IOP Institute of Physics

Background radiation: measuring your annual dose

Information

We absorb background radiation all of the time – as did your parents and their ancestors, and even the dinosaurs. The first part of this worksheet explains where the background radiation comes from, followed by a section that enables you to work out the amount that you receive each year. You may find this frightening but, remember: it has been going on for millions of years and animal and plant species have lived with it for all of that time.

Where does background radiation come from?

There is no single origin. There are, however, four sources that are the most significant:

1 Cosmic radiation

Most of this comes from our galaxy from neutron stars, black holes and supernovae. The Sun also contributes to background radiation and some of it originates from more distant galaxies.

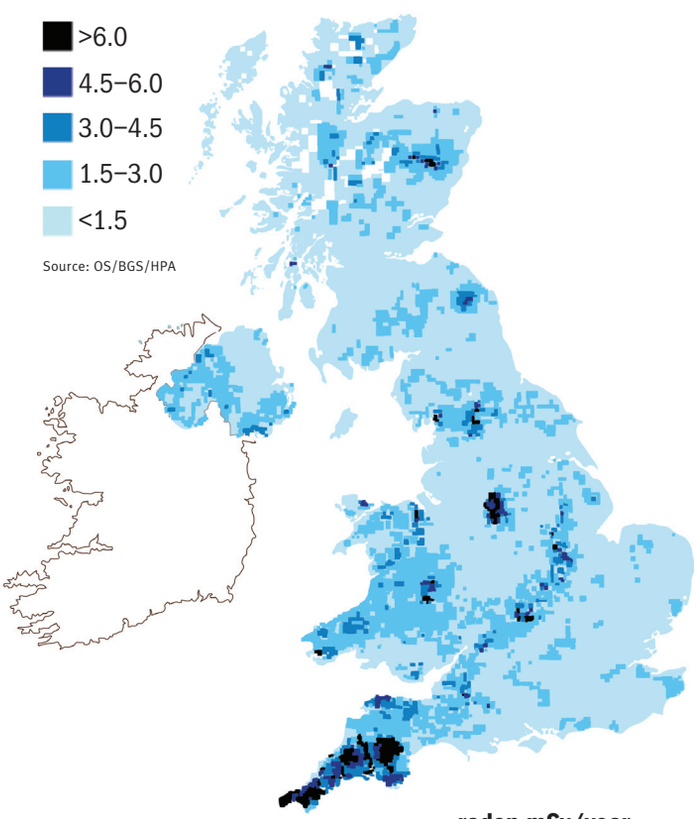
Radiation is changed and absorbed by the Earth's atmosphere, which helps to protect us from some cosmic rays. However, it provides less protection for those who are at higher altitudes. If you are travelling by aeroplane, for example, you receive an extra dose of radiation because you are approximately 9 km up in the air.

2 Food and drink

There are a few naturally occurring elements that contain a small proportion of radioactive isotopes. These are found in food and drink, with 60% of the dose coming from potassium-40. Other isotopes are also found in some specific foods. Large quantities are found in shellfish, beaten only by Brazil nuts (e.g. eating 50 per week will double your dose of radiation from food).

3 Radon

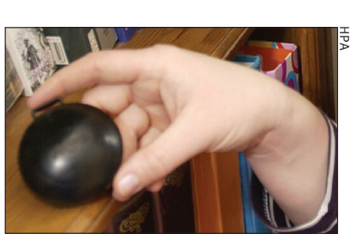
This gas is found in the Earth's atmosphere. It is produced in rocks and seeps out of the ground, collecting in some buildings. Most of the UK has low levels of radon but in some areas it can be significant. In a few locations houses are checked and, if necessary, modified to reduce the level of the gas. The map shows the average indoor levels of radiation from radon across the UK.



radon mSv/year

4 Rocks and buildings

These contain a small proportion of radioactive materials. Most of the radiation is absorbed, but some escapes into the atmosphere.


HPA


TASL

A plastic alpha detector is used to measure levels of radon in a home (left). Alpha tracks in the plastic after the detector has been exposed to gas (right).

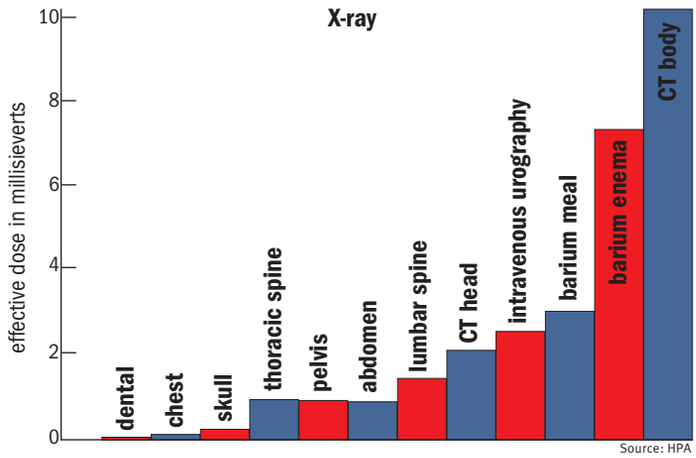
Other sources

The radiation discussed so far has always been present as natural background radiation. We also receive artificial radiation or man-made radiation, mostly in the form of medical X-rays. Some people are exposed to higher levels of radiation because of their work, particularly miners and aircrew.

The three other sources of radiation are described overleaf.

5 Medical X-rays

If you had an X-ray in the last year you will have received an additional dose. This is why doctors limit the number of X-rays, to ensure that the risk that they pose is outweighed by the benefit to us.



6 Miscellaneous sources

There is a small amount of artificial radiation produced as a result of fallout from weapons tests in the 1960s and nuclear accidents, such as at Chernobyl in 1986. The dose is declining every year.

7 Power stations

Both coal-fired and nuclear power stations emit radioactive isotopes into the atmosphere. In a coal-fired power station it is due to the presence of radioactive isotopes in coal, which are released in the burning process.


HPA

A food sample is dried before radioactive atoms (isotopes) are counted.

What is a millisievert?

1 millisievert (1 mSv) is the unit that radiation dose is measured in. The average annual dose per person in the UK is 2.5 mSv, although aircrew receive approximately 4.5 mSv on average.

Now estimate your dose. How does it compare with these figures?

Calculating your annual dose:

1 Cosmic radiation

How high do you live above sea level? At ground level the average dose is 0.25 mSv/year.

- **Add** 0.001 mSv/year for each 30 m that you live above sea level.
- **Add** 0.004 mSv for every hour that you have travelled by aeroplane in the past 12 months.

Ground level 0.25 mSv
Height above sea level ..... m
Extra dose .....
Hours travelled by aeroplane ..... hours
Extra dose .....

Total

2 Food and drink

If you eat a healthy, balanced diet, this will produce 0.27 mSv/year, but anyone who consumes an excessive amount of shellfish or Brazil nuts will increase their radiation dose by approximately 0.1 mSv/year.

3 Radon

Find your home on the map. Add the relevant radon level for your area. The figure that is given is an average. It is impossible to give a more accurate level without measurement. Wherever you live this will amount to at least half of your total dose.

4 Rocks and buildings

Add 0.35 mSv/year for a brick or stone house, 0.3 mSv/year for a concrete building or 0.14 mSv/year for a wooden construction.

Property type .....

5 Medical X-rays

Have you had an X-ray in the last year? .....
Use the graph to calculate your dose.

6 Miscellaneous sources

- **Add** 0.01 mSv/year.

7 Power stations

Do you live near to a power station? .....

- **Add** 0.005 mSv if you live less than 1 mile from a nuclear power station.
- **Add** 0.0002 mSv if you live between 1 and 5 miles from a coal-fired power station.
- **Add** 0.0004 mSv if you live less than 1 mile from a coal-fired power station.

Add the appropriate dose.

Now add up all of the figures in the boxes.
My **total annual dose** of ionising radiation is:

mSv