

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

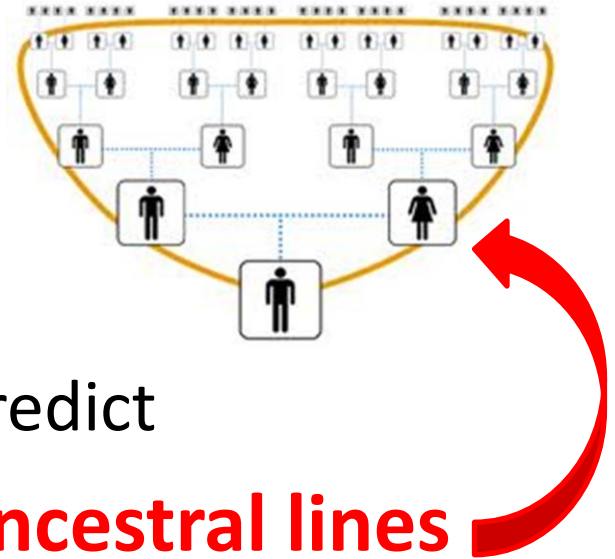
- **DNA Testing and Research can reveal:**
 - Family Secrets (illegitimacy/Adoption)
 - Unexpected Relationships
 - Unexpected Ethnic Makeup
 - Medical Conditions/Preconditions
- Sharing can expose **Personal data**
- Your DNA results can **Inform on Others**

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


ancestry Home Trees Search DNA Help Extras Upgrade

< DNA matches for Andrew James Hochreiter ▾

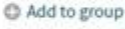
Andrew James Hochreiter's DNA Matches BETA

All matches ▾ Add a filter ▾ Search


Full Sibling

**Hochreiter**
Managed by ajhochreiter

Brother
Shared DNA: 2,641 cM across 63 segments ⓘ




Close Family

**GW**
Managed by ajhochreiter

Close Family
Shared DNA

1st Cousin

**1st-2nd Cousin**
Managed by ajhochreiter

1st-2nd Cousin
Shared DNA

Shared DNA
In Centimorgans

FamilyTreeDNA myFTDNA DNA Tests ▾ Projects Resources ▾

Family Finder - Matches

Most Common Surnames: 10 Wilson 9 Thompson 8 Williams





Search name or ancestral surnames

Advanced Search

1-30 of 1395 < > Page 1 / 47 Go

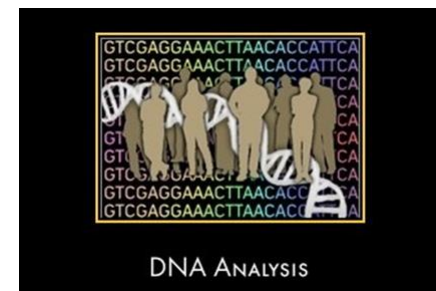
Chromosome Browser In Common With Not In Common With Reset Filter

All (1395) Paternal (109) Maternal (514) Both (2)

	Name	Match Date	Relationship Range	Shared Centimorgans	Longest Block	X-Match	Linked Relationship	Ancestral Surnames
<input type="checkbox"/>	 Hochreiter	07/13/2016	Full Siblings	2,598	214	X-Match	Brother	
<input type="checkbox"/>	 Hochreiter	10/06/2017	Full Siblings, Half Siblings, Grandparent/ Grandchild, Uncle/ Nephew	2,211	151	X-Match	Brother	
<input type="checkbox"/>	 Hochreiter	12/29/2011	Half Siblings, Grandparent/ Grandchild, Aunt/ Niece	1,750	146		Aunt	
<input type="checkbox"/>	 Wilson	06/12/2011	Half Siblings, Grandparent/ Grandchild, Uncle/ Nephew	1,623	151	X-Match	Brother	Brice (England) / McKinley (Britain) / Turner (England) / Alport (England) /

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

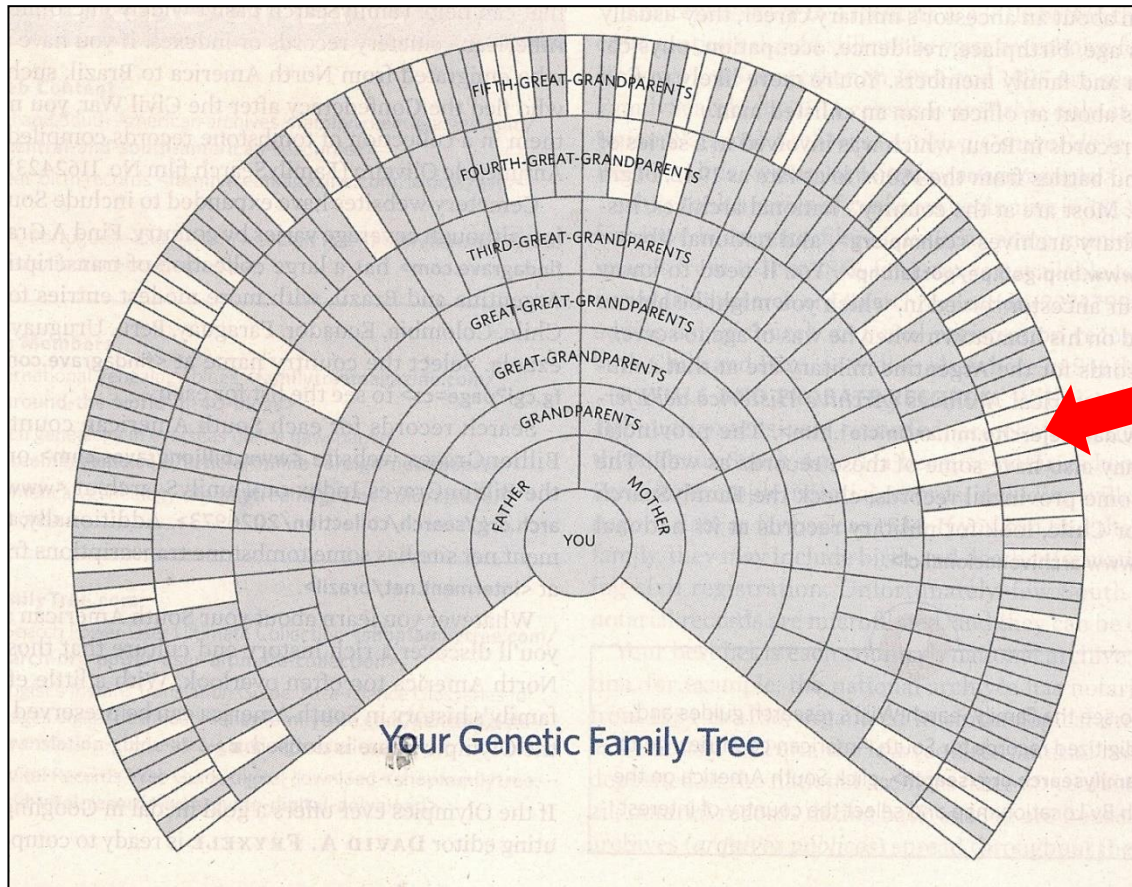


Your 2 Family Trees

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

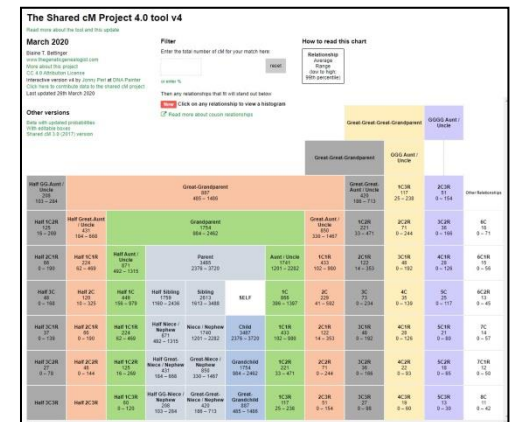
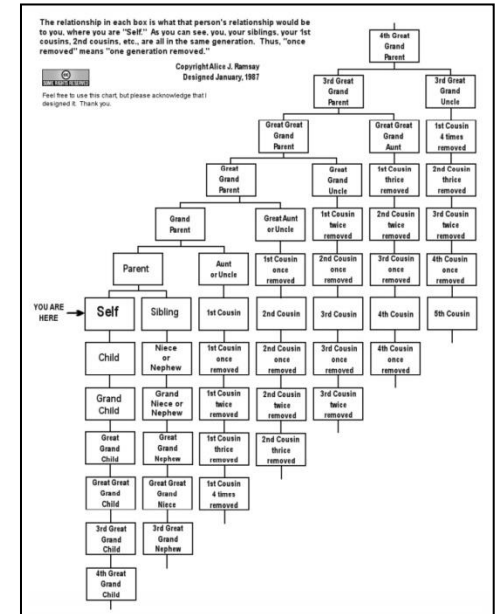
Provides precise positions or relations between two people in a group

- **Genealogical Relationships**

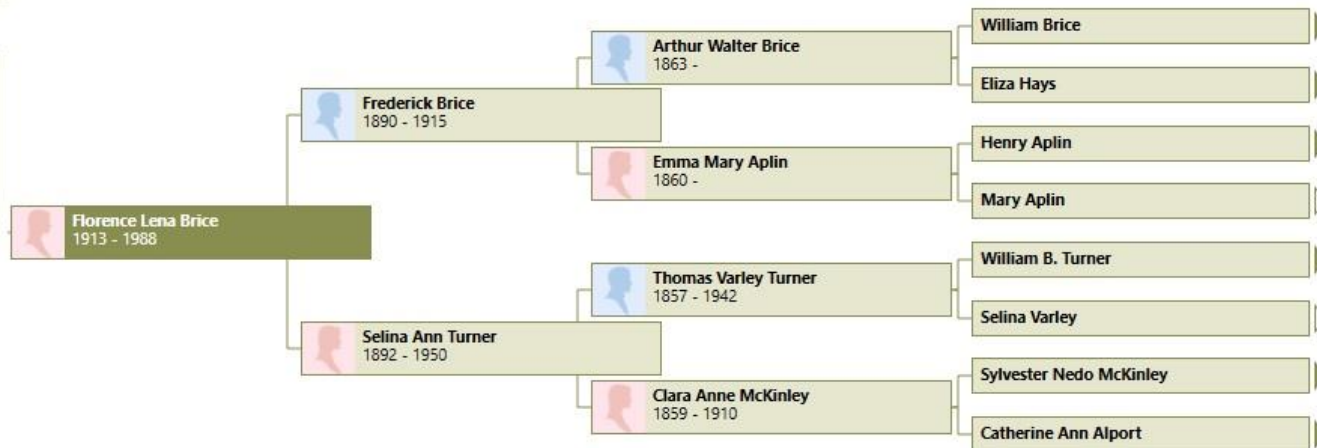
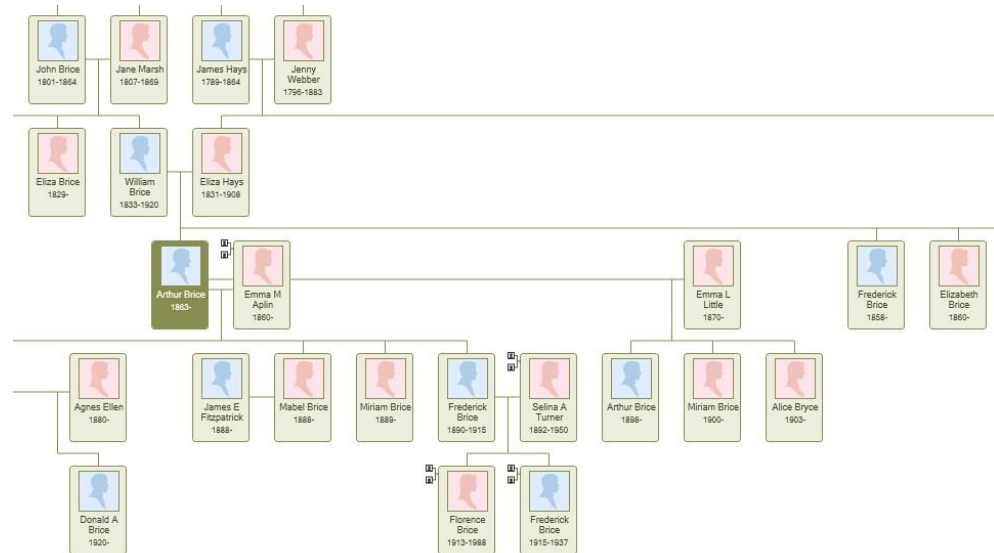
- Understanding a Relationship through Kinship Definitions
- Familial
 - Paternal and Maternal
 - Degrees of cousins
 - Removed & Half Relationships

- **Genetic Relationships**

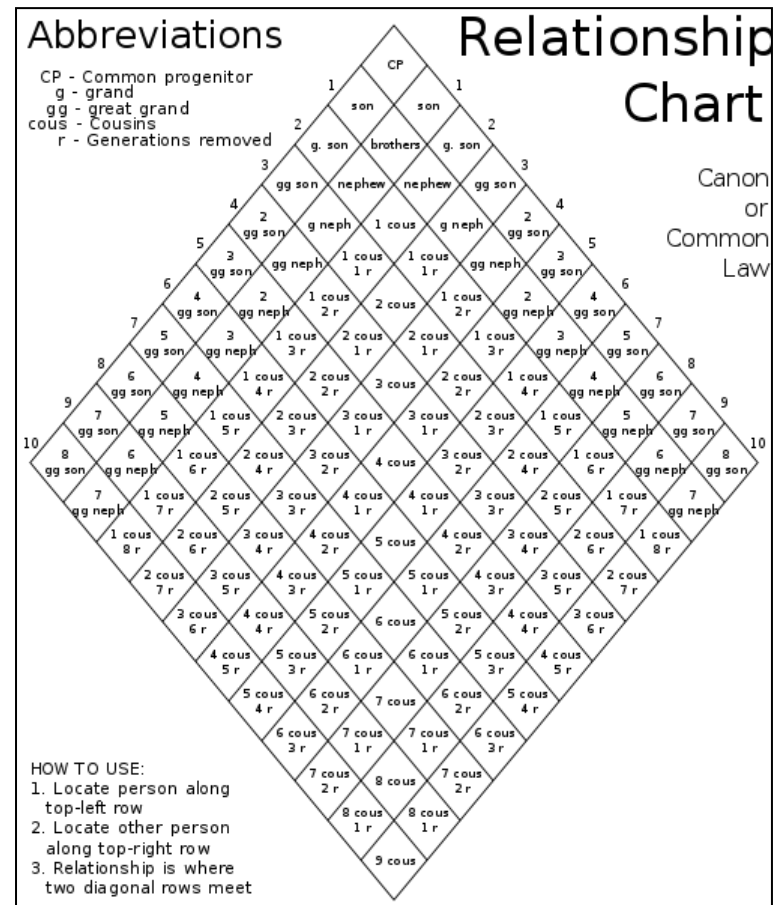
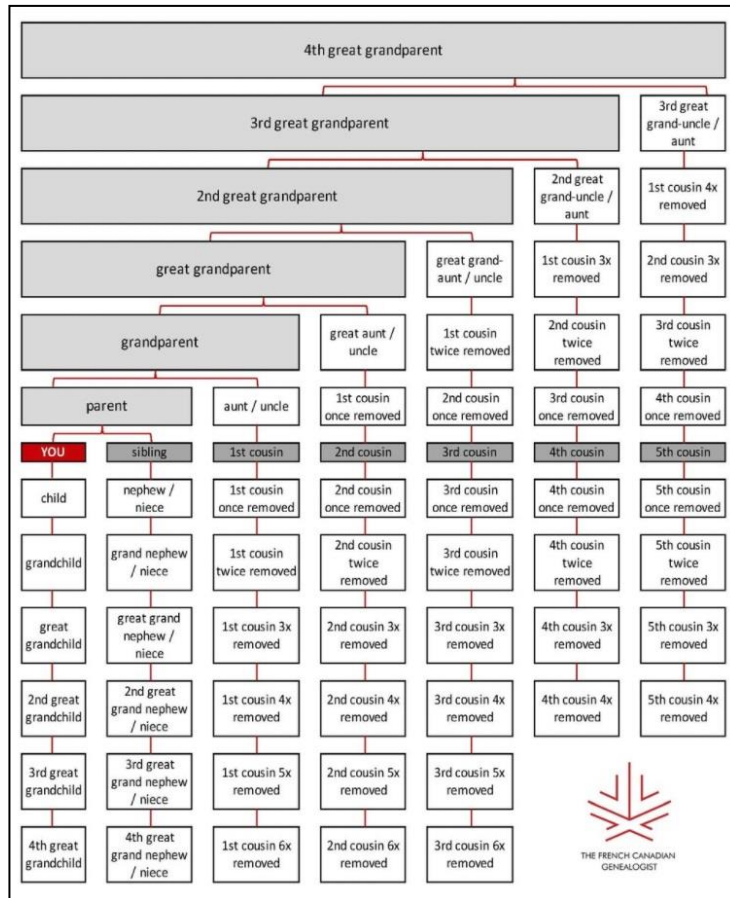
- Understanding a Relationship through Genetic Factors
- Shared DNA & Inherited Segments
 - DNA Matches
 - Genetic Networks



Genealogical Views



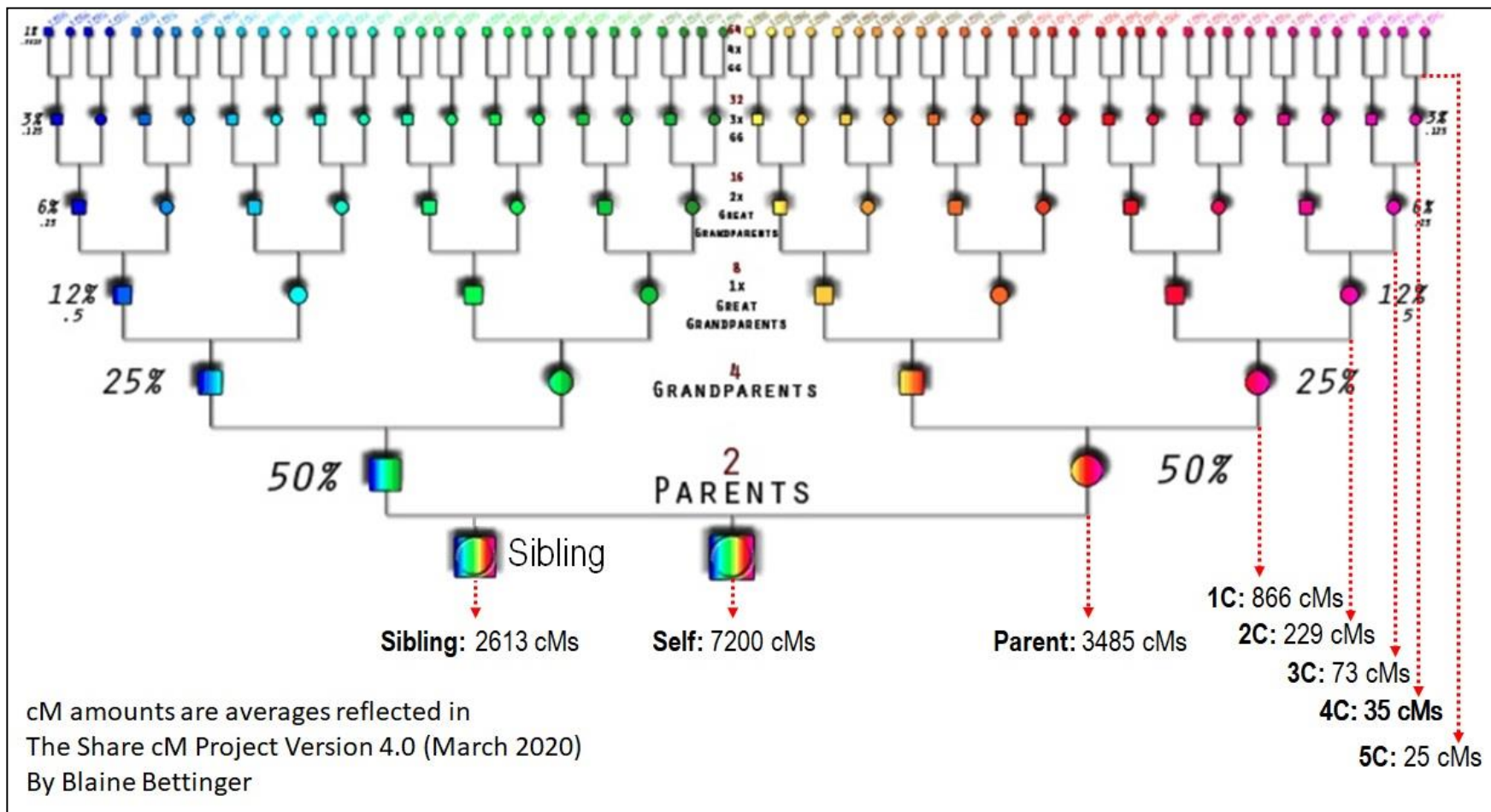
Relationship Chart



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



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)

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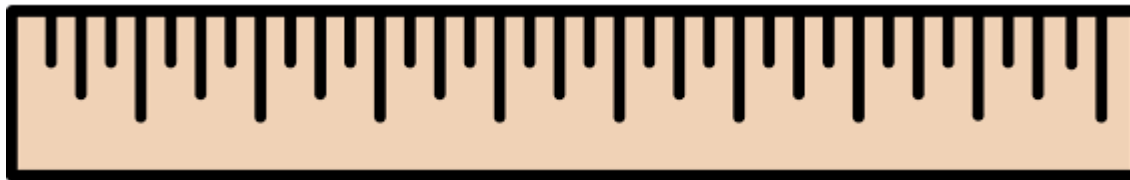
										Great-Great-Great-Grandparent		GGGG Aunt / Uncle			
										Great-Great-Grandparent		GGG Aunt / Uncle			
										Great-Great-Aunt / Uncle		1C3R		2C3R	
										420 186 – 713		117 25 – 238		51 0 – 154	
										Other Relationships					
										Great-Grandparent					
										887 485 – 1486					
										Great-Aunt / Uncle		1C2R		2C2R	
										850 330 – 1467		221 33 – 471		71 0 – 244	
										Grandparent		3C2R		6C	
										1754 984 – 2462		36 0 – 166		18 0 – 71	
										Half Great-Aunt / Uncle		Half Aunt / Uncle		Parent	
										431 184 – 668		871 492 – 1315		3485 2376 – 3720	
										Half 1C2R		Half 1C1R		Aunt / Uncle	
										125 16 – 269		224 62 – 469		1741 1201 – 2282	
										1C1R		2C1R		3C1R	
										433 102 – 980		122 14 – 353		48 0 – 192	
										1C2R		2C2R		3C2R	
										221 33 – 471		71 0 – 244		36 0 – 166	
										Grandchild		4C2R		5C2R	
										1754 984 – 2462		22 0 – 93		18 0 – 65	
										Half 1C3R		Half 2C3R		Half 1C2R	
										60 0 – 120		19 0 – 60		125 16 – 269	
										Half GG-Niece / Nephew		Half GG-Aunt / Uncle		Half 1C1R	
										208 103 – 284		27 0 – 98		431 184 – 668	
										Great-Great-Niece / Nephew		Great-Great-Aunt / Uncle		Great-Niece / Nephew	
										887 485 – 1486		51 0 – 154		850 330 – 1467	
										1C3R		2C3R		3C3R	
										117 25 – 238		27 0 – 98		36 0 – 166	
										Half 3C3R		Half 2C2R		Half 1C2R	
										11 0 – 42		12 0 – 50		125 16 – 269	

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

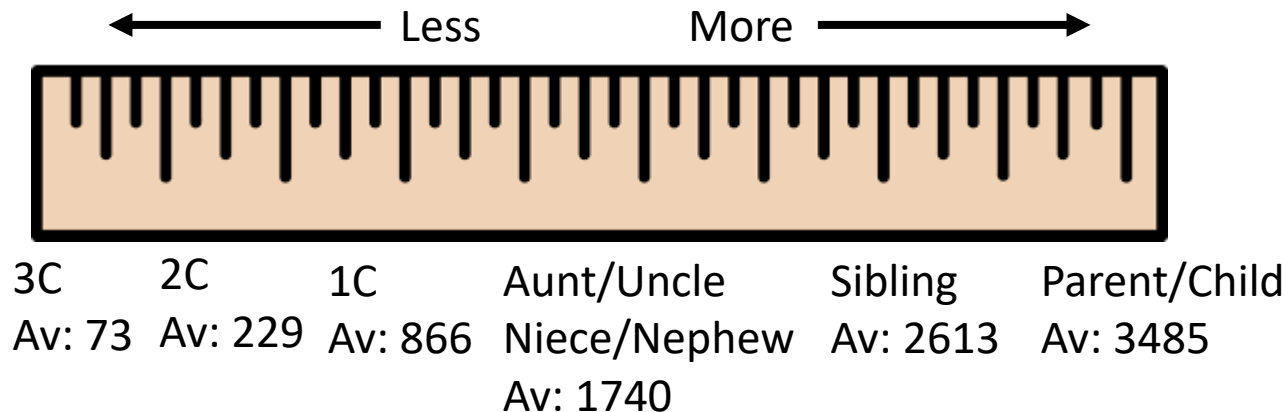
cM and Relationships

- **More total cMs** = Closer Relationship
- **Longer segments** = Closer Relationship
- **More segments** = Closer Relationship
- **Short segments** ($< \sim 7$ 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

← Less **DNA** More →
 ← More **Relationships** Less →



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

AncestryDNA Results for Lisa Woolfson

Sort by: Relationship | Date



Filters Matches Map BETA Q Search

1ST COUSIN




Brenda Hastings (managed by akjenne)
Possible range: 1st - 2nd cousins
Confidence: Extremely High


Shared DNA: 1,221 cM across 34 segments ?



L.J. (managed by akjenne)
Possible range: 1st - 2nd cousins
Confidence: Extremely High

Shared DNA: 1,094 cM across 32 segments ?

 No Trees

 771 people

How do we estimate DNA relationships?

Possible DNA relationships

This table shows the percentage of the time people sharing 1,137 cM have the following relationships:

Percent	Relationship
94%	1st cousin Great-grandparent Great-grandchild Grandaunt/granduncle Grandniece/grandnephew Half aunt/uncle Half niece/nephew See less
5%	Grandparent Grandchild Half sibling Aunt/uncle Niece/nephew

Evaluating DNA Evidence

DNA evidence may support or contradict other forms of evidence, and may point to different sources of evidence. Other possible relationships between people should also be considered.

DNA Painter (Shared cMs)

Possible range: 1st - 2nd cousins

Confidence: Extremely High

Shared DNA: 1,094 cM across 32 segments ?

March 2020

Line T. Bettinger

with the genetic genealogist.com

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Interactive version v4 by Jonny Perl at DNA Painter

Click here to contribute data to the shared cM project

It updated 26th March 2020

Important

For relationships more distant than Half 2C, the ranges 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

Alpha with updated probabilities (with editable boxes)

Shared cM 3.0 (2017) version

Filter

Enter the total number of cM for your match here:

1094

or enter %

Then any relationships that fit will stand out below

[Click here for a shareable link to the cM amount above](#)

How to read this chart

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

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 theadnageek'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](#)

DNA PAINTER
Tools Help Subscribe
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Useful tools and resources for genetic genealogy

TOOLS FOR GENETIC GENEALOGY

As well as trees and chromosome mapping, the site hosts:

SHARED CM TOOL

An interactive tool to show possible and probable relationships based on centimorgans shared

→ Go to the tool

→ Beta version with updated probabilities

	Half GG-Aunt / Uncle 208		Great-Grandparent 887 485 - 1486					Great-Great-Aunt / Uncle 430 188 - 713		Great-Great-Grandparent	GGGG Aunt / Uncle	
Half GG-Aunt / Uncle 48 184 - 668		Grandparent 1764 984 - 2482		Great-Aunt / Uncle 850 330 - 1487		1C2R 117 25 - 238		2C2R 35 0 - 164		3C2R 15 0 - 71		Other Relationships
Half 1C1R 224 82 - 495	Half Aunt / Uncle 871 492 - 1315	Parent 3455 2378 - 5720		Aunt / Uncle 1741 1201 - 2382		1C1R 433 102 - 980		2C1R 122 14 - 353		3C1R 48 0 - 192	4C1R 28 0 - 128	5C1R 15 0 - 56
Half 2C 128 10 - 325	Half 1C 445 156 - 979	Half Sibling 1759 1190 - 2436	Sibling 2913 1913 - 3488	SELF	1C 886 390 - 1387	2C 229 41 - 592	3C 73 0 - 234	4C 38 0 - 139	5C 25 0 - 117	6C 15 0 - 45	7C 12 0 - 37	8C 11 0 - 30
Half 3C1R 85 0 - 190	Half 1C1R 224 82 - 495	Half Niece / Nephew 871 492 - 1315	Niece / Nephew 1740 1201 - 2382	Child 3487 2378 - 5720	1C1R 433 102 - 980	2C1R 122 14 - 353	3C1R 48 0 - 192	4C1R 28 0 - 128	5C1R 15 0 - 56	6C1R 15 0 - 56	7C1R 12 0 - 37	8C1R 11 0 - 30
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Half 2C3R 128 10 - 325	Half 1C3R 445 156 - 979	Half GG-Niece / Nephew 208 103 - 294	Great-Great-Niece / Nephew 430 188 - 713	Great-Grandchild 887 485 - 1486	1C3R 117 25 - 238	2C3R 35 0 - 164	3C3R 15 0 - 71	4C3R 28 0 - 128	5C3R 15 0 - 56	6C3R 15 0 - 56	7C3R 12 0 - 37	8C3R 11 0 - 30

Estimate Relationship

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Confidence: Extremely High

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Most distant common ancestors

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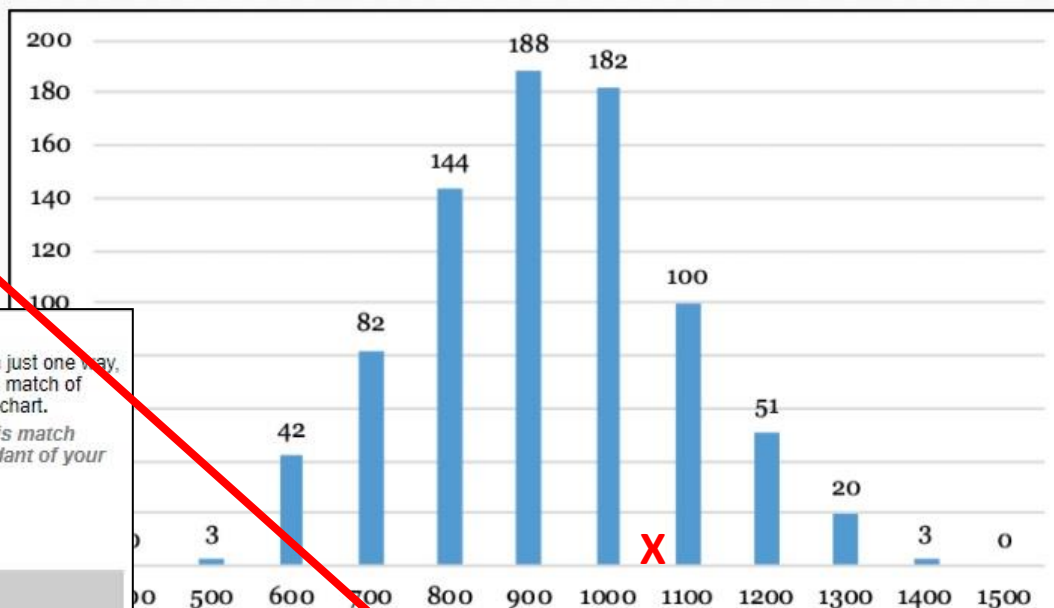
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New Click on any relationship to view a histogram

[Read more about cousin relationships](#)

Submissions for the relationship "Half Aunt / Uncle"

X



What you entered was **1094cM**

Read this histogram

This histogram visualizes 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 from 401 to 500.

The Ladies!



Thanks for joining us!

