

What Is This DNA Stuff and Why Should I Care?

Part 7: Comparison of the Major DNA Testing Companies

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The previous four articles discussed the different types of DNA and their corresponding tests that are available - mitochondrial DNA (mtDNA), Y-chromosome DNA (Y-DNA), X-chromosome DNA (X-DNA), and autosomal DNA (atDNA) - as well as the advantages and disadvantages of each test in terms of what each test could tell you about your genetic ancestors. Now we will focus on the testing companies themselves to help you decide which companies are the best ones for you to use based on your specific reasons for testing your DNA. Since the testing companies are continually evolving their testing procedures, screening array bead chips, population reference algorithms, analysis tools, and product offerings, this comparison will likely be out of date within several years, but for now it will provide a good basic assessment of the leading testing companies offering direct-to-consumer DNA testing.

In my original DNA presentations at the Philadelphia conference in 2018, I compared the four main testing companies available for use here in the United States - 23andMe, FTDNA, Ancestry, and MyHeritage. To confidently compare the DNA testing companies, I tested my DNA at all four of these companies. There is now a fifth company, Living DNA, that I am including in this comparison as they have been making new investments and partnerships and have received good reviews recently. I have not tested my DNA with them, but I did upload my raw DNA data to their website and paid a modest fee of \$19 to use their tools to evaluate my ethnicity estimate in the British Isles and search for additional cousin matches.

Table 1 shows a general comparison of the five leading consumer DNA testing companies ordered according to the number of people tested. Ancestry is currently the largest consumer-based DNA company with approximately 20 million completed DNA tests which is more than the other four leading companies combined. They also have largest number of online user-provided family trees (100 million) and historical records (over 30 billion) which helps tremendously with DNA-based genealogical research. Ancestry began offering their autosomal DNA test in 2012. They previously also offered Y-DNA and mtDNA tests, but these were discontinued in 2014 so they could focus on their consumer-friendly autosomal test.

| Company Information | AncestryDNA | 23andMe | MyHeritage | Family Tree DNA | Living DNA |
|---|--|--|--|-----------------------------------|--|
| Company Headquarters | Lehi, Utah | Sunnyvale, California | Or Yehuda, Israel | Houston, Texas | Frome, Somerset, England |
| Year DNA product launched | 2012 | 2007 | 2016 | 2010 | 2016 |
| Primary purpose for which DNA test was designed | Genealogical (Ethnicity) Personal Ancestry Health & Traits | Medical Genealogical Personal Ancestry | Genealogical (Ethnicity) Personal Ancestry Health & Traits | Genealogical Personal Ancestry | Genealogical (Ethnicity) Personal Ancestry Health & Traits |
| People in their DNA database (Nov 2021) | 20,000,000 | 12,000,000 | 5,200,000 | 1,400,000 | 300,000 |
| Sample Collection Type | Saliva | Saliva | Cheek Swab | Cheek Swab | Cheek Swab |
| Average Time to Results | About 4-6 Weeks | About 6-8 Weeks | About 4 Weeks | About 6-8 Weeks | About 6-8 Weeks |
| Level of Genealogical Knowledge of Matches | Medium | Low | Medium | Medium to high | Medium |
| Responsiveness of Matches | Low | Low | Medium | Medium | Medium |

Table 1. Comparison of the Five Leading DNA Testing Companies: Company Information

Source: Autosomal DNA testing comparison chart: https://isogg.org/wiki/Autosomal_DNA_testing_comparison_chart
(International Society of Genetic Genealogy) and the DNA Testing Companies Websites

23andMe was the first company to begin offering autosomal DNA testing to determine ancestry. Its direct-to-consumer genetic testing business was named Time Magazine's "Invention of the Year" in 2008. It is currently the 2nd largest testing company with 12 million autosomal tests completed and its primary focus is on medical testing, only recently becoming more focused on genetic ancestry. MyHeritage is the largest DNA company outside the United States with about 5.2 million tests completed. They were founded in Israel and are the 3rd largest DNA company overall. MyHeritage is comparatively new to the DNA testing arena, first offering their autosomal test in 2016. They have the 2nd largest number of online user-provided family trees (52 million) and historical records (12+ billion). The main difference between Ancestry and MyHeritage comes from their origin. Ancestry's database is focused more on North American records, while MyHeritage has more records from European countries. FTDNA first offered Y-chromosome STR and mitochondrial DNA tests in 2000 and began offering their autosomal DNA testing kit in 2010. FTDNA is currently the only leading testing company to offer the patrilineal Y-DNA STR and matrilineal mtDNA tests. It is the 4th largest DNA testing company with about 1.4 million autosomal tests completed and is generally preferred by more advanced genealogists studying specific family lines. Finally, Living DNA is the smallest of the testing companies reviewed here with about 300,000 autosomal tests completed since it began offering testing in 2016. Living DNA was founded in the UK and is more focused on European ancestry particularly of the British Isles. For those with British ancestry it is rated the best in terms of its Ethnicity Estimate and offers 21 geographical regions within the British Isles where your ancestors lived, more than any other testing company.

Regarding DNA sample collection, 23and Me and Ancestry collect a tube of saliva whereas the other three request a cheek swab. All the companies advertise turn-around times between 4-8 weeks but in the case of the four companies with which I tested my DNA, all of them came back sooner than publicized. I have included a general evaluation of the average level of genealogical knowledge for those individuals identified as cousins in the autosomal DNA tests as well as the average level of responsiveness for those individuals who are contacted with questions about their ancestral connection as designated by the International Society of Genetic Genealogy (ISOGG). FTDNA generally has the most knowledgeable users whereas 23andMe generally has the least genealogically knowledgeable users since more customers are interested in medical or health related issues. Regarding responsiveness to genealogical inquiry by related cousin matches, 23andMe and Ancestry are generally lower since more users are interested in medical or health related issues, in the case of 23andMe, or are only interested in the ethnicity estimates and less concerned about serious genealogical research, in the case of many Ancestry customers.

Table 2 displays a comparison of the autosomal DNA tests used by each company along with the additional tests available from each. 23andMe, FTDNA, and MyHeritage use the newer Infinium Global Screening Array (GSA) bead chip each with their own custom SNPs. Ancestry uses a slightly older Illumina OmniExpress bead chip which was also previously used by Family Tree DNA and MyHeritage before switching to the GSA chip. Living DNA recently switched from an Illumina GSA chip to the Sirius Affymetrix Axiom bead chip. The costs of each test normally range from \$79-\$99, although sales during special holidays can be found for \$49-\$69 dollars. Large numbers of autosomal SNPs are used by each company, but most also test some Y-chromosome, X-chromosome, and mitochondrial SNPs to test for paternal and maternal haplogroups to determine your ancient ancestry and migration patterns and for analysis of some health and wellness traits. 23andMe and Living DNA provide specific haplogroup reports; Ancestry does not provide any haplogroup information, but you can obtain them from the raw data using GedMatch; FamilyTree DNA does not provide haplogroup information as part of their autosomal test, but you can pay extra for their Y-DNA STR and mtDNA tests to determine that; and MyHeritage does not provide any haplogroup information at this time.

| DNA Testing Comparison | AncestryDNA | 23andMe | MyHeritage | Family Tree DNA | Living DNA |
|---|--|---|---|--|-----------------------------------|
| Microarray Chip Used for DNA Analysis | Custom Illumina OmniExpress chip | Custom Illumina GSA chip | Illumina GSA chip | Custom Illumina GSA chip | Sirius Affymetrix Axiom chip |
| Autosomal Test Name | AncestryDNA | DNA Relatives | MyHeritageDNA | Family Finder | Recent Ancestry |
| Autosomal Test Cost (Typical Sale Cost) | \$99 (\$59) | \$99 (\$69) | \$79 (\$49) | \$79 (\$59) | \$99 (\$59) |
| # Autosomal SNPs tested | 637,639 | 630,132 | 576,157 | 612,272 | 683,503 |
| # Y-chromosome SNPs tested | 1,691 (labeled as chromosome 24) | 3733 | 3,495 | 0 (SNP packages available) | 34,216 |
| # X-chromosome SNPs tested | 28,892 (labeled as chromosome 23) | 16,530 | 29,694 | 16,271 | 15,028 |
| # Mitochondrial SNPs tested | 263 (labeled as chromosome 26) | 4,318 | 0 | 179 (16,569 in mtDNA test) | 3,982 |
| % Ancestry Composition (Name) | Yes (Ethnicity Estimate) | Yes (Ancestry Composition) | Yes (Ethnicity Estimate) | Yes (myOrigins) | Yes (Extended Ancestry) |
| Additional DNA Tests Available | Ancestry Traits (Fitness & Nutrient) \$20 (\$10) | Health (Wellness, Predispositions, Carrier Status) (\$125) | Health Insights (Genetic Risk & Carrier Status) \$120 (\$60) | full mtDNA \$199 (\$149) y-DNA STR (37) \$119 (\$79) Y-DNA STR (111) \$249 (\$199) Big Y STR (700) \$449 (\$379) Additional Y-SNPs \$ variable | DNA Wellbeing Kit \$129 (\$69) |

Table 2. Comparison of the Five Leading DNA Testing Companies: DNA Testing Comparison

Source: Autosomal DNA testing comparison chart: https://isogg.org/wiki/Autosomal_DNA_testing_comparison_chart
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Table 3 shows a comparison of the DNA analysis tools available from each company. All five companies give you an ethnicity estimate which compares your DNA to a series of reference populations from around the world to try and determine where your ancestors came from. However, because the reference populations vary from company to company and the algorithms used to calculate these values also vary, the ethnicity results can vary widely. For those of European descent, it is difficult to differentiate British Isles, Germanic, and Scandinavian descendancy due to influence of the Norman, Anglo-Saxon, and Norse tribes who invaded England at various times in the past. For those of Middle Eastern, African, and Asian descendancy the results can vary greatly due to fewer individuals testing and to smaller numbers of reference populations. However, this will likely change with time as the companies are continually updating their reference populations. The current reference panels from each company are as follows: Ancestry sub-divides the world into 77 population regions using 56,580 reference DNA samples; FTDNA uses 90 regions from 8053 DNA samples; MyHeritage uses 42 regions from over 5000 samples; 23&Me uses 45 regions from over 14,000 DNA samples and Living DNA uses 80 regions. According to ISOOG, on a scale of 1-10 with 10 being the highest, the best overall ethnicity estimate comes from 23andMe (7), followed by Living DNA (6), Ancestry and MyHeritage (both with 5) and finally Family Tree DNA (3.5). Note, however, the Living DNA is rated differently depending on the region, for the British Isles they are rated best with a 9, but for the rest of the world they are only rated a 4. The main point to remember about ethnicity estimates is that these tests do not really tell you where your ancestors came from, instead, they only say where DNA like yours can be found on Earth today.

Cousin matching is the most interesting and beneficial feature of the DNA tests, at least from a genealogical standpoint. All five companies provide cousin matches ranked by predicted relationship as determined by the shared centimorgan (Cm) values (Ancestry, FTDNA, MyHeritage) or % Shared DNA (23&Me, Living DNA). All the testing companies have developed tools to help identify related cousin matches but not all of them have the same tools available. Ancestry and FTDNA can compare matches and then see how they compare to a third shared match. This is a way to manually cluster shared matches and see which matches are related to each other. MyHeritage has improved on this by

developing an automated clustering tool which does this for you. FTDNA, MyHeritage, and 23&Me all have a chromosome browser (neither Ancestry nor Living DNA have one) which is very useful to visually compare shared DNA regions between matches and to triangulate cousin matches. Family Tree DNA is the only company that reports Y-DNA (patrilineal) or mtDNA (matrilineal) matches but only if you pay to take their additional Y-DNA STR and mitochondrial DNA tests respectively.

| DNA Analysis & Tools Comparison | AncestryDNA | 23andMe | MyHeritage | Family Tree DNA | Living DNA |
|---|--|---|---|---|--|
| Ethnicity Estimate | Yes | Yes | Yes | Yes | Yes |
| Number of Ethnicity Regions Used | 77 | 45 | 42 | 90 | 80 |
| Accuracy and Sophistication of the Ethnicity Estimate according to the ISOGG on a 1-10 scale with 10 being excellent and 1 being poor | Overall rating: 5 Consistently overestimates the Central European and Scandinavian lineage for people with British Isles ancestors. The British Isles lineage is overestimated for people with continental European ancestors. | Overall rating: 7 Overall accuracy is reasonably good, but predictions in Europe are still not optimal. | Overall rating: 5 The Ethnicity Estimate generally overestimates the English ancestral component for people whose ancestors were from continental Europe. | Overall rating: 3.5 The myOrigins analysis is much improved, but it still lacks specificity, particularly for Europe. | Overall rating: 6 The Ethnicity Estimate rating for the United Kingdom is 9 and the rating is 4 for the rest of the world. |
| Cousin Matching | Yes | Yes | Yes | Yes | Yes |
| Patrilineal Matching | No | No, but paternal haplogroup info provided | No | Yes | No, but paternal haplogroup info provided |
| Matrilineal Matching | No | No, but maternal haplogroup info provided | No | Yes | No, but paternal haplogroup info provided |
| Can Build an Online Family Tree | Yes | Limited; calculates a tree from DNA matches; manually can add names to the tree | Yes | Yes | No |
| GEDCOM Upload | Yes | No | Yes | Yes | No |
| Link to Historical Records Database | Access to 20 billion historical records w/ subscription | No, DNA testing company only | Access to 16 billion of historical records w/ subscription | No, DNA testing company only | Not yet; partnership with FindMyPast (9 billion records) |
| DNA Results Linked to Family Tree | Yes | Yes (Tree calculated from DNA matches) | Yes | Yes, Limited | No |
| Raw DNA Download Allowed | Yes | Yes | Yes | Yes | Yes |
| Upload of Raw Data Files from Competitors | No | No | 23andMe, FTDNA Family Finder, Ancestry, and Living DNA | 23andMe (Version 3,4,5) and Ancestry files only | 23andMe, FTDNA Family Finder, Ancestry, and MyHeritage |
| DNA Import by GEDMatch | Yes | Yes | Yes | Yes | Yes |
| Chromosome Browser | No | Yes, using the DNA comparison tool associated with relatives | Yes, on the Review DNA Match page | Yes, using the Chromosome Browser tool | No |

Table 3. Comparison of the Five Leading DNA Testing Companies: DNA Analysis & Tools Comparison
Source: Autosomal DNA testing comparison chart: https://isogg.org/wiki/Autosomal_DNA_testing_comparison_chart
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Ancestry, MyHeritage, and FTDNA allow importing of a family tree to link to their DNA data results; 23&Me allows you to build a family tree from a calculated family tree based on your matches but it is a slow process; at this point, Living DNA does not allow a linked tree but they did partner with FindMyPast so it is likely that they will have this capability in the future. Ancestry and MyHeritage have also developed useful tools that automatically evaluate the uploaded family trees and DNA to identify how cousin matches may be related; the tools are called ThruLines and SmartMatch respectively.

All the companies can export their raw atDNA data files, but as shown in **Table 4**, only FTDNA, MyHeritage, and Living DNA can upload other companies DNA files to their website which allows test takers to look for additional cousin matches without having to pay for new tests.

| | | DNA Can Be Imported By This Company | | | | | |
|--------------------------------|------------|-------------------------------------|-------|----------------|-------|-----------|----------|
| | | Ancestry | FTDNA | MyHeritage | 23&Me | LivingDNA | GedMatch |
| DNA Exported from this Company | Ancestry | - | Y | Y | N | Y | Y |
| | FTDNA | N | - | Y | N | Y | Y |
| | MyHeritage | N | Y | - | N | Y | Y |
| | 23&Me | N | Y | Y (v5 only) | - | Y | Y |
| | LivingDNA | N | N | Y | N | - | Y |

Table 4 Comparison of the Five Leading DNA Testing Companies: Raw DNA Upload

Source: Autosomal DNA testing comparison chart: https://isogg.org/wiki/Autosomal_DNA_testing_comparison_chart (International Society of Genetic Genealogy) and the DNA Testing Companies Websites

This concludes our discussion of different major DNA testing companies and highlights the advantages and disadvantages of each one. So which company should you choose? All five of the major testing companies provide autosomal DNA testing. They all provide an ethnicity estimate to identify where your ancestors originated, and they all identify your cousin matches ranked according to your shared amount of atDNA. All of them also now provide some information about inherited genetic traits, health information, and potential carrier status, although all these health-related services require additional fees. For those interested mainly in medical insights with potential predisposition and disease carrier information as opposed to genealogical investigations, 23andMe would be the test of choice. For those interested in combining DNA testing information with historical record searching and cousin matching, either Ancestry or MyHeritage would be the top choices, particularly because they have the largest databases of tested individuals and historical records. I personally have subscriptions from both companies; Ancestry currently has access to more records, but occasionally I do find some records at MyHeritage that I didn't find at Ancestry. If you have particular interest in Y-DNA surname line research or tracing your maternal mitochondrial line, then Family Tree DNA is the company of choice for serious genealogists since they are the only one that offers specific Y-DNA STR or mtDNA tests. Finally, if British Isles information is of particular interest to you, then Living DNA should be considered, although the link to their historical records partner, FindMyPast, is not yet in place.

DNAWeekly (dnaweekly.com) rated the top 10 DNA companies for 2021 and their rankings of these companies are as follows: #1 MyHeritage (Detailed Ancestry & Easy-to-Use Family Tree), #2 Ancestry (In-depth Ancestry & Huge Genealogy Database), #3 Living DNA (Sub-Regional Ancestry Percentages), #6 Family Tree DNA (Detailed Maternal & Paternal Lines), and #9 23&Me (Ancestry with DNA-Related Personality Traits). The other 5 companies in their ratings were very health and wellness specific. Consumer's Advocate rated Ancestry Best for Family Trees & Ancestry Research, MyHeritage Best for Affordability, and 23andMe Best for Health Reports. Finally, Genomelink rated Ancestry Best for Genealogy Research and 23andMe Best for Health. Whichever company you choose, you will learn more about you and your ancestors than you knew before.

The final article in the series (#8) will be an in-depth discussion about GedMatch which is a website you can upload your raw DNA files from any of the five testing companies and look for additional cousins who have also uploaded their testing results. GedMatch has a free set of tools which are useful in identifying cousins, but for \$10 per month you can access additional tools which can make researching your cousin matches much easier and more informative. Until then, happy genealogical hunting!