DEVELOPMENT OF STEAM PARK

PAC 23.14

Program Coordinator- Dr. Shivalika Sarkar

Program Co-Coordinator- Dr. Ashwini Garg

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Introduction`: STEAM stands for Science, Technology, Engineering, Arts and Mathematics and STEAM pedagogy encompasses various activities which involve the integration of STEAM in the classroom. As we move from STEM to STEAM, the integration of arts in STEM has been done to improve student learning, creativity and competencies. STEM was coined by the NSF (National STEAM Foundation) in the USA two decades ago and since then STEM has gained much popularity and has proved to be an effective pedagogy in enhancing student learning and achievement To improve and inculcate the 21st Century skills among the learners, arts was added to STEM and this gave birth to STEAM. Hence STEAM education promises to inculcate among the learners problem solving through innovation, creativity, critical thinking, communication, collaboration and competencies required in the real world. As National Education Policy 2020 "no hard separations between arts and STEAMs, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning"

STEAM Park will help to build child's natural curiosity and desire to create, explore, and investigate the world of early STEAM, science, technology, engineering, art, and maths (STEAM) through creative play. It will provide a natural and free environment for students to learn and familiarize with different scientific concepts. It will also provide innovative ways to communicate STEAM, learning to enthuse, entertain, initiate, excite and to know about the developments of STEAM and technology. The park will also attempt to enhance public understanding of STEAM and spread scientific literacy. It will also fulfil the need of Demonstration Multipurpose School in the RIE campus and societal needs.

Specific Objectives:

- To create STEAM learning environments to enable students for establishing connections on integration between science, technology, engineering, arts and mathematics.
- To provide atmosphere in the form of access points like working models, visual arts, charts, activities, puzzles etc. to engage students in the process of inquiry, dialogue, and critical thinking in the lines of STEAM.
- To provide facilities for hands on experience to children, teachers and teacher educators through learning by doing.
- To inculcate scientific temper and spirit of inquiry among the students.
- To build linkage between STEAM and society and promote citizen science.

Work progress in the current year

Procurement of soil and Development of the Medicinal garden –

The existing medicinal garden was further developed with addition of many new medicinal plants.

Beautification of the STEAM Park.

Around 50 pots were purchased for planting seasonal and other plants. Pots have placed in different parts of the science park. For beautification and easy approach to the Science Park area, second phase work of paver pathways was done. Below are shown the images of the work done.

List of exhibits in the STEAM Park Area

1. Magical Tap
2. Blast Furnace Model
3. Whispering Dishes
4. Infinity Well Model
5. The Archimedean Screw
6. Archimedes Experiment to Calculate the Value of (Pi)
7. Mastering the Mind Games: Mathematical Scale/Abacus/Hanoi Tower
8. World of Numbers
9. Cartesian Plane
10. Geo Board
11. Circular Geo Board
12. Catenary
13. Full Protractor (360° Protractor)
14. Euclidean Space R^3
15. Circular Disks
16. Tesseract
17. Sundial Model
18. Inclined Planes
19. Cycloid Path
20. Double Ended Cone
21. Rotating Discs
22. Set of Levers
23. Lift yourself Up (Pulley Reduces Effort)
24. Action and Reaction – Newton’s Third Law of Motion
25. Bird in a Cage
26. Pendulum Wave
27. Gyroscope
28. Newton's Cradle
29. Three-dimensional crystal structure (NaCl)
30. Newton's Disc
31. Musical Tubes
32. Hyperboloid of One Sheet
33. Centrifugal Force
34. Friction and Speed
35. Planck's Law
36. Baudhāyana Śulvasūtra (Pythagoras Theorem)
37. Vortex
38. Periscope – The Sea Telescope
39. Deoxyribonucleic acid (abbreviated DNA)
40. Periodic Table
41. Lissajous Figures

42. Resonance Strips
43. Wave Formation
44. Geodesic Dome
45. Sympathetic Swing
46. Gravity Tower
47. Naksatra Mandala
48. Rāśi Chakra (Zodiac Circle)
49. Echo Tube
50. Tug of War
51. Projectile\
52. Floating Table
53. Perception of Depth (Zebra Model)
54. Angular Momentum
55. Brachistochrone Curve
56. QR Code
57. Pi Gate
58. Sine Wave
59. Sound Waves
60. Weather Station
61. Kinetic Sculpture
62. Umbrella Planetarium
63. Nano Solar System
64. Play with Gears
65. Eclipse Simulation
66. Telescope
67. Horizontal Sundial
68. Shanku Yantra

WORKSHOP FOR DEVELOPMENT OF STEAM PARK
NOVEMBER 11 TO 20, 2024

Inauguration of the workshop


Inspection of different models by the resource persons

Following models were built during the workshop

1. Umbrella Planetarium

The Umbrella Planetarium at RIE STEAM Park offers an immersive gateway to celestial navigation, blending art and astronomy to map the Northern Hemisphere's night sky. Crafted from a standard umbrella spray-painted black to emulate the cosmos, this model is meticulously aligned with Earth's rotational axis, mirroring the orientation of the celestial sphere. The Pole Star (Polaris), situated at the tail of *Ursa Minor*, serves as the focal point, around which circumpolar constellations like *Ursa Major* and *Cassiopeia* are etched using Right Ascension (RA) and Declination (Dec) coordinates. RA lines, analogous to terrestrial longitude, radiate outward from Polaris, while Dec circles, akin to latitude, parallel the celestial equator. This precision allows visitors to grasp how ancient navigators relied on these unchanging constellations to traverse oceans and deserts.

The model also emphasizes the unique behaviour of circumpolar constellations, which never dip below the horizon in northern latitudes due to their proximity to the celestial pole. For instance, *Ursa Major* (the Big Dipper) appears to rotate counterclockwise around Polaris, a motion reflecting Earth's axial spin. Interactive sessions demonstrate how to locate Polaris using the "pointer stars" of *Ursa Major*, a technique employed by explorers for millennia. Additionally, the umbrella's curvature simulates the dome-like appearance of the night sky, fostering an intuitive understanding of celestial mechanics.

The exhibit also contextualizes the cultural and scientific significance of these constellations. For example, *Cassiopeia's* distinctive "W" shape has been interpreted as a throne, a queen, and even a celestial clock across different civilizations. By merging astronomy with history, the Umbrella Planetarium transforms abstract stellar patterns into relatable narratives, inspiring visitors to appreciate the sky as both a scientific laboratory and a cultural tapestry.

2. Eclipse Simulation

The Eclipse Simulation model at RIE STEAM Park demystifies one of nature's most awe-inspiring spectacles: the solar eclipse. In this hands-on exhibit, participants assume the role of Earth, observing a spherical Moon model and a distant Sun representation positioned distantly away at the scale (1:400 million). This scaling replicates the Sun's actual diameter and distance relative to the Moon at the small level of observation, illustrating why the two appear nearly identical in size from Earth—a coincidence central to total solar eclipses.

As visitors adjust to the Moon's position from the small circular slits near the observer, they practically realize how its shadow—comprising the umbra (total darkness) and penumbra (partial shadow)—falls on Earth (in the case of the model, the observer is the Earth). The alignment required for totality is emphasized: the Moon must be at perigee (closest orbital point) to fully obscure the Sun, while an annular eclipse occurs if the Moon is at apogee (farthest point). The model also highlights the rarity of eclipses; their occurrence hinges on the Moon's orbital tilt (5° relative to Earth's orbit), which ensures alignment only 2–5 times annually. If you are on the wrong opening circular slit, you will not see the eclipse as an observer.

A highlight is the simulation of totality, where when the Moon model is in front of the Sun model it then reveals a hidden corona, mimicking the ethereal glow visible during actual eclipses. Accompanying observations can help one understand the Sun's layered atmosphere (photosphere, chromosphere and corona) under a guided exploration of the model and also learn how the eclipses enable scientists to study solar phenomena like prominences and coronal mass ejections. Historical context is provided during interactive sessions, such as the 1919 eclipse that validated Einstein's theory of relativity by observing starlight bending around the Sun. This exhibit bridges celestial mechanics with human curiosity, showcasing how eclipses have shaped both scientific discovery and cultural mythology.

3. Nano Solar System

The Nano Solar System at RIE STEAM Park compresses the vastness of space into a comprehensible scale, reducing planetary sizes and distances by a factor of 10^{-9} (1 billionth). The Sun, represented by a 140 cm diameter sphere, dominates the centre, while Mercury—a mere 0.48 cm bead—orbits 58 meters away. This scaling reveals the staggering emptiness of space: even Saturn, 116 cm in diameter, lies 1.4 kilometres from the Sun model.

Walking the Solar Path, visitors encounter planets spaced at scaled distances: Venus (12 cm, 108 meters), Earth (12.7 cm, 150 meters), and Mars (6.8 cm, 228 meters). Gas giants like Jupiter (139 cm) and Neptune (49 cm) are positioned kilometres apart, underscoring the outer solar system's expanse. Each station features models that overlay the understanding about the planetary rotations, axial tilts, orbital velocities, relative sizes, distance in space etc. For instance, Jupiter's rapid 9.9-hour spin contrasts with Venus's sluggish 243-day rotation, prompting discussions on gravitational influences and angular momentum.

The exhibit also addresses scale challenges. While planet sizes are accurately reduced, their orbital paths are linearized for practicality, as true elliptical orbits would require vast areas. Informational panels compare scaled measurements to real-world analogues; for example, the Sun's nano-scale density (1.41 g/cm^3) matches a lightweight foam ball, whereas Earth's density (5.52 g/cm^3) resembles solid granite. By translating astronomical abstractions into tangible metrics, the Nano Solar System fosters appreciation for humanity's place in the cosmos.

Facts on Display put near the Sun

Our Sun

Characteristic	Sun
Diameter (km)	1,391,000
Mass (kg)	1.989×10^{30}
Density (g/cm^3)	1.41
Surface Gravity (m/s^2)	274

Escape Velocity (km/s)	617.7
Axial Tilt (°)	7.25
Rotational Period	~27 days
Direction of Rotation	Prograde

Facts on Display on Nano Solar Path – Circle 1 Details

The Terrestrial Planets

Characteristic	**Mercury**	**Venus**	**Earth**	**Mars**
Diameter (km)	4,880	12,104	12,742	6,779
Mass (kg)	3.30×10^{23}	4.87×10^{24}	5.97×10^{24}	6.42×10^{23}
Density (g/cm³)	5.43	5.24	5.52	3.93
Surface Gravity (m/s²)	3.7	8.87	9.8	3.71
Escape Velocity (km/s)	4.25	10.36	11.19	5.03
Orbital Period (days)	88	225	365	687
Axial Tilt (°)	0.034	177.4	23.5	25.2
Rotational Period	58.6 days	243 days	24 hours	24.6 hours
Natural Satellites	None	None	1 (Moon)	2 (Phobos, Deimos)

Facts on Display on Nano Solar Path – Circle 2 Details

Jovian Planets

Characteristic	**Jupiter**	**Saturn**	**Uranus**	**Neptune**
Diameter (km)	139,820	116,460	50,724	49,244
Mass (kg)	1.90×10^{27}	5.68×10^{26}	8.68×10^{25}	1.02×10^{26}
Density (g/cm³)	1.33	0.69	1.27	1.64

Surface Gravity (m/s²)	24.79	10.44	8.87	11.15
Escape Velocity (km/s)	59.5	35.5	21.3	23.5
Orbital Period (years)	11.86	29.46	84.02	164.79
Axial Tilt (°)	3.13	26.7	97.8	28.3
Rotational Period	~9.9 hours	~10.7 hours	~17.2 hours	~16.1 hours
Natural Satellites	95 (e.g., Io, Europa, Ganymede, Callisto)	145+ (e.g., Titan)	27 (e.g., Miranda, Titania)	14 (e.g., Triton)

4. Horizontal Sundial

The Horizontal Sundial at RIE STEAM Park revives ancient timekeeping artistry, demonstrating how solar motion dictates earthly rhythms. A triangle shaped gnomon casts shadows onto a iron dial plate inscribed with hour lines and seasonal markers. Aligned to true north via Polaris, the sundial's design incorporates local latitude (23.25°N for Bhopal), ensuring the gnomon's angle matches the site's geographic position.

As the Sun arcs across the sky, the gnomon's shadow sweeps clockwise, marking solar noon when shortest. Discrepancies between solar time and standard time are explained through longitudinal adjustments (Bhopal's 77°E longitude vs. India's 82.5°E standard meridian) and the equation of time, which accounts for Earth's elliptical orbit and axial tilt. Seasonal variations are highlighted for the observer during discussion as the Sun's higher summer path shortens shadows, while winter's lower angle elongates them.

Historical discussion trace sundial evolution from Egyptian obelisks (3500 BCE) to Greco-Roman hemicycles, emphasizing their role in agrarian societies and religious rituals. An interactive component lets visitors calculate local time using shadow angles, applying trigonometry to derive hour values. This blend of history, geometry, and astronomy underscores humanity's enduring quest to harmonize with celestial cycles.

5. Shanku Yantra

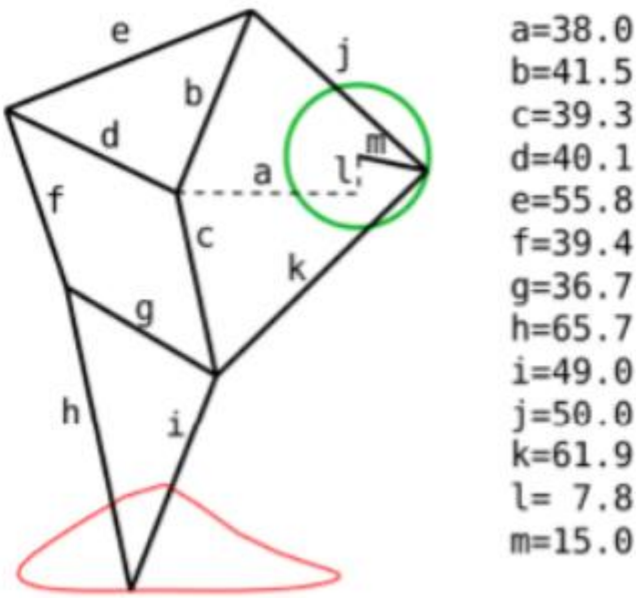
The Shanku Yantra, a centrepiece of RIE STEAM Park's ancient astronomy section, showcases India's pioneering contributions to celestial science. This gnomon-based instrument—a 50 cm vertical rod (Shanku) atop a circular masonry platform—harnesses shadow geometry to determine latitude, solar zenith, and local time. At solar noon, the shadow's length (Chhaya) and direction yield the Sun's declination, enabling calculation of Bhopal's latitude (23.25°N) with remarkable precision.

Referencing treatises by Aryabhata (5th century CE) and Bhaskara II (12th century CE), the exhibit explains how the Shanku Yantra solved complex problems like Earth's circumference and solar trajectory. For instance, shadow ratios during equinoxes and solstices allowed astronomers to deduce the Sun's angular tilt (23.5°), later formalized as the axial tilt. Interactive modules guide visitors through trigonometric calculations: zenith distance (z) is derived from z = arctan (shadow length/Shanku height), while solar altitude (90°−z) reveals seasonal variations.

Cultural context is woven into the narrative, linking the Yantra to Vedic rituals and temple architecture. Many Indian temples, integrated shadow principles to align with solstices. By resurrecting this ancient tool, the exhibit celebrates India's legacy of merging empirical observation with mathematical rigor, inspiring future generations to explore the skies through both tradition and innovation.

6. Four legged mechanical robot

Four legged mechanical robot demonstrates the walking movement to show the kinematics of the Jansen linkage. The Jansen linkage is an eleven-bar mechanism designed by Dutch artist Theo Jansen in his collection "Strandbeest." The mechanism is crank driven and mimics the motion of a leg. Its scalable design, energy efficiency, and deterministic foot trajectory show promise of applicability in legged robotics. Because the linkage has been recently invented within the last few decades, walking movement is currently the primary application. The Jansen linkage demonstrates an exceptional use of a combination of four-bar linkages using one motor/ crank to move the entire leg.



7. Kinetic sculpture

Kinetic sculpture refers to artworks that incorporate movement as a key element of their design. Unlike traditional static sculptures, kinetic sculpture comes to life through motion, engaging viewers in an immersive and interactive experience. These sculptures harness various mechanisms, technologies, and materials to create a dynamic visual narrative. By rotating the pattern in opposite direction using handle, the viewer can see beautiful patterns. This type of kinetic art either moves or creates the illusion of movement.

Kinetics is typically achieved through the use of air, wind, water, magnetism, or electric motors.

8. Coordinate Geometry

Coordinate Geometry describes the link between geometry and algebra through graphs involving curves and lines.

Here the Cartesian plane is provided with 4 quadrants and 4 dice where minimum 2 players and maximum 4 players are needed. The blue dice are considered as positive and red dice are considered as negative. Each player need to select the quadrant and based on the selected quadrant they'll throw the dice for e.g.

Quadrants	Dice 1	Dice 2
Quadrant 1	Blue (+)	Blue (+)
Quadrant 2	Red (-)	Blue (+)
Quadrant 3	Red (-)	Red (-)
Quadrant 4	Blue (+)	Red (-)

Based on the coordinates obtained after rolling two dice by each player, the player will reach to that coordinate and considering it as origin the next round will be played. The one who will reach at the coordinate (6,6) first will be considered as a winner.

9. Align the arrows

This STEAM based game is designed to promote game based learning. Here the player needs to align all the three arrows in same direction again in minimum time (provided all the arrows should be aligned in same direction initially) by selecting any one handle among A,B and C.

Solution of the game: Taking gear 1,2, 3 as A,B,C which has 12, 36,60 teeth respectively. Ratio of A: B: C will be 1:3:5 which give the relationship among the number of rotations of all the 3 gears. Taking the LCM of A, B and C, we will get LCM as 15. Divide LCM by A, B and C we will get ratio as 15:5:3 which means that in 15 rotations of A or 5 rotations of B or 3 rotations of C all the three arrows will come again in same direction. Hence the puzzle will be solved in minimum time with these mathematical calculations.

10. Telescope

Telescope was assembled using the following items:

1:- Parabolic primary mirror

Front coated with aluminium

Diameter 125mm

Focal lengths 900mm

Resolution 1 second of arch

2:- Primary mirror holder

3:- 30mm elliptical flat, front coated secondary mirror.

4:- Secondary mirror holder.

5:- Finder telescope 30×7.

6:- Finder telescope holder.

7:- Fork mount (altazimuth).

8:- Tripod stand.

9:- 140mm outer diameter PVC pipe (4kg pressure).

10:- rack and pinion focuser (1"/1.25" inch).

11:- eyepieces 25mm, 10mm.

12:- Barlow lens 3×.

Models built during the earlier workshops

1) Sine Wave

The "**Sine Wave"** model is a model for understanding how science works in a scientific research park. It is based on the idea of a sine wave, which is a wave that oscillates from one extreme to the other and back again. The model suggests that scientific research parks should be designed so that each element of the park is connected to each other in a dynamic, cyclical fashion. This means that each element is connected to the others in such a way that it influences each other and is also influenced by them in turn. This creates a cycle of innovation and learning, which can be used to create a more efficient and effective research park. The model also includes the concept of conversion of potential energy into kinetic energy.

Place the ball at the top of the path provided and allow it to roll. Observe if the ball crosses all the peaks. Observe how potential energy is converted into kinetic energy and back.

2) Sound Wave Drum

The Sound Wave Drum is a unique piece of equipment designed in STEAM Park. There are two large drums facing each other. The user can control the sound waves and create their own music with the drum. Hit one drum with the stick and see how the thread attached to the other drum moves. It is a great way for people to explore the science of sound and music in a fun and creative way.

3) Set of Levers

The devices which were equipped for making the processes like lifting, and moving heavier objects from one position to another position are known as levers. Such a lever helps mankind to perform the task more easily with the application of less force. The very first time when the lever was invented, Archimedes, the ancient scientist, and mathematician was the person behind this invention. In 5000 BC, the earliest evidence of the lever mechanism was found near East Circa and it was used as a simple balance scale.

The lever of the first order belongs to that category where the fulcrum is located between the load and the effort. In this first order of lever, if the distance between the fulcrum and load is smaller, then less effort is required to move the load for a shorter distance. If the distance between the effort and fulcrum is more, then the load will move for a larger distance. Examples of the lever which belong to the first order are scissors, see-saws, etc.

In our daily life, there are many practical applications where the lever is used. Such practical applications are scissors, bottle openers, shovels, nutcrackers, etc.

Designing:

A lever was a type of simple machine that was used for the amplification of physical force. A complete system that comprised a lever mechanism was called a lever system. Simple machines were known for making the process easier and more efficient. In the lever system, there were major components, i.e., a rigid beam and a fulcrum. In a lever, the fulcrum was that fixed point about which the beam moved on the application of force at any one end of the beam.

For the proper functioning of the lever, an input force (effort) was applied at one end of the beam to get an output force (load) at the other end about that pivoted point (fulcrum). The lever was used in various applications which answered those queries like where the lever was used. Examples of the lever were a wheelbarrow, stapler, weighing machine, hockey stick, hammer, etc.

There were five major components of the lever system which were shown below:

- **Effort Arm:** distance of input force from the fixed point;
- **Load Arm (Resistance Arm):** distance of output force from the fixed point;
- **Fulcrum:** Fixed point of the lever;
- **Effort:** The input force applied on the lever;
- **Load:** The output force obtained after applying effort.

First Order Lever contains a bar which is supported at its stationary point or fulcrum as per its length wise. It is utilized to control the resistance at second point when a force is applied on it at a third point. This equipment demonstrates several mechanical aspects of a first order lever having different fulcrum distances from weight. By moving the fulcrum closer to the heavy end, you were able to use the lever to help you raise the heavier object when you placed a lighter one on the opposite end.

Principle:

Principle of a lever is when two equal forces are applied on an uniform lever in reverse directions i.e. anti clockwise and clockwise, then the applied force generates a state of equilibrium on the applied lever.

A typical system works on the principle of moments. In the context of the lever system, this principle states that the moment of effort about the fulcrum will be equal to the moment about the load about the fulcrum in the equilibrium condition.

4) Naksatra Mandala

The ancient Indians, after a thorough scan of continuous environmental & climatic changes around them noted a systematic and cyclically rotational pattern over a certain interval of time. In this process they took the references of so-observationally fixed 27 stellar *nakṣatra* groups (related to star asterisms) and in their backdrop observed the motion of Earth & Planets. *Vedāṅga Jyotiṣa* and even earlier texts like *Taittirīya Brāhmaṇa*, *Atharva Samhitā* list 27/28 *nakṣatra*. A *nakṣatra* is defined as, "*Na kṣarati Tata nakṣatra*," meaning, "that which does not leave its original place or is fixed in the sky." *Nakṣatra* refer to the 27 equal spaces into which the zodiac can be divided, each space being 360°/27 = 13°20′ wide over the celestial sphere. Each *nakṣatra* is also divided into quarters or padas of 3° 20'. Each sector space of a *nakṣatra* is distinguishably identified using the *yogatārā* (the prominent star or asterisms in or near the respective sectors) after which it is named.

The importance of these sectors of a region of a definite star field called *Nakshatra*s lie in the periodic manner with which the Moon makes a traversal over them. This makes them the counter of time just like the hands of clock pass over the numbers, similarly Moon travels over them cyclically. In Indian Hindu traditions, on that particular Day of the Full

Moon whichever is the *nakṣatra* which the Moon transits, the name of the month is derived from there. Correspondingly, Indian lunar months are: *Caitra, Vaisākha, Jyeshtha, Āshāda, Shrāvana, Bhādrapada, Āswin Kārtika, Mārgasirsa, Paush, Māgha, Phālguna*.

Designing the Model:

The *Nakṣatra Mandala* features the Moon at the centre, symbolizing its pivotal role in the lunar calendar. Encircling the moon is a circular pathway. At the periphery of this path, 28 marker representative sections depict the *nakṣatras*, each adorned with associated visual astronomical information, names in Hindi and English, and their associated stars. This meticulous design allows visitors to embark on an interactive exploration of the lunar mansions. They can also visualize approximately the Moon transiting the *nakṣatra* in a cyclical manner. The 12 *nakṣatra* after which the Indian lunar months have been named are marked distinctively in a separate colour scheme.

Nakṣatra as per Indian Traditions

1. *Aśvini* (अश्विनी)- Associated stars: *β and γ Arietis*,
2. *Bharani* (भरणी)- Associated stars: *35, 39, and 41 Arietis*,
3. *Kṛttikā* (कृत्तिका)- Associated stars: *Pleiades*,
4. *Rohiṇi* (रोहिणी)- Associated stars: *Aldebaran*,
5. *Mṛgaśīrā* (मृगशीर्षा)- Associated stars: *λ, φ Orionis*,
6. *Ārdrā* (आर्द्रा)- Associated stars: *Alhena*,
7. *Punarvasu* (पुनर्वसु)- Associated stars: *Castor and Pollux*,
8. *Puṣya* (पुष्य)- Associated stars: *γ, δ and θ Cancri*,
9. *Āśleṣā* (अश्लेषा)- Associated stars: *δ, ε, η, ρ, and σ Hydrae*,
10. *Maghā* (मघा)- Associated stars: *Regulus*,
11. *Pūrva Phalgunī* (पूर्व फाल्गुनी)- Associated stars: *δ and θ Leonis*,
12. *Uttara Phalgunī* (उत्तर फाल्गुनी)- Associated stars: *Denebola*,
13. *Hasta* (हस्त)- Associated stars: *α, β, γ, δ and ε Corvi*,
14. *Chitrā* (चित्रा)- Associated stars: *Spica*,
15. *Svātī* (स्वाति)- Associated stars: *Arcturus*,
16. *Viśākhā* (विशाखा)- Associated stars: *α, β, γ and ι Librae*,
17. *Anurādhā* (अनुराधा)- Associated stars: *β, δ and π Scorpionis*,
18. *Jyeṣṭhā* (ज्येष्ठा)- Associated stars: *α, σ, and τ Scorpionis*,
19. *Mūla* (मूल)- Associated stars: *ε, ζ, η, θ, ι, κ, λ, μ and ν Scorpionis*,
20. *Pūrva Āṣāḍhā* (पूर्वाषाढ़ा)- Associated stars: *δ and ε Sagittarii*,
21. *Uttara Āṣāḍhā* (उत्तराषाढ़ा)- Associated stars: *ζ and σ Sagittarii*,
22. *Abhijit* (अभिजित) Associated stars: *ζ and σ Lyrae*,
23. *Śravaṇa* (श्रवण)- Associated stars: *α, β and γ Aquilae*,
24. *Dhaniṣṭhā* (धनिष्ठा)- Associated stars: *α to δ Delphini*,
25. *Śatabhiṣa* (शतभिषा)- Associated stars: *Sadachbia*,
26. *Pūrva Bhādrapada* (पूर्वभाद्रपदा)- Associated stars: *α and β Pegasi*,
27. *Uttara Bhādrapada* (उत्तरभाद्रपदा)- Associated stars: *γ Pegasi and α Andromedae*,
28. *Revatī* (रेवती)- Associated stars: *ζ Piscium*.

Abhijit is not a regular *Nakshatra* with four *padas* (quarters) and mostly serves as an intercalary asterism.

5) Rāśi Chakra (Zodiac Circle)

For centuries, humans have gazed at the night sky, weaving stories and myths around the constellations. Among these stories, the zodiac system stands out, dividing the ecliptic plane (the apparent path of the Sun) into twelve equal sections, each associated with a constellation. From an Indian perspective too, *Pañcāṅgam (the Indian Almanac)* apart from its traditional five limbs or divisions, has got one more striking feature of *rāśi* (zodiac). An imaginary belt of 360 degrees along the ecliptic extending between approximately 8° north-south of the ecliptic, under whose backdrop the Sun, the Moon and the planets move, divided into 12 equal parts (360°/12=30°) is called a *rāśi*. Just as a caution it should be noted that the Indian *Jyotiṣa* and Western zodiacs differ in methods of measurement as Indians use the *Nirayana* (sidereal zodiac) while the Western counterparts use *Sāyana* (tropical zodiac). One more fact to note is, under the 1930 IAU constellation boundaries in modern context, *Ophiuchus* constellation is also referred to as "*13th sign of the zodiac"*.

Designing the Model:

The *Rāśi Chakra* (Zodiac Circle) is a circular model with the Sun positioned at its centre. Surrounding the Sun is circular pathway with a wider band at its periphery divided into 13 sections (not as apparently spaced in the visible sky), each representing a zodiac sign. The individual sections showcase the constellation's figure, an artistic sketch, its official International Astronomical Boundaries (IAU boundaries), and the name in both Hindi and English. This design allows visitors to walk along a designated pathway between the Sun and the zodiacs, engaging them in a physical exploration of the celestial sphere.

6) Weather Station

Wind Vane –

A wind vane is mounted on a shaft or spire that is elevated off the ground. The wind catches the rudder blade and makes it rotate. The narrow end of the vane points into the wind and tells you the direction the wind is coming from.

The wind vane measures the direction of the wind. Knowing the direction the wind is blowing is important for meteorologists. It provides information about storm systems and what you can expect soon. Wind direction readings can help indicate where a pressure center is located. Wind direction is important in predicting the direction of wildfire flames and smoke, or hazardous material spills. Mariners and those who operate sailboats also need to know wind direction information. The aviation industry relies on them in many ways. It is also important for those in the construction industry, especially when working on high-rise buildings that use cranes.

Rain Gauge and maximum minimum thermometer will be added to the weather station in future.

7) π-Gate

Standing proudly at the entrance of STEAM Park, the π - Gate is more than just a decorative entryway. Its design embodies the very essence of STEAM (Science, Technology, Engineering, Art, and Mathematics) – a beautiful union of mathematical principles, engineering ingenuity, and artistic flair. "π" (pi), representing the ratio of a circle's circumference to its diameter, with its never-ending decimal representation, embodies the concept of infinity and the vastness of the scientific world, and a symbolic reminder of the endless possibilities. By incorporating this symbol into the STEAM Park entrance, the gate encourages visitors to embrace curiosity, explore the unknown, and appreciate the elegance and interconnectedness of scientific principles.

The π – Gate's design is a captivating interplay of geometry and nature while giving a graceful look to the entrance. Crafted from iron, its frame forms the iconic π symbol. This mathematical abstraction is brought to life by the addition of vibrant plants carefully chosen and arranged within the frame. The verdant foliage adds a touch of organic beauty and symbolizes the interconnectedness of science and nature.

It serves as a powerful symbol, encouraging visitors to explore the exciting world of STEAM. Remember, the pursuit of knowledge is a lifelong journey, and STEAM Park, with its symbolic π – Gate, welcomes you to embark on that exciting adventure!

8) Magical Tap

The magical tap illusion has been adapted and reimagined by artists, designers, and engineers to create innovative installations and interactive experiences. With advancements in technology and special effects, modern interpretations of the magical tap illusion can be found in museums, theme parks, and other entertainment venues. The magical tap is a clever illusion. It consists of a faucet mysteriously hovering above a pool or basin with an endless supply of water gushing out of it from seemingly nowhere.

Designing:

This spectacular effect is achieved by a transparent tube in the middle of the water column that holds the tap in place and, at the same time, keeps feeding it with water pumped from below. The water goes up through the tube and exits at the top. The water column, which is usually turbulent, effectively hides the tube from view. The illusion works best when the supporting pipe is transparent.

Principle:

The magical tap illusion usually starts with requirement of a water source. The water source can be a tank, a container, or even a pipe connected to a water supply. A water pump is used to create pressure and push water from the hidden source to the faucet. The pump is typically located within or near the water source and is powered by electricity. The pump's power and flow rate are adjusted to control the volume and speed of the water flow. Transparent tubing, such as clear plastic or glass, is used to connect the water source to the faucet. The tubing is carefully concealed or integrated into the structure of the illusion to give the appearance that water is magically flowing through the air. The key to the magical tap illusion lies in creating the optical illusion that water is flowing freely from the faucet without any visible support. This is achieved by carefully positioning the tubing and arranging the surrounding environment to hide the tubing from view. The faucet itself is often designed to look convincing and realistic, resembling a traditional water tap. The faucet is positioned in such a way that it appears to be suspended in mid-air, further enhancing the illusion.

9) Blast Furnace Model

Blast furnaces are used to produce pig iron from iron ore for subsequent processing into steel; they are also employed in processing lead, copper, and other metals. The current of pressurized air maintains rapid combustion. Blast furnaces were used in China as early as 200 BC, and appeared in Europe in the 13th century, replacing the bloomer process. Modern blast furnaces are 70–120 ft (20–35 m) high, have 20–45-ft (6–14-m) hearth diameters, use coke fuel, and can produce 1,000–10,000 tons (900–9,000 metric tons) of pig iron daily.

Designing:

The blast furnace is a large cylindrical structure made of steel plates and lined with refractory bricks. The size of the furnace depends on production requirements and can range from small-scale to large-scale installations. This model has been made using clay and is self-explanatory with all the important zones marked in the model.

Principle:

In the Blast Furnaces liquid iron is produced by the process of reduction at high temperature from raw materials like iron ore, base mix, sinter, coke, fluxes (limestone / quartzite), etc. and also air blast / O2. In blast furnace the process is also known as "Counter current process" as solid raw material is being charged from the top and hot air is being blown from bottom. During the process the impurities are removed in the form of slag and hot metal is produced. Liquid metal and slag are being separated in the area known as cast house. The liquid Hot Metal is transported in Hot Metal Ladles / Torpedoes to the Steel Melting Shops (SMS) for the production of steel by the process of oxidation of the Hot Metal in specially designed Convertors.

10) Whispering Dishes

A "whispering dish" model in a science park could be a fascinating exhibit demonstrating the principles of sound propagation, reflection, and focusing. Whispering dishes, also known as whispering galleries or whispering arches, have a fascinating history that spans centuries. These architectural marvels exploit the principles of sound propagation and reflection to allow whispers to travel long distances with remarkable clarity. The concept of whispering dishes dates back to ancient civilizations. One of the earliest known examples is the "Whispering Wall" in the Temple of Heaven complex in Beijing, China, constructed during the Ming Dynasty in the 15th century. It features a circular wall where whispers spoken at one end can be heard clearly at the opposite end, over 65 meters away.

Designing:

The Whisper Dishes are parabolic dishes, meaning they are curved in the shape of a parabola. Parabola-shaped dishes collect, focus and amplify wave signals, including light waves, radio waves and sound waves. The circle at the center of the dish is the focal point. Make a feeble sound such as shaking a bunch of keys or coins in front of the ring, the focus of the Dish. The listener, standing in front of the focus of the other dish hears the sound very clearly.

Principle:

The effect is due to the parabolic shape of the dishes and the positions of the speaker and the listener. They have to be stationed at the foci of the parabolic dishes. The waves reflected by the speaker's dish are brought to a focus by the other dish. Whisper a message standing at a particular position in front of one of the discs. The listener, standing in front of the other disc very clearly hears the whisper while no one standing in the path of the two discs can hear the sound.

11) Infinity Well Model

The Infinity Well Model is an intriguing optical device that creates the illusion of an infinitely deep well by ingeniously employing the principles of reflection. This captivating exhibit traces its origins to early experiments in optics during the 18th century. Inspired by the wonders of light and reflection, pioneers like Étienne-Gaspard Robert, also known as "Robertson," laid the foundation for this mesmerizing visual spectacle.

Designing:

The design of the Infinity Well Model centers on a precisely crafted frame, typically cylindrical or rectangular in shape, with mirrored surfaces lining the inner walls. These mirrors are strategically positioned to reflect an object's image, creating a seemingly endless succession of reflections that appear to recede into the distance. This thoughtful arrangement of mirrors evokes a sense of depth and intrigue, captivating the observer's imagination.

Principle:

At the heart of the Infinity Well Model lies the principle of multiple reflections. When an object is placed within the well, the mirrored surfaces bounce light back and forth, creating an optical illusion of an infinite series of replicated images. Each reflection appears smaller and farther away, giving the impression of a bottomless abyss.

12) The Archimedean Screw

Step back in time and discover the marvel of the Archimedes Screw! This ingenious invention, attributed to the legendary Greek mathematician Archimedes around 250 BC, wasn't just a product of its time. It's a testament to human ingenuity and remains relevant even today. Imagine a long, spiral-shaped ramp winding its way up from a lower body of water to a higher one. Water seemingly defying gravity, gently flowing upwards as the ramp rotates. This ingenious invention is the Archimedean Screw, a hydraulic machine with a surprisingly long and fascinating history. Originally used for lifting water for irrigation and drainage, the Archimedes Screw's simple yet effective design has stood the test of centuries.

Designing:

The Archimedes Screw features a spiral-shaped screw enclosed within a tube. As the screw rotates, it scoops water from the lower end and gently lifts it upwards through the tube. The model at STEAM Park showcases this ingenious design, using clear materials to allow visitors to observe the water flow. The rotation can be manual or powered by a small motor, highlighting the versatility of the concept.

Principle:

The Archimedes Screw operates based on the principles of inclined planes and displacement. As the screw rotates, each section acts as an inclined plane, pushing the water upwards. To elaborate the process, as the screw rotates, each section acts like a ramp, scooping up water at the bottom and gently pushing it upwards along its inclined path. The water essentially travels along the screw's thread, rising with each rotation until it reaches the top. The enclosed tube prevents backflow, ensuring efficient water movement. The model at STEAM Park demonstrates this principle in action, allowing visitors to gain a hands-on understanding of the underlying science.

13) Archimedes Experiment to Calculate the Value of π (Pi)

For centuries, mathematicians have been fascinated by the elusive number π (pi). Representing the ratio of a circle's circumference to its diameter, π holds immense significance in various fields, from geometry and engineering to physics and astronomy. But how do we measure the seemingly immeasurable? Enter the brilliant mind of Archimedes, a 3rd-century BC mathematician who devised an ingenious experiment to approximate π's value. This interactive STEAM Park model brings his groundbreaking work to life, allowing you to delve into the fascinating world of circles and calculations.

Principle:

Archimedes did not explicitly use the concept of π (pi) as we know it today, but he made significant contributions to understanding the relationship between the circumference and diameter of a circle. Archimedes' brilliance lay in the concept of "exhaustion." Archimedes used a method of inscribing and circumscribing regular polygons around a circle to approximate its circumference. This process, often known as the method of exhaustion, laid the foundation for later developments in calculus.

Here's a simplified version of Archimedes' method to approximate π:

- **Inscribe a regular polygon inside the circle:** Start with a regular polygon (like a hexagon) inscribed inside the circle. The vertices of the polygon should touch the circle.

- **Circumscribe a regular polygon outside the circle:** Draw another regular polygon outside the circle, with its sides as tangent to the circle.

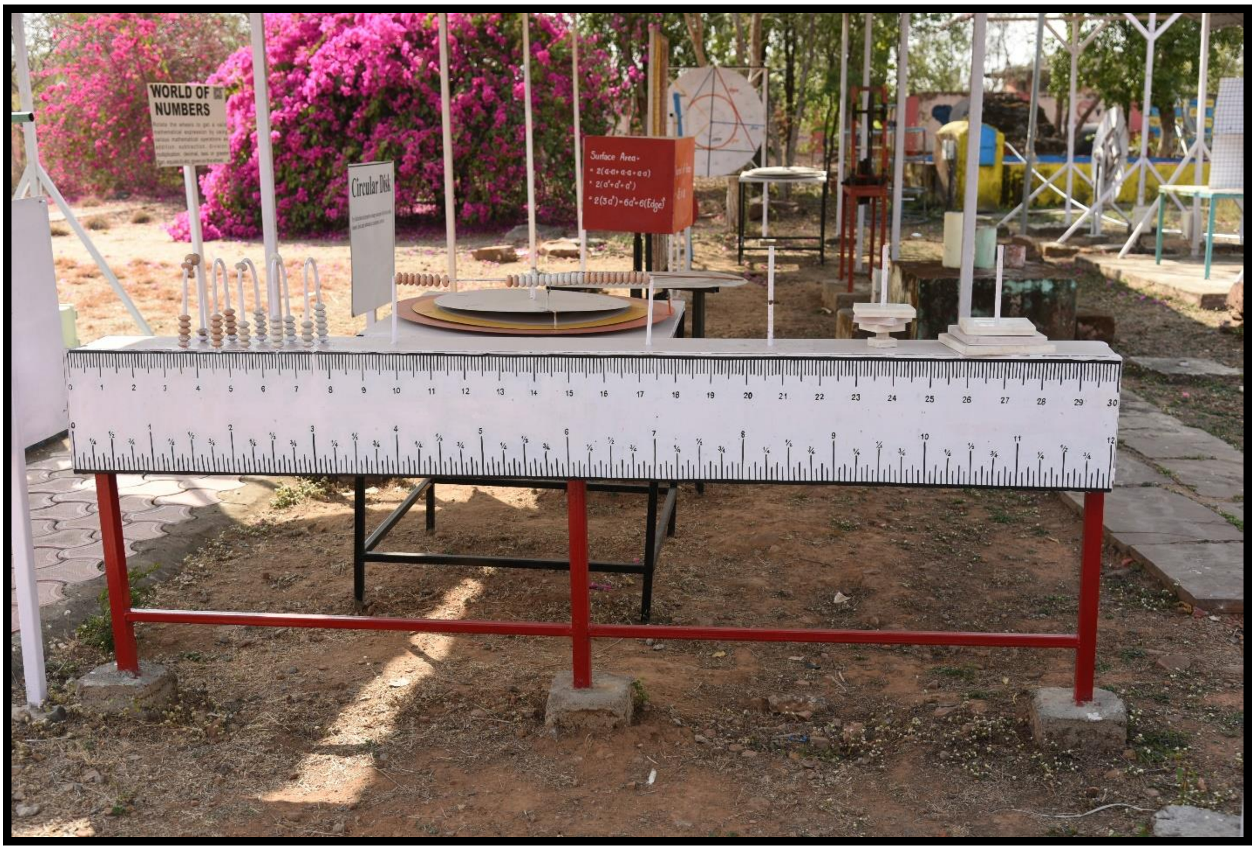
- **Calculate the perimeters of both polygons:** The perimeter of the inscribed polygon will be a lower bound for the circumference of the circle, and the perimeter of the circumscribed polygon will be an upper bound.

- **Repeat the process with polygons of more sides:** As you increase the number of sides in your polygons, the perimeters of both the inscribed and circumscribed polygons will get closer to the circumference of the circle.

The key idea is that the actual circumference of the circle is between the perimeters of the inscribed and circumscribed polygons. Archimedes used polygons with a very large number of sides to get very close approximations. Archimedes computed the perimeters, ultimately proving that $22/7 < \pi < 223/71$, an impressive feat for his time!
While Archimedes' method wasn't algebraic and didn't directly involve the symbol π, it was a precursor to later mathematical developments that led to the definition of π. Today, we use calculus to express the relationship between a circle's circumference and diameter, and that relationship is π. Archimedes' insights were ground breaking and laid the groundwork for these later developments.

14) Mastering the Mind Games: Mathematical Scale/Abacus/Hanoi Tower

This seemingly simple model boasts a rich history spanning continents and centuries. The Abacus, its bead-based ancestor, traces its roots back to Mesopotamia around 2400 B.C., serving as a powerful tool for calculations. The Hanoi Towers, invented in 1883 by French mathematician Édouard Lucas, emerged as a captivating puzzle, later inspiring computer scientists and mathematicians alike. This model beautifully merges these concepts, offering a tangible experience of mathematical principles.



Principle:

The Mathematical Scale/Abacus/Hanoi Tower operates on the fundamental concepts of positional notation and movement restrictions. Positional notation, used in most modern numeral systems, assigns increasing values to digits depending on their position. The beads on the rods represent these values, allowing for visual manipulation of numbers. The Hanoi Tower imposes the rule that a larger bead cannot be placed on top of a smaller one, adding a layer of logical deduction to the puzzle.

A. Mathematical scale

Here the term Mathematical Scale stands for "number scale": In elementary mathematics, a number scale is often represented by a number line. It's a straight line with numbers placed at regular intervals, allowing for the visualization of numerical values and their order.

B. Abacus

The abacus is an ancient calculating tool that has been used for centuries to perform arithmetic operations. It consists of a series of rods or wires, each containing beads that can be moved back and forth. The beads represent different values, and the position of the beads on the rods determines the value of the number being represented.

The basic structure of an abacus typically includes the following components:

- **Beads:** The beads are moved along the rods to represent numbers. In a standard abacus, there are different rows of beads, each representing a different place value.

- **Rods or Wires:** The rods or wires hold the beads in place. Each rod represents a specific place value, and the rods are often arranged in a vertical orientation.

- **Divider:** A bar or line is often placed between sets of beads to help distinguish between different place values.

- **Frame:** The beads and rods are typically mounted on a frame, which provides structure and stability to the abacus.

The abacus can be used for addition, subtraction, multiplication, and division. The process involves moving the beads to perform the desired arithmetic operation. The position of the beads on the rods represents the numerical value.

Abaci (plural of abacus) have been used in various cultures and civilizations throughout history, including ancient China, Greece, Rome, and the Middle East. Different cultures developed variations of the abacus, but the fundamental principle of using movable beads for calculation remained the same. While modern electronic calculators and computers have largely replaced the abacus in everyday use, it still holds cultural and educational significance. Some people continue to use the abacus as a teaching tool for arithmetic concepts, as it provides a tangible and visual way to understand mathematical operations. Additionally, the abacus is sometimes used in competitions to test the speed and accuracy of mental arithmetic.

C. Hanoi Tower

The Tower of Hanoi is a classic problem in the field of computer science and mathematics. It was introduced by the French mathematician Edouard Lucas in 1883 and has since become a popular problem in algorithmic theory and computer science education.

Problem Statement: The Tower of Hanoi consists of three pegs and a number of disks of different sizes which can slide onto any peg. The puzzle starts with the disks in a neat stack in ascending order of size on one peg, the smallest at the top, thus making a conical shape.

The objective is to move the entire stack to another peg, obeying the following simple rules:

- Only one disk can be moved at a time.
- Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack or on an empty peg.
- No disk may be placed on top of a smaller disk.

15) World of Numbers

Think mathematics is dull and complicated? Think again! "World of Numbers" at STEAM Park is a unique model designed to revolutionize your understanding of basic mathematical operations. This interactive display, crafted using repurposed bicycle wheels, takes you on a captivating journey through addition, subtraction, multiplication, and division, all guided by the golden rule of BODMAS (Brackets, Orders, Division/Multiplication, Addition/Subtraction). Whether you're a curious young mind or a seasoned learner, "World of Numbers" promises an engaging and unforgettable experience.

Designing the Model

The "World of Numbers" model is a testament to creativity and resourcefulness. Its core components are repurposed bicycle wheels, skillfully fabricated to represent numbers and their operations. It is a working model to explain about basic mathematical operation between numbers as addition, subtraction, multiplication, division etc. based on the concept of BODMAS. With the help of such model students can understand the general concepts of basic operations and get fun also.

16) Cartesian Plane

Imagine a world without maps, where navigating even familiar streets becomes a daunting task. Thankfully, we have the ingenious invention of coordinate systems, like the Cartesian plane, which helps us pinpoint any location with precision. Developed by French mathematician René Descartes in the 17th century, this system revolutionized geometry and continues to be a cornerstone of mathematics, science, and engineering. The Cartesian plane is a two-dimensional coordinate system used to locate points in space. It is formed by the intersection of two perpendicular lines, often referred to as the x-axis (horizontal) and the y-axis (vertical). The point where the axes intersect is known as the origin, denoted as (0, 0).

Principle Features:

Here are some key features of the Cartesian plane:

1. Axes:

- **X-Axis (Horizontal Line):** Represents the horizontal dimension. Points to the right of the origin have positive x-values, while points to the left have negative x-values.

- **Y-Axis (Vertical Line):** Represents the vertical dimension. Points above the origin have positive y-values, and those below have negative y-values.

2. Quadrants:

- The plane is divided into four quadrants, numbered counterclockwise from the upper-right quadrant as Quadrant I to the upper-left, lower-left, and lower-right as Quadrants II, III, and IV, respectively.
- The signs of the coordinates (x, y) in each quadrant follow specific rules. For example, in Quadrant I, both x and y are positive.

3. Coordinates:

- A point on the plane is represented by an ordered pair (x, y), where x is the horizontal coordinate and y is the vertical coordinate.
- The distance between the point and the axes is measured along the gridlines parallel to the axes.

4. Distances and Slopes:

- The distance between two points (x_1, y_1) and (x_2, y_2) is given by the distance formula:

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

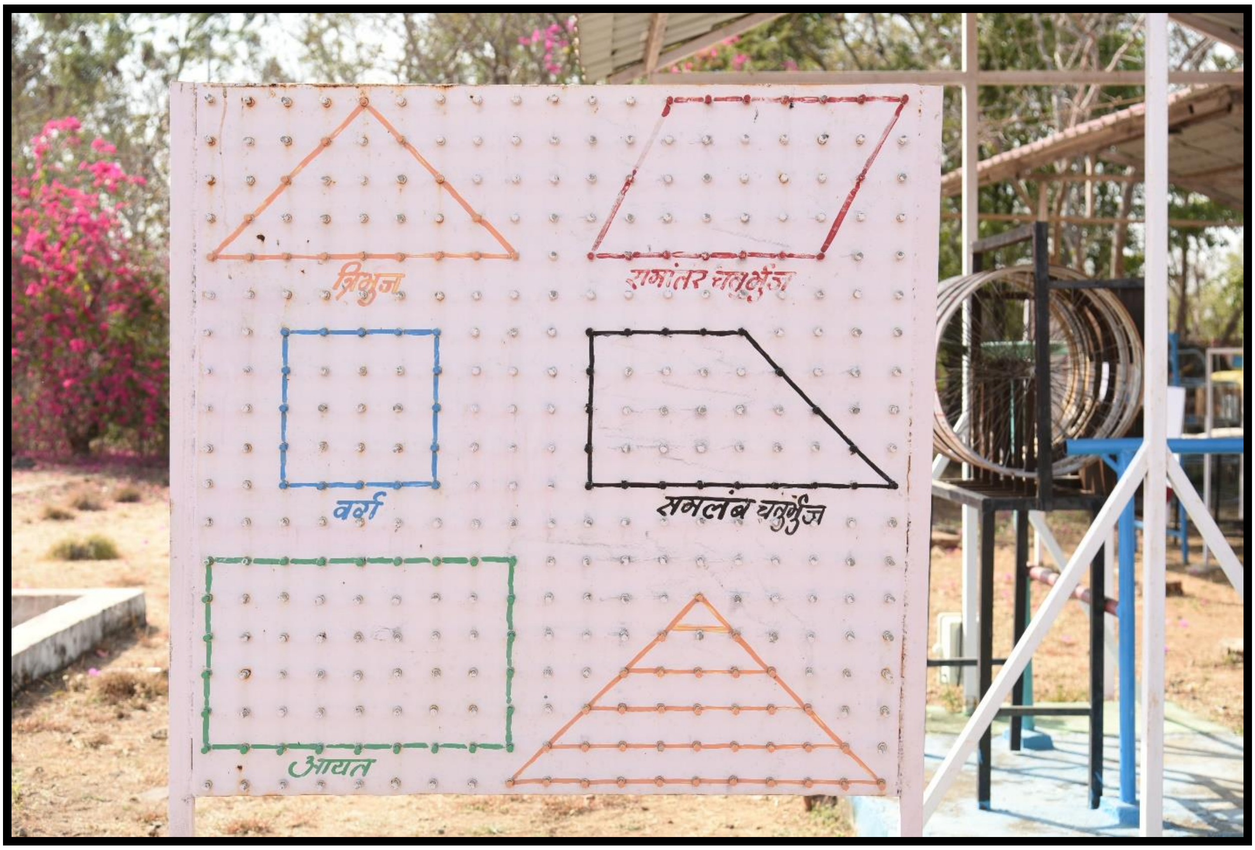
- The slope of a line passing through two points (x_1, y_1) and (x_2, y_2) is given by:

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

Each point on the Cartesian plane is represented by an ordered pair of numbers (x, y), where x indicates the horizontal distance from the origin and y represents the vertical distance. By plotting points and connecting them, you can create shapes, lines, and even complex curves, visualizing mathematical relationships and real-world phenomena.

17) Geo Board

A geoboard is a mathematical manipulative used for teaching geometry, particularly in elementary schools. Invented in the 1950s by Egyptian mathematician Caleb Gattegno, the Geo Board originally consisted of a wooden board dotted with nails. Today, these colorful manipulatives have evolved into various forms, making geometry accessible and engaging for learners of all ages. It consists of a flat board with a grid of pegs or nails arranged in a specific pattern. Rubber bands or elastic bands are then stretched and hooked onto the pegs to create various geometric shapes and patterns.



Designing the Model:

The Geo Board's design is deceptively simple. It consists of a flat board with an evenly spaced grid of pegs or nails, typically arranged in a square or circular pattern. Rubber bands are then stretched and looped around the pegs to form various geometric shapes, lines, and angles. The beauty lies in its flexibility; the same board can be used to create countless configurations, fostering exploration and discovery.

Principle:

The Geo Board brings abstract geometric concepts to life through tangible interactions. By stretching rubber bands, students intuitively visualize and understand fundamental concepts like perimeter, area, angles, symmetry, and congruence. The physical manipulation allows them to experiment, make connections, and solidify their understanding in a way that traditional lectures often struggle to achieve.

Features of the Model and possible activities:

Here are some key features and uses of a geoboard:

- **Grid of Pegs:** The pegs are arranged in rows and columns, forming a grid. Common configurations include boards with 5x5, 11x11, or 15x15 pegs.
- **Rubber Bands:** Rubber bands of different sizes and colours are used to create shapes on the geoboard. By stretching the rubber bands around the pegs, students can explore and construct geometric figures.
- **Shapes and Patterns:** Geoboards are excellent tools for exploring and creating various shapes and patterns. Students can make polygons, rectangles, triangles, and more by using the rubber bands to connect pegs.
- **Area and Perimeter:** Geoboards can be used to teach concepts related to area and perimeter. Students can calculate the number of pegs enclosed by a shape to find its area and count the pegs around the boundary to find its perimeter.
- **Symmetry:** Geoboards are useful for introducing the concept of symmetry. Students can create symmetrical designs by mirroring rubber band patterns across the axes.
- **Coordinates:** Geoboards can also be used to introduce basic coordinate geometry. By assigning coordinates to pegs, students can plot points and understand the relationship between the coordinates of a point and its location on the geoboard.
- **Hands-On Learning:** Geoboards provide a hands-on and visual approach to learning geometry. They engage students in active exploration and help reinforce abstract geometric concepts.
- **Problem Solving:** Teachers often use geoboards to set up problem-solving activities. Students may be given challenges to create specific shapes or patterns, fostering critical thinking and spatial reasoning skills.

18) Circular Geo Board

Geometry is not just about straight lines and right angles! Unlike its rectangular counterpart, this unique board comprises of a circular arrangement of pegs, unlocking a whole new realm of geometric discoveries. The Circular Geo Board, a captivating addition to STEAM Park, invites you to explore the fascinating world of circles, angles, and radial symmetry.

Features of the Model and possible activities:

Here are some key features and applications of a circular geoboard:

- **Circular Layout:** The pegs on the geoboard are arranged in a circular pattern. This circular layout allows for the exploration of concepts specific to circles and angles.
- **Radius and Diameter:** Students can use rubber bands to create circles of different radii by stretching them from the centre peg to the outer pegs. They can also explore the relationship between the radius and diameter of a circle.
- **Central Angle:** The central angle of a circle is the angle formed by two radii extending from the centre to the edge. Students can create and measure central angles using rubber bands on a circular geoboard.
- **Circumference:** Students can experiment with rubber bands to approximate the circumference of a circle. By counting the number of pegs around the circumference, they can explore the relationship between the circumference and the diameter.
- **Sector and Arcs:** The circular geoboard allows students to create and explore sectors (portions of a circle) and arcs (parts of the circumference). They can manipulate rubber bands to form different angles and arc lengths.
- **Radial Symmetry:** Radial symmetry is a key concept in circular geometry. Students can create symmetrical designs by mirroring rubber band patterns around the central point.
- **Pi (π) Exploration:** Teachers can use circular geoboards to introduce the concept of π (pi). Students can experiment with creating circles and measuring their circumference and diameter to approximate the value of π.
- **Angle Measurement:** Circular geoboards provide a hands-on way to introduce and measure angles in a circle. Students can explore concepts like inscribed angles and central angles.

19) Catenary

Have you ever wondered why power lines don't simply sag in a straight line between towers? The answer lies in the fascinating elegant curve known as the "catenary." This graceful arc, formed by a freely hanging chain, has captivated mathematicians and engineers for centuries. This natural phenomenon, observed in everything from spiderwebs to suspension bridges, holds the key to designing strong and efficient structures.

The history of the catenary dates back to the 17th century when mathematicians like Galileo Galilei and Gottfried Wilhelm Leibniz grappled with its mathematical description. Today, its applications span various fields, from architecture and engineering to art and design.A catenary is the shape that a hanging flexible chain or cable assumes under its own weight when supported only at its ends. It is a curve described by a chain hanging freely from two points and is the shape that minimizes the potential energy of the chain. The term "catenary" is derived from the Latin word "catena," meaning "chain."

Designing the Model:

The STEAM Park Catenary model brings this fascinating concept to life. Visitors can witness the curve firsthand by observing a flexible chain suspended between two fixed points. The model is designed to be visually appealing and interactive, inviting exploration and experimentation. Additionally, different chain materials, weights, and support heights can be used to demonstrate how the catenary shape changes under varying conditions.

Principle:

The secret behind the catenary's unique shape lies in a fundamental principle called minimization of potential energy. Imagine a chain hanging freely between two points. Every point on the chain possesses potential energy due to its height above the ground. The catenary curve represents the configuration where the total potential energy of the entire chain is minimized. This results in a curve that balances the chain's weight with the tension pulling it taut. This optimization principle leads to the characteristic shape we observe, where the chain hangs in a smooth, graceful curve and remarkably strong, capable of supporting significant loads.

This curve, known as the catenary, is described by the mathematical equation y = a * cosh(x / a), where ‘a’ is a constant related to the chain's properties. This equation tells us that the catenary is neither a perfect parabola nor a circle but possesses a unique shape that balances the chain's weight against the tension at its ends.

Key features and applications of a Catenary:

- **Mathematical Expression:** The equation that describes a catenary is a hyperbolic cosine function. The standard form of the equation is often given as $y = a\cosh(x/a)$, where a is a constant that determines the width of the catenary.
- **Symmetry:** A catenary is symmetric with respect to its lowest point (the bottom of the hanging chain).
- **Tension and Compression:** The shape of the catenary is such that the tension in the chain is constant, and the chain experiences compression forces along its length.
- **Application in Architecture:** The catenary shape is often used in the design of arches and suspension bridges. The Gateway Arch in St. Louis, Missouri, USA, is an example of a structure with a catenary shape.
- **Physical Examples:** Besides architectural applications, the catenary shape is observed in various natural and physical phenomena, such as the shape of a freely hanging necklace, a power line between two poles, or even the shape of a chain hanging between two hands.

- **Minimal Potential Energy:** The catenary shape minimizes the potential energy of the chain under the influence of gravity. This is a consequence of the principle of least action, where a system tends to evolve towards a state of minimum potential energy.
- **Form-Finding:** In structural engineering, the catenary shape is often used in form-finding processes. When a structure is subject to loads, the ideal shape is sought that minimizes internal stresses and results in a stable configuration.

20) Full Protractor (360° Protractor)

Introduction:

The protractor, a mainstay in geometry classrooms worldwide, has its limitations. Traditional models typically measure angles up to 180 degrees, leaving a significant portion of the circle unmeasured. A "360-degree protractor" is a measuring instrument used in geometry and trigonometry to measure angles in a full circle. It is a circular device marked with degrees from 0 to 360, with each degree representing one degree of angular measurement. This makes it ideal for various applications where angles wrap around a complete circle, such as in trigonometry or measuring the angles of polygons.

Principle:

The 360° protractor operates on the same fundamental principle as its traditional counterpart. It utilizes the concept of a central angle, where the vertex aligns with the centre of the circle, and the two rays extend outwards, marking the desired angle. By aligning the protractor with the vertex and rays of the angle, the corresponding degree reading on the scale reveals the measurement.

Key features of a 360-degree protractor include:

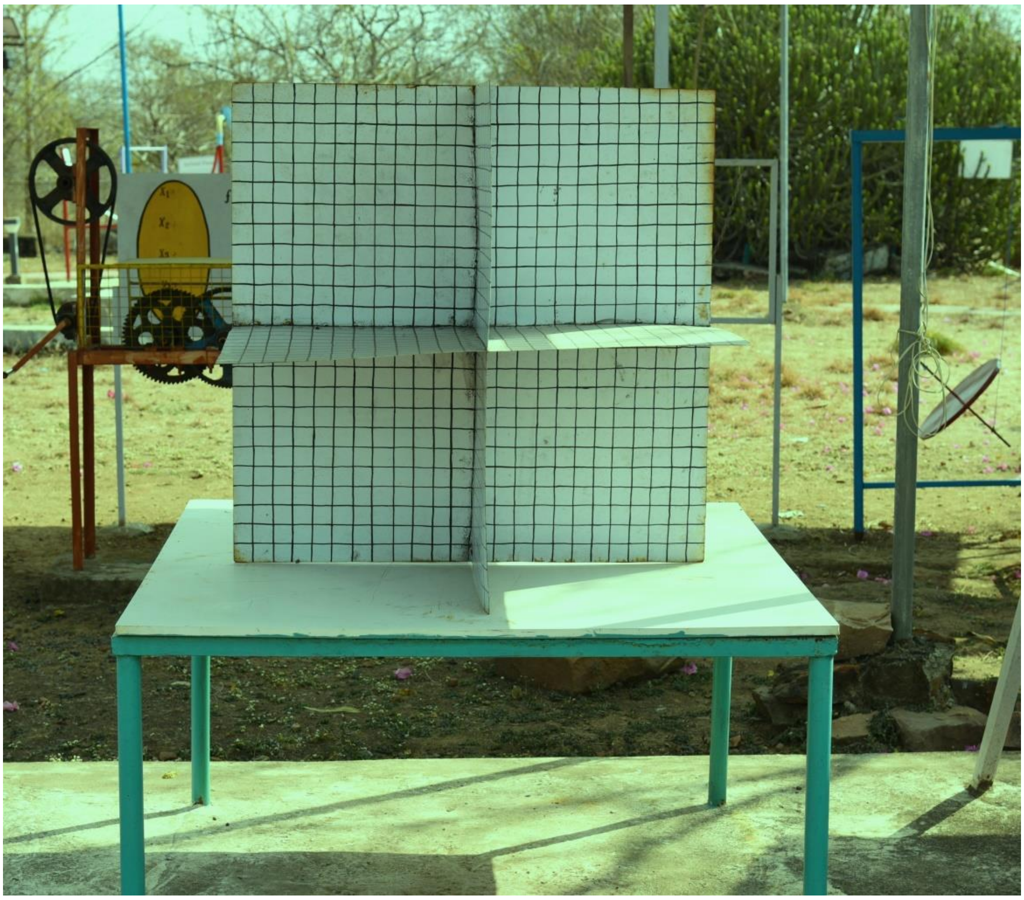
- **Circular Design:** Unlike a traditional half-circle or semicircular protractor that measures angles up to 180 degrees, a 360-degree protractor covers the entire circle.
- **360-Degree Scale:** The circle is divided into 360 degrees, with each degree marked along the edge. This allows for the measurement of angles ranging from 0 degrees (initial position) to 360 degrees (full circle).
- **Radial Lines:** Radial lines extend from the centre of the protractor to the edge, helping to align the protractor with the lines of an angle.
- **Centre Hole:** The centre of the protractor typically has a hole for easy placement and rotation around a point.

Using a 360-degree protractor:

- To measure an angle, place the centre of the protractor at the vertex of the angle (where the two rays meet).
- Align one of the rays of the angle with the baseline, usually the horizontal line on the protractor.
- Read the degree measurement where the other ray intersects the protractor's scale.
- If the angle extends beyond 180 degrees, continue counting in the appropriate direction.

21) Euclidean Space R^3

Have you ever wondered how mathematicians and scientists map and measure the world around us? Enter the fascinating realm of Euclidean space R^3, a cornerstone of Geometry and Physics! Developed by the ancient Greek mathematician Euclid, R^3 represents our familiar three-dimensional space – the length, width, and height that define everyday objects. Euclidean space R^3, also known as 3-dimensional Euclidean space, is a three-dimensional space that forms the basis of classical geometry. It is a mathematical model that represents the familiar three-dimensional physical space in which we live. From calculating the volume of a simple object to understanding the motion of planets, R^3 plays a crucial role in various scientific fields.



Principle:

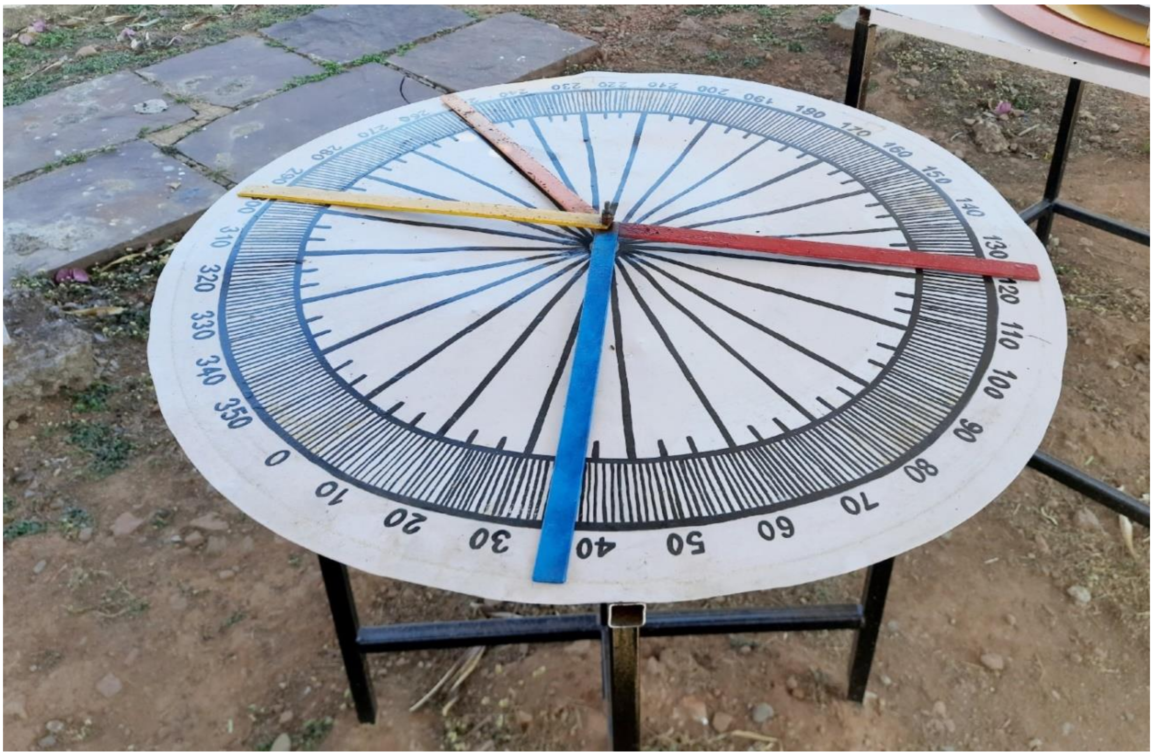
The core principle behind R^3 lies in its coordinate system. Each point is assigned a unique position based on its distance from three perpendicular axes (x, y, and z). This system enables us to define shapes, measure distances, and calculate angles within the three-dimensional space. Additionally, the model demonstrates concepts like parallelism, perpendicularity, and collinearity, providing a tangible understanding of spatial relationships. R^3 allows for operations like rotations, translations, and reflections, providing a powerful tool for geometric analysis.

Here are some key features and concepts associated with R^3:

- **Coordinate System:** R^3 is represented using a Cartesian coordinate system with three perpendicular coordinate axes: x, y, and z.
- **Points:** A point in R^3 is specified by an ordered triple (x, y, z), where x, y, and z are the coordinates along the x, y, and z axes, respectively.
- **Vectors:** Vectors in R^3 are represented as 3D vectors with components (a, b, c), where a, b, and c are real numbers.
- **Distance:** The distance between two points (x_1 , y_1 , z_1) and (x_2 , y_2 , z_2) in $\square^3$ is given by the Euclidean distance formula:
    - $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$
- **Equations of Lines and Planes:** Lines in R^3 can be represented parametrically or using vector and scalar equations. Planes in R^3 are often represented using normal vector and point or scalar equation forms.
- **Scalar and Vector Operations:** Scalar multiplication and vector addition are defined in R^3, and they follow the rules of linear algebra.
- **Cross Product:** The cross product is a vector operation defined for vectors in R^3, resulting in a vector orthogonal to the plane formed by the original vectors.
- **Scalar Triple Product:** The scalar triple product is a scalar quantity derived from three vectors in R^3, and it has geometric significance in terms of volume.
- **Coordinate Transformations:** Transformations like translation, rotation, and scaling can be expressed using matrices in R^3.

22) Circular Disks

The simple and humble figure of the circle, with its perfect form and endless possibilities, has captivated human minds for centuries. From ancient mathematicians like Euclid and Apollonius of Perga to modern engineers and artists, the circle has served as a cornerstone in understanding the world around us. At STEAM Park, we invite you for an interactive exploration of this fascinating shape of Circle with our Circular Disk model.




WORLD OF NUMBERS
Circular Disk

Designing:

One Circular Disk model features a large, sturdy disk marked with angles ranging from 0 to 360 degrees. Four strips which can be rotated manually, extend from the centre of the circle. The strips represent different measurements when used in proper combinations with each other (for e.g., as radius, diameter, chord, central angle) thereby allowing for dynamic exploration. The model's design is simple yet elegant, promoting hands-on interaction and fostering a deeper understanding of the relationships between various parts of a circle. The other circular disk model can be used to calculate the values of trigonometric functions sin, cosine, cot, sec.

Principle:

At the heart of the Circular Disk lies the fundamental relationship between the various components of a circle. The Circular Disk model brings to light, the fundamental properties of the circle, where all points on the circumference are equidistant from the centre. By manually rotating the hands, visitors can observe how changing one measurement (e.g., the angle) dynamically affects the others (e.g., the length of the chord). The circumference (C) is proportional to its diameter (D) through the constant pi (π): $C = \pi D$. Similarly, the length of a chord formed by an angle (θ) is directly related to the radius (R) and the angle itself. Through hands-on manipulation, the model brings these abstract concepts to life, fostering a deeper understanding of circular geometry. This interactive experience allows visitors to grasp concepts like arc length, sector area, and circumference in a tangible and engaging way.

23) Tesseract

A tesseract, also known as a hypercube, is the four-dimensional analogue of a cube. Just as a cube is a three-dimensional solid, a tesseract is a four-dimensional hyper-solid. It is a challenging concept to visualize because our everyday experience is limited to three spatial dimensions. The Tesseract, also known as an 8-cell or 4D-cube, first emerged in the late 19th century through the works of mathematicians like Charles Howard Hinton. Today, the Tesseract continues to captivate mathematicians, artists, and scientists, offering a glimpse into the complexities of higher dimensions.

Features of Tesseract:

Here are some key features of a tesseract:

- **Dimensions:** A tesseract has four spatial dimensions, as opposed to the three dimensions of a cube.
- **Vertices, Edges, Faces, and Cells:** Similar to lower-dimensional shapes, a tesseract has vertices, edges, faces, and cells:
    - **Vertices:** 16 vertices in total.
    - **Edges:** 32 edges connect these vertices.
    - **Faces:** 24 square faces.
    - **Cells:** 8 cubical cells fill the interior.
- **Construction:** The construction of a tesseract can be visualized using a process analogous to how a cube is created from two squares. Similarly, a tesseract can be formed from two cubes.
- **Projections:** Projections of a tesseract into three-dimensional space result in various interesting shapes, often called "shadow" or "net" of the tesseract.

- **Mathematical Representation:** A tesseract can be represented mathematically using coordinates in four-dimensional space. Each vertex would have four coordinates (x, y, z, w).
- **Hyperspace:** Just as a cube is a shadow of a tesseract in three-dimensional space, a three-dimensional object (like a cube) is a shadow of a four-dimensional object in our three-dimensional space.
- **Visualizing a Tesseract:** It's challenging for humans to visualize four-dimensional objects directly. Analogies and projections are often used to provide a sense of what a tesseract might look like in our three-dimensional perception.

24) Sundial Model

The Equinoctial Sundial Model stands as a timeless testament to humanity's age-old fascination with measuring time through the celestial dance of the sun. With roots tracing back to ancient civilizations, sundials have played a vital role in timekeeping for centuries. The equinoctial sundial, in particular, was a marvel of precision, designed to accurately mark the hours during the equinoxes, when day and night are of equal length.

Designing:

The Equinoctial Sundial Model boasts an elegant and symmetrical design. Its centerpiece is a horizontal plate, set parallel to the Earth's equatorial plane. A central rod, known as the gnomon, rises perpendicular to the plate, casting a shadow that serves as the indicator of time. The plate itself is marked with carefully calibrated hour lines and numerical indicators to align with the sun's position throughout the day.

Principle:

The Equinoctial Sundial operates on the fundamental principle of the sun's changing position in the sky throughout the day. During the equinoxes, the sun's path is directly over the equator, allowing the gnomon's shadow to move in a straight line along the hour lines. This unique characteristic ensures precise timekeeping without the need for complex mechanical components.

25) Inclined Planes

Introduction:

Inclined plane is a very simple machine with no moving parts. It is a sloping surface with one raised end. The gentler the slope of an inclined plane, the easier it will be to slide or roll the object. A ramp is a common type of inclined plane. Furniture movers use ramps because it is easier to slide or roll a heavy box up a ramp than to lift it up into a truck.

Inclined planes have been used throughout history in various forms, from the construction of ancient pyramids to the building of medieval castles. They've played a crucial role in engineering and construction, making it easier to transport heavy materials and build structures. It is one of the six classical simple machines and is fundamental to many aspects of our daily lives.

Designing:

The inclined plane was a clever device that allowed us to move objects from one height to another with less effort than lifting them directly. It achieved this by spreading out the force needed to lift the object over a longer distance along the slope. They were used in manufacturing processes, transportation systems, and even in household items like stairs and escalators.

The design of the metallic inclined plane was a meticulous process that involved careful consideration of its dimensions, materials, and structural integrity.

Initially, detailed plans were drafted to outline the specifications of the inclined plane. Factors such as the angle of inclination, length, and width were determined based on the intended application and load requirements.

Iron rods and plates were chosen for the construction of the inclined and surface of the plane was carefully treated to provide traction and prevent slipping of objects being transported.

Fabrication of the inclined plane involved precise cutting, bending, and welding of the metallic components according to the specified dimensions.

After assembly, the metallic inclined plane underwent rigorous testing to evaluate its performance under various loads and conditions. Ready to facilitate the movement of objects with ease and efficiency.

Principle:

The principle behind the inclined plane is that it reduces the amount of force required to lift an object by increasing the distance over which the force is applied. Instead of lifting an object straight up, which requires a lot of force, you can push or pull it up a gradual slope, exerting less force over a longer distance.

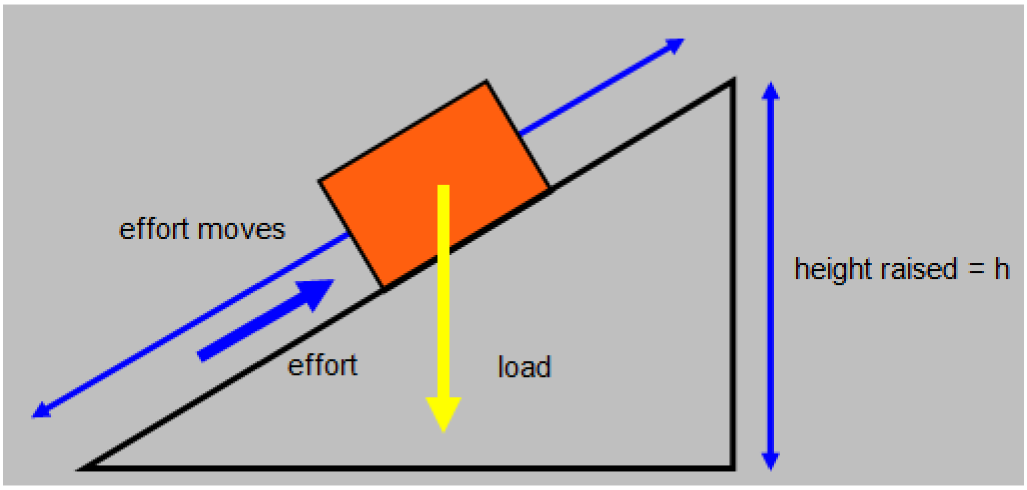


Image Source: https://www.schoolphysics.co.uk/age11-14/Mechanics/Forces%20in%20motion/text/Machines_/index.html

26. Cycloid Path

Have you ever wondered about the path a point on a bicycle tire takes as it rolls? Imagine tracing the path of a point on a bicycle wheel as it rolls forward. That intriguing, wavy line you would draw is a cycloid, a fascinating curve with surprising properties and a rich history. A cycloid is the curve traced by a point on the rim of a circular wheel as the wheel rolls along a straight line without slipping. The cycloid is a specific type of curve known as a trochoid.

The cycloid might appear simple, but its origins lie deep in the minds of mathematical giants. In the 17th century, mathematicians like Galileo Galilei and Marin Mersenne pondered the path traced by points on rolling objects. Their investigations revealed the cycloid's unique properties, sparking further exploration by renowned figures like Gottfried Wilhelm Leibniz.

Principle:

The magic of the cycloid lies in the combination of rotation and translation. As the wheel rolls, each point on its rim undergoes both circular motion around the centre and linear motion along the track. This combined movement results in the characteristic cycloid shape, resembling an elongated arch with pointed cusps.

Here are some key characteristics of a cycloid path:

- **Equations:** The parametric equations for a cycloid, given a circle of radius r, are:

$$x(t) = r(t - \sin t)$$

$$y(t) = r(1 - \cos t)$$

where t is the parameter.

- **Shape:** The resulting shape is a curve that resembles a flattened arch, with a characteristic loop. It is smooth and symmetric.
- **Distance Travelled:** The length of one arch of the cycloid is eight times the radius of the generating circle.
- **Time Parameterization:** The cycloid is often parameterized by time. For example, if t represents time, the cycloid represents the path of a point on the wheel at time t.
- **Brachistochrone Problem:** The cycloid is a solution to the brachistochrone problem, which seeks the curve between two points that minimizes the time for a particle to travel under the influence of gravity without friction.
- **Tautochrone Property:** A unique property of the cycloid is that regardless of the starting point on the curve, a particle released from rest will reach the bottom in the same amount of time.
- **Engineering Applications:** The cycloid has applications in engineering, especially in designing curves for certain types of gears and in understanding the motion of particles under the influence of gravity.
- **Parametric Representation:** The parametric equations describe the position of a point on the cycloid at any given time. As the parameter t varies, it traces the cycloid.

27. Double Ended Cone

In the eighteenth and nineteenth centuries, in order to illustrate Newton's laws of mechanics many apparent paradoxes were found, and therefore a variety of instruments constructed to illustrate them. These devices make it possible to perform astonishing experiments that contradict common sense. However, after deeper observation and analysis, the experiments overcome the initial sense of amazement demonstrating that the phenomena are perfectly consistent with the laws of physics. The most popular mechanical paradox consists of a double cone, formed by joining two identical cones at their bases. The double cone is located on a pair of tilted and diverging rails. When the double cone is placed at the lower end of the rails, it spontaneously begins to move upward giving the impression of defying the universal law of gravitation. Because of this phenomenon, which seems to contradict common sense, the apparatus is often described as a mechanical paradox.

Designing:

A double cone is made of two solid cones of same dimension by joining their bases. This cone is placed on a V shaped inclined rails. The upward motion of the double cone is fascinating and counter-intuitive. It appears to move against gravity. Hence it is also called anti-gravity double cone. For every object, equilibrium is maintained only when its center of gravity lies in its original position. Here a double-ended cone placed on an inclined path goes upward. Place the double cone at the lower end of the inclined V shaped rails and release. It travels on its own to the upper end. How can any object move up on its own? Even though the double cone seems to be moving up, its centre of mass is actually moving down.

Principle:

As we see the double cone kept at the lower end of the inclined V shaped rails moves by its own and reaches the higher end, the striking thought that comes to our mind is that this is a clear violation of the law of conservation of energy. This is because the double cone seems to be gaining energy on its own. It is travelling from the lower end to the higher end. The potential energy is increasing. At the same time, it is also gaining kinetic energy since it is moving. This happens without even giving a little push to the double cone. But, as per the law of conservation of energy what we understand is that creation or destruction of energy is impossible. Rather, transformation from one form to another is always allowed. By looking at the motion of the entire double cone, it is quite natural to think that it is creating energy by itself. At the same time we cannot accept this violation of energy conservation. Under such circumstances, we need to pay attention not to the entire object, but to the centre of mass of the system. Center of mass is an imaginary point where the entire mass of the object appears to be concentrated. For a solid cone, the centre of mass lies on the axis of the cone at a distance ¼ times its height from its base. A double cone can be imagined to be made of two solid cones of same dimension by joining their bases. The centre of mass of it lies on the midpoint of the line joining the centre of masses of the individual cones. Since the rails diverge, the centre of mass (CM) of the double cone, placed on the axis of rotation at the maximum diameter, does not rise when the entire body seems to move up; on the contrary, the CM moves downwards.

28. Rotating Discs

The concept of moment of inertia is crucial when analyzing the rotation of objects, such as a disc. Moment of inertia, denoted by I represents an object's resistance to rotational motion. For a rotating disc, moment of inertia depends on both the mass of the disc and its distribution of mass around the axis of rotation. Understanding moment of inertia is essential in various engineering and physics applications. By applying the concept of moment of inertia to a rotating disc, engineers and physicists can analyze its rotational behavior, predict its response to external forces or torques, and design systems that efficiently utilize rotational motion for various applications.

Designing:

Three discs of equal mass but with different distribution of mass are present. One of the disc has most mass distributed towards its circumference (disc A). The other one has most mass distributed between the center and the circumference (disc B). And the last one has more mass on the center (disc C). Start rotating the discs simultaneously and observe that wheel A will be keep on rotating for the longest time as compared to disc B and disc C. This in agreement with the principle of conservation of angular momentum.

Principle:

Moment of inertia of a body depends on the mass of the body and its radius of rotation. All the three discs are of equal mass bodies. But the mass distribution of the discs is not equal. In this manner moment of inertia of wheel A is the greatest.

Kinetic energy of a rigid body rotating at ω is given by

K= $\frac{1}{2} I \omega^2$

The moment of inertia is a measure of how extended the mass distribution is. If all the mass is concentrated near the axis of rotation then when the body spins it has little rotational kinetic energy. However if most of the mass is concentrated at large radius, like a bicycle wheel where much of the mass is in the rim, then a small spin corresponds to a large rotational kinetic energy.

29. Lift yourself Up (Pulley Reduces Effort)

Have you ever wanted an elevator to use in your house or school? While walking up stairs is good for us, they are hard to climb up because you have to work against the force of gravity that is pulling back toward the ground. Each time you take a step up, you have to push with a force equal to the weight of your body. The working principle of an elevator or lift is similar to the pulley system. A pulley system is used to draw the water from the well. This pulley system can be designed with a bucket, a rope with a wheel. A bucket is connected to a rope that passes throughout a wheel. This can make it very easy to draw the water from the well. Similarly, present elevators use the same concept.

Designing:

An enjoyable interactive play model explains the mechanical advantage gained through pulley system. We can possibly lift objects weighing more than ourselves. We cannot, however, normally, lift ourselves up. But the arrangement here allows us to do just that. Sit on the chair provided with the system. Pull the free end of the rope downwards. The chair, along with you, moves up! The situation is similar to drawing water from a well. It is a lot easier to lift the weight when the rope runs over a pulley than when it is directly pulled up. A pulley is a simple machine that allows us to change the direction of application of force thereby reducing our efforts. It becomes increasingly easier to lift as we increase the number of pulleys.

Principle:

Elevators or lifts are super useful machines. They lift people (and other things) up and down in tall buildings where it would be difficult to move up using a just stairway or a ramp. In order to move people up, elevators must pull with a force strong enough to overcome the force of gravity that pulls down on both the elevator and the things inside it. The basic parts of an elevator include a car, shaft, motor (cranking device), cable, and a counterweight. The car provides a sturdy and safe area for people to ride up and down. The shaft provides the tunnel like structure where the car can move safely from floor to floor. The motor, or cranking device, provides the power needed to pull the elevator to the top. The cable attaches to the motor, the top of the shaft, and the car. The simplest elevator that can be built is to use a pulley system. The pulley is a type of wheel and axle that works with a rope or chain to move an object up and down or back and forth. People use pulleys to lift very large objects or to lower them. Pulleys can also make it possible to lift an object very high off of the ground.

30. Action and Reaction – Newton's Third Law of Motion

The third law of motion, formulated by Sir Isaac Newton, states: "For every action, there is an equal and opposite reaction." If object A exerts a force on object B, object B also exerts an equal and opposite force on object A.

The third law of motion has wide-ranging applications in various fields of physics, engineering, and everyday life. It explains phenomena such as the propulsion of rockets, the operation of engines, the recoil of firearms, and even the simple act of walking. It's a fundamental principle that underpins our understanding of interactions between objects in the universe.

Designing:

1. A platform was secured initially to provide stability for the moving parts of the model.
2. A chair frame was created using iron rods and sheets. It was ensured to be comfortable and capable of supporting the weight of a person.
3. A PVC pipe was attached vertically onto the base, near the chair, to represent the steering column, and an umbrella sheet was implemented over its top.
4. A metal steering wheel was mounted to the PVC pipe, allowing it to rotate freely.

5. Strings and pulleys were used to connect the umbrella to the steering mechanism, allowing it to move in the opposite direction when the steering wheel was turned in clockwise direction.
6. A person was invited to sit on the chair and turn the steering wheel in one direction. As they did this, the mechanism transferred the motion to the umbrella platform, causing the umbrella to move in the opposite direction.
7. Observers were explained how the model demonstrated the third law of motion, where the action of turning the steering wheel resulted in an equal and opposite reaction, causing the umbrella to move in the opposite direction.

Principle: It works on the principle of third law of motion.

31. Bird in a Cage

Have you ever been tricked by an optical illusion? The "Bird in the Cage" model is a captivating example of such illusions. This model utilizes the persistence of vision, a phenomenon where the human eye retains an image for a brief period after viewing it. As a result, when a series of slightly different images are presented in rapid succession, our brain perceives them as a single image. The concept of persistence of vision refers to the phenomenon where the human eye retains an image for a fraction of a second after it disappears from view. This persistence allows us to perceive continuous motion when a series of still images are presented rapidly in succession. It is a fundamental principle behind various optical illusions and visual technologies, including animation, film, television, and motion pictures. The phenakistoscope was an early animation device that relied on persistence of vision. It consisted of a spinning disk with sequential images arranged around the perimeter. When viewed through slots while spinning, the images appeared to animate.

Designing:

This exhibit consists of a revolving plate having a parrot on one side and a cage on other side. Persistence of vision is the phenomenon of the eye by which an afterimage is thought to persist for approximately one twenty-fifth of a second on the retina. This property of retina is utilized in making motion picture. Here is a gadget that exhibits the concept of motion picture, where one side of the frame has a picture of a bird and other side has a bird cage, when this frame is rotated in high speed, we will visualize a picture as if the bird is inside the cage. The retina holds an image for $1/16^{th}$ of a second. If another image falls on the eye during this period the image gets mixed up. Here the bird appears to be inside the cage.

Principle:

When light strikes the retina at the back of the eye, the photoreceptor cells (rods and cones) respond to the stimulus and send electrical signals to the brain through the optic nerve. Even after the light source is removed, these cells continue to fire for a brief period. The brain integrates the signals received from the photoreceptor cells over a short duration, known as the integration time or persistence time. During this time, the brain retains the visual impression of the previously seen image. When a sequence of images is presented rapidly in succession, each image persists in the visual system for a fraction of a second before being replaced by the next image. The brain combines these individual images into a continuous stream of motion. The human visual system has a limited temporal resolution, meaning it cannot perceive individual images presented at a high speed as discrete frames. Instead, the brain integrates these frames into perceived motion, smoothing out any gaps or discontinuities.

32. Pendulum Wave

A pendulum wave is a physical effect based on a series of independent pendulums that are finely tuned relative to their oscillation periods (or frequencies). Uncoupled simple pendulums of monotonically increasing lengths can be used to produce visual traveling waves, standing waves, beating, and random motion. It is a piece of kinetic art and the motion of the pendulums is stunning for any viewer.

Designing: 13 independent pendulums have been fixed to a stable frame. Each pendulum has a different suspension length, and thus a different oscillation frequency. The lengths of the pendulum are adjusted in such a manner that if the longest pendulum executes L oscillations in a time interval T, then each successive shorter pendulum will execute one additional oscillation in that same time. This causes the pendulums to "dance" in waves. Push all the balls at the same time. That's easy with the included pushing bar and see the magic.

Principle:

The oscillation period of a simple pendulum does not depend on its mass, but rather on its suspension length. When we tilt the pendulum out of its position of equilibrium, it acquires potential energy. When released, it begins to move as gravity acts on it, completing an arc directly proportional in length to its suspension length. The oscillation period is the time it takes the pendulum to re-turn to its ini-tial position. A longer pendulum covers a greater distance and moves slightly more quickly, but its oscillation period is longer nonetheless. Short pendulums thus oscillate at a greater frequency than long pendulums. By adjusting the lengths of the pendulums, one can create beautiful moving patterns.

33. Gyroscope

Have you ever wondered how a tiny device can keep a massive ship on course despite rolling waves? Or how a smartphone "knows" which way you're holding it, even when flipped upside down? The answer lies in a fascinating piece of technology called the gyroscope. Its history dates back to the 18th century, invented in the early 1800s by Johann Bohnenberger, where its principles were used in toys and experiments. However, it was in the 20th century that the gyroscope truly took off, finding applications in navigation, aviation, and even space exploration.

Designing:

The STEAM Park gyroscope model aims to showcase this ingenious invention in a way that's both visually appealing and educational. Visitors can spin the wheel using a handle and observe its remarkable stability and interesting precessional motion. Our gyroscope model at STEAM Park is a marvel of simplicity and elegance. As the disc spins rapidly, it resists changes in its orientation, demonstrating the gyroscopic effect. The model is visually captivating, with clear labelling and interactive elements that encourage visitors to explore the science behind its movement.

Principle:

The secret behind the gyroscope's remarkable behaviour lies in the concept of angular momentum. A spinning object, like our model's disc, possesses angular momentum, which tends to resist any change in its rotational axis. Imagine trying to tilt a spinning bicycle wheel – you will encounter resistance due to its angular momentum. This is precisely what allows gyroscopes to maintain their orientation even when their surroundings move. When a force tries to tilt the gyroscope, instead of simply falling over, the wheel precesses – a fascinating sideways movement like a wobbling top.

34. Newton's Cradle

Newton's cradle, also known as Newton's balls or kinetic balls, is a simple yet fascinating device that has captured the imagination of people around the world. It serves not only as an entertaining desk toy but also as a powerful educational tool for demonstrating fundamental principles of physics. The origins of Newton's cradle can be traced back to the 19th century, although its exact inventor is a matter of some debate. It is widely believed that the device was inspired by the scientific principles articulated by Sir Isaac Newton, hence the name "Newton's cradle."

Designing:

The model of Newton's cradle consists of a series of metal spheres (in this model there are six spheres) suspended from a frame in a straight line formation. When one sphere is lifted and released, it swings down and collides with the next sphere in line, causing the last sphere to swing out and then return, mimicking the motion of the first sphere. This rhythmic transfer of energy and momentum through the spheres is both visually captivating and scientifically instructive, illustrating key concepts such as conservation of momentum and energy.

Principle:

The basic principle behind Newton's cradle is the conservation of momentum and energy. When one sphere at the end of the row is lifted and released, it gains potential energy as it moves upward. When it's released, it swings down and collides with the next sphere, transferring its kinetic energy to that sphere. The collision causes the first sphere to come to a stop momentarily, while the momentum is transferred to the second sphere. This process continues through the chain of spheres, with each sphere momentarily coming to a stop as the momentum is transferred to the next sphere in line. Law of conservation of energy states that the total amount of energy in an isolated system remains constant over time. The total energy is said to be conserved over time. This gadget has swinging balls to prove law of conservation.

35. Three-dimensional crystal structure (NaCl)

Sodium chloride is also commonly known as table salt. It is an ionic compound with the chemical formula NaCl, representing a 1:1 ratio of sodium and chloride ions. Sodium chloride is the salt most responsible for the salinity of seawater and of the extracellular fluid of many multicellular organisms. In its edible form, it is commonly used as a condiment and food preservative. Large quantities of sodium chloride are used in many industrial processes, and it is a major source of sodium and chlorine compounds used as feed stocks for further chemical syntheses. Another major application of sodium chloride is deicing of roadways in sub-freezing weather.

Designing:

In this model a rotating three-dimensional crystal structure of NaCl is built. It is a representation of the structure of NaCl. To differentiate the atoms of sodium and chlorine different colours have been used however for construction feasibility the sizes of the atoms have been kept same. In actual structure the size of sodium and chlorine atom is different. The intramolecular bonding is ionic, as it involves the transfer of electrons from Sodium to Chlorine, and bonds ions through electrostatic forces. The polarity of this structure is non-polar, as it is a neutral network and the charges are balanced throughout. Any person viewing the model can understand how the three dimensional structure of NaCl is formed. The model also doesn't represent the charges of each element, which could display the electrostatic forces.

Principle:

A crystal structure is composed of a pattern, a set of atoms arranged in a particular way, and a lattice exhibiting long-range order and symmetry. NaCl has a cubic unit cell. It is best thought of as a face-centered cubic array of anions with an interpenetrating fcc cation lattice (or vice-versa). The cell looks the same whether you start with anions or cations on the corners. Each ion is 6-coordinate and has a local octahedral geometry.

36. Newton's Disc

Introduction & Brief History:

Newton's disc, an intriguing scientific device, provides a captivating demonstration of color blending and persistence of vision. Named after Sir Isaac Newton, the famous physicist, this concept dates back to the late 17th century. Newton utilized a similar principle in his experiments with prisms, where he demonstrated that white light comprises a spectrum of colors. His pioneering work laid the foundation for understanding light and color, contributing significantly to the field of optics and our comprehension of how we perceive the world visually.

Designing:

A Newton's disc comprises a circular platform divided into equal segments, each painted in distinct, vibrant colors. Newton Disc is typically made of vibrant colors which comprise the hues of primary and secondary colors chosen for high contrast and clear visibility. This with an integration of a smooth spinning mechanism either manual handle or a motor which ensures smooth rotation.

Principle:

The key principle underlying Newton's disc is colour blending and persistence of vision. The key principle underlying Newton's disc is colour blending and persistence of vision. Our eyes remember things we see for less than a second, even after they are gone. Due to the rapid spinning of colorful disc, our eyes blend all the colours and cannot segregate them. As a result, the spinning disc appears white.

37. Musical Tubes

The concept of tuned percussion tubes emerged in the late 20th century as a simple and accessible musical instrument for educational and recreational purposes. The exact origins of musical tubes are somewhat unclear, but they gained popularity in the 1990s. Musical tubes typically consist of lightweight, hollow plastic tubes of varying lengths and colors. Each tube is tuned to a specific pitch based on its length, with longer tubes producing lower pitches and shorter tubes producing higher pitches. The tubes are usually struck against a surface or each other to produce sound. Musical tubes quickly gained popularity in educational settings, particularly in elementary schools and music classrooms. They are valued for their simplicity, affordability, and ability to introduce fundamental musical concepts such as pitch, rhythm, and melody to students of all ages.

Designing:

The model here has seven metal pipes of same material with same inner and outer radii, but different lengths. The pipes are suspended from a rigid support. When the pipes are hit by a metal stick one after the other, we can notice that the sound generated by each pipe is different. Strike the set of suspended steel pipes of varying lengths. Each of them produces sound of a particular pitch. The pitch produced depends on the length of the pipe – the longer the pipe the lower the pitch. The sound is produced because the pipes vibrate when struck.

Principle:

Speed of sound in air is about 330 m/s. Speed is actually the product of wavelength and frequency. Here the wavelength increases with length of the pipes. Therefore, the frequency decreases correspondingly. The shorter pipe produces a sound of higher frequency and longer one produces a lower frequency sound.

38. Hyperboloid of One Sheet

Have you ever noticed the cooling towers at power plants, those majestic structures reaching towards the sky? Their unique shape, a single sheet curving upwards, is a beautiful example of a hyperboloid of one sheet. A hyperboloid of one sheet is a three-dimensional surface that can be obtained by rotating a hyperbola about one of its principal axes. It belongs to the class of quadric surfaces, which are second-degree surfaces in three-dimensional space.

Basics of the Hyperboloid of One Sheet:

The general equation for a hyperboloid of one sheet, centred at the origin, is given by:

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}-\frac{z^2}{c^2}=1$$

Here: a, b and c are positive constants that determine the shape and size of the hyperboloid. The hyperboloid opens along the z-axis.

If $a=b=c$, the hyperboloid is a rotationally symmetric hyperboloid of revolution. If a, b and c are all different, the shape may be elongated along one axis.

The hyperboloid of one sheet has some interesting properties:

- **One Connected Surface:** Unlike the hyperboloid of two sheets, which has two disconnected components, the hyperboloid of one sheet is a single, connected surface.
- **Saddle Shape:** The hyperboloid of one sheet has a saddle-like shape. It curves upward in one direction and downward in the other.
- **Asymptotic Lines:** The surface has two families of asymptotic lines. These are curves that, as they move along the surface, approach being parallel to each other.
- **Applications:** Hyperboloids of one sheet appear in various architectural and engineering structures. For example, they are often used in the design of cooling towers and some types of shell structures.

The parametric equations for a hyperboloid of one sheet are typically given by:

$$x(u,v)=a\cosh(u)\cos(v)$$

$$y(u,v)=b\cosh(u)\sin(v)$$

$$z(u,v)=c\sinh(u)$$

Here, u and v are parameters.

It's important to note that the shape and orientation of the hyperboloid can be adjusted by scaling the parameters a, b and c as well as by applying translations and rotations.

RIE Speaks:

“The Hyperboloid of One Sheet is more than just a pretty shape. Its unique properties have found applications in diverse fields. Remember, this model is just the tip of the hyperbolic iceberg! Further research can lead you to discover even more intriguing applications and mathematical complexities within this captivating form.”

39. Centrifugal Force

Centrifugal force is a concept in physics that describes the apparent outward force experienced by an object moving in a circular path. It is a result of the object's inertia, or resistance to changes in motion, as it travels along the curved trajectory. Despite its common use in everyday language, it's important to note that centrifugal force is not a true force like gravity or electromagnetic forces. Instead, it is considered a fictitious or inertial force that arises when observing the motion from a rotating or accelerating frame of reference.

Designing:

- The metallic 4-seater merry-go-round was designed with careful consideration to both safety and aesthetics. Initially, a team drafted detailed plans, outlining the dimensions, materials, and structural requirements.
- Once the design was finalized, fabrication began. Skilled craftsmen meticulously cut, welded, and assembled each component according to the specifications, paying close attention to quality and precision. The merry go round took shape gradually, with each piece fitting together.
- Finally, with the completion of the metallic merry-go-round, it stood as a testament to the creativity and engineering prowess behind its design. Ready to enchant children and adults alike with its timeless charm and spinning delights.

Principle:

The principle behind a merry-go-round involves the physics of circular motion, balancing torque and the forces acting on the rotating system. Here are the key principles:

Centripetal Force: The central axis of the merry-go-round serves as the pivot point. Centripetal force is required to keep the riders moving in a circular path. In the case of a merry-go-round, this force is provided by the friction between the riders' seats and the platform.

Centrifugal Force: As riders on the merry-go-round rotate, they experience an outward force, known as centrifugal force. This force is a result of their inertia and the circular motion.

Friction: Adequate friction between the riders' seats and the platform is essential for generating the centripetal force. The right amount of friction prevents slipping while allowing the riders to stay in place during rotation.

Angular Momentum: Conservation of angular momentum is another key principle. As the merry-go-round rotates, the total angular momentum of the system remains constant unless acted upon by an external torque.

Stability and Center of Mass: The design of the merry-go-round must consider stability and the center of mass. Ensuring a low center of mass for the entire structure and its riders helps prevent tipping.

Force of Gravity: The force of gravity acts vertically downward, affecting the overall stability of the merry-go-round. Proper design considers the gravitational force and its impact on the equilibrium of the system.

Engineers and designers must take into account the physics of motion, forces involved, and structural considerations to create a well-balanced and safe rotating system.

40. Friction and Speed

Introduction & Brief History:

Friction plays a crucial role in various aspects of everyday life, physics, engineering, and many other fields. Friction is force which opposes motion between two surfaces in contact with each other. From our day to day experience it is much easier to skid on a smooth surface like wood than a rough surface like carpet.

Designing:

The friction and speed model comprises of three ramps with different types of surfaces (smooth, hard and very hard). Effect of friction on the distance travelled by a ball and time taken can be easily checked in this model. Roll a ball on the three surfaces one at a time and record the time taken by the ball to reach the far end.

Principle

Friction is a force that arises when things rub against each other. For example, if you rub your hands together very quickly, they get warmer. This is a result of the friction between your moving hands. Different items have different levels of friction when they rub together. In fact, every object has unique characteristics in terms of friction. Engineers are very interested in friction because friction affects how smoothly things work. When surfaces grind against each other with lots of friction, they tend to wear out. For example, if the grinding surfaces are gears in a machine, the machine would wear out faster, and need to be replaced sooner than if there was minimal friction in the machine.

41. Planck's Law

Planck's Law is the fundamental concept in the realm of physics that one can encounter continuously. It is related to how electromagnetic energy can be emitted or absorbed. Planck's law, was formulated by the German physicist Max Planck in 1900 and describes the spectral density of electromagnetic radiation emitted by a black body at a given temperature. A black body is an idealized physical body that absorbs all incident electromagnetic radiation, regardless of frequency or angle of incidence, and emits radiation with a spectral distribution that is only dependent on its temperature.

Designing:

The model consists of circular surfaces painted in different colours (white, red, yellow, green and black). Touch the surfaces and find out which is the hottest. Black surface always absorbs and radiates more heat. Hence it is the hottest one. On the other hand, white surface reflects the heat. Hence it is the coolest one. The plates covered with other colours absorb or reflect different amount of heat according to their wavelengths.

Principle:

Planck's Law has irreplaceable usefulness within physics and numerous scientific fields. It paves the way for the advent of quantum mechanics, characterizes black-body radiation, and impacts thermal radiation emission studies, among other uses. A 'black body' is an idealised object that absorbs all incident radiation, regardless of its frequency or angle of incidence. The equation for Planck's Law is given by:

$E=h\nu$ where h is Planck’s constant that has a value of approximately $6.63 \times 10^{-34} m^2 kg/s$

where E is the energy of the incident radiation and ν its frequency

36. Baudhāyana Śulvasūtra (Pythagoras Theorem)

Have you ever wondered how ancient architects managed to construct perfectly proportioned structures without the aid of modern technology? The answer lies in the wisdom of ancient mathematicians like Baudhāyana, an Indian scholar who lived around 800 BCE. His remarkable text, the Baudhāyana Śulvasūtra, contains the earliest known version of the theorem we now call the Pythagoras Theorem, named after the ancient Greek mathematician Pythagoras of Samos (570 BCE – 495 BCE). The Pythagorean Theorem is a fundamental principle in geometry that relates the lengths of the sides of a right-angled triangle.

The Rule in Baudhāyana Śulvasūtra is described in the verse:

दीर्घचतुरस्रस्याक्ष्णया रज्जुः पार्श्वमानी तिर्यग् मानी च यत् पृथग् भूते कुरूतस्तदुभयं करोति ॥

"dīrghachatursrasyākṣaṇayā rajjuḥ pārśvamānī, tiryagmānī,

cha yatpṛthagbhūte kurutastadubhayāṅ karoti."

It can be understood in very simple terms as: The areas produced separately by the length and the breadth of a rectangle together equal the areas produced by the diagonal.

The Statement of the Pythagorean Theorem: In a right-angled triangle, the square of the length of the hypotenuse c is equal to the sum of the squares of the lengths of the other two sides (a and b).

The Pythagorean Theorem is often written as:

$$a^2 + b^2 = c^2$$

Terms: c is the length of the hypotenuse i.e. the side opposite the right angle. a and b are the lengths of the other two sides.

Applications: The Pythagorean Theorem is widely used in various fields, including:

- **Geometry:** To find distances, angles, or missing side lengths in right-angled triangles.
- **Physics:** In various applications, such as calculating vectors, forces, and distances in space.
- **Engineering:** Especially in fields like structural engineering and computer graphics.
- **Navigation:** In navigation and surveying, for distance calculations.
- **Trigonometry:** The Pythagorean Theorem is closely related to trigonometric functions.

42. Vortex

Vortex is a region in a fluid in which the fluid rotates around an axis line which may be straight or curved. Vortices are rotating regions of fluid, and understanding their dynamics is crucial in fields such as aerodynamics and oceanography. Vortex can be formed by stirring or agitation, flow around obstacles, temperature gradients, shear layers, rotating objects and colliding fluid streams. There are several examples of vortex one can observe in nature like smoke rings, whirlpools or tornado.

Designing:

The rotating fluid subjected to centrifugal force creating funnel shaped formation like tornado. In this model the rotating fluid subjected to centrifugal force creating funnel shaped formation like tornado. A suitable modification was done to this model. Instead of water the tube has been filled with oil. As water evaporated so we have filled the tube with oil.

Principle:

When a fluid particle moves in a non-linear path, such as a curved trajectory or around a central point, its velocity vector changes direction. The conservation of angular momentum requires that the rotational motion of the particle must compensate for changes in its linear motion. As the fluid particles move within the system, they may experience changes in their linear motion. To conserve angular momentum, the fluid particles develop a rotational or swirling motion around a central axis. This swirling motion creates a vortex. To make water move in a circle, forces called centripetal forces must act on the water. These "center-pulling" forces are created by a combination of air pressure, water pressure, and gravity.

43. Periscope – The Sea Telescope

The Periscope Model is a fascinating optical instrument that has played a pivotal role in military strategy, submarine navigation, and even in creative art installations. Its inception can be traced back to the early 19th century, with Sir Charles Wheatstone's work on the Reflecting Galvanometer, a precursor to the modern periscope. Its ingenious design allows users to see around obstacles and into areas that would otherwise be inaccessible.

Designing:

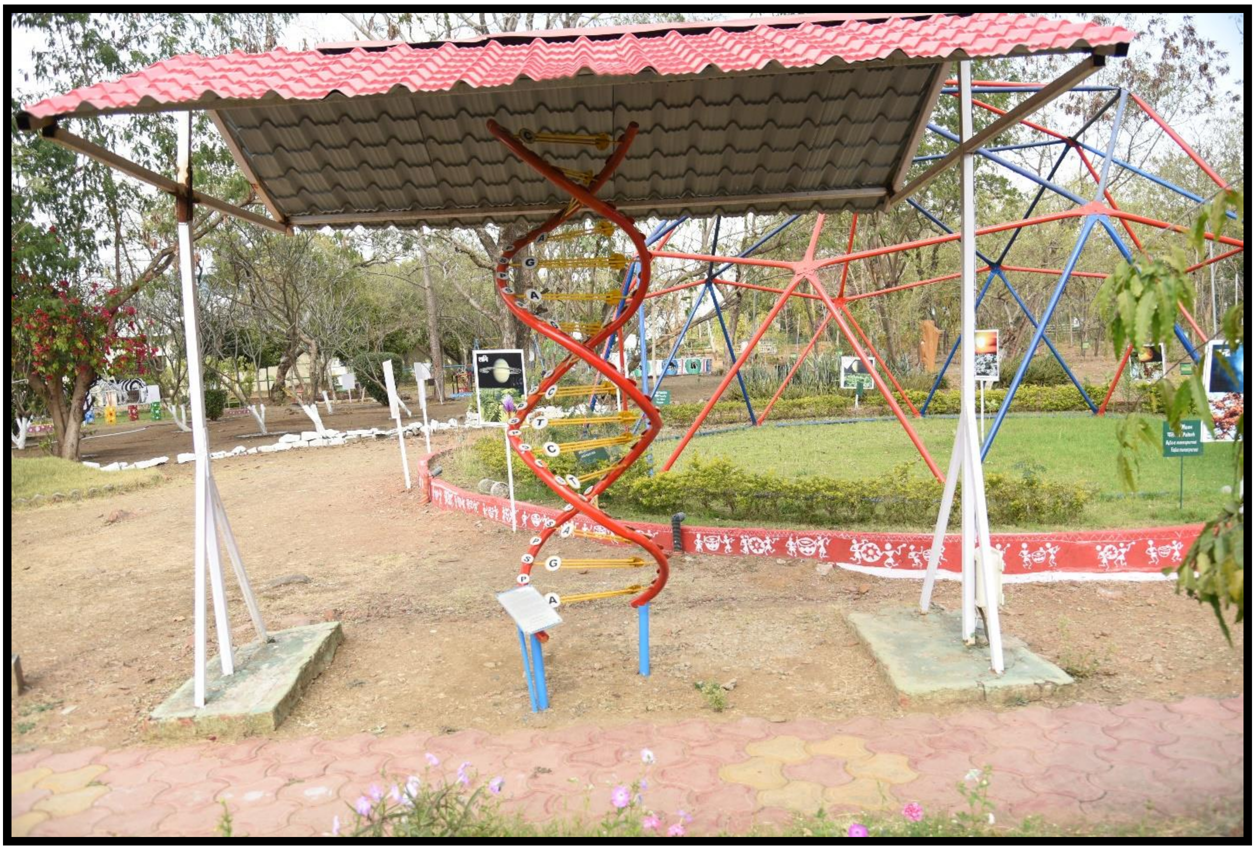
The Periscope Model comprises a series of mirrors or prisms arranged in a specific configuration to redirect light. A typical periscope consists of two parallel tubes, with mirrors placed at 45-degree angles at the top and bottom ends. This arrangement allows light to enter through the top mirror, reflect off the bottom mirror, and exit through the eyepiece, providing an observer with an elevated view of their surroundings.

Principle:

The key principle underlying the Periscope Model is the reflection of light. When light enters the periscope, it strikes the first mirror at a 45-degree angle, causing it to reflect downward. This light then strikes the second mirror, which is positioned parallel to the first but in the opposite direction, resulting in another reflection that redirects the light toward the eyepiece.

44. Deoxyribonucleic acid (abbreviated DNA)

The quest to uncover the structure of DNA has been a long and captivating one in scientific history. Early scientists knew that some substance must carry genetic information, but the nature of this substance remained a mystery. In 1953, James Watson and Francis Crick, aided by Rosalind Franklin's X-ray crystallography images, revolutionized biology by proposing the double helix structure of DNA. Their model explained how DNA can replicate, store information, and serve as the basis of inheritance.



Designing:

The DNA model's design emphasizes clarity, structural accuracy, and interactivity. Color coding and labeling the base pairs ensure accurate representation. Imagine a large-scale DNA model dominating the STEAM Park exhibit. Vibrant colors highlight the four bases (adenine, thymine, guanine, and cytosine) and their precise pairing. The double helix twists and turns, its elegant form representing the complexity of life's blueprint. Allowing visitors to investigate the model enhances their understanding of the molecule's intricate structure.

Principle:

The core principle of the DNA model lies in showcasing the molecule's double helix structure and the specific pairing of the nitrogenous bases. Adenine always pairs with thymine, and guanine always pairs with cytosine. This complementary base pairing is essential for DNA replication, allowing genetic information to be passed down from generation to generation.

45. Periodic Table

The Periodic Table of elements is more than just a colorful chart hanging in chemistry labs. It's the key to understanding the fundamental building blocks of our world. This STEAM Park exhibit invites you to dive into the world of elements, uncovering their secrets and exploring how their unique properties shape the universe around us.

The quest to organize the ever-growing list of elements found in nature has been a long one. Scientists like Antoine Lavoisier and John Newlands laid groundwork by grouping elements based on their properties. However, it was Dmitri Mendeleev's revolutionary proposal in 1869 that truly transformed the field. He arranged elements according to their atomic weights, leaving gaps for yet-undiscovered elements and successfully predicting their characteristics. Later, Henry Moseley refined the table by arranging elements based on atomic number, leading to the modern periodic table we know today.

Principle:

The genius of the periodic table lies in its ability to organize elements by their atomic numbers (the number of protons in their nucleus). This arrangement reveals patterns in their electron configurations, which dictate their chemical and physical properties. The table is divided into groups (columns) and periods (rows), allowing scientists to categorize elements with similar characteristics.

46. Lissajous Figures

The captivating patterns formed by sand falling from a vibrating point were first studied by the American mathematician Nathaniel Bowditch in 1815, and later the curves were investigated independently by the French mathematician Jules-Antoine Lissajous in 1857–58. He used pendulums with different frequencies to create intricate shapes, later named Lissajous figures. Today, these figures find applications in diverse fields, from studying sound waves to designing optical displays.

Imagine a rectangular box suspended from a sturdy frame, its bottom pierced with a small hole. As the box swings back and forth, a steady stream of sand trickles through the hole, tracing its path onto a dark platform beneath. The interplay between the swinging motion and the sand's flow gives rise to an ever-changing dance of lines, curves, and intricate patterns, each one unique and captivating.

Designing the Model:

The beauty of this model lies in its simplicity. The key components are:

- A lightweight box with a small hole in its base
- A sturdy frame to suspend the box
- A mechanism to create a swinging motion (pendulum, spring, or motor)
- Sand (fine and dry)
- A dark platform to collect the sand

The ingenuity lies in adjusting the dimensions, swing frequency, and sand flow rate to create different Lissajous figures. Experimenting with these variables allows visitors to witness the fascinating interplay between physics and art.

Principle:

The sand's movement is a result of the combined horizontal and vertical oscillations of the box. Each oscillation acts like a wave, and their superposition creates the intricate patterns. Speaking elaborately, the magic behind the dancing sand lies in the superposition of two periodic motions: the horizontal swing of the box and the vertical fall of the sand. Each motion translates to a specific frequency, and the resulting pattern depends on the ratio of these frequencies. Changing this ratio alters the shape and complexity of the Lissajous figure, showcasing the fundamental principle of wave interference. The key lies in adjusting the lengths of the strings to control the swing's frequency in both horizontal and vertical directions.

47. Resonance Strips

Have you ever wondered what makes a guitar string vibrate or a tuning fork hum or why bridges hum under certain traffic conditions? The answer lies in the fascinating world of **resonance**, a phenomenon where an object vibrates at its natural frequency when exposed to another vibrating object at the same frequency. This principle finds applications in various fields, from music and engineering to medicine and even astronomy. At STEAM Park, we bring this concept to life with our captivating **Resonance Strips** model!

Designing:

Imagine a collection of metal strips of varying lengths, each mounted securely on a base. When a vibrating force is applied to these strips, they begin to dance, each at its own unique rhythm. The magic lies in the careful design. Our Resonance Strips model features a set of metal strips of varying lengths securely mounted on a base. Each strip exhibits its natural frequency, which depends on its length, thickness, and material properties. By applying external vibrations using a mechanical driver or even a simple speaker, we can excite the strips, causing them to oscillate. The length of each strip determines its **natural frequency**, meaning it will vibrate most intensely when stimulated at that specific frequency. By observing the different vibration patterns of the strips, we can visualize the relationship between length, frequency, and resonance.

Principle:

The heart of the Resonance Strips model lies in the concept of **standing waves.** When a wave encounters a fixed boundary, like the clamped end of a strip, it reflects back. If the reflected wave coincides with the original wave perfectly, it creates a standing wave, where specific points remain stationary while others vibrate. The length of the strip determines the possible wavelengths of standing waves, and each wavelength corresponds to a specific frequency. By applying a range of frequencies to the strips, we can excite different standing waves and observe their unique patterns.

So, the magic happens when the external vibration's frequency matches the natural frequency of a particular strip. This creates resonance, causing the strip to vibrate with much larger amplitude, producing visible and audible effects. You can observe the standing waves forming on the strips, hear the amplified sound, and even feel the increased vibrations!

48. Wave Formation

Did you know that destructive tsunamis and beautiful music have something in common? They are both types of waves. Similarly, shaking a Slinky from one end creates wave motion. Waves are all around us in many forms and are important to just about every branch of physics. While there are two fundamental types of waves - longitudinal and transverse - waves can take many forms (e.g., light, sound, and physical waves). Waves can be described by their exhibited properties: frequency, speed, amplitude, and wavelength. Much of our current understanding of wave motion has come from the study of acoustics. Ancient Greek philosophers, many of whom were interested in music, hypothesized that there was a connection between waves and sound, and that vibrations, or disturbances, must be responsible for sounds. Pythagoras observed in 550 BCE that vibrating strings produced sound, and worked to determine the mathematical relationships between the lengths of strings that made harmonious tones.

Designing:

Waves can take many forms, but there are two fundamental types of waves: "longitudinal" and "transverse". Both of these wave types are traveling disturbances, but they are different because of the way that they travel. As a wave travels through a medium, the particles that make up the medium are disturbed from their resting, or "equilibrium" positions. A beautiful model which shows the wave formation and its characteristics. A handle is provided to rotate the disc which in turn causes rotation of the rods attached. The balls engraved on the rods also begin to rotate creating a wave. Carefully observe the position of the balls on the rods. You will find that each ball is displaced from the previous ball by a small fraction.

Principle:

Waves are produced through the transfer of energy from a source to a medium. The specific mechanism of wave production depends on the type of wave and the nature of the medium. In the context of physics, a wave can indeed be conceptualized as a disturbance propagating through a medium or a field. This disturbance carries energy from one place to another without permanently displacing the medium itself. Waves can take various forms, including mechanical waves (such as sound waves and water waves) and electromagnetic waves (such as light waves and radio waves).

49. Geodesic Dome

Geodesic domes are fascinating structures known for their strength, efficiency, and aesthetic appeal. The history of geodesic domes dates back to the early 20th century, with significant contributions from several innovators. The most prominent figure associated with geodesic domes is Buckminster Fuller, an American architect, inventor, and futurist. Fuller coined the term "geodesic" in the late 1940s and is credited with popularizing and advancing the concept. Fuller's interest in geometry and structural efficiency led him to explore the potential of spherical structures composed of interconnected triangles. In 1927, he patented a design for a "geodesic dome," which he described as a lightweight, strong, and cost-effective structure capable of enclosing large interior spaces without the need for internal supports.

Designing:

A geodesic dome is a hemispherical thin-shell structure (lattice-shell) based on a geodesic polyhedron. The triangular elements of the dome are structurally rigid and distribute the structural stress throughout the structure, making geodesic domes able to withstand very heavy loads for their size. Domes can also be constructed with a lightweight aluminum framework which can either be bolted or welded together or can be connected with a more flexible nodel point/hub connection. These domes are usually clad with glass which is held in place with a PVC coping. The coping can be sealed with silicone to make it water tight. Some designs also allow for double glazing or insulated panels to be fixed in the framework. This allows a fully habitable building to be formed.

Principle:

A geodesic dome is constructed using a network of interconnected triangles, typically made from lightweight and durable materials such as metal or plastic. These triangles are arranged to form a spherical or hemispherical shape. The key principle behind the geodesic dome's strength is triangulation. Each triangle within the dome's structure acts as a rigid unit, distributing external forces such as wind, snow, or gravity evenly across the entire framework. This distribution of stress prevents any single part of the dome from bearing excessive load, enhancing its overall stability.

50. Sympathetic Swing

The phenomenon is described by the Jewish scholar R. Isaac Arama (died 1494) in his book "Akeydat Yitzchak" as a metaphor to the bi-lateral influence between the human being and the world. Everything a person does resonate with the entire world and thus causes similar acts everywhere. The human is the active string, the one that is being struck, and the world is the passive instrument that resonates to the same frequencies that the human activate in him. The scientific phenomenon behind the transfer of energy is the one known as Resonance. It is one of the most common phenomena occurring in nature. There is whole lot of diverse effects that resonance brings about. The colour of an object, sound produced by musical instruments; tall structures collapsing during earthquakes, sensing sound and light are some of them.

Designing:

Two persons should sit in the two swings. First person should oscillate while second should be at rest and while swinging the legs of both the persons should be on the foot rest provided. The energy of the first swing is transferred to the second swing and it starts moving and the first swing now comes to rest. The two swings are acting like two simple pendulums and energy transfer takes place because of the resonance between the swings. This energy transfer may lead to perpetual motion but the energy loss due to friction does not permit this.

Principle:

Sympathetic resonance or sympathetic vibration is a harmonic phenomenon wherein a passive string or vibratory body responds to external vibrations to which it has a harmonic likeness. This principal is applied here where if one person swings in one seat, the other seat starts swinging automatically without any effort.

This is due to the manner in which the rod supporting the swings is held. The supporting rod in the amusement parks is fixed and rigid. However, in the exhibit here, the rod itself is suspended and hence, is free to move back and forth when one of the swings oscillates. The back and forth motion of the rod transfers the energy of motion of one swing to the other at rest. This sets the second swing into motion. As the second swing gains energy, its oscillations cover greater distances from its rest position. Meanwhile, the first swing gradually comes to rest. Now, the transfer of energy from the second swing to the first begins. This goes on until the second swing comes to rest. And, the cycle of transfer of energy between the two swings continues.

If a swing is pulled to one extreme and released without pushing, it makes a certain number of oscillations in a unit time, say one minute. This number is a constant for a given swing and is known as its natural frequency or Resonance frequency. The natural frequency of a swing depends on its length. Longer the swing, lower the natural frequency. Suppose we have more than one object with same resonance frequency. If we have a medium connecting those objects, the motion of one of them brings about the motion of the others. This is resonance. The transfer of energy then is complete and maximum.

51. Gravity Tower

Have you ever wondered what keeps the Leaning Tower of Pisa from toppling over? The answer lies in the delicate interplay of forces, specifically the concept of **Centre of Gravity (CG)**. The Gravity Tower, a seemingly simple model, serves as a captivating tool to explore this fascinating principle.

Designing the Model:

The Gravity Tower model at RIE Bhopal STEAM Park is constructed using iron angles or pipes, with each joint allowing movement in at least one direction. This flexibility is crucial for the experiment. A plumb line, a string with a weight attached to its end, helps identify the vertical plane passing through the structure's Centre of Gravity (CG).

Principle:

The key concept at play is the centre of gravity (CG), the point where the entire weight of an object is concentrated. When the plumb line hangs directly below the CG, the forces acting on the structure are balanced, and it remains stable, even when the angles or pipes are moved. However, if the CG shifts, the forces become unbalanced, and the structure starts to sway or even fall. The magic unfolds when you hang another plumb line at this centre of gravity. As you move the tower, the first plumb line (representing the vertical plane) will remain constant, while the second plumb line (representing the centre of gravity) will swing around it. This demonstrates a very crucial principle: as long as the centre of gravity stays within the vertical plane, the structure remains stable, regardless of its movements.

52. Echo Tube

Sound travels to the far end of the tube and bounces back to make an echo. As it travels, the sound bounces off the sides of the tube. If you clap into the tube, the echo that returns sounds like a drawn out whine that begins with a high pitch and ends with a lower pitch. An echo is a repetition or a partial repetition of a sound due to reflection. Echoes are used by bats, dolphins and fisherman to detect an object / obstruction. They are also used in SONAR (Sound navigation and ranging) and RADAR (Radio detection and ranging) to detect an obstacle.

Designing:

Our brain can distinguish sounds that impinge on the ear at least 0.2 seconds apart. In our exhibit, sound takes about 0.4 seconds to make a to-and-fro trip. Therefore, the echo or the reflected sound is heard clearly. The tube here is thirty meter long. It is placed at a certain height from the ground. One end of the tube has been covered with the same material as that of the tube whereas the other end is open. Position your ear at the open end of the pipe and clap your hand. Echo of the clap caused by the reflection of sound at the far end of the pipe can be distinctly heard. Clap or say “ha” near the open end. The sound that you hear back is a series of claps or “ha’s” one quickly following the other. But if you observe carefully, all of them are not of the same pitch (frequency). You would first hear a high frequency followed by the low frequencies.

Principle:

When we clap or say 'ha' we are producing a sound wave. The sound waves travel in air at a speed of ~340 m/s. When any wave encounters a change in the propagating medium, it undergoes reflection, refraction and transmission. Likewise, the sound waves produced near one end of the tube also get reflected from the walls of the tube and the closed end along with being refracted and transmitted. These reflected waves travel back to the open end and reach our ears. If the time difference between the first sound and the next sound is more than 0.1 second, then our brain perceives them as two different sounds which is called an ‘echo’. If the time difference is less than 0.1 second, then the first sound would still be in our memory when the second sound strikes our mind. Then the brain perceives it as a prolonged sound. This is reverberation. If we want to hear an echo, the time difference between the sounds should be more than 0.1 second. If sound travels ~340 meter in 1 second, it can travel 34 meter in 0.1 second. Therefore, if the length of the pipe is more than 17 meter the sound wave would take more than 0.1 second to reach back to the open end. Thus, the required time difference for the echo to be heard can be achieved.

53. Tug of War

The game of Tug of War has a long and fascinating history, dating back thousands of years. Tug of War likely originated as a practical activity for testing strength and endurance. Ancient accounts suggest that it was practiced by various cultures around the world, including ancient Egypt, Greece, and China. Tug of War remains a popular recreational activity and competitive sport in many parts of the world. It is often played at school events, community festivals, and corporate team-building activities. Understanding the physics behind the Tug of War game involves concepts such as forces, friction, and Newton's laws of motion. Participants can learn about the relationship between force, mass, and acceleration as they exert force to pull the rope. Additionally, they can observe how friction between the ground and their feet affects their ability to generate force.

Designing:

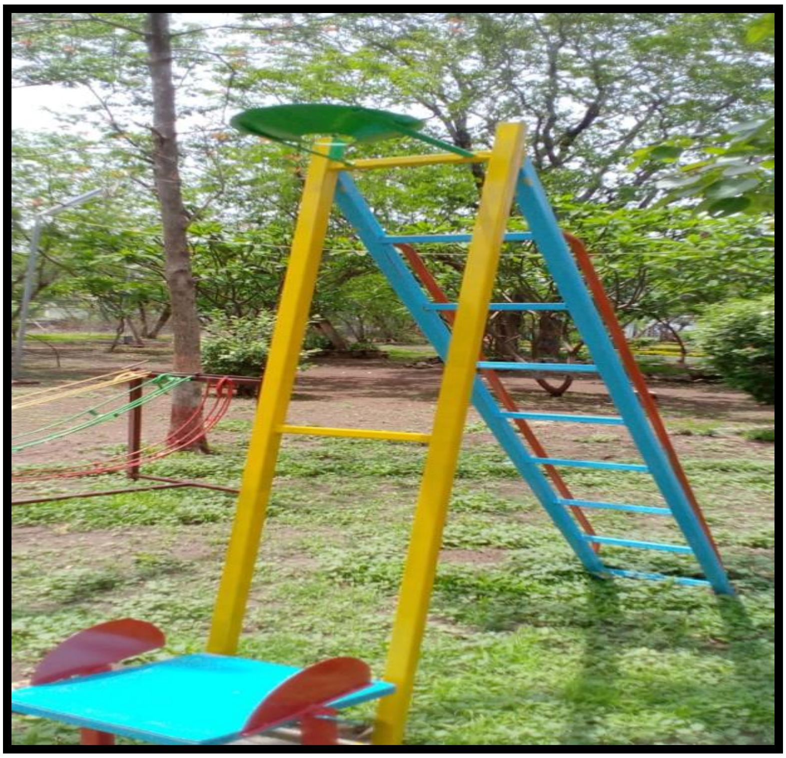
This is a fun model in which two teams pull at opposite ends of a rope until one drags the other over a central line. The two teams pull on opposite ends of a rope, with the goal being to bring the rope a certain distance in one direction against the force of the opposing team's pull. Several principles of physics like Newton's first and second law of motion can be easily explained through this model.

Principle:

All the three Newton's Laws of Motion can be explained using the Tug of War game. In Tug of War, teams apply force to the rope to overcome the inertia of the opposing team and initiate motion. Participants exert force on the rope, and the team with greater force relative to its mass will accelerate in the direction of the pull. The force exerted by one team pulling the rope is met with an equal force exerted by the opposing team in the opposite direction. Friction between the rope and the ground provides the necessary resistance for participants to push against and generate force. Friction between the hands of participants and the rope is also crucial for maintaining a secure grip and effectively transferring force.

54. Projectile

The motion experienced by an object when projected in air under the influence of gravitational field such as that of the Earth is known as projectile motion. The path followed by the object is a curved path or a parabolic path under the action of gravity only. The curved path of objects in projectile motion was shown by Galileo to be a parabola, but may also be a straight line in the special case when it is thrown directly upward or downward. The projectile is the object while the path taken by the projectile is known as a trajectory. The range of a projectile for a given initial velocity is maximum when the angle of projection is
45°.



Principle

If you throw a bunch of balls at the same initial velocity but at different launch angles you can check which ball will cover the farthest distance. The launch angle determines the maximum height, time in the air, and maximum horizontal distance of the projectile. Launch angles closer to 45° give longer maximum horizontal distance (range) if initial speed is the same. This can be easily calculated from the formula given below.

The formula to calculate the horizontal range of projectile motion is given by

$$R = \frac{sin\ u^2\ sin\ 2\theta}{g}$$

Designing:

Place a ball within the funnel provided at the top and drop it with the help of the ladder provided. The ball strikes the metal plate fixed at the bottom and bounces. Note down the distance of the first leap of the ball bounced from the metal base provided and the angle of the metal plate's position with the help of the protractor. Now change the angle of the metal plate and again release the ball from top. Note down the distance of first leap of the ball. Continue the same procedure for many angle positions till you reach maximum distance and note down corresponding angle of the plate. We can find that only at 45° of the plate, the ball covers maximum distance at the first leap. As per the law of projectile a thrown object can obtain a maximum distance only when it is thrown initially at an angle of 45°. This phenomenon is used in canyons and rifles to achieve maximum distance.

55. Floating Table

Tensegrity, short for "tensional integrity" or "tensile integrity," is a structural principle that relies on the balance between tension and compression elements to create stable structures. It was popularized by architect and futurist Buckminster Fuller in the mid-20th century, although its principles can be traced back to earlier architectural and engineering concepts.

The key idea behind tensegrity structures is that they consist of a network of rigid rods or struts floating in a network of tensile elements (such as cables or tendons), with the tensional elements maintaining the structure's integrity by pulling the rods or struts into position. In essence, the compression elements do not touch each other directly but are instead held in place by the tensional elements, creating a stable yet flexible structure.

Designing:

Floating tables give an illusion effect. It seems like how table can stand on chains instead of solid legs. There is nothing magical about it, its plain physics.

Principle:

This table is made on the principle of TENSEGRITY which is a design principle that applies when a discontinuous set of compression elements is opposed and balanced by an internal pressure that stabilizes the entire structure. This was a term coined by Buckminster Fuller an iconoclastic architect, engineer and poet to describe his vision of a new kind of architecture one that looked like it was built by nature instead by humans. While tensegrity was originally an architectural concept, it has an important role in anatomy and physiology in maintaining structural stability. Tensioned structures like the muscles, tendons and ligaments keep the rigid structures like bones aligned with one another.

56. Perception of Depth (Zebra Model)

Perception of depth refers to the ability of an individual to accurately judge the distance and three-dimensional space between objects in their environment. It is a major factor in perceiving the world in three dimensions. Depth perception happens primarily due to stereopsis and accommodation of the eye.

There are several cues that the brain uses to perceive depth such as Binocular Cues, Monocular Cues, Accommodation, Motion cues, Shadow and lighting cues. The brain integrates these cues to create a coherent and accurate perception of depth, allowing individuals to navigate their surroundings effectively and interact with objects in three-dimensional space.

Designing:

1. Metal cutting tools were used to cut zebra shapes from the iron plates. A template was employed to ensure precision, or the zebra outlines were drawn directly onto the iron plates before cutting.
2. After the zebra shapes were cut out, alternating black and white evenly spaced stripes were painted onto each shape.
3. Additional details such as eyes, nostrils, and ears were added using a marker or pen. These details were intended to enhance the perception of depth by providing additional visual cues.

4. Once the paint had dried the zebra shapes were carefully glued or welded together, ensuring proper alignment. A small gap was left between the front and back layers to create a sense of depth.
5. The zebra model was propped up in an upright position using a sturdy base or stand. This allowed viewers to observe the zebra from different angles and distances, enhancing their appreciation of the depth perception achieved by the model.
6. View different parts of the Zebra with only one eye
7. Though the Zebra is divided into several segments they appear as a single entity being in a vertical plane.
8. This illusion is possible because our single eye vision cannot assess the distance between the different parts which are perpendicular to our eye sight.
9. When we see through both the eyes the three dimensional depth is felt.

Principle:

Depth perception refers to the capability to gauge the distance of objects in the surrounding environment through the visual system and sensory perception. This skill is crucial for perceiving the world in a three-dimensional manner. The primary contributors to depth perception are stereopsis and the eye's accommodation.

Various cues contribute to the perception of depth, categorized as binocular cues and monocular cues. Binocular cues rely on receiving sensory input in three dimensions from both eyes, whereas monocular cues can be perceived with only one eye. Examples of binocular cues encompass retinal disparity, utilizing parallax and vergence, with stereopsis being achievable through binocular vision. Monocular cues involve factors such as relative size (where distant objects appear smaller than near ones), texture gradient, occlusion, linear perspective, contrast disparities, and motion parallax.

57. Angular Momentum

Angular momentum is a fundamental concept in physics, particularly in the study of rotational motion. It describes the rotational equivalent of linear momentum and plays a crucial role in understanding the behavior of rotating objects and systems. Angular momentum is a vector quantity, meaning it has both magnitude and direction, and it is defined as the product of an object's moment of inertia and its angular velocity. Understanding angular momentum is essential for analyzing and predicting the behavior of rotating objects and systems in various scientific and engineering contexts.

Designing:

Sit on the single seat provided in the merry go round. Keep the two sliding weights away from the center. Ask your friend to rotate the set up slowly. While revolving pull the weights gently towards the center. The merry go round speed automatically increases. For any rotating body the angular velocity and angular momentum will be more when the concentration of mass at the center is more.

Principle:

Concentration of mass of rotating axis increases angular velocity and angular momentum is explained through this single seat merry go round. The conservation of angular momentum explains that concentration of mass at the center increases the rotational speed. By bringing the weights near the center there is a decrease of moment of inertia. Because angular momentum is the product of moment of inertia and angular velocity, if the angular momentum remains constant (is conserved), then the angular velocity (rotational speed) of the must increase.

58. Brachistochrone Curve

Have you ever wondered about the fastest way to slide down a hill? While a straight line might seem like the obvious choice, science begs to differ. The answer lies in a fascinating curve called the Brachistochrone, meaning "shortest time" in Greek and it has interesting implications in the calculus of variations. In 1696, renowned mathematicians Johann Bernoulli and Isaac Newton challenged themselves to find the curve that minimizes the time taken for a frictionless bead to roll from one point to another under gravity. The solution, surprisingly, was not a straight line or a curve you might intuitively guess. It was a cycloid, the path traced by a point on the rim of a rolling circle. The brachistochrone curve is the curve between two points in a gravitational field along which a particle will fall in the shortest time, under the influence of gravity and assuming no other forces (like friction) are present. The word "brachistochrone" is derived from the Greek words "brachistos" (shortest) and "chronos" (time).

Principle:

The magic lies in the unique shape of the Brachistochrone Curve. It's not a straight line, nor a simple arc, but a cycloid, the trace of a point on the rim of a circle rolling along a straight line. This intricate shape optimizes the balance between potential energy (due to height) and kinetic energy (due to speed), allowing the bead to accelerate efficiently throughout the descent.

Key points about the brachistochrone curve:

- **Cycloid Solution:** The brachistochrone curve is a cycloid, which is a specific type of trochoid. It is the curve traced by a point on the rim of a circular wheel as the wheel rolls along a straight line.
- **Time Minimization:** The brachistochrone problem seeks to find the curve that minimizes the time it takes for a particle to travel between two points under the influence of gravity alone.
- **Path Independence:** The brachistochrone curve is interesting because the time of descent is independent of the starting point on the curve. Regardless of the initial position on the cycloid, a particle will take the same amount of time to travel.
- **Significance in Physics:** The study of the brachistochrone problem is significant in physics and mathematics. It involves principles of classical mechanics and calculus of variations.
- **Principle of Least Time:** The brachistochrone problem is an example of the principle of least time, where a particle follows a path that minimizes the time of travel.

The parametric equations for a cycloid, which is the solution to the brachistochrone problem, are given by:

$$x(t) = r(t - \sin t)$$
$$y(t) = r(1 - \cos t)$$

where t is a parameter, and r is the radius of the generating circle.

59s. QR Code

Have you ever encountered those mysterious black and white squares staring back at you from advertisements, billboards, or even your morning cereal box? These are QR codes, and they're not just fancy barcodes! Packed with information, these little squares can unlock a whole new world of possibilities, just by scanning them with your smartphone.

Invented in 1994 for tracking car parts in Japan, QR codes (Quick Response codes) have come a long way. Today, they're ubiquitous, used for everything from sharing contact details to accessing websites, menus, and even hidden messages in treasure hunts!

Designing:

So, how do these seemingly random patterns encode information? Each QR code is meticulously designed using error correction codes, ensuring information remains intact even if a part is damaged. Clever algorithms arrange tiny squares (modules) in specific patterns to store data efficiently. The number of modules determines the amount of information it can hold, with more modules allowing for more complex data like URLs or text messages.

The Science Behind the Scan

Scanning a QR code is a fascinating interplay between light, optics, and algorithms. When you scan the code with your smartphone camera, the image is processed by software that recognizes the patterns and translates them into the encoded information. This translation relies on sophisticated algorithms that can decipher even slightly distorted codes, making them remarkably reliable.

Visit of Honorable Secretary , Department of School Education & Literacy, Ministry of Education, Sh. Sanjay Kumar and Honorable Director NCERT, Prof. Dinesh Prasad Saklani to STEAM Park

Honorable Secretary , Department of School Education & Literacy, Ministry of Education, Sh. Sanjay Kumar and Honorable Director NCERT, Prof. Dinesh Prasad Saklani visited the STEAM Park on 06/01/2025. They inspected various models in the STEAM park area and gave suggestions for further improvement.

Teachers and students from different institutes all over the country regularly visit the STEAM Park





Report on the Design Thinking Workshop for Students

(under the STEAM Park Project)

Organized by: Regional Institute of Education (RIE), NCERT, Bhopal

Date: December 17-21, 2024

The five-day "Design Thinking Workshop for Students" organized under the STEAM Park project at the Regional Institute of Education (RIE), NCERT, Bhopal, aimed to cultivate creative problem-solving, critical thinking, and an understanding of STEAM (Science, Technology, Engineering, Arts and Mathematics) principles among students. The event was meticulously planned, engaging students from Classes IX to XII from various schools, and offered hands-on, interactive learning experiences focused on optics and telescope-making.

Objectives of the Workshop:

The primary objectives of the workshop included:

- Introducing students to the principles of design thinking and its applications.
- Enabling students to explore STEAM activities at the school level.
- Encouraging creativity and innovation through practical and theoretical learning as envisioned under the NEP – 2020.
- Providing hands-on experience in telescope fabrication to enhance understanding of basic optical physics and astronomy.

Participating Schools

1. Sanskar Valley School Bhopal

2. Demonstration Multipurpose School Bhopal

3. Kendriya Vidyalaya 2 Shivaji Nagar Bhopal

4. Jawahar Navodaya Vidyalaya Ratibad Bhopal

5. GOVERNMENT SUBHASH EXCELLENCE HIGHER SECONDARY SCHOOL SHIVAJI NAGAR

Daily Schedule and Highlights:

Each day of the workshop brought together fresh groups of students. Below is a detailed account of the activities conducted:

1. Pre-Project Survey (10 Minutes):

The workshop commenced with a brief pre-project survey. This activity helped in assessing students' prior knowledge about design thinking and astronomy-related concepts. The survey also gauged their interest and familiarity with STEAM activities, serving as a baseline to evaluate the impact of the workshop.

2. Introductory Session (10 Minutes): -

By - Dr. Shivalika Sarkar (Asst. Prof. Physics RIE, NCERT, Bhopal)

Dr. Shivalika Sarkar, Principal Investigator of the STEAM Park project, inaugurated each day's workshop with a concise yet engaging introductory session. The role of design thinking in bridging theoretical knowledge with practical applications was highlighted. It was emphasized how activities like telescope-making can foster a deeper appreciation for science and technology.

Relatable examples were used to inspire the students. The invention of simple yet impactful tools were cited, like eyeglasses and modern technological marvels like space telescopes, showcasing how design thinking can address diverse challenges.

3. Interactive Discussion on Design Thinking and STEAM Education (40 Minutes):

By – Mr. Amritanshu Vajpayee and Mr. Mukesh Satankar (Invited Subject Experts/Resource Persons)

The interactive discussion was an opportunity for students to engage with experts to understand the fundamentals of design thinking. The session revolved around:

- **Stages of Design Thinking**: Empathy, Define, Ideate, Prototype, and Test. Students were encouraged to relate these stages to real-world problems, such as designing solutions for sustainable energy.
- **Applications in Daily Life**: Examples included redesigning classroom furniture for better comfort or creating eco-friendly packaging for daily use.

Then the discussion was taken to the specific domains under Physics, viz, Optics and Astronomy, in addition to design thinking. The experts touched upon basic principles of optics and their relevance to daily life and astronomy. Students were introduced to how telescopes work and their historical significance in advancing our understanding of the universe. Demonstrations were conducted to show how lenses bend light to form images.

4. Telescope-Making Activity (2 Hours):

By – Mr. Amritanshu Vajpayee, Mr. Mukesh Satankar and Mrs. Shalini Gaur (Invited Subject Experts/Resource Persons)

Guided by experts Mr. Amritanshu Vajpayee, Mr. Mukesh Satankar and Mrs. Shalini Gaur, and supported by volunteer B.Sc.-B.Ed. students of RIE NCERT Bhopal, the participants fabricated their own paper-tube refractor telescopes.

The students were provided with the following materials:

- **Objective lens:** Biconvex lens (50 cm focal length, 40 mm diameter).
- **Eyepiece lens:** Plano-convex lens (2 cm focal length, 15 mm diameter).
- **Objective tube:** 40 cm length, crafted using black pastel/chart paper.
- **Eyepiece tube:** 30 cm length, designed to slide within the objective tube.

Steps of Assembly:

1. **Rolling and Sticking Tubes:** Using PVC pipe molds, students rolled and glued pastel paper into tubes of appropriate diameters.
2. **Fixing Lenses:** Objective lenses were fixed at one end of the objective tube using PVC rings, while eyepiece lenses were mounted using specially crafted chart-paper holders.
3. **First Light Observations:** Students focused their telescopes on distant objects (e.g., treetops or distant signboards) to ensure alignment and image clarity. Excitement filled the room as students exclaimed at their successful "first light" experiences, which refers to the first time a telescope observes a celestial or terrestrial object.

Learning Outcomes:

- Understanding the working of refractor telescopes.
- Learning how to handle delicate optical equipment.
- Grasping the concept of focusing and image inversion in optics.

5. Dos and Don’ts of Telescope Usage (20 Minutes):

By – Mr. Amritanshu Vajpayee, Mr. Mukesh Satankar and Mrs. Shalini Gaur (Invited Subject Experts/Resource Persons)

This brief yet essential session focused on:

- Handling telescopes safely and storing them properly.
- The importance of focusing on objects at infinity for clear observations.
- Tips on observing celestial objects like the Moon and planets and dealing with external disturbances like light pollution.
- Not to observe the Sun directly with the telescopes.

Students also learned about the inverted nature of images observed through basic refractor telescopes and how this affects terrestrial and astronomical observations.

6. Creative Decoration (20 Minutes):

To personalize their telescopes, students decorated them using colourful markers and tapes. This activity allowed for a blend of creativity and functionality, enabling students to showcase their individual artistic expressions while building a sense of ownership.

7. Visit to STEAM Park (60 Minutes):

By – Dr. Shivalika Sarkar (Asst. Prof. Physics, RIE, NCERT, Bhopal), and Mr. Amritanshu Vajpayee Mr. Mukesh Satankar and Mrs. Shalini Gaur (Invited Subject Experts/Resource Persons)

Post-lunch, students toured the STEAM Park under expert guidance. The visit included explanations of:

- **Models in Action:** Demonstrations of pendulum waves, sundials, periscopes, and more.
- **Applications in Daily Life:** Examples of how these scientific principles influence technologies.

Students were encouraged to ask questions and even discuss the applications for the models.

8. Post-Project Survey (20 Minutes):

The workshop concluded with a post-project survey to measure the knowledge and skills gained. Questions revolved around design thinking concepts, understanding optics, and overall satisfaction with the workshop.

Reflections and Impact

The workshop was well-received by students and participating schools. The following observations were made:

- **Enhanced Understanding:** Students demonstrated an improved grasp of optics and the engineering behind telescopes.
- **Stimulated Curiosity:** Many students expressed a desire to learn more about astronomy and explore projects in related fields.
- **Team Collaboration:** The group activity fostered teamwork, communication, and mutual learning.
- **Creativity Boost:** Decorating the telescopes allowed students to combine technical skills with artistic imagination.

Conclusion:

The "Design Thinking Workshop for Students" under the STEAM Park project successfully achieved its objectives of blending theoretical knowledge with practical applications. Through interactive discussions, hands-on telescope-making and exposure to innovative STEAM models, students gained valuable insights into the design thinking process and its relevance to solving real-world problems.

This initiative has laid a strong foundation for fostering innovation and curiosity among students, inspiring them to pursue interdisciplinary learning and contributing to the broader goal of STEAM education in India.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(NCERT, REGIONAL INSTITUTE OF EDUCATION, BHOPAL, M.P.)
TELESCOPE MAKING
STEAM PARK, RIE BHOPAL
दिसम्बर 17 – 21, 2024
(17-21 December, 2024)
This time the students will be making telescopes under the guidance of RIE (NCERT) Bhopal


DESIGN THINK
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