Presenting Abstract Ideas in Science and Mathematical Knowledge:

BITM, Kolkata

- A Case Study

Diptangshu Barman

Department of Mathematics, PG 4th Semester

Mugberia Gangadhar Mahavidyalaya, Purba Medinipur, West Bengal

FIELD VISIT IN BITM

(A Case Study)

Date 16th to 17th May 2023

On May 16, 2023, a group of 31 students from the Department of Mathematics (UG & PG) at Mugberia Gangadhar Mahavidyalaya embarked on a field visit to BITM (Birla Industrial and Technological Museum). The visit was organized and led by Dr. Kalipada Maity, Dr. Manoranjan De, Mr. Suman Giri, and Mr. Goutam Mondal, who are faculty members of the Department of Mathematics (UG & PG).

This visit was organized with the aim of providing the students with practical knowledge and hands-on experience in the fields of Science and Mathematical modeling. The alternative location chosen for the visit offered opportunities for the students to explore and gain insights into the practical application of scientific principles and mathematical modeling techniques. The visit aimed to enhance their understanding of these subjects by allowing them to observe real-world examples and engage in interactive learning experiences.

https://twitter.com/Swapank26545954/status/1660683948966682624?t=hnkKS8qe_Lv0pWExw-GMKw&s=08

https://twitter.com/Swapank26545954/status/1660684820450803713?t=nIXpnSP-XF70Aa_NrNm9SA&s=08

The report of Case Study is prepared by Diptangshu Barman, PG 4th Sem Student under the leadership of Dr. Kalipada Maity, HOD & Associate professor & Dr. Manoranjan De, Assistant Professor, Dept of Mathematics, Mugberia Gangadhar Mahavidyalaya, West Bengal, India.

MUGBERIA GANGADHAR MAHAVIDYALAYA

P.O.—BHUPATINAGAR, Dist.—PURBA MEDINIPUR, PIN.—721425, WEST BENGAL, INDIA
NAAC Re-Accredited B+Level Govt. aided College
CPE (Under UGC XII Plan) & NCTE Approved Institutions
DBT Star College Scheme Award Recipient
E-mail : mugberia_college@rediffmail.com // www.mugberiagangadharmahavidyalaya.ac.in

To

Director

Birla Industrial and Technological Museum

Kolkata – 700 032, BITM

E-Mail: director@bitm.gov.in

9477345291, 9477345292

Sir,

I take this opportunity to inform you that the Mathematics Department of the college is going to organize an Field Visit as University Curricula to "**Birla Industrial and Technological Museum**" under the leadership of Dr. Kalipada Maity, Head of the Dept & Associate Professor in Mathematics, Dr. Manoranjan De, Suman Kumar Giri, Goutam Mondal with a batch of 36 candidates including students 32 (Male-22, Female - 10) and four 4 Teachers (Male-04). This field visit has been organized for the purpose of procuring knowledge about understands the practical use of the optimization in Operational Research.

I shall deem it a great favor if the authority extends all co-operation to the team for helping us to guide through yours museum on 16th May.

Thanking you,

Yours faithfully,

16.05.23

Dr. Swapan Kumar Misra
Principal
Mugberia Gangadhar Mahavidyalaya

Principal
Mugberia Gangadhar Mahavidyalaya

MUGBERIA GANGADHAR MAHAVIDYALAYA

P.O.—BHUPATINAGAR, Dist.—PURBA MEDINIPUR, PIN.—721425, WEST BENGAL, INDIA
NAAC Re-Accredited B+Level Govt. aided College
CPE (Under UGC XII Plan) & NCTE Approved Institutions
DBT Star College Scheme Award Recipient
E-mail : mugberia_college@rediffmail.com // www.mugberiagangadharmahavidyalaya.ac.in

Sl. No.	Name of Student	Phone Number	Class	Gender
1	Amiya Mondal	9641316475	M.Sc , (iv) sem	Male
2	Biren Pahari	70010 04864	M.Sc , (iv) sem	Male
3	BiswajitMondal	74778 62130	M.Sc , (iv) sem	Male
4	Buddhadev Jana	83488 17764	M.Sc , (iv) sem	Male
5	Debebrata Patra	78721 58242	M.Sc , (iv) sem	Male
6	Debajyoti Maity	62946 72428	M.Sc , (iv) sem	Male
7	Diptangshu Barman	70634 48225	M.Sc , (iv) sem	Male
8	Goutam Jana	81013 43306	M.Sc , (iv) sem	Male
9	Krishnendu Pradhan	70633 66703	M.Sc , (iv) sem	Male
10	Poushali Tripathy	81676 75264	M.Sc , (iv) sem	Female
11	Pradyot Dalapati	93825 50960	M.Sc , (iv) sem	Male
12	Priti Das Adhikari	70016 67579	M.Sc , (iv) sem	Female
13	Puspendu Sau	85978 43426	M.Sc , (iv) sem	Male
14	Raja Kumar Shee	83728 03501	M.Sc , (iv) sem	Male
15	Saikat Jana	73195 95903	M.Sc , (iv) sem	Male
16	Sanchayan Laha	74774 45879	M.Sc , (iv) sem	Male
17	Shrabani Jana	83378 06535	M.Sc , (iv) sem	Female
18	SnehasishBhowmik	74778 21116	M.Sc , (iv) sem	Male
19	Snigdha Mandal	6296 475 478	M.Sc , (iv) sem	Female
20	Sreya Jana	95470 21871	M.Sc , (iv) sem	Female
21	Subhadip Mandal	95478 20884	M.Sc , (iv) sem	Male
22	Subhamay Das	90644 97211	M.Sc , (iv) sem	Male
23	Subinoy Patra	96099 54267	M.Sc , (iv) sem	Male
24	Suchismita Pradhan	98834 85133	M.Sc , (iv) sem	Female
25	Sudeshna Maity	70449 66107	M.Sc , (iv) sem	Female
26	Susmita Sahoo	95647 38592	M.Sc , (iv) sem	Female
27	Tapasi Karan	70294 27873	M.Sc , (iv) sem	Female
28	Saheb Bera	62957 59471	M.Sc , (iv) sem	Male
29	Sayan Das	70018 84676	M.Sc , (iv) sem	Male
30	Soumya Kanti Mandal	93828 17045	M.Sc , (iv) sem	Male
31	Sumana Maity	70292 79862	M.Sc , (iv) sem	Female
32	Manoj Maity	70032 23834	M.Sc , (ii) sem	Male

Sl.	Name of Faculty	Gender	Mobile Number
1.	Dr. Kalipada Maity	Male	98836 02108
2.	Dr. Manoranjan De	Male	93822 92498
3.	Sri Suman Kumar Giri	Male	95640 67646
4.	Goutam Mondal	Male	96477 82841

16.05.23
Principal
Mugberia Gangadhar Mahavidyalaya

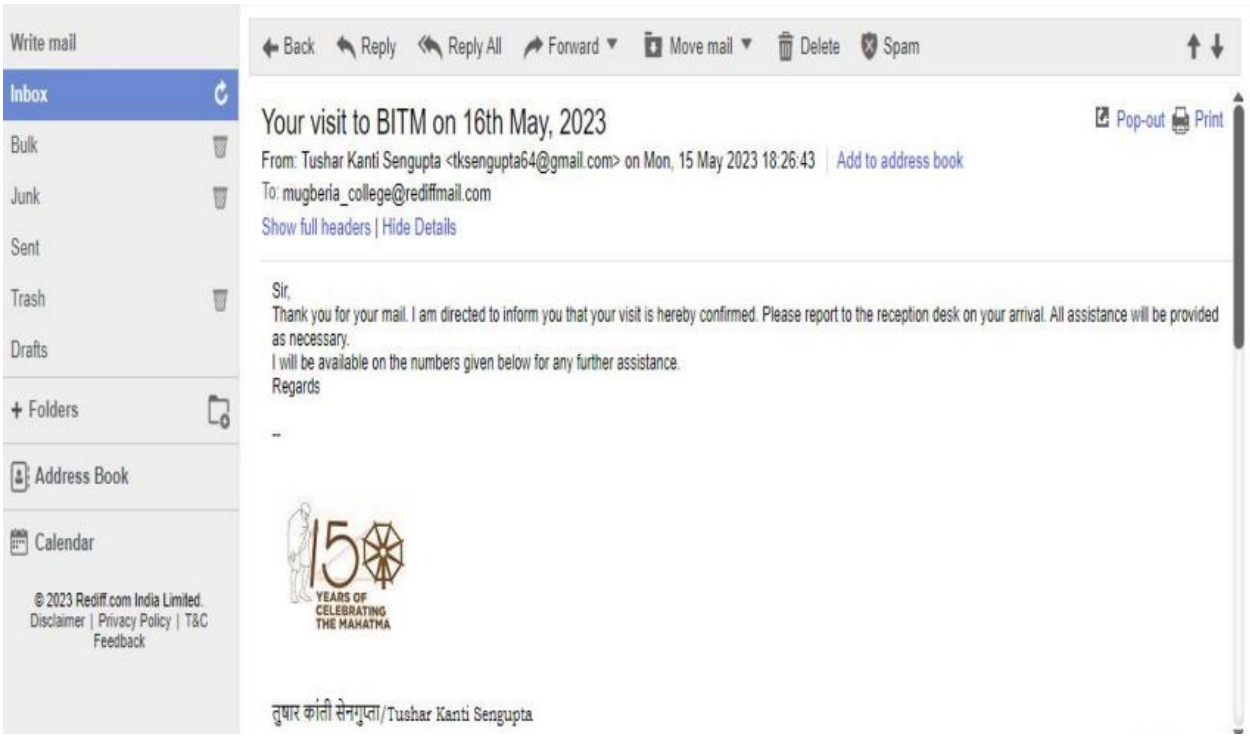

Write mail
Inbox
Bulk
Junk
Sent
Trash
Drafts
+ Folders
Address Book
Calendar
© 2023 Rediff.com India Limited.
Disclaimer | Privacy Policy | T&C
Feedback
Back
Reply
Reply All
Forward
Move mail
Delete
Spam
Your visit to BITM on 16th May, 2023
Pop-out
Print
From: Tushar Kanti Sengupta <tksengupta64@gmail.com> on Mon, 15 May 2023 18:26:43
Add to address book
To: mugberia_college@rediffmail.com
Show full headers | Hide Details
Sir,
Thank you for your mail. I am directed to inform you that your visit is hereby confirmed. Please report to the reception desk on your arrival. All assistance will be provided as necessary.
I will be available on the numbers given below for any further assistance.
Regards
--
150
YEARS OF
CELEBRATING
THE MAHATMA
तुषार कांती सेनगुप्ता/Tushar Kanti Sengupta

Table of Content

ABSTRACT: **7**

INTRODUCTION: **7**

HISTORICAL BACKGROUND: **9**

GEOGRAPHICAL LOCATION: **11**

HISTORY OF THE BITM BUILDING: **11**

DIRECTOR LIST: **12**

GALLERIES: **12**

VINTAGE VOYAGE: COMMUNICATION TECHNOLOGY: 13
DIGITAL ADVENTURE GALLERY: 13
FASCINATING PHYSICS: 14
TRANSPORT: 14
MOTIVE POWER: 15
BIOTECHNOLOGY: 16
MATHEMATICS GALLERY: 16
Unveiling the Wonders of the Mathematics Gallery: *17*
Numbers and Number Systems: 17
Series and Progression: 19
Concepts in Geometry and Algebra: 21
Spherical Geometry: 25
Mathematical Function: 26
Concepts of Calculus: Differentiation & Integration: 27
Law of Average: 29
Maxima – Minima: Application of Differentiation: 29
Mathematical Activities: 31
METALS: 34
POPULAR SCIENCE: 34
ELECTRICITY: 35
TELEVISION: 37
UNDERGROUND MOCK-UP COAL MINE: 38

VISITORS STATISTICS: **39**

REFERENCES ..... ERROR! BOOKMARK NOT DEFINED.

Abstract:

Birla Industrial & Technological Museum (BITM) in Kolkata, the first science museum in thecountry under the National Council of Science Museums (NCSM), Ministry of Culture, Govt. of India, is engaged in popularizing and promoting science especially among the youth through various interactive models, exhibitions, educational programs and activities throughout the year.
BITM facilities are specifically designed to augment the learning curves of the students not only on curricular concepts in basic physics, chemistry, mathematics, biology, astronomy, electricity, electronics etc., but also on current topics of interest in science & technology and related social issues. We also offer a number of very educative and exciting science shows for organized groups.

Introduction:

The Birla Industrial & Technological Museum in Calcutta was inaugurated on May 2, 1959. It falls under the jurisdiction of the Council of Scientific & Industrial Research (CSIR) and is widely considered to be the forerunner of India's science museum movement. Dr. Bidhan Chandra Roy, who was then the Chief Minister of West Bengal, was inspired to create a similar institution in India for public engagement in science and technology after visiting the Deutsches Museum in Munich. Pandit Jawaharlal Nehru, India's prime minister at the time, and businessman Shri Ghanshyam Das Birla both supported and encouraged his vision and efforts in this regard. Birla Park, his grand mansion and surrounding land in Calcutta's affluent Ballygunge area, was donated to the CSIR to establish an Industrial and Technological Museum. In 1956, Pandit Nehru received this generous donation from Shri G D Birla. The journey from the government of India taking over Birla Park in 1956 to the opening of the Museum in 1959 was both remarkable and challenging. The creation of India's first science museum under the auspices of the central government was the result of careful planning and hard work by the Museum's steering committee, which was headed by Dr. B C Roy himself and included several prominent scientists, educators, and business people.

Figure 1: Font of BITM

On May 2, 1959, Prof. Humayun Kabir, the then union minister for scientific research and cultural affairs, marked the global inauguration of the Birla Industrial & Technological Museum (BITM). The ceremony witnessed the esteemed presence of Dr. B C Roy, Prof. M S Thacker, the then Director-General of CSIR, and Shri Amalendu Bose, the BITM Planning Officer. BITM's initial exhibitions showcased a diverse range of subjects including Electricity, Petroleum, Nuclear Physics, Metallurgy of Iron, Steel, and Copper, Optics, Electronics, and Television. Over the years, BITM expanded its collection, introducing additional exhibits such as Motive Power (1962), Communication (1963), Mining (1964), Popular Science (1965), Transport (1973), Underground Mock-up Coal Mine (1983), and Atom (1984).

Recognizing the changing expectations of the public, BITM underwent significant transformations. Many of the older galleries were either completely restored or replaced with modern exhibits, keeping pace with evolving scientific and technological advancements. Since its inception, BITM has been actively involved in providing in-museum instructional programs, including Common Seminars and Film Shows. The Science Demonstration Lectures (SDL) for children, initiated in 1965, have remained a popular and recurring feature of BITM.

Figure 2: College tour of MGM

In the same period, BITM pioneered the concept of a Mobile Science Exhibition (MSE) on wheels, with the theme of 'Our Familiar Electricity.' Launched in 1968, this groundbreaking initiative aimed to reach diverse communities and promote scientific awareness beyond the museum's confines. Additionally, BITM has been hosting the annual 'Science Fair' for pupils since 1968, fostering a platform for young minds to showcase their scientific acumen. Furthermore, in 1968, BITM inaugurated its first-ever Teachers' Training Program (TTP), enabling educators to enhance their understanding of science and effectively impart knowledge to their students.

Throughout its rich history, BITM has continually evolved to meet the changing needs and aspirations of the public. With its commitment to scientific education and outreach, the museum remains a dynamic institution at the forefront of promoting scientific literacy and fostering curiosity among visitors of all ages.

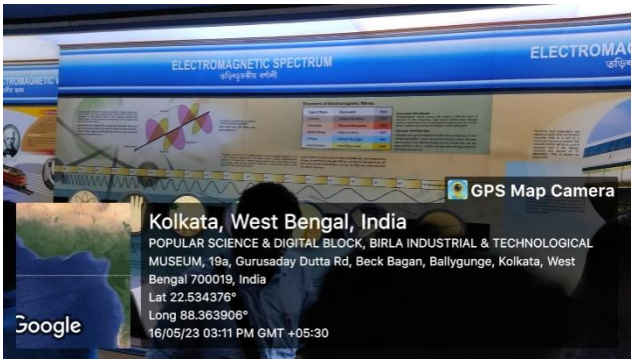


Figure 3: Inside of BITM

Over the decades, Birla Industrial & Technological Museum (BITM) has continuously expanded its range of educational initiatives and community engagement programs. The introduction of Creative Ability Centers (CAC), Computer Awareness Programmes, Engineering Fair, Pet Library, Inflatable Dome Planetarium Show, Public Science Shows, Students' Science Seminar, Science Drama, Vacation Hobby Camps, and numerous other in-museum and community engagement activities have enriched the museum's offerings.

BITM currently showcases 12 educational and interactive art installations, providing visitors with immersive learning experiences. One noteworthy collection is the 'World in Darkness,' specifically designed for visually impaired individuals, promoting inclusivity and accessibility. Throughout the year, BITM hosts a wide array of educational activities, ensuring that there is always something new and exciting for visitors to explore. The museum frequently organizes captivating scientific exhibitions and conducts engaging experiments, keeping visitors enthralled with the wonders of

science. BITM remains committed to fostering a love for learning and scientific exploration through its dynamic and diverse programming

Historical Background:

The Birla Industrial & Technological Museum (BITM) in Kolkata, established on 2nd May 1959, holds a significant place as the pioneering force behind the science museum movement in India. It owes its existence to the visionary leadership of Dr. B C Roy, the Chief Minister of West Bengal at the time. Driven by his visit to the renowned Deutsches Museum in Munich, he was inspired to create a similar institution in India that would engage the public with science and technology.

Dr. B C Roy's ambitious vision received immediate support and patronage from prominent figures such as Pandit Jawaharlal Nehru, the Prime Minister of India, and industrialist Shri G D Birla. Shri G D Birla generously donated his sprawling bungalow, Birla Park, along with the adjacent plot of land in the upscale Ballygunge area of Calcutta, to the Council of Scientific & Industrial Research (CSIR) for the establishment of an Industrial and Technological Museum.

In 1956, Pandit Nehru gratefully received this magnanimous gift from Shri G D Birla, laying the foundation for the future BITM. The museum's inception and its prestigious location highlight the collaborative efforts and the shared commitment of visionary leaders, industrialists, and the scientific community to promote scientific education and public engagement with technology and innovation. BITM continues to stand as a testament to their collective vision and enduring legacy in advancing scientific awareness and knowledge dissemination in India

Figure 4: Pandit Jawaharlal Nehru receiving the title deeds of BirlaPark from Shri G. D. Birla

The journey from the acquisition of Birla Park by the Government of India in 1956 to the grand inauguration of the museum in 1959 was marked by numerous challenges and noteworthy milestones. Led by Dr. B C Roy, the museum's planning committee, comprising eminent scientists, educationists, and industrialists, meticulously planned and worked tirelessly to establish India's first science museum under the purview of the central government.

On 2nd May 1959, the Birla Industrial & Technological Museum (BITM), fondly known as BITM, opened its doors to the public. The momentous occasion was graced by the presence of Prof. Humayun Kabir, the union minister for scientific research and cultural affairs, alongside Dr. B C Roy, Prof. M S Thacker, the Director General of CSIR, and Shri A Bose, the Planning Officer of BITM.

Initially, BITM showcased galleries dedicated to Electricity, Petroleum, Nuclear Physics, Metallurgy of Iron, Steel & Copper, Optics, Electronics, and Television. Over time, the museum expanded its offerings, introducing new galleries one after another. These additions included Motive Power (1962), Communication (1963), Mining (1964), Popular Science (1965), Transport (1973), Underground Mock-up Coal Mine (1983), and Atom (1984). However, recognizing the evolving expectations of the public, many of the original galleries underwent extensive renovations or were replaced entirely with new installations, aligning with the changing demands placed on BITM.

Figure 5: Prof. Humayun Kabir inaugurating the Museum

This continuous process of adaptation and innovation ensures that BITM remains responsive to the needs and aspirations of its visitors. With each transformation, the museum strives to provide an enriching and engaging experience, reflecting the ever-evolving landscape of scientific knowledge and public interests.

Right from its inception, BITM has been dedicated to providing educational activities within the museum premises. Popular Lectures and Film Shows were initiated, engaging visitors in interactive learning experiences. In 1965, Science Demonstration Lectures (SDL) for students were introduced, becoming a prominent feature of BITM's educational offerings. That same year marked a significant milestone with the launch of the first-ever Mobile Science Exhibition (MSE) on wheels by BITM, focusing on the theme of 'Our Familiar Electricity'. This pioneering initiative aimed to bring the wonders of science to diverse communities beyond the confines of the museum.

Figure 6: M. S. Thacker, DG, CSIR addressing the audience in the inaugural function

In 1968, BITM expanded its educational endeavors by organizing the 'Science Fair,' providing a platform for students to showcase their scientific knowledge and creativity. Additionally, the year 1968 witnessed the inauguration of the first Teachers' Training Program (TTP), enabling educators to enhance their skills and expertise in science education.

Over the years, BITM continued to augment its in-museum and outreach educational programs, diversifying its offerings to cater to a wide range of interests and learning styles. The introduction of Creative Ability Centres (CAC), Computer Awareness Programmes, Engineering Fair, Pet Library, Inflatable Dome Planetarium Show, Public Science Shows, Students' Science Seminar, Science

Drama, Vacation Hobby Camps, and numerous other initiatives further enriched the educational experience at BITM.

Presently, BITM boasts 12 educational and interactive galleries, each designed to inspire and engage visitors. Notably, the museum features a special gallery called 'World in Darkness' specifically tailored for individuals with visual impairments, promoting inclusivity and accessibility. Throughout the year, BITM hosts a plethora of educational programs, catering to diverse age groups and interests. The museum consistently offers highly exciting science shows and demonstrations on a daily basis, captivating visitors with the wonders of scientific exploration.

BITM's commitment to educational excellence and its wide range of offerings ensure that visitors of all ages and backgrounds can immerse themselves in a world of discovery and learning.

Geographical Location:

The Birla Industrial & Technological Museum (BITM) is located in Kolkata, West Bengal, India. Situated in the prestigious Ballygunge area, BITM enjoys a prime location within the heart of the city. Its address places it in close proximity to various cultural, educational, and commercial centers, making it easily accessible to visitors from all parts of Kolkata. Nestled amidst the bustling urban landscape, BITM offers a haven of knowledge and exploration, inviting individuals of all ages to embark on a captivating journey through the wonders of science and technology. It is the first science museum in the country under the National Council of Science Museums (NCSM), Ministry of Culture, Govt. of India.

The museum is situated on Gurusaday Road, beside the Ice Skating Rink and adjacent to Modern High School.

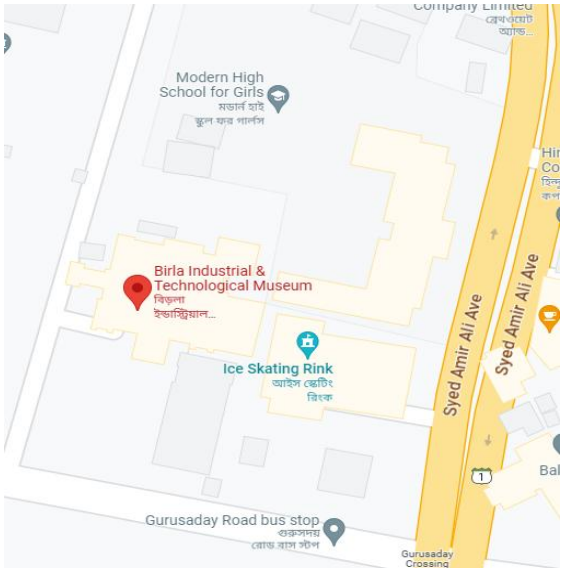


Figure 7: Geographical location of BITM

History of the BITM Building:

Before 1919, the location currently known as Birla Industrial & Technological Museum at 19A, Gurusaday Road had a different address, which was 18, Ballygunge Store Road. Historical records indicate that the Tagore family purchased the property from Mirza Abdul Karim in 1898. Meera Devi, who was the fourth child of Rabindranath Tagore, spent a significant part of her childhood in this house.

In 1919, G.D. Birla acquired the property from Surendranath Tagore, and it came to be known as Birla Park thereafter. Under the ownership of the Birla family, significant changes were made to the property. The original house used by the Tagores was demolished, and the architectural firm N. Guin & Co. was hired to design the current main building structure that stands today.

The architectural style of the main building is a colonial adaptation, combining elements from various styles of European architecture. This blending of different architectural influences gives the Birla Industrial & Technological Museum its unique appearance.

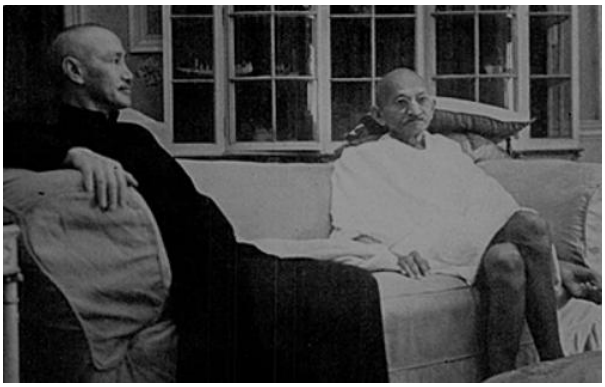


Figure 8: Chiang Kai and Mahatma Gandhi at Birla Park

During the time when the Tagores resided at 19A, Gurusaday Road (Birla Park), the place attracted numerous distinguished personalities from the world of arts, including renowned Japanese artists such as Kakuzo Okakura, Yokoyama, Tikan, Hishida, and Katusta. Additionally, the guest list of the Tagores featured prominent nationalist leaders of that era, such as C R Das, Aurobindo Ghosh, Surendranath Banerjee, Rasbehari Ghosh, and Anandamohan Sen.

With the Birlas taking ownership of the property, 19A, Gurusaday Road (Birla Park) retained its significance as a notable hub for the nationalist movement in India. G.D. Birla's close association with nationalist leaders led to the presence of influential figures like Mahatma Gandhi, Motilal Nehru, Lala Lajpat Rai, and Pandit Madan Mohan Malaviya at Birla Park. It was in Birla Park that Chiang Kai-Shek had the opportunity to meet Mahatma Gandhi, marking a significant historical event.

Director List:

Amalendu Bose, 1959 – 1965 & 1971 – 1974

Saroj Ghose, 1965 – 1971 & 1974 – 1979

Samar Bagchi, 1979–1991

Samaresh Goswamy, 1991–2004

Jayanta Sthanapati, 2004–2008

Sk. Emdadul Islam, 2008-2018

Venkatraman Subramanian Ramachandran, 2018-2022

Subhabrata Chaudhuri, 2022- continuing till date.

Galleries:

BITM offers a diverse range of attractions comprising 14 galleries dedicated to exploring science and technology. These include Vintage Voyage: Communication Technology, Digital Adventure Gallery, Fascinating Physics, Transport, Electricity, Television, Underground Mock-Up Coal Mine, Mathematics Gallery, and more. Visitors can also enjoy captivating Science Shows and engage in educational activities such as Science Demonstration Lectures, Popular Lectures, Science Seminars,

the Science Camp, Science Fairs, Engineering Fairs, Science Dramas, Annual Science Quiz Contests, and the Science Film Festival. By combining all of these offerings, BITM provides a realistic and immersive experience for visitors to gain practical knowledge about science and its numerous advantages. Let us now delve into a detailed discussion about each of the galleries housed within BITM

VINTAGE VOYAGE: COMMUNICATION TECHNOLOGY:

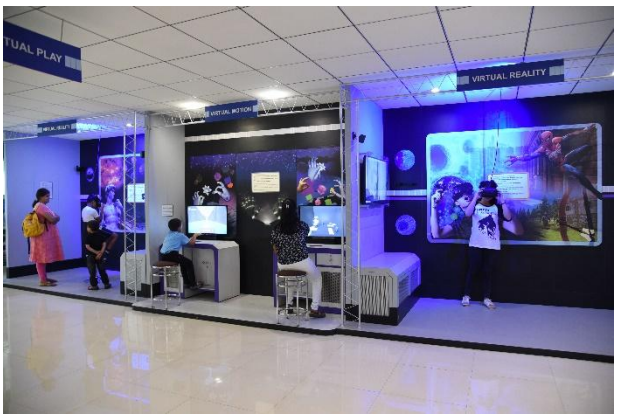
Embracing innovation, automation, and constant improvement, the evolution of communication devices is an enticing journey, where sometimes even the abandonment of older mechanisms paves the way for superior ones. In the captivating 'Vintage Voyage: Communication Technology' gallery, visitors are invited to uncover the intriguing tales of technological advancements and ingenious solutions that have conquered immense distances amidst challenging natural landscapes.

Centered around the essence of two-way communication, the Gallery showcases a captivating array of operational artifacts and technological marvels, all born from our innate human drive to connect. From ancient communication methods to modern breakthroughs, 'Vintage Voyage: Communication Technology' explores a wide spectrum of technologies, including postal systems, telegraphy, telephony, radio, and the ingenious innovations of pioneering Indian minds.

Within the gallery, visitors will be enthralled by a harmonious blend of murals, mannequins, multimedia presentations, and contemporary art installations. Amidst these creative elements, prime positions are occupied by teleprinters, an ionosphere recorder, a gramophone, a manual telephone exchange, wall-mounted telephones, a replica of Bell's liquid transmitter, and a fire-alarm box. Each artifact holds significant historical value, narrating the remarkable stories of both the visionaries behind them and the machines themselves. Embarking on this vintage voyage of rare collectives, BITM invites visitors to witness the evolutionary path that has shaped our current communication technology landscape.

DIGITAL ADVENTURE GALLERY:

Imagine stepping onto a glacial expanse in Iceland, surrounded by playful penguins waddling about. Picture yourself reaching out to pat a leaping dolphin as it emerges from the water, drawing near to you. It may sound whimsical and absurd, but at BITM's new Digital Adventure Gallery, you can witness the magic behind these seemingly fantastical experiences. Prepare yourself for an abundance of thrills and excitement as you delve into a world where your wildest dreams materialize virtually before your eyes.



Spanning an impressive 2500 square feet, this gallery is a captivating journey that harnesses the power of various digital technologies. Its core purpose is to provide an all-encompassing, adventure-filled, and delightfully entertaining experience for visitors. Within its immersive realms, you can embark on daring escapades that surpass the boundaries of imagination, making your dreams come alive in vivid digital landscapes.

FASCINATING PHYSICS:

In BITM's captivating 'Fascinating Physics' Gallery, the intricate realm of physics, driven by systematic observation, experimentation, and mathematical logic, unfolds before your eyes. This branch of science, dedicated to unraveling the enigmas of the physical world, reveals itself in a mesmerizing manner within these walls.

Within the classical physics section, you'll encounter 28 interactive exhibits exploring the realms of Mechanics, Gravitation, Light, and Electromagnetic Waves. Each exhibit invites you to engage, interact, and deepen your understanding of these fundamental principles. As you progress, the modern physics section beckons, transporting you into the intriguing microcosm of subatomic particles, the mysteries of black holes and pulsars, and the ethereal domain near absolute zero—a realm beyond ordinary human experience.

Featuring 38 exhibits adorned with captivating visuals, working models, animations, videos, multimedia presentations, unmanned quizzes, and other innovative presentation techniques, the gallery offers an enthralling experience. Prepare to be captivated as you immerse yourself in the wondrous world of physics, expanding your knowledge and igniting your curiosity.

TRANSPORT:

In 2008, BITM unveiled its newly revamped thematic gallery dedicated to the fascinating world of 'Transport.' Encompassing an expansive area of 500 square meters, this gallery showcases a remarkable collection of 50 models and exhibits that vividly portray the evolution of transportation systems.

The gallery takes visitors on a captivating journey through time, from the invention of the 'Wheel' to the advent of 'Supersonic Jet Engines.' Through a rich display of artifacts, intricate models, and interactive exhibits, the story of transportation unfolds across three distinct sections: water transport, surface transport, and airborne transport.

Among the highlights of this remarkable gallery, you'll find prized treasures such as a 1926 Rolls Royce Car and the Fiat Tipo once utilized by the esteemed scientist Sir Jagadish Chandra Bose. These star attractions add an extra layer of historical significance and allure, offering a glimpse into the remarkable vehicles of the past.

Immerse yourself in this captivating exploration of human ingenuity and technological advancement, as BITM's Transport Gallery unveils the awe-inspiring tale of how we have conquered the realms of movement and travel.

MOTIVE POWER:

The 'Motive Power' gallery tells a compelling story of humanity's insatiable thirst for power throughout history. It unveils the remarkable journey of technological advancements and innovative methods developed to meet the ever-growing power demands of civilization.

From the early utilization of animal power to the harnessing of wind power, water power, and even the advent of nuclear power, the gallery showcases the diverse array of methods employed to generate and harness energy. Each exhibit sheds light on the historical progression of power generation and transmission, unveiling the ingenuity and determination that have shaped our modern power sector.

Delve into the captivating narrative of this gallery as it unveils the evolution of engines and machinery that have played pivotal roles in the generation and transmission of power. Witness the remarkable transformations that have occurred over time, resulting in the sophisticated systems we rely on today.

Through interactive displays, informative exhibits, and engaging storytelling, the 'Motive Power' gallery at BITM offers visitors a unique opportunity to explore the fascinating history of power and gain a deeper appreciation for the technologies that drive our modern world.

BIOTECHNOLOGY:

Biotechnology is a dynamic field that merges biology with technology to harness living organisms, cellular components, and biological processes for practical applications. It encompasses a broad range of scientific disciplines, including genetics, molecular biology, biochemistry, and engineering.

Through biotechnology, scientists and researchers are able to manipulate and modify living organisms at the genetic level, leading to groundbreaking advancements in healthcare, agriculture, environmental conservation, and industry. It has the potential to revolutionize medicine by enabling the development of novel therapies, personalized medicine, and advanced diagnostics.

The term 'Biotechnology' refers to the genetic manipulation of organisms to enhance their capabilities or improve their characteristics, ultimately benefiting humanity. The 'Biotechnology' gallery at BITM simplifies this cutting-edge field through an array of interactive exhibits, making it accessible and easy to comprehend.

In agriculture, biotechnology plays a significant role in enhancing crop productivity, improving nutritional content, and developing resistant varieties to combat pests, diseases, and adverse environmental conditions. It also contributes to sustainable practices by reducing the use of chemical inputs and promoting conservation of natural resources.

MATHEMATICS GALLERY:

The newly established "Mathematics Discovery Center" at BITM (inaugurated on May 8, 2010) is a dedicated space designed to introduce mathematical concepts in an engaging and accessible way. The center aims to foster a love for mathematics among the younger generation and inspire them to pursue higher studies in pure sciences with enhanced self-assurance. By employing interactive models, hands-on exhibits, and captivating demonstrations, the Mathematics Discovery Center offers an alternative approach to presenting mathematical principles, making the subject more comprehensible and enjoyable for visitors. Through this innovative learning experience, the center endeavors to ignite curiosity and cultivate a deep appreciation for the beauty and significance of mathematics.

The Mathematics Exploration Zone, supported by a range of interactive exhibits and captivating graphical illustrations, serves as a dynamic laboratory that brings fundamental mathematical concepts to life. Within its spacious 300 square meter area, the gallery houses an impressive collection of 54 interactive exhibits, each designed to provide visitors with a visual understanding of mathematical principles, problem-solving techniques, and the inherent elegance of mathematics

itself. The thematic canvas of the gallery spans a diverse array of topics, including the history of numbers, number theory, positional number systems with a focus on India's significant contributions, basic arithmetic operations, plane and curved geometry, solid geometry and conics, mathematical functions, probability and statistics, foundational ideas of calculus, the presence of mathematics in nature, as well as a delightful assortment of mathematical puzzles and brain teasers tailored for young minds. Through this multifaceted and immersive experience, the Mathematics Exploration Zone aims to ignite curiosity, foster a deeper appreciation for mathematics, and inspire a sense of wonder in the minds of its visitors.

Within the gallery, an enticing feature known as the "Mathematics Demonstration Corner" awaits, equipped with all the necessary facilities to host engaging class sessions led by accompanying school teachers. This dedicated space allows educators to conduct interactive mathematics lessons, providing a hands-on experience that reinforces learning in a stimulating environment. Additionally, the gallery also houses a vibrant "Children's Activity Area" designed to further enhance the attraction for young visitors. This interactive zone offers a range of math-focused activities tailored to engage and entertain children, fostering their enthusiasm for the subject through playful exploration. Together, the Math Demo Corner and Children's Activity Area complement the gallery's offerings, ensuring an enriching and enjoyable experience for all who step through its doors.

Unveiling the Wonders of the Mathematics Gallery:

Numbers and Number Systems:

The gallery features interactive exhibits that provide a clear understanding of various abstract mathematical concepts. Students have the opportunity to engage with three-dimensional displays that demonstrate concepts such as the Number System, Series & Progression, Plane and Solid Geometry, Algebra, Functions and Variables, and non-Euclidean Spherical Geometry.

Figure 9:Demonstrating the concept of Number Line physicallywhere a sliding indicator can be programmed to indicate the algebraic sum of 2 numerical input values – one positive and the other negative.

For instance, one exhibit represents the Number Line as a vertical line within a simulated well, where the surface of water is designated as '0' (zero). By visually exploring the exhibit, students can grasp the concept of positive and negative numbers. Any value above the water level is considered positive, while values below are identified as negative numbers. This interactive approach allows students to actively

participate in the learning process and gain a deeper understanding of the underlying mathematical principles.

Through the implementation of an electro-mechanical circuit, an interactive exhibit showcases the understanding of algebraic sums on the number line using a toy frog as an indicator. By inputting a positive and a negative number, visitors can observe the movement of the 'frog' along the number line.

For instance, if a visitor inputs +5 and -3, the 'frog' will move and come to a stop above the water surface, precisely at the +2 level. Conversely, if one inputs +3 and -5, indicating a subtraction that exceeds the initial value, the 'frog' will move below the water surface and halt at the -2 level. When the inputs are +3 and -3, representing the subtraction of equal values, the 'frog' will stop at the water surface.

This simulated number line exhibit provides a tangible representation that aids in comprehending challenging concepts such as zero and negative numbers, which can be particularly challenging for young learners. By interacting with the exhibit, visitors can gain a practical understanding of these abstract concepts and deepen their mathematical knowledge in an engaging manner.

A set of interactive exhibits in the gallery elucidate the decimal and binary number systems, which are fundamental to our everyday numerical operations. By engaging with these exhibits, visitors gain a comprehensive understanding of how these systems function.

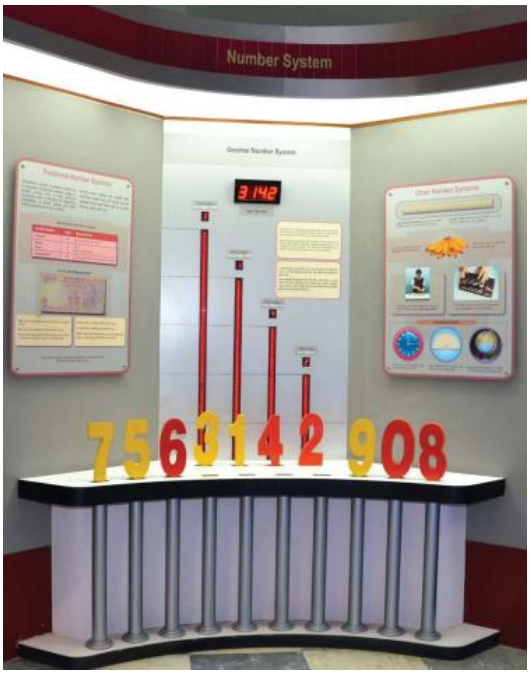


Figure 10: Exhibit on Decimal Number System and Place Value

In one exhibit, visitors explore the Decimal Number System. They discover that this system comprises ten digits, ranging from 0 to 9, which enable the formation of any numerical value, regardless of its magnitude. This interactive experience highlights the fact that the Decimal Number System operates on a base of 10, meaning each digit's value is determined by its position within the number.

Another exhibit focuses on the Binary Number System, providing visitors with an interactive exploration of its unique characteristics. By interacting with the exhibit, visitors comprehend that the Binary Number System utilizes only two digits: 0 and 1. This system operates on a base of 2, where each digit's position signifies a power of 2.

Figure 11: Exhibit explaining the Binary Number System

By engaging with these interactive exhibits, visitors develop a clear understanding of the decimal and binary number systems, which are the foundation of our numerical representation and computation in everyday life.

Within the exhibit, an intriguing arrangement allows visitors to explore the concept of place value in both the decimal and binary number systems. Each of the ten numerical symbols or digits is equipped with metal legs (depicted in Figure 5b), all of equal dimensions. These metal legs serve a dual purpose: providing a physical means for users to position any digit within the ten slots on the table, and functioning as 'codes' that the internal electronic sensor detects.

The exhibit features a display above each slot, indicating the intrinsic value of the digit placed within it. However, the true value of the number generated by the arrangement of digits in different slots is showcased through a large display located above them all. Through playful interaction with this set of digits, users easily grasp that while the intrinsic values of the digits remain constant, the value represented by the sequence changes as they are repositioned relative to one another. This interactive experience fosters a clear appreciation for the notion of place values in the decimal system.

Similarly, the exhibit representing the binary number system operates in a comparable manner to the decimal system. However, it includes only two digits: 0 and 1. By inserting either 0 or 1 into the slots, visitors can form a binary number and observe its equivalent decimal representation on the display panel. As users engage with this exhibit, they gain a deeper understanding of how the binary system functions, recognizing that each movement to the left increases the value by a power of 2.

By actively participating in these exhibits, visitors develop a practical understanding of place value and the interplay of digits within both the decimal and binary number systems. These interactive experiences facilitate a hands-on exploration of numerical concepts, enhancing comprehension and engagement with the underlying principles.

Series and Progression:

The gallery provides a clear and intuitive presentation of Arithmetic and Geometric Progression, enabling visitors to grasp these concepts with ease. The concept of Arithmetic Progression is depicted through a visually appealing representation of a staircase. The staircase consists of equal-height steps, forming a straight line railing. This visual analogy helps visitors understand that in an Arithmetic Progression, each step has a consistent increase or decrease in height, reflecting a constant difference between consecutive terms.

In contrast, Geometric Progression is illustrated by a staircase with uneven steps. The height of each step varies in a multiplicative manner, maintaining a constant ratio between consecutive

terms. For instance, if the first step has a height of 2 units, the subsequent steps would have heights of 4 units, 8 units, and so on. As a result, the railing of such a staircase takes on a curved shape, representing the multiplicative nature of a Geometric Progression.

By visually and tangibly engaging with these exhibits, visitors gain a lucid understanding of Arithmetic and Geometric Progression. The staircase analogies effectively convey the fundamental characteristics of these progressions, facilitating comprehension of their respective patterns and behaviors.

To explore the nature of series, we present visitors with the following question: "What are the values of the series 1+2+4+8+16+32+... and 1/2+1/4+1/8+1/16+1/32+...?" By examining these series, one can observe that both are Geometric Progressions (G.P). However, they possess a distinct characteristic—they are infinite or endless.

Figure 12: Exhibit on Arithmetic Progression (AP) and Geometric Progression (GP). The growth in AP is uniform andlinear, while that in GP is multiplicative and follows a curve as evident from the railings of AP & GP staircases.

The first series mentioned represents an infinite Geometric Progression where the terms increase exponentially. As the value of each term grows, the sum of the series becomes infinitely large. Consequently, this series is classified as a divergent series.

Figure 13: The exhibit on 'Divergent and Convergent Series'

In contrast, the second series exhibits an intriguing distinction. As the series progresses, the sum tends toward a finite value. Each subsequent term in the series becomes smaller and smaller, approaching infinitesimally close to zero. This remarkable behavior designates the series as a convergent series.

By highlighting these contrasting characteristics, visitors gain a deeper appreciation of the divergent and convergent nature of series. The exhibits provide a platform for exploring the fascinating dynamics of infinite series and their tendencies toward infinite or finite values as the terms progress.

The exhibit features a large wooden cube that is divided into several smaller parts, including 1/2 cube, 1/4 cube, 1/8 cube, 1/16 cube, 1/32 cube, and so on, as depicted in Figure 9. By assembling all these

parts together, visitors can reconstruct the original cube. This hands-on activity serves as a visual demonstration that verifies the mathematical concept that 1/2 + 1/4 + 1/8 + 1/16 + 1/32 + ... equals 1.

Engaging in this activity, visitors easily comprehend that the series is converging. Despite having an infinite number of terms, their cumulative sum results in a finite value, which in this case is 1. This activity serves as a tangible representation of the principle that an infinitely expanding series can converge to a definite sum.

Furthermore, this exhibit encourages students to extend their understanding of infinite converging series beyond the specific example provided. Once they grasp the concept, they can explore further observations and apply the knowledge gained to different series.

By offering a concrete and interactive experience, the exhibit enables visitors to intuitively comprehend the convergence of infinite series and the notion that an infinitely large number of terms can add up to a finite sum. Like

$1/3 + 1/3^2 + 1/3^3 + 1/3^4 + 1/3^5 + \ldots\ldots\ldots = 1/2$

$1/4 + 1/4^2 + 1/4^3 + 1/4^4 + 1/4^5 + \ldots\ldots\ldots = 1/3$

…… ……. ……. …….

…… ……. ……. …….

$1/n + 1/n^2 + 1/n^3 + 1/n^4 + 1/n^5 + \ldots\ldots\ldots = 1/(n-1)$

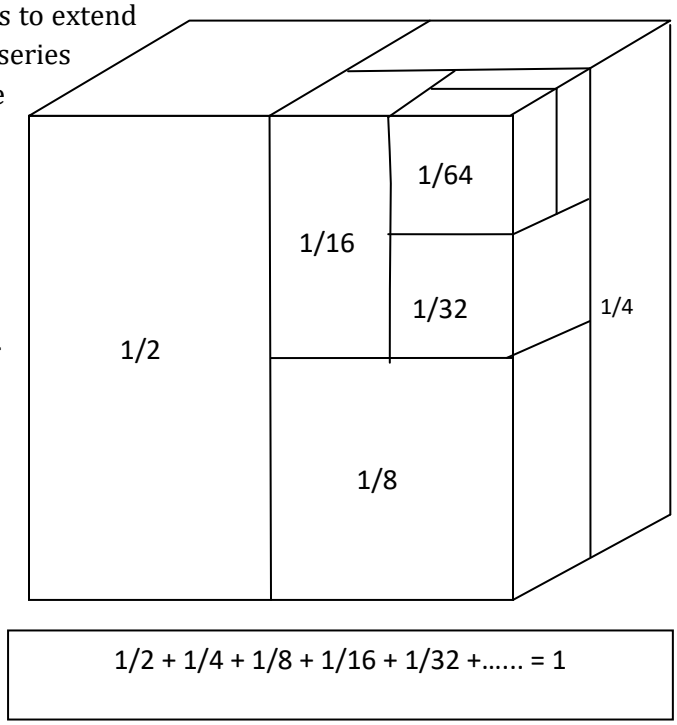


Figure 14: Explaining a Convergent Series

Concepts in Geometry and Algebra:

Engaging activities have been thoughtfully created to provide beginners with an enlightening experience in various mathematical concepts. These activities focus on algebraic formulas, properties of triangles, polygons, and polyhedrons, enabling students to develop a deeper understanding through hands-on exploration.

Figure 15: Verifying the standard Algebraic Identities

In the realm of algebra, students have the opportunity to verify essential algebraic identities through interactive activities. By utilizing wooden and plastic plates and blocks, they can engage in practical demonstrations that validate these identities. This interactive approach allows students to actively manipulate the

materials, enhancing their understanding of algebraic principles.

Similarly, activities are designed to explore the properties of triangles, polygons, and polyhedrons. By interacting with these shapes through hands-on exercises, students gain valuable insights into their properties, such as angles, sides, and symmetry. These activities provide a tangible and visual experience that aids in the comprehension and retention of geometric concepts.

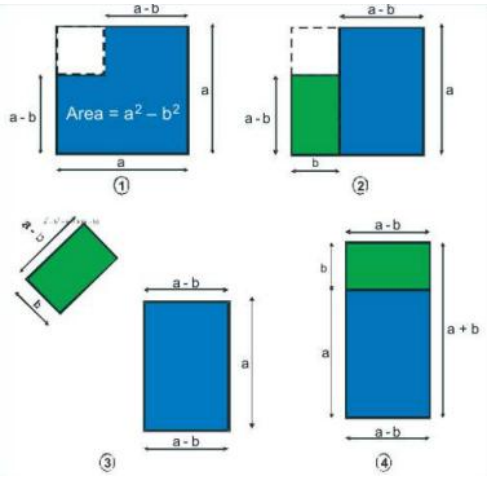


Figure 16: Showing $a^2 - b^2 = (a + b)(a - b)$

Through these carefully designed activities, beginners in mathematics can acquire a more profound understanding of algebraic formulas, as well as the properties of triangles, polygons, and polyhedrons. The hands-on nature of these activities facilitates active learning, making mathematical concepts more accessible and engaging.

$(a+b)^2 = a^2 + 2ab + b^2$

$(a-b)^2 = a^2 - 2ab + b^2$

$a^2 - b^2 = (a + b)(a - b)$

$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

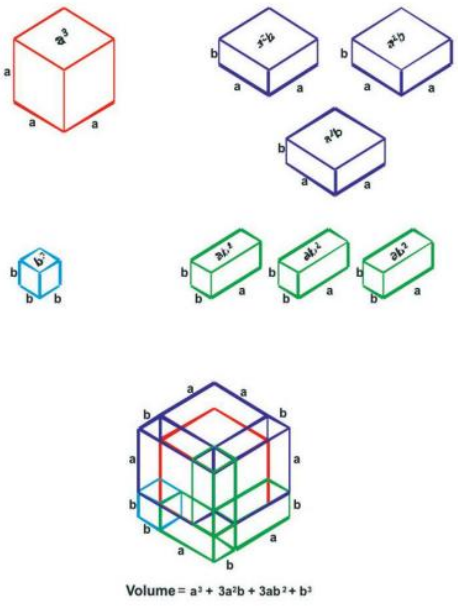


Figure 17: Showing $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

In the realm of Geometry, the gallery includes an exhibit titled 'Plane Geometry', which offers interactive demonstrations. Through the folding or arrangement of triangular laminar sheets, visitors can physically prove fundamental geometric principles. For instance, by following the specific folding patterns, visitors can verify that the sum of the angles within a triangle always amounts to 180°. Similarly, they can establish the formula for the area of a triangle as ½ x base x height.

Continuing the exploration of triangles, visitors can extend their experiments to encompass plane polygons. By recognizing that a polygon is composed of multiple triangles, visitors can easily deduce the sum of the angles or calculate the area of any polygon. This understanding arises from the fundamental relationship between polygons and triangles.

These interactive demonstrations in the exhibit enable visitors to engage with the principles of Geometry in a tangible and visual manner. By physically manipulating the triangular laminar sheets and observing the results, visitors gain an intuitive understanding of geometric concepts and their

interconnections. This hands-on approach fosters a deeper comprehension of the properties and relationships within polygons, enhancing the visitors' geometric knowledge.

The concept of Platonic Solids or Polyhedrons of Plato is a fascinating aspect of Solid Geometry that is explored in the exhibit. This exhibit offers students the opportunity to experiment and gain a deeper understanding of these distinctive solid figures.

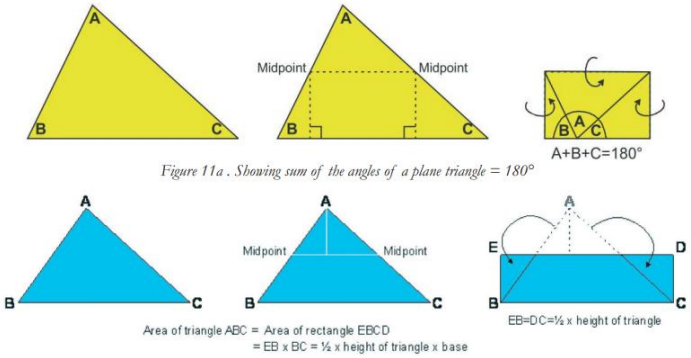


Figure 18: Finding the area of a Plane Triangle

In the exhibit, the polygonal faces of all Plato's polyhedrons are represented by wooden plates, each shaped as a regular triangle, square, or regular pentagon. These plates are placed on a table, inviting students to engage in a hands-on activity. The challenge presented to students is to rearrange these plates in specific configurations, thereby constructing the polyhedrons associated with each Platonic Solid.

Figure 19: Learning the properties of basic Geometrical Figures

By actively participating in this task, students not only get a visual representation of the Platonic Solids but also develop a practical understanding of their unique properties. Through experimentation and manipulation of the wooden plates, students gain insights into the relationships between the faces, edges, and vertices of these polyhedrons.

This interactive exhibit encourages students to think critically, analyze spatial relationships, and explore the principles of Solid Geometry. By engaging in the hands-on construction of Platonic Solids, students enhance their comprehension and appreciation of these remarkable three-dimensional figures.

Through this hands-on activity, students gain an understanding of the unique characteristics of Plato's polyhedrons. These characteristics include:

1. Polygonal faces are all regular: The faces of Plato's polyhedrons are formed by regular polygons. For example, the Tetrahedron, Octahedron, and Icosahedron have equilateral triangle faces, the Hexahedron (or Cube) has square faces, and the Dodecahedron has regular pentagon faces.

Figure 20: Platonic Solid exhibit

2. Polygonal faces are all equal: Each face of a Plato's polyhedron is identical in size and shape. This uniformity is a distinctive feature of these polyhedrons.
3. Face-to-face angles are equal: The angles formed between the faces of a Plato's polyhedron are consistent. Regardless of the specific polyhedron, the angles between the faces remain the same.
4. Edge-to-face angles are equal: The angles formed between an edge and a face of a Plato's polyhedron are also uniform throughout. These angles maintain a consistent measurement across the polyhedron.
5. There are only 5 such polyhedrons possible: Plato's polyhedrons are limited to five unique forms: the Tetrahedron, Octahedron, Hexahedron (or Cube), Dodecahedron, and Icosahedron. These five polyhedrons are the only regular, convex polyhedrons that meet the criteria set by Plato.

By engaging in the activity of constructing Plato's polyhedrons using wooden plates, students not only visualize these concepts but also gain a hands-on understanding of their distinct attributes. This practical exploration deepens their knowledge of solid geometry and fosters an appreciation for the elegance and symmetry of Plato's polyhedrons.

Figure 21: Exhibit showing Pythagoras Theorem

When students visit the Mathematics Gallery, they often encounter a deeper understanding of concepts beyond what their curriculum typically covers. Take, for example, the Pythagorean Theorem, which they may know as "The square on the hypotenuse of a right-angled triangle is the sum of the squares on the other two sides."

However, through their interaction with the 'Pythagorean Theorem' exhibit in the gallery, students discover that the theorem extends beyond squares to encompass any similar figures drawn on the sides of a right-angled triangle. This exhibitpresents very thin square-shaped chambers constructed on the three sides of a right-angled triangle. By observing the exhibit, students realize that a specific volume of liquid that fills the chamber on the hypotenuse also completely fills the square-shaped chambers on the other two sides of the triangle, thus providing evidence for the validity of the theorem.

This interactive exhibit not only reaffirms the Pythagorean Theorem but also demonstrates its broader applicability to similar figures. By witnessing the visual representation and experiencing the filling of the chambers, students grasp the fundamental principle underlying the theorem. This hands-on exploration deepens their understanding of the relationships within right-angled triangles and reinforces the timeless significance of the Pythagorean Theorem in mathematics.

In this exhibit, visitors have the opportunity to verify that the Pythagorean Theorem holds true not only for square-shaped chambers but also for chambers with different shapes, such as semi-circular chambers, built on the three sides of a right-angled triangle. By interacting with this exhibit, visitors

can witness firsthand the consistent validity of the Pythagorean Theorem across various geometric configurations.

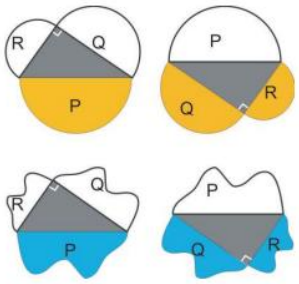


Figure 22: Pythagoras Theorem with semi-circular and similarshaped compartments. Here, P = Q + R

The exhibit features semi-circular and similar shaped chambers constructed on the sides of a right-angled triangle. Through observation and experimentation, visitors can confirm that the volume of liquid needed to fill the semi-circular chambers on the two shorter sides is equal to the volume needed to fill the larger semi-circular chamber on the hypotenuse. This serves as compelling evidence that the Pythagorean Theorem holds true even when applied to these alternative chamber shapes.

By providing concrete examples and allowing visitors to engage with different chamber shapes, the exhibit reinforces the universality of the Pythagorean Theorem. Visitors gain a deeper appreciation for the theorem's applicability and versatility, expanding their understanding of geometric relationships and mathematical principles.

Spherical Geometry:

Upon observing the contrast between a plane triangle and a spherical triangle, visitors to the exhibit gain insight into non-Euclidean spherical geometry. The exhibit showcases the difference between these two types of triangles. It becomes apparent that any three non-collinear points on the Earth's surface form a spherical triangle, where the sides of the triangle are curved, unlike the straight sides of a plane triangle.

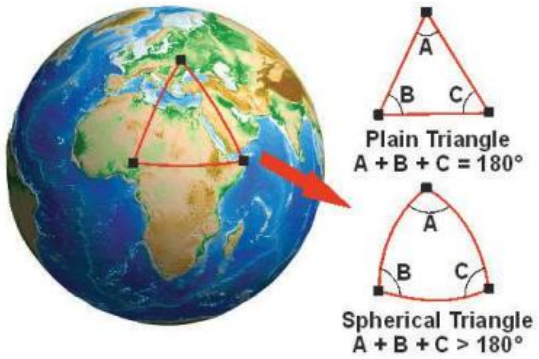


Figure 23: Plain Triangle and Spherical Triangle

One notable distinction is that the internal angles of a spherical triangle add up to more than 180°, in contrast to the 180° sum of internal angles in a plane triangle. This observation provides visitors with a tangible understanding of the unique properties of spherical geometry.

The exhibit also highlights an intriguing phenomenon: when three places on the Earth's surface are in the same line, they appear to lie on a curved line when represented on a map developed on plain paper. This phenomenon arises because non-Euclidean spherical geometry applies to the curved surface of the Earth, rather than the plane Euclidean geometry commonly used on flat surfaces.

Figure 24: Elucidating why the air travel paths in air-routemaps are curved

This realization deepens visitors' understanding

and appreciation for the curved air travel paths depicted on air-route maps. By recognizing the influence of non-Euclidean spherical geometry on the Earth's surface, visitors gain valuable insights into the mathematical principles underlying the representation of geographic features and navigation systems.

Overall, this exhibit provides a captivating exploration of the differences between plane and spherical geometry, enhancing visitors' comprehension of the Earth's curved surface and its implications in various fields of study.

Mathematical Function:

The exhibit on 'Functions' in the gallery offers a unique approach to understanding mathematical

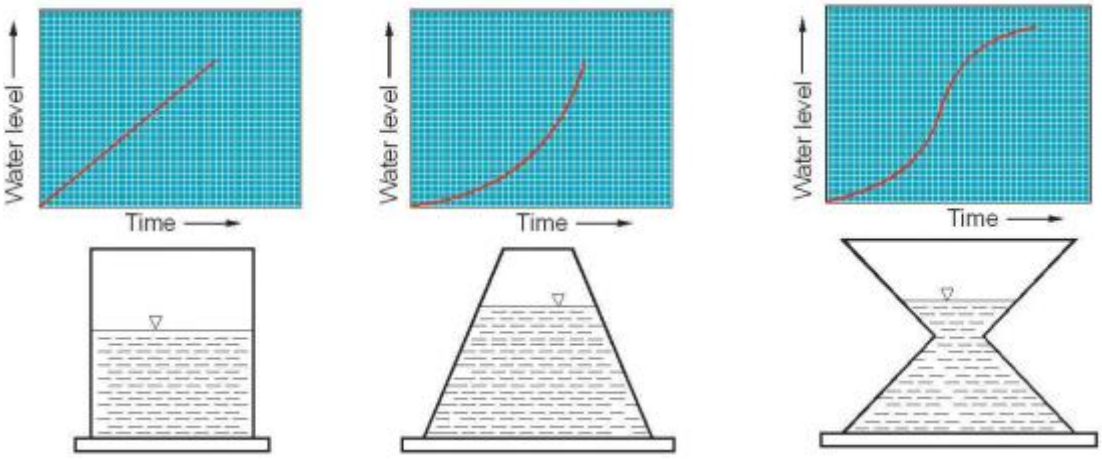


Figure 25: Real time plot of Water Level vs. Time, while uniform flow of water fills three different containers

functions through physical representation. By using three containers of different shapes, as illustrated, the exhibit aims to demonstrate the implications of linear and quadratic (non-linear) functions in a tangible manner.

Figure 26: Showing water level as different functions of timewhile uniform flow of water fills up containers of uniform andnon-uniform cross-section. Here, functions are linear andquadratic.

To conduct the experiment, the containers are filled with water using equally rated pumps, ensuring that the volume of water entering each container per unit time remains the same. The objective is to observe the rise of water levels in these containers over time. To achieve this, special electronic tapes, known as pressure-dependent e-tapes, are utilized to sense the water levels. These measurements are then fed into a computer, which generates corresponding results depicting the relationship between water level and time on the monitors positioned above each container.

Visitors can observe that the container with a uniform cross-section exhibits a linear relationship between water level and time. In contrast, the water levels in the other containers demonstrate a parabolic relationship with time.

By connecting the physical phenomenon of water levels in containers

with mathematical functions, the exhibit provides a visual and interactive way for visitors to grasp the concepts of linearity and non-linearity. This hands-on experience enables a deeper understanding of how functions behave and how their relationships with variables can be represented graphically.

Through this exhibit, visitors gain valuable insights into the real-world applications of mathematical functions and develop a more intuitive understanding of linear and quadratic relationships.

Concepts of Calculus: Differentiation & Integration:

Calculus, as a mathematical tool, can be challenging for young learners to comprehend. However, the gallery features exhibits specifically designed to illustrate the fundamental concepts of calculus, such as limits, differentiation, and integration, in a simplified manner.

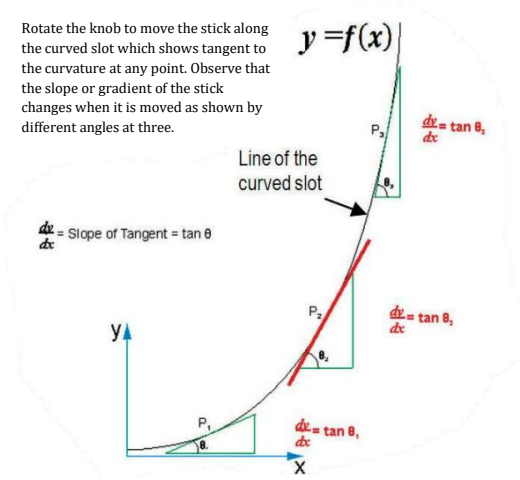


Figure 27: Explaining the concept of Differentiation

The concept of differentiation, which involves measuring rates, is demonstrated through one of the exhibits. By engaging with this exhibit, students can develop a clear understanding of how rates are calculated and how they relate to changes in variables.

Similarly, the concept of integration, which involves a summation process, is elucidated through another exhibit. Students can explore this exhibit to grasp the idea of combining and summing quantities.

These exhibits aim to break down the complexities of calculus and present the concepts in an accessible and intuitive way. By engaging with these exhibits, young learners can develop a solid foundation in calculus and gain a deeper understanding of its practical applications in various fields of study.

To provide a tangible understanding of the concept of differentiation, an exhibit in the gallery employs a moving stick and a curved slot. The stick's mid-point slides within the slot, and its slope or gradient varies, indicated by the angle θ it forms with the x-axis.

At any given point on the curve y = f(x), the rate at which the y-coordinate changes with respect to the x-coordinate, denoted as dy/dx or tanθ, can be determined. To visually represent this rate, a tangent is drawn to the curve at that point. Remarkably, the stick physically assumes the position of the tangent, aligning with the slope of the curve. As the stick moves along the x-y plane, following the curve y = f(x), its slope (dy/dx) continuously changes.

Figure 28: Using differentiation for determining the profile of Curved Surface

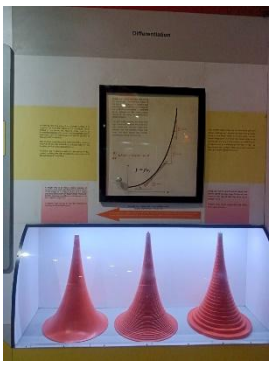


Figure 29: Exhibiting the concept of Integration

By observing the movement of the stick along the curved slot, visitors can witness a direct and physical representation of dy/dx or the process of differentiation. This exhibit provides an interactive and visual means for learners to comprehend how the slope of a curve varies and how differentiation captures this change.

Through this exhibit, students can gain an intuitive understanding of differentiation and develop a concrete connection between the abstract concept of dy/dx and its visual representation using the moving stick and the curved slot.

Once we grasp the concept of differentiation, which enables us to measure the rate of change of one variable with respect to another, we can apply it to compute precise measurements of curved lines and surfaces. This becomes particularly valuable when standard geometrical methods fall short.

Consider the figure provided, showcasing an inverted funnel. Using conventional methods, we could approximate the surface area of the funnel by adding up the peripheral areas of the circular plates that compose it. However, by employing the technique of differentiation, we can calculate the rate of change of height with respect to the radius. This allows us to utilize integration to precisely determine the curved surface area of the funnel.

Integration complements differentiation by providing a means to sum infinitesimally small changes and obtain accurate measurements. In the case of the inverted funnel's curved surface area, integration enables us to compute its exact value by considering the rate of change of height with respect to the radius. This exemplifies the power of calculus in solving intricate geometrical problems that cannot be adequately addressed using traditional geometric methods.

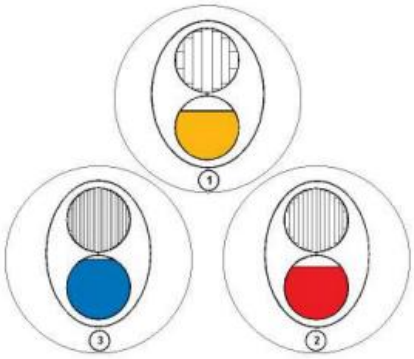


Figure 30: Finding the Area of a Circle

The exhibit on 'Integration' offers a tangible representation of the concept in a way that is easy to understand. It features three circular discs that can be rotated in a vertical plane. Each disc contains two equal circular compartments that are interconnected.

In the first compartment of each disc, there are rectangular areas arranged to form a circular shape. However, the arrangement differs among the discs. In disc 1, the rectangular areas are fewer and wider compared to disc 2. In turn, disc 2 has a greater number of narrower rectangular areas compared to disc 1. Finally, in disc 3, the rectangular areas are even

narrower than in disc 2.

By observing and interacting with these rotating discs, visitors can visualize the process of integration. The varying widths and numbers of rectangular areas on each disc symbolize the integration of infinitesimally small rectangular regions to form a complete circular area. This hands-on exhibit helps to illustrate how integration works by gradually summing up these small areas to calculate the total area of a shape.

By inverting the three discs and allowing the colored liquid from the chambers with rectangular peripheral walls to flow into the circular chambers, an interesting observation can be made. It is evident that the liquid does not completely fill the circular compartments. The amount of unfilled space in the circular compartments depends on the width of the rectangular areas that make up the inner periphery of the upper chambers. When the rectangular areas are narrower, the unfilled space in the circular compartments is smaller, and vice versa.

This experiment highlights an important concept: as the width of the rectangular areas approaches zero, and if we were to have an infinitely large number of these areas, the unfilled space in the circular compartments would tend to zero as well. In other words, the more rectangles we have with infinitesimally narrow widths, the closer we get to filling the circular compartments completely. This concept is closely related to the concept of integration, where we sum an infinite number of infinitesimally small rectangular areas to calculate the exact area of a circle.

By observing this exhibit and understanding the relationship between the rectangular areas and the unfilled space, visitors can appreciate how the concept of integration allows us to compute the precise area of a circle by considering an infinite number of infinitesimally small components.

Law of Average:

The exhibit titled 'Law of Average' aims to introduce visitors to the concept and practical application of statistical techniques. Through a simple measurement activity, visitors can explore the relationship between forearm length (cubit) and height.

In this exhibit, visitors are invited to stretch their forearm fully on a flat bed lined with multiple switches. By pressing the furthest switch they can reach, the length of their forearm (cubit) is measured. This measurement is then used to estimate their height. As the visitor presses the switch, a vertical row of LEDs lights up to indicate the corresponding heights, providing a visual representation of the conversion from forearm length to height.

By observing the results of multiple participants, it becomes evident that there is a statistical relationship between forearm length and height. On average, it is found that our heights are roughly equal to 3.8 to 4 times the length of our forearm. This demonstrates the concept of averages and highlights the statistical principle that individual variations tend to balance out when examining a large group of people.

Maxima – Minima: Application of Differentiation:

The exhibit on 'Maxima – Minima' provides students with a practical understanding of how Calculus is applied to solve real-world problems. In this exhibit, students are presented with a challenge:

they are asked to determine which of the three containers, each having the same volume, has the minimum surface area.

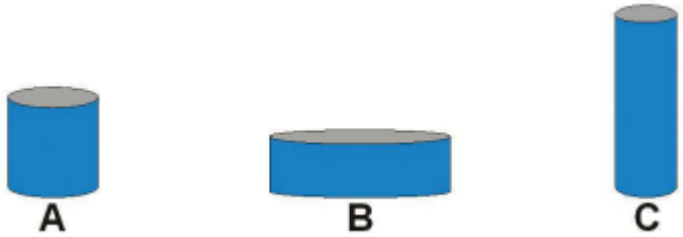


Figure 31: Three containers of equal volume. Which shape hasthe minimum surface area?

By examining the shapes of the containers and considering the principles of optimization, students are encouraged to apply their knowledge of differentiation and integration to find the solution. They are tasked with analyzing the shapes, calculating the surface areas, and comparing them to identify the container with the minimum surface area.

Through this exhibit, students are able to witness firsthand how Calculus can be used to optimize physical properties, such as surface area, and understand its practical application in solving real-life problems. It enhances their problem-solving skills and reinforces the significance of Calculus in various fields of study.

The ability to solve optimization problems, such as minimizing surface area, can have significant practical implications. One such example is in the manufacturing of soft drink cans, where large quantities are produced, and minimizing material usage becomes crucial. Rather than relying on tedious trial and error methods, Calculus provides an efficient solution.

By applying differentiation, the exact solution for minimizing the surface area of a cylindrical container can be obtained. By differentiating the surface area (S) of the container with respect to its radius (r), denoted as dS/dr, one can determine the critical points where the derivative is zero. In

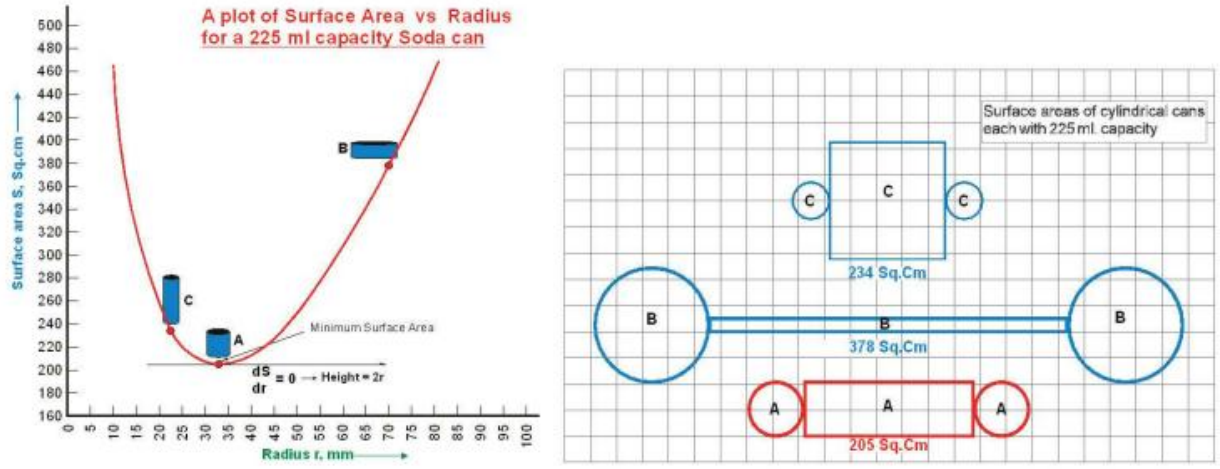


Figure 32: Calculating the minimum surface area of a cylindrical container having equal volume but different shapes. Surface area (S) is a function of Radius (r), S = f(r)

the case of the cylindrical container, it is found that the surface area is minimized when the height of the container is equal to twice its radius (or diameter).

This mathematical insight allows manufacturers to optimize their can design, ensuring the efficient use of materials without compromising the functionality or quality of the product. By utilizing Calculus, they can achieve the desired outcome more accurately and save on production costs. This emphasizes the practical value of Calculus in solving real-world problems and highlights its significance in various industries.

To further reinforce the concept of minimizing surface area using differentiation, students can engage in a hands-on activity. By taking a physical container and comparing its surface area with other containers of different heights, they can visually confirm the relationship.

During the activity, students can observe that the container with a height equal to its diameter, or twice its radius, indeed exhibits the minimum surface area among the containers they examine. By physically measuring and comparing the surface areas of these containers, students can directly witness the correlation between container dimensions and surface area.

This experiential approach not only helps students understand the theoretical concept of optimization but also allows them to connect it with real-world objects and measurements. By actively participating in this activity, students can strengthen their understanding of how Calculus principles, such as differentiation, can be applied practically to solve optimization problems.

Mathematical Activities:

The activity hall of the Mathematics Gallery offers an exciting space filled with mathematical challenges and brain teasers that captivate visitors of all ages. Inside, one can immerse themselves in a world of puzzles, mazes, and mind-bending games that stimulate logical thinking and problem-solving skills. Visitors can indulge in the joy of juggling with shapes and figures, exploring geometric patterns, and unraveling intricate puzzles. The interactive nature of the activities keeps visitors engaged and entertained, providing hours of intellectual exploration and enjoyment. Whether it's navigating through a complex maze or solving a perplexing puzzle, the activity hall offers a dynamic and immersive experience that encourages curiosity, creativity, and a deeper appreciation for the wonders of mathematics.

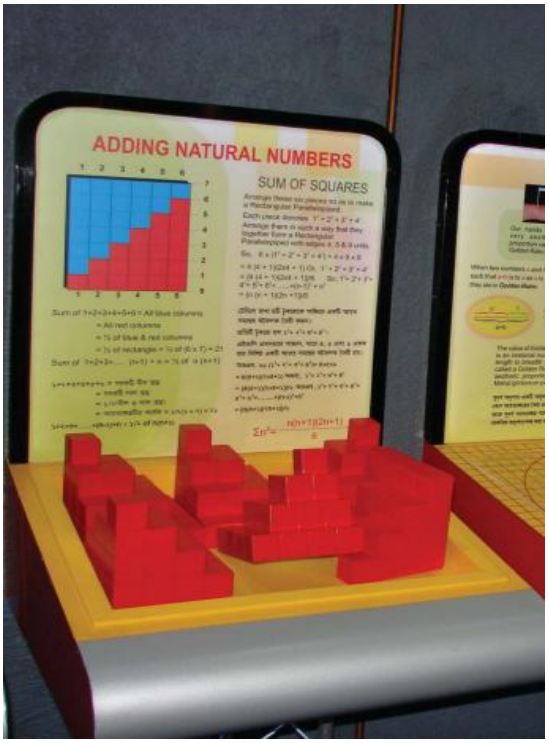


Figure 33: Another 3D model to find out the sum of squares of natural numbers

In addition to the assortment of activities available, the Mathematics Gallery's activity hall provides visitors with opportunities to engage in experiments centered around essential mathematical rules and formulas. One intriguing activity involves an experimental model specifically designed to help students determine the sum of the squares of natural numbers, such as 12 + 22 + 32 + 42 + 52 + ... + n2. The activity utilizes six identically stepped blocks, each containing four square-shaped steps representing different values, ranging from 12 to 42 cubic units. The challenge is to arrange and combine these blocks in a manner that creates a rectangular parallelepiped with edges measuring 4, 5, and 9 units, as illustrated in the figure. Remarkably, the resulting rectangular parallelepiped's volume is equal to 4 x 5 x 9 cubic units. By engaging in this hands-on activity, students not only have the opportunity to explore and manipulate physical objects but also deepen their understanding of mathematical concepts and formulas.

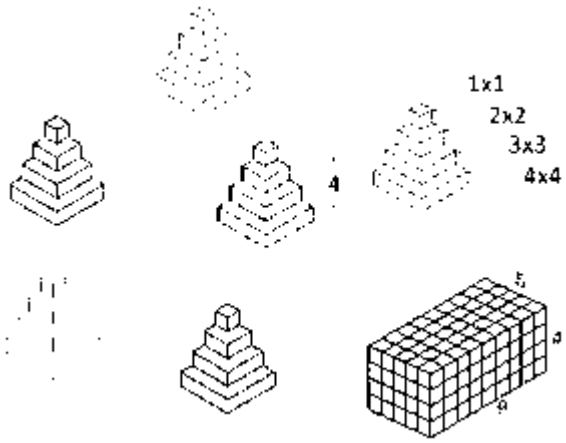


Figure 34: A 3D model to find out the sum of squares of natural numbers

We can say that for 4 steps in the block

$6 \times (1^2 + 2^2 + 3^2 + 4^2) \times 1 = 4 \times 5 \times 9 = 4 \times (4+1) \times (2 \times 4 + 1)$

$\rightarrow (1^2 + 2^2 + 3^2 + 4^2) = 1/6 \{4 \times (4+1) \times (2 \times 4 + 1)\}$

So, for 5 steps in the block $\rightarrow (1^2 + 2^2 + 3^2 + 4^2 + 5^2) = 1/6 \{5 \times (5+1) \times (2 \times 5 + 1)\}$

for 6 steps in the block$\rightarrow (1^2 + 2^2 + 3^2 + 4^2 + 5^2 + 6^2) = 1/6 \{6 \times (6+1) \times (2 \times 6 + 1)\}$

similarly

For n steps in the block $\rightarrow (1^2 + 2^2 + 3^2 + \ldots\ldots + n^2) = 1/6 \{n\ (n+1)\ (2n+1)\}$

Apart from applying the standard method of summation of series in school or college, he can thus get to know the physical interpretation of the summation process by doing this experiment.

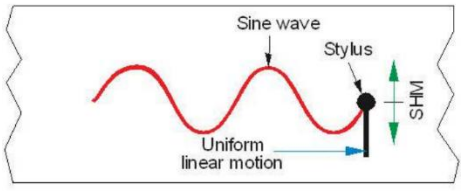


Figure 35: Stylus is given both SHM and uniform linear motion in mutually perpendicular directions

Another engaging activity that captivates students is the creation of a Sine wave or Sinusoidal curve. Typically, students encounter analytical methods for drawing mathematical curves in their school or college curriculum. However, in the Mathematics Gallery, they have the

opportunity to trace a Sine wave using mechanical means, combining Simple Harmonic Motion (SHM) and uniform linear motion in perpendicular directions. Students often face challenges in generating the SHM component. To address this, a clever mechanism has been devised in the gallery to assist them in this activity.

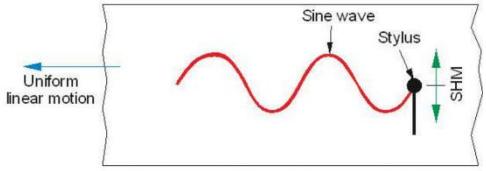


Figure 36: Stylus is given SHM and the paper is given opposite uniform linear motion in mutually perpendicular directions

The mechanism operates by rotating a round plate using a knob, which in turn generates a reciprocating motion of a stylus. Although achieving perfect uniform motion while rotating the plate is practically difficult, this leads to a non-SHM output of the stylus's motion. To overcome this challenge, the circular motion of the plate is ingeniously connected to the linear motion of a canvas belt, on which the Sine wave is to be drawn. This mechanical design ensures the synchronization of the stylus's reciprocating motion with the linear motion of the canvas belt. As a result, whenever there is input circular motion, whether uniform or not, the stylus faithfully traces a Sinusoidal wave on the canvas.

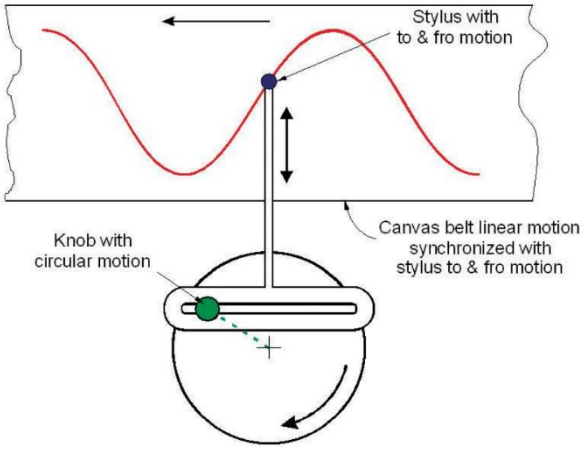


Figure 37: An interactive exhibit to convert circular motion intoa Simple Harmonic Motion and trace a Sine Wave.

By engaging in this activity, students gain a hands-on experience of generating and visualizing mathematical concepts. They explore the relationship between circular and linear motions and witness the creation of a fundamental wave shape. This interactive and tangible approach enables students to deepen their understanding of Sine waves and appreciate the connection between mathematical principles and physical phenomena.

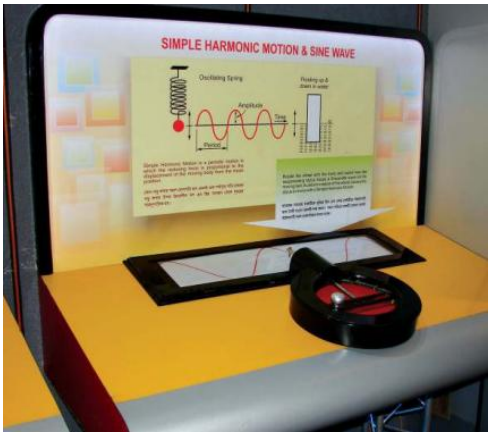


Figure 38: An interactive exhibit to convert circular motion intoa Simple Harmonic Motion and trace a Sine Wave.

In the Activity Area of the gallery, students have the opportunity to explore the presence of mathematical shapes in nature. They discover the fascinating numerical orders and patterns that exist in various aspects of the natural world, such as the human body, leaf structures, floral petal arrangements, building architecture, and even in domains like banking and finance. One prominent example of nature's mathematical beauty is the Golden Ratio, which imbues objects in nature with a sense of beauty, aesthetics, and compactness.

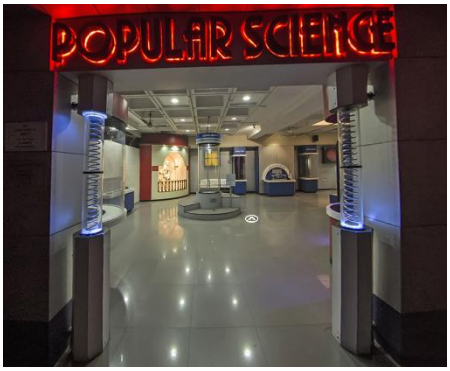
A captivating activity in this area involves creating a beautiful spiral using the Golden Ratio. By applying this mathematical concept, students can generate a visually

pleasing spiral that exemplifies the inherent harmony and balance found in nature. Engaging in this activity allows students to comprehend and appreciate the profound beauty of mathematics as it unveils the hidden patterns present in both the natural and manmade worlds.

By observing and interacting with these mathematical shapes and patterns in nature, students develop a deeper understanding of the interplay between mathematics and the world around them. They begin to recognize the ubiquity of mathematical principles in everyday phenomena, fostering a greater appreciation for the elegance and power of mathematics in explaining and enhancing our perception of the universe.

METALS:

Throughout the course of human history, the pivotal role of metals in advancing civilization cannot be overstated. The relentless progression of human societies owes a great debt to the effective harnessing and utilization of these remarkable materials. Within the confines of the Metals Discovery Gallery at BITM, visitors are transported on a captivating journey that unveils the captivating story of four of the most crucial metals: Copper, Zinc, Iron & Steel, and Aluminium. Through a compelling blend of interactive exhibits, intricately crafted dioramas, animated panels, and immersive multimedia presentations, the gallery brings to life the remarkable tale of these metals. Visitors will gain a profound understanding of their unique properties, discover the ingenious ways in which they have shaped our world, and appreciate the transformative impact they have had on countless engineering achievements. The Metals Discovery Gallery offers an awe-inspiring tribute to the indomitable spirit of human ingenuity and the vital role that metals continue to play in propelling our modern age forward.



POPULAR SCIENCE:

Get ready for a thrilling and action-packed adventure at the new gallery! Bursting with fun and excitement, this immersive space ensures that every step you take and every move you make is met with a dynamic response. Prepare yourself for a truly interactive experience like no other. This gallery is

designed to captivate your senses and engage you at every turn. Whether it's solving mind-bending puzzles, participating in hands-on activities, or exploring cutting-edge technology, every moment promises to be an exhilarating journey. With each action you take, the gallery comes alive, offering a unique and personalized encounter that will leave you energized and amazed. So brace yourself for a world where fun knows no bounds, excitement fills the air, and adventure awaits around every corner. The gallery guarantees an unforgettable and immersive experience that will keep you coming back for more.

Prepare to delve into the captivating world of science, where the underlying logic and principles unfold before your eyes. As you engage with the exhibits and explore the myriad interactive options they offer, you'll embark on a journey of discovery and understanding. This gallery serves as a dynamic stage where science comes to life, allowing you to witness firsthand the fascinating spectacle of why things happen the way they do. Through hands-on experimentation and observation, you'll unravel the secrets of the natural world, unlocking the hidden mechanisms that govern its behavior. With each tinkering and interaction, you'll gain a deeper appreciation for the wonders of science and its ability to explain the complexities of our universe. Get ready to witness science in action, as this gallery invites you to be an active participant in unraveling its mysteries and uncovering the profound logic that underlies it all.

ELECTRICITY:

To commemorate the 56th Anniversary of the Museum, a captivating new gallery dedicated to the wonders of electricity was unveiled on May 2nd, 2015. The distinguished honor of inaugurating this gallery was bestowed upon Shri Manish Gupta, the Hon'ble Minister for Power and Non-Conventional Energy Sources, representing the Government of West Bengal. This momentous occasion marked the beginning of a remarkable journey into the realm of electricity, as visitors were invited to explore and engage with the captivating exhibits within the gallery.

Immerse yourself in the captivating story of electricity as the Electricity Discovery Gallery unveils its narrative through a multitude of three-dimensional interactive exhibits. This gallery takes you on a journey through the diverse sources and forms of electricity, showcasing its remarkable applications in both industry and our homes. Witness firsthand how electricity has played an integral role in the development of our modern, electricity-driven civilization.

At the heart of the gallery lies the mesmerizing "High Voltage Theatre," a central attraction that showcases the enchanting magic of static electricity. Prepare to be thrilled as you embark on an unforgettable, hair-raising experience. The theatre offers an electrifying demonstration that will leave you in awe, showcasing the immense power and wonders of static electricity.

Through a combination of interactive displays, informative exhibits, and captivating demonstrations, the Electricity Discovery Gallery offers an engaging and enlightening experience for visitors of all ages. Discover the captivating world of electricity and gain a deeper understanding of its significance in our daily lives and the remarkable impact it has on shaping our modern world.

Within the gallery, you will discover a diverse range of exhibits that delve into various aspects of electricity, each carefully designed to align with the curriculum of students studying in classes from IX to XII. Let's explore some of the intriguing exhibits awaiting your exploration:

- Curie Point: Unveil the phenomenon of Curie Point and its significance in the world of electricity.
- Spinning Egg: Witness the enchanting interaction between electricity and a spinning egg, revealing captivating scientific principles.
- Grand Shuttle: Explore the workings of a grand shuttle, offering insights into electrical mechanisms and their applications.
- Alternate & Direct Current: Dive into the world of current and uncover the distinctions between alternate and direct current.
- Storage Cells and Batteries: Gain an understanding of storage cells and batteries, their functions, and their role in powering various devices.
- Clean Energy Sources: Discover the fascinating realm of clean energy sources and their importance in a sustainable future.
- Transmission Loss and Transformers: Delve into the realm of transformers and transmission loss, exploring the efficiency of electrical energy transfer.
- Electrical Circuits and Safety: Learn about electrical circuits, their components, and the importance of safety measures while working with electricity.
- LCR Circuit: Unravel the complexities of LCR circuits, studying their behavior and applications.
- Saving Energy: Explore ways to conserve and save energy, gaining insights into sustainable practices.
- Spark Wheel: Experience the mesmerizing display of sparks with the spark wheel exhibit.
- Van De Graff Generator: Witness the power of electricity in action with the Van De Graff generator, generating awe-inspiring effects.

- ❖ Jumping Disc: Encounter the intriguing phenomenon of jumping discs and uncover the scientific principles behind their motion.
- ❖ Electromagnetic Induction: Delve into the world of electromagnetic induction and comprehend its role in generating electricity.

These exhibits, thoughtfully curated to align with the curriculum, offer an engaging and educational experience, providing students with a deeper understanding of the principles and applications of electricity.

The collaboration between the Calcutta Electric Supply Corporation (CESC) and the gallery has brought forth a remarkable contribution in the form of a specially fabricated model showcasing "Energizing the City of Joy." This model offers a captivating display of the intricate network encompassing the production, distribution, and consumption of electricity supplied by CESC. The expansive layout model provides a comprehensive visualization of this process, allowing visitors to witness the journey of electricity as it powers the vibrant City of Joy. Complementing the model, a large digital panel further enhances the exhibition, offering detailed insights and engaging information about the operations of CESC and its vital role in meeting the city's energy needs. This collaborative effort showcases the dynamic synergy between CESC and the gallery, highlighting the significance of electricity in fueling the progress and vitality of the City of Joy.

TELEVISION:

Step into the captivating world of television as the gallery unravels the fascinating journey of this revolutionary technology. From its inception by the visionary Scottish inventor John Logie Baird to its present-day form, the gallery offers a chronological exploration of television's remarkable development. Through a curated collection of 25 state-of-the-art interactive exhibits, models, dioramas, and captivating artifacts, visitors are immersed in an educative and informative ambiance that brings the evolution of television to life.

Embark on a mesmerizing adventure as you witness the milestones that have shaped television over the years. Explore the interactive exhibits that showcase the technological advancements and innovations that have propelled television into its present form. Engage with cutting-edge displays that illustrate the transformation of this medium, from its early days to the stunning high-definition screens of today.

Accompanied by informative narratives and immersive visuals, the gallery provides a comprehensive understanding of the impact television has had on society, culture, and communication. Delve into the fascinating history, witness the evolution of broadcasting, and gain insights into the technological marvels that have revolutionized the way we perceive and consume visual media.

With a blend of interactive exhibits, meticulously crafted models, captivating dioramas, and intriguing artifacts, the Television Gallery offers an enriching and engaging experience that captures the essence of this incredible technology and its profound influence on our lives.

Within the gallery, an enthralling Television Studio awaits visitors, hosting the mesmerizing 'Chromakey Show' for a highly entertaining experience. Prepare to be amazed as you witness the magic of the chroma-keying technique, which allows individuals to seemingly soar through the sky.

In this captivating demonstration, participants have the opportunity to step in front of the chromakey backdrop and experience the illusion of flight. Through the clever utilization of this technology, the background is replaced with stunning imagery, creating the sensation of being suspended in mid-air. Visitors are invited to spread their wings, strike dynamic poses, and capture unforgettable moments as they become part of a breathtaking visual spectacle.

The 'Chromakey Show' exemplifies the creativity and possibilities that television technology can offer, immersing participants in a world of fantasy and imagination. Witness the seamless blending of real-life action with virtual environments, providing a truly unique and thrilling experience for all who partake in this captivating demonstration.

UNDERGROUND MOCK-UP COAL MINE:

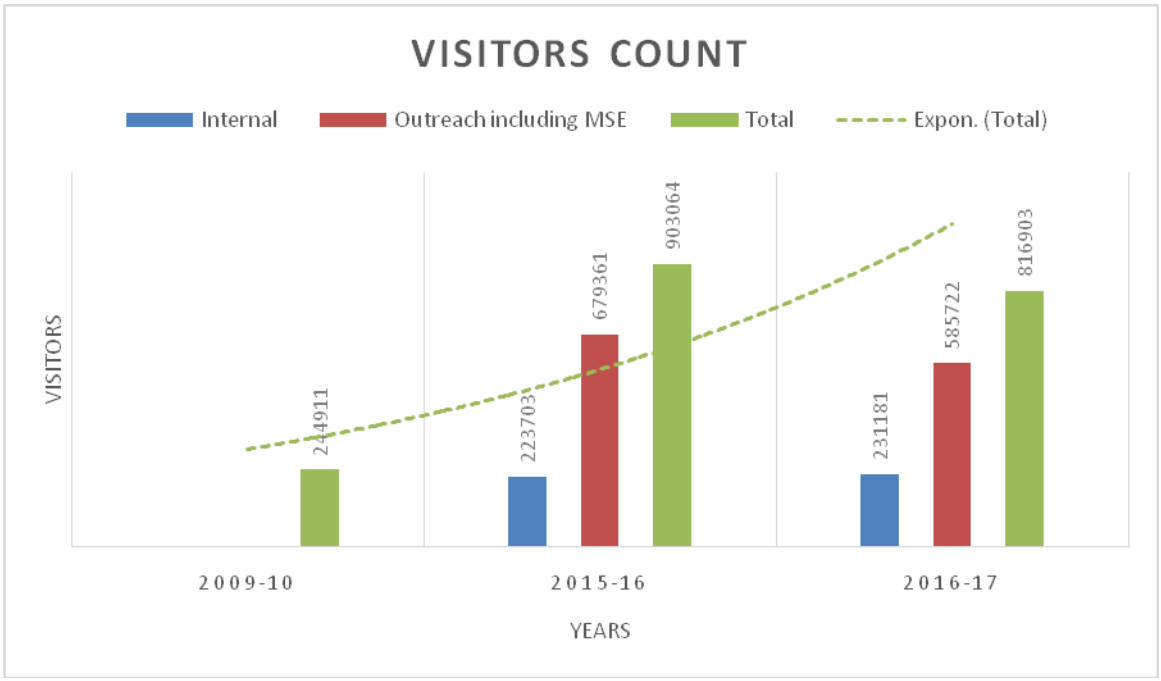
If you've ever been curious about the inner workings of a coal mine and dreamt of experiencing it firsthand, look no further than BITM. Step into the Mock-Up Coal Mine, a one-of-a-kind attraction in India, and embark on a rare and immersive journey into the depths of a real coal mine.

Inside this remarkable exhibit, you will gain a deep understanding of the inner workings of a coal mine. Experience the sensation of being surrounded by the dimly lit and hostile environment that miners endure as they extract coal from the depths of the Earth. Witness firsthand how crucial elements like air circulation and illumination are maintained to ensure the survival and productivity of miners in such challenging conditions.

Delve into the intricacies of coal cutting methods, both manual and mechanical, and grasp the processes involved in transporting coal out of the mine. Discover the engineering marvels that prevent tunnel collapse after coal excavation and learn about the essential safety measures in place to prevent fire, flooding, and roof collapse.

The Mock-Up Coal Mine offers visitors a rare opportunity to unravel the mysteries of the subterranean world. Encounter absorbing and unique facts about the coal mining industry, unveiling the lesser-known aspects that lie beneath the surface. This immersive experience brings the intriguing and unknown facets of the underground world to life, leaving visitors with a profound appreciation for the challenges faced by coal miners and the vital role coal plays in our society.

Visitors Statistics:



References

1. *Birla Industrial & Technological Museum*. (2023, June). Retrieved from Wikipedia: https://en.wikipedia.org/wiki/Birla_Industrial_%26_Technological_Museum
2. *Birla Industrial and Technological Museum*. (2023, June). Retrieved from Kolkata City Tours: https://www.kolkatacitytours.com/birla-industrial-and-technological-museum/
3. *BITM - Birla Industrial and Technological Museum, National Council of Science Museums, Ministry of Culture, Government of India*. (2023, June). Retrieved from Birla Industrial and Technological Museum: https://bitm.gov.in/
4. *BITM:: Training Programs*. (2023, June). Retrieved from BITM Kolkata: http://bitmkolkata.in/Visitors.php
5. Das, S. (2014). Presenting Abstract Ideas in Science Museums/Centres : Mathematics Gallery of BITM, Kolkata - A Case Study. *Propagation: A Journal of Science Communication*, 56-69.

Mugberia Gangadhar Mahavidyalaya Estd.-1964 Bhupatinagar

23.06.2023

Signature of Principal

Principal
Mugberia Gangadhar Mahavidyalaya