Scientist rearranged the whole electromagnetic waves according to wavelength and frequency in a chart called the “electromagnetic spectrum”.

**Matter in quantum physics:**
In quantum mechanics physics the matter considered as wave according to deBroglie formula:

$$\lambda = \frac{h}{p}$$

where, $h$ is the Planck's constant.

$p$ is the momentum.

$\lambda$ is the wavelength.

**Matter in modern theories: (Boher model)**

- Matter consists of molecules.
- Molecules consists of atoms.
- Atoms consists of electrons rotate around a nucleus.
Nucleus consists of positive charged particles called “protons” and neutral particles called “neutrons”.

Atom in ground state:

the atom in ground state each electron rotate around the nucleus in a definite orbit. The orbit near the nucleus is much larger than the orbit far from the nucleus.
Dr. Alaa E. Kotp

Atom in excited state:

By absorbing energy normally from an electromagnetic radiation the electron move to higher orbit for some time then it go back to its orbit and loose the extra energy as a photon (electromagnetic radiation).

**Laser:**

Laser is some kind of light which mean its an electromagnetic wave.
LASER is an abbreviation of Light Amplification Stimulated Emission Radiation.
It produced by a device consists of a ruby cylinder and two mirrors one is completely reflecting and the other is semi-reflecting.
A light is flashed into the ruby cylinder which excite the ruby atoms the the excited atoms loose their energy as electromagnetic radiation and it resonate between the mirrors until it become very power full and comes out as LASER.
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**X-ray:**

![Diagram of X-ray process]

is an electromagnetic it produced by the device shown the filament (K) bombard the material plate (A) by high energy electrons which make the inner electrons of atoms in the plate (A) excited, then it come back to ground state loosing the high energy as an electromagnetic radiation called “X-ray”.

-X-ray used in the radiography medical imaging

**Nuclear radiation:**

In some material the nuclei of the atoms is not stable to become stable

-It radiate a high energy electromagnetic radiation called ”Gamma ray”. 
- It can also produce particles called “alpha particles” which are heavy positive particles.

- It can also produce particles called “Beta particles” which are light negative particles.

These three kinds of emitting are called “Nuclear Radiation.”
Dr. Alaa E. Kotp

Nuclear Radiation Protection:

Scientists study these emitting in order to know how to protect from them and they found that:

**Alpha particles:** can be stopped by only a sheet of paper.
**Beta particles:** can be stopped by a sheet of aluminum.
**Gamma ray:** can be stopped by thick plate of lead

interaction of Nuclear Radiation with matter:

\[
I = R + A + T
\]

when nuclear radiation incident on matter some of the incident radiation (I) reflect (R) and the other is absorbed (A) and the other is transmitted (T). so the interaction given by the equation:

\[
I = R + A + T
\]
Medical uses of Radiation:

There are two main uses of Radiation:

1st the Radiology:
in which the radiation used as diagnosis technique in medical imaging by:

1- X-ray:
in this technique the X-ray is used to image the body of the patient.

2- Computer tomography CT:
in this technique the computer build a 3D image from large series of 2D X-ray images is taking around a single axe.

3- Positron Emission tomography PET:
in this technique a beam of positrons is used to image the patient. After given him or her a nuclear radiative medicine.

4- Magnetic Resonance Imaging MRI:

in this technique the principle of “Magnetic resonance” is used to image the patient.

Magnetic Resonance Principle:

The body is mainly composed of water molecules which each contain two hydrogen nuclei or protons. When a person goes inside the powerful of the scanner these protons align with the direction of the field.

A second radio frequency electromagnetic field is then briefly turned on causing the protons to absorb some of its energy. When this field is turned off the protons release this energy at a radio frequency which can be detected by the scanner.
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5-Gamma Camera:

in this technique the gamma rays is used to image the patient after a nuclear medicine is given to him or her.
2nd the Radiation Therapy: in which the radiation is used as medication such as:

1- ENCOLOGY or XRT: in this technique the Nuclear Radiation used in damaging the DNA of the tumor cells as a Cancer treatment.

For example the Gamma Knife: in which the Gamma rays is used to treat the Brain Cancer by subjecting a power full gamma rays to damage the DNA of Cancer cells in the brain.