X-Ray

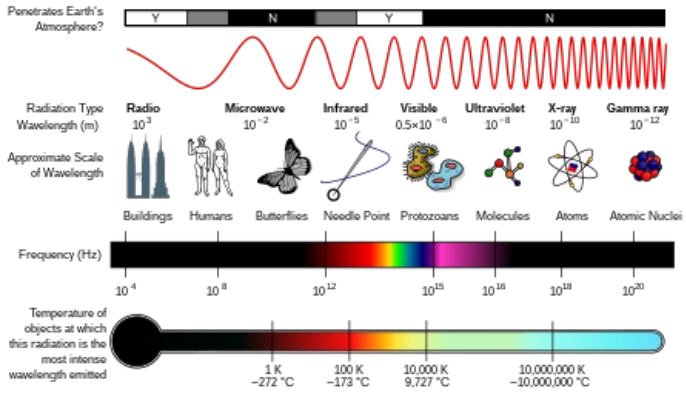
X-rays are a form of electromagnetic radiation, also as radio waves, infrared radiation, visible light, ultraviolet radiation and microwaves. One of the most common and beneficial uses of X-rays is for medical imaging. X-rays are also used in treating cancer and in exploring the cosmos.

How it works

Electromagnetic radiation is transmitted in waves or particles at different wavelengths and frequencies. This broad range of wavelengths is known as the electromagnetic spectrum. The EM spectrum is generally divided into seven regions in order of decreasing wavelength and increasing energy and frequency. The common designations are: radio waves, microwaves, infrared (IR), visible light, ultraviolet (UV), X-rays and gamma-rays.

Types of X-rays

1. Soft X-rays - classified in the range of the EM spectrum between UV light and gamma-rays. Soft X-rays have comparatively high frequencies, about 3 × 1016 cycles per second, or hertz, to about 1018 Hz - and relatively short wavelengths, about 10 nanometers (nm), or 4 × 10−7 inches, to about 100 picometers (pm), or 4 × 10−8 inches. (A nanometer is one-billionth of a meter; a picometer is one-trillionth of a meter.)
2. Hard X-rays - they have frequencies of about 1018 Hz to higher than 1020 Hz and wavelengths of about 100 pm (4 × 10−9 inches) to about 1 pm (4 × 10−11 inches). Hard X-rays occupy the same region of the EM spectrum as gamma-rays. The only difference between them is their source - X-rays are produced by accelerating electrons, while gamma-rays are produced by atomic nuclei.



Electromagnetic spectrum

X-ray imaging

Due to its ability to penetrate some materials, X-rays are used for a number of nondestructive evaluation and testing applications, particularly for identifying flaws or cracks in structural components. The resulting shadowgraph shows the internal features. X-rays are also essential for transportation security inspections of cargo, luggage and passengers. Electronic imaging detectors allow real-time visualization of the content in the packages and items that passengers might carry on their persons. The original use of X-rays was for imaging bones, which were easily distinguishable from soft tissues on the film that was available at that time. However, more accurate focusing systems and more sensitive detection methods, such as improved photographic films and electronic imaging sensors, have made it possible to distinguish increasingly fine detail and subtle differences in tissue density, while using much lower exposure levels. Additionally, computed tomography (CT) combines multiple X-ray images into a 3D model of a region of interest. They are used as a noninvasive and painless method for diagnosing disease and monitoring therapy, and supporting medical and surgical treatment planning.

X-ray therapy

Radiation therapy uses high-energy radiation to kill cancer cells by damaging their DNA. However, the treatment can damage normal cells as well as cancer cells. Therefore, the National Cancer Institute recommends that treatment must be carefully planned to minimize side effects. According to the U.S. Environmental Protection Agency, ionizing radiation from X-rays deposits a large amount of energy into a small area, enough energy to strip electrons completely way from atoms altering their chemical properties and breaking molecular bonds. In sufficient doses, this can damage or destroy cells. While this cell damage can cause cancer, it can also be used to fight it. By directing X-rays at cancerous tumors, the abnormal cells can be killed. The problem is that it also kills healthy cells along the path of the beam. To reduce this problem, the patient lies on a table and is treated with radiation from multiple directions. The exposure to surrounding tissues is minimized, because healthy tissue receives only a single small dose from the moving beam, while the tumor receives doses from every angle.

Risks and side-effects

X-rays use small amounts of radiation to create images of your body. The level of radiation exposure is considered safe for most adults, but not for a developing baby. If you're pregnant or believe you could be pregnant, tell your doctor before you have an X-ray. They may suggest a different imaging method, such as an MRI. If you're having an X-ray done to help diagnose or manage a painful condition, such as a broken bone, you may experience pain or discomfort during the test. You will need to hold your body in certain positions while the images are being taken. This may cause you pain or discomfort. Your doctor may recommend taking pain medicine beforehand.

If you ingest a contrast material before your X-ray, it may cause side effects, such as:

- Hives
- Itching
- Nausea
- Lightheadedness
- Metallic taste in mouth

In very rare cases, the dye can cause a severe reaction, such as anaphylactic shock, very low blood pressure, or cardiac arrest.

History

X-rays were discovered in 1895 by Wilhelm Conrad Röentgen, a professor at Würzburg University in Germany. For his discovery, Röentgen was awarded the very first Nobel Prize in Physics, in 1901. During World War I, X-rays were already being used for medical purposes. In the 50's was built the first ever X-ray microscope.

Wilhelm Roentgen

Links

https://en.wikipedia.org/wiki/X-ray

http://www.slac.stanford.edu/pubs/beamline/25/2/25-2-assmus.pdf

https://en.wikipedia.org/wiki/X-ray_generator

https://medlineplus.gov/xrays.html

https://science.howstuffworks.com/x-ray1.htm