Light

Proporties

You can’t see light just like that
Light can be refracted or reflected
A plane mirror reflects light: the image is as big as the real object.

When light enters a less optically dense medium, it may be reflected sometimes. This phenomenon is called :total reflection.

A white object reflects all colours, a black object absorbs light, so there is no reflection.

A coloured object only reflects one colour.
Red + green + blue is white light

By composing red, green and blue light , we obtain all the colours of the rainbow : ROYGBIV

1. How we see

a) first experiment

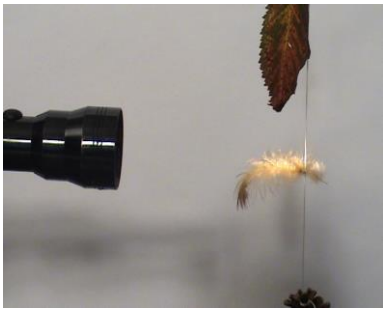
Material
Your eyes, an object

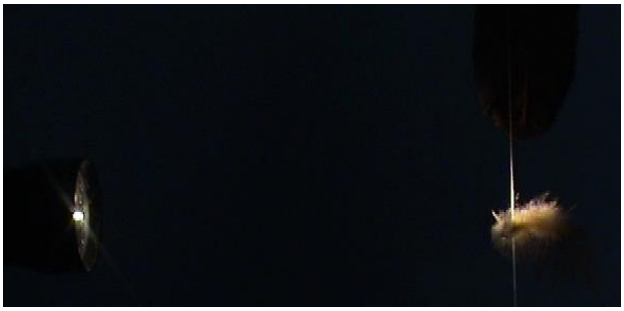
Action
a)keep your eyes open
b)close your eyes

What?
a)you see the object
b)you don't see anything

Why?
In order to see something, light is necessary. The light passes through the lens of the eye and falls on the retina, giving it energy.
Some nerve-cells are conical, other ones are baculiform.
These cells receive stimuli giving information about colour and shape.
All stimuli are passed to the brains through the optic nerve.
This energy generates a reaction in the brains; in this way we are able to define what we see.

b) second experiment





Material
A torch

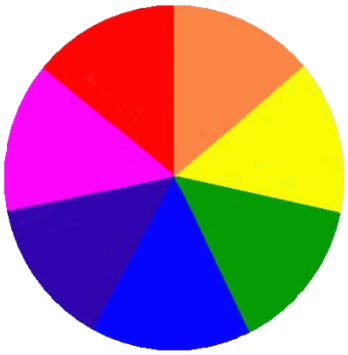
Action
a)Light in the distance and have somebody watch the shaft from aside.
b)drop small feathers in the shaft

What?
a)the shaft is there, but you can't see it.
b)you see objects that are lit up

Why?
Objects reflect the light, so they become visible

2. Colours

a) the colour-disk



Material

A colour disk(see picture), in the middle of which you made two holes; lace a rope through the holes (noosewise) ore take the disk from the kit

Action

-swing the colour disk a few times in order to wind the rope.
-pull (rhythmically) the end of the rope to turn the disk.

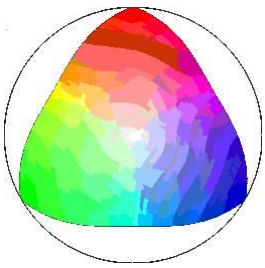
What?

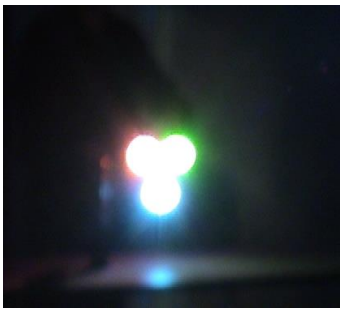
You don't see the colours any more-you only see a white disk

Why?

White light is composed of all colours of the spectrum.
When the disk isn't moving we notice the different colours of the rainbow (spectrum). We are able to see colours because an object absorbs one or more colours The colours which are not absorbed , are reflected and enter our retinas.
A white object reflects all colours. A black object absorbs all colours, so no colours enter our eyes, that's why we see the object in black.

b) the colourful torch





Material

A torch including a red, a green and a blue lamp
A white background or white paper

Action

a)light the white background using the coloured lamps alternatively
b)light the white background using the three lamps simultaneously

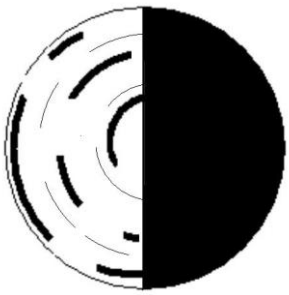
What?

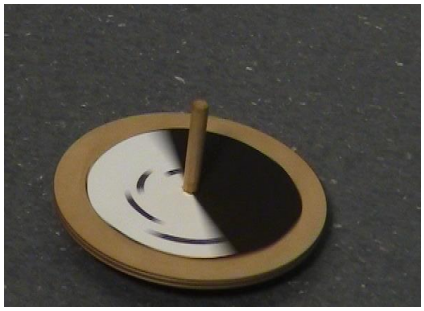
a)you notice the colour of the lamp you used on the background
b)you notice white light on the background

Why?

The primary colours of light are: red, blue and green.
In combining these three colours, we obtain white light(see spectrum of colours, central part)
When mingling colours, we obtain other colours. Red + green =yellow.

c) the black-white disk





Material

A disk:-half of it is black
-half is white with fragments of a circle
-2 holes in the middle
-a rope tied through the holes, making a noose

Action

-stretch the rope(loop) between both hands
-swing the disk a few times in order to wind the rope
-pull both ends of the rope (rhythmically) to make the disk rotate slowly

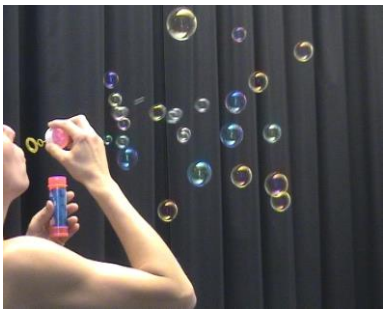
What?

You don't notice the black half any longer
When pulling at the exact rate (not too fast) you see a disk with coloured circles.

Why?

The black half absorbs the light. This part doesn't reflect light and doesn't generate energy stimuli on the retina.
The white half (with some black fragments) does generate energy. White light passes signals of red, green as well as blue light , since red+ green+ blue =white
Energy (light stimuli) on the retina is not continuous.
The sensors pass a fragmented signal to the brains. In this way the information doesn't reach the brains simultaneously, so we see colours like red, green, blue.

d) the rainbow



Material

a)an atomiser and a torch
b)soap-suds to blow bubbles

Action

a)spray fine drops of water in the air and shine the torch slantingly on the water-drops
b)blow bubbles and shine the torch slantingly on the bubbles

What?

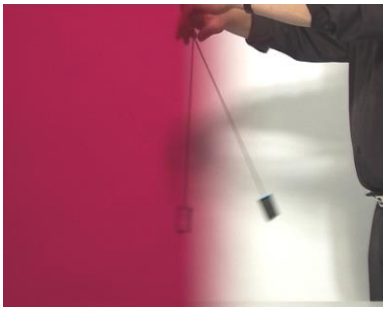
You (sometimes) see the rainbow.

Why?

The shaft (of light) falls on the outside of the drop of water (or the bubble) and passes through it, but it may change its direction.
Because of the refraction, white light scatters into the colours of the spectrum.
When these light-rays reflect on the back of the drop, you may see the spectrum.
In order to see the colours of the rainbow, you have to turn your back to the sun.

In 1666 Newton proved that white light is composed of the seven colours of the rainbow.

3. Optical illusion



Material

Two ropes with a small ball at the bottom and a noose at the top.
Hang the pendulums side by side : slip the nooses over a bar, about 5 cm apart.
Sun-glasses missing one glass

Action

a)Swing both pendulums up and down in a different direction, parallelly.
What do you see?

b)Repeat the action, but watch the swinging by means of the special sunglasses
What do you see?

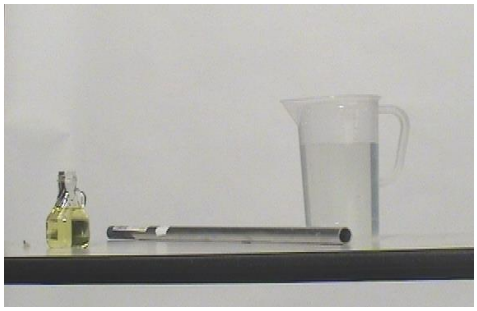
What?

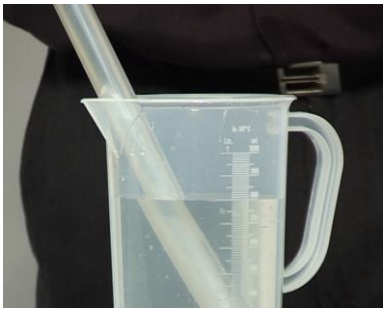
a)you see both pendulums move parallelly
b)the pendulums seen to make a circular movement.

Why?

We see objects, because they reflect light. This light enters our retinas . The information passes to the brains by means of the eyes separately. In the brains the picture is made.
The sun-glasses (in front of one eye)slow down the light-beams, which reach the brains later.
The brains don't get the information simultaneously and create a wrong picture of reality.

4. Refraction of light





a)in water

Material

A bowl of water ,a ruler

Action

Put the ruler into the water ,obliquely.

What?

The ruler seems to be broken

Why?

The light of the ruler is broken when passing the interface of water and air.
That's why we see the ruler as broken.
This phenomenon is called refraction. It occurs when light passes the interface of two media with a different optical density.

b) in almond oil

Material

A bowl of almond oil, a pipette

Action

Put the pipette into the almond oil.

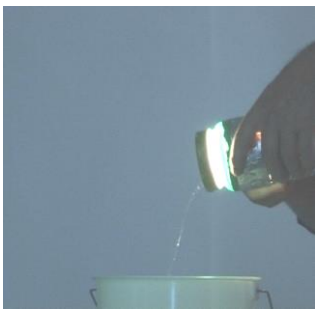
What?

The pipette looks thinner.

Why?

Almond oil and glass have the same optical density, so the light is not reflected by the pipette.
The thin line you see, is the air in the pipette. When you fill the pipette with oil, there is no more reflection, so you won't see the pipette.

5. Fiber optic bundle



a) curved light

Material

- a bowl of water, in the lid of which is a small hole; wrap a piece of paper round the bowl
- a torch
- a bucket

Action

a) keep the bowl vertically, shining the torch through the bowl; see how a light-ray passes through the hole
b) now keep the bowl horizontally, making the water flow through the hole
c) repeat action (b) switching the torch on and off; watch the ray

What?

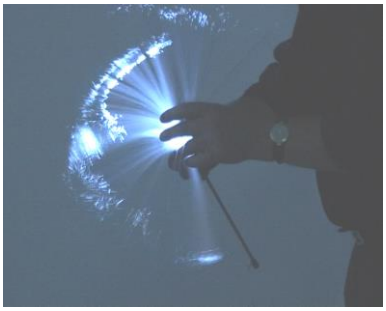
a) the light-ray shines through the hole in a rectilinear way
b) the light-ray is transmitted along the curved stream of water
c) you see phenomenon (b) more clearly

Why?

a) the light passes through the glass and the water in a rectilinear way
b) and c)
the light-ray is curved along with the stream of water; it seems to be caught in the stream of water. The light-ray is continually reflected by the border of the stream of water.

When light enters a less optically dense medium, it is sometimes reflected along the interface of the media. This phenomenon is called total internal reflection.

b)fiber optic



Material

a fiber optic and a torch

Action

Shine the torch on the end of the fiber

What?

The other end lights up

Why

Same explanation as (a)

Fiber optics are applied in telephone transmissions and in medicine (endoscope)

6. Conjuring

Material

A black bag ,three small boxes including objects
Wrap fluorescent rope round each box

Action

Ask somebody to take a box from the bag and to look at the object inside. He can put the box back into the bag.
Can you guess, which box the person took out of the bag?

What?

When you have a close look into the bag, you will easily recognize the box.

Why?

The fluorescent rope of the box that was taken from the bag will light up in the bag

7. Focus

Material

2 headlights of a car, a coin

Action

Put the parabolic mirrors upon each other upside down.
Put the coin in the focus of the first mirror and look through the hole in the upper mirror.

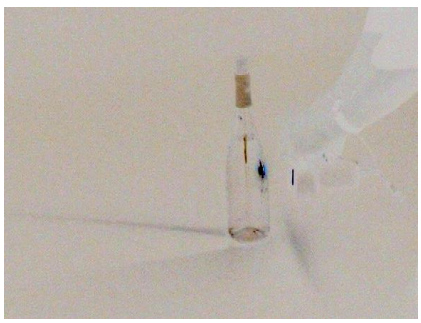
What?

Can you see or touch the coin?

Why?

Through the hole light falls on the coin. This light is reflected parallelly, so that the image is made in the focus of the upper mirror.

8. Light with direction



Material

A prism and a beam of light from a torch or a bottle filled with water.

Action

a) shine the light-beam on the bottle and watch the light being broken and changing direction

b)turn the bottle slowly.

What?

a)a part of the beam passes through the bottle, but is refracted

b)an other part is reflected by the backside

Why?

a)the light beam enters a medium having an other density, it is refracted

b)there is a total internal reflection, because light enters a less optically dense medium

with prisms there may be refraction and reflection

9. Blue sky

Material:

a bottle, water, some milk and a torch

Action

a)fill the bottle with clear water and shine the torch on it

Which colour do you see in the bottle?

b)add some drops of milk to the water

c)shine the torch on the bottle and look at its side and its back

What?

a)you see white light

b) c)on the back you see red light, on the side you see blue light

Why?

The bottle represents the atmosphere of the earth; the atmosphere contains air, vapour and dust. Vapour and dust diffuse light. Blue light is diffused best of all colours. By day the sky is blue because blue light is diffused.

Red light is almost not diffused, so we see a red sunset.

10. Floating

Material:

a large mirror, a pencil, an audience

Action

Stand on the side of the mirror , with your nose against it

In front of the mirror :

- move your leg up and down

-open your mouth, quickly put the pencil under your nose to the back of the mirror, and shut your mouth

-open your mouth again, take the pencil from behind the mirror, under your nose, back to the front of the mirror and shut your mouth again

What?

You seem to be horse-riding or eating a pencil and pulling it back from your mouth

Why?

A flat mirror shows your reflection to its real size and your brains link both images