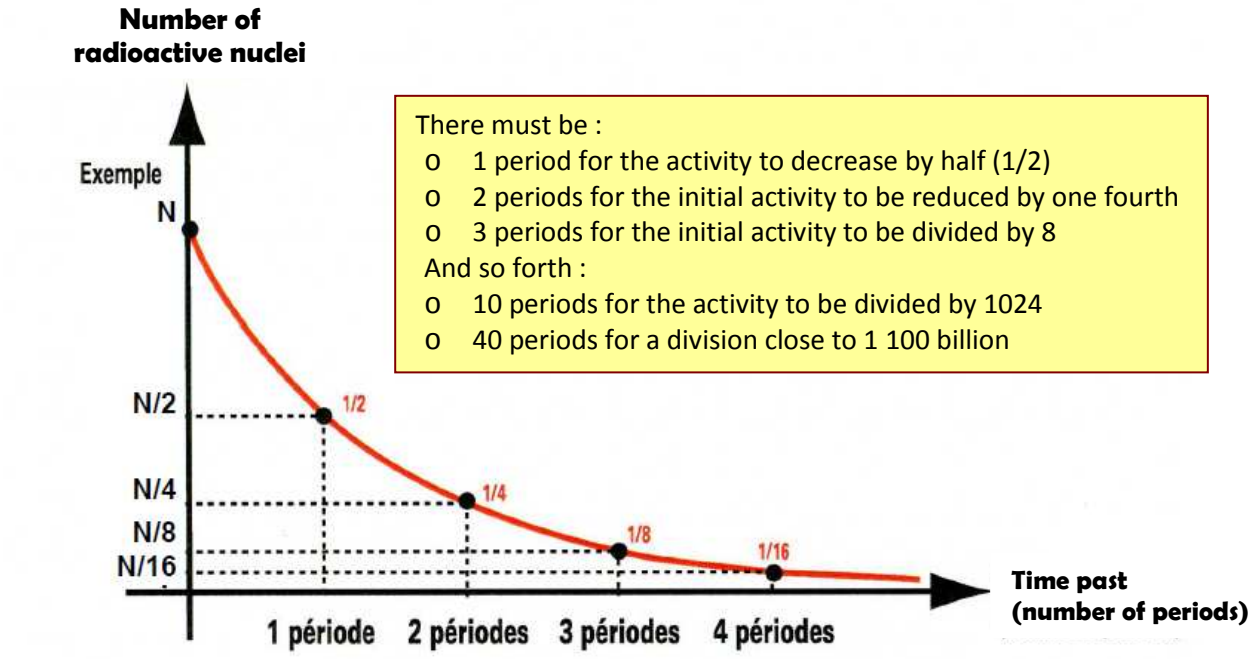
Explanations about the notion of « radioactive period »



There must be :
- 1 period for the activity to decrease by half (1/2)
- 2 periods for the initial activity to be reduced by one fourth
- 3 periods for the initial activity to be divided by 8

And so forth :
- 10 periods for the activity to be divided by 1024
- 40 periods for a division close to 1 100 billion

The radioactive period corresponds to the decrease of a factor 2. At the end of 2 periods, the decrease reaches a factor 4 (half of the half) ; at the end of 3 periods, the activity is divided by 8 (half of the half of half) ; etc.

The table on the right indicates for an increasing number of radioactive periods, the corresponding reduction factor.

It is often stated, but wrongly , **the 10 periods rule :** at the end of 10 periods a radioactive source would be no longer dangerous.

In fact, this value corresponds to a division by 1 000 (precisely by 1 024) of the initial activity. Whether the character of this reduction level is satisfactory or unsatisfactory rests, in fact, on the initial activity of the source.

If it is very high, 30 periods may be necessary ; hence a division by just over a billion ; 40 periods, hence a division by over 1 000 billions ; 50 periods, hence a division of the initial activity by over a million billion or perhaps even longer.

Nombre de périodes	Facteur de réduction
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512
10	1 024
11	2 048
12	4 096
13	8 192
14	16 384
15	32 768
16	65 536
17	131 072
18	262 144
19	524 288
20	1 048 576
21	2 097 152
22	4 194 304
23	8 388 608
24	16 777 216
25	33 554 432
26	67 108 864
27	134 217 728
28	268 435 456
29	536 870 912
30	1 073 741 824
40	1 099 511 627 776
50	1 125 899 906 842 620

The radioactive periods are characteristic to each radionuclide and extremely variable : from less than one billionth of microsecond to hundreds of billions years. Some examples are presented in the periodic table below.

Radionucléide	Période radioactive		Radionucléide	Période radioactive
rubidium 99	0,06 seconde		strontium 90	28,5 ans
calcium 51	10 secondes		césium 137	30 ans
césium 126	1,64 minutes		nickel 63	100,1 ans
technétium 99m	6 heures		américium 241	432,7 ans
iode 123	12,2 heures		radium 226	1 600 ans
iode 131	8 jours		carbone 14	5 730 ans
béryllium 7	53,29 jours		américium 243	7 380 ans
iode 125	60,14 jours		plutonium 239	24 000 ans
cobalt 58	70,92 jours		thorium 230	75 400 ans
césium 134	2 ans		iode 129	15 700 000 ans
cobalt 60	5,27 ans		uranium 235	703 700 000 ans
tritium	12,33 ans		potassium 40	1 277 000 000 ans
plutonium 241	14,4 ans		uranium 238	4 468 000 000 ans
			thorium 232	14 050 000 000 ans

For the activity to be **divided by 4** it will be necessary to wait until 2 periods have passed, which corresponds to :

- 12 hours for the technetium 99m (T= 6 hours)
- 16 days for iodine 131 (T = 8 days)
- 60 years for cesium 137 (T = 30 years)
- 3 200 years for radium 226 (T = 1600 years)
- Close to 9 billion years for Uranium 238 (T = 4,47 billion years)

For the activity to be divided by **one million** a delay of 30 periods will be necessary, in other words :

- 30 x 6 hours or 7,5 days for Technetium 99m
- 30 x 8 days or 240 days for iodine 131
- 30 x 5,27 years or 158 years for cobalt 60
- 30 x 30 years or 900 years for cesium 137
- 30 x 1 600 years or 48 000 years for radium 226