





Light source	Illustration*	Scientific principles
Fluorescent tube  Photo by Simon Eugster CC BY-SA 3.0		<p>Fluorescent light tubes and compact fluorescent lights work by electricity passing through a gas rather than a metal filament. This requires a high voltage across the electrodes and electrical charging of some of the gas in the tube. The gas in the tube becomes plasma when the fluorescent tube is working. A starter switch and ballast were commonly used to produce the right conditions to start and maintain the current at the correct level. They often caused a flickering or humming when starting. Improvements have been made so starting is now quicker.</p> <p>A small quantity of mercury atoms inserted into the tube emit photons of mostly ultraviolet light when the moving electrons and ions collide with them. A coating on the inside of the tube, called phosphor, absorbs the UV light and re-emits white light (i.e. it fluoresces).</p> <p>Fluorescent tubes convert about 22% of electrical energy into light. Life span is 10 to 20 times that of an incandescent globe if run for several hours at a time, i.e. not switched off and on frequently. Produces between 66% and 75% less heat than the equivalent incandescent globe. Fluorescent tubes cannot be dimmed.</p>
Halogen  Photo by Arne Nordmann CC BY-SA 3.0		<p>These are a variation of the incandescent globe. The tungsten filament is encased in what appears to be glass, but is actually a quartz envelope. Glass would melt at the temperatures produced. The gas inside the envelope is a halogen gas (e.g. fluorine). When the tungsten vaporises, it combines with the halogen gas and then re-deposits back on the filament. This means the filament does not readily 'burn out'. Because it runs much hotter than the incandescent, it glows brighter (i.e. produces more light for the same power), but it also gets very hot. Halogen bulbs are often small, so are used in housing that has reflectors. Life span: 2000 to 2500 hours.</p> <p>Touching the 'glass' of a halogen light globe with fingers is not recommended as oil deposited can result in a 'hot spot', increasing the chances of the bulb actually bursting upon failure.</p> <p>Because the temperature of the filament is much hotter than a regular incandescent globe, it produces a white, bright light. Halogen lamps are favoured in spotlights. Halogen globes can be dimmed.</p>

Light source	Illustration*	Scientific principles
Incandescent globe		<p>The filament is a thin piece of tungsten wire that has high resistance to electricity, so it becomes very hot when turned on. It becomes so hot that it glows or incandesces. The globe itself contains an inert gas, such as argon, or a vacuum (i.e. it has had the air pumped out) so that the hot wire does not burn.</p> <p>The frequent heating of the filament causes some of the metal to vaporise. Eventually it becomes so thin that the filament 'burns out'.</p> <p>Incandescent globes are cheap to manufacture but convert only 5% of the electricity to light and can convert 90% of the energy to heat.</p> <p>Life span: 750 to 1250 hours. Incandescent globes can be dimmed.</p>
Light emitting diode (LED) or other	 <p>Photo by Alan J Goulet CC BY-SA 3.0</p>	<p>LEDs work because of the movement of electrons in a semiconductor. So they do not have a filament, do not get hot and have a life span of about 50000 hours. The movement of electrons in the material causes the release of photons. The electrons flow in one direction only so LEDs work using direct current. The type of light (visible, invisible or particular colours) depends on the materials making up the semiconductor in the diode. The light from the diode is 'focused' because of the curved shape of the tiny plastic bulb. LEDs are used in displays, traffic lights, televisions, torches and strip lights but are generally not used as globes in domestic use. Cost and problems of managing current and heat precisely have prevented LED lighting replacing other sources in the home. LEDs are more efficient at lower temperatures. Semiconductor materials have previously been very expensive, but have been becoming cheaper and more readily available since 2000. LED lights can be dimmed.</p>

* Image of incandescent globe from Shutterstock. All other images downloaded from Wikimedia commons

Use the resources listed below to assist in completing the research activity in **Worksheet 5: Group research task**.

Students consider the question: 'Is what is good for individuals always what is good for society?' This should lead to a discussion in greater depth of the environmental issues involved in choosing a light globe.

Legal considerations

Students explore the legislation that was brought in to change the types of light globes available for purchase in Australia. When the new legislation was proposed, there was much debate about the dangers of mercury in fluorescent lighting.

Visit the Australian Government website at energyrating.gov.au/products-themes/lighting/lighting-and-phase-out-general-information/incandescent-light-bulbs-phase-out to learn more about the change in legislation.

Resources relating to environmental considerations for disposal of used light globes

- Royal Society of Chemistry article, 'Q and A: Mercury in energy-saving light bulbs' at rsc.org/chemistryworld/news/2008/january/07010803
- *Scientific American* article, 'Are compact fluorescent light bulbs dangerous?' at scientificamerican.com/article.cfm?id=are-compact-fluorescent-lightbulbs-dangerous
- Transcript of an interview conducted by Kerry O'Brien on the *7.30 Report* at abc.net.au/7.30/content/2008/s2291366
- The solution to the issue of mercury in landfill is the recycling of fluorescent tubes. Students could be given the task of finding how they could recycle fluorescent tubes. See the Australian Government article, 'Disposal of mercury-containing lamps' at environment.gov.au/protection/national-waste-policy/mercury-containing-lamps and follow links to the appropriate state, e.g. epa.nsw.gov.au/managewaste/house-chemicals
- This site informs consumers about chemical collections of fluorescent light bulbs and a range of other materials that should be disposed of responsibly. Visit fluorocycle.org.au to learn about the benefits and costs to organisations of recycling fluorescent tubes.