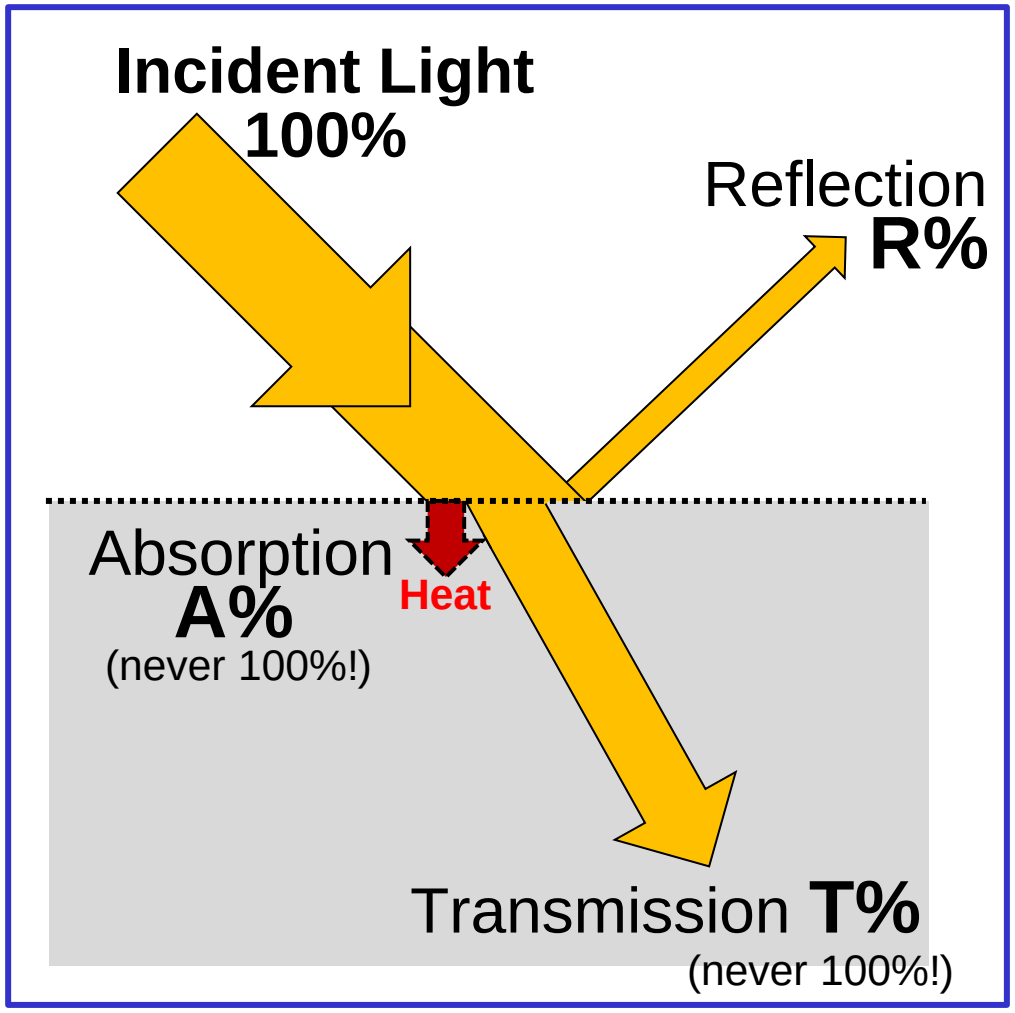
What (always) happens to light?

The material world around us can be viewed as objects (substances, materials) and boundaries (surfaces, interfaces).



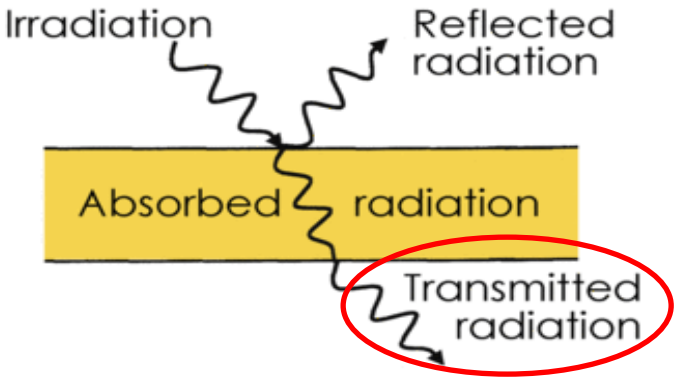
Light (energy!) can be reflected, transmitted or absorbed by matter.

T%+R%+A%=100%

What *exactly* happens to light waves depends on the nature of the material, the smoothness of the surface, the angle of incidence, and the light wavelength.

Transmission

passage of light in forward direction



All objects around us can be classified as:

Transparent

allow transmission of light

(Large T%)

Translucent

partial or selective transmission

Opaque

(most materials) do not allow transmission of light, form shadows

(T%=0)

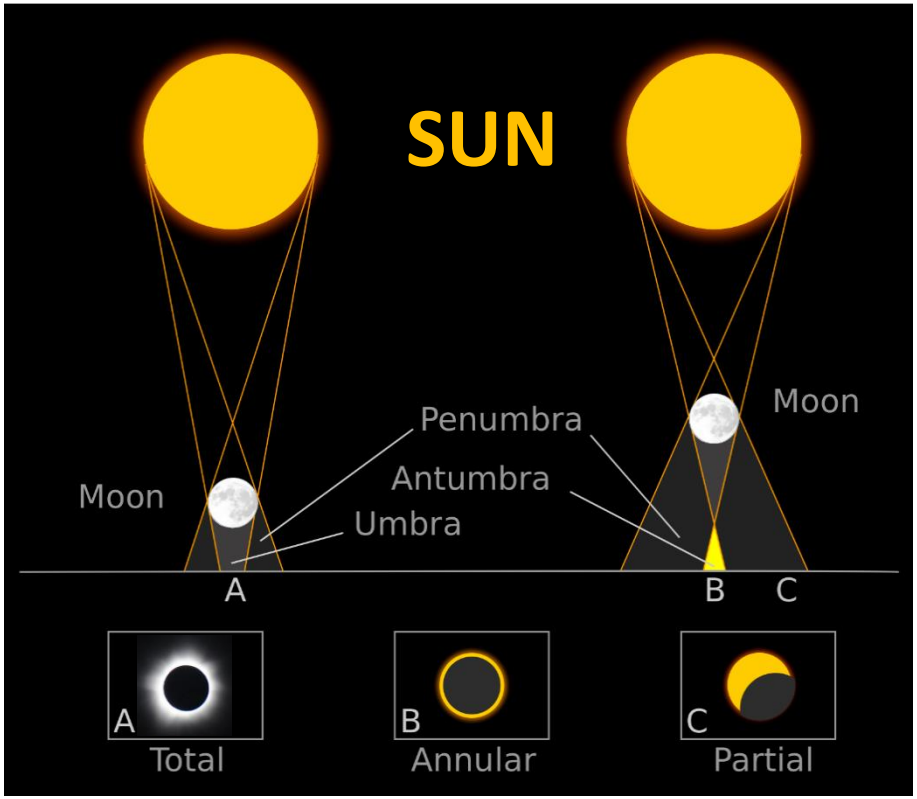
Shadows

Sculpture by Diet Wiegman, Netherlands

- 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.

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

Solar Eclipse



Translucent Creatures

(partial transmission)

Mantis shrimp larva

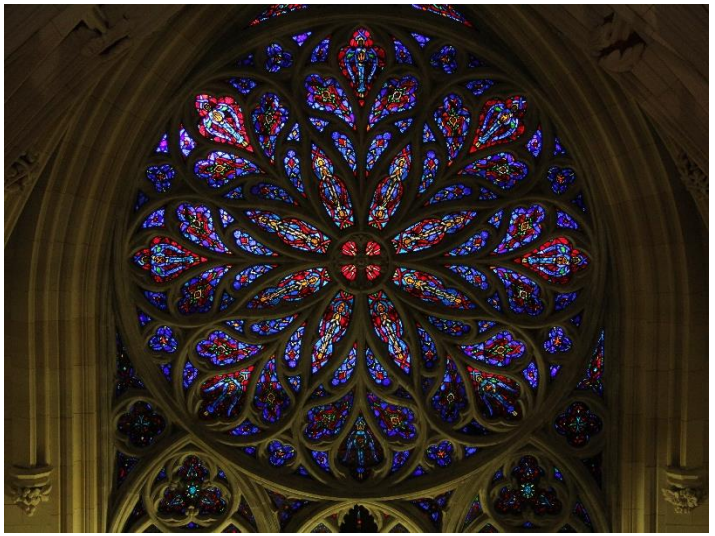
How do you hide in the ocean?

You become see-through!

Light Filters *(selective transmission)*

Rashad Alakbarov, Azerbaijan

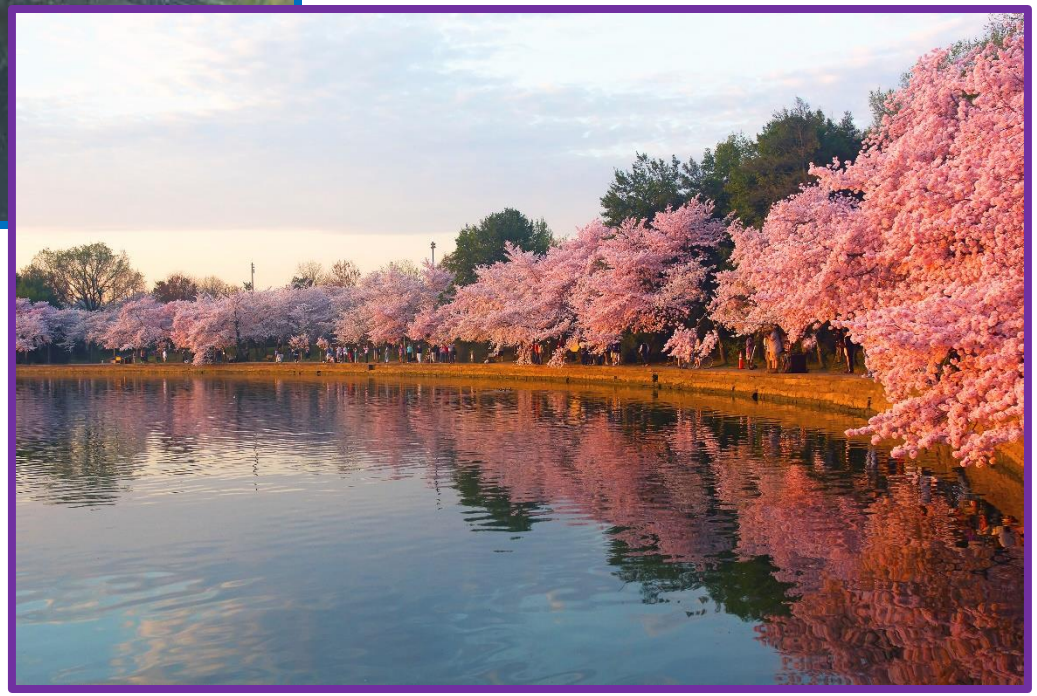
Tom Fruin, USA



Rose Window
St. Patrick's Cathedral, New York

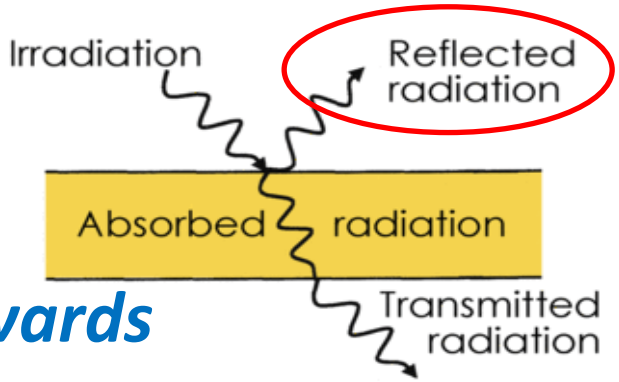
Water: a transparent…mirror?

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

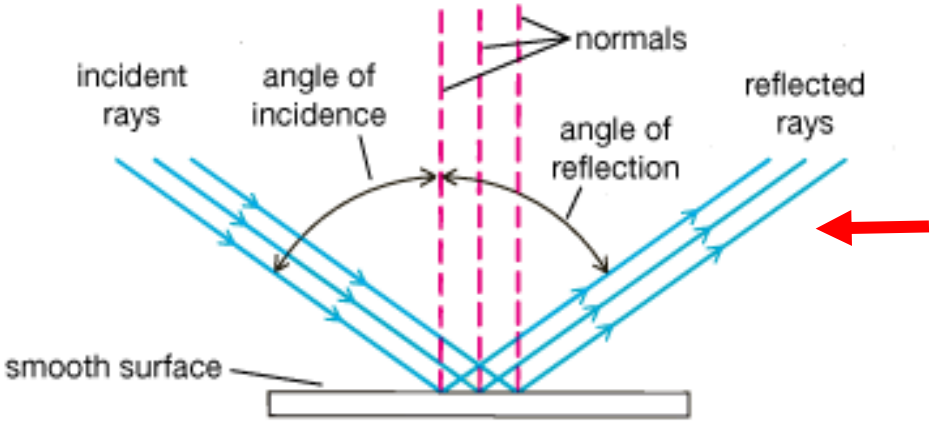


- If light rays strike the surface at some angle, more of the light is reflected (*larger* angle results in *more reflection*).

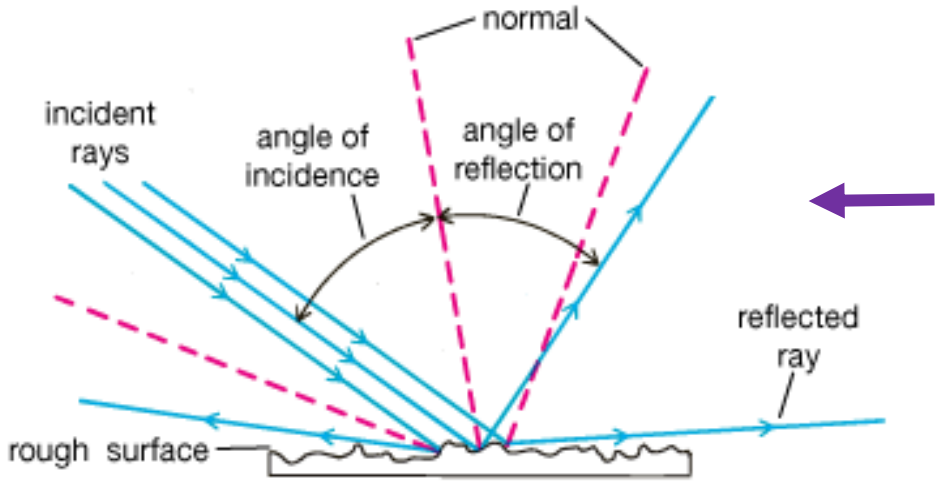
Reflection



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



- **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 details (irregularities).**

How do we see *things*?

- **When we see, we *sense light*.**
- **When we see an object, the light that reaches our eyes can come from two different processes:**

1. **The light can be emitted directly from the object (object=light source), like a light bulb or glow stick.**

2. **The light can come from somewhere else, like the Sun, and get reflected by the object.**

Most of the objects that we see are visible from diffuse reflection.

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.