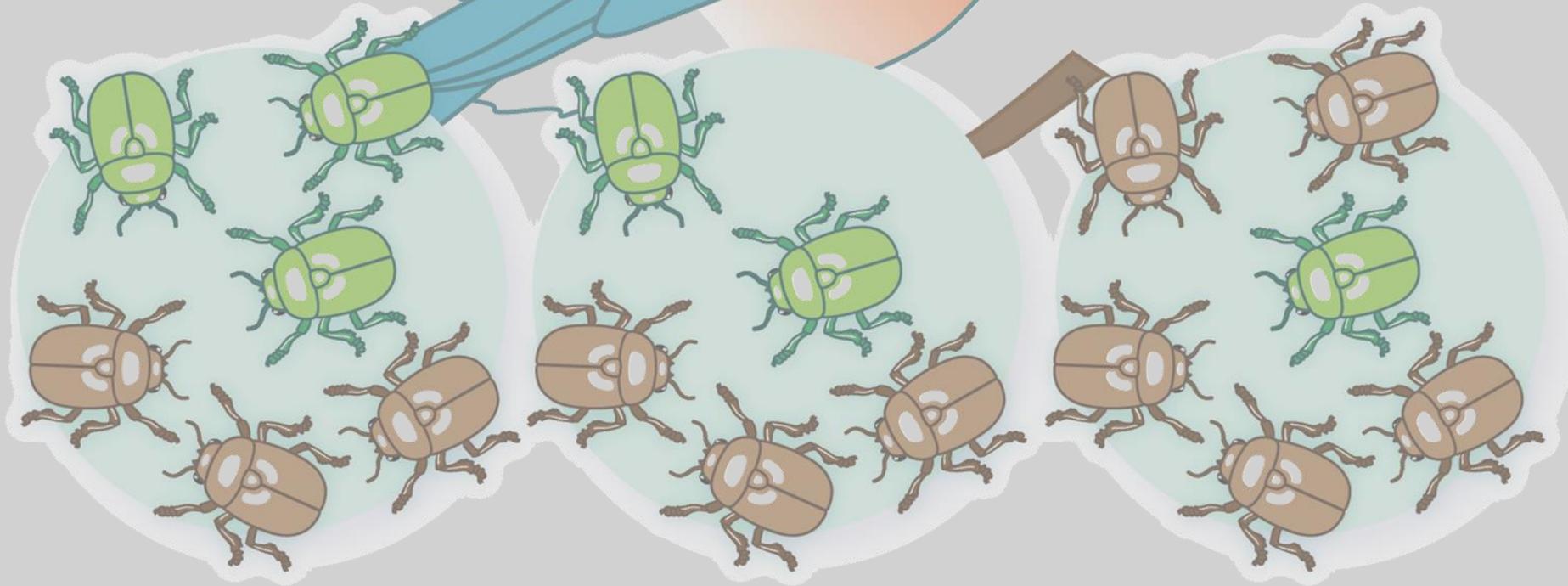




Genética de Poblaciones

Evolución 2024



Diego Ocampo: ocampov.diego@gmail.com

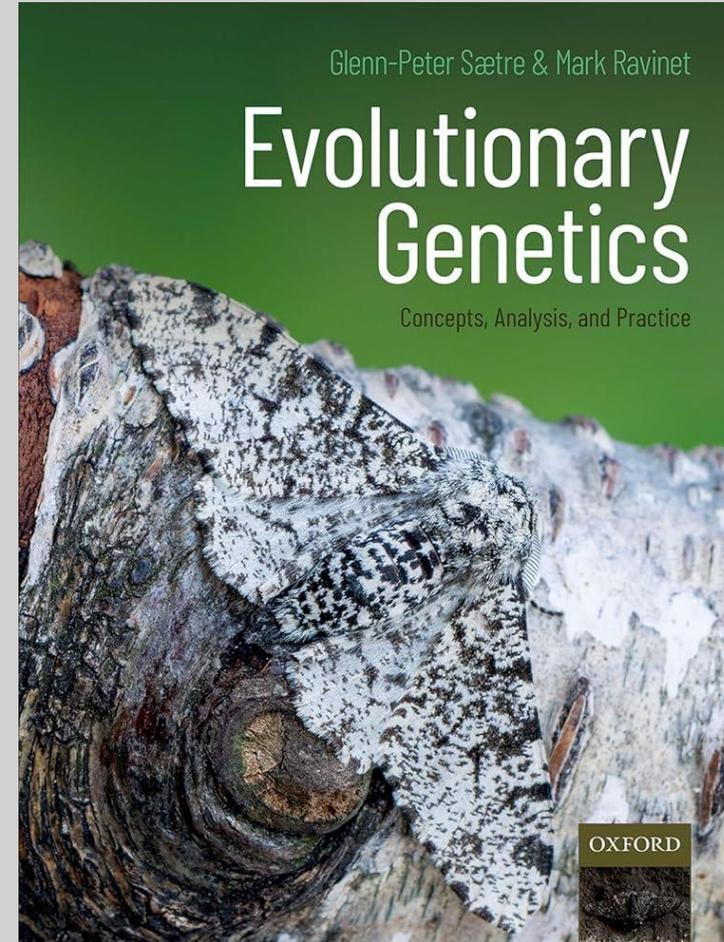
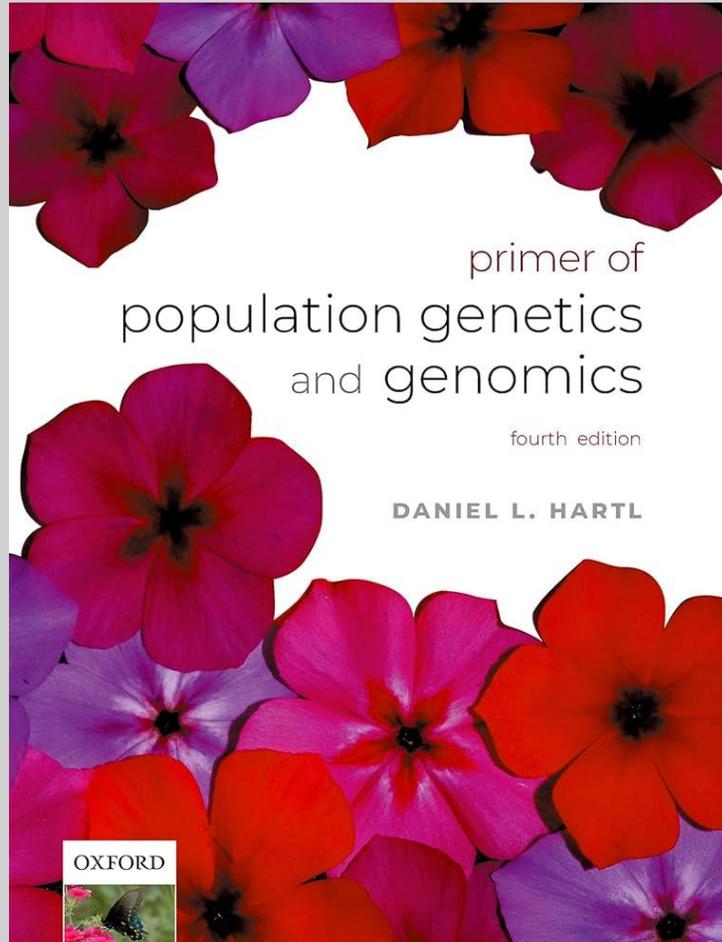
Quiz

Esquema

- Repaso conceptos básicos
- Mecanismos de evolución
- Modelo de equilibrio y supuestos (no evolución)

- Qué pasa cuando no se cumplen
- Tipos de selección
- Inferencia de la historia evolutiva

Libros



Evolución:

- Cambios en las frecuencias alélicas a través del tiempo.

Procesos adaptativos

Procesos aleatorios

Evolución: selección natural

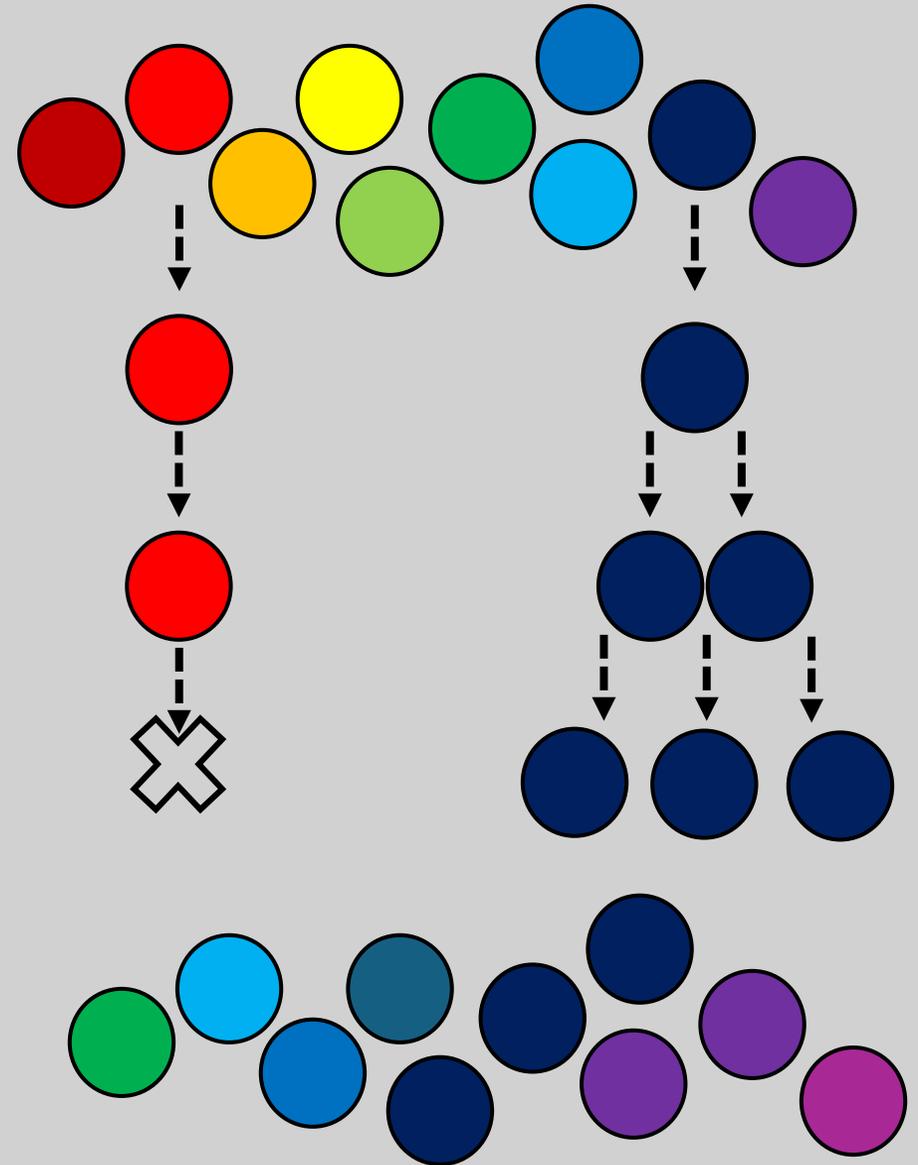
1) Variación

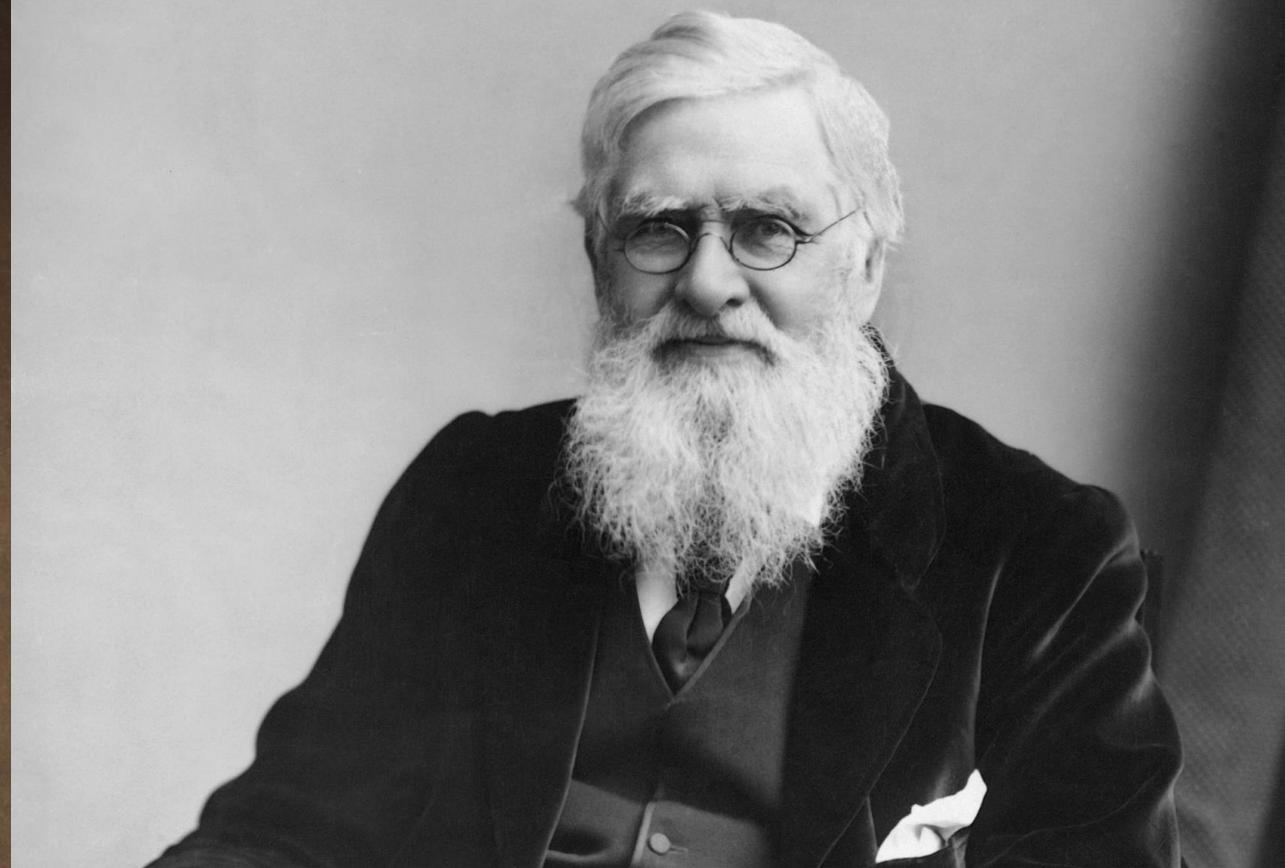
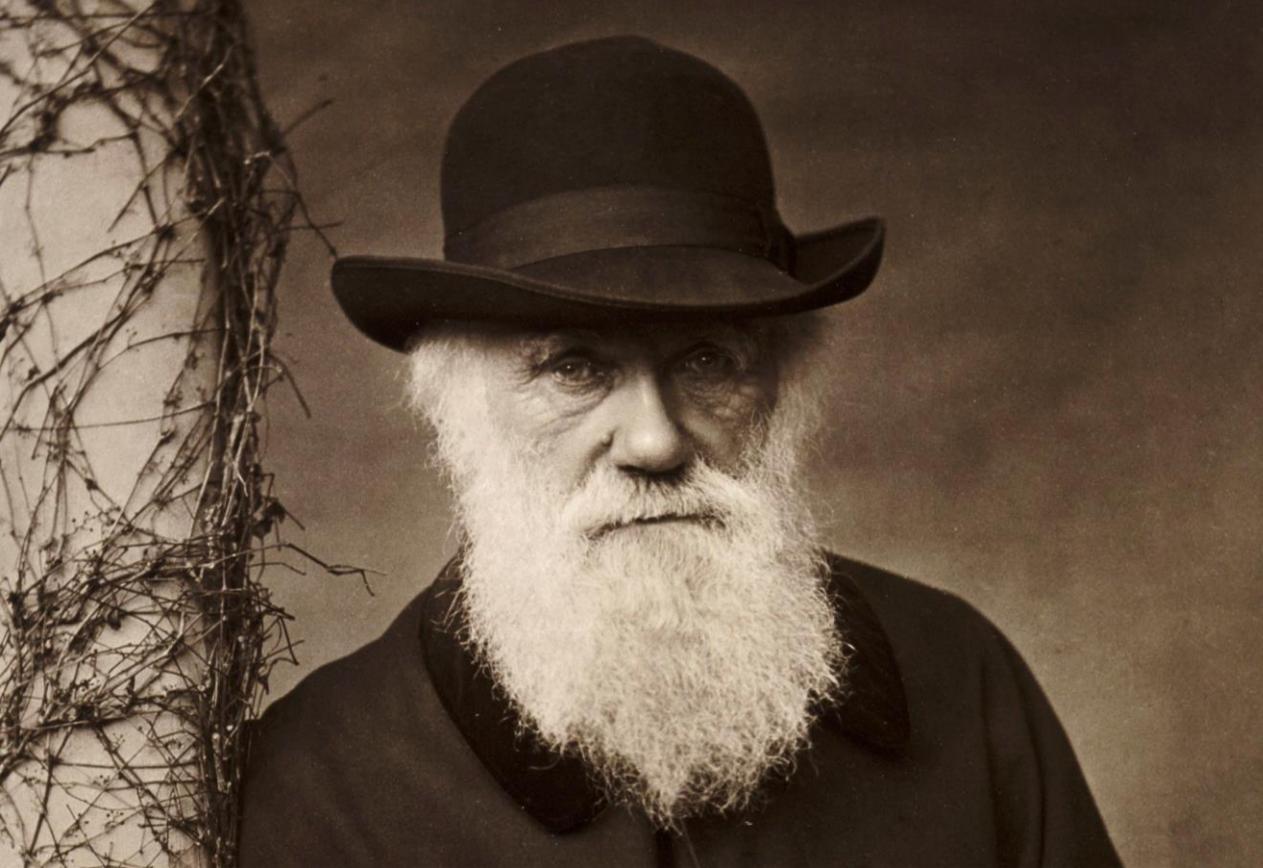
2) Herencia

3) Selección

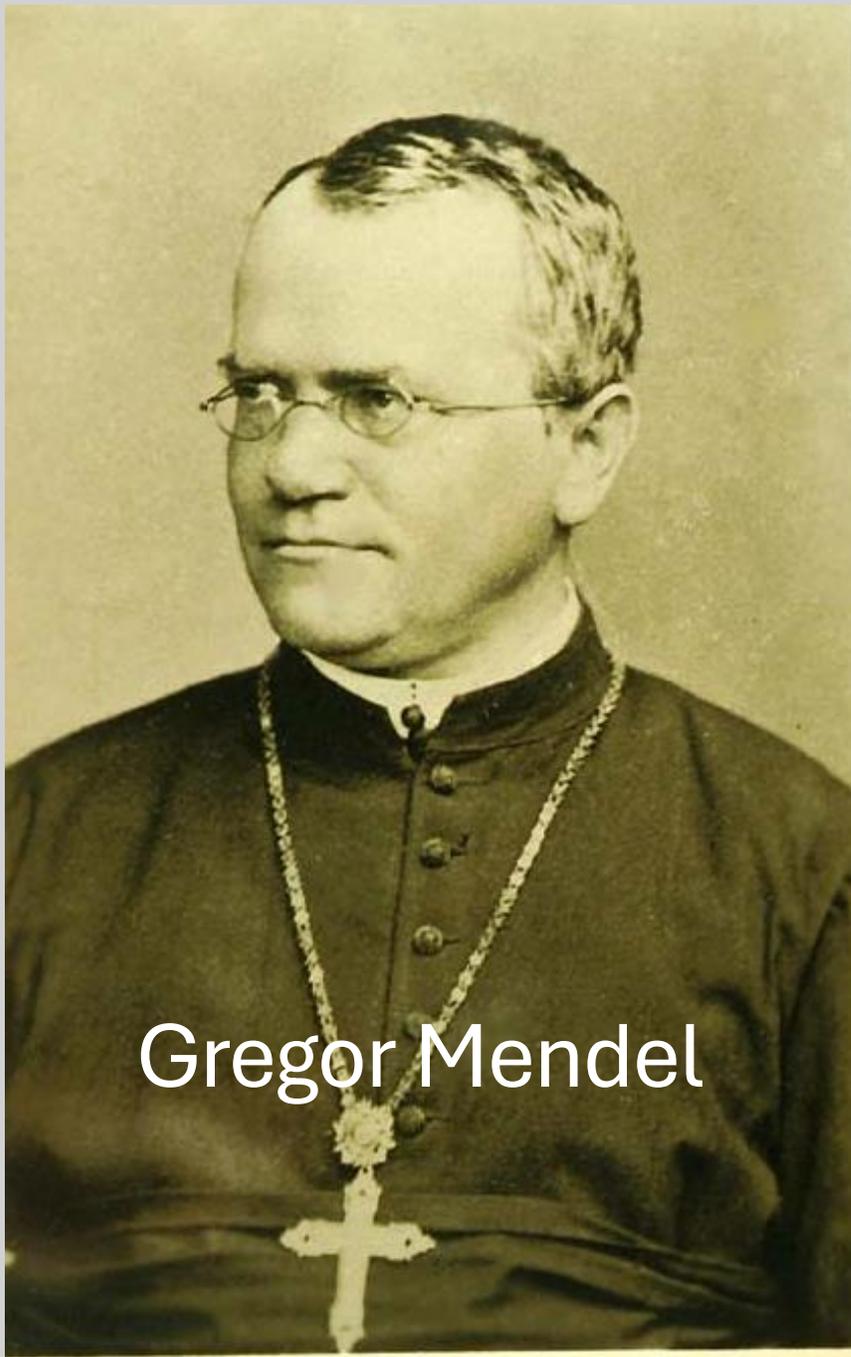
4) Tiempo

5) -> Adaptación

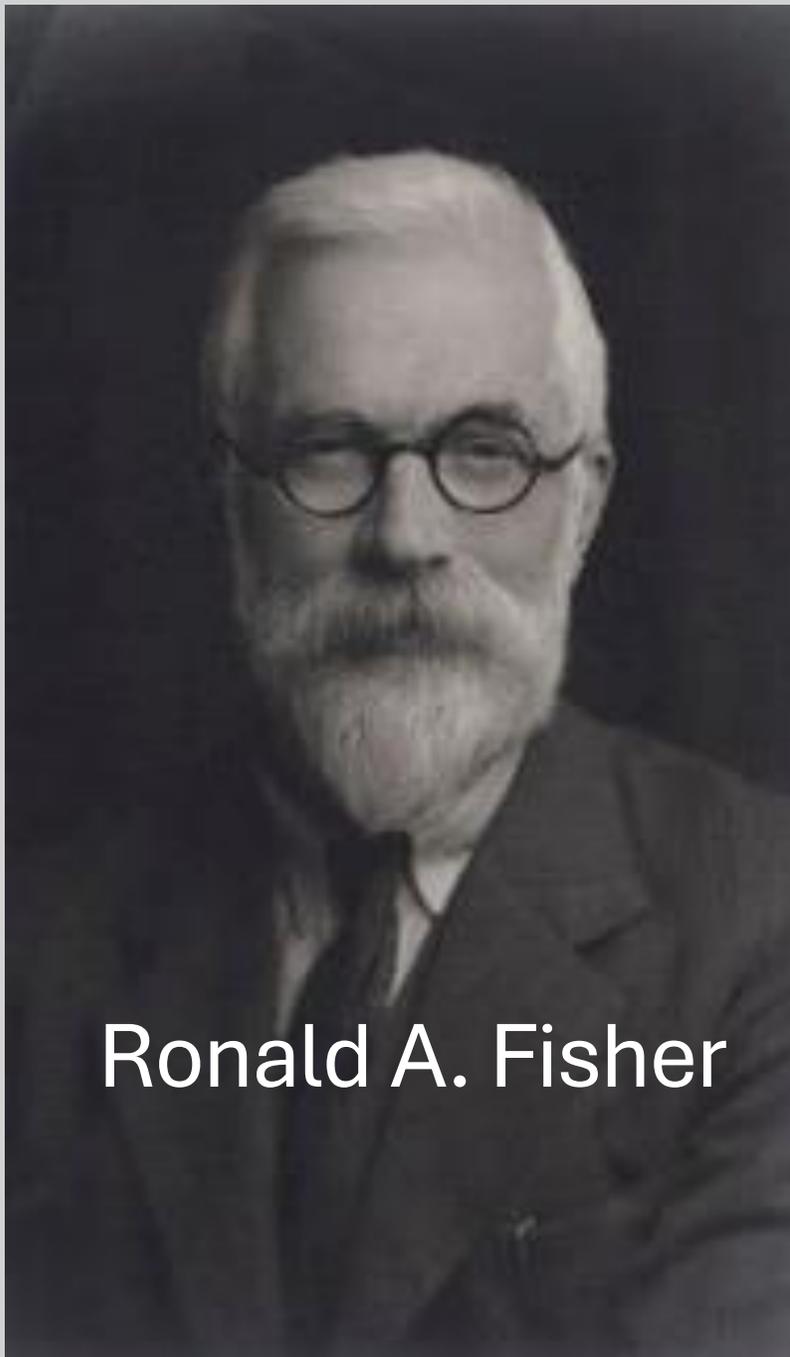




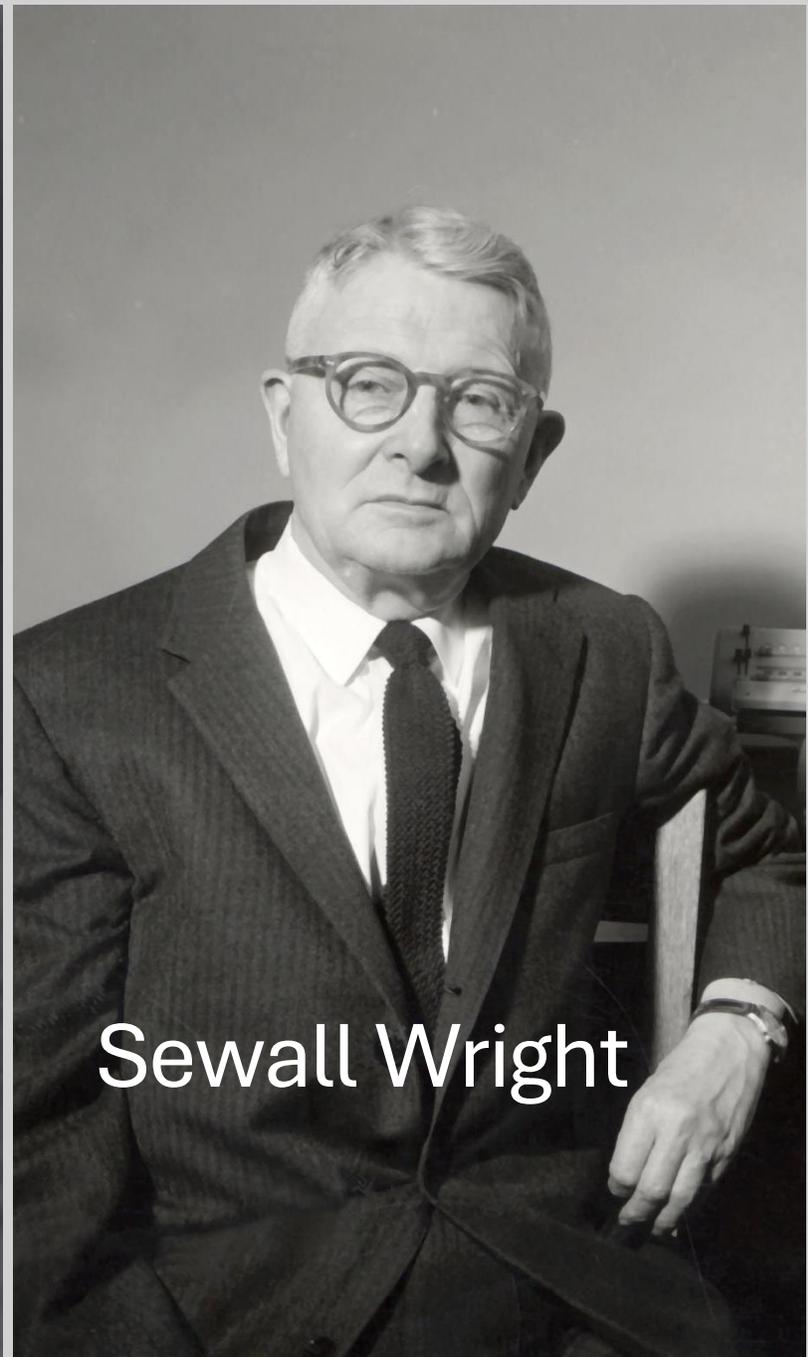
Darwin y Wallace (1858)



Gregor Mendel



Ronald A. Fisher



Sewall Wright

Evolución: selección natural

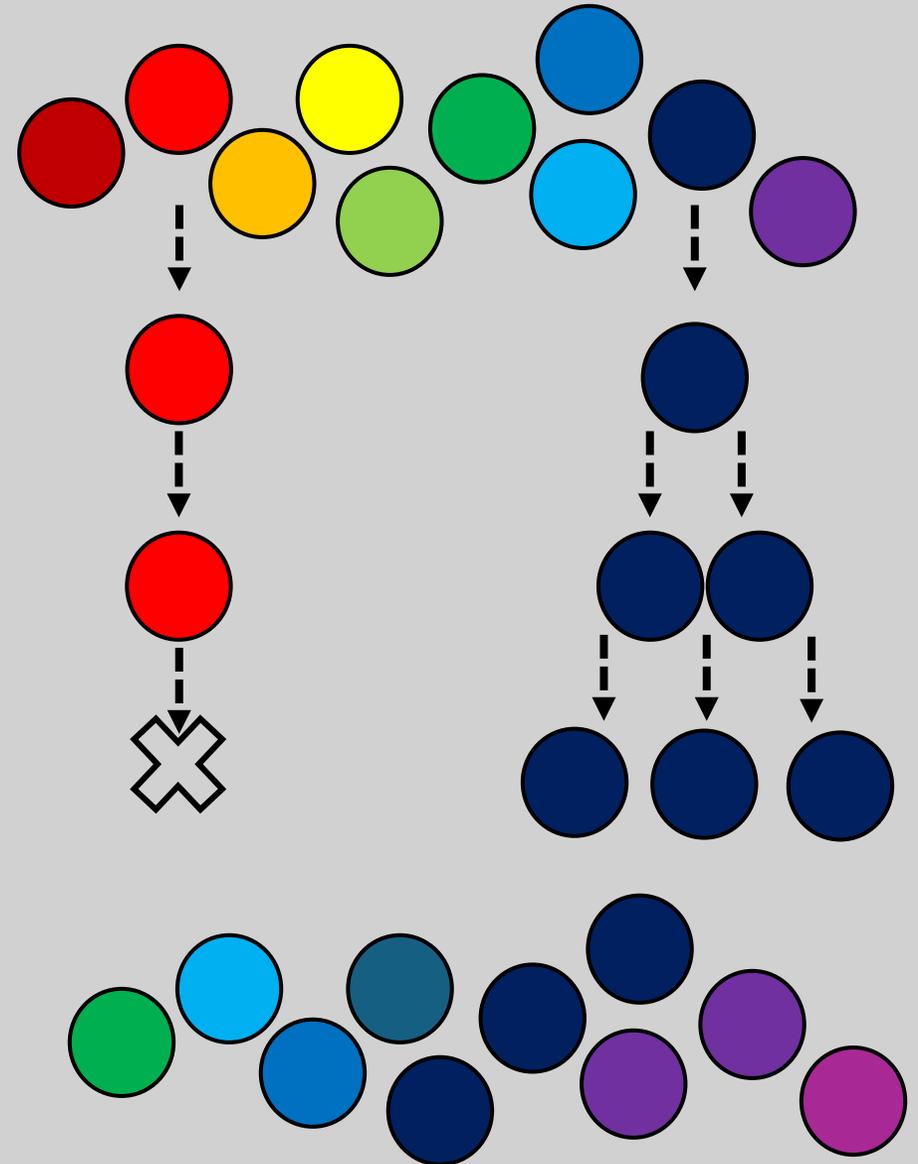
1) Variación

2) Herencia

3) Selección

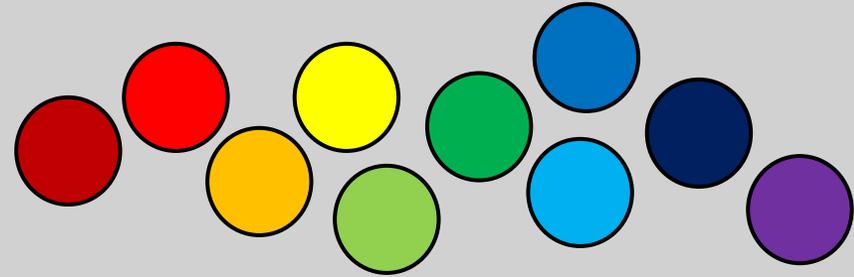
4) Tiempo

5) -> Adaptación



Evolución

1) Variación



Ambiente (plasticidad)

Genética: muchos mecanismos

Poco probables; Aleatorias??

Diversidad genética



Diversidad de variedades de maíz en campos de Mesoamérica.

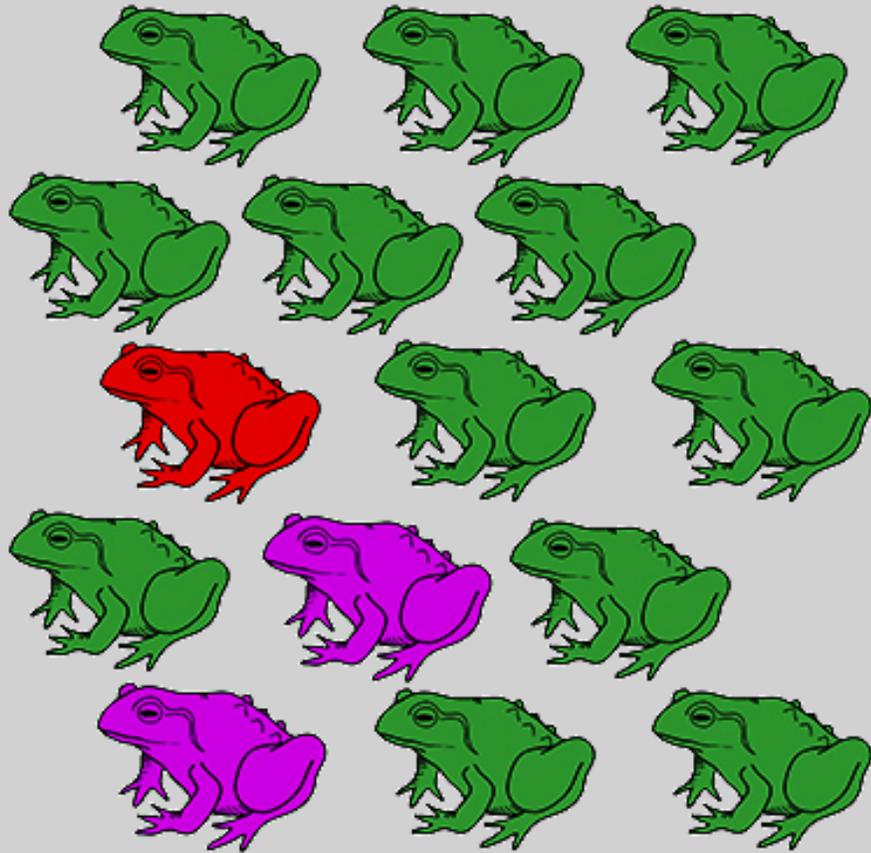
■ Jesús León Santos (CEDICAM, México)



Diversidad de papas nativas en los Andes. ■ Potatopro.com

Poza génica

a population

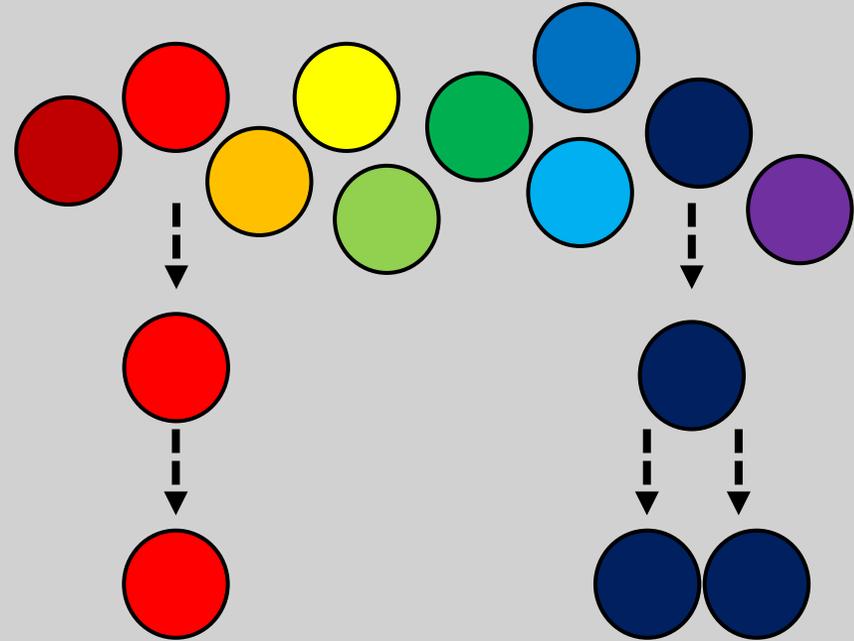


Evolución: selección natural

1) Variación

2) Herencia

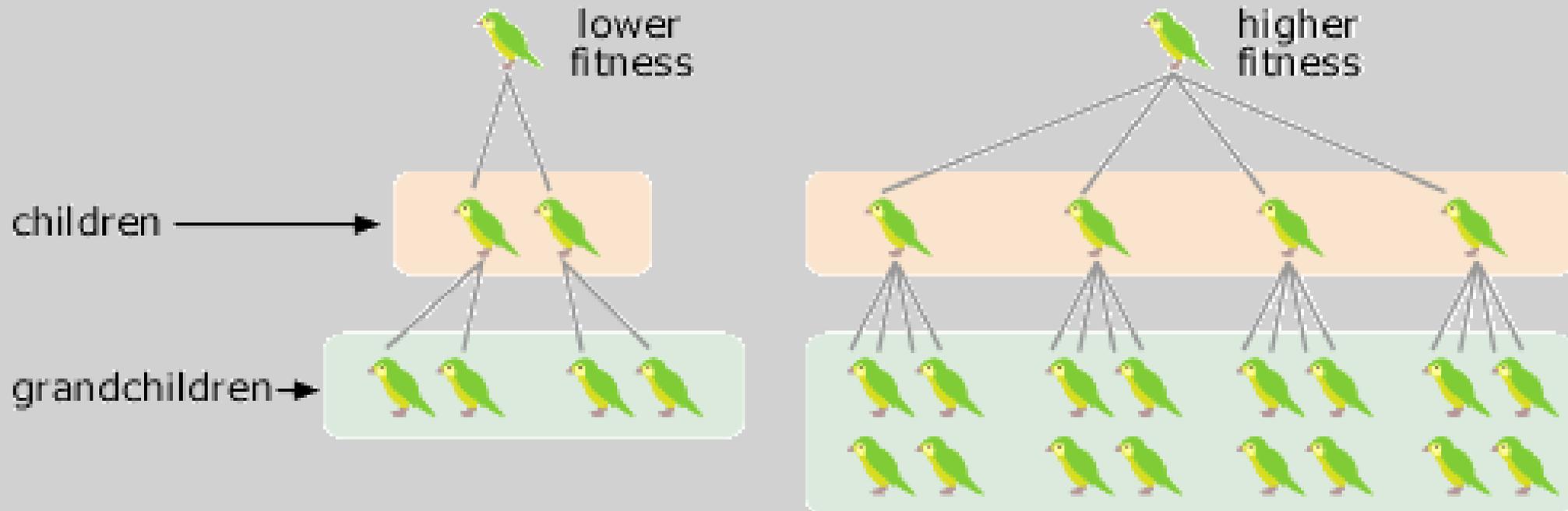
3) Selección



Fitness (Aptitud, o valor adaptativo)

La contribución esperada de un alelo (o genotipo, o fenotipo) a las generaciones futuras.

El fitness es relativo!!





Biston betularia

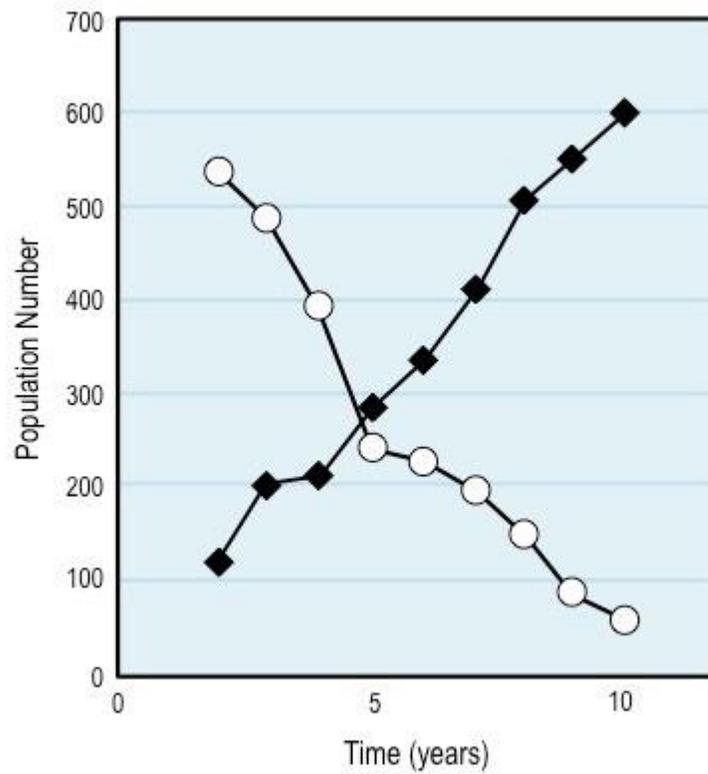
carbonaria



typica



**Pre-Industrial
Revolution**



**Post-Industrial
Revolution**

Peppered Moth Game

Peppered Moth

Natural Selection

Dr. Kettlewell

How to Play

Play Game

Menu

Choose a forest for your experiment



Light Forest



Dark Forest

Peppered Moth Game

New Game



00:22

Moths Eaten: 00



Google: Peppered moth game

<https://askabiologist.asu.edu/peppered-moths-game/play.html>

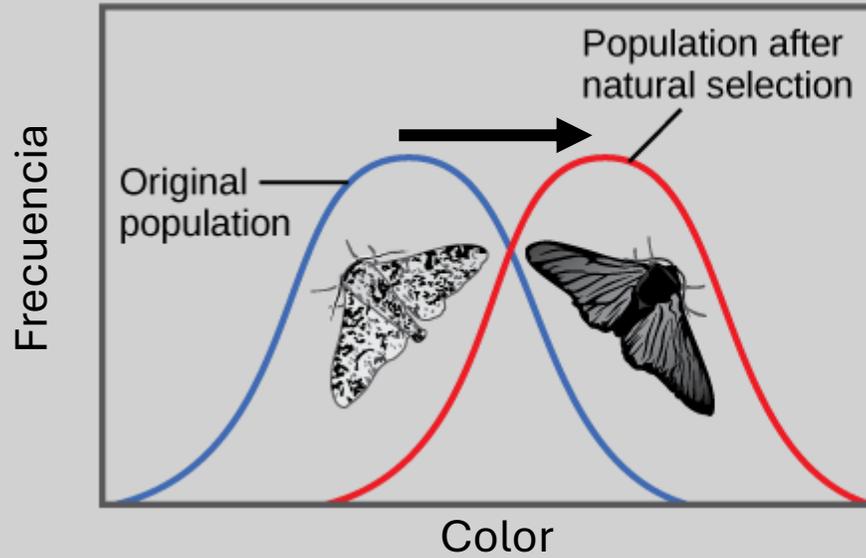
40 – 60 polillas...

- Preguntas

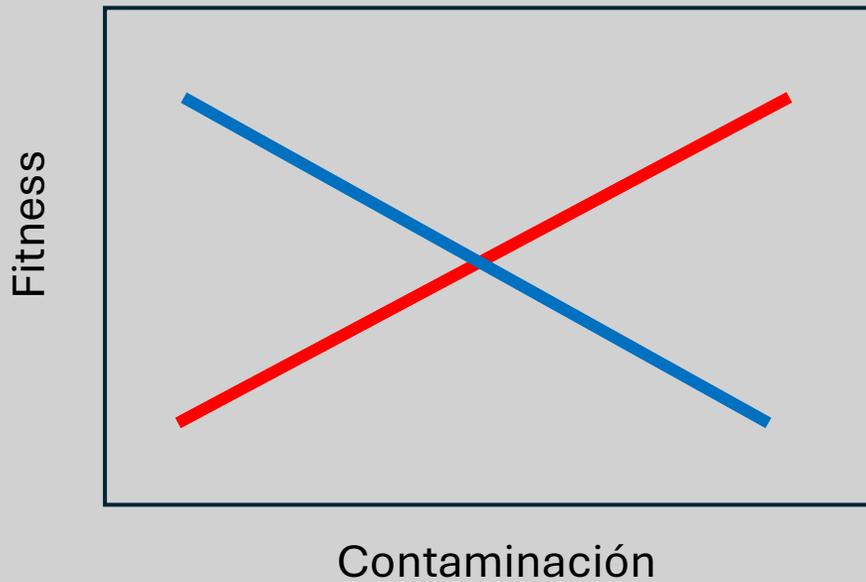


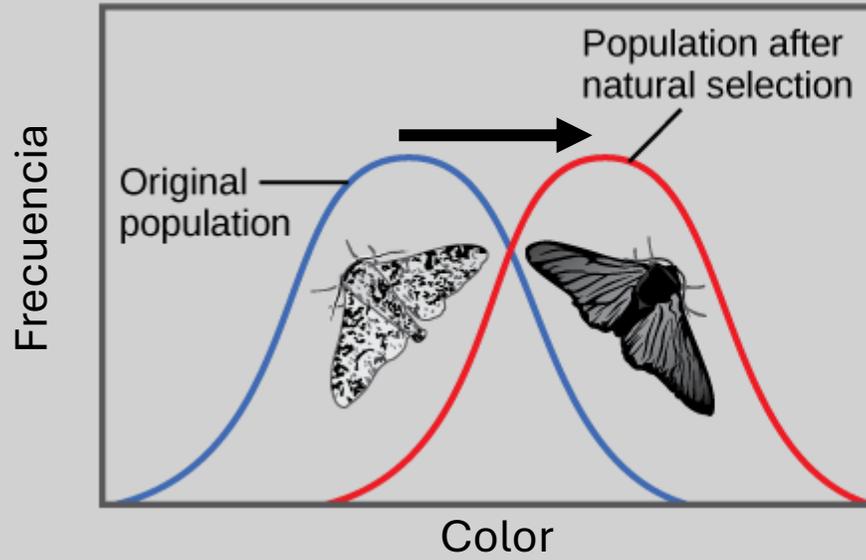
Fitness: 1

$$1.5 : 1 :: 0.5 : X = 0.33$$

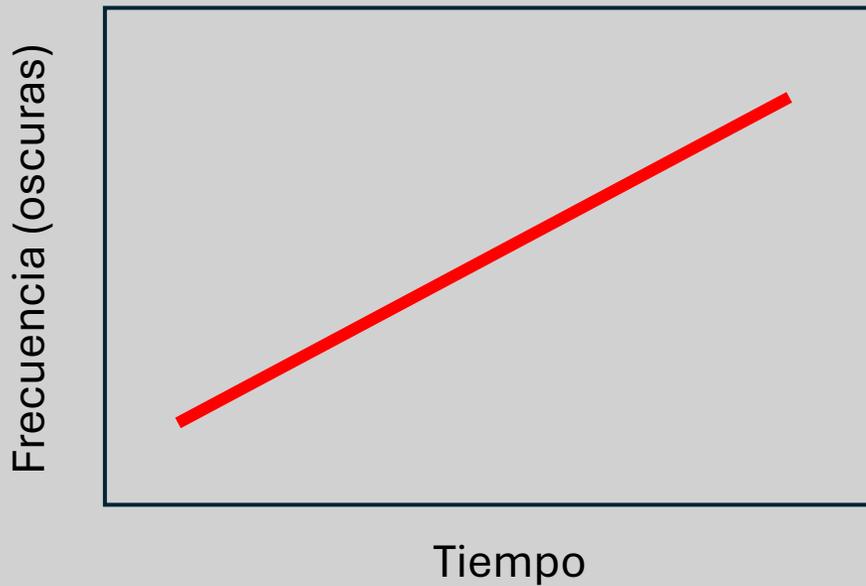


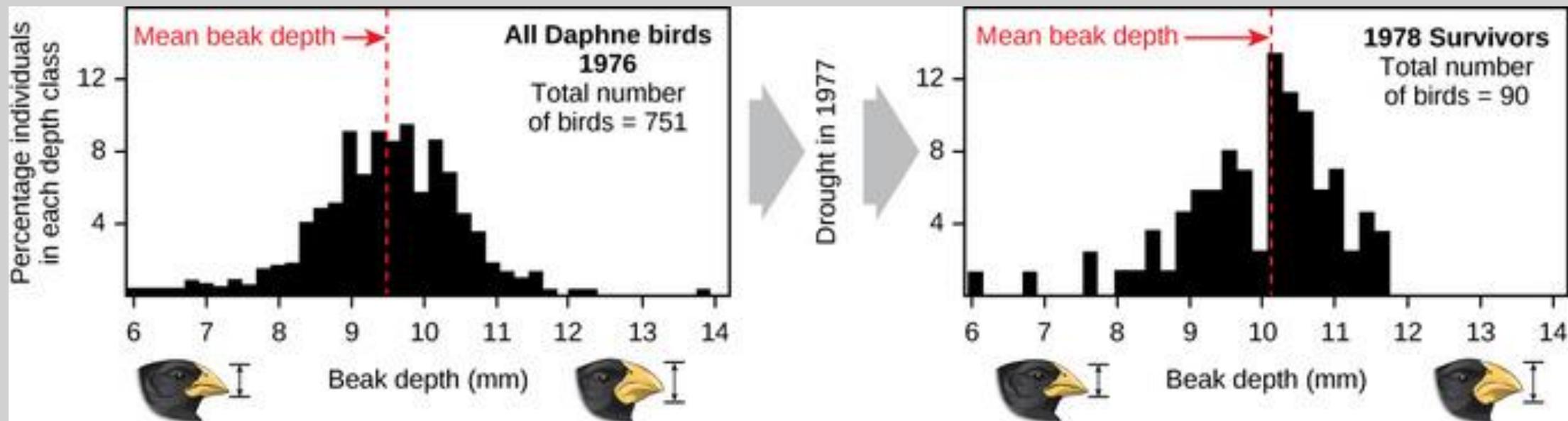
Light-colored peppered moths are better camouflaged against a pristine environment; likewise, dark-colored peppered moths are better camouflaged against a sooty environment. Thus, as the Industrial Revolution progressed in nineteenth-century England, the color of the moth population shifted from light to dark, an example of directional selection.



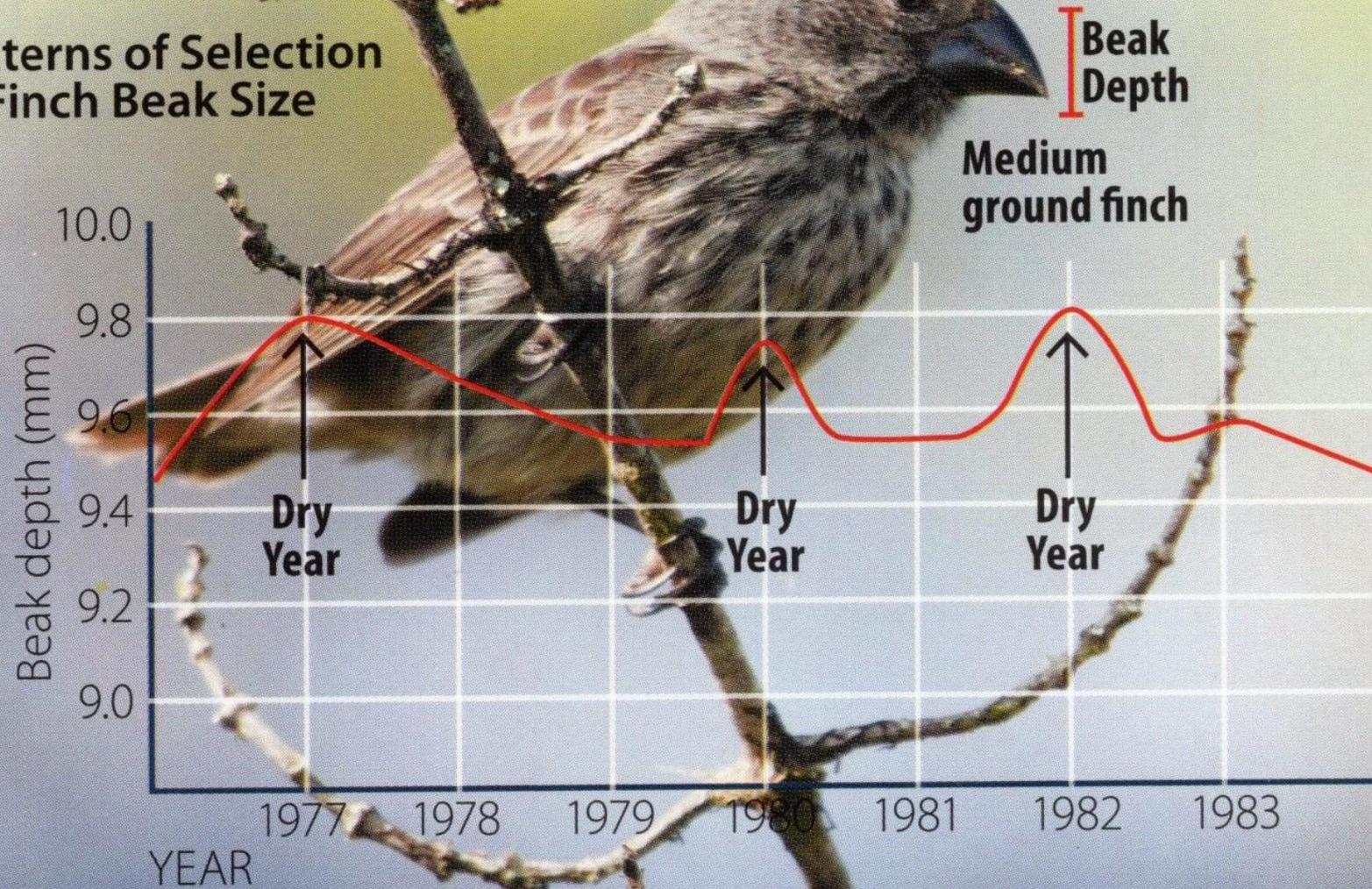


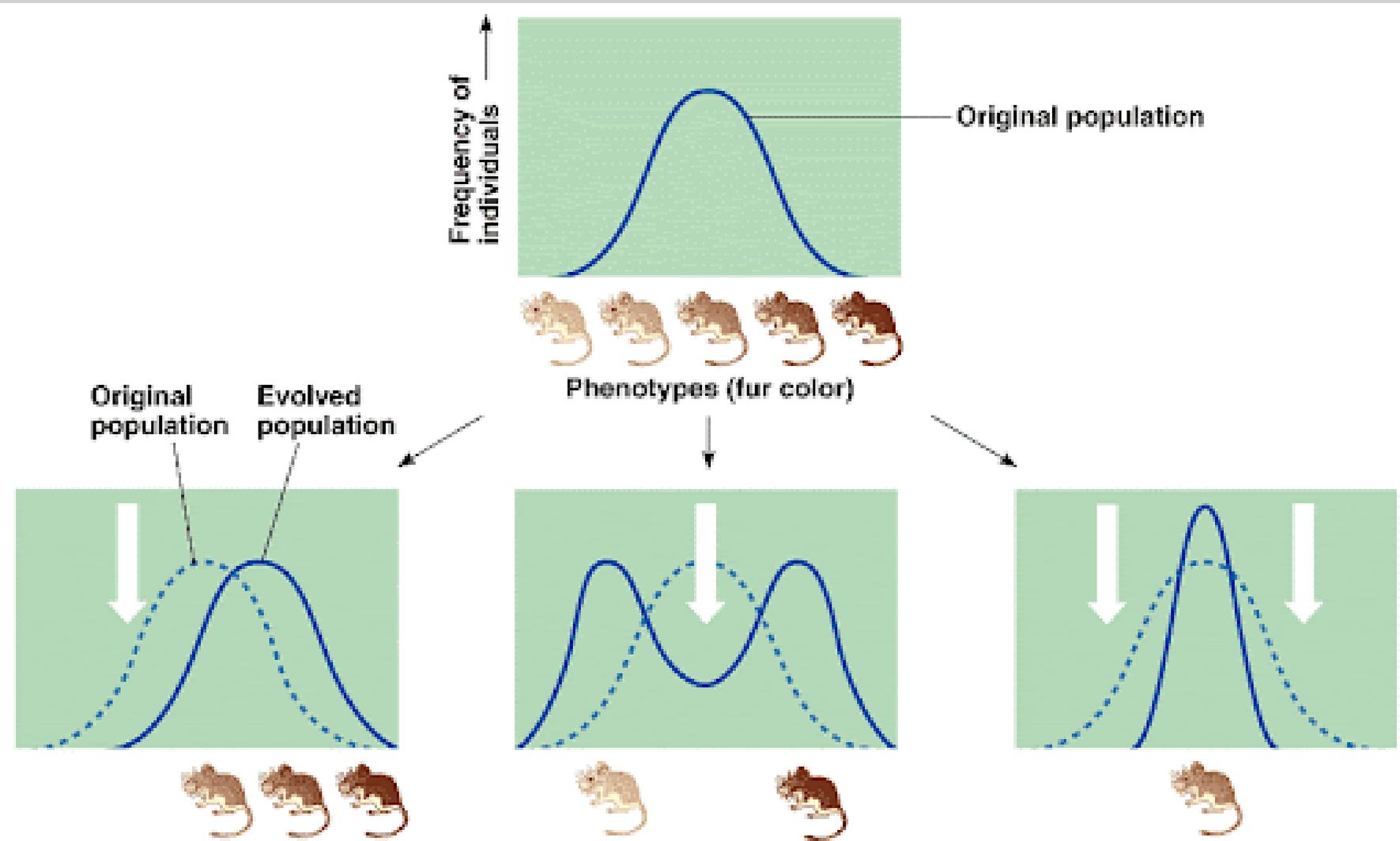
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Patterns of Selection in Finch Beak Size

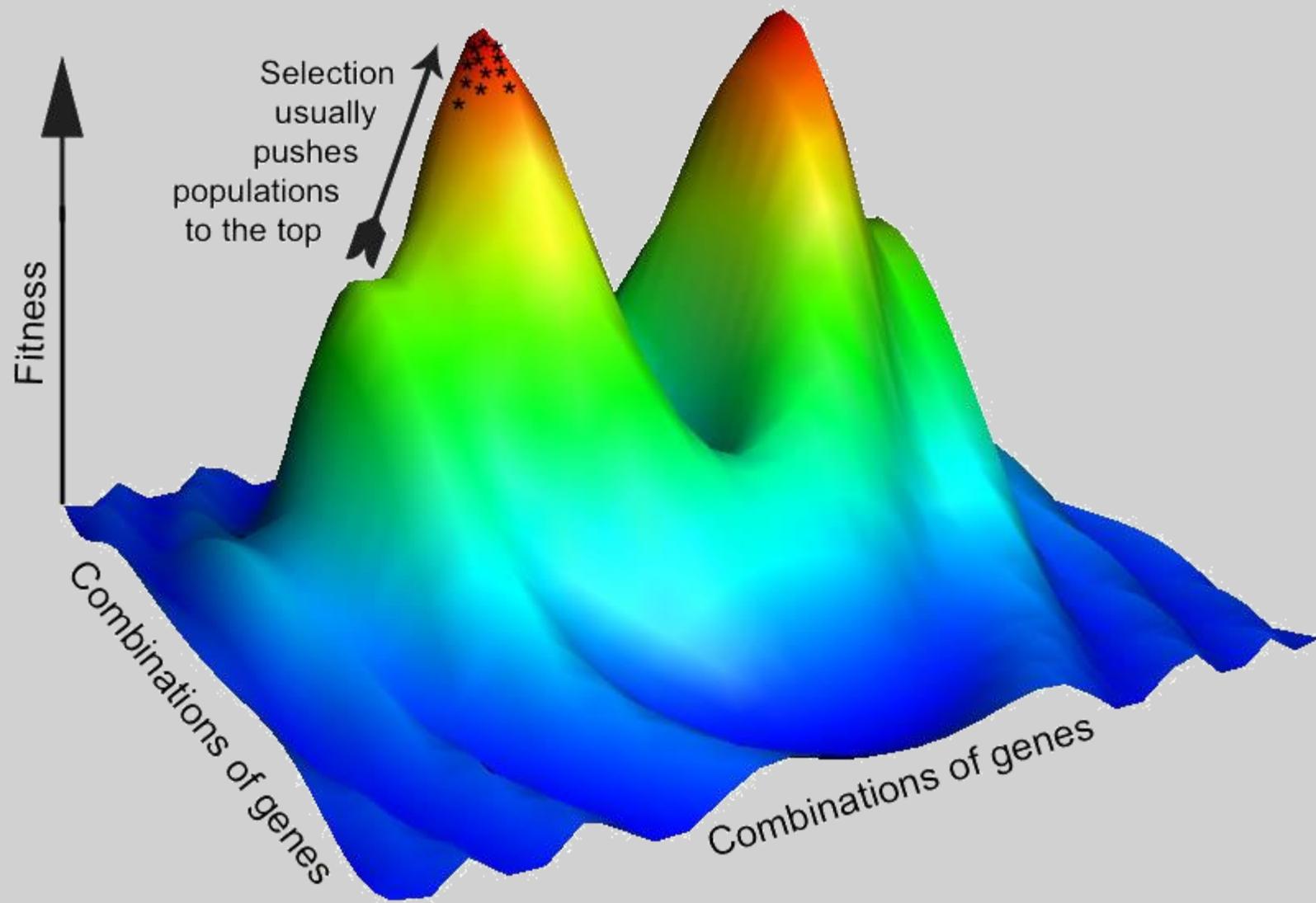




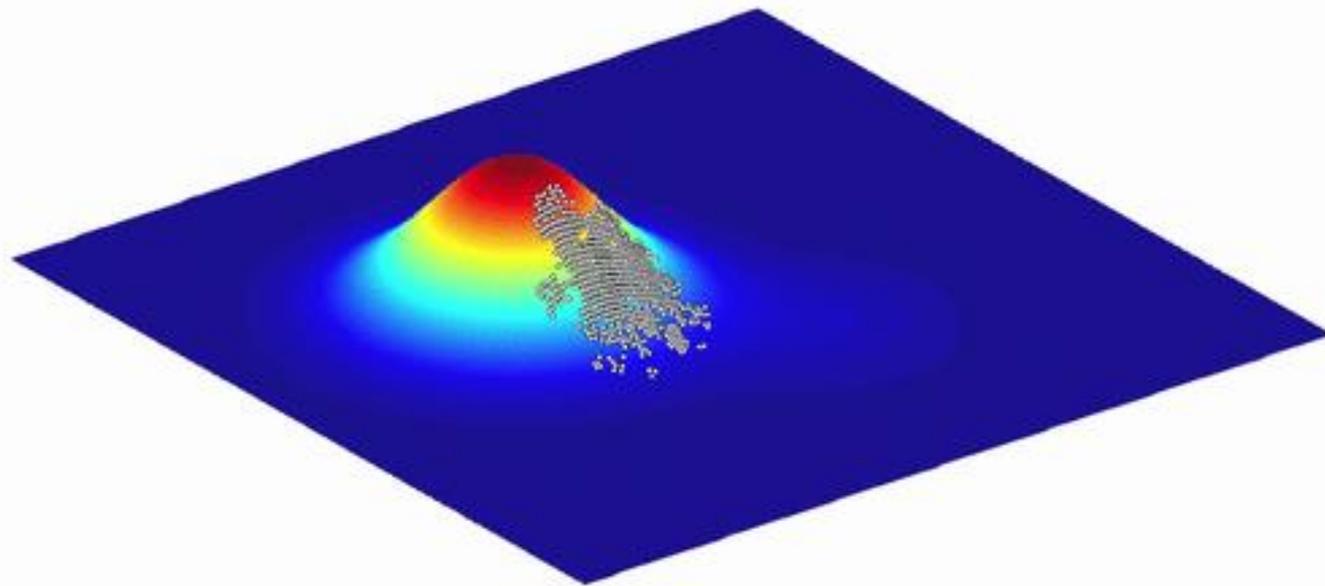
(a) Directional selection

(b) Diversifying selection

(c) Stabilizing selection



Dynamic fitness landscape

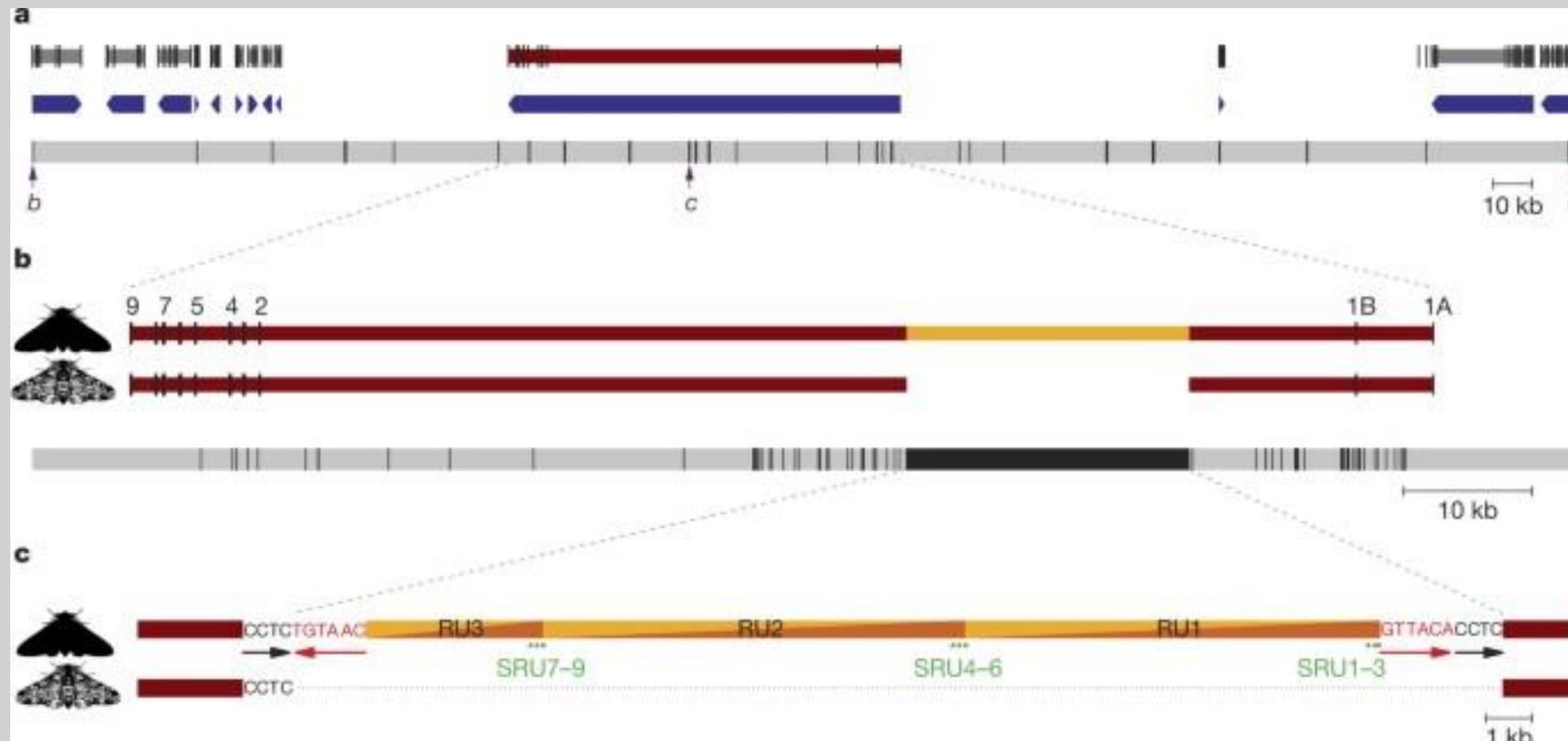


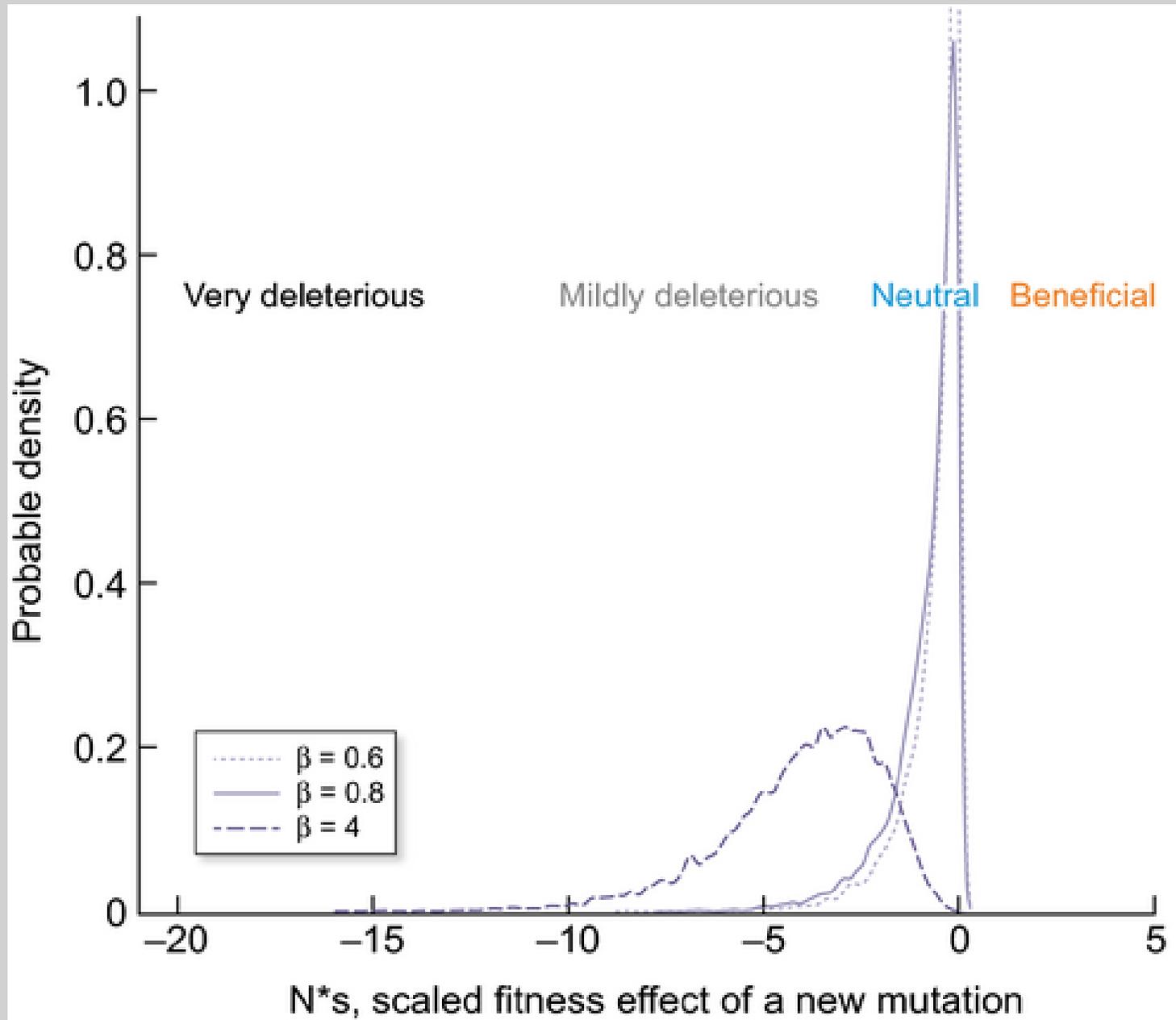
Population size, $N = 2,304$
Mutation rate, $\mu = 0.5$ per trait

© Randy Olson and Bjørn Østman

Origen de la variabilidad

- Mutación



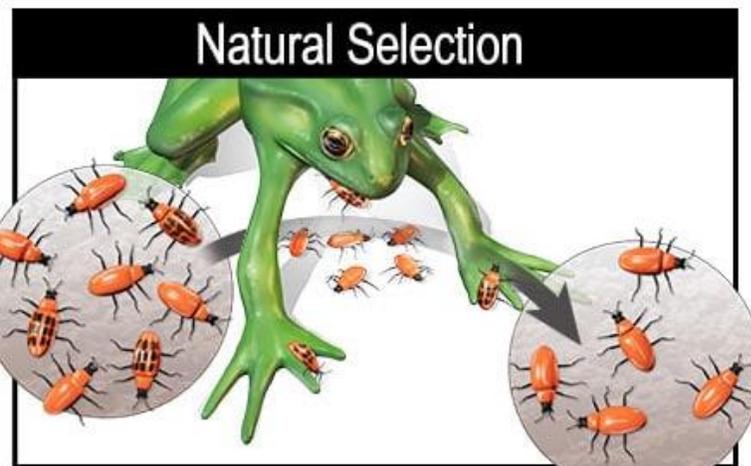
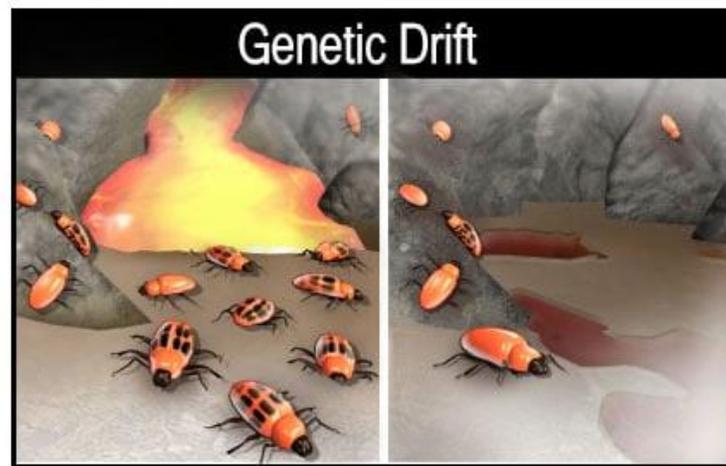
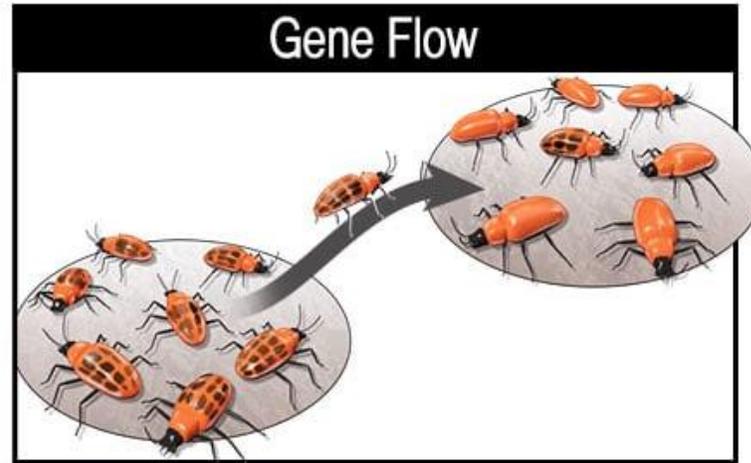
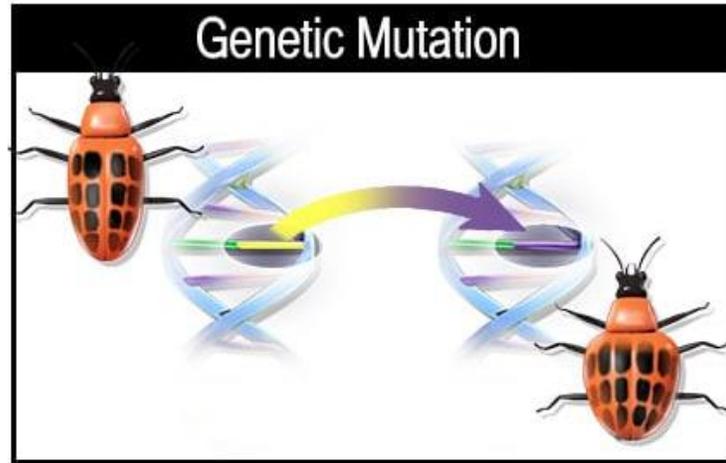


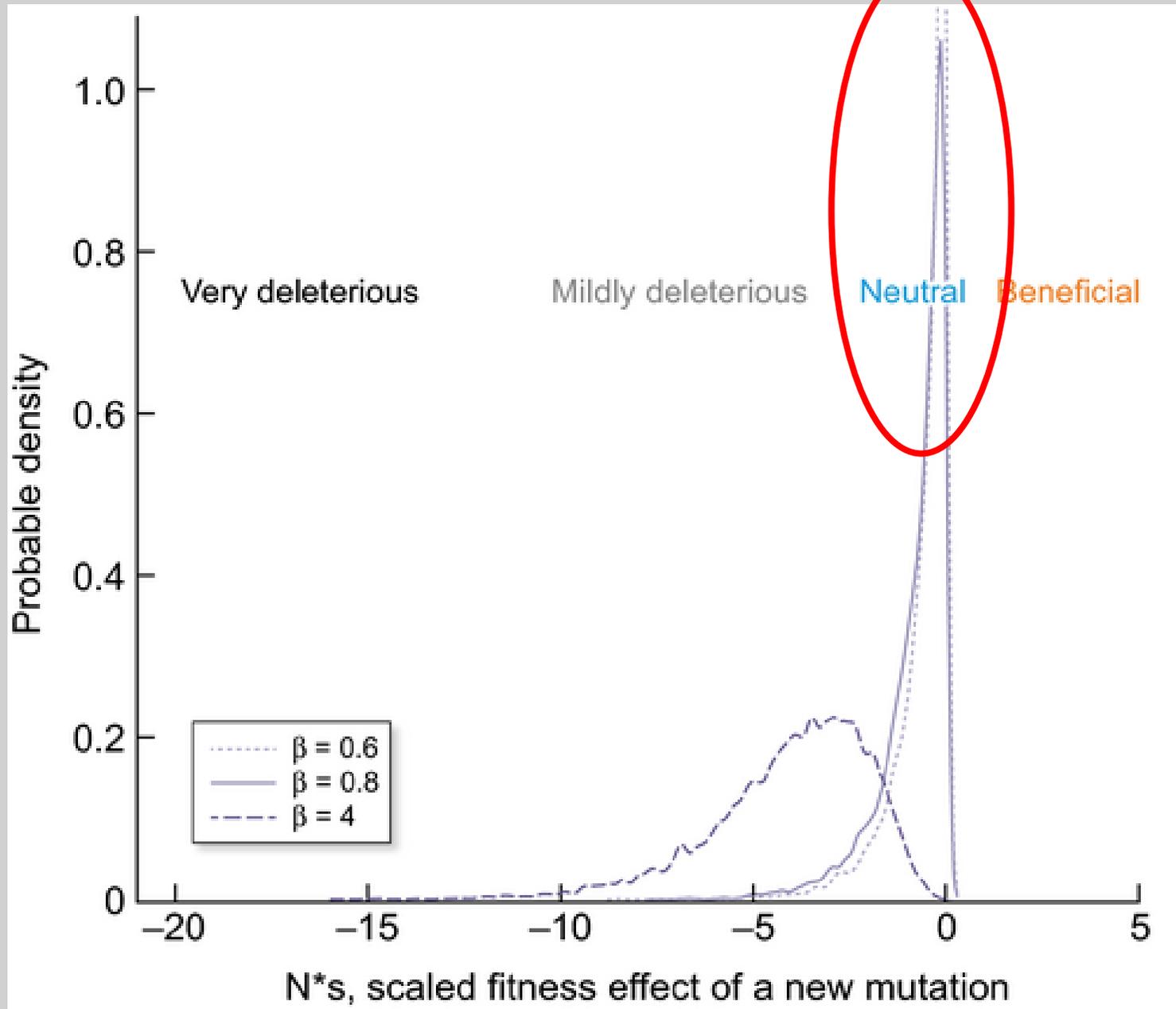
*LUCA

Mutación Preg 1

- Población 1:
 - N=1M individuos
 - Hábitat = Cálido y bonito
- Población 2:
 - N=1M individuos
 - Hábitat = Frio

Mecanismos



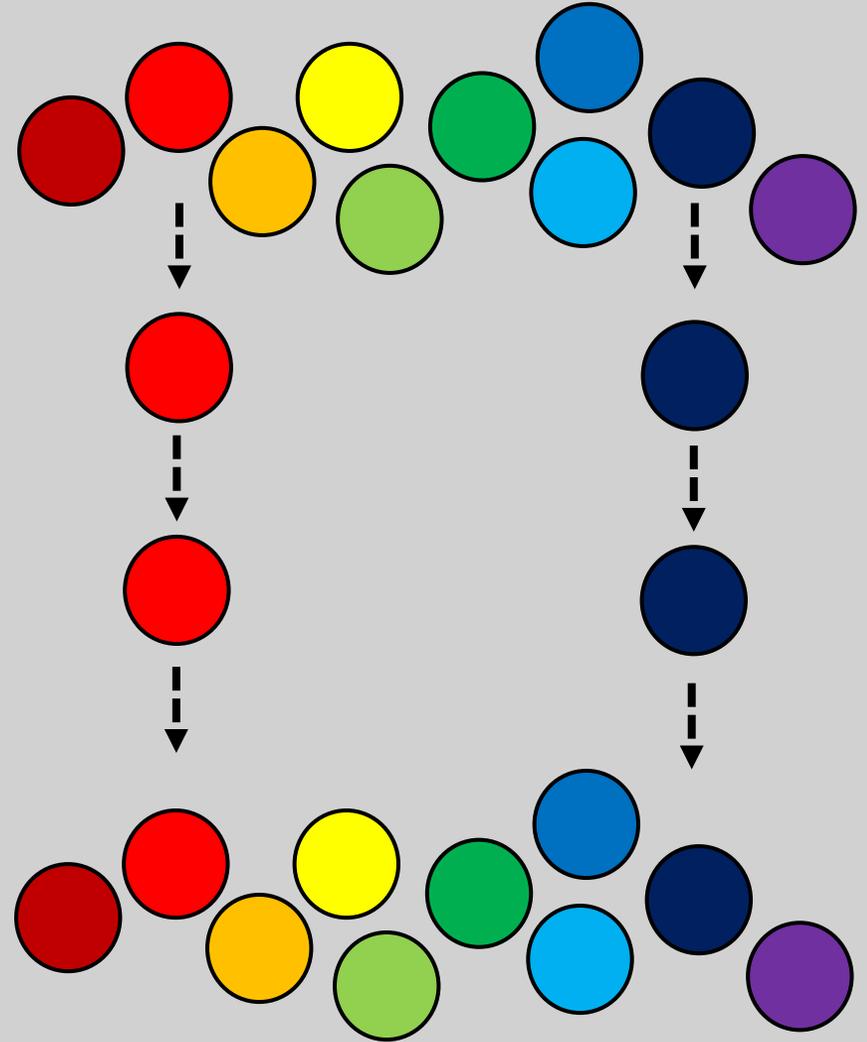


Evolución:

1) Variación

2) Herencia

3) Selección

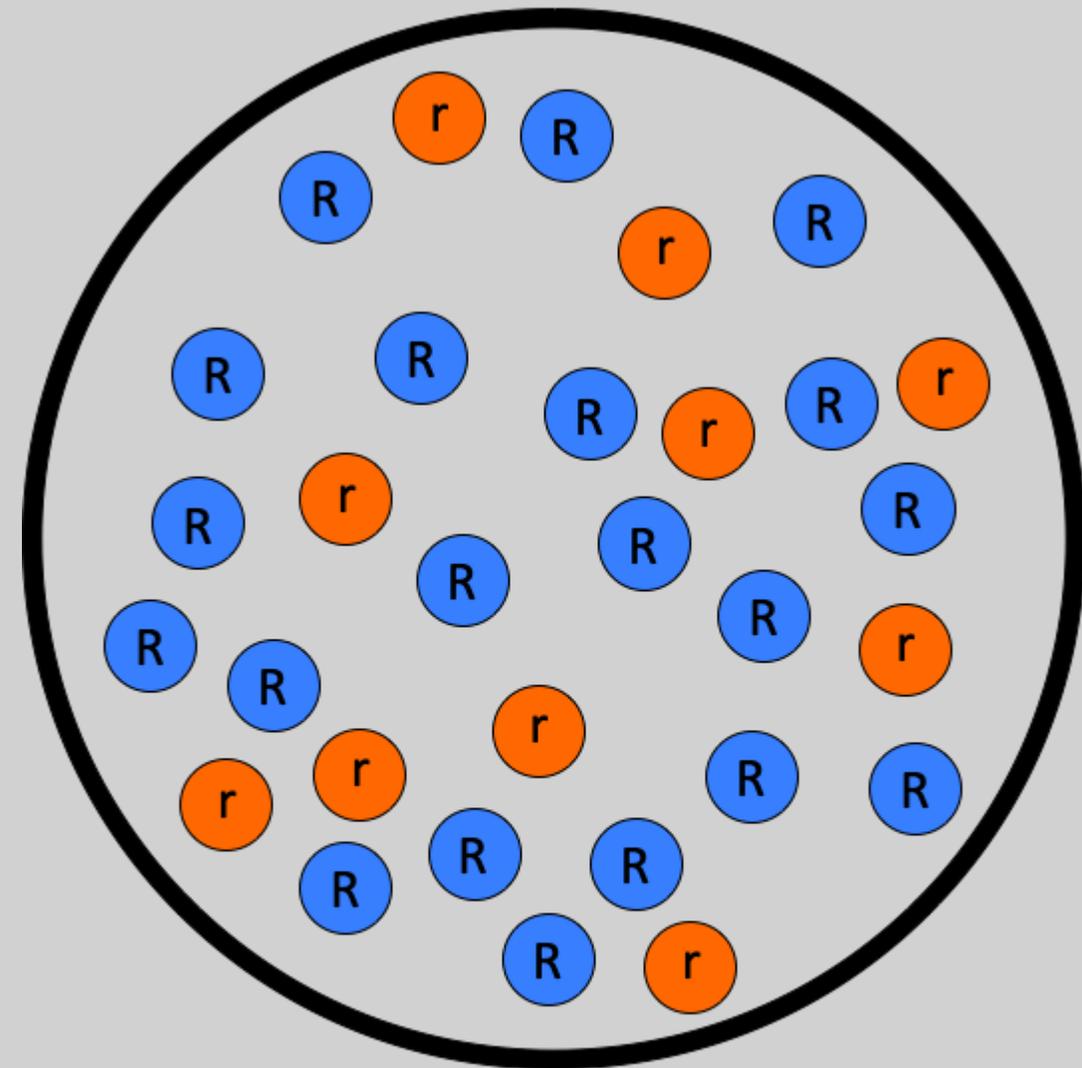


- Mutaciones neutrales \Rightarrow alelos coocurren

Y si no hay Evolución?

Equilibrio de la frecuencia alélica a través del tiempo

Equilibrio Hardy-Weinberg



 Freq(R) = 20/30 = 0.66
 Freq(r) = 10/30 = 0.33

Óvulo

 67%
 33%

Esperma

 67%
 33%

Freq R: p
Freq r: q

G1

->

G2

->

G3

->

Gn

Óvulo

 66%

 33%

Óvulo

 66%

 33%

Óvulo

 66%

 33%

Óvulo

 66%

 33%

Esperma

 66%

 33%

Esperma

 66%

 33%

Esperma

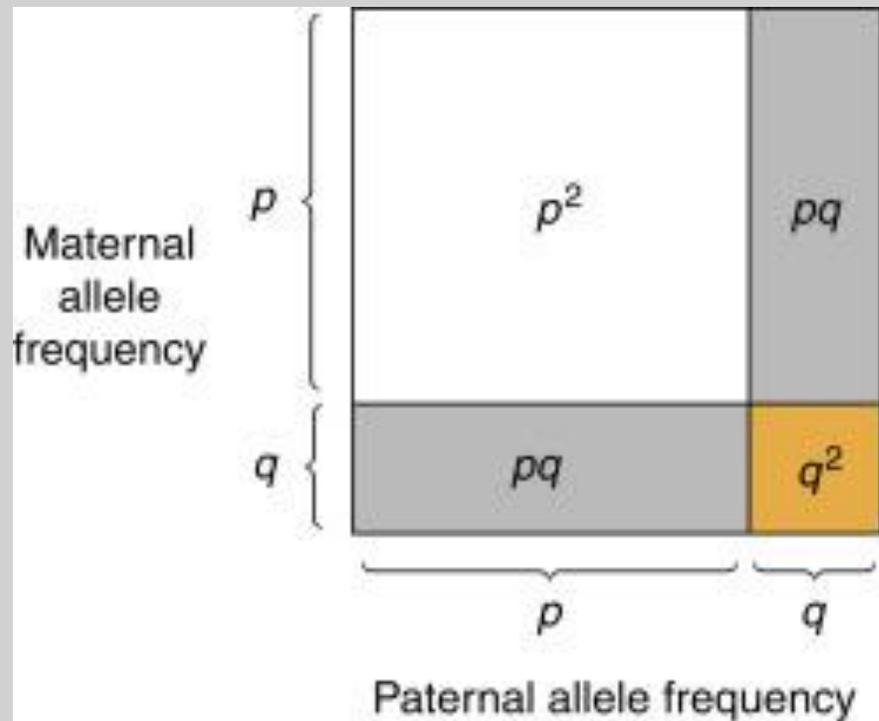
 66%

 33%

Esperma

 66%

 33%



Genotipos: $p^2+2pq+q^2$

Genotipos: $p^2+2pq+q^2$

- Si $p=0.67$ y $q=0.33$
- (RR) $p^2 = 0.67 * 0.67 = 0.45$
- (Rr) $2pq = 2 * 0.67 * 0.33 = 0.44$
- (rr) $q^2 = 0.33 * 0.33 = 0.11$

- Genotipo de 100 individuos (diploides)

$$G_{RR}: 9/100 = 0.09$$

$$G_{Rr}: 49/100 = 0.49$$

$$G_{rr}: 42/100 = 0.42$$

$$p: 18 + 49 = 67 / 200 = 0.33$$

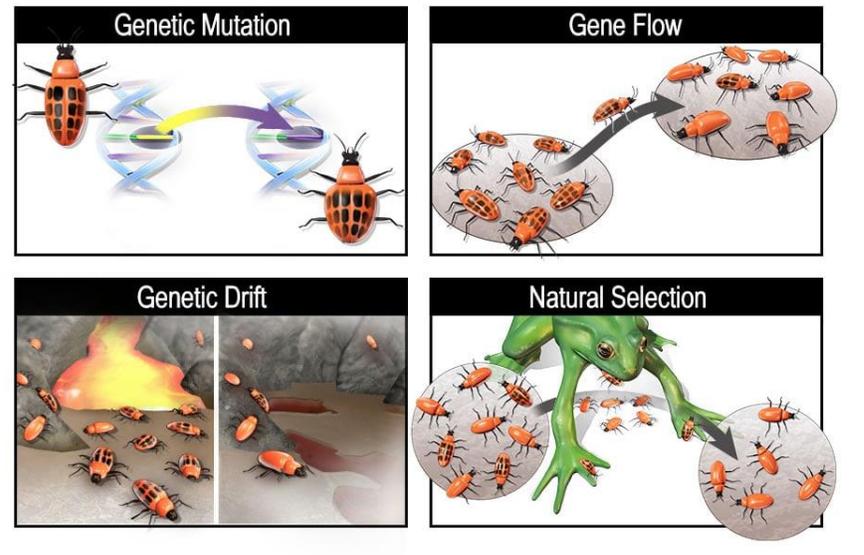
$$q: 1 - p = 0.67$$

Genotipo	N	Observado	Esperado
G_{RR}	9	0.09	0.11
G_{Rr}	49	0.49	0.44
G_{rr}	42	0.42	0.45
Total	100	1	1

Chi cuadrado

Supuestos

- Población es infinitamente grande
- Individuos se reproducen de forma aleatoria
- No hay selección
- No hay mutación
- No hay flujo génico



Mutaciones

- Poco frecuentes!

Humano: 1.2×10^{-8} (Scally y Durbin 2012)

1 en 100M en cada nucleótido

Mínimo efecto en frecuencias alélicas.

Mutación Preg 2

- Población 1:
 - N=100M individuos
 - Hábitat = Cálido y bonito
- Población 2:
 - N=1M individuos
 - Hábitat = Frio

Supuestos

- Población es infinitamente grande
- Individuos se reproducen de forma aleatoria
- No hay selección
- No hay mutación 
- No hay flujo génico

Supuestos

- Población es infinitamente grande
(Poblaciones pequeñas, Deriva y efecto fundador)
- Individuos se reproducen de forma aleatoria
(Estructura poblacional, Endogamia, Apareamiento selectivo)
- No hay selección
(Diferentes tipos de Selección)
- No hay flujo génico
(Flujo génico)