

Electromagnetic Radiation Fundamentals



Bringing together technology and design methods to provide the information needed to create healthy homes and workplaces.



INTERNATIONAL INSTITUTE FOR
BUILDING-BIOLOGY® & ECOLOGY



Welcome

We are very pleased and thankful for your participation, through enrolling in this course, in helping us fulfill our vibrant mission: To create a global village of awareness about the vital interconnection among the indoor environment, human health, and planetary wellness. 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 most up-to-date science, technology, and cutting edge methodology for achieving built environments with nature as the golden rule. May you find your educational experiences enlightening, and we encourage you to take this knowledge out into your community for the benefit of all.

Sincerely,

A handwritten signature in black ink that reads "Michael Conn". The signature is fluid and cursive.

Michael Conn
Executive Director
International Institute for Building-Biology® & Ecology

Course Navigation

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

- Progress through the lessons using intuitive navigation tools. While you study, make sure to be aware of and use all supporting materials, such as pdf files, video and audio clips, and links to other websites or relevant articles or papers.
- 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 with your studies, you will be ready for the online exam. These tests are "open book," designed to help you evaluate your understanding of the subject matter.
- When you have finished the entire Course Pack, a Certificate of Completion is available for download online (look for the hyperlink, in **red** typeface). Should you encounter difficulty in downloading your certificate, a step-by-step guide can be access by clicking [here](#).

Please be aware that links to third party information herein this course might not reflect or support the Building Biology viewpoint. We include them to provide you with a view as to how other people, groups, institutions, etc. present and/or argue the same subject.

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Contents

Lesson 1 – Introduction	2
Lesson 2 - Radiation Climate: Past and Present.....	3
Lesson 3 – Basic Properties of Electromagnetic Radiation.....	5
Radiation Biology.....	5
Electrobiology.....	5
Radiobiology.....	5
The Electromagnetic Spectrum.....	6
Static Electric and Magnetic Fields	6
Sources and Causes of Electrostatic Fields (Electrostatics).....	7
Biological Effects of Air Ionization	8
Biological Effects of Static Magnetic Fields.....	8
Lesson 4 – Electric Fields and Magnetic Fields.....	10
Overview of AC Electric and AC Magnetic Fields	10
Alternating Electric Fields (AC)	11
Alternating Magnetic Fields (AC)	11
Sources and Causes of AC Electric and AC Magnetic Fields	12
Sources of AC Electric Fields Inside the Home.....	13
Alternating Magnetic Fields (AC)	14
Sources of AC Magnetic Fields inside the Home	14
Sources of AC Magnetic Fields outside the Home	14
Biological Effects of AC Electric and Magnetic Fields.....	15
Alternating Electric Fields (AC)	16
Alternating Magnetic Field	16
Recommendations for AC Fields.....	17
Lesson 5 – Overview of RF Radiation	17
Overview of RF Radiation	17
Sources and Causes of RF Radiation	18
Biological Effects as the Result of RF Radiation.....	19
Recommendations for RF Radiation.....	20
Lesson 6 - Radioactivity & Radon.....	21

Radon..... 22

Sources and Causes of Radioactivity and Radon Gas 22

External Radiation Exposure..... 22

Internal Radiation Exposure 22

Radon in Buildings..... 23

Artificially Produced Radioactivity 23

Biological Effects of Radioactivity Exposure..... 23

Recommendations for Radioactivity Radiation..... 24

Sources and Causes of Terrestrial Radiation..... 24

Biological Effects of Terrestrial Radiation..... 25

Symptoms of Geopathic Stress..... 26

Recommendations for Earth Radiation 27

Guidelines and Exposure Limits..... 27

Glossary 29

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 introduce the student to the 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.
- *Some General Recommendations:* Recommendations for how to reduce or eliminate one's exposure to harmful electromagnetic radiation in our living environment.

Note of Caution

The study of this particular course unit by no means qualifies the successful student to perform professional EMR testing and consulting. However, the student is empowered to identify common problems and make helpful recommendations. Anyone interested in becoming a building biology testing specialist is encouraged to contact the International Institute for Building Biology & Ecology (IBE) for training and certification 866-960-0333.

Lesson 2 - 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 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 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 surprisingly low exposure levels. *This holds especially true for situations where low exposure levels are combined with long periods of exposure.* Despite a

growing body of peer reviewed research showing negative cellular level health effects¹, 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 natural background radiation, they find themselves more often cut off from this health-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.

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

¹ See *Cell Phones: Unhealthy at Any Speed*, Course #204.9