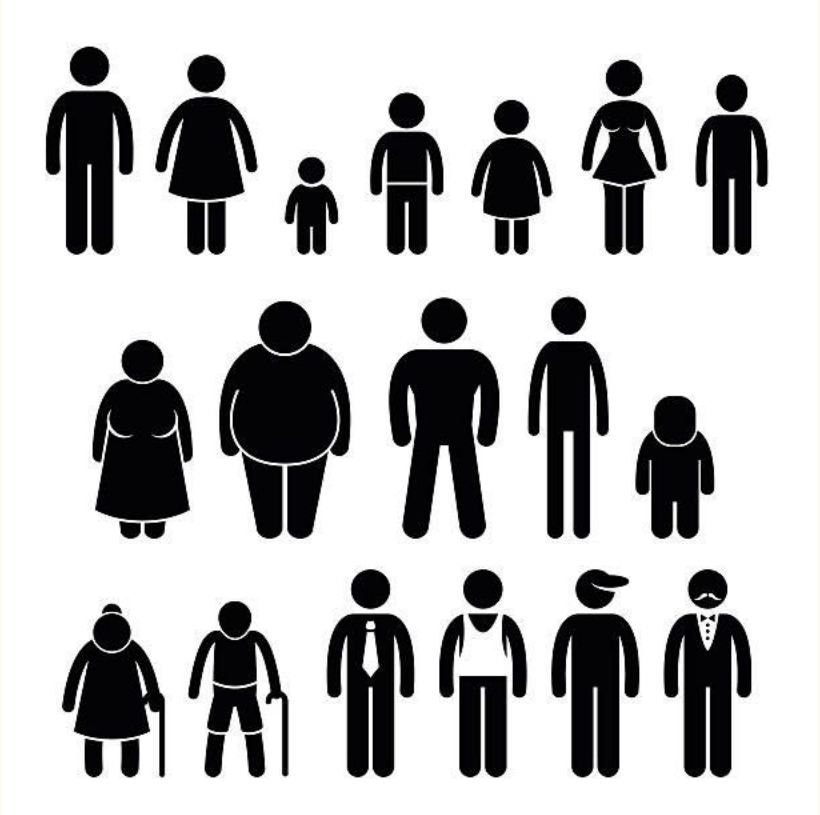
Métodos Monte Carlo

Motivación



Estatura media de una población.

Ley de los grandes números (Law of large numbers)

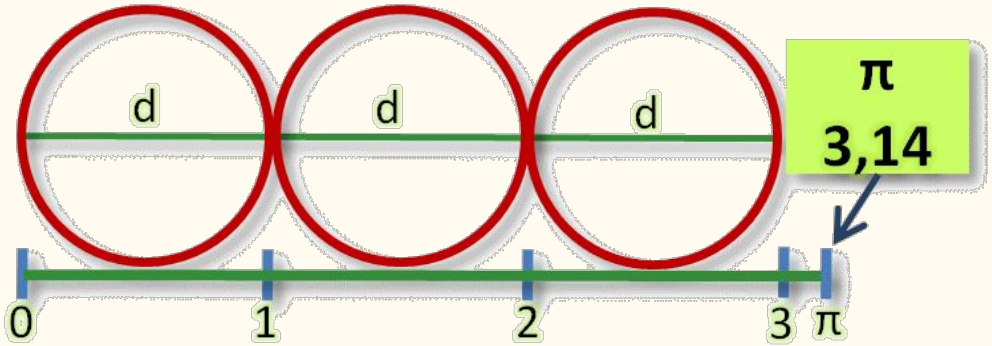
El promedio de los resultados obtenidos de un gran número de ensayos debe estar cerca de la media y tiende a acercarse al valor esperado a medida que se realizan más ensayos.

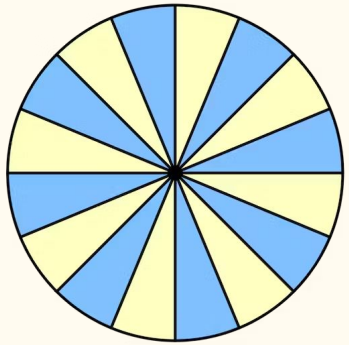
Método Monte Carlo

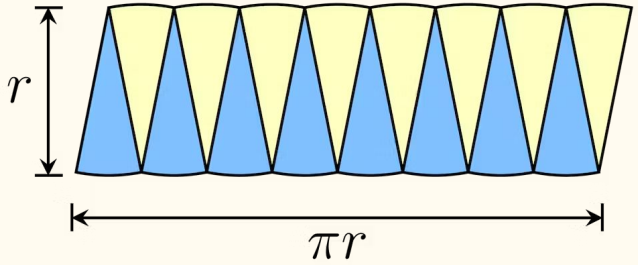
1. Definir un dominio de posibles entradas.
2. Genere entradas aleatoriamente a partir de una distribución de probabilidad sobre el dominio.
3. Realizar un cálculo determinista en las entradas.
4. Construir los resultados.

Estimación de π

Geometría de π



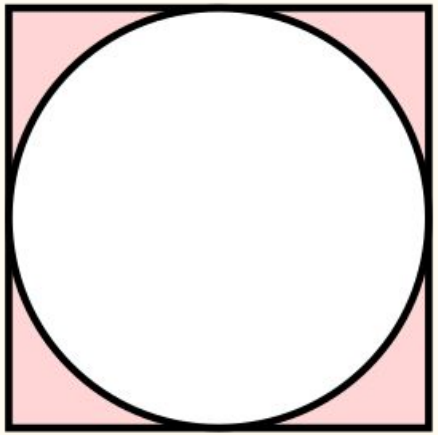




$$C = 2\,\pi\,r$$

$$C = \pi\,d$$

π mediante un círculo inscrito

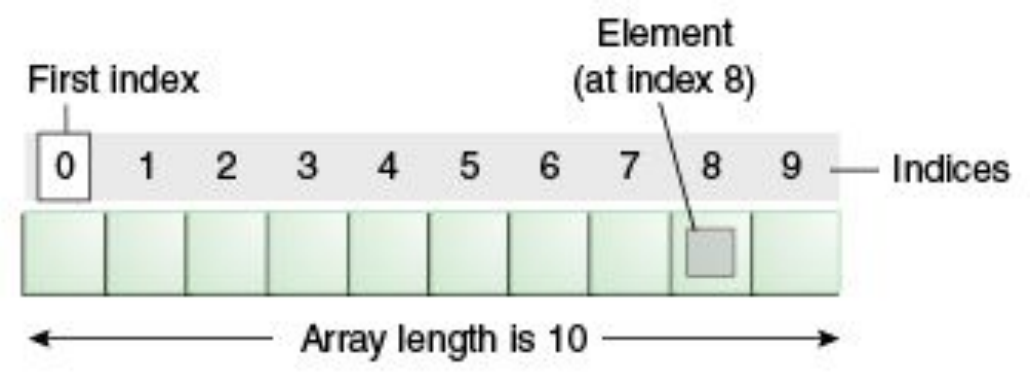


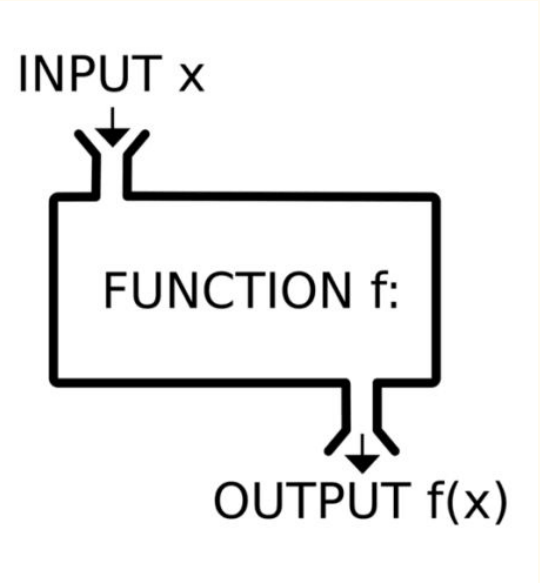
$$A_{\bigcirc} = \pi r^2$$

$$A_{\square} = (2r)^2 = 4 r^2$$

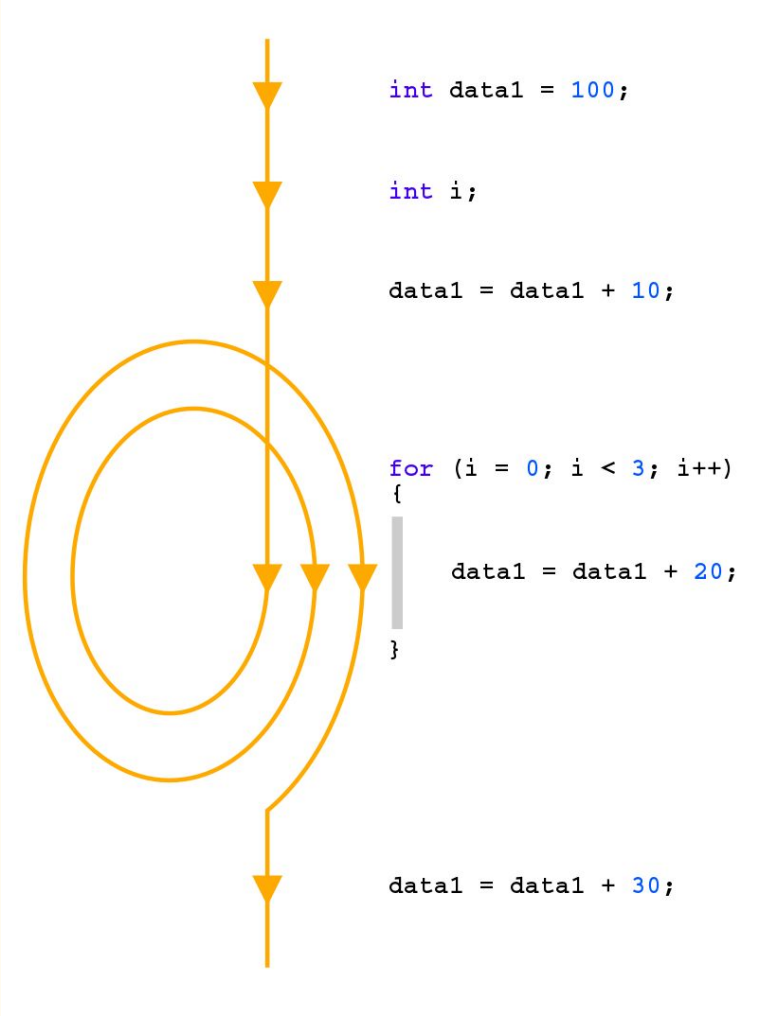
$$A_{\bigcirc}/A_{\square} = \pi/4$$

Conceptos básicos de programación

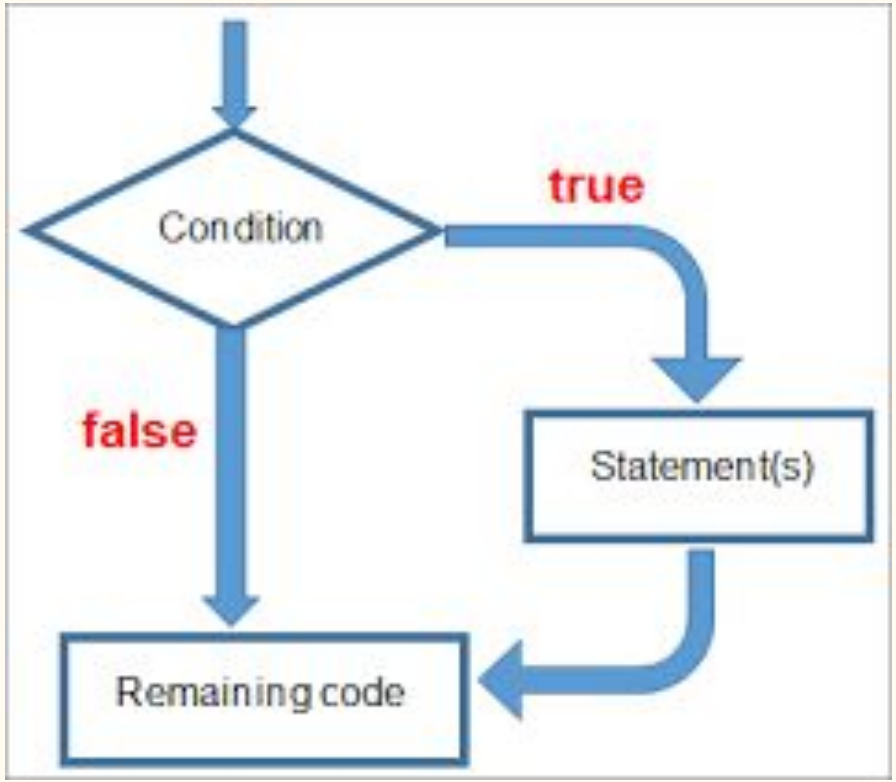




- Arreglos
- Funciones

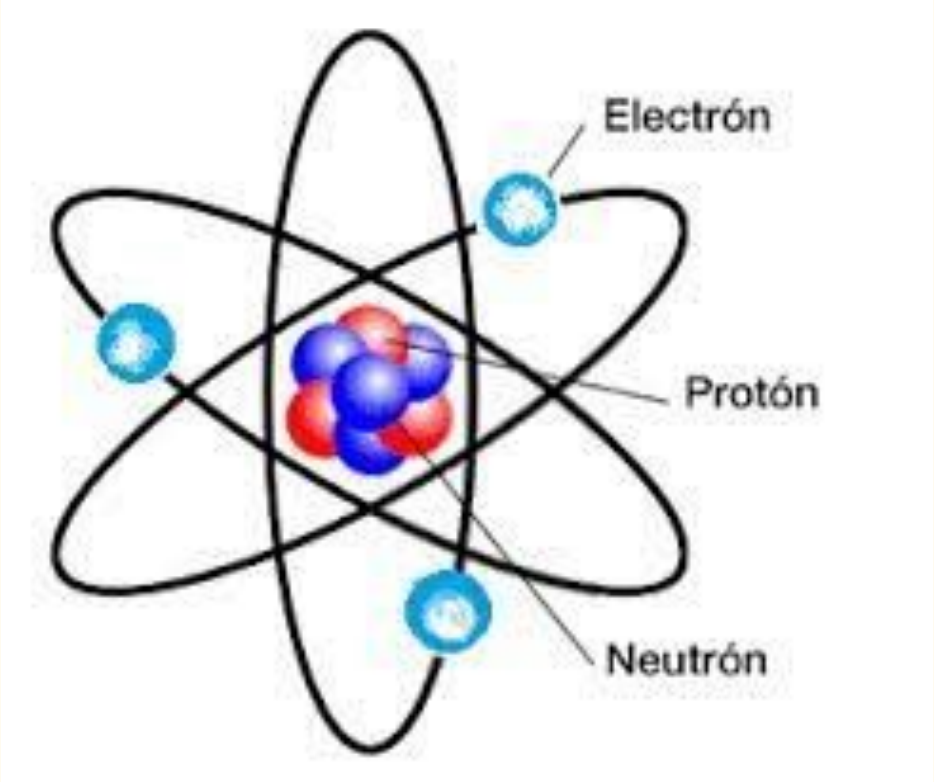

int data1 = 100;
int i;
data1 = data1 + 10;
for (i = 0; i < 3; i++)
{
data1 = data1 + 20;
}
data1 = data1 + 30;

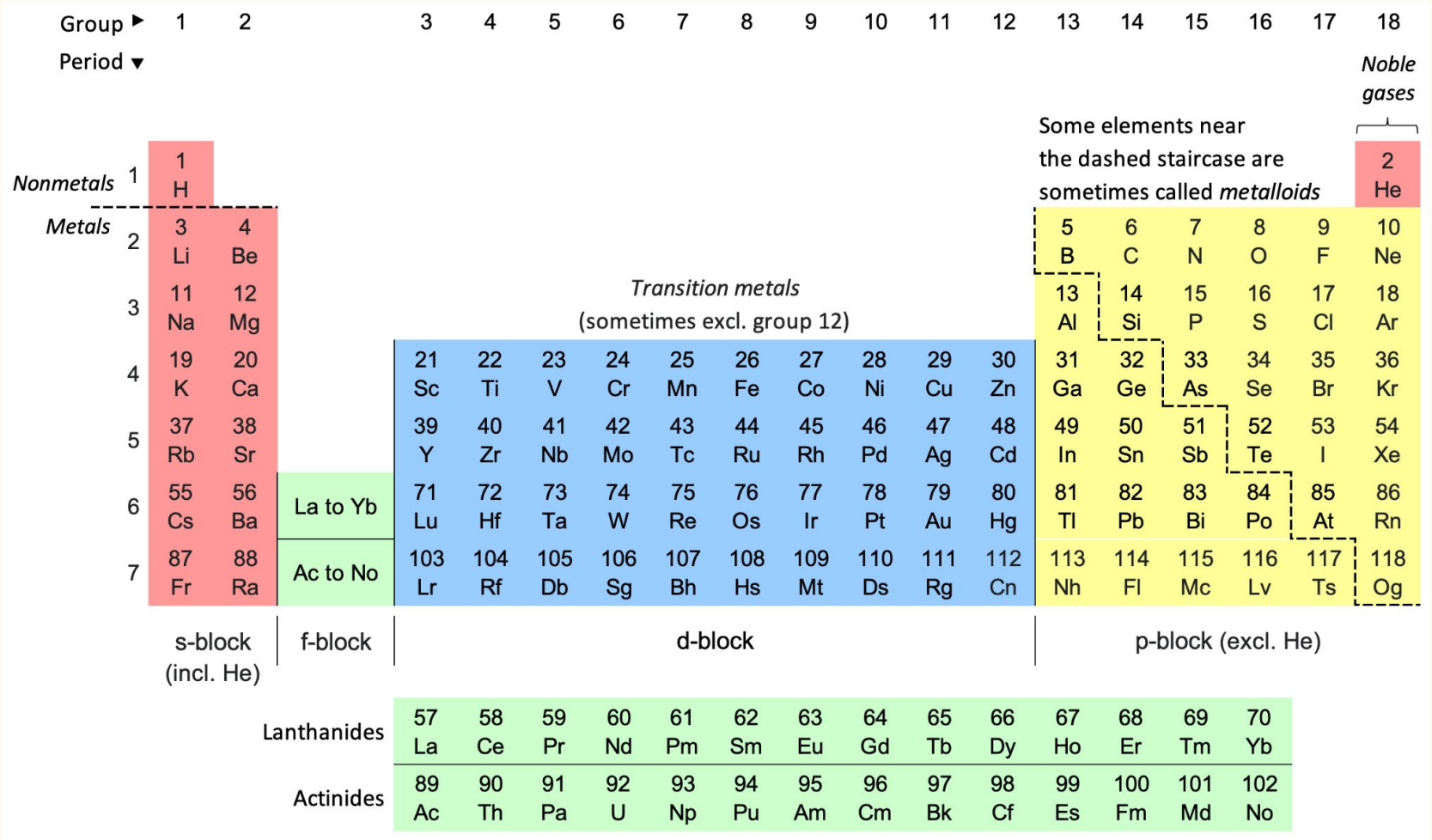
- Bucles

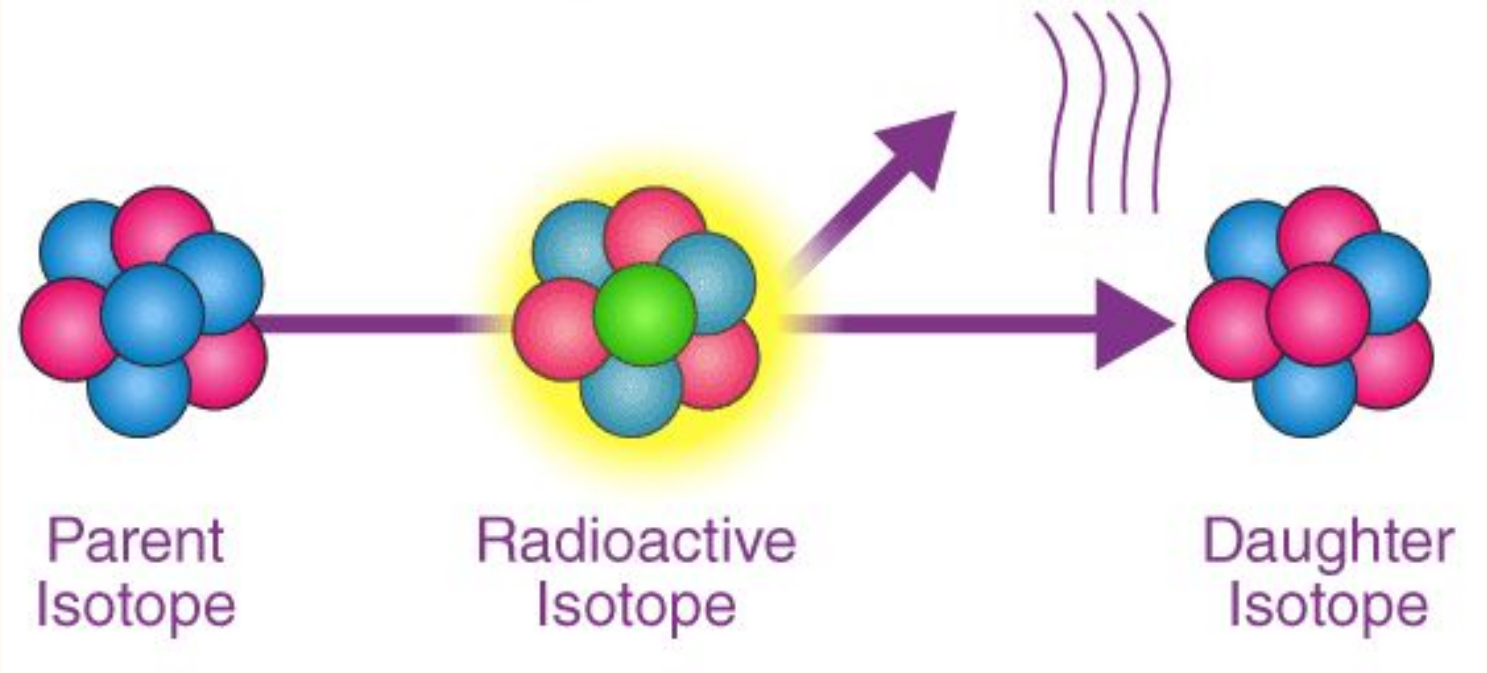


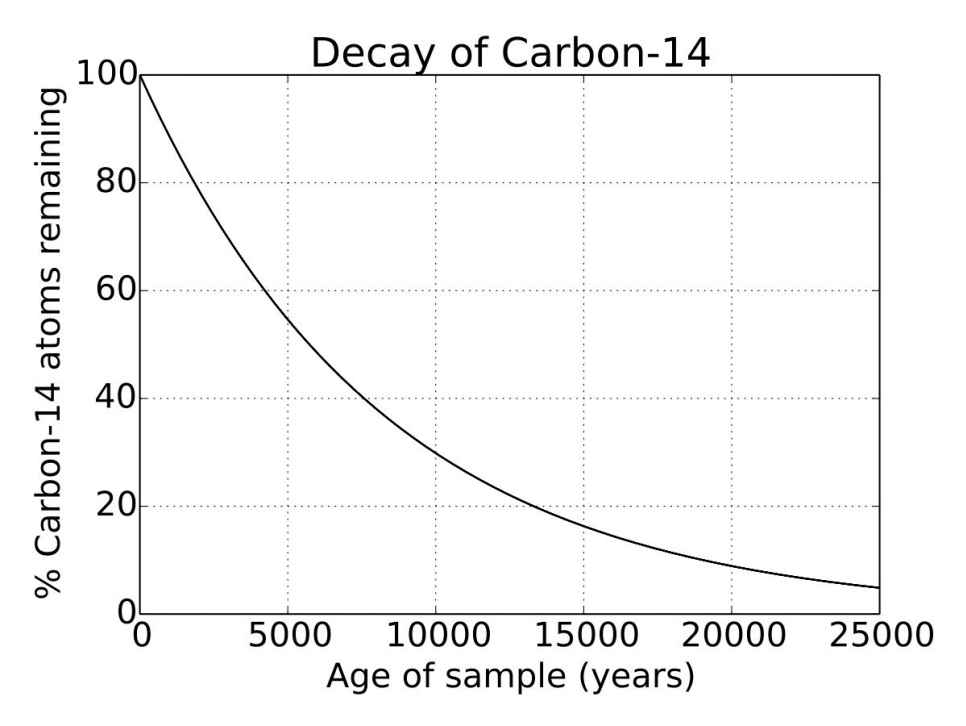
- Condicionales

Desintegración radioactiva


Electrón
Protón
Neutrón


Group ▶
Period ▼
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Noble gases
Some elements near the dashed staircase are sometimes called metalloids
Nonmetals
Metals
Transition metals
(sometimes excl. group 12)
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
La to Yb
71 Lu
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
Ac to No
103 Lr
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110 Ds
111 Rg
112 Cn
113 Nh
114 Fl
115 Mc
116 Lv
117 Ts
118 Og
s-block (incl. He)
f-block
d-block
p-block (excl. He)
Lanthanides
57 La
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
Actinides
89 Ac
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No


Parent
Isotope
Radioactive
Isotope
Daughter
Isotope



$$N(t) = N_0 \exp(-\lambda t)$$

$$\lambda = \frac{1}{\tau}$$

half-life ($t_{1/2}$)

Definition: time required for half of the radioactive parent atoms to decay

From Law of Radioactive Decay:

$$t_{1/2} = \frac{\ln 2}{\lambda}$$

where

λ = decay constant

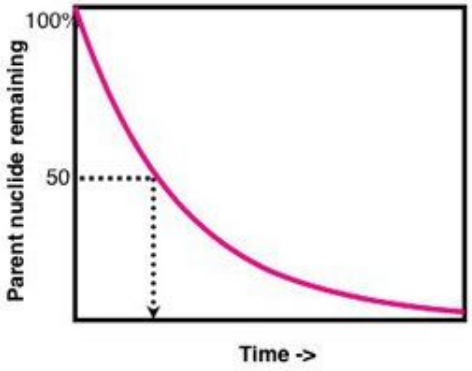
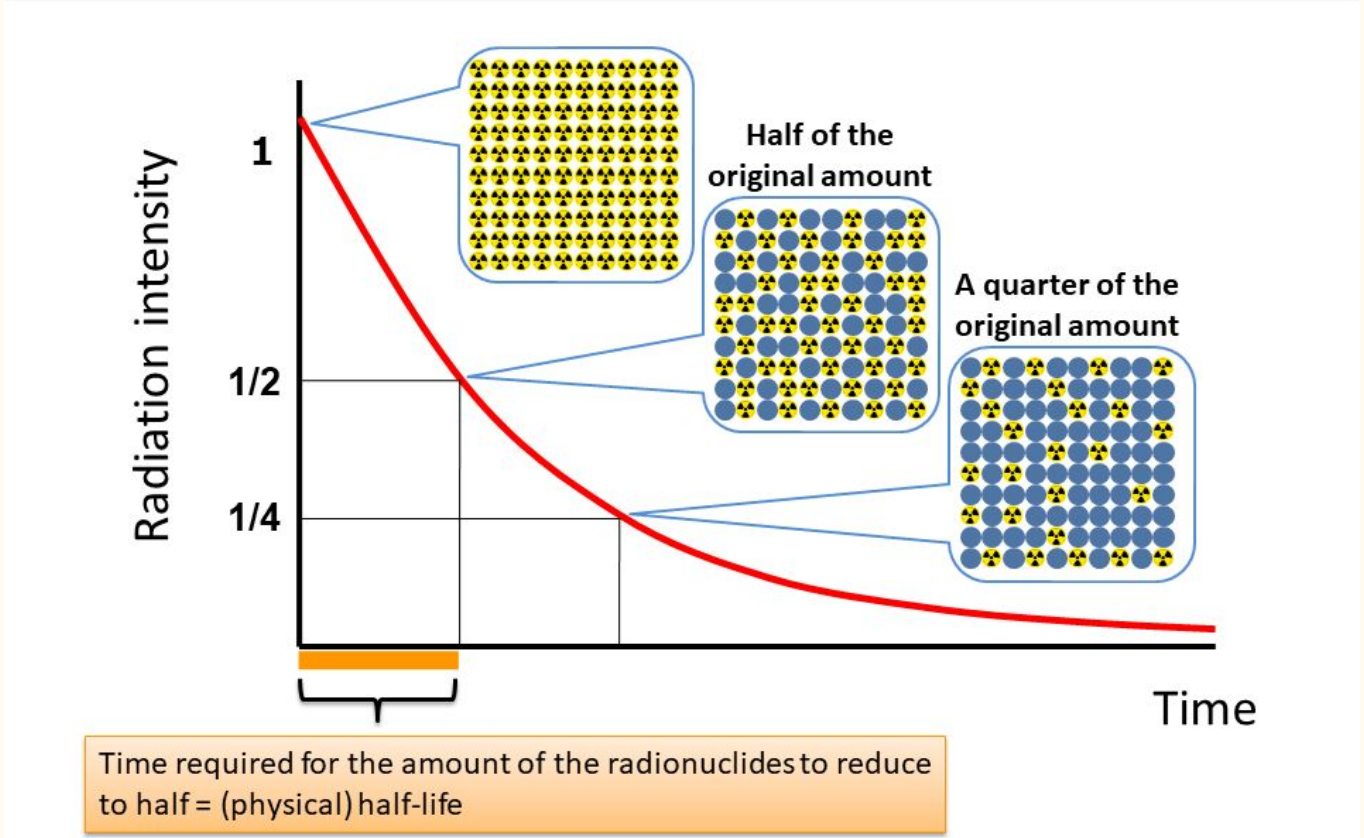
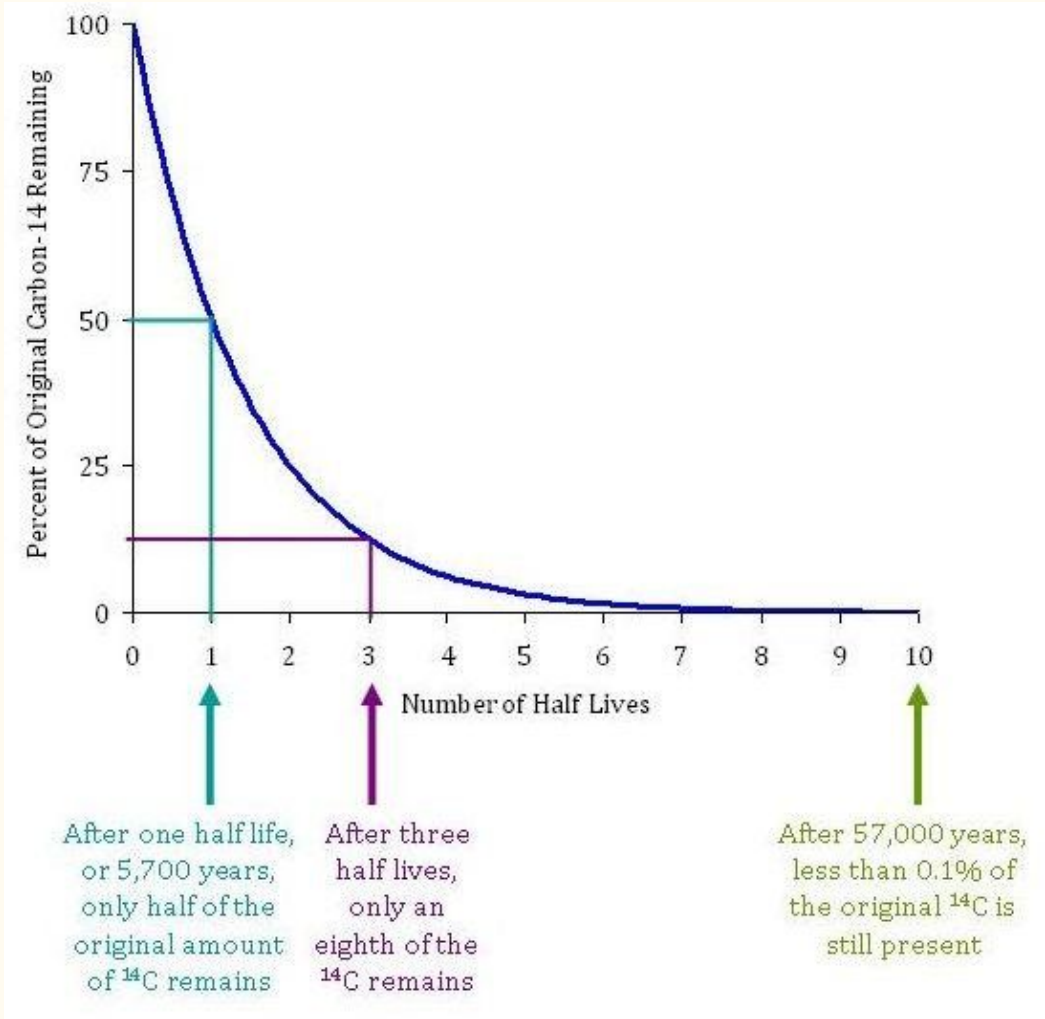


TABLE 10B.3 Half-Lives of Radioactive Isotopes*

Nuclide	Half-life, $t_{1/2}$
tritium	12.3 a
carbon-14	5.73 ka
carbon-15	2.4 s
potassium-40	1.26 Ga
cobalt-60	5.26 a
strontium-90	28.1 a
iodine-131	8.05 d
cesium-137	30.17 a
radium-226	1.60 ka
uranium-235	0.71 Ga
uranium-238	4.5 Ga
fermium-244	3.3 ms

*d = day; a = year.


Radiation intensity
1
1/2
1/4
Half of the original amount
A quarter of the original amount
Time
Time required for the amount of the radionuclides to reduce to half = (physical) half-life


Percent of Original Carbon-14 Remaining
100
75
50
25
0
0
1
2
3
4
5
6
7
8
9
10
Number of Half Lives
After one half life, or 5,700 years, only half of the original amount of ^{14}C remains
After three half lives, only an eighth of the ^{14}C remains
After 57,000 years, less than 0.1% of the original ^{14}C is still present

Stanislaw Ulam & John Von Neumann

Difusión de neutrones en el núcleo de un arma nuclear