Identify a Perpetrator In a Cold Case Sexual Assault Investigation Using Autosomal DNA

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Autosomal DNA Extracted from a Forensic Sample Such as Blood, Hair, or Semen, using The Methodology, Can Be Used to Identify

- **a Perpetrator**
- **Unknown Remains**

The Methodology uses a technique called DNA segment triangulation. DNA segment triangulation was originally developed by DNAAdoption.com to help adoptees use their autosomal DNA to find their birth relatives.

Through their online autosomal DNA classes, DNAAdoption has taught The Methodology to many hundreds of adoptees who have successfully applied the technique to finding their bio relatives.

The Methodology was first applied in a criminal case in 2015 when it was used, successfully, to identify "Lisa Jensen"; Lisa was abducted as an infant in 1981 and now in her 30's did not know who she is or where she was from.

In 2017, the Methodology was first used, successfully, to identify a perpetrator, Lisa Jensen's abductor/abuser, a man of many aliases, using atDNA extracted from a blood sample.

Using The Methodology does not require any specialized knowledge about atDNA or how it is inherited.

There are three types of DNA tests

1. Y-DNA
2. Mitochondrial DNA
3. Autosomal DNA

Types of DNA Tests

The **Y DNA test** is for men only as only men have a Y chromosome. Y DNA can be used to trace the direct male line, which in our culture also typically coincides with the family surname; it is passed down from father to son to his son to his son virtually unchanged. Forensic Y DNA tests include STR based tests such as Y Filer.

Mitochondrial DNA (mtDNA). Mitochondria are small membrane bound organelles located in the cytoplasm of the cell and are a source of energy for the cell. A woman passes her mtDNA on to all of her children, but only a female passes the mtDNA on to the next generation. In much the same way that Y DNA can be used to trace the patrilineal line, mtDNA can be used to trace the matrilineal line. This test can be used on both men and women.

atDNA is the DNA Used in The Methodology

Autosomal DNA (atDNA). We have 23 pairs of chromosomes in the nuclei of our cells, including one set of sex chromosomes. Of these, 22 pairs of chromosomes are referred to as the autosomes or atDNA.

- One member of each chromosomal pair is inherited from our mother
- One member of each chromosomal pair is inherited from our father

People who have common ancestors share atDNA that they have each inherited from those common ancestors. The amount of DNA inherited from a particular ancestor decreases by 50% with each generation. You share about 50% of your DNA with each parent, 25% with a grandparent or a niece/nephew and 12.5% with a first cousin or a great niece/nephew.

The measurement used for shared atDNA is the centiMorgan (cM). Average amounts in cM by relationship are shown on the next Chart.

The Shared cM Project – Version 3.0
August 2017

Blaine T. Bettinger
www.TheGeneticGenealogist.com
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For MUCH more information (including histograms and company breakdowns) see: goo.gl/Z1EcJQ

How to read this chart:
Aunt/Uncle
1750
1349 - 2175
Relationship
Average
Range (low-high)
(99% Percentile)

									Great-Great-Great-Grandparent	GGGG-Aunt/Uncle	
								Great-Great-Grandparent	GGG-Aunt/Uncle		
Half GG-Aunt/Uncle 187 12 – 383	Great-Grandparent 881 464 – 1486							Great-Great Aunt/Uncle 427 191 – 885			Other Relationships
	Half Great-Aunt/Uncle 432 125 – 765	Grandparent 1766 1156 – 2311					Great Aunt/Uncle 914 251 – 2108				6C 21 0 – 86
		Half Aunt/Uncle 891 500 – 1446	Parent 3487 3330 – 3720			Aunt/Uncle 1750 1349 - 2175					6C1R 16 0 – 72
Half 3c 61 0 – 178	Half 2c 117 9 – 397	Half 1C 457 137 – 856	Half-Sibling 1783 1317 – 2312	Sibling 2629 2209 – 3384	SELF	1C 874 553 – 1225	2c 233 46 – 515	3c 74 0 – 217	4c 35 0 – 127	5c 25 0 – 94	6C2R 17 0 – 75
Half 3c1R 42 0 – 165	Half 2c1R 73 0 – 341	Half 1C1R 226 57 – 530	Half Niece/Nephew 891 500 – 1446	Niece/Nephew 1750 1349 - 2175	Child 3487 3330 – 3720	1C1R 439 141 – 851	2c1R 123 0 – 316	3C1R 48 0 – 173	4C1R 28 0 – 117	5C1R 21 0 – 79	7C 13 0 – 57
Half 3c2R 34 0 – 96	Half 2c2R 61 0 – 353	Half 1C2R 145 37 – 360	Half Great Niece/Nephew 432 125 – 765	Great-Niece/Nephew 910 251 – 2108	Grandchild 1766 1156 – 2311	1C2R 229 43 – 531	2c2R 74 0– 261	3C2R 35 0 – 116	4C2R 22 0 – 109	5C2R 17 0 – 43	7C1R 13 0 – 53
Half 3c3R	Half 2c3R	Half 1C3R 87 0 – 191	Half GG Niece/Nephew 187 12 – 383	Great-Great-Niece/Nephew 427 191 – 885	Great-Grandchild 881 464 – 1486	1C3R 123 0 – 283	2c3R 57 0 – 139	3C3R 22 0 – 69	4C3R 29 0 – 82	5C3R 11 0 – 44	8C 12 0 – 50

Minimum was automatically set to 0 cM for relationships more distant than Half 2C, and averages were determined only for submissions in which DNA was shared

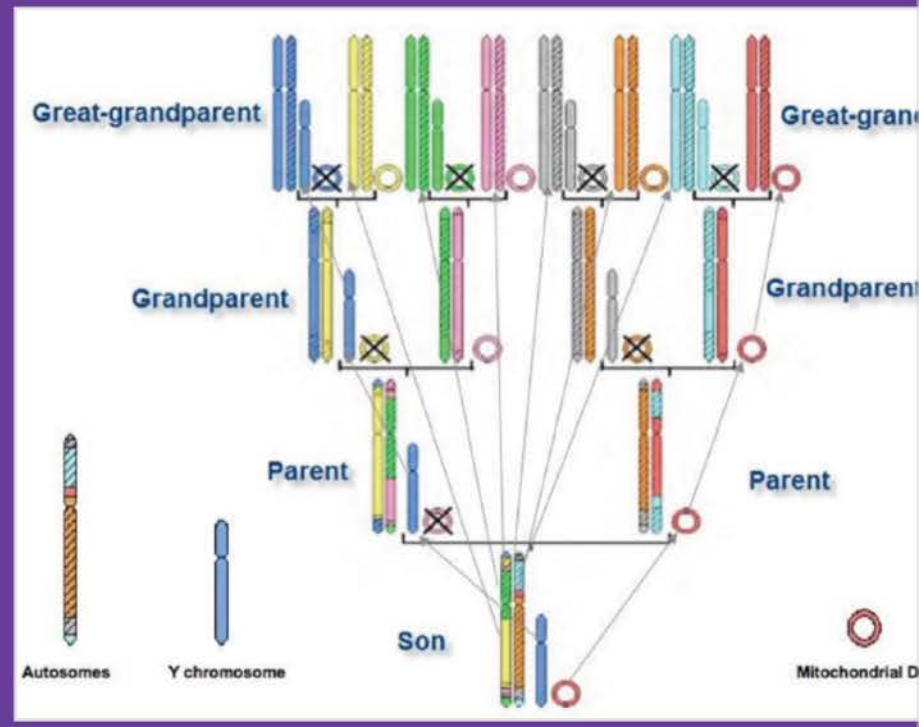
The amount of shared atDNA with an unknown person can be used to calculate the relationship to that person.

In the following two slides, the graphic showing how atDNA is inherited is provided only as a visual explantation for how The Methodology works to identify an unknown individual, whether perpetrator or victim.

It is not necessary for using The Methodology to understand the science that is depicted.

Inheritance of Autosomal DNA

We inherit only 50% of each of our parent's atDNA. And unlike Y DNA and atDNA, at each generation, atDNA is rearranged in a step called recombination. In the graphic, each tall pair of chromosomes represents a single chromosome pair. As shown in the graphic, the blue/yellow paternal grandparent has inherited a mixture of DNA from each of his (blue and yellow) parents, and his wife has inherited a mixture of DNA from each of her (green and pink) parents. The same thing happens with each of the other 21 chromosome pairs.

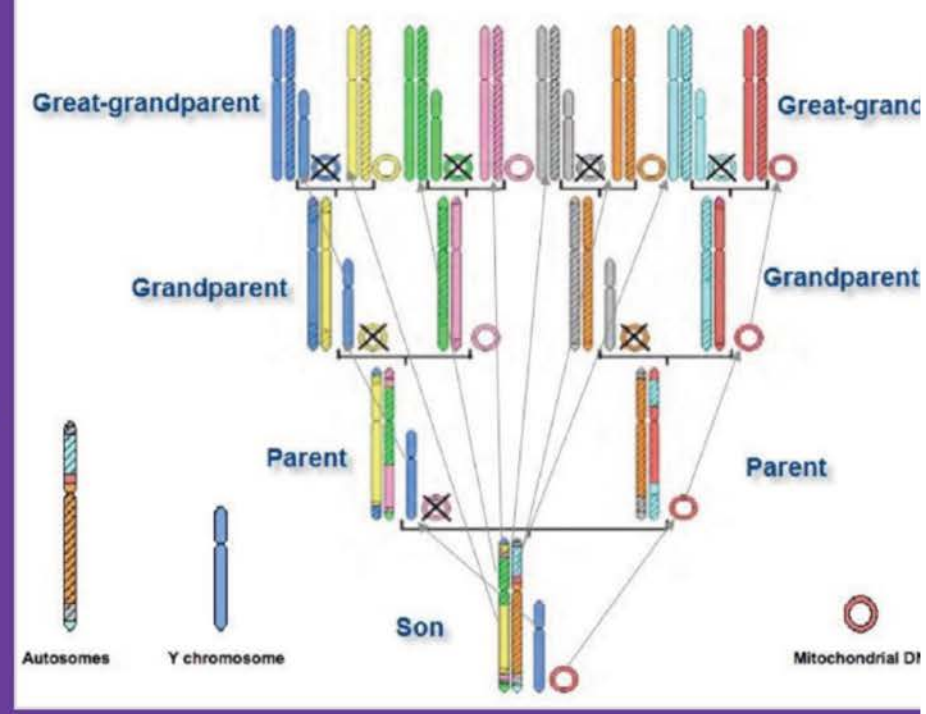


By following the colored plain and hashed segments , you can see from which of his eight great grandparents the son inherited the segments of DNA that make up his shown chromosome pair.

Inheritance of AtDNA

Theory Behind Triangulation

Identifying the ancestral source of matching atDNA can be used to identify a perpetrator. As an example, second cousins share great grandparents. The perpetrator is identified as a second cousin of the son in the graphic, based on the amount of atDNA that they share.



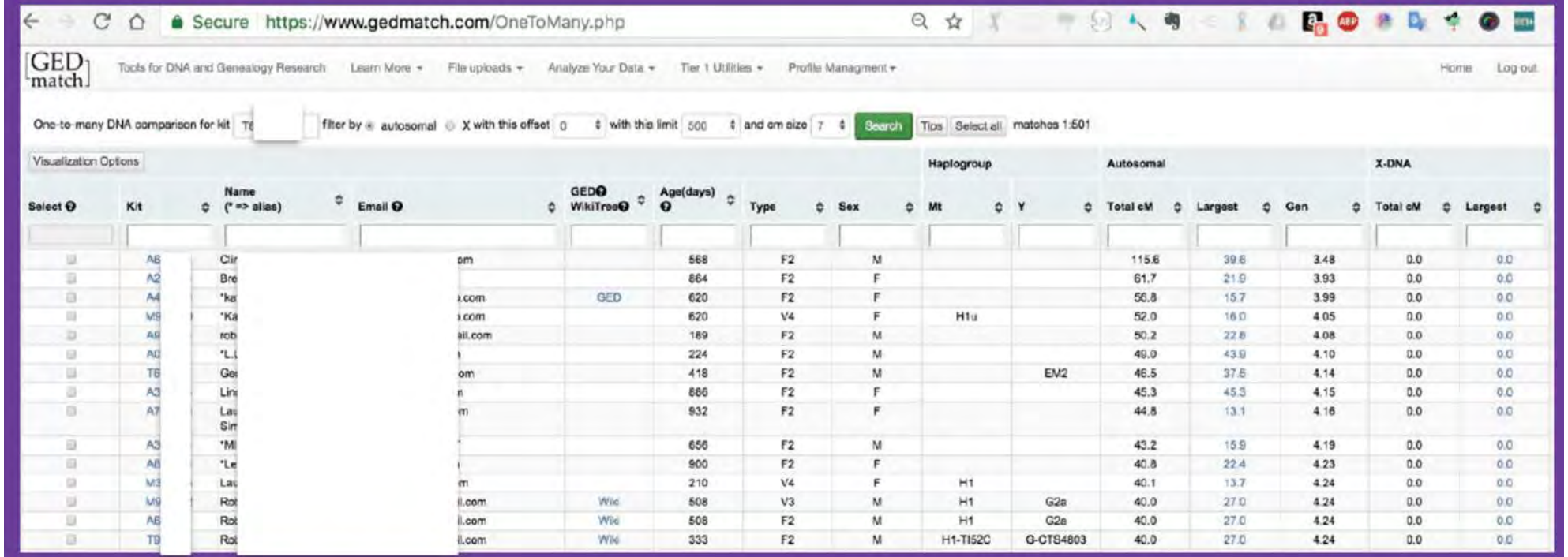
The segment of DNA that they share is the plain yellow segment of DNA. The source of that plain yellow segment of DNA is one of the son's great grandmothers shown in the top row.

By consulting the son's family tree, the shared great grandmother is identified. The perpetrator is amongst the descendants of the great grandmother.

Identifying a Perpetrator Using Autosomal DNA

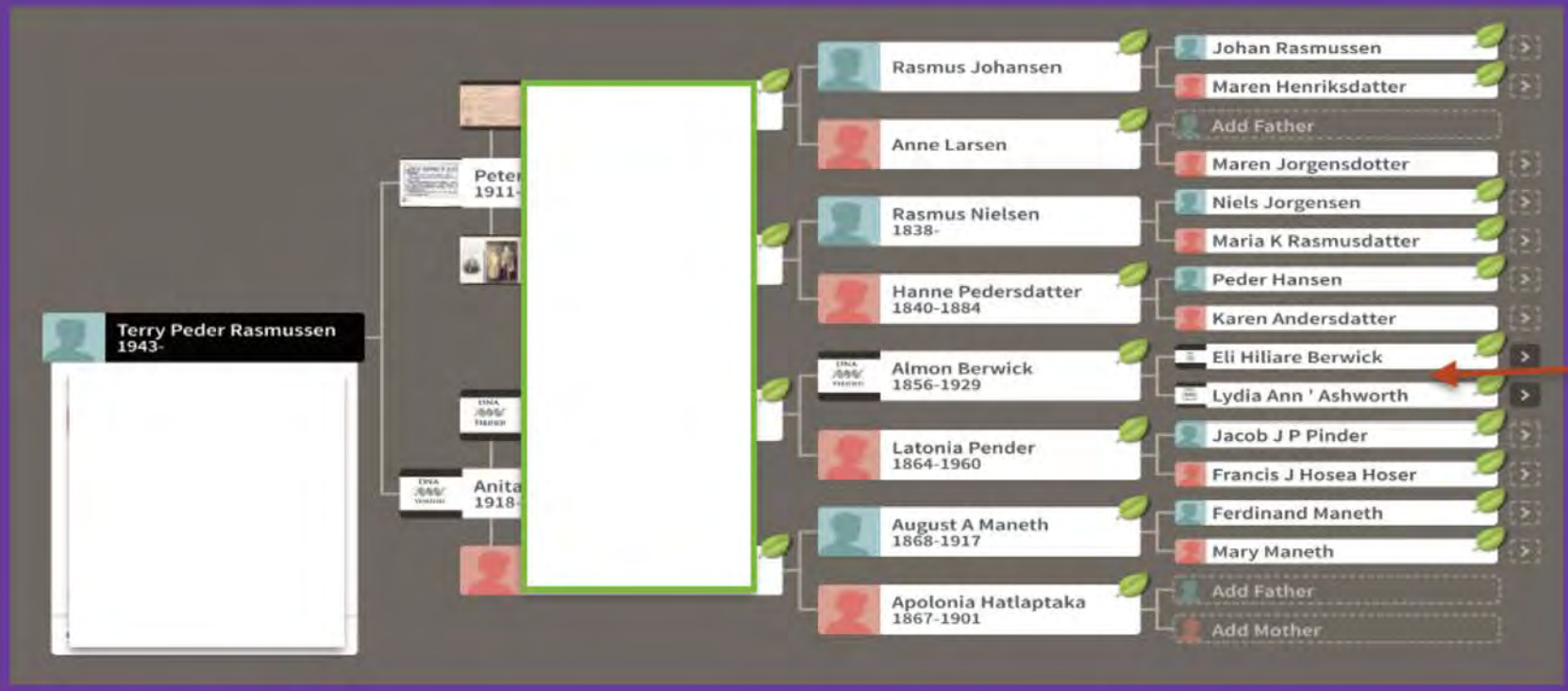
•atDNA is extracted from a forensic sample containing the perpetrator's atDNA using standard lab techniques.

•The extracted atDNA is sequenced and a raw DNA data file obtained is compared in an online database such as gedmatch.com against the atDNA raw data files of other people in the database .



Actual match data from www.Gedmatch.com

A Speculative family tree for the Perpetrator is built based on the family tree for the largest match identified on Gedmatch. To this tree are added matches who share the same ancestry. A Most Recent Common Ancestor (MRCA) is identified for these matches: Eli Hilaire Berwick and his wife Lydia Ann Ashworth.



Build down from the MRCA to identify the Perpetrator

Summary of Steps

- Build trees for matches; combine to form speculative tree
  Combine trees for three matches with shared ancestry to identify MRCA. The Perpetrator is amongst the descendants of the MRCA.

- Apply profile information to candidates to identify Perpetrator
  Profile for Rasmussen included:
  - likely not in contemporary databases (used aliases starting in about 1981)
  - lived in Texas, California, Hawaii
  - electrician

No candidate other than Rasmussen was both a descendant of the MRCA and fit the profile information

Summary of Steps in Rasmussen Cold Case

Identification of Lisa Jensen allowed Law Enforcement to solve the Allenstown, NH 30+ years cold case.

http://www.bostonglobe.com/metro/2017/05/13/finding-lisa-story-murders-mysteries-loss-and-incredibly-new-life/vCCxbYYUD63kjIoIMJQiWM/story.html

Identification of Terry Rasmussen has provided Law Enforcement with information about this serial killer that allows them to search for additional victims.

http://www.bostonglobe.com/metro/2017/08/18/authorities-identify-mysterious-serial-killer-linked-allenstown-murders/6Nma4Dasrj7Quz6aBFsdbO/story.html

Questions?

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