

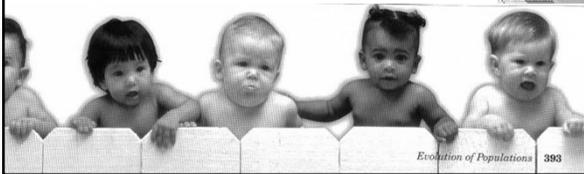
Ch. 16 Evolution of Populations



- ▶ **Gene pool** — the combined genetic information of all the members of a population.
- ▶ There are typically 2 or more alleles for a certain trait. (dominant or recessive)
- ▶ **Allele frequency** — the number of times that an allele occurs in a gene pool compared to other alleles.

Sources of Genetic Variation

- ▶ The 2 main sources of genetic variation are:
 - ❖ Mutations
 - ❖ Recombination-- the genetic shuffling that results from sexual reproduction



Evolution as Genetic Change

- ▶ NS never acts directly on genes
- ▶ NS can only affect which individuals survive & reproduce, & which do not
- ▶ Also, remember that individual organisms do not evolve; only populations evolve.

NS on Single-Gene Traits

- ▶ NS alters the allele frequencies & thus leads to evolution
- ▶ This is called Microevolution



NS on Polygenic Traits

- ▶ NS can affect the distributions of phenotypes in any of 3 ways:
 - ▶ directional selection
 - ▶ stabilizing selection
 - ▶ disruptive selection

NS on Polygenic Traits

- ▶ Directional Selection - favors phenotypes at one extreme.

Directional Selection

Food becomes scarce.

Number of Birds in Population

Beak Size

Peak shifts; average beak size increases.

Number of Birds in Population

Beak Size

Key

- Low mortality, high fitness
- High mortality, low fitness

NS on Polygenic Traits

- ▶ Stabilizing selection - favors the intermediate phenotype.

Stabilizing Selection

Percentage of Population

Birth Weight

Selection against both extremes keeps curve narrow and in same place.

Key

- Low mortality, high fitness
- High mortality, low fitness

NS on Polygenic Traits

Diversifying

- ▶ Disruptive selection - favors both extreme phenotypes.

Disruptive Selection

Largest and smallest seeds become more common.

Number of Birds in Population

Beak Size

Population splits into two subgroups specializing in different seeds.

Number of Birds in Population

Beak Size

Key

- Low mortality, high fitness
- High mortality, low fitness

Natural selection is not the only mechanism through which populations evolve.

- ▶ Gene flow is the movement of alleles between populations.
 - ▶ Low gene flow=new species form
- ▶ Genetic drift is a change in allele frequencies due to chance.
 - ▶ Occurs in small populations
 - ▶ Caused by bottleneck OR a founder effect.

Bottleneck Effect

- ▶ Genetic drift that occurs after an event greatly reduces the size of a population.

Bottleneck effect

Surviving population

- ▶ The founding of a small population can lead to genetic drift. (Founder Effect)
 - It occurs when a few individuals start a new population.
 - The founder effect is genetic drift that occurs after start of new population.

Sexual selection occurs when certain traits increase mating success.

- ▶ Sexual selection occurs due to higher cost of reproduction for females.
 - ▶ males produce many sperm continuously
 - ▶ females are more limited in potential offspring each cycle
- ▶ Therefore, females become choosy about their mates. 2 types of selection:
 - ▶ **Intrasexual**– competition among males
 - ▶ **Intersexual**– males display certain traits to attract females

Evolution vs. Genetic Equilibrium

- ▶ **Genetic equilibrium** - allele frequencies remain constant and the population will **not** evolve
- ▶ 5 conditions are required to maintain genetic equilibrium:
 - ▶ random mating
 - ▶ large population
 - ▶ no movement into/ out of population
 - ▶ no mutations
 - ▶ no NS

The Process of Speciation

- ▶ **Speciation** - formation of a new species
- ▶ Occurs because of isolation
- ▶ The gene pools of 2 populations must become separated for them to become new species

Isolating Mechanisms

- ▶ **Reproductive isolation** - when members of 2 populations can't interbreed & produce fertile offspring
- ▶ The final step in becoming separate species

Isolating Mechanisms

- ▶ **Behavioral isolation** - when 2 populations are capable of interbreeding but have differences in courtship rituals or other reproductive strategies that involve behavior
 - ▶ Ex.) Birds with different mating songs



Isolating Mechanisms

- ▶ **Geographic isolation** - 2 populations are separated by physical barriers like rivers, mountains, or bodies of water
 - ▶ Ex.) Squirrels split by Colorado River

Isolating Mechanisms

- ▶ **Temporal isolation** - when 2 or more species reproduce at different times
 - ▶ Ex.) Orchids releasing pollen on different days

The History of Life



Patterns of Evolution

- ▶ **Macroevolution** - large-scale evolutionary patterns & processes that occur over long periods of time
- ▶ 6 important topics in macroevolution are: extinction, adaptive radiation, convergent evolution, divergent evolution, coevolution, & punctuated equilibrium

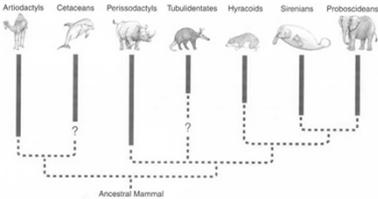
Patterns of Evolution

- ▶ **Extinction:**
 - ▶ More than 99% of all species are now extinct
 - ▶ It usually happens for a reason; species compete for resources, & environments change
 - ▶ Some species adapt & survive, others become extinct



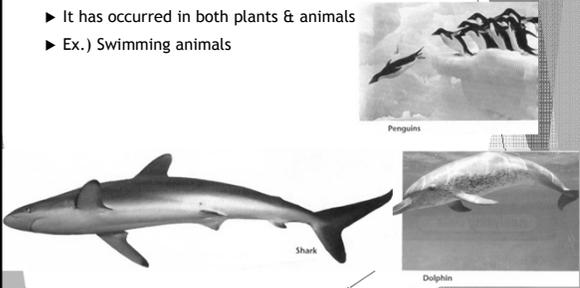
Patterns of Evolution

- ▶ **Adaptive radiation** - when a single species has evolved, through NS, into diverse forms that live in different ways
 - ▶ Ex.) Darwin's Finches



Patterns of Evolution

- ▶ **Convergent evolution** - when unrelated organisms begin to resemble one another
 - ▶ It has occurred in both plants & animals
 - ▶ Ex.) Swimming animals



Patterns of Evolution

- ▶ **Divergent Evolution**--when closely related species evolve in different directions.
- ▶ Ex. The red fox and the kit fox
 - ▶ They have different appearance that have resulted from adapting to different environments.

Patterns of Evolution

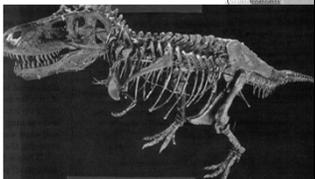
- ▶ **Coevolution** - when 2 species evolve in response to changes in each other over time
 - ▶ Ex.) Orchid has long spur with nectar in its tip, a Hawk moth has equally long feeding tube that allows it to feed on the nectar

Patterns of Evolution

- ▶ **Punctuated equilibrium** - a pattern of long, stable periods interrupted by brief periods of more rapid change

Fossils & Ancient Life (15-1)

- ▶ **Paleontologists** - scientists that study fossils
- ▶ From fossils, scientists can infer what past life forms were like: their structure, what they ate, what ate them, & the environ. where they lived

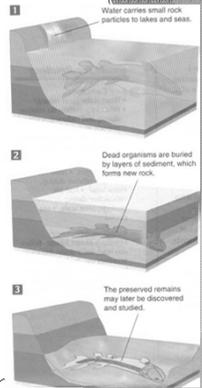


Fossils & Ancient Life

- ▶ They group similar organisms together & arrange them in the order that they lived, from oldest to most recent
- ▶ Together, all this info. about past life is called the fossil record

Fossils & Ancient Life

- ▶ The fossil record:
 - ▶ provides evidence about the history of life on Earth
 - ▶ shows how different species have changed over time



Fossils & Ancient Life

- ▶ The fossil record shows that more than 99% of all species that have ever lived on Earth have become extinct
- ▶ Extinct - the species died out

Interpreting Fossil Evidence

- ▶ Relative dating - determining the age of a fossil by comparing its placement with that of fossils in other layers

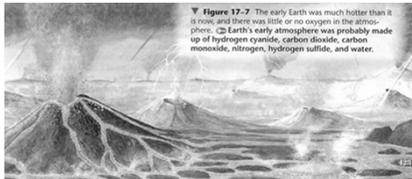


Mass Extinction

- ▶ Mass extinction - when many types of living things become extinct at the same time
- ▶ At the end of the Paleozoic Era, a mass extinction affected both plants & animals on land & in the sea
- ▶ 95% of life in the oceans disappeared

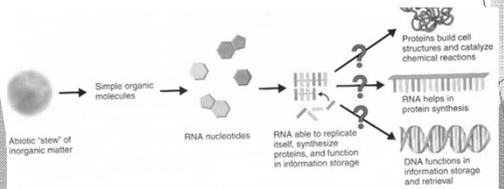
Formation of Earth (14-2)

- ▶ Earth's early atmosphere probably contained hydrogen cyanide, carbon dioxide, carbon monoxide, nitrogen, hydrogen sulfide, & water



The First Organic Molecules

- ▶ Experiments have suggested how simple compounds found on the early Earth could have combined to form the organic compounds needed for life



Free Oxygen

- ▶ The rise of oxygen in the atmosphere drove some life forms to extinction
- ▶ Others evolved new, more efficient metabolic pathways that used oxygen for respiration



The First Life-Forms (14-3)

- ▶ Prokaryotes (archaeobacteria)
 - ▶ Chemosynthetic–
 - ▶ Cyanobacteria–began to produce oxygen as a by-product of photosynthesis

Origin of Eukaryotic Cells

- ▶ Endosymbiotic theory - proposes that eukaryotic cells arose from living communities formed by prokaryotic organisms

