KEY CONCEPT

Hardy-Weinberg equilibrium provides a framework for understanding how populations evolve.

Hardy-Weinberg equilibrium describes populations that are not evolving.

- Biologists use models to study populations.
- Hardy-Weinberg equilibrium is a type of model.

▶ **Hardy-Weinberg equilibrium describes populations that are not evolving.**

- Genotype frequencies stay the same if five conditions are met.

  – very large population: no genetic drift

  – no emigration or immigration: no gene flow

  – no mutations: no new alleles added to gene pool

  – random mating: no sexual selection

  – no natural selection: all traits aid equally in survival

▶ **Hardy-Weinberg equilibrium describes populations that are not evolving.**

- Real populations rarely meet all five conditions.
  - Real population data is compared to a model.
  - Models are used to studying how populations evolve.

▶ **The Hardy-Weinberg equation is used to predict genotype frequencies in a population.**

- Predicted genotype frequencies are compared with actual frequencies.

  – used for traits in simple dominant-recessive systems
  – must know frequency of recessive homozygotes
  – $p^2 + 2pq + q^2 = 1$

	p	q
p	p^2	pq
q	pq	q^2

VARIABLES

p = frequency of allele T (dominant allele)

q = frequency of allele t (recessive allele)

p^2 = frequency of fish with TT (dominant homozygous genotype)

$2pq$ = frequency of fish with Tt (heterozygous genotype)

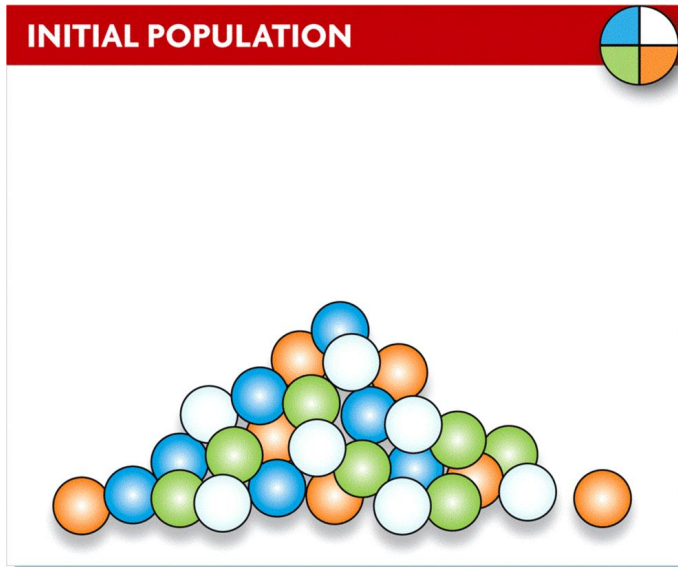q^2 = frequency of fish with tt (recessive homozygous genotype)

▶ **There are five factors that can lead to evolution.**

11.4 Hardy-Weinberg Equilibrium

- Genetic drift changes allele frequencies due to chance alone.
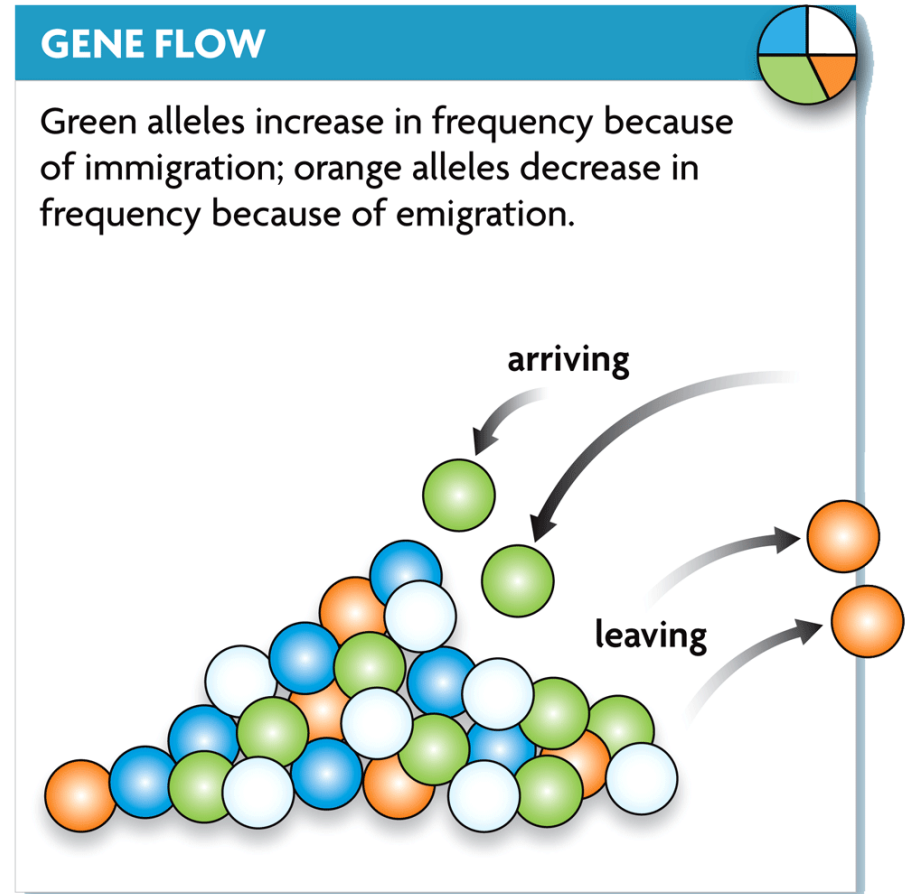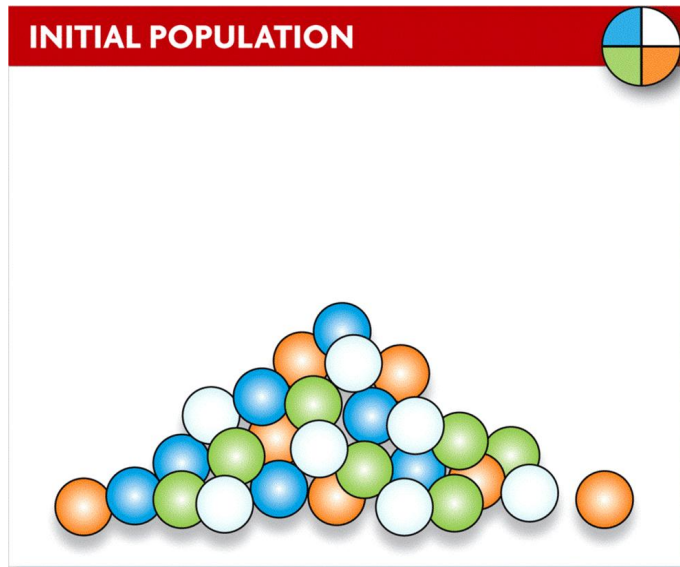
INITIAL POPULATION

GENETIC DRIFT

After a bottleneck event, only orange and blue alleles remained in the small population. Through genetic drift, orange alleles increase in frequency.
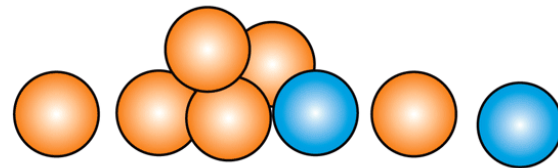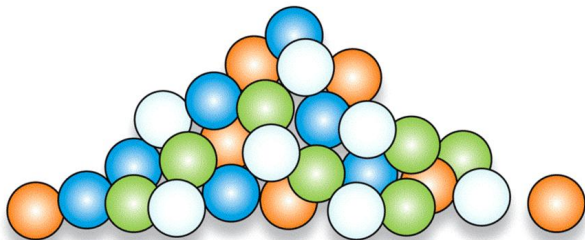
- Gene flow moves alleles from one population to another.

INITIAL POPULATION

GENE FLOW

Green alleles increase in frequency because of immigration; orange alleles decrease in frequency because of emigration.

arriving

leaving

11.4 Hardy-Weinberg Equilibrium

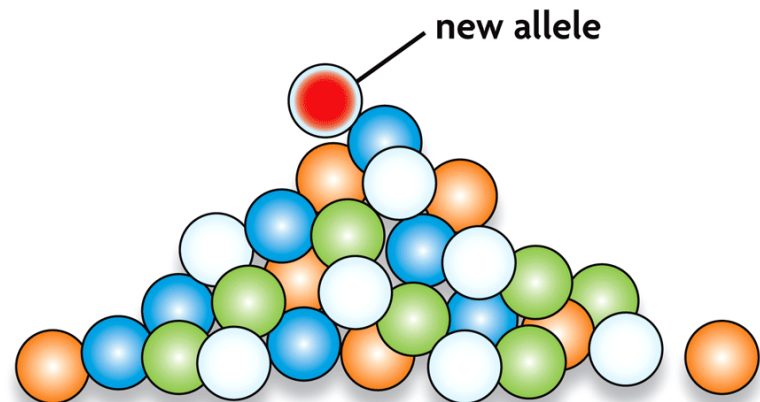- Mutations produce the genetic variation needed for evolution.


INITIAL POPULATION

MUTATION

A new allele, associated with red body color, is formed through mutation. This could affect sexual selection if red body color improves mating success. It could affect natural selection if red body color increases the chance for survival.
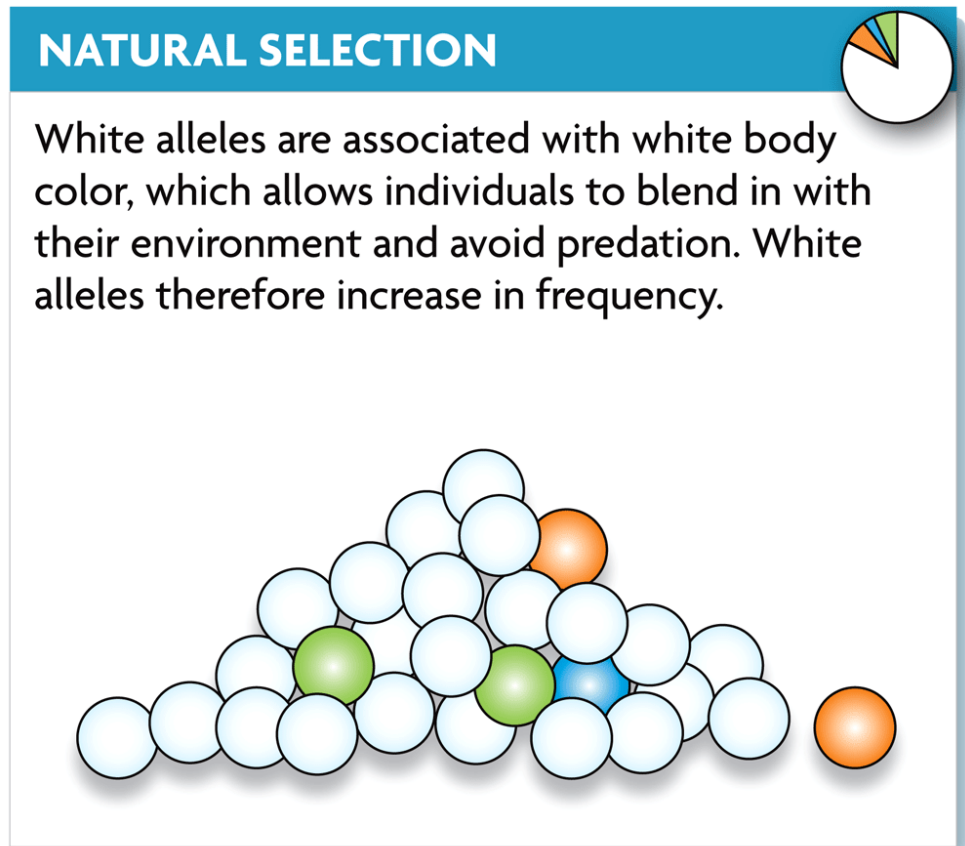
new allele

11.4 Hardy-Weinberg Equilibrium

- Sexual selection selects for traits that improve mating success.

INITIAL POPULATION

SEXUAL SELECTION

Blue alleles are associated with blue body color, which improves mating success. Blue alleles therefore increase in frequency.
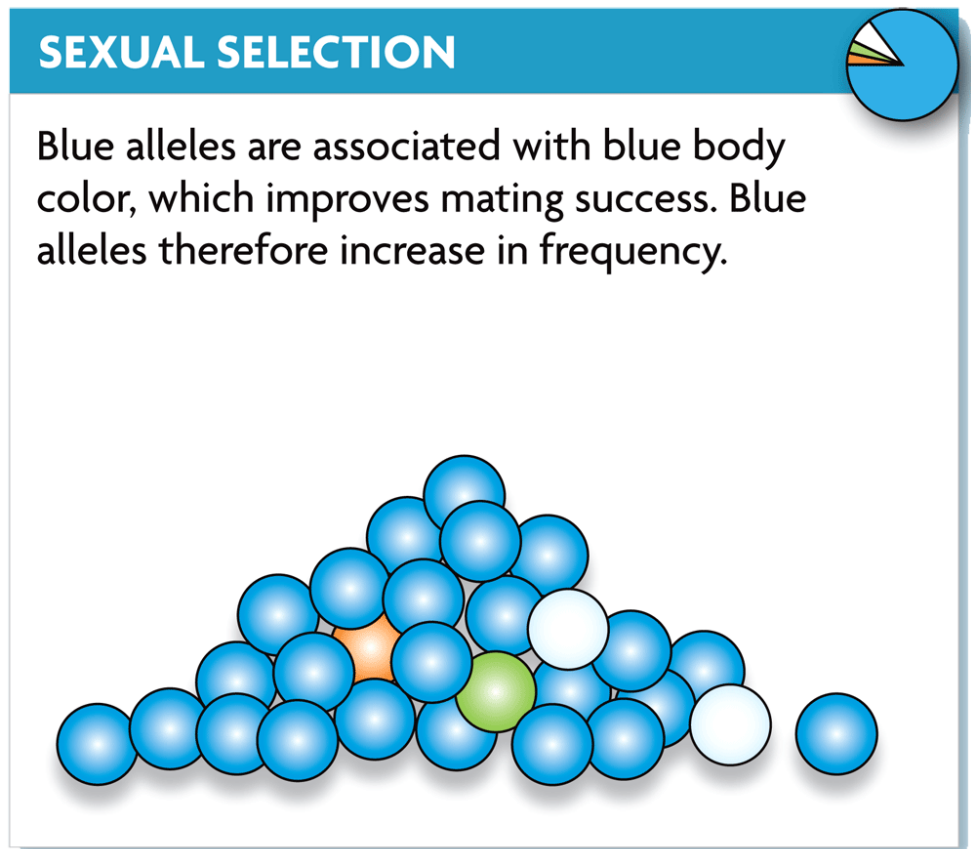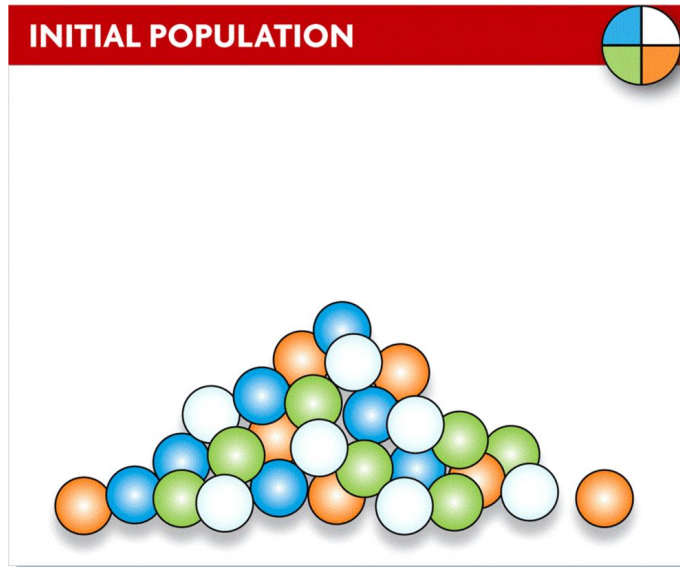
11.4 Hardy-Weinberg Equilibrium

- Natural selection selects for traits advantageous for survival.

INITIAL POPULATION

NATURAL SELECTION

White alleles are associated with white body color, which allows individuals to blend in with their environment and avoid predation. White alleles therefore increase in frequency.
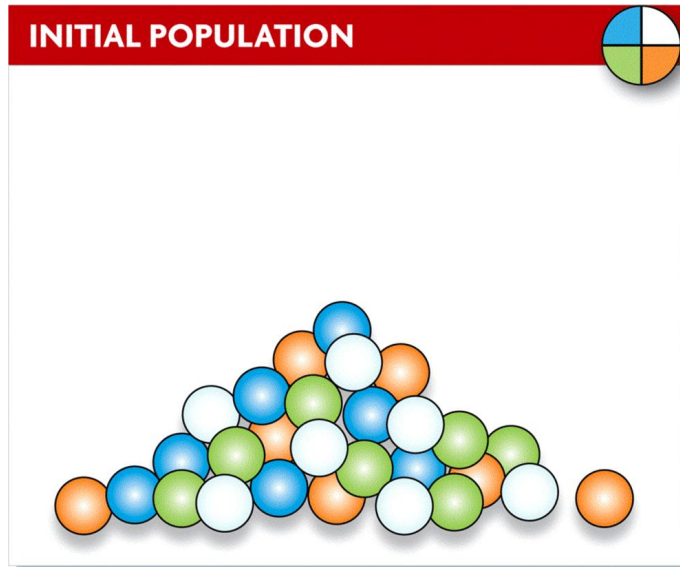
- In nature, populations evolve.

  – expected in all populations most of the time

  – respond to changing environments