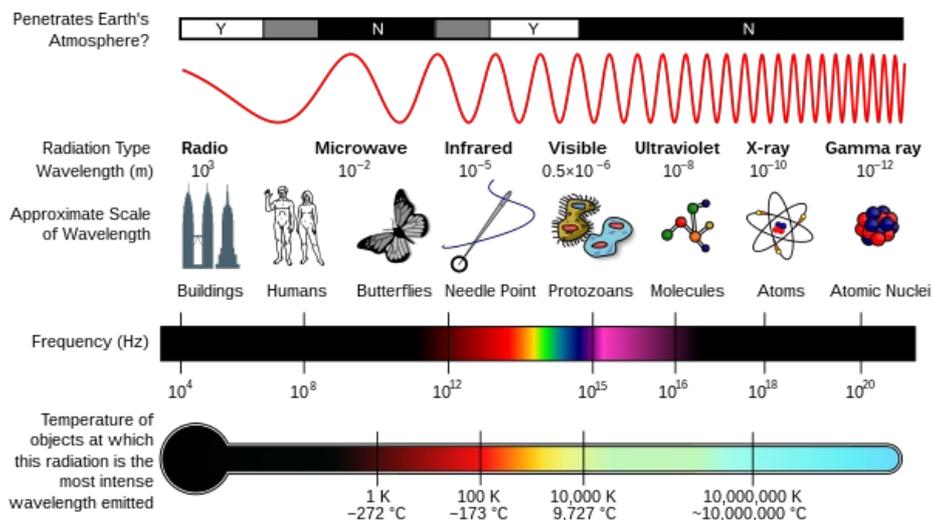


Interactions of electromagnetic fields with living matter

The interactions that can be studied between electromagnetic fields and living matter are divided into two main groups. The interactions that produce thermal effects and the ones that do not produce thermal effects. Non thermal effects are produced with frequencies in the order of MHz (10^6 Hz) or below. Every EMF that exceeds this order will cause thermal effects, that include the burning of living tissue.



We can see here the different types of radiation an EMF might have. Everything above the 10^6 , being $0 < x < 10$ is considered an EMF that causes thermal effects.

CLASS	FREQUENCY	WAVELENGTH	ENERGY
Y	300 EHz	1 pm	1.24 MeV
HX	30 EHz	10 pm	124 keV
SX	3 EHz	100 pm	12.4 keV
EUV	300 PHz	1 nm	1.24 keV
NUV	30 PHz	10 nm	124 eV
NIR	3 PHz	100 nm	12.4 eV
MIR	300 THz	1 μ m	1.24 eV
FIR	30 THz	10 μ m	124 meV
EHF	3 THz	100 μ m	12.4 meV
SHF	300 GHz	1 mm	1.24 meV
UHF	30 GHz	1 cm	124 μ eV
VHF	3 GHz	1 dm	12.4 μ eV
HF	300 MHz	1 m	1.24 μ eV
MF	30 MHz	10 m	124 neV
LF	3 MHz	100 m	12.4 neV
VLF	300 kHz	1 km	1.24 neV
VF/ULF	30 kHz	10 km	124 peV
SLF	3 kHz	100 km	12.4 peV
ELF	300 Hz	1 Mm	1.24 peV
	30 Hz	10 Mm	124 feV
	3 Hz	100 Mm	12.4 feV

Definition of EMF

"EMF stands for electromagnetic fields. Radio waves are one form of EMF. So is ordinary light. Electromagnetic fields are produced by every electrical or electronic device. This includes electrical wiring and power lines, computers, televisions, wireless devices such as cell phones and WiFi devices, microwave ovens, all forms of broadcasting including AM, FM, and TV, etc. Visible light as well as invisible forms such as infrared, and ultraviolet, X-Rays, and gamma rays are also forms of EMF."

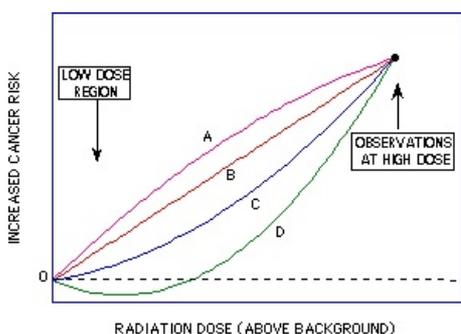
Interaction of weak EMF on living matter (issues)

Effects on the cell membrane

The interaction of weak EMF (EMF just a little above the background levels) on living matter can cause various effects, mostly due to the inward leakage of calcium ions of the cell membrane, which is the main effect of the weak EMFs. By causing this gradient of ions, which is a natural occurrence if the cell itself is receiving membrane

damage, it causes initially the cell to heal the tissue, providing a small growth in the tissue.

However, like all effects of EMF on living tissue, if exposed for too long, these healing mechanisms are surpassed and the tissue itself will start to malfunction and radiation hormesis (an hypothesis that states that although short expositions to weak EMF are beneficial, long term exposition is hazardous) occurs.



(4 is hormesis, the hypothesis used to aid explain beneficial EMF effects)

Effects in gland cells

Gland cells are a good example of this hypothesis, short term exposition to a weak EMF of this epithelial tissue stimulates their growth and production of hormones, but long term exposition to this EMFs causes malfunction in the production of hormones. This results in hypothyroidism and subsequently an increase in the general obesity of the population.

Effects in nerve tissue

In nervous tissue, most noticeably in brain neurons, this inward calcium leakage caused by weak EMFs stimulates hyperactivity, that can be turned into a attention deficit hyperactivity disorder (ADHD). This lack of attention can, in case of children, cause autism and other nervous system disorders.

Effects on the biomolecule of DNA

The damage can be caused to DNA, either by leakage of content of lysosomes to the cellular matrix because of the damage to the membrane of lysosomes or by the release of radical oxygen species that can interact directly with the molecules of DNA. Both of these factors can cause mutations in the DNA by changing its structure and atoms, resulting in higher chance of producing cancerogenic cells. Another content of lysosomes that can be leaked and reach the matrix of the nucleus is the enzyme DNAase. This enzyme has the function to destroy DNA, and if in contact with DNA, it will destroy the hydrogen bond and result in a change of information in the DNA that can result in cancer, hyper or hypo trophy.

Explanation of the inward calcium ions leakage

The inward calcium leakage can be explained as a phenomenon that happens in the cellular membrane. ELF (extremely low frequency) currents that flow throughout the tissue due to EMFs intervention on these have a preference to cause the removal of calcium ions from the membrane. This reaction, described as inward calcium ion leakage, may cause the problems listed above. In normal circumstances, this ELF current do have a beneficial intervention, stimulating the growth of the tissue in a small quantity, but if in constant exposition to the EMF, one may suffer from inhibition of this growth and repair of tissue, due to the excess of energy needed to repair the tissue. In this cases, permanent damage to the tissue may occur.

Interaction of weak EMF on living matter (benefits)

Although in high quantities of weak EMF cause problems associated mainly with the cell membrane, if in localized and in short-term exposition, it may cause benefits.

Interation of weak EMF on (cancer) cells (in vitro observation)

After exposing cancer cells to an EMF in the Megahertz range and with a power of 0.25 Watts, during two hours, the Department of Haematology and Oncology at the University of Hannover observed that the cells suffered an initial aggregation and later a necrosis. Other similar experience is done and repeated many times since 1970 when it was first noticed. If neoplastic HeLa cells are stimulated with the power of 0.25 and using a weak EMF on the tissue during three hours, it can be observed the same that was described above, the HeLa cells will merge in groups of 5 at maximum. After a while their necrosis will happen, leading to a conclusion that the low EMFs cause a change in the cell membrane that stimulates aggregation and fusion of cells, followed by their necrosis. This research has proved to be a step forward in new ways of eliminating cancerogenic cells (if used in long term expositions).

The intracellular changes verified in these cells were the following:

Increase in the alteration level of cytoskeleton fiber in relation to the control cells, demonstrating a higher change in orientation;

Change in the mitochondrial matrix, showing lack of homogeneity compared to the control cells;

Presence of autophages in many cells;

Furthermore, it could be observed Chromatin degeneration, thickening of the chromatin at the nuclear membrane level, nucleus vacuolization and mitochondrial degeneration.

Pulsed EMF therapy

Pulsed electromagnetic field therapy (PEMFT), also called pulsed magnetic therapy, pulse magnetotherapy, or PEMF, is a reparative technique most commonly used in the field of orthopedics for the treatment of non-union fractures, failed fusions, congenital pseudarthrosis and depression. It relies on the usage of Pulses of the EMF, by using the magnetic field to pulse electric signals into the tissue and cell. This pulses simulate the kind of feedback a tissue would receive to start tissue healing. this technique is used by physicians to cure diseases and conditions such as chronic pain, depression, edemas and fractures.



Drolet's 1990 Rhumart system, a PEMF device.

Links

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<http://www.consumerhealth.org/articles/display.cfm?ID=19990303201129>

External links

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