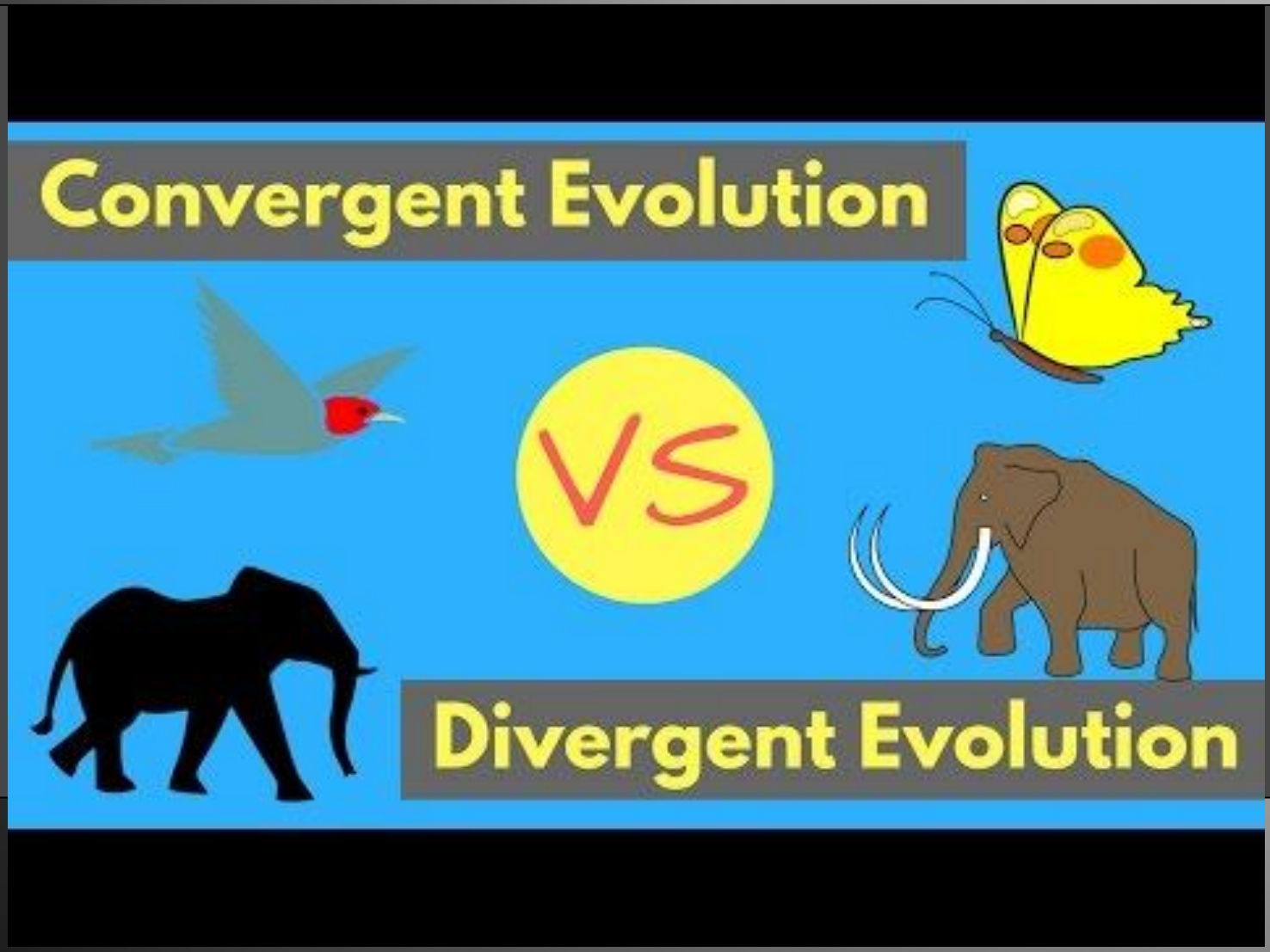
8.3 Patterns of Evolution

Natural selection leads to Predictable Outcomes:

1. Closely related species share many homologous structures, even though they no longer serve the same function
2. Species have vestigial structures that once served a useful purpose in their ancestors
3. Remote islands are inhabited by unique species that are descended from a few individuals of species able to reach them across wide expanses of ocean.



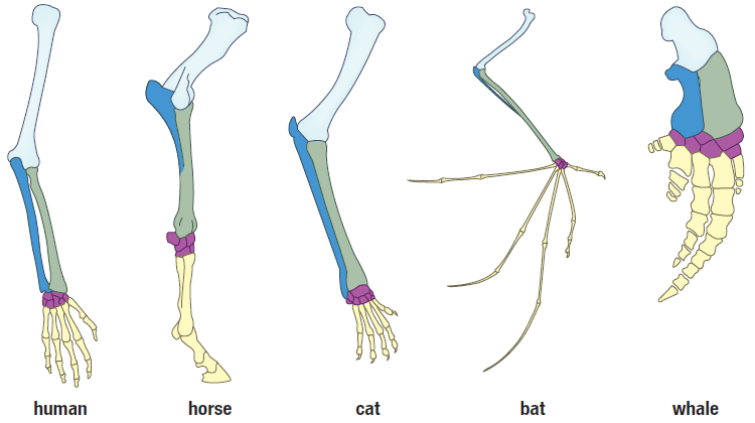
Convergent & Divergent Evolution

Introduction

Divergent Evolution

Divergent Evolution is the evolution of many species from a single common ancestor.

- Occurs when a single species is placed under two different sets of selective pressure



- Results in less competition between the new species

E.g. Humans, horses, cats, bats, and whales evolved from the same common ancestor

Northern Ontario forests are home to many rodents, the largest taxon of mammals:

Figure 3 Ontario has over 20 species of closely related rodents, a group of mammals that has undergone significant divergent evolution. Species include the (a) deer mouse, (b) flying squirrel, (c) porcupine, and (d) beaver.

All of these species evolved from a single common ancestor that existed millions of years ago.

Adaptive Radiation

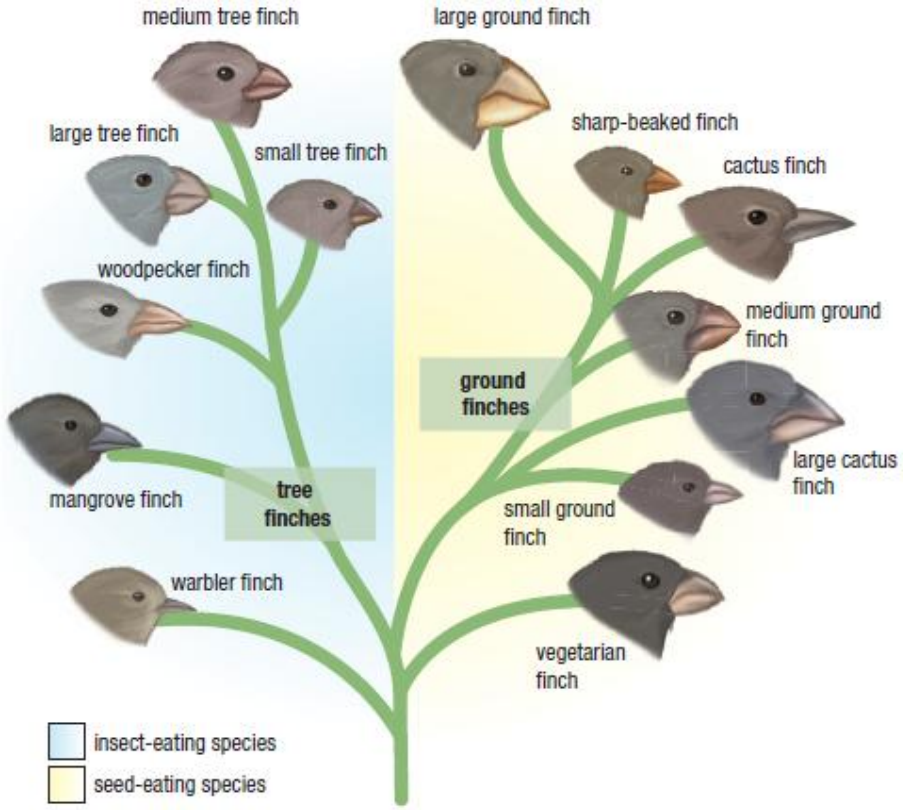
Adaptive radiation is a type of divergent evolution in which a single species is relatively rapidly evolved into many new distinct, but closely related species.

- Occurs when species are in an **isolated region** where few species are competing for resources, e.g.:
  - Islands
  - Areas of mass extinction

Adaptive Radiation

Example: in the Galapagos Islands, finch species with various beak shapes and sizes evolved from a single species

- **Original mainland species** had a medium-sized beak, ideally suited to feed on medium-sized seeds
- Finches with different beaks on mainland faced competition from other bird species



Adaptive Radiation

- In the Galapagos islands, finches born with different beak sizes faced little competition
  - Different beaks are naturally selected in different habitats
    - Galapagos Islands have a diverse range of habitats (moist forests to dry deserts)

Convergent Evolution

Convergent Evolution: the evolution of similar traits in distantly related species

- Occurs when species are placed under similar selective pressure (e.g. must adapt to the same kind of environment)
- Note: while some traits will converge, each species retains their own distinct features

Convergent Evolution

Cacti (from South America) and **Euphorbia** (from South Africa) evolved similar features in response to extremely dry conditions

- Thick green stems (photosynthesis, water storage)
- Sharp protective spines (ward off predators)
  - Cacti spines evolved from leaves
  - Euphorbia spines evolved from the outward growth of stem tissues.

Convergent Evolution

Sharks and dolphins both evolved similar streamlined bodies

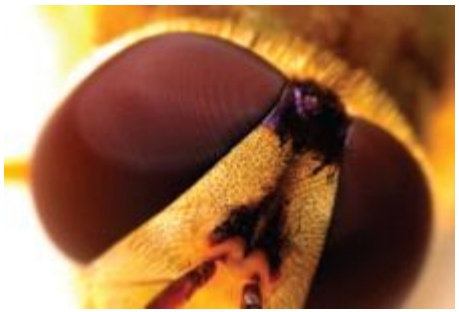
- **Sharks** evolved from primitive fish
  - Tail moves side-to –side, with flukes pointing upward

- **Dolphins** evolved from land mammals
  - Tail moves up-and-down, with flukes pointing sideways

Convergent Evolution

Various species evolved **light-detecting organs** due to the selective advantage of detecting and responding to light

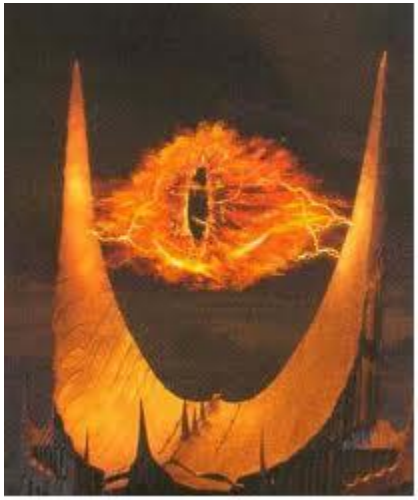
- Protists have simple eyes spots
- Other species have evolved complex and varied eyes



Fly

Spider

Cat



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Coevolution

Coevolution: one species evolves in response to the evolution of another species

- Some plants have evolved hard protective shells to protect their seeds
  Ex. Brazil nut trees

- Some seed-eating mammals have evolved powerful jaws and teeth for chewing through hard shells.
  Ex. Agouti is the only mammal able to open the Brazilian nut tree shells!

Coevolving species may become increasingly dependent on the other.

Coevolution

Coevolution

Madagascar long-spurred orchid is completely dependent on hawk moths to pollinate their flowers

- Orchids have evolved extremely long spurs, which contain nectar.
- Moths depend on nectar for food, and the more time they spend obtaining it, the more likely they will pick up pollen
- Moths evolved tongues long enough to reach the nectar at the bottom of the longest spurs (30cm)

Coevolution

Homework

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