5.1 Lessons on Light

Lesson 1 - What is Light?

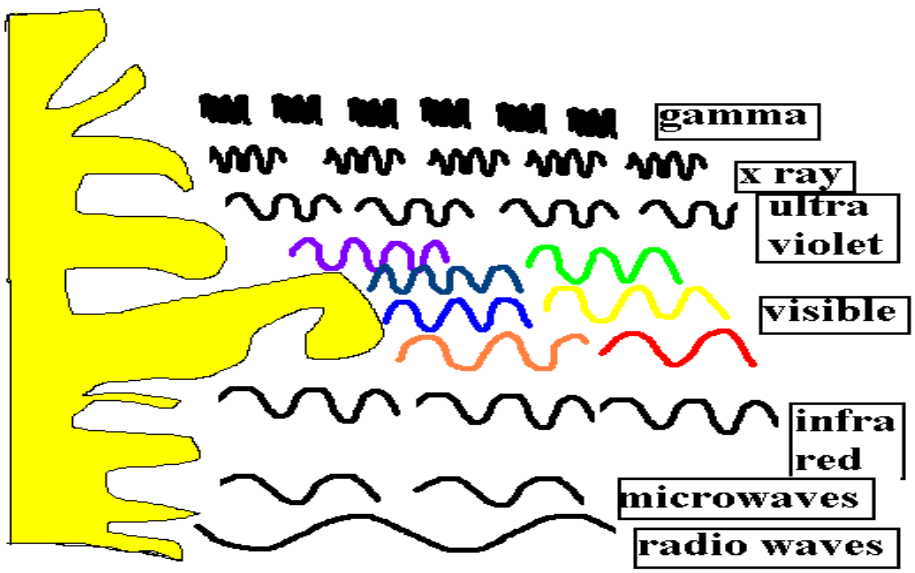
There is a lot more to light then you can see!
The proper name for light is **electromagnetic radiation.**
This has the **visible spectrum** (all the colours of the rainbow) plus light we can't see but is still very important to us.

Invisible light has useful and sometimes harmful **rays** (a single beam of light) such as radio, ultraviolet, infrared, microwaves, X rays and gamma rays.

- **Radio waves** are used to send signals for communication and even used to listen into the stars.
- **Ultraviolet** tans your skin and can cause sunburn or even worse diseases in large doses.
- **Infrared** is really just heat from the sun. Infrared cameras are very useful for seeing at night.
- **Microwaves** are obviously used in Microwave ovens and mobile phones.
- **X Rays** allow doctors to see into your body.
- **Gamma rays** are very harmful but have their uses particularly in killing germs.

Activity: Look up one of these forms of light and report to the class or Group.

Light travels in little waves called **photons** and mostly comes from the sun.
Q. Can you think of light that does not come from the sun?



Visible Spectrum and our eyes.
What we see with our eyes is in the visible range.

Visible light is usually white; a mixture of many colours. This is only separated into single colours when shone through lenses or prisms and rainbows form.
Q. Can you name the seven colours of the rainbow in order?

We have in our eyes colour receptors called cones. There is 3 types picking up different parts of the colour spectrum. People who are colour blind may have problems with one particular type of cone but this is not the only reason they may not see all colours.

Activity: How do different animals see? Is their colour vision better than ours? Look up animals and vision and report to the class about one particular group of animals.

Lesson 2 Light Brightness

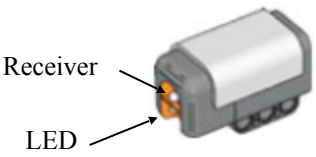
Measuring Light
One thing we can measure about light is how bright it is. This is a measure of the amount of light energy we are receiving. This depends on how bright the light is (a 60 Watt bulb is brighter than a 40 Watt bulb). It also depends on how close we are. Brightness is measured in LUX. Light Meters in photography use this measure to determine how big the cameras aperture (opening) should be and how long it needs to stay open to take a visible picture.

Light Sensors and Meters
Light sensors are used for outdoor lighting, cameras, robots and automatic doors.

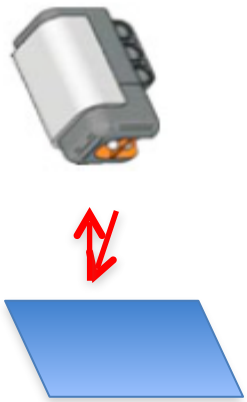
Outdoor lighting on a power pole uses a light sensor that senses when the light brightness is low and turns on the electricity to a large light.
Cameras such as the one on your I Phone will have alight sensor that can decide if the flash light needs to be turned on when you take a picture because the image is not bright enough.
Automatic doors and robots have light sensors that can detect if an object or person walks past and can turn on their motors.

Light Sensors can also be used as meters because they can read how much light is coming to them.

Example of Light Sensor:
LEGO Light sensors have two components inside th



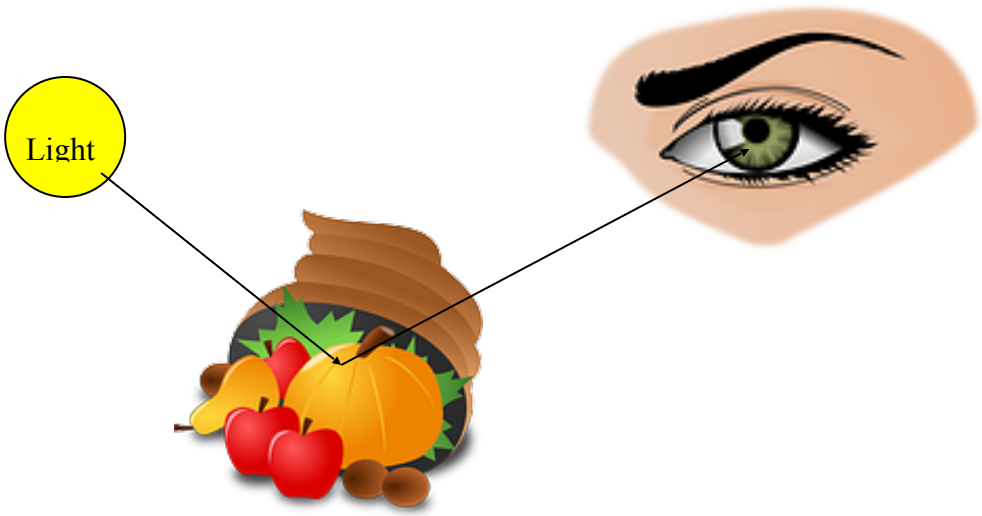
1. **Light emitting diode (LED)** – this shines red light out so that it can reflect off objects.
2. **Light receiver** – this receives reflected light from objects and sends a signal back to the NXT to work out a percentage of how much light is received. (0% none, 100% all)



Do Investigation 5.2 Investigating Light Brightness

Lesson 3 Reflection- Seeing things

We see things by the reflection of light and the power of that marvellous organ; the eye!



Reflection means to **throw back,** because light is thrown back by objects that are **opaque**. (Can't see through).
We see things because light shines on an object and it throws it back or reflects it to our eyes.

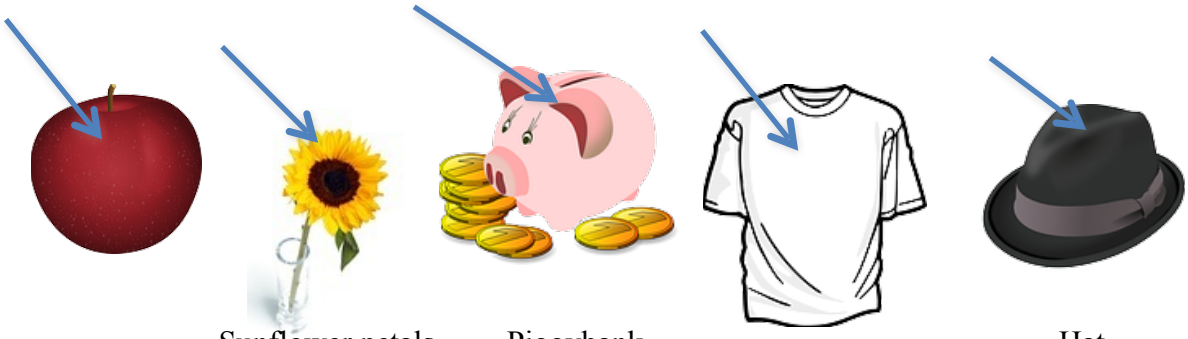
Actually only mirrors and shiny white objects reflect all the light that hits them.
Coloured objects reflect only the colours that they are.
So for example if light from the sun shines on an object, the seven colours of the rainbow which are in the white sunlight will separate so that some are absorbed by the object and some are reflected to your eyes. The colours that go to your eyes are the ones that make up the colour you see.
Examples:

1. A red sports car only reflects red from its metal body to your eyes. All the other colours are absorbed into the car.
2. A blue cup only reflects blue from its material to your eyes. All the other colours are absorbed into the cup.
3. A white sheet reflects some of all the colours, because all the colours together make white.
4. A black pot will only reflect a very little of each colour in fact dark black doesn't reflect any light at all and appears like a hole.
5. A pink ribbon only reflects mainly red and some of the white, which together make pink.

Q. What do you think a brown shoe would reflect?

Activity

Draw the light colours that comes off the following if white light shines on each of them. (Choose from the rainbow colours)



Apple

Sunflower petals

Piggybank

T Shirt

Hat

Coloured objects reflect different levels of brightness, so that light from a dark object isn't as bright as light from a light coloured one? Some colours though tend to look brighter than others.

Q. Which colour would normally be the brightest - red, blue or yellow?

Do Investigation 5.3 Investigating Light Reflections

Lesson 4 Refraction of Light

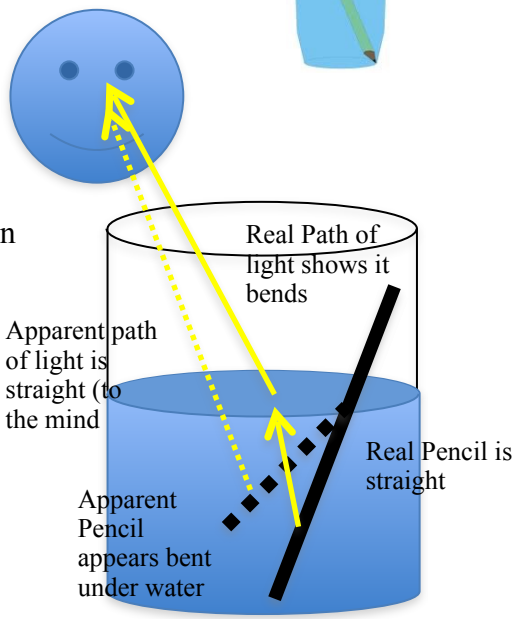
Some objects are transparent (pass all the light through) e.g. a glass for drinking.
Q Can you name some others?

Most objects pass only some light through and these are called translucent objects or filters.
Coloured glass is translucent and so is tinted glass.
*Q Is lemon juice transparent or translucent***?**

When light passes through these objects it can bend. It only bends though if the edge of the object is at an angle to the light. This happens for example when sunlight goes through windows at angle. If you move your eyes the objects outside appear to move.
It also happens if you see objects that are under water. For example if you are standing at the side of a pool and watch your sister standing in the water you will see she has bent legs!

Activity
Try putting a pencil in a glass of water. So that some is above the water, some below.
Now watch it from above and from the side. What do you notice?

This is because light only travels in straight lines until it meets the edge between two transparent objects (water and air) and then it bends.



Then your brain does something weird, it believes light can only come straight so the image it creates appears to be somewhere it isn't!
It is true that your brain plays tricks on you, when using your eyes! Many things we see are not really there e.g. are you really behind that mirror when you look at yourself ?

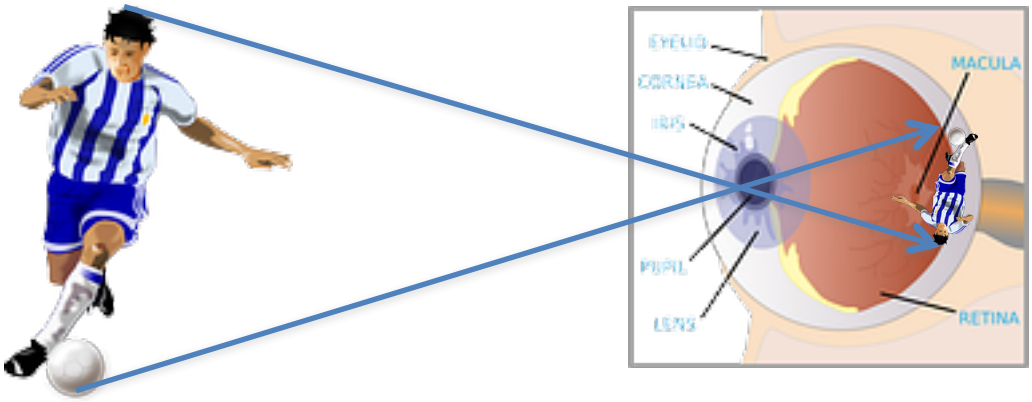
Prisms and Lenses

Triangular Prisms of glass or plastic are very useful because they always bend light.
They can be used in periscopes to see around corners. They also separate white light into its colours producing rainbows.

A Lens is a curved glass or plastic that is transparent.
Q Where do you find lenses?

Lens can magnify images (if they are close) or shrink them (if they are far away)

The eye itself, has a lens which bends all the things we see into a very small image on the back of our eye.



Notice the image we see is upside down! But that's Ok because the brain turns it the right way up!

Do Investigation 5.4 Investigating Light Refraction