

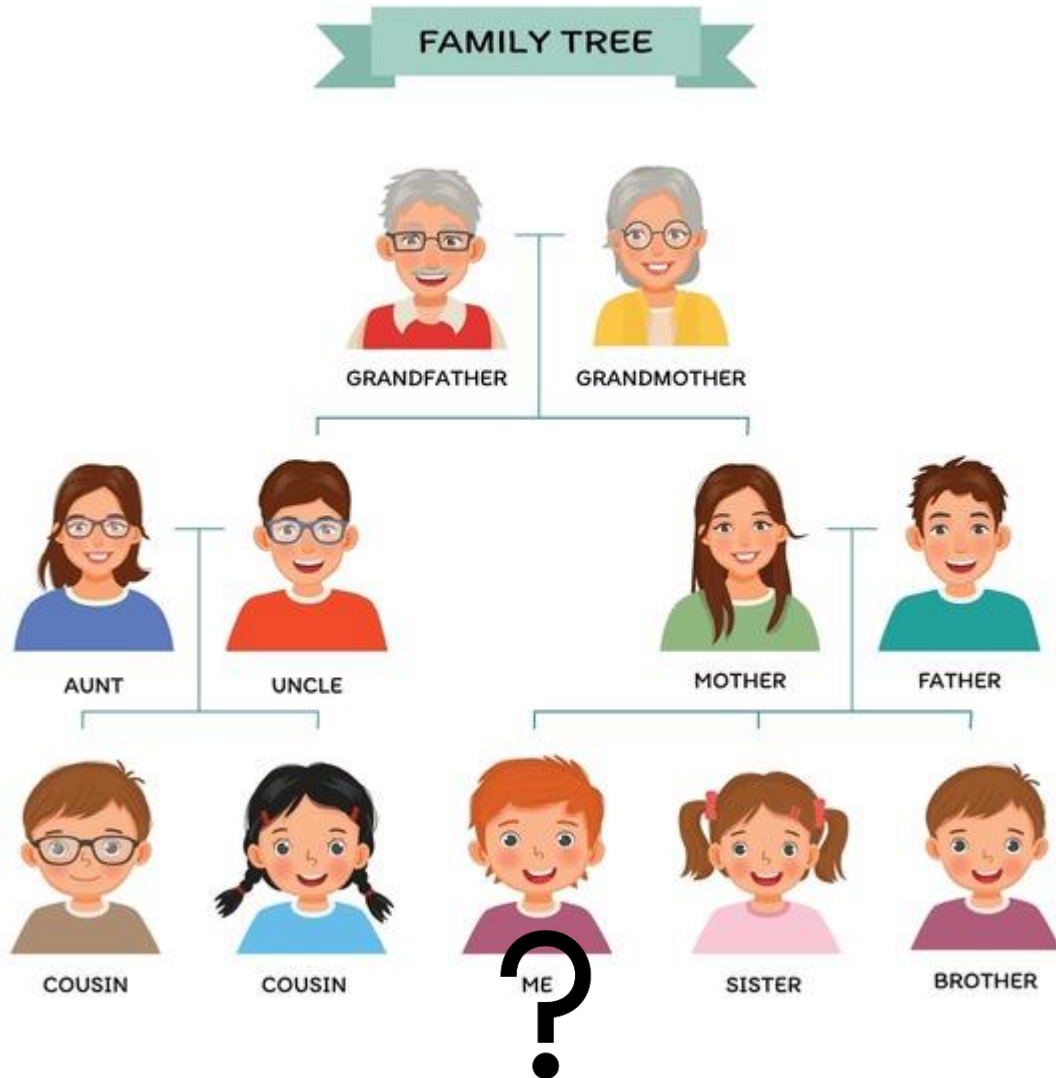


Biological Relationship Establishment

**Techniques, Applications
and Case Studies**

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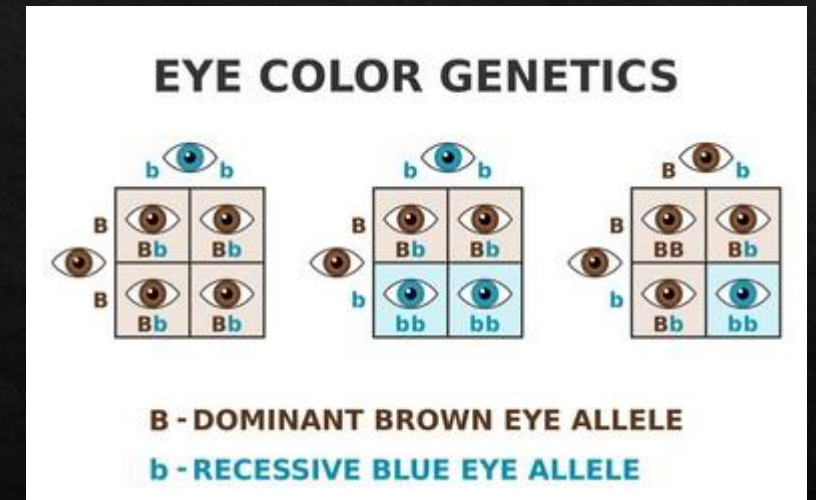
Introduction to Biological Relationships



- ❖ Biological relationships refer to the connections between individuals that are based on shared genetic material inherited through reproduction. These relationships are determined by the transmission of DNA from one generation to the next.
- ❖ Establishing biological relationships is crucial in fields such as genealogy, forensic science, medicine, and legal matters like inheritance and paternity disputes. DNA testing is the most reliable method for determining these relationships by analyzing genetic markers.

Basics about Genetics and Inheritance

- ◆ **Autosomal Inheritance:** Refers to genes located on the autosomes (non-sex chromosomes, chromosomes 1–22 in humans).
- **Autosomal Dominant Inheritance:** One copy of a mutated gene is sufficient for a person to be affected (e.g., Huntington's disease). Affected individuals often have one affected parent.
- **Autosomal Recessive Inheritance:** Two copies of a mutated gene (one from each parent) are required for the individual to be affected (e.g., cystic fibrosis). Carriers (with one copy of the gene) are not affected but can pass the gene to offspring.



Basics about Genetics and Inheritance (contd.)

- ◇ **Sex-linked Inheritance:** Refers to genes located on the sex chromosomes (X and Y).
- ◇ **X-linked Inheritance:**
 - ◇ **X-linked recessive:** Conditions are more commonly expressed in males, as they only have one X chromosome (e.g., hemophilia, color blindness). Males are affected if they inherit the affected X chromosome from their mother. Females are usually carriers unless they inherit two affected X chromosomes (one from each parent).
 - ◇ **X-linked dominant:** A single copy of the affected gene on the X chromosome causes the condition in both males and females (though often more severe in males).
- ◇ **Y-linked Inheritance:** Only passed from father to son, as Y chromosomes are only present in males. Relatively rare, with examples like Y-chromosome infertility.

Types of Biological Relationships

◈ **Parent-Child Relationship:**

- **Direct relationship** where a child inherits 50% of their DNA from each parent.
- **Paternity/Maternity Testing:** Common genetic tests used to confirm a biological connection between a parent and a child by analyzing shared genetic markers.

◈ **Sibling Relationships:**

- **Full Siblings:** Share approximately 50% of their DNA, inheriting different combinations of genes from the same two parents.
- **Half Siblings:** Share about 25% of their DNA, having only one parent in common.
- **Sibling Testing:** Can establish whether individuals are full, half, or unrelated using autosomal DNA and sometimes X-STR markers (for female siblings).

Types of Biological Relationships (contd.)

◆ Grandparent-Grandchild Relationship:

- Second-degree relatives: Grandparents and grandchildren share about 25% of their DNA.
- Grandparentage Testing: Often used when one or both parents are unavailable for testing. This test evaluates whether the grandparents share genetic markers with the grandchild.

◆ Aunt/Uncle-Niece/Nephew Relationship:

- Aunt/Uncle-Niece/Nephew relationships are second-degree relationships, sharing about 25% of their DNA.
- Testing is used in cases where parents are not available, and it is necessary to establish kinship through extended relatives.

Types of Biological Relationships (contd.)

◈ **Cousin Relationships:**

- **First Cousins:** Share about 12.5% of their DNA, as they are the children of siblings (aunt/uncle relationship).
- **Cousin Testing:** Less common than parentage or sibling testing but can be used in certain legal or immigration cases to verify family connections.

◈ **Unrelated Individuals:**

- Share no direct genetic relationship.
- DNA testing can easily exclude the possibility of a biological relationship when no significant overlap in genetic markers is found.

Importance of Biological Relationship Establishment

- **Forensics:** Identifying missing persons, criminal investigations, disaster victim identification.
- **Legal:** Child custody, inheritance disputes, immigration cases.
- **Medical:** Organ transplants, inherited genetic disorders.

Autosomal DNA Testing

- ◈ Tests DNA from the autosomal chromosomes (the 22 non-sex chromosomes). Both men and women can undergo autosomal DNA testing, as everyone inherits autosomal DNA from both parents. DNA segments are randomly recombined across generations, meaning you inherit different pieces of DNA from each grandparent, great-grandparent, and so on.
- ◈ **Applications of Autosomal DNA Testing:**
 - **Parent-Child Testing:** Determines a direct parent-child relationship by identifying shared autosomal markers.
 - **Sibling Testing:** Can differentiate between full siblings, half-siblings, and unrelated individuals based on the proportion of shared DNA.
 - **Extended Family Relationships:** Identifies relationships up to second or third cousins, making it useful for genealogy and family history research.
 - **Grandparentage Testing:** Used when one or both parents are unavailable to test for a child's biological relationships with grandparents.

Famous Paternity Case

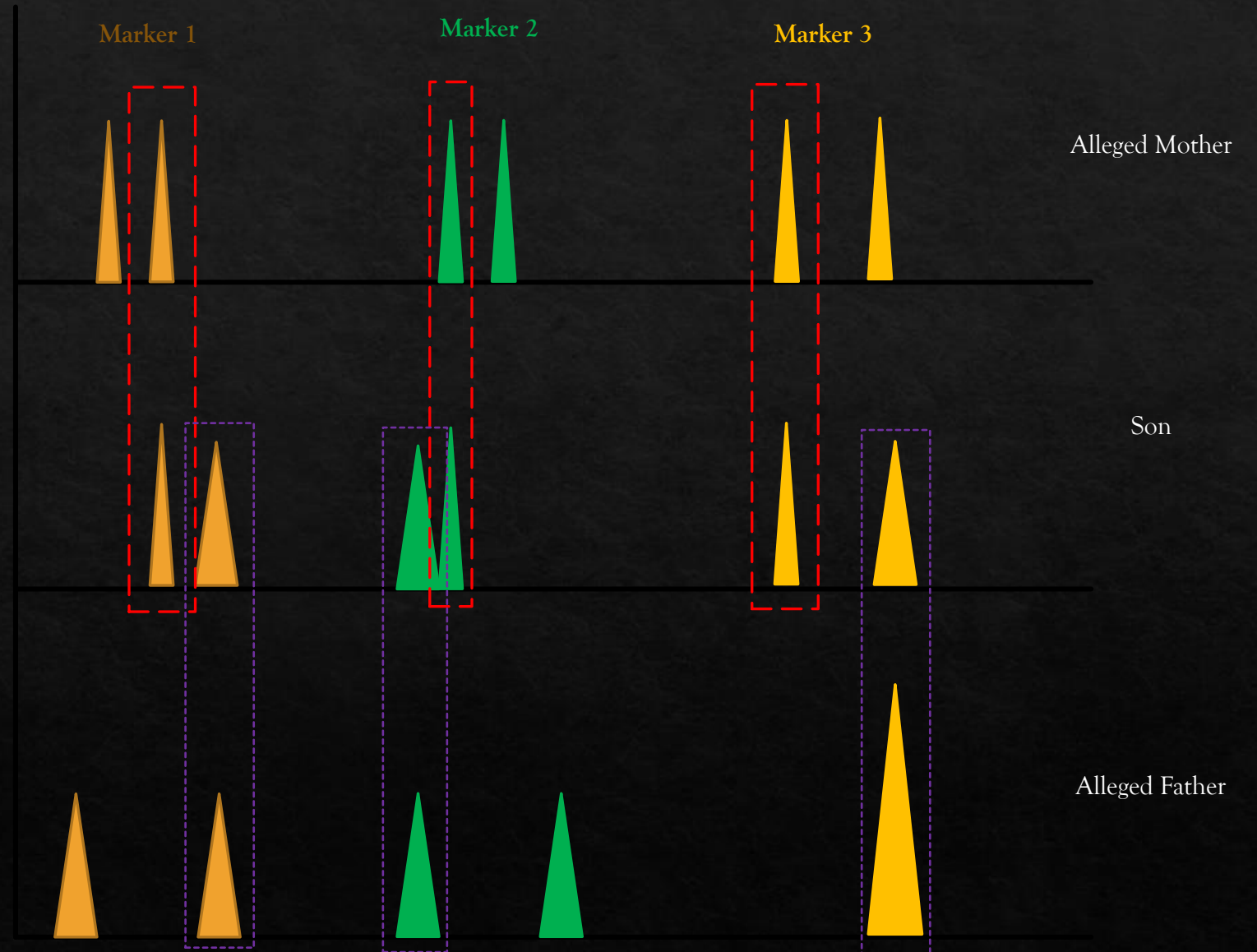
- ◆ In 2013, American basketball player **Michael Jordan** was involved in a paternity suit where a woman, Pamela Smith, claimed that Jordan was the father of her teenage son. She filed the lawsuit demanding a paternity test, child support, and for Jordan to admit to being the father of her son.
- ◆ A **paternity test** was conducted using **autosomal DNA** to compare the genetic markers of Jordan and the child. The results of the test showed that Jordan was **not the biological father** of the child.
- ◆ The case demonstrates how paternity testing can play a critical role in resolving legal disputes by providing clear genetic evidence.

“Validating Your Existence”

- ❖ A young adult was instigated by his relatives into believing that he was swapped at birth and was not born to his parents.
- ❖ He was approached by an old couple, claiming he was their son.
- ❖ Depressed at the thought of not being associated with his parents, the young adult sought scientific validation of his association with the people who had raised him.



- ◆ The young adult and the parents who raised him approached Truth Labs for DNA Profiling.
- ◆ Matching alleles were seen against both the parents.
- ◆ DNA Profiling showed unambiguously that he was the biological child of the people who raised him.



“Grand Old Man from the Sea” or “Recovered from a Watery Grave”



- ◇ An unidentified decomposed dead body was recovered from the sea by the Andaman Police.
- ◇ Facial recognition was impossible due to the highly decomposed nature of the human remains.
- ◇ The postmortem revealed that the body was of an adult male, aged about 25-40 years old, and the time of death was around 3-4 months.

- ❖ They preserved bone and tissue samples from the deceased for future testing and reference.
- ❖ A case was registered by the Andaman Police and a press release was given informing the public about the basic information about the deceased.
- ❖ On vetting the missing person's register, the police identified 3 possible missing males who matched the physical description of the deceased.



- ◈ In order to identify the deceased, blood samples of the family members of the 3 missing men were sent to Truth Labs, along with the bone from the deceased for DNA profiling.
- ◈ DNA Profiling of the deceased did not match with the DNA profiles of any of the family members of the missing men.

