

Where Science is Fun.....

FUN SCIENCE GALLERY

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DEO

Experience Science through many interactive exhibits designed, structured and clustered on the basis of basic fundamental science themes reflecting upon principles of mechatronics, optics and sound in the most engaging and interactive manner.



TRANSFER OF MOMENTUM

- This exhibit demonstrates the principle of transfer of momentum through a group of seven hanging balls in an interesting way.
- A body in motion has momentum which is equal to product of its mass and velocity.
- when one ball is set in motion , one ball on the other side sets into motion. Similarly when two or more balls are set in motion same number of balls move on other side
- Ever thought, Why?
(Find your answer in the next Slide)



TRANSFER OF MOMENTUM

- When four balls in a group are set in motion, the momentum is quadrupled. This means that at the other end four balls should move out. Since there are only three balls, the central ball regroups itself to make a group of four balls to swing out at the other end.



ADDITIONAL INFORMATION

- Every moving body has a momentum which is in the direction of velocity and is equal to mass multiplied by velocity.

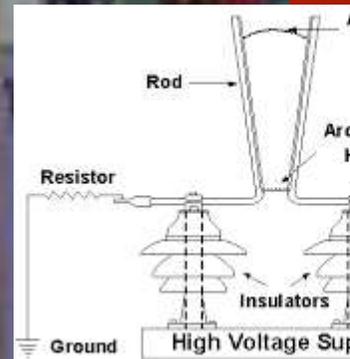
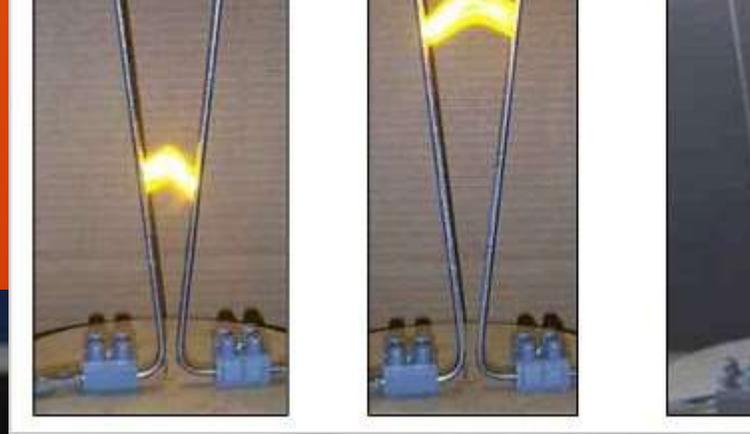
$$\text{MOMENTUM} = \text{MASS} \times \text{VELOCITY}$$

$$\text{UNIT} = \text{kg m / s}$$

- During collision between object one and object two, the total momentum of two objects before collision is equal to the total momentum of two objects after collision i.e momentum is conserved.
- This exhibit can be easily understood during playing of Carrom game, when striker hits the discs they move out in proportion to the momentum applied

JACOB'S LADDER

- In this exhibit low voltage is raised to high voltage by step up transformer. Due to this high voltage difference occurs between two copper rods .
- When the copper rods are close together, the electric force occurs between two copper rods, which is strongest at the bottom.
- These forces are strong enough to tear apart the atoms in the air into electrically charged fragments which carry the electric current between the two rods .
- At certain height due to increases in the distance between both the rods, connection breaks out and no electric current is seen.



ADDITIONAL INFORMATION



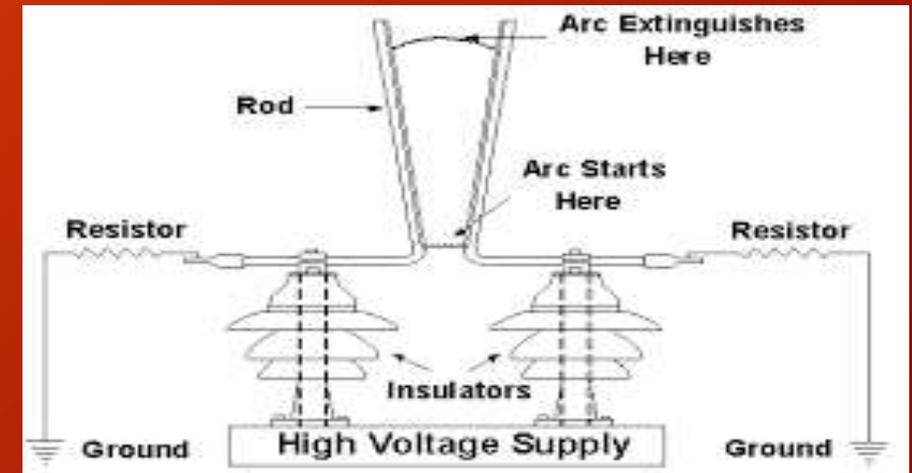
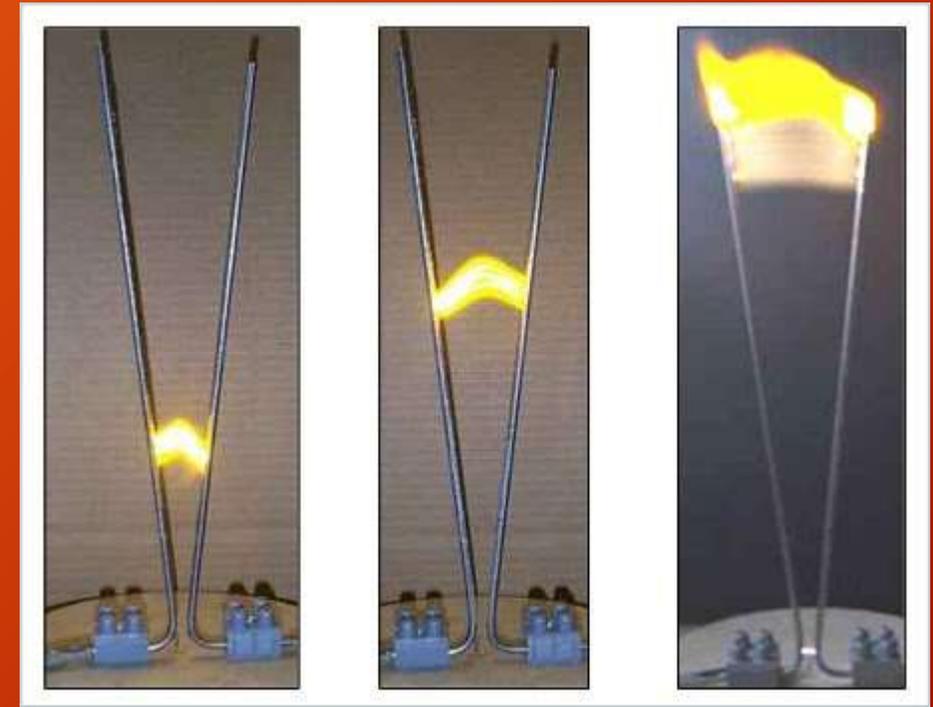
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- This exhibit shows the effect of high voltage electricity on the air molecules.
- The air is non conductor of electricity but when high voltage current is passed through air, the air molecules become ionized and start conducting electricity.
- This exhibit can be easily understood by taking example of lightning. We observe that during thunderstorms, lightning occurs . Due to very high voltage , air molecules becomes ionized to conduct electricity .

Additional information

- ❑ At the base of the Ladder is a transformer (a device that changes an incoming voltage). The voltage is put into one of the vertical wires, increasing its electric potential. The electricity needs to flow somewhere, so it ionizes the air to jump to the other vertical wire. As the electricity arcs, it heats up the ionized air, which causes it to rise. As the wires get further apart, it becomes more and more difficult for the electricity to reach, and the arc eventually stops.
- ❑ Then the transformer builds up the electric potential again, repeating the process all over again.
- ❑ Use :

Spark gaps are often used to protect sensitive electrical or electronic equipment from sudden high-voltage. A small spark gap breaks down during an abnormal voltage surge, safely shunting the surge to ground, thus protecting the equipment. These devices are commonly used for telephone lines as they enter a building; the spark gaps help protect the building and internal telephone circuits from the effects of lightning strikes. :



SINGING PIPES

- The Singing pipes exhibit demonstrates the principle of sound waves.
- Sound is created through the tube when travelling air molecules hit the tube's inner ridges and vibrate against them.
- The exhibit consists of pipes of different length. When we hit the pipes, sounds of different musical notes are emitted due to different length of pipes.
- Pitch or frequency depends upon the air column inside the hollow pipes .
- **The shorter the length of pipe or air column, the higher is the pitch**



ADDITIONAL INFORMATION

- Sound is form of energy that produces sensation of hearing. Sound needs medium to travel and is in the form mechanical waves. It has amplitude, wavelength , frequency & time period .
- Pitch is the shrillness or flatness of sound ,it depends upon frequency of vibration . Higher the frequency higher the pitch and vice versa.
- Frequency is the number of vibration per second
The frequency is measured in hertz (Hz).
The symbol of frequency is ν
- This phenomenon can be observed during filling of water bucket. When bucket is empty, the water coming from tap gives different sound as compared to when bucket is full of water.

POWER BICYCLE

- This exhibit is based on principle of conversion of mechanical energy into electrical energy
- When we pedal the bicycle, the muscular energy is converted into mechanical energy.
- Back wheel of bicycle is connected to DYNAMO which converts it into electric energy resulting in glowing of LED light.
- Fast peddling produces higher voltage , which turns on TV monitor.
- The picture of the peddler is captured by the camera and is displayed on the TV monitor.



Vortex

- Have you ever seen a whirlpool formed in a water body ?
- Or a Tornado in the sky?
- Or clothes being washed in a Washing machine?
(Notice that during washing of clothes, a whirlpool is created in the machine)



- Ever wondered how it happens?
- A **vortex** is a phenomenon of physics that occurs when a gas or a liquid moves in circles. At the center is a **vortex** line that the matter swirls around. They are **formed** when there is a difference in the velocity of what surrounds the line. Hurricanes, tornadoes and air moving over a plane wing are examples of **vortices**.



VORTEX

- See the Vortex exhibit at Science City
- When we rotate the water drum, the water rotates faster towards the center than at the periphery to conserve its angular momentum.
- At the Centre, the velocity is so high that the resulting centrifugal force acting outwards become greater than the cohesive force that holds water particles together.
-
- Air from below escapes easily through this hole letting water spiral down, which results in the formation of funnel shaped air gap.
- This funnel shaped air gap at the center of whirlpool is called vortex.



SNAKE PENDULUM

- This exhibit demonstrates the relationship between length of pendulum and time of its movement .
- Rotate the handle to move all pendulums to one side .
- Now move the handle back to the original position .
- The pendulums will move like the movement of the snake .

Why?

- This is due to fact that pendulums are hung with threads of different lengths resulting in difference in the time of their movements.



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- The length of simple pendulum is measured from the point from which it is hangs.
- The frequency of a pendulum is number of oscillations per second.
- The movement of pendulums create a sequence of cycles that look like a wave motion.
- Pendulums can be seen in mechanical clocks, swings in parks etc

LIFT YOUR OWN WEIGHT

- Can you lift your Own weight?
- You can do it at Pushpa Gujral Science City while sitting on a chair provided in the exhibit by pulling down the rope through a pulley.
- Running the rope around pulley wheels enables less effort. **The pulley is a simple machine which reduces the effort to pull the load.**
- When we use two wheels it requires half effort, three wheels one third and so on.



ADDITIONAL INFORMATION

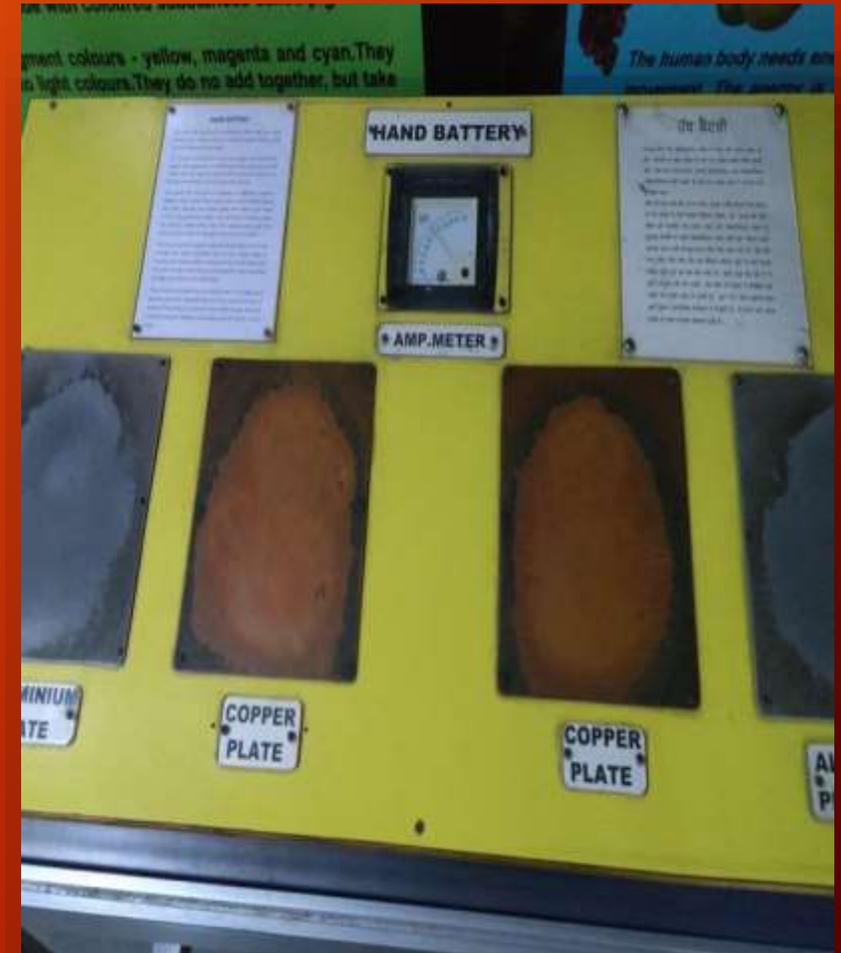


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- Lifting a heavy load is much easier if you attach the load to one end of a rope and sling the rope over a wheel fixed to a high beam. This arrangement is also called a single pulley system.
- Pulley helps to reverse the direction of lifting force . This phenomenon can be observed during pulling of bucket of water from well.

HAND BATTERY

- The exhibit demonstrates that when you touch two metal plates, the thin film of sweat on your hands acts like the acid in a battery,
- Here copper and the aluminum plate is connected to a meter. When we place one hand on each plate, reading on the meter is noticed.
- In one reaction, your hand takes negatively charged electrons away from the copper plate, leaving positive charges behind.
- In the other reaction, your hand gives electrons to the aluminum plate, causing it to become negatively charged.
- This difference in charge between the two plates creates a flow of electrical charge, or electrical current.



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- A Battery is group of electrochemical cells that store electric charge and generate current when there is flow of electrons .
- Skin and two different metals create a battery.
- Batteries are used in our everyday life like in cars, torches etc.
- There are different types of batteries, like,
 - The Nickel Cadmium (NiCd) battery.
 - The Nickel-Metal Hydride (NiMH) battery.
 - The Lead Acid battery.
 - The Lithium Ion battery.
 - The Lithium Polymer battery.

TOTAL INTERNAL REFLECTION



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- Have you seen a mirage at a desert or at sea?
- Why do you see water at a distance while travelling on a very dry road during hot summers?
- This exhibit demonstrates the phenomenon of mirage which causes an optical illusion due to total internal reflection. We see the light bending along the water stream which is contrary to the general notion that light travels in a straight line .
- We know that light travels in the straight line but here the light gets trapped in water stream and bends due to total internal reflection.



This happens because the light is travelling from denser(water) to rarer medium (air), This same phenomena is seen in daily life e.g. mirage effect, optical fibre cable and fully reflecting mirrors.

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- When a light travels from denser medium to rarer medium it bends and if the angle of incidence is greater than critical angle, the light is reflected back in the denser medium and does not move to rarer medium. This phenomenon is called total internal reflection.

CURIE POINT

- Certain materials have magnetic properties. The temperature at which magnetic materials undergoes structural change to become non-magnetic is called Curie Point or Curie Temperature.
- This exhibit in Science City demonstrates the principle of Curie point.
- A hanging magnet sticks to a small iron coil due to the force of attraction. As the switch is pressed and the coil becomes red hot, the magnet swings back.
- This is because with increase in temperature the coil loses its magnetic property and magnetic sticks are no longer attracted to it .



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- The French Physicist Pierre Curie ,who in 1895 discovered the laws that relate some magnetic properties of materials to change in temperature .
- Curie temperature or curie point is the temperature at which magnetic properties of a substance undergo sharp change. Ferromagnetic materials(iron , nickel) become paramagnetic materials (magnesium , lithium) .

BUOYANCY FORCE

- This exhibit demonstrates the buoyancy force.
What Is Buoyancy Force? □
- When a body is immersed in fluid, an upward force is exerted by the fluid on the body. □ This upward force is equal to the weight of the fluid displaced by the body and is called the force of buoyancy.
What causes Buoyant Force?
- Buoyant force is the force on an object exerted by the surrounding fluid.. When an object pushes water, the water pushes back with as much force as it can. If the water can push back as hard, the object floats (boat). If not, it sinks (steel).
- In this exhibit when you put the weight kept on the left side in the basket. You will observe that the balloon sinks. When you remove this weight and put the weight on the right side in the basket. You will observe that the balloon keeps floating in the air.



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- A cork floats in water because it is less dense than the same size volume of water. But it will not float in the air since it is denser than the same volume of air.
- The balloon in the exhibit floats in air because it is filled with gas less dense than air. If you add weight to the balloon it sinks.

Condition of equilibrium of a floating and sub-merged bodies

Positive buoyancy : Buoyant force is greater than weight so the object floats

Neutral Buoyancy : Buoyant force is equal to weight so the object is suspended in the fluid.

Negative buoyancy : Buoyant force is less than weight so the object sinks.

ENERGY BALL

- Ever heard that Energy can neither be created nor destroyed but its form can be changed.
- Watch this at Science City and make a simple ball perform many functions.
- This exhibit demonstrates the principle of conservation of energy. It shows that the potential energy acquired by the ball is transformed into another form of energy.
- In this exhibit the ball is raised up to height and then released.
- As the ball is released its potential energy is transformed into other forms of energy like moving the pendulums, sound energy, turning the wheels, ringing the bells.
- This shows that one form of energy i.e. potential energy is converted into other forms of energy like kinetic energy, sound energy, etc.



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- Energy can neither be created nor be destroyed but it can only be changed from one form to another. This is called principle of conservation of energy. It means that when all forms of energy are taken into account the total energy of universe remains the same. This principle is valid for isolated system i.e one in which no force acts from outside.

POWER TRANSMISSION

- How is power transmitted?
- This exhibit demonstrates the working of gears and pulleys in transmission of power with the help of belts and shafts.
- When you press the switch to operate various pulleys, some pulleys rotate clock wise, others rotate anti-clockwise and there is variations in the number of revolutions at the output end of each gear/pulley system .





- A gear is a part of rotating machine having cut teeth which mesh with another toothed part in order to transmit power .Two or more gears working in tandem are called transmission and can produce mechanical advantages through a gear ratio .
- Bevel gears connects two shafts which rotates with same speed and force . e.g Car contains bevel gears .
- Spur gear has two toothed wheels that are connected to parallel shafts . The first shaft has the larger wheel while the second shaft has smaller wheel that rotates with less speed but greater turning force.

EYE AN APERTURE

- What happens when you go from bright light to a dark area? Or blink them when you go to a brightly lit area?
- This exhibit demonstrates that eye pupil diameter becomes larger or smaller when light intensity is low or high respectively like aperture of a camera .
- The colored part of your eye is a circular muscle (Iris) that controls the pupil's sizes (the hole that admits optimum amount of light to fall on your retina).
- In bright light, pupil diameter shrinks to about 2mm and in dim light it expands to about 8mm to admit adequate amount of light, which is safe and necessary to form the image on the retina.
- Hence, the iris of your eye works like an aperture of a camera which automatically expands or shrinks depending upon the amount of light.



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- Aperture can be defined as the opening in a lens through which light passes to enter the camera.
- It is an easy concept to understand, if you just think about how your eyes work. As you move between bright and dark environments, the iris in your eyes either expands or shrinks, controlling the size of your pupil.
- When we enter a cinema hall we are unable to see for a few seconds, but after some time our pupils constrict and we are able to see in the dark also.

WATER FROM WHERE

- This exhibit on Optical Illusion will boggle your mind. Prepare to be amazed and mesmerized by this exhibit !
- Water flowing inside and outside the plastic pipe gives an illusion as if the water is flowing down from the magic tap without a water connection.
- This exhibit is based on principle of refractive index. Refractive index is the ratio of the velocity of light in a vacuum to its velocity in a specified medium. It describes how fast light travels through the material.
- In this exhibit, the water is pumped up from a bucket of water to the mouth of the tap through a plastic pipe having refractive index close to that of the water. As, eye can not distinguish boundary of two objects having equal refractive indices,
- water flowing inside and outside the plastic pipe gives an illusion as if the water is flowing down from the tap without a connection.



ADDITIONAL INFORMATION



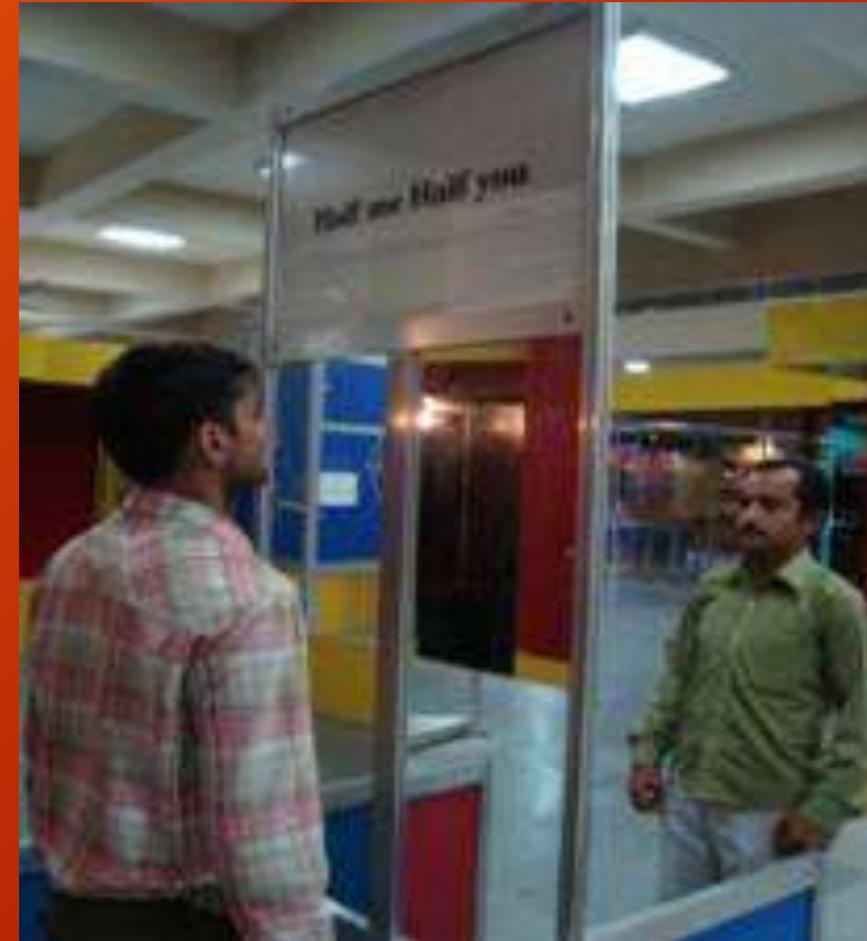
- Refractive index, also called index of refraction, measure of the bending of a ray of light when passing from one medium into another.
- If i is the angle of incidence of a ray in vacuum (angle between the incoming ray and the perpendicular to the surface of a medium, called the normal) and r is the angle of refraction (angle between the ray in the medium and the normal)
- Refractive index n is defined as the ratio of the sine of the angle of incidence to the sine of the angle of refraction; i.e., $n = \sin i / \sin r$.
- Refractive index is also equal to the velocity of light c of a given wavelength in empty space divided by its velocity v in a substance, or $n = c/v$.

HALF ME HALF YOU

- Stand on one side of panel and ask your friend or any other visitor to stand on the other side .
- Match external contours of your body with that of your friend. Now swing your hand, or head. Your mind will boggle about how it happens?

Why ?

- The reflected mirror of your body is formed behind the mirror. In case the person on the other side stands at a same distance as you are, it creates interesting phenomenon for you and the person on the other side.



WORLD OF SYMMETRY

- In this exhibit three different scenes are created by using mirrors. When we stand in front of any scene, it appears that the scene is extended up to 360° thus creating illusion of symmetry

How ?

- Three mirrors inclined at an angle of 120° to each other are used to create this illusion.



VORTEX TUNNEL

- Vortex Tunnel is mind blowing attraction that gives you a virtual, mystifying, spinning, and sloping experience like no other.
- In this exhibit a fluorescent screen is revolving around a still platform. Two mirrors have been placed opposite to each other on both sides, which results in the formation of a very long tunnel.
- When somebody runs through the channel, due to the revolving screen it looks that the platform is also moving. So, the person tilts towards one side and becomes unable to stand properly



Lets Play

Now that you are home, you can play many Science games with your family

- Begin with a brainstorming session about science and everyday life
- Take a picture from a magazine and ask every one to describe the science behind the picture.
 - For example, if there is a car in the picture, science and engineering was used to design and build the car.
 - If there is food in the picture, science can be found in how the food was grown or produced.
- Ask group members to look through magazines and choose pictures that are related to science. They can even make a collage. Discuss:
 - Why did you select the picture?
 - Compare your selections with those of the other groups.
 - Discuss the pictures in everybody's collage .
 - What does your selection say about how you think of science?

Lets Play, learn & Innovate

Draw a Scientist

- Did you draw a male or a female scientist?
- Describe the setting in which your scientist is working.
- What kind of work is he/she doing?
- Why is the work important?

Science in the News

Identify news and stories about health, medicine, new technology, weather, or space exploration. Discuss:

- Why did you select the articles you used?
- How easy was it to find stories about science?
- Which science or health topics were easiest to find? Which were hardest? Compare your selections with those of the other groups.
- Are any science experts quoted in the story? What did they say?

Lets Innovate

- Think of a common problem.
- Can you find out a simple solution? Take help of seniors on what you can do to solve it

You can do several activities individually, or with your family to help understand the diversity in science

THANKS



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