Light

Samacheer , Term - III, Class - VIII

Reflection... Refraction...how light bends...

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Learning Objectives:

- To investigate the relationship between the angle of incidence and the angle of reflection.
- To understand that light gets deflected from its path when it passes from one medium to another.
- To observe and understand total internal reflection.

Pre-Requisite knowledge:

- Understanding that light is a form of energy that travels in straight lines as light rays.
- Knowledge of different sources of light, plane mirrors and process of reflection.
- Ability to measure and draw angles using protractors.

Opening Activity:

The pre-requisite knowledge of the students was checked with the following activity and questions.

The students were asked to take two transparent bottles. One bottle was filled with incense smoke and closed tightly while the other bottle was left empty. Then the teacher told them pass the laser beam from the torch at any angle through both the bottles. The students clearly saw the straight line path taken by the red light inside the bottle with the incense smoke whereas they were not able to see laser in the empty bottle.

1. What are the differences observed in the two bottles?
2. Why is smoke required for this activity?
3. How does light travel?
4. Does a ray of light bend at any point of time?
5. What do they observe when they stand in front of the plane mirror in their homes? How does that happen?

Alternative: Any transparent polythene, preferably an OHP Sheet – wound as a cylinder shall be used instead of a transparent bottle.

Sub concept 01:

To investigate the relationship between the angle of incidence and the angle of reflection.

Activity 01:

The process of reflection was revisited using the following activity. A plane mirror was placed inside the bottle and the bottle was filled with smoke and closed. When the torch was shone on the mirror, the students were able to observe two rays, the one falling on the mirror from the torch, the incident ray and the other emerging from the mirror, the reflected ray.

Then the students were asked to fix a plane mirror vertically on the table and draw a normal line perpendicular to the mirror as shown in the image. This set up enables the learners to measure the angle made by the incident ray to

the normal (the angle of incidence, i) and also the angle made by the reflected ray to the normal (angle of reflection, r).

The beam of light is made to fall on the mirror from an angle and the angle made by the reflected beam is marked using a ruler and measured using a protractor.

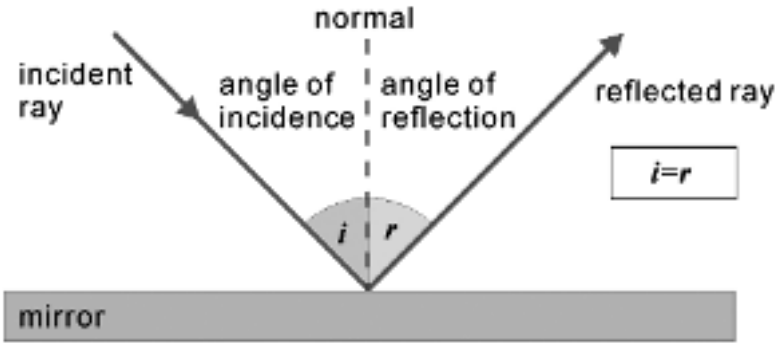

Fig 01: Image showing angle of incidence and the angle of reflection.

The angle of incidence is changed for each trial and the respective angle of reflection is measured and recorded.

Table 01: To investigate the relationship between the angle of incidence and the angle of reflection.

Trial No	Angle of Incidence, ***i***	Angle of Reflection, ***r***	***i*** equal to ***r*** (or) ***i*** not equal to ***r***
1	30	30	***i*** equal to ***r***
2			
3			
4			

The children get to understand that the Angle of incidence, ***i*** & Angle of reflection, ***r*** remains equal to one another at all trials and this is an important law of reflection.

It was interesting to see the way the students who understood the activity in the beginning started helping their peers in marking the emergent reflected ray, measuring the angle of reflection etc.,

Sub concept 02:

To understand that light gets deflected from its straight line path, when it passes from one medium to another.

Activity 02:

Students were asked to fill half of a bottle or a transparent glass with water mixed with a small amount of soap/chalk powder. Then the rest of the vessel was filled with smoke and it was closed.

Then the students were asked to predict, what will happen to the laser beam when it passes through the smoke and the water with soap/ chalk powder dissolved in it?

After eliciting the opinions from the learners, they were asked to pass the beam through the vessel.

When the laser beam was passed from outside at an angle, the students could see the red light ray bending when it entered into water from air. The direction of the deviation depends on the density of the two medium and hence a series of trials are attempted with different densities.

Table 02: To study refraction of light

The same experiment can be tried with different household liquids of varying densities

Trial No	Amount of soap dissolved in 100 ml of water	Observations(the level of deviation)1
1	20g	
2	30g	
3	40g	
4	50g	

eg. Coconut oil, castor oil, gingelly oil, drinking water etc.

At the start of the activity, the students

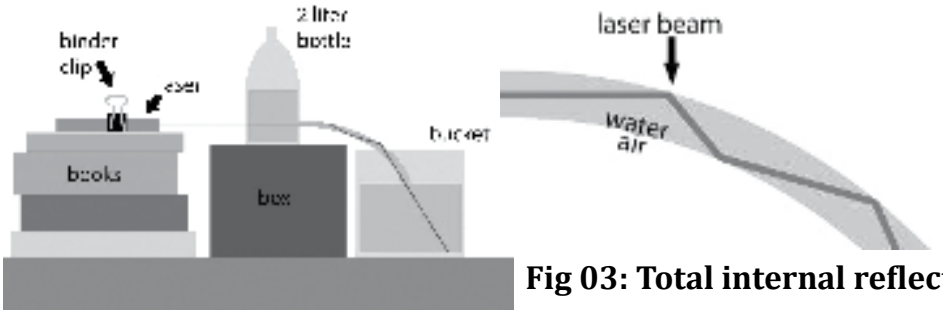

Fig 03: Total internal reflection

themselves started suggesting to mix chalk powder with water to make the laser beam visible similar to the use of incense smoke in air medium.

Sub concept 03:

To observe and understand total internal reflection

Activity 03: Laser Waterfall

Students were asked to observe the following Demonstration.

Experimental set up:

1) Use a hot pin (heated up over a gas flame/ lighter/candle) to carefully burn a circular hole about 10cm up from the bottom of the plastic bottle.

2) Place your finger over the hole (or block with tape) and fill the bottle almost to the top with water.

3) Turn the bottle sideways and carefully shine the laser toward the hole squarely (at the same level) from the back of the bottle.

4) Remove your finger/tape and again make sure that the laser is being aimed squarely (at the same level) at the hole in the plastic bottle.

5) Watch as the laser light transmits down the waterfall. Make sure you have a suitable vessel to catch the falling water.

Light propagates in a straight line path only. What is happening in this activity?

What makes the light bend along with water?

As the laser light hits the edge of the water stream, it does so at an angle greater that the critical angle for water. As a result, the laser light is completely reflected inwards (we call this total internal reflection). As it hits the next edge of the water stream it is once again totally internally reflected and this process continues down through the entire length of the water stream.

The strength and intensity of the laser light reduces as it makes its way down the water stream. This is a result of dispersion of the beam of light and also interference effects within the stream. This is actually a problem that is encountered with real life fibre optic cables and can lead to problems such as signal degradation.

References:

http://physicsed.buffalostate.edu/pubs/StudentIndepStudy/EURP09/TIR/TIR.html

http://www.arvindguptatoys.com/

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