



FOSSILS

Evidence
of change
over time

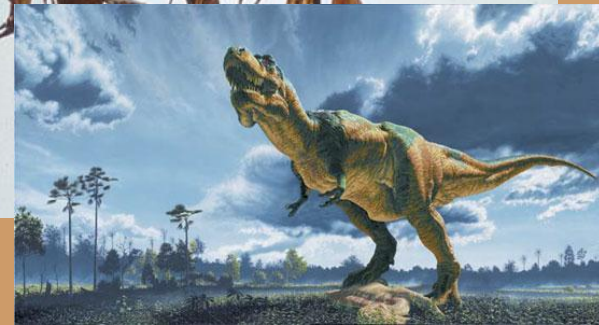
Fossils

What is a fossil?

Preserved remains or evidence of an ancient organism.

What do fossils tell us?

Fossils tell us what an organism was like (structure) and what type of environment it lived in.





Check for understanding

Fossil records can be studied to determine how organisms change through time. Which of the following methods for studying organisms could least likely be accomplished by studying the fossil record?

- A. Comparing sleep patterns of organisms
- B. Dating organisms by the relative order of their fossils
- C. Comparing homologous structures of organisms
- D. Determining when extinction of species occurred



Check for understanding

Fossils help scientists classify extinct species and determine their relationships to current species.

Fossils provide the most information about extinct species' —

A habitats

B structures

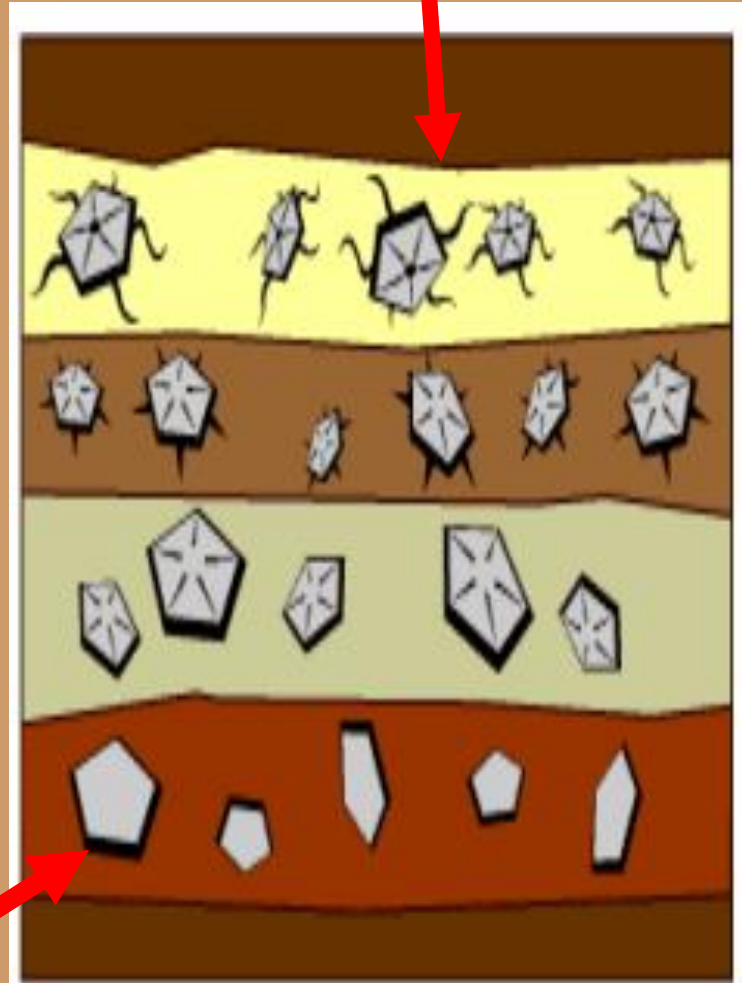
C metabolism

D reproduction

Fossil Record


- The fossil record shows how different groups of organisms have changed over time (evolved).
- It groups similar organisms together and arranges them in order of which they lived- from oldest to most recent.

MOST RECENT



OLDEST

Rock strata with fossils



Check for understanding

Any evidence of an organisms that lived long ago, is a?

a. fossil


b. remain

c. imprint

d. rock



Geologic Time Scale

MILLIONS OF YEARS BEFORE PRESENT	Period	Representative Life	Major Events	
CENOZOIC ERA	1 1/2	Quaternary		
	Tertiary	 Primitive Horses	Opening of Red Sea	
MESOZOIC ERA	65	Cretaceous	Last Dinosaurs	
	140	Jurassic	Quarry Dinosaurs	
	210	Triassic	First Dinosaurs	
	245	Permian	Primitive Reptiles	
	290	Pennsylvanian	Giant Insects	
PALEOZOIC ERA	320	Mississippian	Brachiopods	
	360	Devonian	Primitive Fishes	
	410	Silurian	"Sea Scorpions"	
	440	Ordovician	Nautiloids	
	500	Cambrian	Trilobites	
	570	Fossils older than Cambrian age are rare.		Formation of early super continent

According to this fossil record chart, trilobites probably lived in what ancient environment?

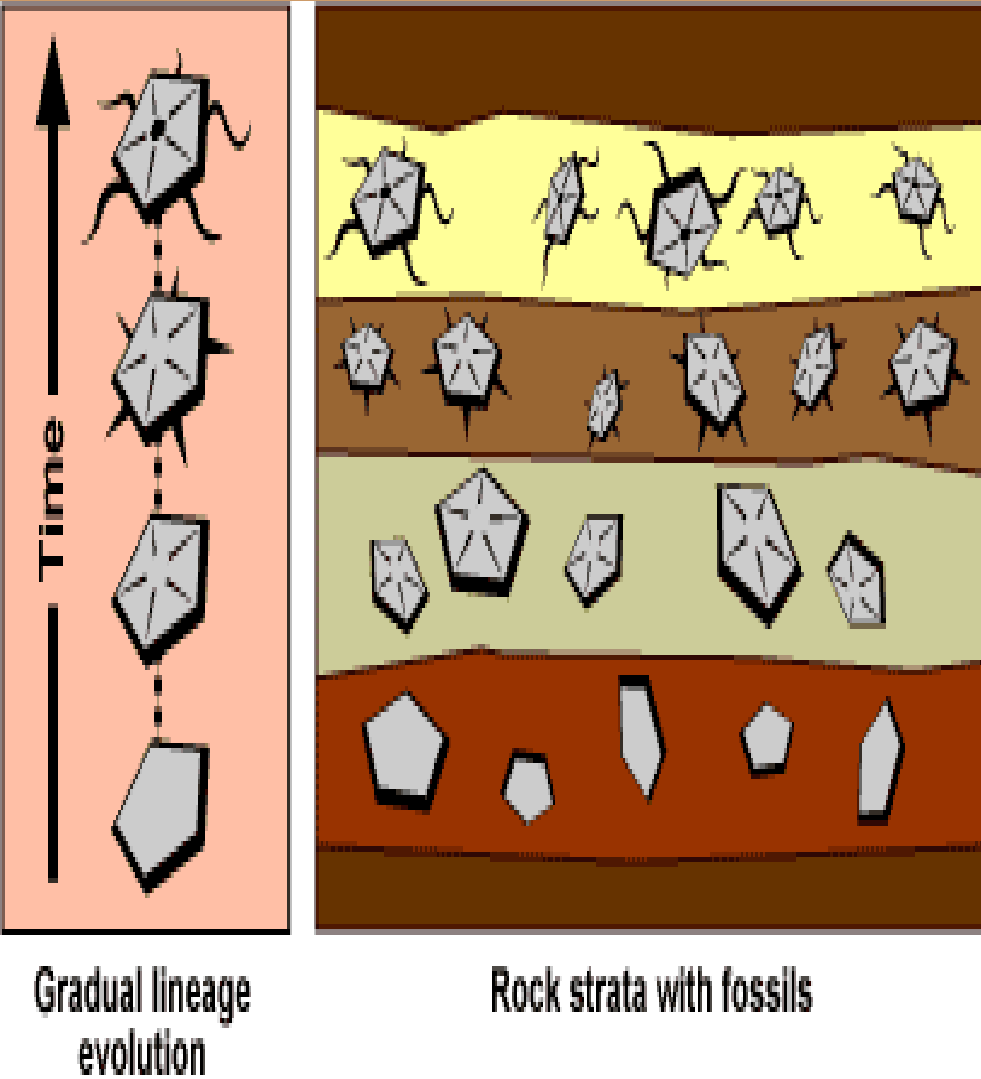
- A** Shallow seas
- B** Mountaintops
- C** Freshwater lakes
- D** Terrestrial forests

Gaps in the fossil record



- Hundreds of transitional fossils document the various intermediate stages in the evolution of modern species from organisms that are now extinct.
- There are still gaps in the fossil record of many species that shrink each year as new fossils are discovered.

The sequential nature of groups in the fossil record

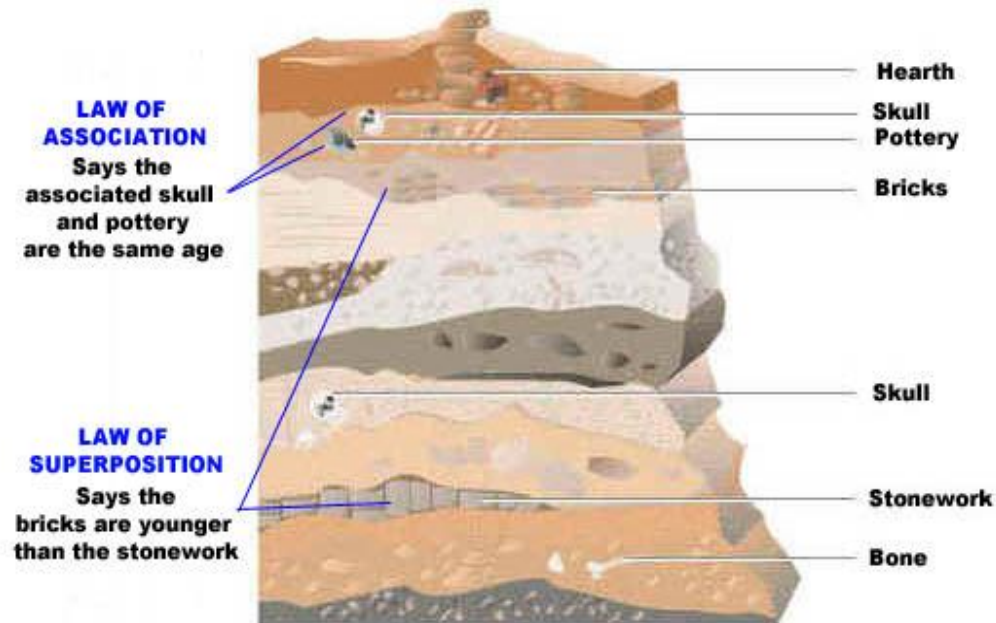
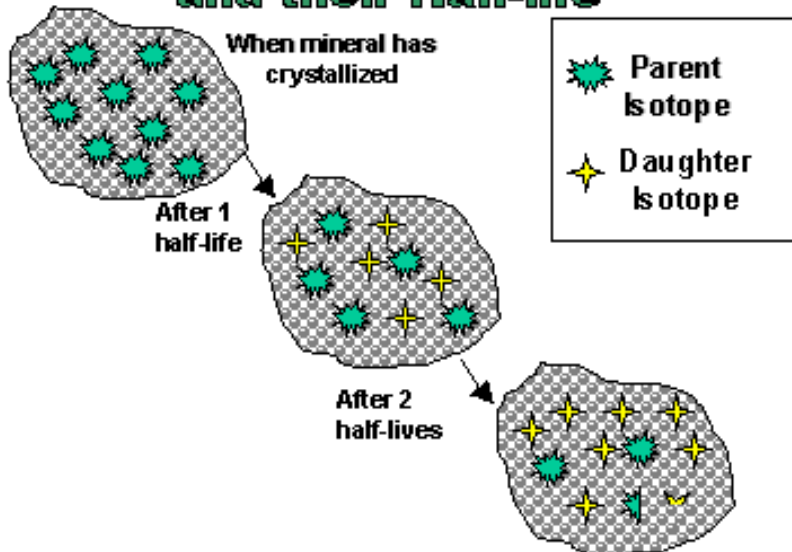


- Groups of organisms can be sequenced from oldest to most recent by arranging them in order of the rock strata in which they were found.

Fossil Evidence

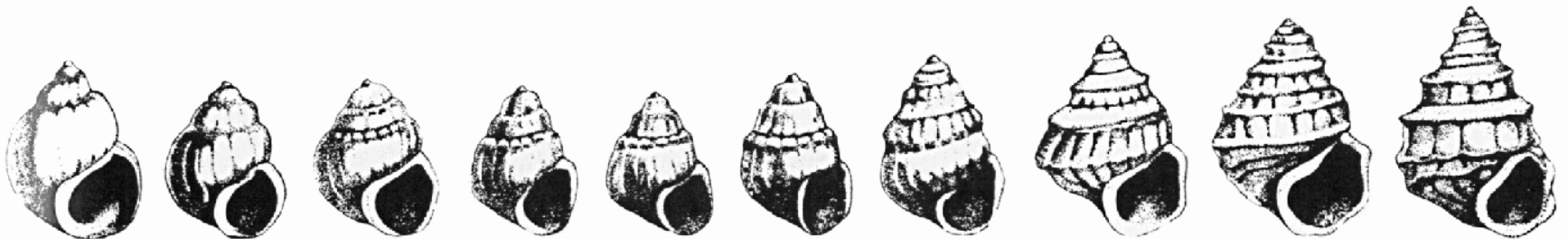
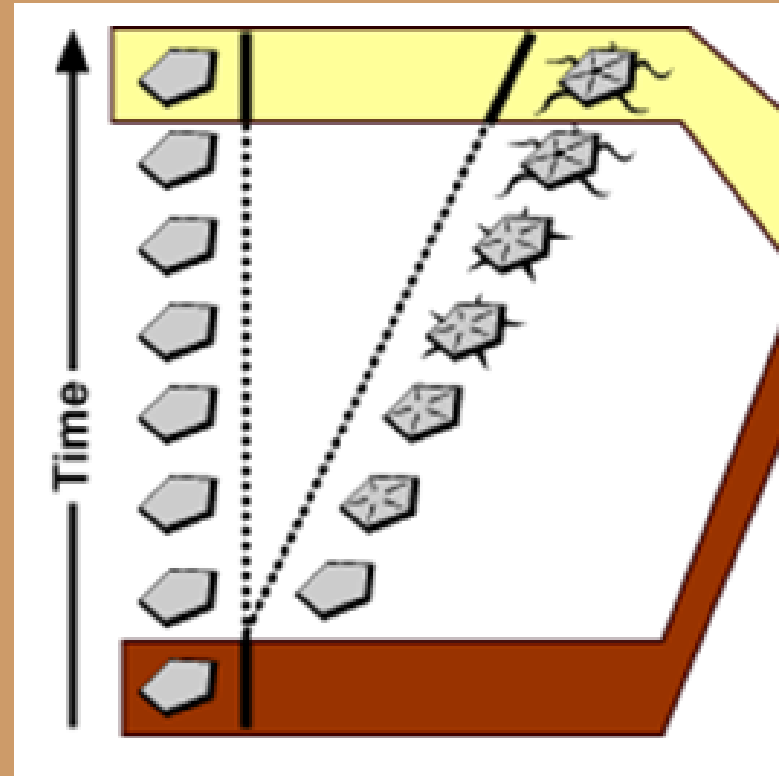
- Absolute dating – date is given in years (radiometric)
- Relative dating – tells on the sequence (before/after)

Radiogenic Isotopes in minerals and their Half-life



Gradualism

- Gradual modification over time among a similar group of organisms.

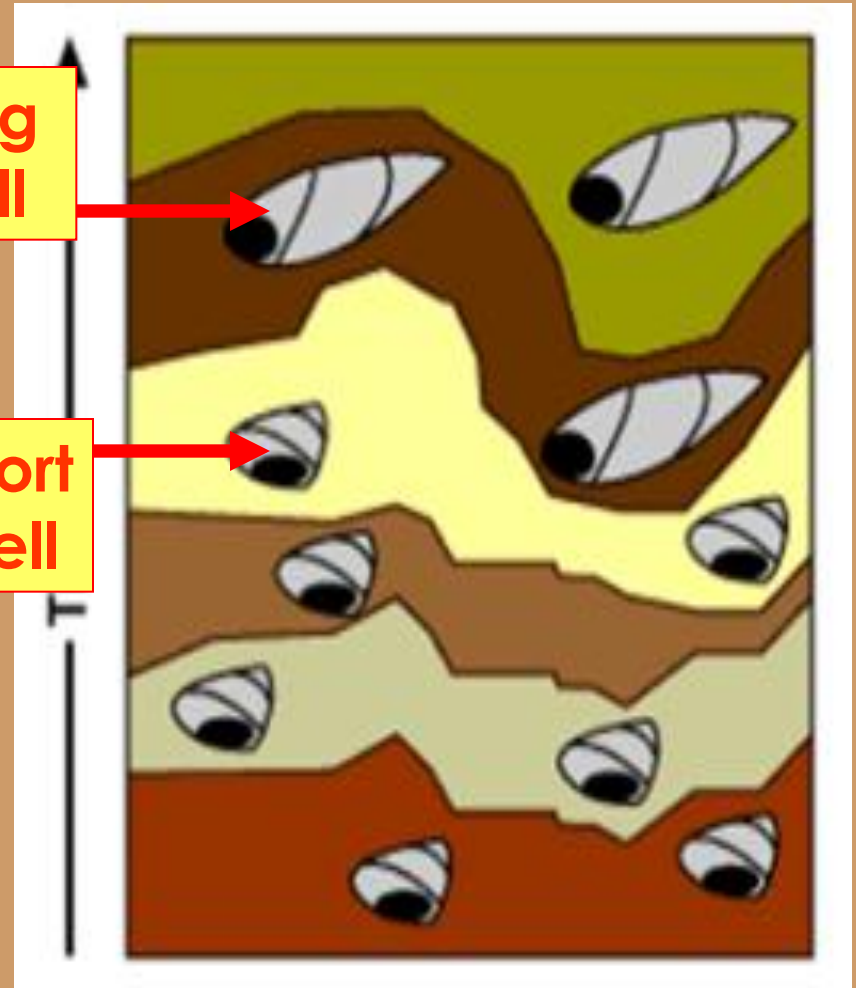


Sudden appearance?

Not all organisms in the fossil record contain transitional forms. Sometimes there can be an abrupt appearance of a new form.

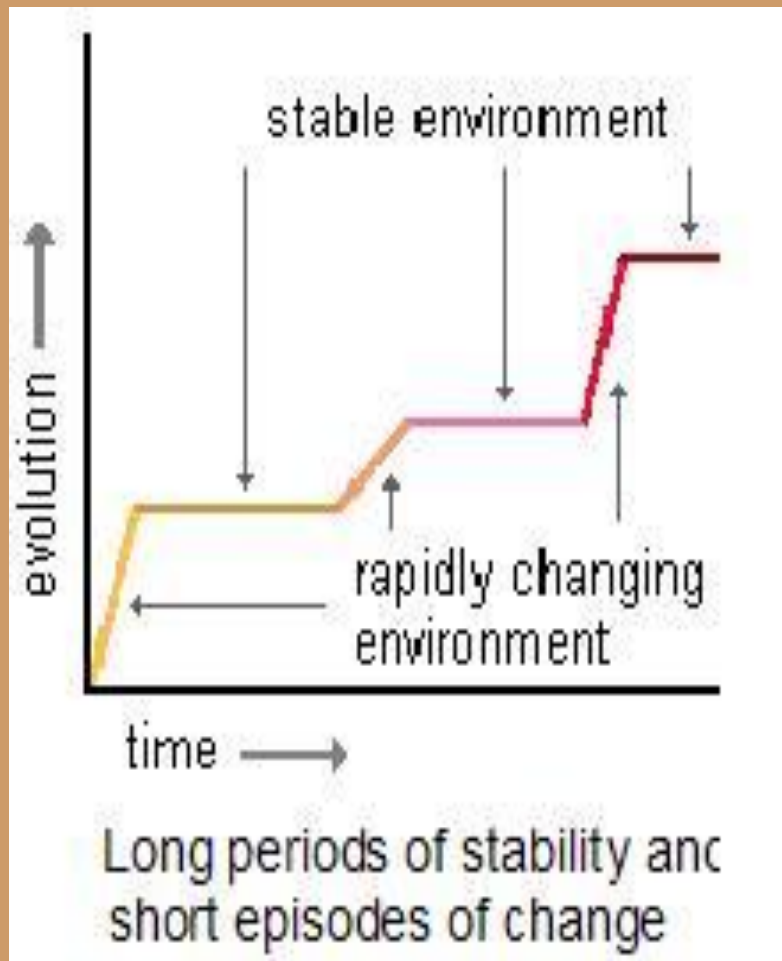
Long shell

Short shell

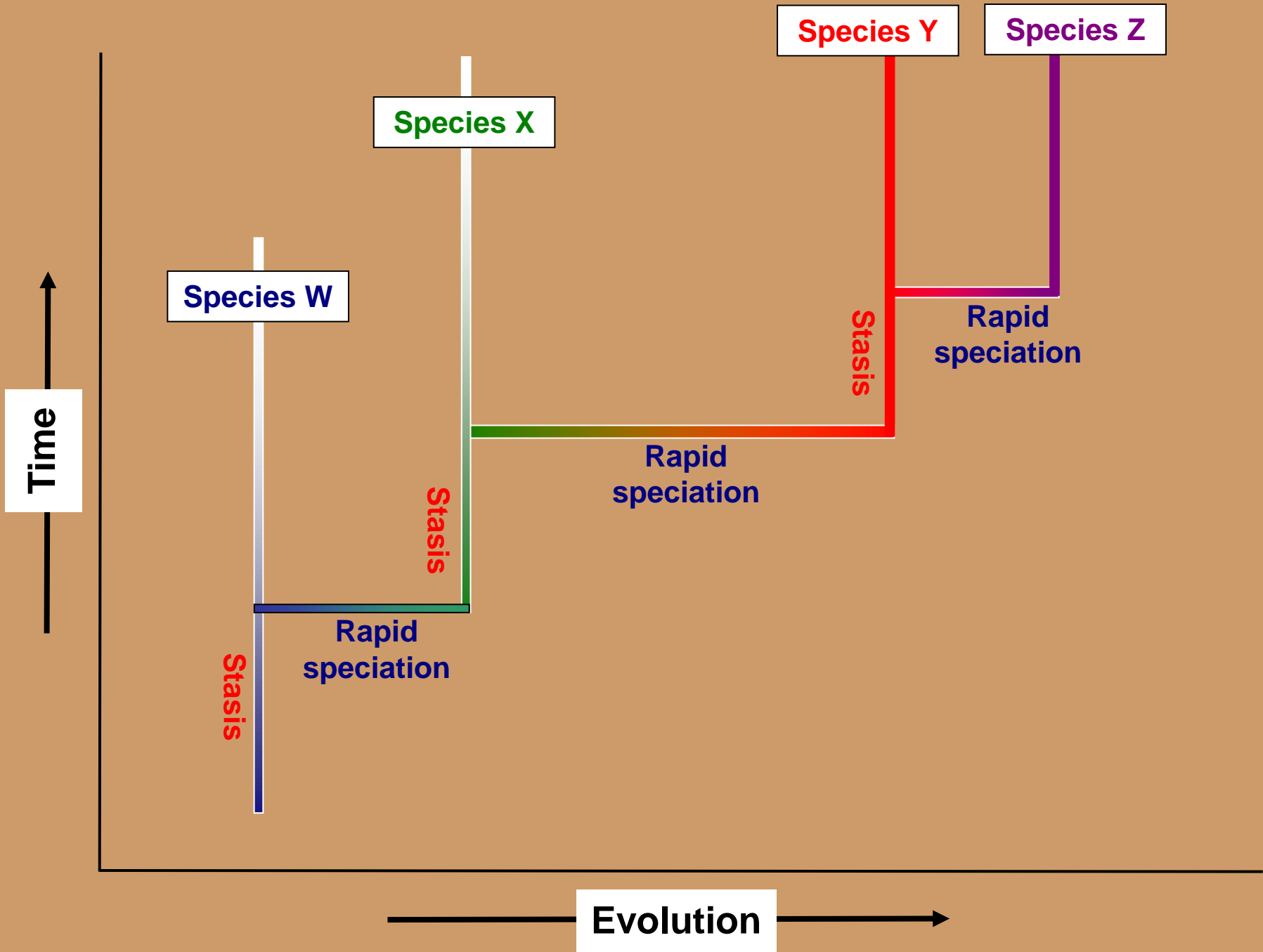


Why does this happen???

Punctuated equilibrium



- Punctuated = to interrupt periodically
- Equilibrium = stable and unchanging
- Theory that predicts that a lot of evolutionary change occurs rapidly separated by long periods of stability (stasis).





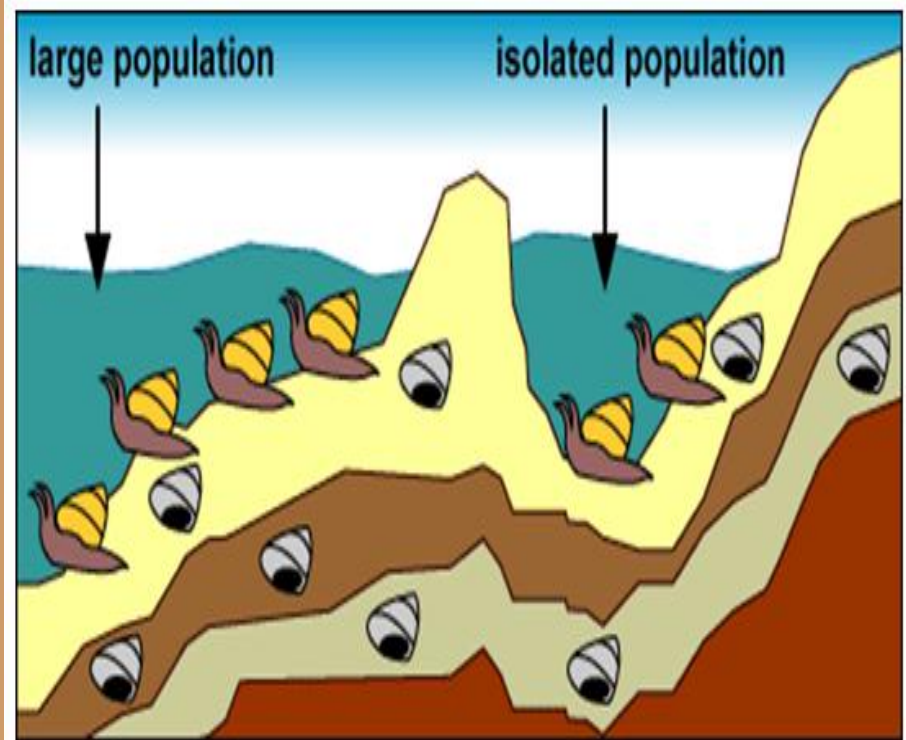
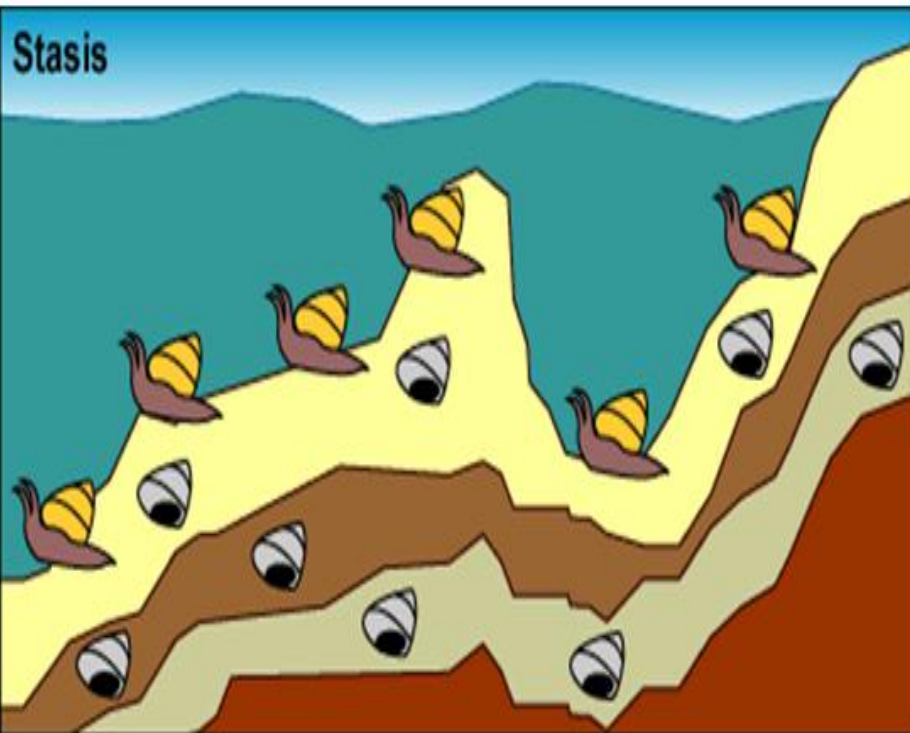
Let's take a closer look at the theory of punctuated equilibrium.

Step 1

A population of mollusks are experiencing stasis

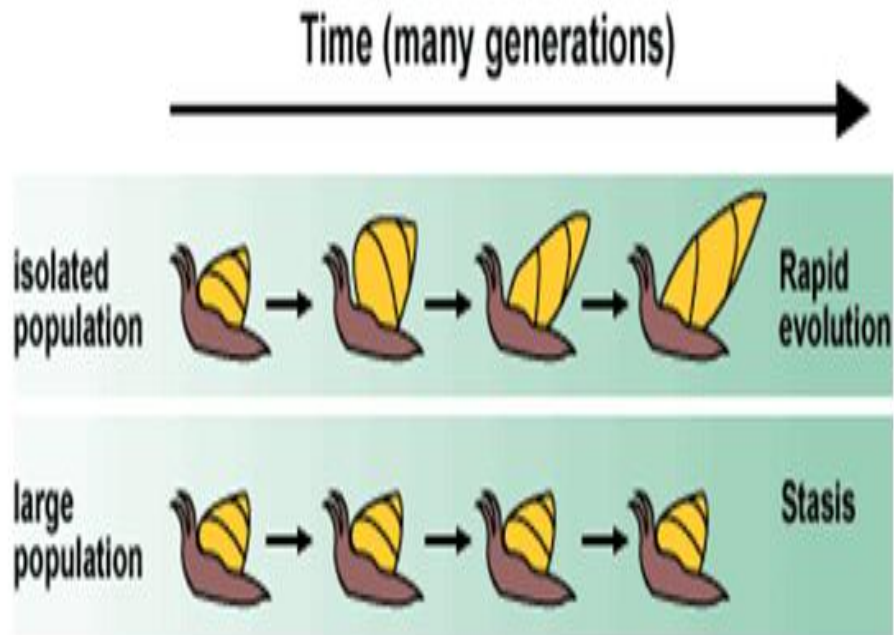
Step 2

A drop in sea level forms a lake and isolates a small number of mollusks from the rest of the population.



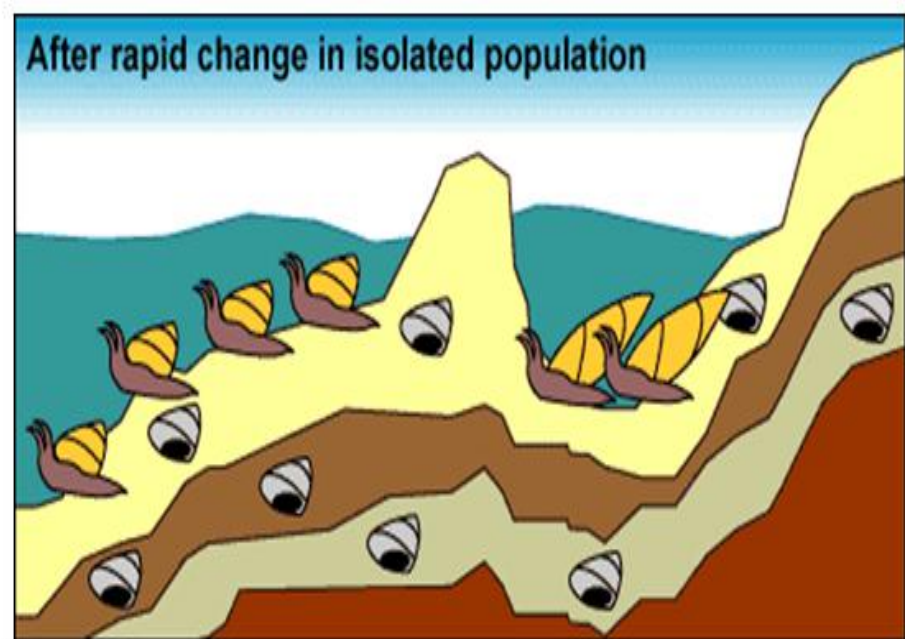
Step 3

The small isolated population experiences rapid change due to the new environment.



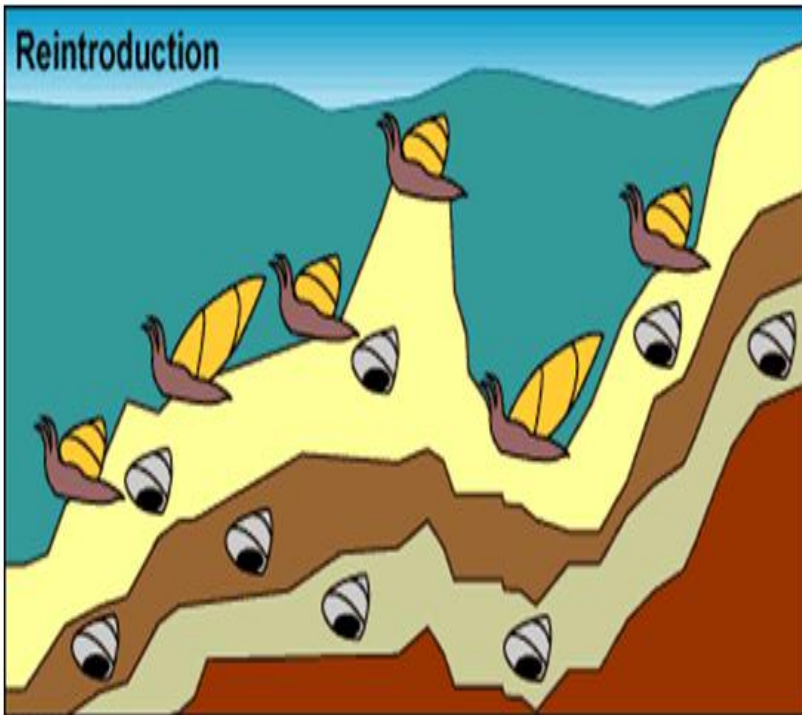
Step 4

No fossils representing transitional forms are preserved because of their small population size and rapid pace of change.



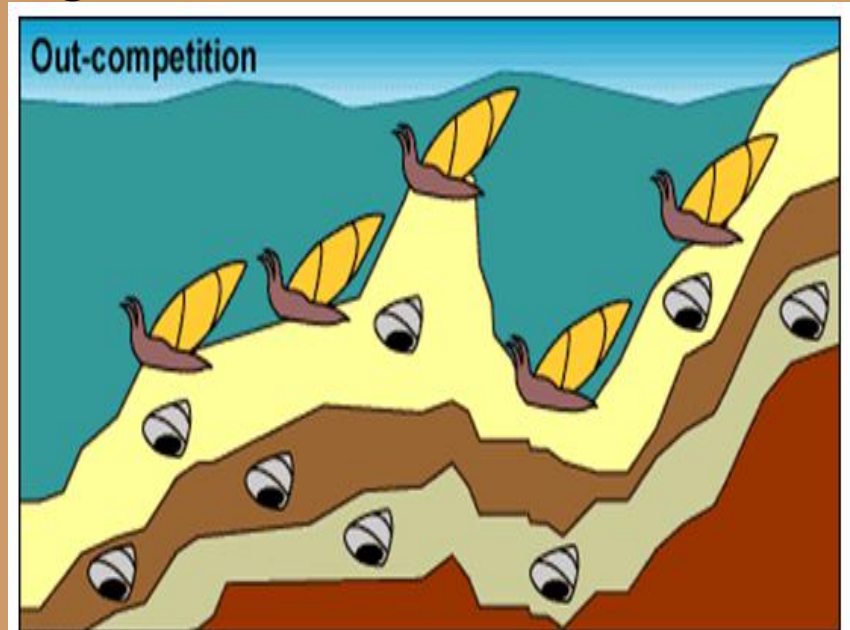
Step 5

Sea level rises, reuniting isolated mollusks with their sister lineage.



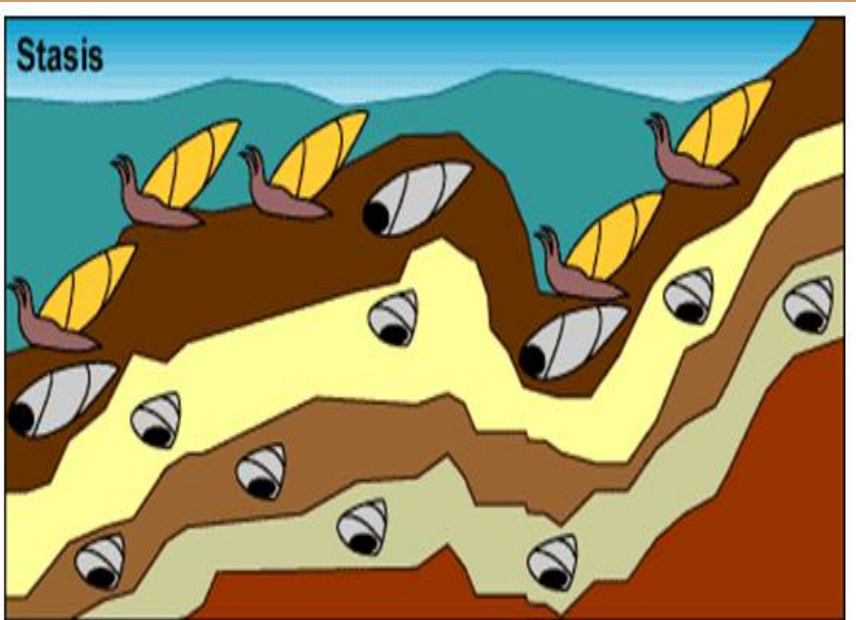
Step 6

Larger population size and stable environment make change less likely. The formerly isolated branch of mollusk may out-compete their ancestral population, causing it to go extinct.



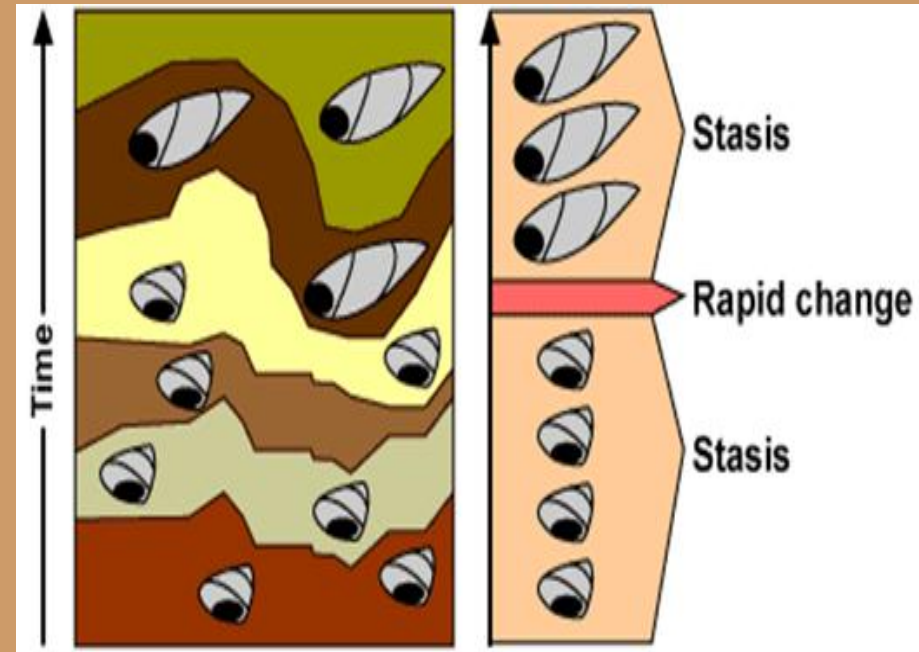
Step 7

Larger population size with larger range leads to stasis with occasional fossil preservation.

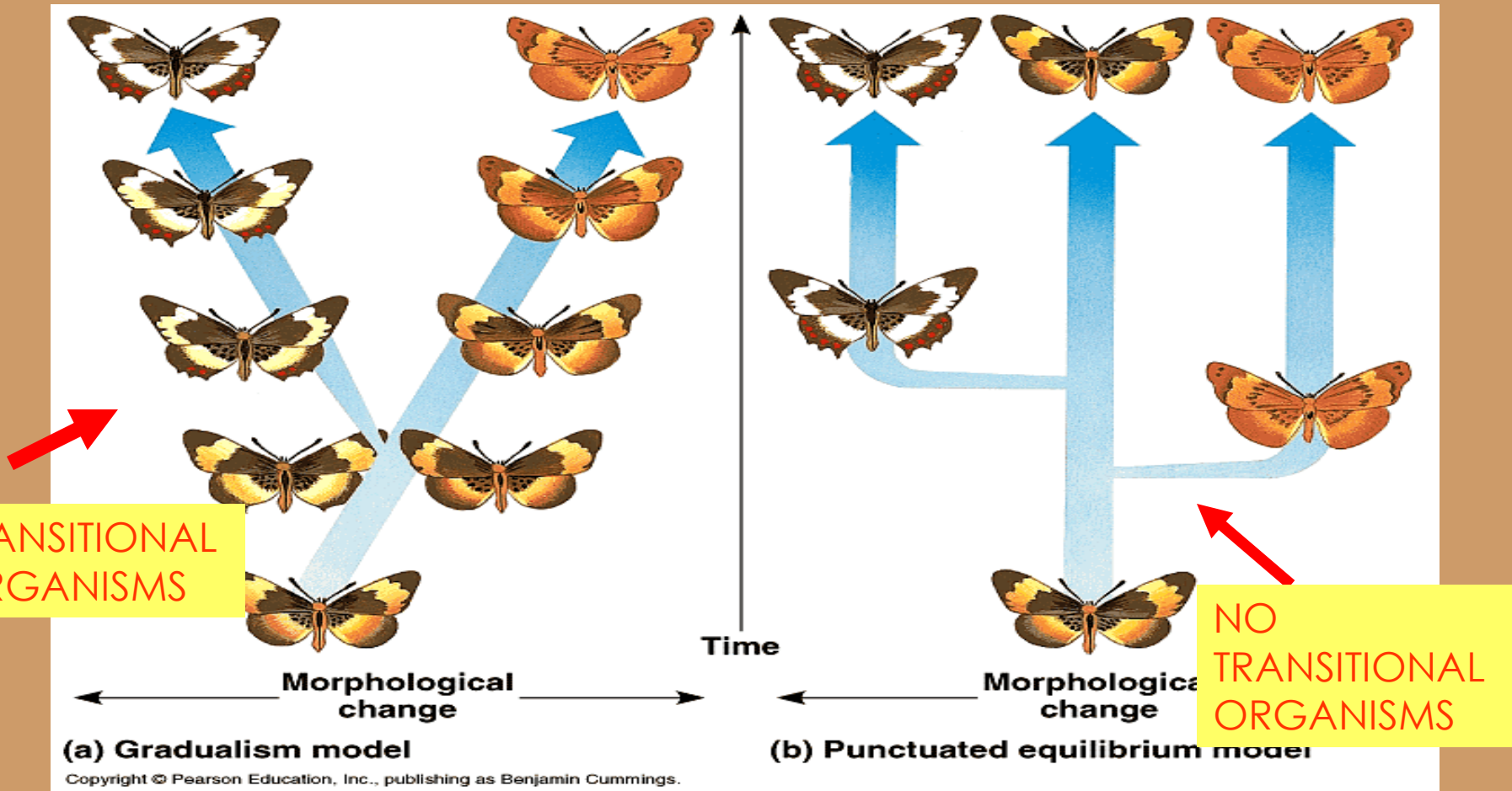


Step 8

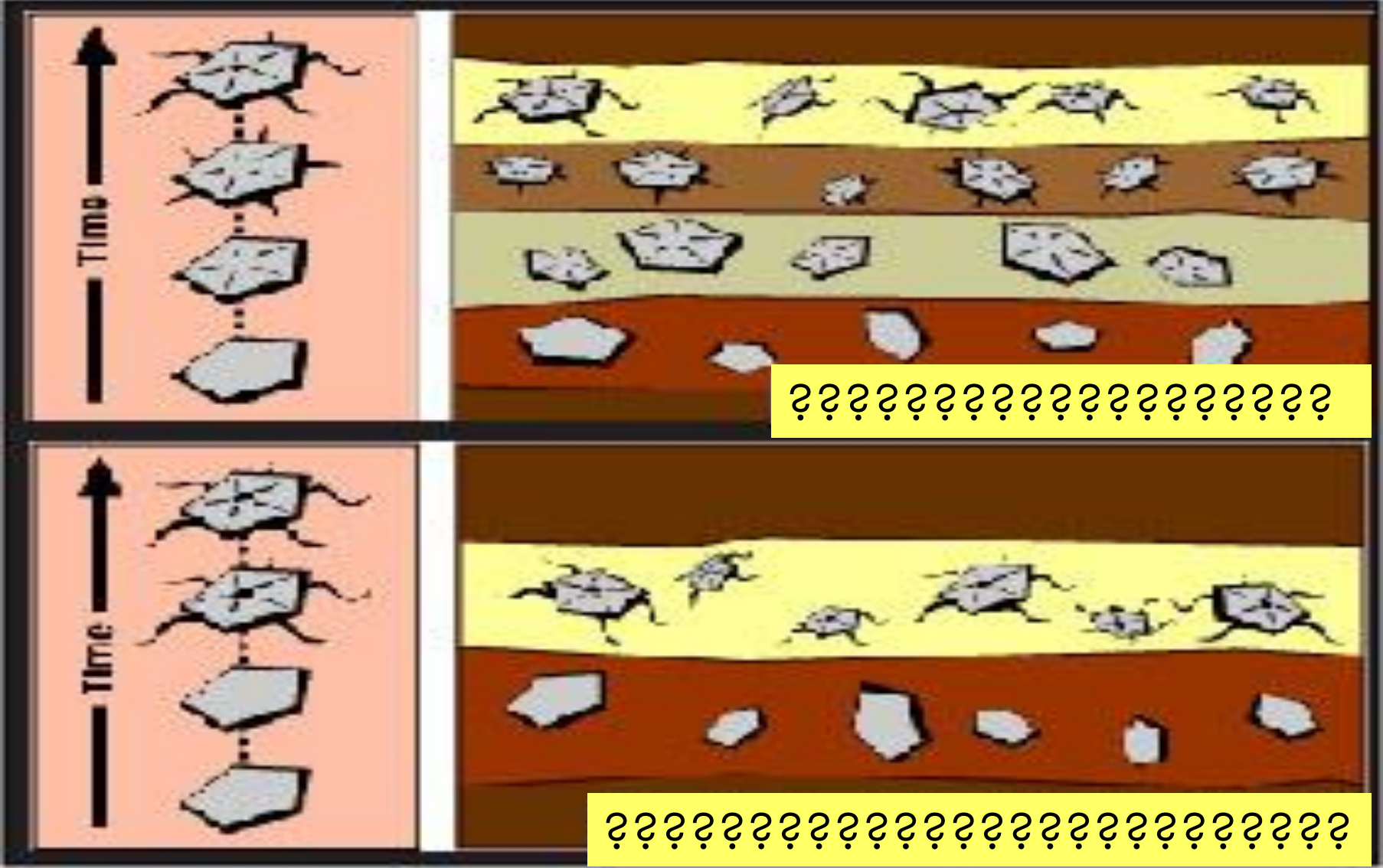
This process would produce the following pattern in the fossil record. Evolution appears to happen in sharp jumps associated with speciation events.



Gradualism vs. Punctuated Equilibrium



Gradualism or Punctuated equilibrium???





Check for understanding

Fossil records indicate that between 80 million and 60 million years ago the structure of the horned dinosaur frequently underwent rapid changes separated by long periods of stability.

This pattern of change best illustrates the concept of...

- A. use and disuse
- B. punctuated equilibrium
- C. gradualism
- D. enzyme specificity



Check for understanding

The idea that evolution takes place at a continuous but very slow rate is known as

- A. succession
- B. artificial selection
- C. punctuated equilibrium
- D. gradualism



Check for understanding

Some scientists suggest that the mass extinction of dinosaurs resulted from sudden global weather changes caused by the impact of an asteroid on Earth. This event most likely promoted the evolution of new species of animals.

These ideas best support the concept of

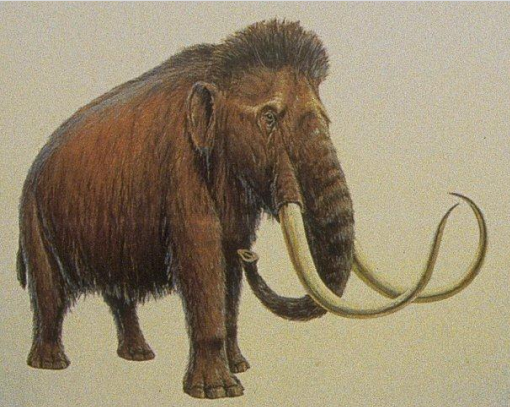
A. punctuated equilibrium

B. use and disuse

C. gradualism

D. geographic isolation

Extinction



- What do all of these organisms have in common?

They are extinct!

- What percentage of all species that have ever lived on earth do you think are extinct?

99%

Mass extinction

- The extinction of a large number of species within a relatively short period of time.
- Due to catastrophic events or environmental change that occurred too rapidly for species to adapt.
- At least 5 mass extinctions have been identified in the fossil record.



<http://www.pbs.org/wgbh/nova/sciencenow/3318/01.html>