Frequently Asked Questions about Electromagnetic Fields (EMF) and Radio Frequencies (RF)

What are electromagnetic fields (EMF) and radio frequencies (RF)?

In short, EMF and RF are invisible areas of energy, or radiation, produced by electrical current. We are surrounded by electromagnetic fields in the atmosphere, originating in part from natural sources, such as from the buildup of electric charges by thunderstorms and from the visible light sent from the sun's natural waves, which create electric and magnetic fields, or radiation. EMF and RF are also emitted by electrical or electronic devices.

- **EMF** stands for electromagnetic fields. Electromagnetic fields are produced by every electrical or electronic device. Common EMF sources are computers, televisions, microwave ovens, wireless devices such as cell phones and Wi-Fi devices, power and transmission lines, internal building wiring systems, electrical panels, transformers, motors, and all forms of broadcasting, including AM and FM radio. Radio waves and ordinary light are forms of EMF. In addition to ordinary visible light, invisible light forms such as infrared, and ultraviolet, x-rays, and gamma rays are also forms of EMF.

- **RF** stands for radio frequency, which is a type of electromagnetic field produced at a high frequency through use of large-scale wireless equipment and data transmission. Common RF sources are radio and television transmission lines, cell towers and antennas, portable phones, cell phones, wireless computer networks (WLAN), radar equipment. Wireless network installations in our homes and buildings are also sources of RF.

- **RF EMF** stands for radiofrequency electromagnetic fields, and is a term used to describe the part of the electromagnetic spectrum comprising the frequency range from 100 kilo hertz (kHz) to 300 Giga hertz (GHz). RF EMF is used in a variety of technologies, most widely for communication purposes (e.g. mobile phones, base stations, Wi-Fi, 5G, radio, TV, security devices). RF EMF is also used in medicine (e.g. Magnetic Resonance Imaging (MRI) equipment), for heating purposes (e.g. microwave ovens), and for wireless power transfer (e.g. Qi).

What are the different types of EMF and RF?

EMFs are typically grouped into one of two categories by their frequency: low-level/non-ionizing radiation or ionizing radiation.

- Low-level radiation, also called non-ionizing radiation, is mild and widely thought to be harmless to people. Appliances like microwave ovens, cellphones, Bluetooth devices, Wi-Fi routers, MRIs, power lines and electronic meters send out low-level radiation.

- High-level radiation, called ionizing radiation, is the second type of radiation. Ionizing radiation is sent out in the form of ultraviolet rays from the sun and X-rays from medical imaging machines.

The FDA maintains a website about radiation emitting electronic products.

Non-ionizing EMFs occur both naturally and through human-made sources. An example of a naturally occurring EMF is the earth's magnetic field, which causes a compass needle to point north. Human-made sources of EMFs include extremely low frequency EMFs (ELF-EMF) and radiofrequency radiation. Some examples of ELF-EMF sources are power lines, electrical wiring, and electrical appliances. Radiofrequency radiation (RF) includes wireless telecommunication devices and equipment such as cell phones, advanced (aka "smart") digital electric and gas meters, portable computer devices, radio and television signals, microwaves, television and computer screens, and wireless local area networks (Wi-Fi).

Read more about non-ionizing radiation from the US Occupational Safety and Health Administration (OSHA).

Who sets standards for exposure to EMF and RF?

The U.S. Federal Communications Commission (FCC) sets exposure limits for RF radiation. FCC works with other federal health and safety agencies to monitor and investigate issues related to RF exposure. Read frequently asked questions from the FCC on RF safety here.

The World Health Organization (WHO) has formally recognized the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which has developed EMF exposure guidelines. The ICNIRP 2020 RF EMF guidelines protect against all potential adverse health effects relating to exposure to RF EMF, including from 5G technologies.

Do EMF/RF impact your health?

Some people have expressed concerns about the health effects of wireless (EMF and RF) signals, particularly because electronic devices are ubiquitous in our lives. This subject has been studied for decades by many national and international organizations. Scientists and the medical community have not been able to find evidence that exposure to non-ionizing EMF/RF has adverse health effects.

- The National Institute of Environmental Health Sciences (NIEHS), which is part of the U.S. Department of Health and Human Services (DHHS) provides information on types of EMF by frequency, examples of where these common sources fall on the electromagnetic spectrum, and research on public health. Visit the NIEHS website for a summary of the agency's research and links to additional resources.

- The World Health Organization (WHO) is another organization that has studied this subject extensively. Their website on electromagnetic fields provides fact sheets on electromagnetic fields and public health, frequently asked questions, and safety standards guidelines.

- The National Cancer Institute states on its website that "no consistent evidence for an association between any source of non-ionizing EMF and cancer has been found."

Does living near electric power lines impact your health?

Power lines emit a lower frequency EMF than the electronic devices in our homes do, including common, everyday devices such as cell phones, radios, televisions, microwaves, and even visible light from bulbs. In an educational booklet with research on health and power line EMF emissions, the NIEHS stated that "magnetic fields close to electrical appliances are often much stronger than those from other sources, including magnetic fields directly under power lines."

In 1992, Congress approved the Energy Policy Act, which authorized national research into exposure to electric and magnetic fields and potential health effects. In the following decades, national and international organizations have also studied this subject and no study has been able to find conclusive evidence that there is a direct association between exposure to power lines and negative health effects.

The National Cancer Institute reports that through numerous epidemiologic studies and reviews of scientific literature, no consistent evidence has been found to associate exposure to electric power lines with potential adverse health impacts such as leukemia or cancer.

What about EMF from high-voltage electric power transmission and distribution lines?

High-voltage transmission and distribution power lines emit a source of non-ionizing radiation which is considered harmless to humans. The California Department of Public Health and California Public Utilities Commission have not concluded that exposure to magnetic fields from electric utility equipment poses a health risk.

Power lines emit lower frequency EMFs than common devices and appliances used every day in our homes and all around us, such as cell phones, televisions, computers, Wi-Fi networks, and microwaves. Additionally, power lines are located a greater distance away from us than such commonly used in-home devices, which further reduces the potential impacts from exposure to this non-ionizing form of radiation. The level of exposure to EMF is greater for someone using a cell phone than for persons working in areas of Wi-Fi or power lines, considering the higher power levels required by a cell phone and the proximity of use to our heads.

Do wireless transmitters such as "smart" utility meters emit EMF or RF?

Wireless signal transmission systems use RF, including "smart" meters. Other examples include cell phones, televisions, AM and FM satellite radio, wireless computers, Bluetooth devices, digital utility meters, and wireless networks such as Wi-Fi. The RF emissions from wireless utility devices such as digital ("smart") electric meters are a very small fraction of those emitted by common household appliances.

These emissions have been studied by reputable organizations such as the Electric Power Research Institute (EPRI), which observed minimal exposure levels to RF from smart meters, especially as compared to exposure from cell phone use. To date, scientific studies have not demonstrated negative health impacts from these advanced electric meters or wireless antennae.

The FCC sets standards for safe operation and exposure to RF. In tests of RF devices operated by the City of Palo Alto Utilities, results have demonstrated that these devices are operating well within these safety standards set by the FCC.

Do EMF and RF affect electrical and utility workers?

The National Institute for Occupational Safety and Health (NIOSH) has conducted research on protecting workers from possible EMF health risks from: RF (radio frequencies) including broadcast antennas, induction heaters, and cellular telephones; ELF (extremely low frequencies) including AC electricity and video display terminals ; and Static Magnetic Fields including DC electricity. Read more about these studies on their website.

Is there more information about EMF in the workplace?

The NIOSH provides some information about typical exposures to EMF in the workplace on its website.

What other studies have been done about EMF and RF?

Federal Communications Commission (FCC): Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields

US Occupational Safety and Health Administration (OSHA): Radiofrequency and Microwave Radiation

US Food and Drug Administration (FDA): Review of Published Literature between 2008 and 2018 of Relevance to Radiofrequency Radiation and Cancer

FDA: Radiation-Emitting Products for Home, Business and Entertainment

National Institute for Occupational Safety and Health (NIOSH): Manual for Measuring Occupational Electric and Magnetic Field Exposures

National Institute of Environmental Health Sciences: Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields

World Health Organization: Extremely Low Frequency Fields Environmental Health Criteria Monograph No.238

National Institute of Health, National Cancer Institute: Electromagnetic Fields and Cancer

California Council on Science and Technology: Health Impacts of Radio Frequency Exposure from Smart Meters

Smart Energy Consumer Collaborative: Video - Separating the Facts from the Fiction about Smart Meters

Supporting Images:

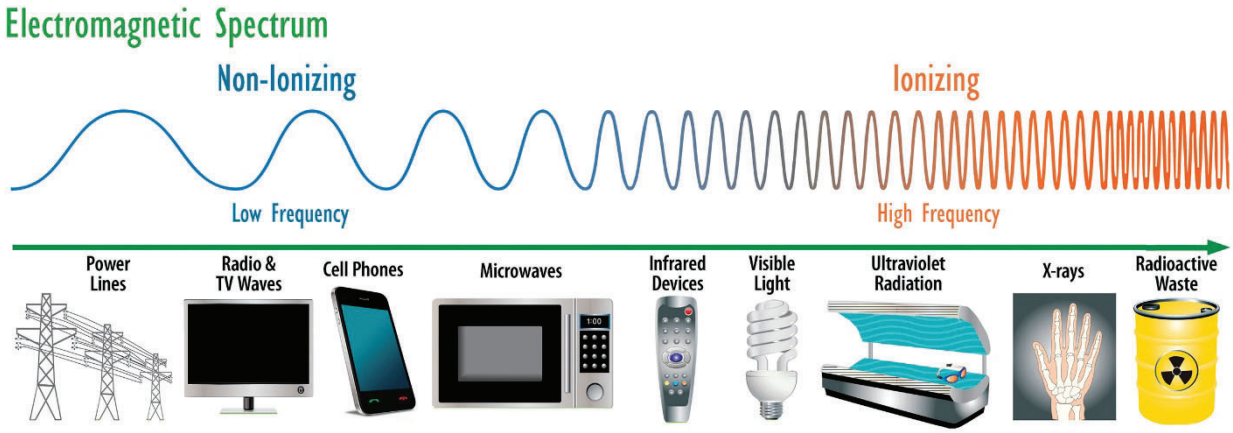
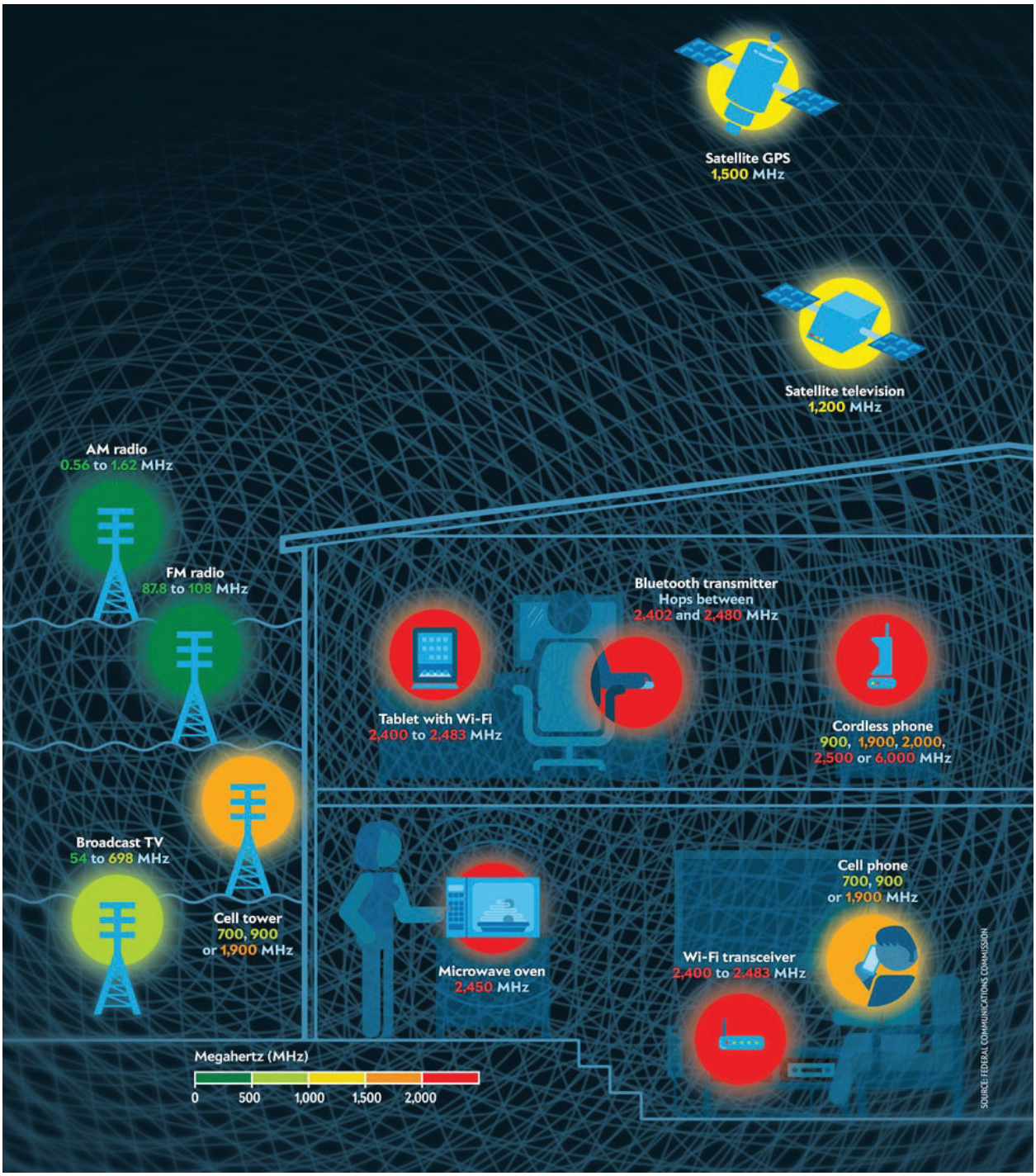


Image courtesy of the National Institute for Occupational Safety and Health (NIOSH)



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