Fossils and Fossilization

Paleobiology

February 24, 2016

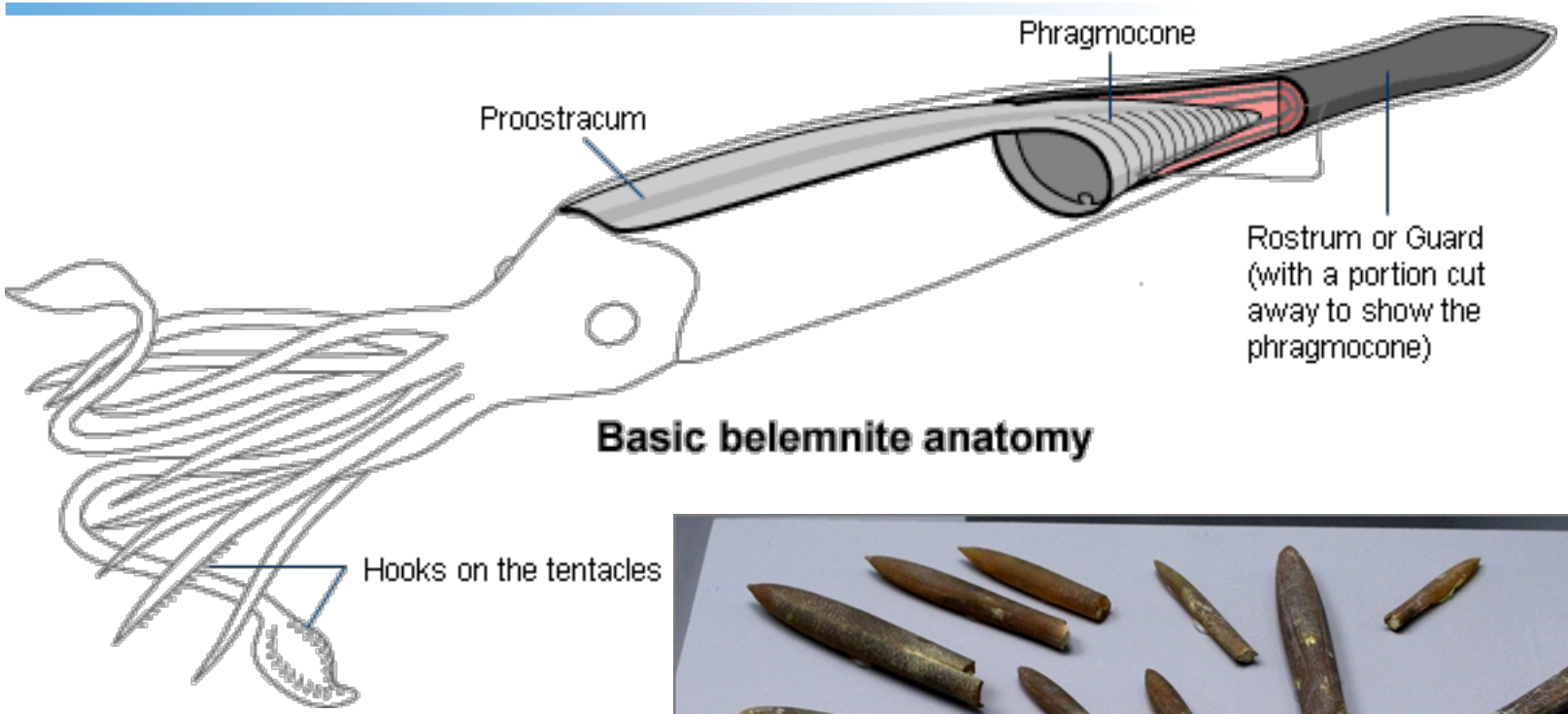
What are fossils?

- Traditional definition
  - Older than 10,000 Years
  - Undergone fossilization – chemical or physical alteration to promote preservation

- Legit definition
  - Any evidence of past life.

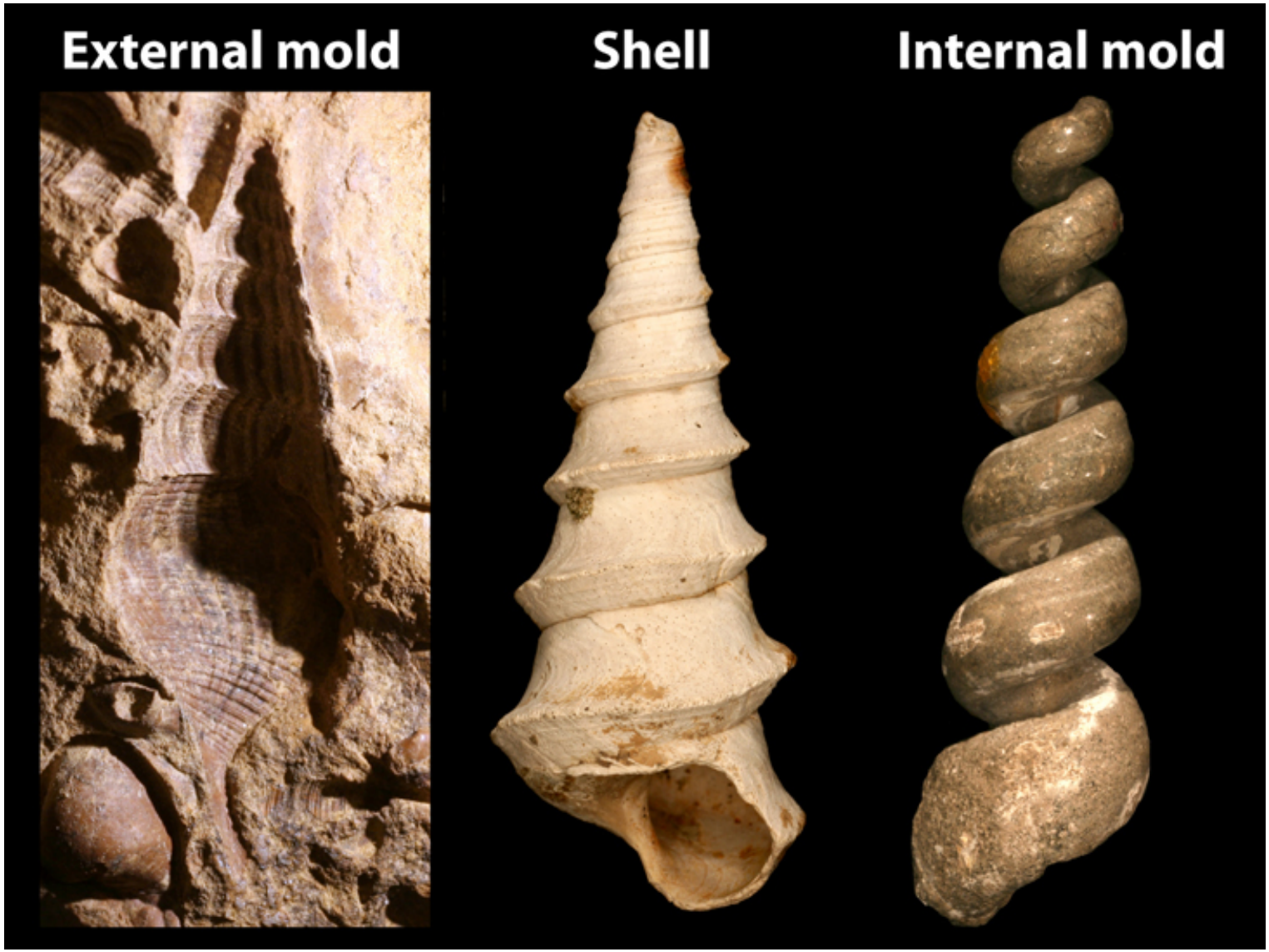
Body Fossils (Skeletons)

Body Fossils (Skeletons)



Basic belemnite anatomy

Body Fossils (Molds)



Body Fossils (Casts)

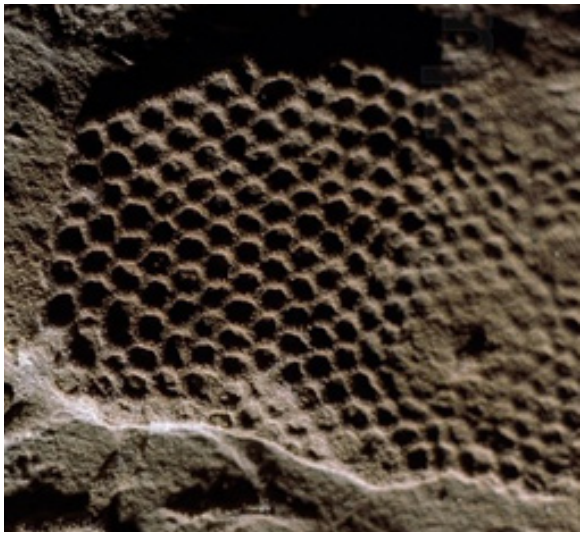
Body Fossils (Molds and Casts)

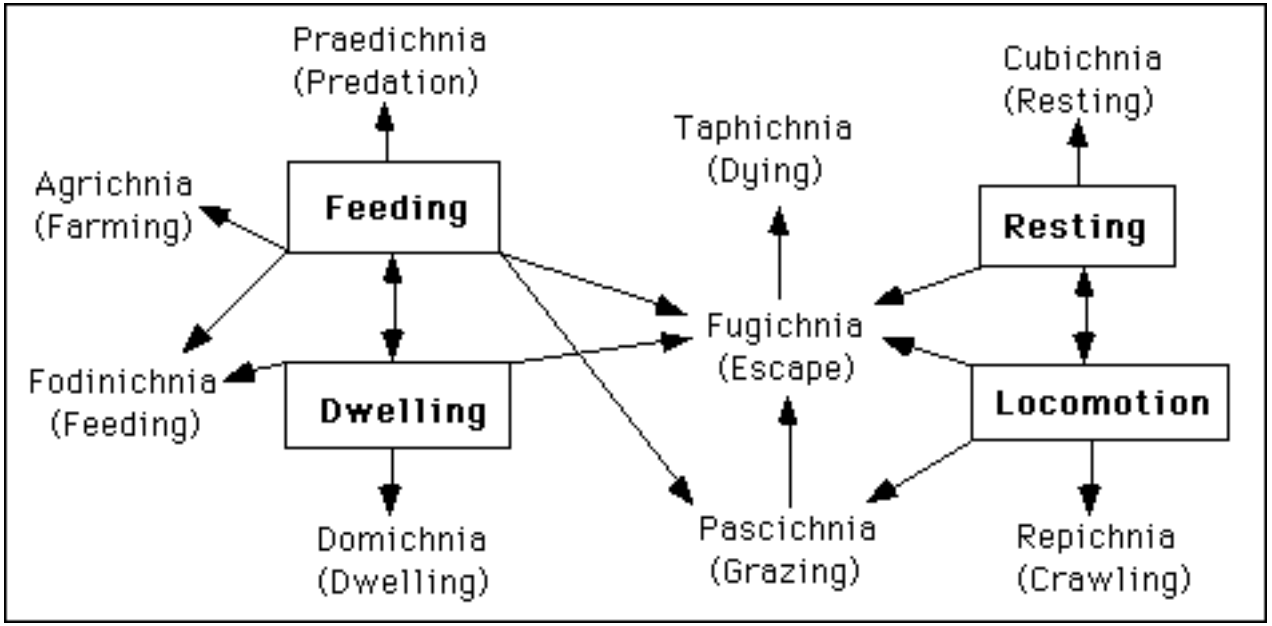
- External Mold – The impression of an object in some surrounding medium – e.g., mud or sand.
- Internal Mold – The inside of an object filled with some other medium – e.g., mud or sand.
- Cast – The internal mold of an external mold.

- Casts tend to be on the bottom of rocks and molds tend to be on the top. This is not a hard and fast rule.

Trace Fossils (Tracks)

Trace Fossils (Modes of Life)



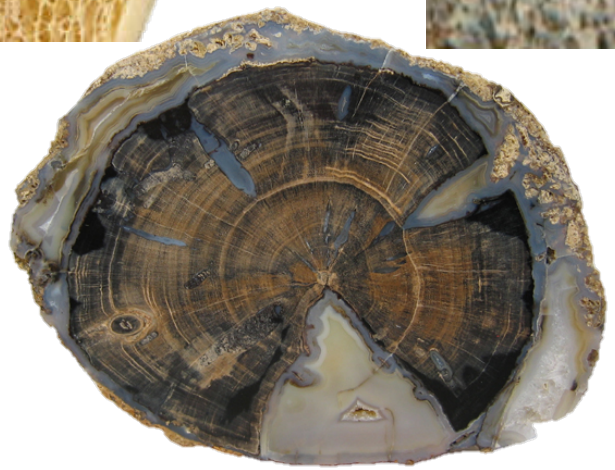


Trace Fossils (Biogenic Structures)

Trace Fossils

Compression and carbonization

Permineralization



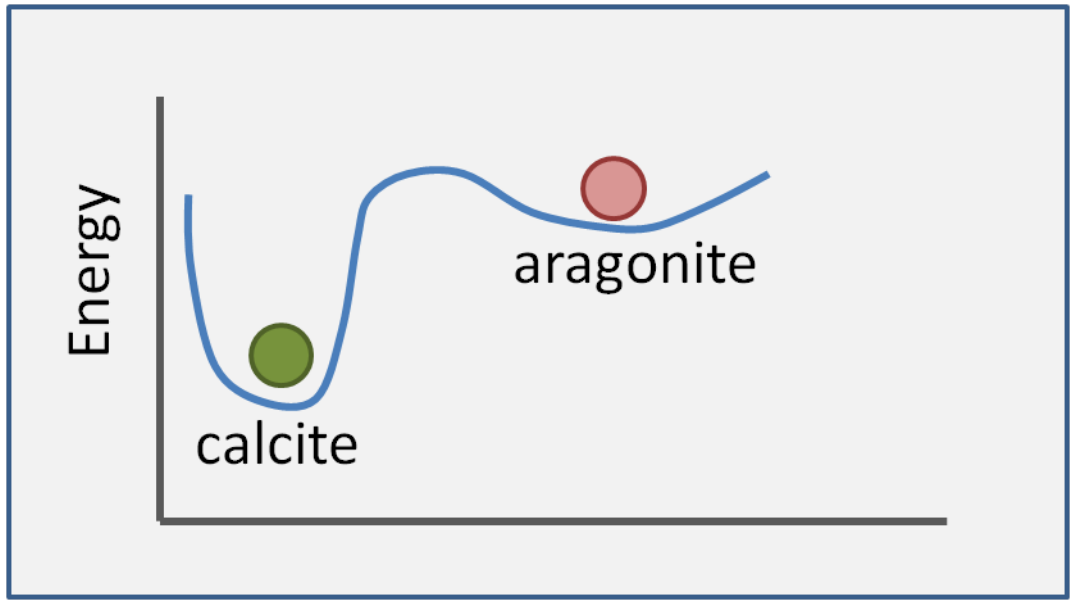
Replacement

Replacement

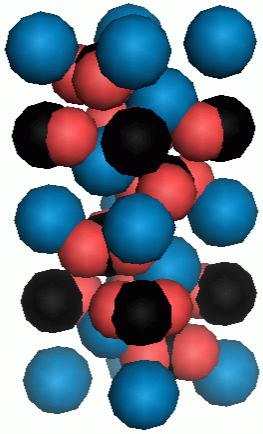
Permineraliztion and replacement

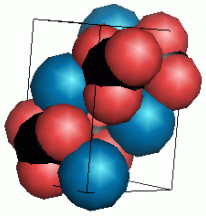
- Permineralization
  - Water flows through the pore spaces.
  - Minerals in the water precipitate out.
  - Minerals fill in the pore space
  - Original material is preserved.
  - Analogous to the formation of internal molds.
- Replacement
  - Generally begins with permineralization
  - The original material (i.e., bone, shell) is replaced by a new material.
  - Can happen on an atom by atom basis
  - Analogous to the formation of a cast.

Recrystallization



- Aragonite – $CaCO_3$ – Most Mollusks
  - (sensitive to warm climates)
- Calcite – $CaCO_3$ – Most Brachiopods, Corals
- Polymorph – Same chemical formula, but different crystalline orientation.
- Metastable – Stable until there is a state change.





Recrystallization

Diagenesis

Concretions

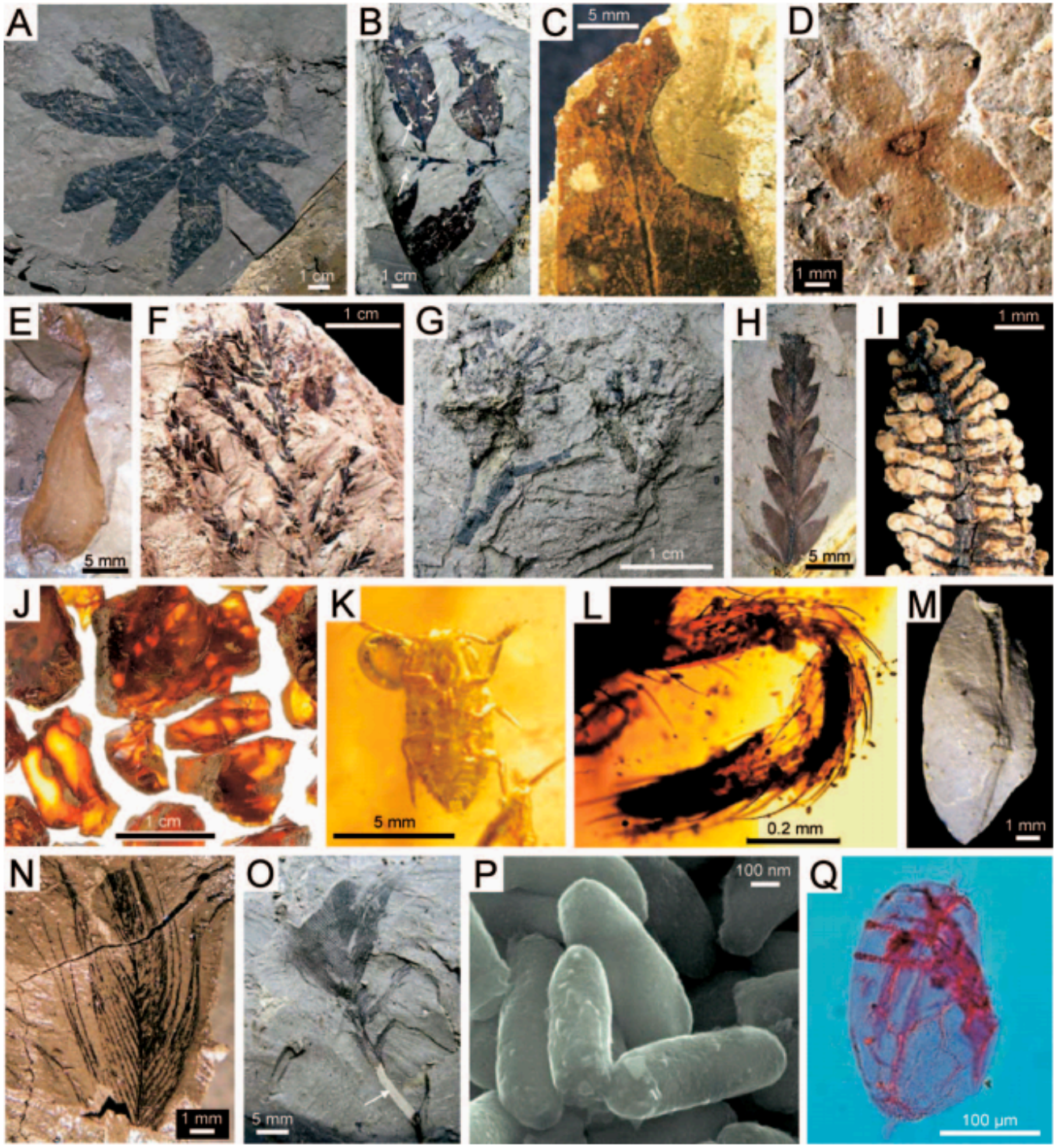
Tar, amber, freezing, and drying

Ash falls

How to preserve fossils?

- Rapid Burial (Obrution)
  - Protects you from mechanical and chemical forces
- Meeting the right kind of bacteria (Stagnation)
  - Reducing water limit bioturbation and scavenging.
  - Promote pyritization (low oxygen replacement).
- Have a hard skeleton
  - Hard parts are more durable against mechanical forces
  - Hard parts are less appetizing to bacteria and scavengers
- Staying dry
  - Ground water can lead to diagenesis
  - Dry is generally bad for bacteria

Lagerstätte



What characterizes a Lagerstätte

- Quantity
  - Unusually high concentration of fossils
- Quality
  - More anatomical detail than usually preserved
  - Soft part preservation
- Rarity
  - Taxa that are not found elsewhere
- Small in extent
  - Ingersoll Shale is <1m thick
- Most marine lagerstätte have similar environmental qualities.
  - Low energy settings
  - Reducing conditions