

Electric & Magnetic Fields



PSEG

What are electric and magnetic fields?

Electrical objects produce two types of fields – electric fields and magnetic fields. The term “field” is used to describe the way an object influences its surrounding area. A temperature field, for example, surrounds a warm object, such as a space heater.

Electric and magnetic fields (EMF) surround any object that is generating, transmitting or using electricity, including appliances, wiring, office equipment, distribution lines and transmission lines. EMFs are invisible and they cannot be felt or heard.

- **Electric fields** are produced by the voltages applied to electrical objects, and
- **Magnetic fields** are produced by the flow of current through these objects.

Just like a temperature field, electric and magnetic field levels decrease quickly with distance. If you measure the temperature right next to a pot of boiling water, it is high. But, move one or two feet away from the pot and the temperature decreases.

It is the same with EMF. Electric field levels are also affected by nearby objects, such as buildings and trees, which block the fields.

A great amount of research has been done on EMF and health, most of which has focused on magnetic fields. Based on this research, no health or scientific agency has concluded that these fields are the cause of any disease. This brochure describes EMF and the research that has been conducted to date.



Our magnetic field exposure

Since electricity plays an essential role in modern society, we are surrounded by magnetic fields in our homes, offices and schools. As illustrated below, these magnetic fields are higher close to the source and decrease quickly with distance. Magnetic fields are measured with an instrument called a gaussmeter in units called milligauss (mG). Compared to appliances, the magnetic fields from power lines drop off more slowly with distance. Transmission lines, however, are generally not close enough to locations where we spend a substantial amount of time to contribute significantly to our magnetic field exposure.



Magnetic Field at Various Distances from the Source* (mG)

	6 inches	1 foot	2 feet
Vacuum cleaner	300	60	10
Hair dryer	300	1	—
Dishwasher	20	10	4
Washing machine	20	7	1
PC with monitor	14	5	2
Color TV	7	2	—

Source: EMF Questions and Answers (NIEHS, 2002)

* The numbers represent the median magnetic field, i.e., half of the appliances tested had higher levels and half had lower levels than those shown in the chart.

Magnetic fields near typical New Jersey transmission lines

The table below shows magnetic field levels calculated by PSE&G under typical conditions for the most common transmission line configurations in New Jersey. The magnetic field from transmission lines varies from minute to minute as the line current changes in response to customer demand. These representative ranges are provided for general information and do not necessarily apply to any particular existing or proposed line. The magnetic field level at any point is determined by the design of the line and the current in all the nearby conductors at that moment. Transmission lines, distribution lines and local building wiring will all create magnetic fields.

Transmission Voltage	Directly beneath lines	50 feet from the line	100 feet from the line	200 feet from the line
500 kilovolt	400 to 130 mG	260 to 87 mG	87 to 29 mG	22 to 7 mG
230 kilovolt	141 to 47 mG	62 to 23 mG	24 to 8 mG	7 to 2 mG
138 kilovolt	29 to 10 mG	16 to 5 mG	7 to 2 mG	2 to 1 mG
69 kilovolt	30 to 10 mG	9 to 3 mG	3 to 1 mG	Less than 1 mG

Scientific process for evaluating health risks

Determining if EMF exposure is a risk to human health is a multi-step process. First, scientists conduct three different types of studies:

{ epidemiology studies in humans, animal studies, and studies on cells and tissues. }

Results from these studies are published in the scientific literature for everyone to read. The way scientists make sense of this research, however, is to compile all of the hundreds of studies together and evaluate the strengths and weaknesses of each study. Then, all of the studies are evaluated together to arrive at a conclusion. This is referred to as a weight-of-evidence review. Scientific organizations assemble panels of experts to conduct weight-of-evidence reviews.

Three different types of research are considered in a weight-of-evidence review

Each of the three study types can be thought of as a puzzle piece. When placed together, the information from all three study types gives us an understanding of possible health effects.

Epidemiology studies – Scientists collect data about human populations in their day-to-day environments to determine whether there are patterns between exposures and diseases (see “What do epidemiology studies measure?”). Most studies evaluating EMF look at whether people with disease have higher estimates of past exposure, compared to people without disease.



Animal studies – Scientists have exposed laboratory animals to magnetic field levels as high as 50,000 mG and as long as their entire lifetime. These studies then compare the amount of disease they observe in exposed animals to the amount of disease they observe in animals that have not been exposed. The strength of animal studies is that scientists are able to control all aspects of the animals' lives to minimize the potential effects of factors other than EMF.

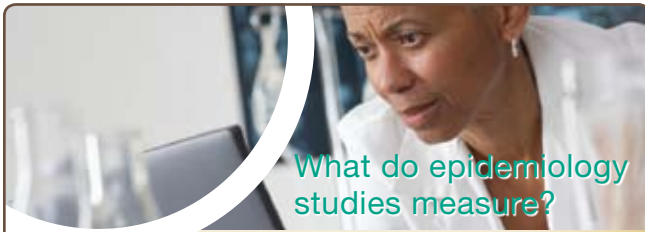


Studies in cells and tissues – These studies involve exposure of isolated cells and tissues in the laboratory to EMF. Scientists then compare the characteristics of exposed and unexposed samples to look for differences that may indicate a disease process. These studies are limited because what happens in cells or tissue outside a human body may not be the same as what happens inside a body.



Who reviews the research?

Numerous national and international organizations responsible for public health have reviewed the research on EMF. They have convened panels of scientists with knowledge in the relevant disciplines to conduct weight-of-evidence reviews (see box below). These panels have weighed the evidence critically to come to a conclusion about whether EMF exposure causes disease.



What do epidemiology studies measure?

Epidemiology studies report “associations,” or how the exposure and disease vary together in the study population. The results from epidemiology studies are valuable because they are conducted in humans. The results of these studies, however, can often be conflicting. This is because epidemiology studies observe people in their natural environments, with no control over their exposures and other factors that affect their health, which can lead to uncertainty in the studies’ findings. This is why the results from experimental studies in the laboratory must be considered alongside the findings from epidemiology studies to evaluate whether there is a true relationship between the exposure and disease.

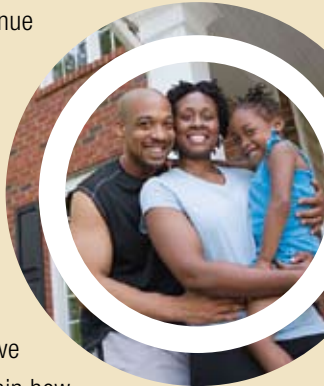
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Scientific agencies that are paying close attention to the possible health effects of EMF exposure:

- WHO:** The World Health Organization
- NIEHS:** National Institute of Environmental Health Sciences
- IARC:** International Agency for Research on Cancer
- HPA:** Health Protection Agency of Great Britain
- HCN:** Health Council of the Netherlands

What did these scientific panels conclude?

The conclusions of these scientific panels, overall, have been consistent. The WHO, whose mandate is to provide leadership on global health matters, released an extensive review in June 2007, after more than 10 years of intensive study and consideration. The conclusions of the WHO report and reports by other agencies can be summarized as follows:

- Overall, the scientific evidence does not demonstrate that exposure to EMF causes any disease.
- A weak association exists in epidemiology studies between childhood leukemia and average exposure to higher levels of magnetic fields to which few persons are exposed. These epidemiology studies have recognized limitations and research will continue to clarify this finding.
- Studies in animals have not supported a conclusion that magnetic fields cause leukemia or any other cancer.
- Studies conducted in the laboratory on cells and tissues have not found any mechanism to explain how magnetic fields could cause disease in humans.
- Because the epidemiology studies have limitations and the experimental studies provide little or no support for an association with cancer, the WHO did not conclude that magnetic fields cause childhood leukemia, or any other disease.
- Considering all of the research together, the reviewers for the WHO and other agencies have not concluded that magnetic fields cause any long-term, adverse health effects. Additional research on focused topics was recommended.



Should any precautions be taken to reduce exposure to EMF?

Since the research has not confirmed any diseases, scientific organizations have not recommended taking drastic or costly measures to reduce exposures. For example, they have not recommended exposure limits in the range of EMF levels that we encounter from everyday sources because the benefits of exposure reduction are unclear. They do recommend, however, taking steps to reduce exposure that are convenient and low in cost. An example of a low-cost precautionary measure is the construction of two transmission lines together - a double-circuit design - that allows for partial cancellation of magnetic fields because of the close proximity of the two circuits.

Where can I find more information?

For more information from PSE&G about EMF, call **1-888-797-7873**.

A fact sheet that describes the main findings of the WHO report is available at:

www.who.int/mediacentre/factsheets/fs322/en/index.html

The NIEHS 2002 report on EMF is available at:

www.niehs.nih.gov/health/docs/emf-02.pdf

The National Cancer Institute provides information on risk factors for cancer and how this disease can be prevented at:

www.cancer.gov/cancertopics/wyntk/overview/page4

The National Cancer Institute also provides a discussion of the research on magnetic fields at:

www.cancer.gov/cancertopics/factsheet/Risk/magnetic-fields

Exponent

This brochure was prepared by epidemiologists and biological scientists in the Health Sciences practice of Exponent, Inc., a leading firm in scientific and engineering disciplines.



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