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 with 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.
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.
Fossils are embedded in the different layers of sedimentary rock.

Trilobite fossil
Dated at 375 million years old

Distance of 67 km separating these rock formations.
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 Fossils

#### Dating Method

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

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

When mineral has crystallized

After 1 half-life

After 2 half-lives

Parent Isotope

Daughter Isotope
The radioactive decay curve
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.
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

Time (years)

0 200000 400000 600000 800000 1000000