



DNA for Genealogists

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- **DNA (DeoxyriboNucleic Acid)** is the genetic material of organisms. Nuclear DNA is present in the cell nucleus and is usually structured into double strands, wound together as the familiar double helix.
- A **GENE** is the basic unit of heredity; a sequence which is part of the long strands of DNA.
- A **CHROMOSOME** is a piece of DNA containing genes. It is the structure by which hereditary information is physically transmitted from one generation to the next.
- A **GENOME** is all the genetic material (although commonly refers to the DNA on the chromosomes. In humans, 46 chromosomes (23 pairs) make up the genome, with a complete copy found in each cell of the body. (There is also a mitochondrial genome).
- An **AUTOSOME** is a chromosome not involved in sex determination. Humans have 23 pairs of chromosomes, 22 pairs of autosomes (numbered 1-22), and one pair of sex chromosomes (the X and Y chromosomes).
- **AUTOSOMAL DNA (atDNA)** tests between 2 people compare the linked blocks of DNA across the 22 pairs of autosomal chromosomes. As autosomes contain random mixtures of DNA from ancestors, closer relatives share larger fragments of DNA in common. Autosomal tests can test for shared ancestors across all lines (male and female) but are most useful if the ancestor in common lived within 5 generations.
- **SEX CHROMOSOMES** (X and Y-chromosomes) are the chromosomes involved in sex determination. Females have two X-chromosomes; males have one X- and one Y-chromosome.
- **DOMINANT / RECESSIVE**: In a matched pair, each chromosome has genes that control the same function (eg freckles/ no freckles). A dominant gene on one chromosome will override a recessive gene on the other.
- A **MUTATION** is any inheritable change in DNA sequence. Mutations usually occur as a result of miscopying by cell enzymes.
- A **MARKER** is a gene at a particular physical location (**locus**) on a chromosome. The greater the number of markers tested between 2 individuals, the better defined is their relationship.
- A **SNP** (*pronounced 'snip'*) (**S**ingle **N**ucleotide **P**olymorphism) is where a single DNA 'letter' differs from person to person, produced by a copying mutation (*'typo'*). SNPs account for 90% of the genetic variation in humans. Nearly all SNPs have mutated only once in human history so large numbers of people have the same SNP.
- An **STR** (Short Tandem Repeat, *think 'stutter'*) is a stretch of DNA where a small sequence repeats itself several times. An STR mutation adds or subtracts one or more repeats. STRs of the Y-chromosome are useful for tracking exclusively male lines over the last few hundred years.
- An **ALLELE** is the number of repeats at an STR marker.
- **DYS (DNA Y-chromosome Single copy sequence)** numbers refer to particular STR marker locations on the Y-chromosome (eg DYS388, DYS390).
- **NON-PATERNITY EVENT** is a situation where the DNA of a family member indicates a different father, perhaps due to adoption, illegitimacy, etc.
- **HAPLOGROUPS** define large groups of genetic populations and are often geographically orientated. For example, the Y-chromosome haplogroup most common to males living along the western coasts of Europe is Haplogroup R1b. The **haplogroup** of an individual is determined by SNPs. There are also mitochondrial haplogroups.
- **MITOCHONDRIAL DNA (mtDNA)** is the circular DNA contained inside the mitochondria. Mitochondria are small organelles residing in animal cells that provide the power to the cell. The mtDNA is passed from mother to her offspring (both sons and daughters), but only her daughters pass it on. Broad genealogies (across several thousands of years) can be deduced by considering mtDNA. However comparing the 'full sequence' of mitochondria can indicate recent relatives with a shared ancestor on the all-female line.
- **CAMBRIDGE REFERENCE SEQUENCE (CRS)** is a standard sequence of mitochondrial DNA against which all other mtDNA is compared. The results of a mtDNA test cite only the markers that differ from this standard.

- **MOST RECENT COMMON ANCESTOR (MRCA)** between two people can be predicted by their DNA. For example, two first cousins share a grandparent as their MRCA. If the cousins were both sons of sons, they would share their grandfather's Y-chromosome. The time when the common ancestor lived can be approximated by the number of markers tested, the mutation rate and the number of mismatches.
- **ADMIXTURE** occurs when two or more previously separated populations inter-breed.
- **GENETIC GENEALOGY** is a new field of family history research, comparing Y-chromosomes, mitochondrial or autosomal DNA to prove or disprove biological connections. The Y-chromosome links the strictly paternal line (father to son), whilst mtDNA links the all-maternal line. Autosomal DNA tests compare all (recent) family lines.

FOR FURTHER INFORMATION

Books

- Collins, Francis *The Language of Life: DNA and the Revolution in Personalised Medicine*, Profile Books, London, 2010 (Amazon)
- Entine, Jon *Abraham's Children: Race, Identity and the DNA of the Chosen People*, Grand Central Publishing, New York, 2007 (Amazon)
- Farmer, Kerry *DNA for Genealogists*, 3rd edition, Unlock the Past, Modbury, S. Aust., 2015 (Gould)
- Kennett, Debbie, *DNA and Social Networking*, The History Press, Stroud (GLS, UK), 2011 (Amazon)
- Kleiman, Rabbi Yaakov *DNA & Tradition*, Devora Publishing Company, New York, 2011 (Amazon)

Major testing companies *(also see their information pages)*

- Family Tree DNA – www.familytreedna.com (*Y-DNA, mtDNA & atDNA tests + projects*)
- 23 and Me – www.23andme.com (*atDNA tests*)
- Ancestry.com – <http://dna.ancestry.com> (*atDNA tests*)
- Genographic Project Geno 2.0 – <http://genographic.nationalgeographic.com> (*deep ancestry*)

Free DNA databases *(for entering and/or comparing DNA test results)*

- Gedmatch – www.gedmatch.com (*tools comparing Y-DNA, mtDNA, atDNA from FTDNA & 23andMe*)
- Mitosearch – www.mitosearch.org/ (*search mtDNA*)
- Ysearch – www.ysearch.org/ (*search by Y-DNA or by surname*)

Further reading

- Autosomal DNA 2015: which test is the best? – <http://bit.ly/DNA-WhichCompany> (*comparing companies*)
- Autosomal percentage estimates – http://bit.ly/YGG_DNApercentages
- Cruwys news – <http://cruwys.blogspot.co.uk/> (*Debbie Kennett's blog*)
- DNA glossary – www.isogg.org/course/glossary.htm (*common genetic terms*)
- DNA Lectures (Who do you Think You Are) – <http://bit.ly/DNA-WDYTYA> (*online lectures*)
- DNA Testing – www.buzzle.com/articles/dna-testing/ (*articles*)
- DNAeXplained – <http://dna-explained.com> (*Roberta Estes' blog*)
- DNAGedcom – www.dnagedcom.com (*extra tools for adoptees*)
- Family Tree DNA webinars – www.familytreedna.com/learn/ftdna/webinars/ (*recorded online lectures*)
- From DNA to Genetic Genealogy – <http://stevemorse.org/genetealogy/dna.htm>
- (The) Genetic Genealogist Blog (Blaine Bettinger) – www.thegeneticgenealogist.com/ (*blog & resources*)
- Genetic Genealogy email lists – www.isogg.org/wiki/Genetic_genealogy_mailing_lists
- Genetics 101 – www.23andme.com/en-gb/gen101/
- Genie1 – www.genie1.com.au/blog (*Louise Coakley's blog, especially for Australians*)
- Genome Mate – <http://genomemate.org> (*tool for managing multiple DNA kits*)
- International Society of Genetic Genealogy (ISOGG) – www.isogg.org (*many resources*)
ISOGG Wiki – www.isogg.org/wiki/ (*many resources*)
- Interpreting Genetic Genealogy results – <http://bit.ly/FTDNAowwhat> (*eBook*)
- Jewish Story & a Reassessment of DNA evidence – www.jogg.info/11/coffman.htm
- Kitty's chromosome mapper graphic – <http://kittymunson.com/dna/ChromosomeMapper.php> (*tool*)
- (The) Legal Genealogist – www.legalgenealogist.com/blog/ (*legal implications, Judy Russell's blog*)
- Most Recent Common Ancestor – www.isogg.org/wiki/Most_recent_common_ancestor
- Most Recent Common Ancestor calculator – <http://nitro.biosci.arizona.edu/ftdna/TMRCA.html>
- National Genographic Project – <https://genographic.nationalgeographic.com>
- Online Journal of Genetics & Genealogy – <http://jgg-online.blogspot.com>
- Promethease – www.promethease.com (*purchase genetic health predisposition report*)
- Short Tandem Repeat Internet DNA Database – www.cstl.nist.gov/biotech/strbase/index.htm
- Tour of the DNA basics – <http://learn.genetics.utah.edu/content/basics/> (*University of Utah*)
- Your Genetic Genealogist – www.yourgeneticgenealogist.com/ (*CeCe Moore's blog*)