

JAF02 Unit 5 Light

Task 1 Speaking

In groups brainstorm everything you know about light in physics. Draw a mind map to illustrate the connections among various phenomena.

Task 2 Reflecting on Light

Read the text below. Formulate at least three questions about the text, then ask the person next to you to answer your questions.

Most of what we know about the world comes to us through our ability to “see“ with our eyes, our telescopes, and our microscopes. But how do we see? Sight is not something that reaches out *from* our eyes. You see this page, for example, because light, reflecting from the sun or an electric light, travels from the paper to your eyes.

Sometimes we see light as it comes from a direct source, such as the sun, fire, lightning, or a light bulb. The rest of the time we see light as it is reflected off objects.

In 1678 the Dutch scientist Christian Huygens was the first to propose that light travels in waves. Since then the work of Albert Einstein and James Maxwell has revealed that light actually consists of particles known as photons and travels in electromagnetic waves. Light seems to travel in straight lines. If you shine a flashlight in the dark, for example, the beam of light appears to be straight. In contrast, sound waves travel in every direction. We can hear people on the other side of a wall but cannot see them.

In certain situations light diverges from a straight path. When it falls on an object, most is either absorbed (in the case of an opaque object such as wood or metal) or passes through (in the case of a transparent object such as water or glass). The remainder of the light is reflected. It is reflected light that changes direction. When light is reflected off a smooth surface, it changes direction in a regular way, that is, the angle that is reflected equals the angle at which it strikes the surface. If the surface is rough, light is reflected in many directions.

Certain silver compounds (like silver bromide) reflect almost all the light that falls on them and are accordingly used for mirrors. The image that is reflected in a flat mirror is identical to the original object, even in size, except that the image is reversed. This is because light on a flat surface changes direction.

When light passes from one transparent medium to another, it changes speed and direction. This process, called refraction, explains the apparent shortening of a person’s legs or the bending of a stick in water.

Light is a form of energy that can be transformed into heat. You can prove this by using a magnifying glass to concentrate the sun’s rays on a piece of paper and burn a hole in it. It is this light energy from the sun that warms the earth and enables living things to grow. Plants get light energy directly from the sun. Animals get it from the plants they eat.

(Zimmerman, F. *English for Science*. Prentice Hall Regents, 1989)

Task 3 Vocabulary

Scan the text again and find the words with similar meaning to the phrases below:

- a) ability to see
- b) to suggest an idea for people to think about
- c) separates and goes in different directions
- d) having a surface that is not even or regular (adj.)
- e) turned the opposite way around
- f) that seems to be real or true but may not be (adj.)
- g) narrow lines of light, heat or other energy

Task 4 Vocabulary: Collocations

Which verbs does the noun 'light' collocate with?

e.g. fluorescent artificial beam of travels

LIGHT

Task 5 Faster than the speed of light

Complete the gaps with suitable forms of the verbs given in brackets, then summarise the main points.

<http://www.telegraph.co.uk/science/science-news/9100009/Scientists-did-not-break-speed-of-light-it-was-a-faulty-wire.html>

It was Albert Einstein who proposed more than 100 years ago that nothing could travel faster than the speed of light. Einstein's theory of special relativity, proposed in 1905, states that nothing in the universe can travel faster than the speed of light in a vacuum.

But researchers at the CERN lab near Geneva claimed they _____ (record) neutrinos, a type of tiny particle, _____ (travel) faster than the barrier of 186,282 miles (299,792 kilometers) per second.

Now it seems Einstein's reputation _____ (be restored) after a source close to the experiment told the US journal Science Insider that "A bad connection between a GPS unit and a computer may be to blame."

Scientists at CERN claimed that neutrinos arrived 60 nanoseconds earlier than the 2.3 milliseconds taken by light. The report in Science Insider said the "60 nanoseconds discrepancy appears to come from a bad connection between a fiber optic cable that connects to the GPS receiver used to correct the timing of the neutrinos' flight and an electronic card in a computer."

"After tightening the connection and then measuring the time it takes data to travel the length of the fiber, researchers found that the data arrive 60 nanoseconds earlier than assumed," it added.

"Since this time is subtracted from the overall time of flight, it appears to explain the early arrival of the neutrinos. New data, however, _____ (be needed) to confirm this hypothesis."

Antonio Ereditato, spokesman for the researchers, said at the time: "We have high confidence in our results. We _____ (check) and rechecked for anything that could have distorted our measurements but we found nothing."

Scientists across the world agreed if the results _____ (be confirmed), that it would force a fundamental rethink of the laws of physics. John Ellis, a theoretical physicist, said Einstein's theory underlies "pretty much everything in modern physics".

The first doubt _____ (be cast) on the findings in November when a team of physicists in Italy conducting a separate study on the same beam of neutrinos at Gran Sasso claimed their findings "refute a superluminal (faster than light) interpretation." Rather than measuring the time it took the neutrinos to travel from CERN to Gran Sasso the second experiment, known as ICARUS, monitored how much energy they had when they arrived.

Tommaso Dorigo, a CERN physicist, wrote on the Scientific Blogging website that the ICARUS paper was "very simple and definitive." He said it showed "that the difference between the speed of neutrinos and the speed of light cannot be as large as that seen by OPERA, and is certainly smaller than that by three orders of magnitude, and compatible with zero."

Prof Jim Al-Khalili, the University of Surrey, who threatened to eat his boxer shorts if the original OPERA result _____ (be proved) right, said: "Usually we see this effect when particles go faster than light through transparent media like water, when light is considerably slowed down."

"So these neutrinos should have been spraying out particles like electrons and photons in a similar way if they were going superluminal – and in the process would be losing energy. But they seemed to have kept the energy they started from, which _____ (rule out) faster-than-light travel."

Task 6 Video

Watch the spokesman describing the ground-breaking findings at the time of the investigation. What are the main points he makes?

<http://www.telegraph.co.uk/science/science-news/9100009/Scientists-did-not-break-speed-of-light-it-was-a-faulty-wire.html>