as well as educate, edify and above all, inspire.'

It was Faraday who showed that the various types of electricity – static, voltaic, animal and thermoelectric – were the same.

Faraday's work on electrolysis had far reaching implication. In 1934, he formulated his famous laws of electrolysis which govern all that happen in electrochemical technology and industry.

Faraday's pioneering research in electrochemistry created the necessity of coining some appropriate terms to describe his work. With the help of his friend Whewell Faraday coined a number of terms which are being commonly used till date: anode (from the Greek ana for 'up' and hodos for 'road', cathode (from the Greek, Kata for 'down'), ion (for 'wanderer' in Greek) and consequently anion or cation. He also coined the terms `electrolyte' and `electrode'.

It was Faraday who created the notion of a 'field' to describe electrical and magnetic forces. Since his childhood Faraday had a profound belief in the inter- connection and unity of natural forces and phenomena. Faraday's belief in the fundamental unity of nature was vindicated by subsequent works of James Prescott Joule (1818-89), Joseph John Thomson (1856-1940), Harmann Ludwig Ferdinand von Helmholtz (1821-94), Rudolf Julius Emmanuel Clausius (1822-88) and James Clerk Maxwell (1831-79).

Faraday was honoured in his home country with commemorative postage stamp

In spite of the technical nature of his research work Faraday was remarkably gifted as an expounder of science to popular audience. Faraday introduced a series of Friday Evening Meetings under the aegis of the Royal Institution. These evening meetings grew into an institution in their own rights, the Friday Evening Discourses. These Discourses reported the latest developments in science to a general audience, who were required to pay a certain fee for attending the discourses. Faraday often turned out to be the speaker in those discourses. Between 1825 and 1862, when he retired, Faraday gave more than a hundred of the Friday lectures. The tradition continues to this day.

In 1826 Faraday started the famous lecture course at the Royal Institution — a series of six Christmas lectures for children. He gave 19 of these lectures courses. For most of these lectures only the notes exist except a couple of lecture courses namely "The Chemical History of a Candle" and "Lectures on Various Forces of Matter" were taken down in short hand and later published. They have become classics. Together, the Friday Evening Discourses and the Christmas lectures have introduced generation of people to the wonder of science. Faraday was not a born lecturer. He assiduously prepared to make himself one of the great lecturers of all time.

Throughout his life Faraday worked at the Royal Institution. Faraday felt indebted to the Institution. In fact without Faraday the Royal Institution would not have survived. He made every effort to earn money for the Institution's survival. For his gratitude to the Institution he did not accept the offer from the University of London of the Chair of Chemistry in 1827.

Faraday died on 25 August 1867. Following his wishes he was buried quietly in Highgate cemetery. His grave is not far from that of Karl Marx. Faraday's headstone bears the following non-descript inscription.

MICHAEL FARADAY Born 22 September 1791 Died 25 August 1867.

On the occasion of the bicentennial anniversary (1991) of birth, Faraday was honoured in his home country with commemorative postage stamp and a special first-day cover. His portrait and signature replaced William Shakespeare on 20 pounds note. A special memorial service was held in Westminster Abbey.

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This is the abridged version of article by Dr S. Mahanti appeared in the May, 2002 issue of 'Dream 2047'.

Cosmetics - Connection with Toxic Chemicals

We are on a quest to smell good, look better, moist skin and have shiny hair, that is why most people use cosmetic products on a daily basis. Unfortunately this short-term look is not worthy as something harmful to our body is hidden beneath these sweet perfumes and cosmetic products. Some cosmetic products contain ingredients that not only accelerate the aging process by damaging skin which sometime cause cancer also.

The list of such ingredients is endless; in fact there are more than 800 chemicals in beauty products, many of there are highly toxic. Some of them are listed below.

Mineral oil, like petroleum it is a crude oil product and commonly used in baby oils. It coats the skin and clogs the pores. The skin's natural immune barrier is disrupted by the coating of mineral oil, because of which, the skin cannot breathe and absorb the moisture and nutrition. The skin's ability to release toxins is also impeded by this coating.

Collagen, a naturally occurring protein found in the flesh and connective tissues of mammals, is used in moisturizers. Similar to mineral oil, it also clogs pores. When used cosmetically, there is a chance of allergic reactions causing prolonged redness.

Alpha-Hydroxy Acid (AHA) is mostly found in cleansers, moisturizers, eye creams, sunscreens, and foundations. It is also found in anti wrinkle creams. It is so powerful abrasive that can damage the outer layer of the skin and more vulnerable to UV rays. Some of its side-effects are mild skin irritations, redness and flaking. However, the severity depends on the concentration and the pH value of the acid used. If the concentrations of these acids are up to 50% or higher, then AHA can damage the skin. It has been observed that glycolic and lactic acids are safe in cosmetic products with concentrations less than 10%, and pH level more than 3.5.

Natural Alpha-Hydroxy Acids	Extracted From
Citric Acid	Citrus Fruits
Glycolic Acid	Sugar Cane
Lactic Acid	Milk
Malic Acid	Apples
Mandelic Acid	Bitter Almonds
Tartaric Acid	Grapes

Surfactant can be found in about 90% of foaming personal care products, hair conditioners and detergents.

It reduces the surface tension of water by adsorbing at the liquid-gas interface; it also reduces the interfacial tension between oil and water by adsorbing at the liquid-liquid interface.

Common Surfactants used in Cosmetic Products
Ammonium Laureth Sulfate (ALES)
Ammonium Lauryl Sulfate (ALS)
Benzalkonium Chloride
Cetalkonium Chloride
Cetrimonium Chloride
Disodium Dioctyl Sulfosuccinate
Disodium Laureth Sulfosuccinate
Disodium Oleamide Sulfosuccinate
Lauryl or Cocoyl Sarcosine
Lauryl Dimonium Hydrolysed Collagen
Potassium Coco Hydrolysed Collagen
Sodium Cocoyl Sarcosinate
Sodium Laureth Sulfate (SLES)
Sodium Lauroyl Sarcosinate
Sodium Lauryl Sulfate (SLS)
Sodium Methyl Cocoyl Taurate
Stearalkonium Chloride
TEA (Triethanolamine) Laureth Sulfate
TEA (Triethanolamine) Lauryl Sulfate

Sodium Lauryl Sulfate (SLS), also known as Sodium Dodecyl Sulfate (C12H25SO4Na), is a common surfactant found in the cosmetic products even in toothpastes also. It is also found in automobile de-greasing solutions and in floor cleaners. It is the most dangerous of all ingredients in cosmetic products. It penetrates eyes and tissues and changes the amounts of some proteins in cells. SLS when combined with other chemicals can be transformed into nitrosamines, which causes the body to absorb nitrates at higher levels than eating nitrate-contaminated food. When SLS is used in shampoos and cleansers containing nitrogen-based ingredients, it can form nitrates, which can enter the blood stream in large quantity. These nitrates may cause eye irritations, skin rashes, hair loss, scalp scurf similar to dandruff, and allergic reactions.

According to a toxicology report, SLS on stays in the body up to five days. It is chemical that it can dry out the skin. It penetrates the skin very easily and once inside the body, it deposited in the heart, liver, lungs and brain. It may also cause cancer when mixed with some other common beauty product ingredients.

Propylene Glycol, also known as 1,2-Propanediol (C3H8O2), is used as a moisturizer in shampoos, hair care products, lotions, after-shaves, deodorants, conditioners, toners, mouthwashes and toothpastes. It is also used in fragrance oils and massage oils. Its vapors may cause headaches, flushing, dizziness, mental depression, nausea and vomiting. It is too toxic that it may damage brain, liver and kidney.

Polyethylene Glycol (PEG) is commonly used in making cleansers to dissolve oil and grease. PEG is used to strip the natural moisture factor and makes the immune system vulnerable. Being highly toxic, it may cause cancer.

Body washes, shampoos, soaps and facial cleansers also contain some hormone disrupting chemicals such as DEA (Diethanolamine), MEA (Monoethanolamine or Ethanolamine) and TEA (Triethanolamine). These chemicals can form cancer-causing nitrates and nitrosamines. According to some scientific reports, DEA and MEA are readily absorbed in the skin and repeated use of DEA-based detergents may cause cancer of liver and kidney.

Paraben is found in shampoos, moisturizers, shaving gels, spray tanning solutions and toothpastes as a preservative. There are four main parabens in use: Methylparaben, Ethylparaben, Propylparaben and Butylparaben. Though, for a normal skin, paraben is non-irritating and non-sensitizing but some times it may be a cause of skin irritations. According to recent studies paraben has been found in extremely low concentrations in breast cancer tumors, which may came from something applied to the skin, such as an underarm deodorant, cream or body spray.

Some cosmetics and hair care products, particularly hair conditioners contain Stearalkonium Chloride (C27H50ClN). At higher concentrations, it causes allergic reactions.

Triclosan (C12H7Cl3O2) is found in soaps, deodorants, toothpastes, shaving creams, mouth washes and cleaning supplies. Use of triclosan in cosmetics has also been suspected as it has been registered as a pesticide. The chemical formulation and molecular structure of this compound are similar to some of the most toxic chemicals and relating it to Dioxins. Triclosan is a chlorophenol, which is suspected as a cause of cancer.

Formalin or Formaldehyde (CH2O) is found in several bath products and nail polishes. It is commonly used to preserve dead bodies. Solutions of formaldehyde in water were formerly used in hospitals, dental surgeries, kitchens, and bathrooms to kill infectious organisms and for preservation of biological specimens. Being a skin irritant, it may cause skin allergy. It is highly toxic to humans. For example, an intake of aquas solution of formaldehyde can cause severe injury to upper gastrointestinal tract, and even death. Fumes from formalin may cause cancer, also.

Formalin is unsafe for use by asthmatic people.

Apart from formalin, toluene is also used in nail polishes. It is a mono-substituted benzene derivative. Inhaling low levels of toluene may cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite and color vision loss. Though, these symptoms usually disappear when exposure is stopped. On the other hand, inhaling high levels of toluene in a short time may cause light-headedness, nausea, or sleepiness. It may also cause unconsciousness, and even death.

Another harmful chemical Dibutyl Phthalate (C16H22O4), also known as DPB, is most commonly found in nail polishes. DPB interferes with hormone system that may cause cancerous tumors, birth defects, and other developmental disorders.

Long eyelashes are considered a sign of femininity, due to which some women use mascaras to enhance their eyelash length artificially. Lacquer or clear varnish is often found in mascaras. Excessive use of this chemical can cause the loss of eye lashes.

Siloxane is found in lipsticks. It is a compound of silicon, oxygen, and alkane. In addition to being added to lipsticks, the siloxane is also found in body lotion, deodorants and hair care products. D4 and D5 siloxanes may cause uterine tumors and reproductive damages.

Types of Siloxanes	IUPAC Name
D3 Siloxane	Hexamethylcyclotrisiloxane
D4 Siloxane	Octamethylcyclotetrasiloxane
D5 Siloxane	Decamethylcyclopentasiloxane
D6 Siloxane	Dodecamethylcyclohexasiloxane

Most of the waterproof cosmetics have a special form of silicone-based oil called dimethicone copolyol. Though, the waterproof cosmetics are very convenient for women because such type of cosmetics keep their make-up looking fresh and clean. But, most of the waterproof cosmetics require special solvents for removal. These solvents are usually quite harsh and also remove the oily substance present in the skin. Such solvents may be a cause for tumor.

Many colour dyes are used to give make up items their colour. These synthetic colours are made from coal tar and on a cosmetic product, they appear as FD&C, or D&C followed by number and colour. These synthetic colours are found in lip glosses, nail polishes, bath oils, body sprays, moisturizers and lipsticks. Repeated use of the colour dyes or the products containing them can cause skin irritations, which is due to the depletion of oxygen in the body.

Most of the popular perfumes, colognes and body sprays are marketed with terms like “floral,” “exotic,” or “musky,” but these are actually a complex combination of natural essences and synthetic chemicals and commonly called fragrances. A fragrance may have up to 4,000 separate ingredients and most of them are synthetic. It is present in most of the deodorants, shampoos and sunscreens. It is also found in skin-care, body-care and baby-care products. Exposure to fragrances can affect the central nervous system, causing depression, hyperactivity, headache, faintness, violent coughing and vomiting, rashes, asthma and asthmatic exacerbation, skin discoloration, and allergic skin irritation. Some fragrances also have a tendency to accumulate in human tissues.

People using perfume, cologne, body spray, aftershave and other scented cosmetics are unknowingly exposed to such toxic chemicals that may increase the risk for certain health problems.

Hormone-disrupting Chemicals in Perfumes, Colognes and Body Sprays
Benzyl Benzoate
Benzyl Salicylate
Tonalide
Benzophenone-1
Benzophenone-2
Butylated Hydroxytoluene (BHT)
Diethyl Phthalate (DEP)
Galaxolide
Lilial (Butylphenyl Methylpropional)
Musk Ketone
Oxybenzone (Benzophenone-3)
Octinoxate (Octyl Methoxycinnamate)

Diethyl Phthalate (C12H14O4), also known as DEP, is found in most of the fragrances and linked to sperm damage in human. Fregrant use of fragrances and other cosmetics by a pregnant woman may expose her growing fetus to DEP that may cause abnormal development of reproductive organs in baby boys.

Musk is also found in fragrances, which concentrates in human fat tissue and breast milk. Synthetic musk fragrance accumulates in our bodies and may cause hormone disruption. Musk comes in two types: nitro musk and polycyclic musk.

Nitro Musks	Polycyclic Musks
Musk Ambrette	Celestolide (Crysolide)
Musk Baur or Tonquinol	Galaxolide (HHCB)
Musk Ketone	Phantolide
Musk Xylene	Tonalide (Musk Plus, AHTN)
Moskene	Traesolide

Nitro musks may cause skin irritations, sensitization, and even cancer. High levels of exposure, it may also cause reproductive and fertility problems in the women. However, both polycyclic musks and nitromusks may affect hormone systems.

Use of Musk Xylene in various domestic products

Product	Mass Fraction (%)
Cologne	0.075
Air Freshener	0.07
Soap	0.04
Aftershave	0.03
Detergents	0.02
Shampoo	0.01
Skin Cream	0.0075
Deodorant	0.0075

Sources: European Union Risk Assessment Report (2005)

Many chemicals from cosmetics products, when sprayed or applied on the skin, are either inhaled or absorbed through the skin. Knowing or unknowing we accumulate chemicals accumulate several chemical in our body. To minimise many of the risks we can use more natural or organic products.

Natural cosmetics are based on natural ingredients obtained from plants, animals and natural sources. Whereas, organic products are those which use plants and herbs grown organically. Some commonly used natural ingredients are yoghurt, honey, oatmeal, chamomile, jojoba, rose hip seed oil, hemp oil, tea tree oil, coconut oil, carrot seed oil, aloe vera, cocoa butter, shea butter, milk, milk cream, beeswax, mud, raw minerals, pigments, eggs, turmeric, saffron, lemon and fruits. Unlike chemical based cosmetics, natural or organic cosmetics do not interfere with the body's absorption of vitamin D and also help in repairing of skin tissues and cells.

Next time when you buy a cosmetic product, you must ensure that the products are organic or natural. Remember that the products containing the harmful ingredients are dangerous to our bodies. Even if you are absolutely fine well, chances are, you won't be so for long if you continue to use the products containing toxic ingredients.

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NOTE :-

The date for sending the nomination form Regional Workshop for VIPNET Clubs has been extend upto November, 2011. The detail of workshops and nomination form are given below.

(For more detail kindly see VIPNET News of the June & August 2011 issue.)

References:

1. Are Toxic Chemicals In Your Cosmetic Products? (www.make-up-cosmetics.com)
2. Digging for the Real Truth in Cosmetic Labeling (www.naturalingredient.org)
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6. Putting on a Good Face – the Chemistry of Cosmetics (www.science.org.au)
7. Skin Care Product Labels – Natural Vs. Toxic Chemicals (www.dermanesse.com)
8. Sodium Lauryl Sulfate (www.Healthy-Communications.com)
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11. The Health Risks of Secret Chemicals in Fragrance by the Campaign for Safe Cosmetics (www.safecosmetics.org)
12. Three Dangerous Ingredients to Avoid in Skincare Products (www.huffingtonpost.com)
13. Toxic Chemicals in Cosmetics - Ingredient Directory (www.hallgold.com)
14. The New Toxic Threats to Women's Health (www.Glamour.com)
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18. www.cidpusa.orgtoxic_chemicals_in_cosmetics.htm
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20. www.wikipedia.com

If you want to know more about Vigyan Prasar, its publications & software, besides the next moves of VIPNET Science Clubs, please write to us at the address given below:-

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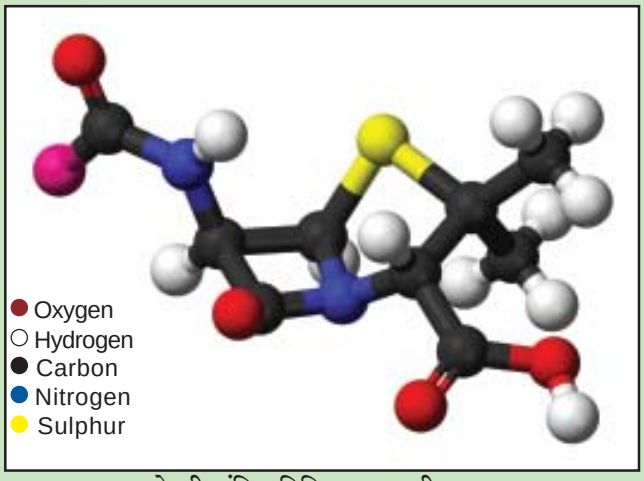
चित्र पहेली- 64 / Photo Quiz - 64

This year the photo quiz will be based on chemistry as part of IYC 2011

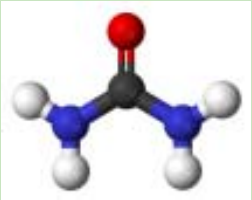
- Identify the Structural model of a Molecule given in the picture? This mulecule was the first group of antibiotics that were effective against many previously untreatable diseases such as syphilis. The chemical structure of this molecule was determined by Britist Chemist Dorothy Crowfoot Hodgkin in 1945.

- चित्र में दिये गए एक अणु की संरचना के मॉडल को पहचानिए? यह प्रथम जीवाणुरोधी समूह का अत्यंत प्रभावशाली पदार्थ है विशेष रूप से सिफलिस हेतु। इस रसायन की संरचना की खोज ब्रिटिश वैज्ञानिक डोर्थी क्रोफुट हॉकिन ने 1945 में की थी।



- उत्तर प्राप्त करने की अंतिम तिथिः 15 जनवरी, 2012
- ड्रॉ द्वारा चयनित विजेताओं को पुरस्कार स्वरूप विज्ञान प्रसार के प्रकाशन भेजे जाएँगे।
- अपने जवाब इस पते पर भेजें : विपनेट चित्र पहेली - 64, विज्ञान प्रसार, ए-50, सेक्टर 62, नोएडा-201 309 (उत्तर प्रदेश)
  VIPNET Photo Quiz , 64, VIGYAN, PRASAR, A-50, Sec. 62, Noida-201 309 (U.P.)

Correct Answer of Photo Quiz 59



Urea, a substance commonly found in urine, was the first organic substance to be synthesised from inorganic salts that disproved the theory of vitalism, which related organic compounds only to living beings. In 1828, the German chemist Friedrich Wohler obtained urea by treating silver isocyanate with ammounium chloride. The results of this experiment showed that there was no need for a mysterious vital force supposedly present in living organisms to generate organic compounds. This insight was a turning point in the development of organic chemistry.

NAME OF THE WINNERS: -

Amit Verma (Kheri, U.P.),
Rajni Bhatia (Mumbai)

Chemical Terminology Puzzle 18

J	B	C	P	C	Y	Y	D	P	C	C	C	B	E	J	D
O	D	D	E	F	E	R	T	C	F	X	S	E	R	O	D
S	S	D	F	E	R	G	R	R	T	R	T	Y	D	H	S
E	E	L	R	D	A	L	T	O	N	E	R	R	T	N	M
P	R	R	E	R	V	D	S	Y	R	E	T	R	E	W	E
H	E	U	R	T	O	Y	U	M	G	T	Y	F	G	E	N
P	R	C	T	Y	G	R	T	Y	Y	U	T	T	R	S	D
R	R	T	T	Y	A	R	T	Y	U	R	T	E	R	L	E
I	R	R	T	T	D	Y	U	G	Y	U	T	R	E	E	L
E	R	E	T	Y	R	E	R	H	H	F	T	R	E	Y	E
S	E	B	R	T	O	R	T	Y	U	H	F	G	R	H	Y
T	D	O	D	F	A	R	A	D	A	Y	R	G	G	Y	E
L	G	R	O	B	E	R	T	B	U	N	S	E	N	A	V
E	D	D	F	G	H	J	K	P	F	E	R	D	F	T	R
Y	D	F	G	H	T	E	R	Y	G	H	T	Y	H	T	H
F	R	I	E	D	R	I	C	H	W	O	E	H	L	E	R

Clue

1. A English theologian usually credited with the discovery of oxygen, having isolated it in its gaseous state
2. English chemist, best known for his pioneering work in the development of modern atomic theory.
3. An Italian chemist and physicist, most noted for his contributions to the theory of molarity and molecular weight.
4. A German chemist, best known for the synthesis of urea.
5. A Russian, best known for his work on the periodic table.
6. A German chemist, *best known for* his invention of the Bunsen burner.
7. A person mainly known for simplifying the production of celluloid, the first industrial plastic.
8. He was awarded the Nobel Prize in Chemistry in 1996 for the discovery of fullerene (with the late Richard Smalley and Harold Krot).
9. An English chemist famous for significant contributions to the fields of electromagnetism and electrochemistry
10. The founder of the Indian School of modern chemistry and pioneer of chemical industries in India.

❑ R. K. Yadav
rky@vigyanprasar.gov.in

- Last date of receiving correct entries: 15 Jan., 2012.
- Winners will get activity kit/ books as a prize.

Please send your entries to:-

Chemicals Terminology Puzzle-18, VIPNET News, Vigyan Prasar, A-50, Sector 62, Noida-201 309 (U.P.)

The puzzle has been Designed as part of International Year of Chemistry-2011

House Hold Chemicals Puzzle- 14

Name of the winners:

1- M. Muthusamy (Chennai)

2- Jyoti Bhatia (Mumbai)

3- Aishna

Club speak

पार्थेनियम उन्मूलन कार्यक्रम

रिसेप्टिव एसेंशियल साइंटिफिक एजूकशेन एड्वांसमेंट रिसर्च कमेटी फॉर ह्यूमनिटी (रिसर्च), शाहजहांपुर, उत्तरप्रदेश ने अगस्त माह में विभिन्न विद्यालयों में पार्थेनियम यानी गाजरघास उन्मूलन कार्यक्रम चलाया। इस अवसर पर संस्था ने जनमानस में गाजरघास के बारे में जागरूकता का प्रसार किया और इसके कुप्रभावों से सबको अवगत कराया। ध्यान रहे गाजरघास एक ऐसी खरपतवार प्रजाति है जो बहुत तेजी से फैलती हुई अन्य वनस्पतियों का स्थान हथिया लेती है। इसके संपर्क में आने पर त्वचा संबंधी बीमारियां फैल सकती हैं।

वृक्षारोपण अभियान

यूनिवर्सल साइंस क्लब, पोखरा, उत्तरप्रदेश ने जूलाई माह में 'वृक्ष लगाओ पर्यावरण सुखद बनाओ' अभियान चलाया। इस अभियान के माध्यम से क्लब सदस्यों ने गांव में पर्यावरण की सुन्दरता और खुशहाली के लिए वृक्षों के महत्व के साथ ही औषधीय पौधों के बारे में जागरूकता का प्रसार किया।

परिचर्चा

अन्वेषण विपनेट क्लब, हजारीबाग, झारखण्ड ने 5 अगस्त को डीएवी स्कूल में पर्यावरण विषय पर एक दिवसीय परिचर्चा कार्यक्रम आयोजित किया गया। इस अवसर पर विद्यार्थियों को जैव विविधता संरक्षण के साथ ही वृक्षारोपण की महत्ता को समझाया गया। इस अवसर पर ब्रिटेन से आयी रिसर्च स्कॉलर लिड़िया ने भी अपने विचार रखे।

Science Exhibition

Angel Metric Higher Secondary School, Thiruninravur, Tamilnadu organised Science exhibition on 20th August, 2011.

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