Jewish Genealogy and DNA

18 Dec 2016

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Genetic Genealogy

- Types of DNA
- Testing Companies
- DNA and “traditional” Genealogy Sites
- Other Online Utilities
- Experience / Pitfalls

Why do we study DNA?

- Health
  - Exome, subset of genome, that is used as an "instruction set" by our body.
- (Ancient) History
  - Understanding human development, migration
- Genealogy
  - Help overcome lack of paper records, generally several generations back
- Adoption
  - Help overcome lack of paper records, generally during recent generations

Types of DNA

- Humans have 23 chromosomes plus some mitochondrial DNA
- Autosomal DNA
  - 22 Chromosomes recombine every generation (*as do XX chromosome pair in females)
- Y-Chromosome (Y-DNA)
  - Only present in males (XY), not females (XX)
  - Passes from father-to-son (~60 Mbp)
- Mitochondrial DNA (mtDNA)
  - Passes from mother-to-child (~68 kbp)
- We look at recombination of Autosomal DNA and X-DNA vs. Mutations of Y- and mtDNA.

mt- and y- DNA

mt-DNA

- Many Ashkenazi Jews share one of 4 mt-DNA Haplogroups, so *may* not be of much value
  - I have 130 matches at gd=0, i.e. perfect matches, and haven't been able to figure out any of them!
- HVR1, HVR2, Full Sequence
- With only ~68k bp, mutates much slower than y-DNA

Y-DNA

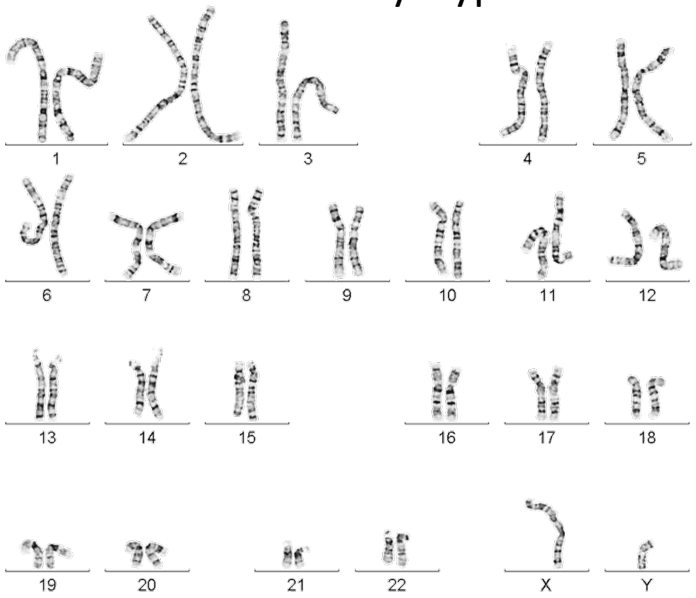
- STRs vs. SNPs
  - Short Tandem Repeats (STRs)
  - Single Nucleotide Pairs (SNPs)
- Good for "ancient" roots
  - Many branches approaching the middle ages
  - Some branches are closing in on paper trails
  - Also some very sparse branches

Autosomal DNA

- Human's have 23 pairs of Chromosomes, 22 Autosomal and a 23rd Gender-Specific pair

- Females (XX) the PAIR *looks* like an "X", Males (XY) the PAIR *looks* like a "Y"

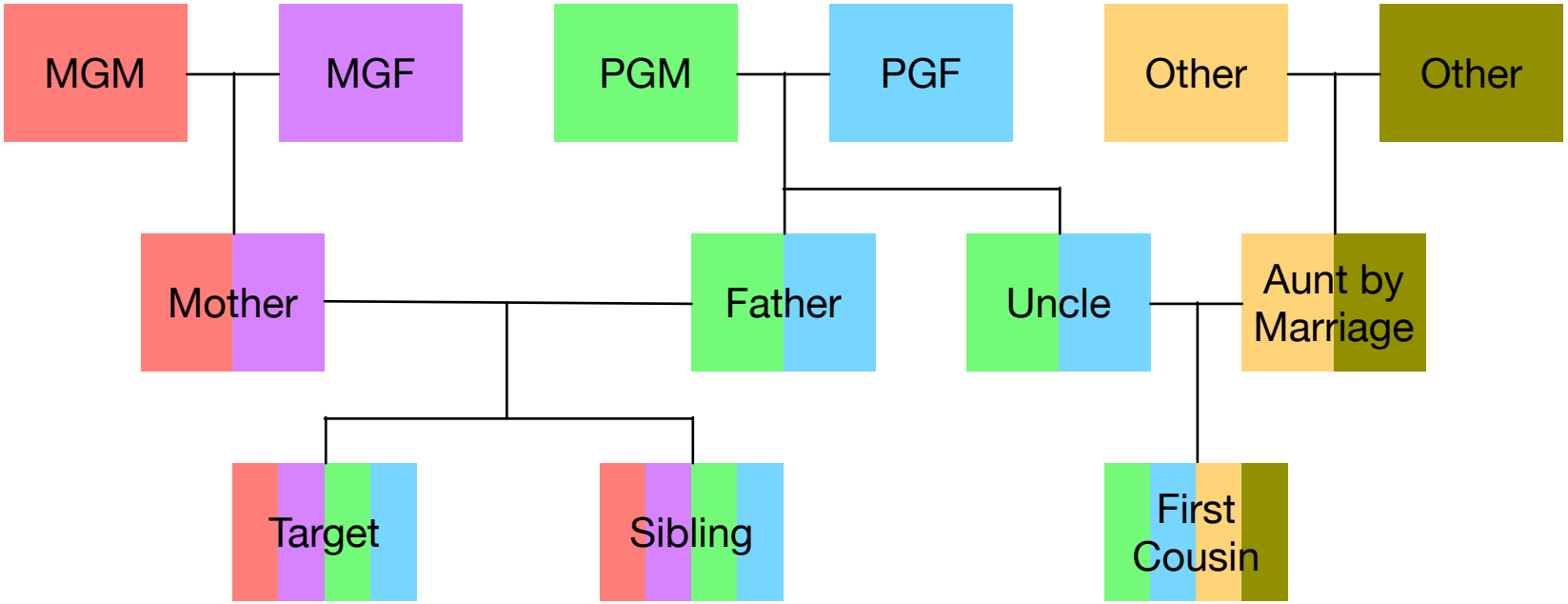
Human Karyotype



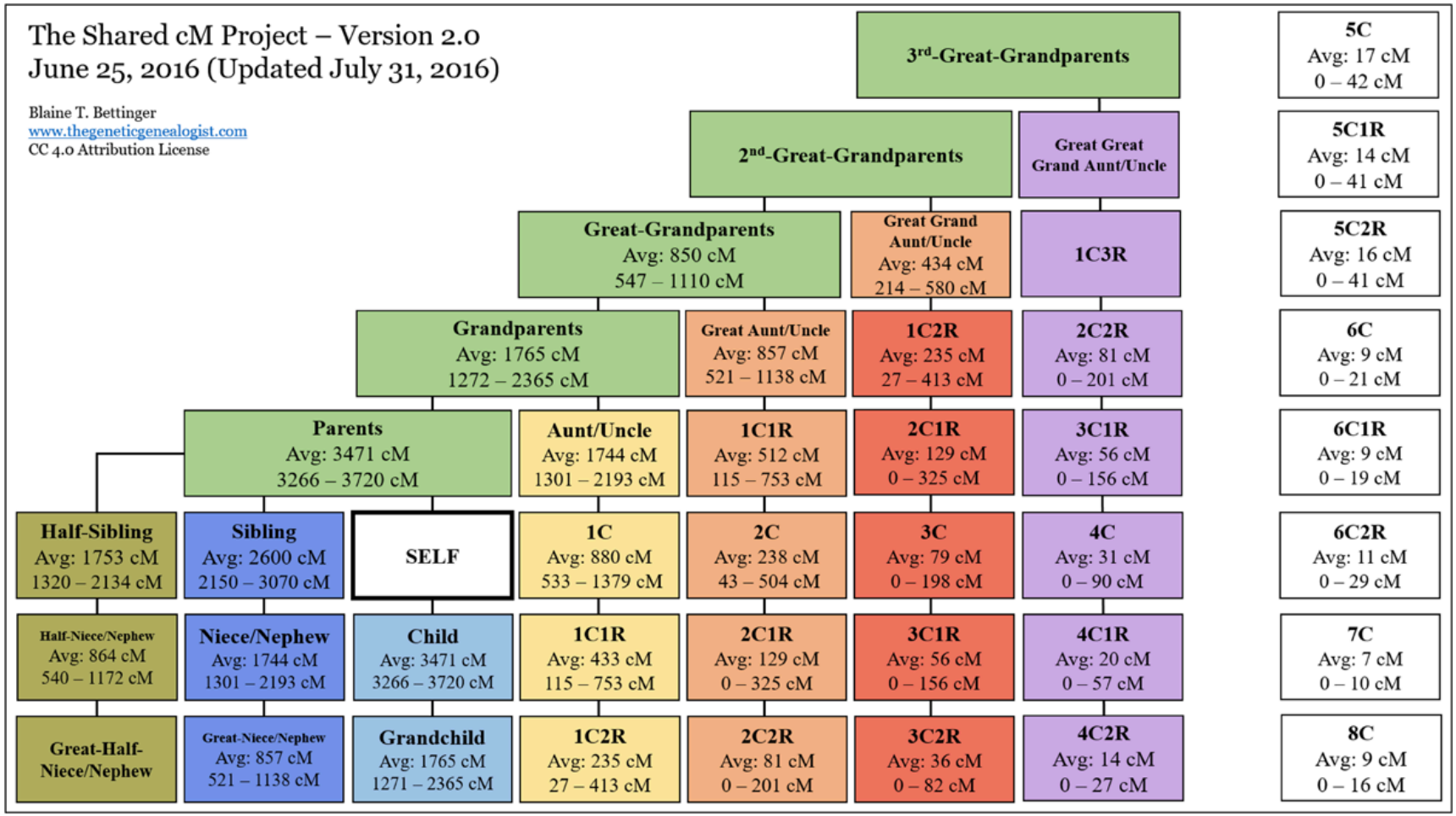
Sex-Determining Genes

XX XY

Simple Family Unit



Shared Autosomal DNA

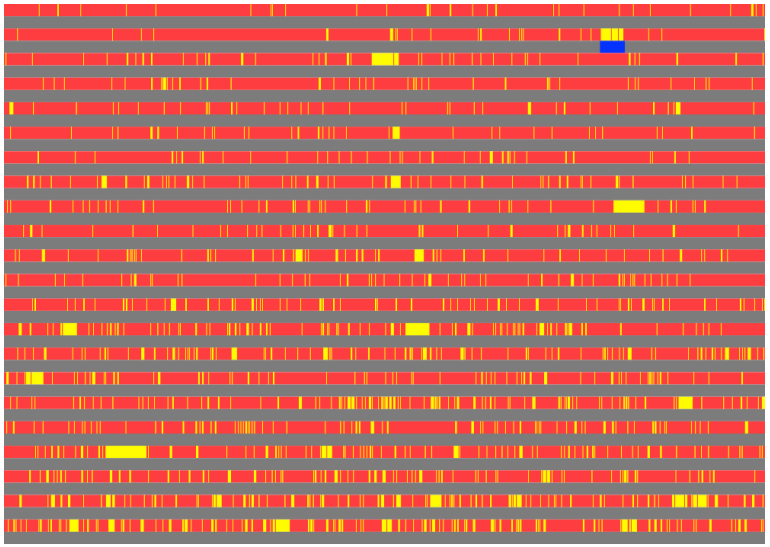


Runs of Homozygosity

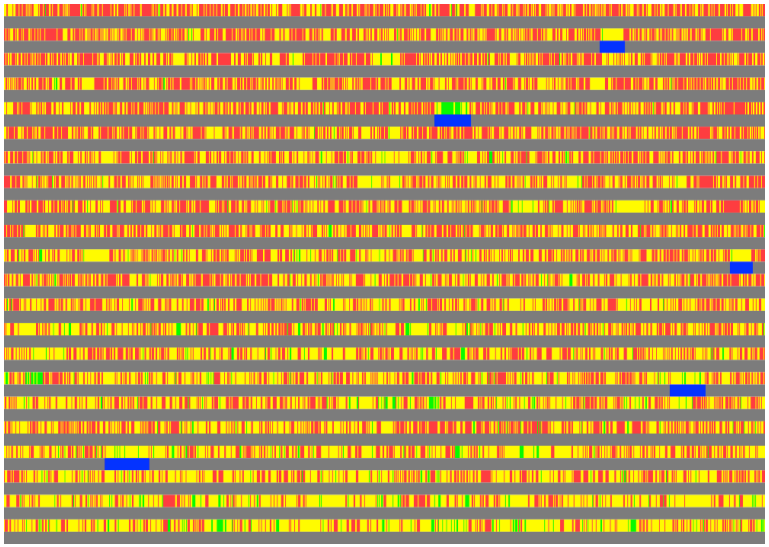
Limits in Resolution

Homozygosity does not identify all areas where parents are related, only where that relationship resulted in two sets of the same segment being passed to the child

ROH on Child

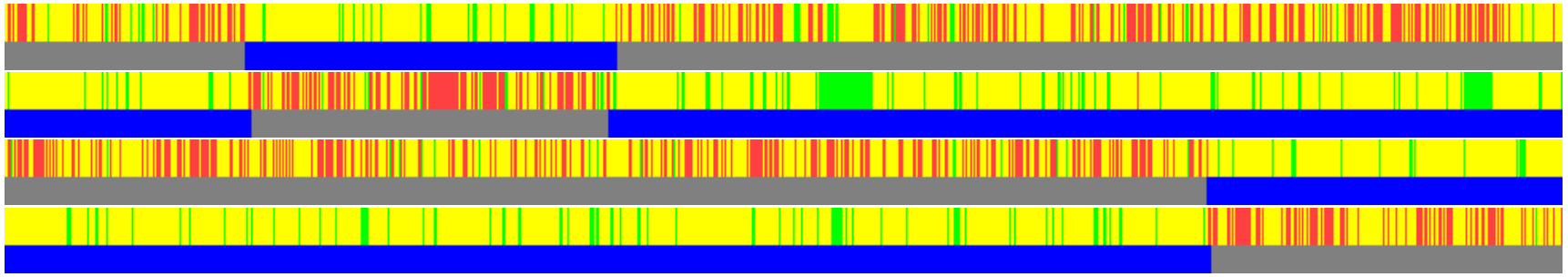


One-to-One on Parents



Recombination

This shows the recombination over 2 generations (4 grandparents/1 grandchild)



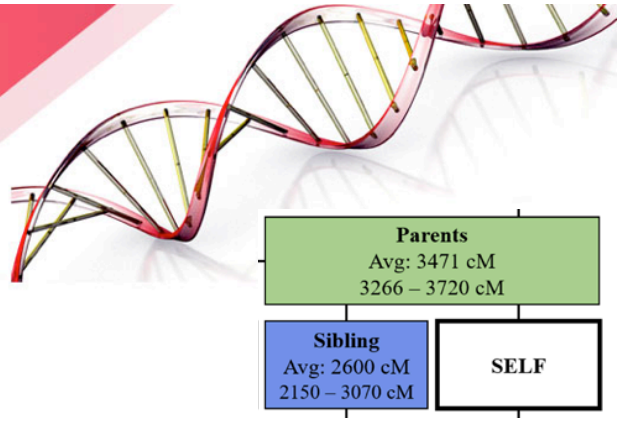
Start Location	End Location	MBP	cM	SNPs
19,285,288	31,497,529	12.2	26.7	2,607
31,411,657	53,380,675	22.0	23.3	3,968
52,958,888	106,353,025	53.4	76.0	10,196
19,285,288	86,587,790	67.3	84.6	12,871
86,570,921	106,353,025	19.8	40.7	3,793

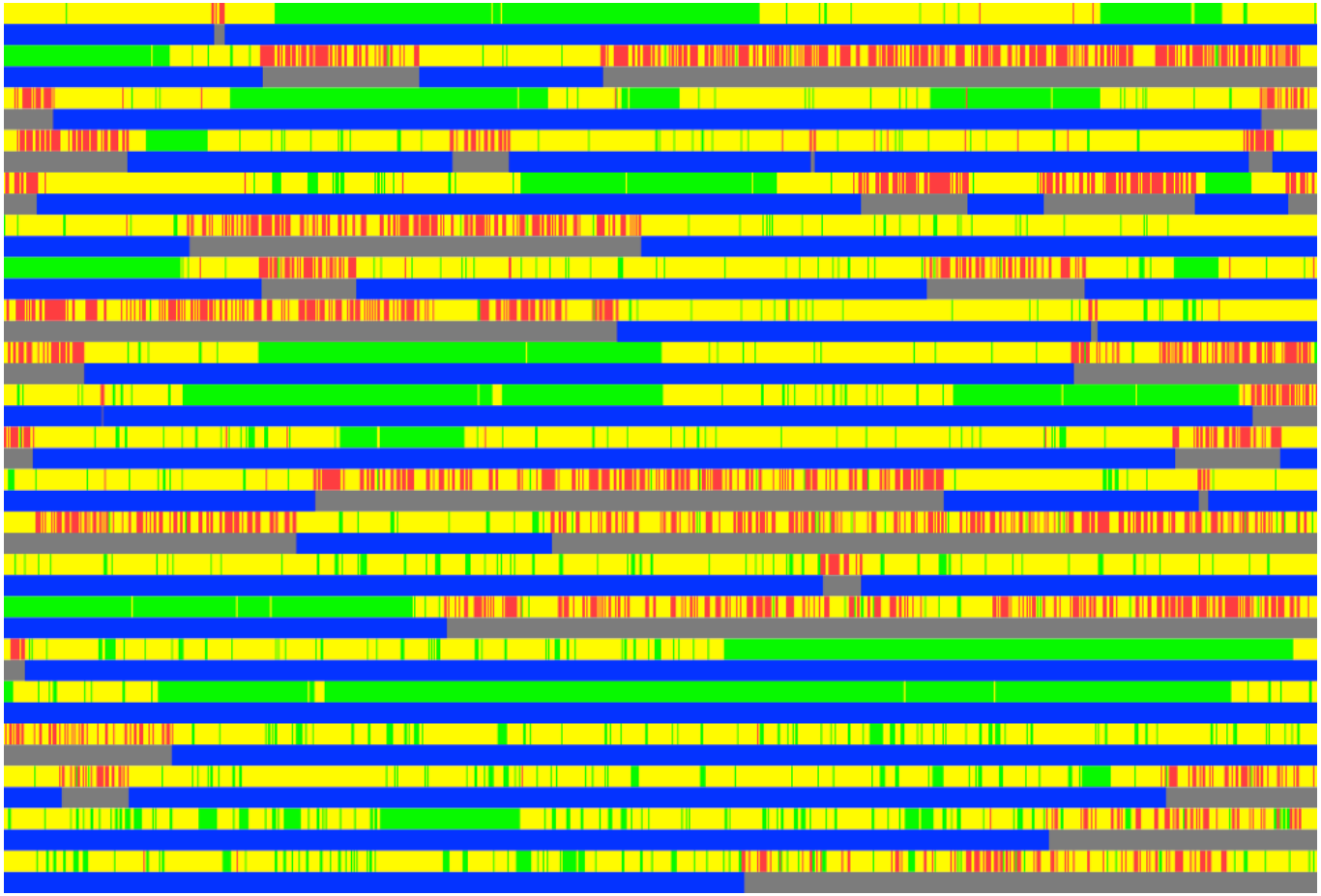
12.2 + 20 + 53.4 = 87.6
67.3 + 19.8 = 87.1

26.7 + 23.3 + 76 = 126.0
84.6 + 40.7 = 125.3

Recombination does not occur evenly across base pairs!
A 100 cM block will likely see a recombination between every generation.

A Closer Look at Siblings

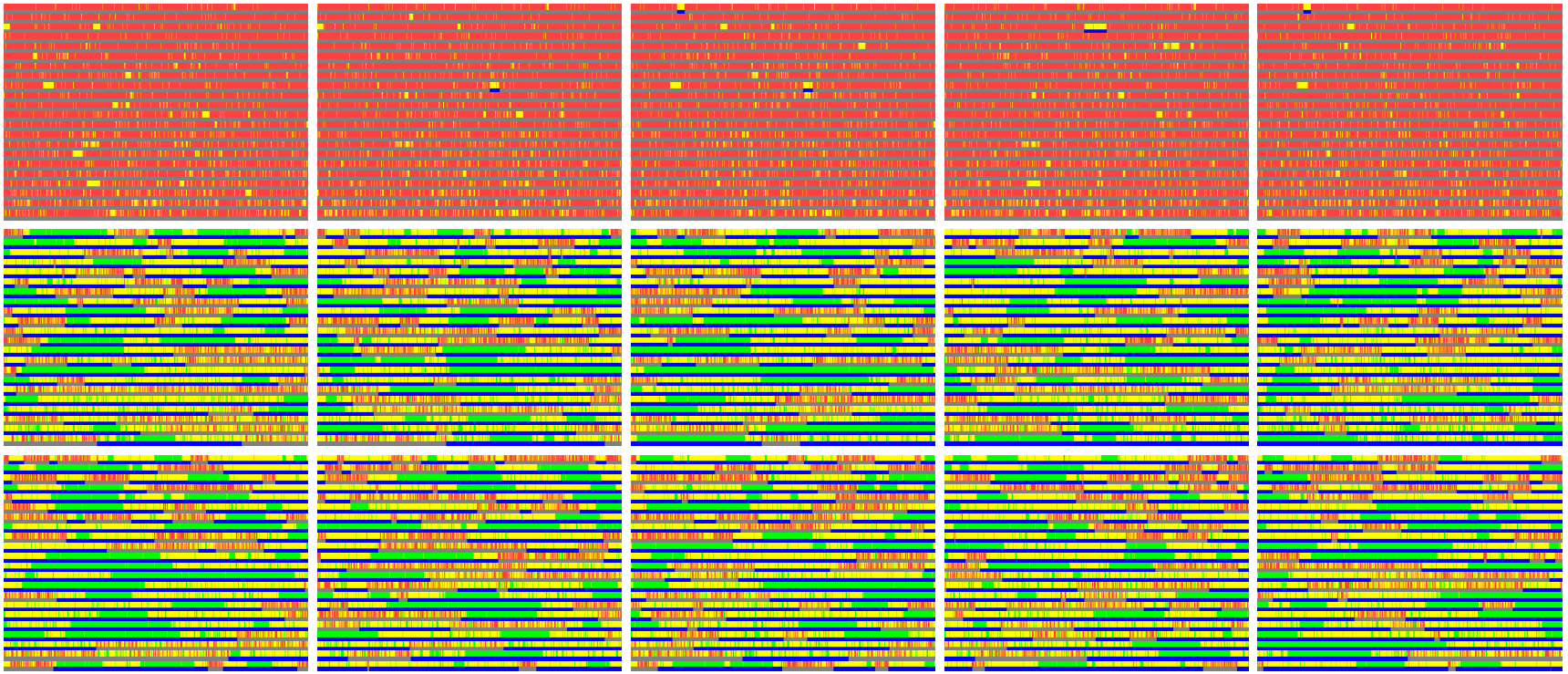




2673.7 cM Shared over 44 Matching Segments

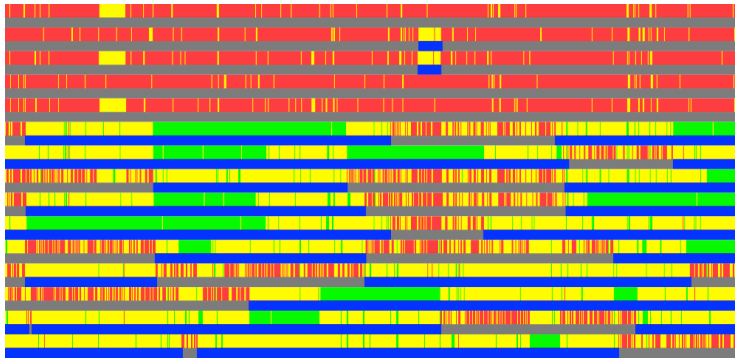
A Study of 5 Siblings:
ROH & Triangulation Sets

Here are the ROH and One-to-One Comparisons for a set of 5 siblings.

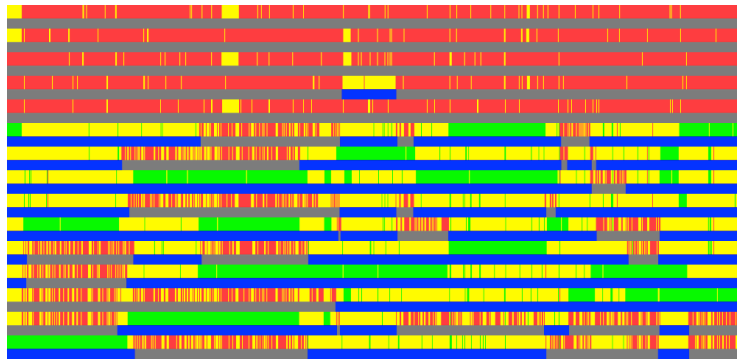


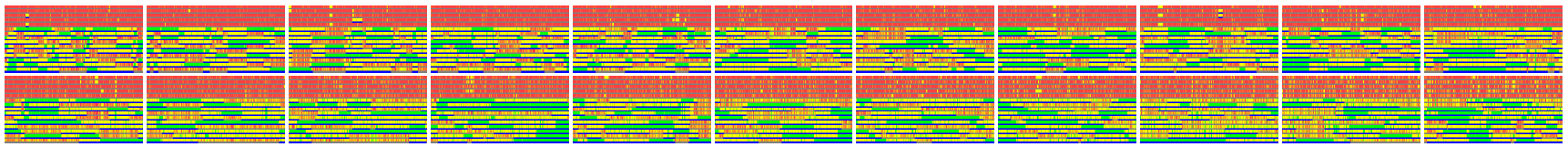
A Study of 5 Siblings:
Ordered By Chromosome

This view has been reorganized to look at a single chromosome at a time.



We see a combination of no-match, half-match, and full matches between the siblings.



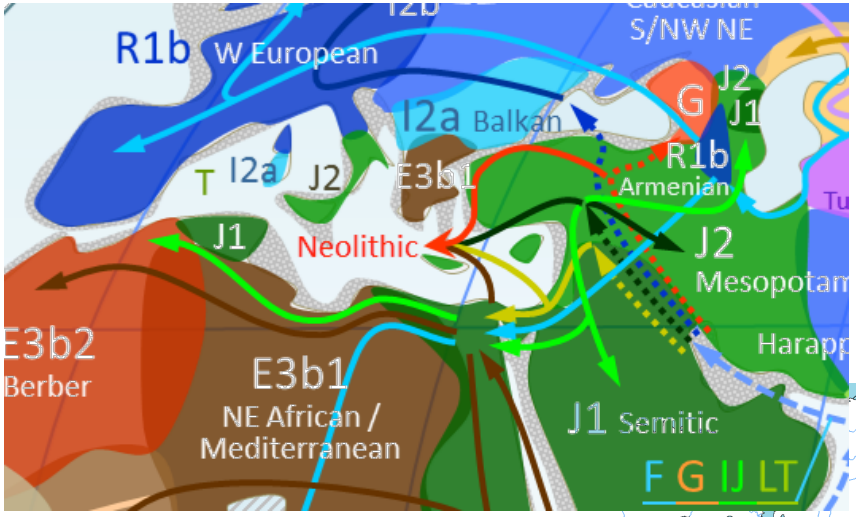


Jewish Genealogy & DNA

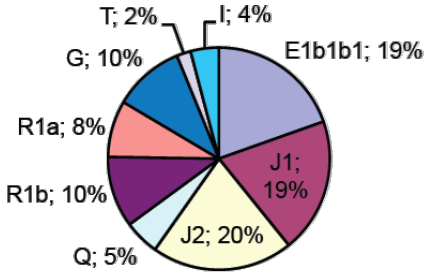
- Historical Context
  - Common Founder Events
- Endogamy
  - Shidduch / Yichus
  - Religious Segregation

Migration Maps

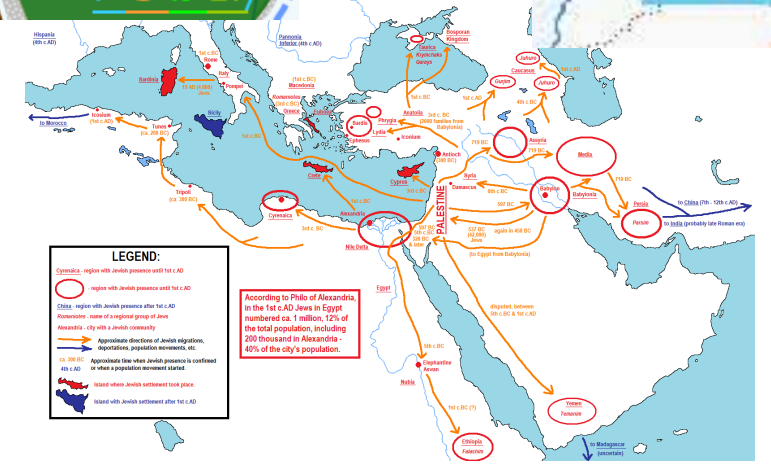
mt- and Y-DNA migration have been used to study the evolution of languages and myths!

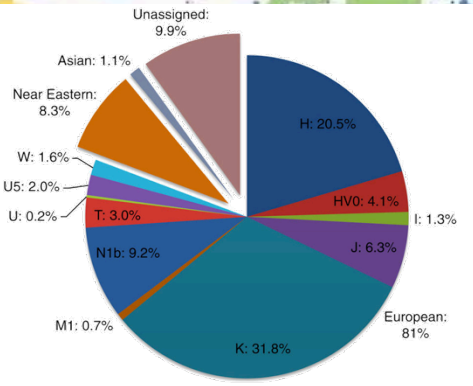


Ashkenazim by Haplogroup



Early Jewish Diaspora
(until the destruction of Jerusalem in 70 AD)





It also has been used to support the accounts of the Jewish Diaspora!

Y-DNA & Cohen/Levite

... for when Rabbi Kalonymus died, his son Rabbi Samuel he-Hasid was only a boy, so he gave (transmitted) it to Rabbi Eleazar he-Ḥazzan of Speyer, and when he, Rabbi Samuel he-Ḥasid, grew up, he received [the secrets] from him, as was ordered by Rabbi Kalonymus the Elder ...

- Judaism is conferred based on matrilineal descent.
- Tribal affiliation comes from the "father", but what makes someone a father?
  - We know that adoption of an unrelated individual confers neither religion nor tribal affiliation
  - We know that someone can lose their tribal affiliation, for example by marrying outside the religion
- We see evidence of tribal affiliation "appearing" and disappearing in "well-documented" rabbical lines, such as the Kalonymos family.

Guetlin's Lineage:

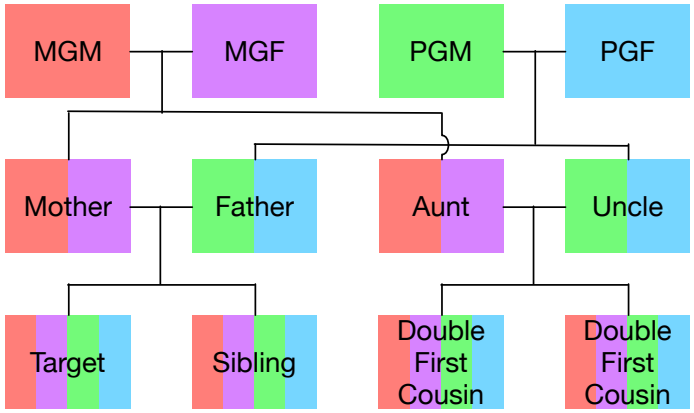
- Guetlin (1328–1417) and Baruch ben Meir Zurich (1319–1382)
- Smoe (Samuel) ben Baruch (1295–1385)
- Bendit Baruch ben Juda (1269–1335)
- Jehuda ben Jitzchak Kalman "Juedlin" Kalonymos Kohen (1248–1328)
- Jitzchak Jerachmiel Kalman "Benditte" Kalonymos Kohen (1225–1309)
- Eleasar Kalonymos (1190–1266)

https://en.wikipedia.org/wiki/Kalonymos_family

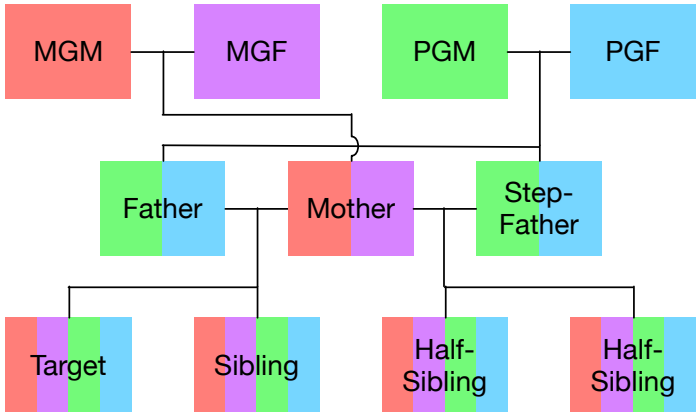
... And Rabbi Eleazar the Great was a student of Rabbi Simeon the Great. For Rabbi Isaac, the father of Rabbi Simeon the Great, and Rabbi Joshua, the grandfather of Rabbi Eleazar the Great, were brothers. This is why Rabbi Simeon was like a father to him, for when Rabbi Isaac died his son Rabbi Eleazar the Great was just a small boy, and he grew up in his house and he taught him the Torah, And he was [with] Rabbi Gershom, Me'or ha-Golah....

https://www.jewishvirtuallibrary.org/jsource/judaica/ejud_0002_0011_0_10655.html

Endogamy

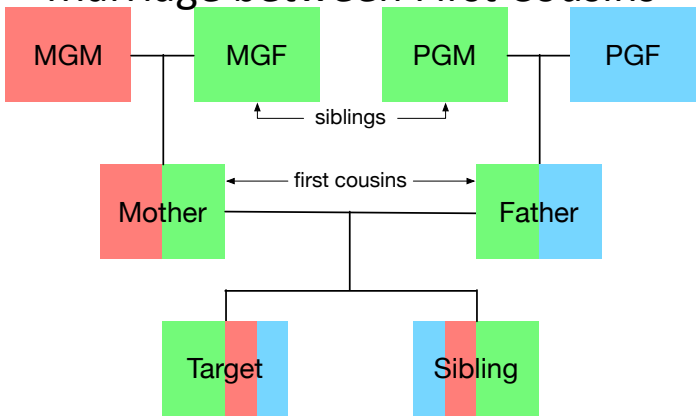


Two Brothers Marry Two Sisters



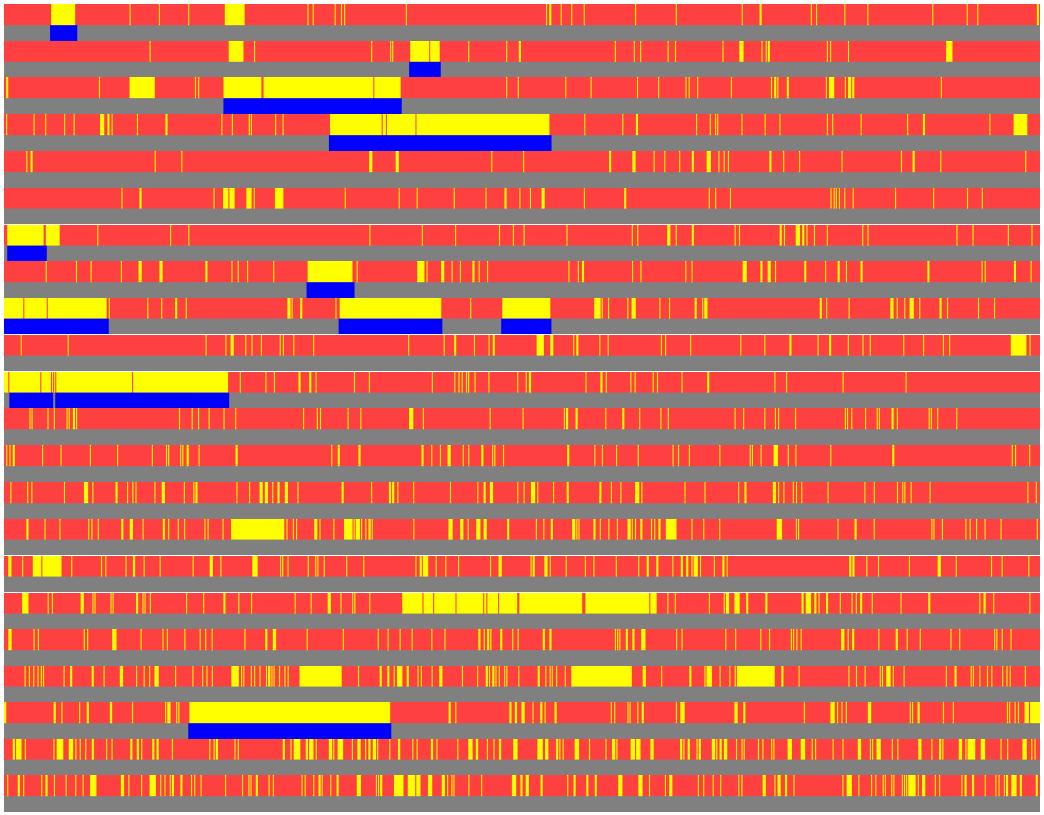
Brother Marries Widow

Marriage between First Cousins



Runs of Homozygosity

Child of First Cousins



Chr	Start Location	End Location	cM	SNPs
1	9399368	14998286	12.0	1023
2	79485855	88445107	7.6	1213
3	30157379	37042420	7.5	1312
3	37065278	63518385	24.3	4563
4	56703884	69104740	9.0	1675
4	69117497	100695083	28.2	4834
7	671099	5993514	9.0	1047
8	24733022	29970271	8.4	1246
9	36587	7371520	17.5	2397
9	27736785	71852509	14.1	2397
9	78744333	84626318	7.9	1143
11	646845	5156251	11.5	1040
11	5204607	21969179	28.7	4211
20	8446519	18241874	19.2	2559

Ashkenazi Endogamy

Occasionally I will get an e-mail from someone claiming to have a "strong" relationship with my daughter.

Kit	Target	Target PGM	Target PGF	Target PGF	Target MGM	Match
Target		2105.5	1517.4	1638.9	1957.5	101.5
Target PGM	2105.5		60.7	53.2	20.8	59.9
Target PGF	1517.4	60.7		63.5	47.4	73.9
Target MGM	1638.9	53.2	63.5		40.9	24.4
Target MGF	1957.5	20.8	47.4	40.9		46.8
Match	101.5	59.9	73.9	24.4	46.8	

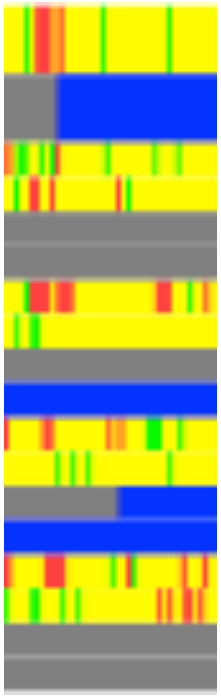
A common problem is that the connection with her is stronger than the link through any *one* of her grandparents!

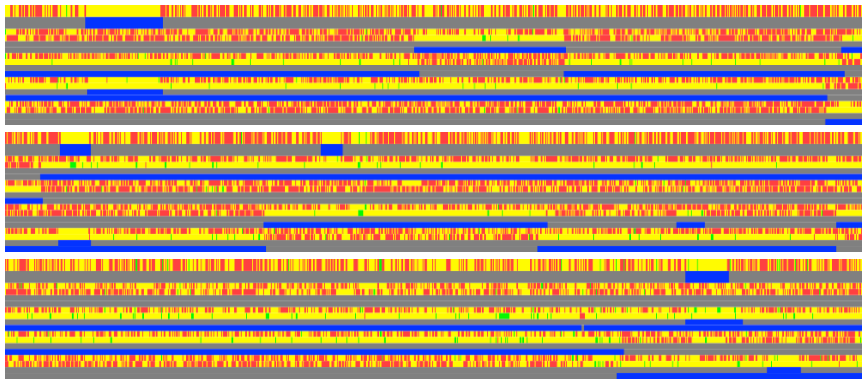
Visual of IBC+IBD

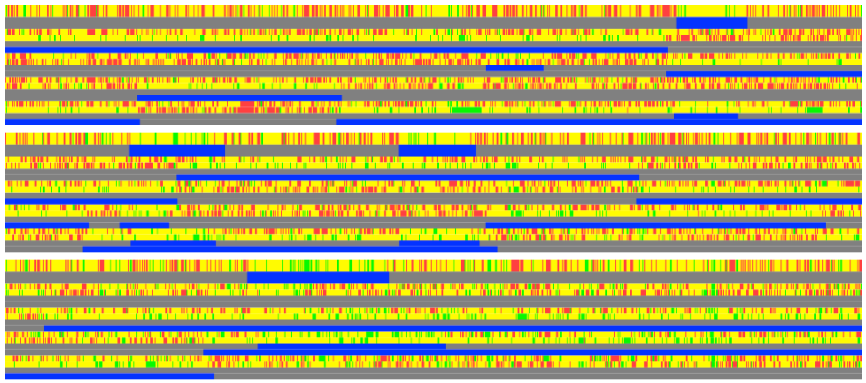
Chr	Start Location	End Location	Centimorgans (cM)	SNPs
1	18,056,011	37,475,919	26.4	2,133
2	10,385,274	16,660,695	12.6	816
2	72,209,703	78,183,536	7.7	571
9	116,323,053	121,671,236	7.4	721
14	89,698,387	94,837,133	10.3	805
19	6,688,063	12,824,143	12.9	679
19	35,498,005	40,521,353	9.8	549
22	25,741,710	31,621,742	8.8	743

Note this only adds up to 96.0 cM, not 101.5 cM, this is why it is important to do 1-on-1 matches!

Notice the match on chromosome 22 is artificially increased based on partial match, so it is partially IBC and partially IBD!







Testing Companies

- J-Screen (not genealogy, but important)
- 23-and-Me
- Ancestry
- Family-Tree DNA
- Other Testing Options

J-Screen

- Although not genealogy in the traditional sense, the Ashkenazi Jewish Population is hit hard by a large number of genetic diseases

- This is the one of the most comprehensive test of genetic diseases relevant to the Ashkenazi Jewish Population

- If you, or someone in your family, is considering having children, it would be a good idea to look into this test!

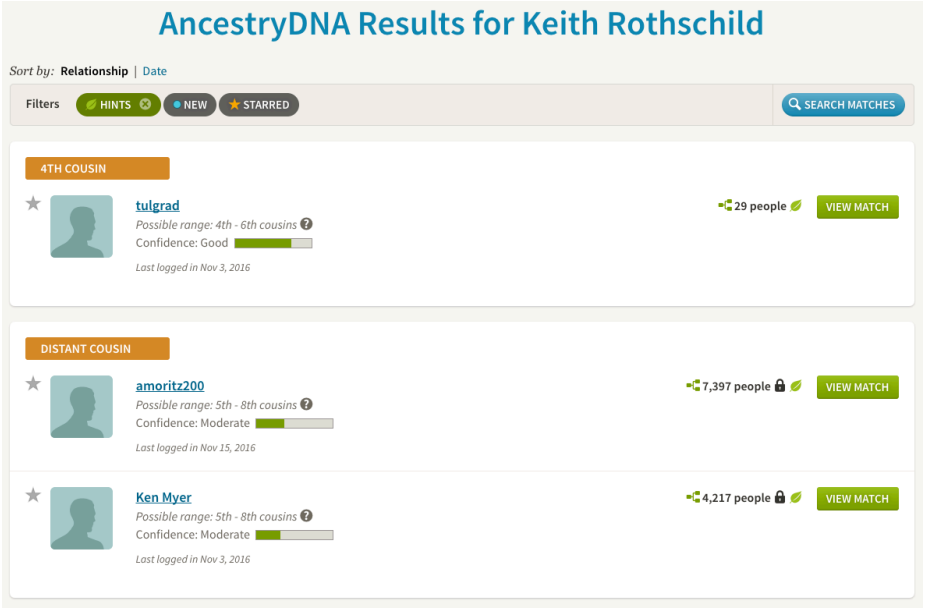
23andMe

- Can test for both Health Reports and Genealogy Only (at a reduced cost).
- Test covers different SNPs than Ancestry/ftDNA – they are tailored more around Health Reports
- Gives you haplotypes estimates for Y- and mt-DNA (rough, not fine-detail)

- This is the company I started with.

Ancestry DNA

- Overall weakest utilities for working with DNA.
- Detects if direct ancestors are common with DNA matches (DNA tree-hints)
- Test covers the roughly same as ftDNA.*
- Does not give you haplotypes estimates for Y- or mt-DNA.



*This may have changed with the most recent tests.

Family-Tree DNA (ftDNA)

- Should note – this is also the testing company for National Genographic and Geni/My Heritage.
- Extensive Y-DNA and mtDNA testing options in addition to autosomal testing.
- Autosomal test does not provide information on Y- or mt-DNA haplogroup!

Y-DNA - Standard Y-STR Values

PANEL 1 (1-12)											
Marker	DYS393	DYS390	DYS19**	DYS391	DYS385	DYS426	DYS388	DYS439	DYS389I	DYS392	DYS389II***
Value	12	23	14	10	14-15	11	16	11	13	11	30

PANEL 2 (13-25)									
Marker	DYS458	DYS459	DYS455	DYS454	DYS447	DYS437	DYS448	DYS449	DYS464
Value	18	9-9	11	11	26	15	20	29	12-14-14-16

PANEL 3 (26-37)										
Marker	DYS460	Y-GATA-H4	YCAII	DYS456	DYS607	DYS576	DYS570	CDY	DYS442	DYS438
Value	10	11	19-22	16	13	17	17	35-39	12	9

PANEL 4 (38-47)									
Marker	DYS531	DYS578	DYF395S1	DYS590	DYS537	DYS641	DYS472	DYF406S1	DYS511
Value	10	7	15-15	8	11	10	8	11	9

PANEL 4 (48-60)												
Marker	DYS425	DYS413	DYS557	DYS594	DYS436	DYS490	DYS534	DYS450	DYS444	DYS481	DYS520	DYS446
Value	12	17-17	14	11	12	12	15	8	11	21	21	13

PANEL 4 (61-67)							
Marker	DYS617	DYS568	DYS487	DYS572	DYS640	DYS492	DYS565
Value	12	11	13	10	12	12	11

PANEL 5 (68-75)								
Marker	DYS710	DYS485	DYS632	DYS495	DYS540	DYS714	DYS716	DYS717
Value	29	16	8	14	11	25	27	19

PANEL 5 (76-85)										
Marker	DYS505	DYS556	DYS549	DYS589	DYS522	DYS494	DYS533	DYS636	DYS575	DYS638
Value	11	12	13	11	11	10	11	11	10	11

PANEL 5 (86-93)								
Marker	DYS462	DYS452	DYS445	Y-GATA-A10	DYS463	DYS441	Y-GGAAT-1B07	DYS525
Value	11	31	12	12	22	14	10	10

PANEL 5 (94-102)									
Marker	DYS712	DYS593	DYS650	DYS532	DYS715	DYS504	DYS513	DYS561	DYS552
Value	26	15	19	10	23	15	12	16	25

PANEL 5 (103-111)									
Marker	DYS726	DYS635	DYS587	DYS643	DYS497	DYS510	DYS434	DYS461	DYS435
Value	12	23	19	10	15	19	9	12	11

I would strongly recommend joining a group to better understand yDNA results!

ftDNA (continued)

Your Results

RSRS Values | rCRS Values

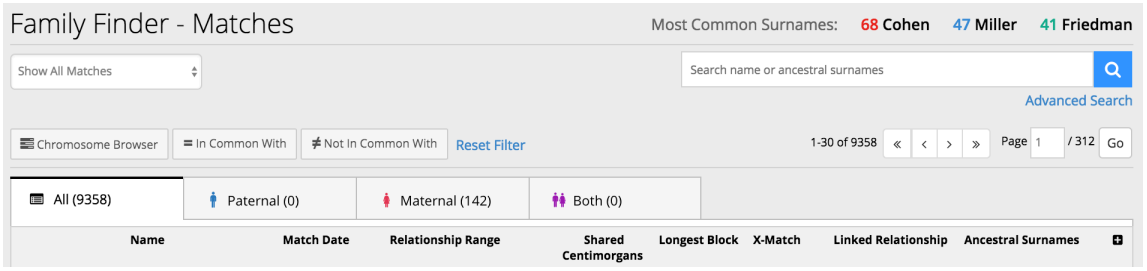
Extra Mutations	315.1C 522.1A 522.2C
Missing Mutations	

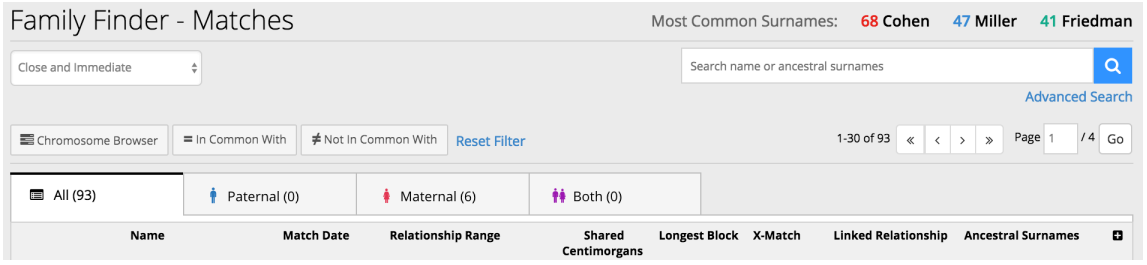
HVR1 DIFFERENCES FROM RSRS						
A16129G	T16187C	C16189T	T16223C	T16224C	G16230A	T16278C

HVR2 DIFFERENCES FROM RSRS					
C195T	A247G	315.1C	A512c	522.1A	522.2C

CODING REGION DIFFERENCES FROM RSRS						
G709A	A769G	A825t	A1018G	A1811G	A2758G	C2885T
A3480G	T3594C	G4104A	T4312C	T4561C	G7146A	T7256C
A7521G	T8468C	T8655C	G8697A	G8701A	G9055A	A9254G
C9540T	T9698C	T9716C	G10398A	A10550G	T10664C	A10688G
C10810T	C10873T	C10915T	T11299C	C11348T	A11467G	A12308G
G12372A	T12705C	G13105A	G13276A	T13506C	T13650C	C14167T
T14798C						

Depending on how unique your mtDNA results are, using the Haplotype may be more useful that looking at the results!





Family Finder – filter down to Close and Immediate when looking at the list!

Other Testing Options

- WeGene – relatively new, heavier focus on the Chinese market, claims to import 23&me & Ancestry
- GenetiConcept & Genos – mostly health focused
- Many "small" options that don't have large databases for comparison/utility support
- Full Genomes – offers really high resolution for expert users
- ySeq – ordering single SNPs on the Y-chromosome

FullGenomes™ DNA SEQUENCING

WEGENE

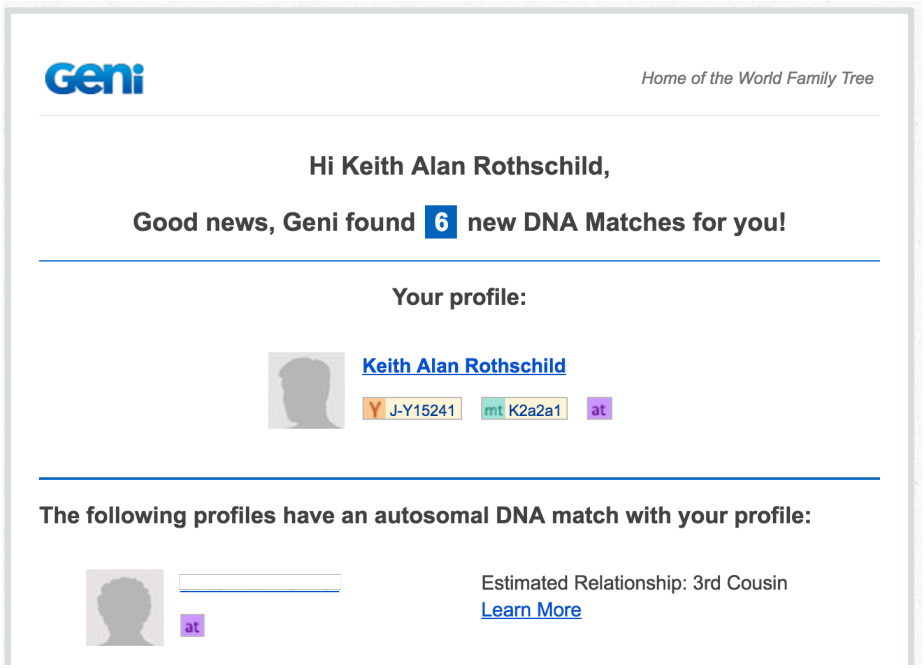
genos beta

GENETICONCEPT™

DNA & "Traditional" Genealogy Sites

- Family Tree Oriented
  - Geni
  - WikiTree
- Tree plus Historical Records Oriented
  - Ancestry
  - My Heritage

geni.com (World Tree)



- Partner of ftDNA.
- "Propogates" Y- and mt-DNA results
- Still new to DNA – right now most "match emails" haven't been useful.
- Best support of multiple language/name variants.

WikiTree

- Not affiliated with any DNA testing companies, lists multiple options.
- Supports showing who else in the tree might share different types of DNA.

DNA Tested

's DNA has been tested for genealogical purposes. It may be possible to confirm family relationships by comparing test results with or other carriers of his ancestors' Y-chromosome or mitochondrial DNA. Y-chromosome DNA test-takers in his direct paternal line on WikiTree:

- Y : Family Tree DNA Y-DNA Test 67 markers, haplogroup , Ysearch , FTDNA kit # [test details]
- Y : Family Tree DNA Y-DNA Test 37 markers, haplogroup , Ysearch , FTDNA kit # [test details]

Mitochondrial DNA test-takers in the direct maternal line:

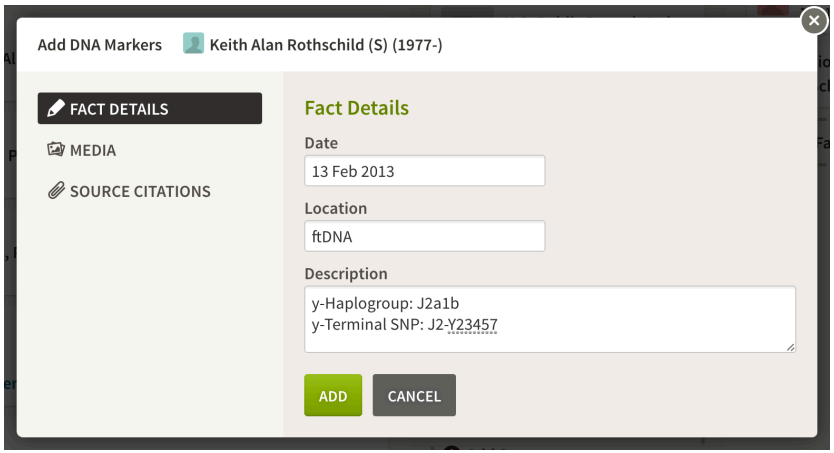
- mt : Family Tree DNA mtDNA Test Full Sequence, haplogroup , Mitosearch , FTDNA kit # [test details]

It is likely that these autosomal DNA test-takers will share DNA with :

- au : 23andMe [test details] + Family Tree DNA Family Finder, GEDMatch T , FTDNA kit # [test details]
- au : 23andMe, GEDMatch M [test details]
- au : Family Tree DNA Family Finder, GEDMatch T , FTDNA kit # [test details]
- au Anonymous : Family Tree DNA Family Finder, GEDMatch T , FTDNA kit # [test details]

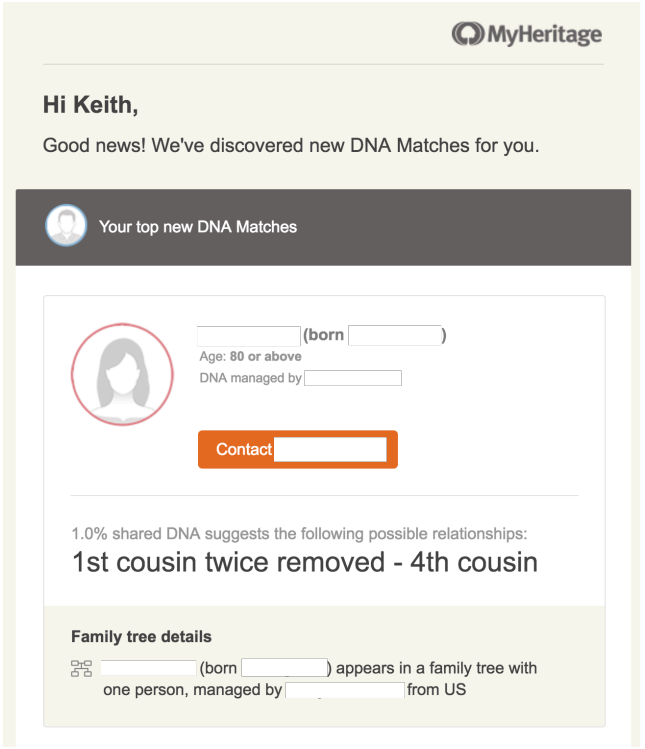
Ancestry

- Low degree of integration
- DNA Markers
  - Manual
  - Date (*tested*)
  - Location (*company that did the testing*)
- No concept of haplotype or propagation of results
- Shows up as “event” on the individual’s timeline



MyHeritage

- Parent company for geni.com
- “Personal” family tree sites (as opposed to the World Tree @ geni.com)
- Partner with 23andMe (family tree provider)
- Partner with ftDNA (DNA test reseller/whitelabel)



MyHeritage

Other Online Utilities

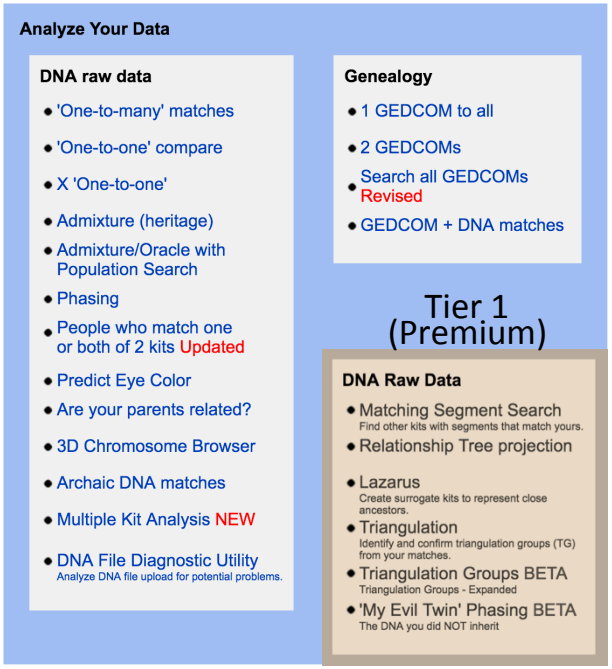
- GEDmatch
- Dna.land
- Advanded Utilities*
  - yFull (post-process BigY)

[GED match]

DNALAND

GED Match

- ROH = Are your parents related?
- One-to-One vs. One-to-Many
  - One-to-One is more accurate so if you find a match on One-to-Many, be sure to do a One-to-One to verify!



					Haplogroup		Autosomal				X-DNA				
Kit Nbr	Type	List	Select	Sex	Mt	Y	Details	Total cM	largest cM	Gen	Details	Total cM	largest cM	Name	Email
T704359	F2	L		M			A	3583.4	281.5	1.0	X	0	0	Keith Alan Rothschild	krothschild@gmail.com
A873380	F2	L		U			A	3583.4	281.5	1.0	X	0	0	Keith Alan Rothschild	krothschild@gmail.com
M107304	V4	L		M	K2a2a1	J2a1b*	A	3550.7	214.5	1.0	X	0	0	*KAR	krothschild@gmail.com

Experience / Pitfalls

- Ashkenazi Endogamy
- STR Mutations
- Alignment Errors
- What to do as a beginner...

Searching for Answers

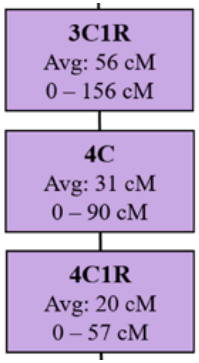
- Keith and Randy are known 4th cousins with a GD=1 on yDNA test with Randy being closer to base group
- Cole doesn't know who his biological father is, *mother is known and not Jewish*
- Theory: Cole's father is a direct male descendent of Keith and Randy's common male ancestor, on the same "branch" as Keith

Genetic Distance (Y-DNA)

STRs	Keith	Cole	Randy
Keith		1	1
Cole	1		2
Randy	1	2	

Shared Autosomal DNA

cM	Keith	Cole	Randy
Keith		66.3	66.3
Cole	66.3		50.3
Randy	66.3	50.3	



STR Mutations

Sometimes STR mutations can be misleading, while they are good at broad-strokes, creating a phylogeny from SNPs is more accurate!

	J-M172	12	23	14	10	14-15	11	16	11	13	11	30	18	9-9	11	11	26	15	20	29	12-14-14-16	10	11	19-22	16	13	18	17	35-39	12	9
Paul	J-Y23456	12	23	14	10	14-15	11	16	11	13	11	30	18	9-9	11	11	26	15	20	29	12-14-14-16	10	11	19-22	16	13	18	17	35-39	12	9
Randy	J-Y23457	12	23	14	10	14-15	11	16	11	13	11	30	18	9-9	11	11	26	15	20	29	12-14-14-16	10	11	19-22	16	13	18	17	35-39	12	9
Keith	J-Y23457	12	23	14	10	14-15	11	16	11	13	11	30	18	9-9	11	11	26	15	20	29	12-14-14-16	10	11	19-22	16	13	17	17	35-39	12	9
Cole	J-Y23456	12	23	14	10	14-16	11	16	11	13	11	30	18	9-9	11	11	26	15	20	29	12-14-14-16	10	11	19-22	16	13	17	17	35-39	12	9
	J-M172	12	23	14	10	14-16	11	16	11	13	11	30	18	9-9	11	11	26	15	20	29	12-14-14-16	10	11	19-22	16	13	17	17	35-39	12	9

Originally we thought the DYS385b mutation (15->16) might have occurred after the DYS576 mutation (18->17), but by doing the BigY we were able to build a more accurate tree based on SNPS!

The theory from the previous slide was proven FALSE.

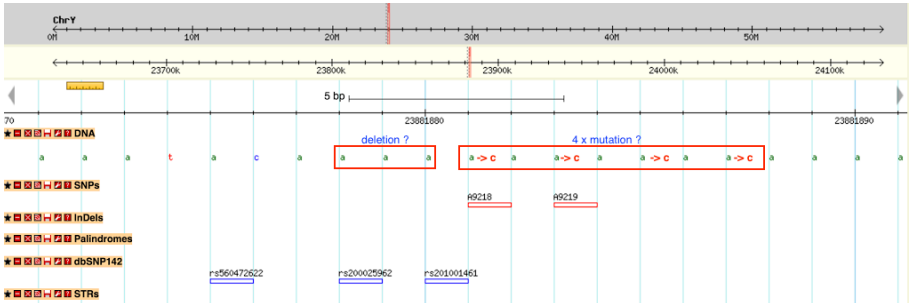
Alignment Errors

Select type: RAW position | 23881880 | Search

Home | J-M410 | J-PF4610 | J-L26 | J-PF5087 | J-PF5116 | J-PF5119 | J-L558 | J-M67 | J-Y4036 | J-Z467

- J-L210
  - J-L210*
    - id:NA20521 - A TSI
  - J-Z489 FGC3361/Z489 formed 4900 ybp, TMRCA 4800 ybp info
    - J-Z489*
      - id:YF01661 - A UNK
    - J-Z482 Z482 * Z27996/Y9001 * Z7628 +9 SNPs formed 4800 ybp, TMRCA 4600 ybp info
      - J-Z482*
      - J-Z478 CTS11011 * Z478 * Z487 +23 SNPs
        - id:NA20801 - A TSI
        - id:NA20787 - A TSI
      - J-Y15222 Y15245 * Y15222 * Y15224 +12 SNPs formed 4600 ybp, TMRCA 2500 ybp info
        - J-Y15222*
          - id:YF06753 - A ITA [IT-PZ]
        - J-Y15223 Y15230 * Y15246 * Y15235 +11 SNPs formed 2500 ybp, TMRCA 1150 ybp info
          - J-Y15223*
            - id:YF04730 - INDEL ENG
            - id:YF03667 - N
          - J-Y24492 Y24492 formed 1150 ybp, TMRCA 1150 ybp info
            - id:YF07138 - INDEL
            - id:YF03901 - INDEL POL [PL-LD]
          - J-Y15238 Y15238 * Y15241 * Y16261 formed 1150 ybp, TMRCA 950 ybp info
            - J-Y15238*
            - J-Y16180 Y16180 formed 950 ybp, TMRCA 600 ybp info
              - id:YF03771 - INDEL
              - id:YF03731 - INDEL BLR [BY-MI]
              - id:YF02520 - INDEL POL [PL-LD]
            - J-Y23161 Y23161 * Y23515 * Y23456 +3 SNPs formed 950 ybp, TMRCA 550 ybp info
              - J-Y23161*
                - id:YF07020 - INDEL
                - id:YF06454 - INDEL
              - J-Y23457 Y23457 formed 550 ybp, TMRCA 450 ybp info
                - id:YF06414 - INDEL DEU [DE-BY]
                - id:YF03372 - INDEL DEU [DE-BY]

Sometimes that great discovery isn't what you think – this is why it is important to collaborate!



"With regards to the mutation(s) you brought forth, Its hard to say. Results in your group seem monophyletic and informative. This would seem like at least something is real, be it the mutation shown or another mutation elsewhere that is causing a misalignment.

However, I was able to find several other kits with this same signature. They come from your group, from another J line (M47), E, R, I, N and O."
- Michael Sager (Private e-mail exchange)

Reaching out to Matches

- Make sure to provide MORE information than you are asking your match to provide.
  - It is "OK" to keep the identity of kits somewhat anonymous, but anything you share with someone else may wind up somewhere on the web...
  - Have a threshold, ask others what their thresholds are and respect them!
    - Minimum Single Segment in non-ROH region of 20 cM for me to initiate contact
    - Minimum Single Segment in non-ROH region of 15 cM and decent amount of information shared for me to actively engage with someone who reaches out to me.
- Have a publically available tree for review
  - www.wikitree.com (Free Option)
  - www.geni.com (Most Popular Option)
- Load your data onto match sites
  - www.gedmatch.com (Best Option)
  - www.geni.com and www.myheritage.com
  - DNA.land
- Make sure to link kits to people
- Understand people may reach out to you for different reasons (adoption/NPE is very different than Genealogy).

Good Resources

These sites have good collections of resources:

- International Society of Genetic Genealogists (isogg.org)
  - http://isogg.org/wiki/Beginner%27_guides_to_genetic_genealogy
- DNA Lectures – Who Do You Think You Are? (YouTube Channel)
  - https://www.youtube.com/channel/UC7HQSiSkiy7ujlkgQER1FYw

- E-mail me at krothschild+dna@gmail.com
  - (if that doesn't work, leave off the +dna)