INSTITUTE OF PLANT SCIENCES

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Microsatellite DNA

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BREEDTECH project: Students' Training Workshop
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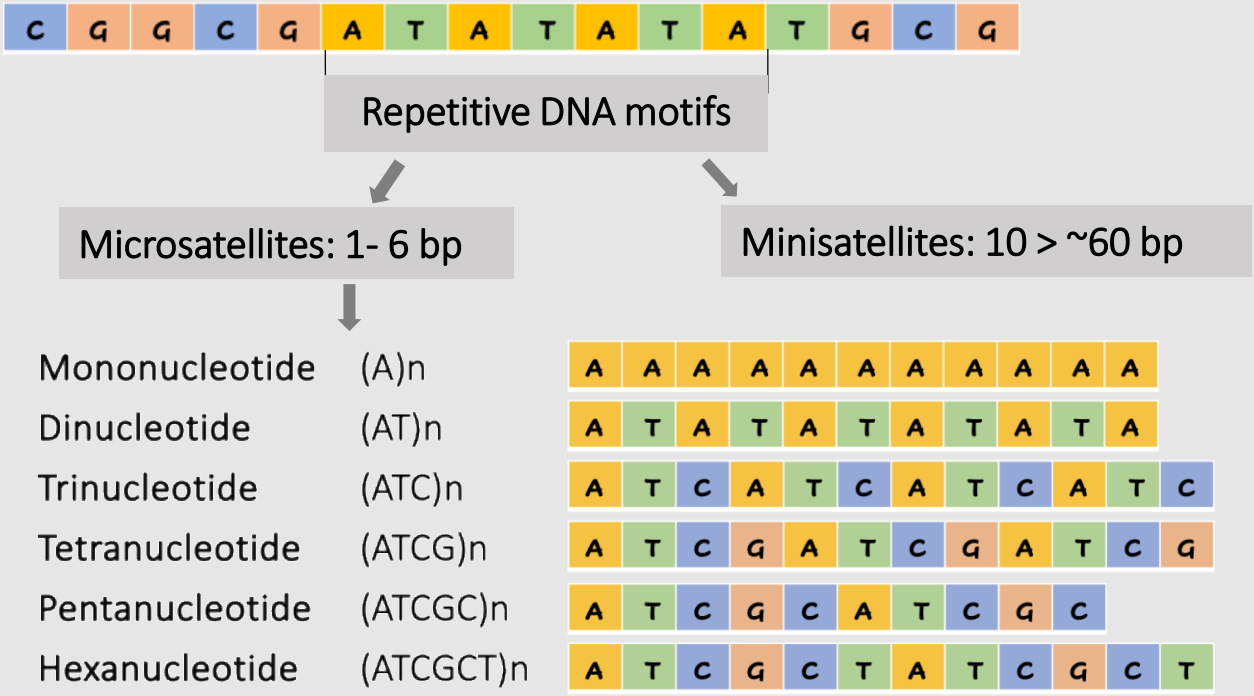
BRIEF INTRODUCTION

Short Tandem Repeats (STRs)/Simple Sequence Repeats (SSRs)



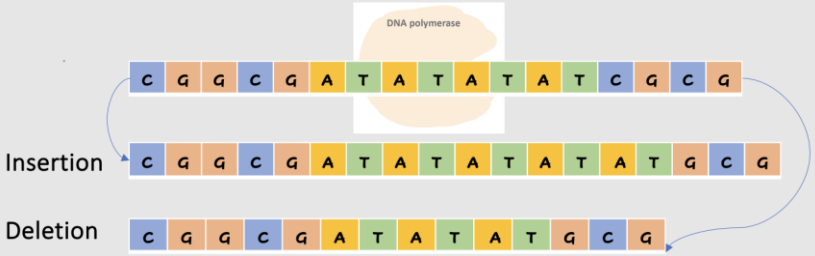
POLYMORPHISM

The variation in the number of repetitive motifs at a specific locus of the genome.

- Can vary between individuals, populations, or species.
- polymorphism is highly useful for genetic diversity studies, population genetics and marker-assisted selection.

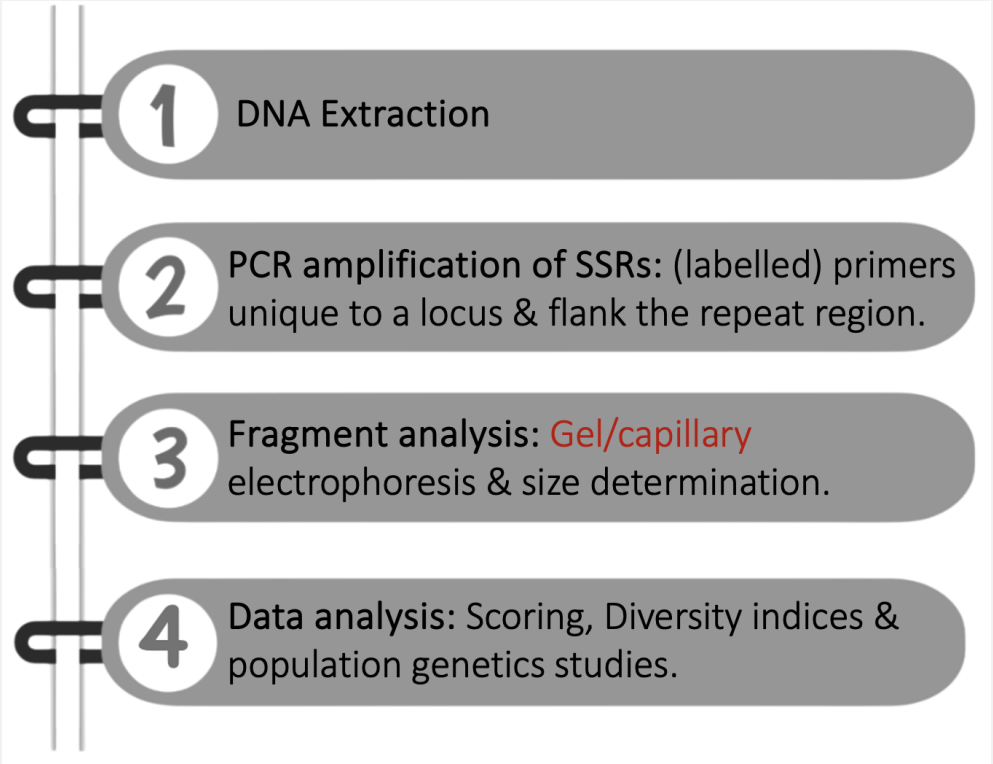
Mechanism of mutation & variability

- Major cause; **Replication Slippage** -DNA polymerase dissociates



- Leading to high mutation rates and genetic diversity.

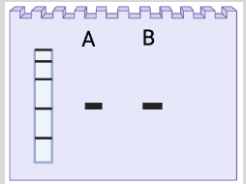
ASSAY WORKFLOW

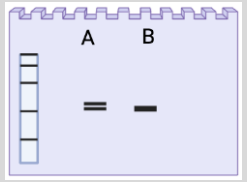


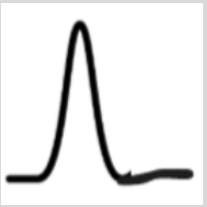
FRAGMENT ANALYSIS

Agarose	Polyacrylamide Gel (PAGE)	Capillary Electrophoresis
Resolution 5–10 bp	1–2 bp	1 bp
Advantages • Simple • Inexpensive	• Higher resolution • Moderately inexpensive	• Highest resolution • Automated, Multiplexing
Disadvantages • Low resolution • Cannot resolve 1- 6 bp differences	• Time-consuming, • Toxic reagents	• Expensive • Specialized equipment

Sample (Diploid)	Allele 1 (bp)	Allele 2 (bp)
A (Heterozygous)	200	210
B (Homozygous)	200	200







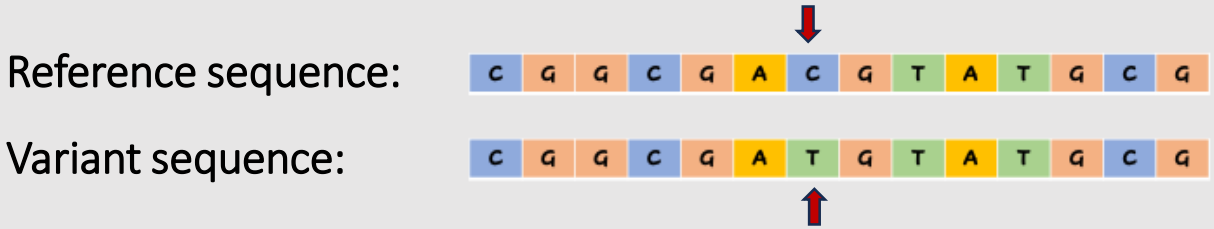
APPLICATIONS

- **Genetic Diversity Analysis:** genetic variation within and between populations, aiding breeding programs.
- **Conservation Genetics:** evaluating genetic bottlenecks and inbreeding in endangered species .
- **Genetic Mapping:** genetic linkage maps essential for identifying genes associated with specific traits.
- **Forensic & Paternity Testing:** the unique allelic profiles are essential for individual identification and kinship testing.

ADVANCES IN GENETIC MARKER TECHNOLOGY

SSRs to Single Nucleotide Polymorphisms (SNPs) in modern genotyping

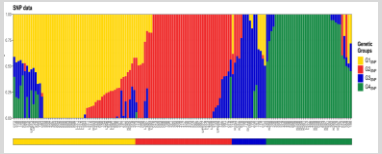
- **A SNP** is variation at a single nucleotide position in the genome.



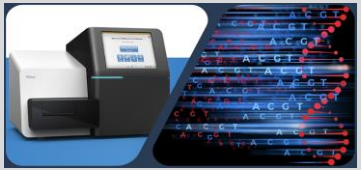
- Occur every 100 - 300 base pairs in genomes.
- SNPs, the **gold standard** in genotyping now.

KEY BENEFITS OF SNPs

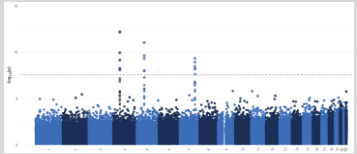
Why are SNPs replacing SSRs?



Denser genetic maps for improved resolution.



High-throughput:
SNP arrays and NGS enable large-scale, automated genotyping *vs* SSR (PCR + gel electrophoresis)



Standardized, reliable data, enhancing GWAS studies ***vs*** SSR (Parentage testing, diversity studies)

Lower mutation rate → Higher Stability: More stable over generations, making them reliable for long-term studies.

SNP genotyping is cheaper per marker for large datasets.

THE FUTURE OF GENETIC MARKERS

- SSRs remain useful in specific applications like:
  - Forensic & Parentage testing (high polymorphism per locus).
  - Studies on recent evolution and genetic drift.
  - Low-cost genotyping for small-scale studies.

- Advances in NGS and AI-driven genomics will further enhance SNP-based studies.

Thank you