

## Class 13: Reflection and Refraction

### Understanding Light

**Light** is a form of electromagnetic radiation that is visible to the human eye. It falls within a specific range of wavelengths in the electromagnetic spectrum.

### Characteristics of Light

- **Visible Light:** This is the range of electromagnetic radiation that humans can see. It comprises the colors seen in a rainbow, from red to violet.
  - **Human Perception:** Humans can only perceive this narrow band of wavelengths.
  - **Animal Perception:** Some animals see different wavelengths:
    - **Dogs:** Can see primarily in shades of gray.
    - **Insects:** Can see ultraviolet light, which is invisible to humans.
- **Speed of Light:**
  - In a vacuum, light travels at a constant speed of **299,792,458 meters per second** (approximately 300,000 km/s).

### Medium of Propagation of Light

**Light** can travel through different types of media, which influence its speed and behavior.

- **Optical Medium:** Any substance that allows light to travel through it is called an optical medium.
  - **Homogeneous Medium:** A medium in which light travels at the same speed in all directions. Examples include pure air and clear glass.
  - **Transparent Medium:** Light can pass through easily without being scattered. Examples include clear glass and clean water.
  - **Opaque Medium:** Light cannot pass through, so it is either absorbed or reflected. Examples include wood and metals.
  - **Translucent Medium:** Light passes through partially and is scattered, making objects on the other side blurry. Examples include frosted glass and thin paper.

### Reflection, Refraction & Dispersion of Light

#### 1. Reflection of Light

**Reflection** occurs when a light ray strikes a smooth, polished surface and bounces back. This fundamental behavior of light is crucial in everyday phenomena and optical devices like mirrors.

#### Key Concepts:

- **Light Travels in Straight Lines:** Light moves in straight lines unless it encounters a different medium or surface.
- **Incident Ray:** The incoming light ray that strikes a surface.
- **Reflected Ray:** The light ray that bounces back from the surface after hitting it.
- **Normal:** An imaginary line perpendicular to the surface at the point where the incident ray strikes.

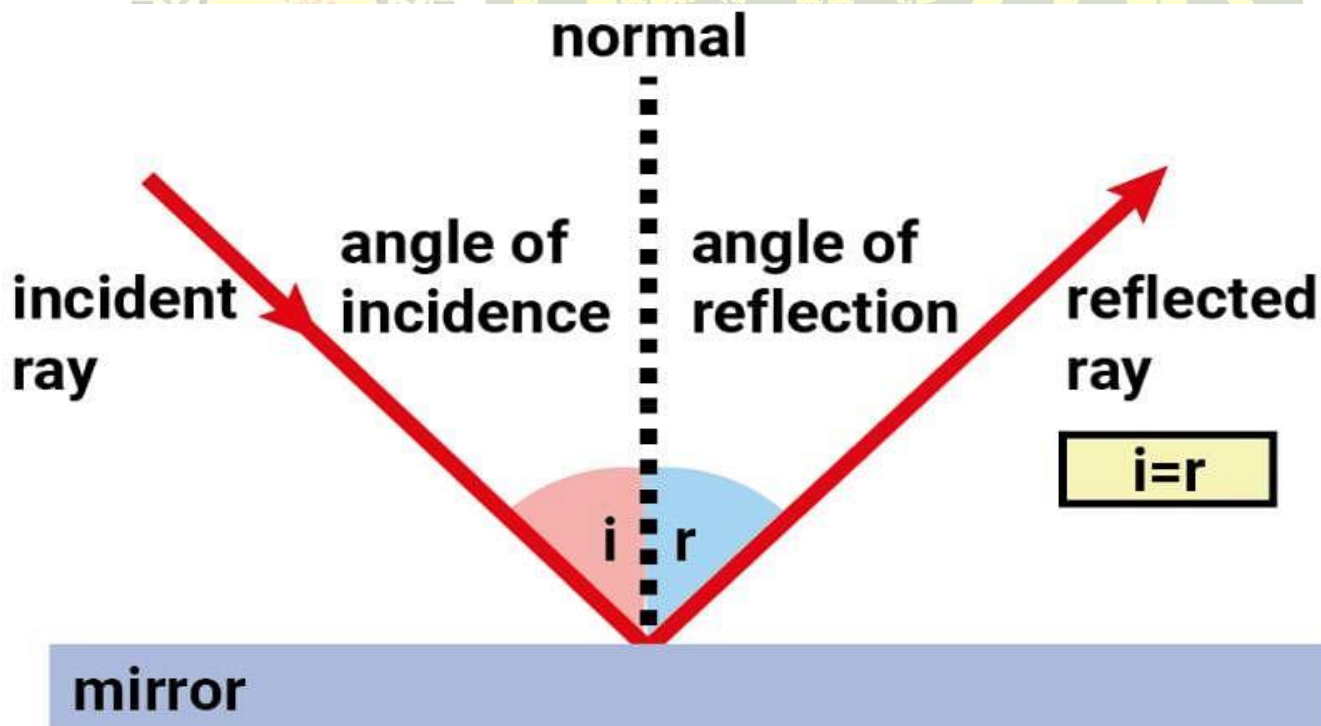
#### Angles in Reflection:

- **Angle of Incidence:** The angle between the incident ray and the normal.

- **Angle of Reflection:** The angle between the reflected ray and the normal.

### Laws of Reflection:

1. **First Law:** The angle of incidence is equal to the angle of reflection.
2. **Second Law:** The incident ray, reflected ray, and the normal all lie in the same plane.



### Types of Reflection:

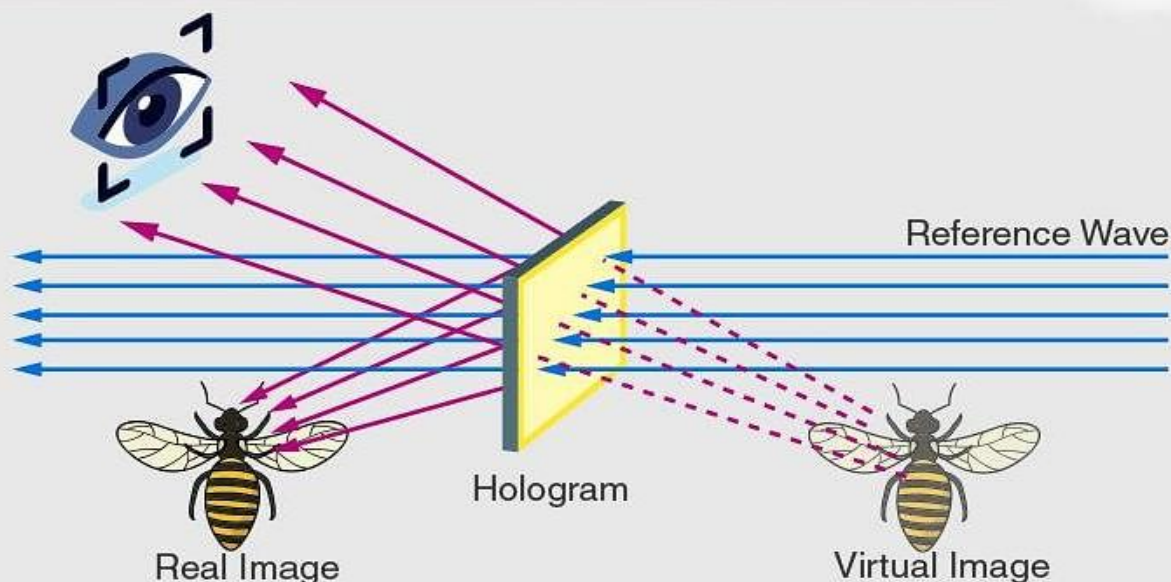
- **Regular Reflection:** Occurs on smooth surfaces like mirrors, where parallel incident rays reflect as parallel rays, producing a clear image.
- **Irregular Reflection:** Happens on rough surfaces, causing reflected rays to scatter in various directions. This type of reflection does not produce a clear image and is also known as diffused reflection.

### Types of Images Formed:

- **Real Image:**
  - Formed when light rays converge at a point after reflection.
  - Can be projected onto a screen.
- **Virtual Image:**
  - Formed when light rays appear to diverge from a point behind the reflecting surface.
  - Cannot be projected onto a screen.
  - The image produced by a plane mirror is virtual, upright, and the same size as the object, appearing at the same distance behind the mirror as the object is in front.



## DIFFERENCE BETWEEN REAL IMAGE AND VIRTUAL IMAGE



### REAL IMAGE

REAL IMAGE IS THE IMAGE WHICH IS FORMED WHEN THE LIGHT RAYS MEET AT A PARTICULAR POINT AFTER REFLECTION FROM THE MIRROR.

### VIRTUAL IMAGE

VIRTUAL IMAGE REFERS TO THE IMAGE WHICH FORMS WHEN THE LIGHT RAYS APPEAR TO MEET AT DEFINITE POINT, AFTER REFLECTION FROM THE MIRROR.

## 2. Refraction of Light

**Refraction** is the bending of light as it passes from one transparent medium to another with a different density. This phenomenon explains why objects appear distorted when viewed through water or glass.

### Key Concepts:

- **Light Bending:** Light changes speed and direction when it enters a different medium at an angle.
- **Refractive Index:** A measure of how much a medium bends light. Higher refractive indices indicate more significant bending.

### Laws of Refraction:

1. **Snell's Law:** The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant, depending on the media. This constant is the refractive index.
2. **Path of Least Time:** Light travels along the path that takes the least time when moving from one point to another across different media.

### Effects of Refraction:

- **Towards the Normal:** Light bends towards the normal when it slows down entering a denser medium.
- **Away from the Normal:** Light bends away from the normal when it speeds up entering a less dense medium.

### 3. Dispersion of Light

**Dispersion** is the splitting of white light into its constituent colors when passing through a prism or other transparent medium.

#### Key Concepts:

- **Spectrum:** The range of colors (red, orange, yellow, green, blue, indigo, violet) that make up white light.
- **Prism:** A transparent optical element with flat, polished surfaces that refract light. It can separate white light into its component colors due to varying degrees of bending for different wavelengths.

#### How Dispersion Works:

- **Different Wavelengths:** Different colors of light have different wavelengths, causing them to refract by varying amounts. For example, violet light bends more than red light in a prism, leading to the separation of colors.
- **Natural Examples:** Rainbows are created when raindrops act like prisms, dispersing sunlight into a spectrum of colors.



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