# Background Radiation

## Starting Point

Radiation is all around us. Virtually everything emits background radiation; even bananas are slightly radioactive!

When we usually talk about radioactive things, we mean the things that give off so much radiation that they are dangerous. Background radiation is unavoidable - but is it dangerous?

There are two types of background radiation: artificial background radiation and natural background radiation.

### Measuring Radiation

Before going any further, it is important to know what you're looking for. The tasks later will ask you to find out how much radiation something gives off or receives. You'll find numbers, with some letters after them. These are the *units of radiation*.

The amount of radiation people get is measured in **Sieverts (Sv)**. You might also see **milliSieverts (mSv)** and **millirems (mrems).**

- 1Sv = 1000mSv.
- 1mSv = 100mrem.

To give you an idea, estimates for the average dose of background radiation received today, by one person in one year, range between **2mSv** and **4mSv**. This amount is perfectly safe.

### Natural Background Radiation

Even without humans building nuclear power stations or having X-Rays, there is radiation around. Natural radiation can come from some elements, or it can come from space.

Common elements that are slightly radioactive are carbon and potassium. Potassium is a metal, and carbon is what large amounts of us are made out of! On average, people contain about 30mg of radioactive potassium (we need potassium to live), and a tiny amount of radioactive carbon. Most of the carbon and potassium in us is not the radioactive type, but nevertheless *we are radioactive!*

Rarer, but much more radioactive, elements are:

- Uranium,
- Thoron,
- Radium,
- Radon.

These are usually found in rocks underground or in the air around us, which means that the ground you're standing on, the walls around you and the air you breathe are all radioactive!

Fortunately, very radioactive elements like these aren't common enough to cause problems.

# Task 1

**Find out more about Uranium, Thoron, Radium and Radon. Who discovered them? How common are they? Do we use them for anything?**

# Task 2

**The radiation you get from the Earth varies depending on where you live. Find out how radioactive each part of the UK is. Colour in the map, using your own key, to show how radioactive each area is. You can split it into "high" areas, "medium" areas and "low" areas if you like; or you could be more precise and use numbers.**

**Find out how big the radiation dose is when: 1) you have an X-Ray,**
**2) hospital equipment is sterilised.**

The other type of natural radiation is called **Cosmic Radiation**, and it comes from space. Most of it comes from the Sun and other stars, and when it hits the Earth's atmosphere it causes high-energy particles to shoot around.
The further down you go, the more the atmosphere protects you - which is why only pilots and cabin crews who are high up regularly need to consider it.

## Artificial Background Radiation

Humans have also contributed to background radiation. Since the 1940s, various countries have been setting off nuclear bombs, which cause huge amounts of radiation when they are exploded. Most have been tests, and only two have been against another country. The nuclear radiation from these bombs will be around for many years, but has faded away to become background radiation.

In the 1980s, a major incident occurred at Chernobyl nuclear power station in Russia, and this has added to background radiation today.

Every time someone has an X-Ray, or Gamma Ray treatment at hospital, the background radiation is added to as well.

These artificial sources can sound dangerous. However, on average only 20% of the radiation received in a year by a person is from artificial sources. The rest is natural.

## The Debate

Precautions are taken all the time to prevent people receiving too much background radiation, and most people don't receive a dose anywhere big enough to put them in danger.

However, some jobs can be risky unless people are careful and safety measures are in place. So who are the people in danger, and are they all aware of the possible effects of background radiation on them?

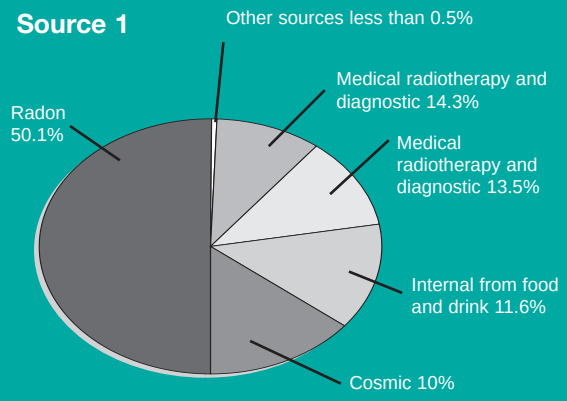
# Task 3

**Find out some of the jobs of the people in the UK who are in danger from background radiation. For each one, say why a person with that job might receive too much radiation unless they are careful. Can you find the most high-risk job?**

# opinion

Below are some sources that might help you with the tasks and the report at the end of this module. Be aware that there is more information out there and some people might disagree with each other!

**Source 1**




Sources of radiation dose to the UK population. The total annual equivalent dose is 0.0026 Sv, but individual doses vary enormously.

| | Equivalent Dose (Sv) |
|---|---|
| Dose required to sterilise medical products | 25,000 |
| Typical total radiotherapy dose to cancer tumor | 60 |
| 50% survival probability, whole body dose | 4 |
| Legal worker dose limit (whole body) | 0.02 |
| Average annual dose from all sources in Cornwall | 0.008 |
| Annual dose from natural radiation | 0.002 |
| Typical chest X-ray dose | 0.00002 |
| Average dose from a flight from UK to Spain | 0.00001 |

**From the National Physics Laboratory website.** www.npl.co.uk/publications/ionising_radiation/

**Source 2**

**DML RADIATION WORKER DOSE BREAKDOWN**

Classified Persons

| Year | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|
| Number of Persons | 476 | 563 | 594 | 573 | 571 |
| Number of Persons with Annual Dose > 0.000mSv | 378 | 537 | 534 | 559 | 547 |
| Highest Individual Dose (mSv) | 2.90 | 4.79 | 5.06 | 4.93 | 2.56 |
| Average Individual Dose (mSv) >0.0mSv (of all workers) | 0.44 | 0.68 | 0.93 | 0.88 | 0.53 |
| Total Dose man (mSv) | 211 | 382 | 556 | 503 | 302 |

**Figures from the website of DML, who run the Devonport Royal Dockyard, Plymouth.** http://www.devonport.co.uk/dose-tables2005.pdf

# opinion

**Source 3**

'The legal dose limit for adult whole-body exposure is currently 20 mSv/year, but in 1997 the average annual dose for occupationally exposed workers was 1.6 mSv with very few workers receiving doses exceeding 15 mSv. There has been a definite and sustained downwards trend in doses since 1986, for example, the average annual dose in the nuclear industry was around 0.6 mSv in 1997, compared with 2 mSv to 3 mSv in the 1980s.'

**From the website of the Department for Environment, Food and Rural Affairs.**
http://www.defra.gov.uk/environment/statistics/radioact/radoccup.htm

**Source 4**

'High radiation doses tend to kill cells, while low doses tend to damage or alter the genetic code (DNA) of irradiated cells. High doses can kill so many cells that tissues and organs are damaged immediately. This in turn may cause a rapid whole body response often called acute radiation syndrome. The higher the radiation dose, the sooner the effects of radiation will appear, and the higher the probability of death. This syndrome was observed in many atomic bomb survivors in 1945 and emergency workers responding to the 1986 Chernobyl nuclear power plant accident. Approximately 134 plant workers and firefighters battling the fire at the Chernobyl power plant received high radiation doses (70,000 to 1,340,000 mrem or 700 to 13,400 mSv) and suffered from acute radiation sickness. Of these, 28 died from their radiation injuries.'

**From the website of the U.S. Nuclear Regulatory Commission.**
www.nrc.gov/what-we-do/radiation/affect.html

**Source 5**

'All persons who work at nuclear plants are directed to keep their radiation exposure as low as reasonably achievable (ALARA). Adult workers may receive a whole body dose 5 Rem per year; minors are restricted to 0.5 Rem per year; pregnant women are restricted to 0.5 Rem during the term of the pregnancy (for protection of the embryo). For comparison, actual physical effects (minor blood changes) from radiation exposure are not expected until a person receives 25 Rem in a short period of time. Higher eye and extremity doses are allowed because these have less effect than on that part of the body containing blood-forming organs.'

**From the website www.nucleartourist.com, a guide to nuclear power stations globally by American energy consultant Joseph Gonyeau.**
http://www.nucleartourist.com/systems/rad.htm

# Main Task

**Write a report on Background Radiation. It can be structured like this:**

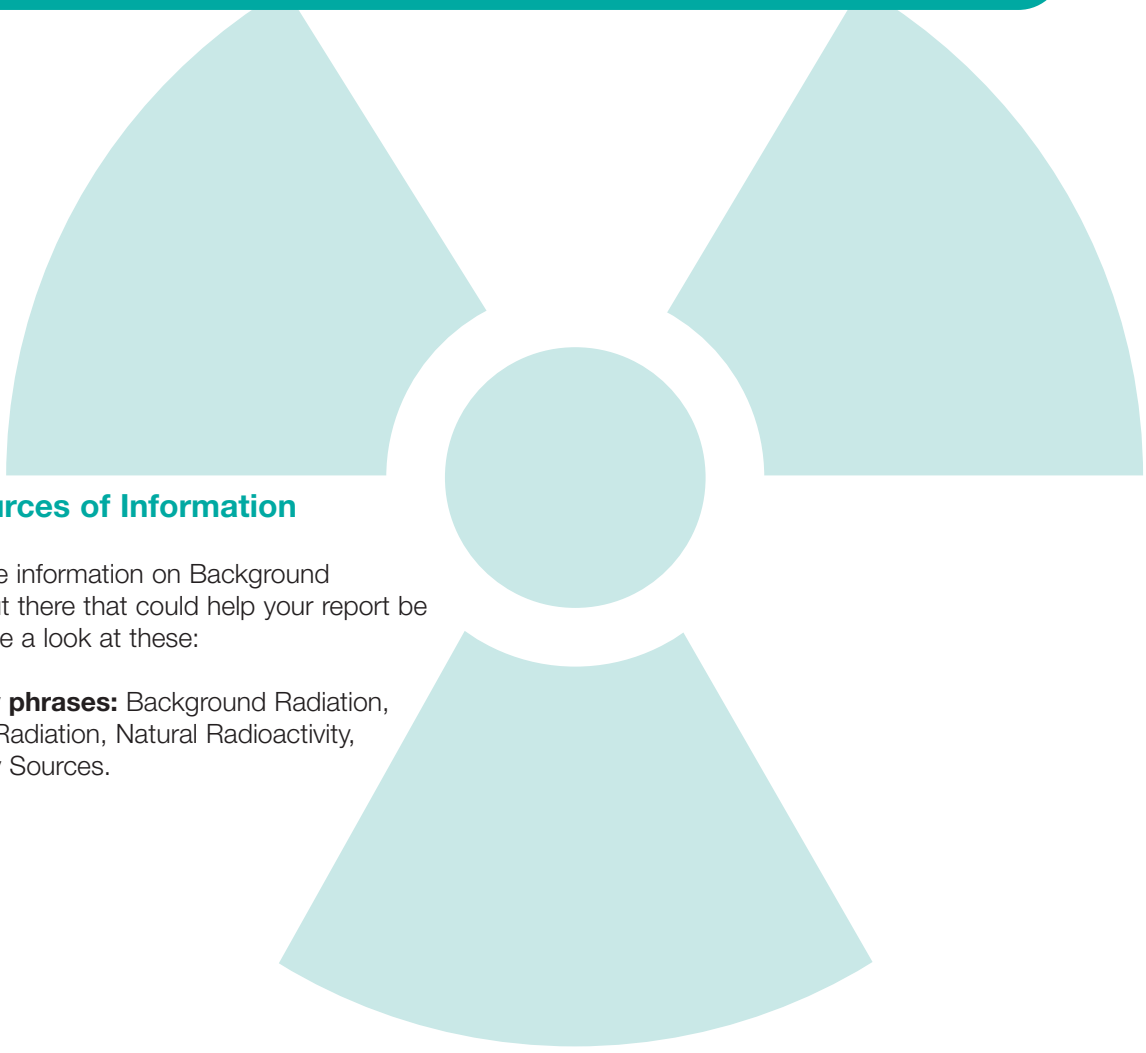
**The Introduction should say what the report is going to be about, what people think about background radiation and what effects it has on life.**

**Next, look into background radiation with more detail. Describe where it comes from and what it actually is (in as much scientific detail as you can).**

**Then do a section using facts and figures you have found out about it - are people in areas of high activity really at risk? How does the amount there compare with, for example, one aeroplane journey or living near a nuclear power station? What do the studies show?**

**Include a bit on people's opinions - are they aware of the radiation? Is there a big fear of it? How much do they know?**

**Lastly, finish off with a Conclusion. This should be a little summary of the facts, and then a section on how dangerous or worrying you think it is, and why.**



## More Sources of Information

Is there more information on Background Radiation out there that could help your report be better? Have a look at these:

**Google key phrases:** Background Radiation, Radon and Radiation, Natural Radioactivity, Radioactivity Sources.

**Task 1**
Find out what you can about the following radioactive elements.

| Uranium | Thoron | Radium | Radon |
|---|---|---|---|
| | | | |

**Task 2**
Colour-code the map below to indicate how naturally radioactive each part of the UK is.

KEY

☐ _____

☐ _____

☐ _____

☐ _____

☐ _____

MAP

How big is the radiation dose when...

1. You have an X-ray

2. Hospital equipment is sterilised

| **Task 3** | |
|---|---|
| Job | Reason to be careful of background radiation |
| | |
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