POPULACIONA GENETIKA

Populaciona genetika

- genetička struktura populacije

Populaciona genetika

- **genetička struktura populacije**

grupa jedinki iste vrste koje su reproduktivno povezane

Populaciona genetika

- **genetička struktura populacije**
  - aleli
  - genotipovi

grupa jedinki iste vrste koje su reproduktivno povezane

Determiniše potencijal za evolutivne promene i adaptacije

Opisivanje genetičke strukture

- **frekvenca genotipova**
- **frekvenca alela**

rr = beli

Rr = pink

RR = crveni

Opisivanje genetičke strukture

- **frekvenca genotipova**
- **frekvenca alela**

200 beli

500 pink

300 crveni

ukupno = 1000 cvetova

frekvenca genotipova:

200/1000 = 0.2 rr

500/1000 = 0.5 Rr

300/1000 = 0.3 RR

Opisivanje genetičke strukture

- frekvenca genotipova
- **frekvenca alela**

200 rr = 400 r

500 Rr = 500 r
500 R

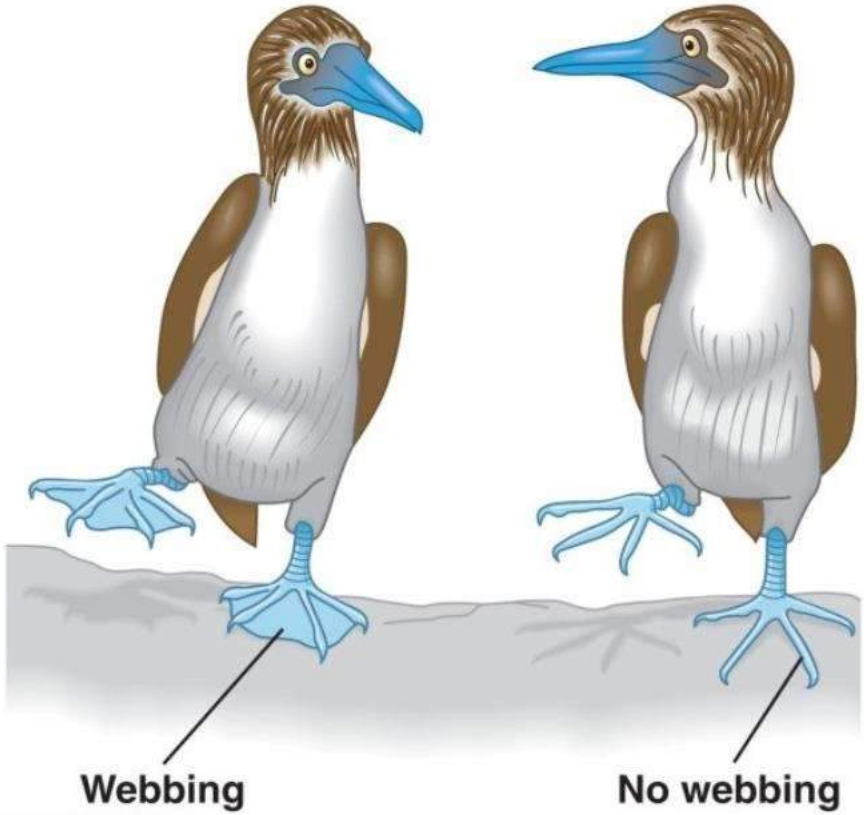
300 RR = 600 R

ukupno = 2000 alela

frekvenca alela:

900/2000 = 0.45 r

1100/2000 = 0.55 R



Phenotypes			
Genotypes	*WW*	*Ww*	*ww*
Number of animals (total = 500)	320	160	20
Genotype frequencies	$\frac{320}{500} = 0.64$	$\frac{160}{500} = 0.32$	$\frac{20}{500} = 0.04$

Number of alleles in gene pool (total = 1,000)

640 *W* | 160 *W* + 160 *w* | 40 *w*

Allele frequencies	$\frac{800}{1,000} = 0.8\ W$	$\frac{200}{1,000} = 0.2\ w$

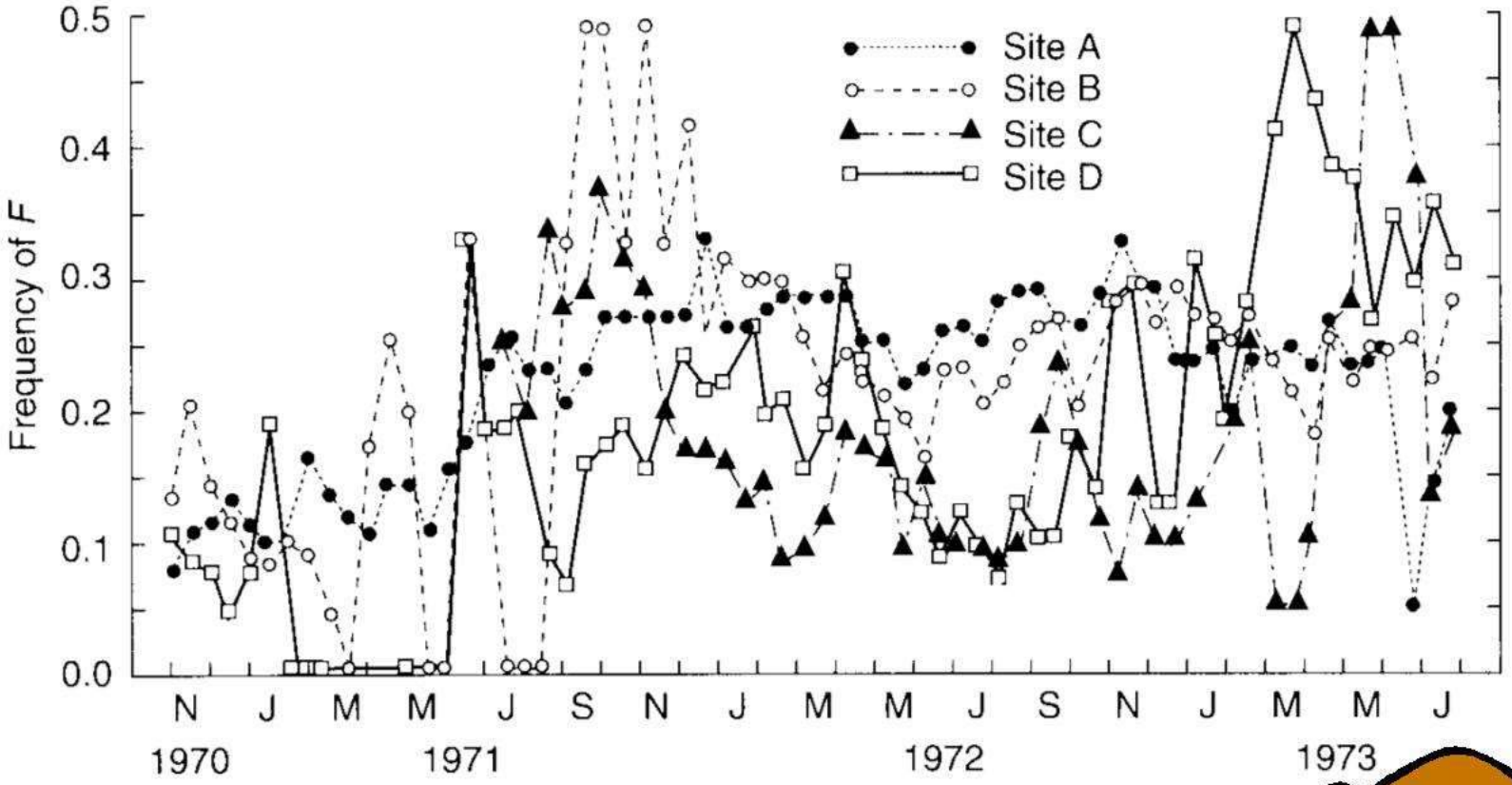
Populaciona genetika

- ✓ Šta je populaciona genetika?
- ✓ Opisivanje
  - frekvenca genotipova
  - frekvenca alela

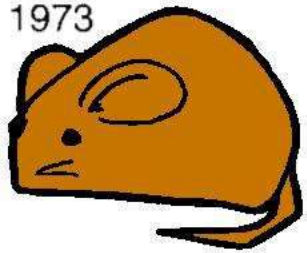
Zašto je bitna genetička varijabilnost?

Kako se menja genetička struktura?

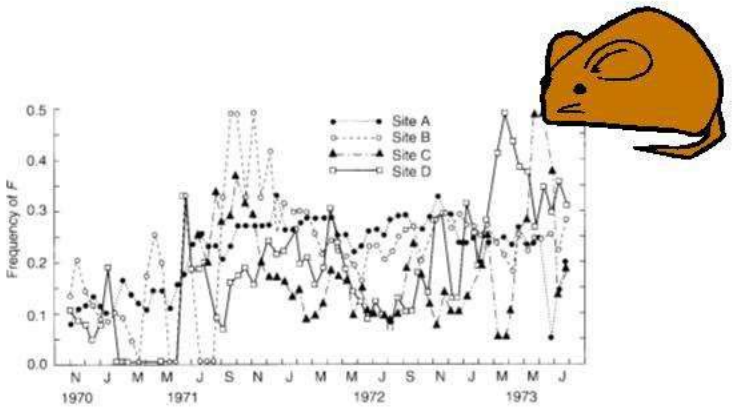
Genetička varijabilnost u prostoru i vremenu



Promene u frekvenci alela F na ***Lap*** lokusu kroz 20 generacija



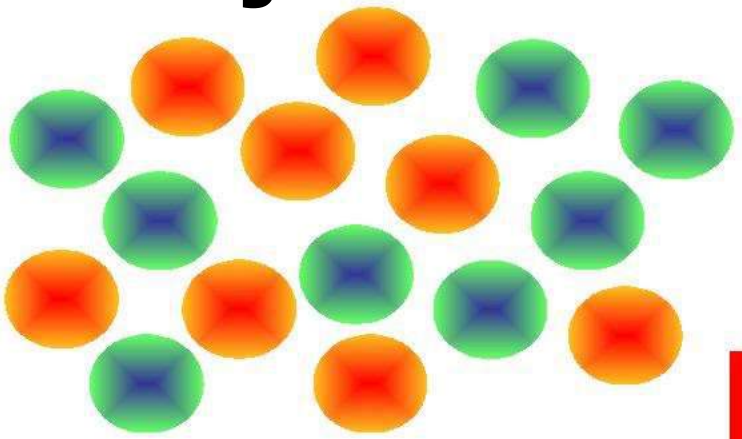
Genetička varijabilnost u prostoru i vremenu



Potencijal promena genetičke strukture

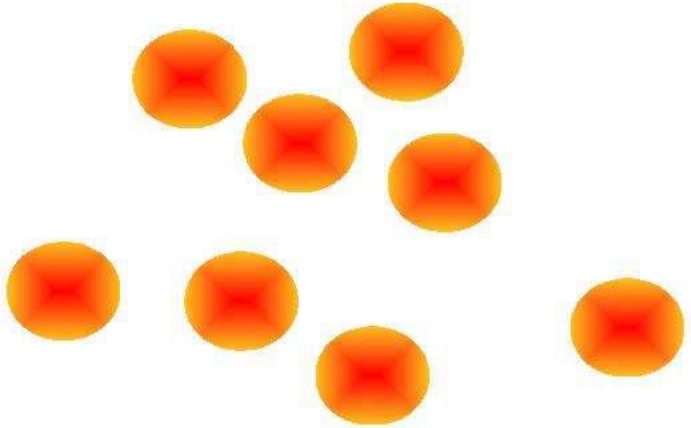
- adaptacije na promene spoljašnje sredine - konzervacija
- divergencija populacija - biodiverzitet

Zašto je bitna genetička varijabilnost?

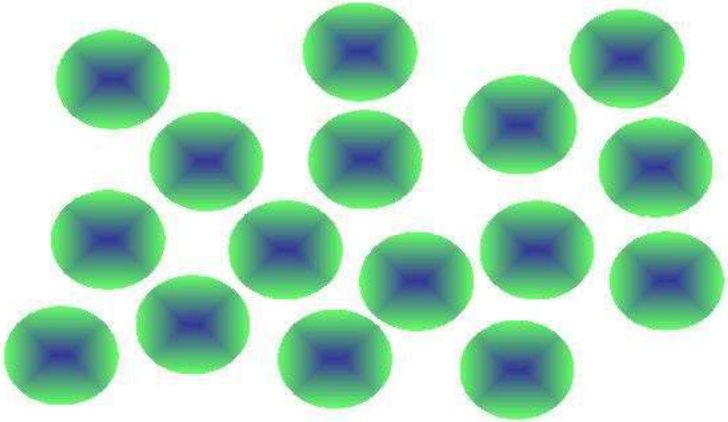


varijabilnost

Promena životne sredine



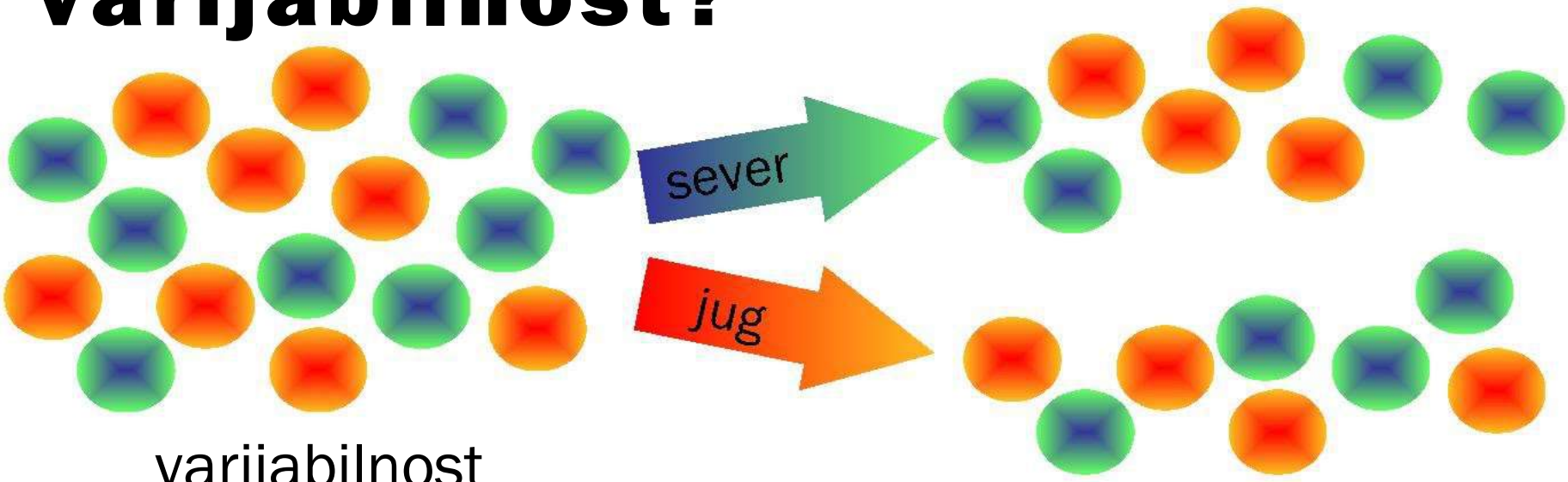
opstanak



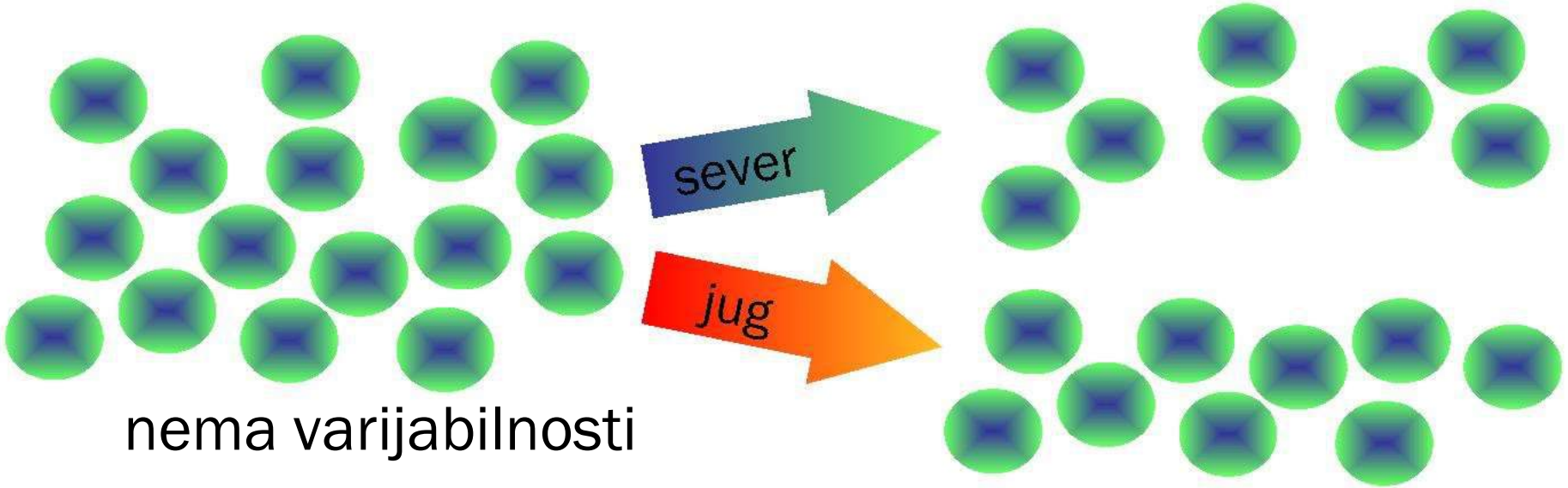
nema varijabilnosti

IZUMIRANJE!!

Zašto je bitna genetička varijabilnost?

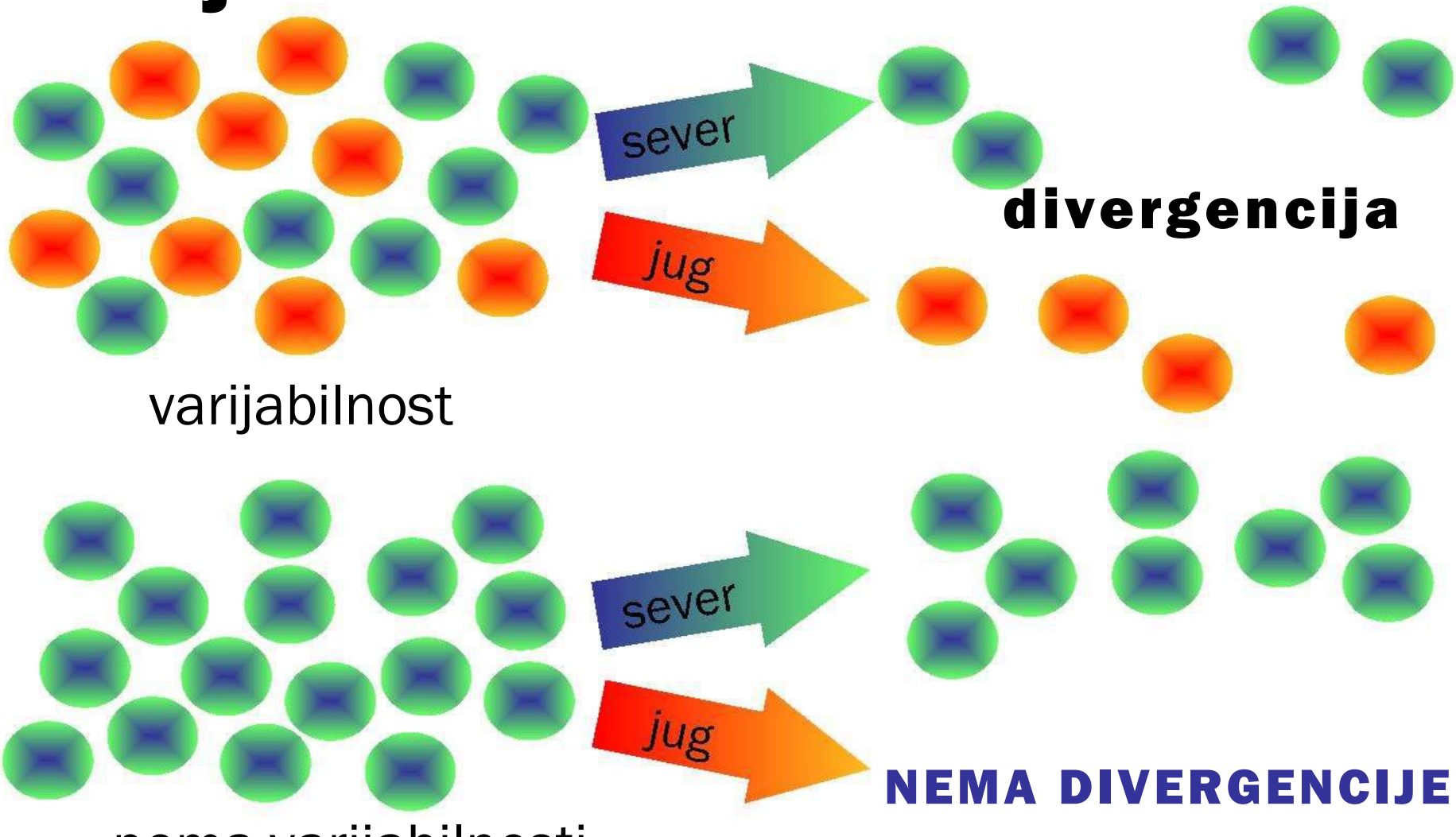


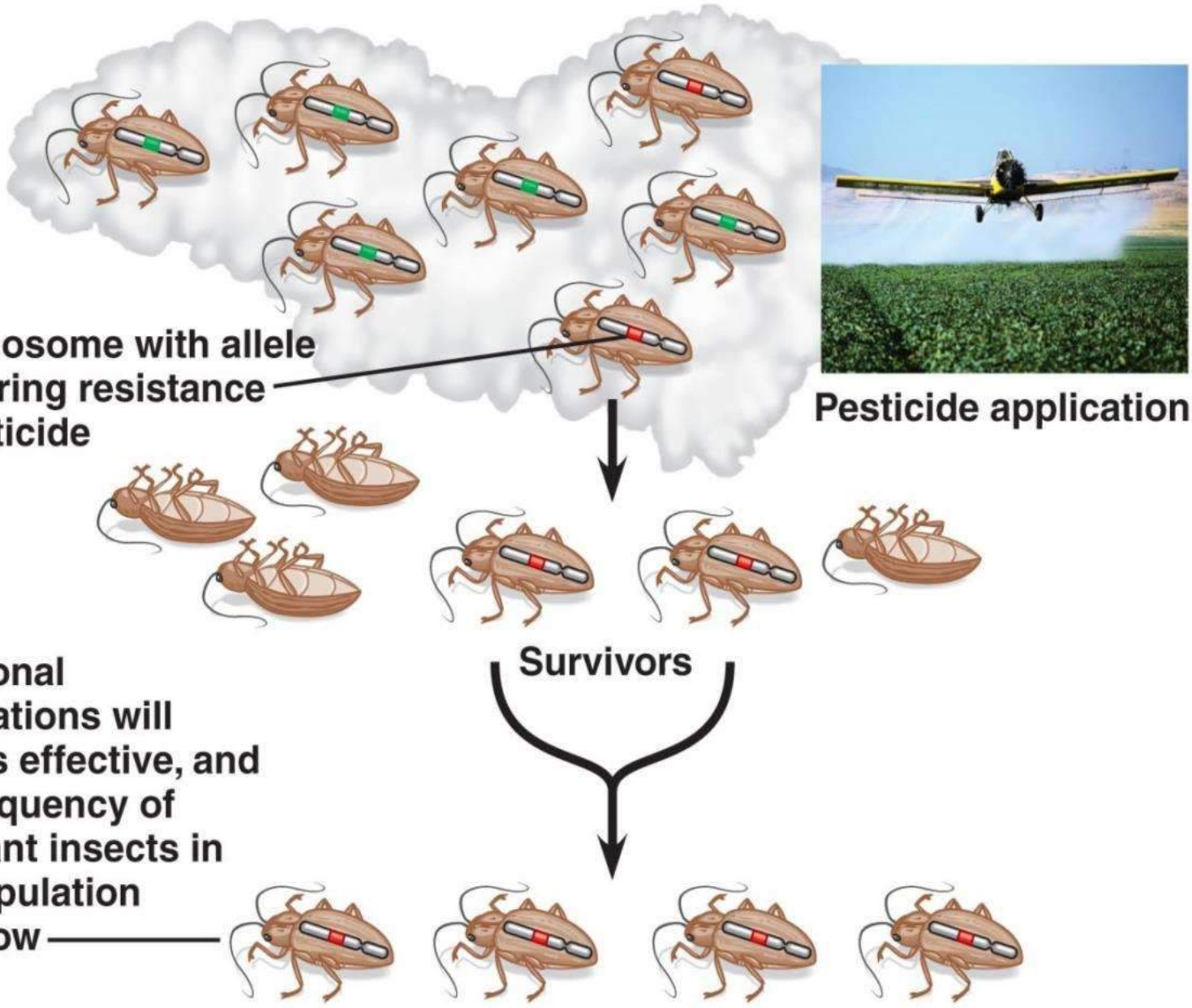
varijabilnost



nema varijabilnosti

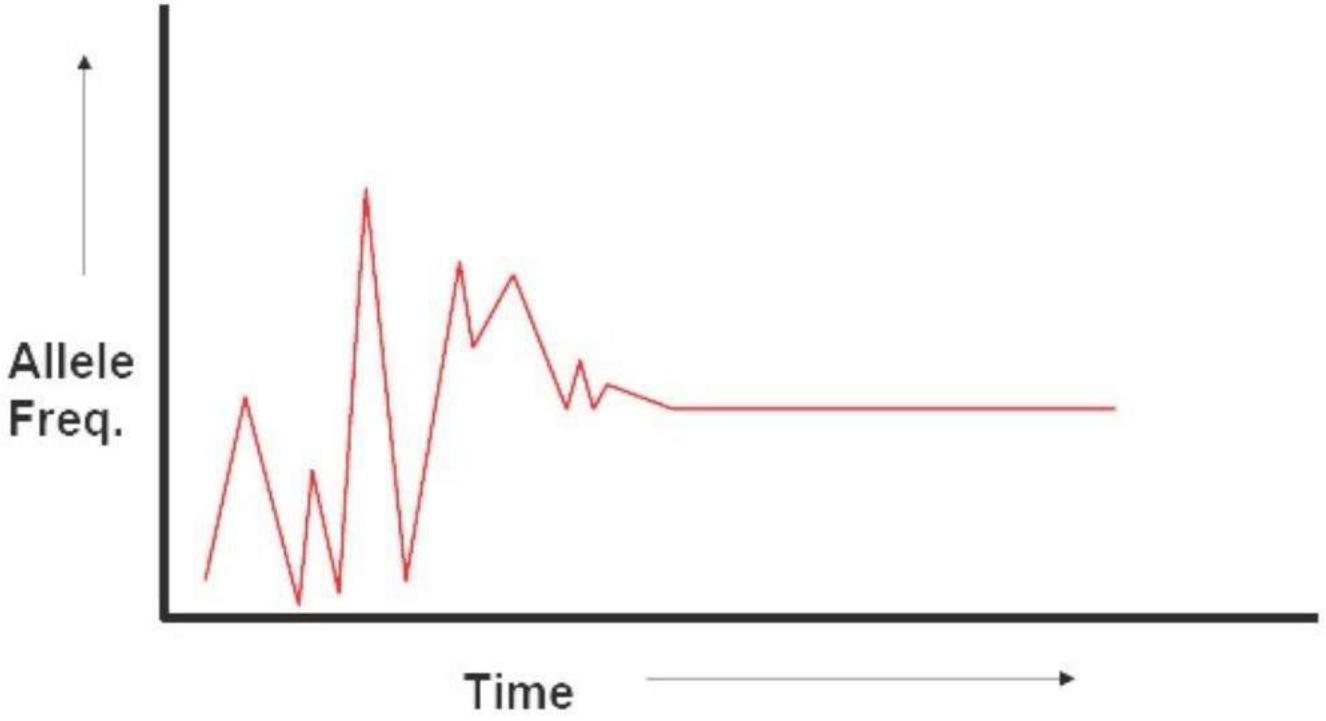
Zašto je bitna genetička varijabilnost?





Kako se genetička struktura menja?

promene u alelskim frekvencama i/ili frekvencama genotipova kroz vreme



Kako se genetička struktura menja?

promene u alelskim frekvencama i/ili frekvencama genotipova kroz vreme

- mutacije
- migracije
- prirodna selekcija
- genetički drift
- neslučajno ukrštanje

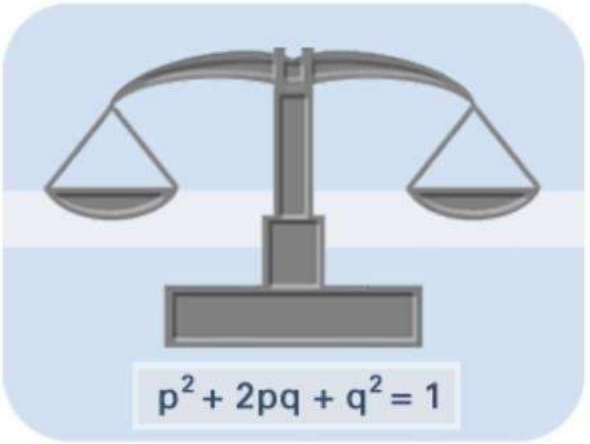
Idealna populacija?!?

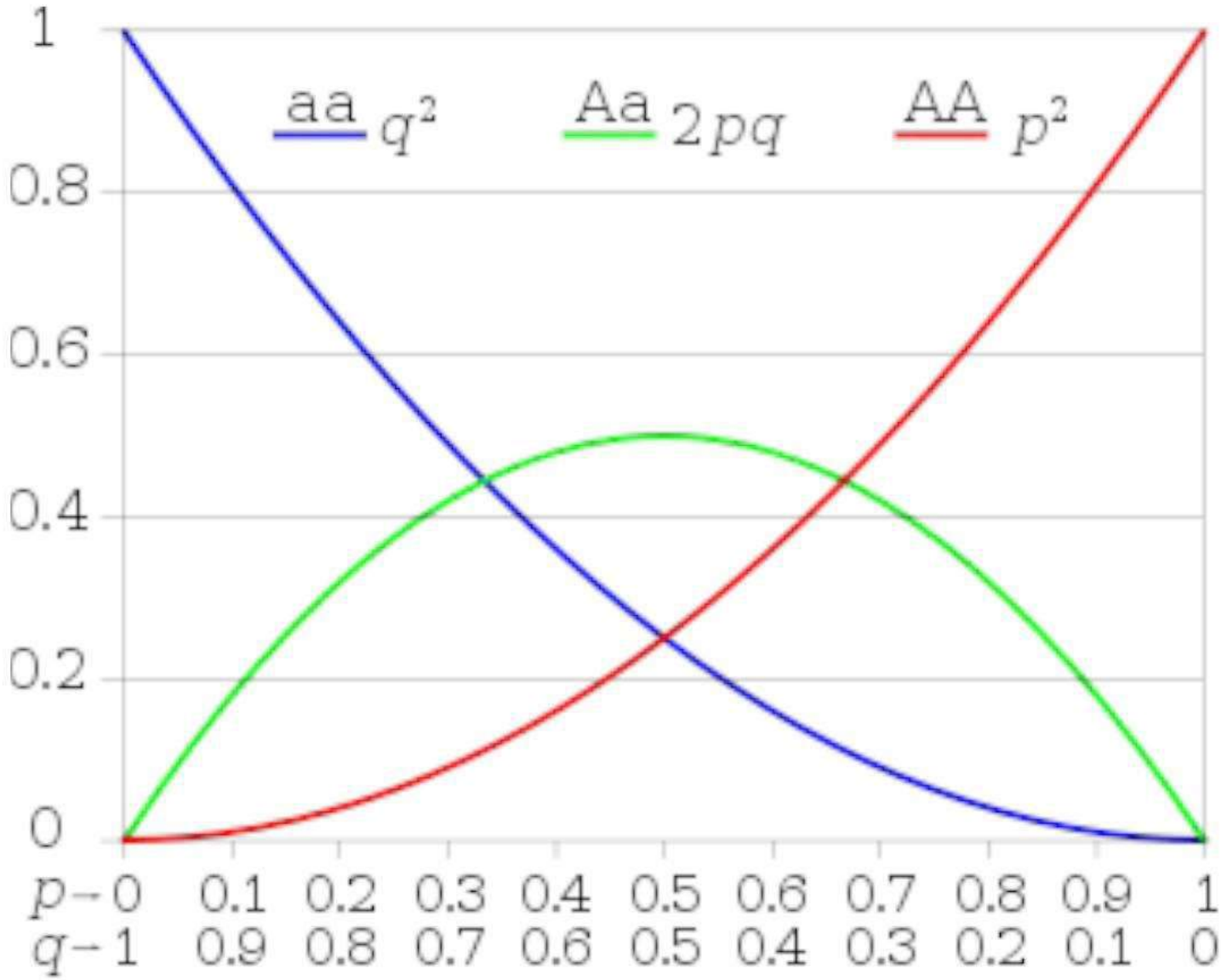
- mutacije
- migracije
- prirodna selekcija
- genetički drift
- neslučajno ukrštanje

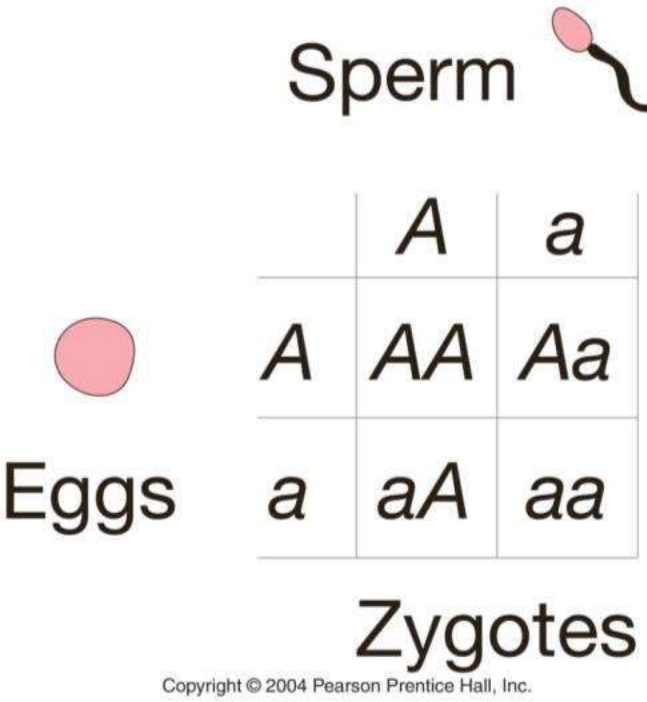
Hardi-Vajnbergov zakon

Hardi-Vajnbergov princip i ravnoteža

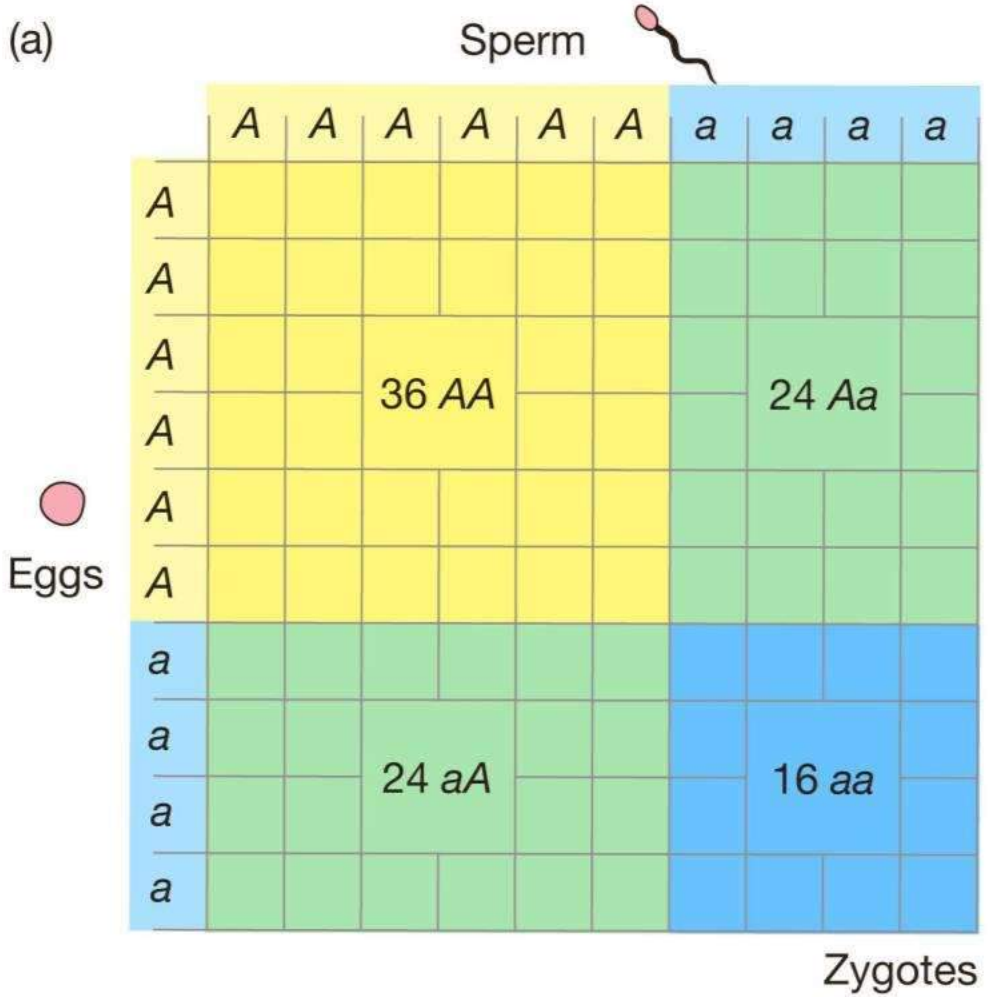
ako je poznata učestalost
alela moguće je odrediti
učestalost genotipova




1
0.8
0.6
0.4
0.2
0
aa q^2
Aa $2pq$
AA p^2
p – 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
q – 1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0



Single cross



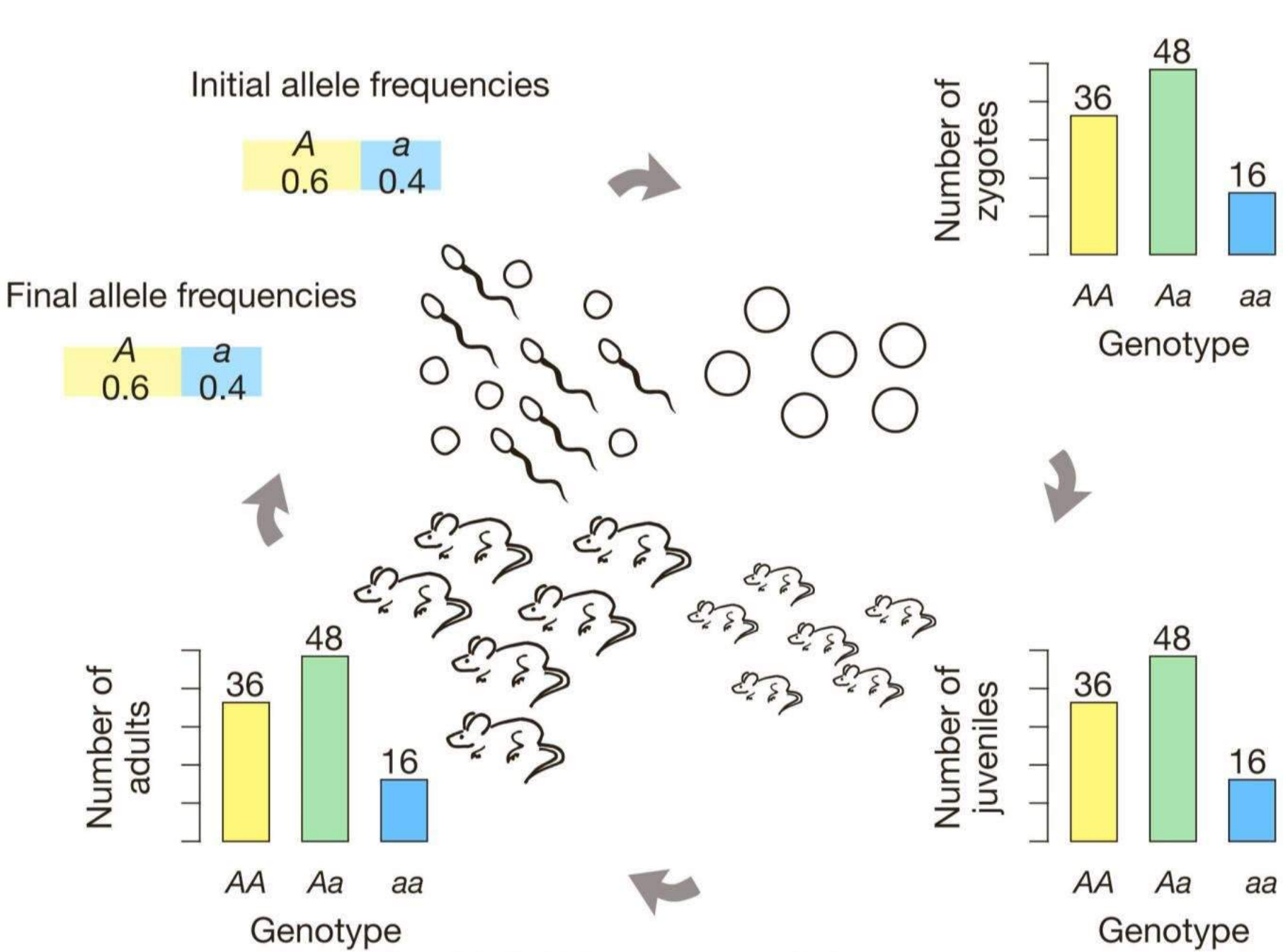
Population level

AA		Aa		aa		Total
36	+	48	+	16	=	100

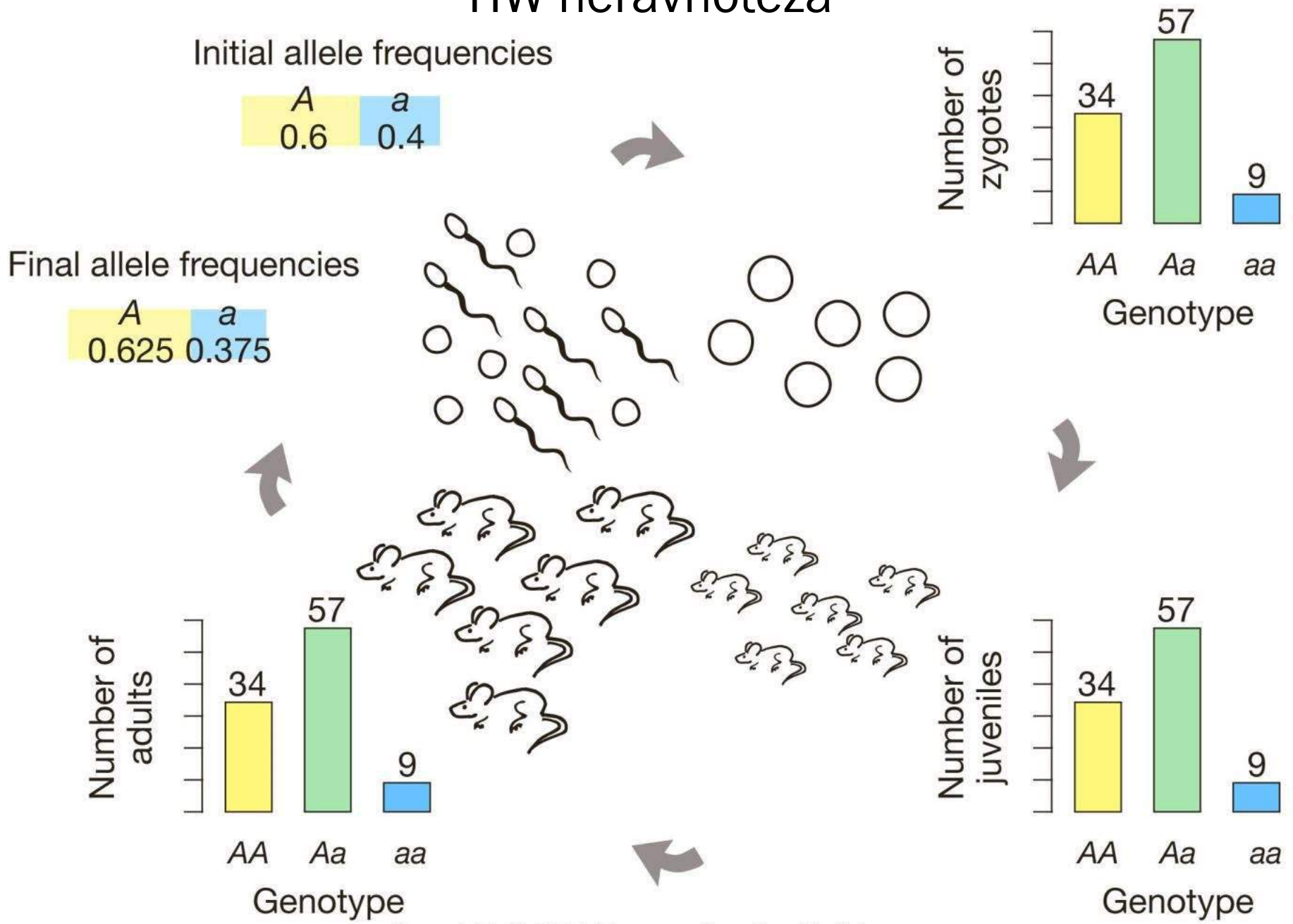
Hardi-Vajnbergova princip i ravnoteža

AA	Aa	aa
p^2	2pq	q^2

učestalosti alela i genotipova se održavaju kroz generacije



HW neravnoteža

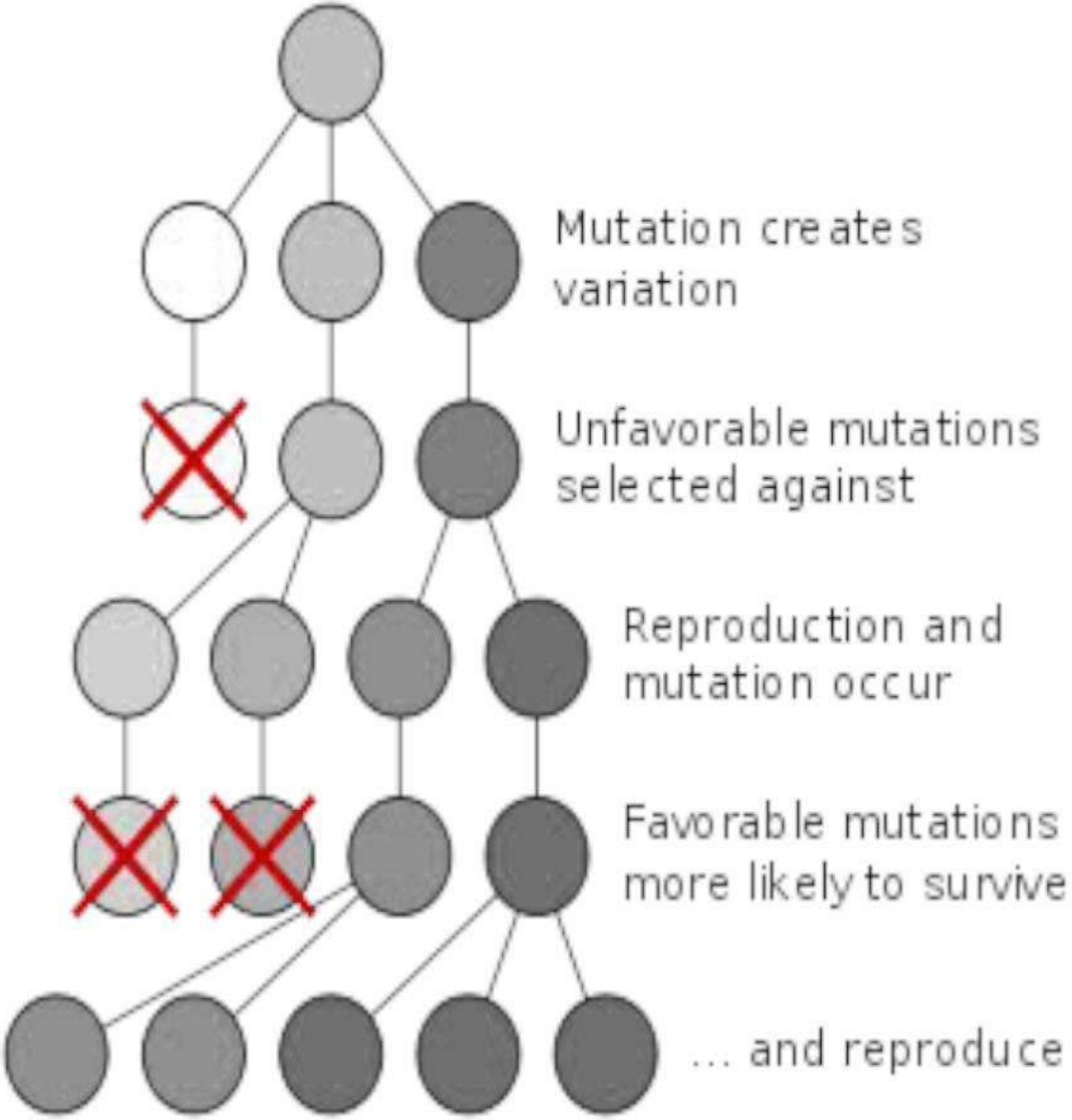


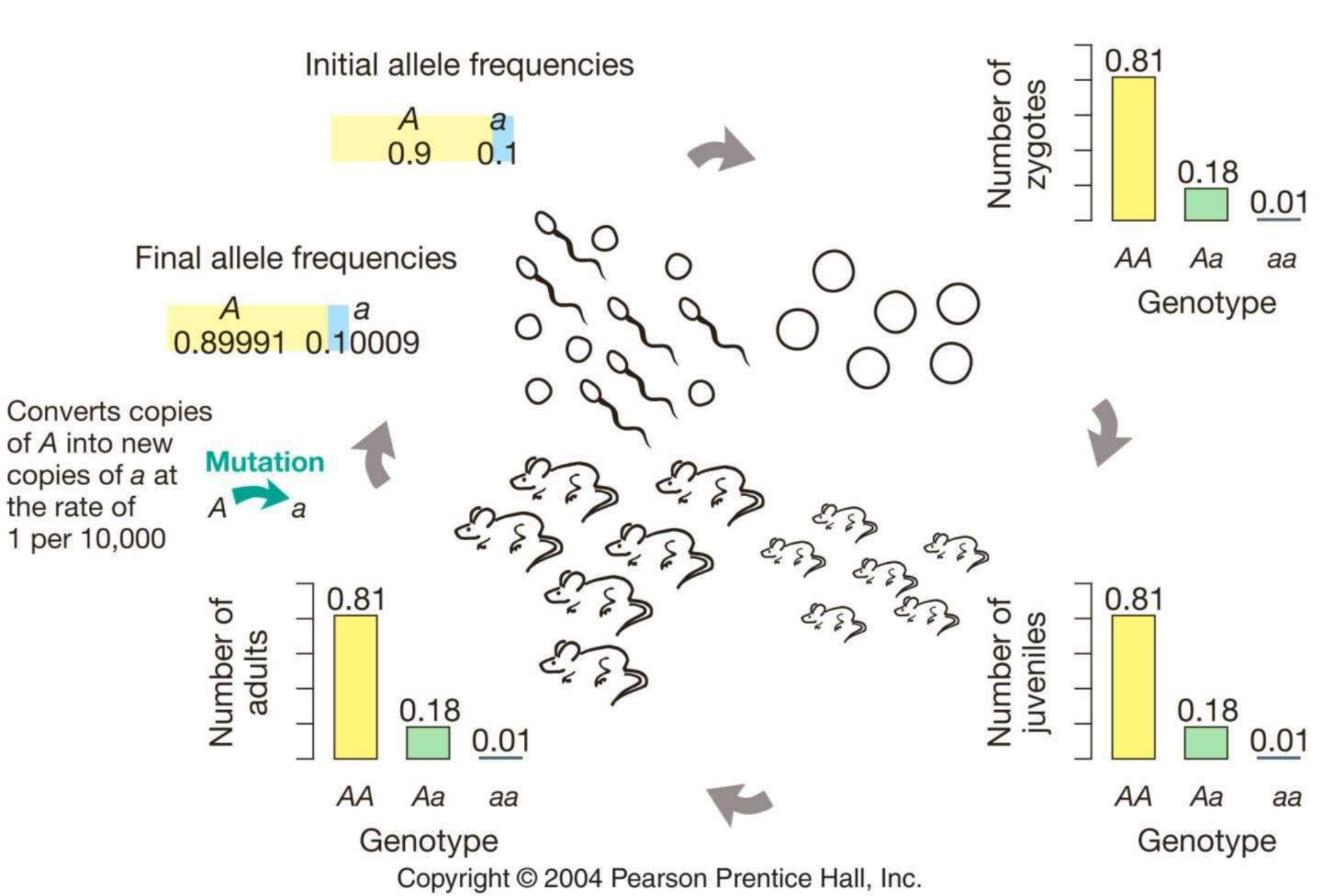
Kako se genetička struktura menja?

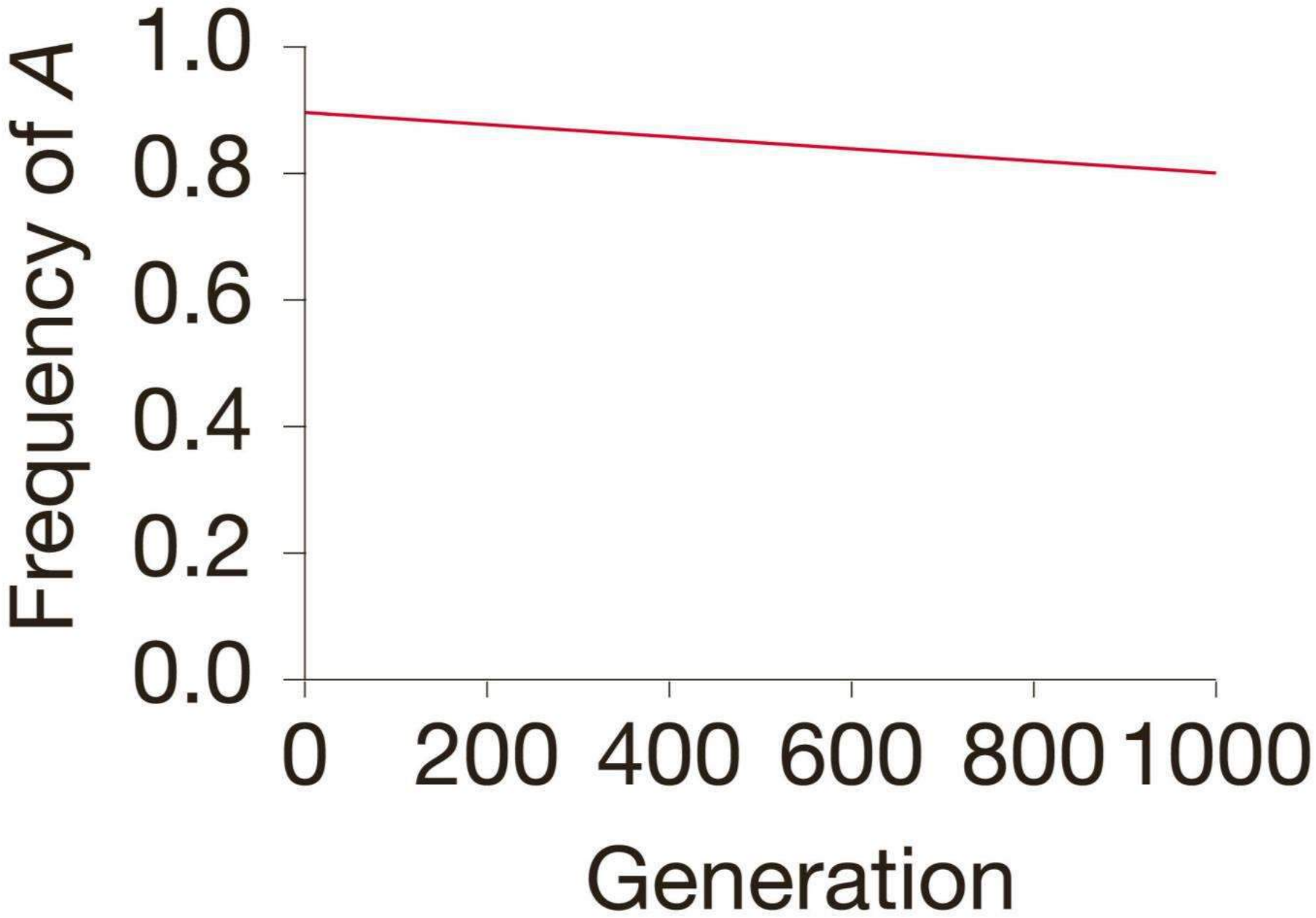
- **mutacije**
- migracije
- prirodna selekcija
- genetički drift
- neslučajno ukrštanje

spontane promene na DNK

- stvaranje novih alela
- izvor genetičke varijabilnosti


Mutation creates variation
Unfavorable mutations selected against
Reproduction and mutation occur
Favorable mutations more likely to survive
... and reproduce





Kako se genetička struktura menja?

- mutacije
- **migracije**
- prirodna selekcija
- genetički drift
- neslučajno ukrštanje

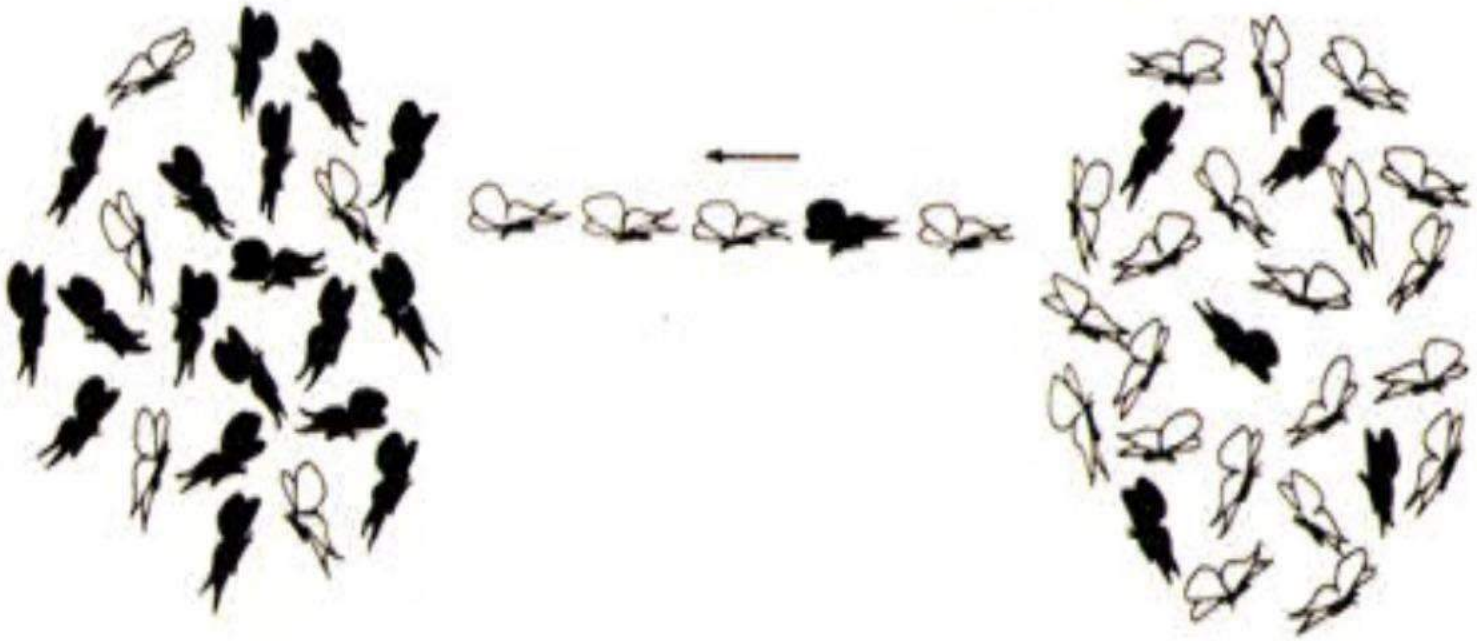
kretanje jedinki izmedju populacija

- izvor novih alela
- protok gena

Population α, with a frequency of q_α of the white allele,

receives a fraction m of its population

each generation from population β, with a frequency q_β of the white allele.



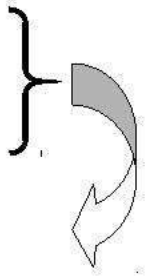
Kako se genetička struktura menja?

- mutacije
- migracije
- **prirodna selekcija**
- genetički drift
- neslučajno ukrštanje

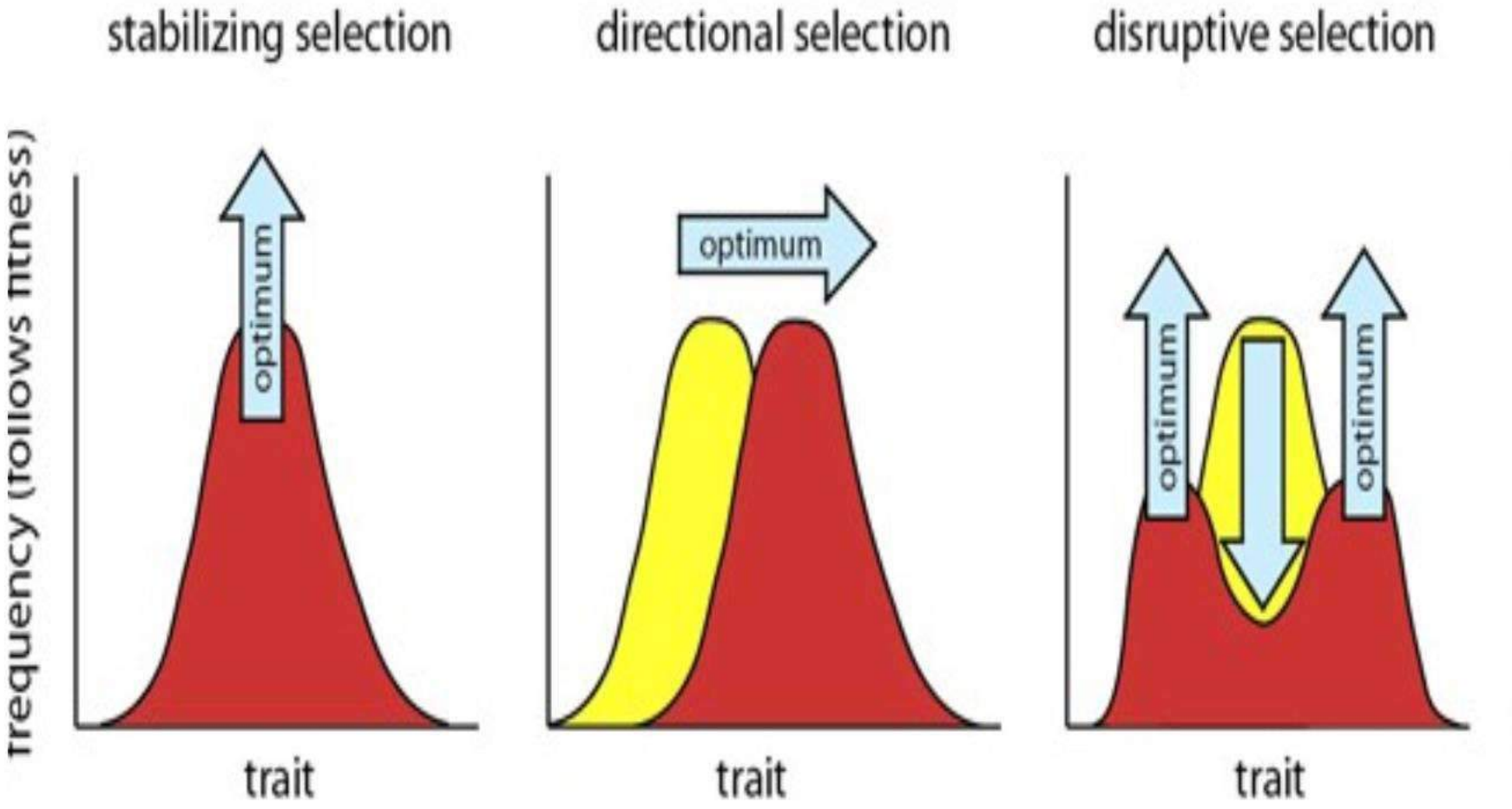
neki genotipovi ostavljaju više potomaka

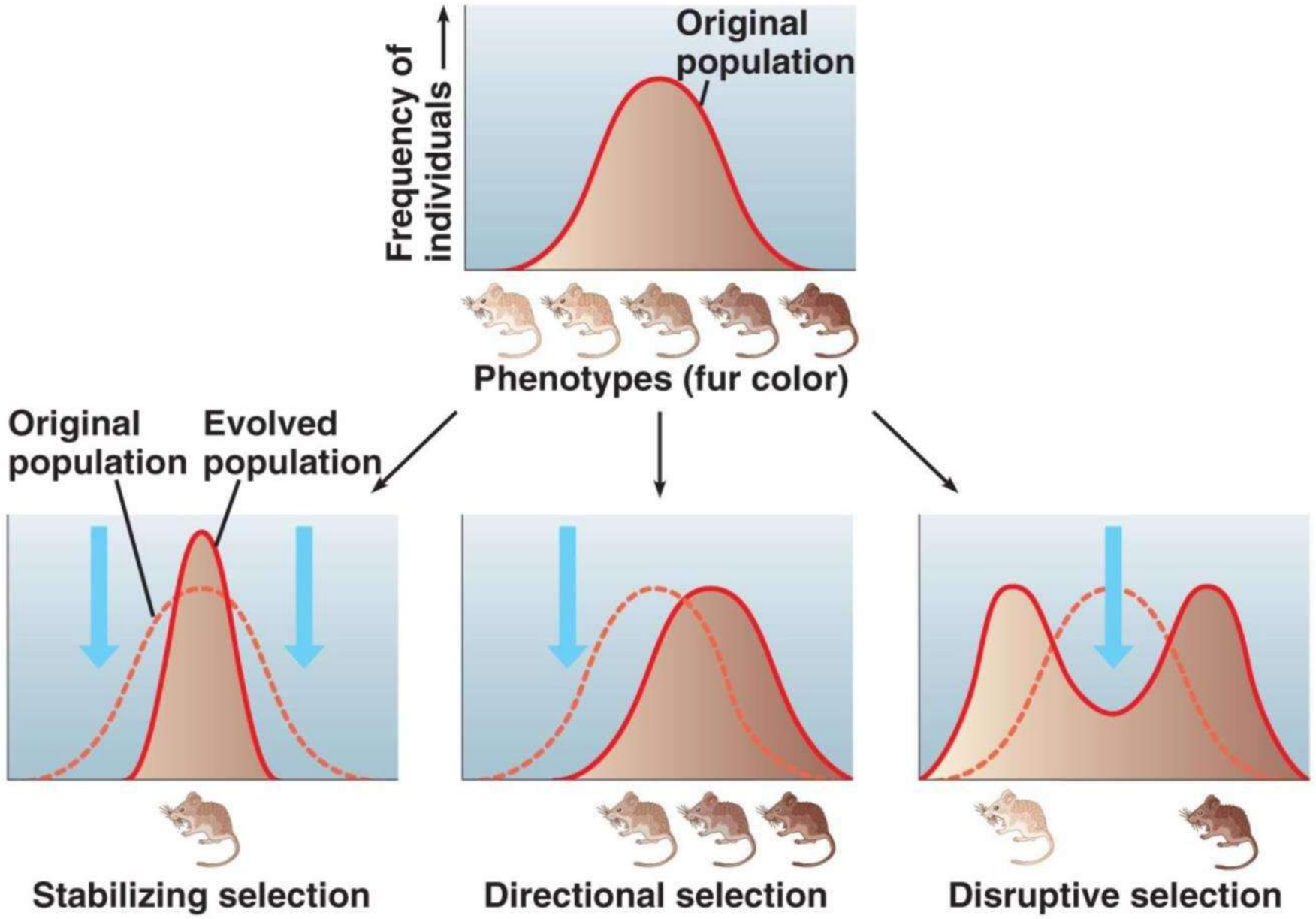
- razlike u preživljavanju i reprodukciji

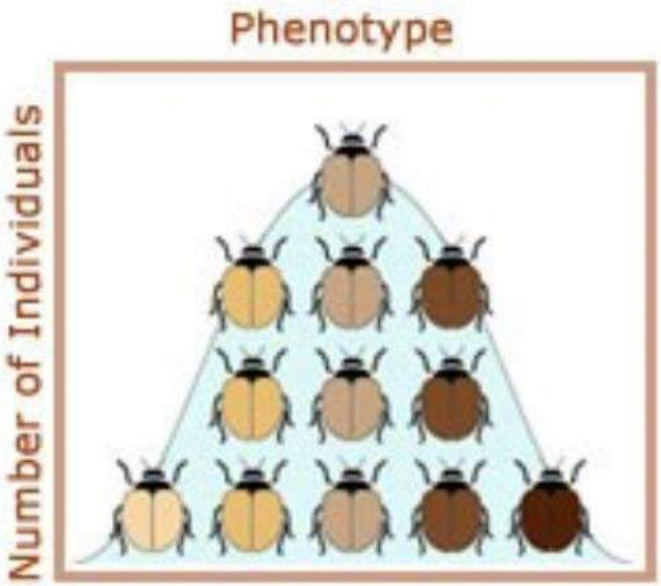
razlike u fitnesu



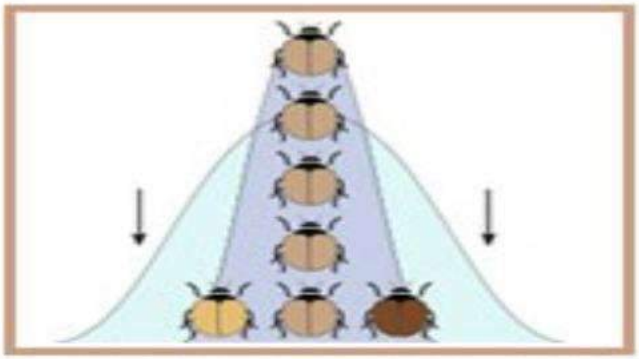
- dolazi do adaptacija


stabilizing selection
directional selection
disruptive selection
optimum
optimum
optimum
optimum
trait
trait
trait

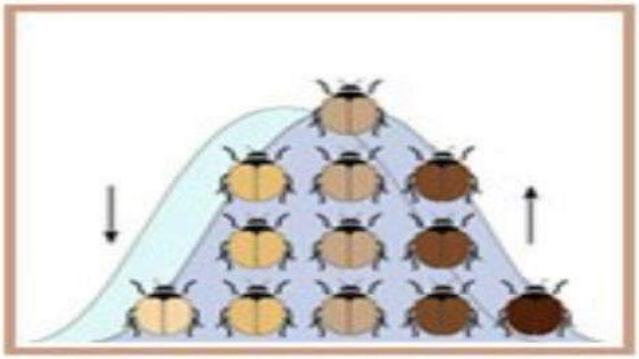




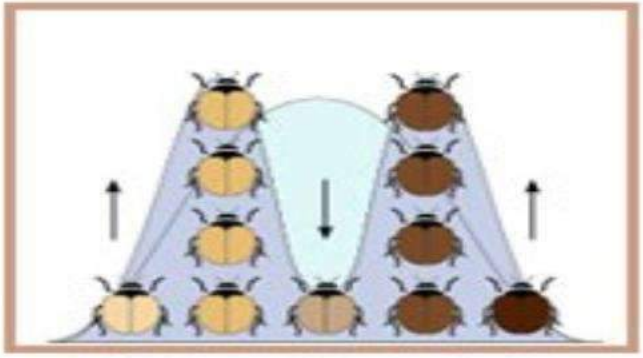
(a) No selection



(b) Stabilizing selection



(c) Directional selection



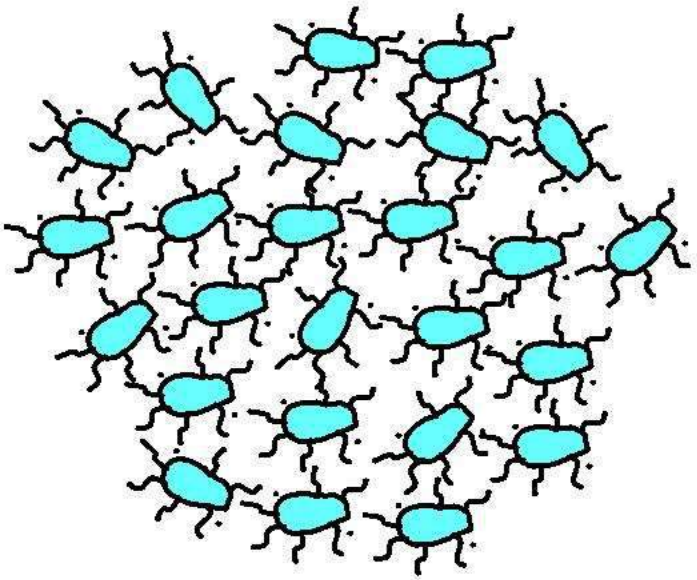
(d) Disruptive selection

Natural selection

Resistance to antibacterial soap

Generation 1: 1.00 not resistant
0.00 resistant

Natural selection



Resistance to antibacterial soap

Generation 1: 1.00 not resistant
0.00 resistant

Natural selection

mutation!

Resistance to antibacterial soap

Generation 1: 1.00 not resistant
0.00 resistant

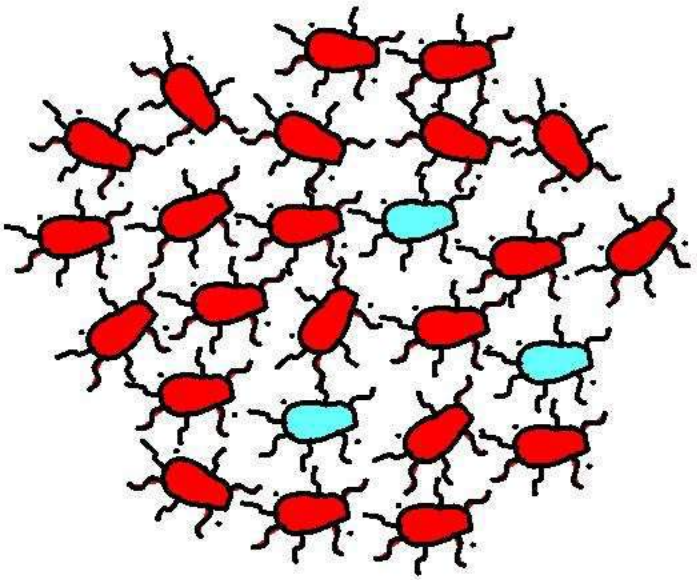
Generation 2: 0.96 not resistant
0.04 resistant

Natural selection

Resistance to antibacterial soap

Generation 1:	1.00 not resistant
	0.00 resistant
Generation 2:	0.96 not resistant
	0.04 resistant
Generation 3:	0.76 not resistant
	0.24 resistant

Natural selection



Resistance to antibacterial soap

Generation 1:	1.00 not resistant
	0.00 resistant
Generation 2:	0.96 not resistant
	0.04 resistant
Generation 3:	0.76 not resistant
	0.24 resistant
Generation 4:	0.12 not resistant
	0.88 resistant

Selekcija alela za srpastu anemiju

aa – abnormalni ß hemoglobin srpaste anemije — **nizak fitnes**

AA – normalni ß hemoglobin podložan malariji — **intermed. fitnes**

Aa – oba ß hemoglobina rezistencija na malariju — **visok fitnes**

Selekcija favorizuje heterozigote (Aa).

Oba alela se održavaju u populaciji (a na niskom nivou).

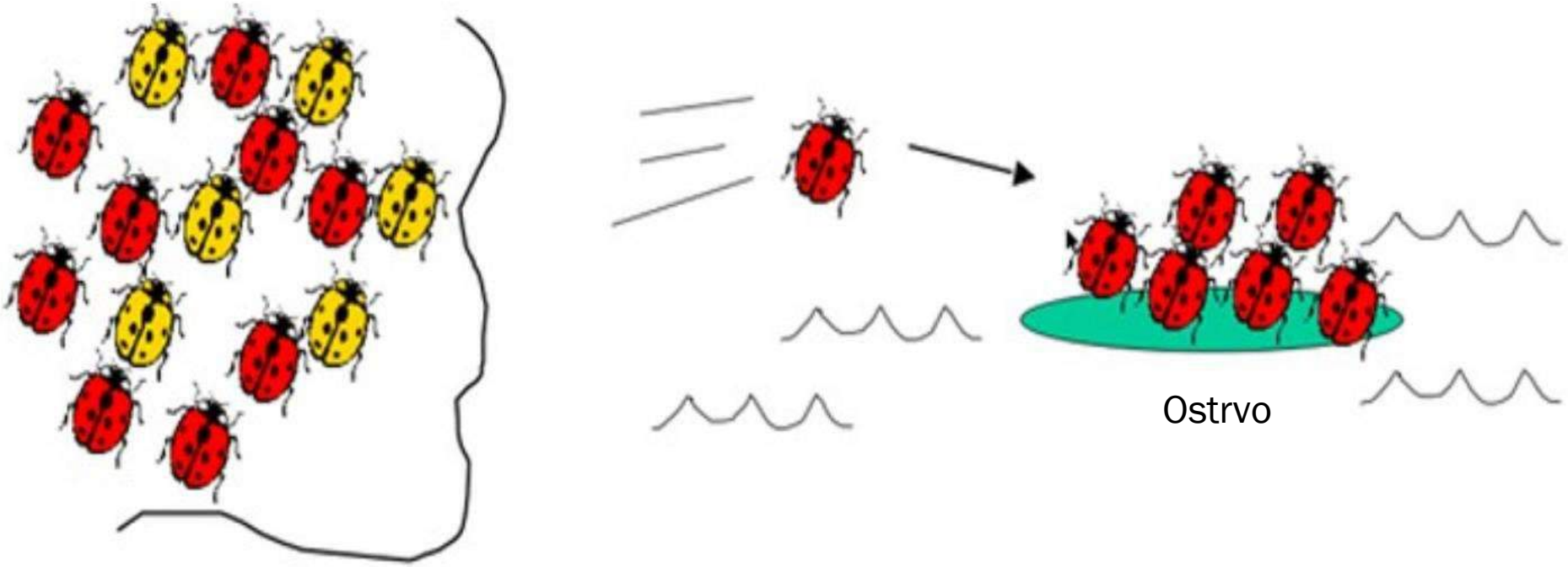
Kako se genetička struktura menja?

- mutacije
- migracije
- prirodna selekcija
- **genetički drift**
- neslučajno ukrštanje

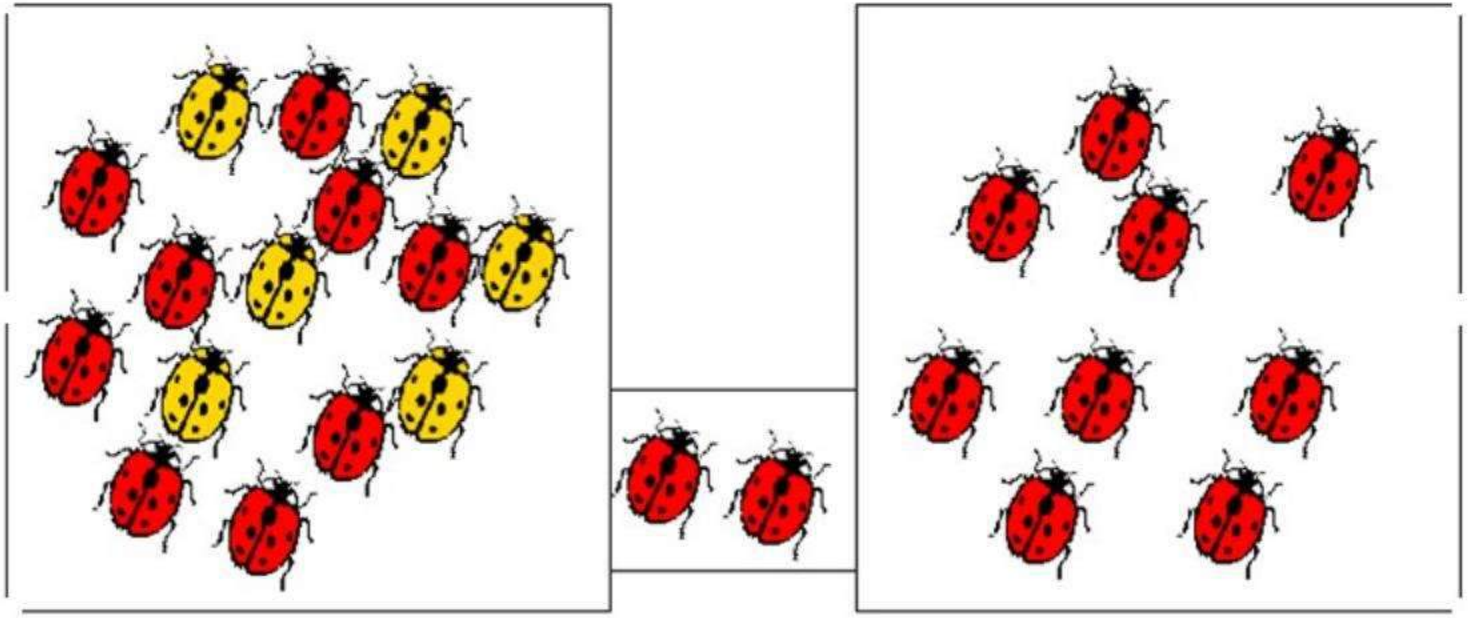
slučajne genetičke promene

- greška uzorkovanja
  - nereprezentativan uzorak
  - mala populacija

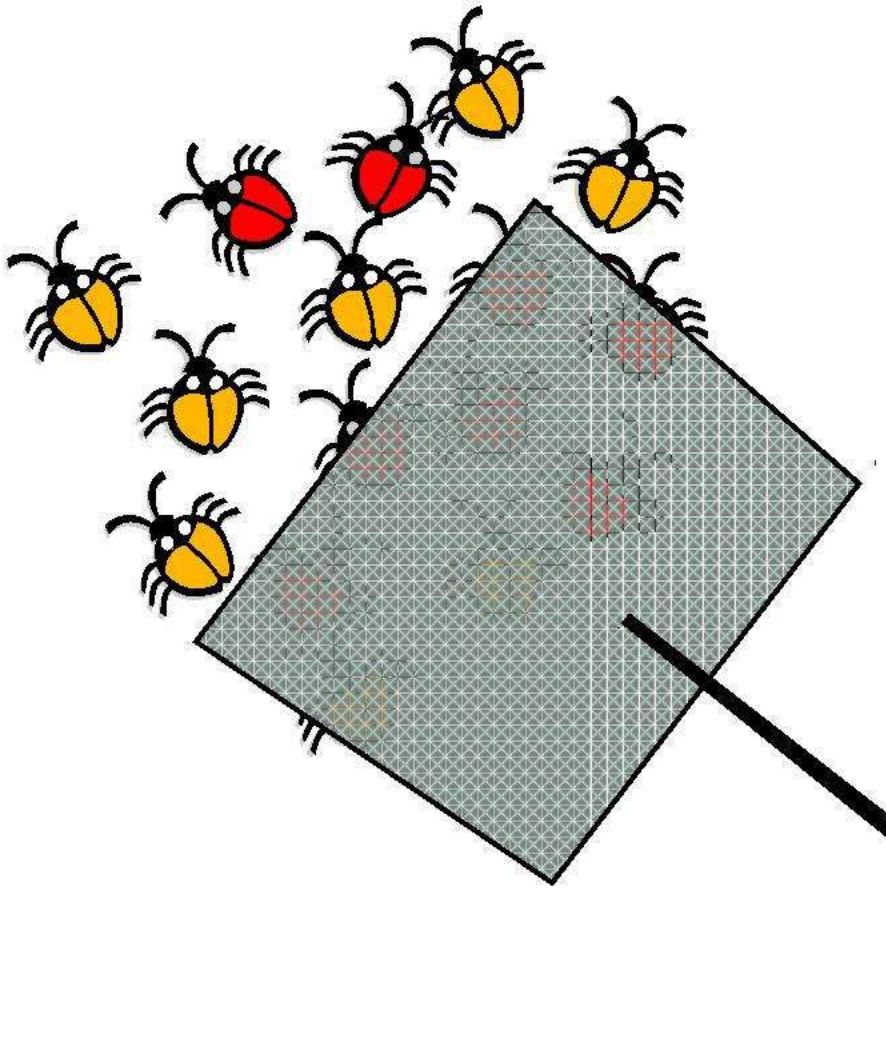
Genetički drift – efekat osnivača



Genetički drift – efekat uskog grla



Genetički drift



Pre:

8 RR → 0.50 R

8 rr → 0.50 r

Posle :

2 RR → 0.25 R

6 rr → 0.75 r

	unutar populacija	između populacija
porast genetičke varijabilnosti	mutacije migracije neki tipovi prirodne selekcije	mutacije genetčki drift neki tipovi prirodne selekcije
smanjenje genetičke varijabilnosti	genetički drift neki tipovi prirodne selekcije	migracije neki tipovi prirodne selekcije

Kako se genetička struktura menja?

- mutacije
- migracije
- prirodna selekcija
- genetički drift

uzrokuju promene u alelskim frekvencama

- neslučajno ukrštanje

Kako se genetička struktura menja?

- mutacije
- migracije
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- neslučajno ukrštanje

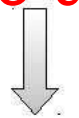
uzrokuje promene u frekvencama genotipova

Kako se genetička struktura menja?

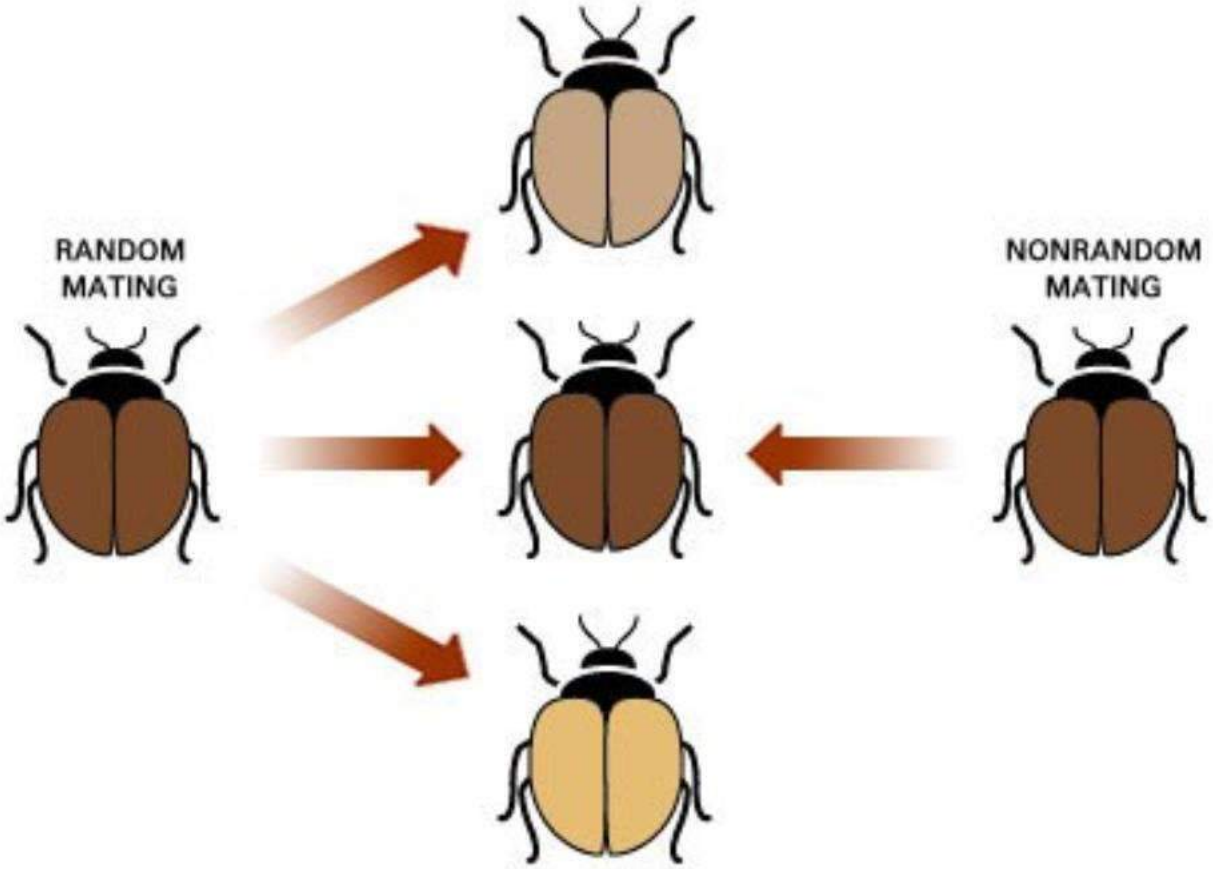
- mutacije
- migracije
- prirodna selekcija
- genetički drift
- **neslučajno ukrštanje**

ukrštanjem se kombinuju aleli u genotipove

neslučajno ukrštanje



neslučajne kombinacije alela


RANDOM
MATING
NONRANDOM
MATING

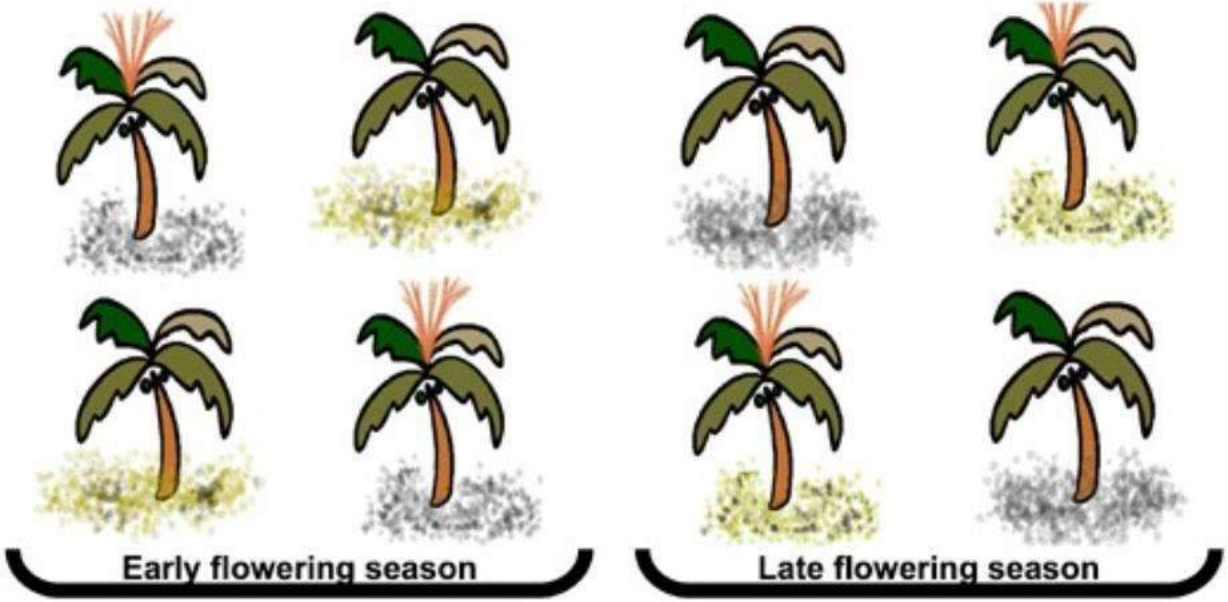
Disruptive selection

Some palms survive better in volcanic acidic soils whereas others perform better in basic calcareous soils

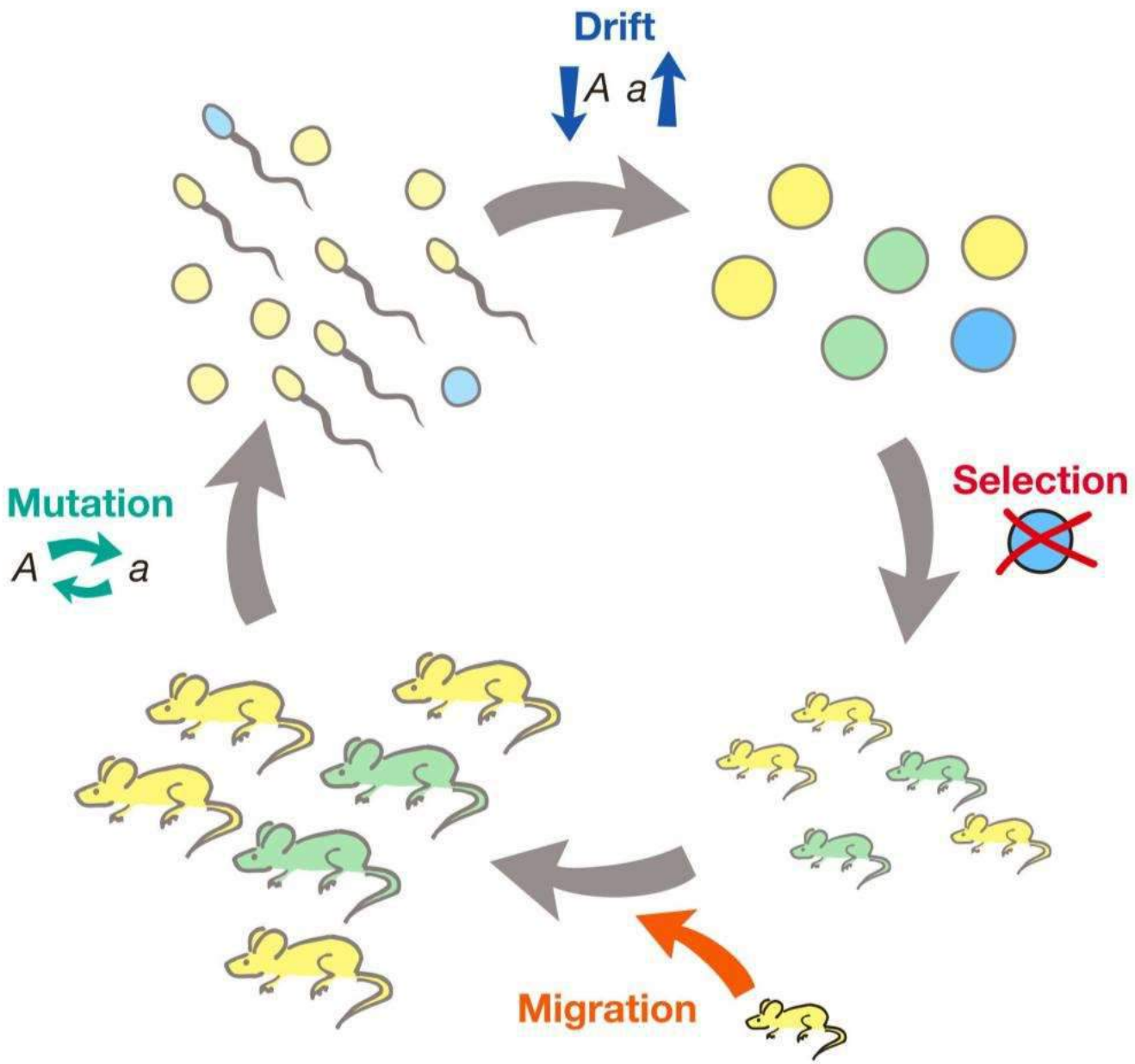
Calcareous soil

Volcanic soil

Assortative mating



Palms growing in calcareous soil tend to flower later than palms growing in volcanic soils



Odstupanje od 2nd HW