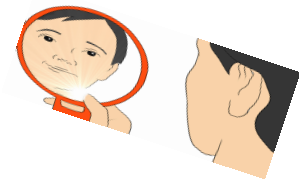


Unit 3

Optics

Light - is the form of energy that you can see

Natural light sources are:

1) The Sun is a star with the most abundant and the least expensive in the world

2) Flames or Sparks from Fire

The sun and other stars emit light in all directions using waves or rays (similar to spokes on a bicycle). This is known as **radiation**. Energy such as light that travels by radiation, like the sun, is known as **radiant energy.**

Since we do not always have the light from the sun, we have developed **artificial light sources** Examples: light bulb, flashlight

Interesting fact - less than $1/10^7$ %of the suns energy actually reaches the earth

All sources of light require energy. A light bulb uses electricity, flash light uses batteries and a match used chemicals. Light from the Sun is formed through a process called **nuclear fusion**.

The first basic property of light us that light is a form of energy.
When light is absorbed by a surface, it can be transformed into one of the following:

1) **Thermal Energy**- energy that comes from heat

ex) black sweater absorbing the sun

2) **Chemical Energy** - energy stored in the bonds of chemical compounds (atoms and molecules)

ex) trees absorbing sunlight to make sugars

ex) glow sticks

3) **Electrical Energy** - uses electrons and conductors to produce the electricity we use in our houses

4) **Solar Energy** - Solar cells change light to electricity

Intensity is the brightness of a light. This indicate how much energy a surface will receive.

Ex) Pavement on a bright sunny day will be hotter than pavement on cloudy day.

Hot Clear day

Cloudy Day

Ex) Compare reading a book right next to a lamp at nigh time, to trying to read it 3 m away from it. How does increasing the distance from the lamp affect the intensity of the light stricking the book's pages?

Sources of Light

There are many different sources of light:

1) **Incandescent sources** - is when an object can be heated to such a high temperature that it gives off visible light.

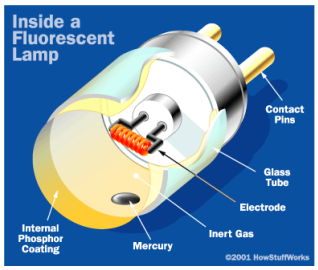
Pathway: Electrical → Thermal → visible

Ex) A regular Light bulb, candle flames

2) **Fluorescent Sources** - High energy, invisible ultraviolet (UV) is absorbing particles to produce visible light **immediately**.

Pathway: Ultraviolet → Energy absorbed by particles → visible

Ex) Black Light, Lights in classroom (long tubes)



Example) Fluorescent light in school. An electrical current from the lead in wires and electrodes cause the mercury vapor inside the tube to give off ultraviolet radiation. A phosphor coating on the inside of the tube absorbs the UV energy.This causes the coating to glow, thus producing light that you can see.

Fluorescent Advantage over Incandescent

- no thermal energy involved so less heat/ energy lost (Energy efficient)

- bulbs are cool to touch

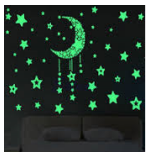
Fluorescent Disadvantage over Incandescent

- expensive

- mercury & phosphorus are toxic thus making them harder to dispose of

Sources of Light continued

3) **Phosphorescent sources** - is when light particles are absorbed by certain particles **that can store energy for a while** then released later as light.



Pathway: Ultraviolet → Energy absorbed by particles → visible

Ex) glow in the dark stickers

4) **Chemiluminescent sources** - chemical reactions that release energy

Pathway: Chemical → visible

Ex) glow sticks

In a glow stick you have breakable barrier that separates two liquid. Bending the stick causes the barrier to break thus mixing the two liquids to cause a chemical reaction that relaes light.

5) **Bioluminescent sources** - unusual source but it is used by sea animals that usuall live deep in the ocean where the sunlight does not reach. Jelly fish use this source of light energy.

Pathway: Chemical → visible

Ex) Jelly Fish

Énergie NB Power

Lighting Measurement

Watt - is a measure of electrical power

- equivalent to 1 Joule per second

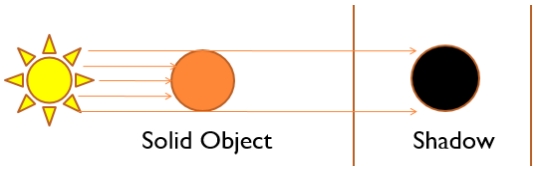
1 W = 1 J/s

- Kilowatt is 1000 W

NB Power Charges 11cents/KW h

The **second basic property of light is that it travels in a straight line, it does not bend**.

Ex) You cannot see the TV id someone is standing in front of it.



Light can travel through things that are **transparent**

Ex) window glass.

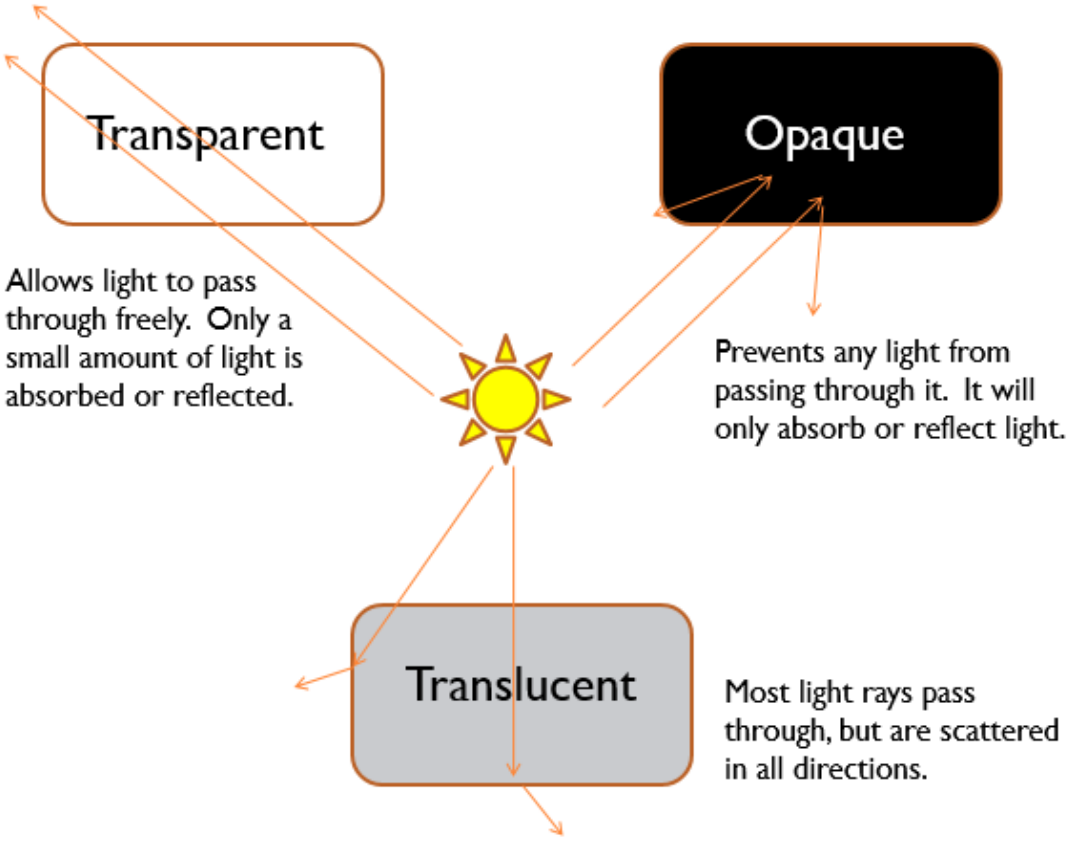
Translucent - allowing some light to pass through

Ex) wax paper.

Opaque - NOT allowing any light to pass through (Produce shadows when stuck by light)

Ex) book.

Copy Figure 7.11 (Page 213) into your notes



Reflecting on Reflection

Luminous - are objects that emit their own light

Ex) Sun

Non-Luminous - are objects that do not produce their own light.

- Can only be seen when light from a luminous source strikes the object and then reflect off the object into your eyes.

Ex) Moon, Books

Reflection - occurs when light bounces off an object

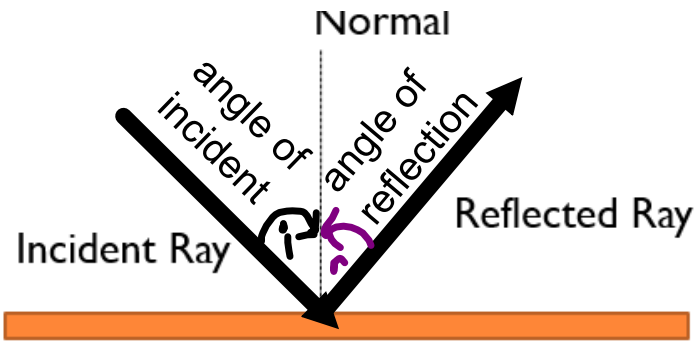
When a room is poorly lit, you see less because less light is reflecting

All the light that hits an object is not all reflected, some is absorbed by the object. Dark objects tend to absorb most of the light, where as light objects reflect the more light. Ex) Dark clothes in the summer VS. Light color clothes

Incident light ray is a light ray that strikes a surface

Reflected light ray is the ray that bounces back off the surface

You can determine the direction in which each light ray is travelling by using a the following picture

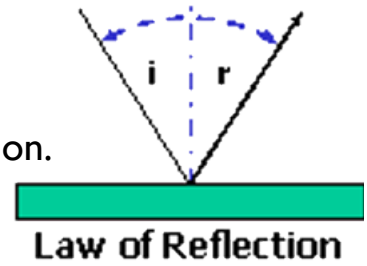


Normal:

- An imaginary line that is perpendicular to the barrier.

Laws of Reflection

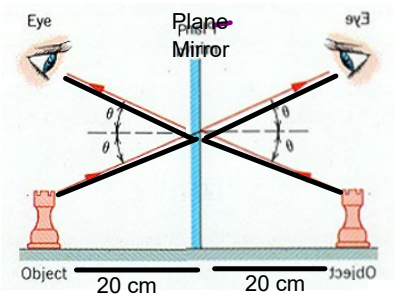
1) The angle of incidence equals the angle of reflection.



Law of Reflection

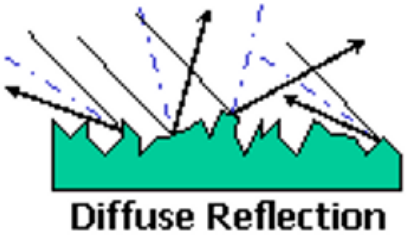
2) The incident ray, the normal, and the reflected ray are always in the same plane. (Same Plane means you can draw this on a piece of paper if you wanted)

In a plane mirror (Flat mirror) you see a smooth identical image



Diffuse Reflection - the type of reflection that occurs off a rough surface, resulting in no clear image

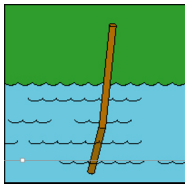
Your reflection off a the side of a car or a wall



What happens when light shines in water?

When swimming in a pool you may have tried to dive down a grap a toy from the bottom. As you reach the object was not where you expected it to be.

See diagram page 226



Refraction - is the bending of light as it travels from one medium to another. Light bends because it changes speed when it moves between materials with different densities. Light usually travels more slowly in comparatively dense materials. The bending of light makes the objects image appear to be in a different position from where the object really is.

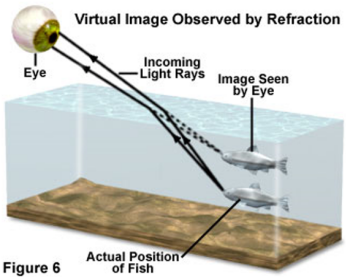
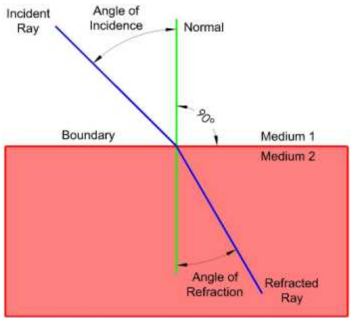


Figure 6



Angle of Refraction - in optics the angle between the normal and the refracted ray

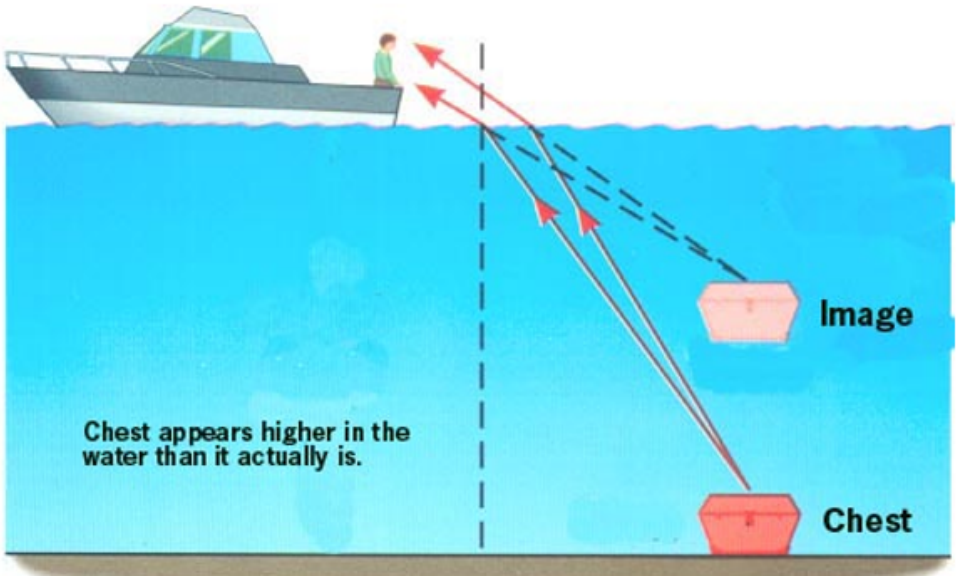


Image
Chest appears higher in the water than it actually is.
Chest

Light bends as it travels through different densities of air, as well. The refraction of light through air can result in a **mirage**. Have you ever been driving along a highway on a hot summer day and notices what looked like pools of water laying ahead? When you got closer to the pools, they mysteriously disappeared. You were seeing a mirage. The air close to the ground is hotter and less dense than air higher up. As a result, light from the sky directed at the ground is bent upwards as it enters the less dense air. The "pools of water" were actually images of the sky refracted by warm air near the ground.

What happens...

1) As light travels from a less dense medium to a more dense medium (ie. Slows down)?
The ray bends towards the normal.

2) As light travels from a more dense medium to a less dense medium (ie. Speeds up)?
The ray bends away from the normal.

3) Why is the object not where you think it is?

If the light travels through two different media before it reaches your eyes, it does not travel in a straight line.

The object is not where your brain thinks it is.

Watch these videos

Reflection

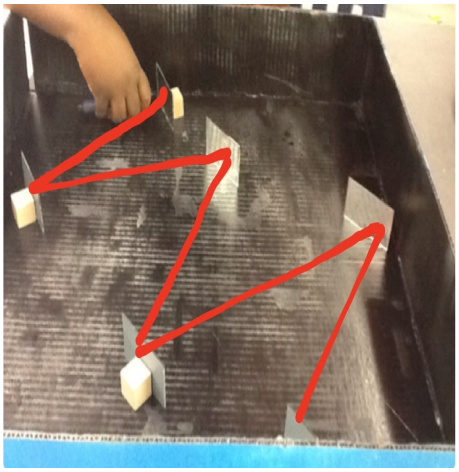
https://www.bing.com/videos/search?q=understanding+the+reflection+of+light&docid=608010722684964490&mid=F0B11CFCF74BC1C29843F0B11CFCF74BC1C29843&view=detail&FORM=VIRE

Light absorption

https://www.bing.com/videos/search?q=absorption+of+light+video&docid=608035594862661549&mid=49A1B8E7BF48BD21293849A1B8E7BF48BD212938&view=detail&FORM=VIRE

Refraction

https://www.youtube.com/watch?v=95V-QJYZ2Dw



Try this: If you have any reflective surfaces at home (mirrors, sunglasses, jewlery, aluminum, etc.) Shine the light from a flashlight or laser pointer at the reflective object and see where the light is reflected. To challenge yourself see if you can set up a series of objects to watch the light change paths because of reflection.