**Isolating mechanisms**

The term isolating mechanisms was introduced by T Dobzhansky in the 1930s, and has been popularized in a number of books by E Mayr. Both authors originally proposed that isolating mechanisms were group traits beneficial at the level of the species. The classification is as follows.

1***) Pre-mating isolating mechanisms***. Factors which cause species to mate with their own kind (*assortative mating*).

a) *Temporal isolation*. Individuals of different species do not mate because they are active at different times of day or in different seasons.
b) *Ecological isolation*. Individuals mate in their preferred habitat, and therefore do not meet individuals of other species with different ecological preferences.
c) *Behavioral isolation*. Potential mates meet, but choose members of their own species.
d) *Mechanical isolation*. Copulation is attempted, but transfer of sperm does not take place.

**2) *Post-mating isolating mechanisms*.** Genomic incompatibility, hybrid inviability or sterility.

a) *Gametic incompatibility*. Sperm transfer takes place, but egg is not fertilized.
b) *Zygotic mortality*. Egg is fertilized, but zygote does not develop.
c) *Hybrid inviability*. Hybrid embryo forms, but of reduced viability.
d) *Hybrid sterility*. Hybrid is viable, but resulting adult is sterile.
e) *Hybrid breakdown*. First generation (F1) hybrids are viable and fertile, but further hybrid generations (F2 and backcrosses) may be inviable or sterile.

Recent authors have pointed out that the word "mechanism" is particularly misleading as *pre-mating* and *post-mating isolation* are likely to evolve as a by-product of natural selection or genetic drift within species, rather than as a direct result of their utility as barriers to fertilization and gene mixing between species (a process known as *reinforcement*).

Isolating mechanisms are intrinsic characteristics of species that reduce or prevent successful reproduction with members of other species. Viewed genetically, they are **characters that act as barriers to the exchange of genes between populations**. Most of these barriers are incidental consequences of divergence between populations but they can be elaborated by natural selection. They can take many forms, from mismatches between mating signals and preferences to genetic incompatibilities causing sterility of hybrids. A major outstanding challenge is to document the contributions of different forms of isolation to the overall barrier to gene exchange between species and to understand the order in which these barriers evolve.

Key Concepts:

* Isolating mechanisms are intrinsic characteristics of species that reduce or prevent successful reproduction with members of other species.
* Many, perhaps most, isolating mechanisms are incidental consequences of divergence between populations, not fashioned by selection for the purpose of preventing gene flow.
* Individual barriers to gene exchange act sequentially, which means that early acting barriers tend to have the greatest effect even though they may not have been the first to evolve.
* Ecological components of isolation evolve through adaptation to local conditions and may reduce the probability of mating or the fitness of hybrids.
* Behavioural components of isolation prevent mating even when reproductively active individuals meet and may evolve due to sexual selection on mating signals and responses.
* Barriers can occur after mating but before zygote formation. These barriers may be a side‐effect of evolutionary conflicts of interest between males and females.
* Divergent populations accumulate genetic differences. Inevitably some of the new genes are incompatible resulting in isolation through reduced viability or fertility of hybrids, especially in the heterogametic sex.
* We still need to know more about the range of barriers operating in individual species pairs, the reasons for their evolution and the order in which they evolved.