

Evolution Notes

Hardy-Weinberg (HW) principle

1. **Allele/genotype frequencies** in a population will **remain constant** over generations in the **absence** of **evolutionary influences**.
2. **Conditions for maintaining HW equilibrium:** *no natural selection, random mating, no mutation, large population size and no gene flow (immigration/emigration).*
3. **HW equation** = determines whether a change in allele frequency is occurring over time as **frequency changes** suggest **evolution** is occurring.
4. **Allele Frequency equation:** $p^2 + 2pq + q^2 = 1$
 p^2 = frequency of homozygous dominant genotype
 $2pq$ = frequency of heterozygous genotype
 q^2 = frequency of homozygous recessive genotype
5. **Genotype frequency.** $p + q = 1$
 p = frequency of **dominant allele**

Processes of Evolution

1. **Evolution** = the **change** over time in the **proportion of individuals** in a population **differing** in at least one **inherited traits**.
2. **Evolutionary changes in allele frequency** occur through
 - **non-random** processes of **natura** & **sexual selection**
 - **random** process of **genetic drift**.

Genetic Drift

1. **Genetic drift** = when **chance events** cause **unpredictable fluctuations** in allele frequencies from one generation to the next.
2. **Genetic drift** = certain **alleles** may be **under/over** represented & allele frequencies change.
3. More important in **small** populations as **alleles** are **more likely** to be **lost** from the gene pool.
4. **Population bottlenecks** = when a population size is **reduced** for at least one **generation**.
5. **Founder effects** = **isolation** of a **few members** of a population from a larger population.
 The new population is **not representative** of the **original gene pool**.

Sexual Selection & Mating Systems

1. Females have a **greater energy investment** in terms of **gamete production & uterus/gestation** than males during sexual reproduction.
2. **Sexual selection** = **non-random** process involving the **selection of male allele** via **female choice** that **increase chances of mating** and **producing offspring**.
3. Sexual selection via **female choice** leads to **sexual dimorphism** with **males** having more **conspicuous** markings, structures and behaviours than females.
4. **Reversed sexual dimorphism** = **females** are **more conspicuous** than males.
5. **Male fitness** is assessed by females via **honest signals** during **male: male rivalry**.
6. **Male -male rivalry** = **displays of conflict** to indicate fitness through **large size OR weaponry** to **increase access** to females.
7. **Honest signals** indicate to females that males have **low parasite burden** OR **favourable alleles** that increase odds of **offspring survival**
8. **Polygamous Lekking behaviour in birds.**
Dominant males = **centre of lek** to **display male: male rivalry** through **conflict**. (large size/weaponry) to indicate **fitness**.
Satellite males = **fringes subordinates/juvenile** engage in **sneaky breeding**.
 Both strategies **increase access to females**
9. **Mating systems** = **how many mates** an individual has during **one breeding season**.
10. **Monogamy** = the mating of a pair of animals to the exclusion of all others.
Polygamy = individuals of one sex have more than one mate (lekking behaviour).
Polygyny = **one male** mates exclusively with a **group of females**.
Polyandry = **one female** mates with a **group of males**.

Evolution Notes

Mutations

1. Mutations = new DNA sequences that are the only source of novel alleles resulting in variations in traits in a population.
2. Natural selection acts on genetic variation in populations.
3. Most mutations are harmful or neutral. Rarely advantageous mutations occur which are beneficial to the fitness of an individual.

Natural Selection & Selection pressures

1. Populations produce more offspring than environment can support leading to certain selection pressures
2. Selection pressure = environmental factors that influence which individuals in a population pass on their alleles.
3. Selection pressures can be
Biotic—competition, predation, disease or parasitism.
Abiotic—change in light, temperature, pH, salinity or temperature.
6. Where selection pressures are strong, rates of evolution can be rapid.
7. Natural selection acts on genetic variation in populations.
8. Fitness = an individual's ability to be successful at surviving to reproduce.
9. Natural selection = Non random increase in frequency of advantageous alleles better suited to survival (higher fitness) & decrease in frequency of deleterious alleles (lower fitness).
10. Individuals with successful alleles survive longer to breed and pass on those advantageous alleles to the next generation.

Fitness Ratios

1. Measures the contribution made to the gene pool of the next generation by individual genotypes
2. Absolute fitness = $\frac{\text{frequency of a particular genotype after selection}}{\text{frequency of a particular genotype before selection}}$
3. Absolute fitness = 1 no change > 1 = genotype increasing < 1 = genotype decreasing
4. Relative fitness = $\frac{\text{number of surviving offspring of a particular genotype}}{\text{number of surviving individuals of the most successful genotype}}$

Symbiosis & Co evolution

1. Symbiosis: co-evolved intimate relationships between members of 2 different species which can be (+) or (−) or (0) for either of the species.
2. Mutualism = both organisms are inter-dependent on each other for resources (+/+).
3. Commensalism = only one of the organisms benefits (+/0).
4. Parasitism = parasite benefits in terms of energy/nutrients and the host is harmed by the loss of these resources (+/-).
5. Co-evolution = process by which at least two species evolve in response to selection pressures imposed by each other.
6. Co-evolution is frequently seen in species that have symbiotic interactions.
7. Red Queen hypothesis = Changes in the traits of one species acts as a selection pressure on the other species.
This means these species in these relationships must adapt to avoid extinction.