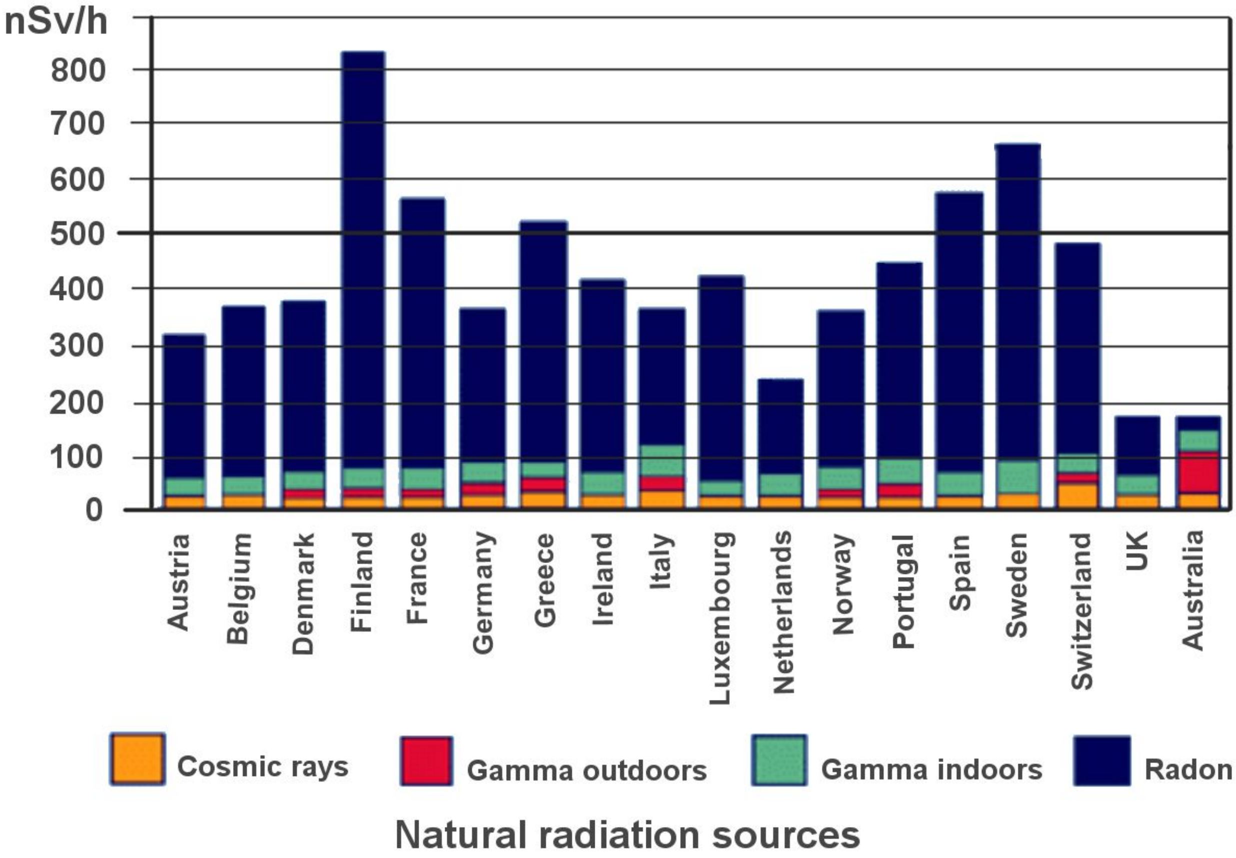
Ambiental radioactivity



The background radioactivity that should be measured in the laboratory, should vary from a minimum of about 50 nSv/h to a maximum of 200 nSv/h, depending on location.

Natural radioactivity

In the natural radioactivity, there are two components, one of terrestrial origin and the other extra-terrestrial.

The first is due to primordial radionuclides contained in varying quantities in the earth's crust inorganic materials (minerals, rocks) since its formation.

The second consists of the cosmic rays, also known as "background radiation"

The main radionuclides are primordial, Potassium (K-40), Rubidium (Rb-87), and the elements of the two decay series of uranium (U-238) and thorium (Th-232)

Various sources

	mS/year	uS/h
Cosmic radiation at sea level	0.3	0,034
Cosmic radiation at 1000 m	0.6	0,068
Radionuclides present in the human body	0.3	0,034

Cosmic rays

If the measurement zone there are no local sources of radiation, almost all of the background radiation will be measured due to cosmic rays.

Since the level of the sea has an average of **a cosmic radiation per minute on a surface of one square centimeter**, impulses of a Geiger tube can be determined by the size of the tube (INTERNAL dimensions of the glass - Ed.)

Cosmic rays can decrease or increase (+/-5%) depending on weather conditions and other factors. For this reason, the measured values may not be the same between one reading and the other; If the measurement time is long enough (at least ten minutes), the values will still be close to each other. Through successive measurements you will be able to understand the behavior of cosmic rays, as well as that of the Geiger tube.

The total cosmic ray intensity at 70.000 ft. has been misurate during the day and night using a single counter. A total of 18 flights has been made and no systematic difference between the day and night intensity has been found greater than the experimental error of 1.4%. This result leads to an upper limit of 0.6×10^{34th} *gauss* cm^3 for the dipole moment of the sun.

Random variations (approx)	+/- 5%
Changes in day / night	+/- 1.5% with a maximum at midnight

Concentration of radon in dwellings (Bq/m³)

	Average value	Maximum value
Canada	34t	1,720
Kazakhstan	10	6,000
Iran	82	3,070
Estonia	120	1,390
Finland	120	20000
Norway	73	50000
Sweden	108	85000
Belgium	48	12000
France	62	4,690
Switzerland	70	10000
UK	20	10000
Czech Republic	140	20000
Slovakia	87	3,750
Italy	75	1,040
Spain	86	15400
Portugal	62	2,700

PicoCurie and Radon calculations

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1Bq  = 1 CPS

1pCi = 0.037 CPS

1pCi = 2.22 CPM

pCi = CPM / 2.22

pCi/l = (CPM / 2.22) / Volume(Liters)

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pCi/l = Bq * 37

pCi/l = Bq/m3 * 37 / 1000

Bq/m3 = pCi/l * 1000 / 37

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Basement with radon = 10 pCi/l

        Raccomended < 4 pCi/l

External Background = 0.2 pCi/l
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Concentrations in building materials

The building materials are, after the soil, an important source of radon in buildings because of their content (radio 226 (progenitor of radon 222) and thorium 232 (progenitor of radon 220). Moreover, the occupants are subjected to radiation range of their children and also potassium 40. addition to these natural radionuclides NORM (Naturally Occurring Radioactive Material) special processing produce radioactive materials (cement added to the fly ash of coal, phosphogypsum from the preparation of phosphates, zircon sands in the production of tiles. For these reasons, in early 2000 the European Commission published a document containing guidelines on radiation protection principles concerning the natural radioactivity in building materials (Radiation Protection 112: Radiological protection principles Concerning the natural radioactivity of building materials).

Since different radionuclides contribute to the dose, to identify critical materials has been established a concentration index of activity, I, defined as follows:

$$I = \frac{\text{Radio 226}}{300\ \text{Bq / kg}} + \frac{\text{Thorium-232}}{200\ \text{Bq / kg}} + \frac{\text{Potassium-40}}{3000\ \text{Bq / Kg}}$$

The determination of these concentrations is normally performed by gamma spectrometry

The danger of a given building material also depends on how it is used, that is, as a structural material or coating and position used for indoor or outdoor realizations. In particular in the second case, the exposure to ionizing radiation for the population is lower.

The following table shows the values of the concentration of the main natural radionuclides in some building materials normally used in Italy.

Building materials	**Ra-226 Bq / kg**		**Th-232 Bq / kg**		**K-40 Bq / kg**	
	Average value	**Interval**	**Average value**	**Interval**	**Average value**	**Interval**
Tuff	209	136-316	349	99-542	1861	1245-2335
Pozzolana	164	33-352	229	53-481	1341	374-2000
Lava	473	79-709	230	36-750	1781	426-2350
Coal ash	160	130-170	130	100-150	420	330-470
Cement	42	7-98	66	9-240	369	80-846
Basalt	308	113-498	466	175-733	2178	1973-2354
Syenite	317	239-384	234	173-342	1255	1181-1390
Peperino	159	109-256	171	152-231	1422	1312-1790
Concrete	22	21-23	16	16	237	253-290
Bricks	29	0-67	26	3-51	711	198-1169
Clay	37	29-45	40	31-49	550	412-687
Tiles	43	31-55	36	18-56	689	474-1026
Sand	18	0-24	22	6-27	530	379-750
Gravel	15	11-21	14	13-16	157	100-248
Plaster	8	0-16	3	1-8	160	59-277
Lime	9	7-15	6	2-8	265	77-312
Stone	24	1-31	37	2-96	645	11-1285
Travertine	1	0-2	< 1	0-1	4	1-18
Marble	4	1-13	1	0-3	8	0-30
Granite	89	24-378	94	36-358	1126	738-1560
Gneiss	87	30-166	71	12-114	1040	496-1480
Gneiss	63	34-102	48	14-84	1432	1199-1891
Serizzo	31	11-42	42	12-54	782	440-1014
Porphyry	41	25-51	59	45-73	1388	1164-1633
Limestone	12	12	1	1	5	5
Log	59	46-64	12	1-47	238	3-942
Tracheitis	36	36	52	51-54	1154	1154

from: http://www.radon.it/site/cosa-facciamo/37-assistenza-progettuale-per-nuove-costruzioni/73-misura-della-concentrazione-di-elementi-radioattivi-in-materiali-da-costruzione.html

Breakdown of Total Dose Background

Here's a summary of the total breakdown of background exposure from UNSCEAR 2000 Report Vol I,Annex B: Exposures from natural radiation sources, Primarily Table 31: Average worldwide exposure to natural radiation sources:

Source		**Average annual effective dose (microSieverts)**	**Percent**
Total cosmic and cosmogenic		390	16.3%
External terrestrial radiation	Outdoors	70th	2.9%
	Indoors	410	17.1%
Inhalation exposure	Uranium and thorium series	6	0.3%
	Radon-222	1150	47.9%
	Radon-220	100	4.2%
	Total inhalation exposure	1260	52.5%
Ingestion exposure	Potassium-40	170	7.1%
	Uranium and thorium series	120	5.0%
	Total ingestion exposure	290	12.1%
Total		2400	100.0%

Breakdown of Dose from Ingested Natural Uranium and Thorium Series

Here's a summary of the data from the UNSCEAR 2000 Report Vol I,Annex B: Exposures from natural radiation sources Table 18: Annual intake and effective dose from ingestion of uranium and thorium series Radionuclides for adults:

Isotope	**Average annual intake (Bq)**	**Type of decay**	**Effective dose coefficient (microSieverts / Bq)**	**Committed effective dose (microSieverts)**	**Percent of Total**
Uranium-238	5.7	alpha	0,045	0.25	0.2%
Uranium-234	5.7	beta	0,049	0.28	0.3%
Thorium-230	3.0	alpha	00:21	0.64	0.6%
Radium-226	22	alpha	00:28	6.3	5.7%
Lead-210	30	beta	0.69	21	19.0%
Polonium-210	58	alpha	1.2	70	63.6%
Thorium-232	1.7	alpha	12:23	0.38	0.4%
Radium-228	15	beta	0.69	11	10.0%
Thorium-228	3.0	alpha	0,072	0.22	0.2%
Uranium-235	0.2	alpha	0,047	0.012	0.01%
Total				110	100.0%