



# A Comprehensive Overview of their Role in Science, Medicine, and Beyond

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## DESCRIPTION

Genetic markers are an essential tool in modern biology and medicine, providing a window into the complex world of genetics. These markers are specific sequences of DNA that are used to identify individuals, populations, or traits. They can serve as indicators for a variety of biological phenomena, from tracking inheritance patterns to diagnosing diseases and predicting responses to medications. The utility of genetic markers spans across fields such as molecular biology, anthropology, forensic science, and personalized medicine, making them a cornerstone of genomic research. In this article, we will delve into the nature of genetic markers, their types, how they are used in research and medicine, and their ethical and social implications. Genetic markers are identifiable sequences of DNA that can be associated with a particular location in the genome. These markers can vary in size, ranging from a single nucleotide change (Single Nucleotide Polymorphism, or SNP) to longer sequences of DNA. The value of genetic markers lies in their ability to reveal information about inheritance patterns, genetic variations, and mutations. Single Nucleotide Polymorphisms (SNPs): These are the most common type of genetic variation, where a single base in the DNA sequence is different between individuals. SNPs can be used to study population diversity, trace ancestry, and even predict susceptibility to certain diseases. Microsatellites (Short Tandem Repeats, STRs): These are short, repetitive DNA sequences that vary in length between individuals. Microsatellites are highly polymorphic, making them valuable for genetic mapping and forensic analysis. Restriction Fragment Length Polymorphisms (RFLPs): These are variations in DNA sequence that affect the length of fragments generated by restriction enzymes, which cut DNA at specific sites. RFLPs were one of the earliest genetic markers used for genetic linkage studies. Copy Number Variations (CNVs): These involve

changes in the number of copies of a particular gene or genomic region. CNVs can influence gene expression and are implicated in several diseases, including cancer and neurodevelopmental disorders. The discovery of genetic markers dates back to the early days of genetics. The concept was first introduced in the context of linkage mapping, where scientists sought to understand how genes were inherited together. In the early 20th century, researchers like Thomas Hunt Morgan used fruit flies (*Drosophila melanogaster*) to establish the idea of gene linkage, laying the groundwork for the use of genetic markers in mapping genomes. In the 1980s, the development of DNA sequencing technologies and the discovery of SNPs and microsatellites revolutionized genetic research. These markers allowed for more precise mapping of the genome and the identification of genetic variations associated with specific traits or diseases. Genetic mapping is the process of determining the relative positions of genes or genetic markers on a chromosome. By studying how frequently two markers are inherited together, researchers can estimate their physical distance from one another. This method, known as linkage analysis, has been instrumental in identifying genes associated with inherited diseases, such as cystic fibrosis and Huntington's disease. Genetic markers are used extensively in evolutionary biology to study the genetic variation within and between populations. They provide insights into the evolutionary history of species, allowing scientists to reconstruct phylogenetic trees and understand how species diverge over time.

## ACKNOWLEDGEMENT

None.

## CONFLICT OF INTEREST

The author's declared that they have no conflict of interest.

<b>Received:</b>	01-October-2024	<b>Manuscript No:</b>	IPBM-24-21795
<b>Editor assigned:</b>	03-October-2024	<b>PreQC No:</b>	IPBM-24-21795 (PQ)
<b>Reviewed:</b>	17-October-2024	<b>QC No:</b>	IPBM-24-21795
<b>Revised:</b>	22-October-2024	<b>Manuscript No:</b>	IPBM-24-21795 (R)
<b>Published:</b>	29-October-2024	<b>DOI:</b>	10.36648/2472-1646.10.5.44

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**Citation** Allen C (2024) A Comprehensive Overview of their Role in Science, Medicine, and Beyond. J Biomark J. 10:44.

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