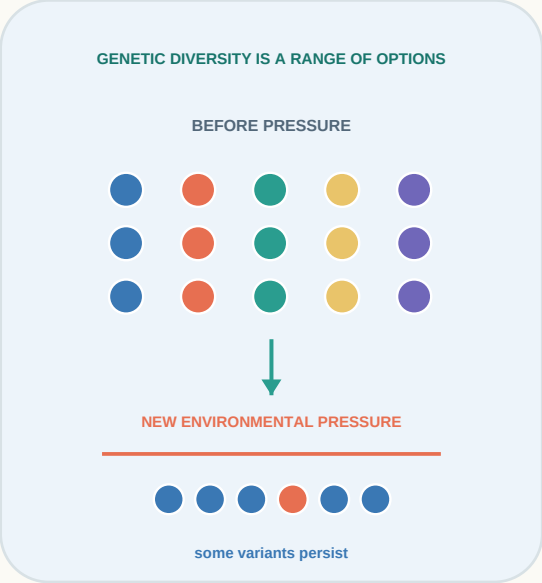
AP BIOLOGY | UNIT 7

TOPIC 7.11 Variations in Populations

Genetic diversity gives a population more possible responses when disease, climate, or other conditions change.



THE CORE CAUSAL CHAIN

DIVERSITY → different alleles

PRESSURE → conditions change

SELECTION → fitness differs

RESILIENCE → some reproduce

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

1. Link genetic diversity to a population's response to change.
2. Explain why allele effects depend on the environment.
3. Predict how bottlenecks and inbreeding affect resilience.

CENTRAL IDEA

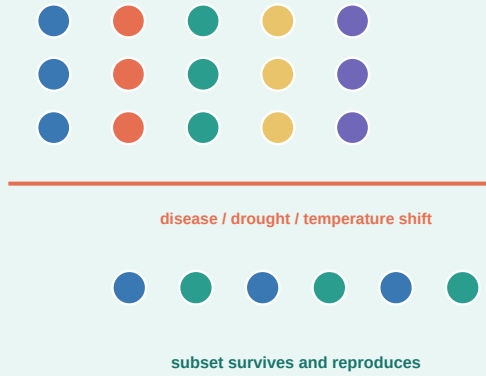
Diversity does not guarantee survival. It increases the chance that some individuals already carry variants useful under a new pressure.

1 Diversity changes the range of responses

An environmental perturbation changes conditions. Natural selection then acts on heritable variation already present in the population.

SAME PRESSURE, DIFFERENT RESPONSE

HIGH DIVERSITY



LOW DIVERSITY



POPULATION-LEVEL RESULT

If survivors reproduce, their alleles become more common. Population size and allele frequencies may both change over generations.

FITNESS IS CONTEXT-DEPENDENT

DRY — **low-water environment**

ADVANTAGE
Allele A reduces water loss and raises fitness.

TRADE-OFF
Slower growth when water is abundant.

WET — **high-water environment**

ADVANTAGE
Allele B supports rapid growth and raises fitness.

TRADE-OFF
Greater water loss during drought.

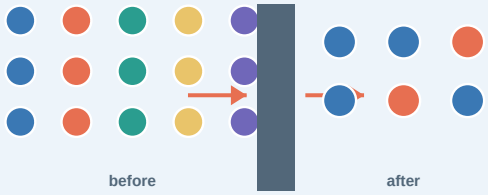
KEY DISTINCTION

An adaptive allele increases fitness in a particular environment. The same allele may be neutral or deleterious when conditions change; there is no universally best allele.

2 Small populations can enter a risky feedback loop

Bottlenecks remove alleles by chance. Inbreeding can then increase homozygosity and expose deleterious recessive alleles.

BOTTLENECK: RANDOM ALLELE LOSS



population size may recover; lost alleles may not

INBREEDING: RELATED INDIVIDUALS MATE

1. **small gene pool**
   few mating options
2. **homozygosity rises**
   matching alleles pair
3. **recessive effects**
   harmful alleles expressed

WHY DIVERSITY LOSS CHANGES POPULATION DYNAMICS

LOWER RESILIENCE

Fewer variants are available when conditions change.

DISEASE RISK

Similar genotypes may share the same susceptibility.

EXTINCTION RISK

Decline is more likely if survival and reproduction fall.

THE EXTINCTION VORTEX

small population → **genetic diversity falls** → **fitness may fall** → **population shrinks**

This cycle is possible, not inevitable; migration and management can add variation.

CONNECT THE EVIDENCE

OBSERVE	allele diversity, heterozygosity, population size
COMPARE	survival or reproduction before and after a pressure
INFER	whether diversity is associated with greater resilience