DNA for Genealogy Librarians

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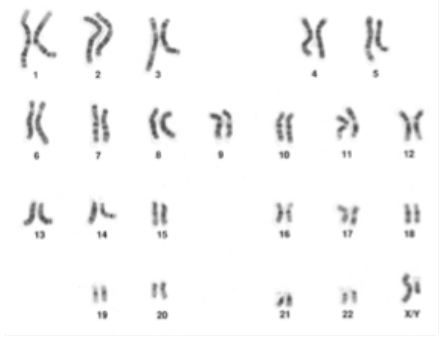
The human body is made up of the building blocks of cells. Every cell has the exact same DNA. DNA is the control center of the cells and codes for every aspect of the human body.

There are two kinds of DNA in the human body:

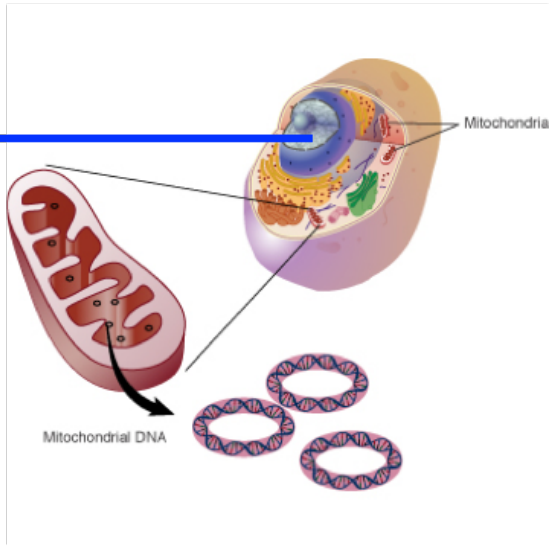
1. Nuclear DNA found in the nucleus of the cell.
The DNA found in the nucleus consists of 23 pairs of chromosomes: 22 pairs of autosomes and one pair of sex chromosomes. Cells of males have one Y chromosome and one X chromosome. Females have two X chromosomes. For each pair of the chromosome, one came from the mother and one came from the father. The Y chromosome, because it's only found in males, comes from the father and is passed only to sons.

2. Mitochondrial DNA is outside the nucleus of the cell. Mitochondria are the "power houses" of the cell and work by converting sugar into the type of energy used by the cell. Although there is only one set of nuclear DNA, there can be hundreds and sometimes thousands of mitochondria in the cell. Each mitochondria has multiple copies of identical, circular-shaped, DNA. The greater the energy requirements of the cell, the more mitochondria are created. The egg carried by the mother contains mitochondria. Only the nuclear DNA of the sperm fertilizes the egg. Thus every child, male or female has his mother's mitochondrial DNA. Only daughters pass on the mitochondria in their eggs.

DNA in the Nucleus
22 pairs of autosomes
1 pair of sex chromosomes (XY or XX)



Cell

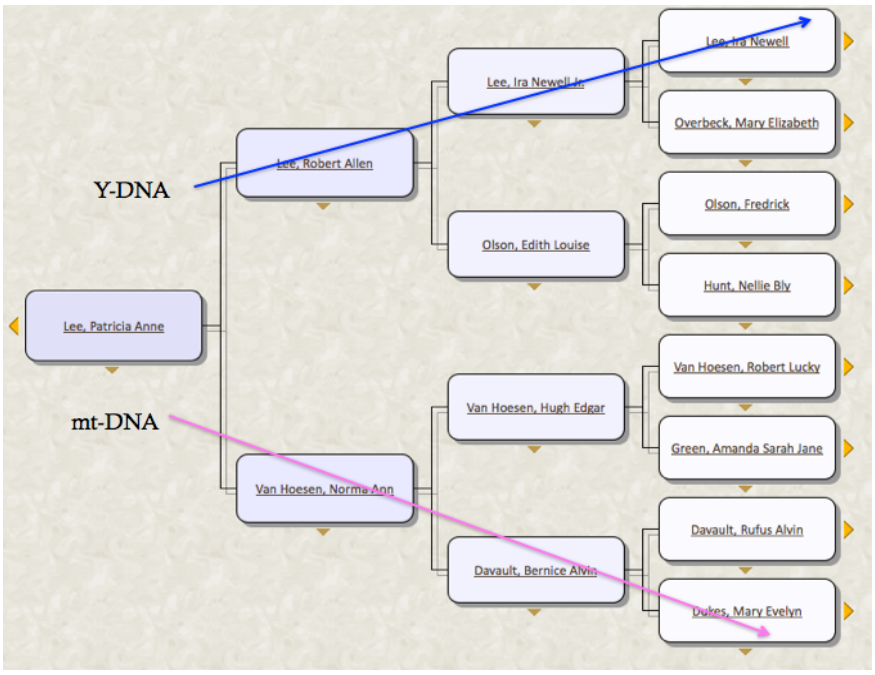


DNA Tests for Genealogy

- Y-DNA (only males)
- Mitochondrial DNA (both males and females)
- Autosomal DNA (both males and females)

Y-DNA and Mitochondrial DNA

Because of the way that Y-DNA is passed down from father to son to son to son, etc.—the same way that surnames have traditionally passed down—Y-DNA test matching can help to identify a common ancestor many generations back. Because the mitochondrial DNA is inherited from the mother who got it from her mother, and so on, it, too, can help to identify a common ancestor many generations back. The problem with mitochondrial DNA is that because of the surname changing in every generation as a result of taking the husband's name in marriage, it can be very difficult to identify a common ancestor. Mitochondrial DNA testing is best used to solve very specific genealogical questions, and testers should not expect to identify an ancestor many generations back. Y-DNA tests the patrilineal line, and mt-DNA tests the matrilineal line.



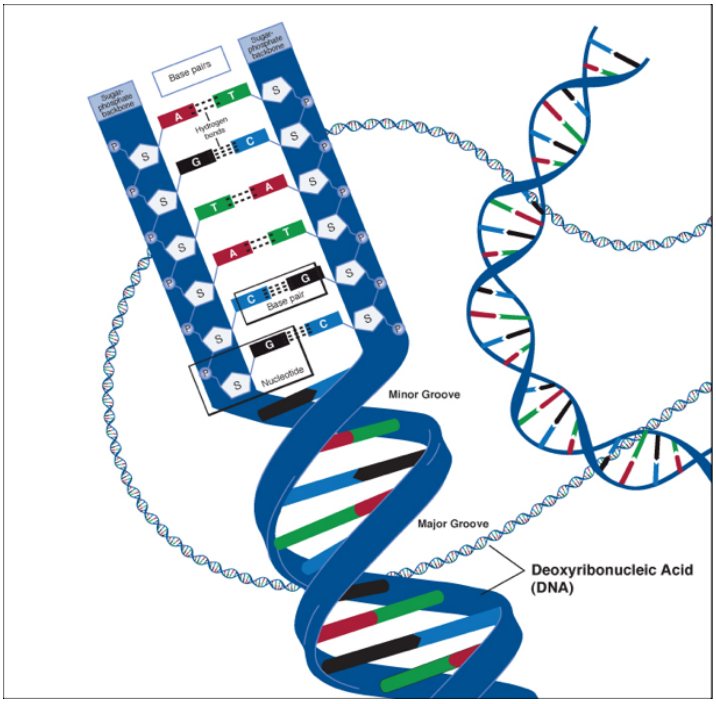
Both Y-DNA and mitochondrial DNA occasionally undergo mutations. Y-DNA mutates more frequently than mitochondrial DNA. The differences in the DNA between two testers is identified by "genetic distance." The genetic distance is a measure of how many differences there are between the DNA of the two testers. The smaller the genetic distance, the closer the relationship is likely to be. However, with mitochondrial DNA, the mutation rate is so low and it is so stable that even perfect matches with a genetic distance of 0 might share an ancestor many hundreds of years back. This is another reason that mitochondrial DNA is best used to

answer specific research questions rather than trying to pick out a distant ancestor.

AUTOSOMAL DNA

Autosomal DNA is the most difficult to analyze. Each parent passes on one chromosome of each pair to his or her child. However, that one chromosome is not just one of the pair he inherited from his parent. When egg and sperm are created, the DNA undergoes a process called recombination. Recombination causes the two chromosomes inherited from each of the parents to switch out pieces. The egg or sperm results in one chromosome (X 22) that is a mixture of the grandparents' chromosomes. When the egg and sperm combine, the egg contains the full complement of nuclear DNA.

Because each child only gets half of each parent's DNA, half of the DNA from ancestors is lost each generation. Because of the way that recombination works, this is not exactly half and a child might have more DNA from one grandparent on one chromosome, and more of another on a different chromosome. Each sibling will have DNA that another sibling does not. Siblings share about half of their DNA. Therefore, it is helpful to gain more of the ancestral DNA by testing siblings of not only yourself, but of your parents, and perhaps even grandparents if they are still living. Testing the older family members while they are still around should be a priority.



DNA is a ladder-like structure that twists into a helical shape. The rungs of the ladder are made up of what are called base pairs. Each letter (A, C, G, and T) are bases. it is the sequence of these bases that perform like words in a sentence or book to create meaningful "sentences" of code.

Autosomal DNA identifies the location of these bases by the chromosome number and the particular location on that chromosome. The sequence of the bases are compared among testers to find matching segments. The segment lengths are measured in units called centiMorgans. People matching on the same segment can then attempt to identify a common ancestral couple. In order to minimize the risk of misidentifying a common ancestor, it is best if three or more people share on the same segment. However, an alternate way of proving common ancestry is when several people from the same family share DNA, but not necessarily on the exact same segment. Person A might match Person B at X location. Person B matches Person C at Y location. Person A matches Person C at Z location, and so on.

It is most efficient to try to find the common ancestral couple with the people who match with the largest cM (centiMorgan) values. They are likely to be more closely related to you thus making the identification easier. Identifying matching segments makes it easier to identify smaller segments and more distant ancestry. Don't worry about trying to determine common ancestry with segments smaller than 7 cM unless they just happen to be on the same segment that you share with someone else to a larger degree.

Testing Companies

- **23andMe** only tests autosomal DNA. There are two pricing structures: one is $199 for ancestry matching and health-related DNA identification. For only ancestry matching, the test is $99. 23andMe is cumbersome to use because people have to agree to share genomes before you can see how you match. Many people on 23andMe have tested for the health identification DNA and do not care about trying to find a common ancestor. Communication through contact forms on the website.
- **Ancestry** tests only autosomal DNA for $99. They have the largest database of testers and all their testers are interested in genealogy. A larger database of testers increases the probabilities of making new discoveries with your DNA. Many also have family trees to aid in identifying the common ancestral couple. However, Ancestry does not give the matching segment data. They do not tell you on what chromosome and location you are matching other people. Therefore, you just have to take their word for the matching. Because of this, Ancestry testers should transfer their raw data to GEDmatch. (http://gedmatch.com. All testers no matter the testing company will benefit by transferring raw data to GEDmatch.) Communication through contact forms on the website.
- **Family Tree DNA** tests all three types of DNA. Autosomal DNA (called the FamilyFinder test) is $79. The 37-marker Y-DNA test is $169, and the mitochondrial-DNA test is $199. Family Tree DNA's sole business is genetic genealogy. They have the best customer service. But they also have the smallest database. Email addresses of matches allow for direct communication.

23andMe and Ancestry DNA kits require spitting into a vial. Family Tree DNA uses cheek swabs. For older family members, it may be easier to use the cheek swabs.

Benefits & Limitation of DNA Testing

- DNA testing works only by comparing DNA of one tester to the DNA of others.
- DNA can confirm ancestral lines.
- DNA can give direction to research.
- DNA can help identify previously unknown ancestors.
- DNA can NOT identify a specific ancestor by itself.
- DNA testing is one piece of indirect evidence, which, when used with documentary evidence, can support suspected lines or identify unknown lines.

Adoptees
There are many people testing who do not have trees and do not know their family lineage because of being adopted. You may be able to help someone identify their biological family.

Ethnicity
This is the aspect that Ancestry pushes the most in their DNA commercials. However, it is also the most misleading. The identification of ethnic groups requires large numbers of testers and the scientists must identify the sequences held in common by various population groups. As the numbers of testers increases, the ethnicity predictions will get better. Many people are disappointed if their DNA does not reflect the expected ethnicities. This can happen because segments for that population have not been discovered or not enough people have tested.

However, one major reason is because of the way that autosomal DNA is lost by half each generation. A person may not have any DNA from that 3 X great-grandmother to show the Indian heritage. Negative results in autosomal DNA testing prove nothing unless the relationship is 2nd cousins or closer. Unexpected ethnicities may also be explained by incorrect genealogical lineages or by holes in our ancestry. Perhaps you know of no Irish heritage, and yet your ethnicity percentages show you are Irish. You discover your great-great grandmother for whom you've long been searching, and low-and-behold, she is from Ireland!

Resources

Institutes
Week-long, intensive genealogical education opportunities
"Practical Genetic Genealogy," Genealogical Research Institute of Pittsburgh, http://www.gripitt.org/past-and-future/ July 16-21, 2017
"Beginning DNA," Institute of Genealogy and Historical Research, http://samford.libguides.com/ighr/ighr-future. http://gagensociety.org/ighr-0 July 23-28, 2017. This will be held at the University of Georgia-Athens Hotel & Conference Center.

Blogs
Bartlett, Jim. *Segment-ology*. http://segmentology.org
Bettinger, Blaine. *The Genetic Genealogist*. http://www.thegeneticgenealogist.com.
Christmas, Shannon. *Through the Trees*. http://throughthetreesblog.tumblr.com.
Cooper, Kitty. *Kitty Cooper's Blog*. http://blog.kittycooper.com
Estes, Roberta *DNAeXplained-Genetic Genealogy*. http://dna-explained.com
Kennett, Debbie. *Cruwys News*. http://cruwys.blogspot.com.
Moore, CeCe. *Your Genetic Genealogist*. http://www.yourgeneticgenealogist.com.
Russell, Judy. *The Legal Genealogist*. http://legalgenealogist.com.
Wayne, Debbie Parker. *Deb's Delvings*. http://debsdelvings.blogspot.com.

Books
Bettinger, Blaine T. *The Family Tree Guide to DNA Testing and Genetic Genealogy*. Cincinnati,

Ohio: Family Tree Books, 2016.
Bettinger, Blaine T. and Debbie Parker Wayne. *Genetic Genealogy in Practice*. Arlington, Virginia: National Genealogical Society, 2016. This is a workbook with instruction and corresponding exercises.
Hill, Richard. *Finding Family: My Search for Roots and the Secrets in My DNA*. N.p.: self-published, 2012. Particularly helpful and inspiring for adoptees trying to find their biological parents.

Email Lists

Autosomal DNA List on RootsWeb. http://lists.rootsweb.ancestry.com/index/other/DNA/AUTOSOMAL-DNA.html.
DNA-Newbie Yahoo Forum. http://groups.yahoo.com/group/DNA-NEWBIE/.

Websites

International Society of Genetic Genealogy. http://isogg.org
ISOGG wiki: http://isogg.org/wiki
Triangulation: http://isogg.org/wiki/Triangulation
DNAadoption: http://dnaadoption.com