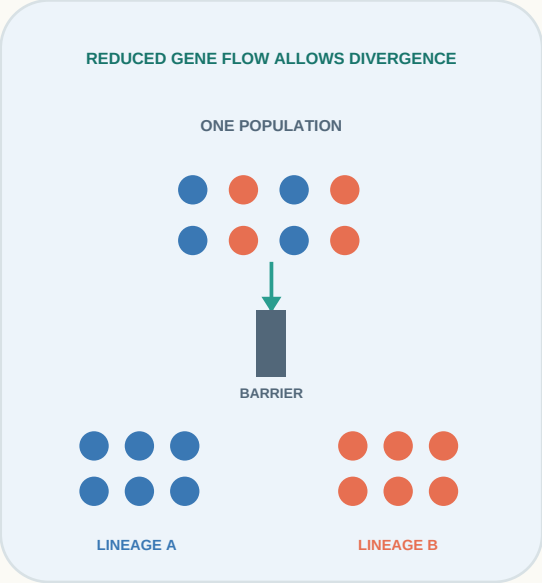
AP BIOLOGY | UNIT 7

TOPIC 7.10

Speciation

New species form when gene flow is reduced, populations diverge, and reproductive barriers keep their gene pools separate.



THE CORE CAUSAL CHAIN

REDUCED FLOW
alleles stop mixing

→

DIVERGENCE
differences accumulate

→

BARRIERS
mating is restricted

→

SPECIES
gene pools separate

BY THE END, YOU SHOULD BE ABLE TO...

1. Connect reduced gene flow with population divergence.
2. Compare allopatric and sympatric speciation.
3. Distinguish pre-zygotic and post-zygotic barriers.

CENTRAL IDEA

Reproductive isolation is the key outcome: even if populations meet again, little or no successful gene flow occurs between them.

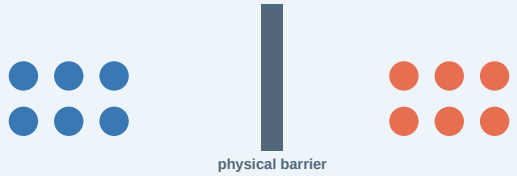
1 Isolation creates independent evolutionary paths

Barriers reduce gene flow, allowing mutation, selection, and drift to produce different allele combinations in separated gene pools.

TWO GEOGRAPHIC PATTERNS

ALLOPATRIC SPECIATION

A physical barrier separates populations.



barrier -> low gene flow -> divergence

SYMPATRIC SPECIATION

Isolation develops despite geographic overlap.



mate choice, habitat use, or polyploidy

BIOLOGICAL SPECIES CONCEPT

A species is a group whose members can interbreed and produce viable, fertile offspring. This concept is limited for fossils and asexual organisms.

REPRODUCTIVE BARRIERS

HABITAT / TEMPORAL

Populations occupy different places or reproduce at different times.

BEHAVIORAL

Courtship signals or mate preferences do not match.

MECHANICAL / GAMETIC

Mating or fertilization cannot occur successfully.

LOW HYBRID VIABILITY

Hybrid offspring fail to develop or survive well.

LOW HYBRID FERTILITY

Hybrid offspring survive but cannot reproduce.

HYBRID BREAKDOWN

Later-generation hybrids have reduced survival or fertility.

PRE- VS POST-ZYGOTIC

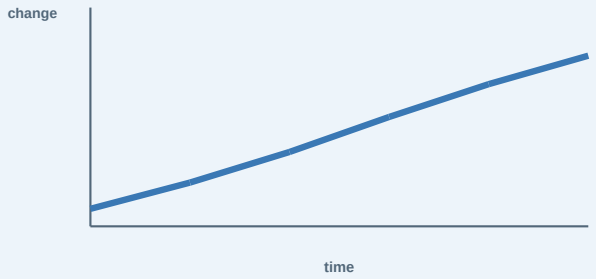
Pre-zygotic barriers prevent fertilization. Post-zygotic barriers act after fertilization by reducing hybrid survival, fertility, or later-generation success.

2 Speciation can proceed at different tempos

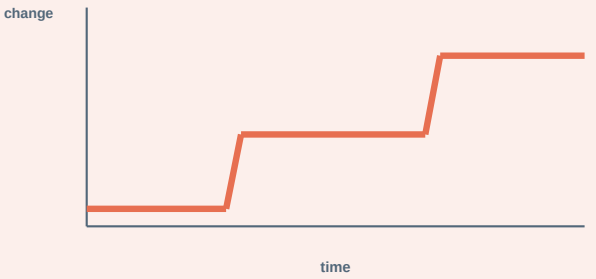
The rate of visible change can be steady or concentrated in relatively short intervals; both patterns can produce branching lineages.

TWO MODELS OF EVOLUTIONARY TEMPO

GRADUALISM



PUNCTUATED EQUILIBRIUM



Punctuated equilibrium does not mean instant change. It describes relatively rapid change compared with long periods of little visible change in the fossil record.

IF DIVERGED POPULATIONS MEET AGAIN

FUSION

Weak barriers allow gene flow to merge the populations.

STABILITY

A hybrid zone persists while lineages remain partly distinct.

REINFORCEMENT

Selection strengthens pre-zygotic barriers when hybrids have low fitness.

POLYPLOIDY CAN CREATE RAPID ISOLATION

In plants, chromosome-number changes can prevent successful reproduction with the original population, producing sympatric reproductive isolation in one or a few generations.

WHAT DEFINES COMPLETION?

Genetic differences alone do not define a new biological species. The decisive pattern is reproductive isolation that prevents sustained gene flow.

FINAL MAP

Reduced gene flow -> divergence -> reproductive barriers -> independent species lineages.