

X rays

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CONCEPT

1

X rays

- Describe the electromagnetic spectrum.
- Identify X rays and their uses.
- Explain why X rays are dangerous.



You probably recognize this somewhat startling image as an X-ray image of a human skull. X rays, which are used to make images like this one, are electromagnetic waves.

Putting X Rays in Context

Electromagnetic waves are vibrating electric and magnetic fields that transfer energy across space as well as through matter. There are several different types of electromagnetic waves that vary in their frequencies and wavelengths. Waves with higher frequencies have more energy. The electromagnetic spectrum pictured in the **Figure 1.1** represents the full range of frequencies of electromagnetic waves.

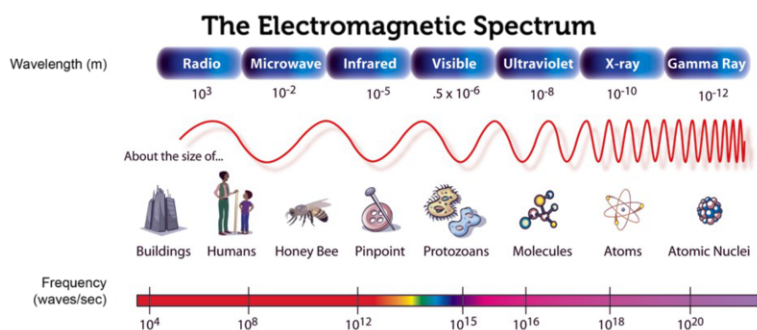


FIGURE 1.1

High Energy Waves

Electromagnetic waves with the highest frequencies and greatest energy are on the right side of the electromagnetic spectrum above. **X rays** have more energy than any other electromagnetic waves except gamma rays. For example, X rays have enough energy to pass through soft tissues such as skin, although not enough to pass through bones and teeth, which are very dense. The bright areas in the skull X ray show where X rays were absorbed by teeth and bones. X rays are used not only for medical and dental purposes but also to screen luggage at airports (see **Figure 1.2**). You can learn about the discovery of X rays as well as other uses of X rays at this URL: <http://www.guardian.co.uk/science/blog/2010/oct/26/x-ray-visions-disease-forgeries>



FIGURE 1.2

Q: What do the dark areas in an X ray image represent?

A: The dark areas represent materials that do not absorb X rays. Instead, the X rays pass through these areas. For example, in the X-ray image above the bag doesn't show up because X rays pass through the soft cloth, but not the dense objects inside.

Dangers of X Rays

Because X rays are so energetic, they can penetrate many substances, including living cells. Therefore, too much X ray exposure can be dangerous. It may damage cells and cause cancer. If you've had dental X rays, you may have

noticed that a heavy apron was placed over your body to protect it from stray X rays. Protective aprons like this are made of lead, which X rays can't pass through.

Summary

- Electromagnetic waves vary in their frequencies and wavelengths, and waves with higher frequencies have greater energy. The electromagnetic spectrum represents the full range of frequencies of electromagnetic waves.
- X rays are high-frequency electromagnetic waves with more energy than any other electromagnetic waves except gamma rays.
- X rays are used to make images of bones and teeth inside the body and to see inside luggage at airports.
- X rays can penetrate the body, damage cells, and cause cancer.

Vocabulary

- **X ray:** Wave in the electromagnetic spectrum with a wavelength between the wavelengths of ultraviolet light and gamma rays.

Practice

Watch the animation about X rays at the following URL. Then fill in the blanks in the paragraph below. <http://www.spineuniverse.com/exams-tests/rays-animation>

An X-ray machine has a cathode and an anode. The cathode releases _____, which are attracted to the anode. This results in the anode releasing energy in the form of _____. When an X ray image is taken, the patient is placed between the _____ and the _____. Some X rays pass through the soft tissues of the body and strike the film. These X rays cause a _____ on the film, and this area of the film appears _____. Areas where X rays are absorbed by bones appear _____.

Review

1. What are X rays? Where do they fall in the electromagnetic spectrum?
2. How are X rays used?
3. Why are X rays dangerous?