

The Science of DNA: Testing Biological Relationships for US Immigration



Technical Bulletin 40-017

Setting the Standard for Quality DNA Identification

United States citizens can petition for their spouses, parents, children or siblings to immigrate to the United States and permanent residents can do so for their spouses and unmarried children.

In cases where there are insufficient written records to validate the relationships and satisfy the requirements of the U.S. Citizen and Immigration Services Department, a DNA relationship test may be requested. The tests are typically requested for immigration and passports and sometimes for other reasons. It is important to ask the reason for testing, as that could dictate which U.S. agency is responsible for sample collection and receiving the reports.

Depending on the specific biological relationship in question, one or more DNA relationship tests may be requested. These tests include paternity, maternity or siblingship.



DNA Relationship Testing

DNA is the alphabet of life and defines the essence of our individuality. Despite the magnitude of the human genome, over 3.2 billion letters, 99.9% of the DNA in all unrelated people in the world is identical. Thus, the vast differences observed in the human race are created from the minute differences in only 0.1% of DNA.

Paternity Testing

A DNA paternity test is an extremely accurate method to determine, whether a man is the biological father of another individual.

Maternity Testing

Similar to a paternity test, a maternity test is used to determine if a woman is the biological mother of an individual.

Siblingship

A siblingship test is useful for determining if two individuals are related as full siblings, half siblings or are unrelated.



Chromosomal Laboratories, Inc

1825 W. Crest Lane

Phoenix, Arizona 85027

877-434-0292

623-434-0292

www.chromosomal-labs.com

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Consanguineous Marriages

Consanguineous marriage is customary in many societies throughout the world. In the United States, consanguinity becomes important in defining who may marry. Some states forbid cousins to marry. Others are more lenient and only forbid people to marry their brothers, sisters, mothers, fathers, or aunts and uncles.

On occasion, embassies may ask a laboratory to prove an unspecified relationship, such as: that a husband and wife are not biologically related. This generic request becomes complex and nebulous. The Department of State and the United States Citizenship and Immigrations Services is aware of the problem and has stated that they are working to change this. They would like the embassies to ask labs to prove a specific relationship, rather than to disprove a relationship.

Analytical Platform

Paternity test results and conclusions are founded in statistics and probabilities. The greater the number of genetic markers examined, the greater the strength of the genetic evidence and hence the greater the reliability of the final result. Chromosomal Laboratories tests a minimum of 16 DNA markers in routine relationship testing. The 16 marker technology can achieve a probability of identity of 1 in 40 quintillion, or 1 in 40,000,000,000,000,000,000.

Genetic Inconsistencies (Mutations)

Genetic inconsistencies (mutations) are naturally occurring mismatches between a child and the alleged parent. The frequencies of these naturally occurring mismatches are factored into the final combined paternity index. Due to the nature of these calculations, the statistical value of the result is significantly reduced; therefore some degree of extended testing is required to obtain a conclusive result.

Extended Testing

For the majority of paternity cases, the 16 genetic marker panel is more than adequate. However, special circumstances can require extended testing to obtain a statistically desirable result. This typically occurs when there is a single genetic mutation or the mother is not included in the test. Extended testing options can include testing the mother, adding more autosomal genetic loci, or Y chromosome testing, if the child is a male. During case review our doctors may determine that extended testing is necessary or statistically useful, and will make recommendations for extended tests that are likely to be the most productive.

Y-Chromosome Testing in Relationship Studies

The Y chromosome is male specific and passes through generations unchanged from father to son. In circumstances where an alleged father is unavailable for testing or is deceased, a male child can be tested against any number of his male relatives including, but not limited to, other known male children,



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brothers and half brothers with the same father, uncles, a grandfather, and grandfather's brothers. Since the Y chromosome is only found in males, this type of testing is not useful for female offspring. This test is also not appropriate for paternity in circumstances where there are two related alleged fathers.

Result Interpretation - Siblingship Studies

The results of siblingship, avuncular and grand paternity testing are generally reported as the likelihood in support of or against an alleged relationship. While interpretation of the strength of the statistical value can be variable, and should ultimately be considered in context with all case circumstances, the table below summarizes published interpretative criteria for use as a guide.

Combined Likelihood Ratio	Value of Evidence in Support of Hypothesis
<1	Does not support hypothesis
1	Neutral
1 to 10	Limited Support
10 to 100	Moderate support
100 to 1,000	Strong Support
1,000 and greater	Very Strong Support



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