A Guide for Schools Visiting DoScience

Quick Introduction

DoScience is an experiential science learning space. Operating since 2017, DoScience provides

- an outdoor space with over 50 hands-on models that allow users to explore and discover concepts of Science (Mechanics, Sound, Light) and Maths, and
- a VR Astronomy space with a range of immersive astronomy shows.

DoScience is run by a non-profit, Bookmark Trust. Please look us up at www.facebook.com/dosciencenow and www.doscience.co.in. We are located inside the Sanjeevaiah Park, on Necklace Road in Hyderabad; the google maps location is https://g.page/doscience-hyderabad?share.

1. Learning Models at DoScience

We currently have over 50 installations at DoScience. These cover the areas of Physics (Mechanics, Sound, Light) and Mathematics, with a few play models (Chess, Path to Independence) included. All our installations are mostly hands-on, mechanical models; we do not use electronic gadgets.

Each DoScience installation is supported by a detailed signage, which guides the user on how to interact with the model, the underlying principle behind the model, and some everyday applications of the principle. Most signages have a QR code which will take the visitors to a relevant YouTube explanatory video.

2. VR Astronomy

DoScience Virtual Reality Astronomy space provides an immersive experience of the universe. We believe that VR is the closest to an experiential learning of astronomy that most of us will have. The objective of the DoScience VR Astronomy centre is to introduce young learners to the marvels of the universe and hopefully spark an interest in astronomy.

We currently have five VR devices and can accommodate 20 viewers per hour. We change the shows at the Astronomy space regularly; shows being aired currently are

- Solar System (Beginners, 10 min)
- Mars (Intermediate – slightly above beginners, 12 min)
- Hot and Energetic Universe (Intermediate – slightly above beginners, 12 min)

Preparation before Visiting DoScience

DoScience: We have shared exhibit signages for most of the installations at DoScience as an annexure. We urge teachers to review the information before their visit, so that they can guide the students suitably. Our team of trained demonstrators will help the teachers in managing the field visit.

Two popular approaches to exploring DoScience for school groups are –

1. Students explore by themselves by using the explanatory signages. Teachers and our demonstrators will be available at hand, to discuss and explain as required.

2. Students are split in smaller groups of 20-25. Each group is assigned a DoScience demonstrator, who will guide them through about 15 installations (taking around 30-40 minutes). Students are given time for exploration and free play subsequently.

We encourage teachers to plan the structure of the visit beforehand, so that students end the day with both a learning and a fun experience. Our team will follow the teachers' guidance and support them as required.

VR Astronomy: If you plan for the students to experience the Astronomy shows as well, please do take a moment to the following in advance –

1. We have shared the summaries of the three shows currently being aired as an annexure. Please check with us at the time of booking for the shows live at that time. Go through the summaries and let us know which shows you would like the students to watch. We will prepare in advance.
2. Each show takes around 15 minutes on an average, and 5 students can watch at a time. So, we can accommodate 20 students in an hour with our current capacity (we plan to increase capacity soon). Please plan you timings taking this into account.
3. We can start the VR space at 8.00 am if you would like us to.

We have enclosed the summaries of the three shows currently being aired as an annexure. Please ask us at the time of booking for the shows live at that time.

Facilities at DoScience

DoScience is located within the 99-acre Sanjeevaiah Park. The park has other interesting options to explore as well, including a cactus garden, a large national flag, a garden maze, a butterfly park, a bamboo garden, a nursery and a wide range of trees.

While the park has only a small pantry with basic food items available, its vast lawns present an opportunity for pleasant picnics. Please note that blankets and food are allowed to be brought inside the park, but play equipment (balls, bats, bicycles) is not allowed.

The washrooms in the park are the common amenities maintained by the park authorities.

Given the tropical weather conditions in Hyderabad and the vast spaces to be explored in the park, we urge children to carry hats and water bottles with them at all times of the year. DoScience will provide refills of mineral water into their water bottles.

Entry Fees, Group Sizes, Age-Groups, and Timings

Entry Fees

1. To Sanjeevaiah Park (as DoScience is located within the park, it is essential to enter the main park as well)
   - Rs. 10 per person per day
   - Free for government school children

- An introductory letter from the school is required by the park authorities (to be handed over at the ticket counter before entering.)

2. To DoScience only
   - Rs. 70 per person per day
   - In case of school groups, free entry for the teachers and support staff accompanying the children
   - Free entry always for government school children. We request you to connect local government schools with us – we will be very happy to block dedicated time at DoScience for them.
3. To VR Astronomy and DoScience together
   - Rs. 150 per person per show (includes entry to DoScience for the day)
   - Rs. 100 per additional astronomy show
   - In case of school groups, free entry for the teachers and support staff accompanying the children

We are a non-profit organisation and charge as little as possible. So, we request private schools to not ask for discounts; their contribution goes towards managing the space and providing free entry to government schools.

We encourage digital payments. We have shared our bank account information and QR code for digital transfers at the end of this note.

Group Sizes

1. DoScience can accommodate a maximum of 500 students in a 4-hour time frame (when supported by the teachers in forming and coordinating smaller groups of students, after entering the main park).
2. VR Astronomy can accommodate 20 viewers per hour.

Age Groups

1. Most of the science and maths principles demonstrated at DoScience are a part of the middle and high school curricula in India. So, children from classes 3 upwards connect the experiences at DoScience directly with their school sessions.
2. We believe that every learner is on their own unique learning journey and will garner knowledge appropriate for them at that point in time. So, we encourage children and grown-ups of all age-groups to visit DoScience.
3. In case of groups of children less than 8 years of age, we urge schools to send adequate number of teachers and support staff to take care of the children. Most of our models are made of metal, so a bit of caution helps.
4. About the suitability of VR shows for younger children, we urge teachers to visit us prior and view the shows to evaluate appropriateness. We rate the shows individually by the depth of information.

Timings

Our regular working hours for schools are –
Monday through Sunday – 9.00 am to 5.30 pm

(Please note that we are closed on Mondays for regular walk-in visitors)

We hope this document provides adequate information for you to plan a visit to DoScience. We would be happy to have a detailed conversation to clarify any doubts or to schedule a visit. Please call +91 88972 04422 or write to us at contact@doscience.co.in for any discussion or to check availability.

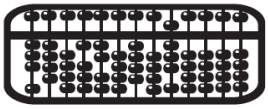
Bank Account Information

Bookmark Projects
Trust Current account - 59209177202202
HDFC Bank
Hitec Branch - IFSC Code HDFC0000545

Annexure 1 - Signages

ABACUS
The Counting Machine

WHAT TO DO



USE THE BEADS FOR QUICK ARITHMETIC CALCULATIONS. SEE THE ADJACENT EXAMPLE.

PLACE VALUES AND BEAD VALUES:
Each column of beads represents a place value.
The top row represents the number value 5, and the other beads of 1. So, the farthest column on the right has the Ones (1-9), followed by the Tens (10-90), and the Hundreds (100-900) and so on

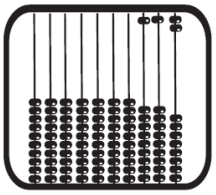
HOW TO MULTIPLY:
Example, 34 x 12.
Assign 4 columns on the left for the digits of multipliers.
Leave the rest of the columns to the right for the product.

Step 1. Multiply 3 and 1. Record their product in the 7th column.
Step 2. Multiply 3 and 2. Record their in the 8th column.
Step 3. Multiply 4 and 1. Add that product (4) to the 8th column. When you add 4 to 6 in the 8th column, carry one bead over to the 7th .
You now have 4 in the 7th column and 0 in the 8th.
Step 4: Multiply 4 and 2. Record their product in the 9th column.
The 7, 8 and 9 columns now have 4, 0, and 8.
Your answer is 408!

EVERYDAY SCIENCE EXAMPLE
Abacus-based mental calculation (AMC), is a useful method where you calculate in your mind with an imagined abacus.

ABACUS
The Counting Machine

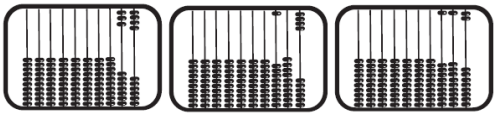
WHAT TO DO



USE THE BEADS FOR QUICK ARITHMETIC CALCULATIONS. SEE THE ADJACENT EXAMPLE.

PLACE VALUES:
Each column of beads represents a place value.
So, the farthest column on the right has the Ones (1-9), followed by the Tens (10-90), the Hundreds (100-900) and so on.

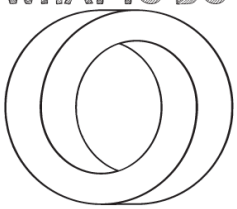
HOW TO ADD:
Addition: Example 34 + 78
Step 1: Start by having 34 in abacus.
Step 2: Tens - Since we have to add 70 to 34, push up 7 beads in tens. This 10 beads in tens we can trade with 1 bead of 100th and push down all tens.
Step 3: Add 8 beads in ones, where after adding 6 you have to trade again all units for 1 tens. Push remaining 2 beads of ones to get 1,1 and 2 beads!



EVERYDAY SCIENCE EXAMPLE
A Cranmer Abacus is commonly used by the visually impaired.
Children's brain power is enriched by learning to use an Abacus during their early years.
A Binary Abacus is used to explain how computers manipulate numbers

MOBIUS STRIP
Go Round, and Round, and Round.

WHAT TO DO

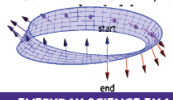


CLIMB ON TO THE PLAY MODEL.
WALK AROUND TILL YOU COME BACK TO THE SAME PLACE.
OBSERVE THE DISTANCE YOU COVERED.

Mobius Strip has only one side and one boundary.
It does not have an orientation.
You can make a Mobius Strip yourself - take a paper strip, give it a half-twist, and then join the ends to form a loop.
Try it with your DoScience band.
Mobius Strip is unique and has some unusual properties.
1. Try cutting the Mobius Strip horizontally along the middle. It does not split into two strips because it has only one side.

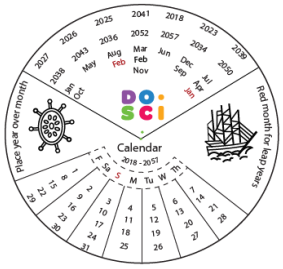
Cutting strip along centerline gives one long strip with two full twists

2. The normal vector moving all the way around the surface points in the opposite direction and it didn't switch sides of the surface. For this reason, the Mobius strip is not



EVERYDAY SCIENCE EXAMPLES
Conveyor belts looped to ensure unifrom wear along the belt;
Continuous-loop recording tapes; Mobius resistors cancelling own magnetic interference

40 Year Calendar
Guess the day!



THINK OF A DATE IN THE FUTURE.
ALIGN THE MONTH WITH THE YEAR.
YOU CAN DETERMINE THE DAY OF THE WEEK FOR THAT DATE FROM THE CALENDAR

What is a Leap Year?
Earth takes about 365.2422 days to go around the sun once. However, a normal Gregorian calendar year has 365 days. The left over fraction of a day every year is added up as an extra day every four years, February 29.

Every fourth year is thus a leap year. However, every hundredth is not a leap year, while every four hundredth year is.

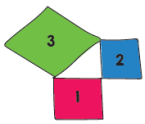
How does the 40 year calendar work?
365 days divided by 7 days in a week gives a remainder of 1.
366 days divided by 7 days in a week gives a remainder of 2.

So, if Jan 1 is a Monday in year 1, it will be
- a Tuesday in year 2, if year 1 is a normal year or
- a Wednesday in year 2, if year 1 is a leap year.

EVERYDAY SCIENCE EXAMPLE
Calendars help in planning and managing schedules

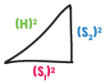
THE RIGHT ANGLE
Pythagoras Theorem

WHAT TO DO



PLACE THE JIGSAW PIECES IN
1. SQUARES 1 AND 2
2. SQUARE 3

PYTHAGORAS THEOREM
FOR RIGHT ANGLED TRIANGLES



(SIDE 1)² + (SIDE 2)² = (HYPOTENUSE)²

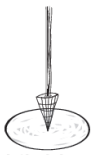
YOU CAN PROVE THE THEOREM USING THE FOLLOWING RELATION.

AREA OF (SQUARE 1) + AREA OF (SQUARE 2)
=
AREA OF (SQUARE 3)

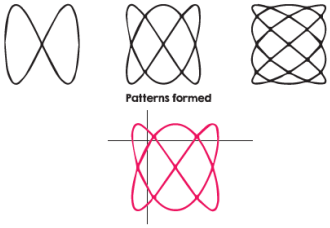
EVERYDAY SCIENCE EXAMPLE
You can replace length with any metric. Distance, energy, work and time!

LISSAJOUS FIGURES

WHAT TO DO



RELEASE THE PENDULUM
1. LEFT TO RIGHT
2. TOP TO BOTTOM
3. AT AN ANGLE



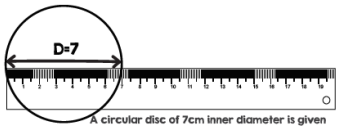
When the pendulum is released from an angle, there is a difference in tension in the two strings at the top. Hence unlike a simple gravity pendulum, which has a single time period, Lissajous' pendulum has two time periods. Lissajous' figures are thus formed by combining two perpendicular oscillatory motions.

EVERYDAY SCIENCE EXAMPLE - An oscilloscope is used to read Lissajous figures and is a part of medical and electronic devices.

PI

Deriving the value of PI (π)

What To Do?



A circular disc of 7cm inner diameter is given

PLACE THE MARKER ON THE DISC AT POINT 0 ON THE SCALE. ROLL THE MARKER ALONG THE SCALE, AND NOTE THE POINT AT WHICH IT STOPS. THIS IS THE CIRCUMFERENCE.

PI is a mathematical constant, denoted by the Greek symbol π

π is defined as circumference of the circle divided by its diameter

The value of π is 22/7 or approximately 3.14. This value remains the same for all circles of all sizes

In this example, diameter = 7 cm

So, circumference should be 22 cm

EVERYDAY SCIENCE EXAMPLE

PI has uses in mathematics, science, trignometry, geometry, nature, thermodynamics, fractals, number theory, electromagnetism, computing & more.

ANTI-GRAVITY MIRRORS

Float in Air

WHAT TO DO

Human body is symmetrical. So, a mirror reflection of the right side of the body will appear exactly like the left side, to an observer.

Stand with the edge of the mirror bisecting your body. You will appear whole to a person observing from the front!

So just straddle the mirror, raise one leg, and fly!

EVERYDAY SCIENCE EXAMPLE

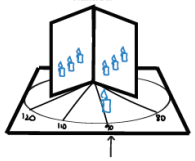
SPECTACLES, TELESCOPES, MICROSCOPES, OPTICAL FIBRES

BETWEEN THE MIRRORS

Number of images depends on the angle between the mirrors

WHAT TO DO

MIRROR



1. PLACE AN OBJECT BETWEEN THE MIRRORS
2. ADJUST THE ANGLE BETWEEN THE MIRRORS
3. COUNT THE NUMBER OF IMAGES IN THE 2 MIRRORS

A MIRROR REFLECTS EVERYTHING IN FRONT OF IT, INCLUDING ANOTHER MIRROR. IF YOU PLACE TWO MIRRORS AT AN ANGLE, YOU INCREASE THE NUMBER OF REFLECTED IMAGES THAT YOU CAN SEE.

CALCULATE THE NUMBER OF IMAGES

IF θ IS THE ANGLE BETWEEN MIRRORS, AND IF $360/\theta$ IS EVEN

NUMBER OF IMAGES (n) = $360/\theta - 1$

EXAMPLE: $\theta = 60°$

$n = 360/60 - 1 = 6 - 1 = 5$

IF $360/\theta$ IS ODD, THEN NUMBER OF IMAGES (n) = $360/\theta$

EXAMPLE: $\theta = 120°$

$n = 360/120 = 3$

AS THE ANGLE BETWEEN MIRRORS INCREASES, THE NUMBER OF IMAGES DECREASES

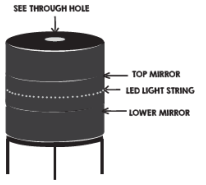
EVERYDAY SCIENCE EXAMPLE

In sweet shops, showrooms and temples, mirrors are mounted on walls and ceilings to create an illusion of more objects and to make it easier to see objects from all angles

INFINITY WELL

Multitude of images with parallel mirrors

WHAT TO DO



SEE THROUGH THE HOLE ON TOP OF THE INFINITY WELL. OBSERVE THE NUMBER OF ROWS OF LIGHTS.

INFINITY WELL HAS TWO MIRRORS.

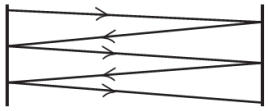
- THE TOP MIRROR IS A TWO-WAY MIRROR. WHILE IT REFLECTS THE IMAGE, YOU CAN ALSO SEE THROUGH IT FROM THE OTHER END.
- THE LOWER MIRROR IS A REGULAR ONE-SIDE MIRROR.

THE TWO MIRRORS ARE PLACED PARALLEL TO EACH OTHER. AND A STRING OF LEDS IS PLACED BETWEEN THE TWO.

THE ANGLE BETWEEN THE MIRRORS IS 0 DEGREES.

HENCE, THE NUMBER OF REFLECTIONS IS (360 / 0), WHICH IS INFINITY.

THAT IS, LIGHT BOUNCES OFF THE TWO SURFACES MULTIPLE TIMES RESULTING IN A NUMBER OF IMAGES.



EVERYDAY SCIENCE EXAMPLE

As room accents and in artwork

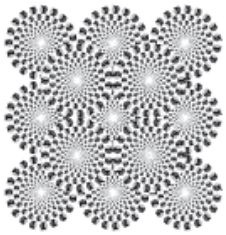
SCIENCE WITH A SPIN

Types of Optical Illusions

LITERAL ILLUSION

Here the brain interprets an image differently from individual elements of the image.
In this painting, a young girl sits in front of a mirror that appears to be a skull. There isn't actually a skull there - the objects in the painting come together to create that effect.

PHYSIOLOGICAL ILLUSION



This is the result of the brain and eyes being exposed to an external stimulus for a certain period. Exposure to the external stimulus often produces an after-image.

COGNITIVE ILLUSION

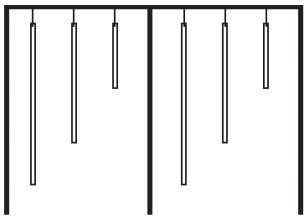
Here the brain perceives an object based on prior knowledge or assumptions.
In the above image, the brain was looking for something familiar to it - in this case, either two faces or a vase.

MUSICAL PIPES

Frequency of sound waves in hollow pipes

WHAT TO DO

STAINLESS STEEL COPPER



HIT THE DIFFERENT PIPES AND OBSERVE THE SOUNDS

When a pipe is hit, the air column inside vibrates. These vibrations are the sound waves that are picked up by our ears.

The sound waves depend on the length and width of the air column and the material of the pipe. Observe the difference in the sounds produced by the copper and steel pipes.

The frequency of the sound waves varies with the length of the pipe. Shorter tubes generate higher pitch sounds while longer tubes generate lower pitch sounds.

$F = V/\lambda$

V ⟶ Speed of sound
λ ⟶ Wavelength
F ⟶ Frequency

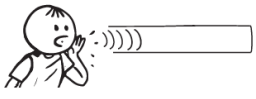
Here λ is the wavelength and is a factor of the length of the pipe. Speed of sound in air is around 340 metres per second. These factors determine the frequency of sound generated in each pipe.

EVERYDAY SCIENCE EXAMPLE
Wind instruments like trumpets, trombones and flutes

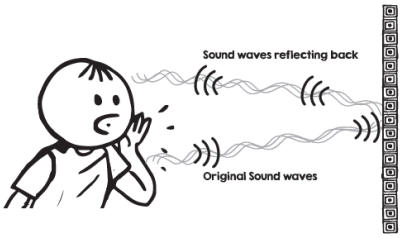
HELLO... HELLO... HELLO

Echo tube

WHAT TO DO



GO AHEAD AND SCREAM INTO THE TUBE.



Echo is a reflection of sound that comes back to the speaker with a delay when it bounces off a surface.

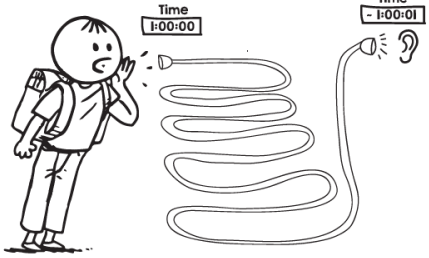
EVERYDAY SCIENCE EXAMPLE
Clapping at the Golconda main portico;
Medical devices such as ECG, 2D and 3D echo; SONAR

SPEED OF SOUND

Delayed Sound

WHAT TO DO

SPEAK INTO THE MOUTH PIECE AND HEAR YOUR VOICE THROUGH THE EAR PIECE.



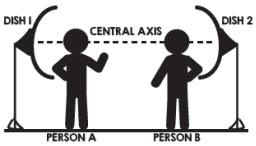
In air, sound travels at the speed of approximately 340 m/sec.
This exhibit has a pipe length of around 300 metres. So, when you speak through the mounth piece, you hear yourself from the mouth piece after a lag of around 1 sec.

EVERYDAY SCIENCE EXAMPLE
Make a string telephone and see for yourself.

PARABOLIC SOUND REFLECTORS

Whisper Dishes

What To Do?



1. PERSON 'A' STANDING CLOSE TO DISH '1' SPEAKS SPEAKS SOFTLY INTO IT
2. PERSON 'B' STANDING CLOSE TO DISH '2' HEARS THESE SOUNDS CLEARLY

GUESS HOW THIS HAPPENS?
NOTICE THE SHAPE OF THE DISH?
ITS A PARABOLA.

A parabolic dish is a good device for reflecting and collecting sound waves.

Because of the shape of the dish, sound waves that travel parallel to its central axis and strike the dish, get reflected to its focal point.

Initial sound gets reflected from the "acoustic mirror", propogates to the other dish and gets concentrated at its focal point.
This conservation of sound allows us to hear low whispers also, as if the sound is being originated right next to us.

EVERYDAY SCIENCE EXAMPLE
TV signals, radio signals, light waves are transmitted and received using parabolic dishes. Large telescopes use parabolic dishes to gather light from distant stars, allowing us to study them.

RESONANCE BARS

WHAT TO DO

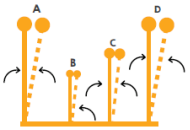
SET BAR 'A' VIBRATING.
WHAT DO YOU NOTICE?
BAR 'B' OF SAME LENGTH IS ALSO SET INTO VIBRATION.
TRY WITH C, D, E & F BARS

Natural Frequency: Frequency at which a system oscillates when not subjected to a continuous external force.

Resonance: When an external stimulus - with a frequency close to the natural frequency of the object - is applied, then abnormally large vibrations are produced.

In this exhibit, one object vibrating at the natural frequency of the second object forces the second object also to vibrate.

RESONANCE TRIGGERED IN SIMILAR BARS



The vibrations in bar A trigger vibrations in the base and surrounding air particles. These trigger vibrations in bars B, C and D.

The amplitude of vibration is highest in bar D which has the same length and natural frequency as bar A.

EVERYDAY SCIENCE EXAMPLES
Musical instruments like guitar and veena use resonance to generate loud sounds. When the strings are pulled, air particles inside the instruments vibrate to generate louder sounds.
Resonance in machinery, buildings and vehicles may however cause their breakdown or collapse.

PERCUSSION DRUMS

Sounds generated by vibrating air columns

WHAT TO DO

PLAY THE DRUMS.
OBSERVE THE SOUNDS GENERATED BY EACH DRUM.

Sounds produced by a drum depend on - 1. the drum head and 2. the drum shell.

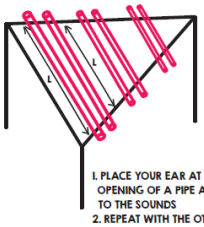
Drum Head - determines the the dominant frequencies produced. While a heavier drum head dampens higher frequencies, a lighter drum head enables them.

Drum Shell - shape and size of the shell determines the air column. The larger the volume of the resonating body, the easier it is to resonate in the lower frequency band, while the smaller the volume, the easier it is to resonate in the higher frequency band. The larger the diameter, or the deeper the shell, the thicker and heavier the tone, and the smaller or shallower the shell, the brighter and lighter the tone

EVERYDAY SCIENCE EXAMPLE
Sounds generated by air columns are used for communication over large distances
Drums are used in music art; for setting a marching pace; or for announcements.

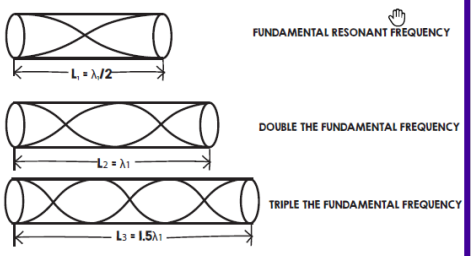
NATURAL FREQUENCY OF OBJECTS
Resonance Pipes

WHAT TO DO



1. PLACE YOUR EAR AT THE OPENING OF A PIPE AND LISTEN TO THE SOUNDS
2. REPEAT WITH THE OTHER PIPES. OBSERVE THE DIFFERENCE IN THE SOUNDS

WHEN THE FREQUENCY OF A BODY MATCHES THE FREQUENCY OF AN EXTERNAL SOURCE, RESONANCE OCCURS. RESONANCE CAUSES A SHARP INCREASE IN THE AMPLITUDE OF VIBRATION

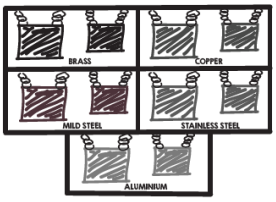


Observe that the resonance varies with the length of the pipe

EVERYDAY SCIENCE EXAMPLE
Musical instruments like the flute, trumpet and saxaphone use resonance in open pipes to generate beautiful music

METAL GONGS
Transmission and Dampening of Sound

What To Do?



HIT THE DIFFERENT GONGS
OBSEVE THE DIFFERENCE IN SOUNDS GENERATED

Sounds generated by objects depend on two key factors:
I. elasticity and 2. shape of the object

ELASTICITY
Elasticity is the object's ability to retain its shape after impact. For example, steel has greater elasticity than air. So, sound is transmitted better through steel than through air.

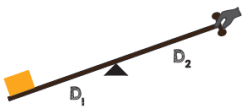
In other words, steel trasmits sounds while air dampens sound.

SHAPE
On impact with a mallet, gongs can generate a range of sounds. The sounds depend on -
I. Area - bigger, usually lower frequency and deeper sound
II Thickness - thicker, usually higher frequency and sharper sound

EVERYDAY SCIENCE EXAMPLE
As different materials transmit sound differently, we use some materials to transmit sound and some others to dampen sound.

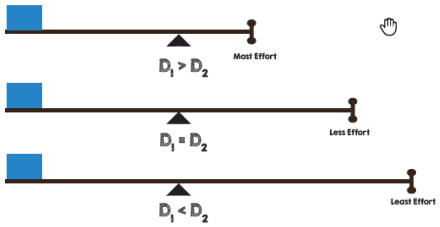
FIRST ORDER LEVER
See Saw

WHAT TO DO



LIFT THE WEIGHTS BY PUSHING DOWN EACH LEVER.

LEVERS ARE MECHANICAL DEVICES USED TO SCALE THE AMOUNT OF FORCE AND/OR TRAVEL IN A MECHANISM



COMMONLY USED TO CREATE MECHANICAL ADVANTAGE, THE PRINCIPLE OF TURNING EFFECT OF FORCE OR MOMENT IS USED HERE

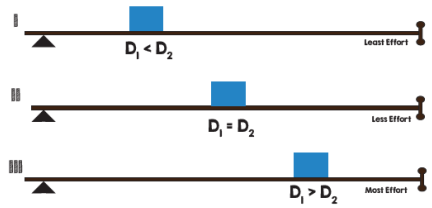
EVERYDAY SCIENCE EXAMPLE
See saw, Construction sites, Crow bar, Scissors, Bottle opener, Row boat.

SECOND ORDER LEVER
Wheel-barrow

WHAT TO DO

LIFT THE WEIGHTS BY PULLING UP THE LEVERS.

SECOND ORDER LEVERS ARE SIMPLE MACHINES USED TO MULTIPLY THE AMOUNT OF FORCE IN A MECHANISM

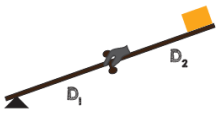


DISTANCE BETWEEN FIRST WEIGHT AND FULCRUM IS THE LEAST. SO IT IS THE EASIEST TO LIFT.
DISTANCE OF THE THIRD WEIGHT IS HIGHEST. SO, IT IS MOST DIFFICULT TO LIFT.

EVERYDAY SCIENCE EXAMPLE
Wheelbarrow, Nut crackers, Staplers and Nail clippers.

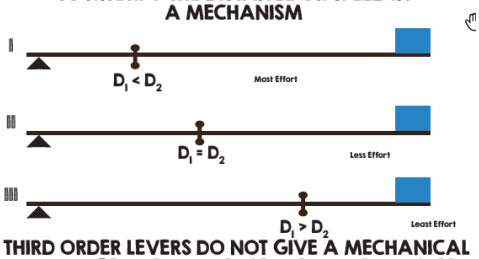
THIRD ORDER LEVER
Fishing Rod

WHAT TO DO



LIFT THE WEIGHTS BY PULLING UP THE LEVERS.

THIRD ORDER LEVERS ARE SIMPLE MACHINES USED TO MULTIPY THE DISTANCE OR SPEED IN A MECHANISM



THIRD ORDER LEVERS DO NOT GIVE A MECHANICAL ADVANTAGE. THEY INCREASE THE TRAVEL OR SPEED.

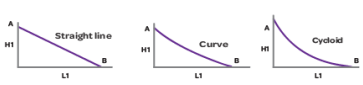
TURNING EFFECT OF THE FORCE IS HIGHEST IN THE THIRD CASE ABOVE.

EVERYDAY SCIENCE EXAMPLE
Shovels, fishing rods, human arms and legs, tweezers, and ice tongs.

Distance, Curvature and Speed
Cycloidal Path

WHAT TO DO?

- DROP THE BALLS ALONG THE THREE PATHS. OBSERVE THE TIME TAKEN BY THE BALLS TO REACH THE END POINT
- SHORTEST PATH BETWEEN POINTS A AND B IS A STRAIGHT LINE
- A CYCLOID IS THE PATH TAKEN BY CIRCLE AS IT ROLLS DOWN A STRAIGHT LINE.
- FASTEST PATH BETWEEN POINTS A AND B IS ALONG A CYCLOID
- AS THE BALL ROLLS DOWN THE CYCLOID, IT PICKS UP SPEED. AVERAGE SPEED ALONG THE CYCLOID IS THE HIGHEST, COM PARED WITH ALL PATHS CONNECTING A AND B



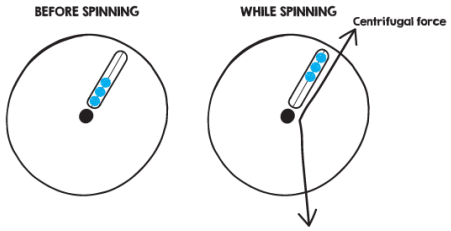
EVERYDAY EXAMPLES
DESIGN OF GEARS, CONVEYOR BELTS, PENDULUMS

DEFYING GRAVITY
Centrifugal Force

WHAT TO DO

SPIN THE DISC TO SEE THE BALLS MOVE AWAY FROM THE CENTRE.

Due to inertia, a body tries to move in a straight line.
Centrifugal force is the result of this inertial force when in curcular motion.
Centrifugal force makes the balls to slide radially outwards.



CENTRIFUGAL FORCE > GRAVITATIONAL FORCE

The steel balls defy gravity as the centrifugal force acting on them is greater than the gravitational force.

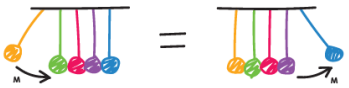
EVERYDAY SCIENCE EXAMPLE
Washing Machine, Centrifuges, Governors for throttle control, Turbine blade design.

ART IN MOTION
Newton's Cradle

WHAT TO DO

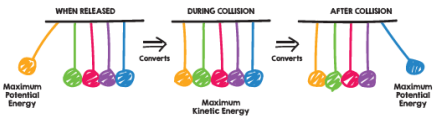
LIFT A SPHERE AND RELEASE IT. NOW, LIFT TWO SPHERES AND RELEASE THEM.

CONSERVATION OF MOMENTUM (M)



WITH THE COLLISIONS BEING ELASTIC, TOTAL MOMENTUM REMAINS CONSTANT

CONSERVATION OF ENERGY



ENERGY CAN NEITHER BE CREATED NOR DESTROYED

EVERYDAY SCIENCE EXAMPLE
Snooker balls colliding, cars in a crash.

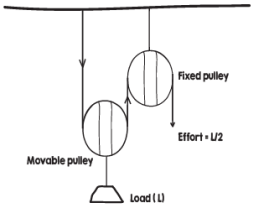
THE CLIMBING CHAIR
Lift yourself Pulley

WHAT TO DO

Sit on the chair and try hoisting yourself up.

PULLEYS REDUCE EFFORT REQUIRED TO LIFT LOADS

In a 2-pulley system, effort required to lift a weight is half the load.
This effort decreases with an increase in the number of pulleys.
Simultaneously, the length of rope pulled increases with the decrease in effort.
Hence, total work done to lift a given weight to a given height, remains constant.

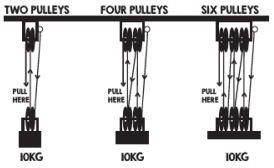


In this exhibit, we use a 6-pulley system which means that you need to apply an effort equal to 1/6th of your weight to lift yourself up.
Try lifting yourself up.

EVERYDAY SCIENCE EXAMPLE
Bosun's Chairs used in construction work.

LIFTING WITH PULLEYS
Mechanical advantage of using pulleys

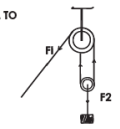
WHAT TO DO



1. LIFT THE 10 KG WEIGHTS USING THE TWO-PULLEY SYSTEM, AND THEN THE FOUR-PULLEY AND SIX-PULLEY SYSTEMS
2. OBSERVE THE EFFORT REQUIRED IN EACH OF THE PULLEY SYSTEMS FOR LIFTING A SIMILAR WEIGHT

IN A TWO-PULLEY SYSTEM, FORCE NEEDED TO LIFT A BODY IS EQUAL TO 1/2 OF ITS WEIGHT.

WORK DONE = FORCE X DISTANCE
F1 X S1 = F2 X S2
5 NEWTON X 20 CM = 10 NEWTON X 10 CM
= 100 NEWTON-CM



IN A FOUR-PULLEY SYSTEM, FORCE NEEDED TO LIFT THE SAME BODY IS 1/4TH OF ITS WEIGHT BUT THE DISTANCE IS DOUBLE THAT IN THE TWO-PULLEY SYSTEM.

WORK DONE = 10/4 NEWTON X 40 CM
= 100 NEWTON-CM

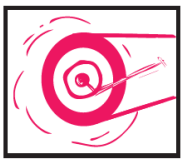
IN A SIX-PULLEY SYSTEM, FORCE NEEDED TO LIFT THE SAME BODY IS 1/6TH OF ITS WEIGHT BUT THE DISTANCE IS THRICE THAT IN THE TWO-PULLEY SYSTEM.

WORK DONE = 10/6 NEWTON X 60 CM
= 100 NEWTON-CM

EVERYDAY SCIENCE EXAMPLES
To lift heavy weights conveniently. Such as, lift water from well using a pulley, rescue people using a winch or in the lift (elevator) systems in buildings

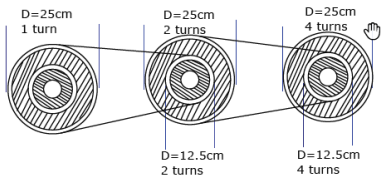
BELTS AND PULLEYS
Change Torque, Speed, and Direction

WHAT TO DO



ROTATE THE SHAFT
OBSERVE THE DIRECTION AND SPEED OF THE MOVING PULLEYS.

Here, energy is transferred from a larger wheel to a smaller wheel, and then again to a larger wheel. Hence, overall speed is increased while maintaining the size of the wheel.



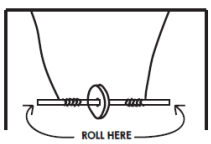
Cross belts between the pulleys will enable a change in the direction of rotation.

Pulley work better than when we need to transfer torque over a longer distance. However, there is a greater loss in energy transfer in pulley systems as compared with gears.

EVERYDAY SCIENCE EXAMPLE
USED IN MILL INDUSTRY, CONVEYOR BELTS

SCIENCE OF YO-YOS
Conservation of energy

WHAT TO DO



1. ROLL THE ENDS OF THE YO-YO STUB UPWARDS AND LET IT GO
2. WATCH IT SPIN, COME DOWN THE ROPE AND CLIMB UP AGAIN

Energy can neither be created nor be destroyed.
It can only be converted from one form to another.

A Yo-Yo demonstrates the conservation principle effectively.

P.E ⇌ Translational K.E + Rotational K.E

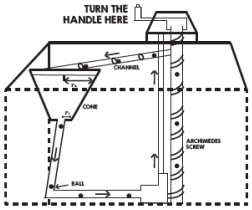
At the top	While moving
Potential energy	Translational + Rotational kinetic energy

Energy gets continously converted from one form to another. The kinetic energy in the system cannot get destroyed when the yo-yo reaches the bottom. So it gets converted to potential energy and the yo-yo rises back.

EVERYDAY SCIENCE EXAMPLES
Wheels going down the hill, water gushing down a dam.

BLACK HOLE

WHAT TO DO



TURN THE HANDLE ON TOP, AND OBSERVE THE MOVEMENT OF THE BALL

THERE ARE A NUMBER OF INTERESTING THINGS TO OBSERVE HERE

1. MOMENTUM OF THE BALL ON RELEASE MAKES IT SLIDE ALONG THE SIDES OF THE CONE INSTEAD OF FALLING STRAIGHT DOWN

2. VELOCITY OF THE BALL INCREASES AS THE RADIUS OF THE CONE DECREASES, TO MAINTAIN A CONSTANT ANGULAR MOMENTUM

3. ARCHIMEDES SCREW ON THE SIDE USES ROTATORY MOTION TO MOVE THE BALL VERTICALLY

EVERYDAY SCIENCE EXAMPLES
1. CELESTIAL OBJECTS INFLUENCED BY GRAVITATIONAL PULL (INCL IN A BLACK HOLE)
2. RACING IN A VELODROME OR DEATHWELL
2. CAR JACK AND WATER SCREWS IN AGRI FIELDS

Reverse Bicycle

Turn left or turn right?

What to do?

RIDE THE CYCLE
- TURN LEFT. TURN RIGHT
- OBSERVE THE TWO GEARS CONNECTING THE HANDLE TO THE FRONT WHEEL

- WHEN TWO GEARS MESH TOGETHER, THE SECOND GEAR ALWAYS MOVES IN THE OPPOSITE DIRECTION
- IN THIS CYCLE, THE HANDLE AND FRONT WHEEL ARE CONNECTED THROUGH TWO SIMPLE GEARS. HENCE, THEY MOVE IN OPPOSITE DIRECTIONS
- IF YOU CAN RIDE A NORMAL CYCLE, IT WILL TAKE YOUR BRAIN AROUND 8 MONTHS TO LEARN TO RIDE THIS REVERSE CYCLE! FURTHER, BY THEN, YOUR BRAIN WILL FORGET HOW TO RIDE A NORMAL CYCLE!! THIS IS CALLED NEUROPLASTICITY.

EVERYDAY EXAMPLES:
REVERSE GEARS IN VEHICLES, MECHANISMS FOR TURNING OBJECTS (LIKE TELESCOPES, GUNS, POINTING DEVICES)

RACE THE ROLLERS

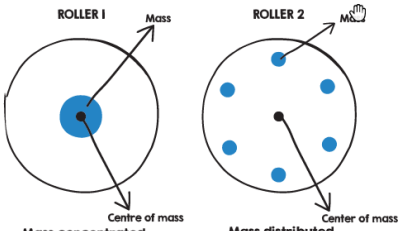
Distribution of Mass

WHAT TO DO

PLACE BOTH THE ROLLERS ON TOP OF THE INCLINE.
GIVE THEM BOTH A SIMILAR PUSH AND SEE WHICH ONE WINS THE RACE.

Moment of inertia (MOI) in rotational motion is analogous to mass in linear motion.

MOI of a rigid body is a measure of its resistance to angular acceleration when a torque is applied. MOI depends on distribution of mass - when mass is distributed away from the axis of rotation, it resists motion more than when the mass is distributed closer to the axis,



Roller I wins the race

EVERYDAY SCIENCE EXAMPLE
Formation and movement of stars and planets.
Flywheels of engines are designed to have high MOI.

ROTATING IN YOUR ORBIT

Spinning Chair

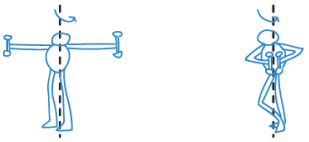
WHAT TO DO

SIT IN THE CHAIR.
SPIN YOURSELF SLIGHTLY.
NOW MOVE WEIGHTS INWARD & OUTWARD.

LAW OF CONSERVATION OF ANGULAR MOMENTUM

ANGULAR MOMENTUM (L) IS A FUNCTION OF ANGULAR VELOCITY (ω) AND MOMENT OF INERTIA (I). IN THE ABSENCE OF AN EXTERNAL TORQUE, ANGULAR MOMENTUM IS CONSERVED.

NOTE: MOMENT OF INERTIA IN ANGULAR FRAMEWORK IS AKIN TO MASS IN LINEAR FRAMEWORK.



BODY MASS IS DISTRIBUTED AWAY FROM THE ROTATION AXIS, SO I IS MORE AND ω IS LOW.

BODY MASS IS DISTRIBUTED CLOSE TO THE ROTATION AXIS, SO I IS LESS AND ω IS HIGH.

EVERYDAY SCIENCE EXAMPLE
Skating on ice; distribution of mass in automobile wheels

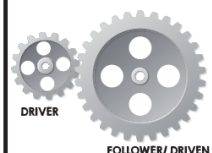
Spur Gears

Change in Torque, Speed and Direction

WHAT TO DO

ROTATE THE SHAFT
OBSERVE THE DIRECTION AND SPEED OF THE MOVING GEARWHEELS.

Gears are rotating machine parts with teeth, which mesh together to transmit torque from one point to another.



NUMBER OF TEETH IN DRIVER IS 16
NUMBER OF TEETH IN FOLLOWER IS 30

THE GEAR TRAIN HAS A GEAR RATIO OF 30/16. HENCE IF AN INPUT TORQUE OF 160N IS GIVEN, THE OUTPUT TORQUE WILL BE (30/16)X160, i.e. 300N. HERE MECHANICAL ADVANTAGE OF 1.875 IS GAINED.

Gears enable devices to change torque, speed and direction. Two gears in direct contact exert equal and opposite forces on each other. They create a mechanical advantge in the process, depending on their gear ratio.

There are different types of gears - such as helical, bevel, worm, and rack and pinion.

Apart from changing direction of rotation, gears (such as bevel gears) can be used to change the axis of rotation.

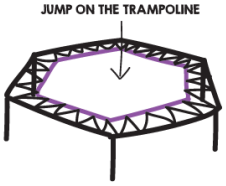
EVERYDAY SCIENCE EXAMPLE
Automotives, clocks, bicycles, conveyer belts.

TRAMPOLINE

For every action there is an equal and opposite reaction

WHAT TO DO

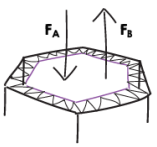
JUMP ON THE TRAMPOLINE



THE TRAMPOLINE PUSHES YOU AND YOU BOUNCE BACK

WHEN YOU (OBJECT A) EXERT A FORCE (F_A) ON THE TRAMPOLINE (OBJECT B) BY JUMPING ON IT, YOU ARE PUSHED BACK BY AN EQUAL FORCE IN THE OPPOSITE DIRECTION

$F_A = - F_B$



NEWTON'S THIRD LAW OF MOTION

FOR EVERY ACTION, THERE IS AN EQUAL AND OPPOSITE REACTION

WHEN YOU SWIM ⟶ YOU PUSH THE WATER BACK AND THE WATER PUSHES YOU FORWARD

WHEN YOU SIT ⟶ YOUR BODY EXERTS A DOWNWARD FORCE ON CHAIR WHILE CHAIR EXERTS AN UPWARD FORCE ON YOUR BODY

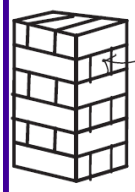
CAN YOU THINK OF OTHER EXAMPLES?

EVERYDAY SCIENCE EXAMPLES
WALKING, SWIMMING, BIRDS FLYING, CARS MOVING ON ROADS ARE ALL EXAMPLES FOR NETWON'S THIRD LAW OF MOTION

HOW TALL A TOWER CAN YOU BUILD
Jenga Blocks

Lower CG and centered line of gravity is important for stability of objects

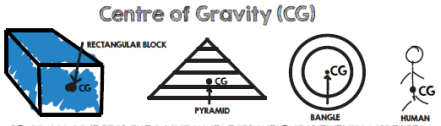
WHAT TO DO



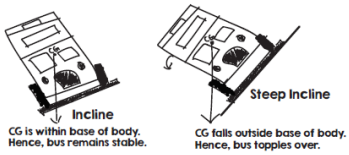
REMOVE BLOCKS ONE AT A TIME

1. REMOVE A BLOCK AND STACK IT ON TOP OF THE EXISTING TOWER. ENSURE YOUR TOWER REMAINS STABLE.
2. REPEAT.

Centre of Gravity (CG)



CG OF AN OBJECT IS THE POINT WHERE ITS WEIGHT IS EVENLY DISPERSED AND ALL SIDES ARE IN BALANCE



CG is within base of body. Hence, bus remains stable.

CG falls outside base of body. Hence, bus topples over.

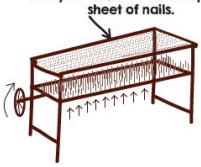
EVERYDAY SCIENCE EXAMPLE

1. A well-trimmed tree may remain stable during fierce winds, while a top-heavy tree topples over.
2. A short stocky man cannot be easily pushed down because his CG is lower.

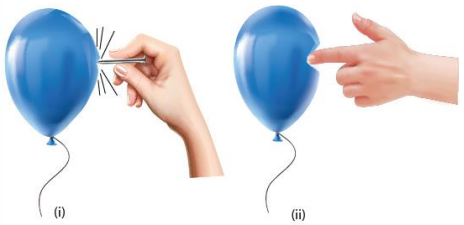
BED OF NAILS
Distribution of Force

WHAT TO DO

Lie on the bed distibuting your weight evenly.
Ask your friend to crank up the sheet of nails.



Pressure is Force acting upon a unit Area.
For the same force applied, pressure is lower if the contact area is more.



Force applied by the hand is same in both the balloons above.
But pressure is more in case (i) as force is concentrated at a single point, i.e. the nail tip.
In case (ii), pressure is less and hence the balloon does not burst.

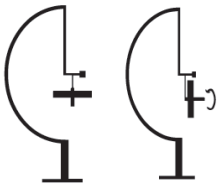
Similarly, when you sit on a single nail, it will likely pierce through your skin.
However, when you lie on a bed of nails, your weight is distributed over a wider area and it does not hurt.

EVERYDAY SCIENCE EXAMPLE

A sharp knife cuts through easily while a blunt one may not.

GYRO WHEEL
Conservation of Angular Momentum

WHAT TO DO



Rotating objects tend to maintain their orientation of rotation.

Principle of conservation of angular momentum entails that angular velocity of a rotating object remains constant and also its axis of rotation remains the same.

To change the axis, you need a torque (force with a direction). Or in converse, you will experience torque, if you change the axis.

You will experience considerable resistence, when you try to change the axis of rotation of the spinning wheel.

EVERYDAY SCIENCE EXAMPLE

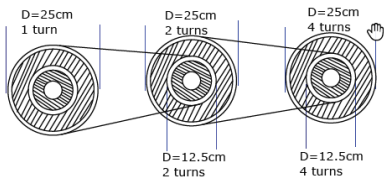
Gyro Compass used in Aircrafts, Steadicam

BELTS AND PULLEYS
Change Torque, Speed, and Direction

WHAT TO DO

ROTATE THE SHAFT
OBSERVE THE DIRECTION AND SPEED OF THE MOVING PULLEYS.

Here, energy is transferred from a larger wheel to a smaller wheel, and then again to a larger wheel. Hence, overall speed is increased while maintaining the size of the wheel.



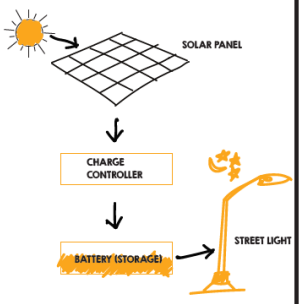
Cross belts between the pulleys will enable a change in the direction of rotation.

Pulley work better than when we need to transfer torque over a longer distance. However, there is a greater loss in energy transfer in pulley systems as compared with gears.

EVERYDAY SCIENCE EXAMPLE

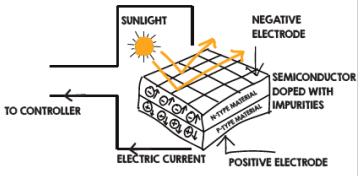
USED IN MILL INDUSTRY, CONVEYOR BELTS

SOLAR POWER
The free and renewable energy source



SOLAR PANELS CONTAIN PHOTOVOLTAIC (PV) CELLS WHICH CONVERT SOLAR ENERGY TO ELECTRICAL ENERGY.

THIS HAPPENS WHEN THE ELECTRONS IN THE SILICON CELLS OF THE PV PANELS ARE EXCITED BY THE PHOTONS IN THE SUNLIGHT. THIS IS CALLED THE PHOTOELECTRIC EFFECT.

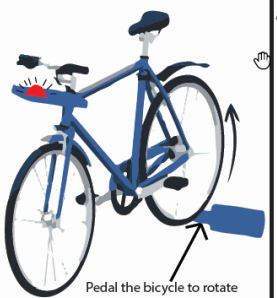


SOLAR ENERGY
- IS RENEWABLE
- IS ENVIRONMENT-FRIENDLY AS IT IS NON-POLLUTING
- IS FREELY AVAILABLE YEAR-ROUND IN COUNTRIES LIKE INDIA

EVERY DAY EXAMPLES

STREET LIGHTS, IN HOMES, FOR VEHICLES, SATELLITES IN SPACE. MANY VILLAGES ARE POWERED ENTIRELY BY SOLAR POWER.

DYNAMO
Bicycle Generator



Pedal the bicycle to rotate the shaft of the dynamo
Observe the LEDs glowing

A dynamo converts mechanical energy to electrical energy.

Faraday's Law of Electromagnetic Induction
Move a wire back and forth in a magnetic field.
The field pushes electrons in the metal.
This movement of electrons is electric current.

A dynamo has a magnetic stator and a coil rotator. Following Faraday's principle, the rotating coil inside the magnetic field results in electricity being generated.

Here, when you pedal and the wheel rotates, it turns the shaft of the dynamo and generates electric current. This current in our case averages to 13 Amps.

This current is used to light up the LEDs.

EVERYDAY SCIENCE EXAMPLE

Hand cranked dynamos are used in clockwork radios, hand powered flashlights and other human powered equipment to recharge batteries.

RACE THE ROLLERS

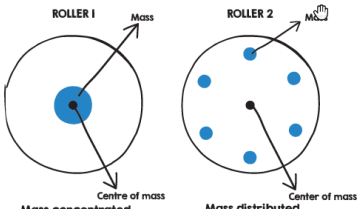
Distribution of Mass

WHAT TO DO

PLACE BOTH THE ROLLERS ON TOP OF THE INCLINE.
GIVE THEM BOTH A SIMILAR PUSH AND SEE WHICH ONE WINS THE RACE.

Moment of inertia (MOI) in rotational motion is analogous to mass in linear motion.

MOI of a rigid body is a measure of its resistance to angular acceleration when a torque is applied. MOI depends on distribution of mass - when mass is distributed away from the axis of rotation, it resists motion more than when the mass is distributed closer to the axis,

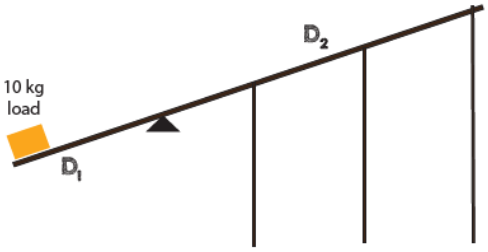


Roller I wins the race

EVERYDAY SCIENCE EXAMPLE
Formation and movement of stars and planets.
Flywheels of engines are designed to have high MOI.

GIANT LEVER

WHAT TO DO



LIFT THE WEIGHT BY PULLING DOWN THE ROPES, INDIVIDUALLY.

LEVERS ARE MECHANICAL DEVICES USED TO SCALE THE AMOUNT OF FORCE AND/OR TRAVEL IN A MECHANISM

THE PRINCIPLE OF TURNING EFFECT OF FORCE OR MOMENT IS USED HERE TO CREATE MECHANICAL ADVANTAGE

EVERYDAY SCIENCE EXAMPLE - Pliers, scissors, a crow bar, a claw hammer, a see-saw and a weighing balance

INVISIBLE BATMAN!

The Dark Knight disappears when viewed from a specific position.

Position 1
Side View

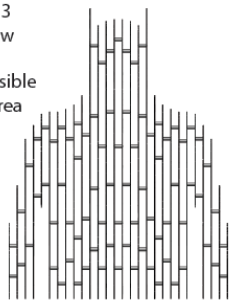
Very High Visible Surface Area

Position 2
View at an Angle

Medium Visible Surface Area

Position 3
Front View

Very Low Visible Surface Area



The visible surface area of the metal sheets varies depending on the position they are viewed from.

In position 1, the sculpture is viewed from the flat side of the metal sheets. The surface area of the sheet from this position is very high.

In position 3, the sculpture is viewed along the edge of the metal sheets. The surface area of the sheet from this position is very low.

This is a reason for the sculpture turning nearly "invisible" in the front view.

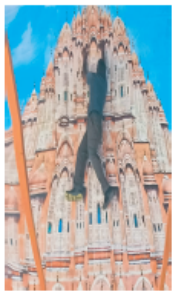
MAGIC MIRROR

Merge two reflected objects to create an illusion

What you do

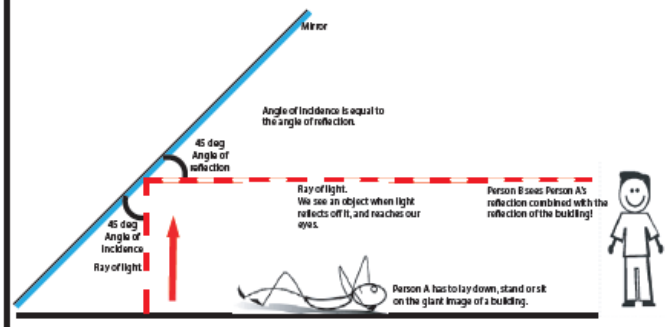
What you see

What you show!



STAND OR LAY DOWN ON THE GIANT IMAGE.
SEE YOURSELF HANGING FROM THE BUILDING IN THE REFLECTION!
ASK YOUR FRIEND TO TAKE A PHOTO!
(CROP THE PHOTO TO CAPTURE THE ILLUSION NICELY!)

Tag us on social media! Instagram Facebook



Behaviour of Light

When light hits an object, it bounces back - that is, it reflects.

When light hits a mirror at an angle, it reflects at the same angle.

In the Magic Mirror, reflections of two objects are combined to create an illusion of a combined object.

The reflection of Person A and that of the building combine and it appears as if Person A is hanging from the building!

EVERYDAY EXAMPLE

Before computer generated visual effects became common, films and television shows used mirrors to create illusions and tricks. Magicians also use mirrors to perform their magic tricks and create illusions.

DO SCI LIBRARY SOLUTIONS
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SNAKE PENDULUM

Time period of a pendulum depends on its length

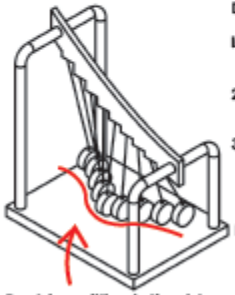
WHAT TO DO

GIVE THE HANDLE WHEEL A FULL TURN AND WATCH THE BALLS SLITHER IN THE AIR.

Pendulums swing or oscillate, when a force is applied on them.

Pendulums of different lengths take different "time periods" to complete one swing or oscillation. Longer pendulums take more time and shorter pendulums take less time.

In the Snake Pendulum, we use pendulums of lengths ranging from 60 cm to 80 cm. This results in time periods ranging from 1.6 sec to 1.8 sec.



Pendulums slither in the air!

Differences in the time periods result in interesting patterns.

1. Snake-like movement at the beginning, because of the short differences in time periods of adjacent pendulums
2. Followed by a seemingly chaotic pattern, followed by alternate pendulums moving in perfect opposition
3. Then, chaotic pattern again, followed by the snake-like movement.

In a friction-free environment, all the above would be perfectly visible!
But in an outdoor space like DoScience, it is a bit difficult to identify the final snake-like movement!
But do look for it --- it does happen
(though it looks like a worm!).

EVERYDAY SCIENCE EXAMPLE
Clocks, Playground Swings, Gongs in Bells.

The above cover a large share (but not all) of the installations at DoScience.

Annexure 2 – VR Astronomy Show Summaries

Wonders of Solar System

Age groups - All

Knowledge level - Beginners

Duration - 10 min

Show summary -

In this show, we embark on a journey through our Solar System, a vast expanse that includes the Sun, 8 planets, 173 known moons, 5 dwarf planets, and many other celestial bodies. Our adventure begins at Neptune, the farthest planet from the Sun, aboard a state-of-the-art spacecraft capable of incredible speeds.

Our first stop is Neptune, a gas giant with unique features such as great dark spots—massive storm systems that form and disperse over time. Because of its significant distance from the Sun, Neptune's outer atmosphere is among the coldest places in the Solar System.

As we move closer towards the Sun, we approach Uranus, another gas giant with planetary rings formed by collisions with its orbiting moons. Unlike other planets, Uranus spins on its side, adding to its mystery.

Saturn, often claimed to be the most beautiful planet, captivates with its gaseous sphere and hypnotising rings, which are the remains of a shattered moon.

Among Saturn's moons, Enceladus stands out, with its ice-covered surface concealing a subsurface ocean that scientists speculate may harbour primitive life forms. We witness the breath-taking eruptions of ice volcanoes on Enceladus, offering a glimpse into its intriguing dynamics.

Next in our voyage is Jupiter, the largest planet in the Solar System, with a volume that could accommodate 1,400 Earth-sized planets. Jupiter's striking feature is the great red spot—a persistent storm raging for centuries.

Our journey then takes us to Mars, the Red Planet, known for its iron oxide-covered surface that gives it a rustic colour. Valles Marineris, the largest canyon in our Solar System, stretches 5,000 km, dwarfing Earth's Grand Canyon.

Returning closer to home, Earth, the only known hub of life in the cosmos, stands out with its diverse ecosystems. A glimpse from the Moon's surface reminds us of the beauty of our blue planet.

Approaching Venus, a rocky planet similar in size to Earth, we learn of its scorching temperatures reaching around 500 degrees Celsius, despite its greater distance from the Sun compared to Mercury, the smallest and least explored planet. Mercury, with numerous impact craters, is rather similar to our Moon.

Our celestial journey concludes with a close look at the Sun, the central star of our Solar System. From a distance, it appears as a yellow sphere, but up close, it reveals a turbulent ocean of gas with temperatures reaching 5500 degrees Celsius on the surface and 14 million degrees Celsius at its centre.

The show takes us through a distance of 4.5 billion kilometres and makes us reflect on the vastness of our Solar System and the various mysteries that it presents.

Mars, the Red Planet

Age groups - All

Knowledge level - Intermediate (slightly above Beginners)

Duration - 12 min

Show summary -

Mars, known since antiquity as a bright orange star, was named after the God of War because of its distinctive colour.

Early observers of Mars speculated about the straight lines on its surface, which they believed were channels transporting water by a once-thriving civilisation. However, astronomer Eugene Antoniadi discovered in 1909 that these lines were geological formations.

Telescopic advancements post-World War II led to a better understanding of Mars' atmosphere and surface morphology. Real exploration of the planet began in the 1970s with unmanned spacecraft, providing details about the planet's features. We have so far not been able to find any signs of life on the planet.

Mars' thin atmosphere is composed mainly of carbon dioxide, which results in extreme temperatures and frequent dust storms. Polar ice on the planet changes with seasons, and consists of frozen carbon dioxide and possibly water ice.

Mars has a diverse geography, including mountains, valleys, deserts, and riverbeds. The planet had ample water in the past, which is now confined within its crust. Some notable landmarks on the surface of the planet include Mount Olympus, Solar System's largest volcano, and Valles Marineris, a canyon stretching over 4000 kilometres.

Two irregular-shaped moons, Phobos and Deimos orbit Mars.

Human exploration plans for the planet include building scientific colonies, with designed instruments and vehicles for astronauts. It is quite likely that humans will set foot on Mars in the not too distant future to unravel its mysteries.

Hot and Energetic Universe

Age groups - All

Knowledge level - Intermediate (slightly above Beginners)

Duration - 12 min

Show summary -

This show has the distinct objective of giving us a flavour of the Universe viewed through different parts of the electromagnetic spectrum. Astronomers employ the entire spectrum (not just visible light) to study the universe. Different types of light tell us different stories.

In this immersive show, we explore the breathtaking realms of celestial objects, each emitting waves of electromagnetic radiation, from gamma rays to microwaves.

Our cosmic journey starts with the explosive death of massive stars, leading to the creation of stellar black holes and neutron stars. Subsequently, the dance of binary stars showcases the formation of accretion discs, emanating captivating x-ray radiation.

The show also highlights the spectacular explosions resulting from star mergers, unveiling the universe's most potent forces — gamma rays and x-rays. And, at the centre of our galaxy, a colossal black hole interacts with surrounding stars, shaping their destiny.

As galaxies organise into clusters and superclusters, we explore their complex dynamics, fuelled by scorching temperatures in the millions of degrees.

We hope that this journey through the "Hot and Energetic Universe" deepens your understanding and sparks a renewed sense of curiosity about the mysteries that surround us.