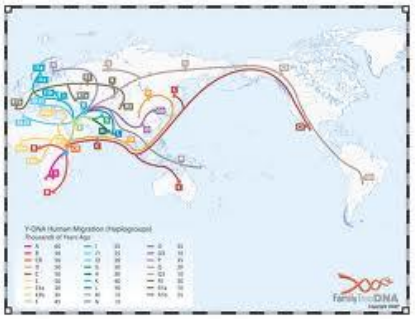


Genetic Genealogy

"Surprise… DNA just uprooted my family tree"

Baltimore County Genealogical Society

November 28, 2021

Andrew Hochreiter
Lisa Woolfson
Linda Jenne

East Coast Genetic Genealogy Conference

Hybrid Event: In-person and Virtual Attendance
National Speakers
Website: https://ecggc.org/

Genealogy's Newest Tool

- **Genealogy research:**
  - **Study of Family History**
  - **Identifies Kinships & Pedigrees**
  - **Traditional Research Tools include:**
    - **Records & Documentation**

- **Genetic Genealogy is latest tool**
  - **Genetic genealogy** is the application of genetics to traditional genealogy.
  - Genetic genealogy uses genealogical **DNA testing** to determine the level and type of the **genetic relationship** between individuals

Why Test?

Purposeful Testing

- Break down a **Brick Wall**
- Reveal **Ethnic Origins**
- Answer a **Question**
  - Who was my 2xg-grandfather?
- **Find Relatives** - how we're related & make contact
- **Adoptees** - find close relatives and birth parents
- It was a **Holiday Present**

Serendipity

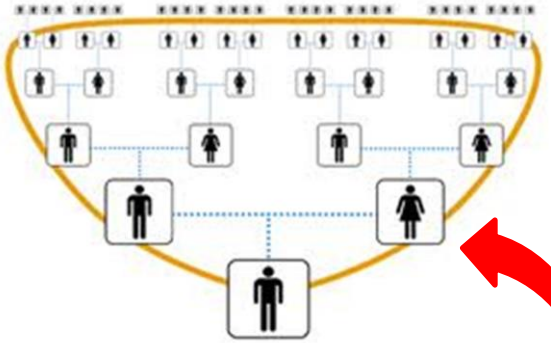
Issues

- **DNA Testing and Research can reveal:**
  - Family Secrets (illegitimacy/Adoption)
  - Unexpected Relationships
  - Unexpected Ethnic Makeup
  - Medical Conditions/Preconditions
- Sharing can expose **Personal data**
- Your DNA results can **Inform on Others**

Types of DNA

- Y-DNA
- X-DNA
- Mitochondrial DNA
- Autosomal DNA

Inherited atDNA



- **50% from each parent**
- ~25% from each grandparent
  - **% is variable**
  - Farther back, % is difficult to predict
- atDNA inherited from **all of ancestral lines**
- Inherited atDNA goes back **6-7 generations**
- Some distant ancestors may not contribute atDNA due to **random nature** of inheritance

Autosomal (atDNA) Tests

- Tests DNA from **Chromosomes 1-22**
- DNA is divided every generation by about half

Relationship to You	Approximate % Of Their DNA You Share
Parents	Exactly 50%
Grandparents	25
Great-grandparents	12.5
Great-great-grandparents	6.25
Great-great-great-grandparents	3.125
Great-great-great-great-grandparents	1.5625

- **Both males and females** inherit autosomal DNA
- Known 2nd cousins share on average 212.5 cMs
- But exceptions, as little as 47 cMs or as much as 760cMs.
- Conversely, the relationship of individuals with 212.5cMs can be aunt-or-uncle/niece-or-nephew or 3C1R.

% Shared DNA

Expected Percentages of Shared DNA

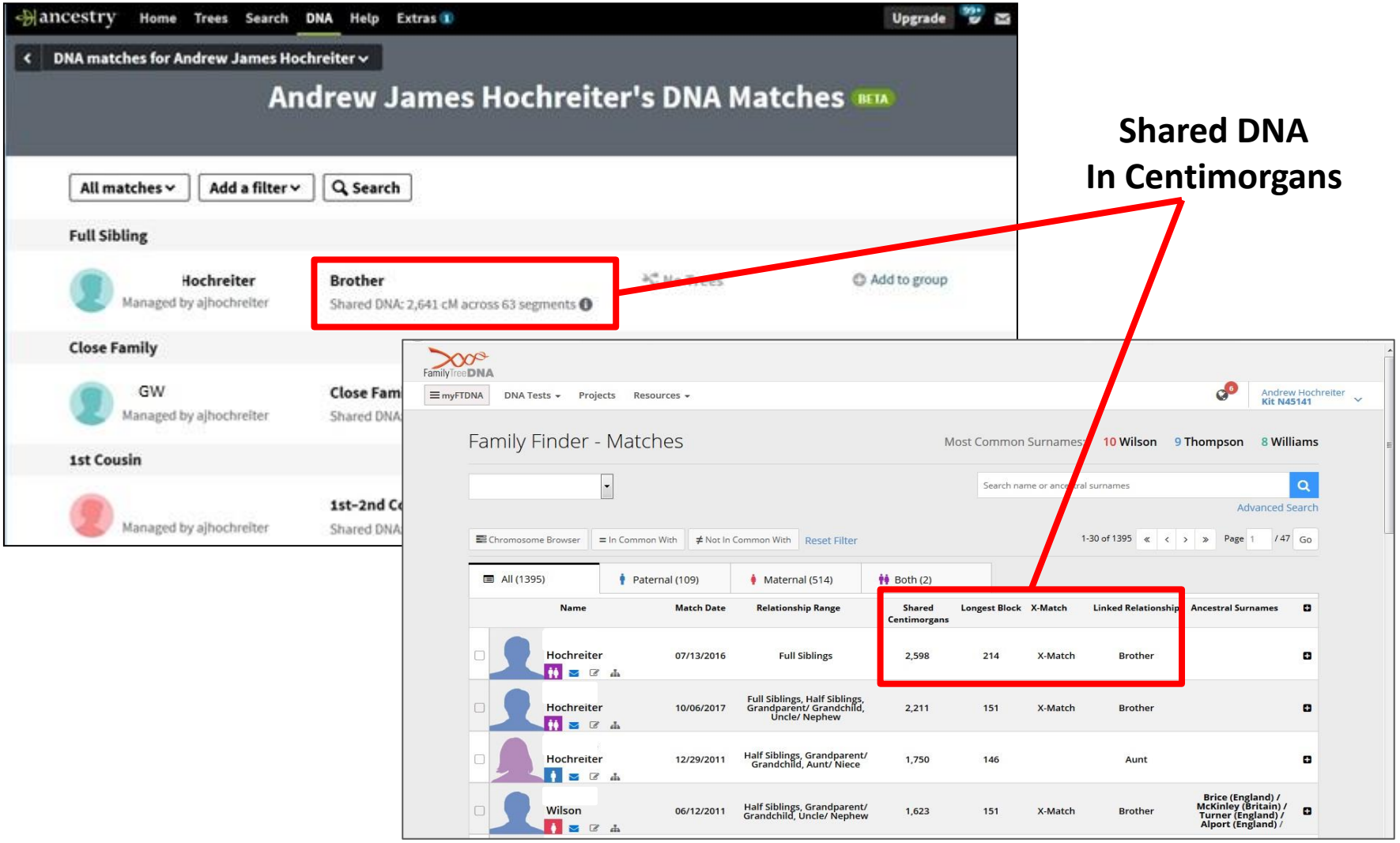
Average expected percentage of shared DNA between:

- Parent/child/full siblings = 50%
- Grandparents/grandchild/aunt/uncle/nephew/niece/ half-siblings = 25%
- 1st Cousins/great-grandparent or child/great aunt or uncle/ grandnephew or niece = 12.5%
- 1st Cousins once removed = 6.25%
- 2nd Cousins = 3.125%
- 2nd Cousins once removed = 1.563%
- 3rd Cousins = .781%
- 4th Cousins = .195%
- 5th Cousins = .049%
- 6th Cousins = .012%
- 7th Cousins = .003%
- 8th Cousins = .001%

What You Get from DNA

- **Raw Data**
  - Your base pair values (A,T,C,G)
- **Ethnicity & Admixture / Ancient Origins**
- **Relative Connections (Matches)**
  - Relationships back along any Family Tree branch unless shared DNA becomes eliminated
  - You get access to contact information for anyone in the database who is a genetic relative of yours, usually up to sixth cousin

Matches Page



Shared DNA
In Centimorgans

Matches

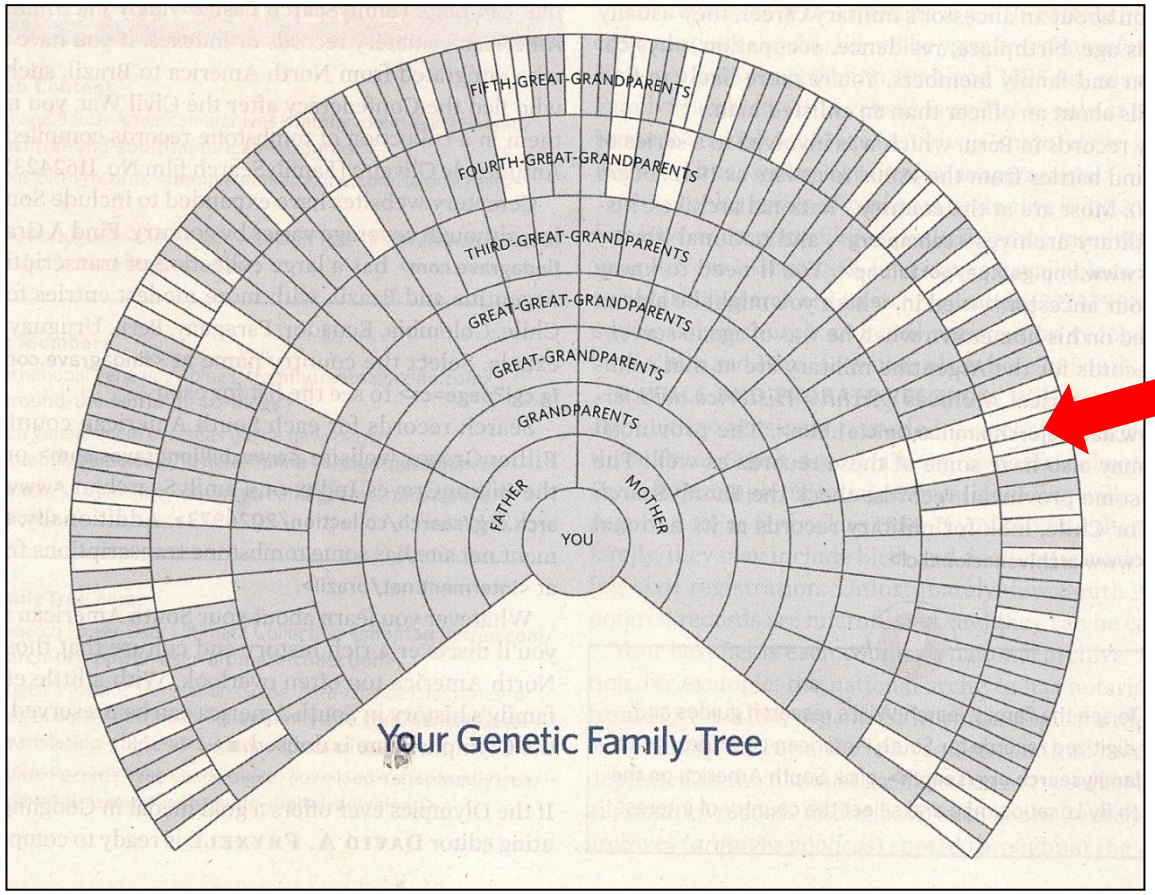
- If **enough DNA** is shared, **Match** is made
- Match is made based on **amount of shared DNA**
- List of Matches is generated
- Listed in **order of closeness**
- **Some matches are close, most are distant**
  - We have many more distant cousins
  - Shared DNA becomes smaller with distance
- Each company has own **Match Threshold**
- **Estimated Relationship** to Match

Your 2 Family Trees

Genealogical Tree: all your ancestors

Genetic Tree: ancestors whose DNA you inherited

- **Your Genetic Tree is a sub-set of your Genealogical Tree**
- **Siblings have the same Genealogical Tree but different Genetic Trees**

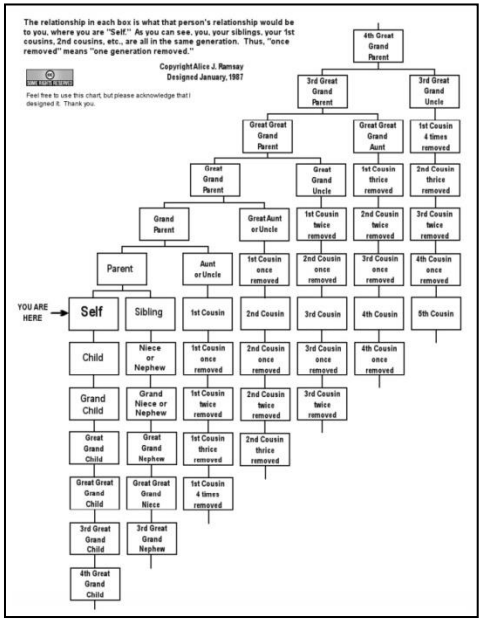


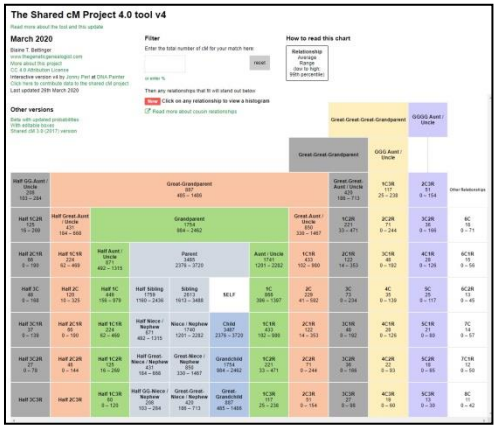
Ancestors who "drop off" the Genetic Tree

Two Relationship Views

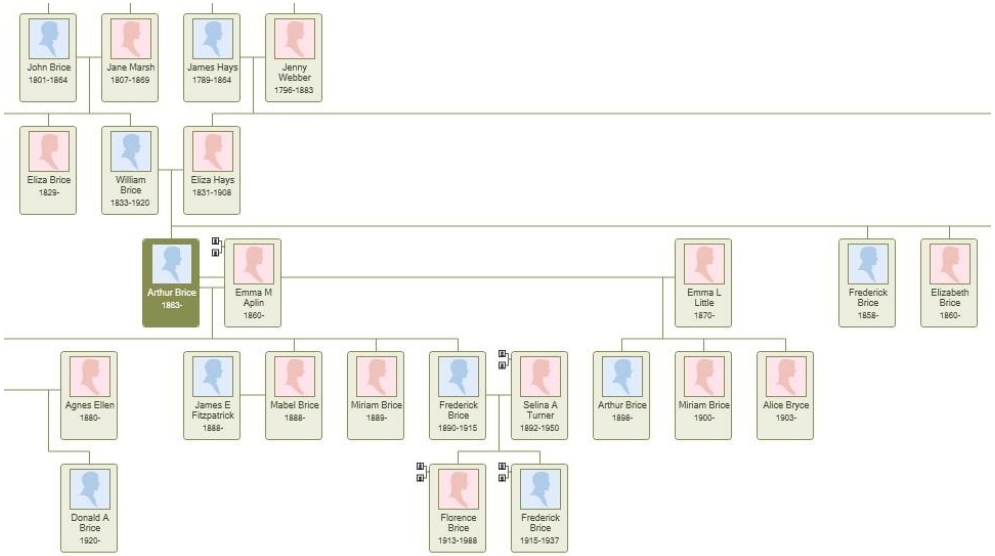
Provides precise positions or relations between two people in a group

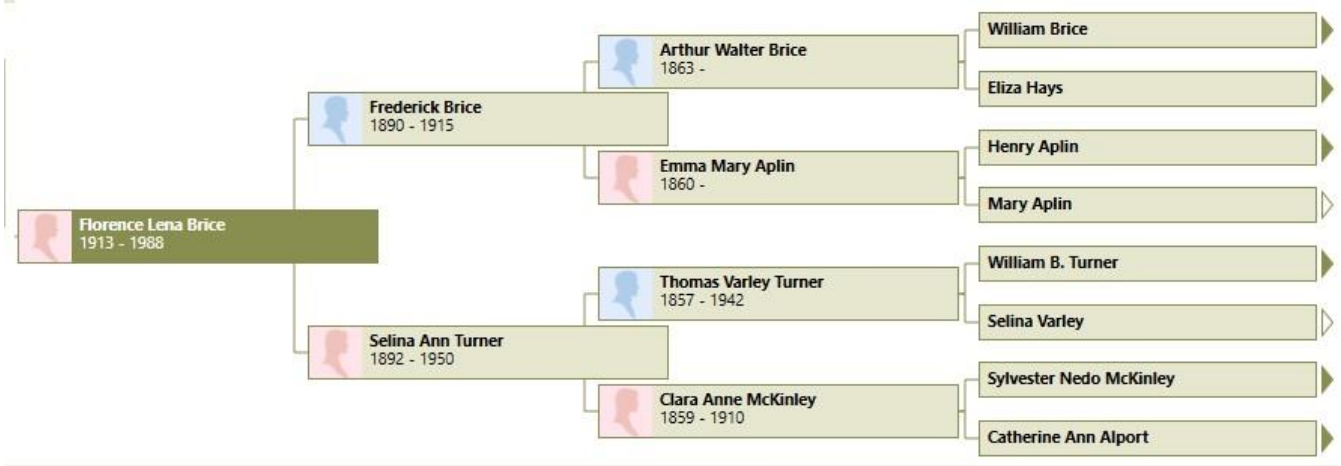
- **Genealogical Relationships**
  - Understanding a Relationship through Kinship Definitions
  - Familial
    - Paternal and Maternal
    - Degrees of cousins
    - Removed & Half Relationships
- **Genetic Relationships**
  - Understanding a Relationship through Genetic Factors
  - Shared DNA & Inherited Segments
    - DNA Matches
    - Genetic Networks



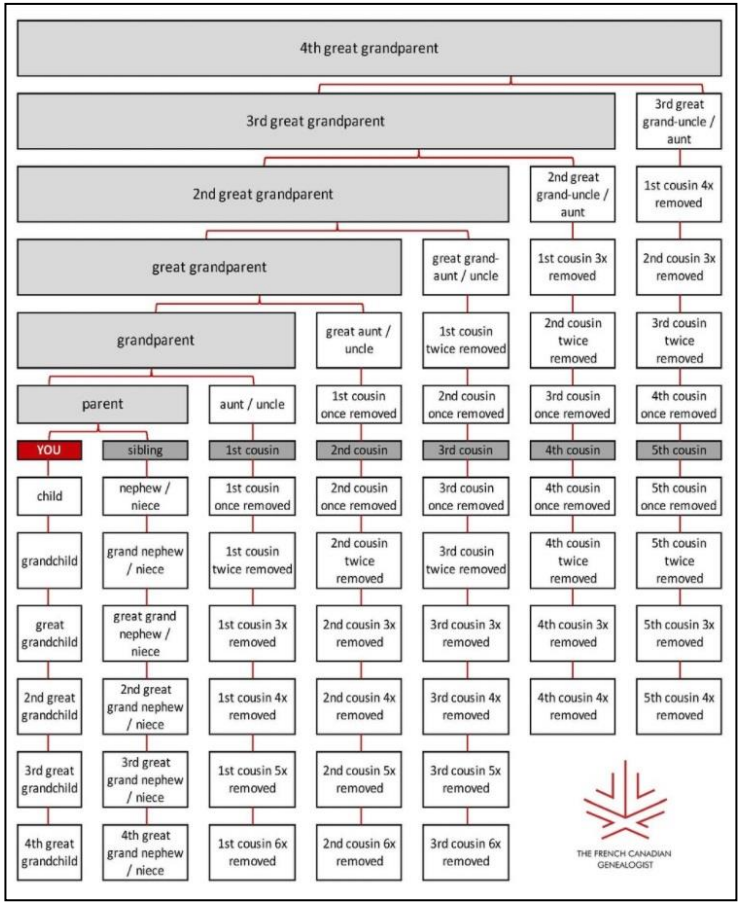


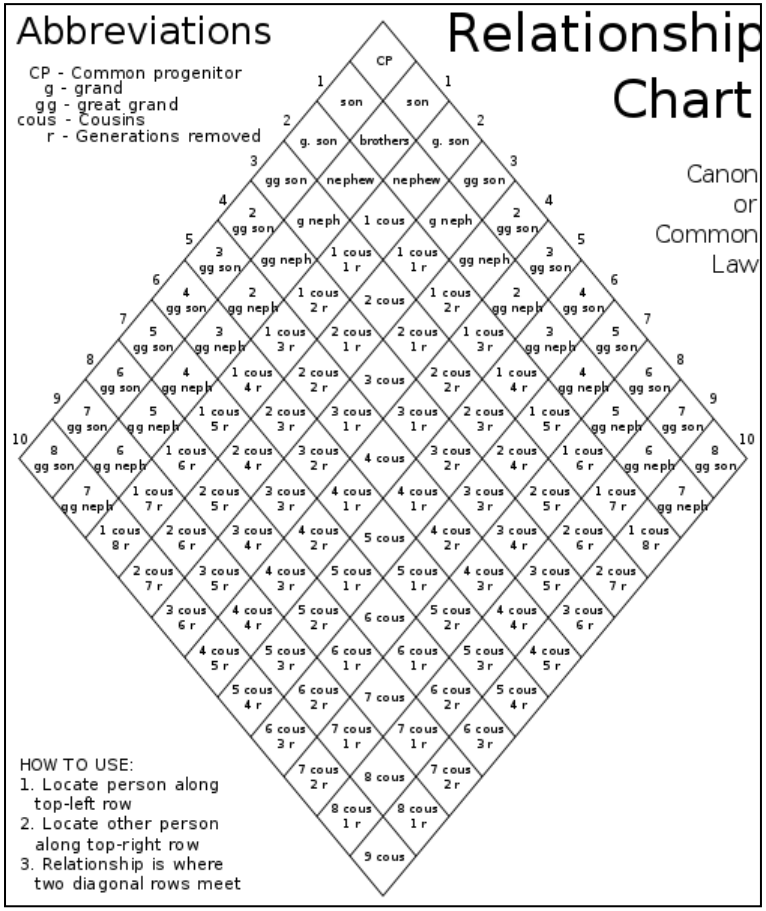
Genealogical Views





Relationship Chart

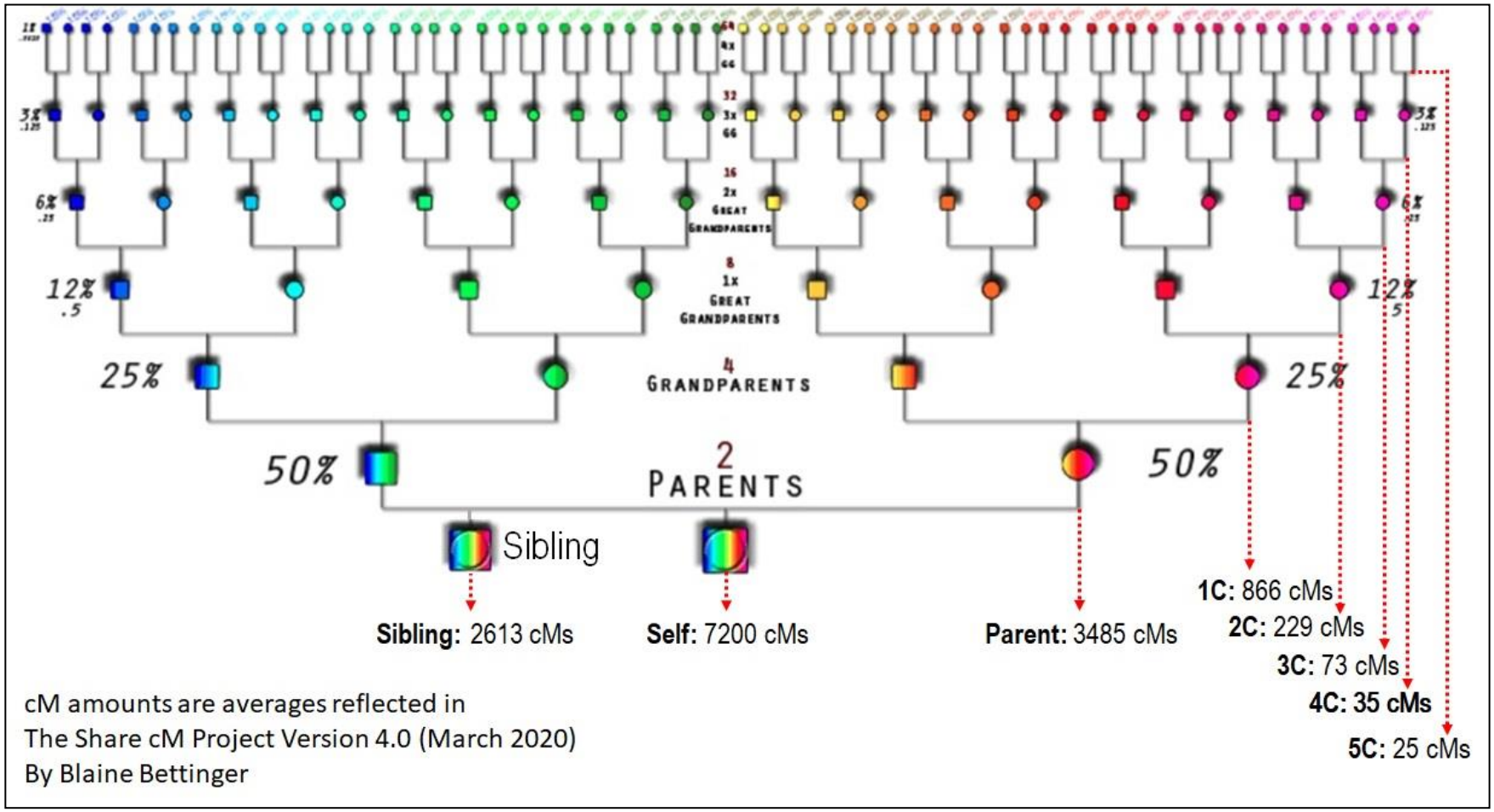




Genetic Views

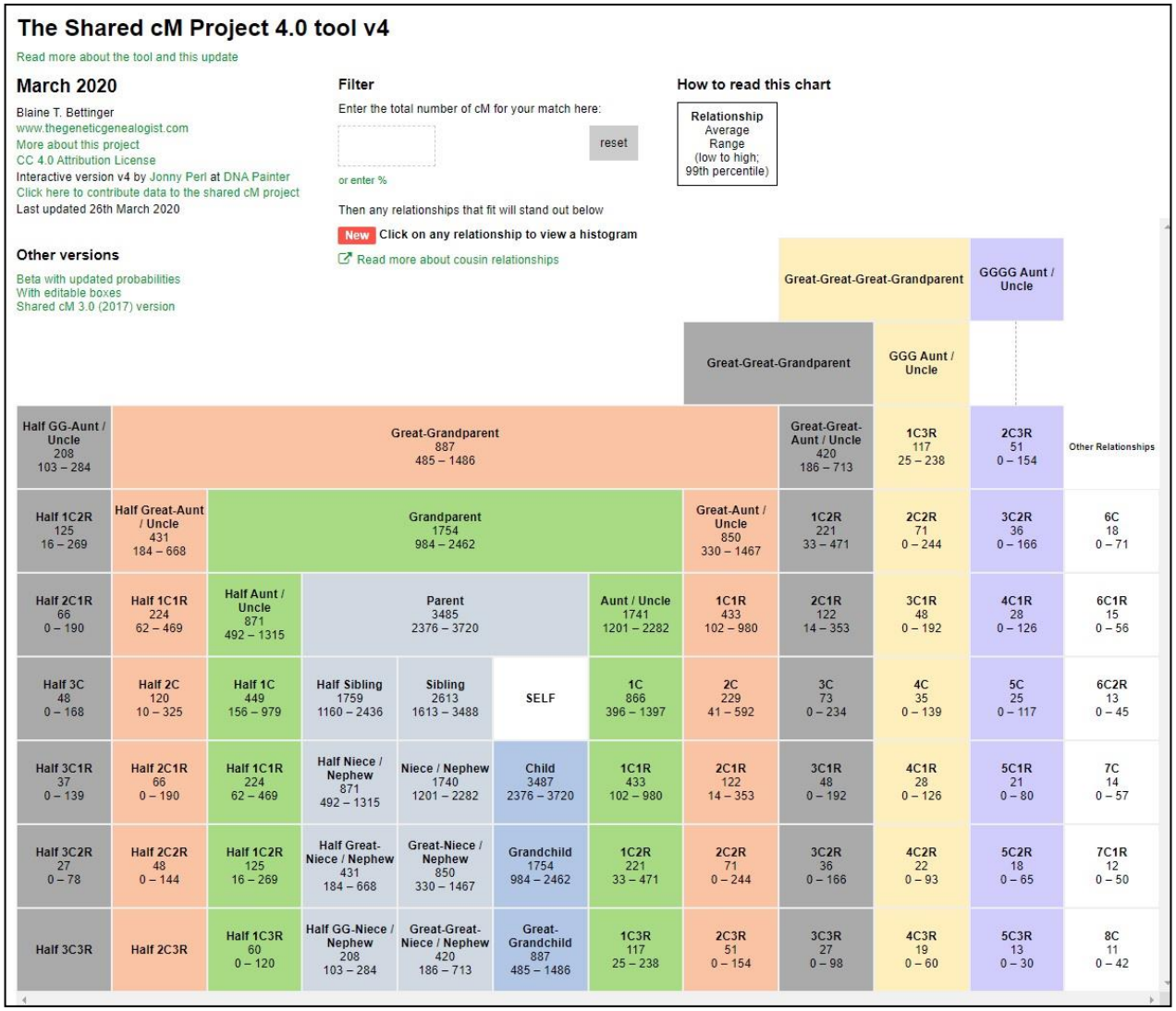
- Using a **DNA Match** to discover Ancestry
- Estimating relationship by **Shared DNA**
- Shared DNA measured in **Centimorgans**
- Most Recent Common Ancestor (MRCA)
  - Looking for **Source** of Shared DNA
- **Generation of Connection** to Match
- Exploring **Genetic Networks**

DNA Relationships



cM amounts are averages reflected in
The Share cM Project Version 4.0 (March 2020)
By Blaine Bettinger

Shared cM Project



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

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

New Click on any relationship to view a histogram

Read more about cousin relationships

How to read this chart

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

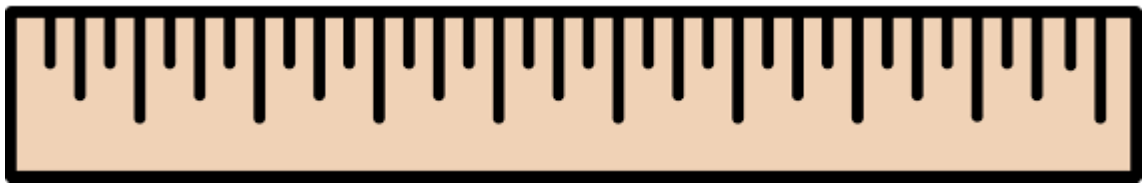
								Great-Great-Great-Grandparent		GGGG Aunt / Uncle	
							Great-Great-Grandparent		GGG Aunt / Uncle		
Half GG-Aunt / Uncle 208 103 – 284	Great-Grandparent 887 485 – 1486							Great-Great-Aunt / Uncle 420 186 – 713	1C3R 117 25 – 238	2C3R 51 0 – 154	Other Relationships
Half 1C2R 125 16 – 269	Half Great-Aunt / 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
Half 3C3R	Half 2C3R	Half 1C3R 60 0 – 120	Half GG-Niece / Nephew 208 103 – 284	Great-Great-Niece / Nephew 420 186 – 713	Great-Grandchild 887 485 – 1486	1C3R 117 25 – 238	2C3R 51 0 – 154	3C3R 27 0 – 98	4C3R 19 0 – 60	5C3R 13 0 – 30	8C 11 0 – 42

Centimorgans

- Matches share **DNA segments** on chromosomes
- Shared DNA measured in **Centimorgans (cMs)**
- Amount of shared cM can predict relationship
- **Matching segment**: DNA from common ancestor
- **More DNA shared, closer ancestor is in time**
- Total cMs vs. Longest block
- **Number vs. Length** of segments
  - All small: Distant & multiple relationships
  - Single long: identifiable common ancestor

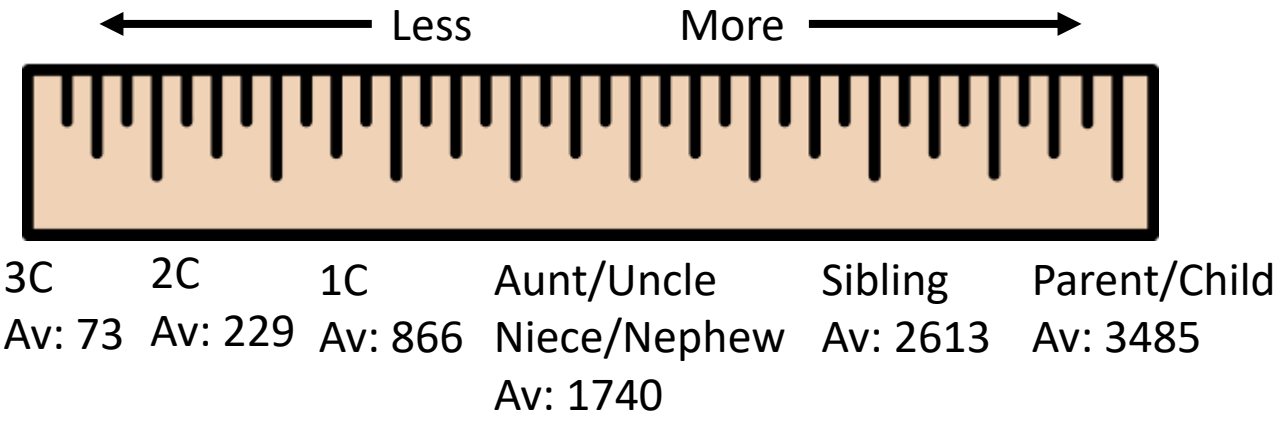
cM and Relationships

- **More total cMs** = Closer Relationship
- **Longer segments** = Closer Relationship
- **More segments** = Closer Relationship
- **Short segments** (<~7 cM) = False positive (?)
- cMs are units of **probability** NOT units of physical distance, BUT think in terms of **quantity**



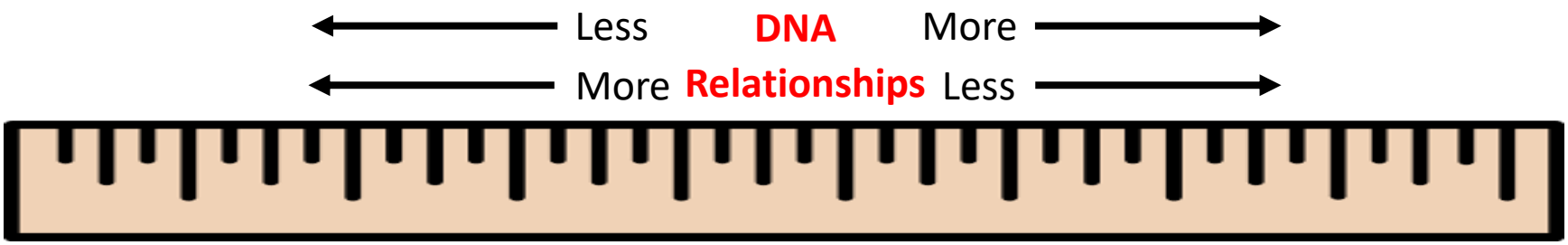
Predicted Relationships

- Relationship **estimated** based on cM amount
- Average vs Range
- More = Closer, Less = More Distant



Genealogy vs Genetics

- Think **flexibly** about Unknown Match relationship
- More cM = Less relationship possibilities
- Less cM = More relationship possibilities



3C	2C	1C	Aunt/Uncle	Sibling	Parent/Child
Av: 73	Av: 229	Av: 866	Av: 1740	Av: 2613	Av: 3485
Half 3C	Half GG Aunt/Uncle	Great Grandparent	Niece/Nephew		
3C1R	Half GG Niece/Nephew	Great Aunt/Uncle	Grandparent		
Half 2C2R	Half 1C1R	Great Grandchild	Half Sibling		
2C3R 3C	1C1R	Half Aunt/Uncle	Grandchild		
Half 2C1R	Half 2C	Half Niece/Nephew			
2C2R	2C1R				
Half 1C3R	1C2R				
Half 2C					
2C1R ...etc.					

Centimorgans and Relationships

Odds of Matching a Cousin

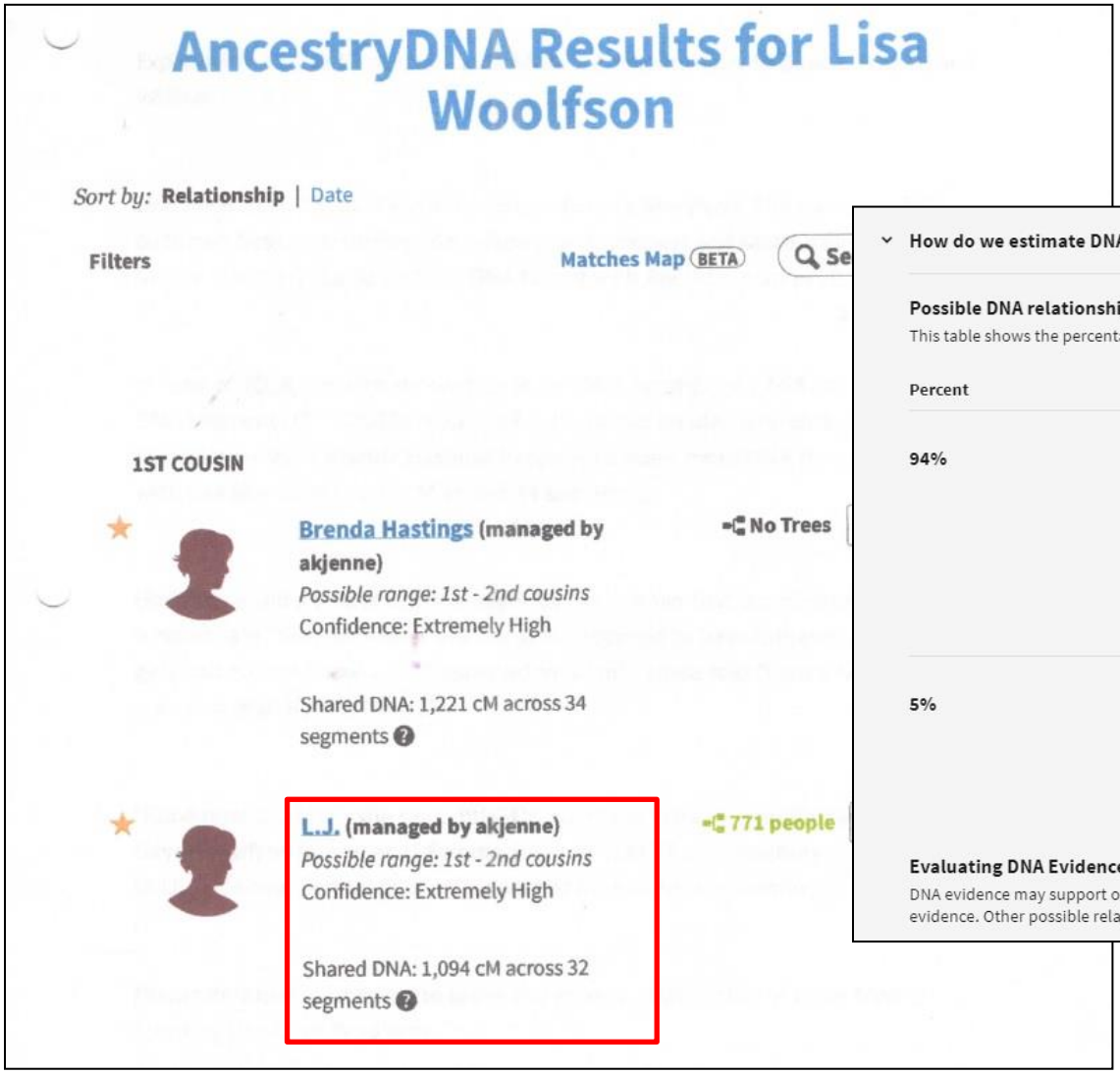
- 1st cousin or closer: 100%
- 2nd cousin: >99%
- 3rd cousin: ~90%
- 4th cousin: >50%
- 5th cousin: >15%
- 6th cousin and more distant*: <5%

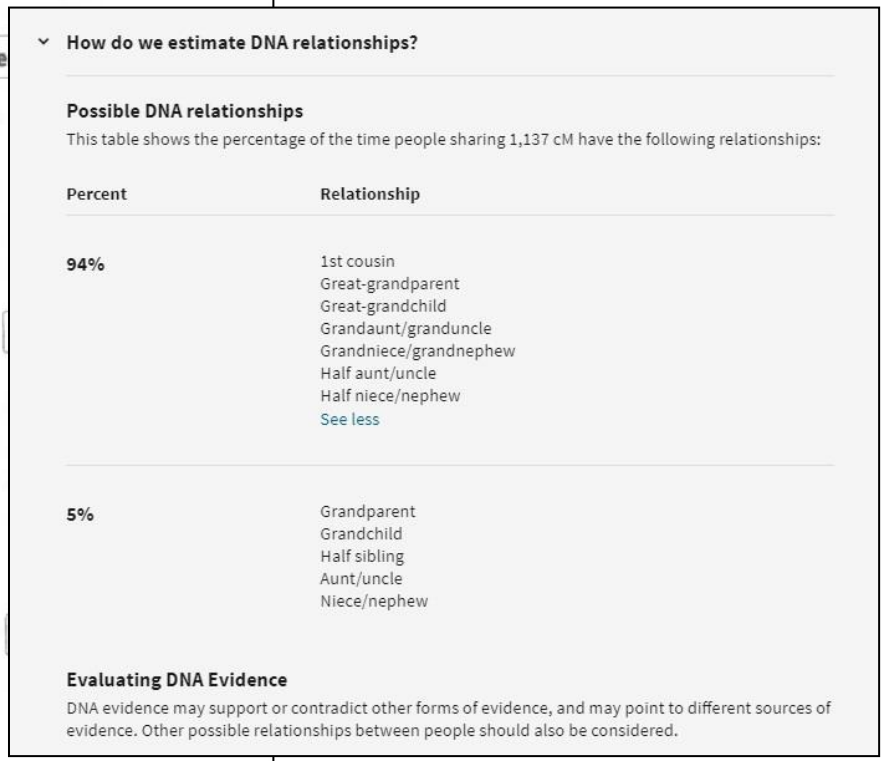
*Remember that we all have a large number of distant cousins, so even with these small odds, we will still find many at this level.

Establish Relationships

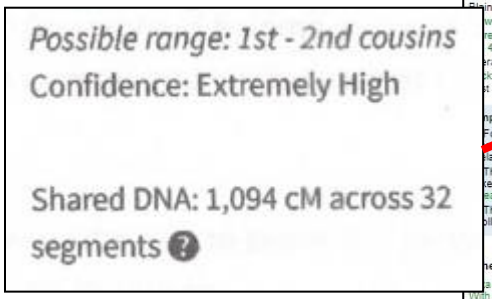
- Known Relationship
- Unknown Relationship
  - Find by Documentation
  - Tree Matching
  - DNA Matching
- Generation of Relationship
  - Concurrent
  - Removed
- Pedigree Collapse, Endogamy, NPEs

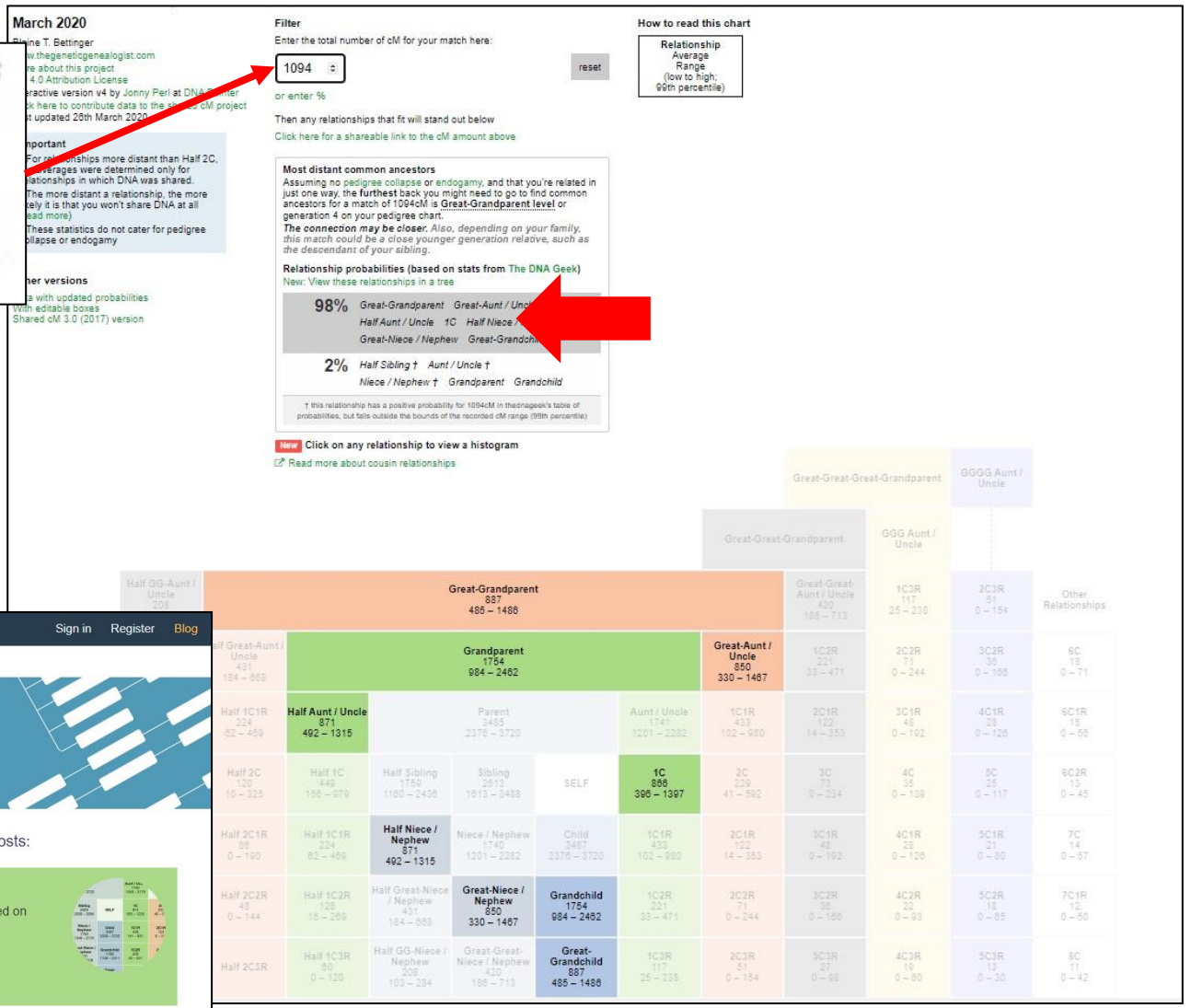
Ancestry DNA Results

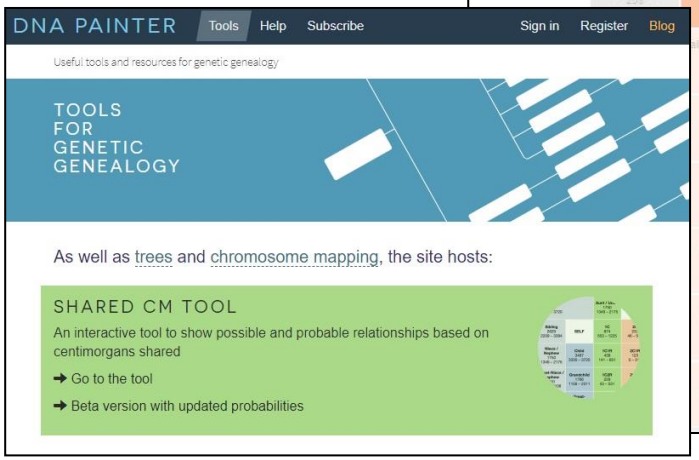




DNA Painter (Shared cMs)







Estimate Relationship

Possible range: 1st - 2nd cousins
Confidence: Extremely High

Shared DNA: 1,094 cM across 32 segments

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 1094cM is **Great-Grandparent level** or generation 4 on your pedigree chart.
The connection may be closer. *Also, depending on your family, this match could be a close younger generation relative, such as the descendant of your sibling.*

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

98% *Great-Grandparent Great-Aunt / Uncle Half Aunt / Uncle 1C Half Niece / Nephew Great-Niece / Nephew Great-Grandchild*

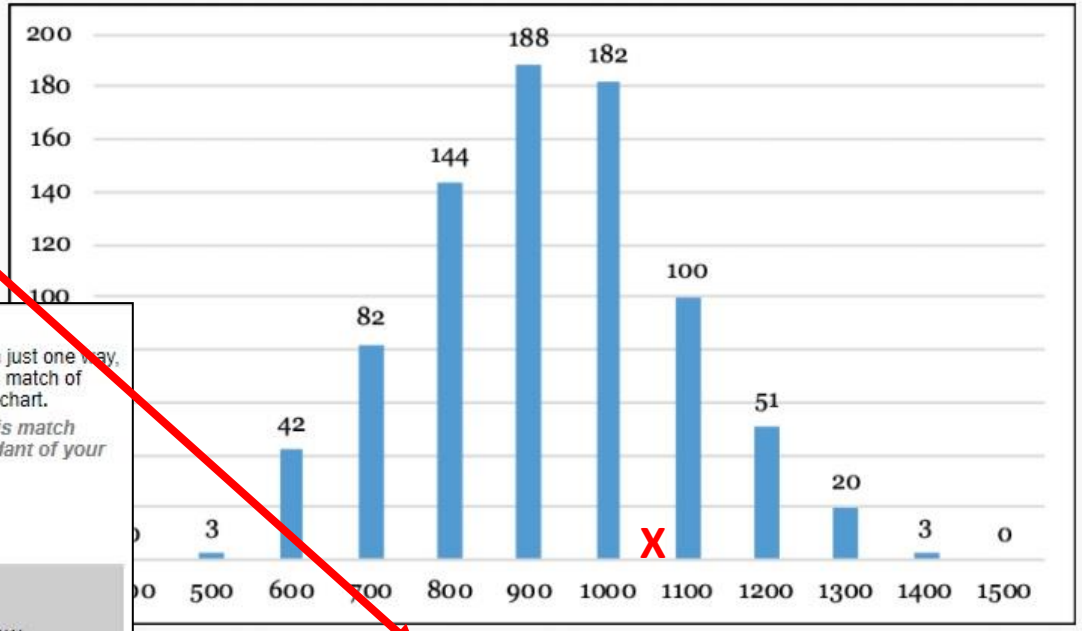
2% *Half Sibling † Aunt / Uncle † Niece / Nephew † Grandparent Grandchild*

† this relationship has a positive probability for 1094cM in thednageek's table of probabilities, but falls outside the bounds of the recorded cM range (99th percentile)

New **Click on any relationship to view a histogram**

Read more about cousin relationships

Submissions for the relationship "Half Aunt / Uncle" X



*t you entered was **1094cM***

d this histogram

izes the submissions for the relationship "**Half Aunt / Uncle**" relationship terminology tips

along the bottom are "bins," ranges of total shared cM

at the top of each blue bar is the total number of data entries for each interval or "bin"

for a bin represents the LARGEST number for that bin. So "500" means that the bin comprises data 401 to 500.

The Ladies!

Thanks for joining us!