

Evolution



V Sem B.Sc. Zoology – Core Course VII – Ethology,
Evolution & Zoogeography

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ADAPTIVE RADIATION



INTRODUCTION



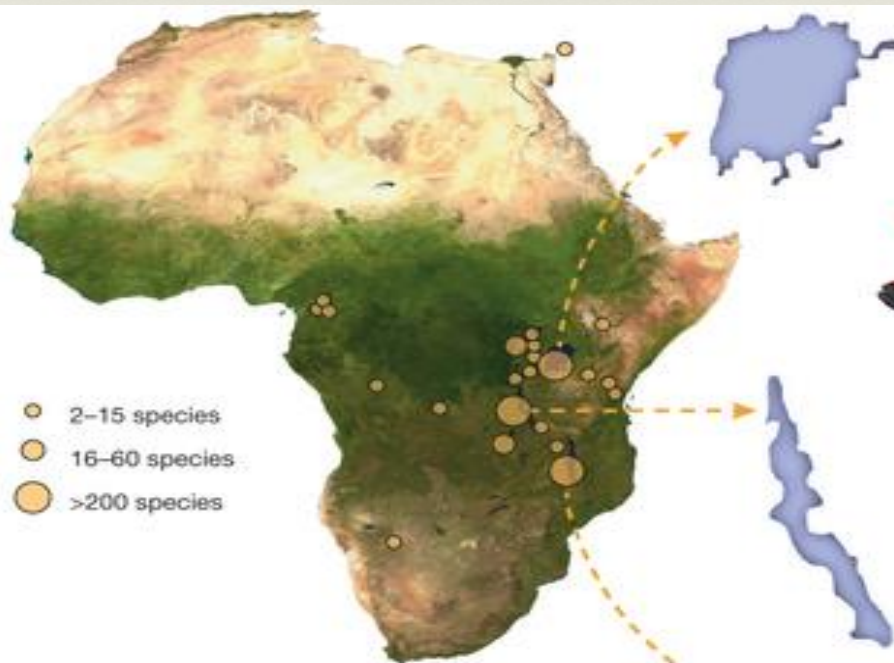
- ∞ Unrelated groups of animals – same habitat – acquire similar adaptations – in morphology and mode of life – **Evolutionary Convergence, Convergent Evolution or Parallel Adaptation.**
- ∞ Animals of same or closely related groups – exhibit great divergence – in morphology, mode of life and habits – in different habitats – **Evolutionary Divergence or Adaptive Radiation or Divergent Evolution.**



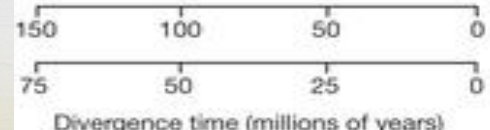
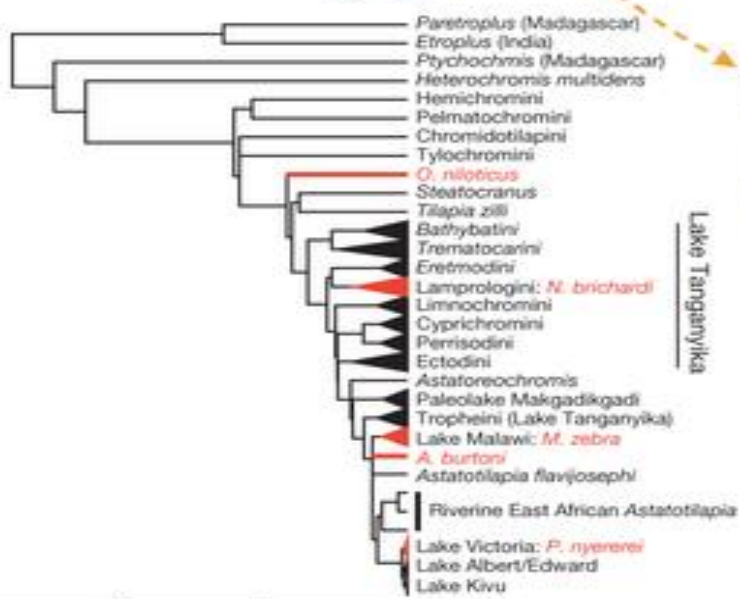
- ❧ Adaptive radiation – arrival of organism in an environment with unoccupied niches – like newly formed lakes, isolated island chain
- ❧ Lake Victoria isolated lake formed in African Rift valley - 300 species of Cichlid fishes adaptively radiated from one parent species in just 15000 years.

Cichlid fishes

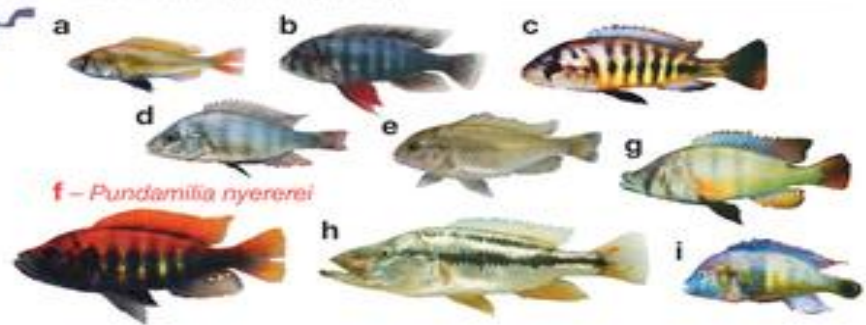




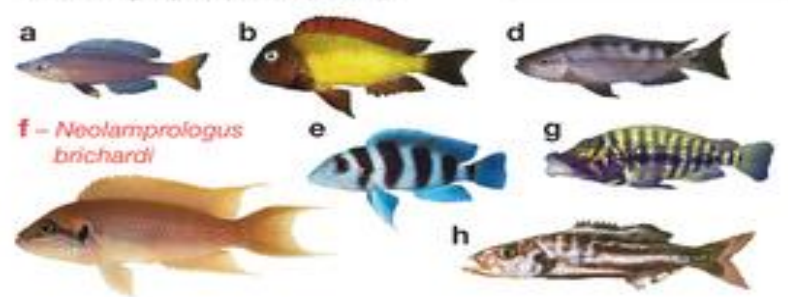
- 2-15 species
- 16-60 species
- >200 species



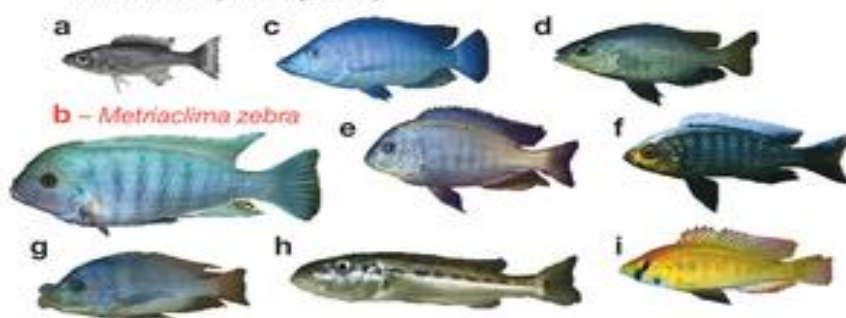
Lake Victoria (~500 species)



Lake Tanganyika (~250 species)



Lake Malawi (~500 species)



Rivers



Astatotilapia burtoni

Oreochromis niloticus

Lake Victoria



Lake Victoria



Large Fish



Cause of Adaptive Radiation

- ❧ Need for food and safety
- ❧ Suitable breeding grounds
- ❧ Absence of predators
- ❧ Availability of diverse ecological niches
- ❧ Migration
- ❧ Isolation

Significance of Adaptive Radiation

- ❧ Important role in evolution – formation of new species , genera, family, order and higher categories like class and phylum
- ❧ Forms the basis of evolutionary diversification of a group of organisms – in short period of time
- ❧ It enables organisms to live in different habitats and modes of life by developing different types of adaptations in response to particular conditions of available niches.

Examples



(1) Limb pattern of placental mammals.

Arboreal(tree living)-----↔-----Aerial(Volant)



Terrestrial ----->-----Cursorial
(insectivore) (running)



Aquatic
(swimming)



Fossorial (burrowing)

Examples



- (2) Tooth radiation in mammals
 - a. Carnivorous type of dentition
 - b. Herbivorous type of dentition
 - c. Omnivorous type of dentition
 - d. Myrmecophagous type of dentition

DARWIN'S FINCHES

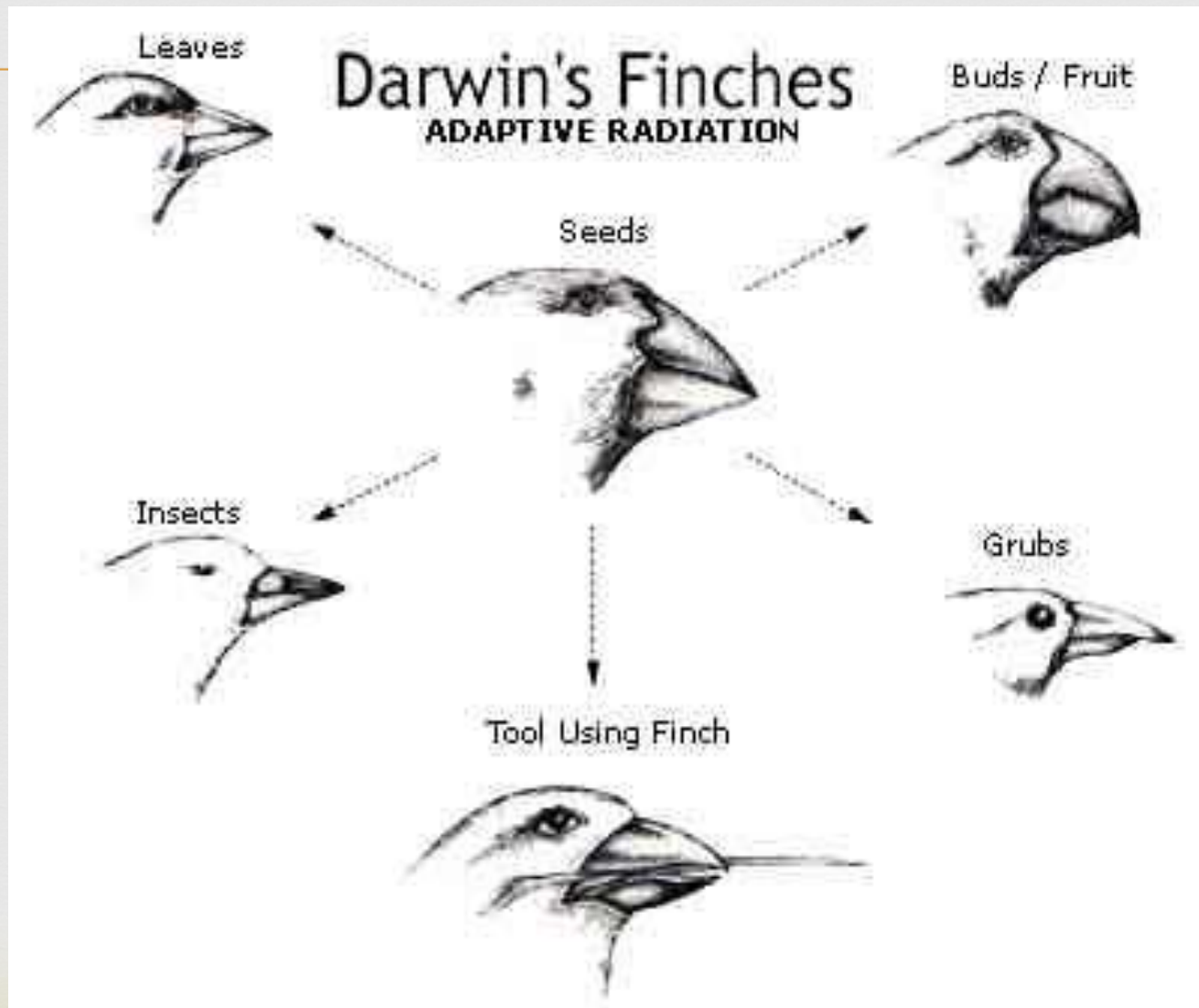


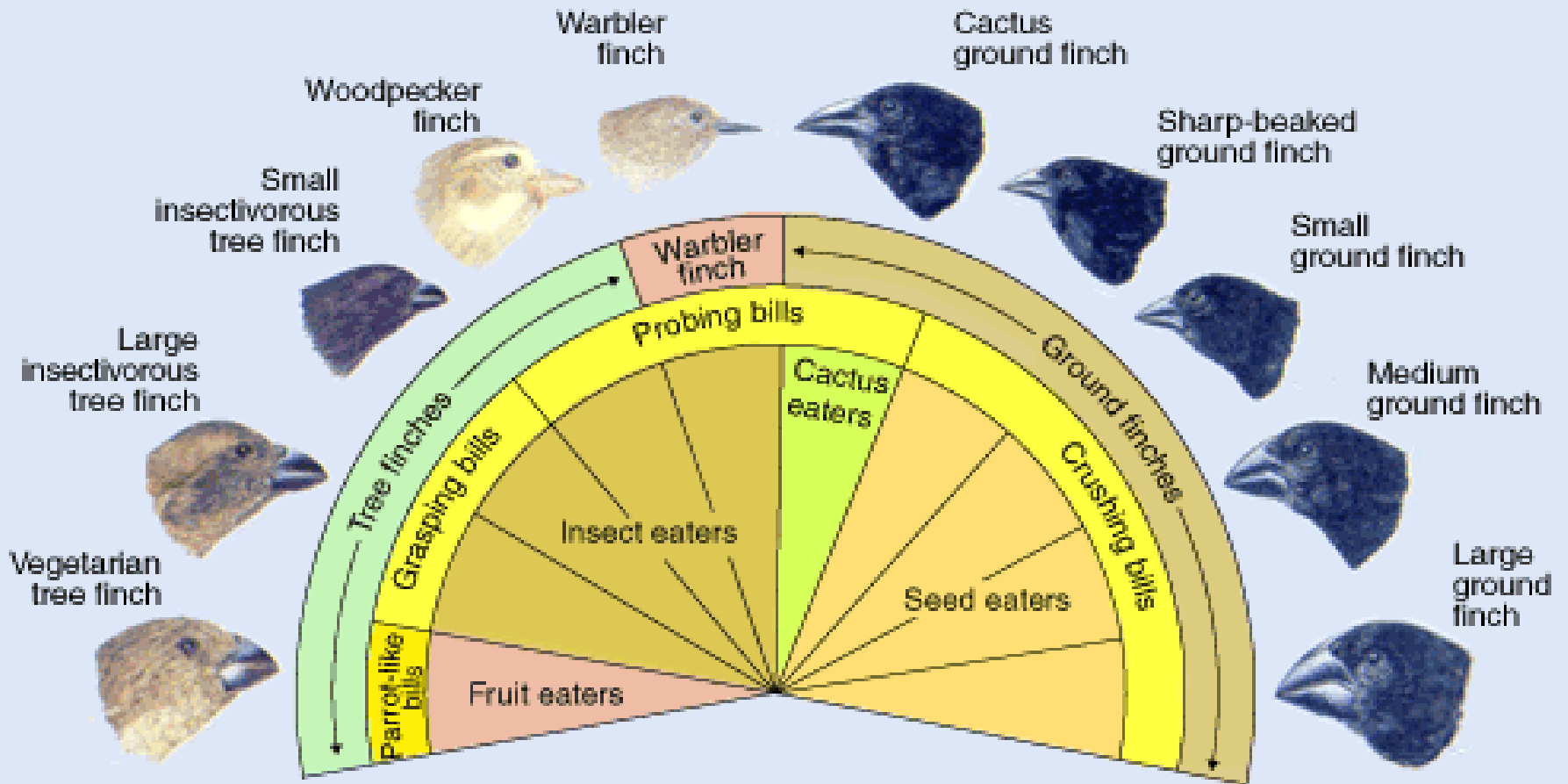
- ❧ Galapagos finches – 14 closely related species of dull coloured birds – finches
- ❧ 13- Galapagos island
- ❧ 1 Cocos Island
- ❧ Similar in colour and size
- ❧ Different in feeding habits, feeding adaptations- size and shape of their beak



- ⌘ According to Darwin all birds evolved from a single ancestor
- ⌘ 14 species in 14 islands – different habitats

DARWIN'S FINCHES







Common Cactus-Finch



Large Cactus-Finch



Small Tree-Finch



Medium Tree-Finch



Large Tree-Finch



Sharp-beaked Ground-Finch



Small Ground-Finch



Medium Ground-Finch



Large Ground-Finch



Gray Warbler-Finch



Green Warbler-Finch



Vegetarian Finch



Woodpecker Finch



Mangrove Finch

DARWIN'S FINCHES

BEAK ADAPTATIONS



- ❧ Ground Finches: variation in beaks – seed eaters – beak size correlation with seed size
- ❧ Warbler Finches – insectivores – beak slender
- ❧ Woodpecker Finches – long stout and straight beak – searching and capturing insects
- ❧ Vegetarian tree finches – beak short and thick for feeding on leaves, buds and fruits



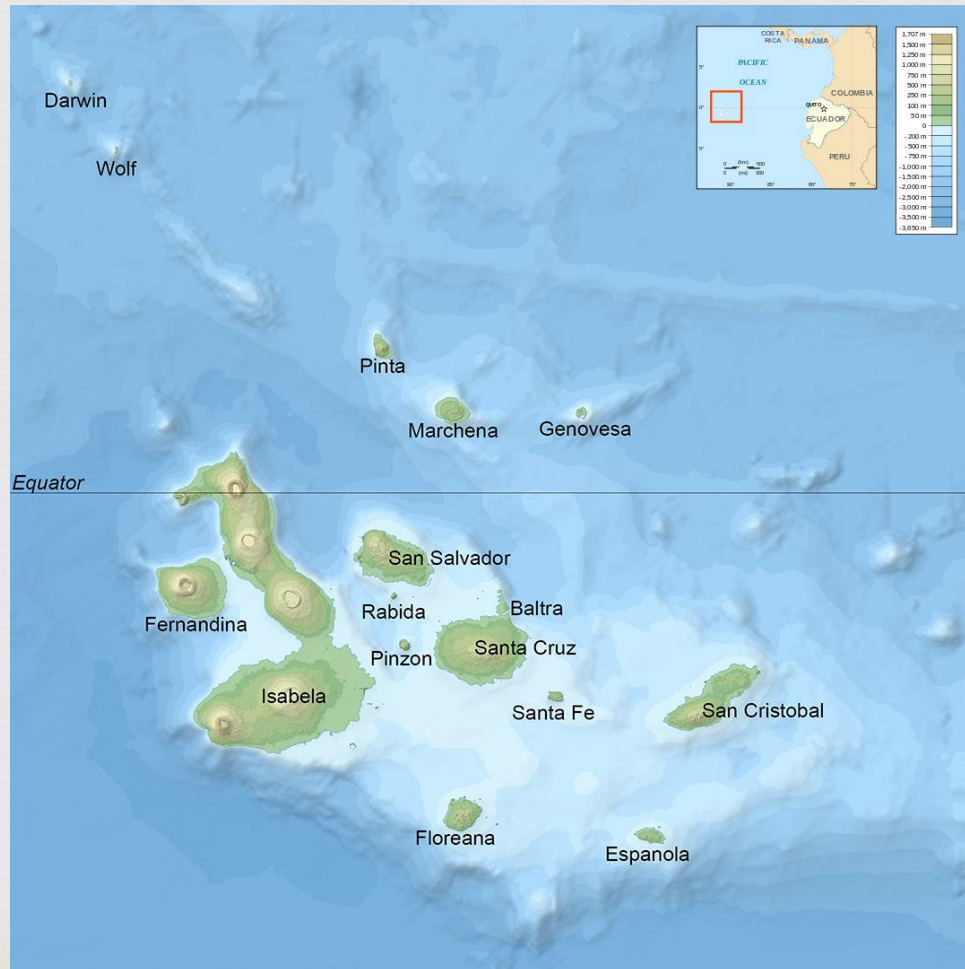
- ❧ Insectivorous Tree finches – similar to vegetarian tree finches – specialized to feed on beetles and insects
- ❧ Cactus Tree Finches – long and curved beak and split tongue for feeding on nectar and soft pulp of cacti

GALAPAGOS ISLANDS



GALAPAGOS ISLANDS

MAP



GALAPAGOS ISLANDS



GALAPAGOS ISLANDS

CB



GALAPAGOS ISLANDS



GALAPAGOS ISLANDS



GALAPAGOS ISLANDS



GALAPAGOS ISLANDS



Post Adaptations



- ❧ Direct adaptations developed by an organism to the conditions of stable environment they are living.
- ❧ Perfects the animal for living there.
- ❧ Eggs aquatic adaptations of fishes
- ❧ Volant adaptations of birds

Pre adaptations



- ❧ Certain adaptations developed by organism – may not be of any value presently – but may prove beneficial in some other environment
- ❧ Fits an animal to invade another environment

Examples

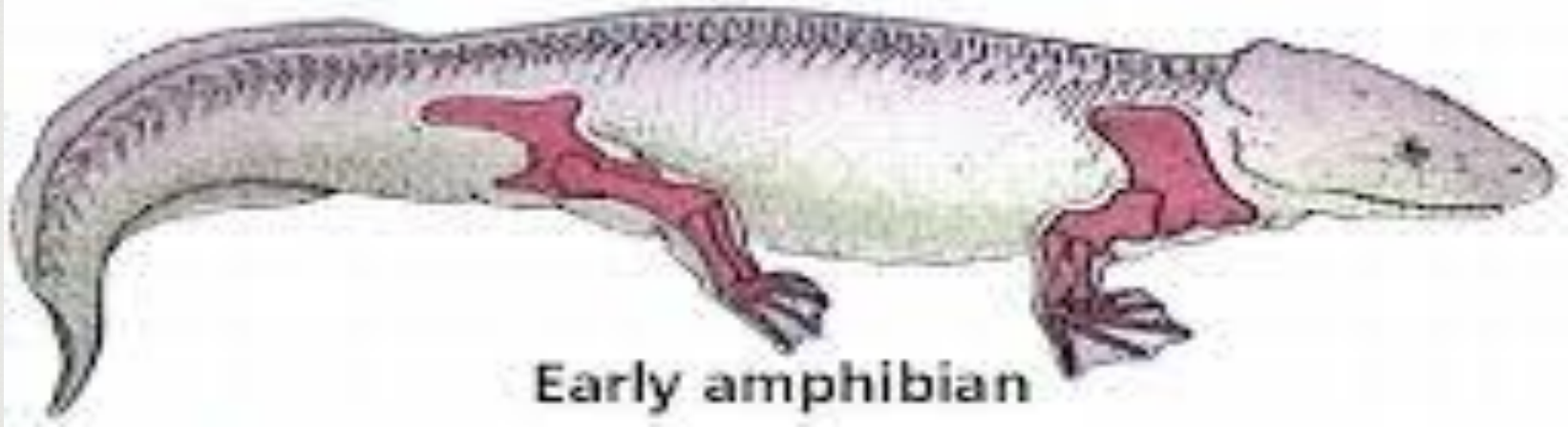


- ❧ **Crossopterygian fishes** – Devonian period – ancestors of amphibians – lobed fins – walking on soft mud or in shallow waters. Fin had skeleton modified into limbs for locomotion on land
- ❧ Devonian fishes developed lungs and internal nostrils- adaptation to supplement oxygen during dry seasons.

CROSSOPTERYGIAN FISHES



Lobe-finned fish



Early amphibian

CROSSOPTERYGIAN FISHES

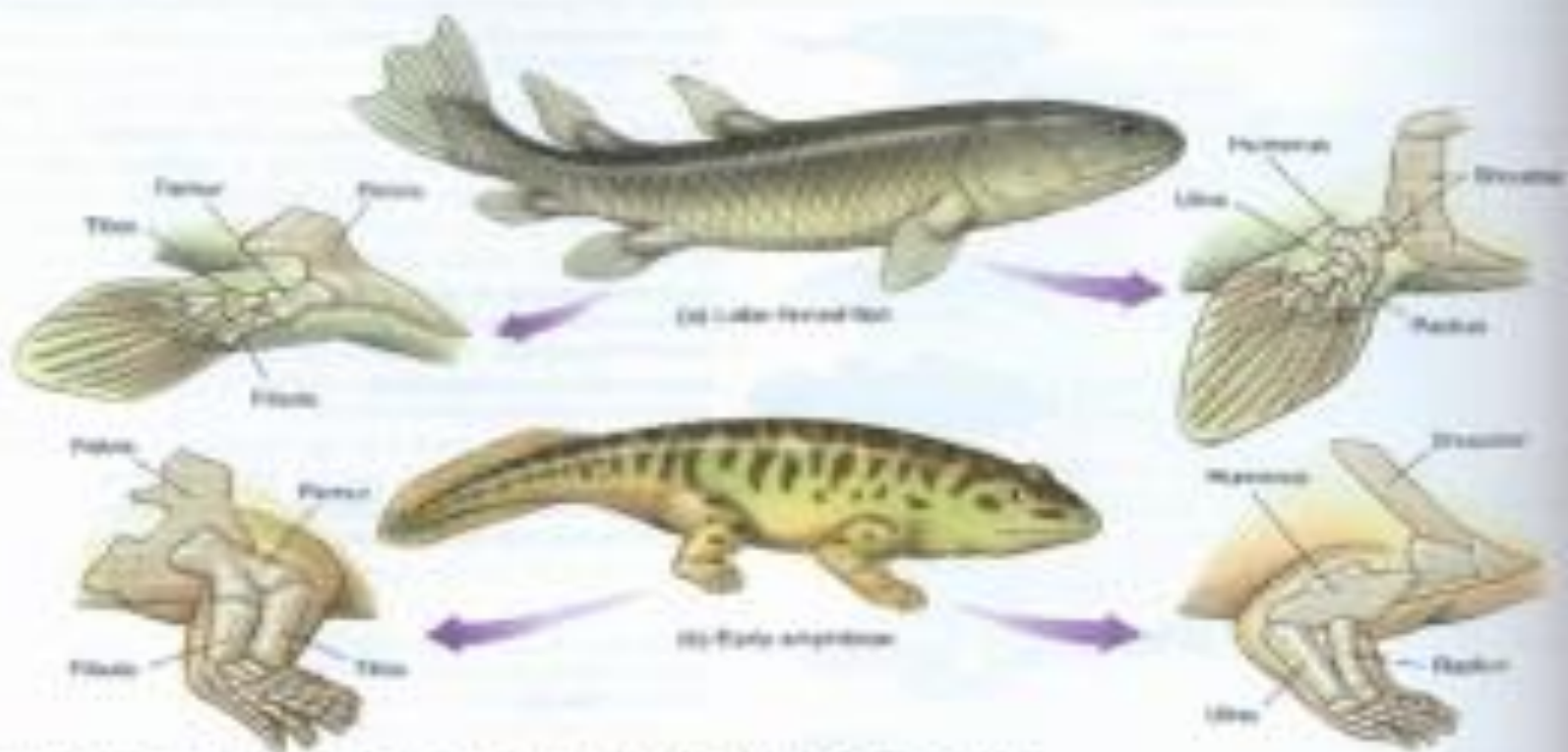


Figure 19.15 A key adaptation of amphibians: the evolution of legs.

(a) The limbs of a lobe-finned fish. Some lobe-finned fishes could raise out onto land. (b) The limbs of an early amphibian, as illustrated by their skeletal structure. (c) The leg of a modern amphibian could carry a function on land better than could the fin of a lobe-finned fish.

CROSSOPTERYGIAN FISHES

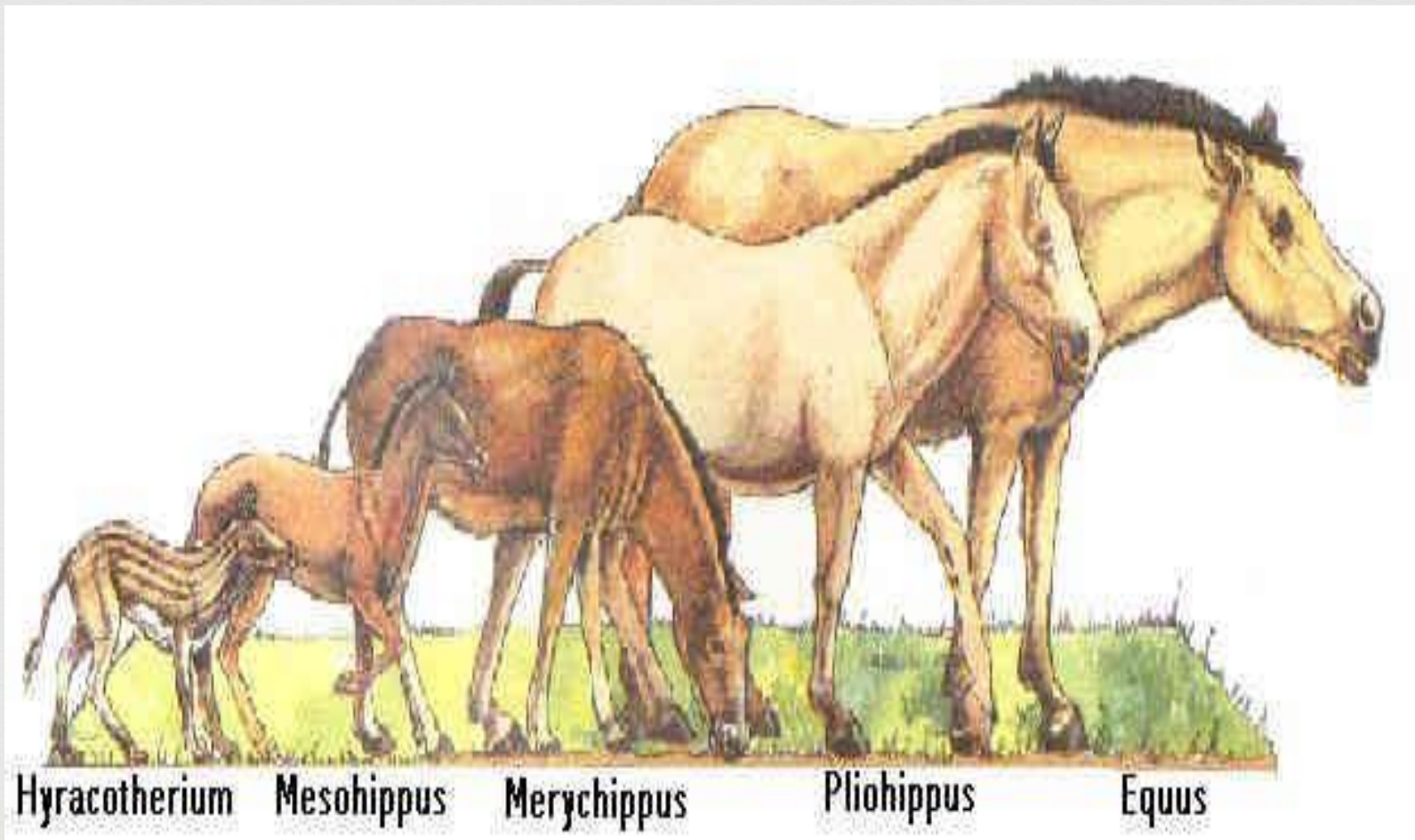


Examples



- ❧ **Evolution of horses** – browsing animal – feeding on leaves/twigs of shrubs and trees and living in forest – genetic change altered teeth structure – pre adapted for grazing (grass eating) instead of browsing.

Evolution of horses



Hyracotherium

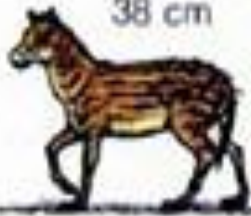
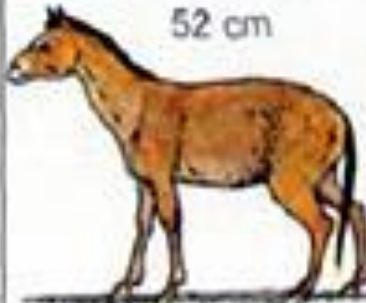
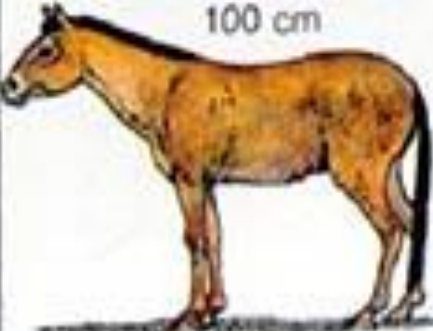
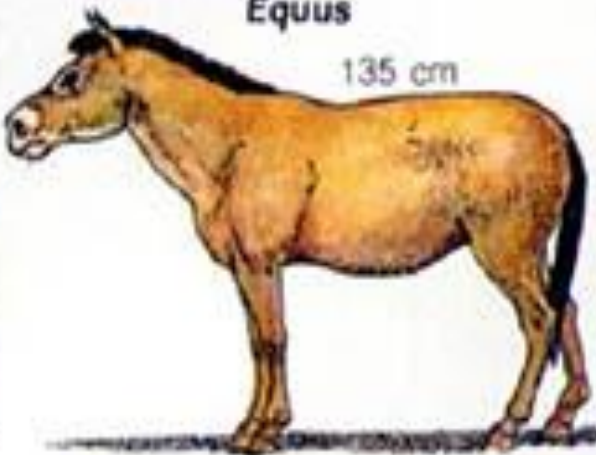



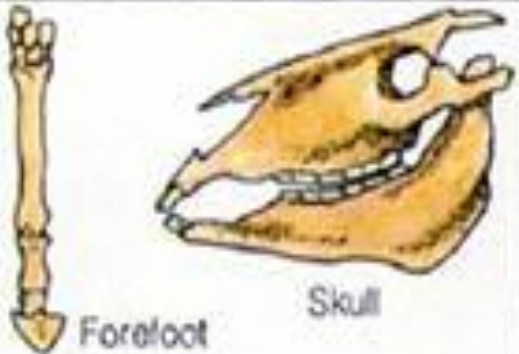
Mesohippus

Merychippus

Pliohippus

Equus

Evolution of horses

50 million years ago	35 million years ago	26 million years ago	3 million years ago
<i>Eohippus</i>  38 cm	<i>Mesohippus</i>  52 cm	<i>Merychippus</i>  100 cm	<i>Equus</i>  135 cm
 Forefoot Skull	 Forefoot Skull	 Forefoot Skull	 Forefoot Skull

Examples



- ❧ The **adhesive pads in the digits** of tree frogs – first appeared in ground forms – as adaptation for jumping – pre adaptation for arboreal life
- ❧ **Man's erect posture** made his hands pre- adapted towards performance of delicate manual operations – development of technology and culture

ADHESIVE PADS



CONVERGENT EVOLUTION



- ❧ Process by which different groups (genetically unrelated groups) of organisms evolve similar adaptations due to same ecological niches or similar environments.
- ❧ Acquire similar morphological features, adaptations, modes of life and behaviour.
- ❧ Opposite of adaptive radiation or divergent evolution
- ❧ Eg:- Wings of Insects, Birds, Pterosaurs and Bats.

CONVERGENT EVOLUTION



Falcon



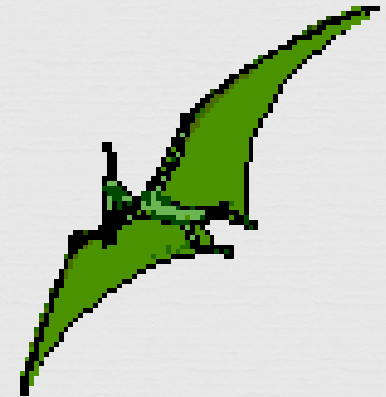
Ancestral
bird



Bat



Ancestral
mammal



Pteradactyl



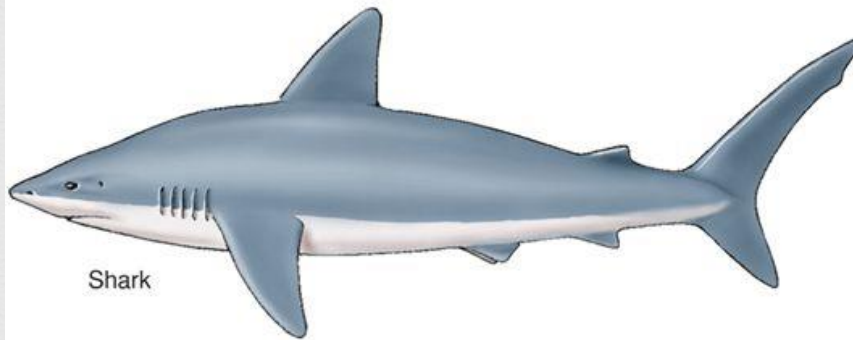
Ancestral
reptile

CONVERGENT EVOLUTION

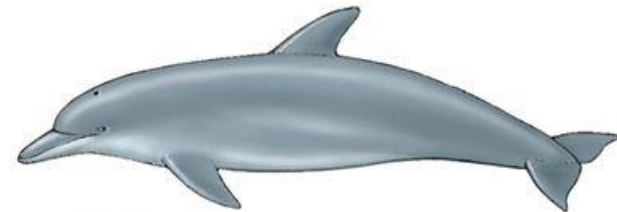


Convergent Evolution: Streamlining

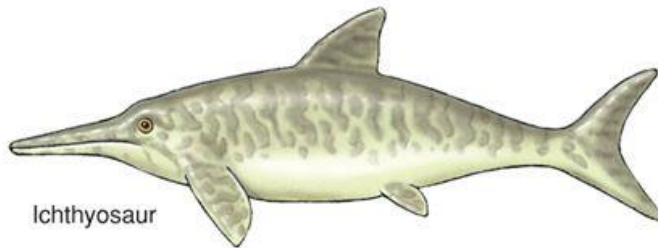
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Shark



Dolphin



Ichthyosaur



Penguin

Convergent evolution is the process by which unrelated species evolve similar physical characteristics because they have similar lifestyles

ANALOGOUS STRUCTURES



- ∞ Result of convergent evolution
- ∞ Wings of Insects, Birds, Pterosaurs and Bats.

6. Analogous structure
convergent evolution

- Superficially similar features.
- Such as wings of an insect and of a bird...no relationship in the structure exists!
- Just similar environments!

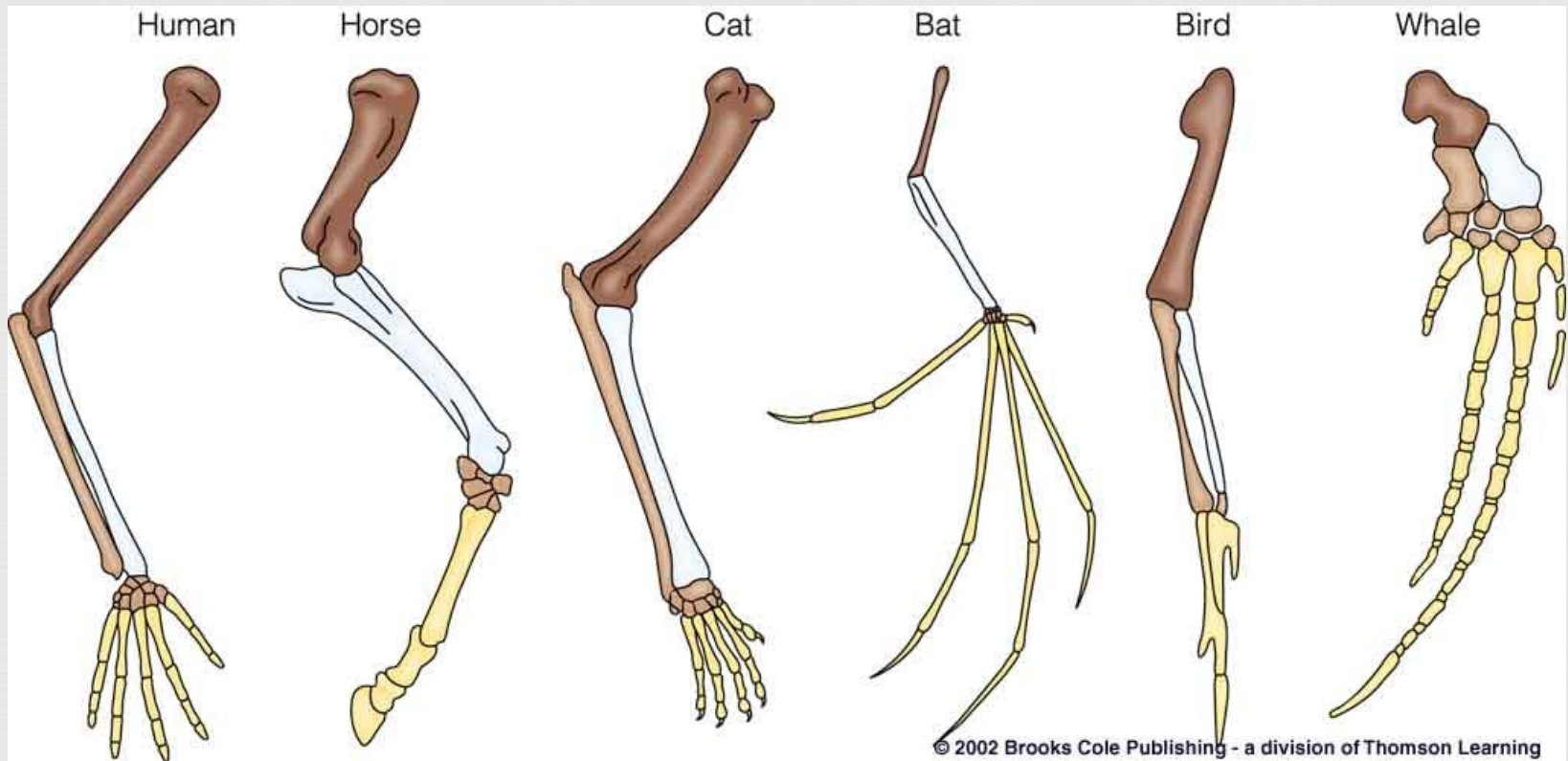
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HOMOLOGOUS STRUCTURES

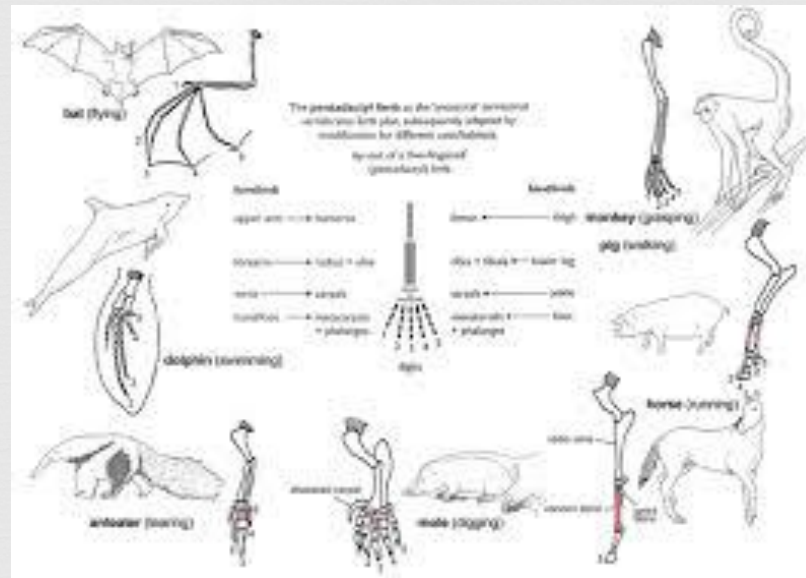


- ✧ Structures have a common origin
- ✧ Wings of Bat and forelimbs of man and other mammals.

FORELIMB OF MAMMALS



FORELIMB OF MAMMALS



THANK YOU

