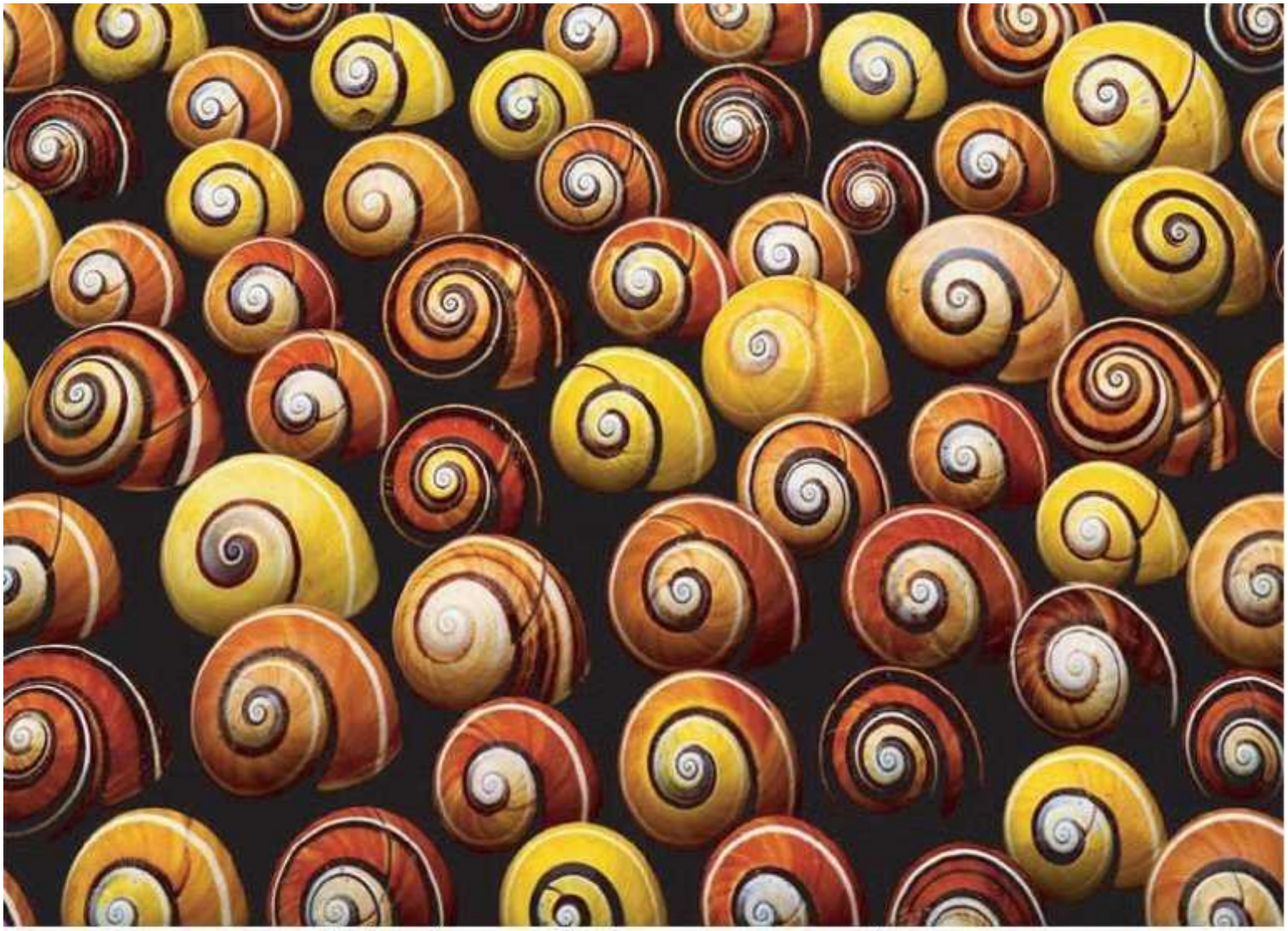
Variation

LS 2201

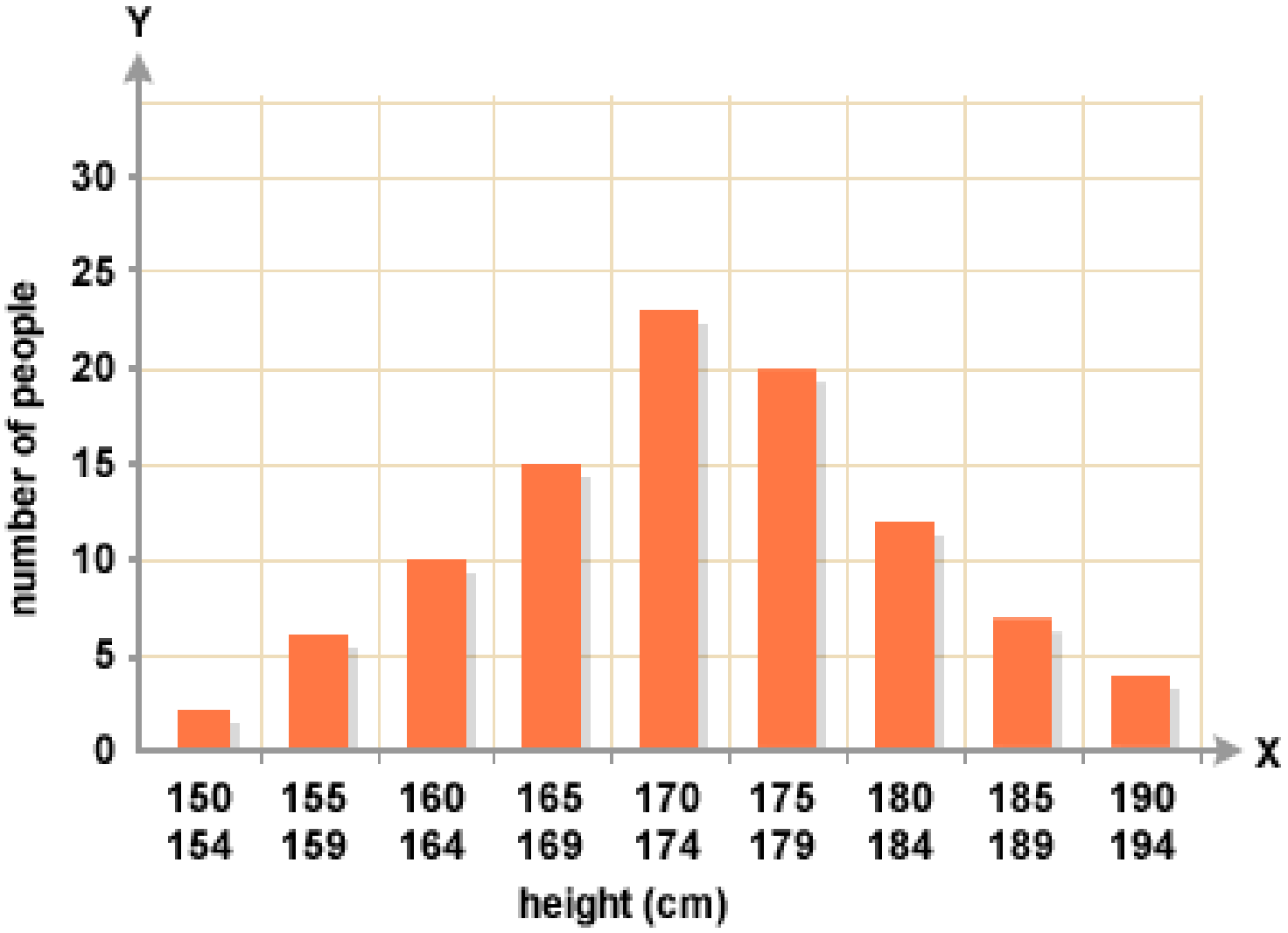
Instructor: Anindita Bhadra

Morphological Variation



Cuban tree snails (*Polymita picta*)

Continuous Variation



Discrete Variation

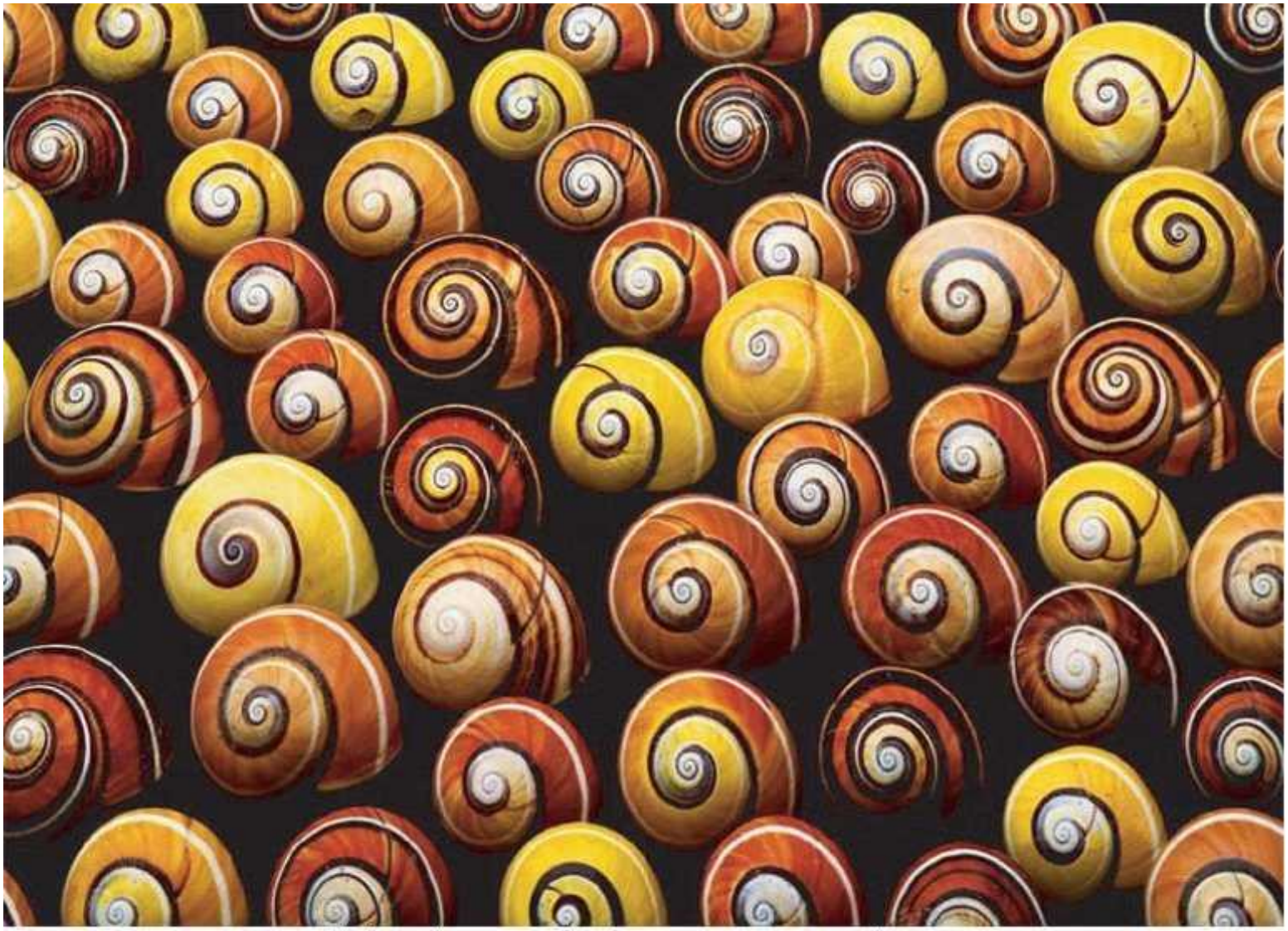
Variation at the Cellular Level

Number of chromosomes

Banding patterns of chromosomes

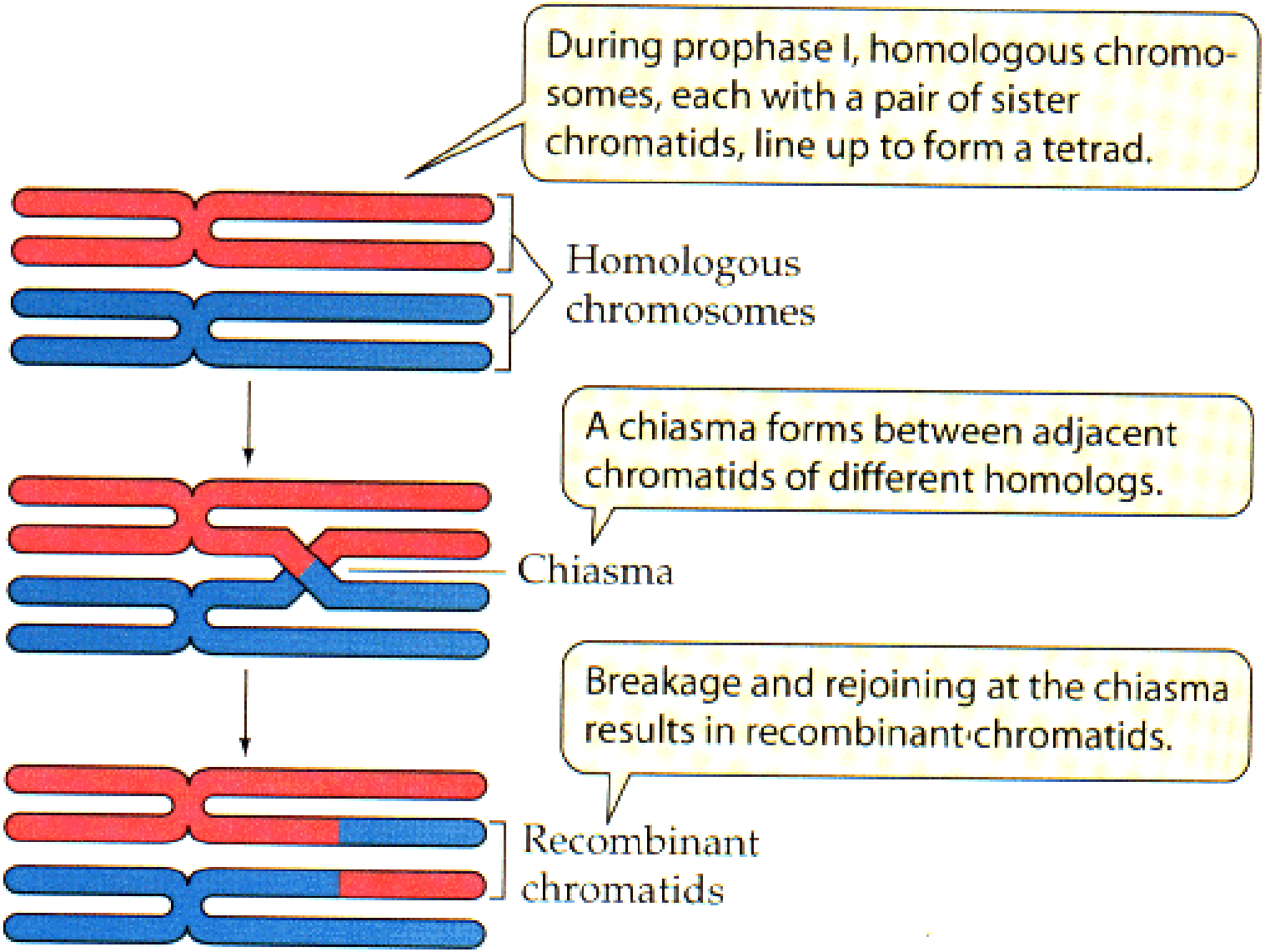
DNA sequences

Sources of Variation

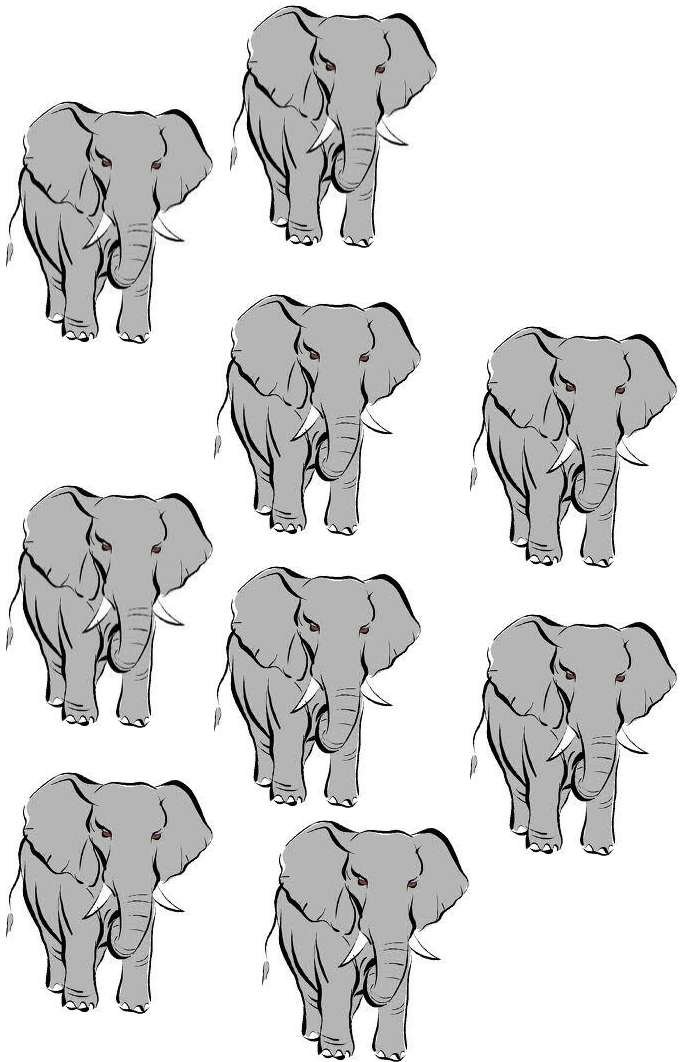


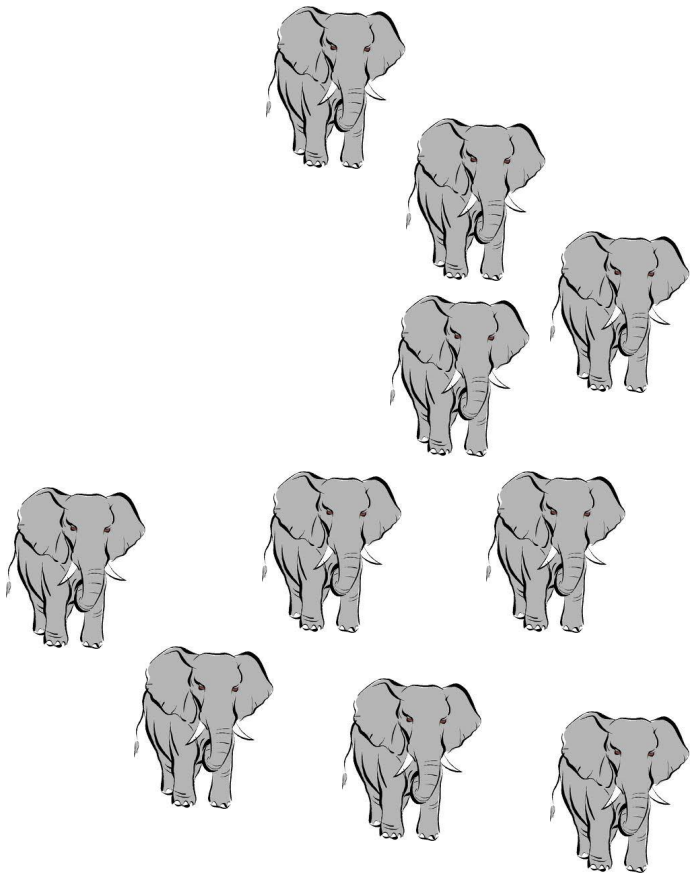
Cuban tree snails (*Polymita picta*)

Genetic Recombination

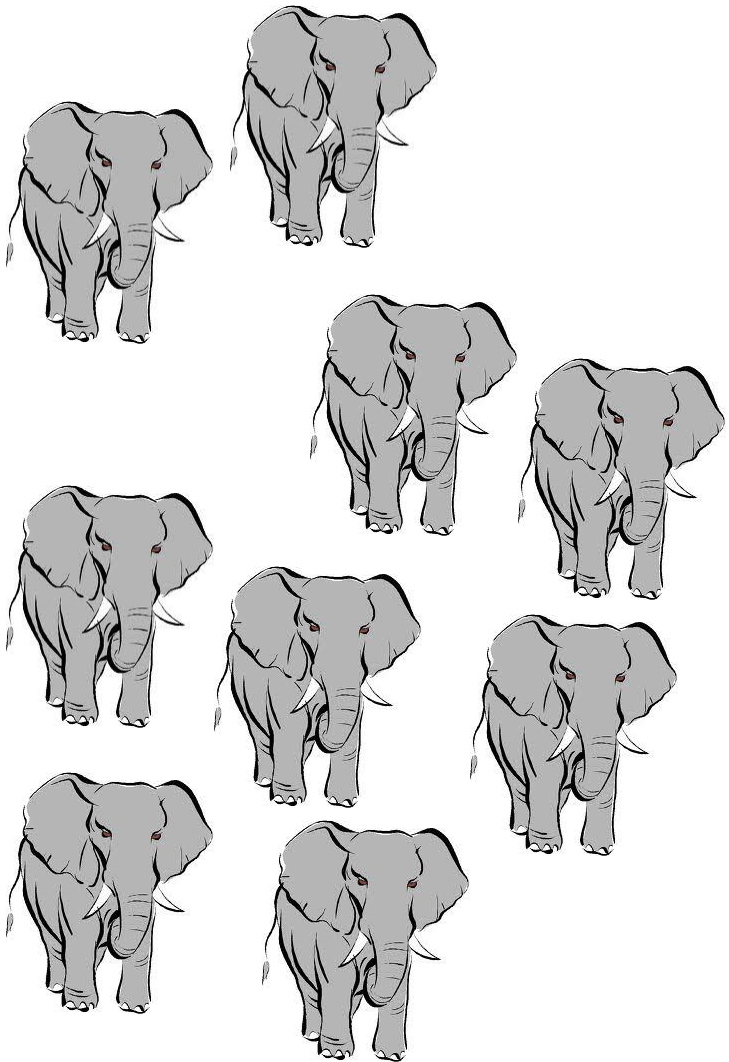


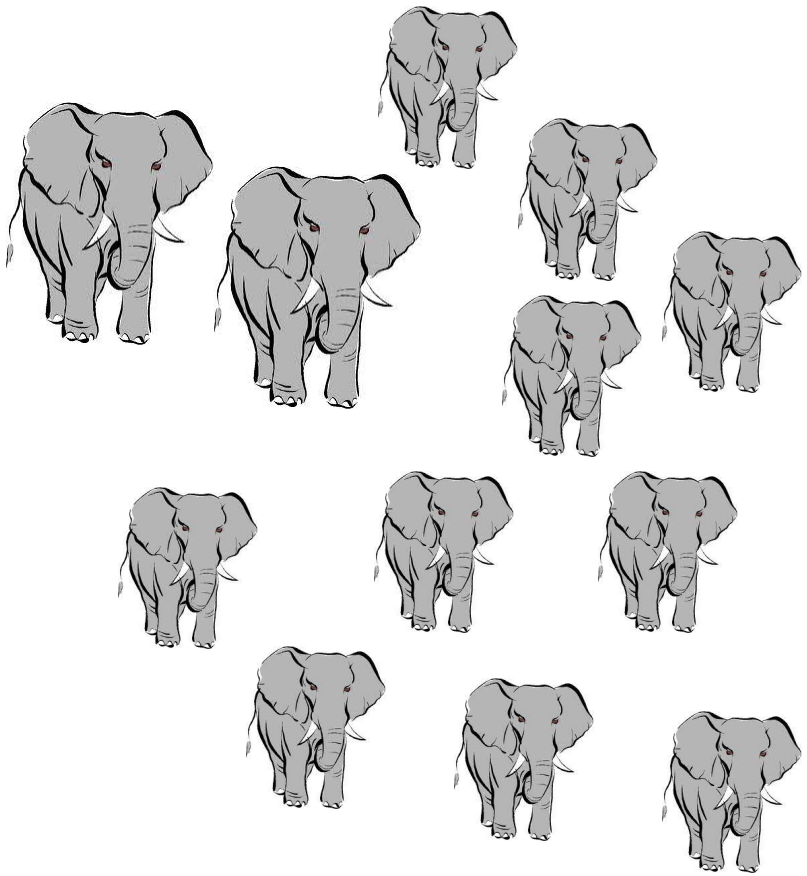
Migration





Migration





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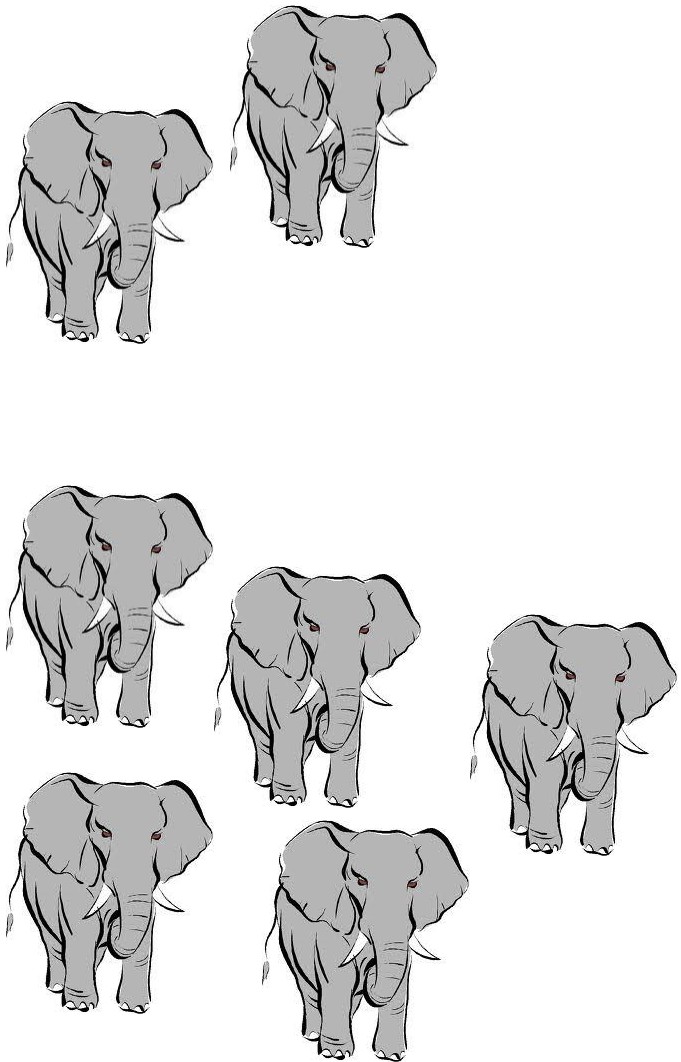
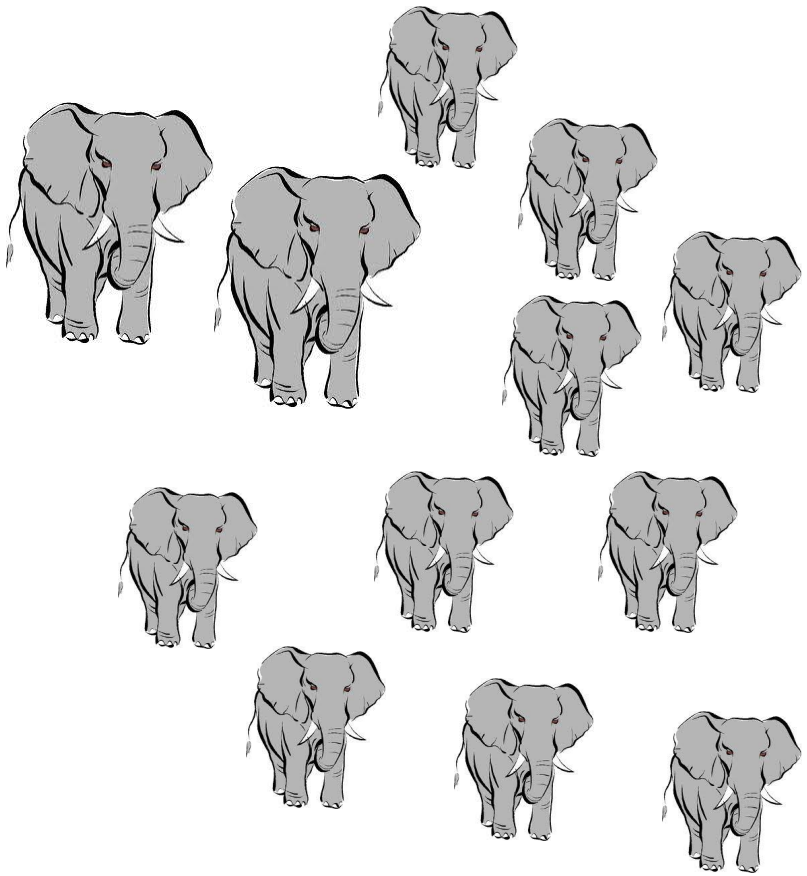
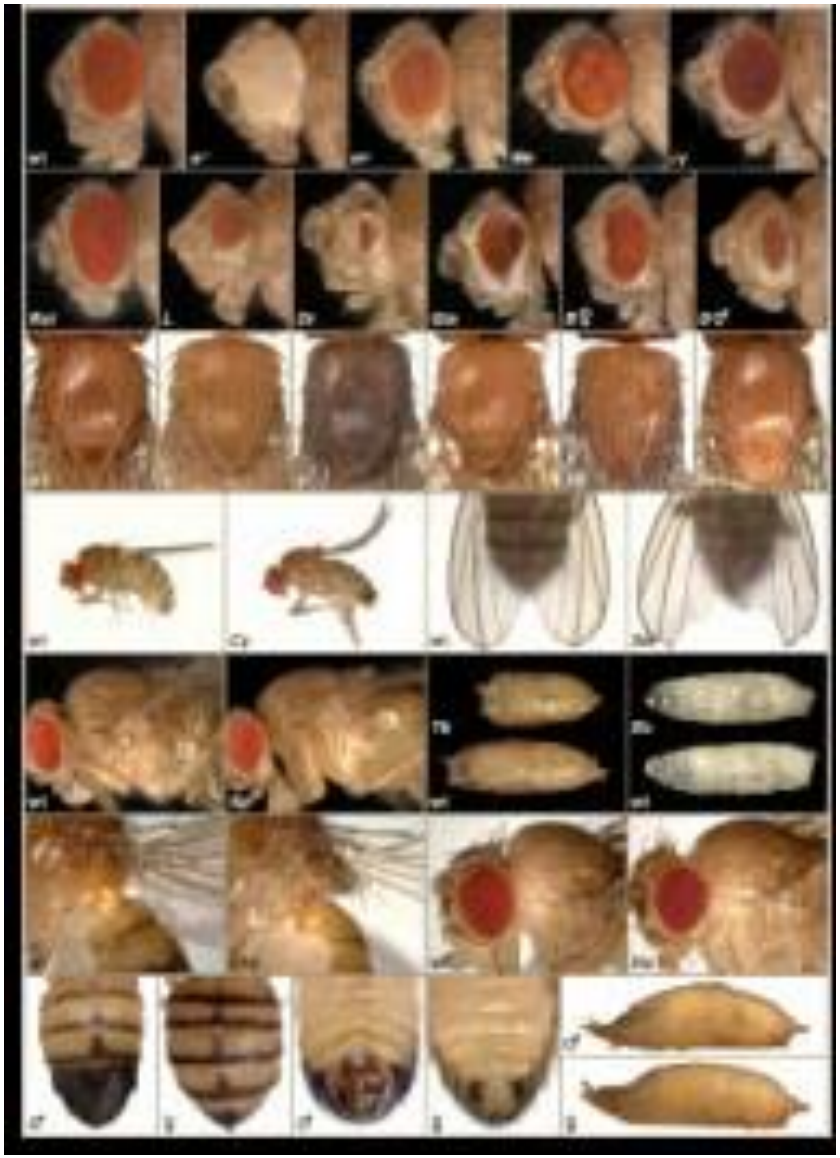




Mutation



The only original source of variation in populations.

Mutations can occur at the chromosomal and basal levels.

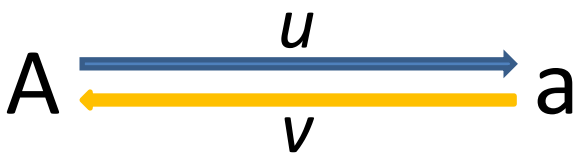
Mutations are Random

Adaptive evolution is uncoupled from the direction of variation.

Natural selection imposes direction on evolution, using undirected variation.

Gene frequency can be affected by the frequency of mutation.

Mutations Rates



P p_0, q_0

F1 $(p_0 + vq_0), (q_0 + up_0)$

The change in the frequency of *a* (Δq) = $up_0 - vq_0$

If *p* is large and *q* is small, Δq would be large and *q* would increase rapidly.

When q is large and p small, Δq would diminish.

Mutational Equilibrium

The point at which Δq is zero, p and q are balanced in their mutation frequencies.

This is called mutational equilibrium.

$$\Delta q = 0 = up - vq, \text{ or } up = vq \text{ at } q'$$

$$p = 1-q,$$

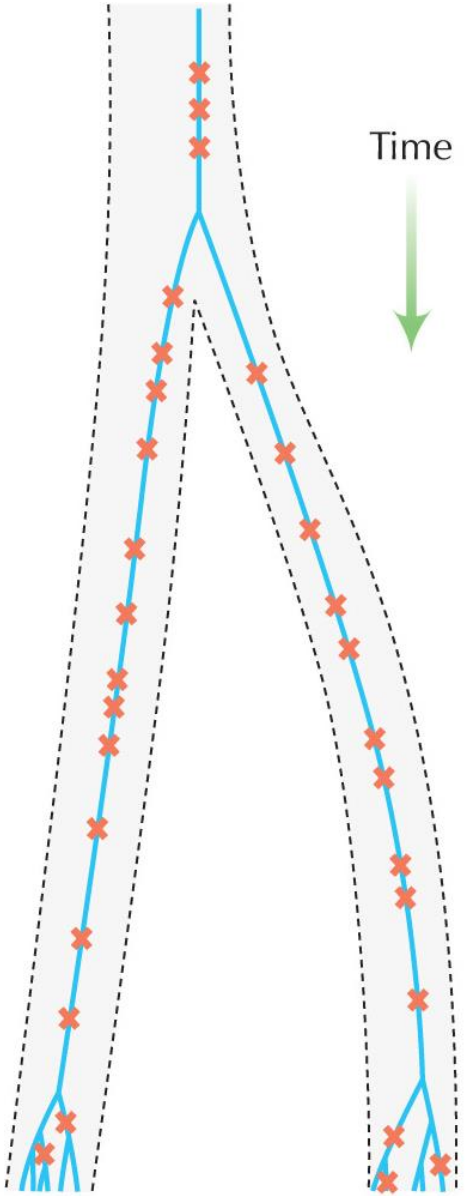
$$up = vq$$

$$u(1-q) = vq$$

$$u = uq + vq = q(u + v)$$

$$q' = u/(u + v)$$

Mutation and Evolution



All the genes within a species descended from a single ancestral lineage, which traces back into the distant past. Thus the rate at which two species diverge over time is equal to the rate at which their two ancestral lineages accumulate mutations.

Neutral Mutation

Mutations that are not under the effect of natural selection.

Glutamic acid: GAA, GAG
Serine: UCA, UCG, UCC, UCU, AGU, AGC

Neutral mutations can accumulate in the population due to random genetic drift.

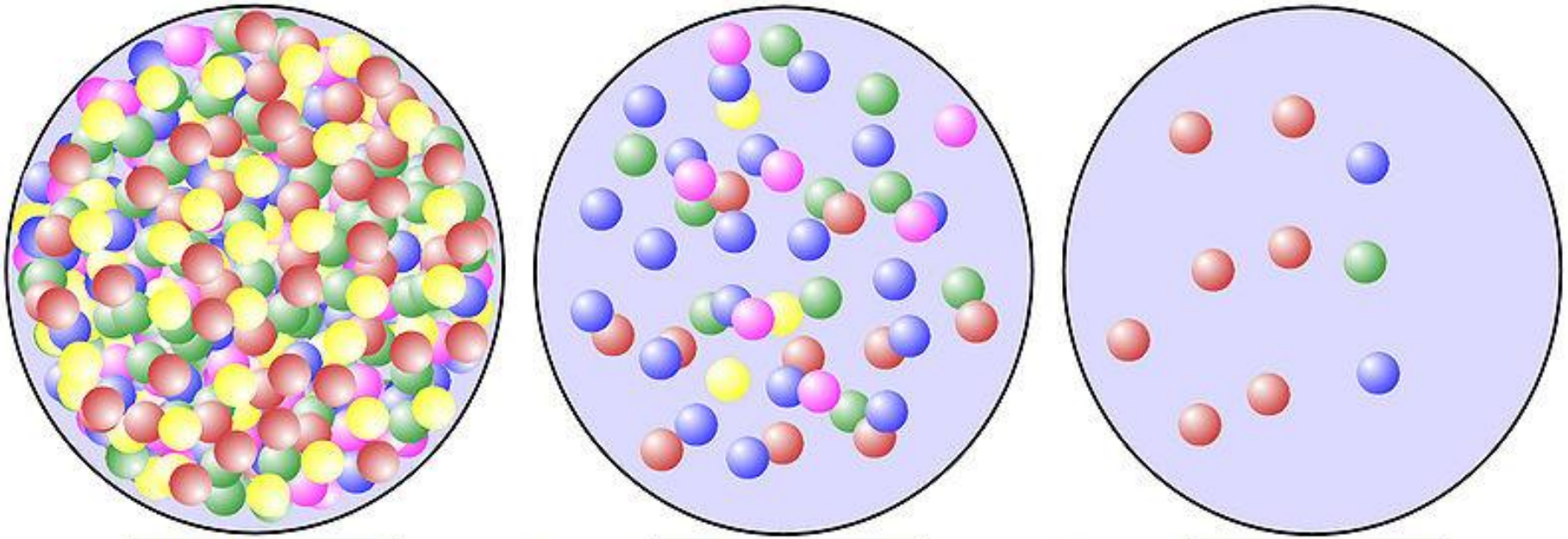
Most mutations that arise in the population do not affect fitness.

Founder Effect

"The establishment of a new population by a few original founders (in an extreme case, by a single fertilized female) which carry only a small fraction of the total genetic variation of the parental population.“

The 250 people making up the human population on the island of Tristan da Cunha, are mostly descended from one Scottish family who arrived in 1817.

Founder Effect



Initial frequency distribution	
	0.20
	0.20
	0.20
	0.20
	0.20

5th generation frequency distribution	
	0.40
	0.06
	0.20
	0.14
	0.20

10th generation frequency distribution	
	0.20
	0.00
	0.10
	0.00
	0.70

Genetic Bottleneck

A small fraction of the original population survives due to a natural (or anthropogenic) disturbance.

The surviving population grows and the final population has a different genetic distribution from the original population.

Both Founder Effect and Genetic Bottleneck both result in Genetic Drift, which is a random change in allele frequencies from generation to generation.