

UV Radiation

That portion of the electromagnetic spectrum extending from the violet, or short-wavelength, end of the visible light range to the X-ray region. Ultraviolet (UV) radiation is undetectable by the human eye, although when it falls on certain materials it may cause them to fluoresce—i.e., emit electromagnetic radiation of lower energy, such as visible light. Many insects, however, are able to see ultraviolet radiation.

Ultraviolet radiation lies between wavelengths of about: 400 nanometres (*1 nanometre [nm] is 10^{-9} metre, or 10 angstrom units*) on the visible-light side and about: 100 nm on the X-ray side, though some authorities extend the short-wavelength limit to: 4 nm.

In physics, ultraviolet radiation is traditionally divided into four regions:

1. near (400–300 nm),
2. middle (300–200 nm),
3. far (200–100 nm), and
4. extreme (below 100 nm).

In biology, three conventional divisions have been observed:

1. near (400–315 nm), which is absorbed relatively poorly by organisms;
2. actinic (315–200 nm), which is absorbed most readily by organic matter and thus has the greatest effects on organisms; and
3. vacuum (less than 200 nm), which is absorbed by most substances, including nitrogen in the air, and so is of little use in biological experimentation.

Based on the interaction of wavelengths of ultraviolet radiation with biological materials, three divisions have been designated:

1. UV A (400–315 nm), also called black light;
2. UV B (315–280 nm), responsible for the radiation's best-known effects on organisms; and
3. UV C (280–100 nm), which does not reach the Earth's surface.

Ultraviolet radiation is produced by high-temperature surfaces, such as the Sun, in a continuous spectrum and by atomic excitation in a gaseous discharge tube as a discrete spectrum of wavelengths.

Most of the ultraviolet radiation in sunlight is absorbed by oxygen in the Earth's atmosphere, which forms the ozone layer of the lower stratosphere.

Of the ultraviolet that does reach the Earth's surface, almost 99 percent is: UV A radiation.

When the ozone layer becomes thin, more UV B radiation reaches the Earth's surface and may have hazardous effects on organisms.

Unlike X rays, ultraviolet radiation has a low power of penetration, hence its direct effects on the human body are limited to the surface skin. The direct effects include:

- reddening of the skin (sunburn),
- pigmentation development (suntan),
- aging, and
- carcinogenic changes.

Ultraviolet sunburns can be mild, causing only redness and tenderness, or they can be so severe as to produce blisters, swelling, seepage of fluid, and sloughing of the outer skin. The blood capillaries (*minute vessels*) in the skin dilate with aggregations of red and white blood cells to produce the red coloration.

Tanning is a natural body defense relying on melanin to help protect the skin from further injury.

Melanin is a chemical pigment in the skin that absorbs ultraviolet radiation and limits its penetration into tissues. A suntan occurs when melanin pigments in cells in the deeper tissue portion of the skin are activated by ultraviolet radiation, and the cells migrate to the surface of the skin. When these cells die, the pigmentation disappears.

Persons of light complexion have less melanin pigment and so experience the harmful effects of ultraviolet radiation to a greater degree. The application of sunscreen to the skin can help to block absorption of ultraviolet radiation in such persons.

Constant exposure to the Sun's ultraviolet radiation induces most of the skin changes commonly associated with aging, such as wrinkling, thickening, and changes in pigmentation. There is also a much higher frequency of skin cancer, particularly in persons with fair skin.

The three basic skin cancers:

1. basal- and squamous-cell,
2. carcinoma, and
3. melanoma

have been linked to long-term exposure to ultraviolet radiation and probably result from changes generated in the DNA of skin cells by ultraviolet rays.

Ultraviolet radiation also has positive effects on the human body, however. It stimulates the production of vitamin D in the skin and can be used as a therapeutic agent for such diseases as psoriasis.

Because of its bactericidal capabilities at wavelengths of: 260–280 nm, ultraviolet radiation is useful as both a research tool and a sterilizing technique.

Fluorescent lighting, which exploits the ability of ultraviolet radiation to interact with materials known as phosphors and cause the emission of visible light, is a highly efficient form of artificial lighting.