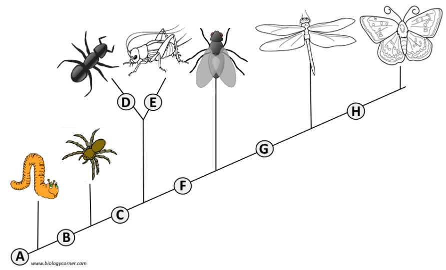
Unit 6: Population Ecology and Genetics — Chapters 23, 24, 25, 26, 53

Key Terms:

Abiotic factor
Adaptation
Adaptive radiation
Allele frequency
Allopatric (allopatry)
Analogous structures
Ancestral characteristic
Artificial selection
Autotroph
Binomial nomenclature
Biogeographic distribution
Biotic factor
Bottleneck effect
Carrying capacity
Cladistics
Cladogram
Coevolution
Community
Convergent evolution
Darwin
Density dependent (k-selection)
Density independent (r-selection)
Derived characteristic
Directional selection
Disruptive selection
Divergent evolution
Endosymbiotic theory
Exponential growth
Evolution
Fitness
Fossils
Fossil record
Founder effect
Gene flow
Gene pool
Genetic drift
Genetic variation
Genotype
Gradualism
Habitat
Hardy-Weinberg equations
Heterotroph
Homologous structures
Hybrid
Logistic growth
Migration
Morphology
Mortality
Mutation



Key Concepts

- Populations are rarely in genetic equilibrium, therefore their allele frequency changes over time.
- The Hardy-Weinberg equation can be used to calculate and predict the changes in the allele frequencies of populations.
- Changes in the allele frequencies in populations are determined by many processes, including genetic drift, mutation, migration, and natural selection.
- These processes are relatively more important in small populations and in a changing environment.

Essential Knowledge:

Natural Selection and Evolution (1.A.1)

☐ Briefly describe Darwin's theory of **natural selection** and its significance. Understand the terms **adaptation** and **evolutionary fitness**.

☐ Understand the concept of **gene pool** and state the principle of **genetic equilibrium**. Understand that he condition for genetic equilibrium are seldom, if ever, met and explain the consequences of this.

☐ Evaluate evidence to qualitatively and quantitatively investigate the role of natural selection in **evolution.**

☐ Explain the basis of the **Hardy-Weinberg equation**. Use the Hardy-Weinberg equation to calculate change in allele frequencies for a population over time.

The Role of Variation (1.A.2)

☐ Describe the role of **genetic variation** in providing the raw materials on which natural selection can act. Use specific examples, e.g. sickle cell disease, to relate phenotypic variation to fitness.

☐ Describe and evaluate examples of genetic change in real populations over time. Examples include peppered moths in the UK, sickle cell disease, &/or DDT resistance in insects.

☐ Describe the impact of human activity on variation in other species. Examples could include **artificial selection** in crops or livestock, or antibiotic misuse creating a selective environment for resistance.

The Role of Random Processes (1.A.3)

☐ Use the Hardy-Weinberg equation to predict future changes in the **allele frequencies** for a population given certain events, e.g. **founder effect, bottleneck**, and **migration.**

☐ Analyze **genetic drift** and the effects of selection in the evolution of specific populations. Recognize the importance of genetic drift in small populations. Justify the use of mathematical models to make these analyses.

☐ Make predictions about the effects of genetic drift, migration, and artificial selection on the genetic makeup of a population. Explain your rationale.

Phylogeny and Biogeography(1.A.4)

☐ Explain how organisms with similar **morphologies** or DNA sequences may be closely related.

☐ Understand the differences between **homologous** and **analogous** structures. Be able to give examples of each.

☐ Compare Linneaus's classification system to **cladistics** (cladograms).

☐ Be able to create a **cladogram** from morphological or genetic evidence.

☐ Understand how current research has changed our classification systems.

☐ Explain the difference between **convergent** and **divergent evolution**. Be able to provide evidence and examples of both.

Key Terms:

Natality
Natural selection
Niche
Phenotype
Phylogeny
Polyploidy
Population
Postzygotic Isolation
Prezygotic Isolation
Primordial environment
Punctuated equilibrium
Random mating
Sexual selection
Species
Speciation
Stabilizing selection
Survivorship curves
Sympatric (sympatry)
Systematics
Taxonomy
Vestigial Organs

- ☐ Explain why fossils are used as evidence for evolution. Recall how fossil-bearing rocks have provided the data for dividing the history of life on Earth into geological periods.
- ☐ Explain how the geographical distribution of living (extant) and extinct organisms provide the evidence of dispersal from a point of origin.
- ☐ Explain how the major **taxonomic** categories (kingdom, phylum, etc) work and how **binomial nomenclature** is used.

Key Concepts

- Molecular and genetic evidence supports a common ancestry of all living things.
- Reproductive Isolation is essential for speciation. This is often proceeded by allopatry.
- Larger scale patterns of evolution involve the diversification and extinction of species.
- Current populations provide scientific evidence for the fact that populations continue to evolve.
- Divergent evolution is frequently associated with the diversification of species into new niches.
- Common ancestry of all organisms if reflected in biochemical similarities and shared core processes.
- Structural evidence at the subcellular level supports the relatedness of all eukaryotes.
- Phylogenic trees and cladograms provide models of phylogeny and can be tested using new evidence.
- Organisms are identified using a binomial naming system: genus and species.

Species and Speciation

- ☐ Explain what is meant by a (biological) **species**.
- ☐ Describe the role of **natural selection, genetic drift**, and **isolation** in **speciation**. Use data to predict the effect of selection pressures on a population over time.
- ☐ Explain **allopatric speciation** in terms of migration, isolation and adaptation leading to reproductive isolation of gene pools.
- ☐ Describe and explain the mechanisms of **reproductive isolation**, distinguish between **prezygotic** and **postzygotic** barriers.
- ☐ Describe sympatric speciation. Understand how **polyploidy** can lead to instant speciation in plants.

Patterns of Evolution

- ☐ Recognize patterns of species formation: **Gradualism**, **coevolution**, **divergent evolution**, and **adaptive radiation**
- ☐ Describe examples of **coevolution**.
- ☐ Explain why speciation rates vary. Distinguish between **punctuated equilibrium** and **gradualism**.
- ☐ Describe examples to support the current evolution of populations. Examples could include evolution of chemical resistance in plants, phenotypic change in a population etc.

Origin of life

- ☐ Describe the **Primordial environment**.
- ☐ Describe evidence that suggests prokaryotes were the first forms of life.
- ☐ Understand the **endosymbiotic theory** for the evolution of mitochondria and chloroplasts and other eukaryotic organelles. Summarize evidence in support of this theory.

Population dynamics

- ☐ Distinguish between **population** and **community.**
- ☐ Understand that populations are dynamic and exhibit attributes not shown by the individuals themselves.
- ☐ Explain how population size can be affected by **natality**, **mortality**, **immigration**, **emigration.**
- ☐ Explain how what life tables are and the role of **survivorship curves** in analyzing populations.
- ☐ Describe and explain the typical features of r and K selection.
- ☐ Describe **exponential** and **logistic growth**. Explain patters of population growth in colonizing, stable, and declining populations.
- ☐ Describe factors affecting final population size. Include reference to **carrying capacity** (K), environmental resistance, **density dependent** (k-selection) and **density independent** (r-selection) factors.
- ☐ Describe and explain demographic trends in human populations.
- ☐ Understand the connection between energy flow (availability) and population growth in an ecosystem.