A Beginner's Guide to Using DNA to Build Your Tree
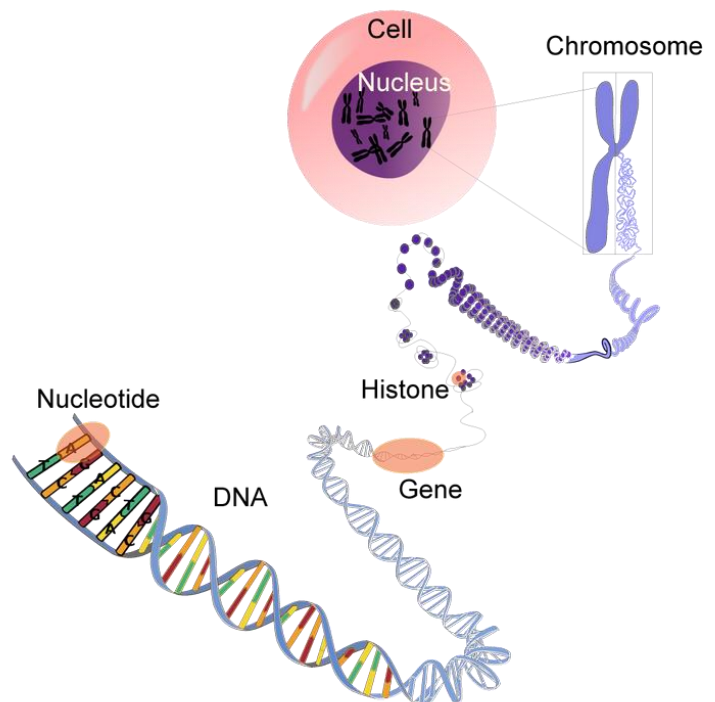

DNA Definitions

- atDNA: autosomal DNA

- cM: centimorgans, a measurement of genetic distance

- IBD: Identical by Descent or a true match

- IBS: Identical by State or a segment that is too common to be genealogically relevant.

- MRCA: Most Recent Common Ancestor
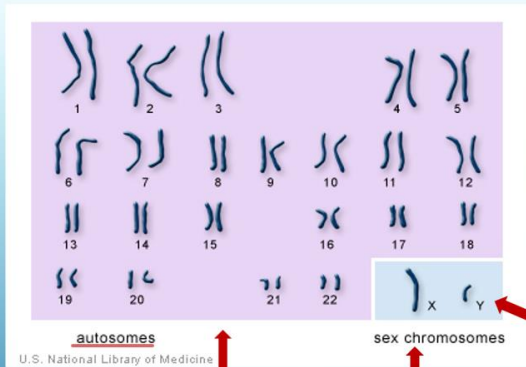
- MRCC: Most Recent Common Couple

Chromosomes and Deoxyribonucleicacid

Segments of DNA are often measured in centimorgans (cM).

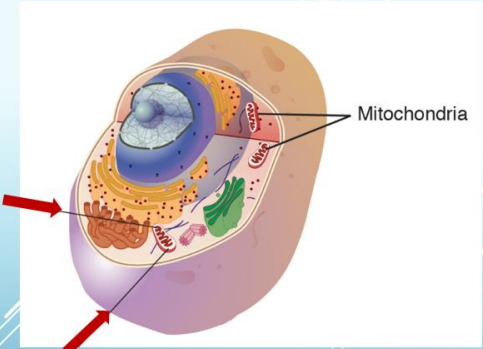- *cM is not a measurement of length.*
- *cM is a measurement of genetic distance.*

Four types of DNA, each with a unique inheritance pattern

3) Y DNA

1) autosomal DNA

2) X DNA

4) Mitochondrial DNA

Credit: https://medlineplus.gov/genetics/__understanding/basics/howmanychromosomes/

Credit: https://www.genome.gov/genetics-glossary/Mitochondria


DNA Inheritance

- There are four types of DNA tests: autosomal DNA, mitochondrial DNA, Y-DNA, and X-DNA. Each type of DNA has a unique inheritance pattern. The most common DNA test is atDNA, ex. Ancestry or MyHeritage.

- DNA segments are measured in centimorgans (cM), a measurement of genetic distance.

- The higher the cM shared with a match, the closer the family relationship is. For example, the cM shared with a parent range from 2,376 - 3,720 cM, but for second cousins the range is 42 - 592 cM.

- Humans have two copies of each chromosome – one from the father and one from the mother.

- The autosomal chromosomes undergo recombination during meiosis, meaning there is an exchange of DNA segments between the maternal and paternal copies of the chromosomes.
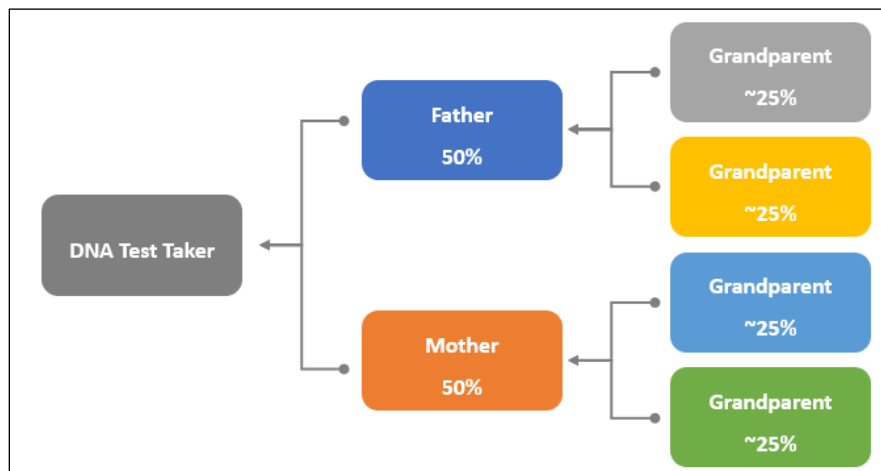
Chromosomes exchange segments during meiosis in a process called recombination.
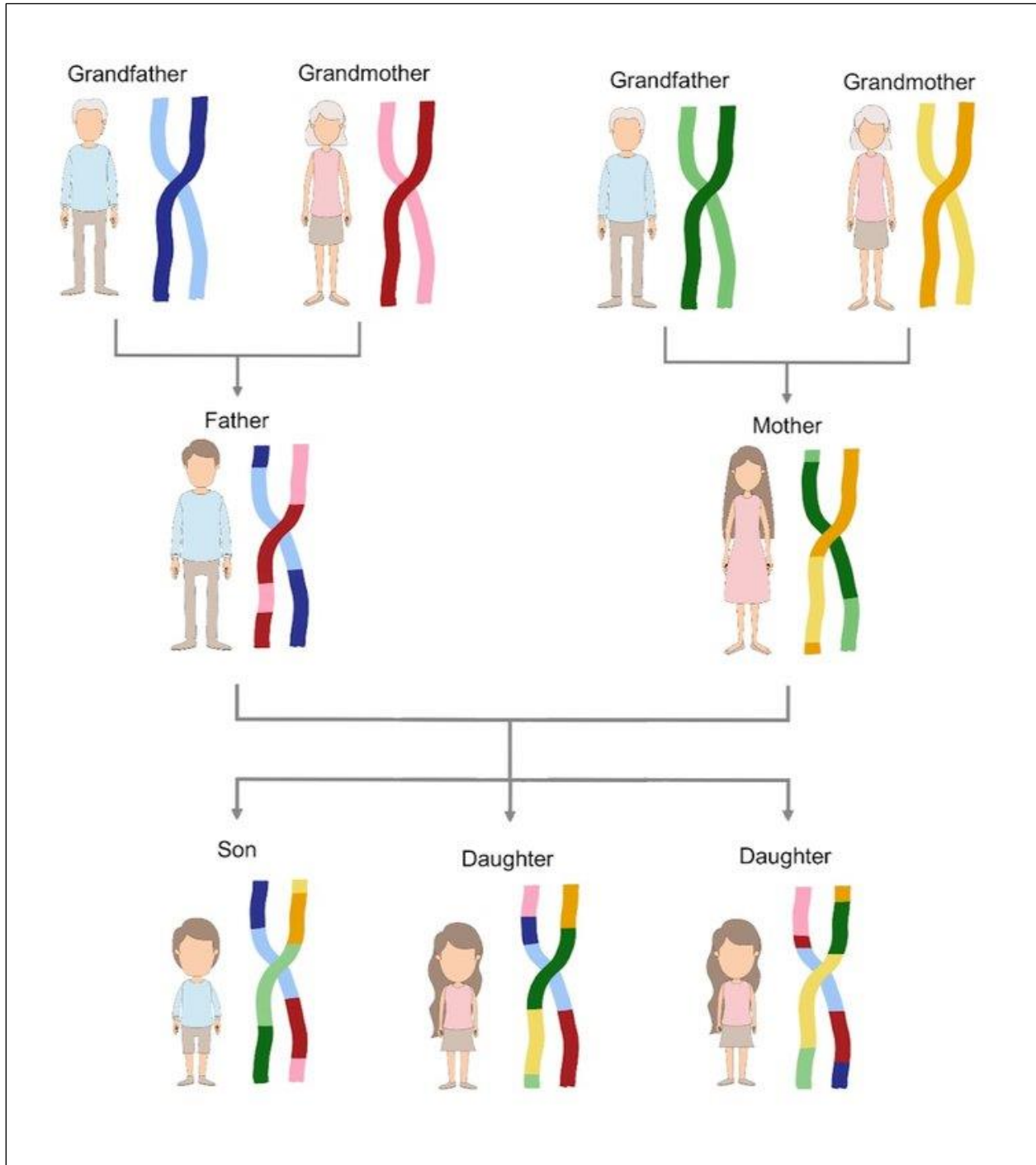
Each person inherits DNA from all four grandparents, but due to recombination, they do not receive an exact 25% from each grandparent. The more generations you go back, the higher the chance is that you will not share autosomal DNA with all your 3rd cousins, 4th cousins, etc.

Autosomal DNA Testing Comparison Chart

Company	AncestryDNA	23andMe	MyHeritage	Family Tree DNA
Type of DNA test	Autosomal	Autosomal X-DNA	Autosomal	Autosomal, Y-DNA, X-DNA or Mitochondrial
People with atDNA tests (March 2023)	23,000,000 people	13,400,000 people	6,800,000 people	1,520,000 people
Upload DNA from other companies?	No	No	Yes	Yes
Segment data?	No	Yes	Yes	Yes

Information from https://isogg.org/wiki/Autosomal_DNA_testing_comparison_chart

DNA Evidence

According to *Genealogy Standards*, genealogists need to address all relevant variables of evidence to fully analyze DNA test results.

1. Accuracy, completeness, and depth of each tree included in the analysis
2. The possibility of more than one common ancestor for each pair of DNA test takers
3. Reported and typical amounts of shared DNA
4. Sizes and locations of chromosome segments
5. Information about tested mutations, markers, or regions
6. Numbers and genetic relationships of people who were tested
7. Composition of genetic groups, including triangulated groups
8. Thoroughness of relevant documentary research
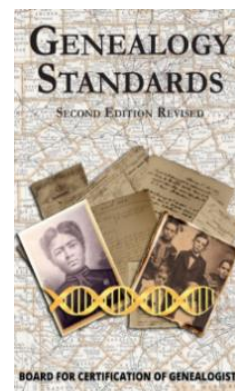
Board for Certification of Genealogists, Genealogy Standards, 2nd ed. (New York: Turner Publishing Company, 2019), 30

Principles Behind DNA Evidence

Principle #1:

The more cM a person shares with a DNA match, the closer the relationship.

The Shared cM Project on DNA Painter shows possible relationships.

Principle #2:

A shared match group is also called a genetic network. They share a Most Recent Common Ancestor (MRCA).

The larger the genetic network, the stronger the evidence.
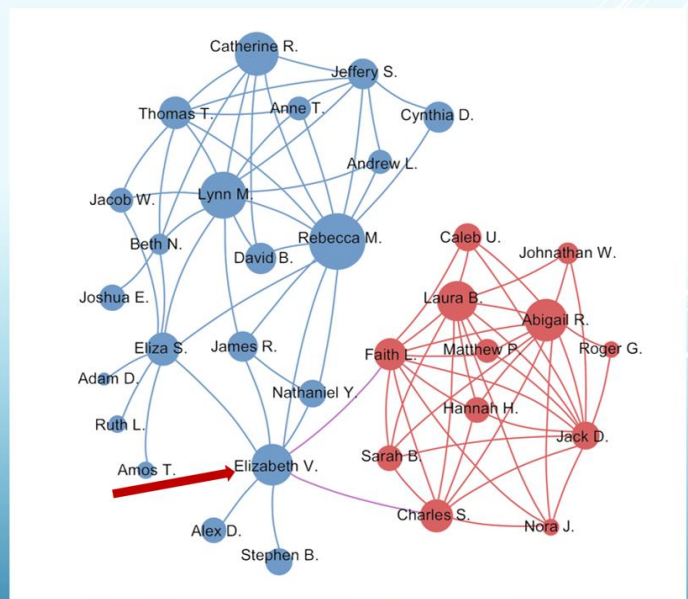
DNA Shared Match Group = Genetic Network

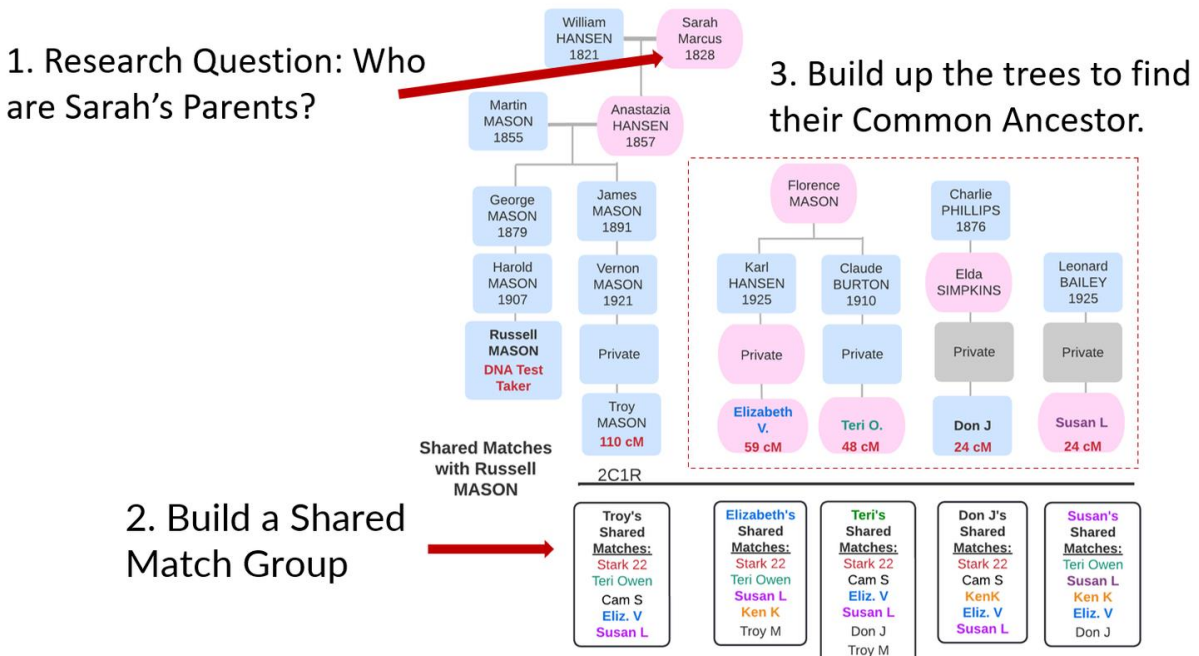This DNA Shared Match Group shares a Most Recent Common Ancestor (MRCA).
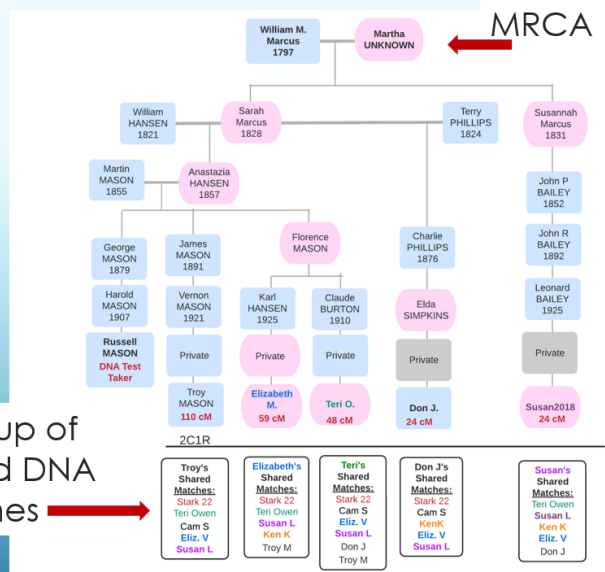
If you have multiple DNA matches in a shared match group (genetic network), you can identify the Most Recent Common Ancestor (MRCA) you all descend from by building out the trees of your DNA matches.

Research Example

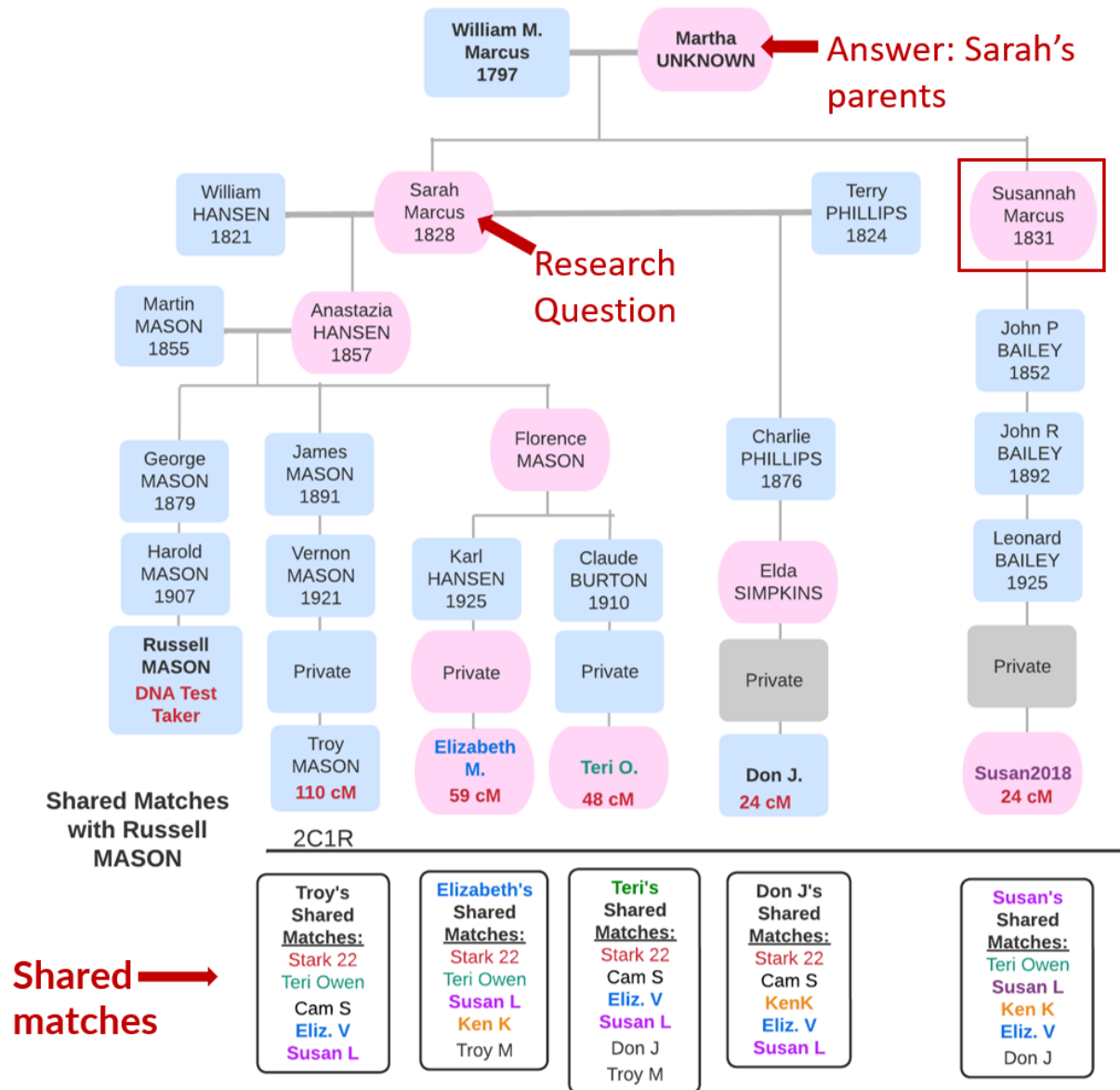Research Question: Who are Sarah's parents?

Research Answer:

- All of these Shared Matches descend from William and Martha Marcus.
- Documents found for Susannah Marcus named her parents.
- DNA can lead to additional records to research.

Family tree diagram:

William M. Marcus 1797 — **Martha UNKNOWN** ← Answer: Sarah's parents

William HANSEN 1821 — **Sarah Marcus 1828** ← Research Question — **Terry PHILLIPS 1824** — **Susannah Marcus 1831**

- Martin MASON 1855 — Anastazia HANSEN 1857
- John P BAILEY 1852

- George MASON 1879
- James MASON 1891
- Florence MASON
- Charlie PHILLIPS 1876
- John R BAILEY 1892

- Harold MASON 1907
- Vernon MASON 1921
- Karl HANSEN 1925
- Claude BURTON 1910
- Elda SIMPKINS
- Leonard BAILEY 1925

- **Russell MASON** DNA Test Taker
- Private
- Private
- Private
- Private
- Private

- Troy MASON **110 cM**
- Elizabeth M. **59 cM**
- Teri O. **48 cM**
- Don J. **24 cM**
- Susan2018 **24 cM**

Shared Matches with Russell MASON

2C1R

Shared matches →

Troy's Shared Matches:	Elizabeth's Shared Matches:	Teri's Shared Matches:	Don J's Shared Matches:	Susan's Shared Matches:
Stark 22	Stark 22	Stark 22	Stark 22	Teri Owen
Teri Owen	Teri Owen	Cam S	Cam S	Susan L
Cam S	Susan L	Eliz. V	KenK	Ken K
Eliz. V	Ken K	Susan L	Eliz. V	Eliz. V
Susan L	Troy M	Don J	Susan L	Don J
		Troy M		

The Shared cM Project on DNAPainter

- The Shared cM Project tool estimates relationships between two DNA matches based on the number of shared centimorgans in the match.

- The number below the title of the relationship represents the average number of cM shared for the given relationship.

- The two numbers below the average represent the range of possible shared centimorgans for a particular relationship.

- Enter the number of cM you share with a match into the top box.

- The Shared cM Tool highlights the possible relationships.

DNA PAINTER — Tools Help Subscribe — Blog Sign in

The Shared cM Project 4.0 tool v4

Read more about the tool and this update

March 2020

Blaine T. Bettinger
www.thegeneticgenealogist.com
More about this project
CC 4.0 Attribution License
Interactive version v4 by Jonny Perl at DNA Painter
Click here to contribute data to the shared cM project
Last updated 26th March 2020

Important
- For relationships more distant than Half 2C, the averages were determined only for relationships in which DNA was shared.
- The more distant a relationship, the more likely it is that you won't share DNA at all (read more)
- These statistics do not cater for pedigree collapse or endogamy

Other versions
Beta with updated probabilities
With editable boxes
Shared cM 3.0 (2017) version

Filter

Enter the total number of cM for your match here:

[   ]   reset

or enter %

Then any relationships that fit will stand out below

Click here for a shareable link to the cM amount above

Most distant common ancestors
Assuming no pedigree collapse or endogamy, and that you're related in just one way, the furthest back you might need to go to find common ancestors for a match of 244cM is 3rd-Great-Grandparent level or generation 6 on your pedigree chart.
The connection may be closer.

Relationship probabilities (based on stats from The DNA Geek)
New: View these relationships in a tree

How to read this chart

Relationship
Average
Range
(low to high;
99th percentile)

New Click on any relationship to view a histogram

Read more about cousin relationships

|								Great-Great-Great-Grandparent	GGGG Aunt / Uncle	
							Great-Great-Grandparent	GGG Aunt / Uncle		
Half GG-Aunt / Uncle 208 103 – 284			Great-Grandparent 887 485 – 1486				Great-Great-Aunt / Uncle 420 186 – 713	1C3R 117 25 – 238	2C3R 51 0 – 154	Other Relationships
Half 1C2R 125 16 – 269	Half Great-Aunt / Uncle 431 184 – 668		Grandparent 1754 984 – 2462				Great-Aunt / Uncle 850 330 – 1467	1C2R 221 33 – 471	2C2R 71 0 – 244	3C2R 36 0 – 166	6C 18 0 – 71
Half 2C1R 66 0 – 190	Half 1C1R 224 62 – 469	Half Aunt / Uncle 871 492 – 1315	Parent 3485 2376 – 3720			Aunt / Uncle 1741 1201 – 2282	1C1R 433 102 – 980	2C1R 122 14 – 353	3C1R 48 0 – 192	4C1R 28 0 – 126	6C1R 15 0 – 56
Half 3C 48 0 – 168	Half 2C 120 10 – 325	Half 1C 449 156 – 979	Half Sibling 1759 1160 – 2436	Sibling 2613 1613 – 3488	SELF	1C 866 396 – 1397	2C 229 41 – 592	3C 73 0 – 234	4C 35 0 – 139	5C 25 0 – 117	6C2R 13 0 – 45
Half 3C1R 37 0 – 139	Half 2C1R 66 0 – 190	Half 1C1R 224 62 – 469	Half Niece / Nephew 871 492 – 1315	Niece / Nephew 1740 1201 – 2282	Child 3487 2376 – 3720	1C1R 433 102 – 980	2C1R 122 14 – 353	3C1R 48 0 – 192	4C1R 28 0 – 126	5C1R 21 0 – 80	7C 14 0 – 57
Half 3C2R 27 0 – 78	Half 2C2R 48 0 – 144	Half 1C2R 125 16 – 269	Half Great-Niece / Nephew 431 184 – 668	Great-Niece / Nephew 850 330 – 1467	Grandchild 1754 984 – 2462	1C2R 221 33 – 471	2C2R 71 0 – 244	3C2R 36 0 – 166	4C2R 22 0 – 93	5C2R 18 0 – 65	7C1R 12 0 – 50

Organizing and Researching your DNA Matches

IMPORTANT TIP: If your own tree is built out first with your direct-line ancestors and your collateral lines, it makes it easier for you and the DNA tools to identify how you relate to your DNA matches.

Step 1: Create eight DNA groups on Ancestry, MyHeritage, or in Microsoft Excel for your great-grandparents.

- If you don't have a big tree or thousands of DNA matches, you could start with four groups for your grandparents.
- Name the groups with the surnames of the parents of your great-grandparent.
- When you group your matches, these eight groups would include all surnames further back on that great-grandparent line.
- If a great-grandparent is unknown, label the group "Father/Mother of…"
- When choosing colors on Ancestry, the middle row has eight colors which are easy to distinguish and work well for your eight great-grandparents.
- Use the first half of the middle row for your maternal lines and the second half for your paternal lines.
- Use the remaining colors for research focus groups.
- You can number your DNA groups to force the sort order you want.
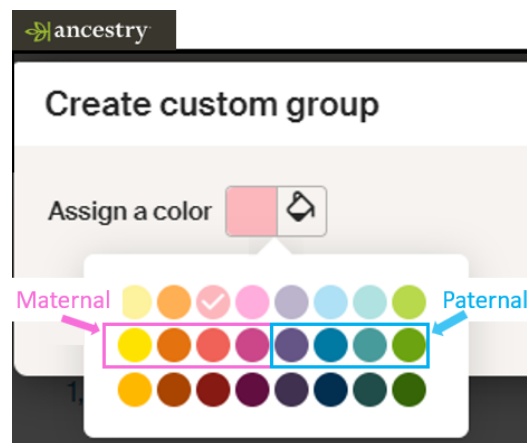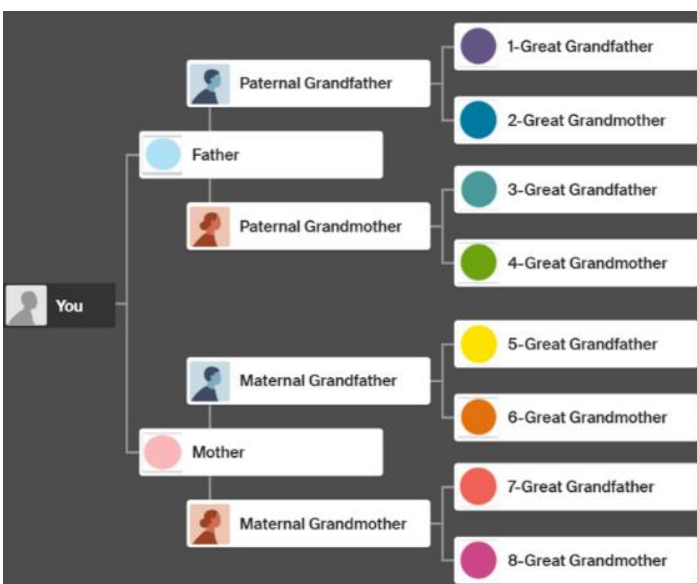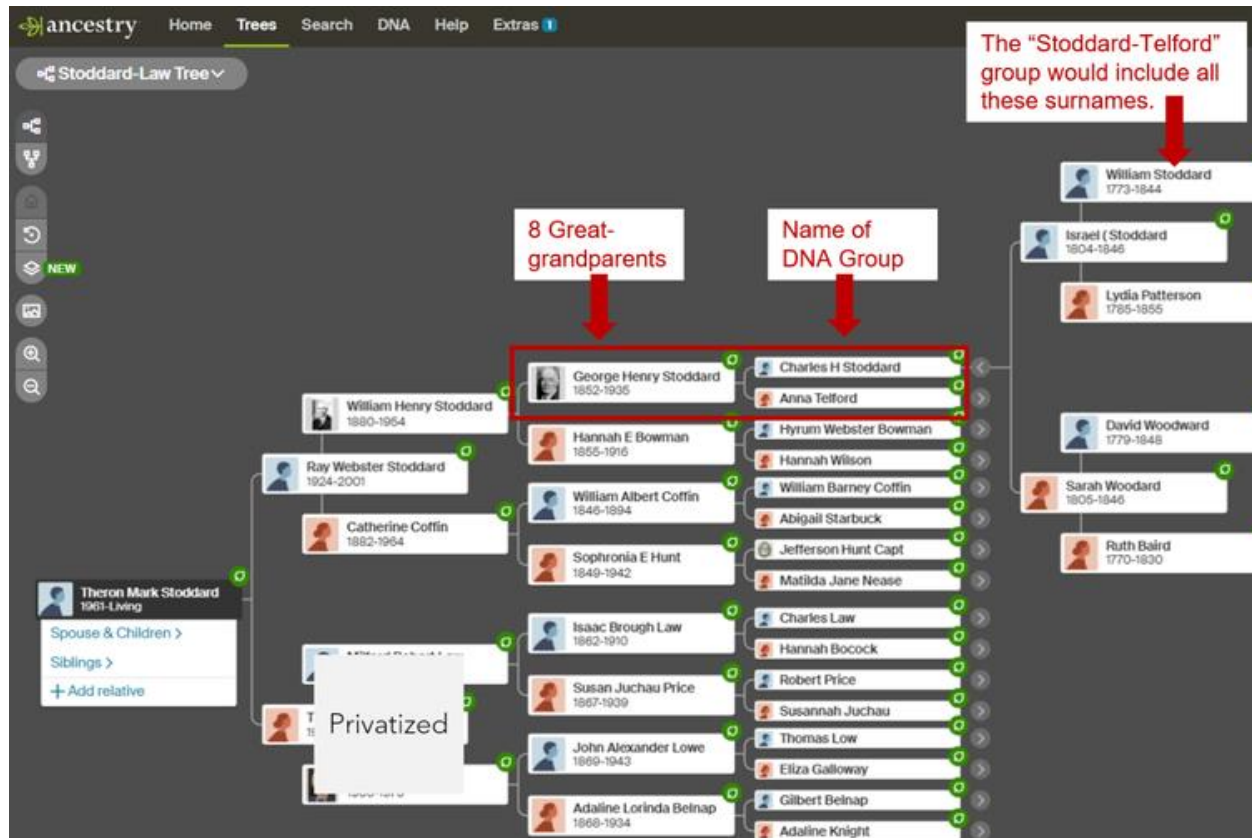
Step 2: Determine your research question (target ancestor) and create DNA focus groups for that research.

- Name the DNA focus group after your research question, ex. "Wm Stoddard & Lydia Patterson."

- For misattributed parentage research, create Paternal Unknown 1, Paternal Unknown 2, etc.

Step 3: Group your DNA matches by starting with your first or second cousins on your DNA match list and place any "Common Ancestor" DNA matches into one or more of your DNA groups.

- These become your reference group of known relationships for comparing shared matches later.

- Group around 50 matches to research recent ancestors and 100+ DNA matches for more distant ones.

- To get the Common Ancestor feature on Ancestry, you must attach your family tree to your DNA.

- As you group your matches, add notes to each DNA match such as "Common Ancestors: Charles Stoddard & Anna Telford through son, John."

- You may share more than one common ancestor with a DNA match, even if the match's tree does not show it.

- NOTE: If you don't find DNA matches to place in each of your eight groups, it may indicate there is no biological relationship to that line. Conversely, if you want to confirm a line, identify DNA matches to a mother's maiden name.

Step 4: Add the closet matches (highest cM) to your target ancestor to a DNA focus group, using their Shared Matches. Continue with other close matches.

- The number one tool for DNA research is the Shared Match tool.
- NOTE: Ancestry's Shared Match tool only goes down to 20 cM.

Step 5: Build quick trees for your DNA matches until you can find a MRCC. After finding a MRCC, verify each of the quick trees. These tools facilitate tree building:

- Ancestry Trees with Hints
- Ancestry's ThruLines Tool or MyHeritage Theory of Family Relativity
- Use FamilySearch Family Tree, Ancestry's Public Member Trees, etc. to check for existing research.

- Search your DNA matches for the surname you are looking for, especially if it is not a common surname.

TIP: You can create one Ancestry tree named "DNA Matches" to build multiple quick trees for your DNA matches.

- Each time you start a new tree for a DNA match, add the first person to your existing tree and then "unlink" the relationship.
- This allows you to have multiple, unconnected trees in one master "DNA Matches" tree.
- Make sure the tree settings are "private and unsearchable."