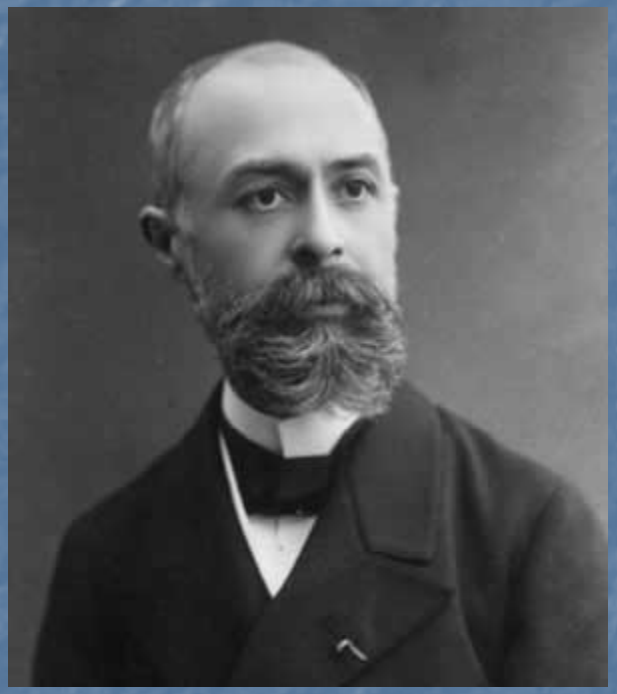
# Absolute Dating

It's a decaying relationship.

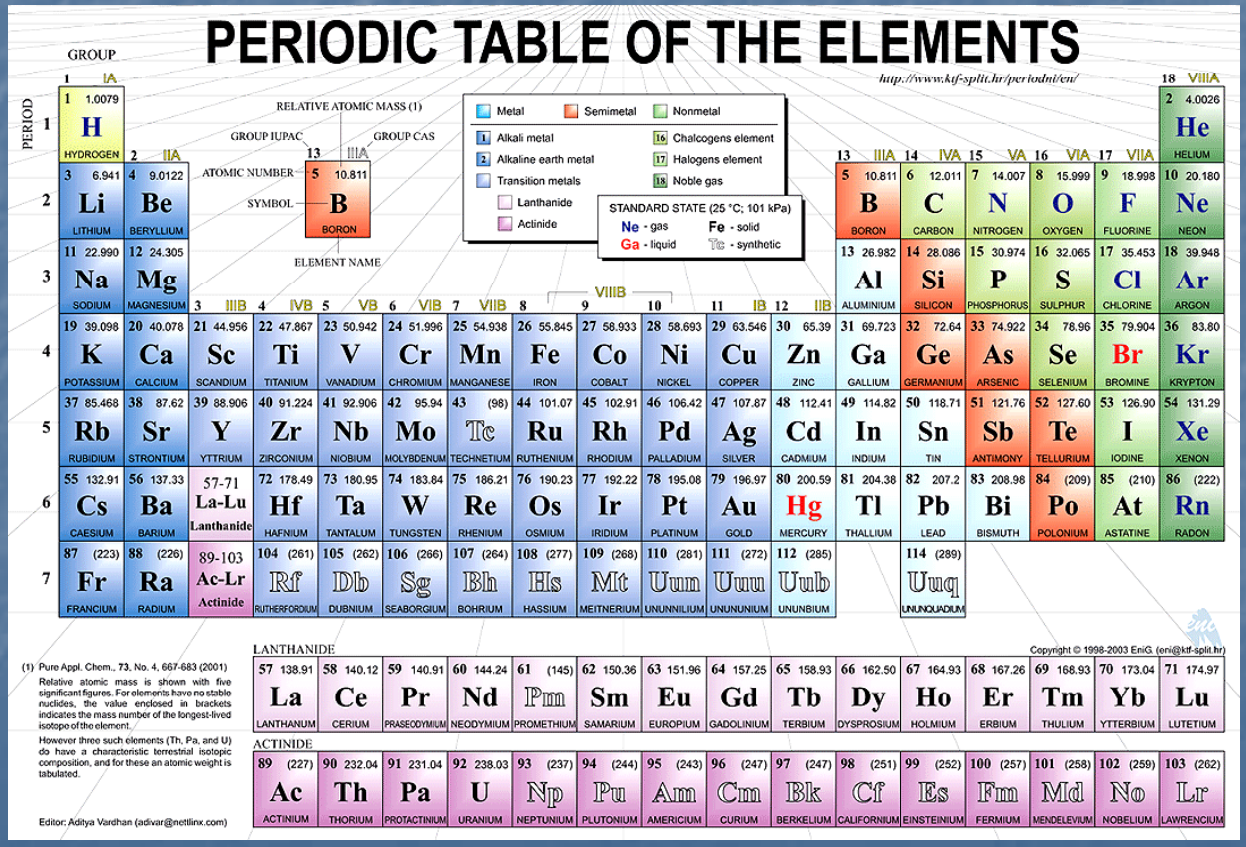
# Radioactivity

- Henri Becquerel discovered radioactivity in 1895.
- Until then there was no way of finding the absolute age of a rock or fossil.

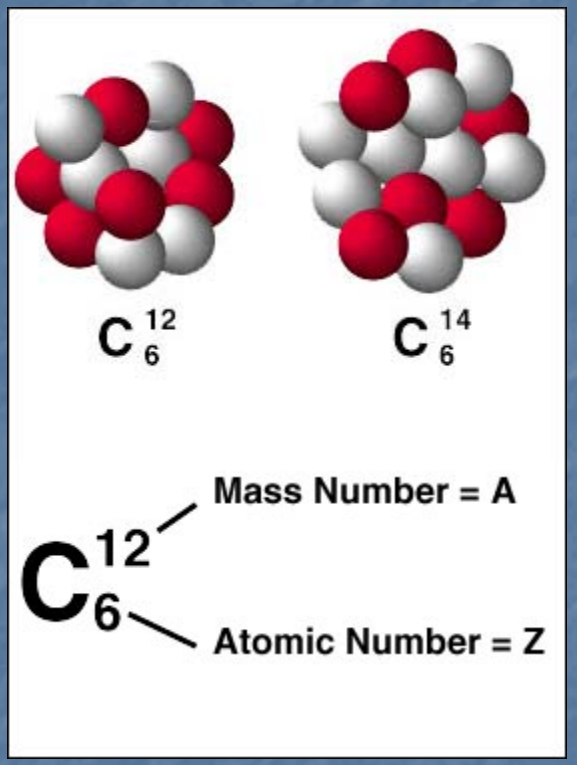


# Elements

- Elements are composed of atoms.
- Atoms are composed of 3 different kinds of particles: protons (+), neutrons (0) and electrons(-).
- Protons and neutrons are found in the nucleus, electrons in the space around the nucleus.

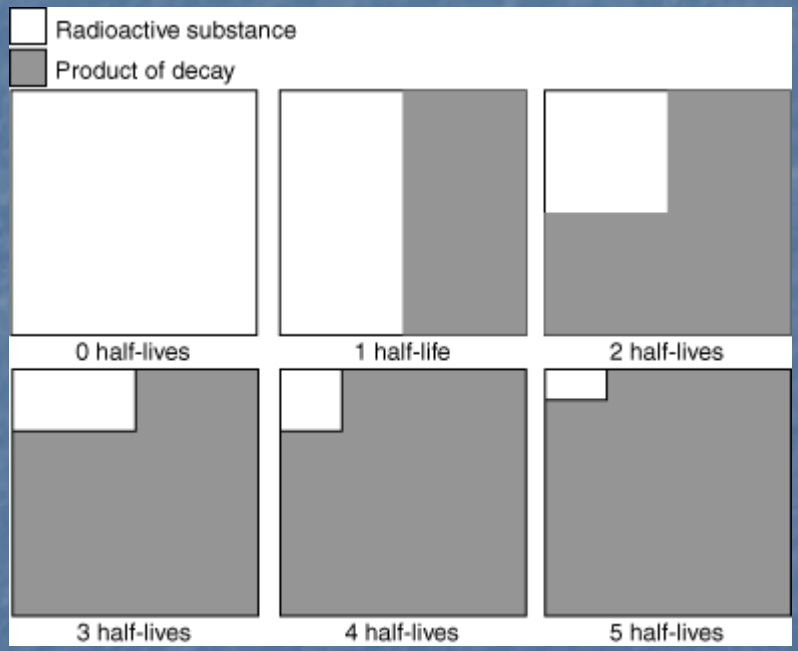


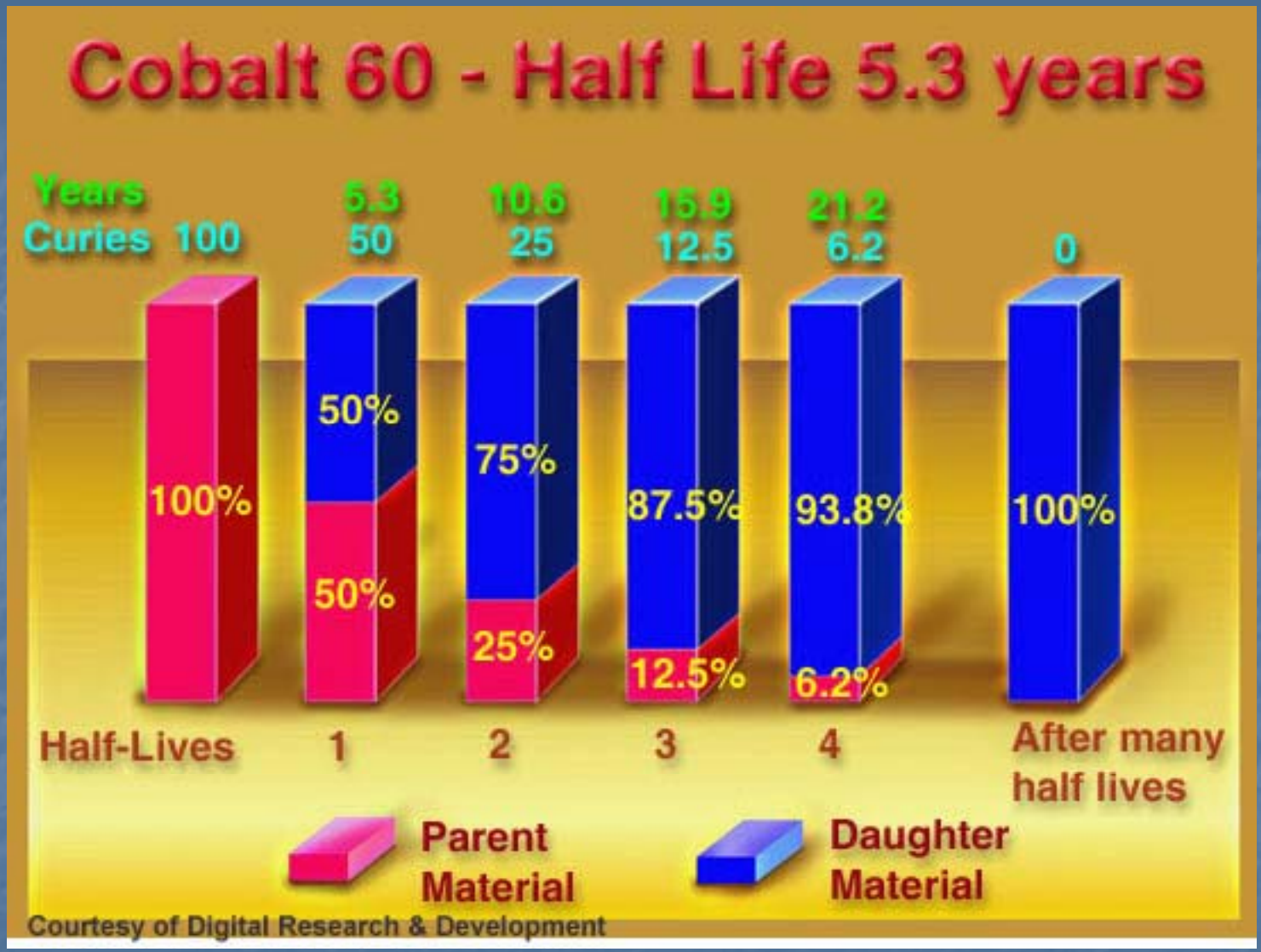

- An isotope of an element differs in the number of neutrons in the nucleus.
- Some isotopes are unstable and undergo radioactive decay.
- During the decay process they are transformed into more stable elements.



# Half-life

- Each radioisotope has a predictable constant rate of decay. (Look in your ESRTs!)
- The length of time needed for half of the sample to convert to a stable for of the isotope is called the half-life.
- The original element is called the parent isotope and the product of decay is called the daughter isotope.




Cobalt 60 - Half Life 5.3 years
Years
Curies 100
5.3
50
10.6
25
15.9
12.5
21.2
6.2
0
100%
50%
50%
75%
25%
87.5%
12.5%
93.8%
6.2%
100%
Half-Lives
1
2
3
4
After many half lives
Parent Material
Daughter Material
Courtesy of Digital Research & Development

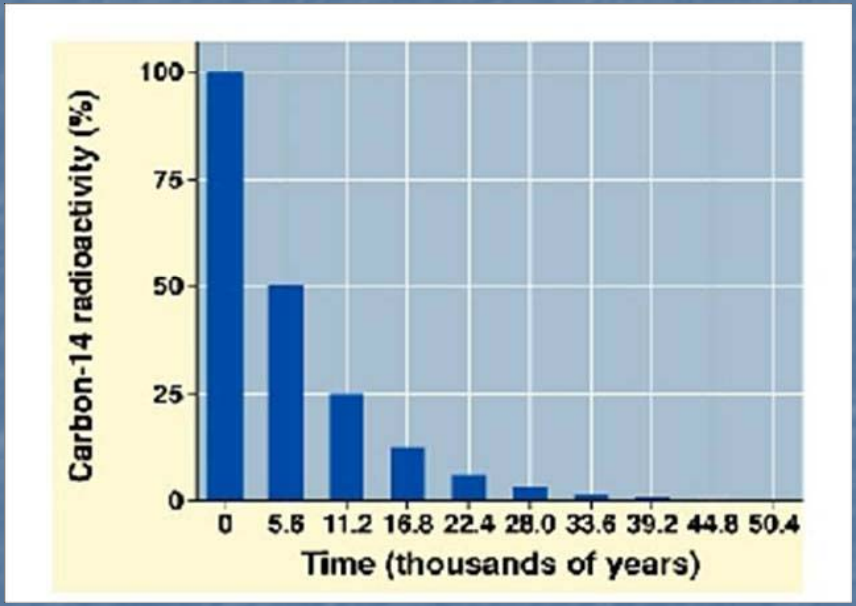
# Earth Science Reference Table

## Radioactive Decay Data

| RADIOACTIVE ISOTOPE | DISINTEGRATION | HALF-LIFE (years) |
|---|---|---|
| Carbon-14 | $C^{14} \rightarrow N^{14}$ | $5.7 \times 10^3$ |
| Potassium-40 | $K^{40} \rightarrow Ar^{40}$ <br> $K^{40} \rightarrow Ca^{40}$ | $1.3 \times 10^9$ |
| Uranium-238 | $U^{238} \rightarrow Pb^{206}$ | $4.5 \times 10^9$ |
| Rubidium-87 | $Rb^{87} \rightarrow Sr^{87}$ | $4.9 \times 10^{10}$ |

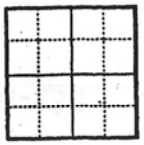
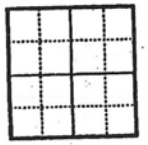
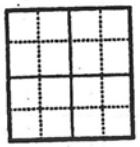
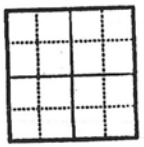
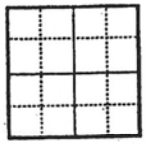
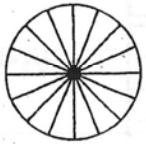
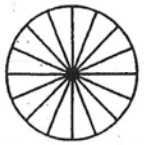
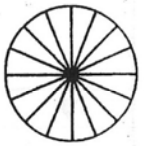
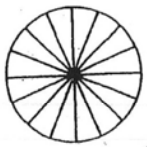
# Carbon-14

- Important to scientists studying recent artifacts.
- Can be used only with organic remains. MUST CONTAIN CARBON!!!!
- Has a half-life of 5,700 years.
- Only useful with artifacts up to 50,000 years old.



# Half-Life Carbon – 14

**Directions:** Complete the following tables and graphs. Use one color for **Carbon-14,** the radioactive element. Use a different color for the decay product, **Nitrogen-14.**

| **Beginning**<br>Time = 0 years | **1 Half-Life**<br>Time = _____years | **2 Half-Lives**<br>Total time = 11,400 yrs. | **3 Half-Lives**<br>Total time = _____ yrs. | **4 Half-Lives**<br>Total time = _____ yrs. |
|---|---|---|---|---|
|  |  |  |  |  |
| ***Fraction*** | ***Fraction*** | ***Fraction*** | ***Fraction*** | ***Fraction*** |
| (C-14) All radioactive element / (N-14) No decay product | ½ radioactive element / ½ decay product | ___ radioactive element / ___ decay product | ___ radioactive element / ___ decay product | ___ radioactive element / ___ decay product |
| A  | B  | C  | D  | E  |
| ***Percent*** | ***Percent*** | ***Percent*** | ***Percent*** | ***Percent*** |
| (C-14) 100% radioactive elem. remaining / (N-14) 0% decay product | 50 % radioactive elem. remaining / 50 % decay product | ____% radioactive elem. remaining / ____% decay product | ____% radioactive elem. remaining / ____% decay product | ____% radioactive elem. remaining / ____% decay product |