Light Level Sensors

Light level Sensor
Product No. 3120

Range 1: 0 to 1000 Lux
Resolution: 1 Lux
Range 2: 0 to 110% Transmission
(Slow linear response)

Light level Sensor
Product No. 3122

0 to 100,000 Lux
Resolution: 30 Lux
(Smoothed linear response)

Light level Sensor
Product No. 3123

Range 1: 0 to 1000 Lux
Resolution: 1 Lux
Range 2: 0 to 110% Transmission
(Fast linear response)

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Light Level Sensors

Introduction

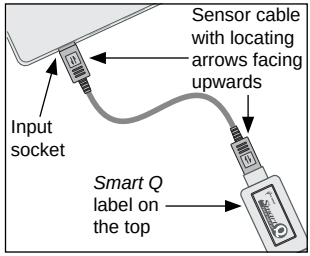
A *Smart Q* Light level Sensor uses a photodiode which produces a voltage proportional to light intensity. It is sensitive to light in the range from 350 nm to 700 nm. The Sensor has a built in infrared rejection filter, giving it a spectral response similar to that of the human eye.

The *Smart Q* Light level Sensors are equipped with a micro controller that greatly improves the accuracy, precision and consistency. They are supplied calibrated and the stored calibration is automatically loaded when the Light Sensor is connected.

Connecting

The **EASY**SENSE unit will automatically detect that the Light level Sensor is connected.

- Hold the Light Sensor housing with the *Smart Q* label showing on the top.
- Push one end of the sensor cable (supplied with the **EASY**SENSE unit) into the shaped socket on the sensor housing with the locating arrow on the cable facing upwards.
- Connect the other end of the cable to the Input socket on the **EASY**SENSE unit (with the locating arrow facing upwards).

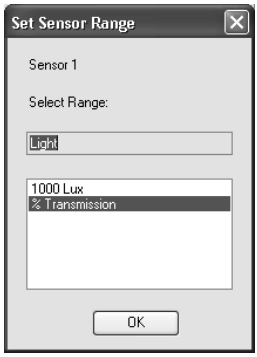


To set the range

Two of the types of Light level Sensor (Product No. 3120 and 3123) have a choice of ranges – 0 to 1000 Lux and 0 – 110% Transmission.

The range can be changed by selecting **Sensor config** from the **Settings** menu in the **EASY**SENSE program: -

- Connect the Light Sensor to the **EASY**SENSE unit.
- Open the **EASY**SENSE program and select one of the logging options from the Home page. Select **Sensor Config** from the **Settings** menu.
- Select the Light Sensor from the list (it will be listed using its current arrange) and click on the **Change Range** button.
- The current range will be highlighted. Select the required range and click on OK.
- Close Sensor Config. Click on New and then Finish for the change in range to be detected by the logging option.



The range setting will be retained until changed by the user. With some **EASY**SENSE units it is possible to change the range from the unit. Please refer to the **EASY**SENSE unit's user manual.

Light level Sensor (Product No. 3122)

Range: *0 to 100,000 Lux*

This Sensor is used mainly for measurements in sunlight. The large range makes it ideal for environmental monitoring. The response from this Sensor is smoothed to filter out unwanted signals of higher frequencies.

Investigations

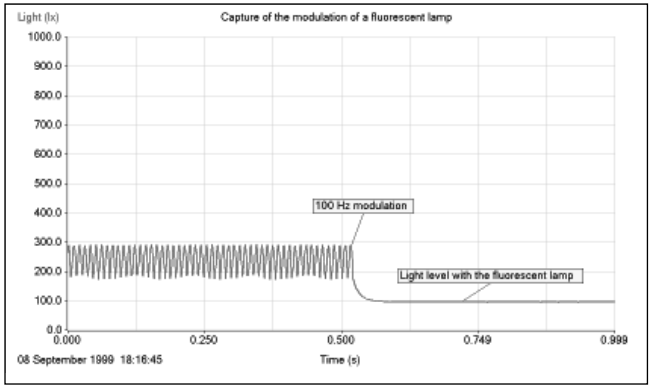
- *Environmental monitoring*
- *Weather study to monitor sunrise and sunset times*
- *Photovoltaic panel performance*

Light level Sensor (FAST response) (Product No. 3123)

Range 1: *0 to 1000 Lux*
Range 2: *0 – 110% Transmission*

This Light Sensor can monitor rapid variations in light intensity, which cannot be observed with the eye: e.g. fluctuations in the light intensity of a bulb due to voltage fluctuations. These variations can be a source of interference to the Sensor in general use.

Investigations



- *Modulations of a fluorescent lamp due to mains frequency and the effects of on/off switching of the light using a FAST recording time.*
- *Remote control modulation patterns.*

Light level Sensor (Product No. 3120)

Range 1: *0 to 1000 Lux*
Range 2: *0 – 110% Transmission*

This is a general-purpose Sensor with a range that makes it suitable for use at indoor light levels. It has a built-in filter to smooth the flicker from fluorescent lamps.

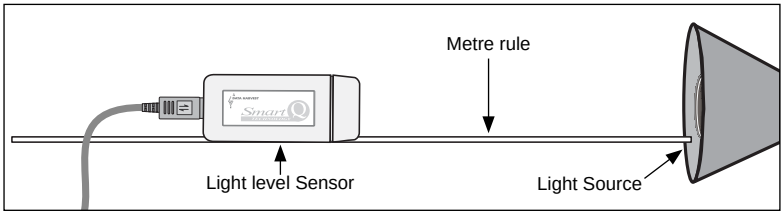
Investigations

- *Inverse square law*
- *Makeshift Colorimeter*
- *Studies of the light intensity in various parts of the school*
- *Studies of plant growth*
- *Rates of reaction*
- *Transparency of materials*
- *Efficiency of reflectors*
- *Investigating different sources of light and their brightness*
- *Measuring the intensity of a bulb in a simple electrical circuit*

Inverse Square Law

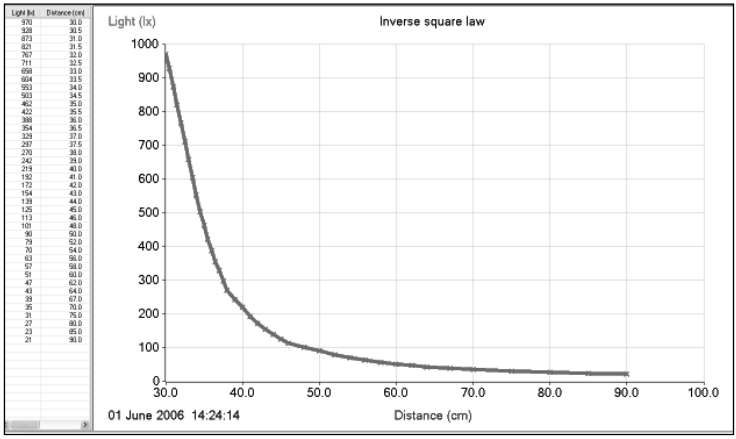
For this activity the 3120 Light Sensor is used to measure the intensity of light from a lamp as the Sensor is moved away from it. The Light Sensor should be set to the Lux range.
Note: *This investigation is best done in a room with the lights off.*

- Lay a metre rule along the work surface. Connect the Light level Sensor to the **EASY**SENSE unit and place alongside the metre rule. Position the light source at the end of the rule pointing at the Light Sensor.



- Open the **EASY**SENSE program and select **Snapshot** from the Home page.
- Select **Pre-log Function** from the **Tools** menu.
- Select a **Preset** function, with **General** from the first drop-down list and then **Asks for Value** from the second list. Next. Type in ‘Distance’ as the name and enter the units to be used e.g. cm. Finish.
- From the **Options** icon select **X-Axis** and select **Channel**. OK.

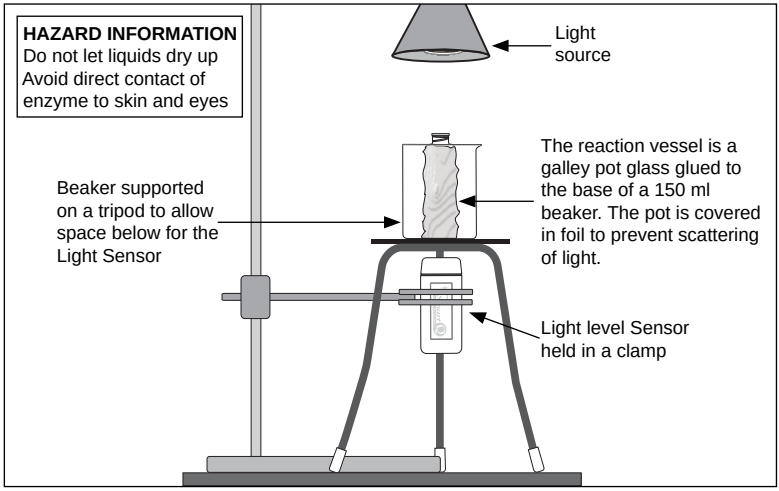
- If necessary, click below the X axis so that 'Distance' is displayed.
- Select **Test Mode** from the **Tools** menu. Switch on your light source. Move the Light Sensor away from until the value from the Sensor is within it's range e.g. 950 Lux or less.
- Click on the **Start**/Stop icon. Click in the graph area to take a snapshot measurement and type the distance between the Sensor and light source into the 'enter value box'. OK.
- Move the Light Sensor further away from the light source e.g. 0.5 cm, and record another measurement. Repeat these steps until the value from the light source becomes too low. Click on the Start/Stop icon to finish recording.



The collected data could be imported into Excel for further investigation e.g. for determining the equation for best fit, by selecting **Transfer to Excel** from the **Edit** menu.

How does an enzymes (protease) activity change with pH?

This experiment uses an enzyme that digests the proteins in a powdered milk solution to make it go from white to transparent. As the milk becomes more transparent, light will travel through it more easily. The Light Sensor should be set to the % Transmission range.



Milk = Powdered milk made to 1% w/v
Protease = Neutrase made to 0.5% v/v

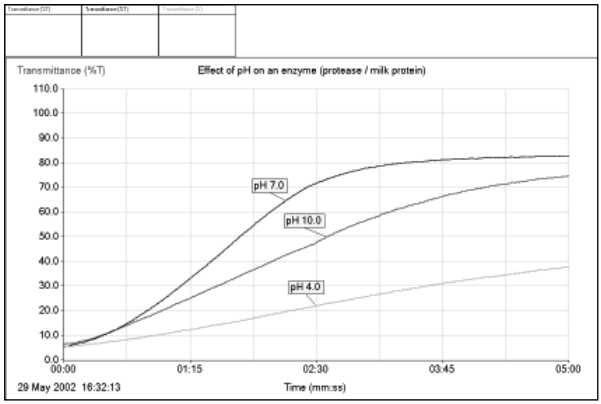
The enzyme was supplied by the National Centre for Biotechnology Education: http://www.reading.ac.uk/NCBE

Table of Solutions used:

	Milk (cm^3)	Enzyme (cm^3)	**pH** of Buffer	Buffer (cm^3)
1	6	4	1	2
2	6	4	4	2
3	6	4	7	2
4	6	4	10	2

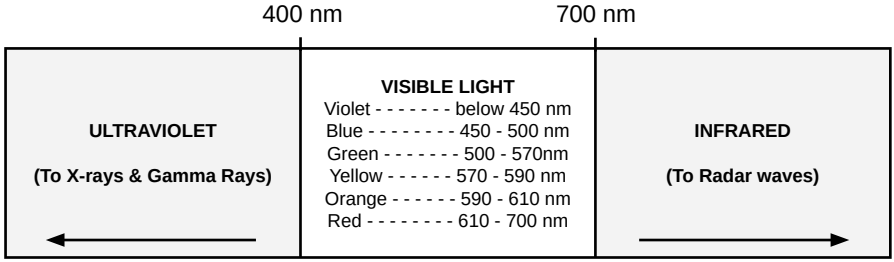
1. Assemble the apparatus as shown in the diagram. Set up the Light level Sensor so that the only way light can enter is through the central pot in the beaker. Turn the light source on.
2. Open the **EASY**SENSE program and select **Graph** from the Home page. Select a recording time of **5 minutes**.
3. Place 4 cm^3 of protease and 2 cm^3 of a buffer into the central galley pot (see table).

4. Fill the beaker with water at 30ºC - this provides heat to speed up the reaction (the temperature of the water does not need to be precise, but needs to be the same for each run of the experiment). Leave for several minutes to let the apparatus reach the same temperature.
5. Select **Test Mode** from the **Tools** menu and adjust the height of the light source so the Light Sensor gives a reading of approximately 100% transmission.
6. Place 6 cm^3 of milk into the central galley pot and click on the **Start**/Stop icon.
7. When the recording has stopped, **right** click in the graph area and select **Add Text**. Label the graph with the pH of the buffer used.
8. Select **Overlay** and repeat the experiment using the range of buffers supplied.

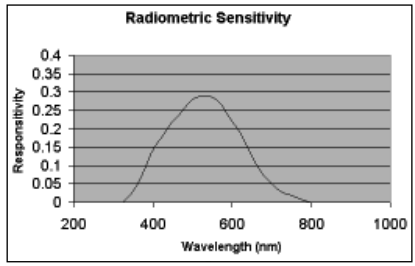


Theory

Light is produced by the release of energy from the atoms of a material when they are excited by heat, chemical reaction or other means. It travels through space in the form of an electromagnetic wave – a form of radiant energy. There are many kinds of energy, including ultraviolet, infrared rays, radio waves and X rays. We only see a minute part of the radiant energy spectrum – the part that is called visible light. Each type of radiation has its characteristic wavelength, which is defined as the distance a wave travels in one cycle. The wavelength of UV, visible light and IR waves are very small and are measured in nanometres (nm) i.e. billionths of a metre.



The Light Sensor utilises the photometric system of measurement that defines light in terms of how it is perceived by the human eye. The eye's sensitivity is dependent on the wavelength or colour of the light. Peak sensitivity occurs in the green part of the visible spectrum while the eye's response to infrared or ultraviolet is zero.



The photodiode used in this Sensor has selected for its maximized response through the visible part of the spectrum and its built-in infrared rejection filter.

Lux measurement

One unit of Lux is the equivalent of the light from a candle at a distance of 1 metre.
50 Lux = a 60 watt bulb at a distance of 1 metre
100 Lux = a 100 watt bulb at a distance of 1 metre
500 Lux = Florescent light
1000 Lux = Overcast Day
20,000 Lux = Winter Sun
80,000 Lux = Summer Sun

Warranty

All Data Harvest Sensors are warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase provided they have been used in accordance with any instructions, under normal laboratory conditions. This warranty does not apply if the Sensor has been damaged by accident or misuse.

In the event of a fault developing within the 12-month period, the Sensor must be returned to Data Harvest for repair or replacement at no expense to the user other than postal charges.

Note: *Data Harvest products are designed for educational use and are not intended for use in industrial, medical or commercial applications.*

WEEE (**W**aste **E**lectrical and **E**lectronic **E**quipment) Legislation

Data Harvest Group Ltd are fully compliant with WEEE legislation and are pleased to provide a disposal service for any of our products when their life expires. Simply return them to us clearly identified as 'life expired' and we will dispose of them for you.