

Evolution Biol 4802
Lecture 8 – Material from Chapter 5

Topics for today

History of life on earth – Part 2

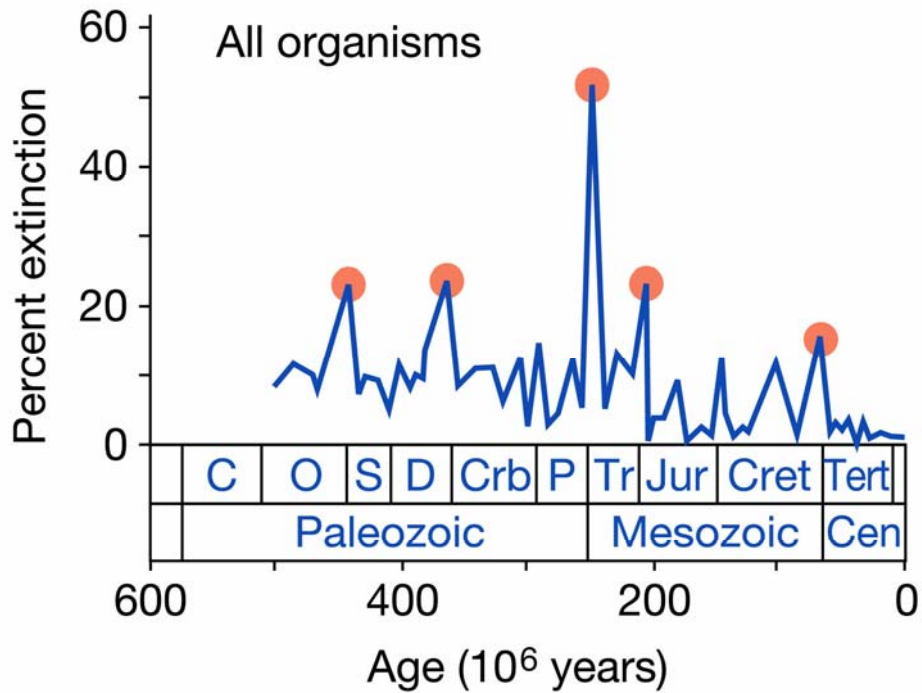
1. Paleozoic
2. Mesozoic
3. Cenozoic

EvoBeaker: HIV

Exercise 3

PALEOZOIC

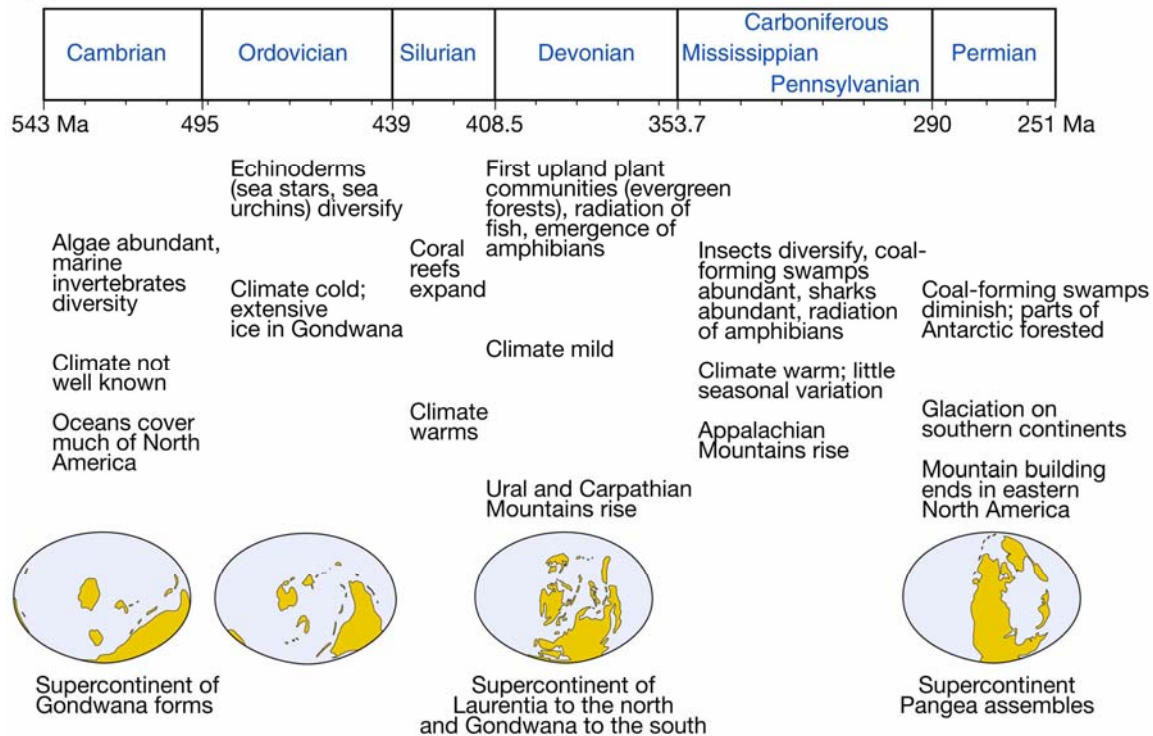
- Three bouts of diversification followed by extinction
- Most massive marks the end of era



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Highlights of the Paleozoic

(a2) The Paleozoic, or "ancient life", era



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Animal phyla diversified in the Ordovician

1. 21 classes of echinoderms
2. Only 5 classes are extant today
3. Most were attached to the sea floor, some burrowed
4. Predators were starfishes and cephalopods (mollusks related to squid)

Plants make first inroads to terrestrial environment in the Ordovician

1. Fossilized spores and sporangia
2. Very small plants resembling liverworts
3. Protected embryo (embryophytes)

Terrestrial life requires protection from desiccation

1. Embryophytes

- a. Plants with internalized sexual organs

End of Ordovician marked by mass extinction

1. Probably caused by glaciations:
 - a. Drop in temperature
 - b. Drop in sea level

Fishlike vertebrates survived and diversified through Silurian

1. Well-armored

Vascular tissue allowed water movement

1. < 10 cm high
2. Leafless
3. Lacked true roots

Devonian plant diversification

1. Land plants greatly diversified

- a. Ferns
- b. Clubmosses
- c. Horsetails
- 2. Some large trees
- 3. Transition from dominant haploid to dominant diploid phase of the lifecycle
- 4. But still had swimming sperm

Arthropods invade land in early Devonian

- 1. Two major groups with marine ancestors
 - a. Predatory spiders, mites, scorpions
 - b. Detritus-feeding millipedes, predatory centipedes, primitive wingless insects

Devonian marine diversification

- 1. Cephalopod mollusks among the most diverse of extinct animals

Late Devonian

- 1. Fish diversify into two groups
- 2. Lobe-finned fishes give rise to the amphibians
- 3. Ray-finned fish gave rise to the larger group of modern fish

Carboniferous to the Permian

- 1. Continued diversification of vascular plants – preserved as coal beds we mine today

Seed plants begin to diversify

- 1. Advantages for terrestrial life
 - a. Wind-dispersed pollen allowed fertilization without water
 - b. Seeds protected embryo from desiccation
 - c. Store of nutrients for young plant to grow rapidly and overcome adverse conditions

First winged insects

- 1. Rapidly diversified into many orders
- 2. Carboniferous:
 - a. Dragonflies
 - b. Roaches
 - c. Grasshoppers
 - d. Leaf hopper
- 3. Permian lineages with complete metamorphosis:
 - a. Beetles
 - b. Flies
 - c. Caddisflies
 - d. Moths
 - e. Butterflies

Amphibians diversify

- 1. Gave rise to the first known amniotes
 - a. Eggs could survive out of water
 - b. Direct development without the aquatic larval stage

Amniotes diversify

- 1. **Synapsids** - mammals

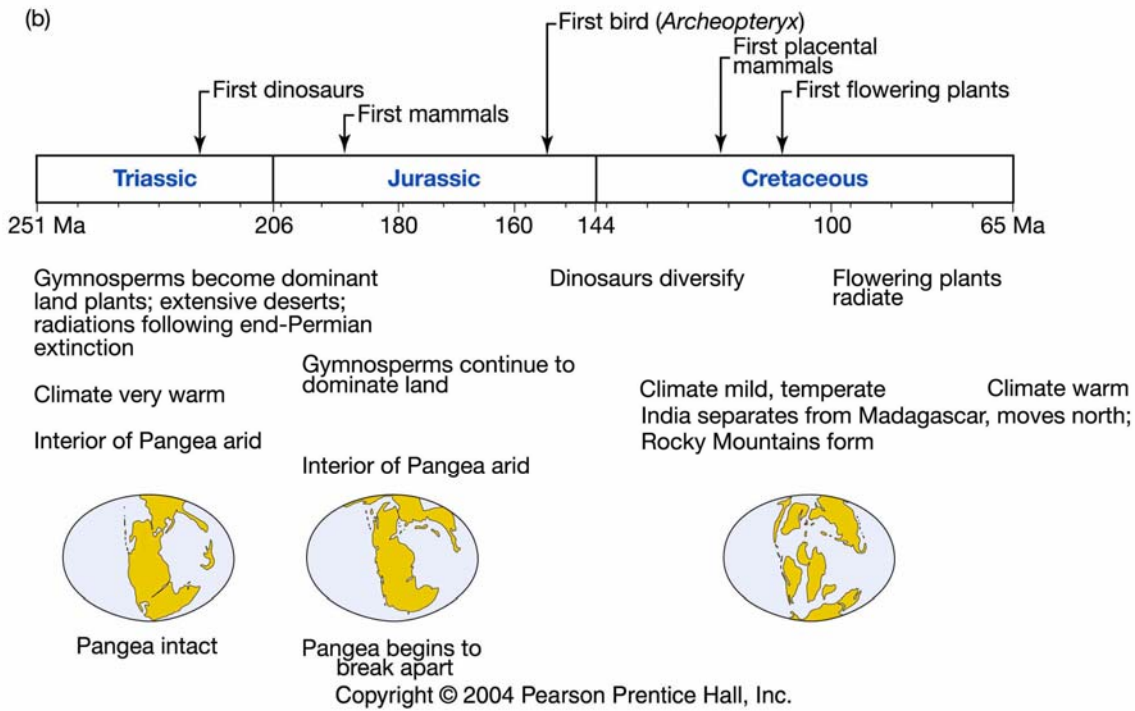
- a. Single opening during development allows attachment of stronger jaw muscles
- 2. **Diapsids** - reptiles
 - a. Two openings allow attachment of strong jaw muscles that can open more widely

Massive extinct ends the Paleozoic

- 1. Single continent formed
- 2. Climate cooled
- 3. Sea level dropped to lowest point in history
- 4. Extinction of 52% of families, 96% of all marine invertebrates with skeletons

MESOZOIC

Highlights of the Mesozoic



Plant diversification in the Mesozoic

- 1. Dominated by gymnosperms and cycads
- 2. Some gymnosperms attracted insects for pollination
- 3. Gave rise to the flowering plants

Age of reptiles

- 1. Pangea began to break up
- 2. Sea level rose and many continental areas covered with shallow sea
- 3. Mostly warm climates

Two groups of mammals

- 1. **Eutherians**
 - a. young nourished by placenta and born fully developed

2. Marsupials

- a. young born partially developed and complete development in a pouch

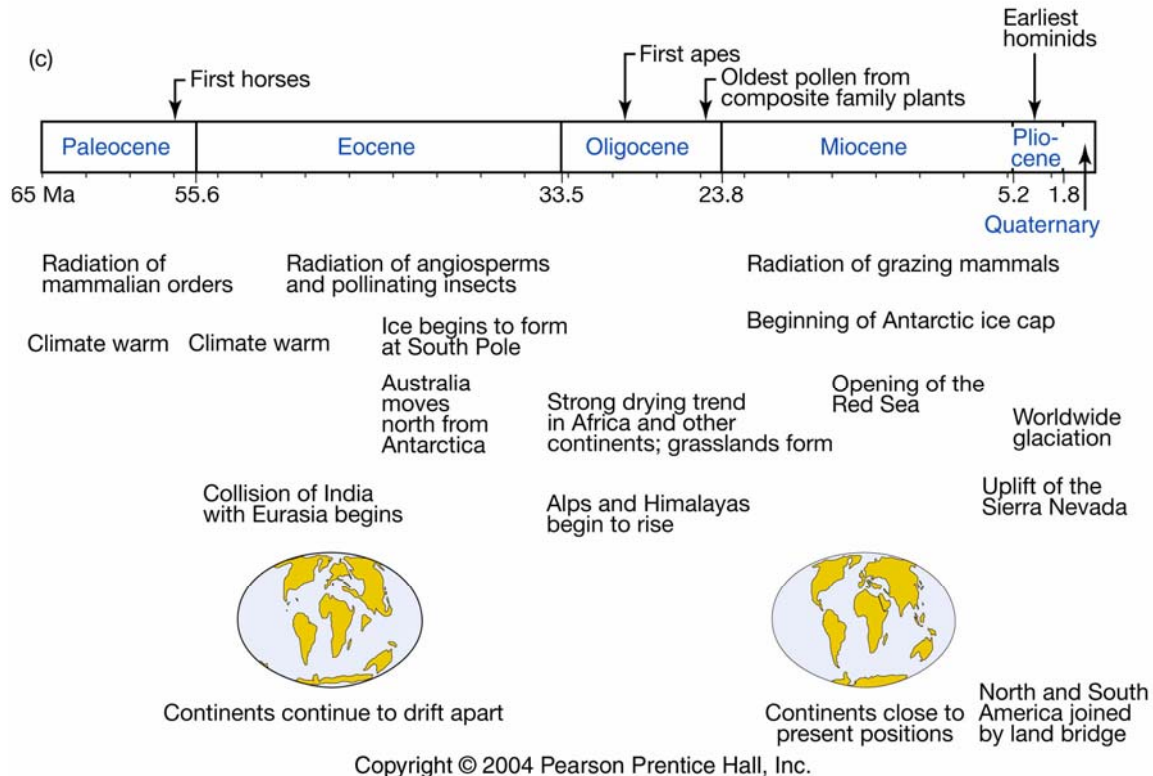
Molecular data suggest earlier radiation of mammals than fossil record

1. Why?

- a. Small size
- b. Relatively uncommon

CENOZOIC

Highlights of the Cenozoic



Plant-insect codiversification

1. Most modern families of angiosperms and insects became differentiated early
2. Fossil insects belong to genera that are extant
3. Grasses underwent major adaptive radiation

Mammals became dominant

1. Why?
 - a. Released from competition and predation from dinosaurs

Great American Interchange

1. Marsupial fossils on all continents including Antarctica
2. Today occur in Australia, S.A. and one N.A. lineage
3. Most extinct by the end of the first period of Cenozoic
4. S.A. was isolated
5. Many marsupials, hoofed mammals that resembled sheep, rhinoceroses, camels, elephants, horses, and rodents
6. 3.5 mya N.A. and S.A. joined for the first time

7. N.A. mammal groups such as bears raccoons, weasels, peccaries, and camels moved to S.A. and contributed to extinction

The late Cenozoic - Pleistocene

1. Continents in the same place
2. Pleistocene species are similar or indistinguishable from living species that descended from them
3. At least 4 major glacial advances (many minor)
4. More recent maxed out 18,000 years ago melted 15,000-8,000 years ago
5. Sea level dropped connecting islands to land masses
6. Connection many islands to nearby land masses

Low sea levels allowed movement

1. England has fossils of elephants, hippos, and lions
2. Species stranded in islands of remnant habitat "glacial disjuncts"

Major themes in history of earth

1. Climate and distribution of land masses effects evolution of organisms
2. Earth's history marked by mass extinction followed by evolutionary radiations
3. Diversification has included increases in number of organisms and the ecological niches they can exploit
4. Few of the forms in higher taxa in the remote past still exist
5. The composition of the biota increasingly resembles that of the present