FOSSILS

What is a fossil?

Fossils are evidence of past life on Earth.

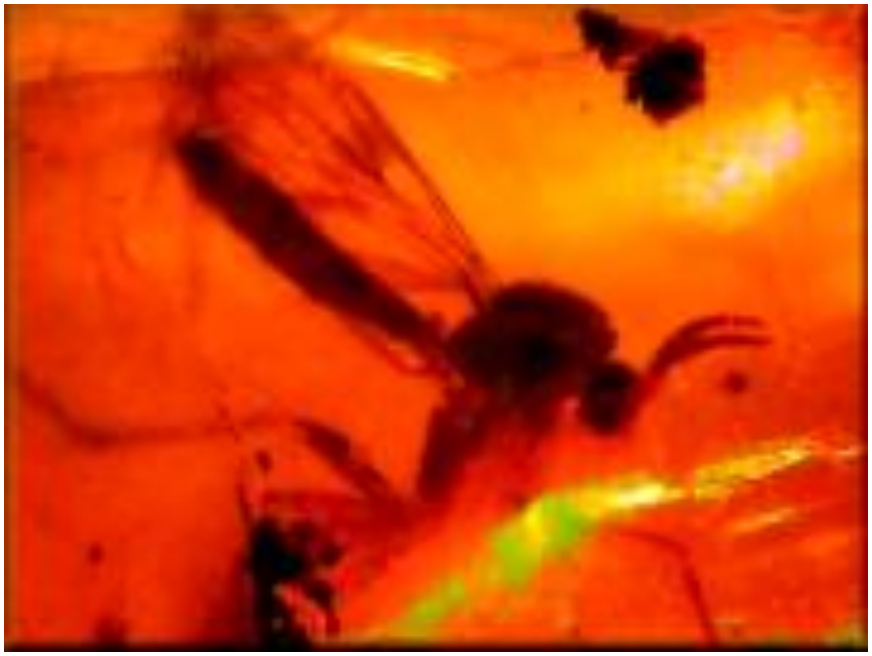
What are the 2 main fossil categories?

- **Body fossils** - part of (or in some cases the entire) body of the creature.
- Often shells, bones, petrified wood, and leaves

Types of body fossils

- **Compression** – sediment layers pile on top, compressing specimen, making a flat layer.
- **Casts & molds** – organic material decays, depression fills in w/ shape of organism
- **Petrified wood** – minerals replace organic material

What is amber and why is it important?



- Amber – tree resin, preserves organic materials, insects & plant material most often captured
  - Important – other fossils don't preserve organics.

What are the 2 main fossil categories?

- **Trace fossils** – evidence of the activity and physiology of the creature left without a body. Often footprints, pollen, feeding traces, worm burrows, even fossilized feces.

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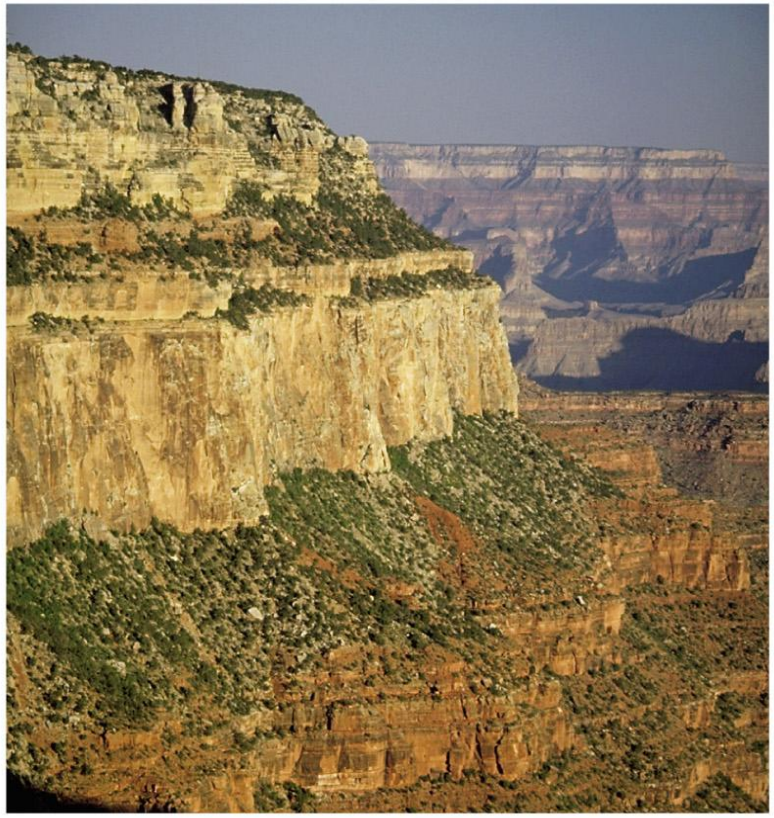
Conditions Favoring Preservation

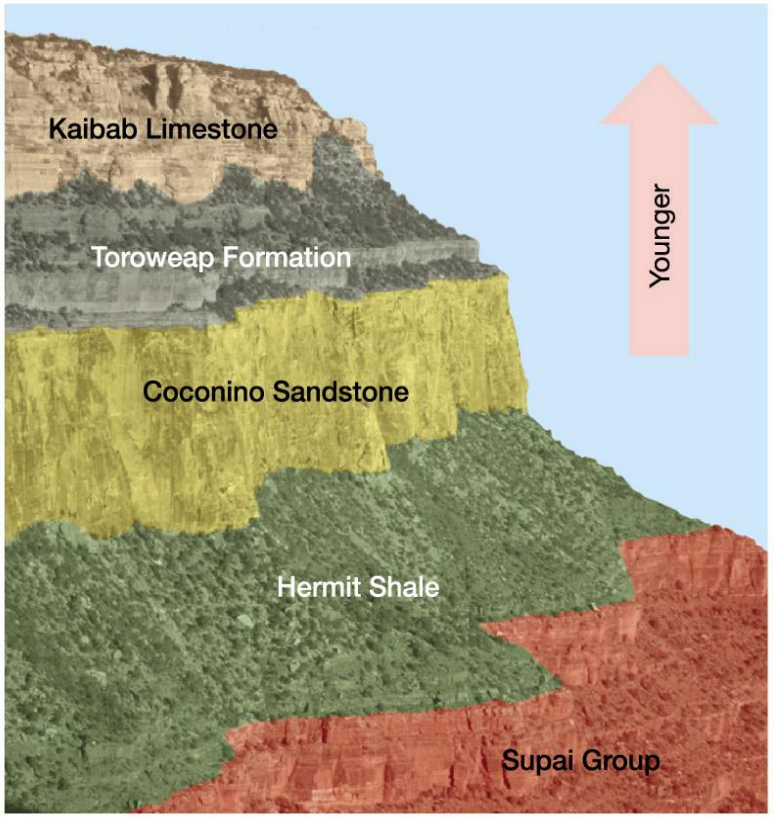
- See video clip
- Rapid burial
- Possession of hard parts

Relative dating

- Placing rocks and events in a relative chronological order based on strata levels

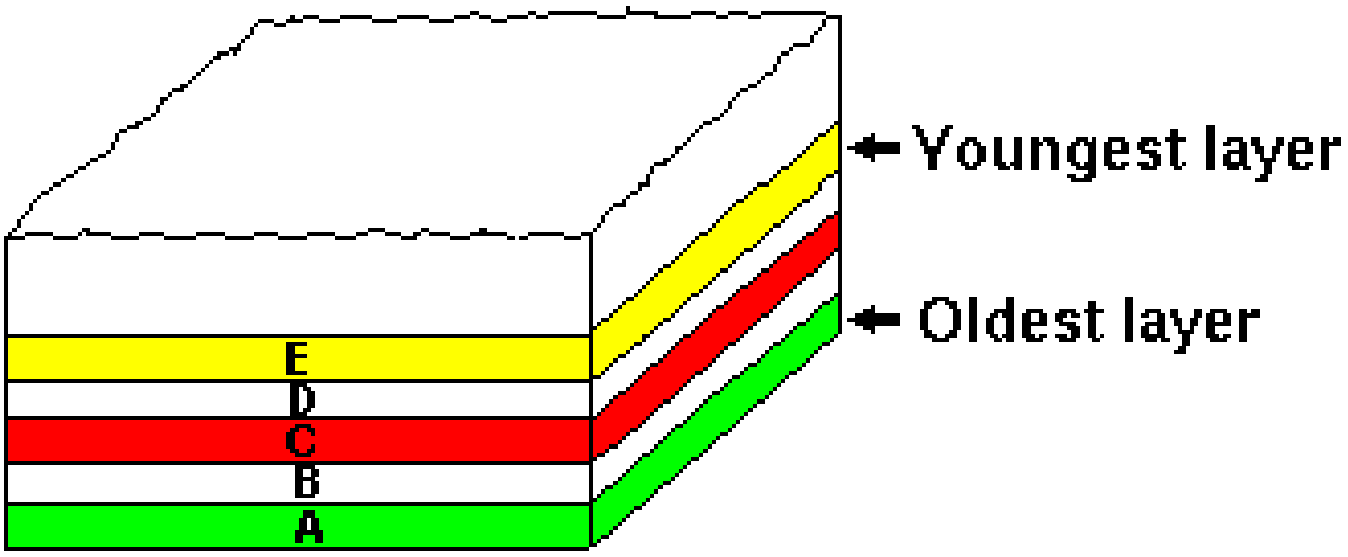


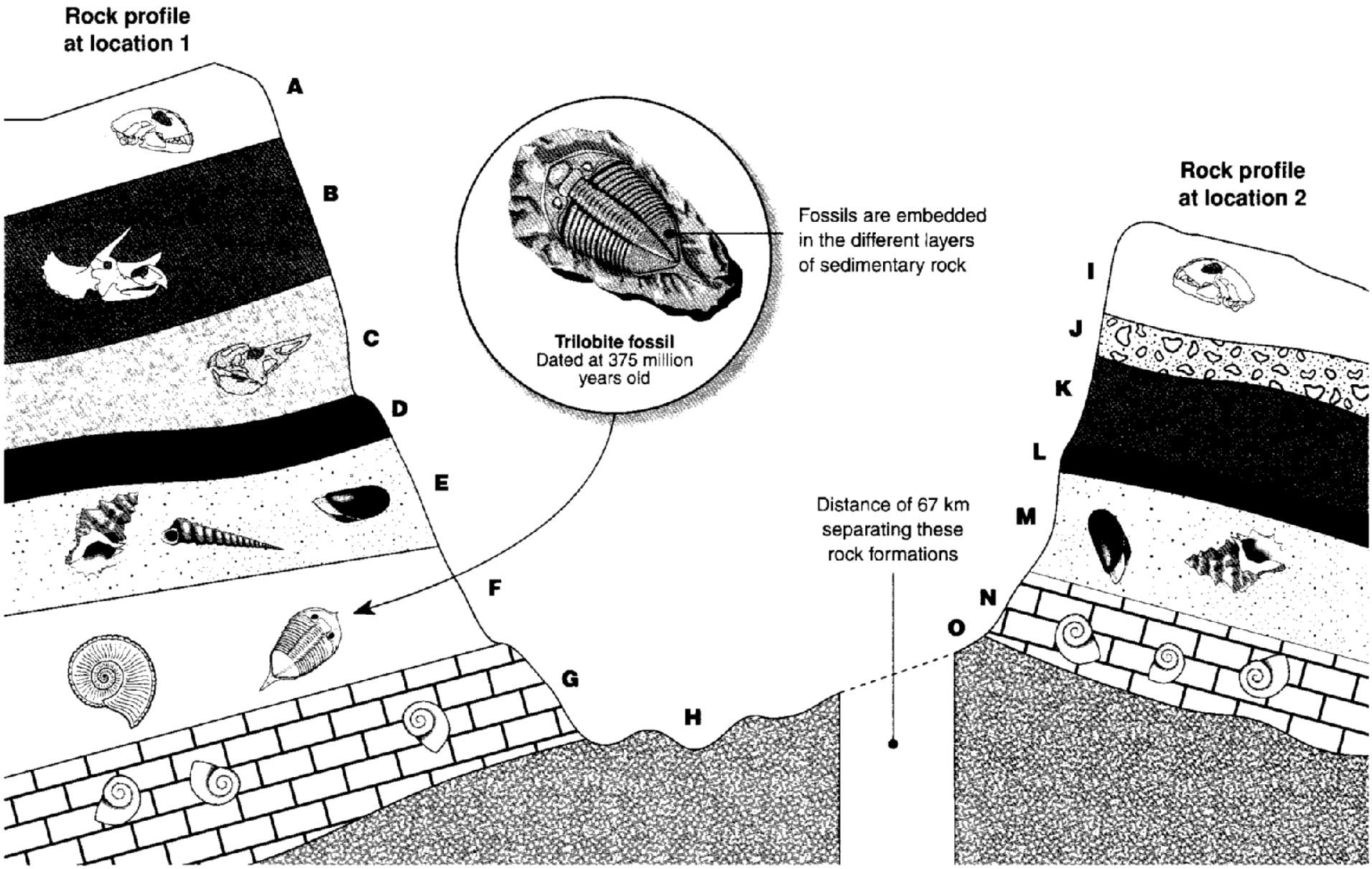
A.



B.

Based on the **Principle of Superposition:** Younger sedimentary rocks are deposited on top of older sedimentary rocks.




Rock profile
at location 1
A
B
C
D
E
F
G
H
Trilobite fossil
Dated at 375 million
years old
Fossils are embedded
in the different layers
of sedimentary rock
Distance of 67 km
separating these
rock formations
Rock profile
at location 2
I
J
K
L
M
N
O

Dating Fossils

- The relative age of fossils is useful, but fossils provide reliable historical data only if we can determine their **absolute age**.

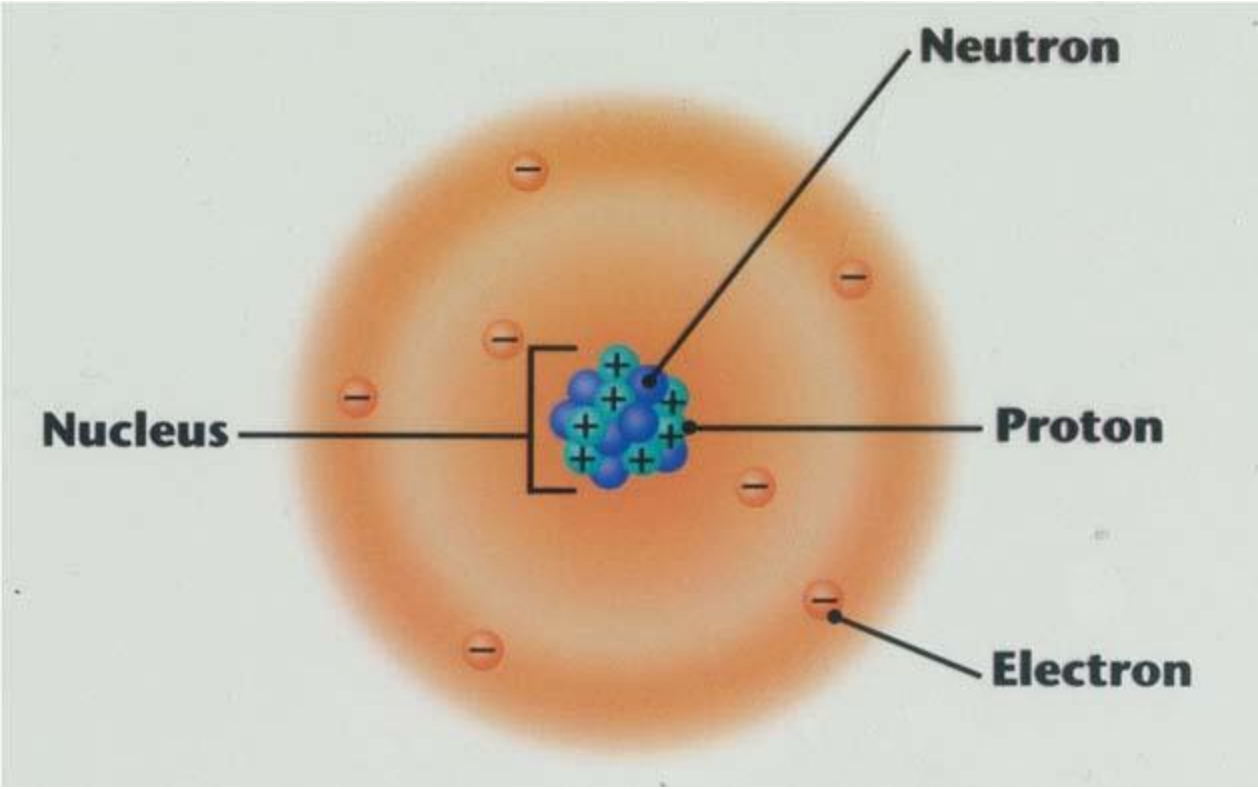
- A number of methods are used to date fossils.

Dating Method	Age Range (years)	Material Dated
Electron Spin Resonance	500 000 – 1000	Bone, tooth enamel, cave deposits
Fission Track	1 million – 100 000	Volcanic rock
Obsidian Hydration	800 000 – present	Obsidian (volcanic glass)
Amino acid racemization	1 million – 2000	Bone
Thermoluminescence	less than 200 000	Pottery, fired clay, bricks, burned rock
Uranium/Thorium	Less than 350 000	Bone, tooth dentine
Carbon 14	1000 – 50 000+	Bone, shell, charcoal
Potassium/Argon	10 000 – 100 million	Volcanic rocks

A fossil trilobite, a primitive arthropod that dwelled in the seas of the Devonian period 370 million years ago

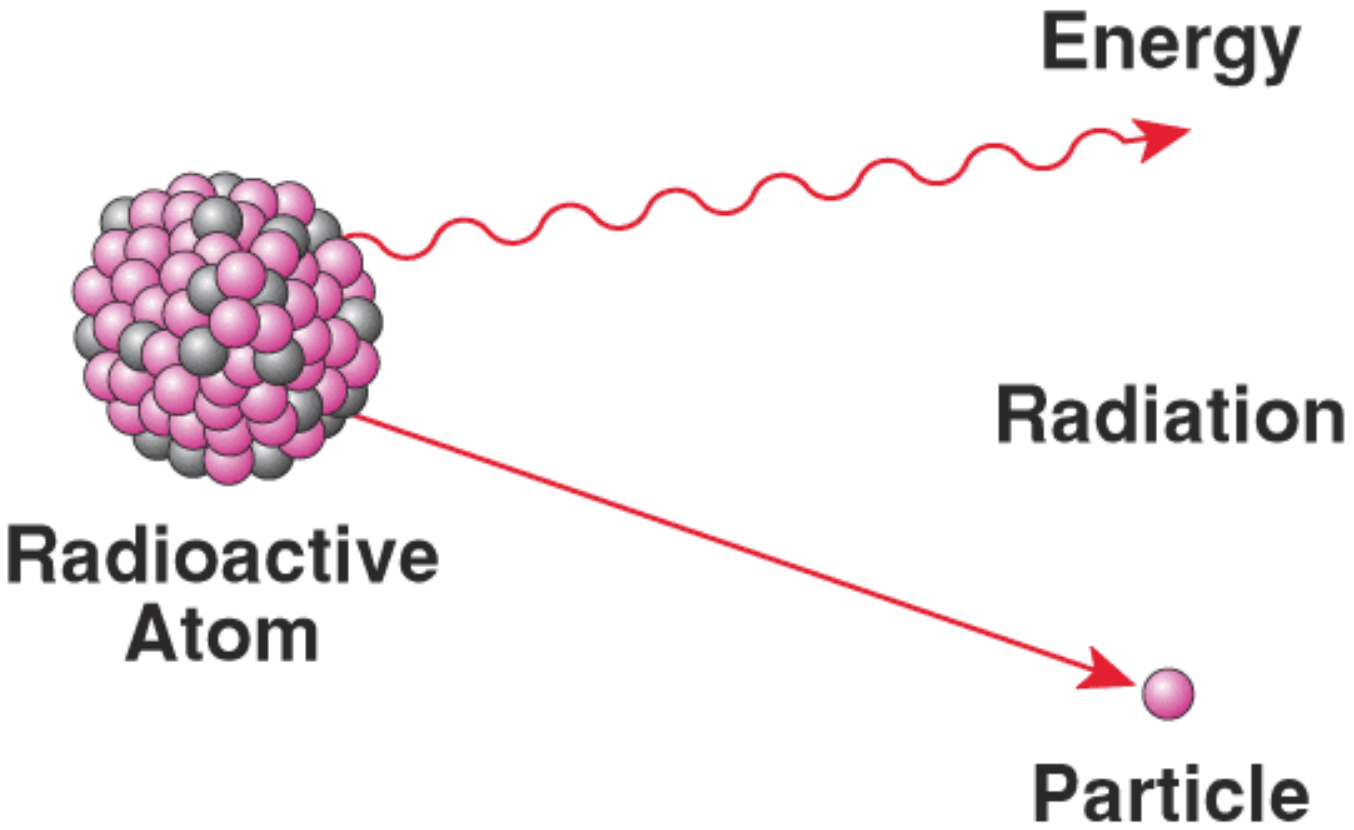
Background Info: Atomic structure reviewed

- Nucleus
  - Protons (determines atomic number)
  - Neutrons
- Orbiting the nucleus are electrons – negative electrical charges



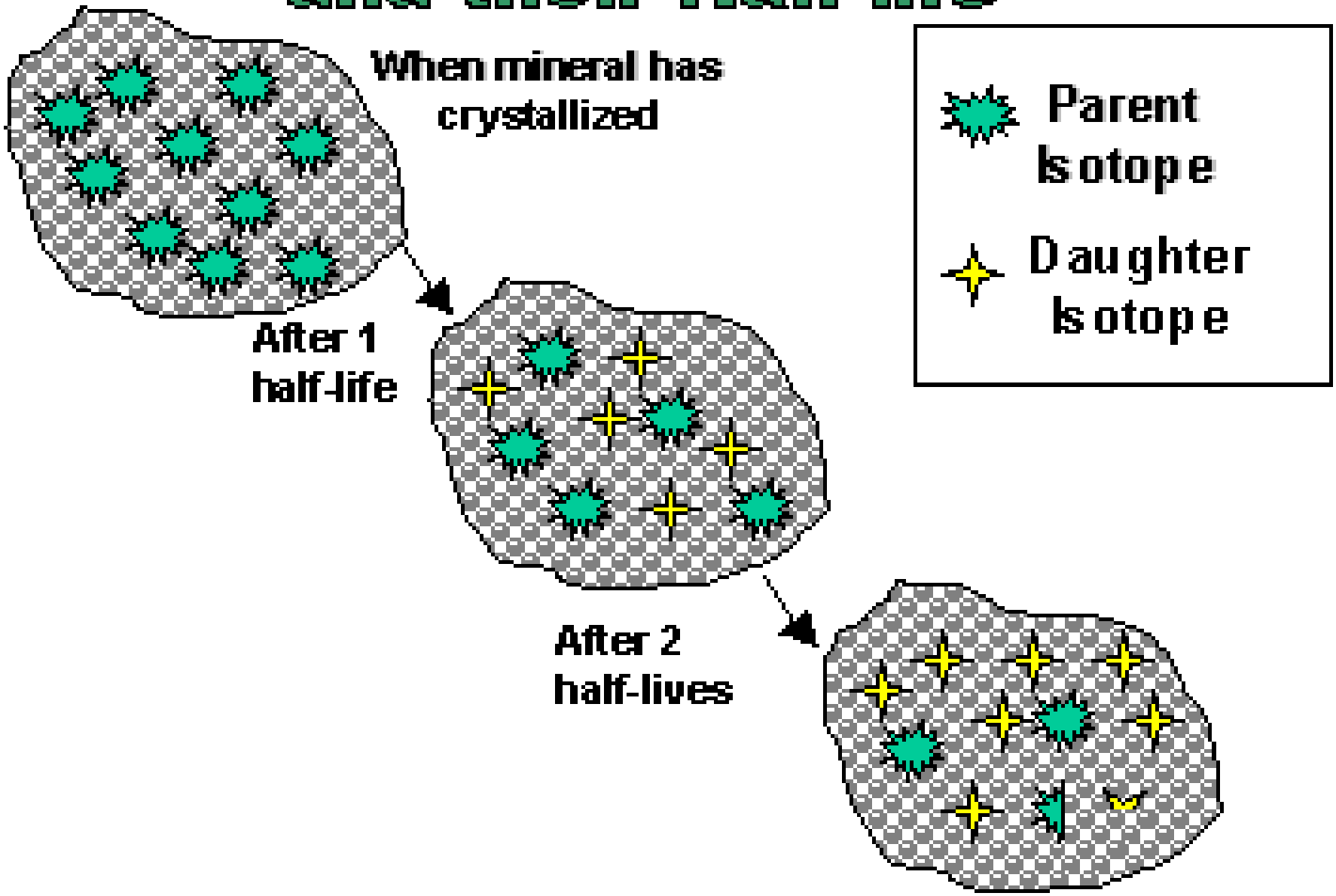
Radioactive Decay

- Radioactive decay is the loss of some neutrons and/or protons from an atom

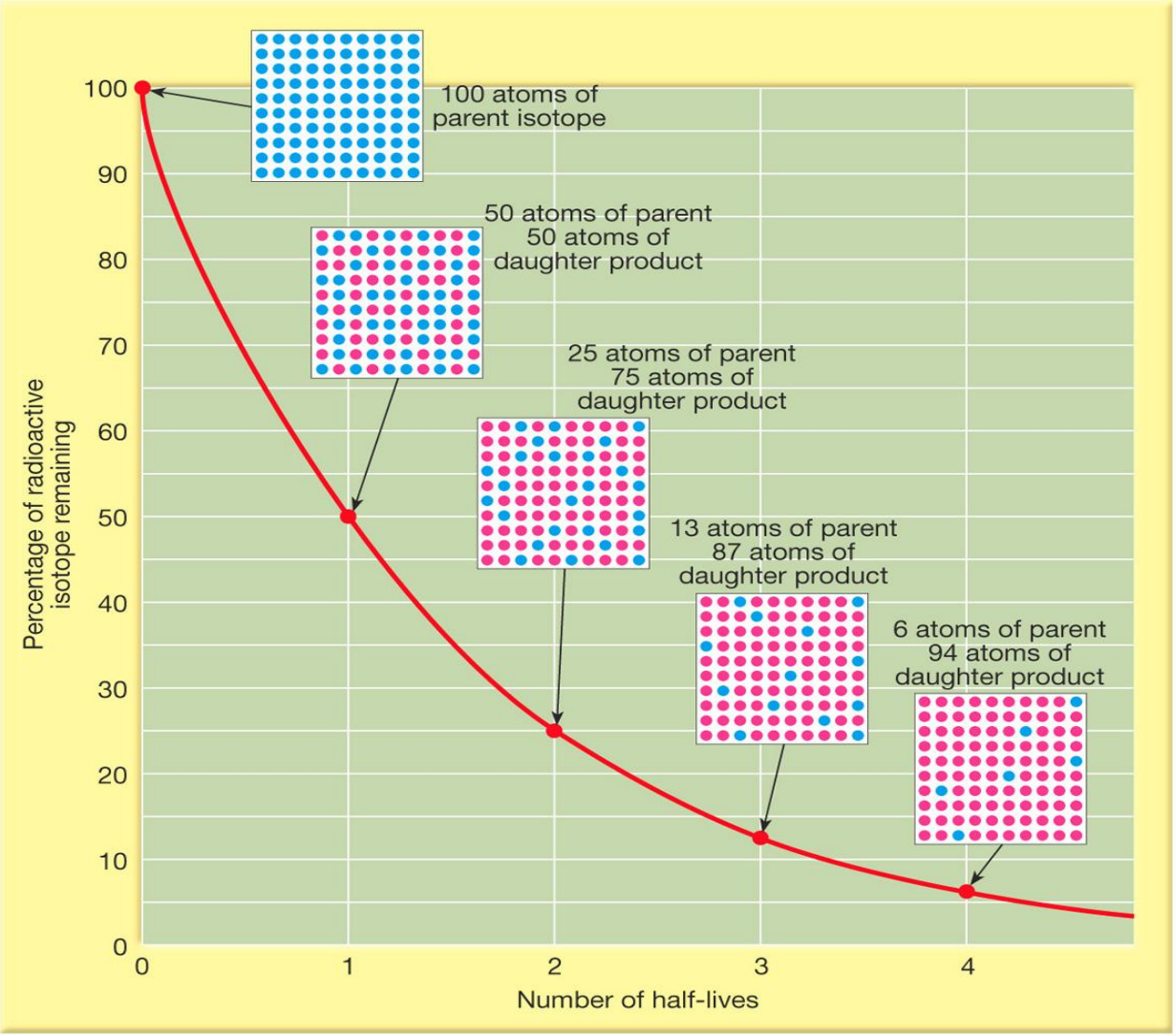


- Radiometric dating
  - When sedimentation occurs radioactive atoms are incorporated into rock
  - These atoms decay to form other atoms at a known rate.
  - This rate is measured as the half-life, defined as the time taken for half the parent atoms to decay to the daughter atoms.
- **Video clip**

Radiogenic isotopes in minerals and their Half-life



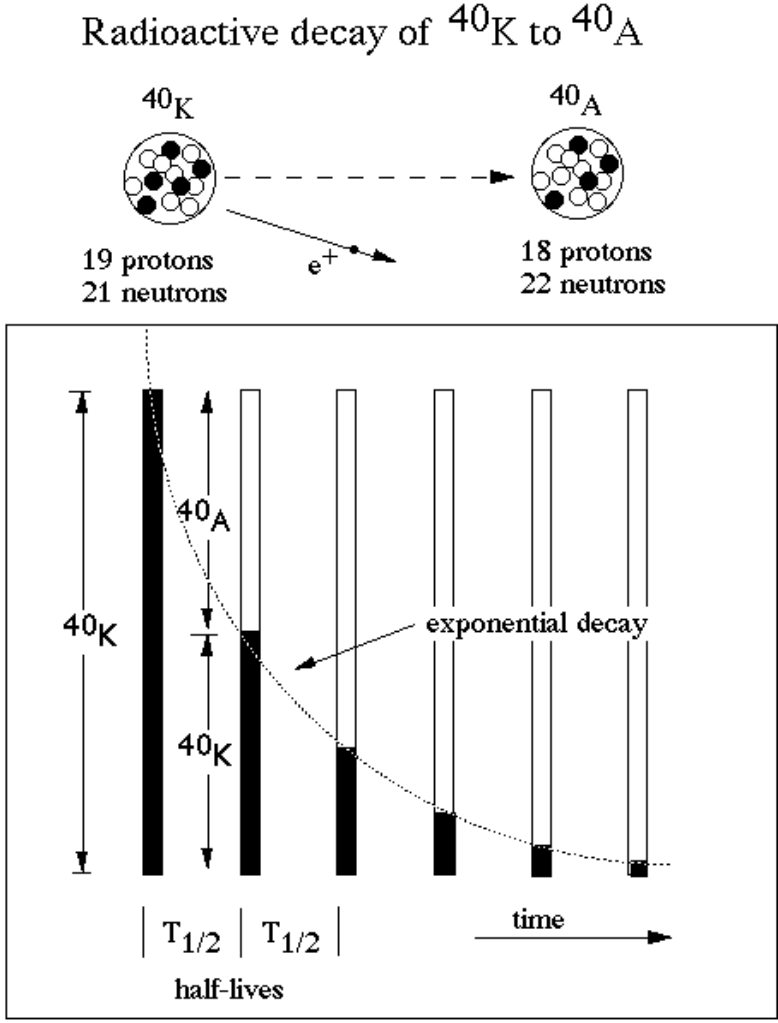
The radioactive decay curve



DATING OF SEDIMENTARY ROCK

Potassium-Argon Method.

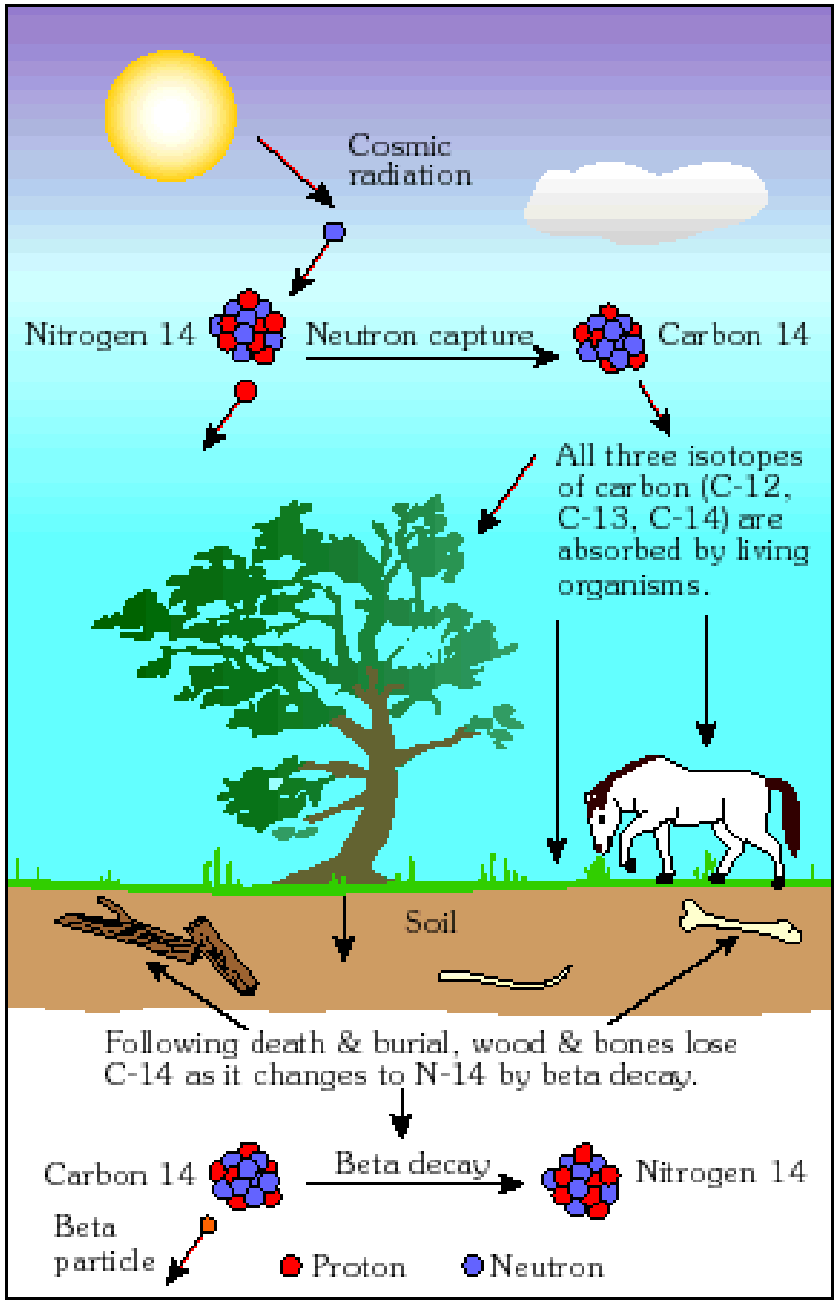
- Potassium-40 (40-K) decays to form Argon-40 (40-Ar), which is trapped in the rocks.
- Useful for dating very old rock (as old as the Earth).
- Volcanic rock is particularly useful for this technique. Volcanic rock, however, does not contain fossils.

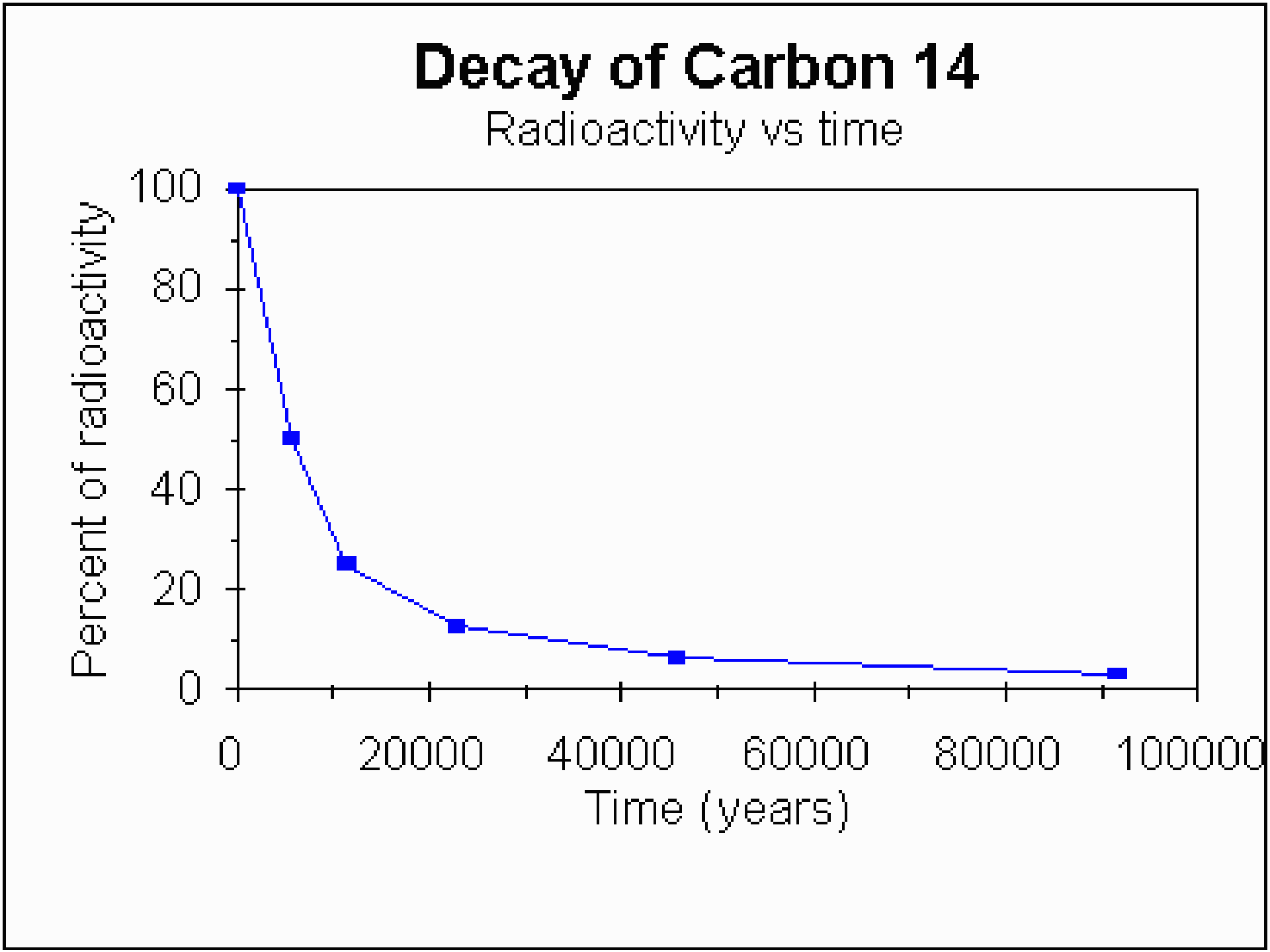


For $^{40}K \rightarrow {}^{40}A$ decay, the half-life is 1.3×10^9 years

Carbon-14 Method

- C-14 becomes incorporated in living tissue through photosynthesis and travels up the food chain.
- While an organism is living it incorporates carbon-14.
- At death, no more is taken in, and so the amount declines as the 14-C decays to 14-N.
- The half-life of 14-C is 5,730 years, so it is used to date very recent remains.




Decay of Carbon 14
Radioactivity vs time
Percent of radioactivity
100
80
60
40
20
0
0
20000
40000
60000
80000
100000
Time (years)