

## Genetic Genealogy: An Introduction to DNA

Have you heard your friends and fellow genealogists enthuse about DNA but don't know what it's all about? Wondering if a DNA test is right for you? Come learn about DNA, why it's valuable, which tests you can take, and how it might be helpful in your genealogy research.

### What is DNA?

DNA, or deoxyribonucleic acid, is the genetic code that defines each individual's biological characteristics. DNA is made up of strings of individual bases or nucleotides which are paired with their counterparts. These strings of DNA are coiled into packages or chromosomes. Chromosomes are found in the nucleus (or center) of most of cells. Each nucleus contains 23 paired chromosomes (46 total chromosomes). One of these paired chromosomes (the sex chromosomes, usually identified as X and Y) defines whether you are biologically male or biologically female. The other 22 paired chromosomes are known as autosomes.

Many cells also have mitochondria, which act as the powerhouse of the cell. These mitochondria are located outside the cell's nucleus but have their own DNA.

### Why is DNA Valuable?

DNA is valuable because it is inherited. Your DNA is a composite of your parents' DNA, your grandparents' DNA, and your great-grandparents' DNA. Half of your DNA comes from your father and half from your mother. Because DNA is inherited, it is useful for genealogy when it is compared with the DNA of other people. When you share segments of DNA with other people, it is assumed that you both descend from the same ancestor. By searching your family trees (created through traditional research), you can locate that common ancestor and verify the relationship.

### Types of DNA

#### yDNA

The Y chromosome (one of the two paired sex chromosomes) is only carried by men and is passed from father to son. By comparing the Y chromosome of two males, you can determine whether or not they share a common patrilineal ancestor.

#### mtDNA

MtDNA, or mitochondrial DNA, is found in a cell's mitochondria. Mitochondria are passed from a woman to all of her children, regardless of whether they are male or female. By comparing the mitochondrial DNA of two individuals, you can determine whether or not they share a common matrilineal ancestor.

#### atDNA

Autosomal DNA includes all of the chromosomes (excluding the sex chromosomes). Autosomal DNA can help identify ancestors within the last 5-7 generations. However, because you only inherit half of each of your parents' DNA, some of your ancestors "fall off" your genetic tree (meaning you did not inherit any of their DNA). You are also guaranteed to share DNA with 2nd cousins or closer.

# DNA and Genealogy

## Ethnicity

Most DNA companies provide a guess as to your ethnic origin. This ethnic origin is based on the comparison your DNA to reference samples collected by each DNA company from throughout the world. Ethnicity can be interesting and may help focus your research, the results should not be taken as fact.

## Projects

Many genealogists who test their Y and mitochondrial DNA join projects. Projects may be grouped around geographic regions, surnames, or haplogroups. Projects are run by extremely knowledgeable administrators who group the DNA of project members based on unique markers. After joining a project, check to see how your DNA compares to the DNA of others in the project.

## Chromosome Mapping

Chromosome mapping is the process of mapping DNA segments to specific ancestors. Once you know how you are related to a match, you can assume that the DNA segments you share were inherited from your common ancestor and you can assign those segments to that ancestor on a visual representation of your chromosomes.

## Adoptions

Adoptees and others with unknown parentage are using DNA to find and connect with their biological parents. Adoptees test with all three DNA companies. Starting with their close matches, they identify explore trees and identify common ancestors that appear in more than one tree. They then search for those ancestors' descendants to find potential biological relatives. Learn more at [adoptiondna.blogspot.com](http://adoptiondna.blogspot.com).

## Brick Walls

Genealogists can break through brick walls using DNA though it does take time and money. To solve a brick wall, start by using traditional research to hypothesize a potential relationship. Then, locate multiple living descendants of your ancestor and living descendants of the family you think you are related to and test their DNA. If a high enough percentage of the descendants share the predicted amount of DNA, you can come to a conclusion regarding that relationship.

## DNA Companies

**AncestryDNA** – AncestryDNA tests autosomal DNA. Your DNA is collected by spitting into a tube. Results are tied to your Ancestry.com account and family tree(s). AncestryDNA is group matches into DNA Circles and will try and help you discover new ancestor with New Ancestor Discoveries. ([dna.ancestry.com](http://dna.ancestry.com))

**FamilyTreeDNA** – FamilyTreeDNA provides kits for testing yDNA, mtDNA, and atDNA (called Family Finder). Your DNA is collected by scraping your cheek. FamilyTreeDNA provides matching tools and chromosome browser. (<https://www.familytreedna.com>)

**23andMe** – 23andMe is primarily focused on DNA and health data. 23andMe tests autosomal DNA. DNA is collected by spitting into a tube. 23andMe also has ethnicity tools and match comparisons. Currently, 23andMe kits are more expensive. (<https://www.23andme.com>)

## 3rd Party Tools

**GedMatch** – GedMatch lets you upload and compare your raw DNA data regardless of which company you tested with. GedMatch also provides additional admixture tools, one-to-many comparison, one-to-one comparisons, and more. Requires registration and contribution of a raw DNA file.

(<https://gedmatch.com>)

**DNA Gedcom** – Use the Autosomal DNA Segment Analyzer to group matches by segment using your 23andMe or FamilyTreeDNA data. DNA Gedcom also includes GWorks, a tool which compares GedCom files. Requires registration. (<https://www.dnagedcom.com>)

**DNA.land** – Similar to GedMatch but newer, DNA.land provides additional ethnicity tools and connects you with additional matches. Requires registration and contribution of a raw DNA file. (<https://dna.land>)

**ISOGG Wiki** – The International Society of Genetic Genealogists has created and maintains a wiki (community written encyclopedia) on DNA and how it is used for genealogy. ([isogg.org/wiki/Wiki](https://isogg.org/wiki/Wiki))

**Genetic Genealogy Standards** – The genetic genealogy community has established a set of standards for genealogists using DNA as part of their research. ([www.geneticgenealogystandards.com](http://www.geneticgenealogystandards.com))

## DNA Vocabulary

**Admixture:** see **Ethnic Origins**

**Autosomes:** numbered (non-sex) chromosomes

**atDNA (autosomal DNA):** Consists of the 22 numbered chromosomes (also called autosomes); shared segments longer than 7-10 centiMorgans indicate a probable common ancestor

**Base Pair:** Two complementary bases located on opposing DNA strands; see nucleotide

**cMs (centiMorgans):** a unit of measurement for DNA segments

**Chromosome:** A package for carrying DNA in the nucleus of cells

**Chromosome Browser:** a feature offered by some genealogy companies that allow you view matching segments on a visual map of the chromosomes

**Chromosome Mapping:** The process of assigning ancestors to individual DNA segments

**DNA (deoxyribonucleic acid):** The genetic code that defines each individual's biological characteristics

**DNA Circle:** A feature of AncestryDNA that connects users who have a common ancestor and who share DNA

**DNA Project:** A group of people whose DNA or surname indicates a biological connection; project administrators for DNA projects are very knowledgeable and group DNA results in similar groups

**Endogamy:** When a population becomes genetically isolated over multiple generations making it difficult to use DNA to identify true relationships; examples include island populations and Ashkenazi Jews

**Ethnic Origins:** The percentage of your DNA inherited from specific ethnicities based on a comparison between your DNA and reference samples; different companies will report ethnic origins differently

**Family Finder:** atDNA test offered by FamilyTreeDNA

**Genetic Distance:** on FTDNA, the number of mutations that differentiate two individuals in yDNA and mtDNA results; on GEDMatch, the suggested number of generations between two individuals

and their common ancestor based on their matching segments

**Genetic Genealogy:** The use of DNA to identify family members, both living and deceased

**Genetic Genealogy Standards:** Ethical and usage standards for genealogists using DNA

**Haplogroup:** A group of similar haplotypes that share a common ancestor based on a single mutation

**Haplogroup Project:** A project consisting of those who share a common haplogroup

**Haplotype:** A group of alleles that are inherited together, also known as a genetic signature

**IBD (inherited by design):** Segments of DNA that are longer than 10 centiMorgans are considered to be inherited by design, indicating a common ancestor

**IBS (inherited by state):** Segments of DNA that are shorter than 7 centiMorgans are considered to be inherited by state, indicating no common ancestor

**ISOGG Wiki:** A wiki built and maintained by the International Society of Genetic Genealogists

**Match:** Individual identified by a DNA company as having shared segments of DNA

**Mitochondria:** Located in the cytoplasm of a cell, the mitochondria are the cell's powerhouses where sugar is converted into energy

**MRCA (most recent common ancestor):** The most recent ancestor or ancestral couple that is shared by two individuals who have matching segments of DNA

**mtDNA (mitochondrial DNA):** DNA associated with a cell's mitochondria; passed down from mother to child

**Mutation:** A change in the DNA

**NAD (new ancestor discoveries):** A beta project of AncestryDNA designed to help users identify ancestors based on their DNA

**NPE (non-paternal event):** when the father identified through paper trail research is not the biological father; in yDNA when there is a break between the surname of the son and the surname of the biological father

**Nuclear DNA:** DNA located in the cell's nucleus; made up of 23 paired chromosomes

**Nucleotide:** the basic structure of DNA; there are four known nucleotides

**Paper Trail:** Genealogy done by researching traditional records such as census, probate, vital, etc.

**Phasing:** the process of assigning DNA to each parent

**Surname Project:** A project consisting of DNA samples from all individuals with the same surname

**Triangulation:** the process of triangulating a DNA match with paper trail records, leading to the most recent common ancestor

**xDNA:** one of two sex chromosomes; individuals with two X chromosomes are female; x chromosomes have a unique inheritance pattern because an X chromosome cannot be passed from father to son.

**yDNA:** one of two sex chromosomes; individuals with a Y chromosome are male; yDNA is passed from father to son