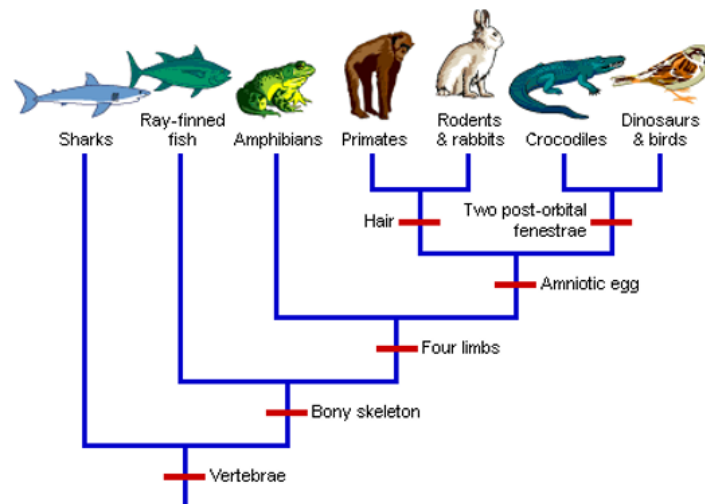


## Chapter 13. How Populations Evolve

- **Taxonomy:** The branch of biology concerned with identifying, naming and classifying species
- **The Linnaean system (林奈系统):** naming species + hierarchical classification
  - ✧ **Naming:** binomial—two part Latinized name. genus + species within a genus. The first letter of the genus is capitalized and the whole binomial is *italicized*.
  - ✧ **Hierarchical classification:** species (种) → genus (属) → family (科) → order (目) → class (纲) → phylum (门) → kingdom (界) → domain (域).
- **Evidence of evolution:**
  - (1) **Evidence from fossils**
    - ✧ **Fossils:** Imprints or remains of organisms that lived in the past—document differences between past and present organisms and show that many species have become extinct.
    - ✧ **The fossil record:** The ordered sequence of fossils as they appear in the rock layers, marking the passage of geologic time.
  - (2) **Evidence from homologies** 若两个或多个结构具有相同的祖先，则称它们同源 (Homology)
    - ✧ **Homology (同源):** Similarity resulting from common ancestry.
    - ✧ **Structural and molecular homologies reveal evolutionary relationship.**
  - (3) **Evolutionary trees:** Patterns of descent branch off from a common trunk—the first organism—to the tips of millions of twigs representing the species living today. At each fork of the evolutionary tree is an ancestor common to all evolutionary branches extending from that fork. Closely related species share many traits because their lineage of common descent traces to a recent fork of the tree of life.



"Family Tree"

- **Artificial selection:** The selective breeding of domesticated plants and animals to promote the occurrence of desirable traits in the offspring,
- **Natural selection:** In a population that varies, individuals best suited for a particular environment are more likely to survive and reproduce than those that are less suited to that environment.

- **Sources of genetic variation:**

(1) **Mutation:** Mutation is the ultimate source of the genetic variation that serves as raw material for evolution.

(2) **Sexual reproduction:** independent orientation of homologous chromosomes at metaphase 1 of meiosis; crossing over; random fertilization.

- **Population (种群):** A group of individuals of the same species that live in the same area and interbreed.

- **Gene pool (基因库):** Consists of all copies of every type of allele at every locus in all members of the population.

- **Analyzing gene pools—Hardy-Weinberg equation**

✧  $p + q = 1$

✧  $p^2 + 2pq + q^2 = 1$

✧  $p, q$ : the frequency of alleles.

Allele Frequencies	$p + q = 1$ $p$ = frequency of dominant allele (eg. A) $q$ = frequency of recessive allele (eg. a)
Genotypic Frequencies	$p^2 + 2pq + q^2 = 1$ $p^2$ = freq. of homozygous dominants (AA) $q^2$ = freq. of homozygous recessives (aa) $2pq$ = frequency of heterozygotes (Aa)
Conditions	Large population size Random mating No migration No mutation No selection

- **Microevolution:** A generation-to-generation change in allele frequencies of a population is evolution viewed on the smallest scale.

- **Mechanisms that alter allele frequencies in a population:**

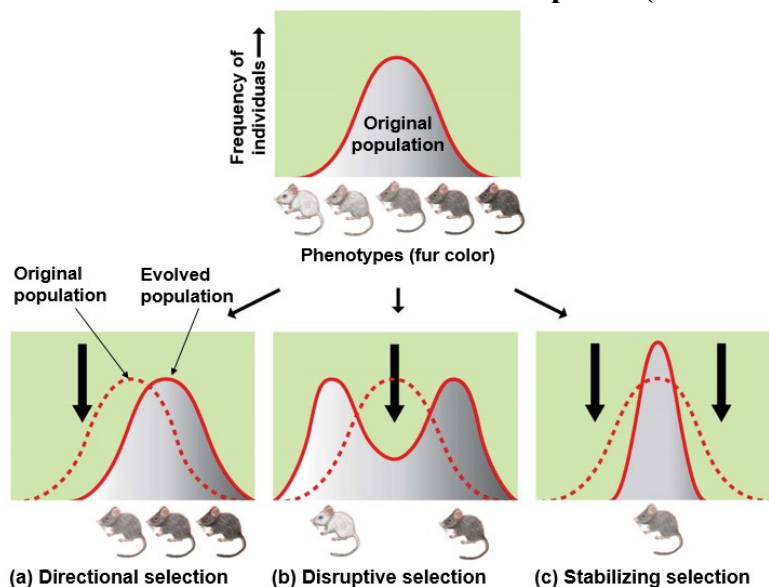
(1) **Natural selection:** directional selection, disruptive selection, stabilizing selection.

✧ **Directional selection (定向选择)** shifts the overall makeup of a population by selecting in favor of one extreme phenotype.

✧ **Disruptive selection (歧化选择)** can lead to a balance between two or more contrasting phenotypes in a population.

✧ **Stabilizing selection (稳定型选择)** favors intermediate phenotypes.

✧ **Sexual selection:** Individuals with certain traits are more likely than other individuals to obtain mates. → **Sexual dimorphism (雌雄异型)**



Genetic drift is the result of chance

(2) **Genetic drift (基因漂变):** A change in the gene pool of a population due to chance.

✧ **The bottleneck effect:** genetic drift due to a drastic reduction in population size;

✧ **The founder effect:** genetic drift resulting from the establishment of a small, new population whose gene pool differs from that of the parent population.

(3) **Gene flow (基因流):** Genetic exchange with another population. It tends to reduce differences between populations.

## Chapter 14. How Biological Diversity Evolves

- **Speciation (物种形成):** The process in which one species splits into two or more species.
- **Species:** A group of populations whose members have the potential to interbreed with one another in nature and produce fertile offspring (off-spring that can reproduce).
- **Reproductive barrier:** Anything that prevents individuals of closely related species from interbreeding.
  - (1) **Prezygotic barriers:** prevent mating or fertilization between species.
    - ✧ Temporal isolation (时间隔离); Habitat isolation (生态隔离); Behavioral isolation (行为隔离); Mechanical isolation (机械隔离); Gametic isolation (配子隔离)
  - (2) **Postzygotic barriers:** operate if interspecies mating actually occurs and results in hybrid zygotes.
    - ✧ Reduced hybrid viability (减损杂种存活率); Reduced hybrid fertility (降低杂种生育率); Hybrid breakdown (杂种衰退)
- **Mechanisms of speciation:**
  - allopatric speciation (分区物种形成), sympatric speciation(同域物种形成)
    - ✧ **Allopatric speciation:** the initial block to gene flow is a geographic barrier that physically isolates the splinter population.
    - ✧ **Sympatric speciation:** the origin of a new species without geographic isolation. Hybridization leading to polyploids is a common mechanism of sympatric speciation in plants.
- **Macroevolution:** Evolutionary change above the species level.
- **Geologic time scale:** It divides Earth's history into a sequence of geologic periods.
  - ✧ The Precambrian (前寒武纪), a general term for the time before about 540 million years ago; The Paleozoic era (古生代); The Mesozoic era (中生代); The Cenozoic era (新生代)
- **Radiometric dating:** A method based on the decay of radioactive isotopes.
- **Plate tectonics (板块构造论):**
  - ✧ The continents and seafloors form a thin outer layer of solid rock, called the **crust (地壳)**, which covers a mass of hot, viscous material called the **mantle (地幔)**.
  - ✧ The crust is not one continuous expanse, however. It is divided into giant, irregularly shaped plates that float atop the mantle.
  - ✧ In a process called **continental drift (大陆漂移)**, movements in the mantle cause the plates to move.
  - ✧ The boundaries of some plates are hotspots of geologic activity.
- **Mechanisms of macroevolution:**
  - ✧ **Large effect from small genetic changes:** A subtle change in the genes that control a species' development can have profound effects.
  - ✧ **The evolution of biological novelty:**
    - (1) An exaptation (功能变异) is a structure that evolves in one context and gradually becomes adapted for other functions.
    - (2) Most complex structures have evolved incrementally from simpler versions having the same function.