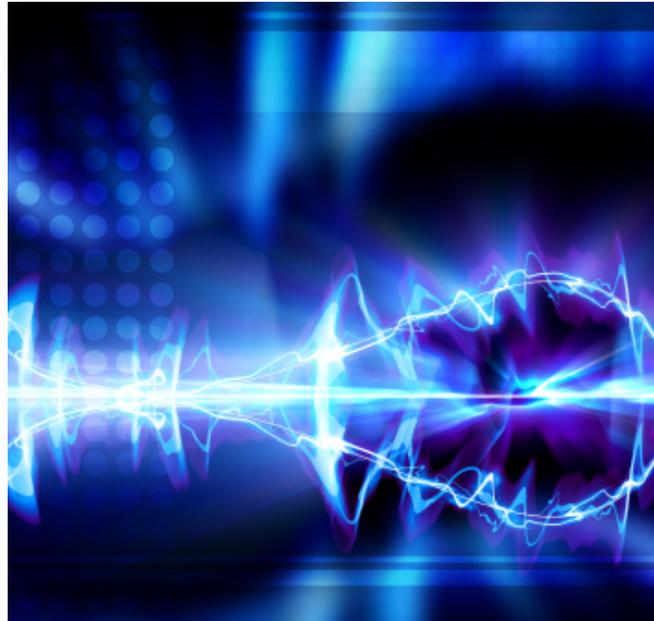


International Institute for
Bau-biologie® & Ecology

IBE 204.3

IBE 204.3 ELECTROMAGNETICS



**BRINGING TOGETHER TECHNOLOGY AND DESIGN
METHODS TO PROVIDE THE INFORMATION
NEEDED TO CREATE HEALTHY HOMES AND
WORKPLACES**



Electromagnetic Radiation – IBE 204.3

Welcome

*Thank you for choosing IBE for your educational needs. Current environmental realities demand a new approach to ensuring that our homes, schools and office buildings support the health and wellness of all who dwell there. We strive to provide the latest information and cutting edge methodology on the vital, complex relationship between the natural and the built environments. May you find your educational experiences enlightening, and take this knowledge out into your community for the benefit of all. **Michael Conn**, Executive Director, Institute for Bau-Biologie & Ecology.*

Course Navigation

You will find that it is very easy to navigate through this course.

- Progress through the lessons using intuitive navigation tools. When you study, make sure to be aware of and use all supporting materials, such as pdf files, video and audio clips, links to other websites or relevant articles or papers, as well as the online forum.
- The last lesson will give you the option of downloading an electronic version (PDF) of the course. Please be aware that this information is copyright protected.
- When finished, you will be ready for the test. These tests are "open book" and are designed to help you evaluate your understanding of the subject.
- When you have finished the entire Course Pack, a Certificate of Completion is available on-line.

By using the Forum feature, students can share information and solve problems. We would like to see truly interactive discussions take place.

Please be advised that links to third party information may not reflect or support the Building Biology viewpoint. However, it might be of some interest to see how other people, groups, institutions, etc. argue the same subject.

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Lesson 1 – Introduction

In this course module, we will study electromagnetic radiation and how its various types of energy affect human well-being. Though the term sounds rather scientific, it is an integral part of our everyday living environment. Electromagnetic energies come in many different forms ranging from natural sources including sunshine, UV radiation and the earth's magnetic field and from man-made sources such as power lines, cellular phones and microwave ovens. They have a physiological effect on brain wave patterns, heart beats and nerve signals.

The building biology approach is unique insofar as it has established the first guidelines for sleeping areas to ensure long-term health. The recommendations are inspired by beneficial radiation patterns in nature and based on the latest scientific findings. The discussion follows the procedures as set out in the Standard of Building Biology Testing Methods. This information is subdivided into the following subject areas:

- **Basic Physical Properties:** Some basic laws and properties of electromagnetism and radiation are reviewed to refresh the student's knowledge in fundamental units and workings necessary for understanding the complex nature of interactions between electromagnetic radiation and living organisms.
- **Sources and Causes:** Common sources of electromagnetic radiation in our living environment are presented, specifying their general causes, distribution patterns and field characteristics.
- **Biological Effects:** Known biological effects caused by electromagnetic radiation as well as suspected ones are discussed.
- **Building Biology Testing Methods:** General principles and procedures specific to EMR testing methods in building biology are outlined.
- **Recommendations and Remediations:** Recommendations for how to reduce or eliminate one's exposure to harmful electromagnetic radiation in our living environment. Appropriate remediation strategies and shielding options are also presented.

Thereafter we will discuss official guidelines and exposure limits and how they compare with the ones established by building biology.

We will conclude with general considerations for EMR surveys performed in sleeping areas, on properties, at workplaces and for building materials.

The special requirements for a low-EMR wiring design are dealt with in a separate course module called "Residential Wiring Systems".

In the appendix, you will find the Standard of Building Biology Testing Methods summarizing the procedures required for the various testing methods and the current Building Biology Guidelines for Sleeping Areas detailing the recommendations for exposure limits. There you can also look up tables that show typical exposure levels of the various electromagnetic energies occurring in our living environment, highlighting the information given in the respective chapters.

Note of Caution

The study of this particular course unit or the completion of the entire correspondence course does by no means qualify the successful student to perform professional EMR testing and consulting. However, the student is empowered to locate common problems and make helpful recommendations for the acquisition of new electrical appliances and the installation of new wiring systems. In order to assess an individual risk properly, precise measurements would have to be taken. Anyone interested in becoming a building biology testing specialist is encouraged to contact the International Institute for Bau-biologie' and Ecology (IBE), Florida, for training and certification.

Radiation Climate: Past and Present

Various types of electromagnetic radiation sustain life on earth. In nature the quantity and quality of the many different electromagnetic energies surrounding us and flowing through us follow a very distinct pattern. It all starts with the sun. Though the sun gives off energy throughout the entire electromagnetic spectrum, only certain types penetrate the protective layers of the earth's atmosphere.

We can see with our eyes that visible light is invited and we can feel on our skin that heat (infrared radiation) is also allowed in – both frequencies are essential to life. Most ionizing radiation, however, beginning at the upper end of the UV radiation, is fortunately absorbed through the ozone layer protecting life on earth from its damaging effects. There is another protective shield, the so called ionosphere, which absorbs most of the non-ionizing radiation at the lower end of the electromagnetic spectrum. This comes with a large radio window, allowing whispers from the farthest corners of our galaxy (pulsars, quasars) to reach us.

Underneath these atmospheric covers, the earth itself also gives off various types of electromagnetic energies. Wrapped in the fold of its own magnetic field, the earth keeps a more or less steady beat so essential to the rhythm of life.

In the course of evolution, all living organisms have adapted themselves to this very unique radiation climate prevalent on planet earth. This natural balance is being threatened now because over the last 100 years humans have been very busy adding their own versions of electromagnetic energies without giving due considerations to the biological implications.

In science, the damaging (toxic) effects of ionizing radiation such as high-energy radiation in the form of X-rays, gamma rays and particle radiation as well as ultraviolet radiation (UV) are rather well understood, even at very low dosages. However, non-ionizing types of electromagnetic radiation such as radar radiation, radio frequency radiation (RF), laser rays as well as power frequency radiation (ELF) and static electric and magnetic fields can also have detrimental biological effects at amazingly low exposure levels. This holds especially true for situations where low exposure levels are combined with long periods of exposure. Though this mechanism is very poorly understood, highly industrialized countries keep producing more and more emitters of non-ionizing radiation (e.g. cellular phones, digital TV, home electronics). Even at low levels this starts to add up and poses a risk for human health, which should not be underestimated. This new kind of pollution is referred to as “electromagnetic pollution”.

Our daily dosage of electromagnetic radiation continues to be on the increase – due to natural as well as human-made sources. Natural sources include, for example, increasing amounts of UV radiation because the protective ozone layer in the stratosphere continues to be depleted. We also expose ourselves to more high-energy radiation or radioactivity from natural (e.g. high-altitude air travel) as well as human-made sources (medical X-ray exams). And in our everyday living environment, we expand our usage of wireless communication (microwaves), entertainment (radio waves), electricity (power frequency), synthetic materials (static electricity) and magnetized metals (static magnetism).

Generally speaking, potential risks can be detected and assessed. In most cases the exposure level can be drastically reduced or even eliminated with comparatively little effort and without having to sacrifice the luxury and convenience of electricity.

Most of our living spaces and workplaces have exposure liability due to some form of undesirable electromagnetic radiation, especially from the lower end of the electromagnetic spectrum including magnetic and electric fields (ELF) as well as radio and microwaves (RF). In building biology, we are concerned with EMR under exposure, especially from natural sources; EMR over exposure, particularly from human-made sources, and EMR exposures foreign to our natural settings. The individual dosage is determined by the following external factors:

- Site and Location of Building,
- Building Materials,

- Type of Construction,
- Type and Amount of Electrical Appliances and Installations.

Since modern humans spend most of their time indoors or in cars, away from the natural background radiation, they find themselves more often cut off from this life-sustaining stream of natural electromagnetic information. In exchange, we surround ourselves with many more electronic gadgets that put out radio frequency energies as well as alternating and static electric and magnetic fields into forms which rarely occur in nature. This unnatural radiation climate leads on the one hand to natural radiation deficiency and on the other hand to unnatural radiation stress. To counter the effects of these stressed man-made sources it is highly recommended by building biologists to spend as much time in undisturbed nature as possible to give one's body and mind a chance to rest and heal.

In our modern world, the rapid development and broad usage of electric and electronic equipment unfortunately stands in stark contrast to our limited knowledge base of radiation biology and all of its consequences. In a society, which acknowledges the human right to a life of dignity, preventive health care strategies and responsible actions for future generations should be at the top of the global health agenda. However, in the area of radiation biology, more health-centered research and holistic-minded specialists (e.g. Building Biology Consultants) are needed not only to interpret the available data, but above all to help create a safe and healthy living environment for everybody.

It is the mission of the Building Biology Online Study Program to educate, encourage and empower interested individuals and organizations in how to create and sustain healthy living and work spaces in harmony with nature. The detailed knowledge of our electromagnetic realities and the conscious awareness of the electromagnetic interactions between cosmos, earth and living organisms will encourage the student to make responsible use of the vast electromagnetic resource for the benefit of all.

Lesson 2 – Radiation Biology

Radiation biology is an interdisciplinary branch of science, which deals with the effects of radiation on living tissues and organisms. In general, radiation biology is understood as radiobiology, which only looks at effects caused by the ionizing section of the electromagnetic spectrum. Another classic branch of radiation biology is photobiology, which studies the interaction of living organisms with visible light and ultraviolet radiation.

In building biology, we extend the term radiation biology to other parts of the non-ionizing section of the electromagnetic spectrum to keep a holistic perspective. One such important study area of radiation biology is electrobiology. Its main focus lies in the interaction between living organisms and non-ionizing electromagnetic energy in the form of magnetism, electricity and radio frequency radiation. In biology the study of the electrical phenomena associated with a cell are also referred to as bioelectricity. Geobiology is also included here. This research area is concerned with the biological effects triggered by changes in the natural background radiation of the earth.

First of all, we will have a closer look at the various research tools used by natural science to study the biological effects of electromagnetic radiation.

Epidemiological Studies

Epidemiological studies look at the available data of a disease or death register in relation to defined exposure levels of radiation. People are classified into several groups depending on their radiation dosage received. An unexposed or control group is also assigned.

Human Studies

In a laboratory setting, test persons are exposed to electromagnetic fields, whose parameters are all exactly known. Then the impact on physiological functions (e.g. heart rate, pulse rate, EEG, ECG, changes in blood, urine or hormone levels) as well as psychological events (e.g. emotions and perceptions) are monitored.

Animal Experiments

In a laboratory setting, test animals are divided into several groups, which are exposed to well-defined but varying levels of electromagnetic radiation. Investigators strive to have the exact same test conditions (food, lighting, temperature, etc.) for the unexposed control group.

Cell Experiments

Cell cultures such as cancerous cells, bacteria or yeasts are exposed to specific external electromagnetic radiation. Parameters tested for include growth and metabolic processes as well as changes in chromosomes.

Statistics Assessments

The result of a study is expressed as a risk factor, stating for instance how much higher the risk of attracting a disease is in comparison with the control group. The risk ratios reported by such studies are understated because even the control group is exposed to some man-made electromagnetic radiation.

Formulation of Plausible Mechanisms

In order to have a hypothesis, emerging from an experiment or a series of experiments, recognized by the scientific community, a plausible mechanism of how things work also needs to be presented. Such a model will then allow predicting the outcome of further experiments. If it can be validated often enough, it will become established theory.