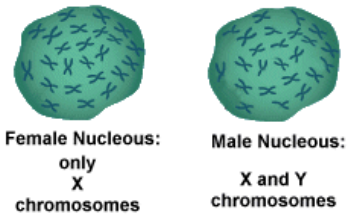
Understanding DNA

DNA is the carrier of our genetic information, and is passed down from generation to generation. All of the cells in our bodies, except red blood cells, contain a copy of our DNA.

At conception, a person receives DNA from both the father and mother. We each have 23 pairs of chromosomes. Of each pair, one was received from the father and one was received from the mother. These 23 pairs of chromosomes are known as nuclear DNA because, with the exception of red blood cells, they reside in the nucleus of every cell in our body.

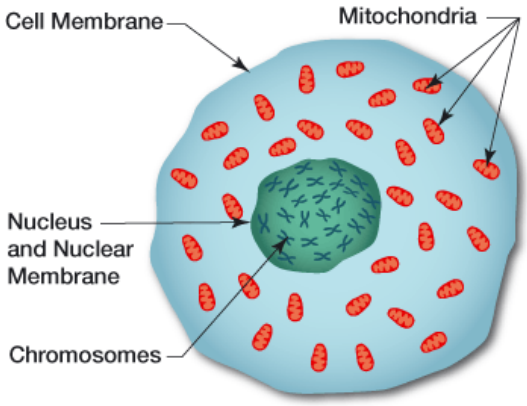
The 23rd chromosome is known as the sex chromosome. As with the other chromosomes, one is inherited from the father, and one from the mother. The 23rd chromosome from the mother is always an X. From the father, a person either inherits an X chromosome or a Y chromosome. The chromosome inherited from the father determines their gender. An X from the father would result in an XX combination, which is a female. A Y from the father would result in an XY combination, which is a male.



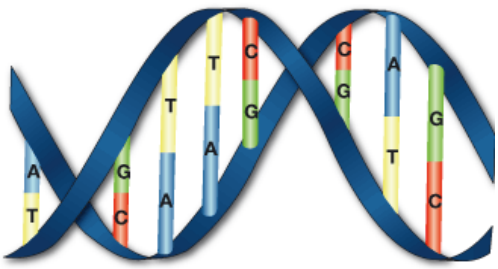
Female Nucleous: only X chromosomes

Male Nucleous: X and Y chromosomes

We also inherit our mitochondrial DNA, mtDNA, from our mother, and none from our father. Mitochondrial DNA is located outside the nucleus of the cell.



DNA is made up of four bases: adenine (A), cytosine (C), thymine (T), and guanine (G). The order of these bases is called the DNA sequence.



Thymine (Yellow) = T Guanine (Green) = G

Adenine (Blue) = A Cytosine (Red) = C

Whenever a particular base is present on one side, its complementary base is found on the other side. In the example above, see how the bases always occur in complementary pairs. Guanine (green) always pairs with cytosine (red) and thymine (yellow) always pairs with adenine

(blue). So we can write the DNA sequence by listing the bases along either one of the two sides. In the example shown, one side reads:

T G T T C G T C etc.

For Genetic Genealogy, which is the application of DNA testing to genealogy research, two types of DNA can provide information useful in conjunction with genealogy research. These two types are the Y chromosome and mitochondrial DNA.

Y-Chromosome DNA

The Y chromosome is transmitted from father to son. Testing the Y chromosome provides information about the direct male line, meaning the father to his father and so on. The locations tested on the Y chromosome are called markers. Occasionally a mutation occurs at one of the markers in the Y chromosome. Mutations are simply small changes in the DNA sequence. They are natural occurrences and take place at random intervals. Overall, they are estimated to occur once every 500 generations per marker. Mutations can sometimes be valuable in identifying branches of a family tree.

Each marker has a name assigned to it by the scientific community, such as DYS#391, DYS#439 or GATA H4. The scientists classify these markers as Short Tandem Repeats

STRs

The markers used in our standard Y-DNA Tests are classified by scientists as Short Tandem Repeats, STR. They are called because at each of these marker locations a short DNA code repeats itself. The result for a marker is the number of times the code repeats at that location and is called the allele value. Each marker has a name assigned to it by the scientific community, such as DYS391, DYS439 or GATA H4.

The result received for a Y-DNA test is a string of allele values called a haplotype. Here is an example of a haplotype for someone who took the Y-DNA 37 marker test:

PANEL 1

LOCUS	1	2	3	4	5	6	7	8	9	10	11	12
DYS#	393	390	19*	391	385a	385b	426	388	439	389-1	392	389-2
ALLELES	12	24	14	10	11	15	12	12	12	13	13	29

PANEL 2

LOCUS	13	14	15	16	17	18	19	20	21	22	23	24	25
DYS#	458	459a	459b	455	454	447	437	448	449	464a**	464b**	464c**	464d**
ALLELES	17	9	10	11	12	24	15	19	28	15	16	17	17

*Also known as DYS 394
**On 5/19/2003, these values were adjusted down by 1 point due to a change in Lab nomenclature.

You can read about using Short Tandem Repeats on the y-Chromosome to compare results (/reading-and-comparing-test-results.aspx).

Surname Project

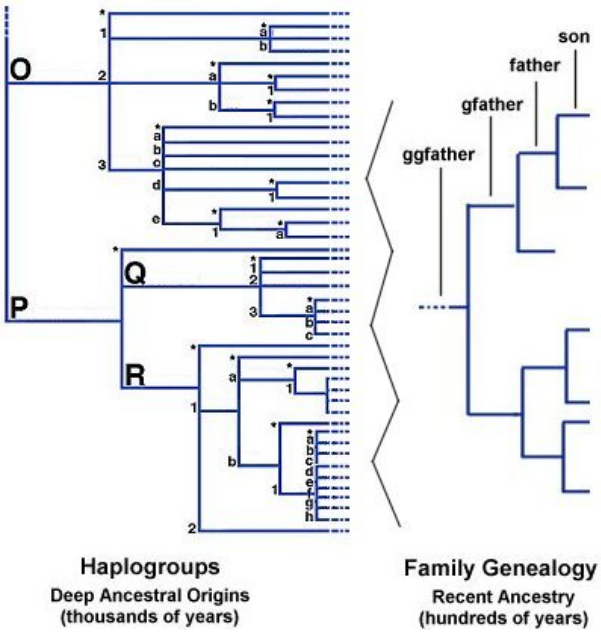
A Surname Project is a project which is established to test and compare those with a common surname and variants. A Surname Project has a leader known as the Group Administrator. This person assists the members with understanding their results, typically interprets the results for the group, and may publish this information in a newsletter or web site.

There are a wide variety of applications for Y-DNA testing. Y-DNA testing can be used to confirm the paper genealogical research for your family tree. It can determine which family trees with the same or variant surnames are related, and can provide clues to help you with your genealogy research. These are just a few of the applications for Y-DNA testing.

Since the Y chromosome is only found in men, those who take the Y-DNA test must be males. For females who are interested in the Y-DNA result for their surname or family tree, a close male relative with that surname would need to provide the sample.

Y-DNA Haplogroups

Using the results of a Y-DNA marker test, Family Tree DNA estimates the tester's haplogroup. The haplogroup identifies the person's major population group and provides information about the ancient origin of the male line. Family Tree DNA also offers a haplogroup test which participants can use to confirm their haplogroup assignment. The "Backbone" haplogroup test confirms the base haplogroup assignment, and the "Deep Clade" haplogroup test identifies the branch of the haplogroup the person belongs to.



SNPs

Using the results of any of our Y-DNA tests, Family Tree DNA also predicts the haplogroup. The haplogroup identifies the person's major population group and provides information about the ancient origin of the male line. Family Tree DNA also offers a haplogroup test which participants can use to confirm their haplogroup assignment. The "Backbone" haplogroup test confirms the base haplogroup assignment, and the "Deep Clade" haplogroup test identifies the branch of the haplogroup the person belongs to. You may read more about y-chromosome and SNP testing... click here (/snps-r-us.aspx)

Mitochondrial DNA

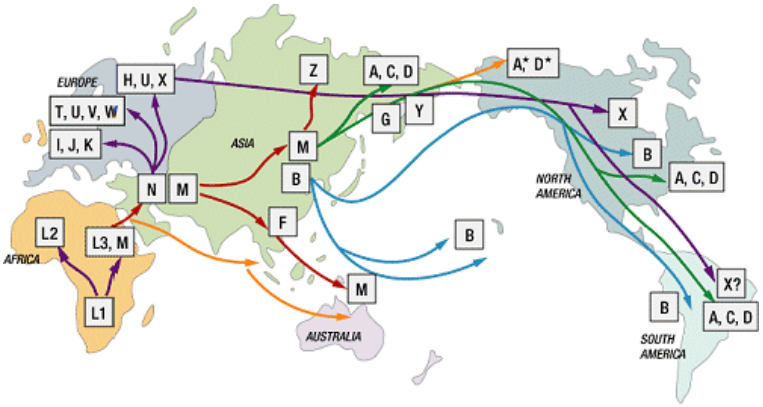
Mitochondrial is passed from mother to child. Since only females pass on their mtDNA, testing the mtDNA tells about the mother, to her mother, and so on along the direct maternal line. Both males and females receive mtDNA from their mothers, so both men and women can test their mtDNA.

While mutations occur in mitochondrial DNA, the rate of mutation is relatively slow. Over thousands of years these mutations build up so that one female line will have a sequence distinguishable from another. As people spread throughout the world, mutations occasionally occurred in different populations over time. This allows us to test the mtDNA to identify the world origin of a person's lineage.

mtDNA is tested and the result is compared to a reference sequence called the Cambridge Reference Sequence (CRS). By comparing an mtDNA sequence to the CRS, we can identify the ancient lineage to which you belong, called the haplogroup. Many haplogroups are continent-specific and some of their branches are region-specific.

Mitochondrial Haplogroups

Haplogroups are labeled alphabetically. Today, anthropologists have identified certain haplogroups that originated in Africa, Europe, Asia, the islands of the Pacific, the Americas, and sometimes particular ethnic groups. Of course, haplogroups that are specific to one region are sometimes found in another, but this is due to more recent migration.



EXPANSION TIMES *(years ago)*	
Africa	120,000 - 150,000
Out of Africa	55,000 - 75,000
Asia	40,000 - 70,000
Australia/PNG	40,000 - 60,000
Europe	35,000 - 50,000
Americas	15,000 - 35,000
Na-Dene/Esk/Aleuts	8,000 - 10,000

FamilyTreeDNA
mtDNA Migrations Map