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## Radiofrequency (RF) Radiation

Radiation is the emission (sending out) of energy from any source. X-rays are one example of radiation, but so is the light that comes from the sun and the heat that constantly comes off our bodies.

When talking about radiation and cancer, many people think of specific kinds of radiation such as x-rays or the radiation made by nuclear reactors. But there are other types of radiation that act differently.

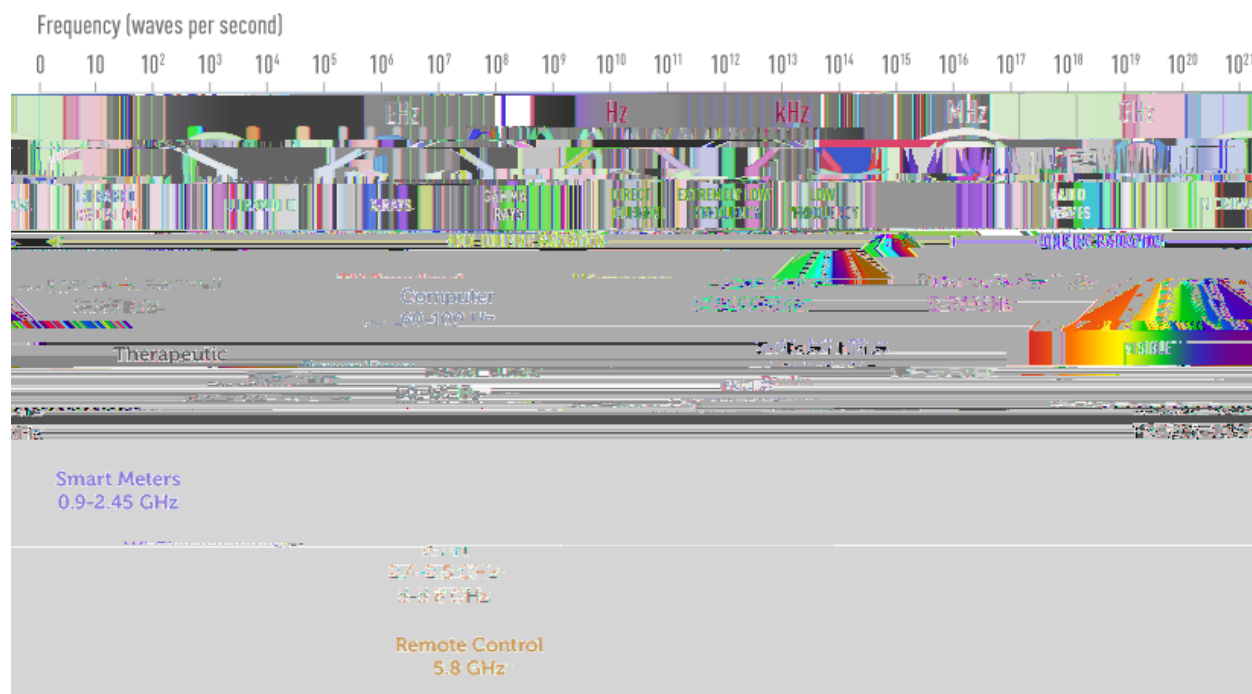
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Radiation exists across a spectrum from very low-energy (low-frequency) radiation to very high-energy (high-frequency) radiation. This is sometimes referred to as the **electromagnetic spectrum**.

The electromagnetic spectrum illustration below shows the possible frequencies of electromagnetic energy. It ranges from extremely low frequencies (such as those from power lines) to extremely high frequencies (x-rays and gamma rays), and it includes both non-ionizing and ionizing radiation.

Examples of high-energy radiation include [x-rays and gamma rays](#)<sup>1</sup>. These rays, as well as some higher energy [ultraviolet \(UV\) rays](#)<sup>2</sup>, are forms of **ionizing radiation**, which means they have enough energy to remove an electron from (ionize) an atom. This can damage the DNA (genes) inside of cells, which can sometimes lead to cancer.

# ELECTROMAGNETIC SPECTRUM



## What is radiofrequency (RF) radiation?

Radiofrequency (RF) radiation, which includes radio waves and microwaves, is at the low-energy end of the electromagnetic spectrum. It is a type of **non-ionizing radiation**. Non-ionizing radiation does not have enough energy to remove electrons from an atom. RF radiation has lower energy than some other types of non-ionizing radiation, like infrared and visible light, but it has higher energy than [extremely low-frequency \(ELF\) radiation](#)<sup>3</sup>.

If RF radiation is absorbed by the body in large enough amounts, it can produce heat. This can lead to burns and body tissue damage. Although RF radiation is not thought to cause cancer by damaging the DNA in cells the way ionizing radiation does, there has been concern that in some circumstances, some forms of non-ionizing radiation might still have other effects on cells that might somehow lead to cancer.

## How are people exposed to RF radiation?

People can be exposed to RF radiation from both natural and human-made sources.

Natural sources include:

- Outer space and the sun
- The sky – including lightning strikes
- The earth itself – most radiation from the earth is infrared, but a tiny fraction is RF

Human-made RF radiation sources include:

- Broadcasting radio and television signals
- Transmitting signals from cordless telephones, [cell phones](#)<sup>4</sup> and [cell phone towers](#)<sup>5</sup>, satellite phones, and 2-way radios
- Radar
- Wi-Fi, Bluetooth<sup>®</sup> devices, and [smart meters](#)<sup>6</sup>
- Some medical procedures, such as radiofrequency ablation (using heat to destroy tumors)
- “Welding” pieces of polyvinyl chloride (PVC) using certain machines
- Millimeter wave scanners (a type of full body scanner used for security screening)

Some people can have significant RF exposure as part of their jobs. This includes people who maintain antenna towers that broadcast communication signals and people who use or maintain radar equipment. Other people who may have higher levels of RF exposure include some healthcare workers (particularly those working near MRI scanners) and people who work with devices that use RF radiation, such as plastic sealers, certain types of welding equipment, and induction heaters.

Most people are exposed to lower levels of RF radiation every day, from RF signals all around us. They come from radio and TV broadcasts, Wi-Fi and Bluetooth devices, cell phones (and cell phone towers), and other sources.

## Some common uses of RF radiation

### Microwave ovens

Microwave ovens work by using very high levels of a certain frequency of RF radiation (in the microwave spectrum) to heat foods. When food absorbs microwaves, it causes the water molecules in the food to vibrate, which produces heat. Microwaves do not use x-rays or gamma rays, and they do not make food radioactive.

Microwave ovens are designed so that the microwaves are contained within the oven



causes cancer.

*The following is a brief summary of some of the major studies that have looked at this issue to date. However, this is not a comprehensive review of all studies that have been done.*

### **Studies done in the lab**

RF waves don't have enough energy to damage DNA directly, the way that ionizing waves do. Because of this, it's not clear how RF radiation might be able to cause

Studies of people who might have been exposed to higher levels of RF radiation at their jobs (such as people who work around or with radar equipment, those who service communication antennae, and radio operators) have found no clear increase in cancer risk.

A number of studies have looked for a possible link between cell phones and cancer. Some studies have shown a possible link, but many others have not. For many reasons, it is hard to study if there might be a link between cell phones and cancer, including the relatively short time that cell phones have been in widespread use, changes in the technology over time, and difficulty in estimating each person's exposure. The topic of cell phones and cancer risk is covered in more detail in [Cellular Phones](#)<sup>9</sup>.

### What do expert agencies say?

**The American Cancer Society (ACS) does not have an official position or statement on whether or not radiofrequency radiation from cell phones, cell phones towers, or other sources is a cause of cancer.** ACS generally looks to other expert organizations to determine if something causes cancer (that is, if it is a carcinogen), including:

- The **International Agency for Research on Cancer (IARC)**, which is part of the World Health Organization (WHO)

So far, the **National Toxicology Program (NTP)** has not included RF radiation in its *Report on Carcinogens*, which lists exposures that are known to be or reasonably anticipated to be human carcinogens. (For more on this report, see [Known and Probable Human Carcinogens](#)<sup>11</sup>.)

According to the **US Federal Communications Commission (FCC)**:

“[C]urrently no scientific evidence establishes a causal link between wireless device use and cancer or other illnesses. Those evaluating the potential risks of using wireless devices agree that more and longer-term studies should explore whether there is a better basis for RF safety standards than is currently used.”

## Can I avoid or limit my exposure to RF radiation?

Because sources of RF radiation are so common in the modern world, there is no way to completely avoid exposure to it. There are some ways you can lower your exposure to RF radiation, such as:

- Avoiding jobs with increased RF exposure
- Limiting the time you spend near appliances, equipment, and other devices (such as Wi-Fi routers) that give off RF radiation
- Limiting the time you spend with a cell (mobile) phone placed against your ear (or close to another part of your body)

Still, it isn't clear that doing these things will be helpful in terms of health risks.

## Hyperlinks

1. [www.cancer.org/cancer/risk-prevention/radiation-exposure/x-rays-gamma-rays.html](http://www.cancer.org/cancer/risk-prevention/radiation-exposure/x-rays-gamma-rays.html)
2. [www.cancer.org/cancer/risk-prevention/sun-and-uv/uv-radiation.html](http://www.cancer.org/cancer/risk-prevention/sun-and-uv/uv-radiation.html)
3. [www.cancer.org/cancer/risk-prevention/radiation-exposure/extremely-low-frequency-radiation.html](http://www.cancer.org/cancer/risk-prevention/radiation-exposure/extremely-low-frequency-radiation.html)
4. [www.cancer.org/cancer/risk-prevention/radiation-exposure/cellular-phones.html](http://www.cancer.org/cancer/risk-prevention/radiation-exposure/cellular-phones.html)
5. [www.cancer.org/cancer/risk-prevention/radiation-exposure/cellular-phone-towers.html](http://www.cancer.org/cancer/risk-prevention/radiation-exposure/cellular-phone-towers.html)





*\*Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit [www.cancer.org](http://www.cancer.org).

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### **Written by**

The American Cancer Society medical and editorial content team  
(<https://www.cancer.org/cancer/acs-medical-content-and-news-staff.html>)

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