Population Statistical Method

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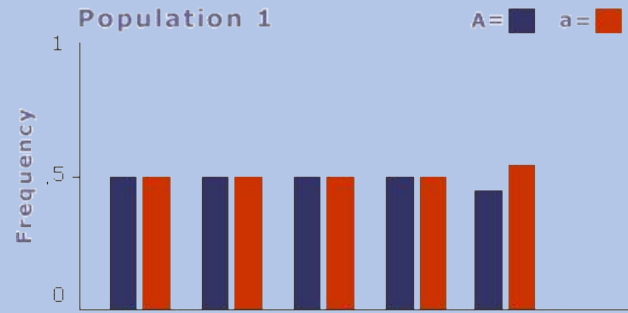
ETHAUL AND ADHVIK AS

frequency of homozygous dominant genotype

frequency of homozygous recessive genotype

$$p^2 + 2pq + q^2 = 1$$

frequency of heterozygous genotype



STATISTICAL POPULATION

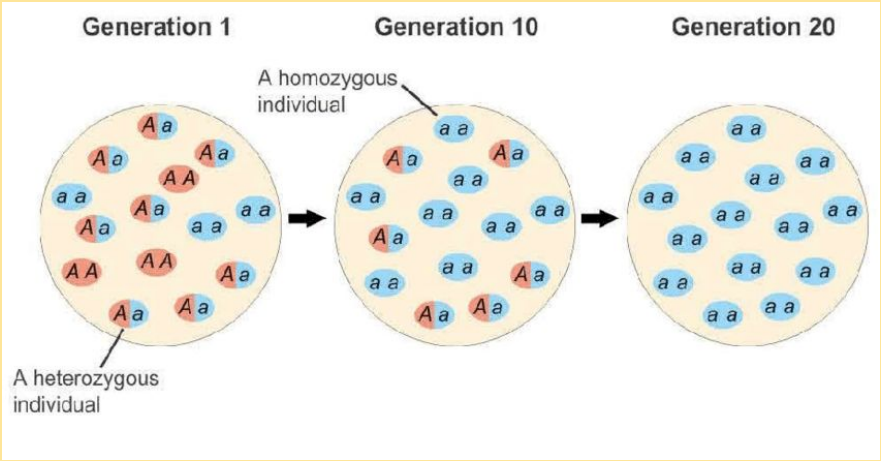
Variation, inheritance and evolutionary theory may now be explained by evidence from a branch of biology known as population genetics.

Population genetics is the study of change in the frequencies of allele and genotype within a population.
2. Population geneticists study the genetic structure of populations, and how they change geographically and over time.

Population: A group of organisms of the same species that live in a specific area.
Species:
A group of organisms that can interbreed and produce fertile offspring. To study the genetics of a population, scientists must collect a population sample.

GENE POOL

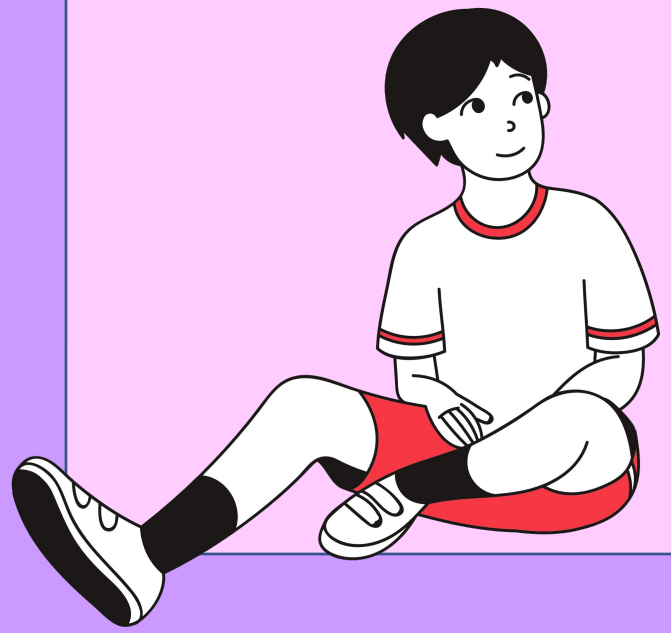
Gene pool : A gene pool is the total variety of genes and alleles present in a sexually reproducing population, and in any given population the composition of the gene pool may be constantly changing from generation to generation.
Changes in a gene pool are the basic requirement for evolution to be able to occur.



What can cause a change in a gene pool?
1-Mutation
2- Natural Selection
3-Mate Selection
4- Migration
5-Genetic drift.

Allele Frequency

Allele frequency- The appearance of any physical characteristic, for example coat color in mice, is determined by one or more genes. Several forms of each gene may exist and these are called alleles. The number of organisms in a population carrying a particular allele determines the allele frequency (which is sometimes, incorrectly, referred to as the gene frequency).



Allele Frequency

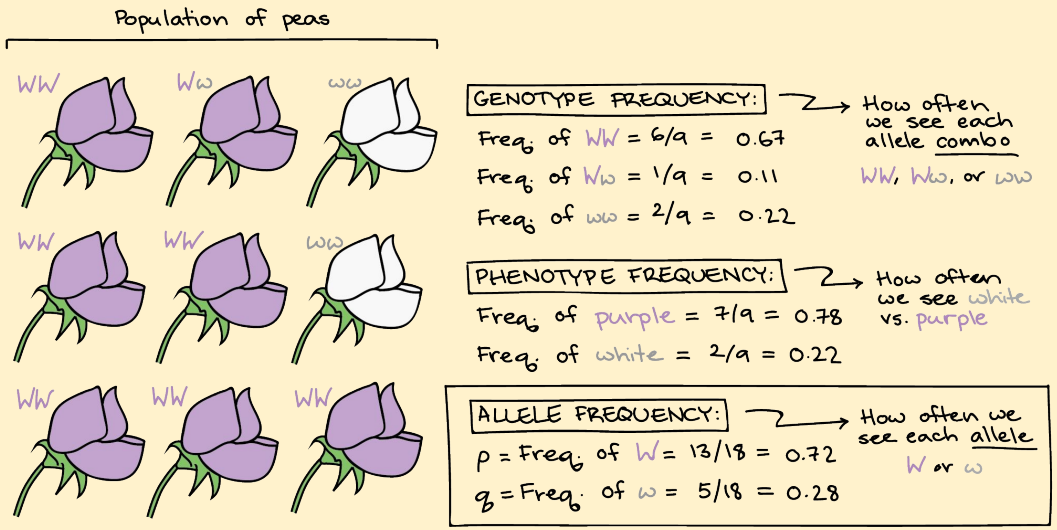
how often an form of a gene shows up in a population over several generations

GG Gg gg

the number of copies of a particular allele divided by the number of copies of all alleles at the genetic place in a population.

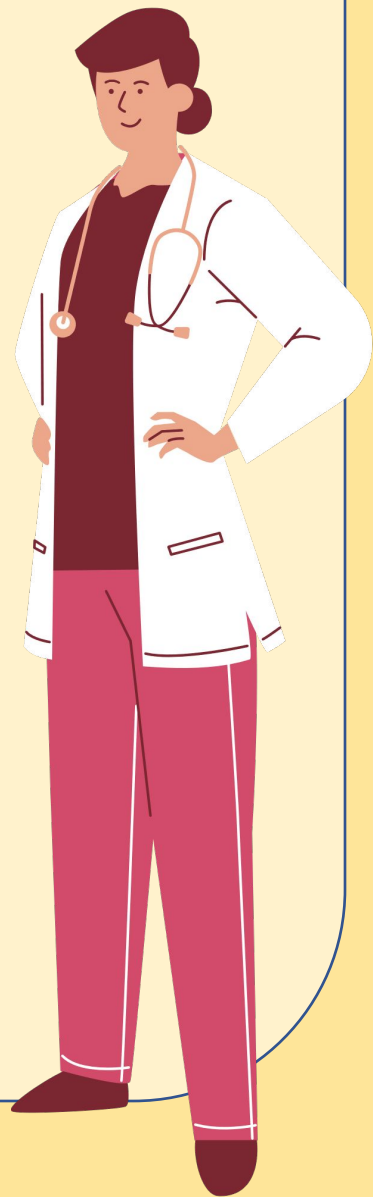
Genotypic Frequencies

Genotype frequencies –
The frequencies of particular alleles in the gene pool are of importance in calculating genetic changes in the population and in determining the frequency of genotypes. Since the genotype of an organism is the major factor determining its phenotype, calculations of genotype frequency are used in predicting possible outcomes of particular matings or crosses. This has great significance in horticulture, agriculture and medicine.



How Scientists Monitor The Frequency

- Scientists monitor frequency of the dominant and recessive allele in a population year after year.
- In other words, scientists may monitor the values of p and q for a population over several generations.
- If the values of p and q… -remain the same the population is not evolving according to scientists. -change then scientist say the group is evolving.
- Evolution- “genetic change” amongst population
- Scientist argue all populations will evolve unless “certain conditions” are upheld within the group



Hardy Weinberg Principle

The mathematical relationship between the frequencies of alleles and genotypes in populations was developed independently in 1908 by an English mathematician G. H. Hardy and a German physician W. Weinberg.

The relationship known as the Hardy-Weinberg equilibrium is based upon a principle, which states that «the frequency of dominant and recessive alleles in a population will remain constant from generation to generation provided certain conditions exist»

These conditions are:

(1) the population is large;

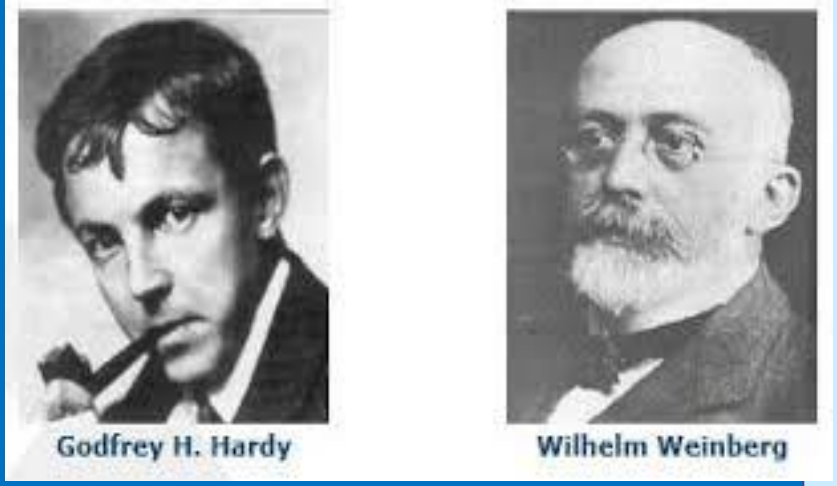
(2) mating is random;

(3) no mutations occur;

(4) all genotypes are equally fertile, so that no selection occurs;

(5) generations do not overlap;

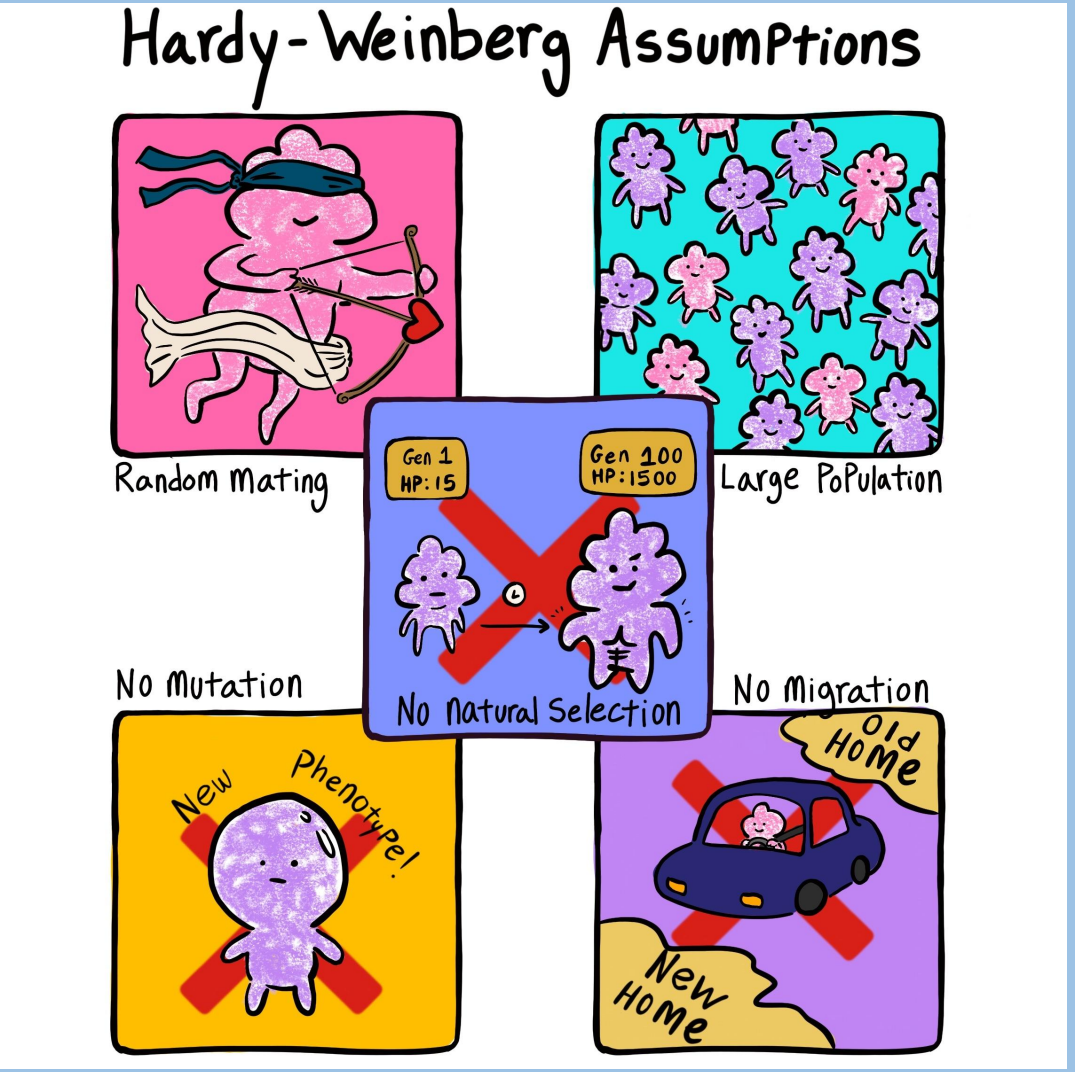
(6) there is no emigration or immigration from or into the population, that is, there is no gene flow between populations.



Hardy Weinberg Conditions

HARDY WINBERG CONDITIONS-

1. No mutations
2. No individual can be more adapted to survive than any other (no “survival fittest”).
3. The population must be large and stay the same size (no immigration or emigration).
4. Mating must be completely random.



How Do Scientists Determine p and q

- How do scientists determine values of p and q in a population?
- First, they collect a population sample.
- For example, 100 racerunners of which 85 have white stripes and 15 yellow stripes.
- What is the genotype 85 with white stripes? -TT or Tt
- What is the genotype of 15 with yellow stripes? -tt
  Using this information, scientists can find values for p and q of the population.

Understanding Hardy Weinberg Principle

In terms of genotype frequency the sum of the three genotypes presented in the population equal one, or, expressed in terms of the symbols p and q, it can be seen that the genotypic probabilities are:

p 2 + 2pq + q 1 = 1

(In mathematical terms p + q = 1 is the mathematical equation of probability and p 2 + 2pq + q 2 = 1 is the binomial expansion of that equation (that is (p + q)2).

To summarise, since

p = dominant allele frequency

q = recessive allele frequency

p 2 = homozygous dominant genotype

2pq = heterozygous genotype

q 2 = homozygous recessive genotype

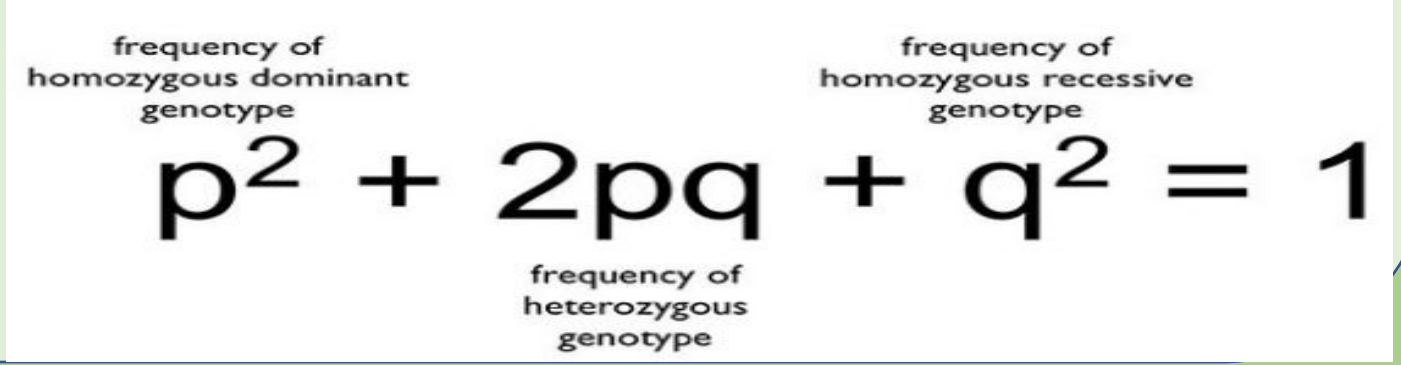
it is possible to calculate all allele and genotype frequencies using the expressions:

allele frequency

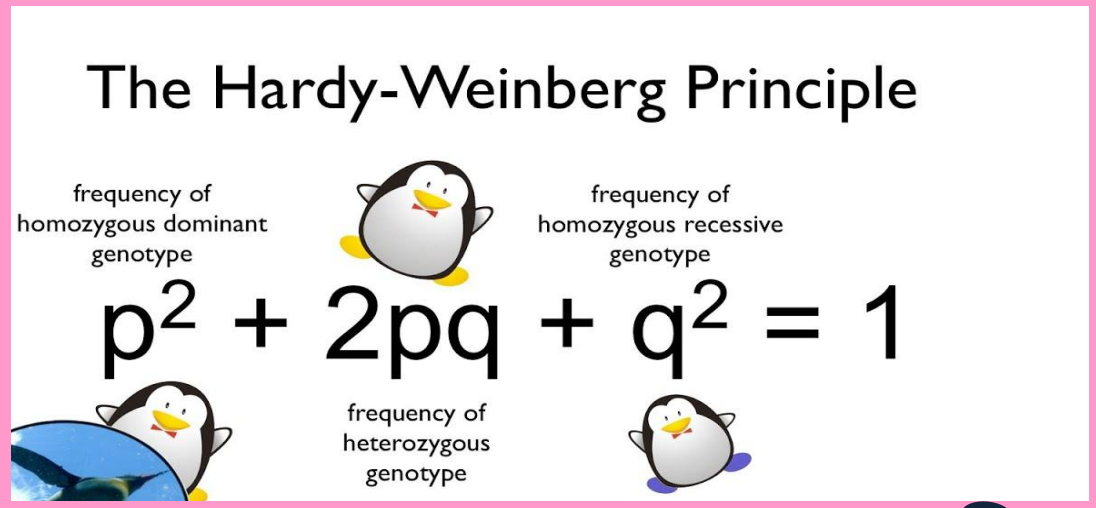
p + q =1,

and genotype frequency

p 2 + 2pq + q 2 = 1.

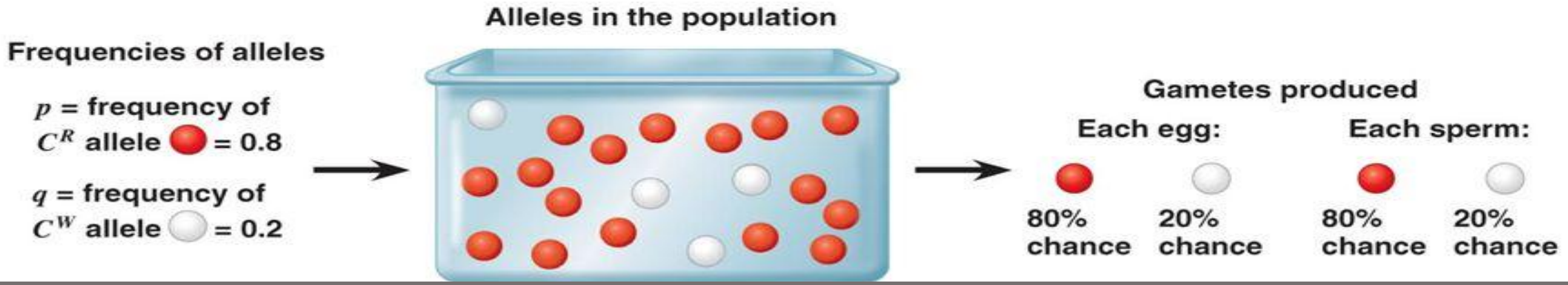


The Hardy-Weinberg equation Whilst the Hardy-Weinberg equation provides a simple mathematical model of how genetic equilibrium can be maintained in a gene pool, its major application in population genetics is in calculating allele and genotype frequencies.



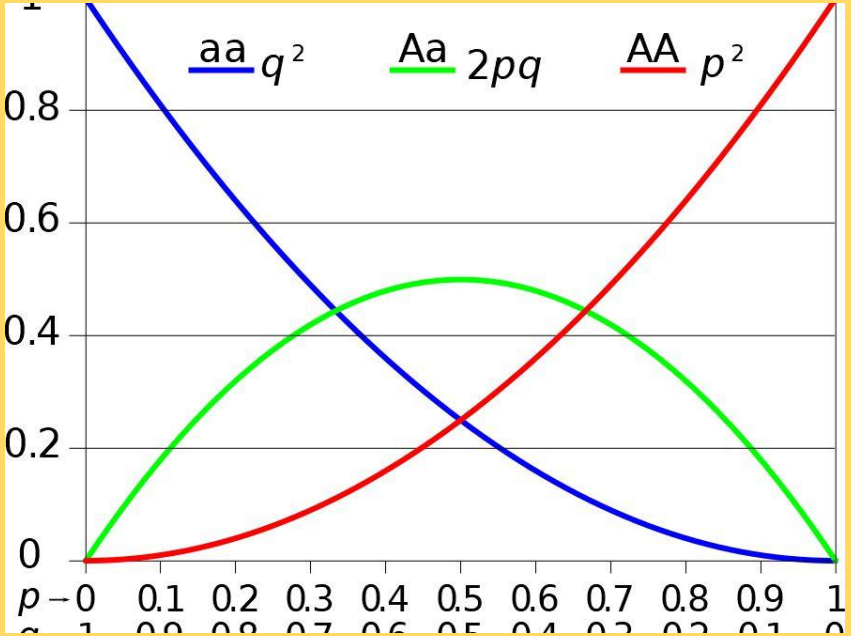
Population Genetics

- Hardy-Weinberg Principle/equilibrium
  - Allele frequencies remain unchanged generation to generation



Significance

- The Hardy-Weinberg model enables us to compare a population's actual genetic structure over time.
- If genotype frequencies differ from those we would expect under equilibrium, we can assume that one or more of the model's assumptions are being violated.

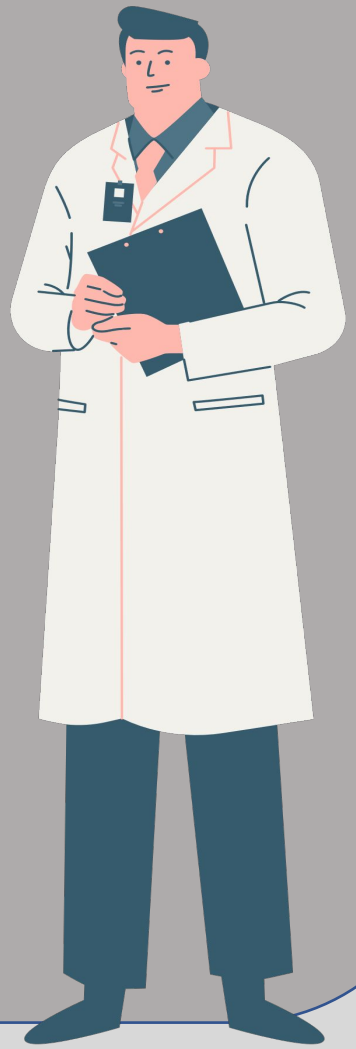


Interpretations

- The correctness of the frequencies can be verified by the substitution of the values in the equations p + q=1 p2 + 2pq + q2 = 1
- Thus genotype frequencies at the EST locus are in Hardy-Weinberg equilibrium.
- We can expect these allele frequencies to remain constant over time.
- This equilibrium in the genetic structure of the population at the EST locus indicates that this particular locus is not changing. Hence the population is not evolving.

Limitations

- One or more of the assumptions are violated in most situations.
- Most populations are under the influence of natural selection.
- Many populations are not even large enough to be functionally infinite.
- Oftentimes populations are not completely isolated from one another and migration of individuals into or out of one population can change its genetic makeup.



WORKSHEET-

Keerthana -What is Gene pool ?
Explain Hardy-Weinberg equilibrium
Nidhi -Factors affecting hardy Weinberg equilibrium
What you mean by Hardy-Weinberg equation
Sakhi -Importance of frequencies of particular alleles in the gene pool
Explain Allele?
Ekta - What is allele frequency ?
How does Allele frequency affect gene pool ?
Teena- Explain population genetics?
What is the main purpose of population genetics?
Karmshil - Significance of Hardy - Weinberg equation ?
explain hardy Weinberg principle?
Amit – what are the hardy Weinberg conditions?
what do you understand by genetic frequencies?
Aishwary – Write the hardy Weinberg equations?
How do scientists determine p and q?
Hari Shankar – write the limitations of Hardy Weinberg principle?
How do scientist monitor the frequency?
Vikram – Explain population?
what do you understand by population genetics?
Harish – What do you understand by gene pool?
what is genotypic frequency?