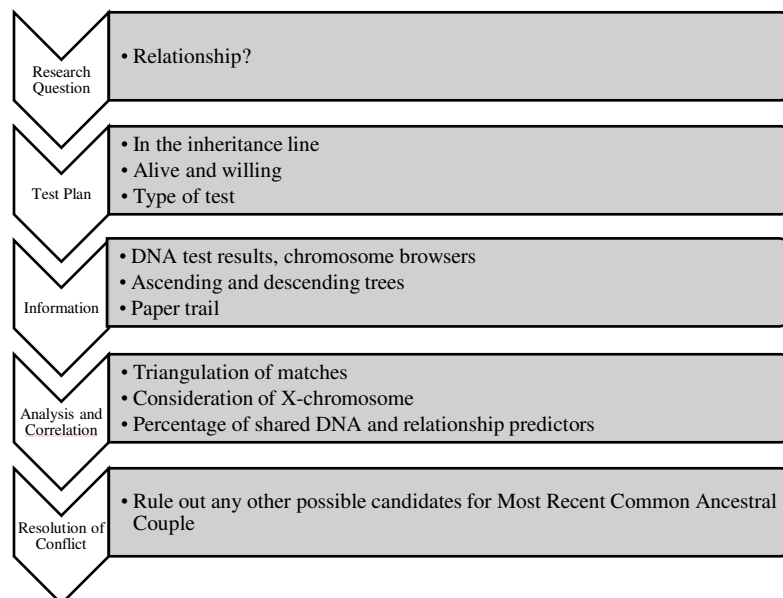# Weaving DNA Test Results into a Proof Argument
Board for Certification of Genealogists® Webinars
Legacy Family Tree Webinars

Karen Stanbary, MA, CG℠ ◊ karenstanbary@gmail.com

The Process

Research Question	• Relationship?
Test Plan	• In the inheritance line • Alive and willing • Type of test
Information	• DNA test results, chromosome browsers • Ascending and descending trees • Paper trail
Analysis and Correlation	• Triangulation of matches • Consideration of X-chromosome • Percentage of shared DNA and relationship predictors
Resolution of Conflict	• Rule out any other possible candidates for Most Recent Common Ancestral Couple

MOST RECENT COMMON ANCESTRAL COUPLE

DNA and the GPS

Element One: Thorough Research

Thorough research requires one to search for information in sources that might help answer a specific research question. It assures us that our conclusions are not based on incomplete research. In the case of unknown paternity, DNA test results are essential sources. However, DNA test results are just one of the components in the larger body of evidence that proof requires. For example, the case for a candidate parent is made stronger when the researcher documents that the proposed parents also shared a location at the time of conception.

Achieving proof of unknown paternity requires assembling a "theory tree" that will include the base test-taker and the selected matches, tracing them back to the most recent common ancestral couple. This often is an extensive tree that likely includes many generations on multiple lines. THOROUGH RESEARCH REQUIRES EACH

GENERATIONAL LINKAGE ON EACH STUDIED ANCESTRAL LINE IS CITED. The threshold for proof can be decreased when DNA evidence is used, especially when including multiple independent kits in a study group and/or segment triangulation. Consideration of the accuracy and depth of the proposed theory tree may require additional research to fill gaps. Gaps in the theory tree could be another common ancestor.

We must eliminate contender lines of potential common ancestors until only one possibility remains. Other ancestral couples who could have contributed the shared chromosomal segment between the test-taker and the match present a competing hypothesis. The Genealogical Proof Standard requires elimination of competing hypotheses. Sometimes additional targeted testing is necessary to eliminate competing hypotheses.

Element Two: Informative Citations

As with citations to documentary sources, citations to DNA test results show that our research is reasonably exhaustive. A complete DNA source citation communicates which sources we used to identify the test-taker's matches. Because we do not have access to the raw data for the matches, the report of the DNA values is not our source. Instead, our sources are the individual testing companies and third-party sites that provide details of the matches. As with documentary research, we must demonstrate through our source citations that we understand the data we are looking at. For example, we might want to include in a citation the number of shared segments in addition to the total amount of shared centimorgans as this often provides information about the closeness of the genetic relationship. Since testing companies employ different matching algorithms, we need to identify the specific match list that we use when discussing the matching segments.

Element Three: Analysis and Correlation

There are several levels where correlation occurs. First, the base test-taker's results generates a list of matches. Correlation of the matches and their trees helps the researcher to sort the matches into likely maternal and paternal groups. Correlation of the shared DNA between the base test-taker and a match will help predict potential relationships. Correlation of the matches with each other further refines those relationships. Once a theory tree is proposed, the researcher can test the proposed relationships by correlating the shared DNA among the people in the tree with the known shared centimorgan ranges. Correlation of specific shared segments (triangulation) helps the researcher identify groups of matches who share a common ancestral couple.

Correlation also occurs between the DNA test results, the theory tree and the documentary evidence. Is the paper trail consistent with the proposed relationships?

Element Four: Resolution of Conflicts

　　If the percentages of shared DNA conflicts with the proposed theory tree, this conflict must be resolved. Sometimes, there may be multiple common ancestral lines between the base test-taker and a match. If so, the researcher may be able to resolve the conflict by doing an analysis of runs of homozygosity.

　　DNA test results are often used to resolve conflicts between the named father and the biological father. Additional linkages of misattributed paternity (in other generations) may present conflicts even in the proposed theory tree to resolve the unknown paternity. Additional information from supplemental targeted testing can help to resolve these conflicts.

Element Five: Written Argument

　　Proving relationships, including unknown paternity, within the framework of the Genealogical Proof Standard requires the researcher to not only document the information, but also the analysis and reasoning. The conclusion of the specific genetic relationship must be explained. Even the relationship between a parent and child has a potential alternate relationship if that parent has an identical twin. ALL AMOUNTS OF SHARED AUTOSOMAL DNA SUPPORT MULTIPLE TYPES OF RELATIONSHIPS. Y-DNA test results only prove that two men are related on their patrilineal lines. There are many inherent assumptions in DNA analysis which require careful consideration and explanation.

　　The burden is on the writer to prove that each generational linkage is proved on all studied ancestral lines. The burden is also on the writer to demonstrate that the pedigrees of both the test-taker and the key matches are expansive enough to eliminate competing hypothesis. Failure to do so renders an unconvincing argument.

　　DNA test results are often best expressed using tables and figures. The correlation of data involves numbers which is often easiest to grasp in side-by-side comparative tables. It is useful to include a Descendancy tree depicting how all the key matches descend from a common ancestor or ancestral couple.

My atDNA Methodology

1. • Collect & sort segments
2. • Look for "hot spots"
3. • Identify overlap match ICW
4. • Triangulate, if possible
5. • Sort matches into groups

6. • Predict the relationship
7. • Eliminate non-contender lines
8. • Compare and build trees
9. • Identify MRCA couple candidates
10. • Confirm with paper trail/targeted testing

MOST RECENT COMMON ANCESTRAL COUPLE

Step One: Collect and Sort Segments
- Match's name and contact information
- Segment (chromosome, start point, end point, cMs)
- In Common With (ICW)
- Use *Genome Mate Pro* or *Excel* spreadsheets
- Preferably segments over min of 10 cM
- Preferably phased segments
- Sort by chromosome number and then start point

Step Two: Look for "Hot Spots"
- Multiple significant larger segments (15 – 30 cMs)
- Ignore "Sticky Regions"

Step Three: Identify the Overlapping Match's ICW
- Tools include
  - ICW in *Genome Mate Pro*
  - ftdna matrix
  - *Gedmatch* autosomal matrix
  - *Gedmatch* Tier I Matching Segment Tool
  - *DNAGedcom* Autosomal DNA Segment Analyzer (ASDA)
  - *AncestryDNA* ICW tool

Step Four: Triangulate
- Must match you and each other on the same segment
- If the segments overlap, only that piece contained within all three is a triangulated match
- *Gedmatch* Tier I Triangulation Tool

Step Five: Sort into Groups
- Group 1 (paternal)
- Group 2 (maternal)
- IBS (identical by state)
- Undetermined

Step Six: Predict the Relationship
- Matching algorithms differ by companies
- Use Relationship Prediction charts
- Target generation to search for MRCA

Step Seven: Eliminate Non-contender lines
- Ethnicity
- X-chromosome
- Geographic location
- Targeted Testing

Step Eight: Compare and Build Trees
- Consider creation of private, collaborative, theory tree on *Ancestry.com*
- Ask for match's online trees, gedcoms or anything at all they will give you
- *Google* and *Facebook* often useful for matches who do not respond

- *AncestryDNA* DNA circles
- Verify match's generational linkage connections are consistent with GPS
- Also consider the depth and accuracy of the base-test's tree as well as all of the trees in the study group
- Be aware of assumptions

Step Nine: Identify Most Recent Ancestral Couple Candidates
- May have to go back on the line to include all triangulated matches
- Rule out other lines are contenders

Step Ten: Confirm the Relationship
- Additional targeted DNA testing
- Paper trail genealogical research

Relationship Prediction	- Due to random recombination, siblings inherit some different segments of their DNA from each parent - Not all of your third, fourth and fifth cousins will match you 90% chance of 3C detection 50% chance of 4C detection - Will detect SOME of your more distant cousins - Use relationship charts and calculators to see if your hypothesized relationship to the match falls within the expected range - Use relationship charts, calculators to point you to the generation on your family tree to begin searching for MRCA couple *23andMe* gives you percentage of shared DNA calculations *FTDNA* gives you a relationship prediction but if you want percentage of shared DNA, you need to do the calculation
Case Study Components	- Identification of focus group of matches with ancestral lines in the same location - Analysis of "In Common With" (ICW) and triangulated segments - Incorporate other matches into the focus group from differing ancestral sibling lines - Documentary research to create ancestral trees - Consideration of percentage of DNA shared to predict potential relationships - Testing hypothesis by searching for additional matches in other databases

- Segment triangulation of expanded focus group
- Identification of hypothetical candidate
- Analysis of X-chromosome inheritance data
- Testing hypothesis with targeted testing
- X-chromosome analysis to narrow candidates
- Additional shared DNA analysis to narrow candidates
- Additional targeted testing to narrow candidates
- Analysis of runs of homozygosity to resolve conflict
- Coherent written argument including information and reasoning
- Proof of biological father

Karen Stanbary, CGᔆᴹ   P A G E | **7**

Selected Resources

Bettinger, Blaine T. "Evaluating a Genetic Genealogy Proof Argument." *Association of Professional Genealogists Quarterly* (September 2015): 162–5.

———. *The Family Tree Guide to DNA Testing and Genetic Genealogy.* Blue Ash, Ohio: F+W Media, 2016.

———. "The DNA Era of Genealogy." *The Genetic Genealogist,* 17 December 2016. http://thegeneticgenealogist.com/2016/12/17/the-dna-era-of-genealogy/ : 2017.

———. "Unlocking the Genealogical Secrets of the X Chromosome." *The Genetic Genealogist,* 21 December 2008. http://www.thegeneticgenealogist.com/2008/12/21/unlocking-the-genealogical-secrets-of-the-x-chromosome/ : 2015. Includes downloadable inheritance charts.

———. "Update to the Shared cM Project." *The Genetic Genealogist,* 31 July 2016. http://thegeneticgenealogist.com/2016/06/26/update-to-the-shared-cm-project/ : 2017.

Bettinger, Blaine T. and Debbie Parker Wayne. *Genetic Genealogy in Practice.* Arlington, Va.: National Genealogical Society, 2016.

Board for Certification of Genealogists. *Genealogy Standards.* Nashville & New York: Turner Publishing, Ancestry Imprint, 2014.

Byrne, Melinde Lutz and Thomas W. Jones. "Editors' Corner: DNA Standards." *National Genealogical Society Quarterly* 101 (December 2013): 293.

----------. "Genealogical Scholarship and DNA Test Results." *National Genealogical Society Quarterly* 102 (September 2014): 163

Devine, Donn. "Sorting Relationships among Families with the Same Surname: An Irish- American DNA Study." *National Genealogical Society Quarterly* 93 (December 2005): 283–293.

Fox, Judy Kellar. "Documents and DNA Identify a Little-Known Lee Family in Virginia." *National Genealogical Society Quarterly* 99 (June 2011): 85–96.

GEDmatch, Inc. "Are Your Parents Related?" Third-party tool. *GEDmatch: Tools for DNA & Genealogy Research.* (https://www.gedmatch.com/compare_parents1.php : 2017).

Genetic Genealogy Standards Committee. "Genetic Genealogy Standards," 10 January 2015. Paper presented to Colloquium. Salt Lake City, Utah. http://www.geneticgenealogystandards.com : 2017.

Gleeson, Maurice. "Autosomal DNA, Adoptees and Finding Long Lost Irish Relatives."
    Royal Dublin Society. Genetic Genealogy Ireland 2013 (19 October 2013).
    Recording. *Youtube*. https://www.youtube.com/watch?v=qDv3lZw2h9c.

Hollister, Morna Lahnice. "Goggins and Goggans of South Carolina: DNA Helps
    Document the Basis of an Emancipated Family's Surname." *National
    Genealogical Society Quarterly* 102 (September 2014): 165–176.

Immanuel, Felix. "Pedigree Collapse Calculator." Third-party tool. *Genetic Genealogy
    Tools.* http://www.y-str.org/2014/12/pedigree-collapse-calculator.html: 2017.

International Society of Genetic Genealogists. "Autosomal DNA Statistics." *ISOGG wiki.*
    http://www.isogg.org/wiki/Autosomal_DNA_statistics : 2016.

Jones, Thomas W. *Mastering Genealogical Proof*. Arlington, Va.: National Genealogical
    Society, 2013.

———. "Too Few Sources to Solve a Family Mystery? Some Greenfields in Central and
    Western New York." *National Genealogical Society Quarterly* 103 (June 2015):
    85– 10.

Mills, Elizabeth Shown. "Testing the FAN Principle Against DNA: Zilphy (Watts) Price
    Cooksey Cooksey of Georgia and Mississippi." *National Genealogical Society
    Quarterly* 102, June 2014, 129–52.

———. *QuickSheet: Citing Genetic Sources for History Research Evidence Style.*
    Baltimore, Maryland: Genealogical Publishing Company, 2015.

Parker Wayne, Debbie. "Percentage Shared atDNA Chart." *Deb's Delvings*. 29 October
    2013. http://debsdelvings.blogspot.com/ : 2015.

———. "Using Autosomal DNA for Genealogy." National Genealogical Society. *NGS
    Magazine* 40 (April-June 2014): 50–4.

———. "Using X-DNA for Genealogy." National Genealogical Society. *NGS Magazine*
    40 (July-September 2014): 57–61.

———. "X-DNA Inheritance Charts." *Deb's Delvings*, 25 October 2013.
    http://debsdelvings.blogspot.com/2013/10/x-dna-inheritance-charts.html :
    2015.

Perego, Ugo A., Ann Turner, Jayne E. Elkins and Scott R. Woodward. "The Science of
    Molecular Genealogy." *National Genealogical Society Quarterly themed issued
    Genetics and Genealogy* 93 (December 2005): 245–59.

Pike, David. "Search for Runs of Homozygosity (ROH)." Third-party tool. *David Pike's
    Utilities.* http://www.math.mun.ca/~dapike/FF23utils/roh.php : 2017.

Pratt, Warren C. "Finding the Father of Henry Pratt of Southeastern Kentucky."
National Genealogical Society Quarterly vol. 100, June 2012, 85–103.

Russell, Judy G. "DNA Testing for Adoptees." *The Legal Genealogist,* 8 January 2017.
http://www.legalgenealogist.com/2017/01/08/dna-testing-for-adoptees-2017/
: 2017.

Sorenson Molecular Genealogy Foundation. "Animations.
http://www.smgf.org/pages/animations.jspx. Topics include: Introduction to
Molecular Genealogy, Four Types of DNA, Autosomal DNA, X

Stanbary, Karen. "Rafael Arriaga, A Mexican Father in Michigan: Autosomal DNA
Helps Identify Paternity," *National Genealogical Society Quarterly 104* (June
2016), 85–98.