FamilySearch

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 help you 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 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 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 her children, regardless of whether they are male or female. By comparing the mitochondrial DNA of two individuals, you can determine whether they share a common matrilineal ancestor.

atDNA

Autosomal DNA includes all 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 only 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 of your DNA to reference samples collected by each DNA company from around the world. Ethnicity may help focus your research, however, the results should not be taken as fact.

Projects

Many genealogists who test their Y and mitochondrial DNA join projects. Projects may be grouped by geographic regions, surnames, or haplogroups. Projects are run by 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 using 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 explore trees and identify common ancestors that appear in more than one ancestry. They then search for those ancestors' descendants to find potential biological relatives. Learn more at adoptiondna.blogspot.com.

Brick Walls

Genealogists can break through brick walls using DNA. 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 provides ethnicity results, match lists and groups users into Genetic Communities and DNA Circles. (dna.ancestry.com)

MyHeritage – MyHeritage DNA tests autosomal DNA. Your DNA is collected by scraping your check. MyHeritage provides ethnicity results and match lists. (www.myheritage.com/dna)

FamilyTreeDNA – FamilyTreeDNA provides kits for testing yDNA, mtDNA, and atDNA (called Family Finder). Your DNA is collected by scraping your cheek. FamilyTreeDNA provides match tools and a chromosome browser. (www.familytreedna.com)

23andMe – 23andMe is 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. (www.23andme.com)

3rd Party Tools

GedMatch – GedMatch lets you upload and compare your raw DNA date 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 – 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 used for genealogy. (isogg.org/wiki/Wiki)

Genetic Genealogy Standards – The genetic genealogy community has established a set of standards for genealogists using DNA as part of your research. (www.geneticgenealogystandards.com)

DNA Vocabulary

Admixture: see **Ethnic Origins**

Autosomes: numbered (non-sex) chromosomes

atDNA (autosomal DNA): 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 knowledgeable and group the DNA results of group members

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 report ethnic origins differently

Family Finder: atDNA test offered by FamilyTreeDNA

Genetic Communities: a feature on AncestryDNA which groups Ancestry members into common ancestral geographic regions based on similarities in DNA

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: 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

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

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