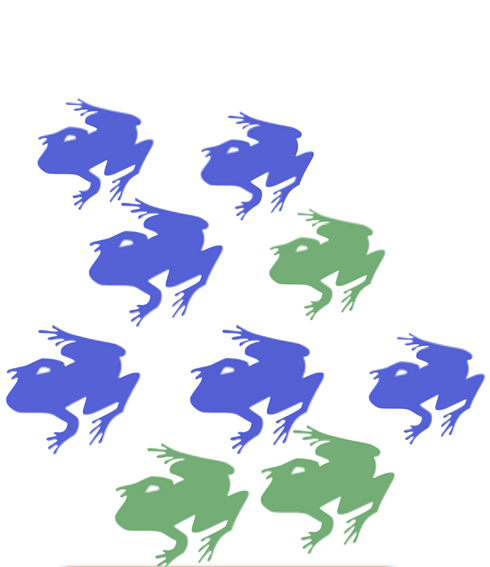
Variation & Selection

Lecture 3



VARIATION

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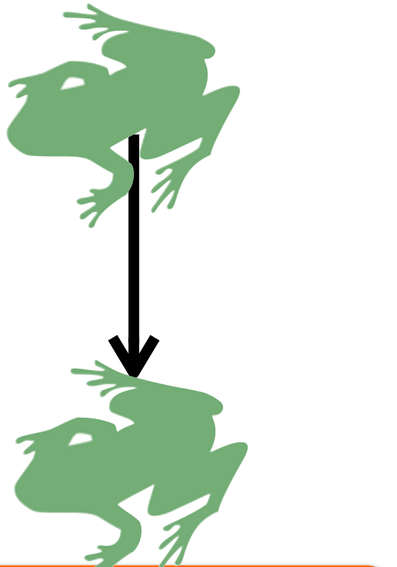

HEREDITY

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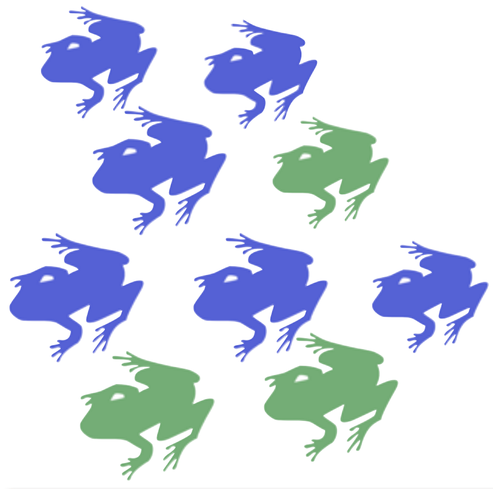

NON-RANDOM SURVIVAL & REPRODUCTION

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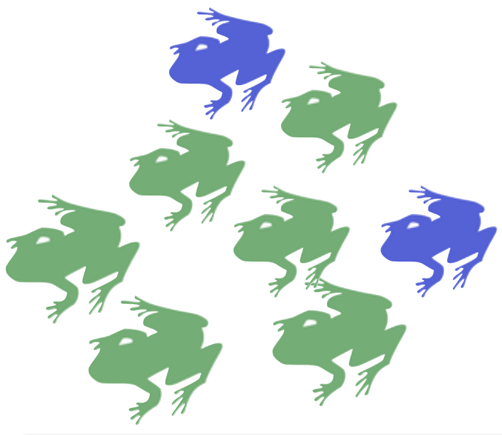
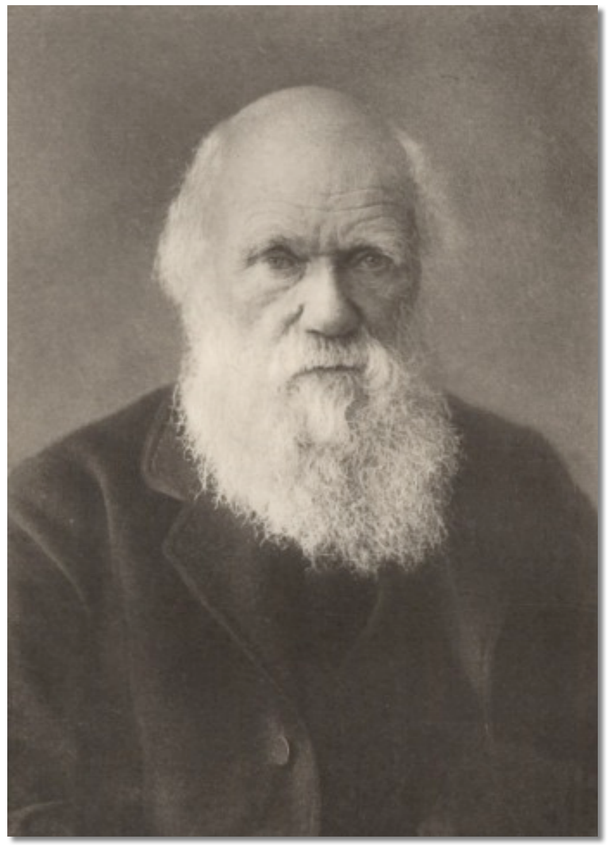


CHANGES IN THE CHARACTERISTICS OF THE POPULATION

Variation is the raw material for evolution

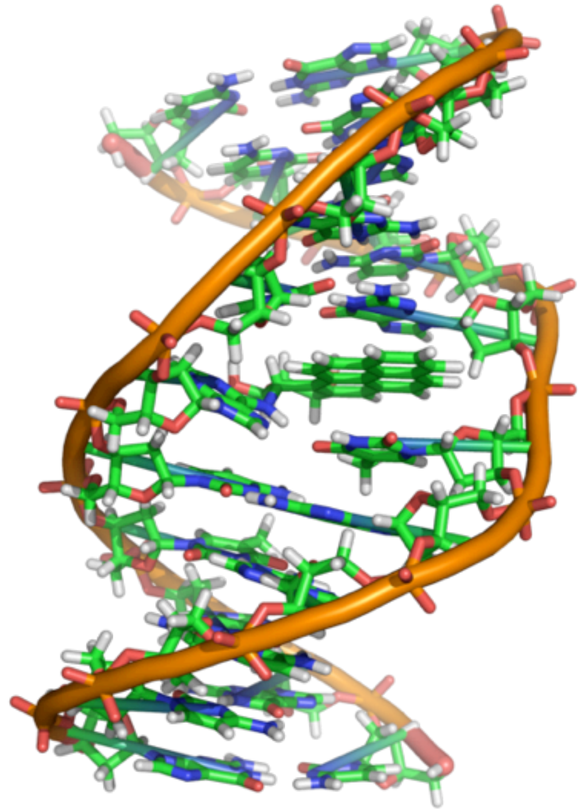
Modern definition of evolution

1859



Descent with modification

~1930

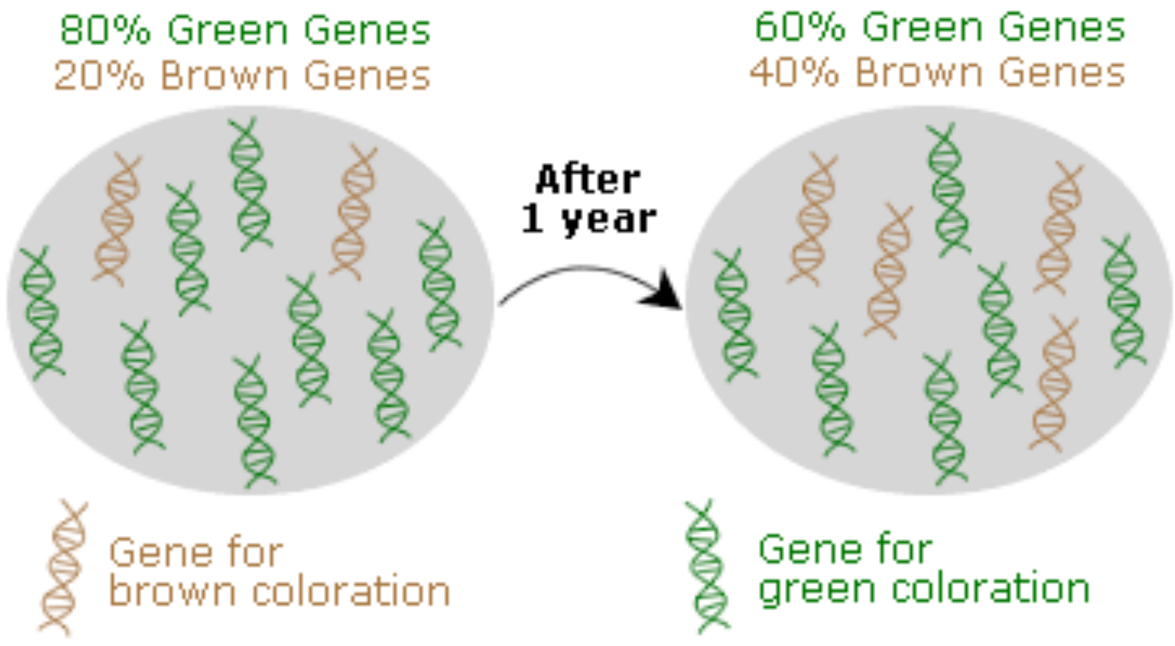


Change in the allele frequency of a population across generations

Modern definition of evolution

- **Allele frequency:** the relative abundance of the different alleles at one loci in a population

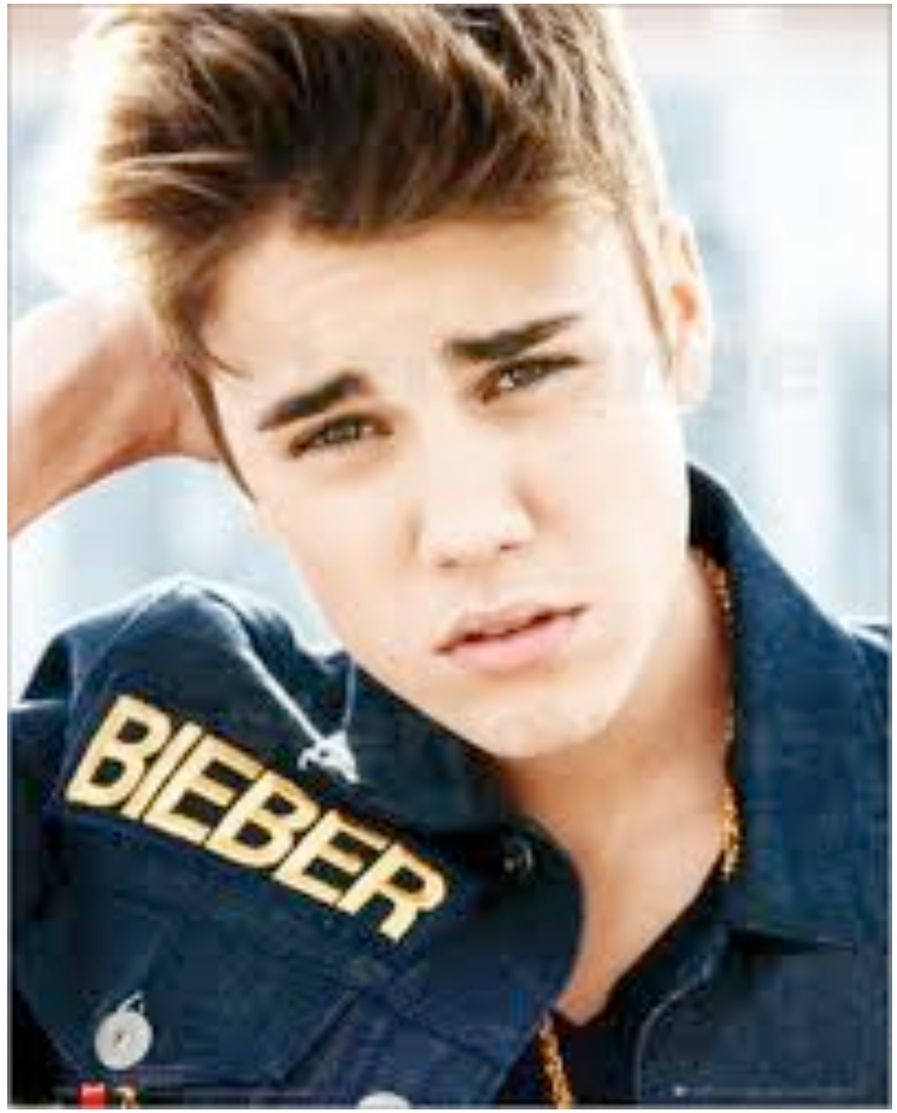
- **Evolution:** change in allele frequency between generations



Source: http://evolution.berkeley.edu/evolibrary/article/evo_24

How do I feel about Justin Bieber?

- A) I love him
- B) I can't stand him
- C) I am Bieber indifferent



The Bieber gene (B)

2 Alleles for B (B & b)

Incomplete dominance

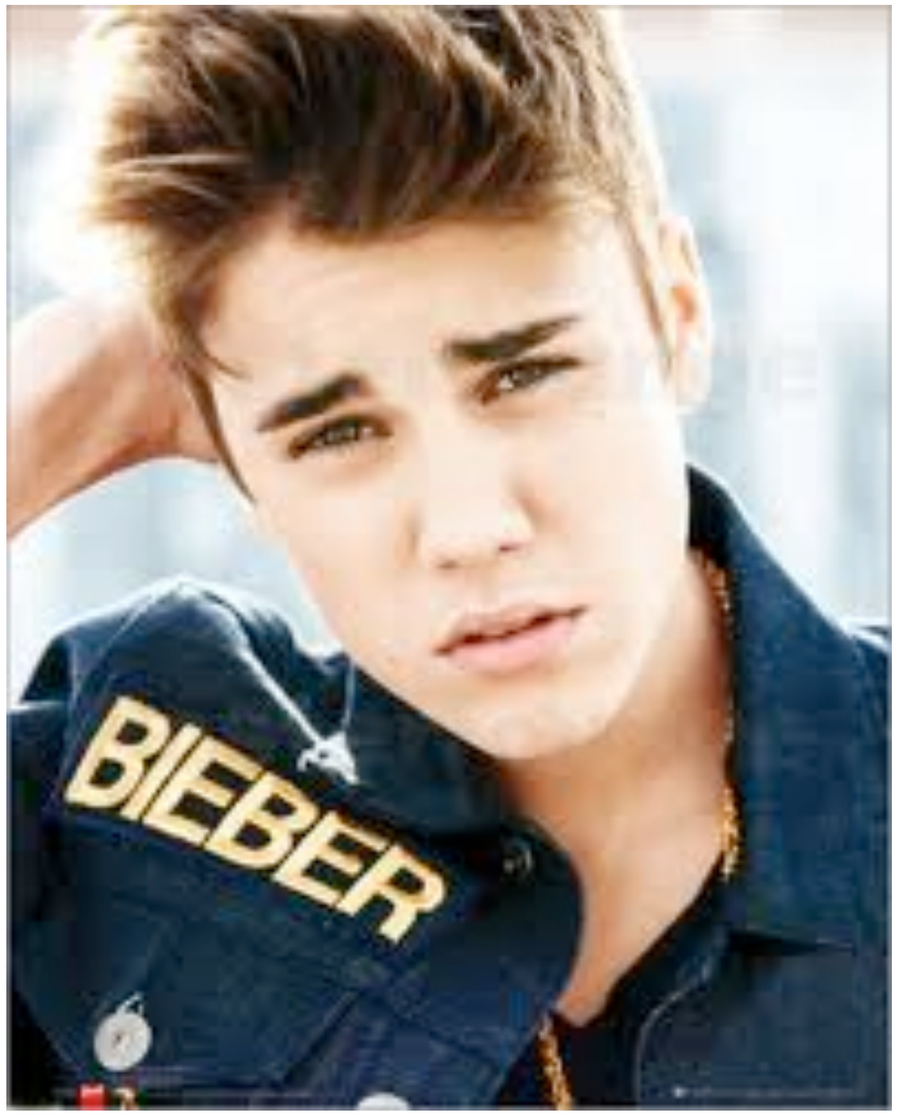
BB = Love

Bb = Hate

bb = Indifferent

Genotype

Phenotype



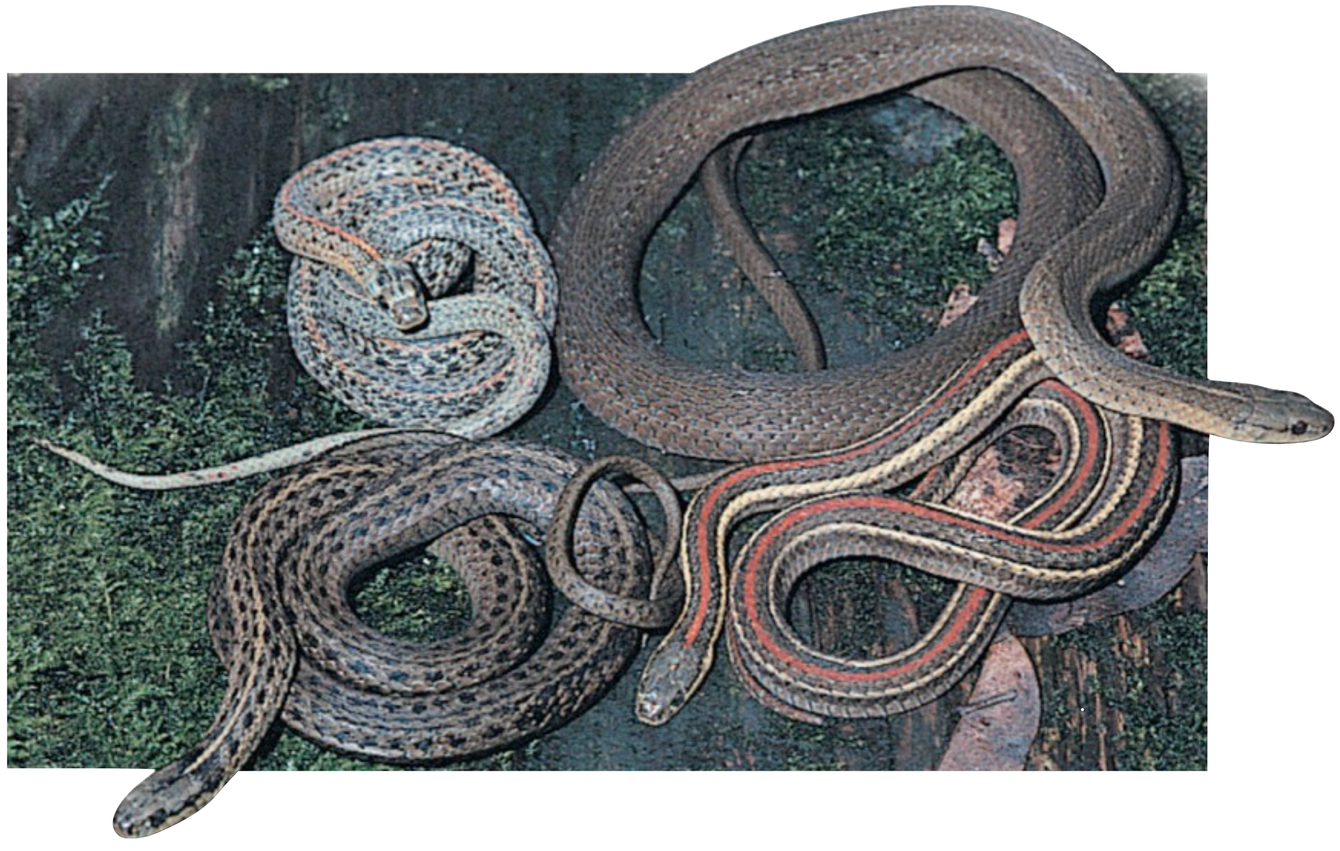
Allele frequency

Phenotype	Genotype (g)	Number of individuals	Genotype frequency	Total number of a alleles	Total number of A alleles
Can't stand	bb				
Love	BB				
Indifferent	Bb				
	Total				

Because each individual has two alleles, the number of alleles is twice the number of individual.

Frequency of B =
Frequency of b =

Variation



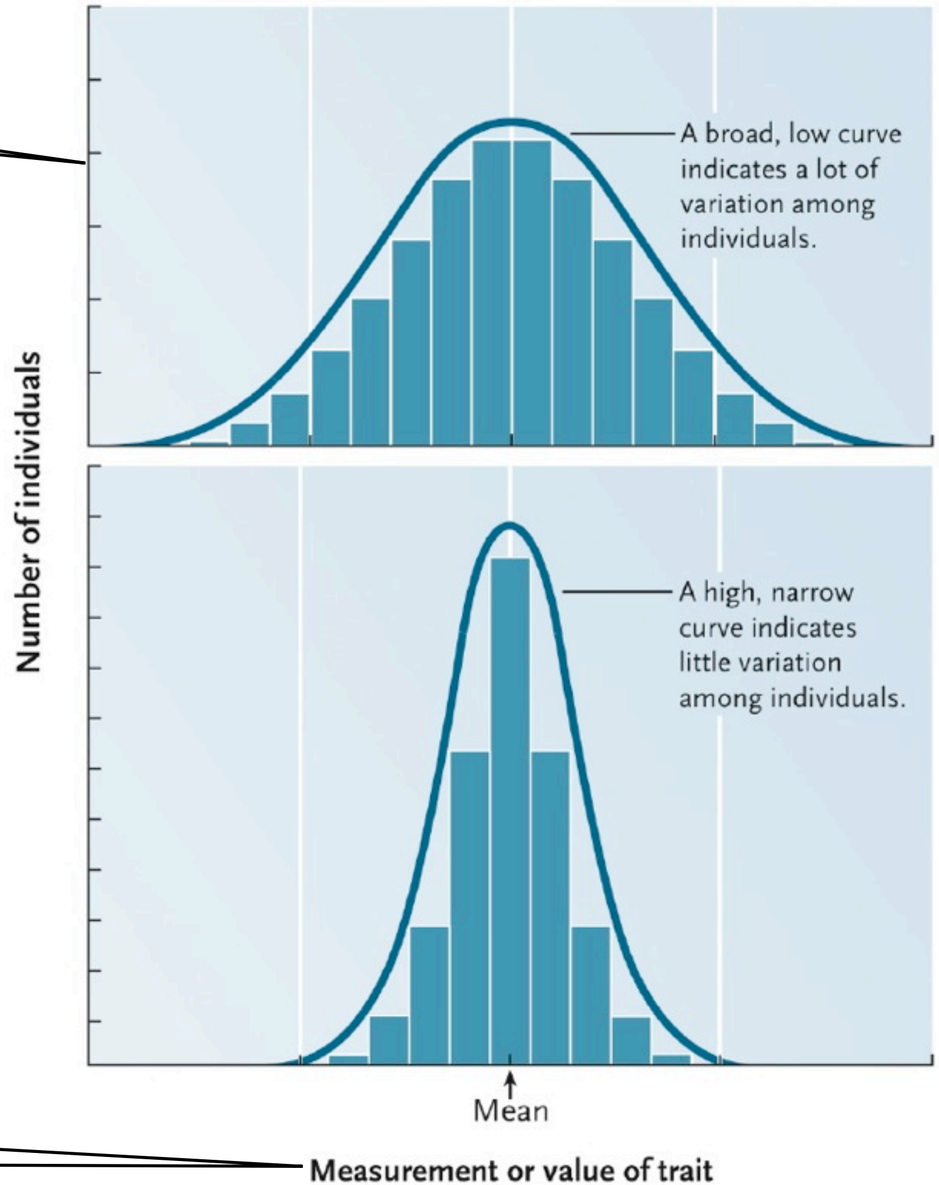
Variation in morphology, physiology, and behavior exist in all populations but it may be more subtle in some populations than other

Variation

- Traits can be continuous (e.g. height) or discrete (e.g. color)

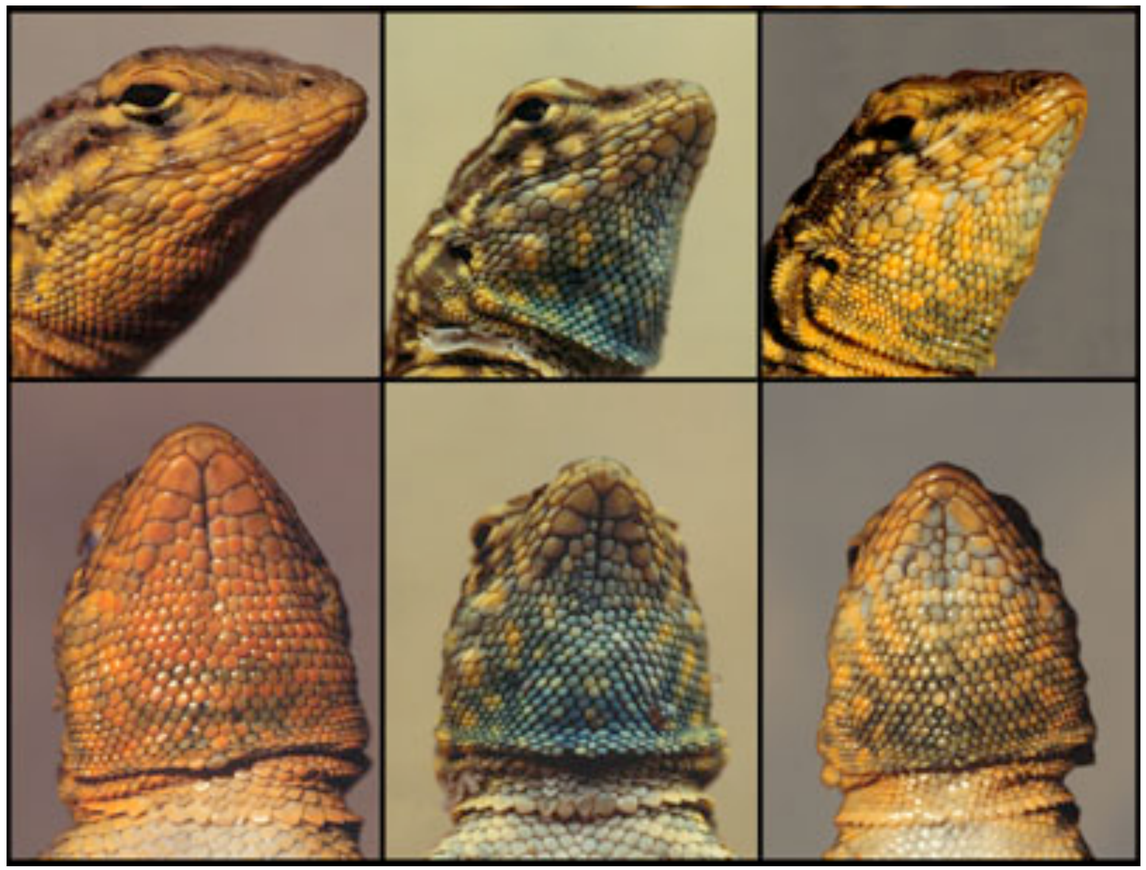
- Variation in **continuous traits** is typically displayed with histograms (frequency distribution)

- The existence of multiple variants of a **discrete trait** is called **polymorphism**



Polymorphism

Side blotched lizard (*Uta standburiana*)



http://bio.research.ucsc.edu/~barrylab/lizardland/lizard_heads.jpg

Red back salamander (*Plethodon cinereus*)

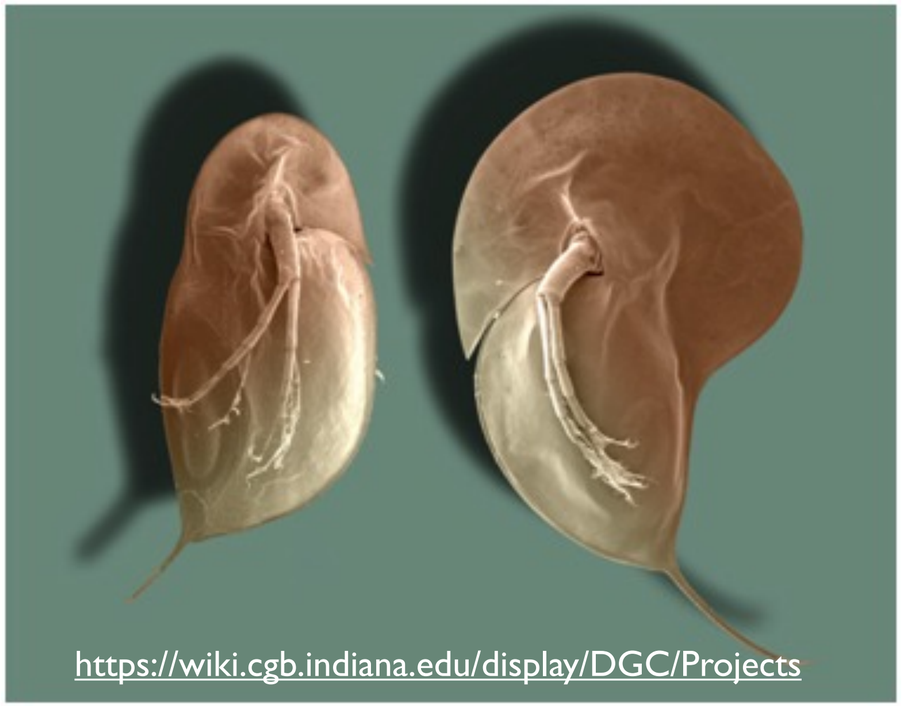
http://euclid.nmu.edu/~jophilli/red-backed-salamander1.1.jpg

Genotype vs Phenotype

Genotype: The genetic make-up of an organism

Phenotype: The expressed traits of an organism.

The same genotype may express different phenotype depending on the environment (**Phenotypic plasticity**)



Phenotypic plasticity

Phenotypic variation

Variation is due to differences in the environment

Variation due to genetic differences

Only variation caused by genetic differences can lead to evolution

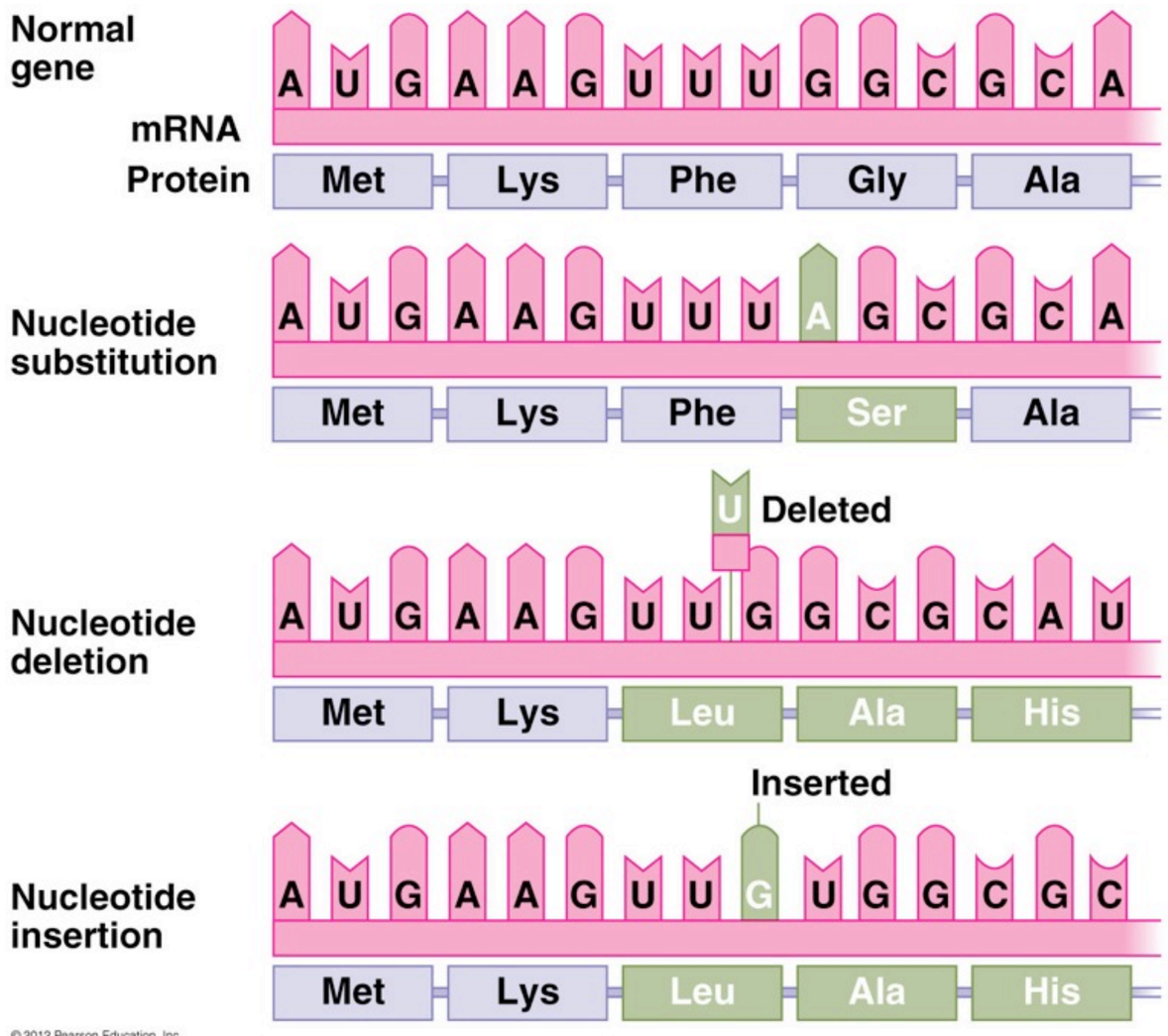
Where are new alleles coming from?

Mutation: a change in the nucleotide sequence of DNA

Most mutations are harmful but some rare ones are beneficials

Mutations are the ultimate source of genetic variation

Because mutations can create new alleles they cause evolution



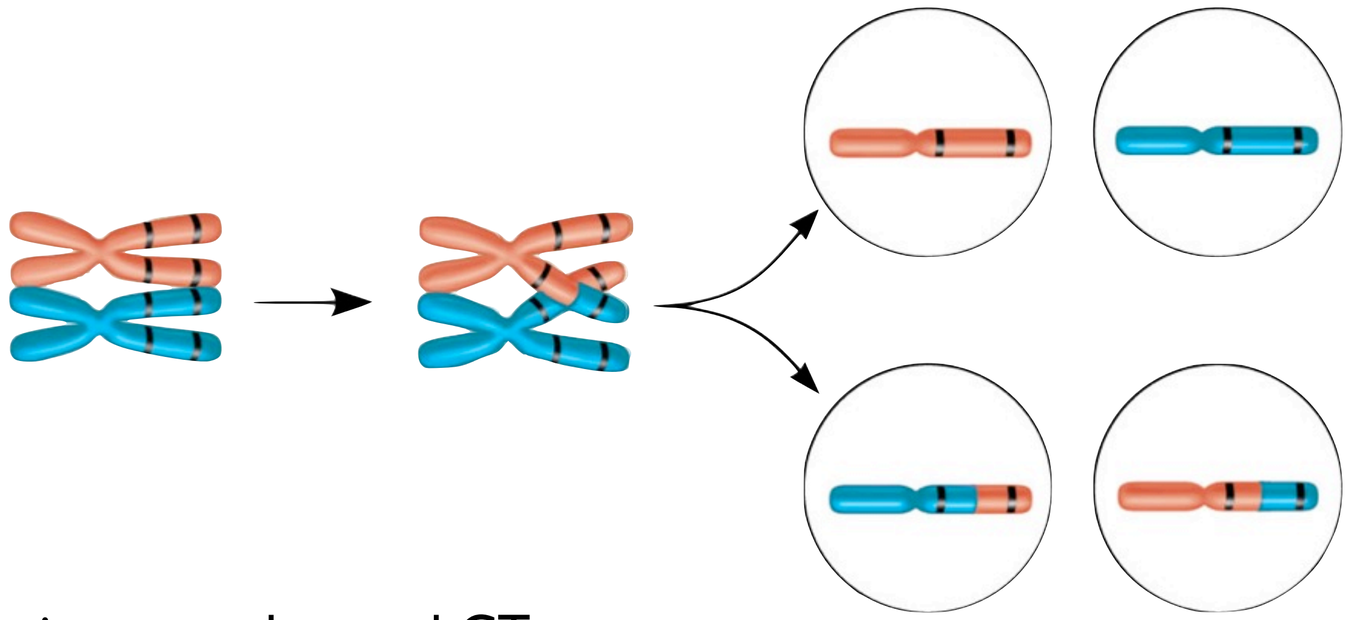
Other sources of genetic variation

Genetic recombination (sexually reproducing organisms):

1. **Independent orientation of chromosomes** (meiosis)

2. **Crossing over** (meiosis)

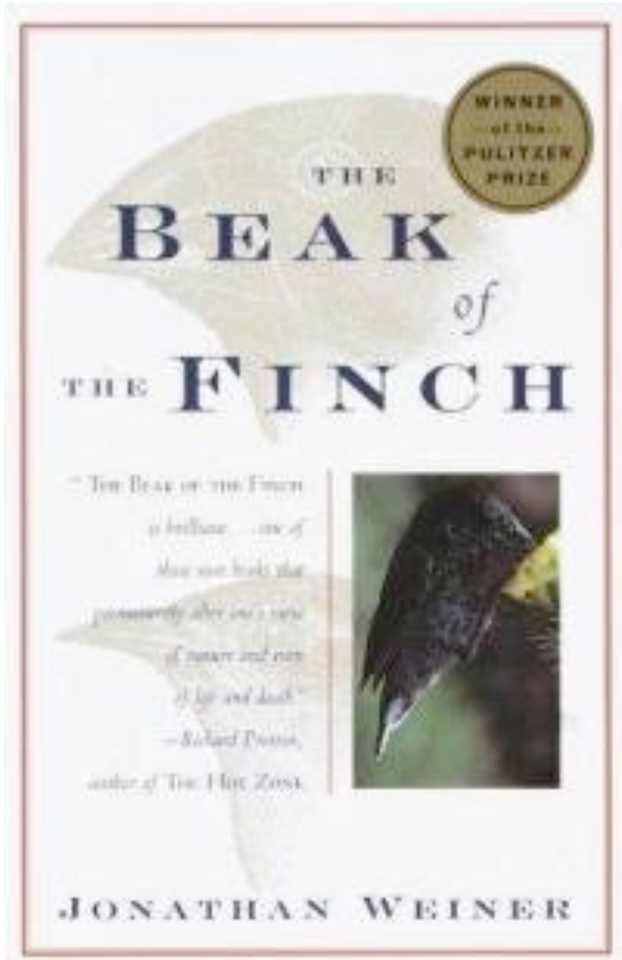
3. **Random fertilization**



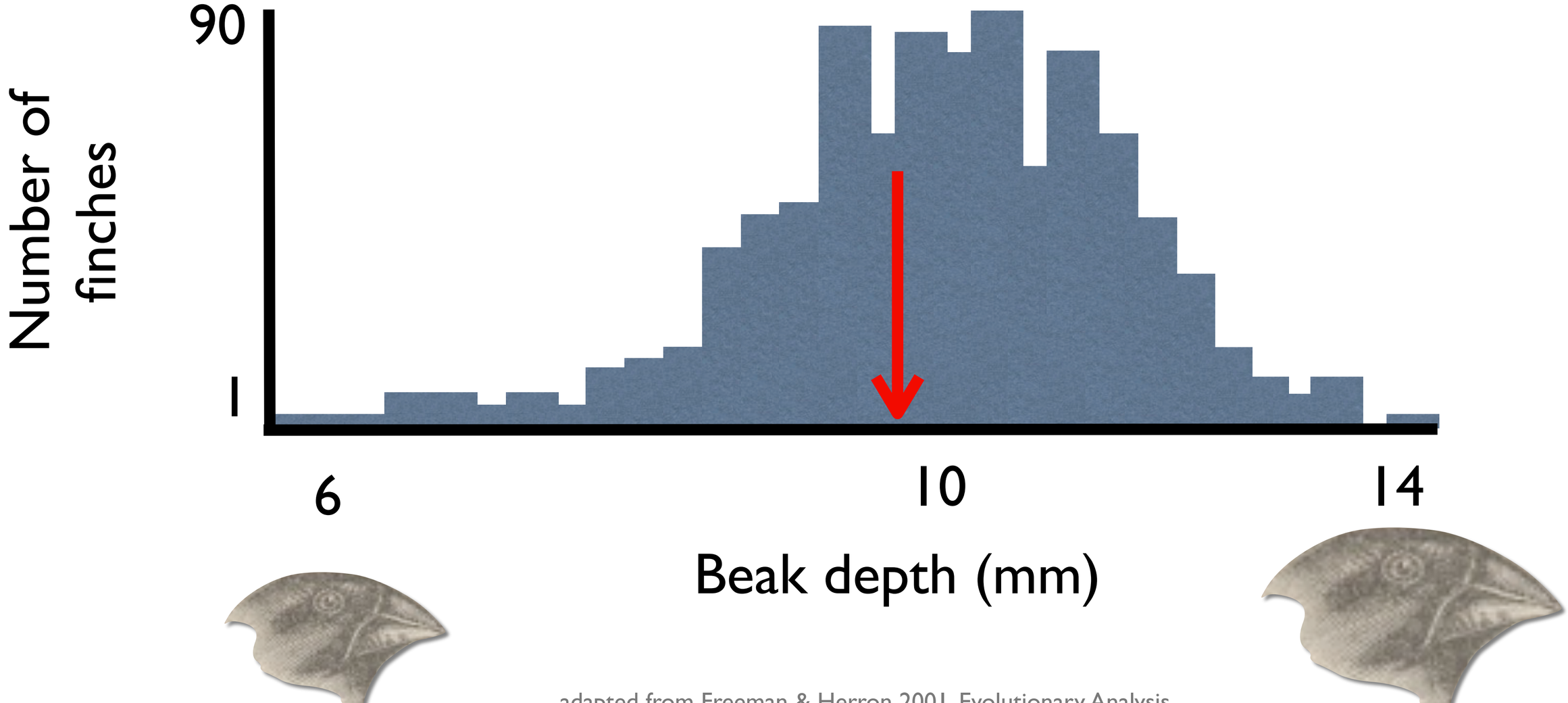
see pages 136 to 142 of textbook for review + animation posted on webCT

Variation & Selection in Nature

Peter and Rosemary Grant

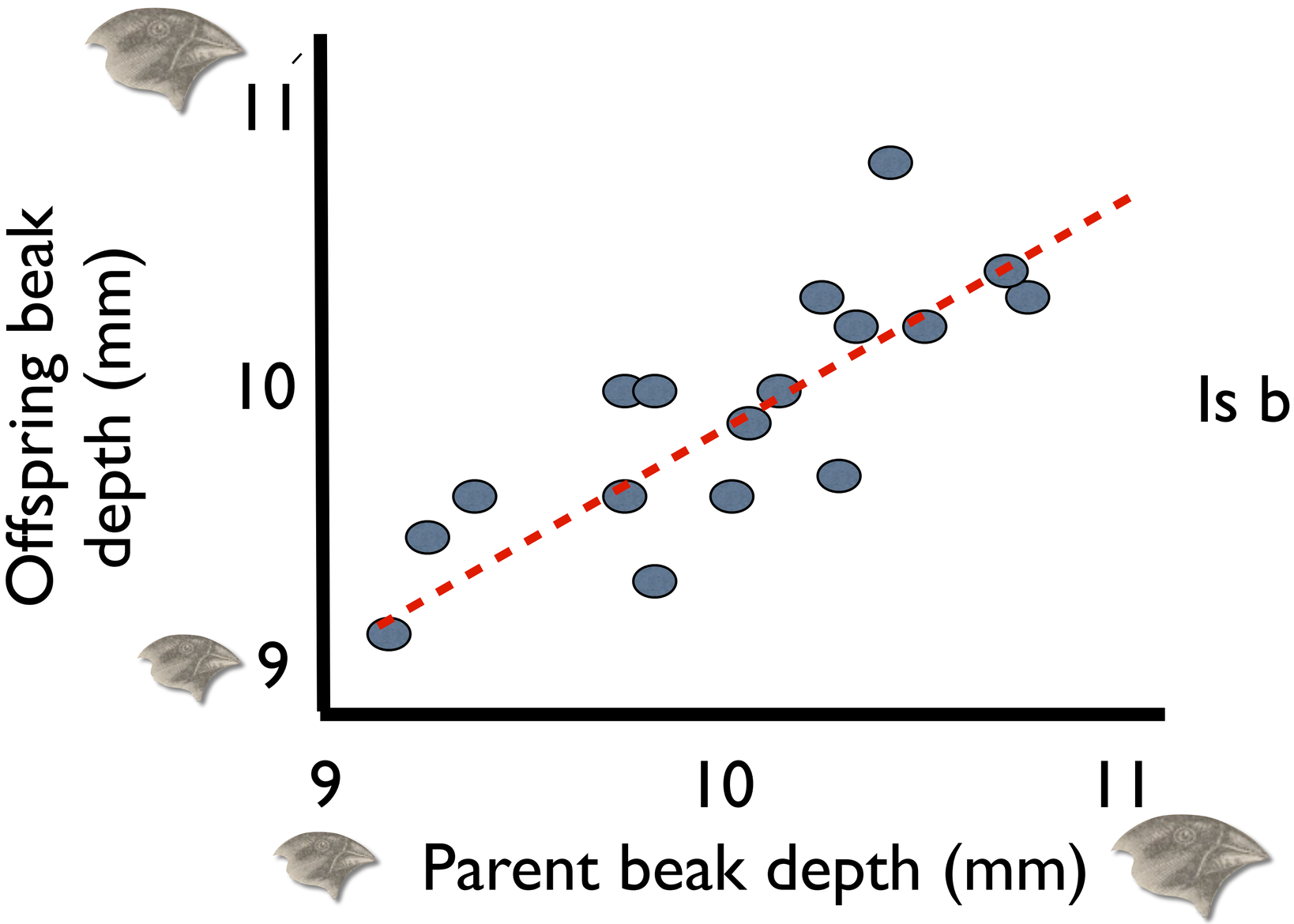


Variation in beak size



adapted from Freeman & Herron 2001. Evolutionary Analysis

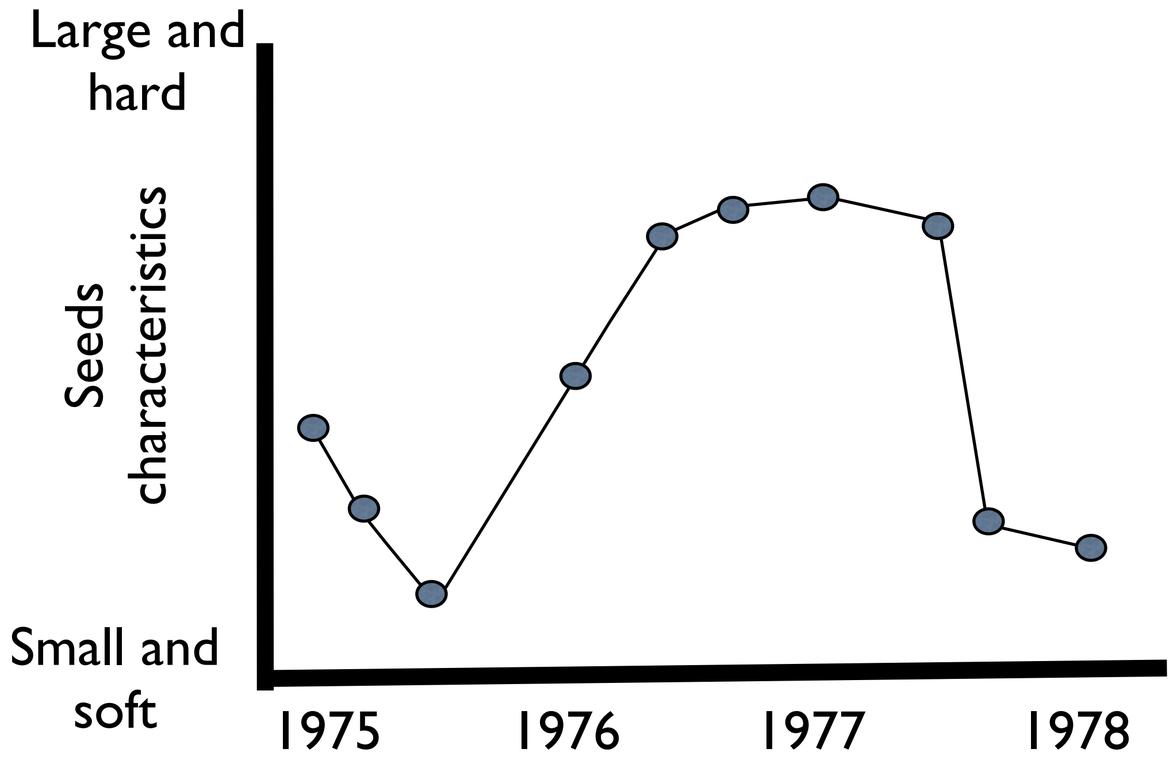
Heritability

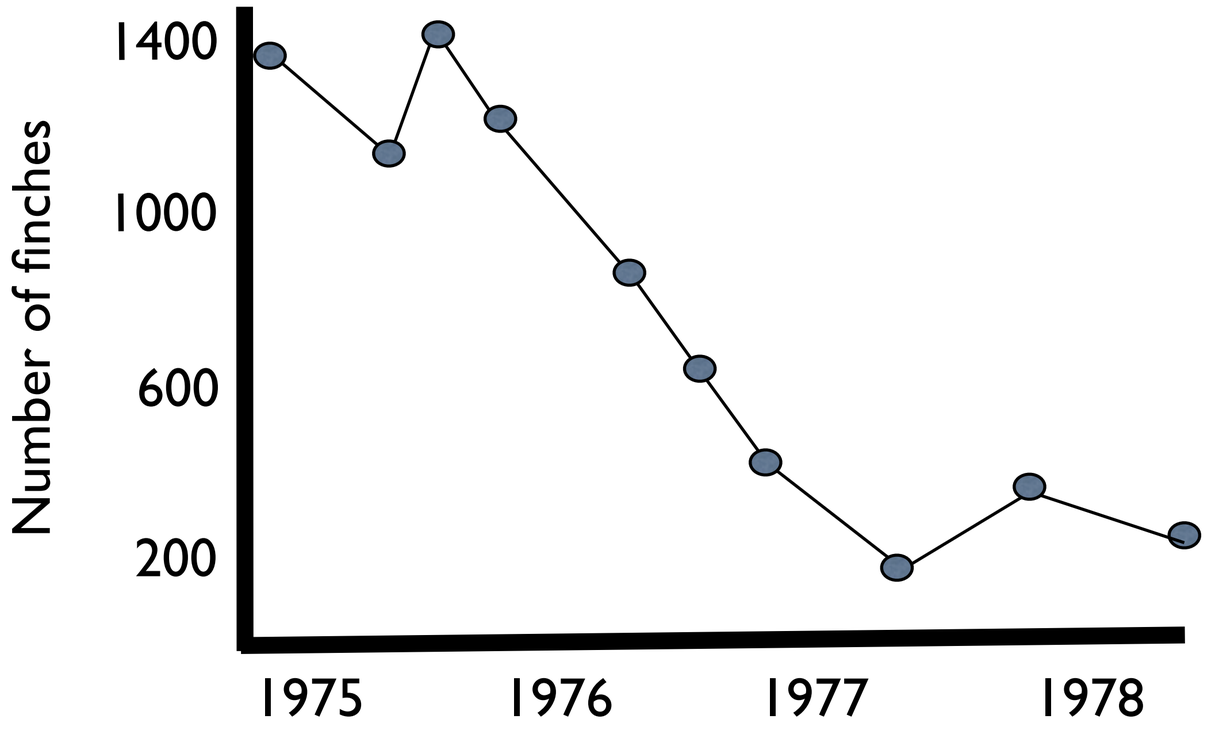


Is beak size a heritable trait?

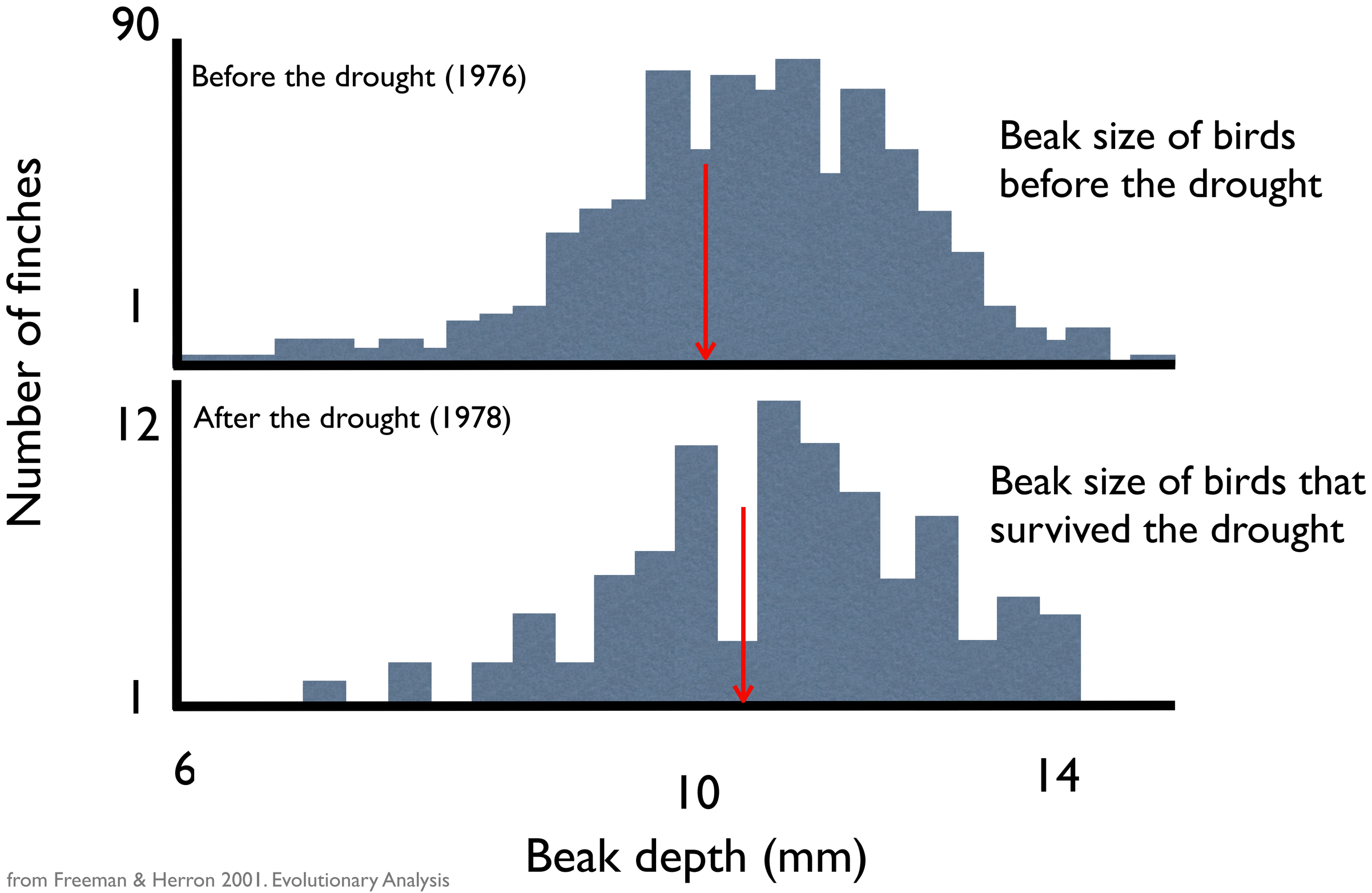
adapted from Freeman & Herron 2001. Evolutionary Analysis

Change in the environment





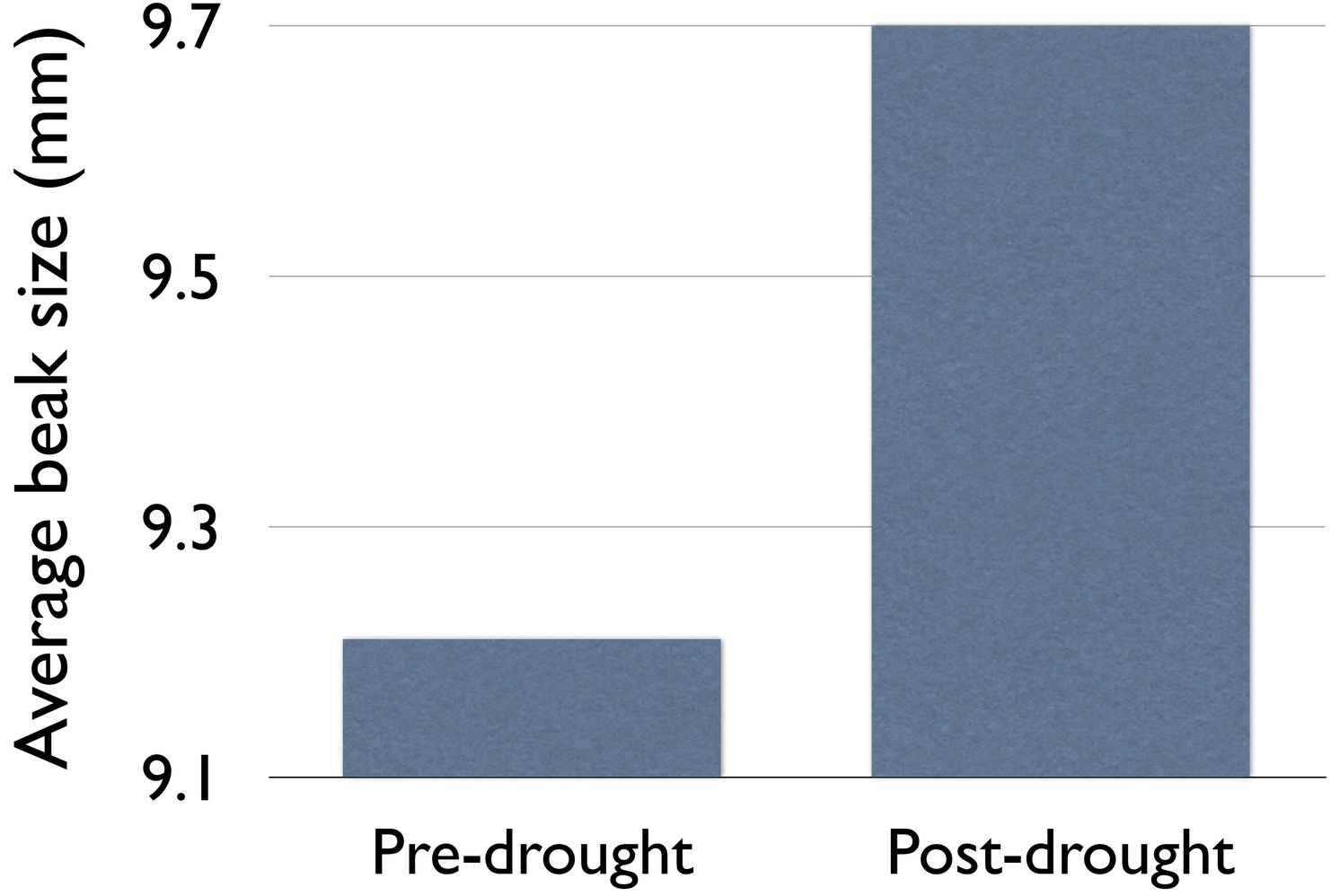
adapted from Freeman & Herron 2001. Evolutionary Analysis



adapted from Freeman & Herron 2001. Evolutionary Analysis

Beak size of offsprings

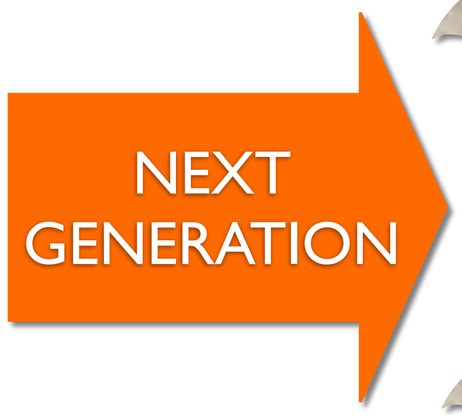
Change in the heritable characteristics of a population between generations



adapted from Freeman & Herron 2001

Natural selection acts on individuals but its consequence, evolution, occur in population

Natural selection acts on **individuals** within generation



Evolution occurs in **populations** between generation

Fitness

- **Darwinian fitness**: the extent to which an individual contributes genes to future generations

- Natural selection is not about survival nor being the best (i.e. the fittest)

- Survival is necessary but not sufficient for individual to be selected. Selected individuals are those that produce offsprings carrying their genes.

- Natural selection does not select the *fittest* but the *fit enough* given current conditions

Adaptation

- **Adaptation:** An heritable trait that increases the ability of an individual to survive or reproduce compared to an individual without the trait. A trait that increases fitness is said to be adaptive.

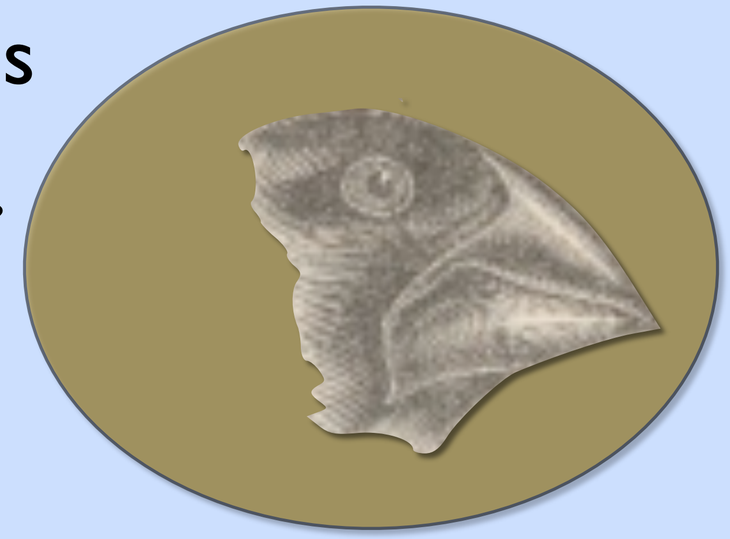
- **Organisms are not trying to adapt**. They either have the necessary genetic variation to survive and reproduce or they don't.

- **Natural selection has no intention** to create more adapted species. Selection is only a consequence of the differences in fitness among individuals

Adaptation doesn't involve trying.

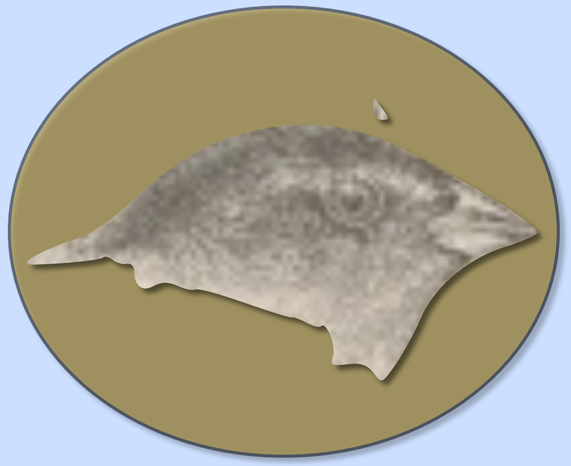
http://evolution.berkeley.edu/evosite/misconceps/IDtrying.shtml

Island with
big/hard seeds



Mainland

Island with
small/soft seeds

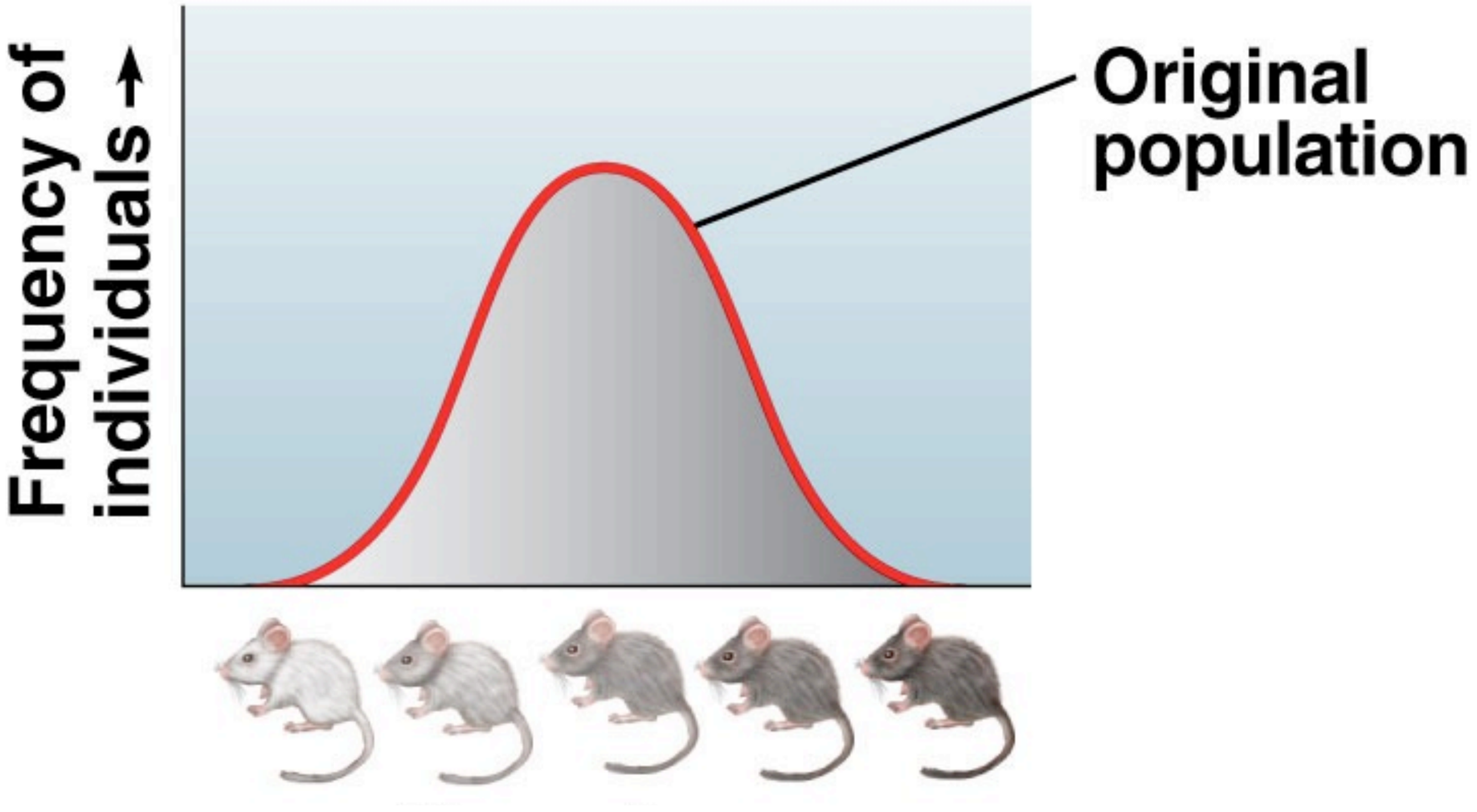


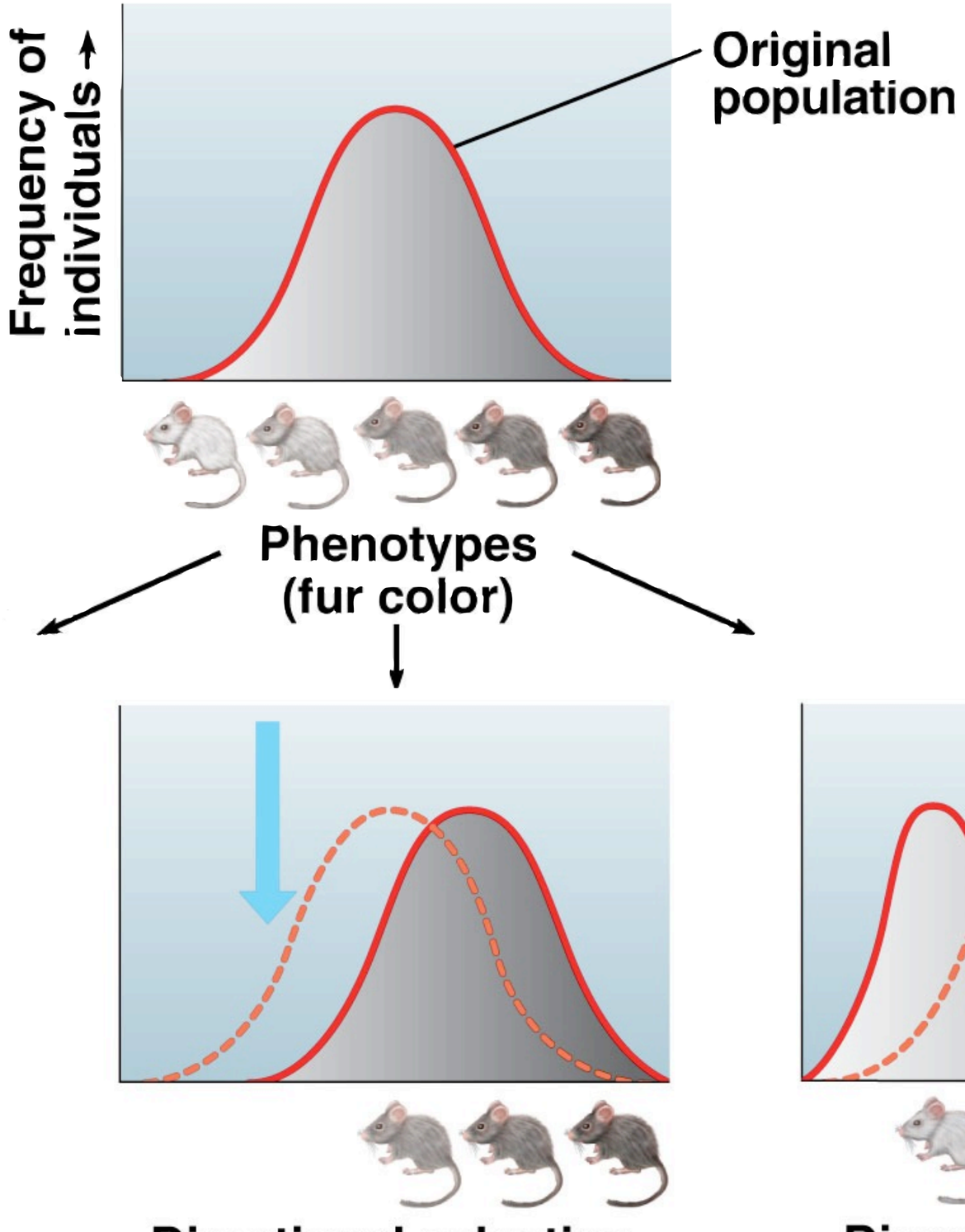
QUESTIONS

- Long legs appear to be an adaptation for running in cheetahs. However even longer legs would allow cheetah to run faster and be more efficient at capturing prey and escaping predators.

- Why longer legs did not evolve in cheetahs?

Selection can alter variation in a population in three ways




Frequency of individuals
Original population
Phenotypes (fur color)
Original population
Evolved population
Stabilizing selection
Directional selection
Disruptive selection

What type of selection was operating in the Darwin finch example?

A) Directional
B) Disruptive
C) Stabilizing
D) Impossible to say from the data

Which of the following pattern of survival will lead to stabilizing selection ?