June 5, 2019

Genetic Genealogy Primer

The following is a primer about genetic genealogy. It is comprised of four posts made to the "Tripp Family Genealogy" Facebook page in the spring of 2019. The only changes to the posts are additions of post titles, the placement of images to be appropriate for printed pages, and references to them when needed. Also a section was added for Mitochondrial DNA.

DNA Testing for Genealogical Purposes – Posted 4-3-19

This is the first of a few posts to come on genetic genealogy, in order for us to discuss benefits of adding DNA to our genealogical research toolbox. I am not trained in "bio" anything, but I am studying and learning fast, so you can too. I encourage and invite those Tripps who do have knowledge to add to or correct my posts. Let's make this a conversation!

The Human Genome Project was founded in 1990 and by 2003 the result of mapping the human genome was reported. Since then accuracy, understanding, and speed of sequencing the genome has been improving at break neck speed. Early human genome research was done for scientific purposes only. But some genealogists saw the potential benefit, so commercial DNA testing for genealogical purposes was first established in 2000. In 2005 the International Society of Genetic Genealogy (ISOGG) was founded for the promotion and education of genetic genealogy.

DNA is a molecule composed of two chains that coil around each other to form a double helix. It is the hereditary material found in the nucleus of nearly every cell and the constituent of chromosomes.

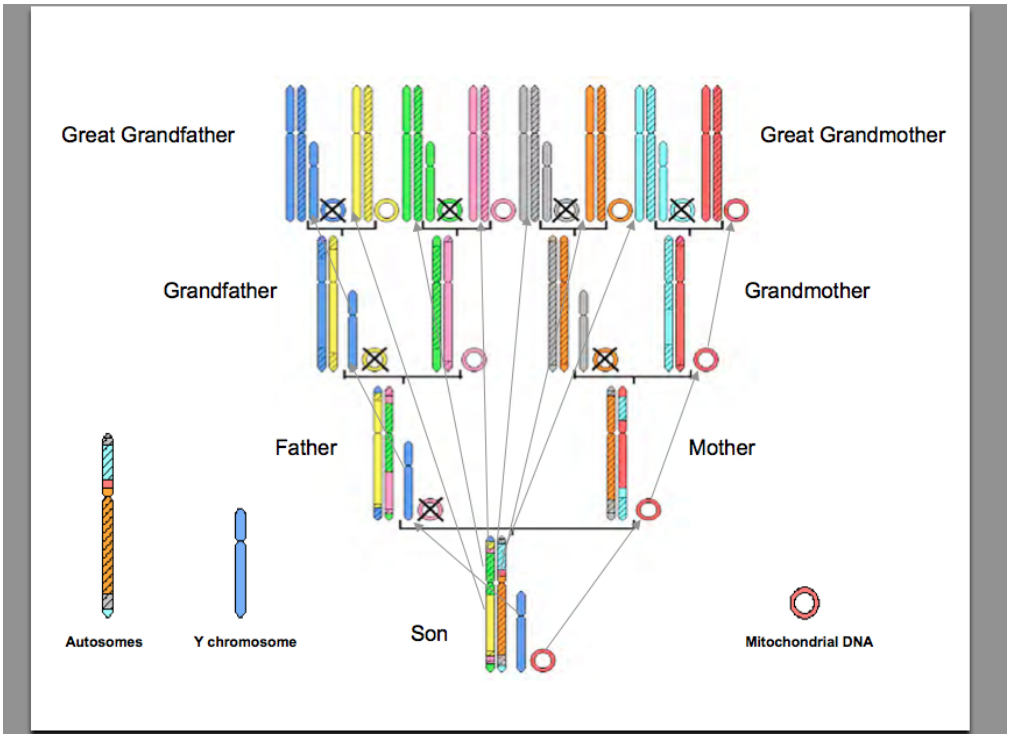
Humans have 23 pair of chromosomes: Chromosomes 1 through 22 are called Autosomes. Chromosome 23 is the pair of sex chromosomes. It is comprised of Y, the male chromosome, and X, the female chromosome. Women inherit one X from their mother and one X from their Fathers. (XX=female). Men inherit their X from their mother and the Y from their father (XY=male).

Each parent contributes one chromosome to each of the 23 pairs. Autosomal and Sex chromosomes are inherited differently. For this reason the results are different and determine which test will best help to answer your specific questions. Inheritance is the subject of next week's post.

How DNA Is Inherited – Posted 4/10/19

Last week we ended with the knowledge that Autosomal and Sex chromosomes are inherited differently. For me a picture is worth a thousand words, so take a look at the chart, courtesy of Family Tree DNA. At the bottom the Autosomes are depicted as a multi colored long stick, the Y chromosome as a shorter blue stick, and Mitochondrial DNA as an orange circle. (Mitochondrial will be discussed later.) The top of the chart shows a representation of the chromosomes of your four great grandparents. Just be aware that only one pair of Autosomes is shown for each great grandparent, when there are 22, and that the X chromosome is not shown. (Mitochondrial DNA is shown, but we will tackle that later).

As **Autosomes** (chromosomes 1 - 22) are passed from parents to child, they go through a process called recombination. Pairs exchange segments and recombine so that each parent contributes one chromosome to each new pair that is passed to the child. In the chart, the blue chromosome from the great grandfather on the left combines with a yellow chromosome from the great grandmother, and the cross marks depict some mixing up. This means that their offspring get half of their chromosomes from their mother and half from their father. But which chromosomes are passed to each child is totally random, therefore is different from child to child.



The son gets his **Y chromosome** from his father. When it is passed down it is virtually unchanged (not mixed up like the autosomes). This is shown in the chart as the blue stick passing from great grandfather, to grandfather, to father, then to son more or less unchanged for hundreds and thousands of years. The X chromosome is not shown on this chart, and being trickier to work with, is not used as much for genetic genealogy.

Autosomes are tested by Ancestry, 23andMe, and Family Tree DNA. X chromosome testing is included in the FamilyTreeDNA and 23andMe autosomal tests, but not the Ancestry test. As you can envision from the chart, the son gets 50% of his DNA from his father, and 50% from his mother. And that DNA on the average contains 25% from each of the four grandparents, and 12.5% from each of the 8 great grandparents, and so on. So that after about five generations, the amount contributed from those

ancestors is so diluted there is a good chance you did not inherit any from them. Therefore the Autosomal test is good for researching fairly recent cousins on any ancestral line.

Y-DNA testing is only done by Family Tree DNA. And, as shown in the chart the Y-chromosome is not diluted through the generations, so its value is in identifying paternal lines to a much greater distance than the Autosomes. Surname projects were established to help identify a common ancestor with the same surname.

Of course it is more complicated than that, so next week we will dive into the significant details.

Y-STR Testing – Posted 4-17-19

Last week we learned that Chromosomes 1-22, the Autosomes, came 50% from your father and 50% from your mother, but random and mixed up. And the Y part of Chromosome 23 came only from father to son virtually unchanged, not mixed up. We'll discuss the Y-Chromosome test now.

Certain areas along the Y chromosome when tested provide information relative to genealogy. The most interesting test for paternal ancestry is called the Y-STR test (Short Tandem Repeats, pronounced "stirs"), because short sequences of DNA repeat "x" number of times. Among the building blocks of DNA are the chemicals adenine, guanine, thymine, and cytosine (A, G, T, C), or the DNA alphabet. An example of a Y-STR test result might be TATTTATTTATT. The sequence TATT is repeated three times in a position, called a marker. Each marker has a name such as DYS393, and the test result in our simple example is 3, because the sequence TATT repeats 3 times. So Y-STR test results are a string of marker names and their number of repeats, example: Marker 1, DYSxx1 = 13, Marker 2, DYSxx2 = 16, Marker 3, DYSxx3 = 14 and so on for the number of markers that you choose to have tested. See the screen shot from the Public Tripp Surname project that shows the names of the markers in blue or burgundy starting in column four. The Mode row (values that appear most often) is the Y-STR signature for that Group, and the following rows are the testers who match that group. The rows and columns of numbers are their test results (number of repeats for each marker).

Kit Number	Paternal Ancestor Name	Haplogroup	DYS393	DYS390	DYS19	DYS391	DYS385	DYS426	DYS388	DYS439	DYS389I	DYS392	DYS389II	DYS458	DYS459	DYS455	DYS454	DYS447	DYS437	DYS448	DYS449	DYS464	DYS460	Y-GATA-H4	YCAII	DYS456	DYS607	DYS576	DYS570	CDY
Group 1 - John Tripp (1610-1678) - "The Founder"																														
MIN			13	24	14	10	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-15-17	11	11	19-23	15	16	17	17	35-37
MAX			13	24	14	11	14-15	12	12	12	13	13	29	18	9-9	11	11	24	15	19	30	15-16-16-17	11	12	19-24	16	17	19	18	37-38
MODE			13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	16	18	17	36-37
416000		R-M269	13	24	14	10	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-24	16	16	18	17	36-38
198232	John Tripp, b. 1610	R-M269	13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-15-17	11	11	19-23	16	16	18	18	35-37
268644	George Asa Tripp, b.1866 and d.1943	R-M269	13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-15-17	11	12	19-23	16	16	17	18	35-38
179529	John Tripp, 1611-1648, b. England - d. Portsmouth,	R-M269	13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	16	18	17	35-37
N12578	Joshua Tripp b. 1805 Pitt Co., NC	R-M269	13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	16	18	17	36-37
229695	John Tripp, b. 1818	R-M269	13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	16	18	17	36-37
N97138	John Tripp, 1611 - 1678	R-M269	13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	16	18	17	37-37
108340	John Tripp 1640-1719	R-FGC22516	13	24	14	11	12-15	12	12	11	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	16	19	17	36-37
45421	Charles Tripp, 1761-1844, Dutchess Co., New York	R-FGC37160	13	24	14	11	12-15	12	12	12	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	15	17	18	17	36-37
247348	John Tripp B 1611 d 1678	R-M269	13	24	14	11	12-15	12	12	12	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	16	18	17	36-37
864773	William Tripp	R-M269	13	24	14	11	12-15	12	12	12	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	17	18	17	36-37
327291	Daniel Tripp, b.c. 1775 and d. 1828	R-M269	13	24	14	11	12-15	12	12	12	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	17	18	17	36-37
127335	Benjamin Tripp, b. 1817 Upper Canada	R-M269	13	24	14	11	12-15	12	12	12	13	13	29	17	9-9	11	11	24	15	19	29	15-15-16-17	11	11	19-23	16	17	18	17	36-37
303799	Charles Tripp 1784-1828, Scarborough	R-M269	13	24	14	11	12-15	12	12	12	13	13	29	17	9-9	11	11	24	15	19	29	15-16-16-17	11	11	19-23	16	17	18	17	36-37
Group 2 - Sylvanus Tripe [Tripp] of Kittery, Maine																														
MIN			13	23	16	10	12-13	11	13	12	14	11	29	17	8-10	11	11	25	14	21	26	11-14-14-15	11	11	11-21	14	11	18	20	33-34
MAX			13	23	16	10	12-13	11	13	12	14	11	29	17	8-10	11	11	26	14	21	26	11-14-14-15	11	11	11-21	14	11	18	21	33-34
MODE			13	23	16	10	12-13	11	13	12	14	11	29	17	8-10	11	11	26	14	21	26	11-14-14-15	11	11	11-21	14	11	18	21	33-34
45328	Sylvanus Tripp d 1716 Kittery, York Co., ME, USA	I-P37	13	23	16	10	12-13	11	13	12	14	11	29	17	8-10	11	11	25	14	21	26	11-14-14-15	11	11	11-21	14	11	18	20	33-34
69407		I-P37	13	23	16	10	12-13	11	13	12	14	11	29	17	8-10	11	11	26	14	21	26	11-14-14-15	11	11	11-21	14	11	18	21	33-34
45174	Sylvanus Tripp (Tripe) b.c. 1662 Kittery, ME	I-M26	13	23	16	10	12-13	11	13	12	14	11	29	18	8-10	11	11	26	14	21	26	11-14-14-15	11	11	11-21	14	11	18	20	33-34
Group 3 - Tripp haplotype R-DF13																														
MIN			13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	28	15-15-17-17	11	11	19-23	15	15	18	15	37-40
MAX			13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	31	15-16-17-17	11	11	19-23	15	15	19	16	39-41
MODE			13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	30	15-16-17-17	11	11	19-23	15	15	18	16	38-40
160154		R-DF13	13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	30	15-16-17-17	11	11	19-23	15	15	18	15	38-41
156333	James Tripp	R-M269	13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	30	15-16-17-17	11	11	19-23	15	15	18	16	38-40
344763	John Tripp 1610-1678	R-M269	13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	30	15-16-17-17	11	11	19-23	15	15	18	16	38-40
314027	James Tripp b. 1656 Rhode Island	R-DF13	13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	30	15-16-17-17	11	11	19-23	15	15	18	16	38-40
317222	James b. Tripp 1656; John b. 1611 Lincolnshire	R-DF13	13	23	14	11	11-11	12	12	13	14	13	30	16	9-10	11	11	25	15	19	31	15-16-17-17	11	11	19-23	15	15	18	16	39-40
Group 4 - Isaac Tripp (1792-1870)																														
MIN			13	24	14	11	13-13	12	12	12	13	13	29	16	9-10	11	11	25	15	19	30	15-15-15-16	11	11	19-23	16	15	18	17	35-37
MAX			13	25	14	11	13-13	12	12	12	13	13	29	16	9-10	11	11	25	15	19	30	15-15-15-16	11	11	19-23	16	15	18	17	35-38

So many numbers are mind boggling, you may say, and you are correct. The "take away" is that you and your close matches in a group descend from a common male ancestor. If you took the Y-37 marker test and had an exact match with a tester, all 37 marker values were the same, you and that tester have a Genetic Distance of 0. This means your relatedness to your common ancestor is predicted to be a 50%

probability within 5 generations or less, and a 95% probability within 8 generations. Naturally, markers that don't match reduce the probability to the common ancestor within the given generations.

This is important information to you and to a surname study if you are researching your male ancestry. When a study has enough testers, a Y-STR signature or group for an ancestor can be established. And the Tripp Surname Project has been able to establish Groups (Y-STR signatures) for descendants of John Tripp, from Portsmouth, Rhode Island, Sylvanus Tripp, from Kittery, Maine, Nicholas Tripp from Maryland, and several other lines.

STR mutations are changes to values during a replication from father to son. When they happen, this person's male descendants will carry the mutated value. Mutations are shown in the graph as pink and blue shading over the marker values.

The other Y test is of an area of the Y chromosome called SNPs (single nucleotide polymorphism pronounced "snip"). SNPs are very different from STRs because they represent big branches of the ancient human family tree. Every SNP mutation creates a new branch in the human family tree called a Haplogroup. (We'll discuss mutations and Haplogroups more in a later post.)

Next week we'll finish by looking at Autosomal results. Then, finally, we can discuss the Y-DNA Tripp Surname Project to see what we have learned from genetic genealogy.

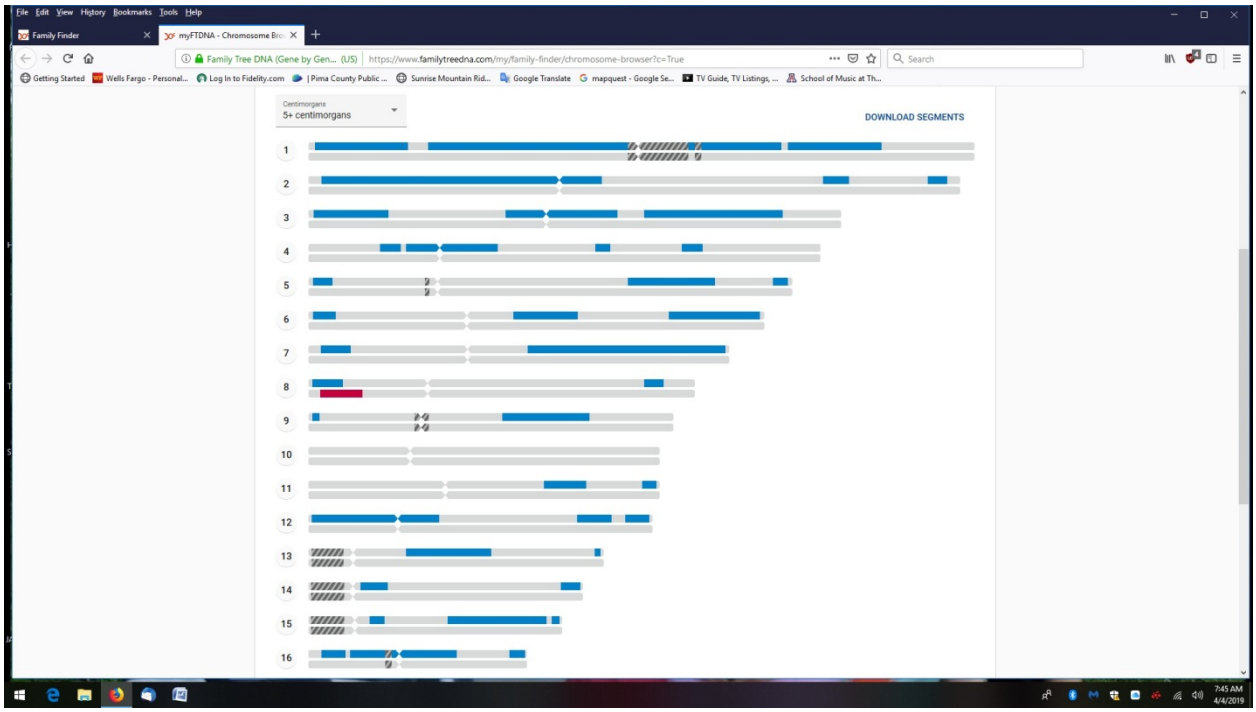
Autosomes – Posted 4-24-19

Recall we learned that Chromosomes 1-22, the Autosomes, came 50% from your father and 50% from your mother, but random and mixed up. Now let's learn more about Autosomal testing.

Human DNA is 99.9% the same, and it is still very expensive to sequence the whole genome. So since testing sameness doesn't give us much information, an Autosomal test looks for areas (segments) that are different, called SNPs (Single Nucleotide Polymorphisms). In other words rather than test all the areas on a chromosome, the ones that are the same are left out and only SNPs are tested. That means that tested areas (SNPs) are usually not adjacent. They can actually be very far apart. If we stretch out the untwisted Helix, we can assign addresses to positions, like locations on a street. For example an address on Chromosome 1 might be Chr 1 27595090 which is just a position on a chromosome.

A cM (centimorgan) is a measurement that represents a stretch of DNA. So a cM is just a unit used to measure the length of a segment of DNA.

Our matches are individuals whose segments of DNA match us along a given chromosome. The screen shot below is from Family Tree DNA's Chromosome Browser. It shows where I match on each chromosome with my niece (in blue) and my 3rd cousin (in red). The common ancestors for my niece and I, are my parents, so we share DNA from both my Mom's and Dad's side. The Common Ancestors for my 3rd cousin and I are our 2nd great grandparents on my Mom's side, so we only share DNA on my Mom's side. It is not until chromosome 8 that all three of us have matching segments.



Most Chromosome Browsers will give details such as the starting and ending address, amount of matching cMs, and SNP Numbers. In my example the details are:

Niece: Beginning addr: 1860947 – Ending addr: 13424650, 20.48 cM, & SNP No. 5159.

3rd Cousin: Beginning addr: 5216304 – Ending addr: 20732923, 26.65 cM, SNP No. 6228

Ancestry does not have a Chromosome Browser, but its strength is their attached trees and large database. If you are interested in a visual image showing exact chromosome matching, you can download your raw DNA file from Ancestry and upload it to Family Tree DNA or GedMatch. The instructions are on their web sites and are very easy to follow. I did it, to both companies.

That leaves the subject of phasing (determining whether a cousin is from your Mom's or Dad's side). And in the example above we just saw the beginning of how this is done. If I ask Family Tree to find others who match both me and my 3rd cousin, the matches will be from my Mom's side.

The last section is about Mitochondrial DNA.

Mitochondrial DNA

Mitochondrial DNA, often called mtDNA, is not from the 23 pair of chromosomes. Mitochondrial are separate, independent pieces of DNA outside of the cell's nucleus. Mitochondrial DNA is inherited from a mother to all her children, however only daughters pass their mitochondria to their next generation. So MtDNA testing gives information about your maternal line, both to living relatives and to ancient migration paths.