29 AN EXERCISE TO DEMONSTRATE THE ROLE OF NATURAL SELECTION IN FIXING FAVOURED ADAPTATIONS AND ELIMINATING MALADAPTATIONS

29.1 INTRODUCTION

In the previous exercise we illustrated the role of natural selection in evolving adaptations. In effect this means that occurrence of those variations which are less adapted to an environment will be slowly minimized in the population. In the example of *Biston betularia,* the non-melanics in a non-condusive environment dwindled in numbers over a period of time since they were easily located by the birds and were predated upon. This was also true of melanics which rested on lichen covered trees and therefore were easily sighted by birds. The elimination of an allele does not occur unless there is an alternate allele superior in terms of survival. In an environment where malaria is not prevalent the frequency of sickle cell allele would be very low. It is also true that the selection process does not totally eliminate an undersirable allele from the population since other evolutionary forces such as mutations continue to generate the allele. This experiment illustrates the role of natural selection in promoting or reducing the frequency of alleles that are better adapted or ill adapted respectively to a given environment.

Objectives

At the end of this exercise you should be able to:

- discuss that natural selection does not totally promote (100%) any allele however will adapted it is to the environment
- describe that the allele for maladaptations continue to occur at very low frequencies in the population.

29.2 MATERIALS REQUIRED

plastic beads (bigger sized ones) of red, black, blue and green colour-500 of each colour.

a plastic bowl

a white cloth towel with rough texture.

29.3 PROCEDURE

1. Place the 2000 beads — 500 each of blue red, black and green — in a plastic bowl and mix throughly.
2. At random pick out 100 beads from a total of 2000 in the bowl without looking into it and place them on the white towel spread on the table. The purpose of using the white towel is that coloured beads will be seen clearly on a white background and the beads will not roll off. You may pick more than 100 but picking out 100 would make percentage calculations much easier.
3. In the next step, separate the 100 heads according to the colour on the towel itself. Since you have picked 100 heads randomly from a population of 2000 heads, you may have picked close to 25 numbers of each colour. Assume that the number of heads you have picked is as follows:

Green	26
Red	24
Blue	26
Black	24

Record these numbers in your record note book.

4. Now let us say that natural selection is operating. Assume that the selection favours green beads and opposes black beads in the population. To represent this concept, add 10 more green beads to the 100 you have picked out and remove 10 black beads. The new frequencies will be as follows:

Green	36
Red	24
Blue	26
Black	14
	100

Record these numbers in your note book.

5. With these frequencies let us make a new population of 1000 individuals. This means you will mix up 360 green beads, 240 red ones, 260 blue ones and 140 black ones, to make a total of 1000. These 1000 individuals belong to the 2nd generation. From this population of 1000 beads, pick out a 100 beads.

Suppose that the new sample 100 individuals has the following distribution:

Green	34
Red	27
Blue	23
Black	16

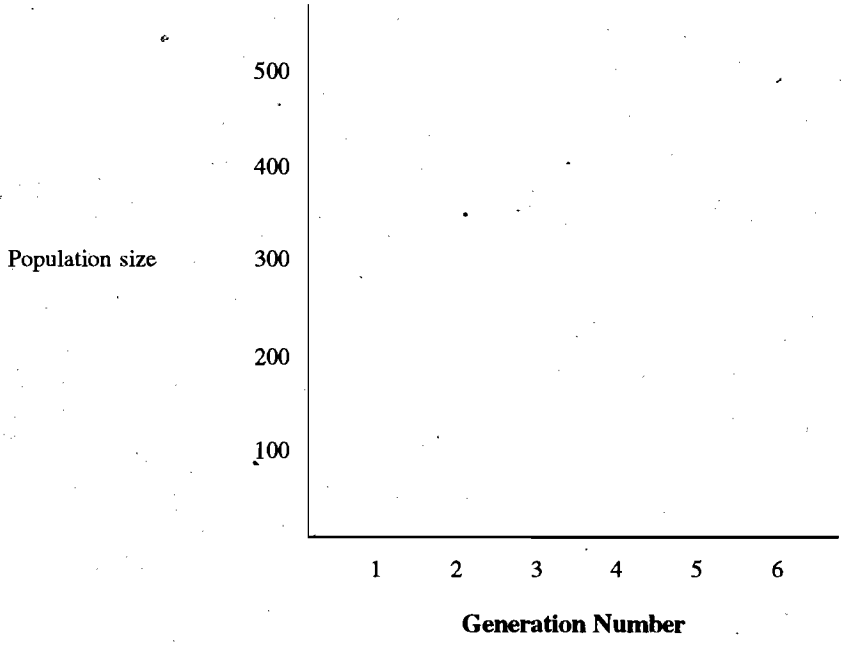
Record the numbers in your observation note book. Because of the selection process, the frequencies of beads have changed. There is an increase in the numbers of favoured beads (characters or alleles) and a decrease in the number of not so favoured ones. Let the selection continue to act. Add 10 more of green beads and remove ten of the black beads. The new population that constitutes the third generation will be as follows:

Green	44
Red	27
Blue	23
Black	6
	100

Record these results in your note book. You may continue to do the experiment for a number of generations. But confine yourself to six or seven generations and record the results in the following table.

Generation	No of greens	No. of reds	No. of blues	No. of blacks
I				
II				
III				
IV				
V				
VI				

Plot the results in a graphical form



29.4 INFERENCE

From Unit 11 of the LSE-07 course, you may recall that one definition of evolution, the definition proposed by population geneticists is that evolution is a systematic change in gene frequencies. You may say that such changes in gene frequencies are a measure of evolution. You may also observe that after a few generations the frequencies of various traits (colours in this exercise) more or less remain the same. The green colour after a few generations would end up with having a frequency ranging from 40 to 60%. The red and blue with twenties or less; and the black registering less than 5%. At the same time the black may not be eliminated totally from the population. In other words, at the end of the six or so generations, all the traits (colours), the 'fittest' green, the 'fitter' red and blue and the 'least fit' black continue to exist in the population. Natural selection may not completely fix (100% presence) or eliminate (0%) any allele in the population. When environmental condition are favourable natural selection promotes the frequency of favoured alleles but does not eliminate totally the least adapted ones from the population. This is how the role of Darwinian selection is perceived in recent times.