

## Introduction to Use of DNA for Genealogy - - handout

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Goals - - Understand ethnicity estimate; find distant cousins; find biological family; break down genealogical brick walls; investigate family or medical mysteries. Set a realistic goal; work on one goal at a time. Be emotionally prepared for DNA surprises; you may find unknown close family members; you may discover that your biological heritage is different than you believed. You may discover “not parent expected/non-parental events” (“NPEs”) in your ancestry.

### Three types of DNA tests

mitochondrial DNA (“mtDNA”) - - Mitochondrial DNA (mtDNA) is the DNA that’s passed down exclusively from your mother. It reveals your mother’s mother’s mother, back through time. Analyzing mtDNA will reveal the ancient migration patterns and ancestry of your maternal line. mtDNA is not passed down from a mother to her children. Only daughters can continue to pass down their mother’s mtDNA. Mitochondrial DNA test results are generally less useful for genealogical research purposes. At this time, only one major company offers mtDNA testing.

Y-DNA - - Y-DNA is inherited from father to son through the Y-chromosome, and reveals your father’s father’s father, back through time. Through Y-DNA testing you can discover the ethnic heritage of your father, and ancient migration patterns over many generations of your paternal line. Only males have a Y-chromosome, therefore, only males can take a Y-DNA test. Y-DNA testing can be useful for determining the ethnic heritage of an unknown father. At this time, only one major company offers Y-DNA testing.

autosomal DNA - - The most common ancestry DNA test analyzes autosomes, which are the 22 chromosomes that you inherit from all the ancestors of both your parents. This makes it ideal for discovering your heritage and ancestors, because it covers your father’s father’s line, your mother’s mother’s line, and everyone in between. This type of DNA analysis is usually very accurate. This is the type of DNA test offered by all the DNA testing companies, and it is the most useful for genealogical research.

Testing companies - - Direct-to-consumer DNA tests involve providing either a cheek swab or a saliva sample. Test kits come with easy-to-follow instructions about how to take the test and return the kit. It is important to activate your kit promptly by registering the unique numerical code that comes with each kit so that when the testing company receives your sample, your DNA results will be linked to the correct tester. For the most useful analysis, you should link a family tree to your DNA test at each testing company.

There are a number of features that DNA testing companies have in common with each other, including the ability to download your raw DNA data in order to upload it to other testing

companies or to third party websites, and the ability to communicate with your DNA matches. Most companies provide an ethnicity estimate; allow you to upload (GEDcom) a family tree and link it to your DNA data; and provide a shared-matches tool to enable you to group your matches. Most companies do not share data with law enforcement. Some companies allow you to import your raw DNA data from other companies; provide a summary of your DNA communities where your DNA has been during recorded history; provide colored dots and notes features to help you group your matches; and some companies have special clustering programs, or features that show where your family tree overlaps with the trees of your DNA matches. Some DNA websites are daunting to navigate. There are various pros and cons at each DNA testing company.

23andMe - - offers autosomal DNA test and DNA + Health test; no family trees; good for finding matches outside U.S., especially for South American and African ancestors, although predictions in Europe are not optimal. If you want your DNA at 23andMe, you must purchase their kit. 23andMe shows percentage of Neanderthal DNA; identifies haplogroups; but has currently disabled its chromosome browser tool. Has beta “DNA tree” feature, although that feature may, or may not, be accurate.

<https://www.23andme.com/>

AncestryDNA - - offers autosomal DNA test; many testers have linked and unlinked family trees; largest database of users; excellent for finding matches in North America. Especially useful for people with ancestry from the British Isles, Scandinavia and western Europe; increasingly useful for matches in Australia and New Zealand. In order to have your DNA results at AncestryDNA, you have to purchase their kit. Ancestry has ThruLines® tree-matching feature, but no chromosome browser; does not show haplogroups. Shows accurate DNA communities. Has helpful shared matching utility and grouping and notes features. Best when used with Ancestry’s pricey tree-building subscription or monthly Pro Tools subscription.

<https://www.ancestry.com/dna/>

FamilyTreeDNA - - only company to offer Y-DNA test (available only to men), mitochondrial DNA test (available to both men and women), and autosomal DNA test. Will accept DNA data uploads from other companies into the autosomal database. FamilyTreeDNA’s default is to opt users out of law enforcement sharing; users must proactively opt in. Good for determining distant ancestry and complete haplogroup designation. Especially useful for people with Jewish ancestry because their algorithms help to offset problems with endogamy. Has chromosome browser; links to matches’ family trees at MyHeritage. FT-DNA has many DNA projects (e.g., surname projects, ethnic group projects, geographical projects), although some projects are limited to users who have taken the mtDNA and/or Y-DNA test.

<https://www.familytreedna.com/>

MyHeritage - - offers autosomal DNA test; linked family trees often available. Will accept DNA data uploads from other companies into the database for free, but requires a modest fee to unlock the analytical tools. MyHeritage is excellent for finding European matches and probably the best company for testing if your ancestors were recent European immigrants. Has a similar matching tool to Ancestry's ThruLines® called Theory of Family Relativity™; has an AutoCluster feature; and has a chromosome browser. Provides automatic identification of shared surnames and shared ancestors between matches' family trees in a feature called Smart Matches. You can see how closely shared matches connect to each other. Has grouping and notes features, and a robust photo editing capability. Recently acquired French site Filae. Some features require a tree-building subscription.

<https://www.myheritage.com/>

Living DNA - - offers autosomal DNA test and DNA + health test. Will accept DNA data uploads from other companies into the database. Relatively small database, but is a good site for people with English, Scottish, Irish and Welsh ancestry. High resolution ethnicity estimates for the United Kingdom; i.e., shows areas of strongest DNA connection down to the county level in the U.K. You cannot link a family tree at Living DNA. The website dashboard is difficult to navigate and has many fewer tools for analysis than other sites. Has no chromosome browser and no option to confirm known genealogical relationships between matches. A recently added "Matchbox" colored dot feature allows you to create groups of shared matches.

<https://livingdna.com/>

The most economical way to find as many DNA matches as possible is to purchase the DNA kit at AncestryDNA and/or 23andMe, then transfer your raw DNA data from 23andMe and AncestryDNA, to MyHeritage, FamilyTreeDNA (autosomal), and Living DNA. Generally, you can transfer your data for free, but you need to pay a small fee to unlock the analytical tools at each site. You will find European matches at MyHeritage, U. K. matches at Living DNA, Jewish matches at FamilyTreeDNA, and South American and African matches at 23andMe. Make a testing plan. Test as many family members as you can. The more relatives you test, the better able you will be to group your shared DNA matches into paternal and maternal groups.

### Terminology

Centimorgans ("cM") - - Your list of DNA matches will show how much DNA you share with a match in a unit called centimorgans. A centimorgan is a unit of measurement. The more centimorgans you share with a DNA match, the closer your cousin relationship is to that match. If you have two matches with the same number of shared centimorgans, the match with fewer but longer shared segments will be the closer match.

Chromosome browser - - A chromosome browser is an analytical tool that allows a DNA tester to do a comparison with one or more DNA matches to see which specific segments of DNA are shared in common, and to see the location of the shared segment(s) on one or more specific chromosomes.

Haplogroups - - Some DNA companies will indicate your maternal and paternal haplogroups as part of your DNA results summary. A haplogroup is a genetic population of people who share an ancient common ancestor along the paternal or maternal line. The common ancestor may have lived many thousands, or even tens of thousands, years ago.

NPE - - Some testers will discover that they have a “non-parental event,” or NPE, suggested by their DNA results. Also called “not parent expected,” or “misattributed parentage,” NPEs occur when your DNA results do not support your genealogical research tree. There are many potential scenarios that result in an NPE, such as infidelity, assault, sperm donor conception.

### Strategies

To begin working with your DNA matches, look at your closest DNA matches. These may be first or second cousins. Do you recognize these cousins and know how they fit into your family? It is ideal to begin with first and second cousins, as they are key to separating paternal matches from maternal matches. Review the family trees of your second-cousin matches. Do those trees include ancestors you recognize? Once you have identified a second cousin, that person becomes what DNA guru, Diahna Southard, calls a “best known match.”

When you have identified your best known match, use the “shared matches” tool at the DNA site, which is sometimes called “in common with,” to find the people who match both you and your best known match. These people form a DNA group in which all the people in the group descend from a common ancestral couple. Then use grouping tools to tag each DNA match in the group, such as colored dots or notes.

You can name your groups after the various ancestral surnames that you are researching. You might start with eight named groups, one for each of your eight great-grandparents. Or you can begin with sixteen named groups, one for each of your second great-grandparents. You can also group your matches by utilizing spreadsheets or by creating word documents.

Once you have done genealogical document research to learn the names of your great-grandparents and second great-grandparents and add them to your linked tree, you can then utilize special tools, such as ThruLines® at Ancestry, or Theory of Family Relativity™ at MyHeritage, to receive clues to DNA matches whose family trees overlap with your tree. Their tree may show a known ancestor, providing you with clues to research to determine a shared ancestor. Each DNA cousin you identify will have shared matches with you, who you

can then add to that named DNA group. Of course, like all genealogy endeavors, ThruLines® and Theory of Family Relativity™ hints are clues that must be researched to confirm.

### Cousins

It's easy to get confused about what level of cousin are you to your DNA matches, even after you have figured out the ancestral couple you both descend from. As you know, you share grandparents with your first cousins. You share great-grandparents with your second cousins. You share two-times great-grandparents with your third cousins.

An easy way to remember what level of cousin you are is to count the Gs:

Grandparents - - one G - - first cousin

Great-Grandparents - - two Gs - - second cousin

Great, Great-Grandparents - - three Gs, third cousin, etc.

“Removed” cousins - - Removed cousins can be either in a younger generation, or an older generation, than you. Stated another way, cousins are once removed or twice removed if you and your cousin are not in the same generation as each other in terms of descent from a common ancestor. “Once removed” cousins can be either in one closer generation, or one more distant generation, than you are from your common ancestor. You can Google “removed cousins chart” to see examples.

Half cousins - - If your grandmother married more than one spouse, you would be a half first cousin to grandchildren of your grandmother and her other spouse - - the spouse who is not your grandfather. Your children would be half second cousins to the children of your half first cousin. And so on. It's confusing, for sure! But you can google cousin relationships to find all manner of charts that show full cousin relationships, removed cousin relationships, and half cousin relationships.

### More strategies

You will want to evaluate the closeness of each of your DNA matches. Each DNA testing company provides a relationship range, estimated by the amount of DNA shared between you and your match. You can also see the quantity of shared centimorgans (cM) of DNA, the number of shared segments, and the length of the longest segment.

Although all the DNA companies provide a rough estimate of the degree of closeness of each of your DNA matches, sometimes that estimate is rather vague. An excellent way to help narrow down the various ways you might match an unknown DNA cousin is to use Blaine Bettinger's Shared Centimorgan Tool at DNA Painter. By entering the number of shared cM into the tool, you are given a list of potential relationships, listed in descending order from

most likely to less likely. You can click on any of the relationships to see a histogram (a bell-curve graphic) which further enhances your understanding of that relationship.

<https://dnainter.com/tools/sharedcmv4>

### Potential complications

Endogamy - - Endogamy results when a group of people lives in geographical or cultural isolation and intermarries within that closed group over an extended period of time. This results in a situation where descendants are all related to the same original population of ancestors in many different ways. This makes it more difficult to determine how you might be connected to your DNA matches, since the amount of shared DNA might suggest a closer generation of connection than actually exists.

Pedigree collapse - - Pedigree collapse occurs when genetically-related people, such as first or second cousins, have children together. This results in the same ancestral couples appearing multiple times in the family tree, causing the tree to “collapse” at more distant generations. This makes it more difficult to determine where you connect with your more distant DNA matches. Marriage between cousins was quite common in the past, so most family trees will contain occasional instances of pedigree collapse, especially in earlier ancestral generations. Pedigree collapse can become endogamy if it happens repeatedly over many generations.

Adoption and NPEs - - If you are adopted, or encounter an NPE, you are working with many unknowns. This will make it more difficult to determine your best known match, and harder to determine how you connect with your DNA matches. There are many online articles about how to use DNA to find birth parents, and groups to assist adoptees in locating birth family.

Recent immigration - - If you are the child of parents who immigrated to the United States, you may find that you have many fewer DNA matches than do persons whose ancestors have been in North America for a longer period of time. The key to discovering how you connect with your matches is determined by being able to see all the other people you match with. If you have only a few matches, this shared match grouping becomes more difficult.

Identical by descent vs. Identical by state - - Conversely, if your ancestors have been in North America for hundreds of years, you will have many, many distant DNA matches, with whom you share small amounts of DNA. Once you drop below 20cM of shared DNA, you may be an identical match by state - - meaning that you and your match might not actually share an ancestor at all. If you share short segments of DNA with your matches, you and your match may share DNA by coincidence. Longer segments of shared DNA can confirm that you and your match are likely identical by descent, that is, you both actually do descend from a common ancestor.

## Communicating with matches

After identifying distant cousin DNA matches, you have the opportunity to communicate with your matches and work collaboratively to learn more about your mutual ancestors. You can exchange information, sources, photos, and family stories. All the DNA testing companies provide messaging protocols, either by way of in-house messaging systems or by providing e-mail addresses of users.

When messaging a DNA match, be concise and friendly. Perhaps provide a list of surnames reflecting your eight great-grandparents as a starting point. Close by expressing willingness to exchange information, and sign using at least a first name. You are much more likely to receive a response if your recipient feels like they have been contacted by a real person, and if you don't overwhelm them with too much information in your initial message. Don't be dismayed if your correspondent does not reply right away, or at all. Keep trying!

## DNA Education

Each DNA company has FAQ sections and explanatory notes about how best to use results at that respective site. Ancestry has a "DNA Academy," free video tutorials containing research tips, genealogy insights and how to use their DNA tools. MyHeritage and 23andMe have tutorials on their respective YouTube channels.

<https://www.ancestryacademy.com/understanding-dna>

Google "MyHeritage DNA on YouTube" to see a list of YouTube videos

Google "23andMe DNA on YouTube" to see a list of YouTube videos

Printed sources include books such as:

The Family Tree Guide to DNA Testing and Genetic Genealogy, Second Edition, by Blaine Bettinger.

Your DNA Guide, the Book, by Diahhan Southard.

Research Like a Pro with DNA, by Diana Elder, Nicole Dyer and Robin Wirthlin.

The Complete Guide to FamilyTreeDNA, by Roberta Estes.

See also, frequent DNA articles in *Family Tree Magazine*. *Family Tree magazine* is available at the library, newsstands, and by subscription. Be sure to explore "DNA in Genealogy Research" at the FamilySearch.org wiki, and the "Beginners' Guides to Genetic Genealogy" at isogg.org, (International Society of Genetic Genealogy).

[https://www.familysearch.org/en/wiki/DNA\\_Basics](https://www.familysearch.org/en/wiki/DNA_Basics)

[https://www.familysearch.org/en/wiki/DNA\\_in\\_Genealogy\\_Research](https://www.familysearch.org/en/wiki/DNA_in_Genealogy_Research)

There are numerous archived DNA presentations from RootsTech 2021 through RootsTech 2024, which are available for free viewing online. At the RootsTech website, click on “see more” to review a full list of archived videos.

<https://www.familysearch.org/rootstech/expohall/dna-learning-center>

Finally, you may find helpful information in DNA blogs, YouTube videos and Facebook groups.

DNA eXplained blog, by Roberta Estes, who sometimes offers free webinars

<https://dna-explained.com/>

Your DNA Guide, by Diahan Southard, who also offers free webinars

<https://www.yourdnaguide.com/ydgblog>

The Genetic Genealogist, by Blaine Bettinger

<https://thegeneticgenealogist.com/>

Legacy Family Tree Webinars, some free archived webinars, others require annual membership subscription; occasional free 24-hour binge webinar series

<https://familytreewebinars.com/>

Free short videos by Andy Lee, with Family History Fanatics

Google “DNA videos by Andy Lee” to see a comprehensive list

Google “genealogy groups on Facebook” for a comprehensive list of categories

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