

Light energy: what it is, 25 examples, the energy changes, and the types of waves

Light energy is energy carried by electromagnetic radiation: a transverse wave of electric and magnetic fields travelling at 300,000 km/s that needs no medium, arriving in photons of energy $E = hf$. Visible light is 400 nm (violet) to 700 nm (red); infrared, ultraviolet, radio, microwaves, X-rays and gamma rays are the same kind of energy at other wavelengths.

25 examples, by where the energy comes from

Source	Examples
nuclear fusion	1 the Sun; 2 the stars
burning	3 a candle; 4 a campfire; 5 a gas flame; 6 fireworks; 7 a match
electricity through a filament or gas	8 incandescent bulb; 9 fluorescent tube; 10 neon sign; 11 halogen headlight; 12 lightning
electricity through a semiconductor	13 LED; 14 phone, TV or computer screen; 15 laser; 16 torch
chemical reaction without burning	17 glow stick; 18 luminol
living things (bioluminescence)	19 firefly; 20 glowing plankton; 21 anglerfish lure
very hot matter	22 molten lava; 23 a red-hot hob or iron
the sky	24 the aurora; 25 a meteor's streak
invisible light energy	infrared from a heater or remote; ultraviolet from the Sun; X-rays; microwaves; radio

Energy changes into and out of light

From	To	Where
electrical	light	bulb, LED, screen, laser
chemical	light and heat	candle, fire, glow stick, firefly
nuclear	light and heat	the Sun and stars
heat	light	glowing filament, lava
light	chemical	photosynthesis; camera film; vitamin D in skin
light	electrical	solar panel; camera sensor; the retina
light	heat	a dark road in the sun; solar water heater

A solar panel turns about 20% of the light into electricity; a leaf stores about 1% as sugar; a filament bulb gives 5% light and 95% heat, an LED about 40% light.

From

sciencewithshobha.com/blog/light-energy-examples-what-light-energy-is-25-examples-the-conversions-to-and-from-it-and-the-types-of-waves-transverse-longitudinal-mechanical-electromagnetic-with-a-printable-sheet/ · 1-on-1 online physics and chemistry, free 30-minute first class.

The types of waves, the electromagnetic spectrum, and practice

By the oscillation		Examples
transverse	oscillation at right angles to the travel; crests and troughs; can be polarised	light and all EM waves; water ripples; a shaken rope; seismic S waves
longitudinal	oscillation along the travel; compressions and rarefactions	sound; a pushed slinky; seismic P waves; ultrasound
By the medium		Examples
mechanical	needs a solid, liquid or gas	sound, water waves, string, seismic
electromagnetic	crosses empty space at 3×10^8 m/s	radio, microwaves, infrared, visible, ultraviolet, X-rays, gamma

Wave equation $v = f\lambda$. Light at 700 nm: $f = 3 \times 10^8 \div 7 \times 10^{-7} = 4.3 \times 10^{14}$ Hz. Sound in air 343 m/s, nearly a million times slower: lightning is seen before thunder is heard; no sound crosses space.

The electromagnetic spectrum (wavelength shrinks, frequency and photon energy rise, left to right)

Band	Wavelength	Used or found
radio	over 1 m (band down to 1 mm)	broadcasting, Wi-Fi, phones, radar
microwaves	1 mm to 1 m	ovens, satellite links
infrared	700 nm to 1 mm	heaters, remotes, thermal cameras
visible	400 to 700 nm	red 620-750, orange 590-620, yellow 570-590, green 495-570, blue 450-495, violet 380-450 nm
ultraviolet	10 to 400 nm	sunburn, vitamin D, sterilising
X-rays	0.01 to 10 nm	medical imaging
gamma	under 0.01 nm	radioactive decay, cancer treatment

Practice

- [] 1. Five sources of light energy: one each from burning, electricity, a living thing, a chemical reaction without burning, the sky.
- [] 2. The energy change in a solar panel? a leaf? a candle?
- [] 3. Transverse or longitudinal? One piece of evidence.
- [] 4. Why can light cross space but sound cannot?
- [] 5. Two examples of light energy the eye cannot see.
- [] 6. Which is faster, light or sound, and by about how much?
- [] 7. Order by increasing wavelength: X-rays, radio, visible, ultraviolet, infrared.
- [] 8. More energy per photon: red or violet?
- [] 9. A slinky pushed end to end: transverse or longitudinal?
- [] 10. Why does an LED stay cool while a filament bulb gets hot?

Answers

- 1) candle; LED; firefly; glow stick; aurora 2) light to electrical; light to chemical; chemical to light and heat 3) transverse; it can be polarised 4) light is electromagnetic, sound mechanical 5) infrared, ultraviolet 6) light, about a million times 7) X-rays, UV, visible, IR, radio 8) violet 9) longitudinal 10) the LED turns most of its energy into light, the filament 95% into heat