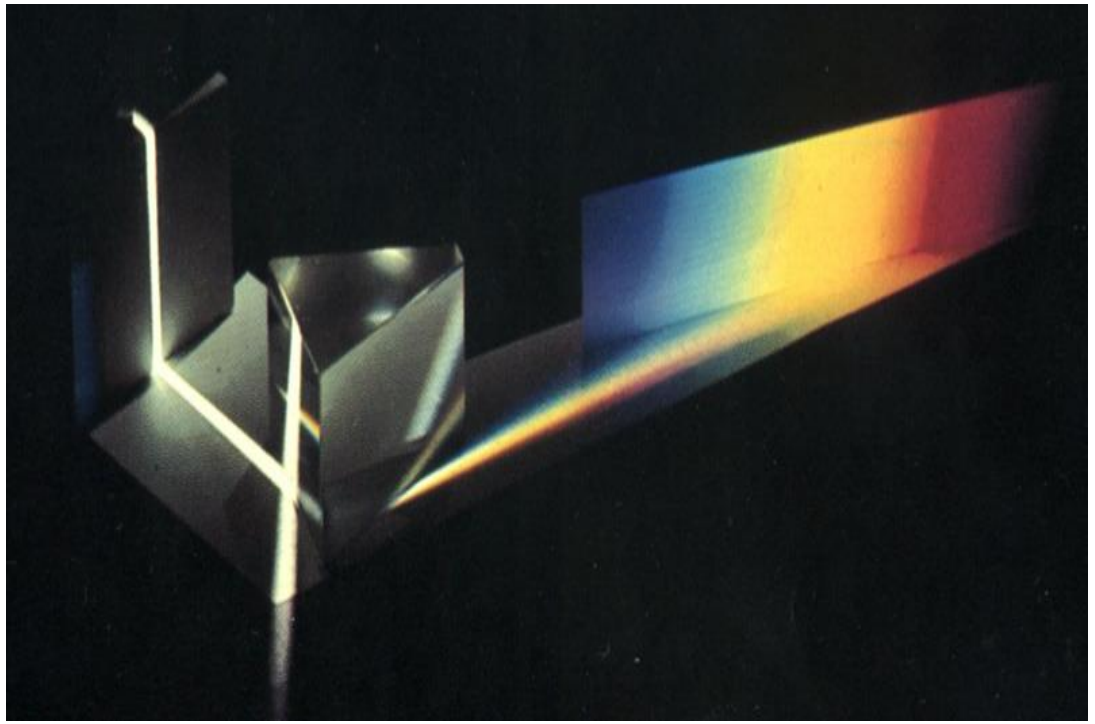
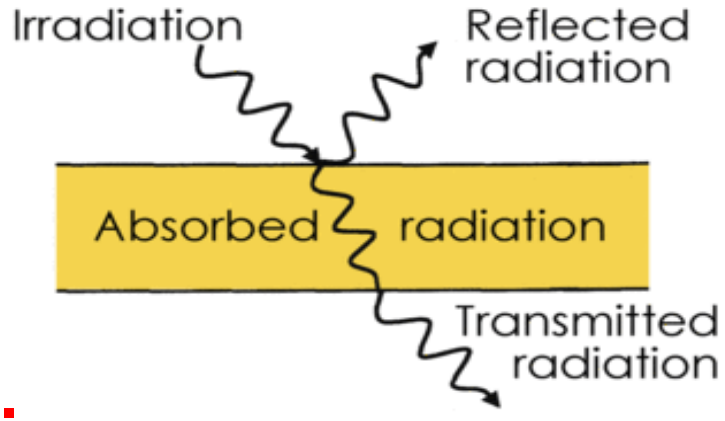
# Light meets Matter



# Light Interaction with Matter

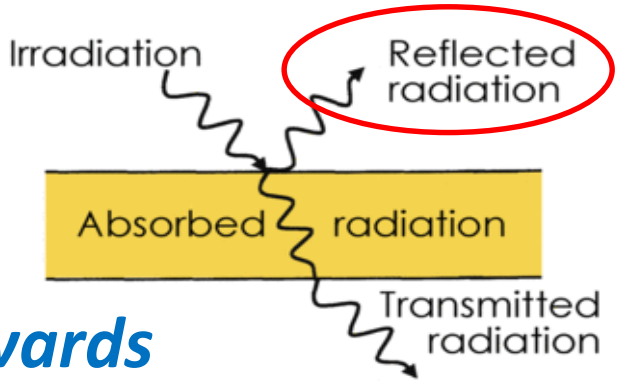
- **A ray of light travels in a straight line from a source until it encounters some object or particles of matter.**
- **The material world around us: substances (materials) and boundaries (surfaces, interfaces).**
- **In general, light can be reflected off, scattered, transmitted through or absorbed by materials.**



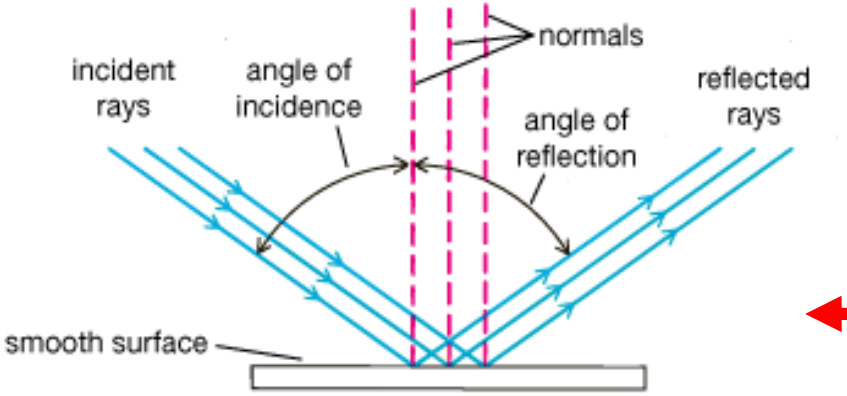

**Any combination can take place.**

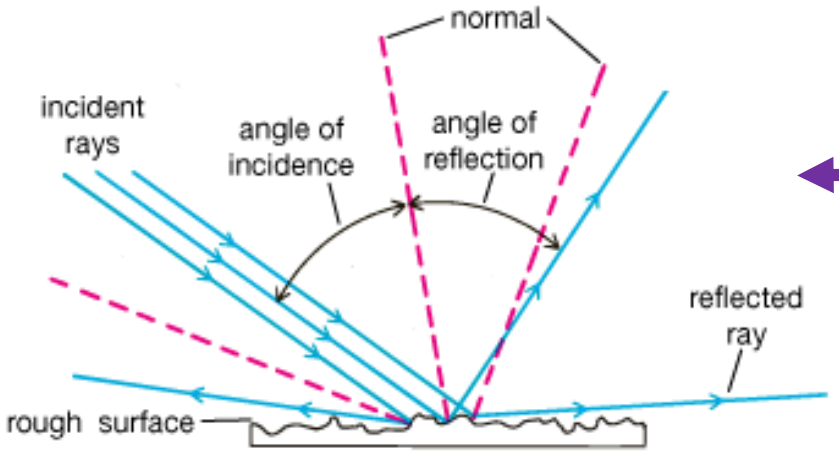
- **What *exactly* happens to the light depends on the nature of the material, the smoothness of the surface, the angle of incidence, and the light wavelength.**
- **A particular substance is usually characterized by what it mostly does to light.**

# Reflection




**bouncing of light off the surface, change in the direction of travel *backwards***



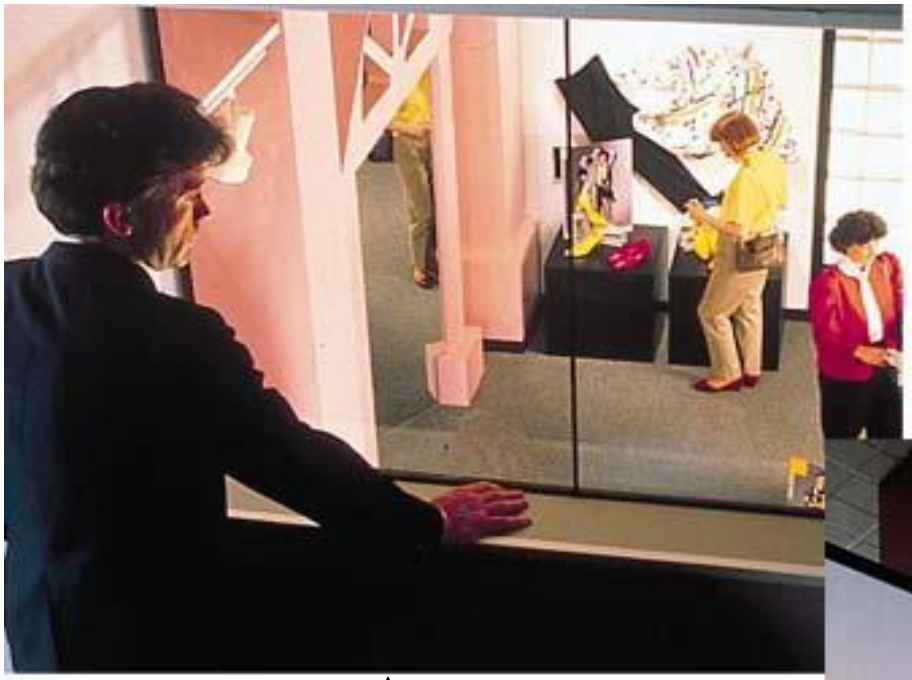



- **Reflection is <u>re-radiation of light by the electrons</u> in the reflecting material.**

**Specular reflection: if a surface is perfectly smooth, rays of light move out in definite directions.**

**Diffuse reflection: if a surface is not smooth, the light rays are *scattered* in many random directions by microscopic irregularities.**

# One-way Mirror
## (reflection+transmission)

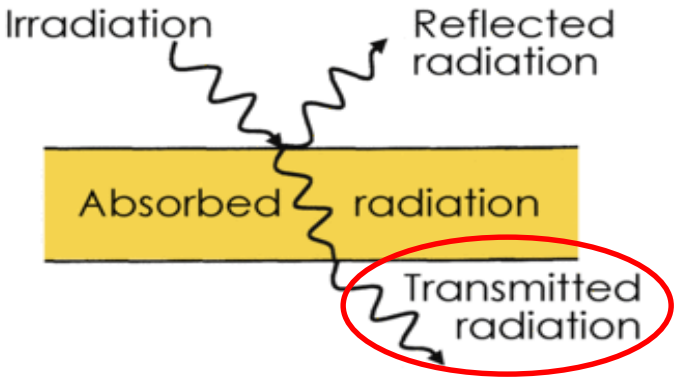


**A one-way mirror reflects most of the light that strikes its surface**

**It also transmits some light to a person behind the mirror in a darkened room.**

# Transmission

## passage of light in forward direction




**All objects around us can be classified as:**

**Transparent**

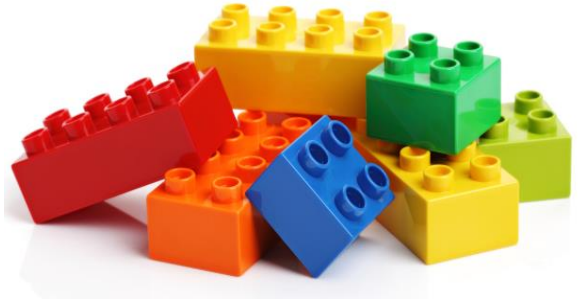
**allow transmission of light**

**Translucent**

**materials in between (partial transmission)**

**Opaque**

**(most materials) do not allow transmission of light**



# Translucent Creatures

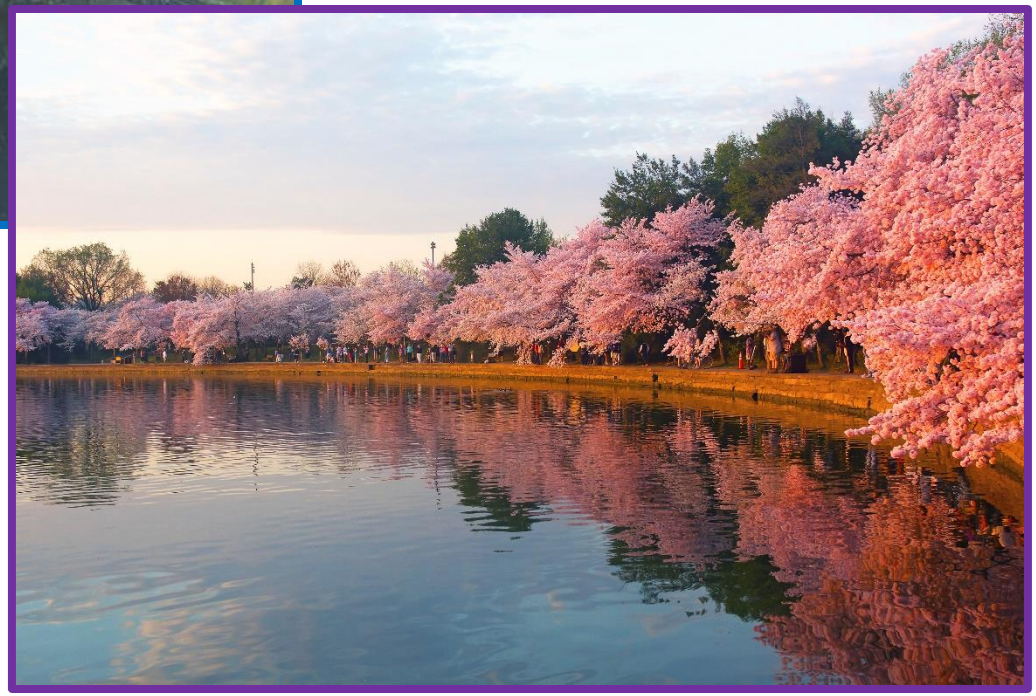
Mantis shrimp larva

**How do you hide in the ocean?**

**You become see-through!**

# Water: a transparent…mirror?

- Vertical rays of light are mostly transmitted through a transparent material (with *just a little reflection* and *absorption*).



- If light rays strike the surface at some angle, more of the light is reflected (*larger* angle results in *more reflection*).

# Shadows

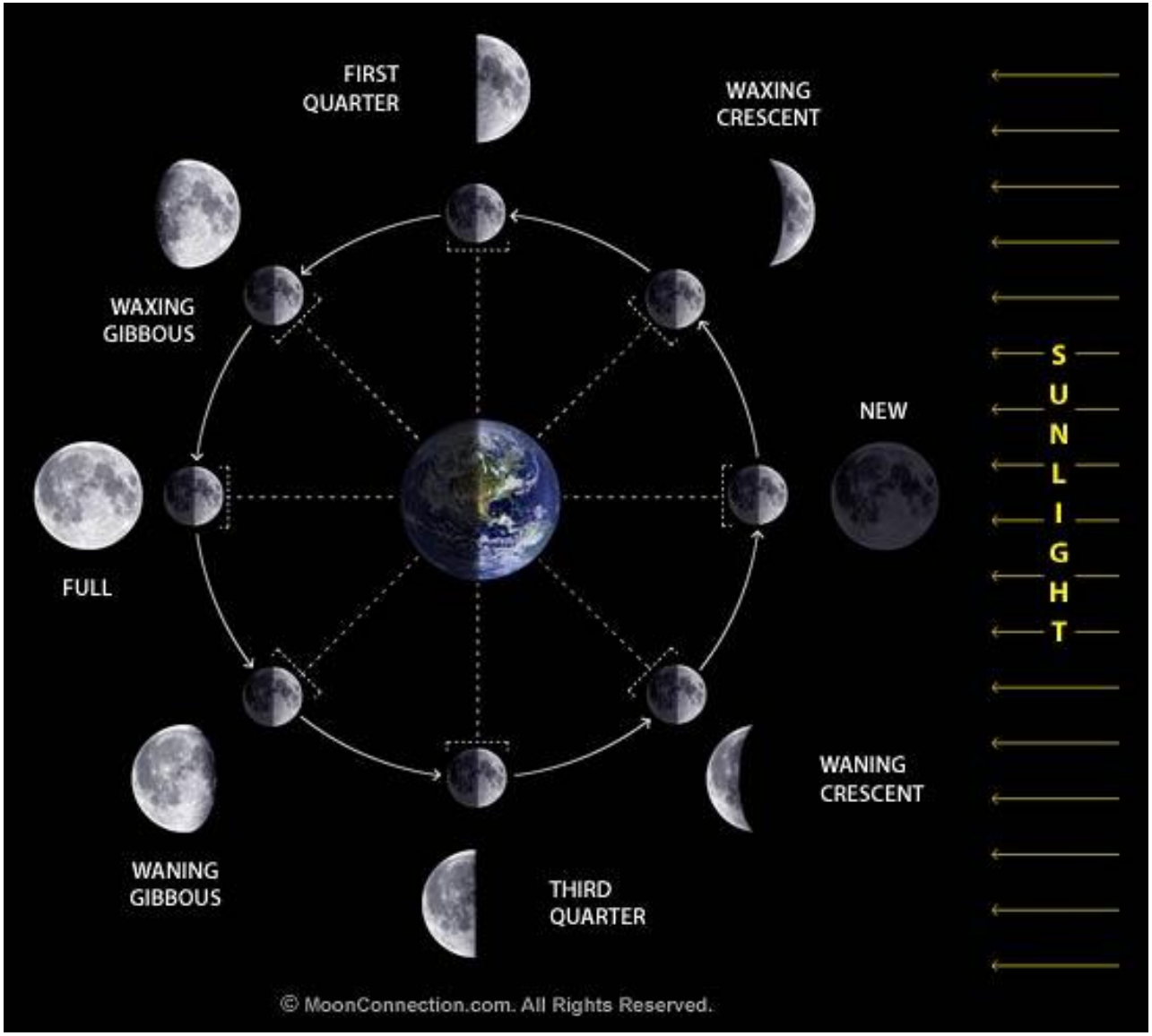
- Light rays travel in straight lines, radiating out from the light source.
- If rays are blocked by an opaque object, a **shadow** forms where the light cannot reach.
- If the light source is moved relative to the object, different amount of light is blocked and a different shadow is formed.

Sculpture by Diet Wiegman, Netherlands

Egyptian obelisk at St. Peter's Square, Vatican City

# Phases of the Moon

- Half of the Moon is always lit by sunlight.
- As the Moon revolves around the Earth, we see the lighted part of the Moon's surface from different angles.
- The different shapes we see are called "phases" of the Moon.



# Solar Eclipse