

# 100

EDUCATIONAL  
ACTIVITIES ABOUT

LIGHT AND

# PHOTONICS

A QUICK REFERENCE GUIDE







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**6+**

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1

# Anti-Gravity Mirror

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## LEARNING OBJECTIVES

Learn about the law of reflection and make people think that you are flying using a big mirror.

## COMMENTS

Introduce the law of reflection before performing this activity.

<http://unawe.org/light/1/>



## LEARNING OBJECTIVES

Learn how to make a lens and how our eye manipulates the light that enters it.

## COMMENTS

This is a simple model of our eye.

<http://unawe.org/light/2/>



# Bird in the Cage

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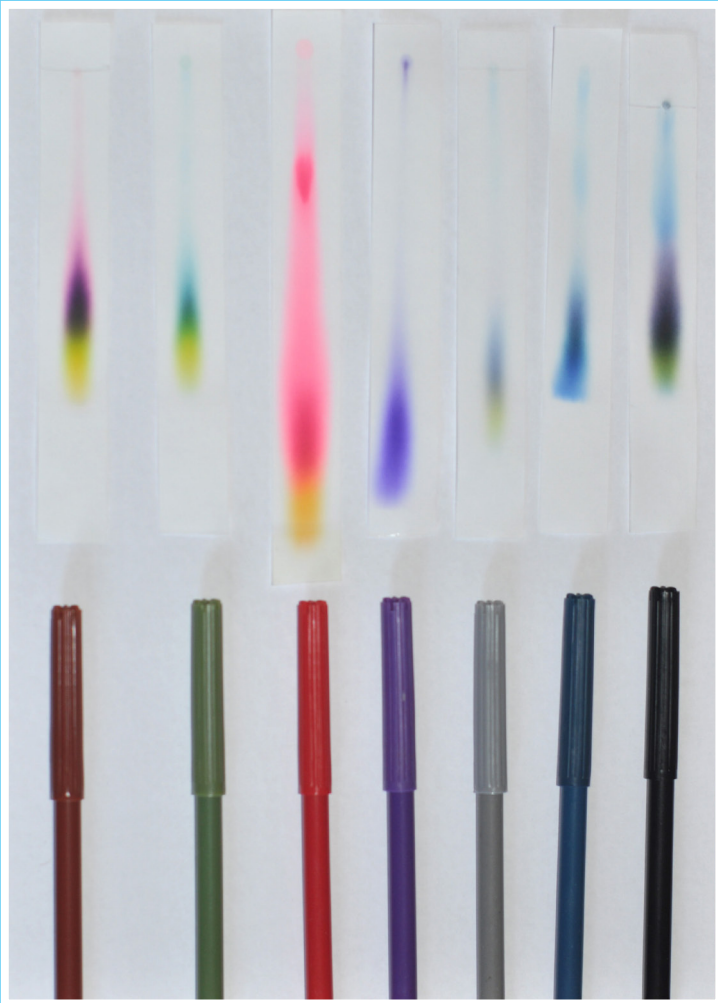
## LEARNING OBJECTIVES

Understand how our eyes work and that we see colour when receptor cells (called cones) on our eye's retina are stimulated by light.

## COMMENTS

Before performing the activity explain what an afterimage is, what cones are and how they work.

<http://unawe.org/light/3/>



## LEARNING OBJECTIVES

Learn that the black pigment (ink in this case) is actually made up of many different colours.

## COMMENTS

While exploring the chromatography, the concept of capillary action (how water moves up paper) is introduced. A similar activity is “Black Magic (Colour Chromatography)”.

<http://unawe.org/light/4/>





## LEARNING OBJECTIVES

Explore these fascinating natural phenomena with an easy-to-build model. Learn about the movement of the Sun, the Earth and the Moon and how sun light is related to them.

## COMMENTS

Adult supervision is needed for children. Introduce and explain the concept of eclipse before performing the activity.

<http://unawe.org/light/5/>



## LEARNING OBJECTIVES

Learn about the most famous constellations and build a different box for each of them.

## COMMENTS

For help see:

<https://en.wikipedia.org/wiki/Constellation>

[https://en.wikipedia.org/wiki/88\\_modern\\_constellations](https://en.wikipedia.org/wiki/88_modern_constellations)

[http://en.wikipedia.org/wiki/List\\_of\\_constellations\\_by\\_area](http://en.wikipedia.org/wiki/List_of_constellations_by_area)

<http://unawe.org/light/6/>





## LEARNING OBJECTIVES

Learn the concept of shadow and of additive colour, that is how different colours of light can interact and mix to produce various new colours and coloured shadows.

## COMMENTS

Connect with the fact that many of the current video displays use the concept of additive colour, where three different colours of light are combined in order to produce a wide range of colours. The primary colours often used are red, green, and blue (RGB).

Try to mix together also coloured pigments in order to see the differences and discuss the results and see this activity <http://www.ehow.com/ehow-mom/blog/at-home-science-color-mixing-experiment/>.



<http://unawe.org/light/7/>



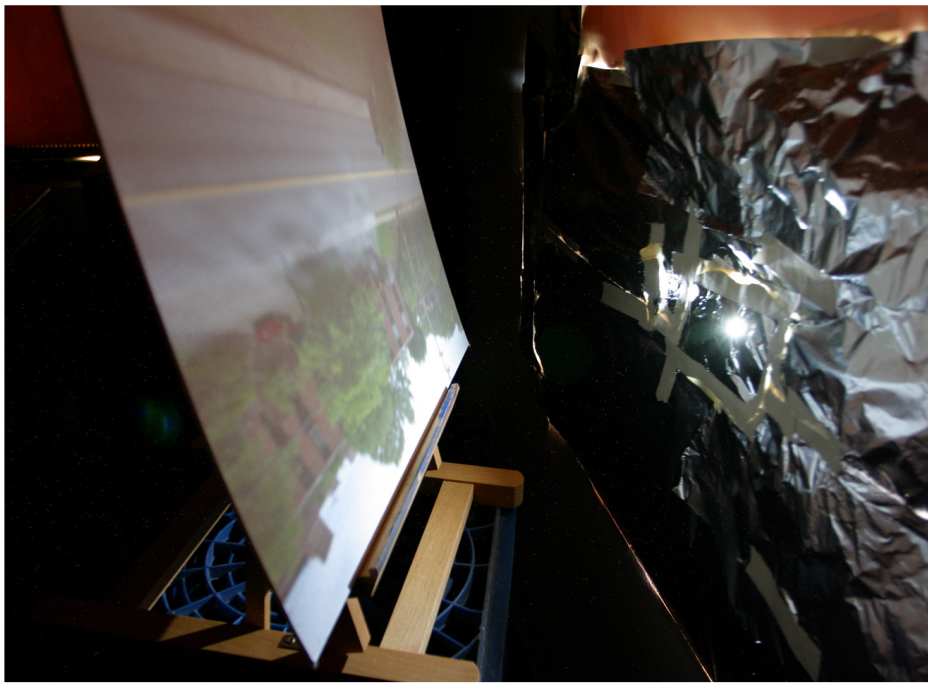
## LEARNING OBJECTIVES

Learn about the different components of the light and discover that some of them are invisible to our eyes. Prove the existence of Infrared light and detect it thanks to a webcam or camera phone.

## COMMENTS

Before doing the activity explain that white light is composed by different colours, some of them are visible and other invisible. Explain that remote controls for devices like televisions, cable boxes and DVD players typically operate in the infrared. On the front of the remote is a light emitting diode (LED) that produces light in the infrared region.

<http://unawe.org/light/8/>



## LEARNING OBJECTIVES

Construct a pinhole camera in order to learn how light behaves and how light rays pass through a small hole.

## COMMENTS

Explain that light rays move in straight line. Useful to explain how our eyes work and also on what principles photography is based.

A connection with technology can be made, see the activity "Create a Pinhole Camera".

<http://unawe.org/light/9/>





## LEARNING OBJECTIVES

Understand the law of refraction and how magnifying glasses work using a large page-magnifier lens.

## COMMENTS

**CAUTION:** Don't use the sun! The image you make can become so hot that it can burn the paper, and so bright that it can damage your eyes.

Discuss the fact that the lens creates an image that hangs in midair. Notice that the lens also creates upside-down images of distant objects and right-side-up images of nearby objects.

<http://unawe.org/light/10/>



## LEARNING OBJECTIVES

Prove the fact that many of the current video displays, newspapers and magazines use pictures made up of little dots.

## COMMENTS

Explain the concept of objects' resolution and connect with the fact that many of the current video displays use the concept of additive colour, where three different colours of light are combined in order to produce a wide range of colours. The primary colours often used are red, green, and blue (RGB).

<http://unawe.org/light/11/>



## LEARNING OBJECTIVES

Build your own sundial.

## COMMENTS

**CAUTION!** Do not look into the Sun!  
A sundial is an ancient device for measuring time by using only the sun and its shadows.

<http://unawe.org/light/12/>





## LEARNING OBJECTIVES

Understand what shadow is and explore some of the features of shadows.

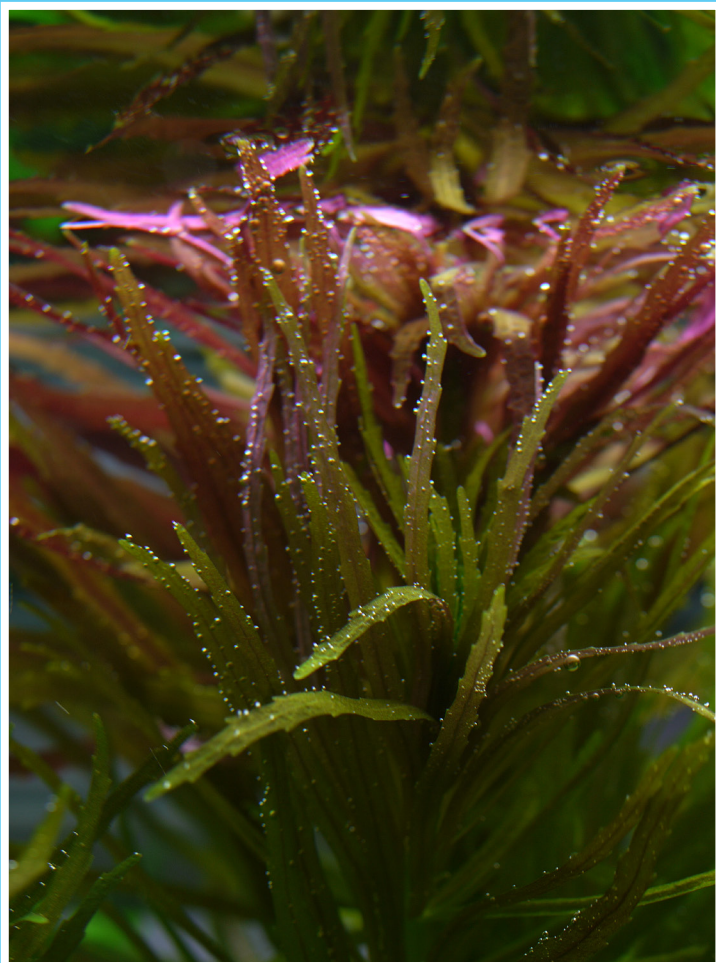
## COMMENTS

Go further in the topic discussing the use of several light sources and considering the distance of objects from the source.

<http://unawe.org/light/13/>

# Learn About Plants

## Photosynthesis Experiment 1

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### LEARNING OBJECTIVES

Oxygen bubbles: a simple experiment to understand the connection between photosynthesis and light.

### COMMENTS

This is a video, just follow the instructions and reproduce the experiment. Explain photosynthesis in advance. For help see <http://en.wikipedia.org/wiki/Photosynthesis>.

<http://unawe.org/light/14/>

# Learn About Plants

## Photosynthesis Experiment 2

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### LEARNING OBJECTIVES

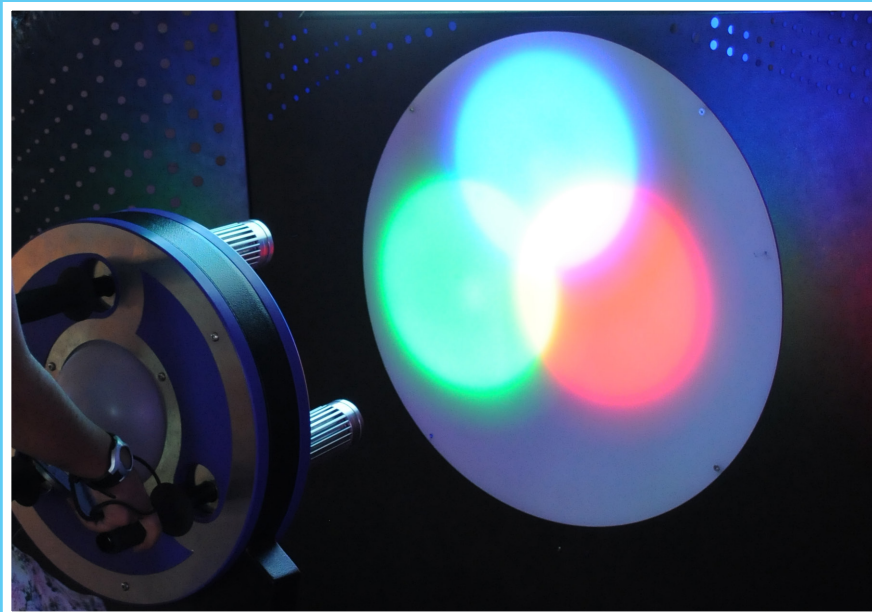
Why leaves are green: a simple experiment to understand the connection between photosynthesis and light.

### COMMENTS

This is a video, just follow the instructions and reproduce the experiment. Explain photosynthesis in advance. For help see <http://en.wikipedia.org/wiki/Photosynthesis>.

<http://unawe.org/light/15/>





# Light Mixing

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## LEARNING OBJECTIVES

Learn the concept of additive colour, which is how different colours of light can interact and mix to produce various new colours.

## COMMENTS

Connect with the fact that many of the current video displays, such as a computer monitor or television, use the concept of additive colour, where three different colours of light are combined in order to produce a wide range of colours. The primary colours often used are red, green, and blue (RGB). A potentiometer can be added into the circuit in order to control the amount of current fed into the LED.

<http://unawe.org/light/16/>



## LEARNING OBJECTIVES

Understand how different materials interact with light.

## COMMENTS

Investigate five characteristics of materials: translucency, transparency, opaqueness, reflectivity and refractivity. Explain these characteristics and the respective behaviour of light in advance.

<http://unawe.org/light/17/>



## LEARNING OBJECTIVES

Experiment with one method of detecting infrared radiation.

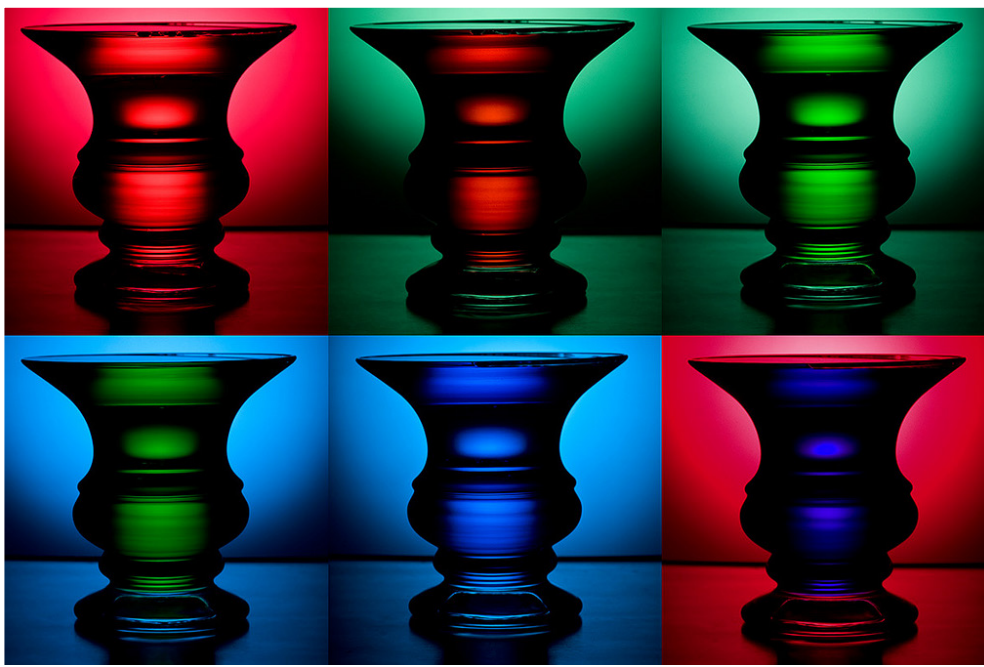
## COMMENTS

This is a simulation of infrared radiation detection using a liquid crystal sheet. Explain that infrared telescopes have a detector sensitive to infrared light. Before doing the activity explain that light is composed by different colours, some of them are visible and other invisible. It contains light from the ultraviolet, visible and infrared regions.

<http://unawe.org/light/18/>



# Make a Green Gumball Black

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## LEARNING OBJECTIVES

Understand that we see, for instance, red objects because the red light is reflected back to our eyes. All the other colours of visible light are absorbed into the object.

## COMMENTS

Analyse what happens to the objects' colours if we use coloured light (filters) instead of white light.

<http://unawe.org/light/19/>



## LEARNING OBJECTIVES

Learn how mirrors and reflection work in a simple periscope.

## COMMENTS

CAUTION! Sharp tools! Ask an adult to do all the cutting.  
Explain law of reflection and how mirrors work in advance.

<http://unawe.org/light/20/>

# Mirror, Mirror on the Wall:

## Angles of Reflection

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### LEARNING OBJECTIVES

Simple experiment with a mirror to understand how reflection works.

### COMMENTS

Introduce the concept of angle of incidence and angle of reflection. Underline the fact that light bounces off a mirror at the same angle that it arrives.

<http://unawe.org/light/21/>





## LEARNING OBJECTIVES

Make fun of your brain with a mirror.

## COMMENTS

Introduce the law of reflection before performing this activity. This activity uses the same concepts as the activity Anti-Gravity Mirror, but produces a different effect.

<http://unawe.org/light/22/>



## LEARNING OBJECTIVES

Build a shadowbox theater and shadow puppets and have fun with them.

## COMMENTS

Explain what shadow is and explore some of the features of shadows in advance.

<http://unawe.org/light/23/>



## LEARNING OBJECTIVES

Learn that the white light is composed by different colours, the colours of rainbow.

## COMMENTS

Explain that this occurs because we see the coloured light reflected by objects. In this case, the sum of rainbow's colours gives white light.

Introduce law of refraction and make connection with activities in which we see the different colours of rainbow starting from white light.



<http://unawe.org/light/24/>





## LEARNING OBJECTIVES

Learn how magnifying glasses work. Thanks to them we can use the behaviour of light to create images.

## COMMENTS

Discuss the behaviour and the properties of light in advance and explain the law of refraction.

<http://www.optics4kids.org/home/content/classroom-activities/easy/watch-tv-upside-down-on-a-piece-of-paper/>



## LEARNING OBJECTIVES

Make a lens and a magnifying glass by filling a bowl with water and use the law of refraction to focus light as in the 1700s.

## COMMENTS

Explain the law of refraction and how magnifying glasses work in advance.

<http://unawe.org/light/26/>

# What Colour is a Tomato?

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## LEARNING OBJECTIVES

Shine white and coloured light (try different colours) on several objects (tomato, orange, etc.) in order to understand how light affects the colours we see.

## COMMENTS

Explain why we see colours: the reflection and absorption of the wavelengths and the detection by our eyes of the reflected visible ones.

<http://unawe.org/light/27/>





## LEARNING OBJECTIVES

Four stations to examine light behavior: refraction, magnification, prisms and polarization.

## COMMENTS

Before doing the activity introduce the concept of wavelength and explain that light coming from the sun or white light is made up of a large range of wavelengths. It contains light from the ultraviolet, visible and infrared regions.

<http://unawe.org/light/28/>



# An Ice Lens

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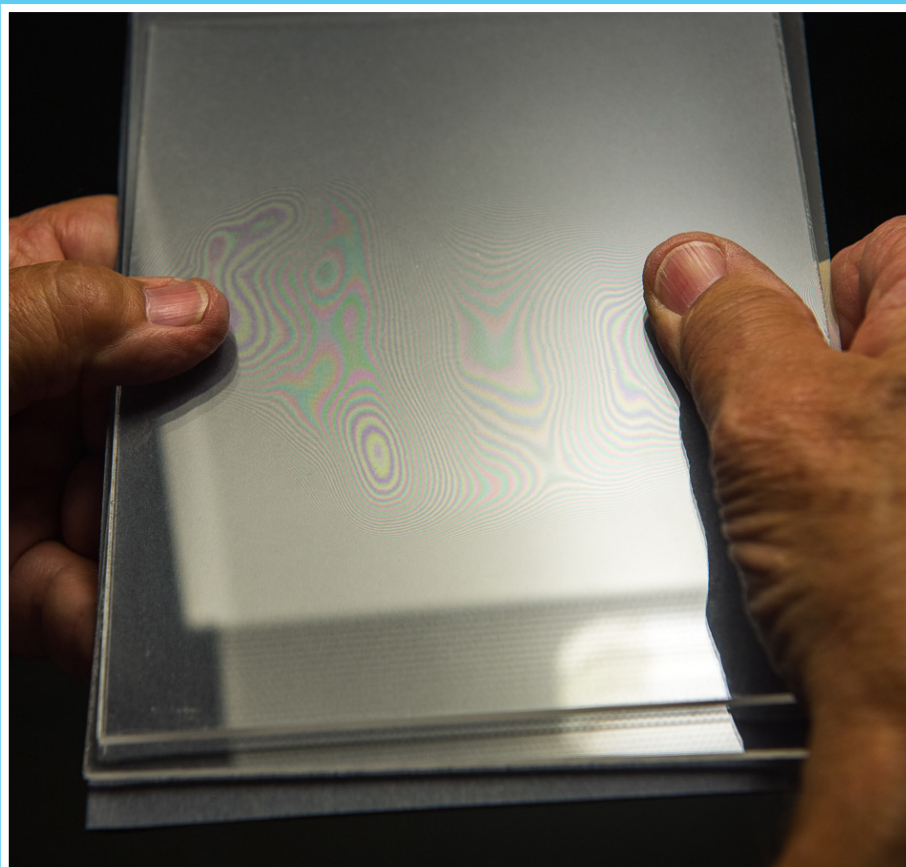
## LEARNING OBJECTIVES

Understand the basic lens-making techniques and how these affect quality of lenses.

## COMMENTS

Before constructing the ice lens explain properties of lenses and behavior of light through them.

<http://unawe.org/light/29/>



## LEARNING OBJECTIVES

Understand constructive and destructive interference of light waves producing a rainbow-coloured interference pattern.

## COMMENTS

Before doing the activity explain what a light wave is and its properties. Introduce the laws of reflection and refraction of light in connection with thin slits.

<http://unawe.org/light/30/>





## LEARNING OBJECTIVES

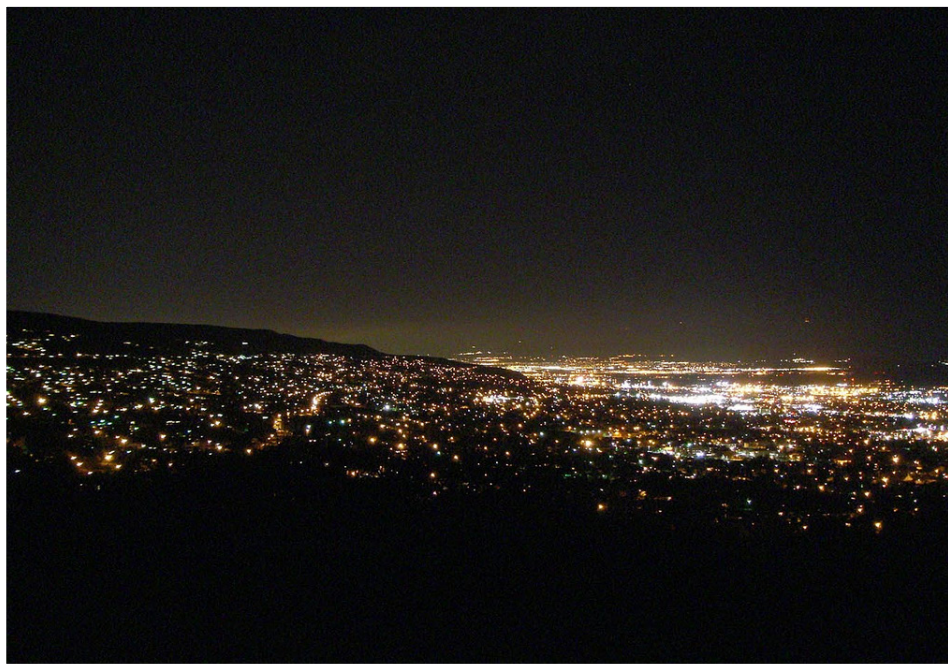
Understand the law of reflection using a corner reflector.

## COMMENTS

Explain that objects which don't give off their own light must reflect light in order to be seen.

Discuss the fact that the number of images that you see in the mirrors depends on the angle that the mirrors form. Notice that in a corner reflector, multiple reflections reverse the image and invert it.

<http://unawe.org/light/31/>



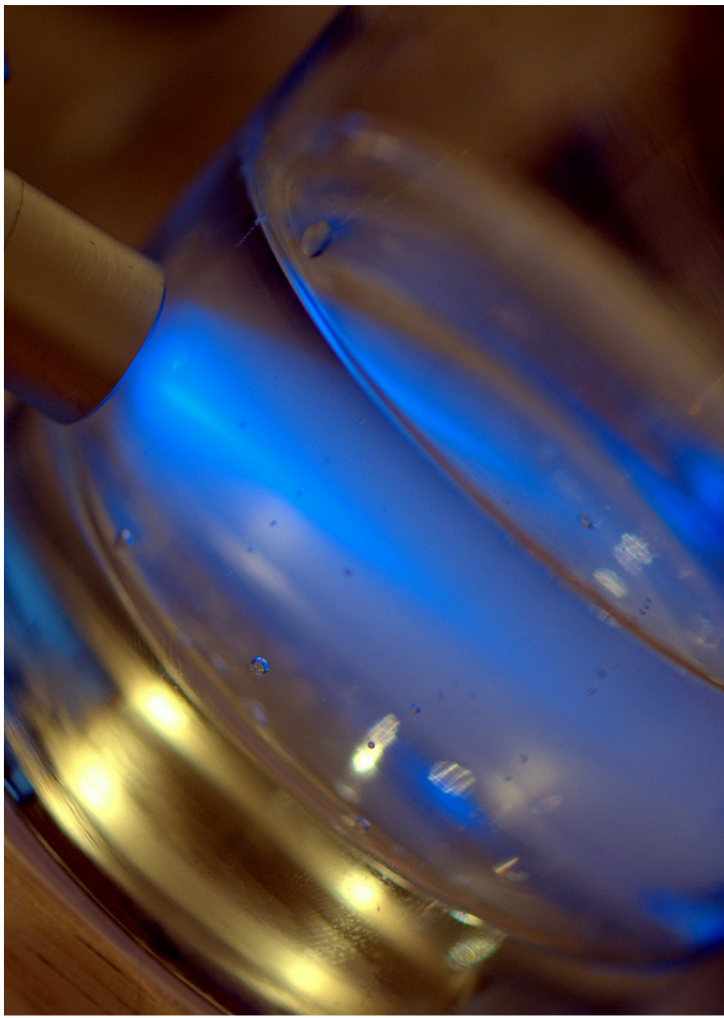
## LEARNING OBJECTIVES

To demonstrate what constitutes light pollution, by illustrating the effects ineffective lighting has on energy consumption, cost and our ability to see the stars.

## COMMENTS

This interactive demonstration illustrates the effects of lighting on our view of the night sky and how shielding can reduce light pollution while at the same time making the lighting more effective. This demonstration is best done when in a completely darkened room.

<http://unawe.org/light/32/>



## LEARNING OBJECTIVES

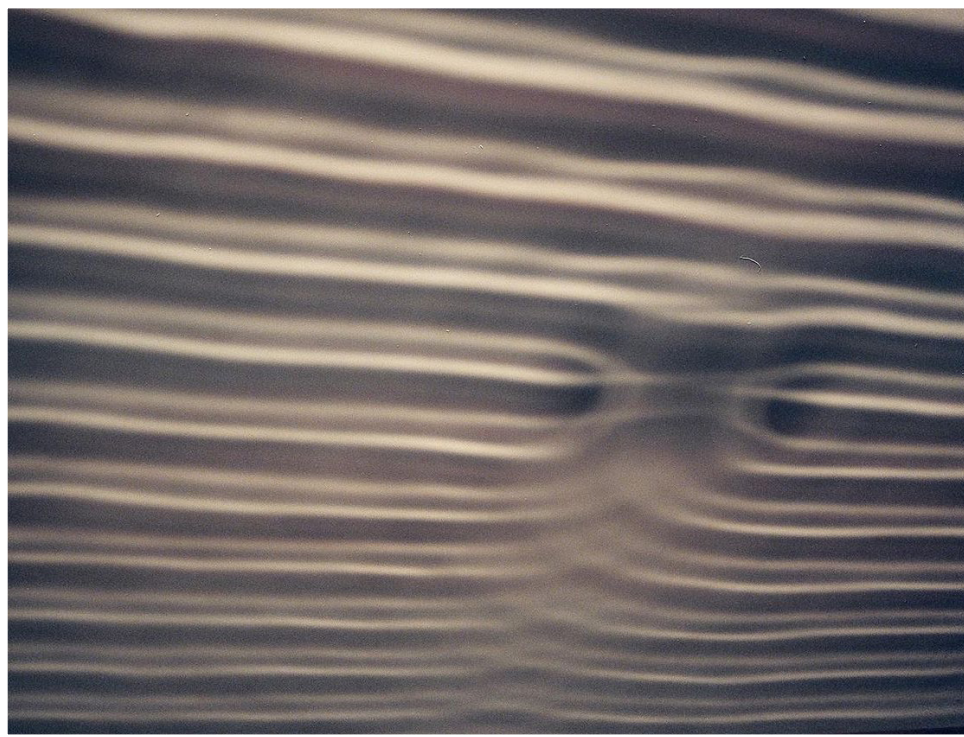
Prove the existence of ultraviolet light and understand the concept of fluorescence.

## COMMENTS

Before doing the activity introduce the concept of wavelength and explain that light coming from the sun or white light is made up of a large range of wavelengths. It contains light from the ultraviolet, visible and infrared regions.

<http://unawe.org/light/33/>





## LEARNING OBJECTIVES

Understand the diffraction of light using a Ripple Tank.

## COMMENTS

This is a simulation of light wave behaviour using waves in water. Before doing the activity introduce the concept of wavelength and explain that light is made up of several wavelengths. Possible connection with the wave-particle duality of light. If in need of help for the Ripple Tank see [http://en.wikipedia.org/wiki/Ripple\\_tank](http://en.wikipedia.org/wiki/Ripple_tank).

<http://unawe.org/light/34/>





## LEARNING OBJECTIVES

Understand the reflection of light by making multiple images of yourself.

## COMMENTS

Build a kaleidoscope and create hundreds of reflected images. Explain the law of reflection in advance. The basic kaleidoscope is a triangle, but mirror tiles can be formed into other shapes and angles as well.

<http://unawe.org/light/35/>



## LEARNING OBJECTIVES

Learn about the laws of reflection and refraction and see yourself become someone else thanks to a “two-way” mirror.

## COMMENTS

Explain the laws of reflection and refraction in advance.

<http://unawe.org/light/36/>



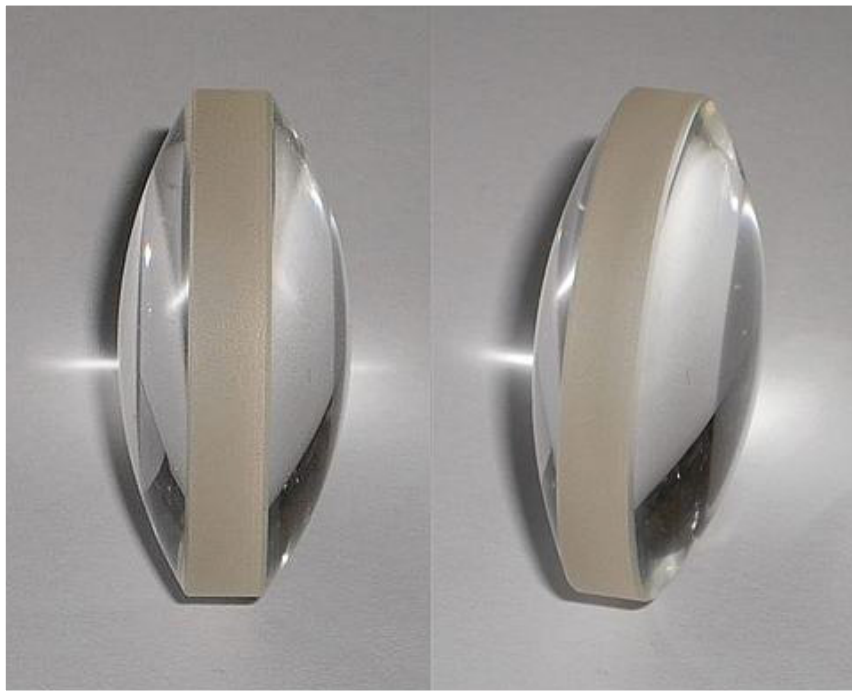
## LEARNING OBJECTIVES

Detect ultraviolet light and discover if sunscreens protect us well against it through simple experiments with ultraviolet beads, different material (glass, coloured and transparent plastic) and several sunscreen lotions.

## COMMENTS

**CAUTION!** Do not stare at the Ultraviolet light or shine it in someone's face. Before doing the activity explain that white light is composed by different colours, some of them are visible and other invisible. Explain what ultraviolet light is, that it is dangerous on our skin and why.

<http://unawe.org/light/37/>



## LEARNING OBJECTIVES

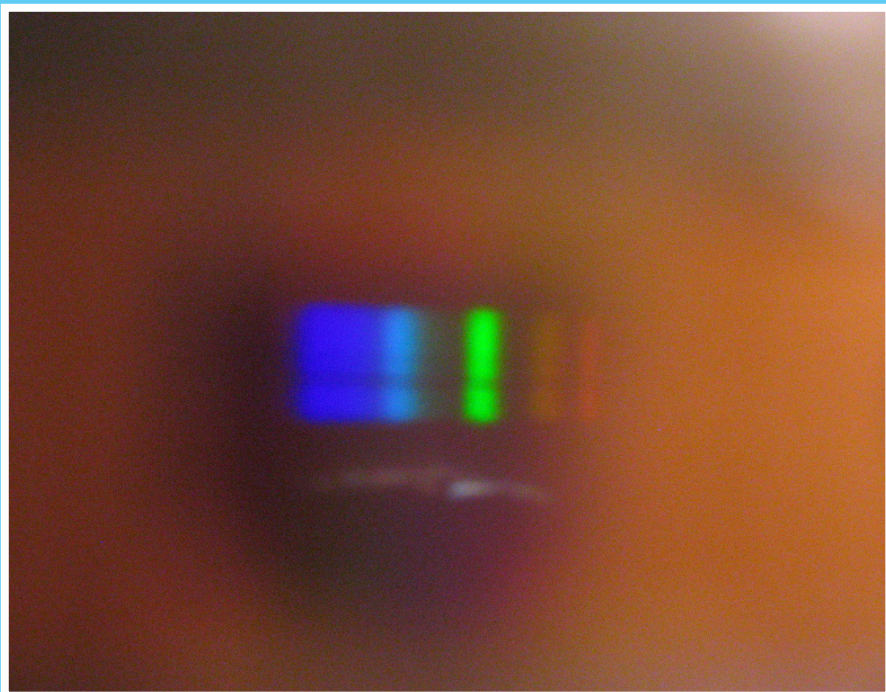
Understand how law of refraction works between different media.

## COMMENTS

CAUTION! Do not look into the laser cavity or at any reflections of the laser from shiny surfaces. Construct an "air lens" and use this and other lenses (made by glass, plastic, etc.) in air and water.

<http://unawe.org/light/38/>





## LEARNING OBJECTIVES

Construct a spectroscope in order to examine the different colours of light (the spectrum) radiated by several different sources.

## COMMENTS

CAUTION! Do not look into the laser cavity or at any reflections of the laser from shiny surfaces. Do not look into the Sun! Introduce in broader way what colours compose the light (visible and not) and explain that each colour has a different wavelength and what a wavelength is. Similar to the activity "Spectra".

<http://unawe.org/light/39/>



## LEARNING OBJECTIVES

Understand the law of refraction using laser (or a flashlight) and gelatine and learn how lenses work.

## COMMENTS

**CAUTION!** Do not look into the laser cavity or at any reflections of the laser from shiny surfaces.

Underline the connection with the concept of light that travels from air to glass and then with eyeglasses lenses. Explain that the strength of the lens depends on its shape and the material it is made of. If you have more gelatin, try different curvatures and see how the light behaves with each shape. The great thing about these simple lenses is that you can layer them to manipulate light in many ways.

<http://unawe.org/light/40/>



## LEARNING OBJECTIVES

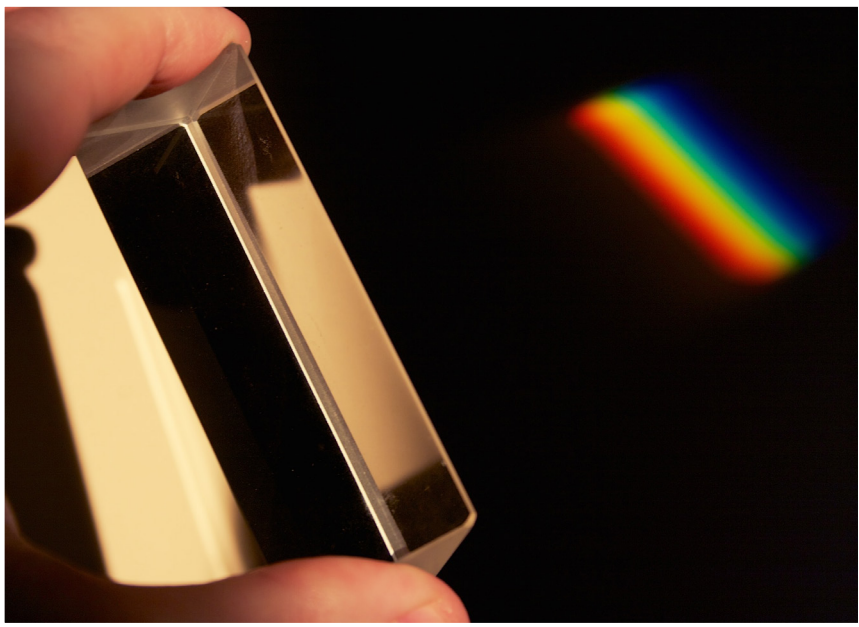
Understand that dark-coloured materials both absorb and reemit energy contained in light (visible and infrared light) more readily than light-coloured materials.

## COMMENTS

Explain the concept of light spectrum and of energy contained in light before doing the activity.

<http://unawe.org/light/41/>





## LEARNING OBJECTIVES

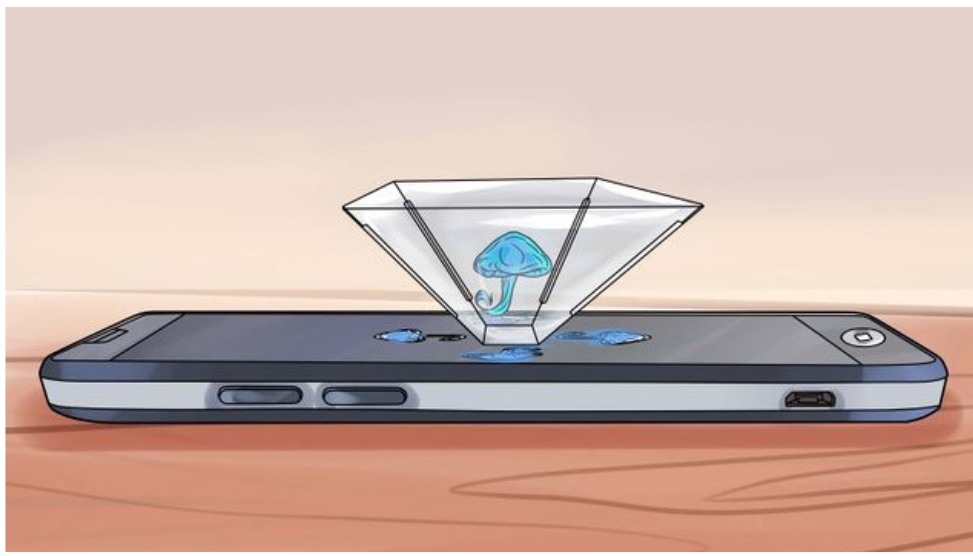
Learn that every colour (visible or invisible) which composes white light has its own temperature. From this experiment we can prove the existence of Infrared light.

## COMMENTS

Before doing the activity introduce the concept of wavelength and explain that light coming from the sun or white light is made up of a large range of wavelengths (and colours - some of them are visible and other invisible). It contains light from the ultraviolet, visible and infrared regions.

<http://unawe.org/light/42/>





## LEARNING OBJECTIVES

Learn about holography and make a 3D hologram.

## COMMENTS

**CAUTION!** Do not look into the laser cavity or at any reflections of the laser from shiny surfaces. Adult supervision is necessary!

Explain holography (with interference and diffraction) in advance.

For help and examples see:

<http://en.wikipedia.org/wiki/Holography>

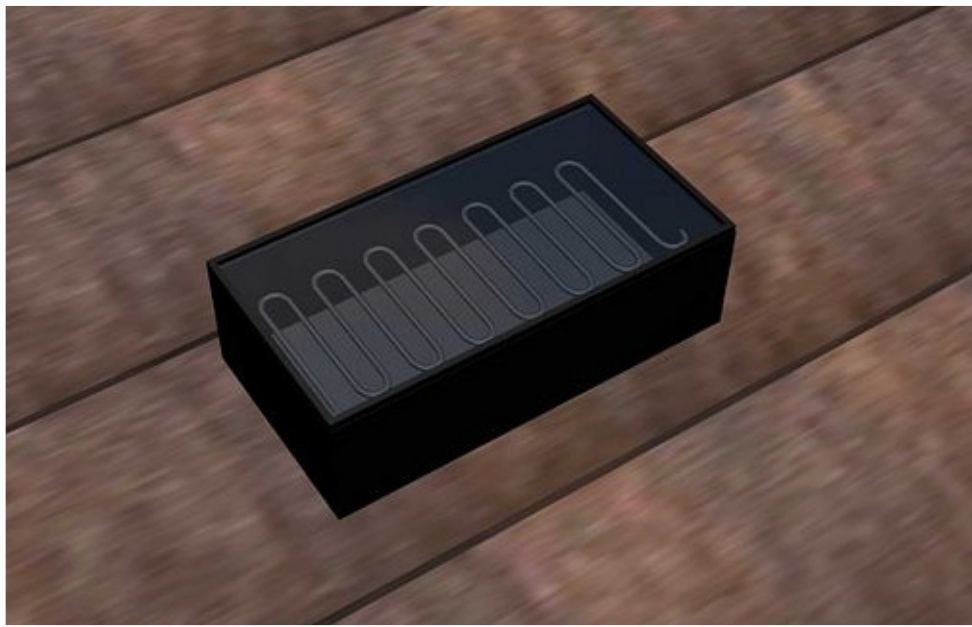
[http://kids.britannica.com/](http://kids.britannica.com/elementary/art-88729/)

[elementary/art-88729/](http://kids.britannica.com/elementary/art-88729/)

[Holography-uses-no-camera](http://kids.britannica.com/elementary/art-88729/)

[http://web.mit.edu/museum/](http://web.mit.edu/museum/collections/holography.html)  
[collections/holography.html](http://web.mit.edu/museum/collections/holography.html)

<http://unawe.org/light/43/>



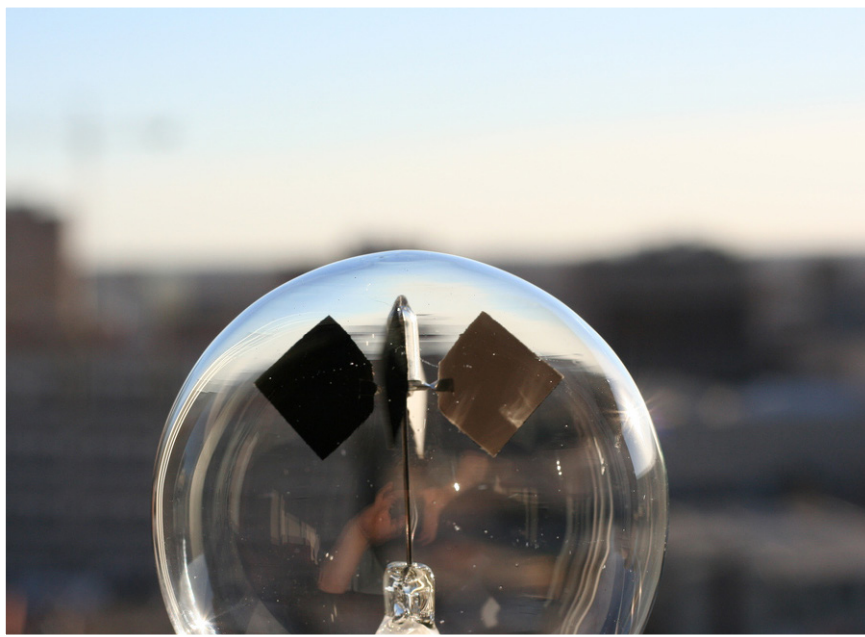
## LEARNING OBJECTIVES

Understand how light can be used to heat water and build a homemade solar collector.

## COMMENTS

For more information about solar water heating and solar collectors see:  
[https://en.wikipedia.org/wiki/Solar\\_water\\_heating](https://en.wikipedia.org/wiki/Solar_water_heating)  
[http://en.wikipedia.org/wiki/Solar\\_thermal\\_collector](http://en.wikipedia.org/wiki/Solar_thermal_collector)  
[http://www.green-the-world.net/passive\\_solar\\_water\\_heater.html](http://www.green-the-world.net/passive_solar_water_heater.html)

<http://unawe.org/light/44/>



## LEARNING OBJECTIVES

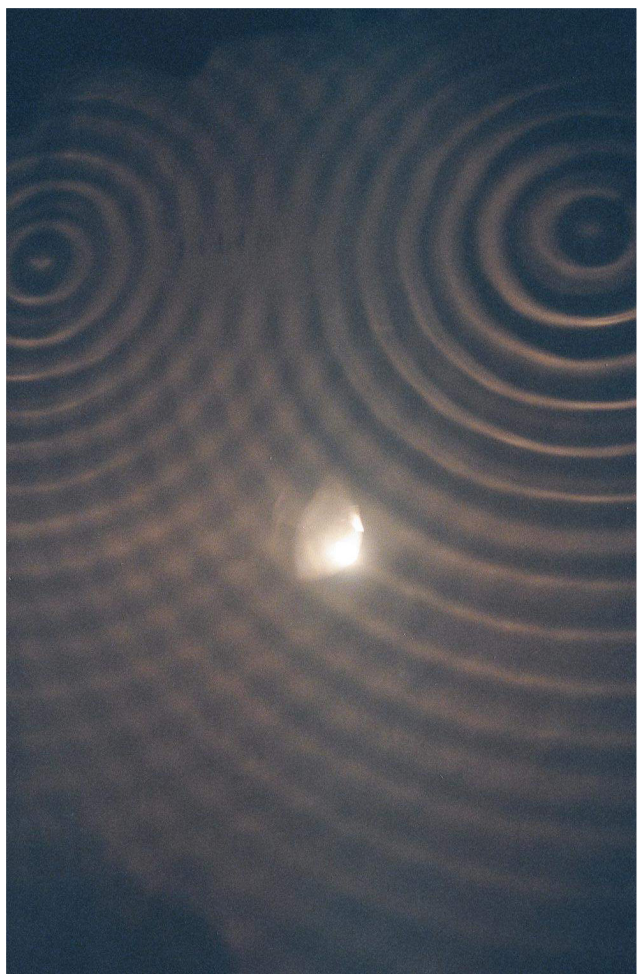
Understand how a radiometer works and build a homemade Crookes radiometer.

## COMMENTS

For more information about Crookes radiometer see:

[http://en.wikipedia.org/wiki/Crookes\\_radiometer](http://en.wikipedia.org/wiki/Crookes_radiometer)

<http://unawe.org/light/45/>



## LEARNING OBJECTIVES

Understand what happens when waves collide in a Ripple Tank and learn interference of light.

## COMMENTS

This is a simulation of light wave behaviour using waves in water. Before doing the activity introduce the concept of wavelength and explain that light is made up of several wavelengths. Possible connection with the wave-particle duality of light.

If in need of help for the Ripple Tank see [http://en.wikipedia.org/wiki/Ripple\\_tank](http://en.wikipedia.org/wiki/Ripple_tank).

<http://unawe.org/light/46/>



# Laser Target Shoot

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## LEARNING OBJECTIVES

Understand the law of reflection using laser and mirrors.

## COMMENTS

CAUTION! Do not look into the laser cavity or at any reflections of the laser from shiny surfaces.

<http://unawe.org/light/47/>



## LEARNING OBJECTIVES

Learn the refraction law of light and understand how different types of lenses work.

## COMMENTS

In this activity two kinds of lenses are discussed, convex and concave and their properties.

<http://unawe.org/light/48/>



## LEARNING OBJECTIVES

Understand the law of reflection and see how images can repeat forever.

## COMMENTS

Introduce the law of reflection before performing this activity.

<http://unawe.org/light/49/>



# Magic Wand

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## LEARNING OBJECTIVES

Understand how we see with this activity by seeing pictures in thin air thanks to a “magic wand”.

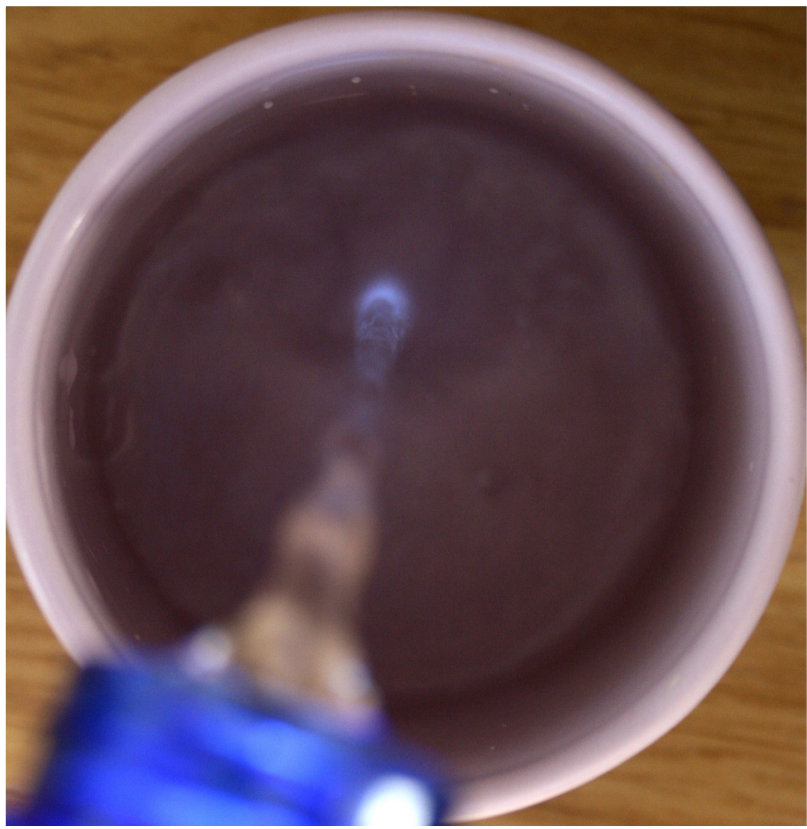
## COMMENTS

This activity will help you investigate and understand how we see.  
Explain the behaviour of light and its properties in advance. Discuss how our eyes work.

<http://unawe.org/light/50/>



# Make a Light Fountain

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## LEARNING OBJECTIVES

Understand the law of light reflection inside a stream of water.

## COMMENTS

Use this activity to illustrate total internal reflection, as well as how optical fibers work.

<http://unawe.org/light/51/>



## LEARNING OBJECTIVES

Understand the law of refraction using a cup, a coin and water.

## COMMENTS

Explain the concepts of light that travels from water to air and index of refraction. Possible connection with the wave-particle duality of light.

<http://unawe.org/light/52/>



## LEARNING OBJECTIVES

Understand law of reflection using two mirrors.

## COMMENTS

Explain that objects which don't give off their own light must reflect light in order to be seen.

Discuss relationship which combines the angle between two hinged mirrors with the number of images you see.

<http://unawe.org/light/53/>



# Parabolas

AGE  
8+

## LEARNING OBJECTIVES

Learn about the law of reflection and create an illusion, which is done with mirrors, that would do credit to any magician.

## COMMENTS

Introduce the law of reflection before performing this activity. This tool can be bought in many stores, but if you want to create your own Mirror Mirage see [http://www.exploratorium.edu/snacks/real\\_image/index.html](http://www.exploratorium.edu/snacks/real_image/index.html)

<http://unawe.org/light/54/>





# Photosynthesis

AGE  
8+

## LEARNING OBJECTIVES

Experiment to show that a plant needs light for photosynthesis.

## COMMENTS

CAUTION! It's necessary an adult supervisor to handle boiling alcohol and water.

Introduce photosynthesis in advance. For help see <http://en.wikipedia.org/wiki/Photosynthesis>.

<http://unawe.org/light/55/>



## LEARNING OBJECTIVES

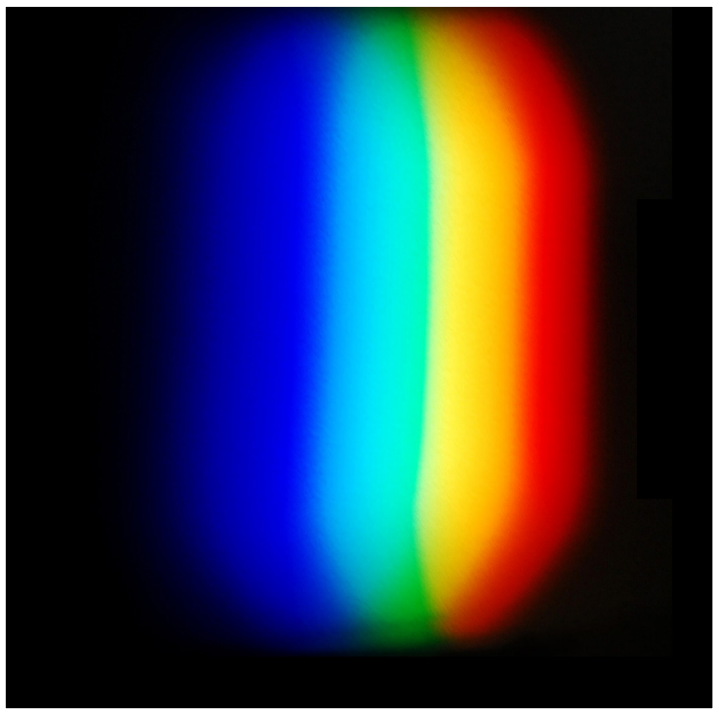
Understand through refraction's law that white light is composed by 7 different visible colours (the rainbow's colours).

## COMMENTS

Explain what wavelength is and why we usually see the light white. Remember that some wavelengths are not visible to our eyes.

Possible connection with rainbow (what is, why it forms), see also <http://en.wikipedia.org/wiki/Rainbow>.

<http://unawe.org/light/56/>



## LEARNING OBJECTIVES

Prove the existence of Ultraviolet light.

## COMMENTS

CAUTION! This experiment uses ammonia to develop blueprint paper. The ammonia should be handled by an adult only.

Before doing the activity explain that light coming from the sun or white light is composed of different colours, some of them are visible and other invisible. It contains light from the ultraviolet, visible and infrared regions.

<http://unawe.org/light/57/>



## LEARNING OBJECTIVES

Understand how shadows occur and create a sculpture that looks like a pile of trash, but finds meaning when you shine a light on it.

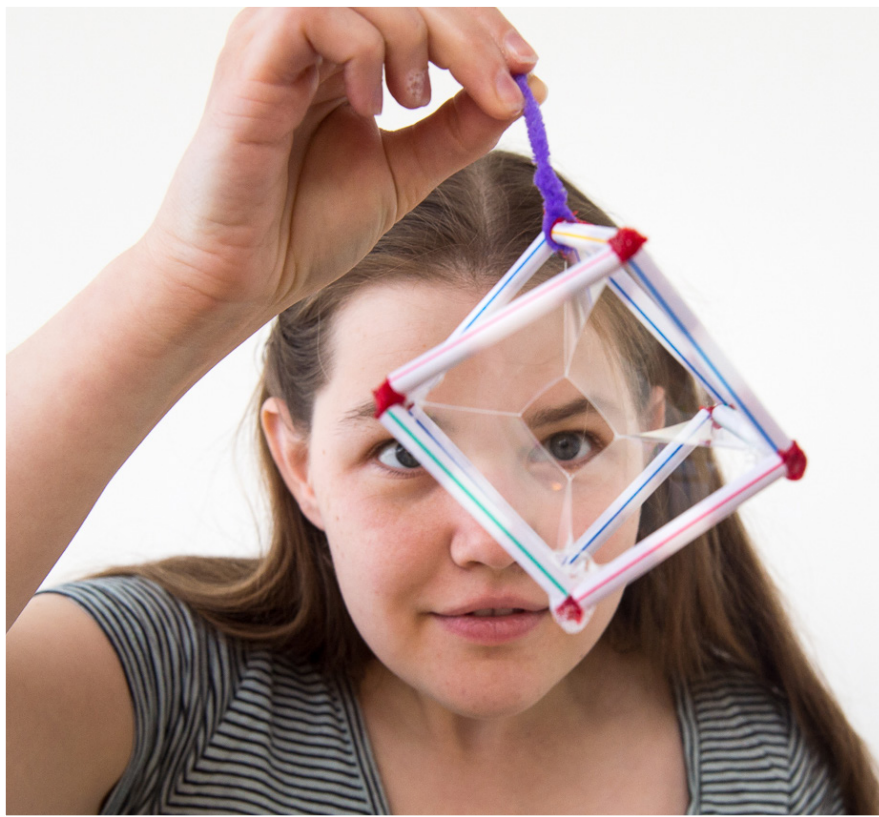
## COMMENTS

Explain how shadows occur and its properties in advance. Then follow the instructions and use your fantasy.

For examples of shadow sculpture see:  
<http://freeyork.org/art/the-art-of-shadows-by-kumi-yamashita>  
<http://www.thisismarvelous.com/i/4-Amazing-Shadow-Sculptures-by-Tim-Noble-and-Sue-Webster>

<http://unawe.org/light/58/>





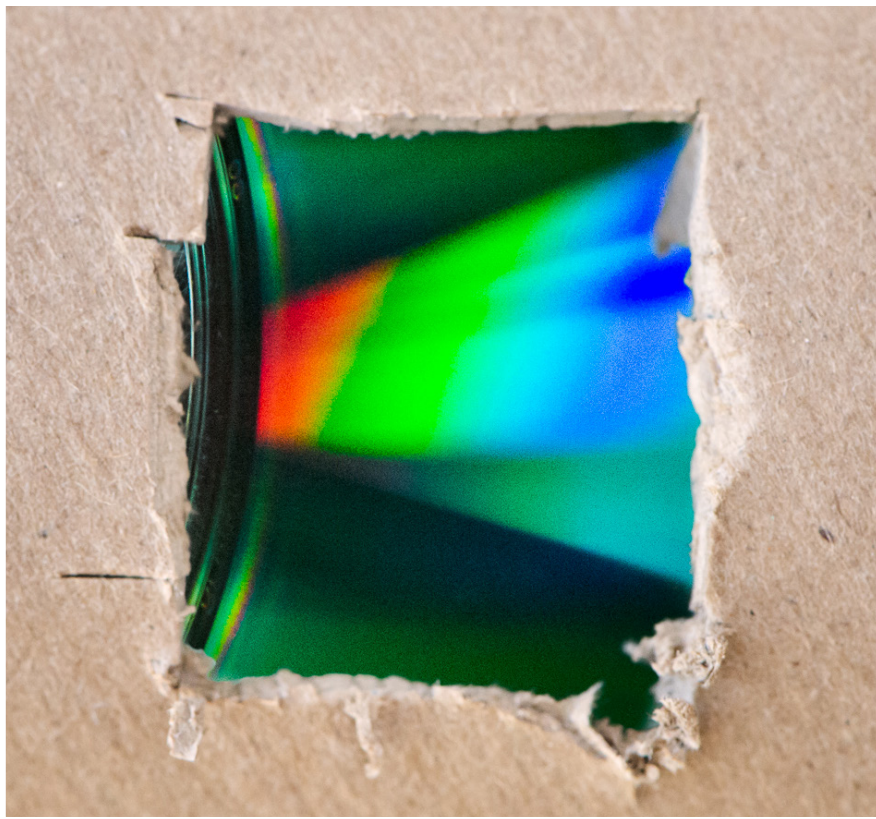
## LEARNING OBJECTIVES

Learn about the laws of reflection and refraction of light and create geometric art with soap films.

## COMMENTS

Explain the laws of reflection and refraction of light in advance and then explore what happens with thin slits (bubbles, oil slicks). For help see the activity "Why Are Bubbles So Colourful?".

<http://unawe.org/light/59/>



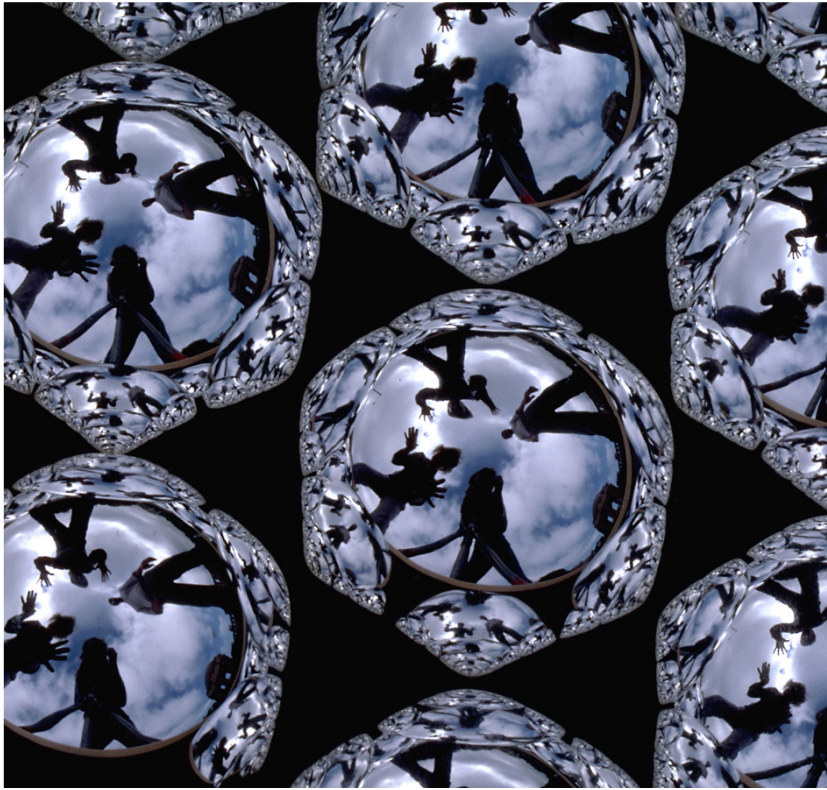
## LEARNING OBJECTIVES

Construct a spectroscope in order to examine the different colours of light (the spectrum) radiated by several different sources.

## COMMENTS

**CAUTION!** Do not look into the Sun!  
Introduce in broader way what colours compose the light (visible and not) and explain that each colour has a different wavelength and frequency and what they are.

<http://unawe.org/light/60/>



## LEARNING OBJECTIVES

Learn about the law of reflection while discovering art and science in a myriad of spherical reflections.

## COMMENTS

Study the properties of spherical mirrors creating a colourful mosaic of reflections. Explain the law of reflection in advance.

<http://unawe.org/light/61/>





## LEARNING OBJECTIVES

Understand that white light is a mixture of many colours and every colour correspond to a wavelengths. Investigate the properties of filters.

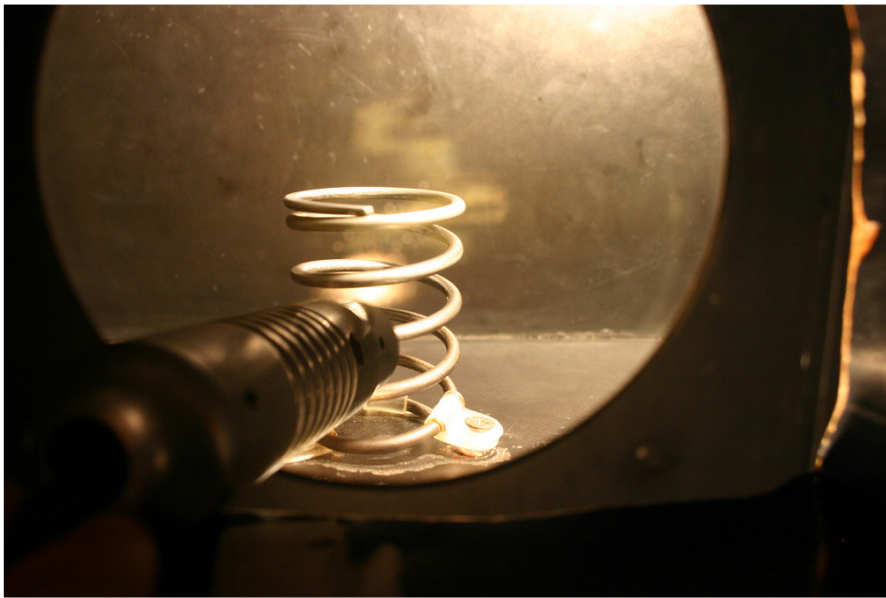
## COMMENTS

Explain the concept of light spectrum and of wavelength before doing the activity. Instead of a transmission-diffraction grating you can use a prism or piece of a CD with the shiny label removed.

<http://unawe.org/light/62/>



# Touch the Spring

AGE  
8+

## LEARNING OBJECTIVES

Understand the law of reflection. You can see the light bulb, but you can't touch it. This is a magician's illusion at its finest.

## COMMENTS

Introduce the law of reflection before performing this activity.

<http://unawe.org/light/63/>



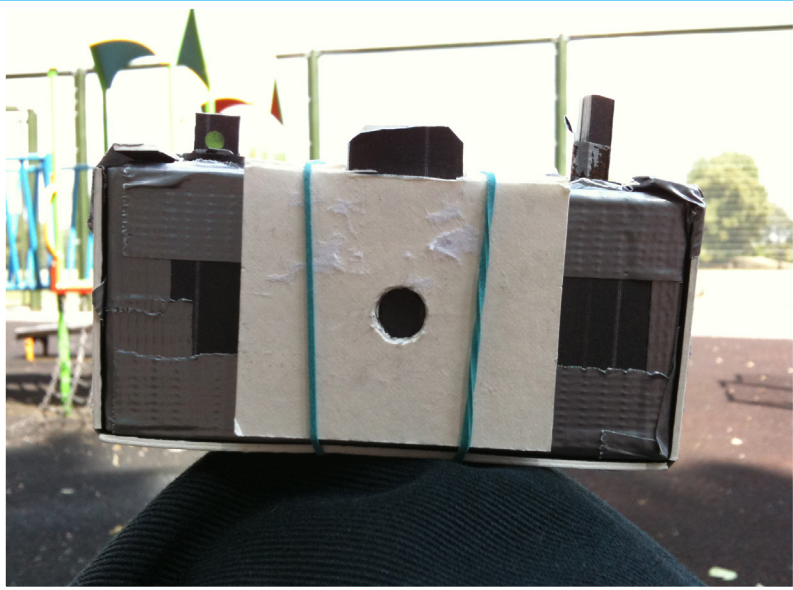
## LEARNING OBJECTIVES

Understand laws of reflection and refraction of light in connection with thin slits.

## COMMENTS

Explain the laws of reflection and refraction of light in advance and then explore what happens with thin slits (bubbles, oil slicks).

<http://unawe.org/light/64/>



## LEARNING OBJECTIVES

Understand how light rays travel in straight lines and how they are used in the processing of images.

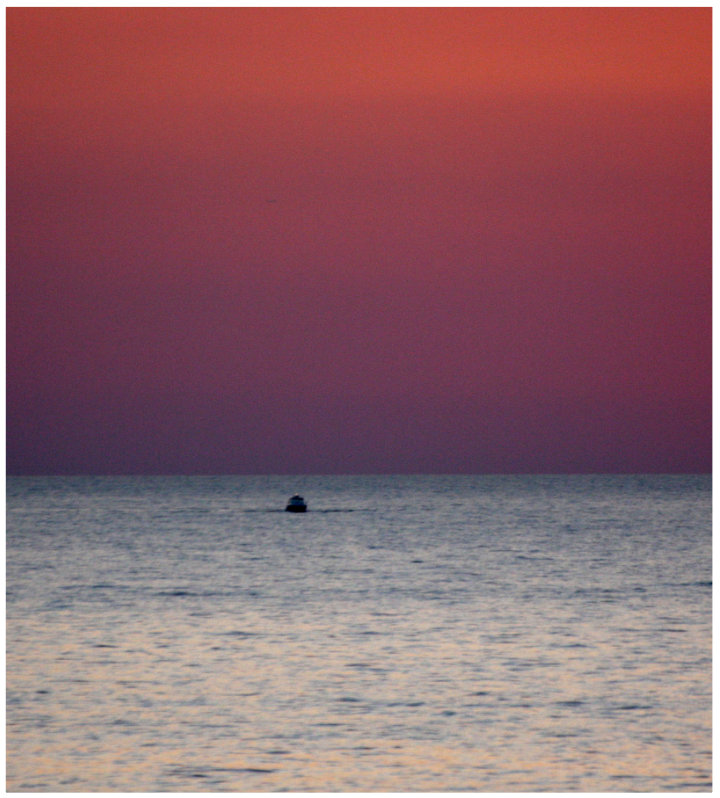
Build a pinhole camera and use light rays and their properties to create photographic images.

## COMMENTS

Before doing the activity explain that light travels in straight lines and is inverted when it passes through a small hole.

It could be also helpful introduce the concepts of longitudinal and transverse waves, wavelength and amplitude, frequency and electromagnetic waves.

<http://unawe.org/light/65/>



## LEARNING OBJECTIVES

Simple experiment to learn why the sky is blue and the sun is red at sunset.

## COMMENTS

Explain in a simple way what scattering is and why different colours of light are scattered by different amounts.

<http://unawe.org/light/66/>





## LEARNING OBJECTIVES

Build an effective microscope using simple materials.

## COMMENTS

Adult supervision is necessary.  
Introduce the concepts of focal length  
and lens before doing the activity.  
Here you can find a similar microscope  
[http://brunelleschi.imss.fi.it/esplora/  
microscopio/dswmedia/risorse/how\\_to\\_  
make\\_microscope.pdf](http://brunelleschi.imss.fi.it/esplora/microscopio/dswmedia/risorse/how_to_make_microscope.pdf)

<http://unawe.org/light/67/>



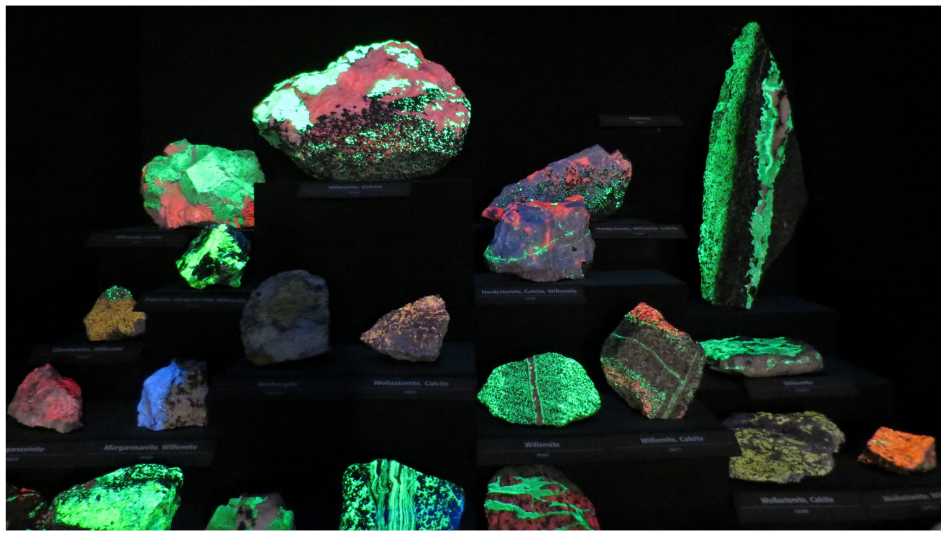
## LEARNING OBJECTIVES

Simple experiment to understand what the index of refraction is and demonstrate its role in our ability to differentiate the appearance of different materials and see transparent things.

## COMMENTS

Explain (demonstrating with laser if possible) that traveling from air to glass or viceversa (see also Activity "Exploring Refraction (Gelatin Optics)"), part of light is reflected because of the difference in the index of refraction. This is why we see transparent things.

For this activity CAUTION! Adult supervision is recommended because it involves paint thinner. Instead of paint thinner you can use vegetable oil.



## LEARNING OBJECTIVES

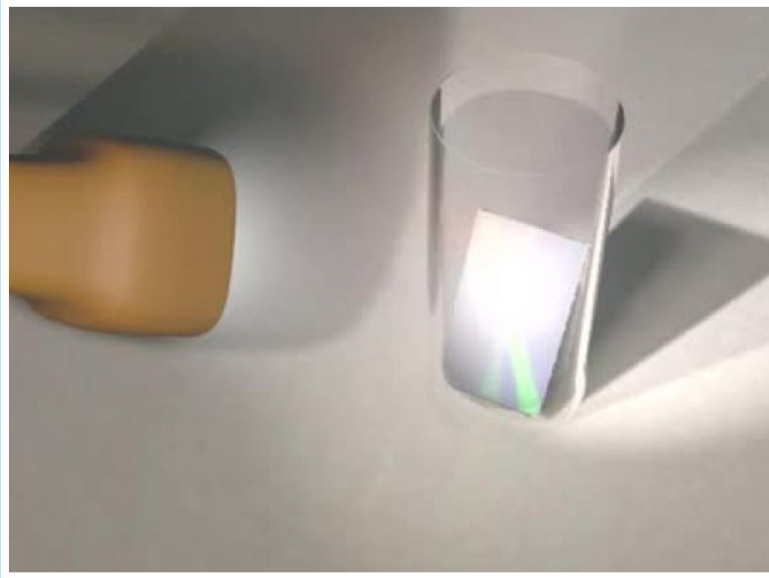
Understand the difference between fluorescence and phosphorescence lighting up different materials (which have these properties) with Ultraviolet flashlight, coloured LED lights and laser beam light.

## COMMENTS

CAUTION! Do not stare at the Ultraviolet light or shine it in someone's face.

<http://unawe.org/light/69/>

# 70



## Exploring Light: Absorb, Reflect, Transmit or Refract?

AGE  
10+

### LEARNING OBJECTIVES

Explore light's properties of absorption, reflection, transmission and refraction through various experimental stations within the classroom.

### COMMENTS

Explain light properties and the laws of refraction, reflection, absorption and transmission in advance.

<http://unawe.org/light/70/>



# How Light Pollution Affects the Stars: Magnitude Readers

AGE  
10+

## LEARNING OBJECTIVES

Determine how light pollution affects the visibility of stars and understand the meaning of “limiting magnitude” by using a Magnitude Reader.

## COMMENTS

Explain in advance the concept of magnitude and what constellations are. This activity involves direct observation of a constellation. Introduce the chosen constellation with related mythology and teach how to find the constellation in the night sky.

<http://unawe.org/light/71/>



## LEARNING OBJECTIVES

Build an analemmatic sundial. With link for the mathematical detailed version for 16+ students.

## COMMENTS

For children, adult supervision is needed.

Here you can find the Analemmatic Sundial Generator <http://analemmatic.sourceforge.net/cgi-bin/sundial.pl> and few more websites that can help you to build this or other sundials:  
<http://www.eaae-astronomy.org/WG3-SS/WorkShops/Sundials.html>  
[http://www.mysundial.ca/sdu/sdu\\_horizontal\\_analemmatic\\_sundial.html](http://www.mysundial.ca/sdu/sdu_horizontal_analemmatic_sundial.html)

This is the complete mathematical detailed version with the theory of analemmatic sundials, suitable for 16+ students:  
<http://plus.maths.org/content/analemmatic-sundials-how-build-one-and-why-they-work>

<http://unawe.org/light/72/>

# Make a Refractor Telescope

AGE  
10+

## LEARNING OBJECTIVES

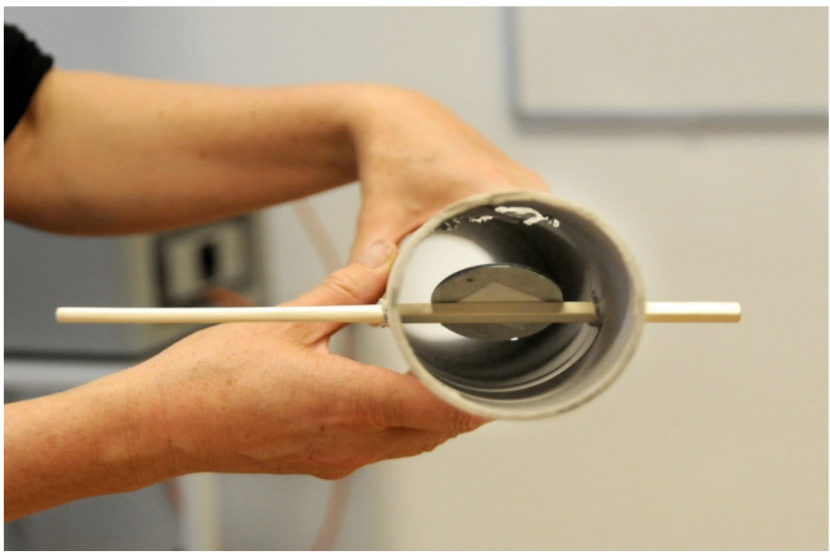
Learn how lenses and refraction work in a simple telescope.

## COMMENTS

This activity demonstrates how to make and use a simple refractor telescope, similar to the first one. Introduce the concepts of focal length of a lens before doing the activity.

<http://unawe.org/light/73/>

# Make a Reflective Telescope

AGE  
10+

## LEARNING OBJECTIVES

Learn how mirrors and reflection work in a simple telescope.

## COMMENTS

This activity demonstrates how to make and use a simple reflective telescope. Introduce the concepts of focal length before doing the activity.

<http://unawe.org/light/74/>





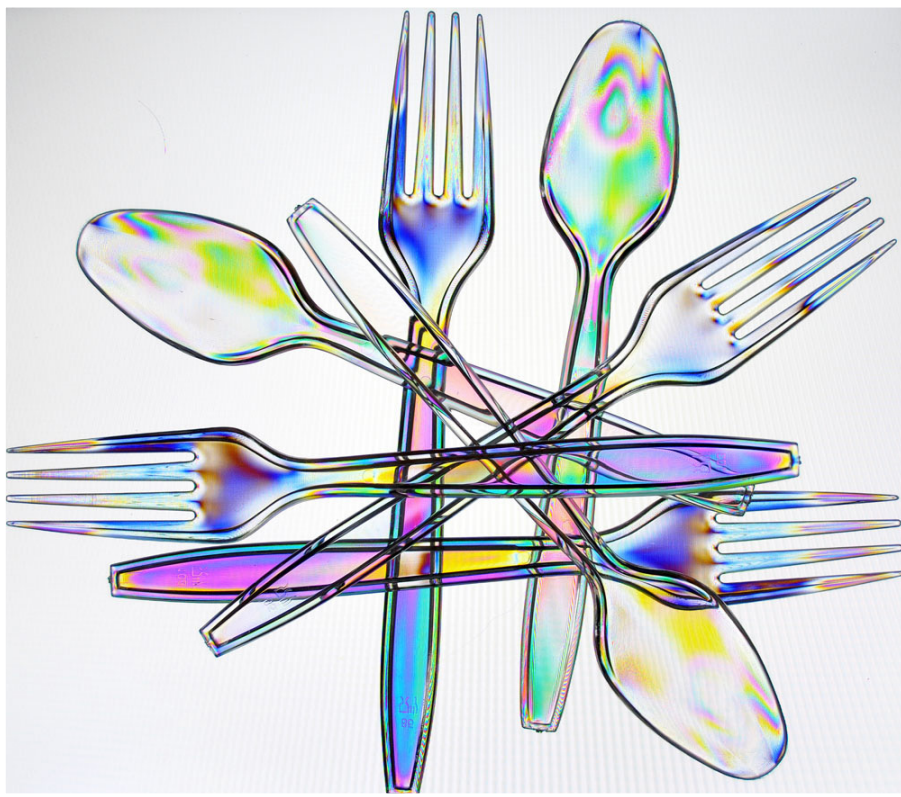
## LEARNING OBJECTIVES

Turn your mobile into a piece of expert kit using a block of wood and a laser pointer.

## COMMENTS

Adult supervision and help is **NECESSARY** for the assembly of the rig. Introduce the concept of lens in advance. For help see also the video [https://www.youtube.com/watch?v=KpMTkr\\_aiYU](https://www.youtube.com/watch?v=KpMTkr_aiYU)

<http://unawe.org/light/75/>



## LEARNING OBJECTIVES

Learn what polarization of light is and its properties using two polarizers.

## COMMENTS

Light scattering from molecules and applications of polarization (eyeglasses, insects' sight, art, photography) can be also explained during this activity.

<http://unawe.org/light/76/>



## LEARNING OBJECTIVES

A simple exercise and knowledge about diffraction in order to learn the Rayleigh's Criterion and understand objects' resolution.

## COMMENTS

Connection with art, television images, magazine images. Furthermore Rayleigh's criterion also applies to the lenses of instruments such microscopes and telescopes.

<http://unawe.org/light/77/>





## LEARNING OBJECTIVES

Simple experiment to learn what Rayleigh scattering is and understand why the sky is blue and the sun is red at sunset.

## COMMENTS

A connection can be made with Activity “Exploring polarization” and go more in depth with the analysis of light properties.

<http://unawe.org/light/78/>





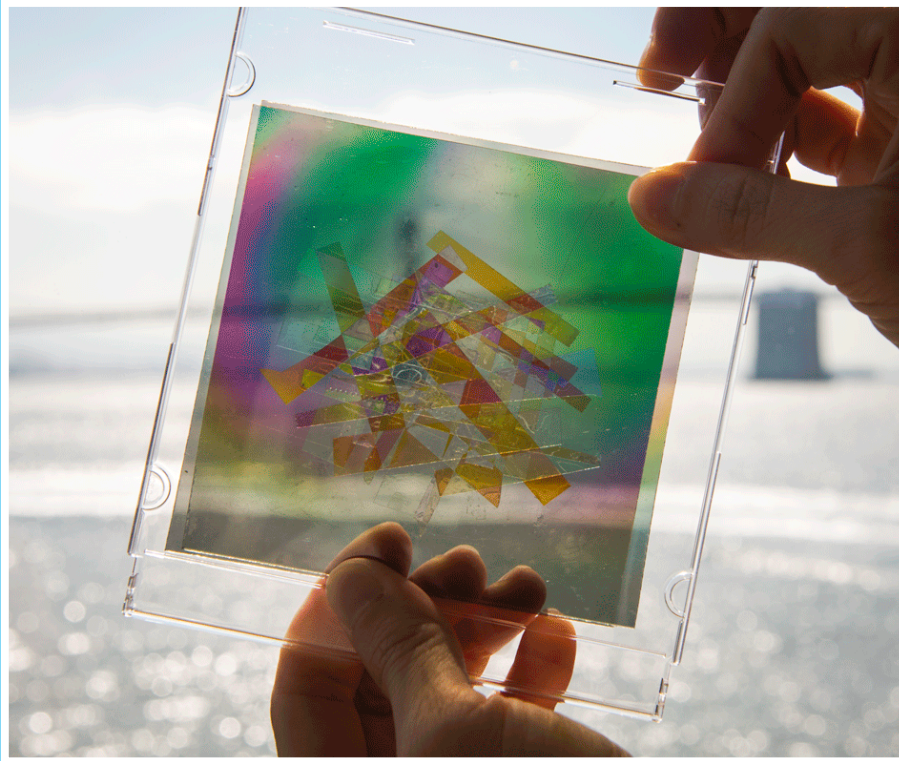
## LEARNING OBJECTIVES

Understand how anaglyph 3D works and build a pair of 3D glasses.

## COMMENTS

For information about anaglyph 3D and stereoscopy see [http://en.wikipedia.org/wiki/Anaglyph\\_3D](http://en.wikipedia.org/wiki/Anaglyph_3D); <http://en.wikipedia.org/wiki/Stereoscopy>. You can use your 3D glasses to watch video like this <https://www.youtube.com/watch?v=2Lh0dSRqH4E> or 3D movies.

<http://unawe.org/light/79/>



## LEARNING OBJECTIVES

Understand what polarized light is and use it to make colourful pictures.

## COMMENTS

Introduce light polarization and its properties before performing this activity, use the activities “Exploring Polarization” and “Polarized Sunglasses” as help.

<http://unawe.org/light/80/>



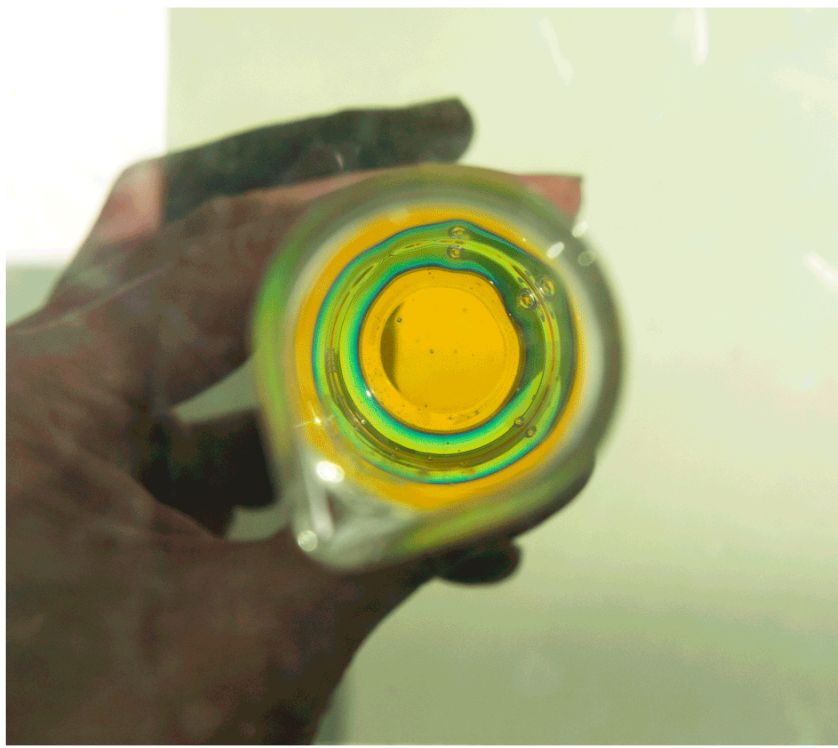
## LEARNING OBJECTIVES

Understand what polarization of light is and how polarized sunglasses work.

## COMMENTS

Introduce light polarization and its properties before performing this activity, use Activity “Exploring Polarization” as help.

<http://unawe.org/light/81/>



## LEARNING OBJECTIVES

Understand what polarization of light is and introduce its properties by passing it through sugar, water “rotates” to reveal beautiful colours.

## COMMENTS

Before performing the activity introduce the concept of wavelength and explain that light coming from the sun or white light is made up of a large range of wavelengths. Finally introduce light polarization and its properties.

<http://unawe.org/light/82/>





## LEARNING OBJECTIVES

Learn about light polarization and its properties and construct a magic box with a wall with no resistance inside it thanks to light and polarization.

## COMMENTS

Introduce light polarization and its properties before performing this activity, use “Exploring Polarization” as help.

<http://unawe.org/light/83/>



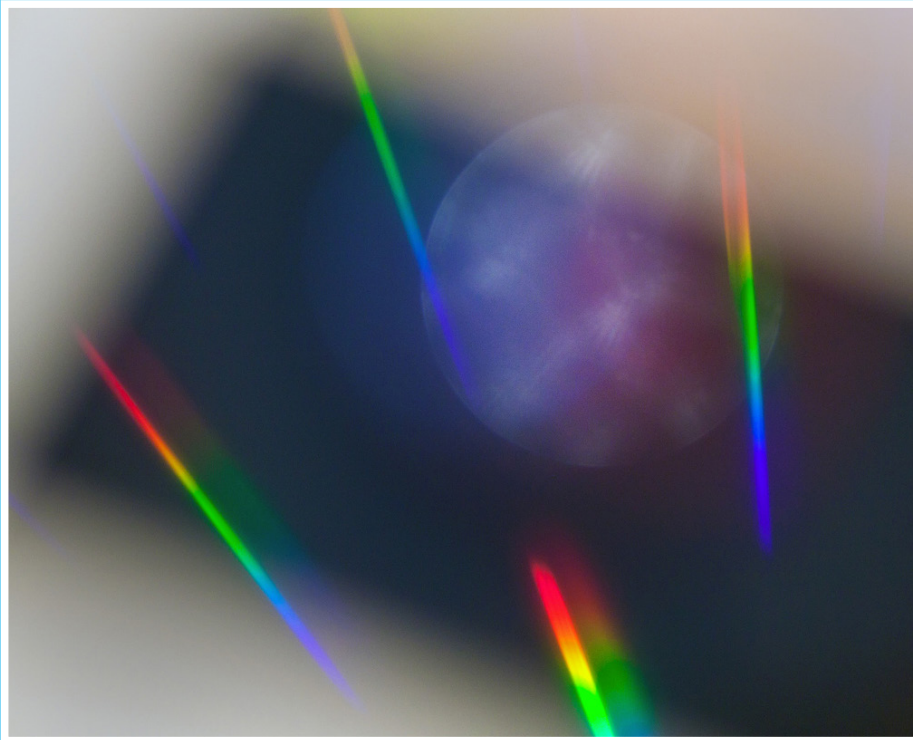
## LEARNING OBJECTIVES

Create and decorate your own spectrographs in order to examine the spectrum of light.

## COMMENTS

**CAUTION!** Do not look into the Sun!  
Explain the difference between absorption and emission spectrum. Instead of a transmission-diffraction grating you can use a piece of a CD with the shiny label removed.

<http://unawe.org/light/84/>



## LEARNING OBJECTIVES

Learn the law of refraction using an open spectrograph to calculate the angle light is bent when it passes through a diffraction grating.

Use the Pythagorean Theorem to size a spectrograph prototype.

## COMMENTS

**CAUTION!** Do not look into the Sun!

Instead of a diffraction grating you can use a piece of a CD with the shiny label removed. It could be helpful to perform the activity "Building a Fancy Spectrograph" in advance.

<http://unawe.org/light/85/>



## LEARNING OBJECTIVES

Determining the Earth's circumference using shadows and maths.

## COMMENTS

Calculate Earth's circumference using shadows, angles and maths.

<http://unawe.org/light/86/>





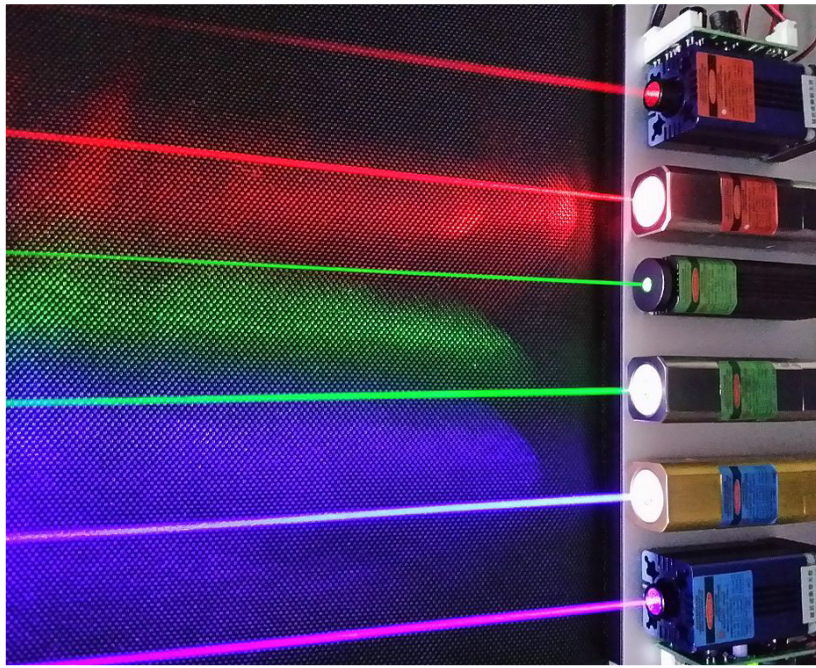
## LEARNING OBJECTIVES

Identify why some light bulbs are more efficient (more light with less energy) than others.

## COMMENTS

Discuss the fact that in a light bulb, electromagnetic energy (electricity) is converted into heat and light, which is also an electromagnetic form of energy. Introduce these concepts in advance.

<http://unawe.org/light/87/>



## LEARNING OBJECTIVES

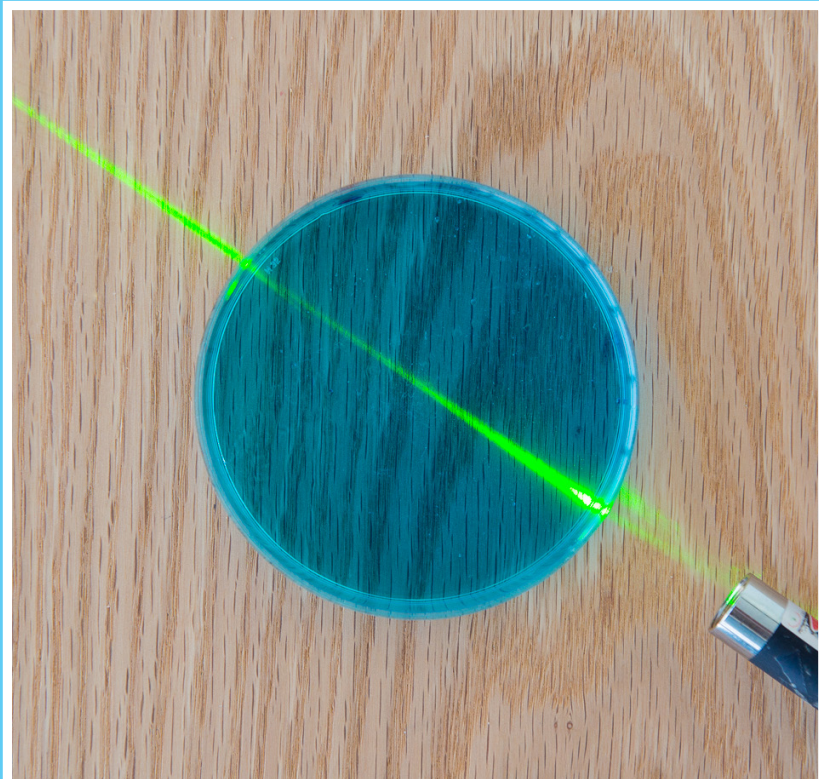
Learn the properties of laser beams and the differences between flashlight and laser (divergence, diffraction and colours, coherence) through simple experiments. Predict the size of a laser beam with calculation (optional).

## COMMENTS

**CAUTION!** Do not look into the laser cavity or at any reflections of the laser from shiny surfaces.

The optional maths part is for students aged 15+.

<http://unawe.org/light/88/>



# Laser Jello

AGE  
13+

## LEARNING OBJECTIVES

Understand the laws of reflection and refraction using laser and gelatin.

## COMMENTS

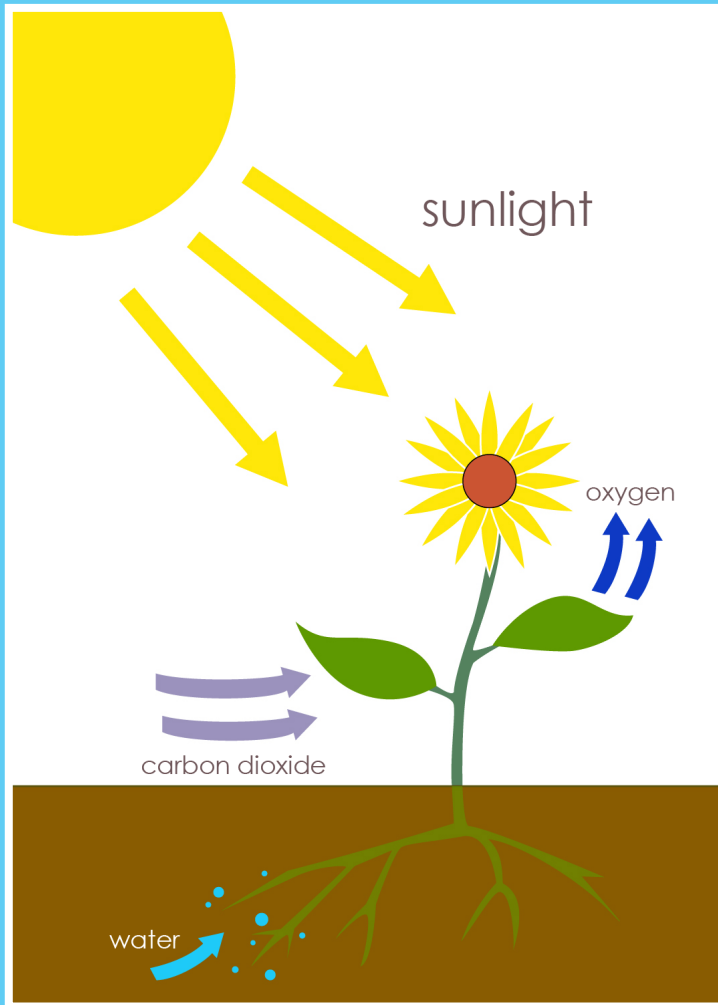
CAUTION! Do not look into the laser cavity or at any reflections of the laser from shiny surfaces.

Use gelatin as a smoked lens, to view total internal reflection and as a colour filter. Introduce the concept of wavelength, what colour filters are and explain how lenses work.

<http://unawe.org/light/89/>

# The Floating Leaf Disk Assay

for Investigating Photosynthesis



## LEARNING OBJECTIVES

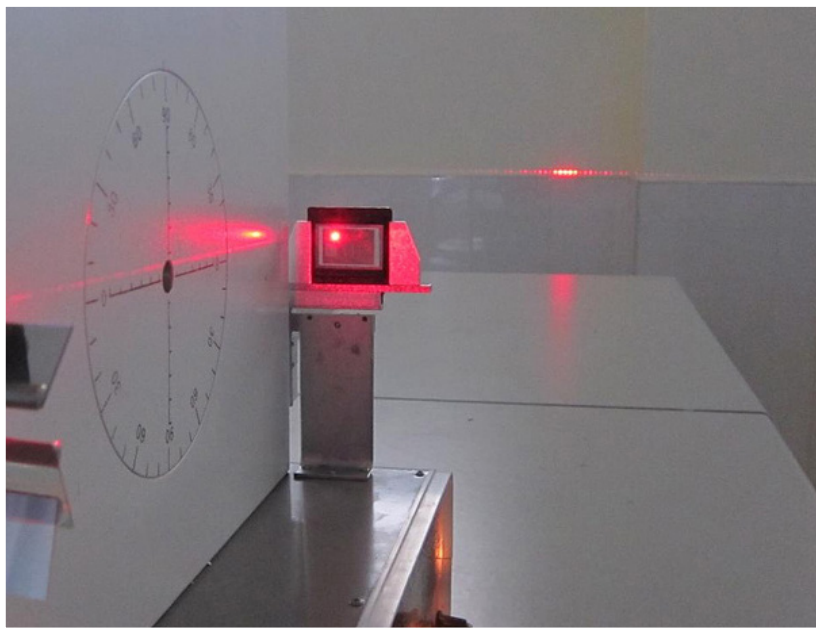
Quantitative procedure that can be used for exploring photosynthesis and its connection with light.

## COMMENTS

Students must be familiar with the technique they can readily design experiments to answer their own questions about photosynthesis. Explain photosynthesis in advance. For help see <http://en.wikipedia.org/wiki/Photosynthesis>.

<http://unawe.org/light/90/>





## LEARNING OBJECTIVES

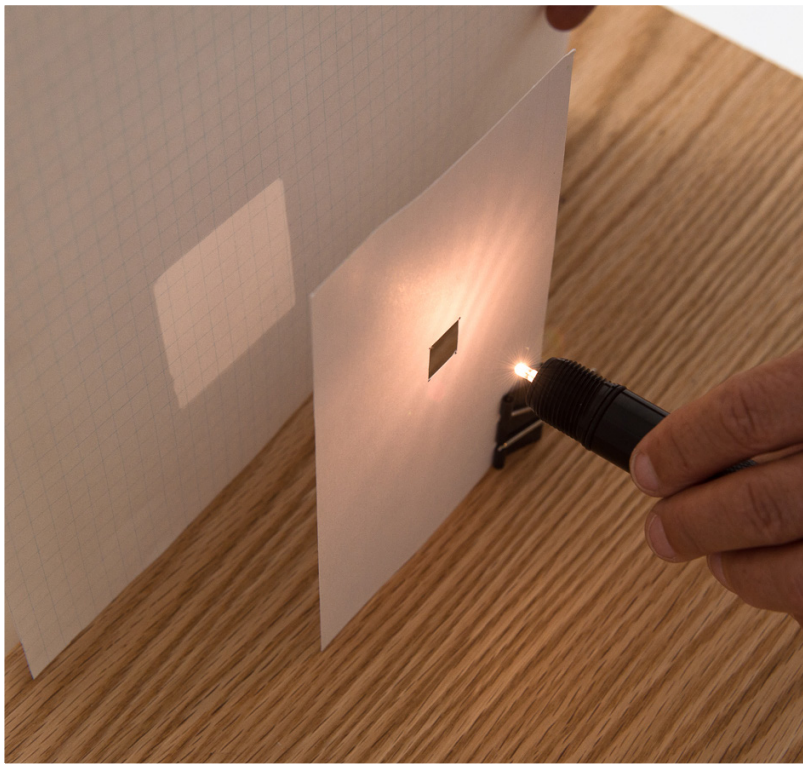
Understand the diffraction of light using laser and a hair.

## COMMENTS

**CAUTION!** Do not look into the laser cavity or at any reflections of the laser from shiny surfaces.

Through few calculations and thanks to diffraction of light you can measure the thickness of your hair. Without the maths, diffraction can be also explained and shown to younger students.

<http://unawe.org/light/91/>



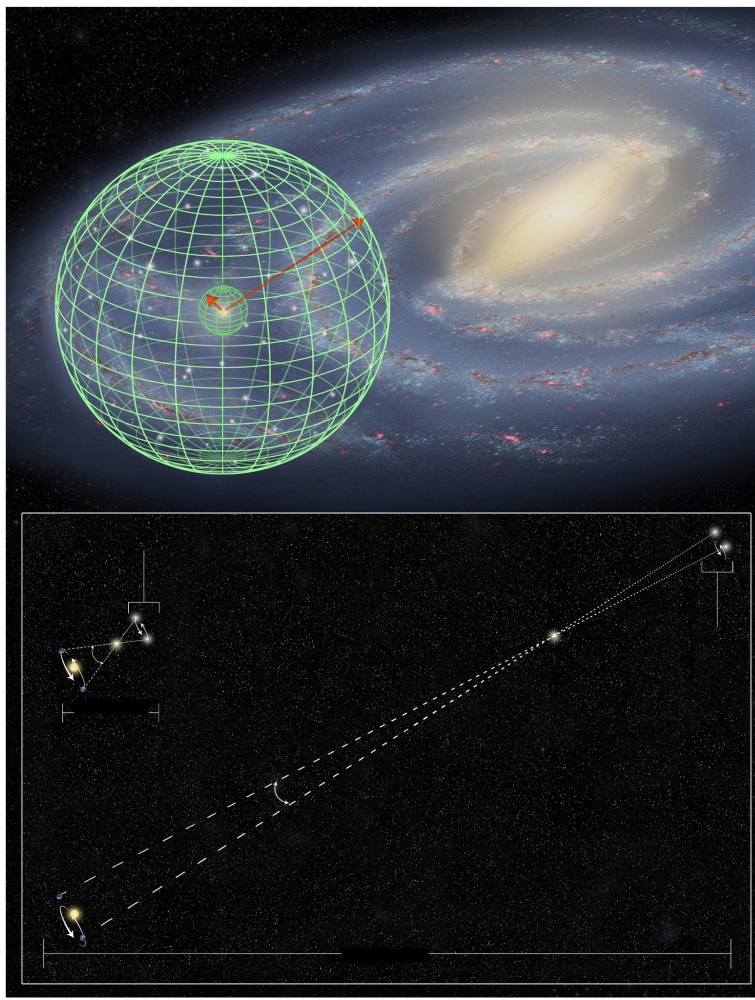
## LEARNING OBJECTIVES

Understand the inverse-square law that relates the light's intensity to the distance from the light's source.

## COMMENTS

Before doing the activity explain the relation between the illuminated area and the intensity of light and what intensity is. Use proper maths calculations to support your explanation. For help see [http://en.wikipedia.org/wiki/Inverse-square\\_law](http://en.wikipedia.org/wiki/Inverse-square_law)

<http://unawe.org/light/92/>



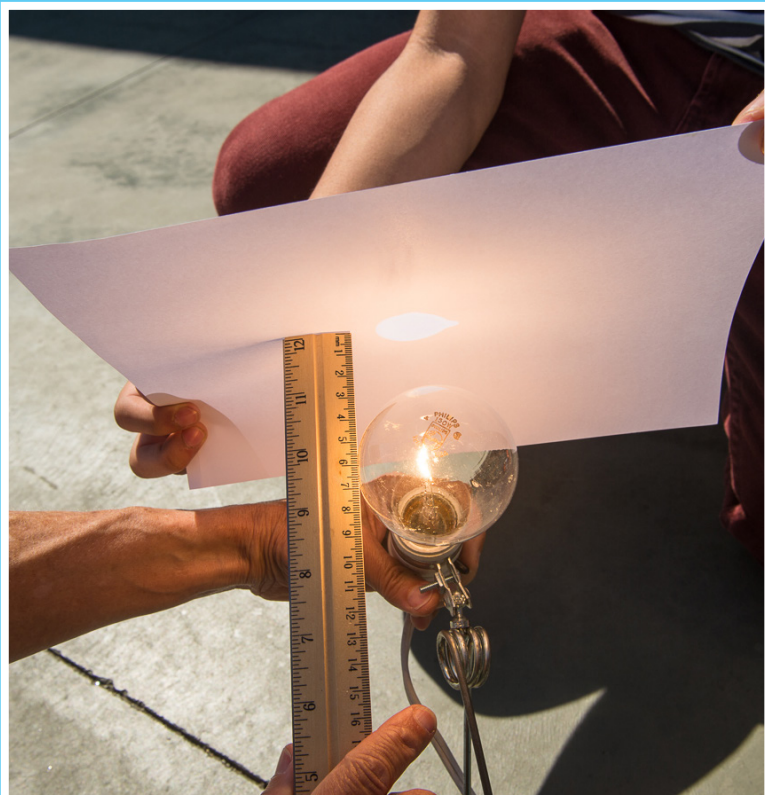
## LEARNING OBJECTIVES

Understand what parallax is and how to use it to calculate distances.

## COMMENTS

This series of activities will help you to understand how distances in the universe can be measured by the parallax method.

<http://unawe.org/light/93/>



## LEARNING OBJECTIVES

Estimate the power output of the sun using a simple handmade photometer.

## COMMENTS

Before performing the activity introduce the inverse-square law with the proper maths calculations. See the activity "Inverse Square Law".

<http://unawe.org/light/94/>





## LEARNING OBJECTIVES

Understand how in space massive objects bend light like lenses.

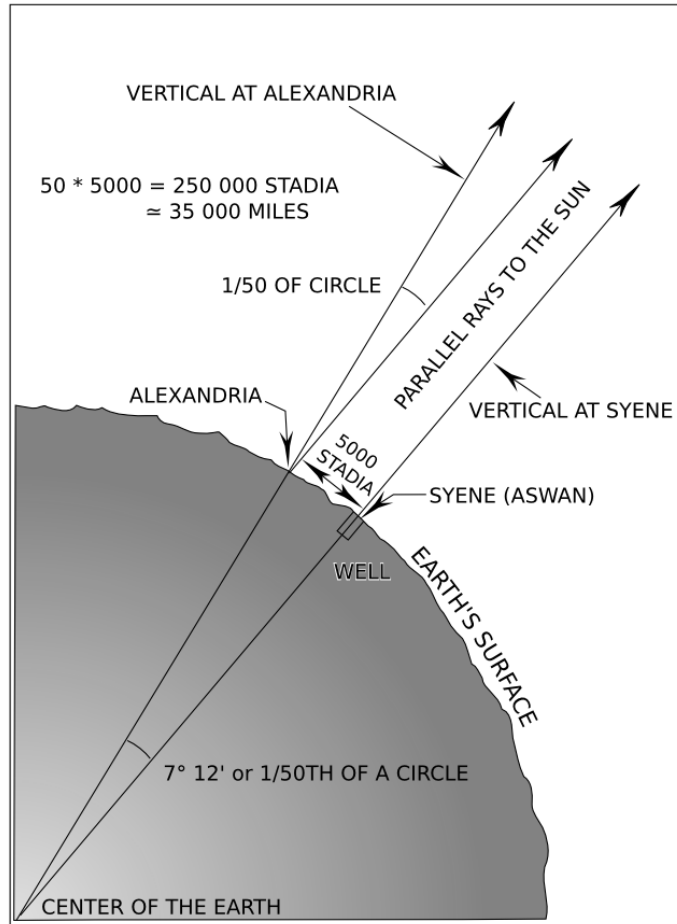
## COMMENTS

This workshop presents the theory of gravitational lenses, what they are and how they work. The more interesting activities related to the topic are “Experience3” and “Experience 4” on pages 6-9.

From page 11 you can find the geometrical approach and numerical examples which are suited for 18+ students.

These are two simple videos that can help:  
<https://www.youtube.com/watch?v=2Vf3cz0B37w>  
<https://www.youtube.com/watch?v=vLp6CwEIGP4>

<http://unawe.org/light/95/>

ERATOSTHENES METHOD FOR DETERMINING  
THE SIZE OF THE EARTH

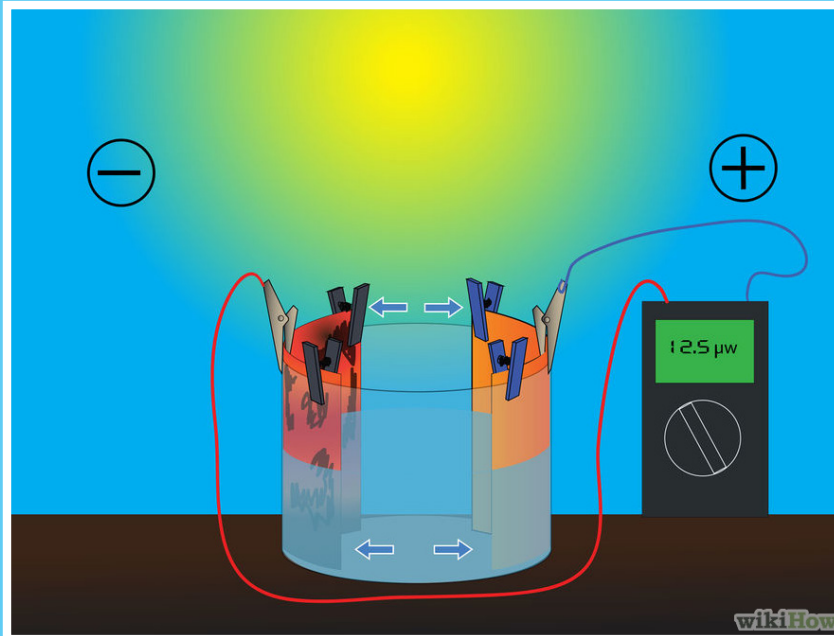
## LEARNING OBJECTIVES

Determining the Earth circumference using shadows and maths.

## COMMENTS

Calculate longitude and latitude of a place using shadows, angles and trigonometry.

<http://unawe.org/light/96/>



## LEARNING OBJECTIVES

Understand how light can be converted into electrical current and build a homemade solar cell.

## COMMENTS

CAUTION! Adult supervision is necessary to use the burner.

For more information about photovoltaic effect and solar cells see:

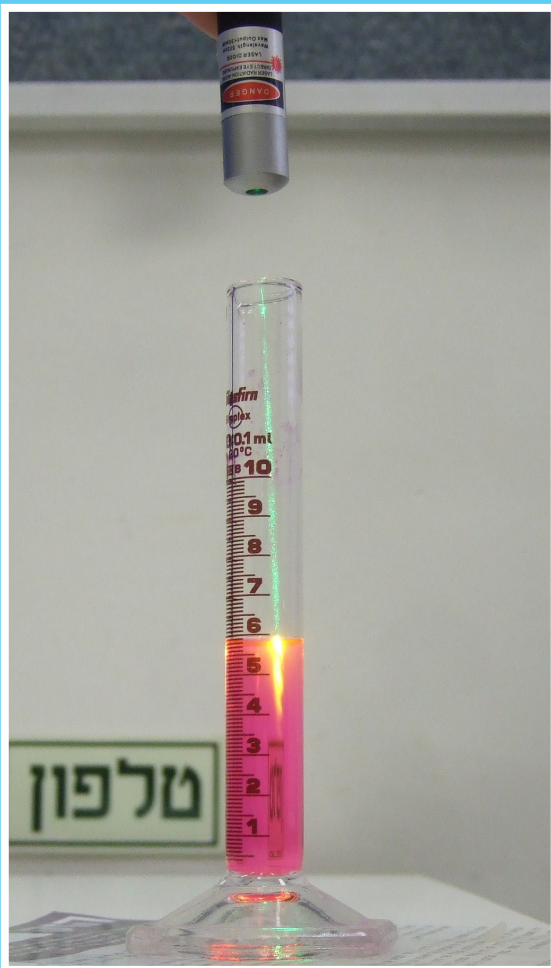
<http://en.wikipedia.org/wiki/Photovoltaics>

[http://en.wikipedia.org/wiki/Theory\\_of\\_solar\\_cell](http://en.wikipedia.org/wiki/Theory_of_solar_cell)

[http://en.wikipedia.org/wiki/Solar\\_cell](http://en.wikipedia.org/wiki/Solar_cell)

Here you can find an explanatory video: <https://www.youtube.com/watch?v=g5Edw99PgZQ>

<http://unawe.org/light/97/>



## LEARNING OBJECTIVES

Understand the Beer's law and derive the relationship between light and number of layer of attenuation.

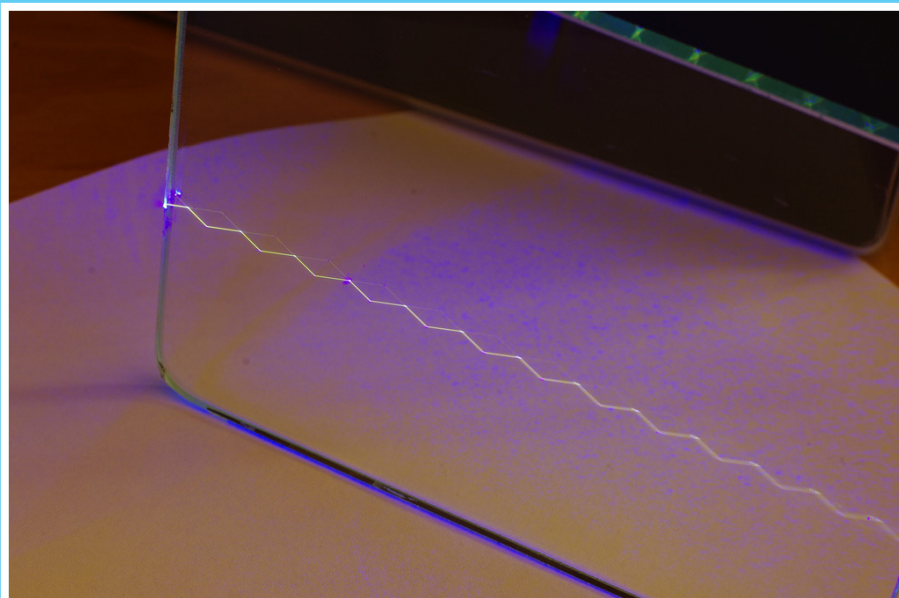
## COMMENTS

Introduce the equation used to calculate intensity and measure light intensity through different numbers of sheets of transparencies. Discuss the fact that different substances absorb light differently.

For more information about Beer's law see [http://en.wikipedia.org/wiki/Beer%E2%80%93Lambert\\_law](http://en.wikipedia.org/wiki/Beer%E2%80%93Lambert_law)

<http://unawe.org/light/98/>





## LEARNING OBJECTIVES

Understand law of refraction and reflection, what index of refraction is and its relationship with incidence and transmitted angles. Learn the Snell's law and how total reflection occurs.

## COMMENTS

**CAUTION!** Do not look into the laser cavity or at any reflections of the laser from shiny surfaces.

The activity execution is similar to “Make a Light Fountain” but with laser. Using the proper physical equations to demonstrate the discussed laws, the activity is suited for 16+ .

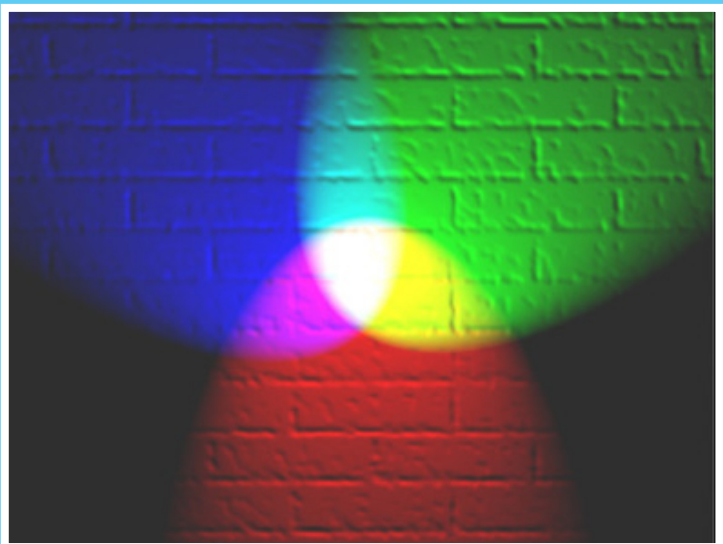
Use this activity to illustrate total internal reflection, as well as how optical fibers work.

<http://unawe.org/light/99/>



# How to Build a Cheap Integrating Sphere for Colour Light Demonstrations

FOR  
TEACHERS



## LEARNING OBJECTIVES

How to build and use an integrating sphere to show how red, green and blue light combine together to produce other colours including white light.

## COMMENTS

This video has the purpose of helping teachers in performing activities with RGB coloured light.

Moreover, if you know simple electric circuits, you can easily build a sphere like this one.

A Venn diagram consisting of three overlapping circles: a blue circle on the left, a green circle in the middle, and a red circle on the right. The overlapping areas create various colors, and the center where all three overlap is white.

<http://unawe.org/light/100/>

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