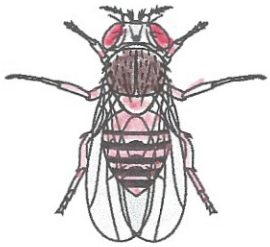
Genetic Drift in the Lab

In the 1950s, Peter Buri performed an experiment with Drosophila to test whether in small populations, genetic drift could cause large changes in allele frequency.

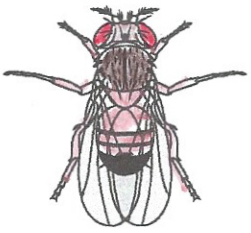
- He used flies in his experiment with two eye color alleles in one autosomal gene:

RR flies were red eyed.
Rr flies were orange eyed.
rr flies were white eyed.

- He crossed orange heterozygote flies (8 males and 8 females).
- When those flies had offspring, he removed the first 8 new males and first 8 new females (some were red, orange, or white), and crossed those to get the next generation.
- He repeated this experiment multiple times and found that often within 19 generations of the same population, one allele became "extinct" in that population.



Orange female (Rr) x 8

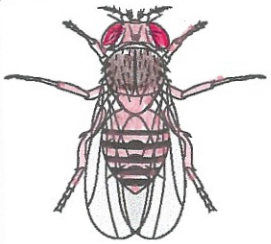


Orange male (Rr) x 8

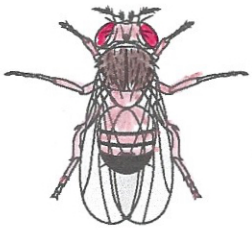
p = 8 / 16 = 0.5
q = 8 / 16 = 0.5

Founder effect:
Scientists observe genetic drift occuring in small founder populations, small populations that move to a new region, in nature, just like in this lab experiment.

Some trials



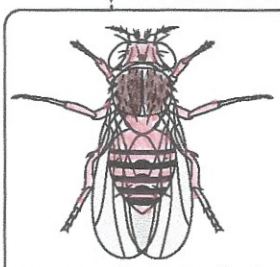
Red female (RR) x 8



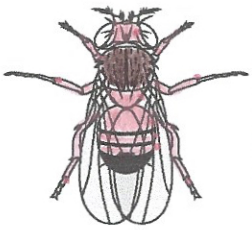
Red male (RR) x 8

p = 16 / 16 = 1
q = 0 / 16 = 0

Some trials



White female (rr) x 8



White male (rr) x 8

p = 0 / 16 = 0
q = 16 / 16 = 1

- Genetic drift is the term scientists use for an event where there are changes in allele frequencies in a population, due to random chance.
- Genetic drift can greatly affect populations that are small or have little genetic variation. Random chance (genetic drift) can cause an allele to be totally lost in a number of generations.

Name: _____

Genetic Drift

Bottleneck Effect

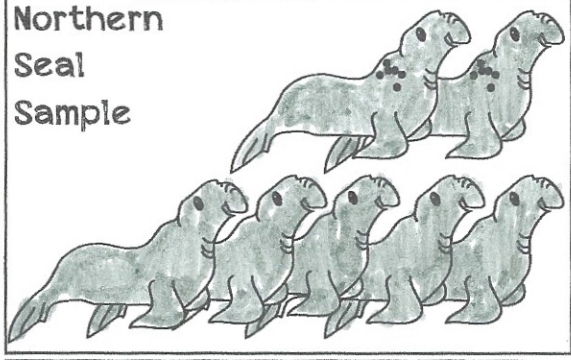
Today's Northern Elephant Seal:

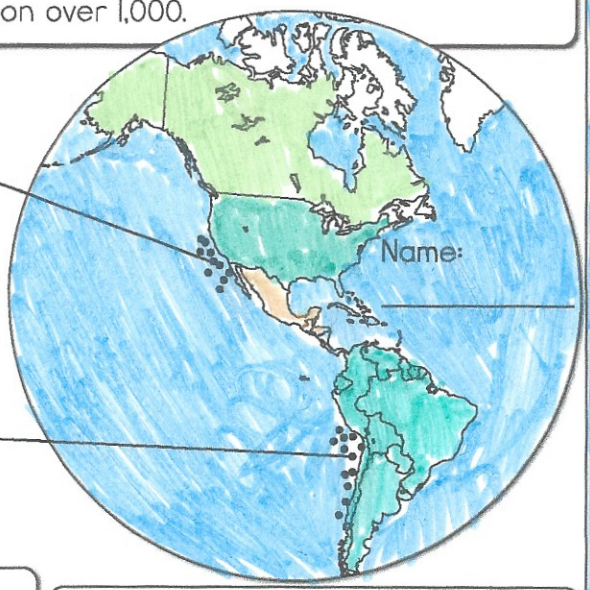
- Smaller body size
- Average lifespan: 9 years
- Many more congenital birth defects in the population as compared to other marine mammals.
- Much less genetic diversity in the Northern populations as compared to Southern seal populations.

Elephant Seal Example:

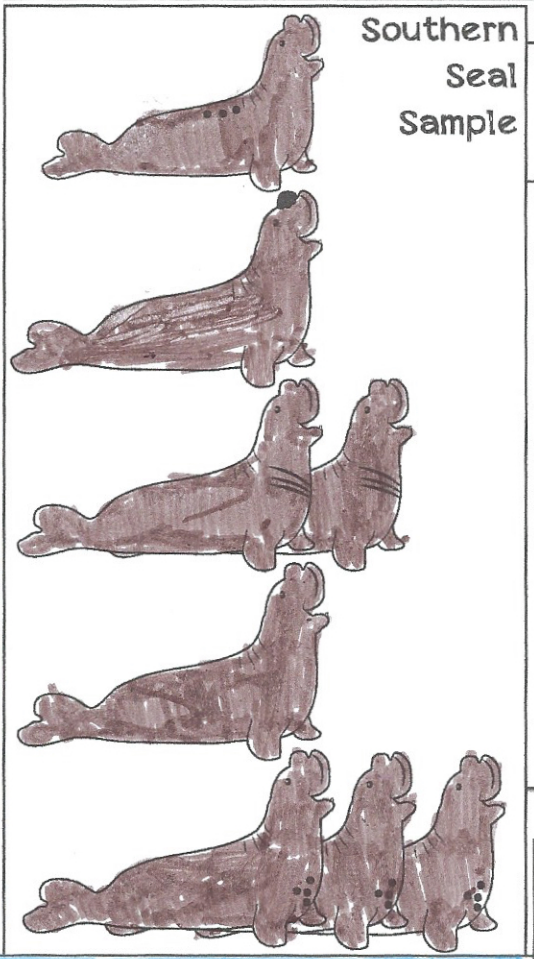
- Intense hunting of the elephant seal in the 1890s drastically reduced their population size.
- There are two very similar species of elephant seal: the Northern Elephant Seal and the Southern Elephant Seal.
- At one point in the 1890s, scientists believe there were only 20 Northern seals left. The Southern seals are believed to always have had a population over 1,000.

Northern Seal Sample





Southern Seal Sample



Today's Soutern Elephant Seal:

- Larger body size
- Average lifespan: 20-25 years
- Less congenital birth defects

Bottleneck Effect:

- This effect is the term scientists use for the population effects that come after a disaster or large population-shrinking event that kills many individuals in a population. The few remaining individuals may have a different p and q (for many alleles of genes) than the original population.
- After a bottleneck event, a population may increase in size, but the genetic diversity of that population will be reduced.

Nonrandom Mating

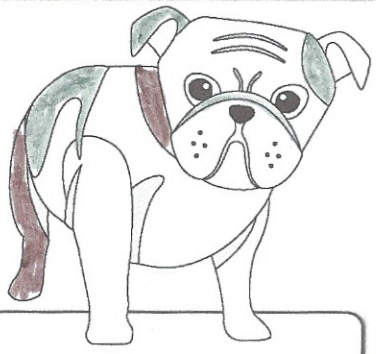
- Nonrandom mating by itself does not cause allele frequencies to change in a large population.

- In a small population, it can cause genetic drift to speed up and cause the overall fitness of a population to decrease.

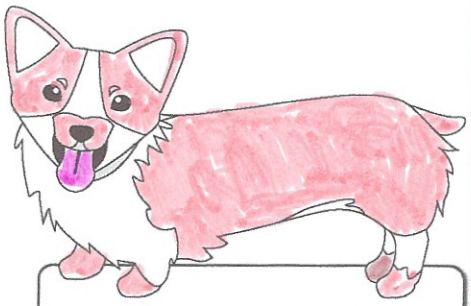
- Inbreeding is a form of nonrandom mating. When inbreeding takes place, homozygotes increase in frequency and heterozygotes decrease in frequency

- Inbreeding depression is a term scientists use for when inbreeding within a population reduces the average fitness or health in the population.

Assume that individuals with two recessive alleles in any of the genes have reduced fitness. Individuals with aa or bb or ii for example could have smaller puppy litters, increased puppy mortality, shorter lifespan, lower overall helath, or reduced fertility.



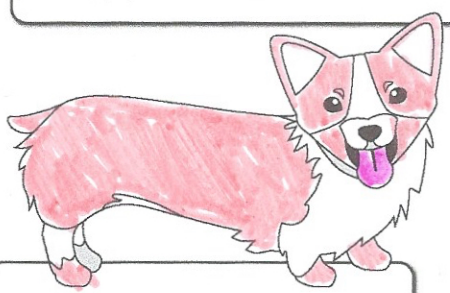
Aa BB CC DD EE FF GG HH Ii



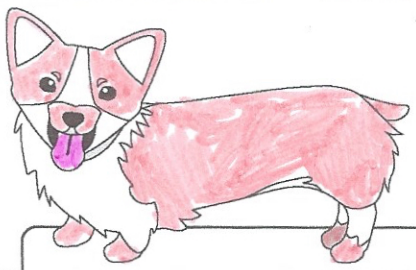
AA Bb CC DD Ee FF GG HH II

If two unrelated dogs mate and have offspring, their offspring are much less likely to have two recessive alleles in the same gene.

What is the chance that the two dogs above will have a puppy with two recessive alleles in the same gene? very low



AA Bb CC DD EE Ff GG HH II



AA Bb CC DD Ee FF GG HH II

If two closely related dogs mate and have offspring, their offspring are more likely to have two recessive alleles in the same gene, because their parents carry similar "harmful" recessive alleles.

What is the chance that the two dogs above will have a puppy with two recessive alleles in the same gene? 1/4

Name: _____

Nonrandom Mating