Population Genetics:

Scientists use population statistics to figure out how common certain alleles are in a population and how often there are population changes.

Peppered Moth Population:

In the English peppered moth population, there are two alleles: dark and light. The dark allele (D) is dominant. The light allele (d) is recessive.

In the early 1800's, there were a lot more light colored peppered moths than dark ones. (See example population below.)

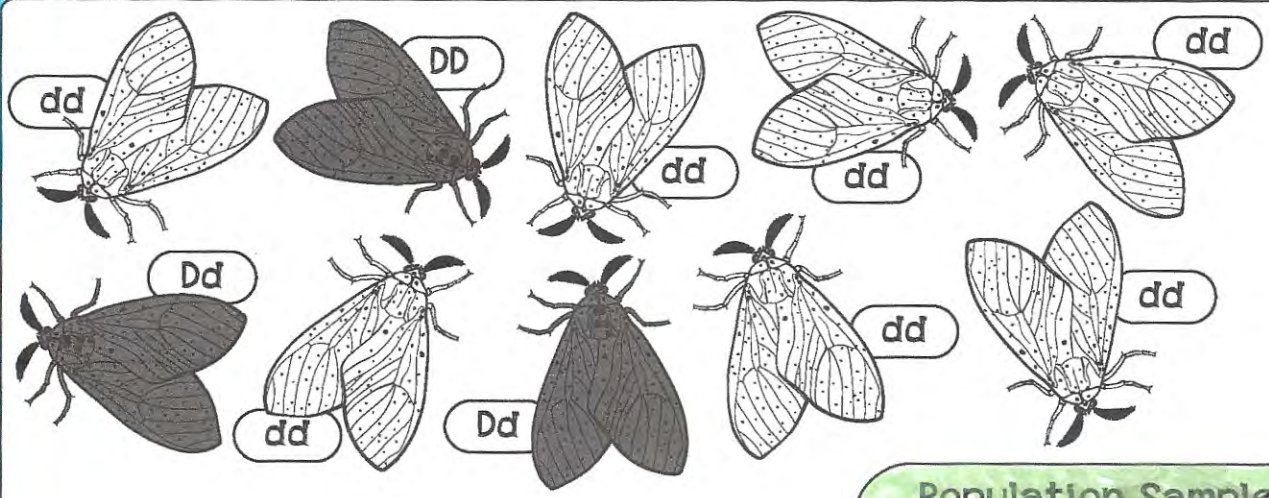
Phenotype Frequencies:

$$\text{Freq (light)} = \frac{\text{\# light moths}}{\text{\# total moths}}$$

$$\frac{\text{\# light moths}}{\text{\# total moths}} = \frac{7}{10}$$

$$\text{Freq (dark)} = \frac{\text{\# dark moths}}{\text{\# total moths}}$$

$$\frac{\text{\# dark moths}}{\text{\# total moths}} = \frac{3}{10}$$



Population Sample ~ 1820

Genotype Frequencies:

$$\text{Freq (DD)} = \frac{\text{\# DD moths}}{\text{\# total moths}} = \frac{1}{10}$$

$$\text{Freq (Dd)} = \frac{\text{\# Dd moths}}{\text{\# total moths}} = \frac{2}{10}$$

$$\text{Freq (dd)} = \frac{\text{\# dd moths}}{\text{\# total moths}} = \frac{7}{10}$$

Allele Frequencies:

- Scientists study allele frequencies to measure how population genetics change over time.
- They use "p" as a symbol the frequency of the dominant allele.
- They use "q" as a symbol the frequency of the recessive allele.

$$p = \frac{\text{\# D alleles}}{\text{\# total alleles}} = \frac{4}{20} = \frac{1}{5}$$

$$q = \frac{\text{\# d alleles}}{\text{\# total alleles}} = \frac{16}{20} = \frac{4}{5}$$

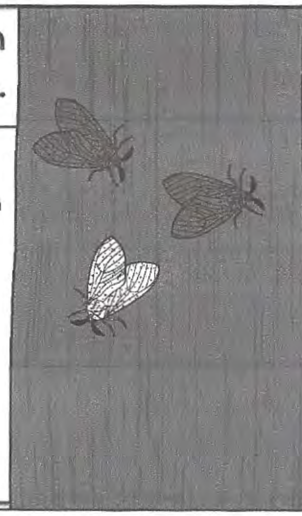
Name: _____

Population Genetics

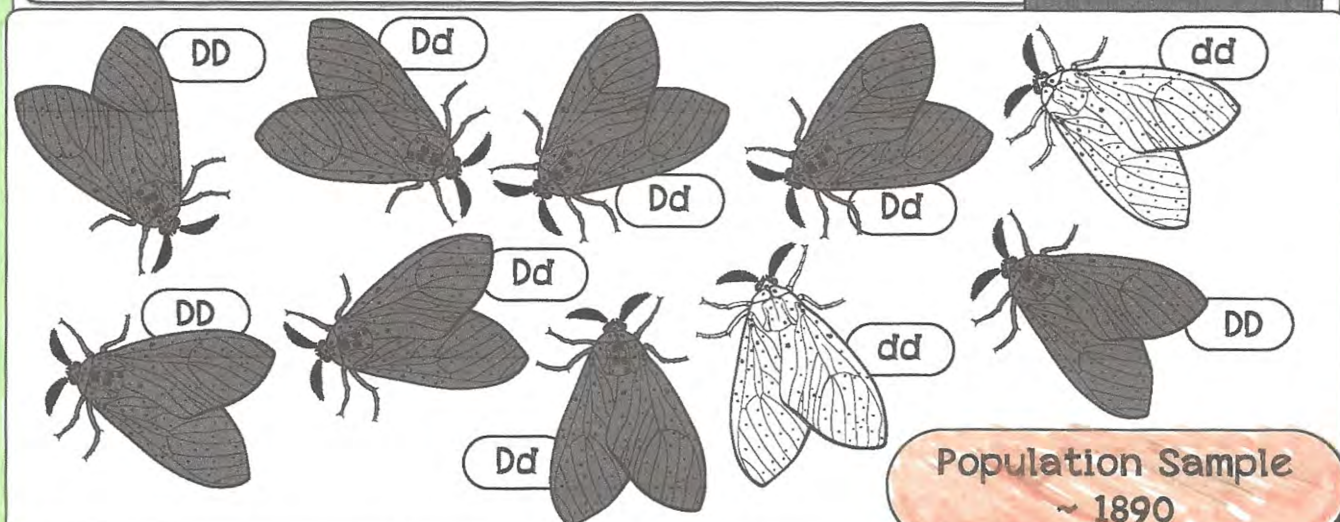
Before the Industrial Revolution

• In the early 1800's, the forests where the moths lived were filled with light-colored trees.
• Predators were more likely to see dark-colored moths.
• Light-colored moths were more likely to survive long enough to reproduce. Light-colored moths are more likely to have offspring that will have their alleles in a future generation.

Then the Industrial Revolution happened...



• In the mid to late 1800s, soot and sulfur dioxide gas greatly increased in the air. This pollution affected the color of the trees in the forest where the peppered moths lived.
• Once the tree bark became darker, predators were more likely to see light-colored moths.
• In this environment, the dark-colored moths were more likely to survive to produce offspring and pass their alleles to the next generation.



Population Sample ~ 1890

Allele Frequencies:

$$\text{new } p = \frac{\#\text{ D alleles}}{\#\text{ total alleles}} = \frac{11}{20}$$

$$\text{new } q = \frac{\#\text{ d alleles}}{\#\text{ total alleles}} = \frac{9}{20}$$

• When p and q are changing, scientists define that population as "evolving".
• Evolution occurs when there is a change in allele frequency within a population over time.
• Natural Selection due to a change in the environment is causing the moths to "evolve".
• Natural Selection is only one mechanism of evolutionary change.