

## Unit 9: Waves

### Content Outline: Optics (9.7)

#### I. Optics

- A. This field of physics is the scientific study of the *wave behavior of light*.
- B. Sound and light both transfer energy in the form of waves.
  - 1. The way that sound and light *interact with objects and substances (medium)* that they come into contact with is wave behavior.

#### II. Reflection

- A. This is when a wave hits a *smooth surfaced medium*, cannot pass through and *bounces off* changing direction.
  - 1. *Sound waves* reflecting off of smooth surfaces are called **echos**.
- B. Reflection of sound waves is used in sonar technology and by animals as **echolocation**.
- C. *Light waves* hitting mirrors, polished metal, or any reflective surface are called **reflections**.

#### III. Law of Reflection

- A. All waves will *bounce off* a smooth surface at an *angle opposite* to the angle in which it *hit the surface*.
  - 1. **Incident Ray** - wave *coming into* the barrier. **Drawn as a solid line with an arrow pointing "away" from the object emitting light. (What you are looking at.)**
  - 2. **Reflected Ray** – wave *leaving* the barrier. **Drawn as a solid line with arrow pointing "toward" the collecting device, such as an eye.**
  - 3. **Angle of Incidence (AI or  $\theta_i$ )**– angle made from **incident ray** to the normal line.
    - a.  $\theta$  is the symbol for "angle". It is the Greek letter "theta"
  - 4. **Angle of Reflection (AR or  $\theta_r$ )**– angle made from **reflected ray** to the normal line.
  - 5. **Normal Line (NL)** – the direct head on view of the mirror at a  $90^\circ$  angle with the mirror.
  - 6. **Angle of Incidence (AI) = Angle of Reflection (AR).**
    - a. Angles made by the incident ray ( $AI_s$  or  $\theta_{is}$ ) and reflected ray ( $AR_s$  or  $\theta_{rs}$ ) *from the surface* are also equal to each other.
      - i. All angles must add up to equal  $180^\circ$  (A flat plane is *half of a circle* ... $180^\circ$ )  
 **$\theta_i + \theta_r + \theta_{is} + \theta_{rs} = 180^\circ$**

#### IV. Refraction

- A. This is when a wave is traveling and *changes from one medium to another* which causes the wave to slowdown or speeds up.
  - 1. When the wave changes speed it will *slightly change direction too*.

Example: Sound traveling through areas of different temperature. Light waves changing from air to water, glass, clear plastics cause a change in speed and cause magnification.