The Definition of What the Light is

What is light?

Light arrives on our planet after a speedy trip from the Sun, 149 million km (93 million miles away). Light travels at 186,000 miles (300,000 km) per second, so the light you're seeing now was still tucked away in the Sun about eight minutes ago. But why does light make this journey at all? As you probably know, the Sun is a nuclear fireball spewing energy in all directions. The light that we see it simply the one part of the energy that the Sun makes that our eyes can detect. When light travels between two places (from the Sun to the Earth or from a flashlight to the sidewalk in front of you on a dark night), energy makes a journey between those two points. The energy travels in the form of waves (similar to the waves on the sea but about 100 million times smaller)—a vibrating pattern of electricity and magnetism that we call electromagnetic energy. If our eyes could see electricity and magnetism, we might see each ray of light as a wave of electricity vibrating in one direction and a wave of magnetism vibrating at right angles to it. These two waves would travel instep and at the speed of light.

How does light behave?

Light waves behave in four particularly interesting and useful ways that we describe as reflection, refraction, diffraction, and interference.

Reflection

The only reason we can see the things around us is that light, either from the Sun or from something like an electric lamp here on Earth, reflects off them into our eyes. Cut off the source of the light or stop it from reaching your eyes and those objects disappear. They don't cease to exist, but you can no longer see them. Reflection can happen in two quite different ways. If you have a smooth, highly polished surface and you shine a narrow beam of light at it, you get a narrow beam of light reflected back off it. This is called specular reflection and it's what happens if you shine a flashlight or laser into a mirror: you get a well-defined beam of light bouncing back towards you. Most objects aren't smooth and highly polished: they're quite rough. So, when you shine light onto them, it's scattered all over the place. This is called diffuse reflection and it’s how we see most objects around us as they scatter the light falling on them.

Refraction

Have you noticed how your body slows down when you try to walk through water? You go racing down the beach at top speed but, as soon as you hit the sea, you slow right down. No matter how hard you try, you cannot run as quickly through the water as through the air. The dense liquid is harder to push out of the way, so it slows you down. Exactly the same thing happens to light if you shine it into water, glass, plastic or another more dense material: it slows down quite dramatically. This tends to make light waves bend—something we usually call refraction.

Diffraction

The light will spread out in an identical way if you shine it on a tiny opening that's of roughly similar size to its wavelength. You may have noticed this effect, which is called diffraction if you screw your eyes up and look at a streetlight in the dark. As your eyes close, the light seems to spread out in strange stripes as it squeezes through the narrow gaps between your eyelids and eyelashes. The tighter you close your eyes, the more the light spreads (until it disappears when you close your eyes completely).

Interference

If you stand above a calm pond and dip your finger in, you'll see ripples of energy spreading outwards from the point of the impact. If you do this in two different places, the two sets of ripples will move toward one another, crash together, and form a new pattern of ripples called an interference pattern. Light behaves in exactly the same way. If two light sources produce waves of light that travel together and meet up, the waves will interfere with one another where they cross. In some places, the crests of waves will reinforce and get bigger, but in other places, the crest of one wave will meet the trough of another wave and the two will cancel out.

Where does light come from?

It turns out that light is made inside atoms when they get "excited". That's not excited in the silly, giggling sense of the word, but in a more specialized scientific sense. Think of the electrons inside atoms as a bit like fireflies sitting on a ladder. When an atom absorbs energy, for one reason or another, the electrons get promoted to higher energy levels. Visualize one of the fireflies moving up to a higher rung on the ladder. Unfortunately, the ladder isn't quite so stable with the firefly wobbling about up there, so the fly takes very little persuading to leap back down to where it was before. In so doing, it has to give back the energy is absorbed