Activity 2 – Allele Frequency Game

With this activity you will learn how to calculate allele frequencies in a population and observe how allele frequencies may favor in response to natural selection or genetic drift. You have a bag of M&M's in two different colors. Let's assume these colors are 2 different types of alleles, for example: red and blue. Let's assume also that red is dominant over blue. This means that if you have a heterozygous individual (one of each color), the phenotype will be red, because red is dominant. Homozygous individuals will have two alleles of the same color.

First, create a population of 24 individuals. 6 individuals are homozygous red, 12 are heterozygous red and 6 are blue. Lay out pairs of alleles on the table to create this population as specified above.

1. How many alleles does an individual have?

2. How many alleles in total do we have within this population?

3. How many total red alleles are in the population?

4. What is the proportion of red alleles? (divide the number of red alleles by the total number of alleles in the population)

5. How many total blue alleles are in the population?

6. What is the proportion of blue alleles? (divide the number of blue alleles by the total number of alleles in the population)

7. Both proportions (red and blue) should equal 1. Does the sum of the proportions you calculated add to 1?

Next, let's put all the alleles in a bag. This bag represents a population! Let's see what happens in a new generation. For this, draw 2 alleles from the bag at random. This represents an individual in the next generation!

8. What is the phenotype (color) of this individual? (Remember that red is dominant over blue)

Repeat the last step two more times. Now you have three individuals which constitute the new generation.

9. Which is the phenotype (color) of each individual?

   Individual 1: _____ Individual 2: _____ Individual 3: _____

Do you remember what the concept of genetic drift is? Genetic drift is a change in the gene pool by chance. Let's simulate what the effect of genetic drift would be in your population. Let's imagine that a tornado kills half of your population. For this, take half of the individuals from the bag, one at a time (remember that each individual has two alleles). Record those individuals in the Table below. Do not eat them! We will need them for later.

Individual	1	2	3	4	5	6	7	8	9	10	11	12
Phenotype (color)												
Genotype (heterozygous or homozygous)												

10. Now calculate how many red and blue alleles are left in your population. For this, look at the numbers you counted in 5 and 7):

    Red: _____ Blue: _____

11. Now recalculate the proportions of red and blue alleles (Remember the sum of both proportions has to be 1):

    Red: _____ Blue: _____

12. Are they different from the proportions on your original population? How? What was the effect of genetic drift in your population?

Do you remember what the concept of natural selection is? Natural selection is when a phenotype gives an advantage of survival to an organism, then that organism survives and reproduces, passing along the genes behind that phenotype to the next generation. This makes the offspring better adapted to that particular environment. Let's simulate the effect of natural selection in your population. Put all the M&M's on the table to recreate your original population of 24 individuals: 6 homozygous red, 12 heterozygous red and 6 blue. Let's imagine that a bird eats M&M's individuals and it prefers the red ones. Randomly take half of the red individuals out (remember that the red individuals can be homozygous red or heterozygous red), those are the ones that were eaten by the bird.

13. How many red individuals did you have in your original population?

14. How many red individuals are left?

15. Now calculate the proportions of red and blue alleles in your new population (Remember the sum of both proportions has to be 1):
    Red:_____ Blue:_____

16. Are they different from the proportions on your original population? How? What was the effect of natural selection in your population?

Activity 2 – Allele Frequency Game Answer Key

1. How many alleles does an individual have?

   Answer: 2

2. How many alleles in total do we have within this population?

   Answer: 48

3. How many total red alleles are in the population?

   Answer: 24

4. What is the proportion of red alleles? (divide the number of red alleles by the total number of alleles in the population)

   Answer: 24/48=0.5

5. How many total blue alleles are in the population?

   Answer: 24

6. What is the proportion of blue alleles? (divide the number of blue alleles by the total number of alleles in the population)

   Answer: 24/48=0.5

7. Both proportions (red and blue) should equal 1. Does the sum of the proportions you calculated add to 1?

   Answer: 0.5+0.5=1 – Yes

8. What is the phenotype (color) of this individual? (Remember that red is dominant over blue)

   Answer: Varies

9. Which is the phenotype (color) of each individual?

   Answer: Varies

10. Now calculate how many red and blue alleles are left in your population. For this, look at the numbers you counted in 5 and 7):

    Answer: Varies

11. Now recalculate the proportions of red and blue alleles (Remember the sum of both proportions has to be 1):

    Answer: Varies

12. Are they different from the proportions on your original population? How? What was the effect of genetic drift in your population?

    Answer: Yes, the proportions are probably different. The conclusion is that genetic drift changed the proportions of red and blue alleles and thus the morphology of the individuals also changes (there are more red or blue individuals now).

13. How many red individuals did you have in your original population?

    Answer: Varies

14. How many red individuals are left?

    Answer: Varies

15. Now calculate the proportions of red and blue alleles in your new population (Remember the sum of both proportions has to be 1):

    Answer: Varies

16. Are they different from the proportions on your original population? How? What was the effect of natural selection in your population?

    Answer: Yes, the proportions are different. The conclusion is that because the bird prefers red individuals, the blue individuals will have a better chance to survive and thus the next generation will have more blue individuals because the proportions of blue alleles in this population increased