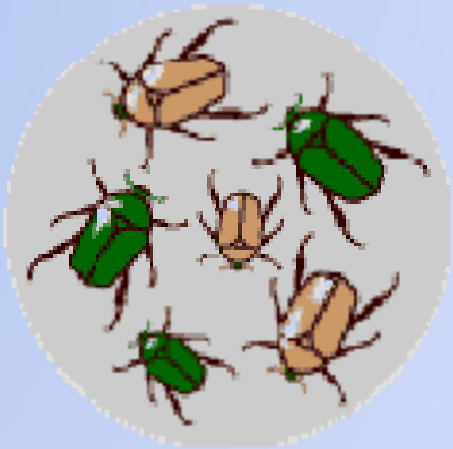
Microevolution

Evolution at the Genetic Level

How does natural selection result in species changing over time?

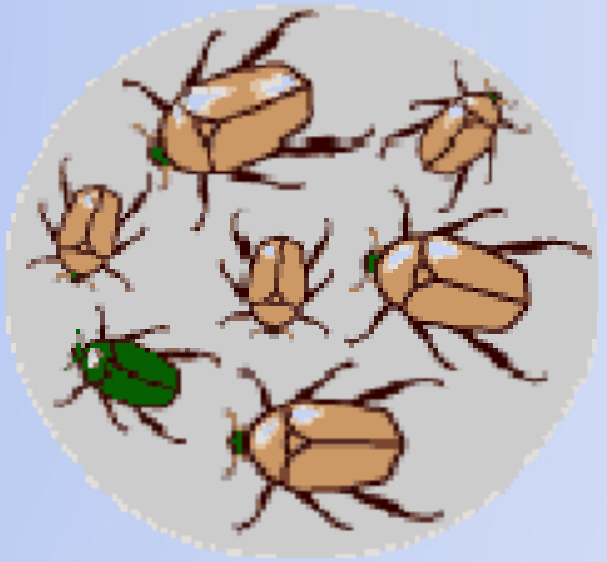
1. There must be variations in a population.



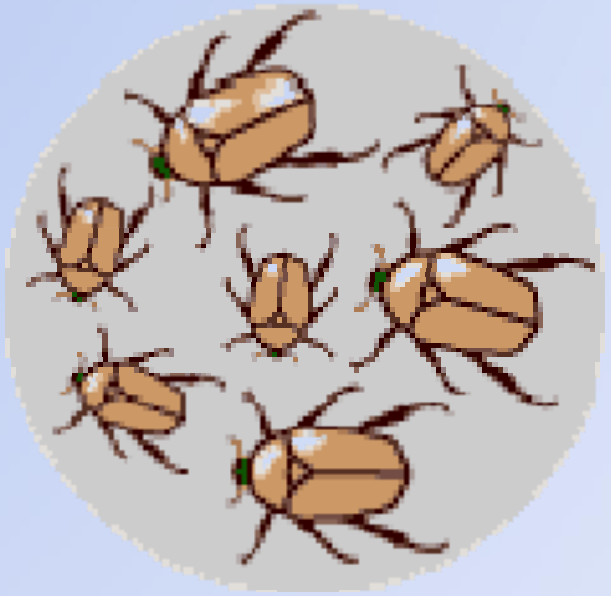
2. Some variations are better fit to the existing (or changing) conditions in the environment.

Example: The brown beetles camouflage better than green beetles.

3. Individuals with the favorable variation survive to reproduce and pass on their traits to their offspring.



4. Over time, there will be more individuals in the population with the favorable variation & fewer individuals with the less favorable variation.



In the beetle example, does natural selection work on phenotypes (appearance) OR genotypes (genes)?

Natural selection works on phenotypes NOT genotypes.

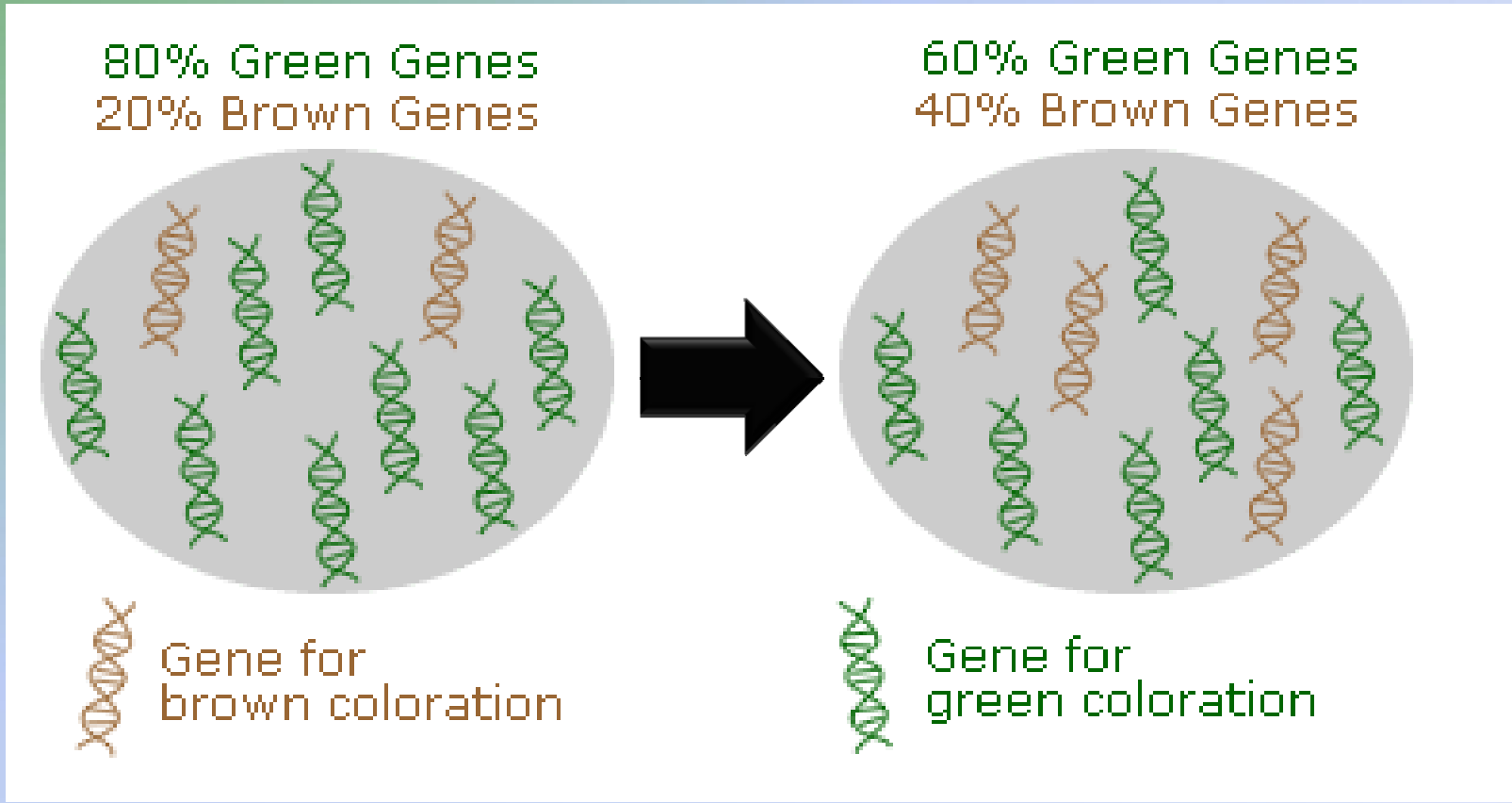
So then what is the source of the variations in phenotypes?

Genes

If we look at evolution at the genetic level, then we are looking at how all of the possible variations of genes are changing over time.

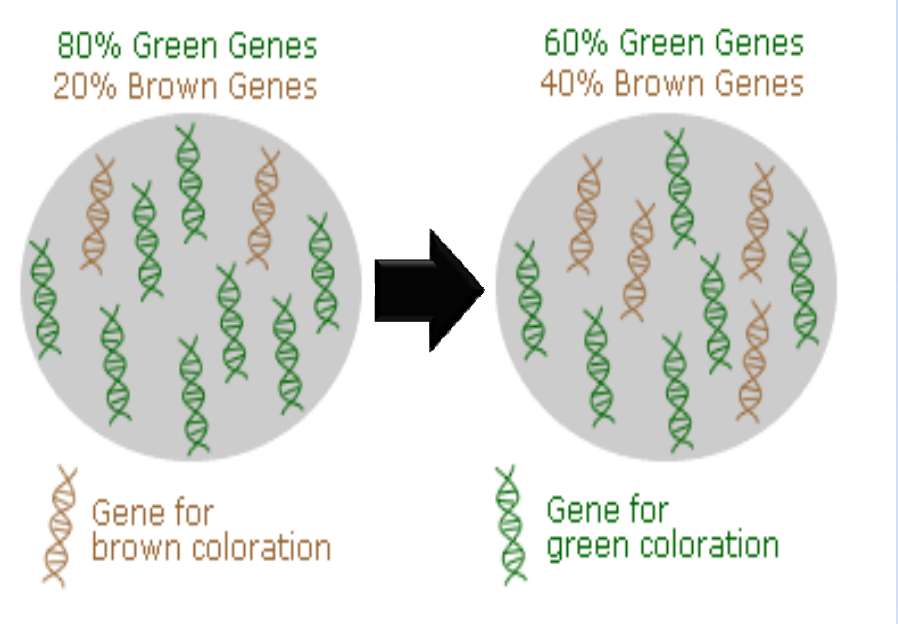
Evolution of Beetles at the Genetic Level

There is a change in the number of brown genes and green genes in the population.



Gene Frequency

- The amount of each type of gene in a population is called gene frequency.
- Gene frequency is usually expressed as a percentage (%). *Must always = 100%.*



What is the frequency of the green genes in the 1st circle? **80%**

What is the frequency of the green genes in the 2nd circle? **60%**

Over time, what happened to the frequency of green genes for this population?

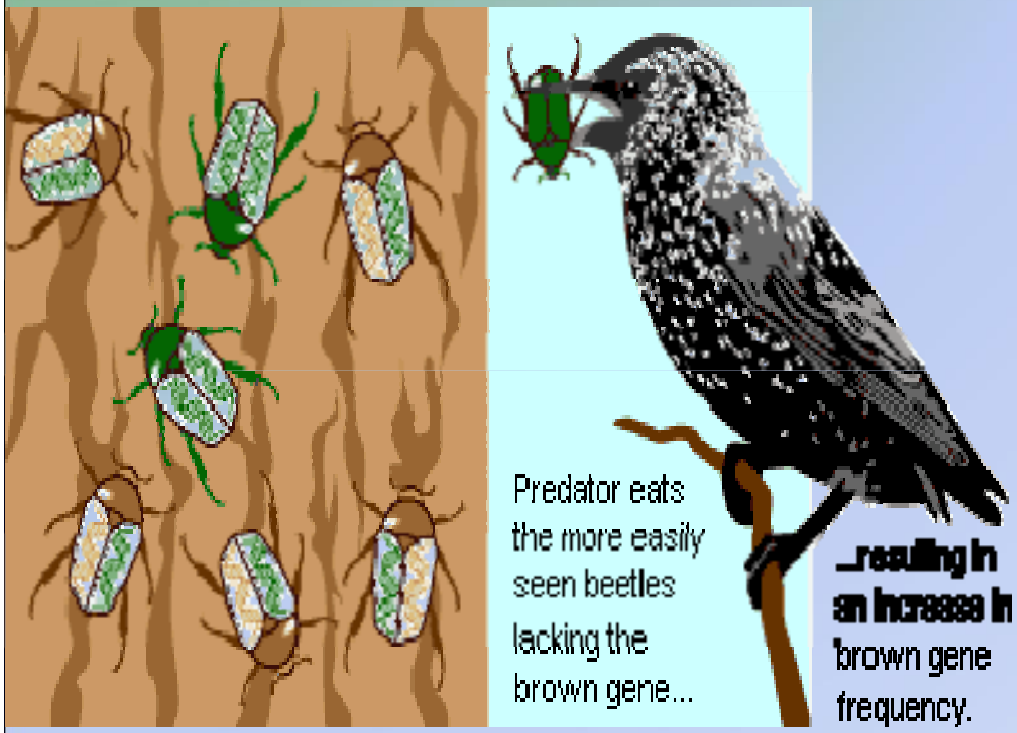
Gene Pool

- All of the genes in a population are called the gene pool.
  - There must be at least 2 (or more) alleles for a gene in a gene pool.
- What are the **variations (alleles)** of genes for beetle coloration in the beetle gene pool?
  - Brown genes and Green genes
- In terms of genetics **how has this population of beetles changed over time**?
  - Frequency for the green genes reduced by 20%
  - Frequency of the brown genes increased by 20%.

There are 4 ways gene frequency in a gene pool is affected:

1. **Natural selection**

   - reduces the # of alleles (& variations) that are less fit to the environment.



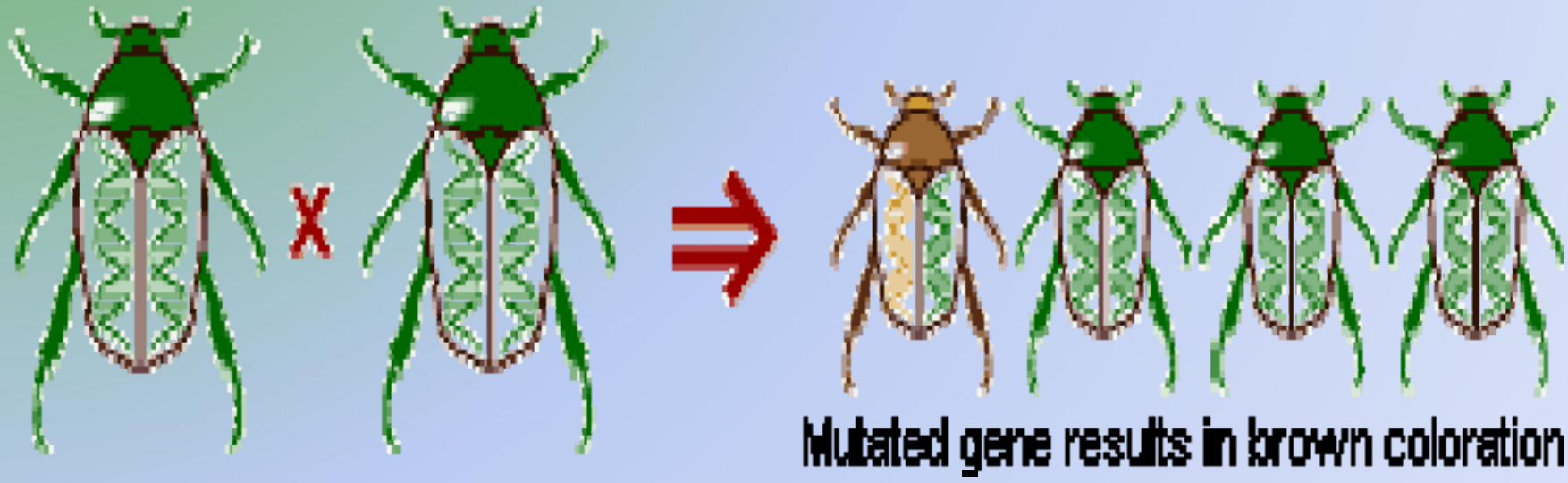
Example:

Beetles with brown genes escaped predators and survived to reproduce more than beetles with green genes, so that more brown genes got into the next generation.

Gene frequency is affected by…

2. Mutation: random change in a section of DNA.

- Mutations introduce new variations or traits into a gene pool.

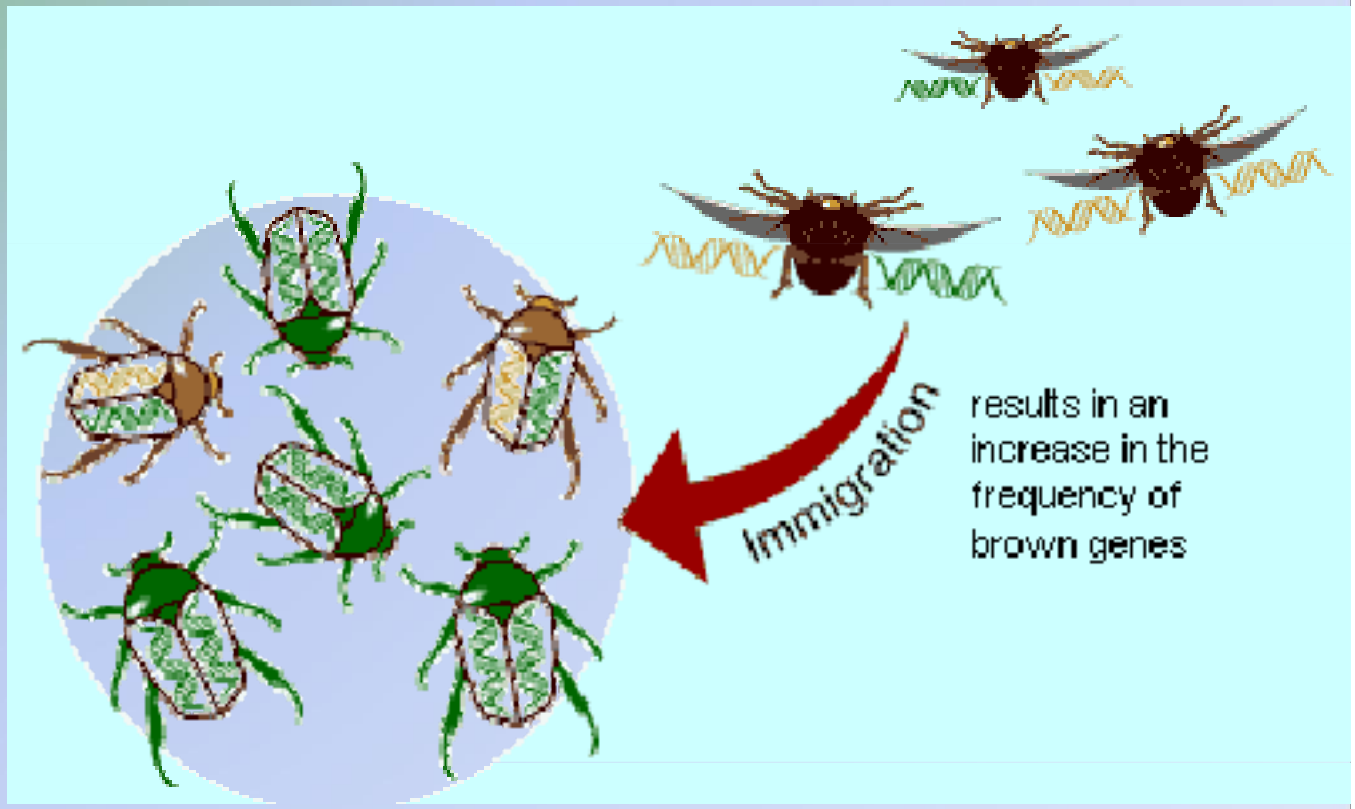


Example: Some "green genes" randomly mutated to "brown genes”.

Gene frequency is affected by…

3. Migration (gene flow): individuals moving into a population (carrying new variations) OR individuals moving out of a population (taking variations away).

Example:
New beetles moving into a population.

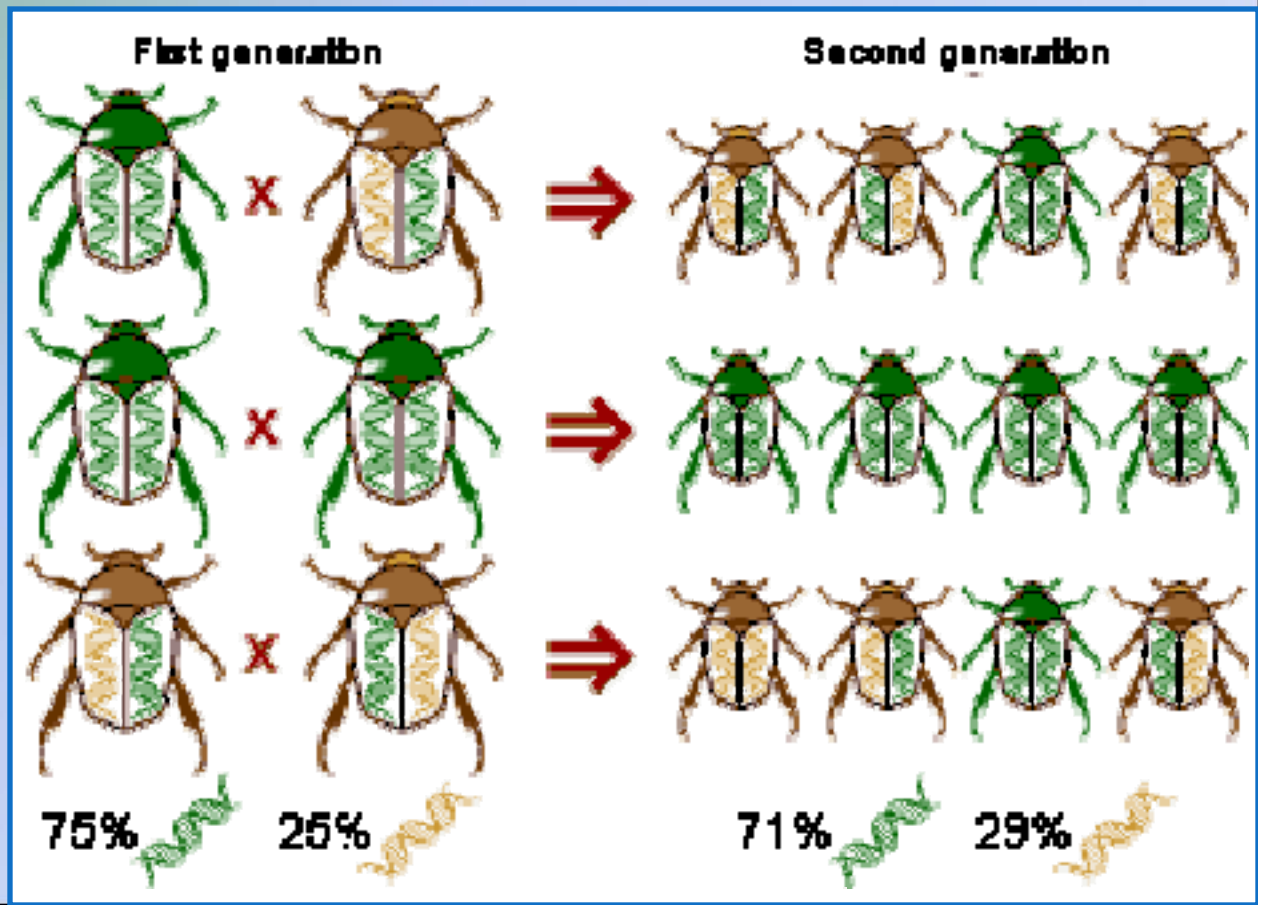


Gene frequency is affected by…

4. Genetic drift: the random change in the frequency of alleles in a gene pool.

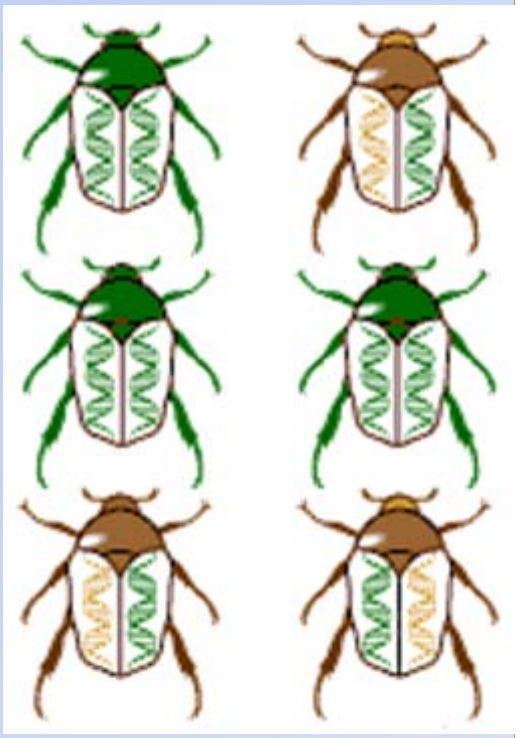
Some individuals with a certain allele may have more offspring than others.

Example: When the beetles reproduced, just by <u>random luck</u> more brown genes than green genes ended up in the offspring.



Practice Calculating Gene Frequency

- Find the total number of each allele in the gene pool.
  - green color = **9**
  - brown color = **3**



- Divide the # of each allele by the total # alleles in the gene pool & find the percent.
  - Total # of alleles = **12**
  - Frequency of green allele = $\frac{9}{12}$ = 75%
  - Frequency of brown allele = $\frac{3}{12}$ = 25%

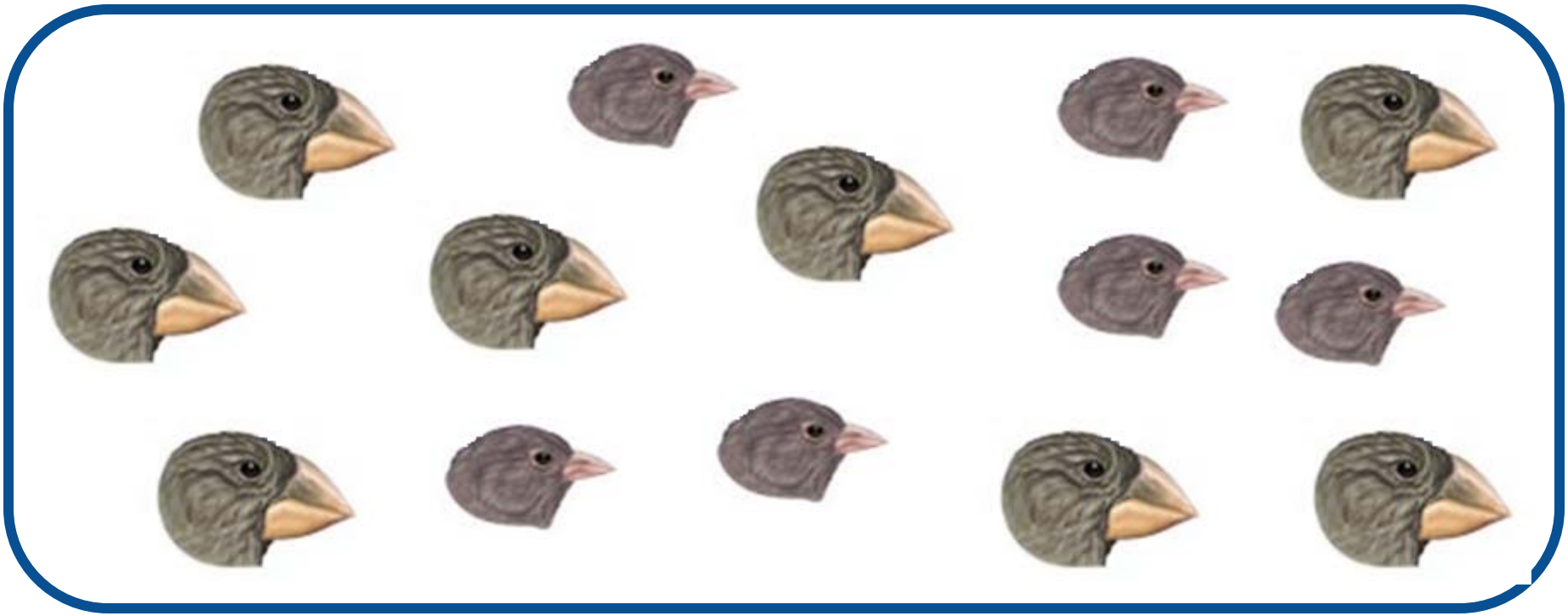
Do the frequencies for the brown and green alleles in this gene pool = 100%? 75% + 25% = 100%

Practice Calculating Gene Frequency

Finch with LARGE BEAK = BB

Finch with SMALL BEAK = bb

Calculate the allele frequency for the gene pool below.



How many B's? **16**

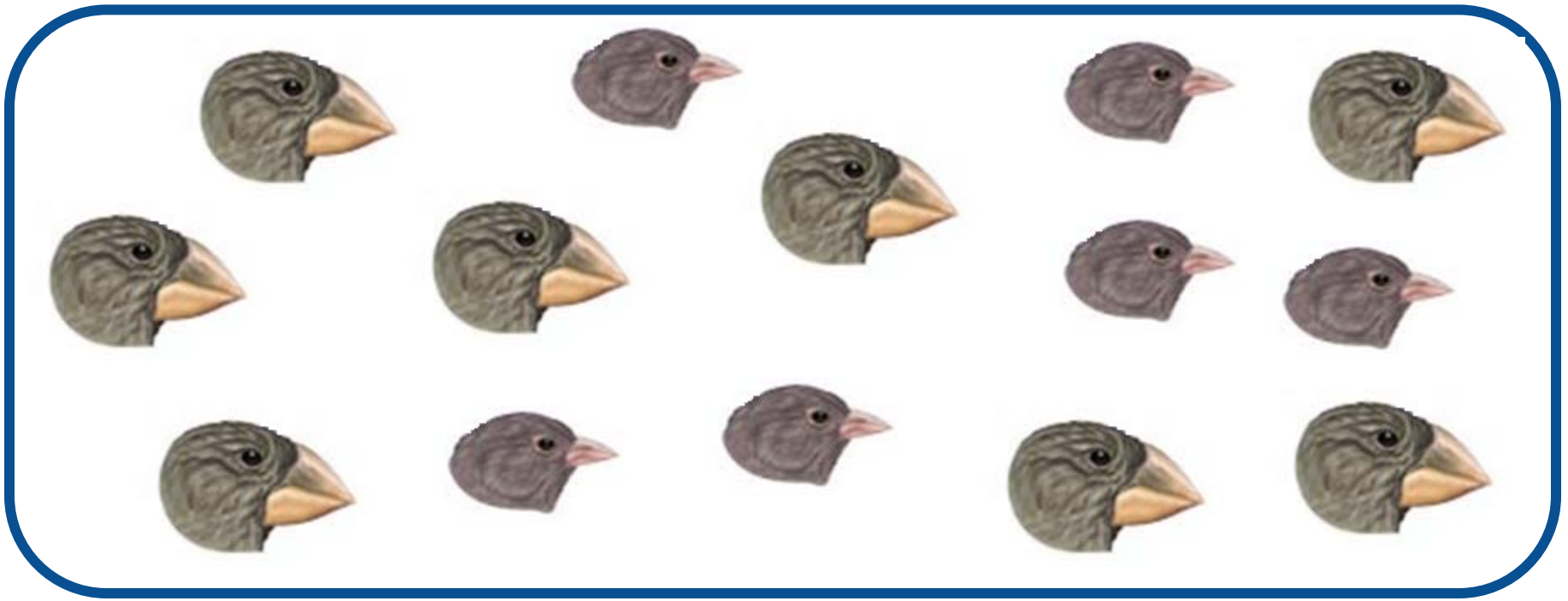
Frequency of B? $\frac{16}{28}$ = 57.143%

How many b's? **12**

Frequency of b? $\frac{12}{28}$ = 42.857%

Total # of alleles? **28**

Do the frequencies equal 100%?



References

- University of California Museum of Paleontology and the National Center for Science Education. http://evolution.berkeley.edu/evolibrary/article/0_0_0/evo_36