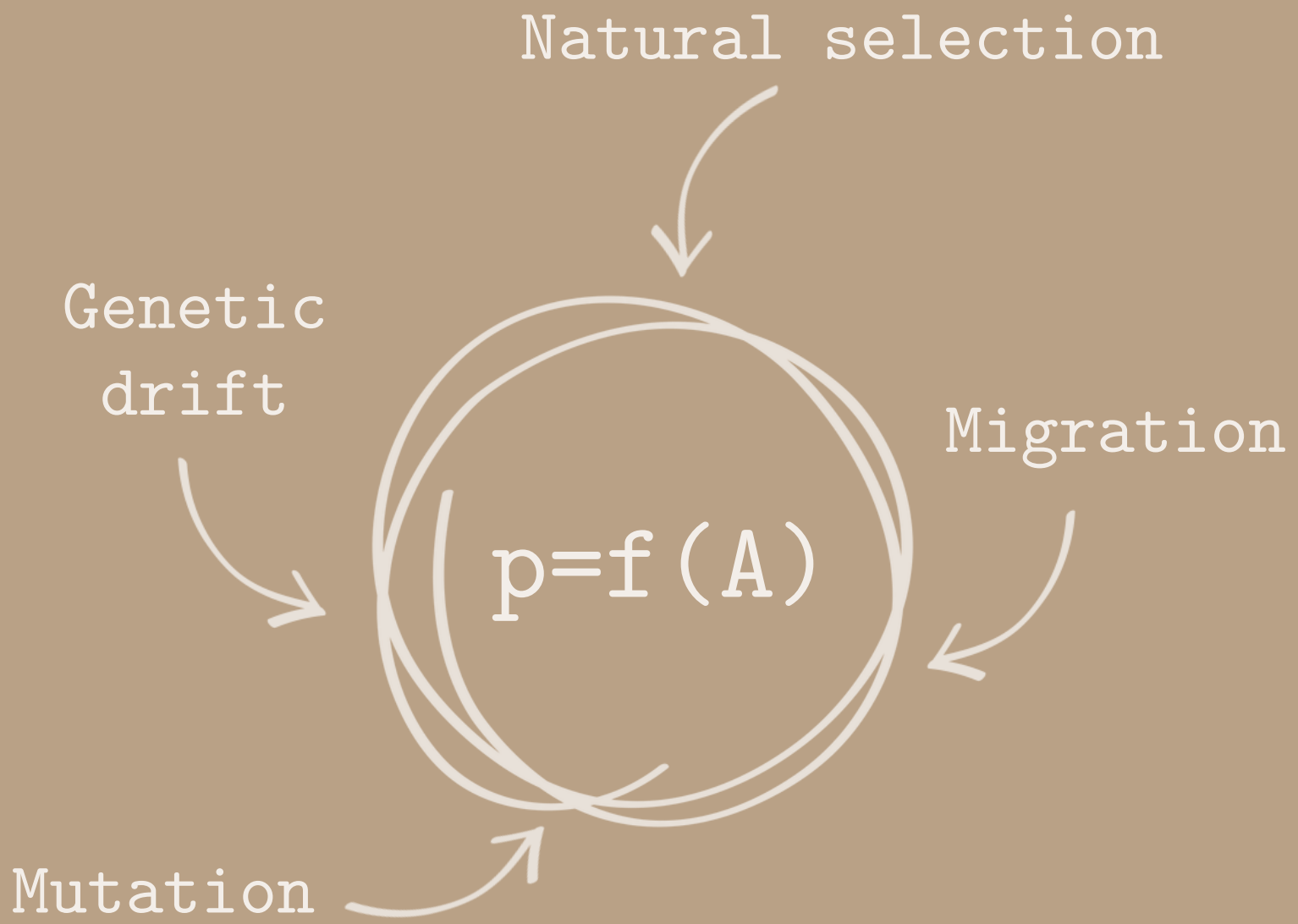
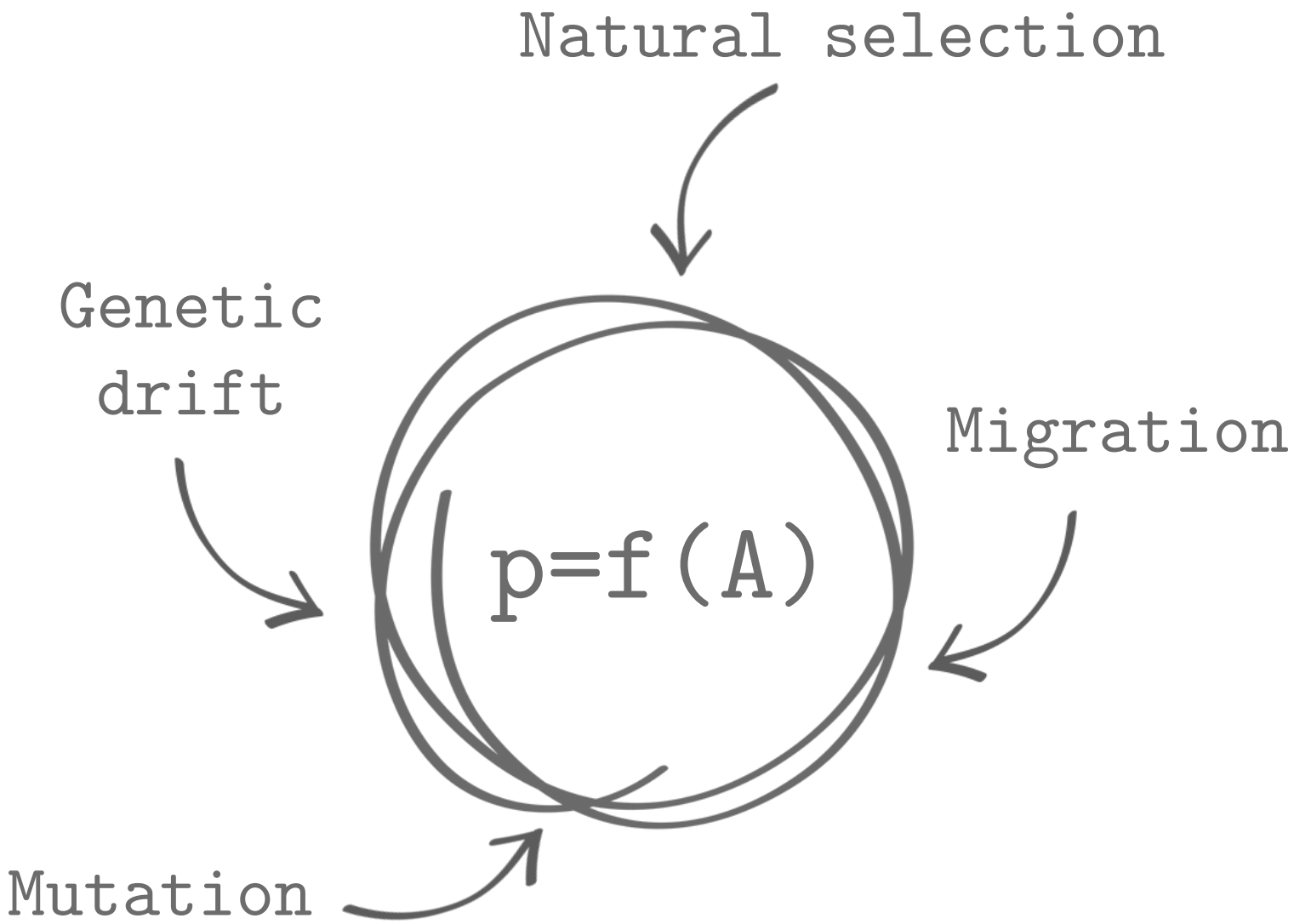


Part 1

Study of the main forces that modulate evolution

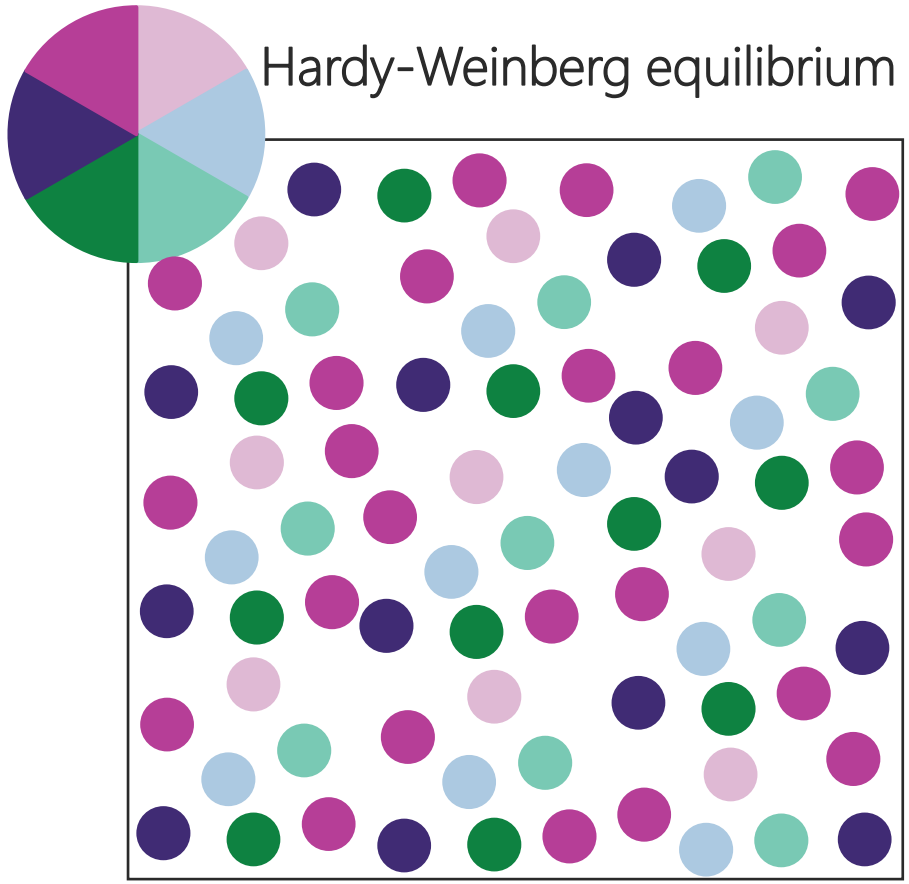
Population genetics



Population genetics explains the mechanisms underlying **microevolution**:

- Changes in allelic frequencies in a population over time
- Variation in populations
- Provides a basis for natural selection and other evolutionary forces

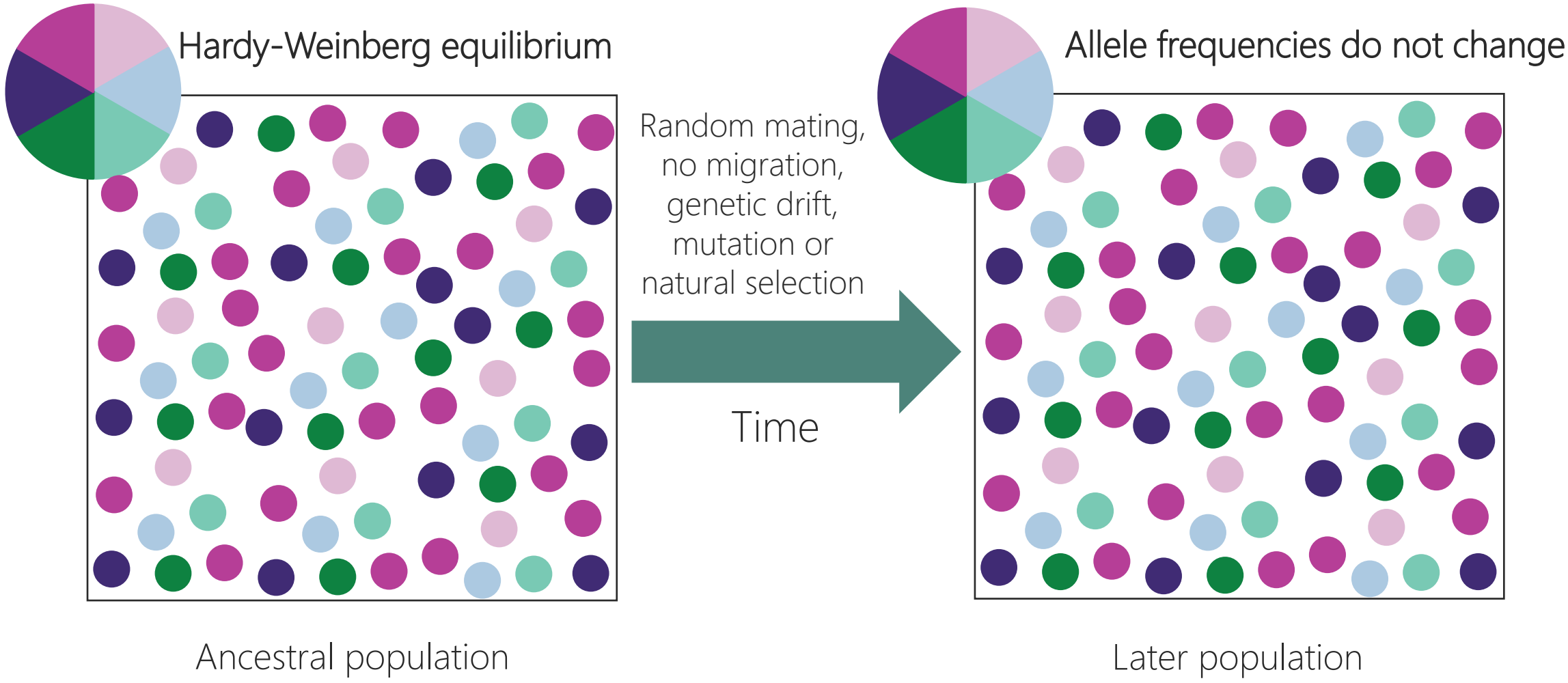
Evolution of allele and genotype frequencies in populations



Random mating, no migration, genetic drift, mutation or natural selection

Ancestral population

Evolution of allele and genotype frequencies in populations



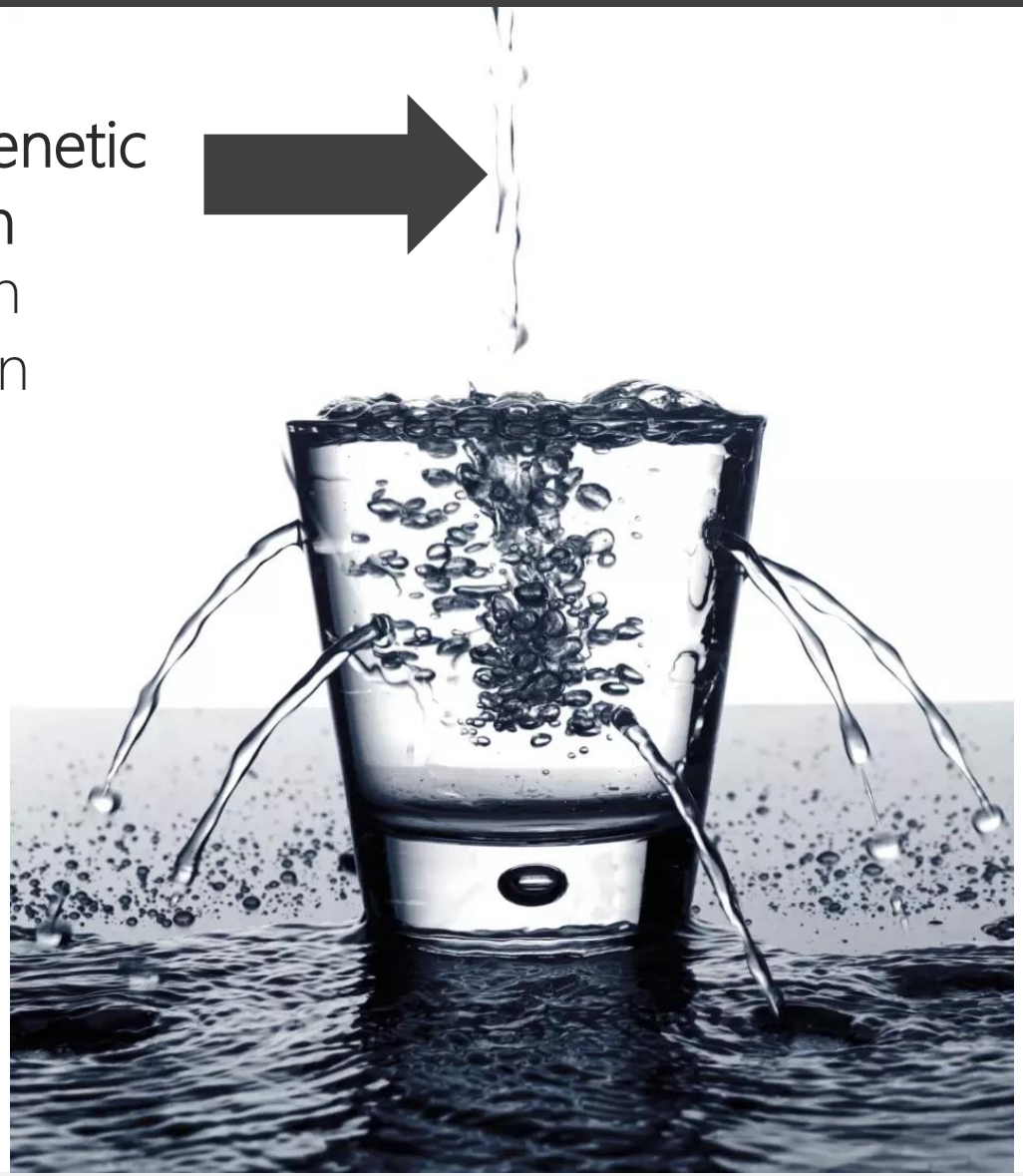
Main forces that modulate evolution

Main forces that modulate evolution

Sources of genetic variation

Mutation

Migration

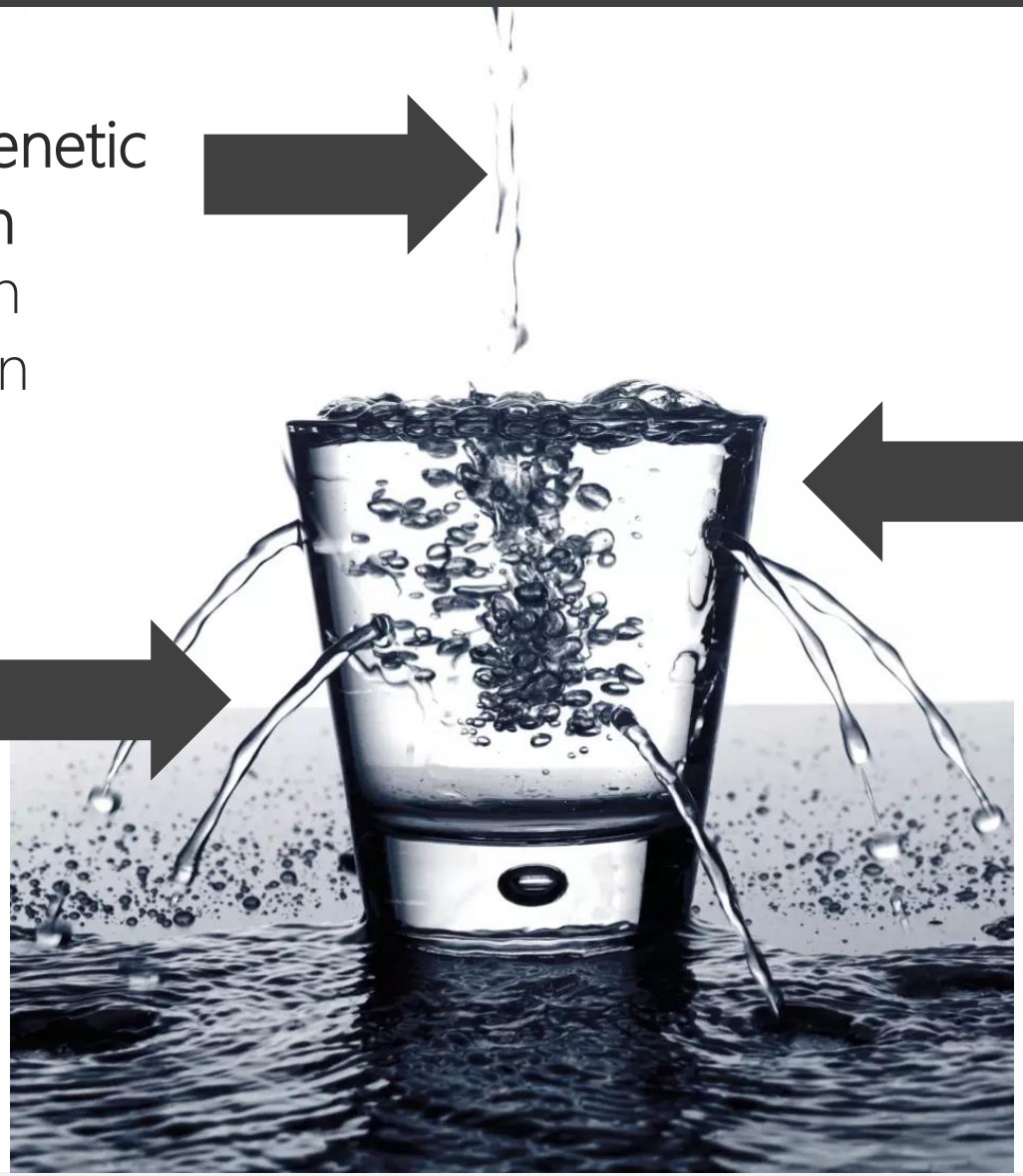


Main forces that modulate evolution

Sources of genetic variation
Mutation
Migration

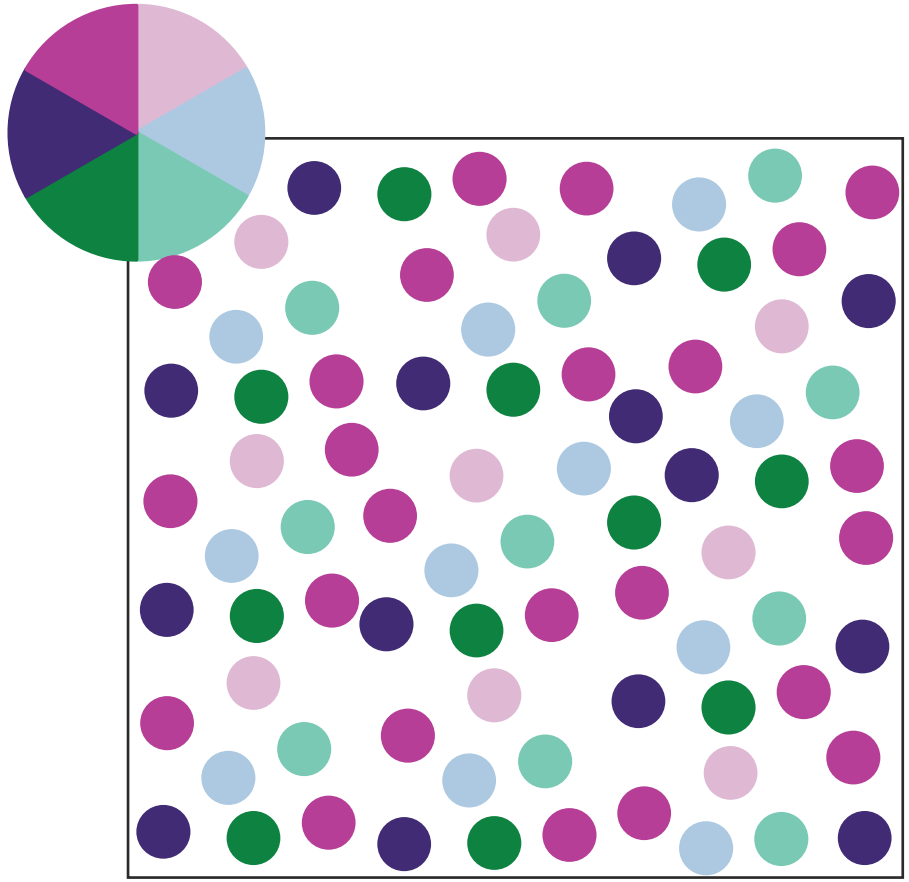
Maintenance of genetic variation
Balancing selection

Loss of genetic variation
Natural selection
Genetic drift



Mutation

Mutation is the source of all genetic diversity, but it is a weak evolutionary force in the short term (very low mutation rates): mutations continually replenish the variability of the gene pool.



One genotype becomes another

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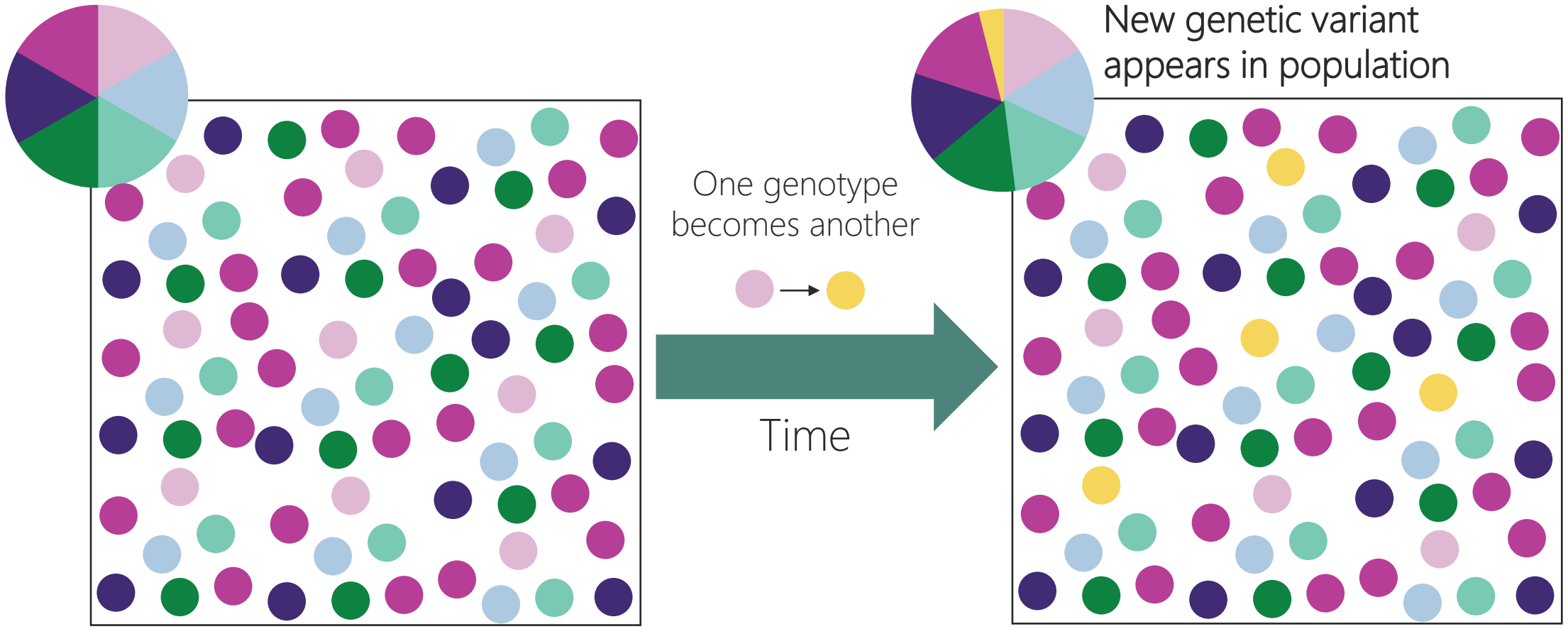
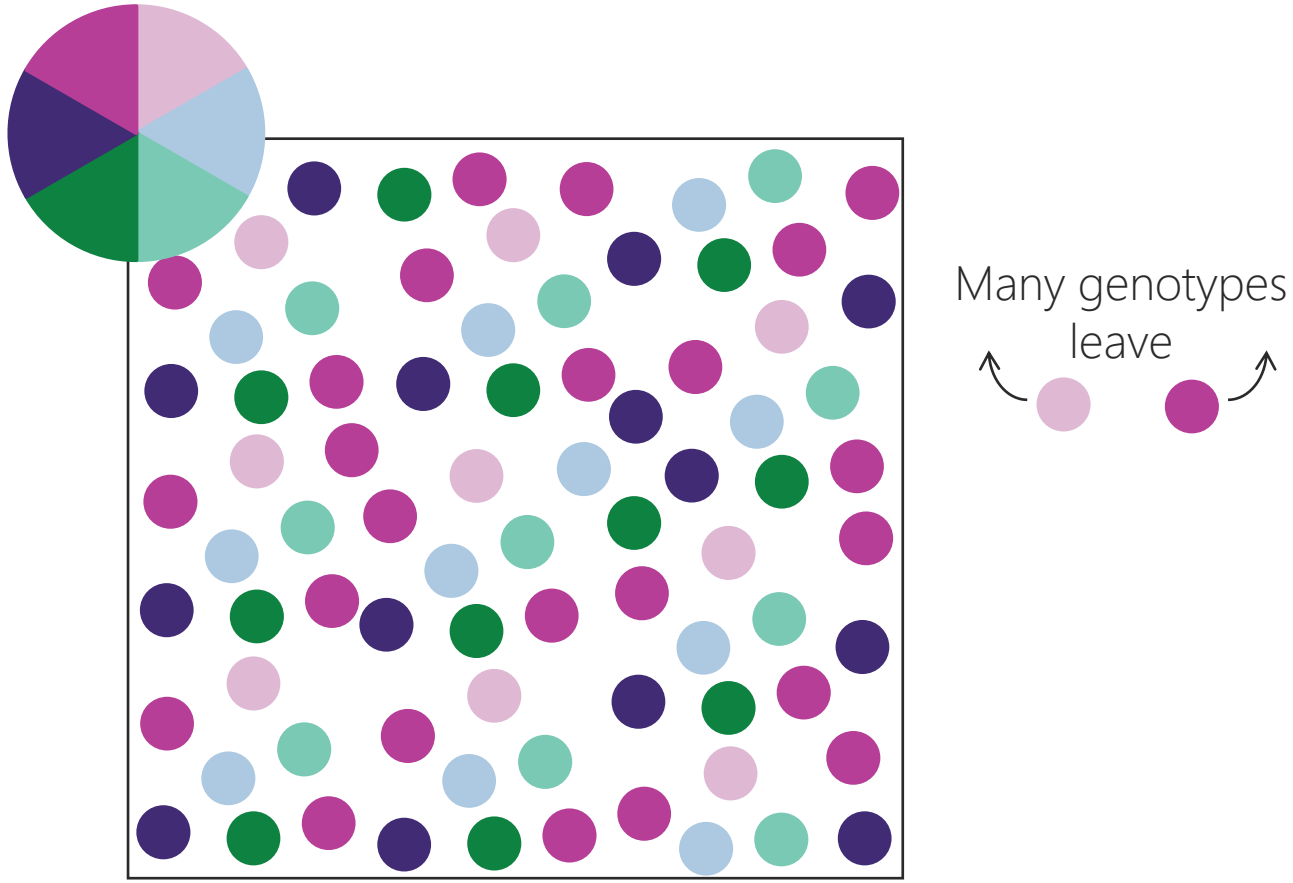


Migration

Migration (gene flow) rapidly reduces differences due to mutation, selection and drift: tends to increase variation within local populations, but reduces differentiation between adjacent populations.



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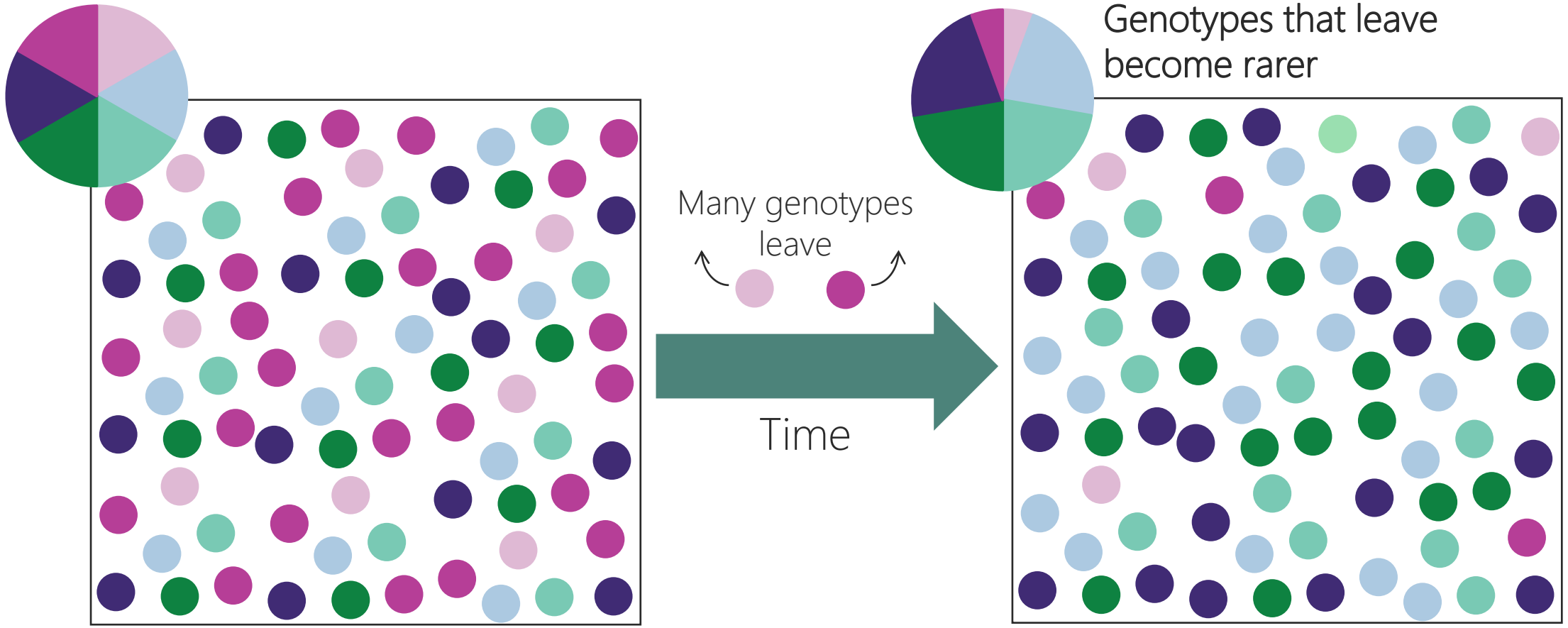
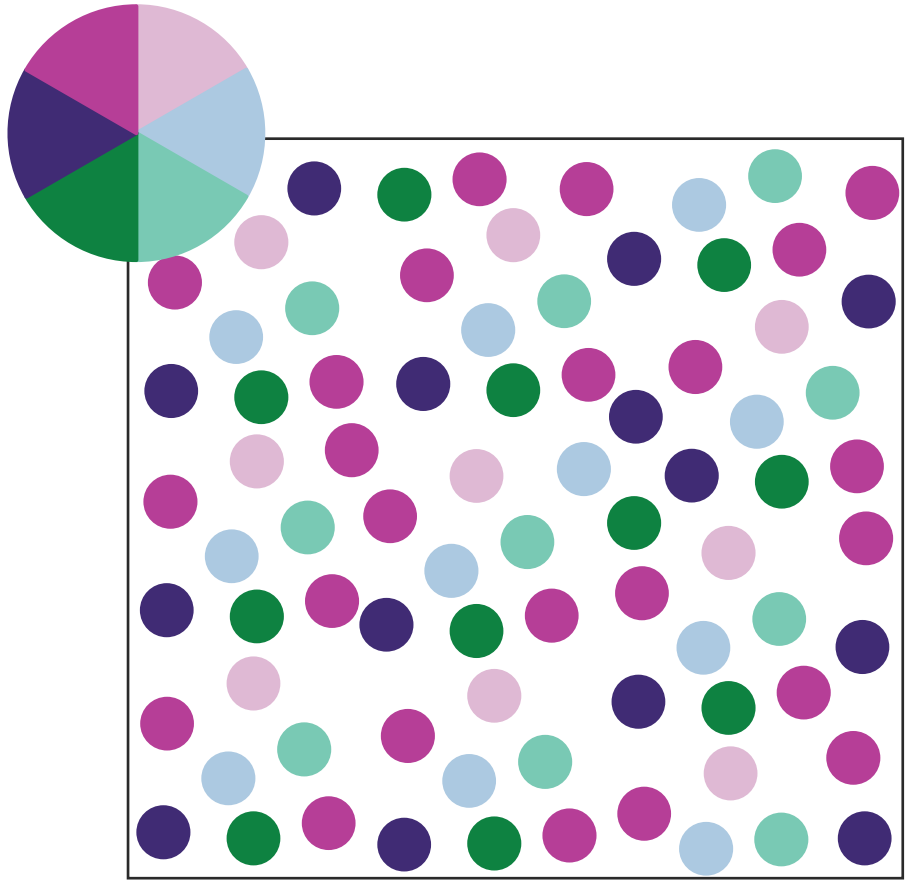


Genetic drift

In small populations, sampling errors can cause random changes in allele frequencies generation after generation (genetic drift): leads to a loss of genetic diversity.



chance event restricts alleles to subset of ancestral population

Genetic drift

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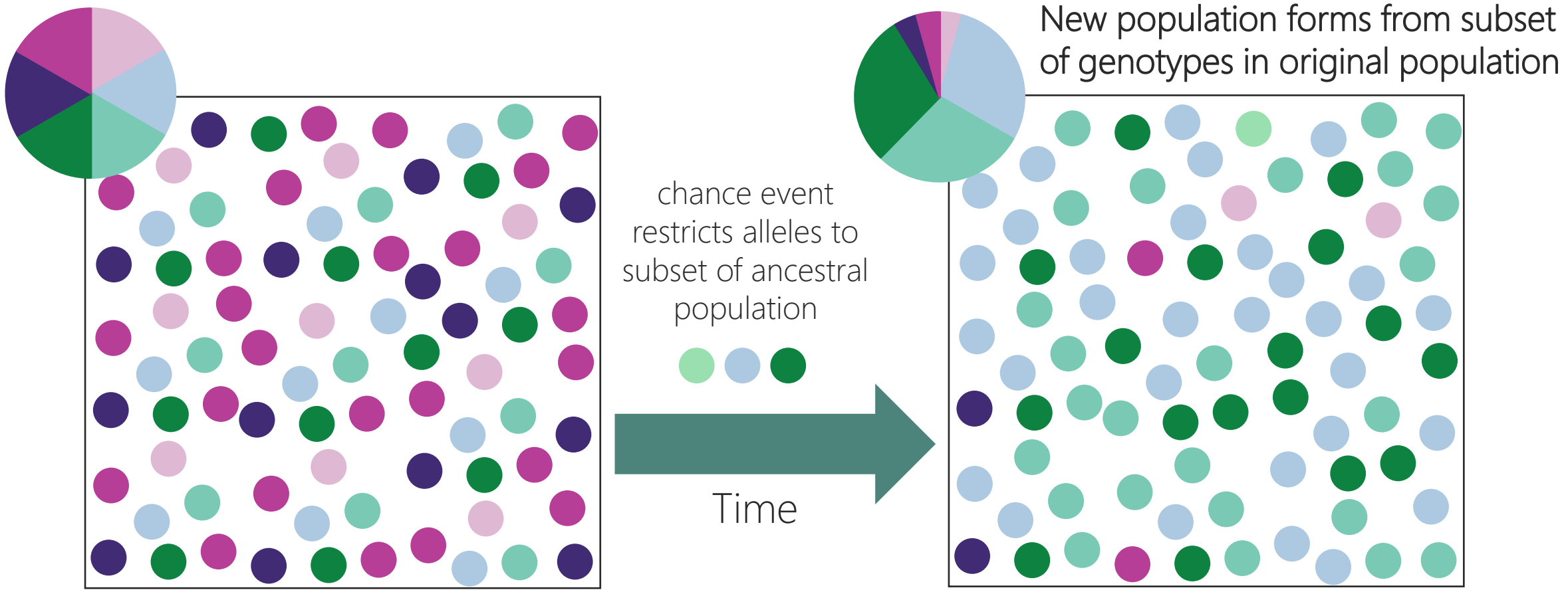
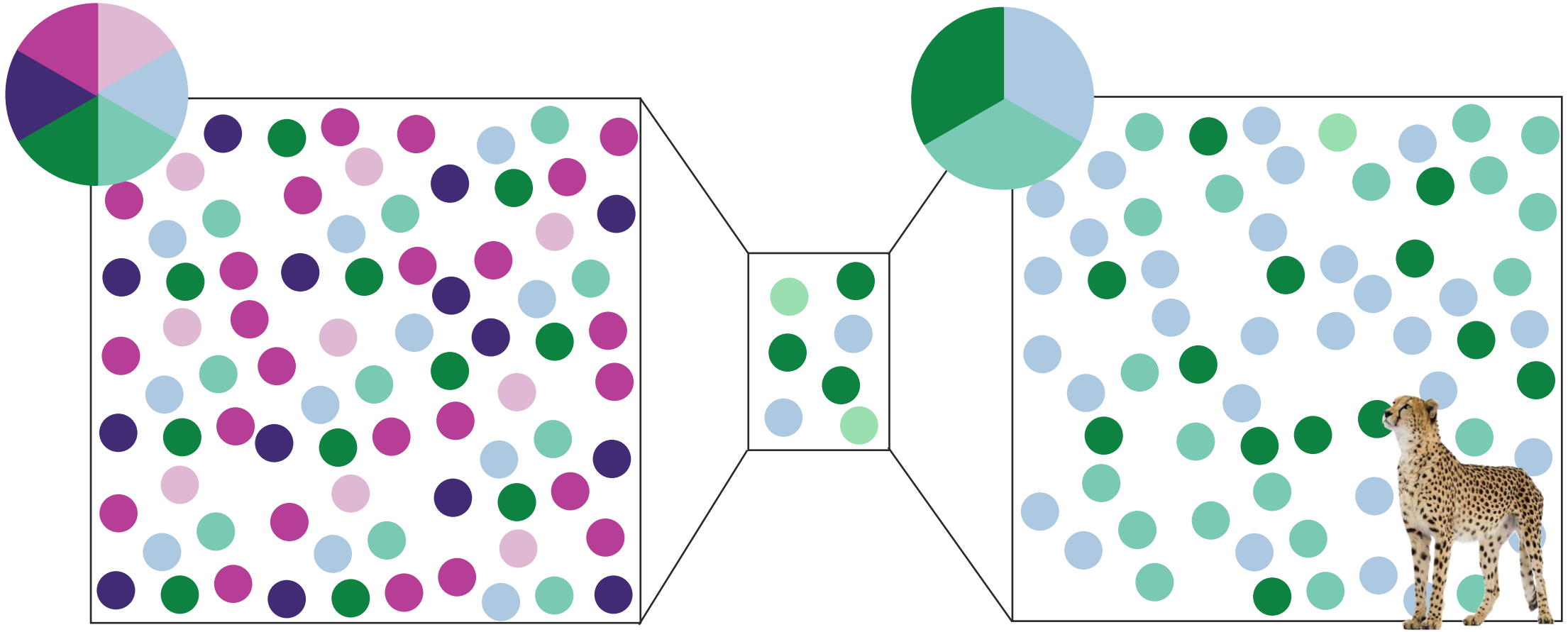


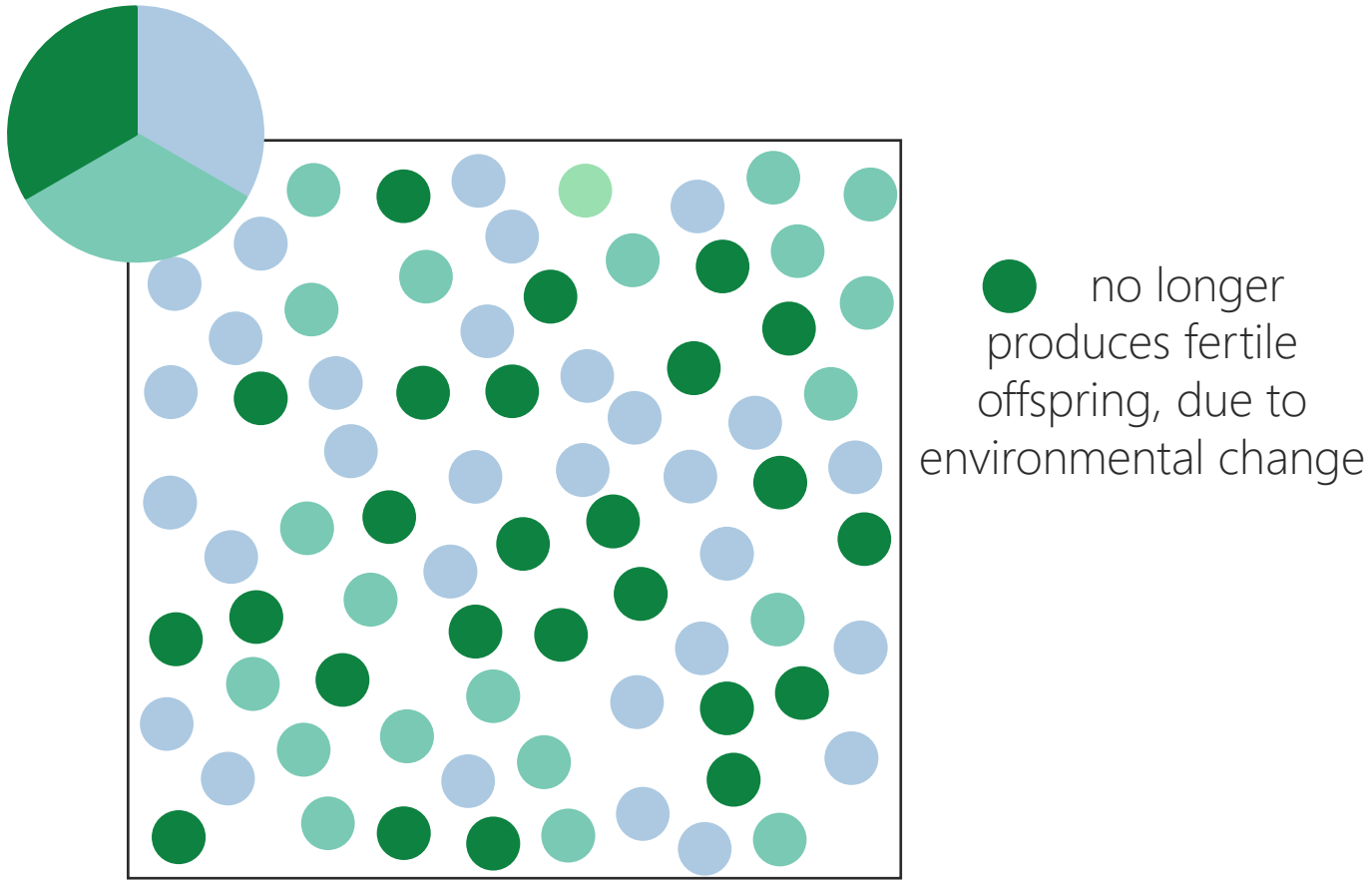
Genetic drift

Examples of genetic drift: founder effect and population bottleneck: a **founder** event occurs when a small group of individuals is separated from the rest of the population, whereas a **bottleneck effect** occurs when most of the population is destroyed.



Natural selection

Natural selection is the only force that causes evolutionary changes that better adapt the populations to their environment: deleterious allele frequency decreases over time.



no longer produces fertile offspring, due to environmental change

Natural selection

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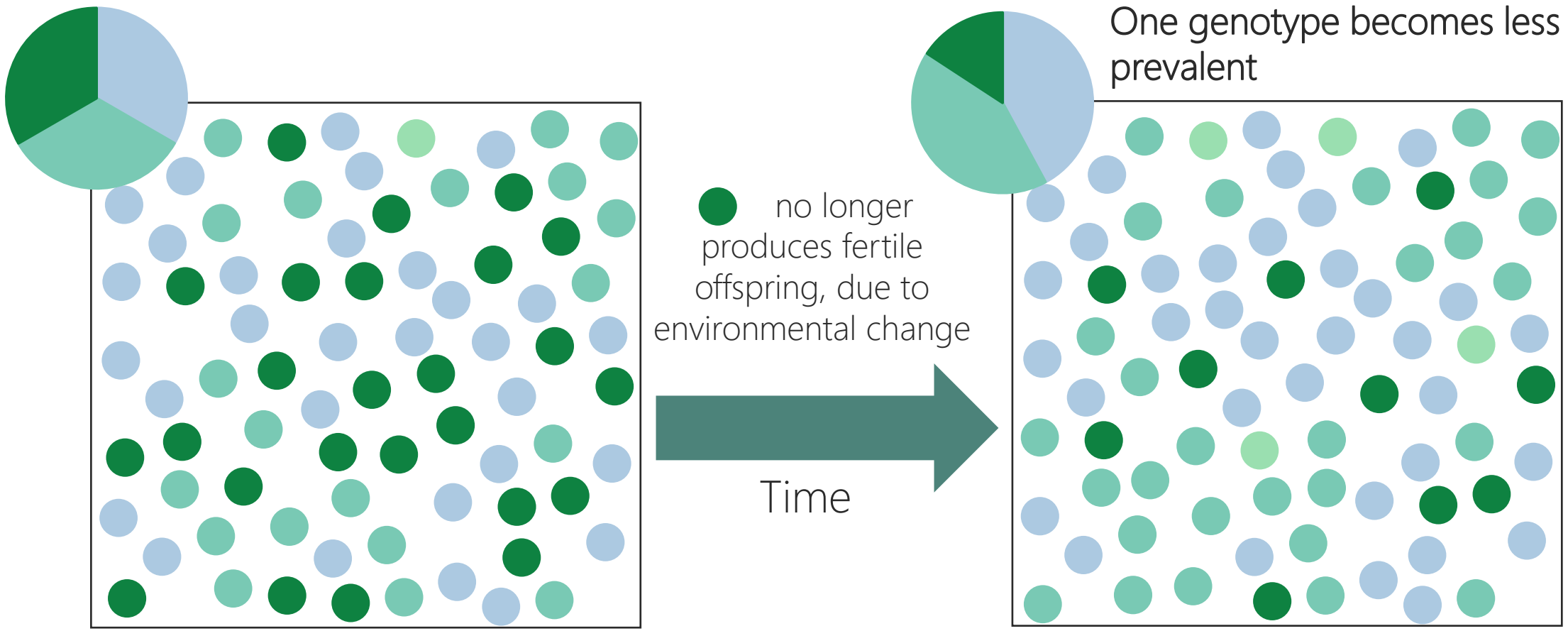
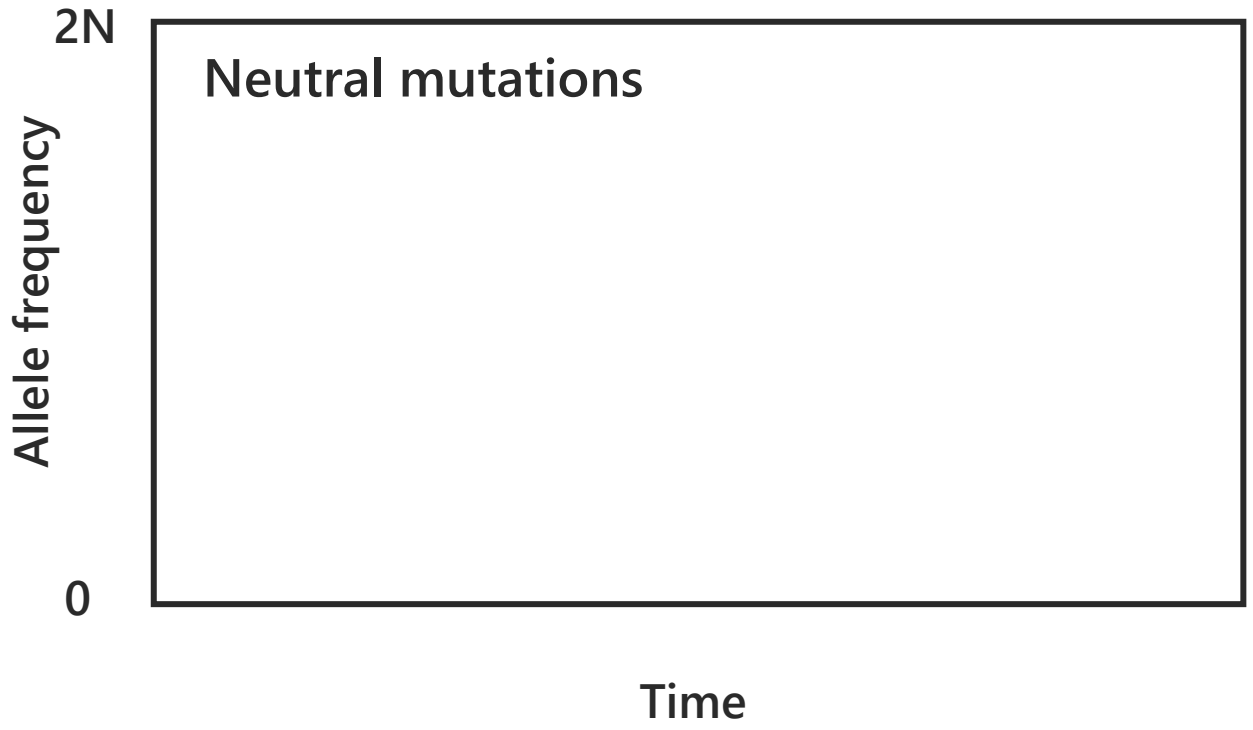
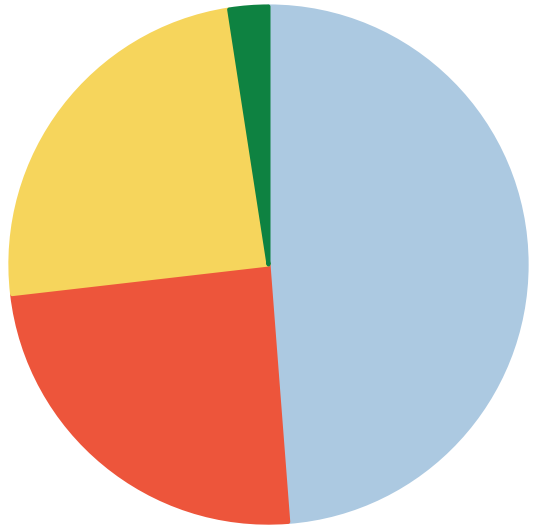


Fate of new mutations

In small populations, new mutations can spread rapidly in the absence of selection and eventually become fixed.





Neutral variation

Mutation-drift balance

Fate of new mutations

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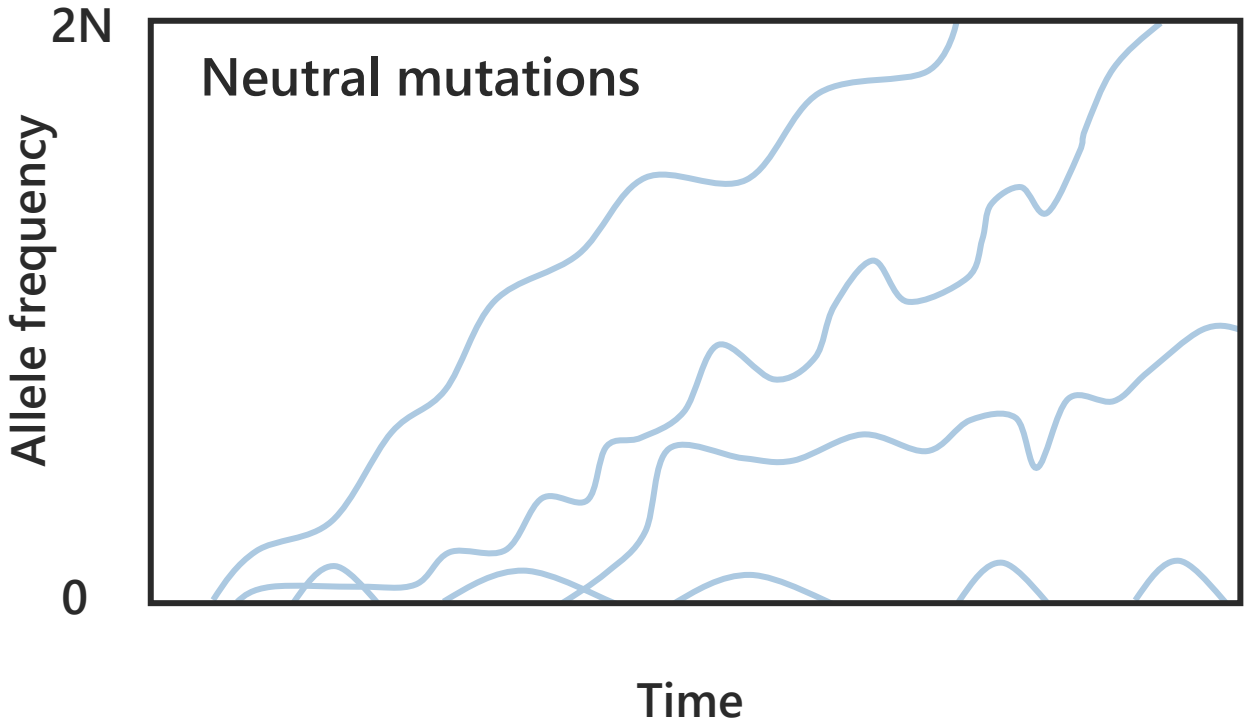

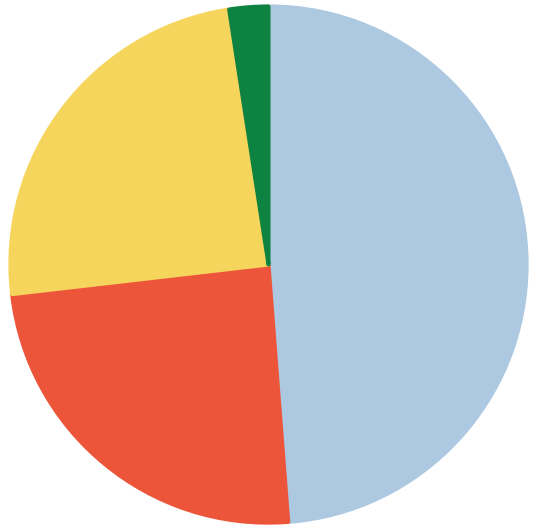

Neutral variation

Mutation-drift balance

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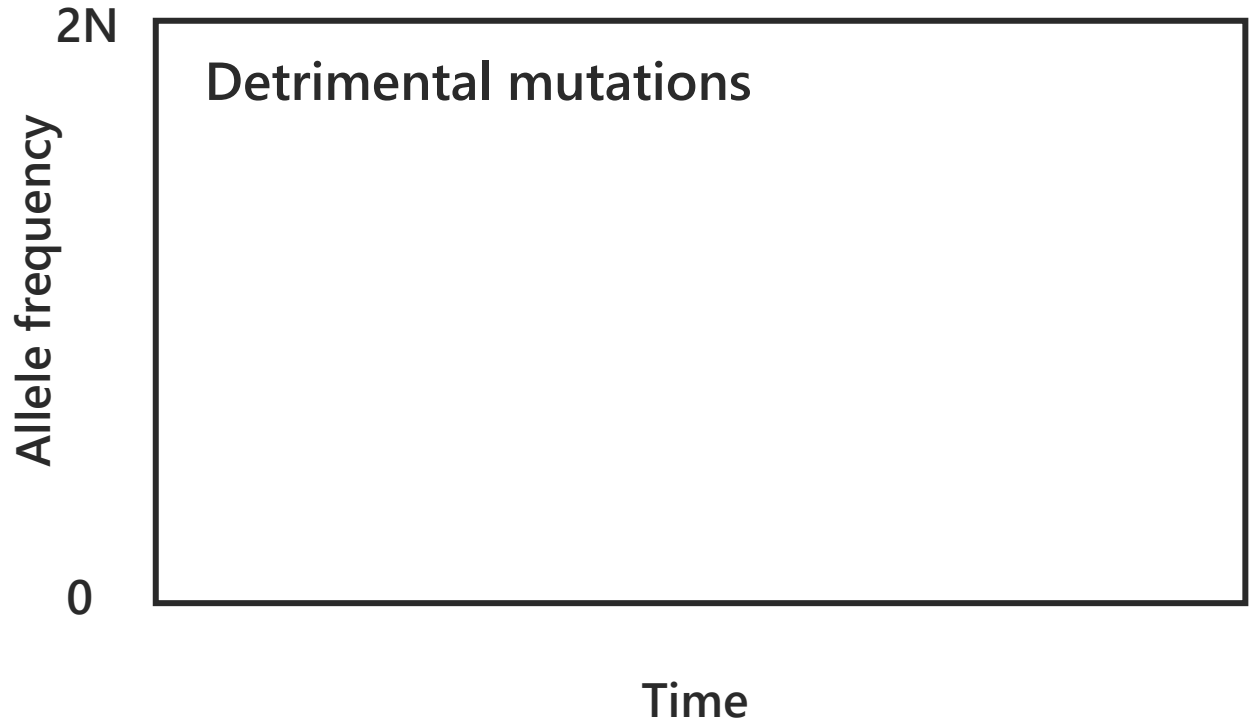
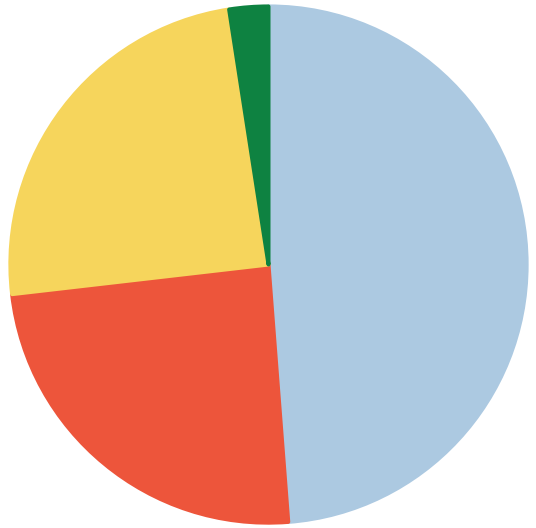
As a result of the action of natural selection, the frequency of a deleterious allele decreases with time. If it is recessive, a deleterious allele can "hide" in the heterozygous individual.





Detrimental mutations

Mutation-selection balance

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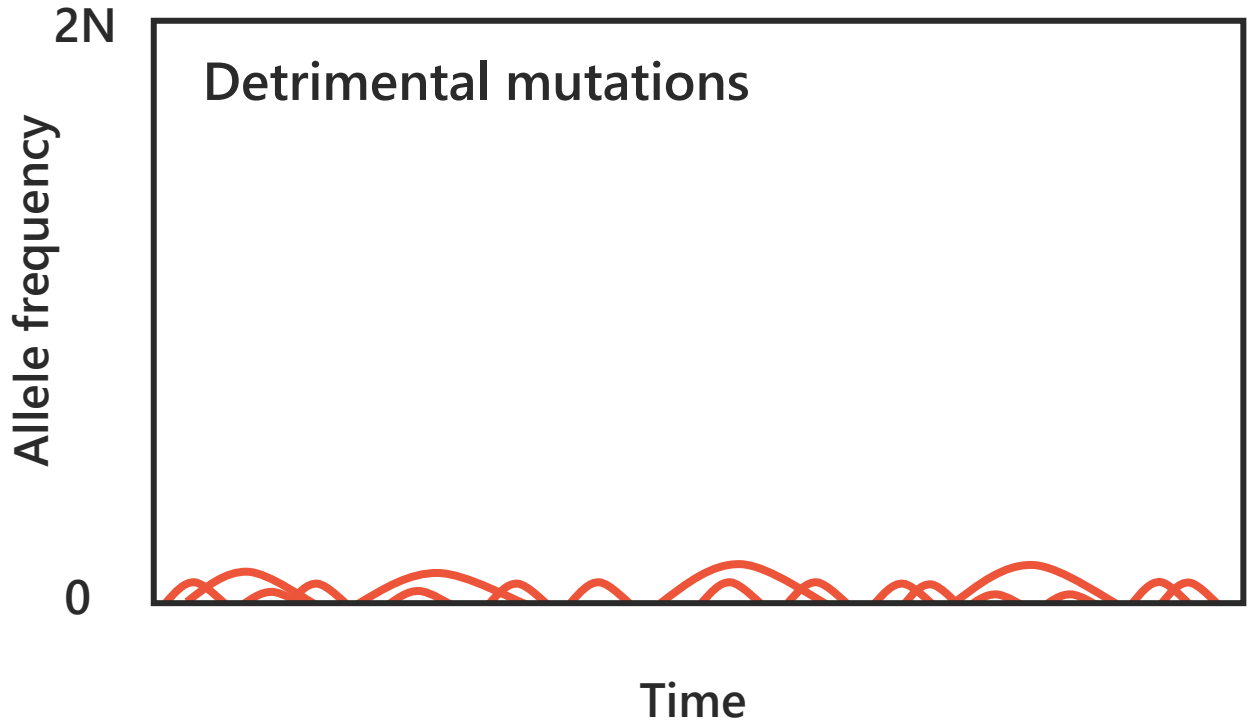
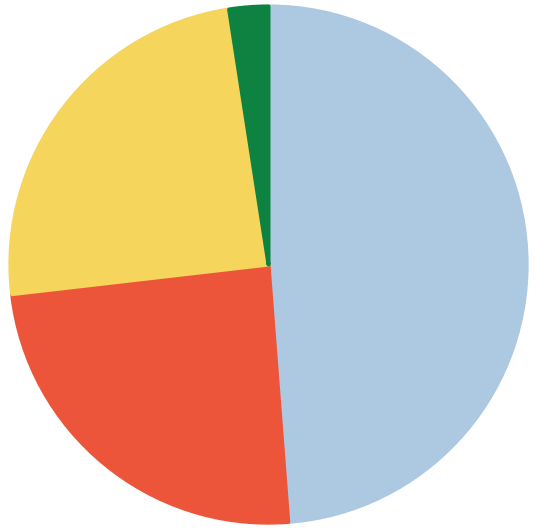


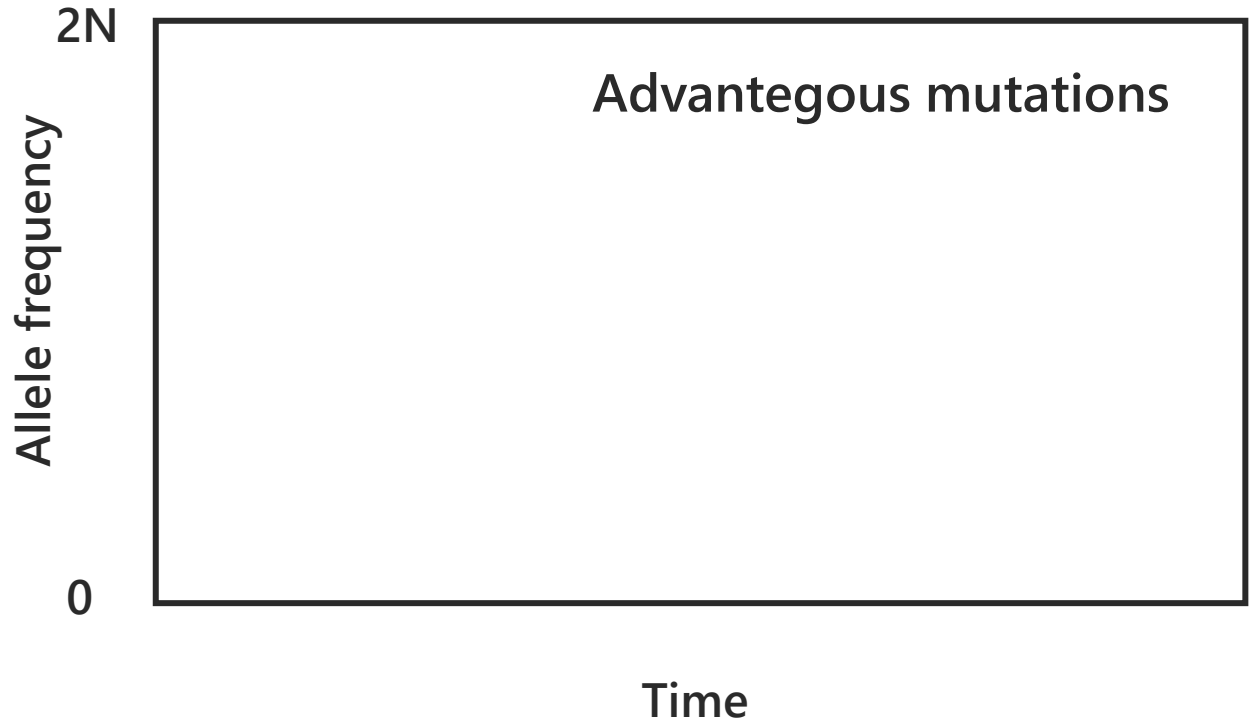


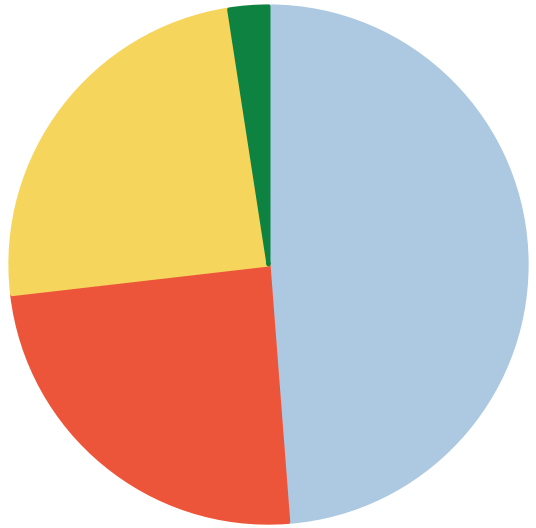
Detrimental mutations

Mutation-selection balance

Fate of new mutations

Natural selection rapidly increase the frequency of advantageous alleles.





Advantegous mutations

Transient polymorphism

Fate of new mutations

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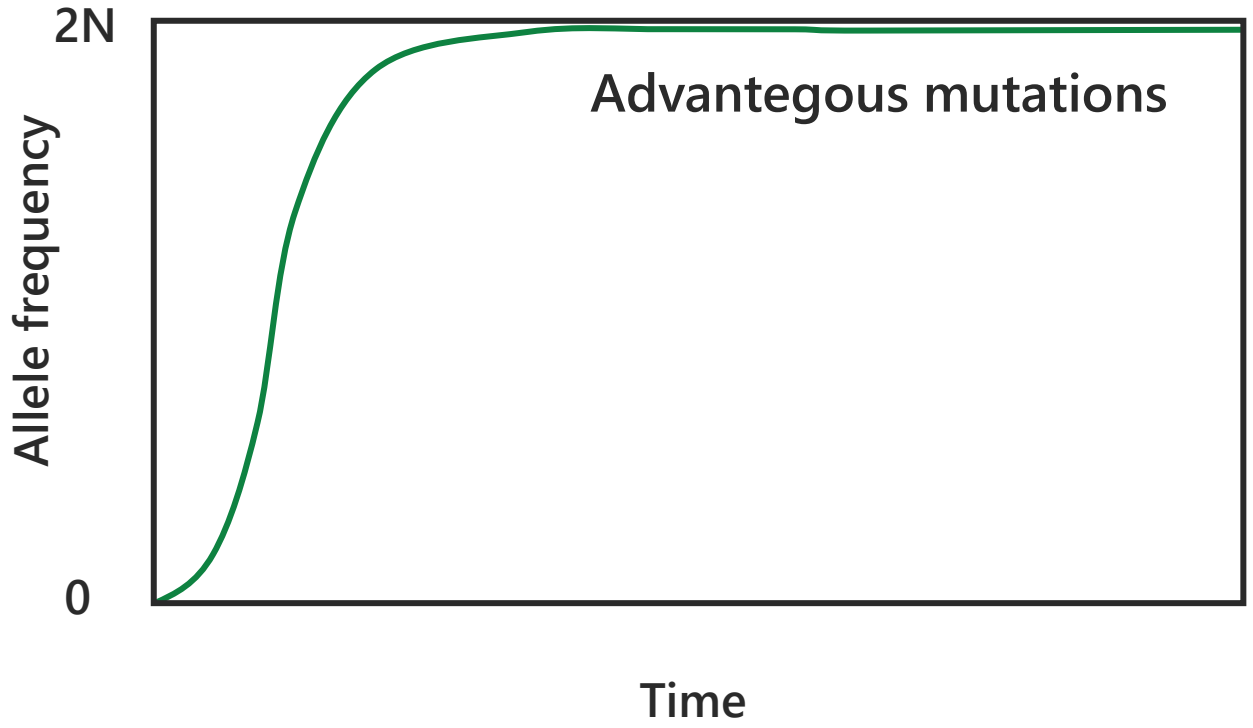
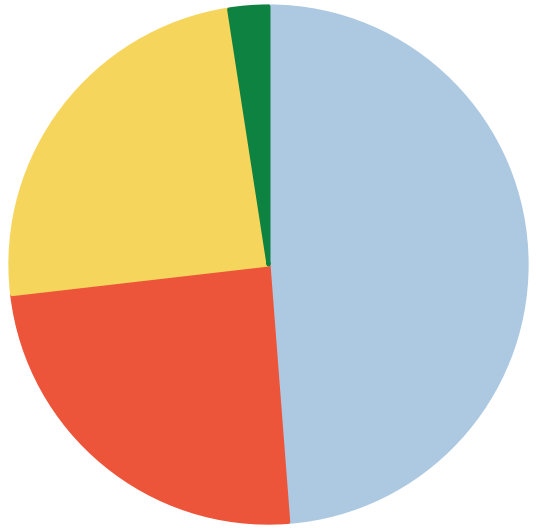


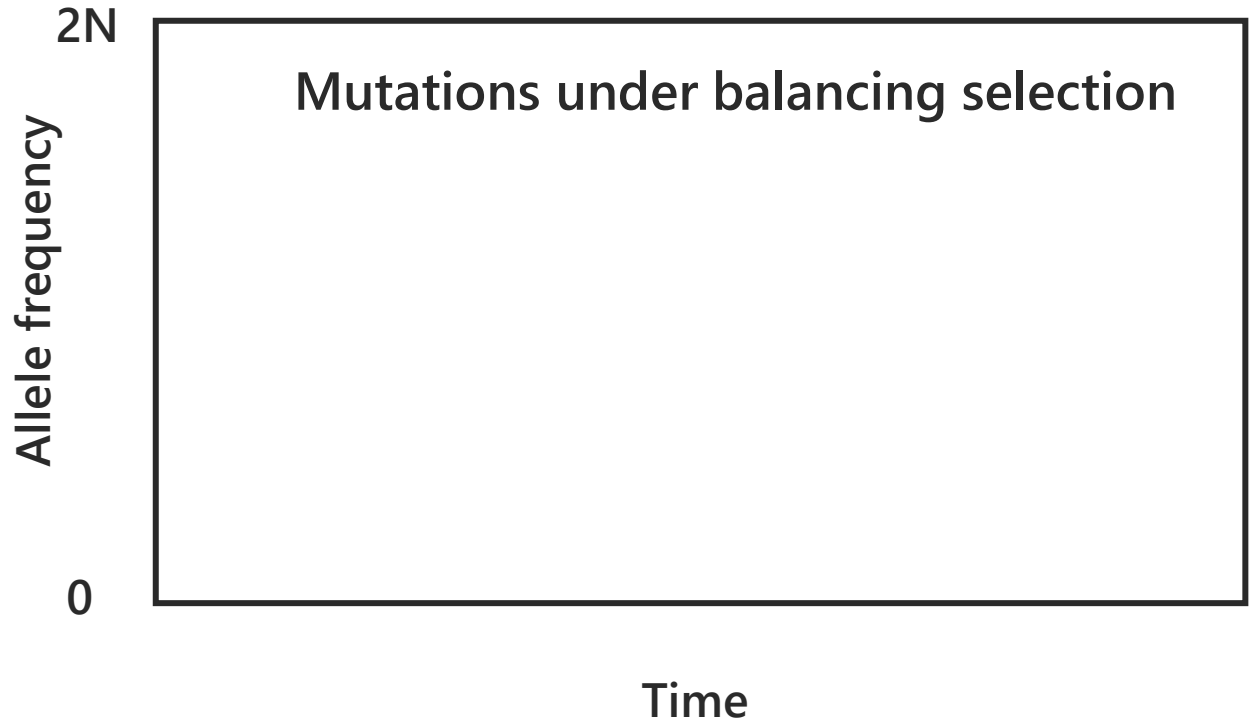


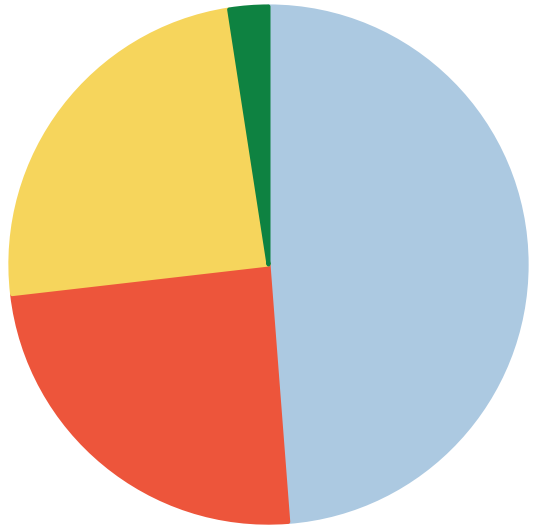
Advantegous mutations

Transient polymorphism

Fate of new mutations

A deleterious can be maintained at a high frequency in the population when the heterozygote is unusually resistant to a specific, usually infectious disease (balanced polymorphism).





Balancing selection

Balanced polymorphism

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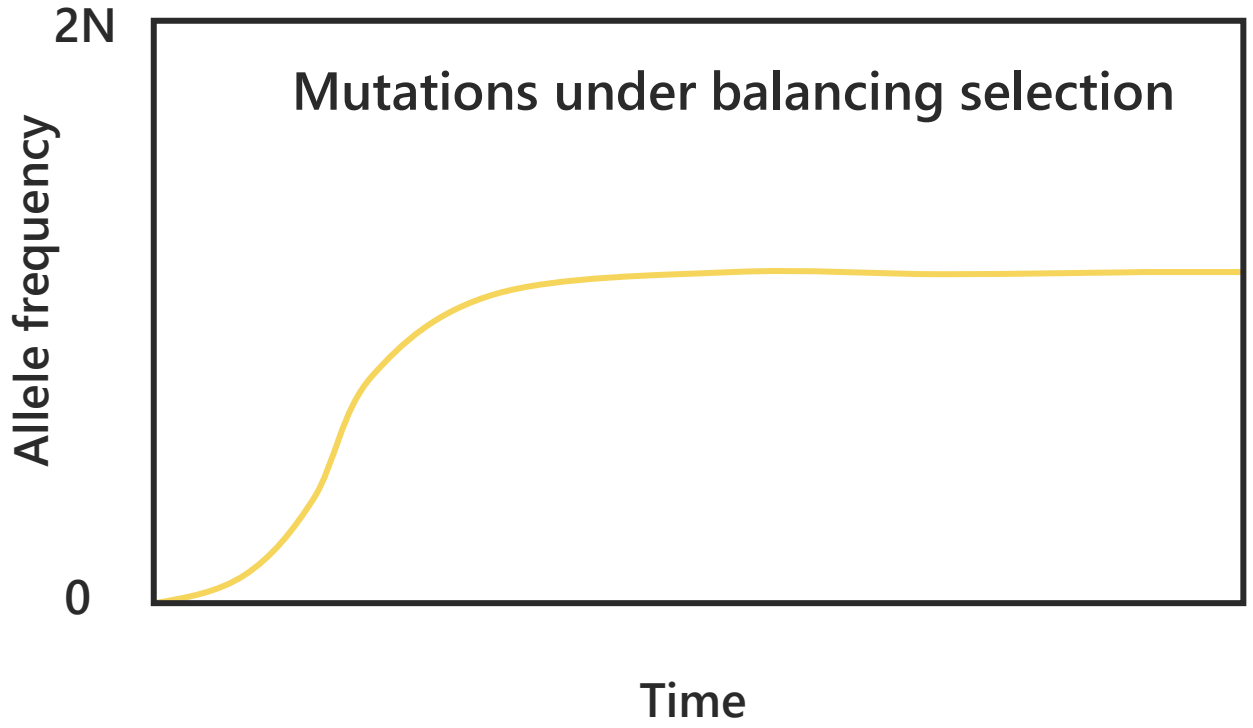
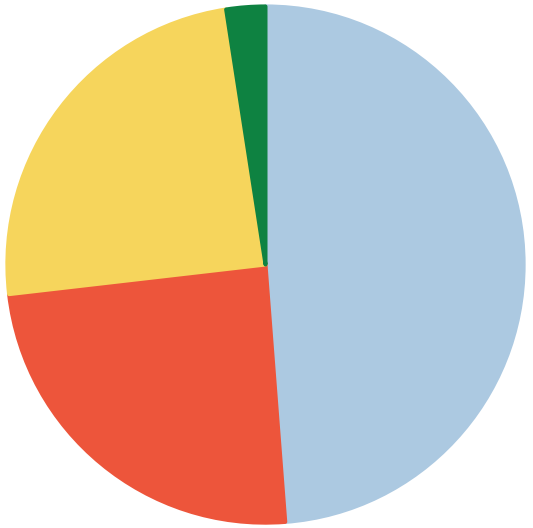




Balancing selection

Balanced polymorphism

Contact information

- Practical sessions:

  Marta Coronado (**Marta.Coronado@uab.cat**)

  Olga Dolgova (**olga.dolgova@crg.es**)

Contact information

- Practical sessions:

  Marta Coronado Zamora (**marta.coronado@csic.es**)

  Olga Dolgova (**olga.dolgova@crg.es**)

- ? Course delegates

Practicals organization

- **Practical 1.** Estimation of genetic variation and testing Hardy-Weinberg equilibrium

  Estimation of genetic variation from allozymic and nucleotide data and testing Hardy-Weinberg equilibrium.

- **Practical 2.** Simulation of genetic drift and mutation

  Inferring the effect of genetic drift and mutation on the temporal dynamic of genetic variation by simulations.

- **Practical 3.** Simulation of genetic drift and natural selection

  Describing allele frequencies trajectories under the general viability selection model. Simulation of diploid selection with drift.

- **Practical 4.** Revising short population genetics problems + mid term exam

  Revision of population genetics problems and testing your knowledge.

Work in class

Deliver in Aul@

1 week submission

Short problems

- **Short problems on Hardy-Weinberg** (10 problems)
- **Short problems on genetic drift and mutation** (10 problems)
- **Short problems on migration, natural selection and neutral theory** (10 problems)

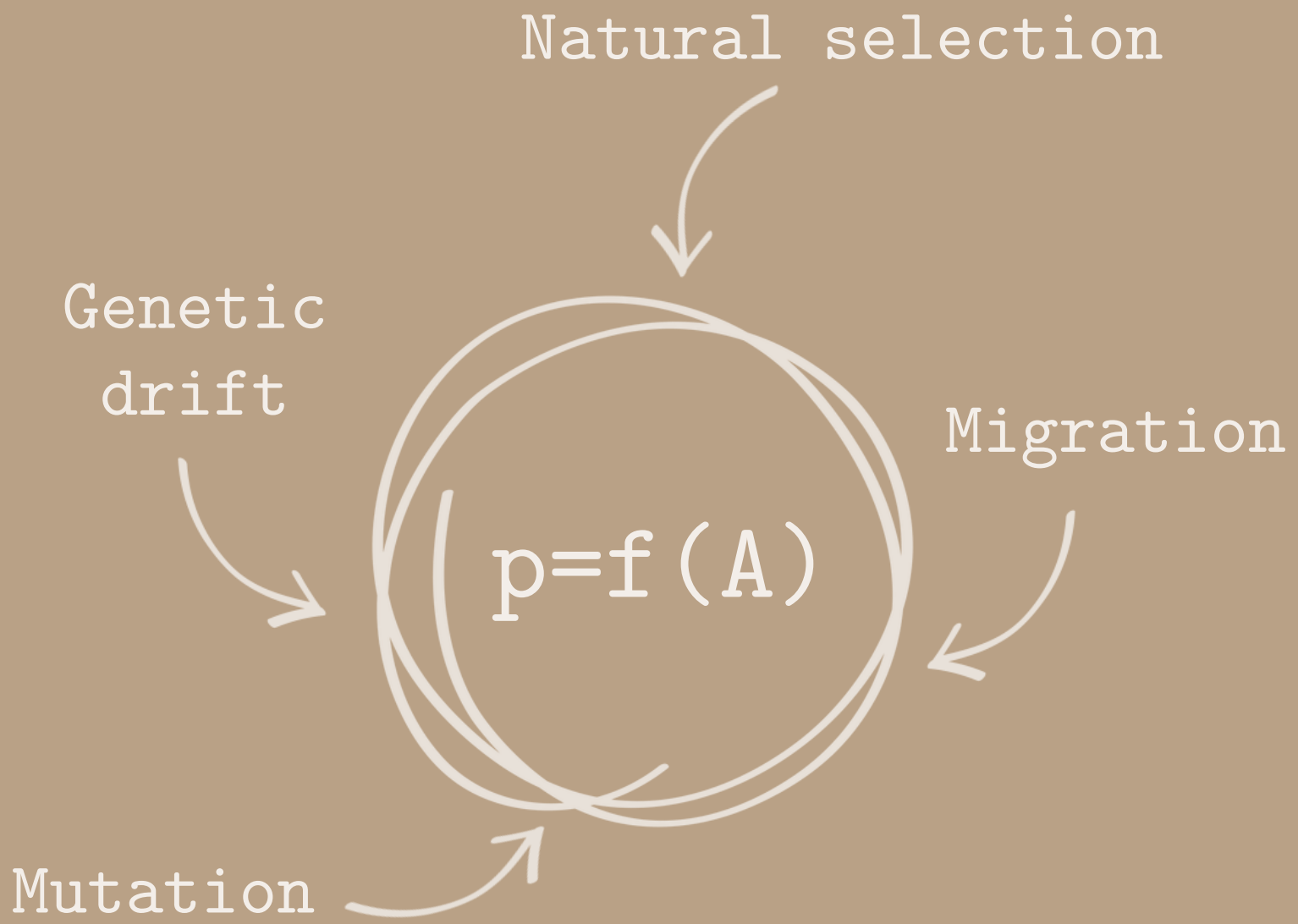
They are solved applying the formulas that you'll learn in theoretical class. Three of them will be solved in practical class. Grading just for trying solving them.

If you are stuck in a problem: contact us! Or use the Forum so other colleagues can benefit

Work at home

Deliver in Aul@

Revision in class



Part 1

Study of the main forces that modulate evolution