Radioactivity: Questions and answers

1 How can you protect yourself against radiation?

- Limit your exposure. The shorter the time spent near a source of radiation, the lower the radiation dose a person receives. Brief contact with even the most powerful X-ray equipment during medical procedures will not do serious harm. Lengthy exposure, however, will burn living tissue.
- Keep your distance. Radioactive emissions decrease the greater the distance from a compact source. If, at a distance of 1 metre from a source of radiation, a dosimeter shows a radiation dose of 1,000 microroentgens per hour (µR/h), the reading will be about 40 µR/h at a distance of 5 metres. This demonstrates why sources of radiation are often difficult to detect.
- Cover yourself. Put as much material substance as possible between you and any source of radiation. The larger and denser the substance, the more radiation it can absorb. In the event of indoor radiation (radon and its decay products), buildings and rooms should be well ventilated and aired out as frequently as possible.
- Know your source. Alpha radiation consists of alpha particles (the nuclei of helium atoms) that travel only a few centimetres in the air and can be rendered harmless with a sheet of paper, a mask or rubber gloves. Protection against beta radiation (a fast electron flux with a smaller dimension than alpha particles and an air-travel distance of up to several metres) requires a thin layer of aluminium, glass or acrylic glass and/or a gas mask. Metals such as steel, lead, tungsten and iron are needed to ward off gamma radiation, while water and polymers (such as polyethylene) are effective against neutron radiation.

2 How safe is a small dose?

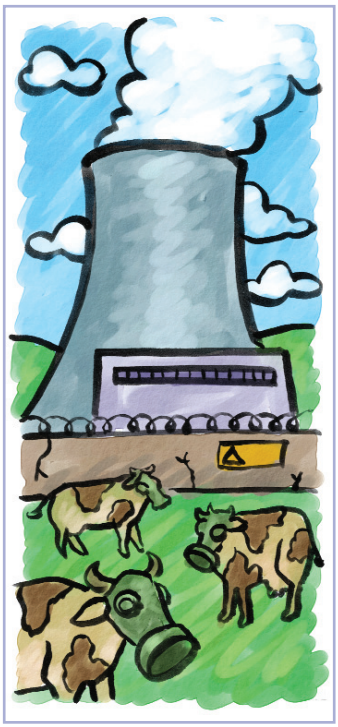
- The planet's background radiation has increased significantly in recent years. The main reasons for this are the intensive testing of nuclear weapons in the mid-20th century, the widespread use of nuclear energy, and the use of ionising radiation in different branches of the economy. All this has shifted the emphasis in radiobiological studies to the impact of radiation exposure on humans. Some scientists maintain that radiation in small doses is harmless, although this has not been proved. It is known, however, that prolonged exposure to even low doses of radiation can cause irreparable damage.

3 What is a small dose?

- There is no scientific consensus on this question. Depending on where you are on the planet, natural background levels are between 10 and 20 µR/h. Radiation levels above 100 µR/h are considered to be already dangerous.

4 What are the biological effects of low doses of radiation?

- To answer this question we need to understand how ionising radiation affects deoxyribonucleic acid (DNA). Even a single photon hit can cause permanent damage to the DNA and lead to gene mutation. Modified genetic information often leads to cell death. Since a single particle of radiation (photon) can cause irreparable harm to a living organism, any dose of radiation even slightly in excess of natural background levels is highly undesirable from a biological point of view, and can even be quite dangerous. Of course, the higher the level of radiation, the greater the risk of it getting into the structure of the DNA and the greater its potential to disrupt the genetic apparatus.
- Low or natural doses of radiation can have stimulating effects, increasing cell division, accelerating germination and even increasing agricultural yields. Chicks hatch in greater numbers and have lower mortality rates, while adult chickens gain weight more quickly and lay more eggs. Low-level radiation strengthens animals' immune systems against bacterial and viral infections.
  There is thus a range of doses of ionising radiation that can stimulate living things. However, there are scientists who argue that hormesis (a favourable biological response to low levels of toxins or stressors) can still lead to undesirable mutations in the future, although there is insufficient evidence to reach a conclusion on this. Ionising radiation is actively used in agriculture, but no one is quite sure about how crop yields are affected.



- It is suspected that higher levels of irradiation (20 to 30 units of absorbed radiation dose, or rad) are linked to chromosome damage, leukemia and other forms of cancer. It is extremely difficult to establish a true correlation because there are cancers that are not associated with exposure to radiation. It remains difficult to draw any unequivocal conclusions on this matter, and extensive research continues.
- Given that we still have much to learn about the effects of low-level radiation on the human body, it seems safe to suggest that the lower the levels of background radiation around you, the better.
- X-rays were widely considered to be safe when the new technology was introduced in the early 20th century. However, later surges in the rates of cancer have led to the avoidance of X-ray technology for standard medical examinations.