

Electromagnetic waves

James C. Maxwell

The discovery of electromagnetic waves dates back to 150 years ago, when an English scientist, James Clerk Maxwell, noticed that electric fields and magnetic fields could combine to form electromagnetic waves and travel through space. An electromagnetic wave exists when the changing magnetic field causes a changing electric field. Once created, an electromagnetic wave will continue on forever unless it is absorbed by matter.

Heinrich Hertz

Maxwell's theories were further developed by a German physicist, Heinrich Hertz, who proved the existence of radio waves and demonstrated that the velocity of radio waves is equal to the velocity of light. In his experiment he used a **spark gap** attached to an induction coil and a separate spark gap as the receiving antenna. He noticed that when the waves, created by the sparks of the coil transmitter, were absorbed by the receiving antenna, sparks would jump. Hertz concluded that these signals had all the properties of electromagnetic waves. Subsequently, he demonstrated that electrical and magnetic fields could be made to detach themselves from wires (becoming wireless) and travel through air.



Heinrich Hertz

Applications

From these simple demonstrations, people can now tune a radio to a specific wavelength and listen to their favourite music. The radio receives electromagnetic waves and converts them into mechanical vibrations in the speaker to create soundwaves. Further developments of Hertz's discoveries that have become common in the modern world are television and Wi-Fi: in other words, he, among others, paved the way for the digital era that is based on modems, routers, laptops, tablets, smartphones, smart TVs and the like.

Drawbacks

All of these high-tech items have become of crucial importance and they could not operate if Hertz had not demonstrated the existence of electromagnetic waves. Unfortunately, the increase in the number of devices emitting radiation in all segments of society has posed some questions about the possibility that they could affect people's health. Researchers are investigating the effects of the electromagnetic radiation emitted by modems and routers to send their signals to computers and other devices connected to them. Some researchers have been persuaded that this radiation may contribute to a range of health problems such as cancer, developmental disorders and chronic diseases.

Nonetheless, wireless exposure is expected to increase with the adoption of smart home systems, the smart grid and, ultimately, with the latest 5G technology. The latter has even been blamed for being one of the causes of the spread of Covid-19, but without any scientific evidence whatsoever.

Adapted from: <https://www.aaas.org/heinrich-hertz-and-electromagnetic-radiation>

nonetheless: *tuttavia*
spark gap: *spinterometro*

1 Answer the questions.

1. Who was James Clerk Maxwell?
2. What did Heinrich Hertz show with his experiments?
3. How do radios use electromagnetic signals?
4. What do some researchers suspect?
5. How could electromagnetic radiation affect people's lives?
6. What has the 5G system been held responsible for?

2 Match the two parts to complete a sentence.

- | | | |
|---|--------------------------|---|
| 1. Electromagnetic waves have... | <input type="checkbox"/> | a. to carry communications from one point to another. |
| 2. Unless it is absorbed by matter, ... | <input type="checkbox"/> | b. by the frequency of their wavelength. |
| 3. Electromagnetic waves are formed... | <input type="checkbox"/> | c. to send signals to computers. |
| 4. Wireless Internet routers use electromagnetic radiation... | <input type="checkbox"/> | d. when an electric field couples a magnetic field. |
| 5. Radio waves are used... | <input type="checkbox"/> | e. an electromagnetic wave will go on travelling through space. |
| 6. Electromagnetic waves are classified... | <input type="checkbox"/> | f. both electric and magnetic characteristics. |

3 Read the text and complete it with the words below. There are two unnecessary words.

danger • crest • energy • wave • types • nucleus • size • denser • higher • smaller • distance • microwave

Electromagnetic Waves

When you listen to the radio, watch TV or cook dinner in a microwave oven, you are using electromagnetic waves. Radio waves, television waves, and microwaves are all **1.** of electromagnetic waves. They only differ from each other in their wavelength. Wavelength is the **2.** from one wave **3.** to the next.

Waves in the electromagnetic spectrum vary in **4.** from very long radio waves the size of buildings, to very short gamma-rays smaller than the size of the **5.** of an atom. Yet their size can be related to their **6.**: the smaller the wavelength, the **7.** the energy. For example, a brick wall blocks visible light wavelengths yet **8.**, more energetic, x-rays can pass through brick walls, but are themselves blocked by **9.** material such as **lead**.

While it can be said that waves are "blocked" by certain materials, the correct understanding is that **10.** lengths of energy are "absorbed" by objects, or they are not and can pass through. In other words, wave length energy can only be *absorbed* by certain materials.

Adapted from: <https://www.weather.gov>

4 **PAIR WORK** Express your opinion about these suggestions for a responsible use of technological devices.

- You should reduce the amount of time spent using your wireless device.
- When using a smartphone, you should use earphones or a headset to reduce proximity of the device to your head.
- You should increase the distance between wireless devices and your body.
- You should consider texting rather than talking on the phone (but don't text while you are driving).