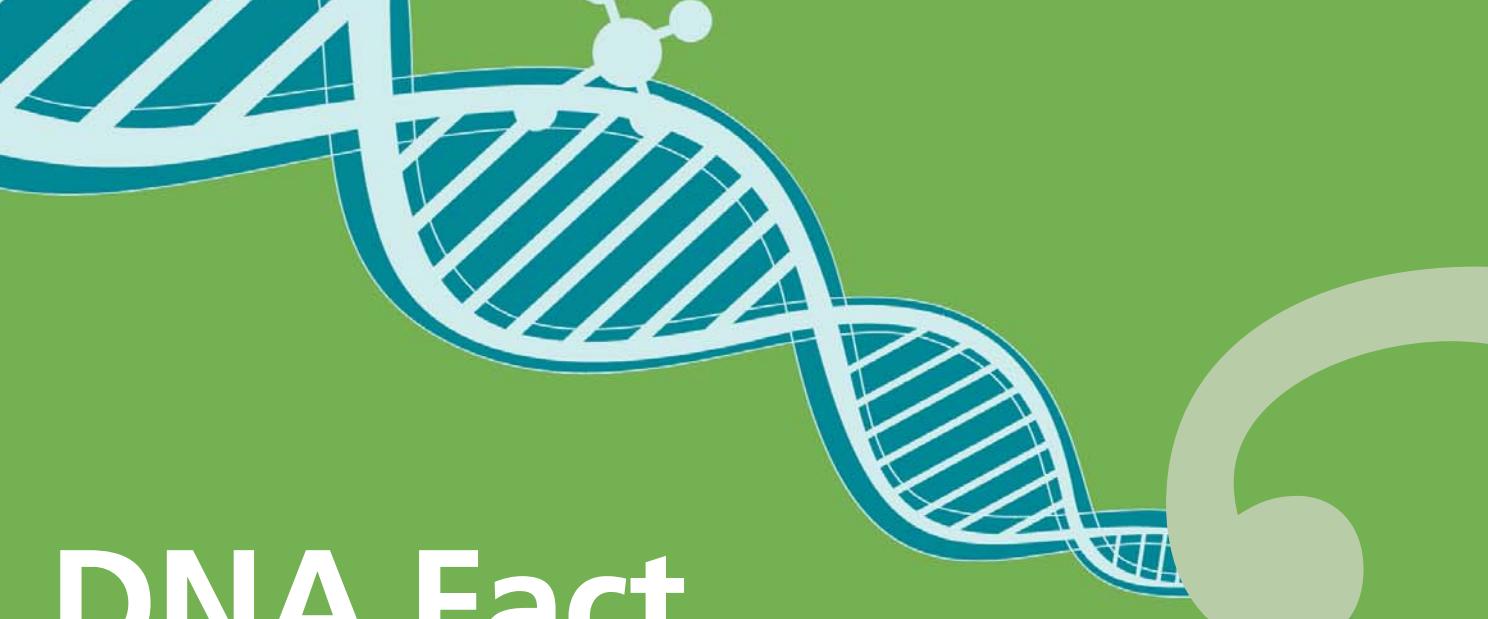


JUMP INTO GENETIC GENEALOGY

Use Genealogical DNA Testing
to Solve Family Mysteries



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DNA Fact OR Science Fiction?

Discover the truth behind six common genetic genealogy misconceptions—and figure out how DNA testing really fits into your family tree search.

By Lauren Gamber

Jenny Oligos suspected that her great-grandparents had emigrated from Piraeus, Greece, just like her friend Helen's (Helen and Jenny have the same maiden name), but she couldn't locate the documentation to prove her hunch. After years of scouring immigration records, she finally found her holy grail.

A second cousin who collected family heirlooms gave Jenny their great-grandmother's hairbrush, which still contained a few wispy strands. Jenny had heard that scientists can use the DNA in hair to trace a person's genetic origins. She carefully wrapped the brush and sent it to a DNA testing company for analysis. Because Helen had already confirmed through records that her ancestors had emigrated from Piraeus, she sent a sample of her own hair to the company for comparison.

Six weeks later, Jenny received a full report that provided the answers she'd sought for years. Not only did she find out that her ancestors had in fact hailed from Piraeus, but she also learned that she and Helen are fourth cousins.

The company even identified who Jenny and Helen's common ancestors are. Cousins currently living in Greece had obtained samples of their ancestors' DNA by exhuming their bodies. They'd submitted the DNA samples to the same testing company, which maintains a database genealogists can use to find genetic matches. Now that Jenny has identified her family's origins, she can focus her research efforts.

Does this tale of genealogical discovery sound far-fetched? That's because it is. Jenny Oligos is a figment of imagination. The story illustrates common misconceptions about DNA testing, the latest trend in family history research and the source of much confusion—and even fear. Let's tackle those misconceptions one by one so you can learn the truth about your genetic genealogy testing options.



MYTH**1**
Geneticists use hair and blood samples to trace a person's ancestry.

Although scientists do utilize hair and blood samples for paternity tests and forensic analysis, there's no need to draw blood or pluck hairs for a genetic genealogy test.

When you order a DNA test for yourself or someone else (see page 29 for a list of testing companies), you'll receive a cheek-swab kit or a mouthwash kit in the mail—complete with instructions, a consent form and a return envelope. For the cheek-swab kit, you'll use a sterile swab or toothbrush-like device to painlessly scrape the inside of your cheek for a few seconds. (The company may provide multiple swabs in order to obtain backup cheek-cell samples, just in case the first one doesn't yield clear results.) For the mouthwash kit, you'll swish the supplied rinse for a specified amount of time and spit it back into the container.

Then you'll just sign the consent form and mail it and your DNA sample back to the company. You should receive results in the mail or on a password-protected Web site within a few weeks.

Reality check: So could "Jenny" have sent her great-grandmother's hair to a DNA lab for testing? There are forensic labs that test hair, but this type of analysis comes with a much higher price tag.

MYTH**2**
A DNA test can pinpoint precisely where your ancestors lived or which tribe they belonged to.

If your ancestors and their offspring had stayed in one geographic region and never allowed outsiders to enter, it would be relatively easy to distinguish their DNA (and yours) from the DNA of people living in other regions. Over time, all of the inhabitants of your region would come to share specific genetic mutations (usually harmless changes in DNA), which would identify them as a distinct population, the same way a surname identifies members of a family.

But our ancestors didn't stay in one place. For thousands of years, humans have moved about, leaving their genetic imprints wherever they procreate and making it increasingly difficult for geneticists to distinguish one region's population from another's.

Scientists can make inferences about your ancestry based on trends among populations, but they can't say for sure that your ancestors lived in a specific country, much less a specific town. Testing companies analyze a person's genetic makeup by comparing his or her DNA to a reference database of DNA samples from modern individuals living in various regions—such as residents of present-day African countries (turn the page for more on African-American DNA testing). But it's important to keep in mind that today's inhabitants of a given region are genetically different from the people who lived there before migration occurred. Just because your DNA matches the DNA of someone who currently lives there, that doesn't necessarily mean your ancestors came from that place. Likewise, your DNA might match

that of a modern-day African tribe, but your ancestors may not have identified with that particular group.

Biogeographical tests such as DNA Testing Systems' <www.dnaconsultants.com> DNA Fingerprint tests will estimate where in the world your ancestors originated. Yet scientists haven't agreed upon definitions for even broad genetic ethnicities, so if you test with more than one company, you may get different results.

By combining genetic genealogy and traditional genealogical research methods, however, you can make headway in pinpointing your family's origins. As more people get tested and contribute both their DNA test results and their family trees to online databases (see myth 5 for more on these), scientists will be able to identify additional patterns and draw better conclusions.

Reality check: While browsing a database, Jenny might have noticed that her close relatives' DNA matches the DNA of people with confirmed roots in a certain part of Greece. She could then focus her research efforts on that locale. But at this point, it's unrealistic to expect a DNA testing company to provide that level of assurance in your test results.

MYTH**3**
To find out if you and another researcher descend from the same third-great-grandfather, you need to dig up his body for a DNA sample to test.

We strongly recommend letting Great-grandpa rest in peace. There are easier ways to prove a genetic link that don't involve literally turning relatives over in their graves.

To find out if you and someone else descend from the same male ancestor, you should turn to Y-DNA testing. The Y chromosome (also called Y-DNA) is passed virtually unchanged from father to son, just like (in most cases) a surname. So Great-grandpa should have the same Y-DNA as his son, his son's son and so on. You can use Y-DNA to trace your paternal lineage, which is represented by the top line of a pedigree chart.

If you and your fellow researcher are both male and have the same surname

as the man you think is your third-great-grandfather, then you both should have your Y-DNA tested. (Even if one of you has a different surname, you still could be related; a surname might've changed after an adoption or during an immigrant ancestor's assimilation process.) If you're indeed related, your Y-DNA test results should be identical or nearly identical, because mutations do occur occasionally.

But even with a perfect match, there's no telling whether you're related through your third-great-grandfather or a different ancestor, unless you can find the records to prove your hypothesis. That's because mutations don't occur at regular intervals, so it's hard to predict exactly when the most recent common ancestor (MRCA) might've lived. Most DNA testing companies provide an estimate, though.

Because women don't have Y chromosomes, a female researcher would need to turn to someone with the same Y-DNA as her biological father. She could ask her father, brother, uncle (her father's brother), a male cousin (her father's brother's son) or a nephew (her brother's son) to take a Y-DNA test.

Geneticists use another type of DNA, called mitochondrial DNA (mtDNA),

Testing, Testing ...

An African-American genealogist's DNA test leaves her with more questions than answers.

Like many other African-Americans, I've found genealogy challenging once I hit the barrier of slavery. A scarcity of records makes it difficult to discover what we're looking for—a connection to our ancestral homeland in Africa.

In 2006, while working with University of South Carolina geneticist Bert Ely's research partner on a non-genealogical project, I decided to answer a burning question: Do I have Ethiopian ancestry?

This question first arose three years prior when I lived in Virginia, where I was often mistaken for Ethiopian. I'd walk down the street or enter a restaurant and native Ethiopians would start speaking to me in Amharic, their country's official working language. What was it about me that made people believe I was Ethiopian? I hoped a mitochondrial DNA test would provide an answer.

Genetic testing offers the tempting possibility of giving African-Americans that link to their ancestors. Several companies offer African-American DNA tests, some of which give the impression they'll connect African-Americans with a specific place or a tribe in Africa. African Ancestry <www.africanancestry.com>, for example, positions itself as the only company that traces your ancestry back to a present-day African country of origin, and often, a specific ethnic group. How? The company compares your genetic sequence against 25,000 samples from modern indigenous Africans to connect your roots to one or more African

countries, as well as ethnic groups when possible.

African DNA is a partnership between Family Tree DNA <familytreedna.com> and Henry Louis Gates Jr., a Harvard University history professor and host of PBS' "African-American Lives" series. Clients get a genealogical report tracing their ancestry back to 1870 and an mtDNA and Y-DNA analysis with a migration map of your ancestors.

But can DNA testing actually link African-Americans to a specific tribe? When my own test results arrived I was excited, then quickly disappointed. I do have Ethiopian ancestry, but through a "close" match, rather than an "exact" one. I got little in the way of answers and instead, ended up with more questions.

My DNA sequence belongs to haplogroup LOala, most common in West Central and Southern Africa. (See the glossary, opposite, for an explanation of haplogroups.) My exact matches were Cabinda (a tribe originating in Angola), Sukuma (Tanzania) and Mozambique Bantu. The report further stated:

Your direct maternal lineage appears to have originated in the Bantu people. Since the Bantu are widespread across west central to southern Africa due to multiple historical migrations, it may be unlikely that we will better localize your lineage.

Bantu is a large category of languages used as a general label for more than 400 ethnic groups in Sub-Saharan Africa. Sukuma, according to the University of Pennsylvania African Studies

Center, is the largest ethnic group in Tanzania, representing 13 percent of the population. Sukuma means north; this tribe originates in Northwestern Tanzania on or near Lake Victoria.

I also discovered that a significant portion of slaves from Mozambique were transported to Brazil around the Cape of Good Hope. So how did my maternal ancestor end up in North America? An estimated 2 percent and 23.8 percent of all slaves shipped to North America were from Mozambique and Angola, respectively.

Besides Ethiopian, my close matches were Kenyan, Cameroon and multiple southeastern Bantu. On the plus side, I was delighted to learn that I had Kenyan ancestry because I'm named after Jomo Kenyatta the former President of Kenya.

Ely, a principle researcher in the African-American Roots project <www.uml.edu/roots>, says DNA analysis for ethnic origins is particularly difficult in Africa because the continent's population is more genetically diverse—and harder for geneticists to understand—than any other in the world. In addition, humanity has been in Africa longer than anywhere else, leaving more time for all those ancestral migrations to occur (see page 27). It's impossible to use only mitochondrial DNA to determine a single ethnic group as the source of an ancestor. Further developments in genetic genealogy may yet tell me exactly where my ancestors came from.

—Kenyatta D. Berry

Gene Tool

Clip and save this quick-reference genetic genealogy cheat sheet.



GENETIC GENEALOGY TESTING COMPANIES

- **23andme**
[<www.23andme.com>](http://www.23andme.com)
- **African Ancestry**
[<www.africanancestry.com>](http://www.africanancestry.com)
- **AfricanDNA**
[<www.africandna.com>](http://www.africandna.com)
- **Ancestry DNA**
[<dna.ancestry.com>](http://dna.ancestry.com)
- **deCODEme**
[<www.decodeme.com>](http://www.decodeme.com)
- **DNA Consulting**
[<dnaconsultants.com>](http://dnaconsultants.com)
- **DNA Heritage**
[<dnaheritage.com>](http://dnaheritage.com)
- **Family Tree DNA**
[<familytreedna.com>](http://familytreedna.com)
- **FamilyBuilder**
[<familybuilder.com>](http://familybuilder.com)
- **GeneTree**
[<genetree.com>](http://genetree.com)
- **National Geographic Genographic project**
[<www3.nationalgeographic.com/genographic>](http://www3.nationalgeographic.com/genographic)
- **Oxford Ancestors**
[<oxfordancestors.com>](http://oxfordancestors.com)
- **Pathway Genomics**
[<www.pathway.com>](http://www.pathway.com)

GLOSSARY

TERM	DEFINITION
admixture	ancestry that originates from more than one ethnic group
allele result	also called a marker value, the numeric value assigned to a genetic marker
autosomal DNA	all your DNA except what's on the X and Y chromosomes
confidence range or confidence interval	Your DNA results report will show the most likely ancestry percentages (for a biogeographic test) or date an MRCA lived (for a Y-DNA test). It'll also provide a confidence range showing other possible results
haplogroup	an identification of the genetic group your ancient ancestors (10,000 to 60,000 years ago) belonged to
haplotype	collectively, the marker values on your Y-DNA test results
HVR (hypervariable region)	sections of mtDNA (such as HV1 and HV2) used to determine your haplogroup
mitochondrial DNA (mtDNA)	genetic material mothers pass on to their children
MRCA (most recent common ancestor)	the most recent ancestor two individuals both descend from
mutation	changes in DNA that can help reveal how long ago an MRCA lived when two people have closely matching marker values
recombination	the process by which chromosomes cross and switch genetic material at conception
SNP (single nucleotide polymorphism)	harmless mutations in autosomal DNA that can indicate where your ancient ancestors came from
STR (short tandem repeat)	a type of DNA marker used to determine relationships between individuals
Y-DNA	genetic material fathers pass to their sons

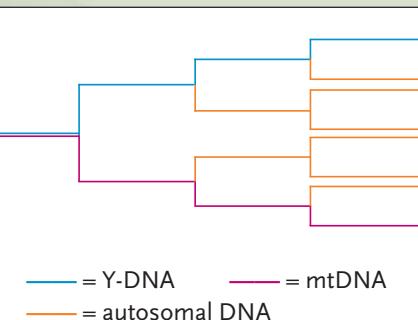
TYPES OF GENETIC GENEALOGY TESTS

TEST	WHAT IT DOES	WHO CAN TAKE IT
Y-DNA	Determines whether families with the same last name are related and about when the common ancestor lived. Results relate only to men on the top line of your family tree chart (blue on the chart below). Y-DNA tests also can determine a haplogroup.	Men (a woman can have her paternal grandfather, father, brother, father's brother or the brother's son take the test)
mitochondrial (mt) DNA	Best for learning about ancient maternal-line ancestry. Can confirm a relationship, but you won't know how long ago the common ancestor lived. Results apply to the women on the bottom line of your family tree chart (pink on the chart below). Results assign a haplogroup.	Men and women can take this test.
ethnic	Compares your DNA markers to those typical of certain ethnicities, such as African-American or American Indian.	Men and women
biogeographical (also called admixture tests)	Examines autosomal DNA markers to determine genetic heritage among anthropological groups	Men and women
autosomal (Short Tandem Repeat, or STR)	Can confirm if you're related to a living person, including what relationship (if any) exists. Both individuals must provide a DNA sample.	Men and women

RESOURCES

- **Cyndi's List: Genetics, DNA and Family Health**
www.cyndislist.com/dna.htm
- **Cyndi's List: Surname DNA Studies and Projects**
www.cyndislist.com/surn-dna.htm
- **Deep Ancestry: Inside The Genographic Project** by Spencer Wells (National Geographic, \$12.95)
- **DNA and Genealogy** by Colleen Fitzpatrick (Rice Book Press, \$22.50)
- **DNA and Tradition: The Genetic Link to the Ancient Hebrews** by Yaakov Kleiman (Devora Publishing, out of print)
- **dna-forums.org**
dna-forums.org
- **DNA-NEWBIE Mailing List**
lists.rootsweb.com/index/other/DNA/DNA-NEWBIE.html
- **Family History in the Genes: Trace Your DNA and Grow Your Family Tree** by Chris Pomery (The [UK] National Archives, \$12.95)
- **FamilyTreeMagazine.com Genealogy Insider: Genetic Genealogy**
blog.familytreemagazine.com/insider/CategoryView,category,GeneticGenealogy.aspx

- **GENEALOGY-DNA Mailing List**
lists5.rootsweb.com/index/other/DNA/GENEALOGY-DNA.html
- **Genetealogy**
genetealogy.com
- **The Genetic Genealogist**
www.thegeneticgenealogist.com
- **Genographic Project**
genographic.nationalgeographic.com/genographic
- **International Society of Genetic Genealogy**
isogg.org
- **Journal of Genetic Genealogy**
www.jogg.info
- **Roots Television DNA Channel**
www.rootstelevision.com/players/player_dna3.php
- **The Seven Daughters of Eve** by Bryan Sykes (W.W. Norton & Co., \$16.95)
- **Saxons, Vikings, and Celts: The Genetic Roots of Britain and Ireland** by Bryan Sykes (W.W. Norton & Co., \$16.95)
- **Trace Your Roots With DNA** by Megan Smolenyak Smolenyak and Ann Turner (Rodale, \$16.95)



HEIRLOOM DNA

DNA isn't equal-opportunity: Y-DNA follows your male line; mtDNA sticks with your female line. The chart above shows you which type of DNA informs you about which part of your family tree.

Barring any mutations and nonpaternity events, the men on the blue line—and their sons—have identical Y-DNA to yours (if you're a guy) or to your father and brother (if you're a gal). The ladies on the pink line (and all their children) have identical mtDNA to yours.

Autosomal DNA covers the branches in the middle of your tree. Tests can't provide specific information about any particular branch, though, because you don't know who on those branches contributed a given DNA marker.

to trace maternal lineage, what's shown on the bottom line of a pedigree chart. Mothers pass their mtDNA to their daughters and their sons, but only daughters pass mtDNA on to the next generation. Genealogists can use mtDNA in much the same way as Y-DNA, although it's not as useful because it doesn't correspond to surnames. Plus, mtDNA mutates more slowly than Y-DNA does, making it even harder to predict when an MRCA might've lived.

Typically, genealogists use mtDNA to explore their ancient ancestry or to weed out people who aren't related through their maternal lines. If your mtDNA results don't match exactly with someone else's, you're probably not closely related. Rarely do two people with one or more differences in their mtDNA have a common ancestor who lived recently enough that she might appear in written records.

Testing your own or a close relative's Y-DNA or mtDNA can reveal information about your paternal line (your father's father's father) and your maternal line (your mother's mother's mother) but not about anyone in between. But you can enlist the assistance of your male and female cousins to learn about the ancestors named in the middle of your pedigree chart.

Reality check: To find out if they're related, Jenny and Helen could've had their mtDNA tested (using cheek-cell or saliva samples, not hair). If their results had revealed an exact match, though, Jenny and Helen couldn't have known when the MRCA on their maternal line lived without turning to traditional roots resources—that ancestor could've walked the earth hundreds of years ago.

The two women also could've asked male relatives to get their Y-DNA tested. The DNA company would have been able to use those test results to estimate with more precision when the MRCA on their paternal line might've lived—for instance, a 12-marker match might mean there's an 80 percent chance they share an ancestor within the past 15 generations—but again, this would be just an estimate. Geneticists wouldn't be able to tell them that they're fourth cousins. Which leads us to the next myth.

MYTH 4

The results of ancestral DNA tests are 99.9 percent accurate, just like the DNA tests on CSI.

Genetic genealogy isn't an exact science—it involves quite a bit of interpretation. Although your DNA doesn't lie, scientists use it to calculate the probability that you and another researcher are related or that you have African roots, based on genetic patterns they've observed in populations. This means that genetic genealogy can suggest, but not prove, a relationship.

Biogeographical test results in particular must be taken with a grain of salt, because scientists haven't agreed upon definitions of genetic ethnicity. What makes interpreting results from biogeographical tests even trickier is that these tests rely on autosomal DNA, a mixed bag of genetic information inherited from both mothers and fathers. A test may suggest that you have some American Indian ancestry, but you won't know whether it comes from your mother's side or your father's side unless both of your parents get tested as well. Nor will you know how long ago your American Indian ancestor (or ancestors) lived.

Interpreting Y-DNA test results also presents some challenges. The number of Y chromosome markers you get tested influences the reliability of these tests. Men can choose to test between 12 and 67 markers. The more markers tested, the greater the chance of finding genetic mutations (or differences) and, therefore, the smaller the chance of having an exact genetic match. In other words, a 67-marker test is more precise than a 12-marker test, and less likely to imply a "false positive" relationship. It's also more expensive.

If two men have the same surname and the same Y-DNA test results, there's a very good chance they're related within a genealogically significant time period. One or two different marker values, depending on the number of markers tested, also could indicate a genetic link. Remember that a genetic mutation can occur at any time, so even a father's and son's results might not match exactly, although this rarely occurs.

The Sorenson Molecular Genealogy Foundation (SMGF), which offers Y-DNA, mitochondrial DNA and autosomal DNA databases at <www.smgf.org>, generally recommends that genealogists order 36-marker Y-DNA tests. According to the SMGF Web site, two men with the same surname who match 34 out of 36, 35 out of 36, or 36 out of 36 markers probably have a common ancestor who lived within the past 500 years. Two men with different surnames but with at least a 34 out of 36 match also may have a common ancestor who lived in the recent past. Fewer matches may indicate a connection before the widespread use of public records.

Geneticists know that some markers mutate faster than others, and they take this into consideration when interpreting test results. But you can see why different mutation rates can make predicting when an MRCA might've lived even more difficult.

Reality check: Again, a testing company wouldn't have told Jenny and Helen how many generations back their MRCA lived. The company might have provided a range based on probability.

MYTH 5

If you take a DNA test, you can finally find out who your great-grandmother's parents were.

Your DNA test results won't reveal your ancestors' names, but you can use them to do a little detective work online. Plug your Y-DNA marker values—or your relative's—into a public DNA database (see the chart on page 66), and you may connect with other genealogists who have the same haplotype. (As noted in the glossary on page 29, "haplotype" refers to a series of marker values. Your haplotype is essentially a list of numbers, each corresponding to a DNA marker.)

You may find that people with the same haplotype as you all live in the same region or even the same country. Although you won't know for sure that your ancestors hailed from that place, you may want to do some further investigating in written records.

Of course, you'll want to pay particular attention to any genetic matches

whose surnames are the same or similar to yours. By swapping notes with these DNA cousins, you might just figure out who your great-grandmother's parents were. But you won't make this discovery through DNA testing alone.

Regardless of which company provided your test, you can contribute your results to any public online database. Once you sign up for a database, you may receive an e-mail notification each time someone with your haplotype adds his test results. We also recommend joining a surname or geographic project to meet people who share your surname or whose ancestors lived in the same region as yours. You can join a project before or after having your DNA tested.

You can upload your DNA test results and your family tree to Web sites such as GeneTree <www.genetree.com> and the SMGF database. Once you meet genetic matches, you can let them view your family tree online, which saves you the trouble of mailing files back and forth.

Reality check: A DNA test can't tell you your ancestors' names, let alone the

ancestors you share with someone else. But if you connect with a researcher whose haplotype matches yours, you may add to your family tree simply by sharing what you already know.

MYTH 6

"Big Brother" could get your DNA if you try genetic genealogy.

Does the idea of your DNA test results' ending up in an online database make you nervous? Testing companies take your privacy seriously, and they won't post your results on the Internet without your consent. If you do want to include your information in an online database, you can determine how much personal information you want to reveal.

Testing companies also make a point of safeguarding customers' DNA specimens—attaching a bar code, not personal information, to each sample, for instance. Some companies destroy all samples after analyzing them. Others give customers the choice of having their

specimens destroyed or allowing the company to securely store their samples for any additional tests. To learn more about a company's privacy policy, check its Web site or make a phone call.

Even though Y-DNA is passed from father to son, a Y-DNA test isn't a paternity test. The results can disprove paternity, but they can't be used to prove paternity in court. Law enforcement officials could potentially use DNA test results databases to further an investigation—a controversial topic in the scientific community—but it's unlikely they'd be able to identify a specific suspect using genetic genealogy research.

Reality check: Rest assured. Getting your Y-DNA or mtDNA tested won't open you up to identity theft, criminal investigation or paternity suits. But it may introduce you to new research avenues, so you can write your own (true) success story. ☀

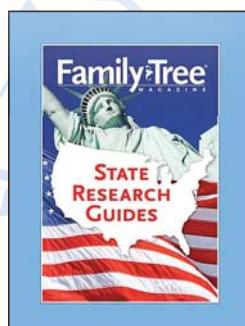
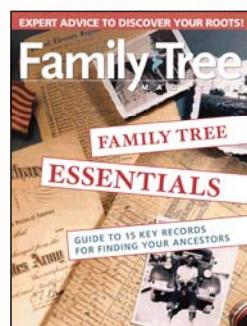
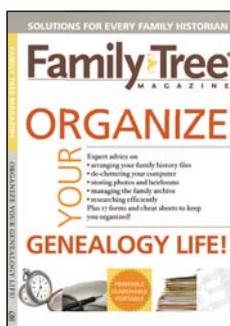
Freelance writer and editor LAUREN GAMBER wrote about how gender affects DNA testing options in the May 2009 *Family Tree Magazine*.

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DNA Success Stories

Got an adopted ancestor, conflicting records or other family history mystery on your hands? We'll show you how four genealogists are breaking through brick walls with DNA testing.

BY BLAINE T. BETTINGER

• THE NAME CHANGE at Ellis Island. The American Indian "princess." The unbreakable brick wall. Every genealogist has a mystery lurking within his or her family tree. Often the subject of years of persistent research, the mystery is pulled out of dusty files and re-examined from time to time, in hopes that a new database or new clue will finally reveal the answer.

This is an incredible age for genealogists with unsolved mysteries. The advent of online access to old records has revolutionized genealogy and broken through thousands of brick walls. Yet some mysteries fail to yield their secrets despite all the tools the modern genealogist has at his disposal.

Genetic genealogy is another valuable tool that should be in your toolbox—answers to family mysteries often hide in our very DNA. Genetic genealogy tests allow you to uncover relationships and connections that have long been forgotten or, sometimes, were intentionally concealed. Since these tests became available almost 15 years ago, many thousands of people have swabbed or spit (the most common methods for obtaining DNA samples). They've learned about their ancient origins, found genetic cousins and solved genealogical mysteries.

But choosing the proper DNA test to probe a particular question can be a daunting task. Should you order a Y-DNA, mtDNA or autosomal DNA test, or some combination? When you get the results back, how do you apply them to your family tree or mystery?

To answer these questions, we'll examine four real-life mysteries that everyday genealogists have investigated, and

sometimes even solved, using DNA. (We changed some of the names for privacy reasons.) You'll learn not only which tests will shed light on which types of mysteries, but also how to use DNA testing results to get the answers you're looking for.

1 The mystery of the adopted father

Shortly after her father's death, Linda Spanos was shocked to learn he'd been adopted as an infant. Even her father likely didn't know he'd been adopted. His wife, Linda's mother, had accidentally discovered the truth decades ago and kept the secret to herself. Intensely curious about their biological roots, Linda and her siblings launched a two-decade search that would lead them through a roller coaster of twists and turns before DNA testing finally revealed an answer.

■ **THE TEST:** Linda's brother agreed to take a Y-DNA test in hopes of learning their father's biological surname. A Y-DNA test examines markers on the Y chromosome, a piece of DNA that's only found in males and which is passed down only



TIP: If you've taken a DNA test, especially with 23andme <23andme.com> or FamilyTreeDNA <www.familytreedna.com>, you'll find tools to help you analyze your results at DNAGedcom <www.dnagedcom.com> and 23andyou <23andyou.com>.

from father to son—usually, along with a surname. Therefore, Y-DNA testing can examine the relatedness of men with the same or similar surname. Male adoptees use Y-DNA testing so they can search large DNA databases for a match, thereby giving them a clue as to their own biological surname.

■ **THE VERDICT:** Linda's brother had a relatively close match with someone of the surname Mayer. Through research in historical records, Linda and her family found several possible candidates of that surname who lived in the right place at the right time to be her biological grandfather. A short time later, though, an even closer match appeared in the database with the similar surname Meyer, which the match said had been changed from the original Meier. This close match shared a wealth of genealogical information, including the fact that three of his male relatives had immigrated to the United States and lived within a reasonable distance of Linda's biological grandmother, thus making all three excellent candidates for the biological grandfather.

■ **NEXT STEPS:** Although the Y-DNA test identified a possible surname, it couldn't identify which Meier relative was Linda's biological grandfather. To solve this mystery, the family turned to autosomal DNA testing. This type of test, which both men and women can take, examines thousands of locations throughout the DNA and compares them to the DNA of everyone else in the testing database in order to identify the test-taker's genetic cousins.

To determine which of the three candidates was most closely related to Linda's family and therefore the most likely biological grandfather, Linda's brother and the descendants of each candidate took autosomal DNA tests. (Linda could have taken the autosomal test instead of her brother, but the testing company already had her brother's DNA sample.) The results showed that although all three men were related to the family, one man in particular was much more closely related. His ancestor is likely Linda's grandfather.

■ **LESSONS LEARNED:** When looking for an adopted male's possible biological surname, Y-DNA is a great way to start. While that will often reveal possibilities, other types of DNA testing, particularly autosomal DNA, may be needed to confirm a match. Sometimes it takes more than one type of DNA to solve a mystery.

2

The mystery of the inconclusive records

At the Phillips DNA Project <www.phillipsdnaproject.com>, Ron Phillips writes about his quest to determine whether the Rev. George Phillips of Watertown, Mass., is his paternal ancestor. Several sources suggest that the father of his most-distant known Phillips ancestor, Theophilus, was Zerobabel Phillips. Zerobabel was the first son of the Rev. George Phillips with his second wife, Elizabeth. But those sources don't give any verifiable evidence, and other sources suggest that Zerobabel had no offspring.

■ **THE TEST:** The Rev. George Phillips would have passed his DNA to his sons, who passed it to their sons, and so on.



Testing, Testing

Dozens of genetic genealogy testing companies offer a broad range of Y-DNA, mtDNA and autosomal tests to help you find relatives and/or discover your ethnic origins. You can see a list of testing companies, along with the types of tests each one offers, at <www.isogg.org/wiki/List_of_DNA_testing_companies>. To examine the types of genealogical questions described here, I recommend working with the tests available from these companies:

- **23ANDME** <23andme.com>: autosomal test
- **ANCESTRYDNA** <ancestrydna.com>: autosomal test
- **FAMILY TREE DNA** <www.familytreedna.com>: Y-DNA, mtDNA and autosomal (called Family Finder) tests

If he is Ron Phillips' ancestor, the two should have matching Y-DNA—so a Y-DNA test could answer this mystery. Of course the Rev. George Phillips is long dead, so Ron Phillips first had to find a known male-line descendant of the reverend to establish his Y-DNA signature. That took considerable research, but eventually two descendants of the Rev. George Phillips with well-researched pedigrees underwent testing. Their results could be compared to each other as well as to Ron Phillips' Y-DNA test results.

■ **THE VERDICT:** The two identified descendants of the Rev. George Phillips indeed matched one another, suggesting that the reverend's Y-DNA profile had been successfully identified. Ron Phillips then compared his own Y-DNA results to the identified signature to determine whether he was also a match. The results showed that Ron Phillips' Y-DNA was in fact not a match to the signature of the Rev. George Phillips. This suggests that Theophilus Phillips was likely not the son of Zerobabel Phillips, and thus that Ron was not a descendant of the Rev. George Phillips.

■ **NEXT STEPS:** The results of Y-DNA testing weren't a perfect resolution to this mystery: Ron Phillips still doesn't know who Theophilus' father was. But the negative outcome will save Ron's family all the time they might have otherwise wasted trying to prove a connection to the Rev. George Phillips. Perhaps someone else with a Y-DNA signature matching

Ron's will take a Y-DNA test, turn up in a results database, and reveal new genealogical information.

■ **LESSONS LEARNED:** Even negative DNA test results can be revealing. Evidence that you don't match someone can save you from years spent on the wrong research. Further, it can force you to pursue other avenues you wouldn't otherwise have considered.

DNA testing complements and builds on extensive genealogical research to examine a mystery.

3

The mystery of the American Indian ancestor

Sometimes, DNA testing creates a mystery instead of solving one. In 2012, Anne Marie Hadaway agreed to take a mitochondrial DNA (mtDNA) test her cousin had purchased. Because women pass mtDNA to their children, and mutations are rare, the test would examine Anne Marie's mother's mother's mother's (and so on) line back to ancient times. Although not then a genealogist, Anne Marie thought it would be interesting to learn about the ancient origins of her maternal line. But when her test results came back, Anne Marie was surprised that her mitochondrial DNA belonged to a distinctly American Indian haplogroup labeled A2.

■ **THE TEST:** Because Anne Marie had no knowledge of American Indian roots in her maternal line, she wondered if she had any other Native American DNA, and how much. To examine this, Anne Marie took an autosomal DNA test, which can be used to identify the geographical origins of DNA.

■ **THE VERDICT:** The company that performed Anne Marie's test estimated that approximately 3 percent of her DNA was American Indian in origin. This suggests that her closest Indian ancestor was recent enough to have left a signature in her autosomal DNA.



TIP: When pursuing genetic genealogy, be sure to understand the limitations and benefits of each type of test. You'll save yourself considerable time and money before and after testing.

■ **NEXT STEPS:** Bitten by the genealogy bug, Anne Marie recruited her mother to take an autosomal DNA test to learn more about their Native American roots. Those test results revealed that Anne Marie's American Indian autosomal DNA was inherited from her mother, just as her mtDNA was. The two autosomal tests also identified several genetic cousins who have matching mtDNA in addition to autosomal DNA. Anne Marie is now researching her maternal line in genealogical records, hoping to identify her mysterious Indian ancestor.

■ **LESSONS LEARNED:** It can be challenging to narrow down which ancestor you and a genetic match share, or which family line a particular ancestor is in, using autosomal DNA alone. That task may be easier with a Y-DNA or an mtDNA test. Anne Marie's American Indian mtDNA points her to the line she should research to identify her American Indian ancestor.

4

The mystery of the great-grandmother's parents

Helen Johnson was born March 2, 1889, in upstate New York. Although her birth was recorded in one of the earliest New York state birth certificates, her father was listed as "not known." Her mother, although named, remains a mystery to Helen's descendants who've tried to research her. No fewer than three families took in Helen before she turned 13, and she married into the last family to adopt her. Although she lived a long and content life, she died without knowing who her biological parents were.

■ **THE TESTS:** Helen died long before the advent of genetic genealogy. The only DNA available for testing would have to

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come from one or more of her many descendants. Helen had two children, a son and a daughter, each of whom had at least one child. Helen's daughter inherited her mother's mtDNA and passed it on to her son. The simplest testing approach was for this grandson to take an mtDNA test in hopes of finding a match, but none have been found.

Next, the family turned to autosomal DNA. Each of Helen's children inherited half of their autosomal DNA from their mother. Each of *their* children share approximately 25 percent of their DNA with their grandmother. Two male grandchildren, one from each of Helen's children, underwent autosomal DNA testing to find genetic relatives that match both of them. A person matching both grandsons would suggest all three are related through either Helen or her husband. If the family tested just one grandchild, or even two grandchildren who are siblings, a match might be related through the grandchild's other parent and not through Helen's line.

■ **THE VERDICT:** Although Helen's grandsons share slightly less DNA than the 12.5 percent that first cousins typically share, they're well within the range of first cousins. The testing company's database contains numerous matches to both men, including some relatively close matches estimated to be third cousins.

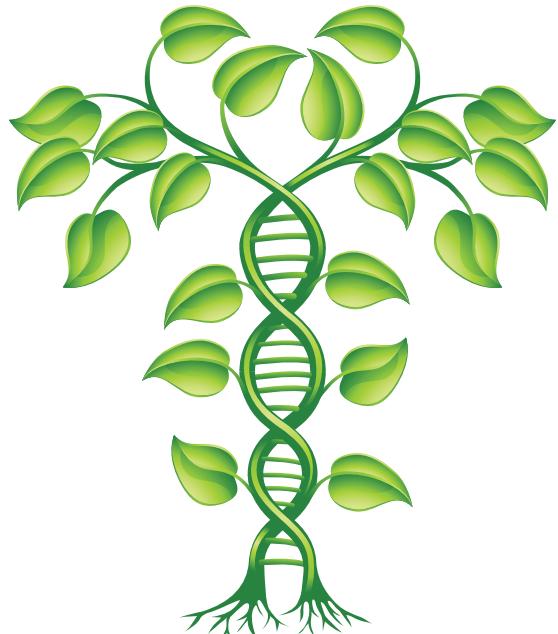
■ **NEXT STEPS:** The two cousins have so far determined that one of their matches is related through Helen's husband's side. They're continuing to work with their genetic relatives and conduct genealogical research to find candidates for Helen's biological parents. Finding a common ancestor with genetic matches can be challenging enough, but this family is trying to find a common ancestor based only on a time and place, without the benefit of any surnames. They hope to find enough overlap in the matches' family trees to narrow down who Helen's parents might be. In addition, a match to the initial mtDNA test still might turn up.

■ **LESSONS LEARNED:** Although potentially powerful, autosomal DNA testing rarely provides an immediate answer. Traditional genealogical research is usually needed to find a common ancestor with an autosomal DNA match.

One of the most important points these examples emphasize is that DNA testing alone rarely operates as a bulldozer for a brick wall. Instead, DNA testing complements and builds on extensive genealogical research to examine a mystery or provide a definitive answer.

An important and often overlooked genetic genealogy strategy is using more than one type of DNA test to examine a family mystery. For example, a Y-DNA test may suggest a surname, as it did for Linda Spanos' family, and following up with an autosomal DNA test can narrow down a list of candidates. Then research in genealogical records might put one candidate in the right place and time.

When you're considering using DNA to solve a research problem, first make a plan of attack: Which types of DNA



Gene Therapy

Get help planning your genetic genealogy testing strategy and interpreting your test results with these websites.

■ DNAEXPLAINED—GENETIC GENEALOGY BLOG

<dna-explained.com>

■ FAMILY TREE DNA SURNAME PROJECTS

<www.familytreedna.com/projects.aspx>

■ THE GENETIC GENEALOGIST BLOG

<www.thegeneticgenealogist.com>

■ INTERNATIONAL SOCIETY OF GENETIC GENEALOGY

<www.isogg.org>

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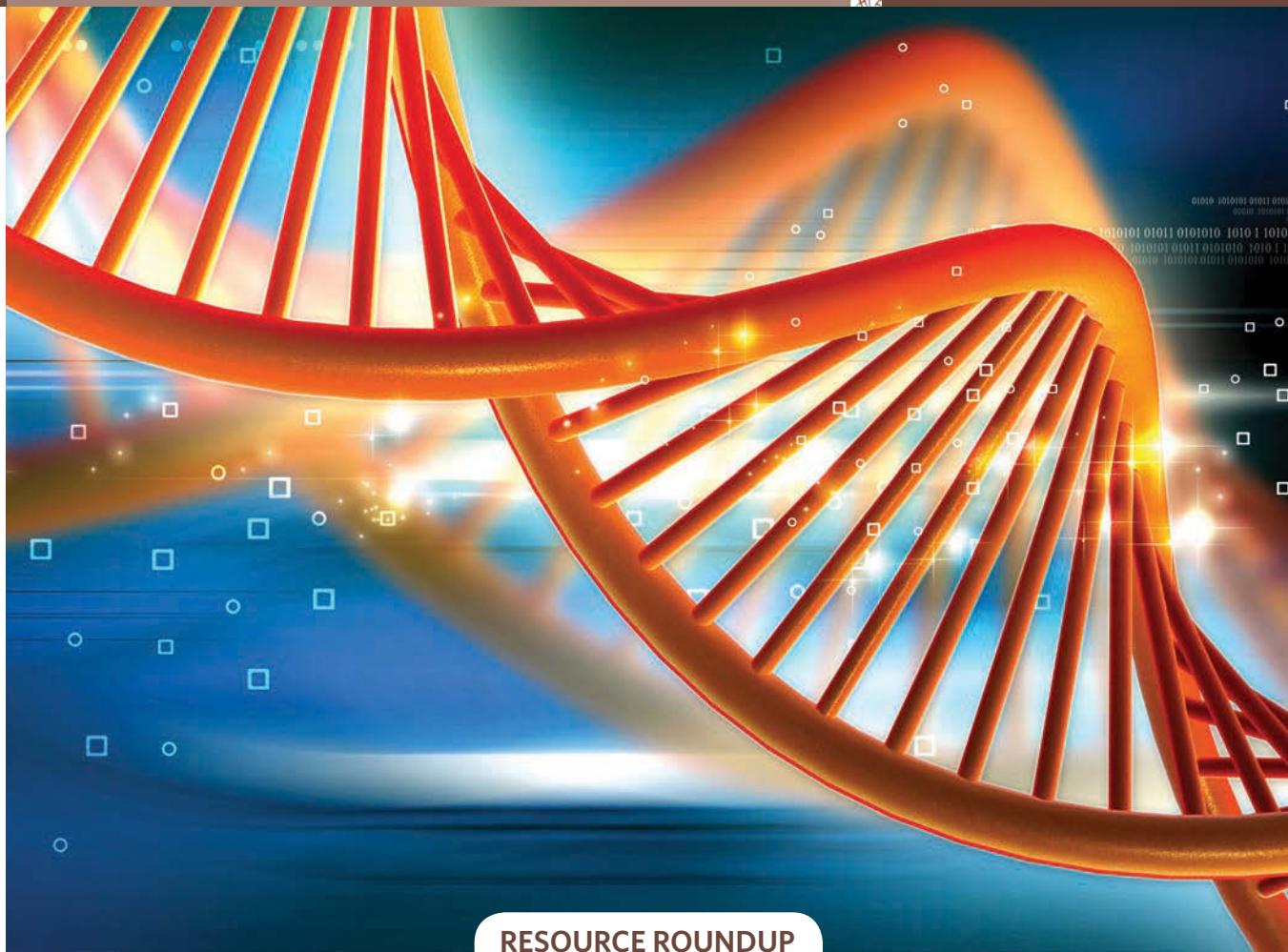
<jgg-online.blogspot.com>

■ YOUR GENETIC GENEALOGIST BLOG

<www.yourgeneticgenealogist.com>

testing can you use to examine your particular mystery? Who can you ask to take the DNA tests you've identified? How will your plan change if the results are inconclusive, or if they refute your original hypothesis? What additional genealogical research can you do before and/or after testing to help you find the right answer? When you've answered or at least considered these questions, you're ready to begin your genetic genealogy adventure. What mysteries can your DNA solve? ■

BLAINE BETTINGER blogs at the Genetic Genealogist <www.thegeneticgenealogist.com>. His latest Family Tree University webinar is Using DNA to Solve Family Mysteries, available as a recording from ShopFamilyTree.com <shopfamilytree.com/using-dna-to-solve-family-mysteries-webinar>.



RESOURCE ROUNDUP

Top Genetic Genealogy Tools

Testing companies

Considering a genetic genealogy test? Look to these leaders in the DNA testing field:

23ANDME <www.23andMe.com>

This test provides information about your Y-DNA (if you're male), mtDNA and autosomal DNA. Using innovative, visually appealing displays, the Ancestry Composition tool reveals the percentage of your DNA from each of more than 20 populations throughout

the world. The Relative Finder tool compares your DNA to other test-takers in the company's database in order to identify genetic relatives, although you'll be able to communicate with matches only if they're interested in sharing with you. You also can learn about your genetic predisposition to certain diseases and conditions, response to certain medications, and physical traits. Don't forget to check out Ancestry Labs for an estimate of your Neanderthal ancestry.

MORE GENEALOGISTS THAN ever before are turning to DNA testing to explore their family trees. In addition to traditional Y-DNA and mtDNA tests, which examine your paternal and maternal lines, testing companies now offer autosomal DNA testing lets you explore the rest of your family tree. And third-party sites let you do even more once you have your DNA results in hand. Start your search for genetic genealogy tests and tools with these companies and resources.



TIP: Having a clear purpose in mind—such as finding out where your maternal roots lie or whether you're related to someone else with your surname—is essential to choosing the right genetic genealogy test.

ANCESTRY.COM <dna.ancestry.com>

Ancestry.com's huge subscriber base means the AncestryDNA database is growing by leaps and bounds. After testing, you can link your DNA to your Ancestry.com-hosted family tree, and the service will compare your tree to the Ancestry trees of any genetic relatives to help you find a common ancestor. AncestryDNA also offers a Genetic Ethnicity Summary that compares your results to the DNA signatures of populations around the world.

FAMILYTREEDNA <www.fttdna.com>

One of the first genetic genealogy companies, Family Tree DNA has offered Y-DNA and mtDNA testing for well over a decade, and has built a comprehensive database of potential matches. Its new autosomal DNA test, Family Finder, ranks your genetic cousins in the Family Tree DNA database by their predicted relationship to you (ranging from very close to very distant). You'll receive contact information for Family Finder matches so you can share genealogical information.

NATIONAL GENOGRAPHIC PROJECT

<genographic.nationalgeographic.com>

Autosomal DNA testing, called Geno 2.0, is a recent addition to this project's Y-DNA and mtDNA testing. The Genographic Project is a joint nonprofit venture of the National Geographic Project and IBM to study human origins and migration. In addition to Y-DNA and mtDNA haplogroup information, the Geno 2.0 test estimates your ancient ancestral origins by comparing your DNA to more than 40 reference populations. You'll also learn about your Neanderthal and Denisovan ancestry—two

human lineages that have gone extinct, but that appear to have left their mark in our DNA.

Analysis tools

In addition to the analysis your testing company provides, use these third-party websites and software to look for matches and learn more about your test results:

DNA TOOLS <www.dnagedcom.com>

Although created to help adoptees find their birth families, anyone can use this free resource. Family Tree DNA customers can use these tools to easily download and store Family Finder matches, as well as information about each DNA segment shared with those matches. 23andMe customers can download certain test result data and information about genetic cousins.

GEDMATCH <www.gedmatch.com>

Upload raw autosomal DNA results to the free GEDmatch to search for genetic cousins, compare your results to those of someone in the GEDmatch database, or use admixture calculators to examine your ancient ethnicity in meticulous detail. You can also use GEDmatch to compare your GEDCOM with a match's to help identify your shared ancestors.

INTERPRETOME <esquilax.stanford.edu>

This free browser-based tool from Stanford University analyzes your 23andMe raw data. You can learn more about your genetic propensity for conditions such as diabetes and analyze your ancient ethnicity. An added benefit: Your raw data isn't uploaded to another location.

More DNA Resources

■ **MITOSEARCH.ORG** <www.mitosearch.org>

[mitosearch.org](http://www.mitosearch.org): This free database of mtDNA test results is hosted by Family Tree DNA, but also contains results from other testing companies.

■ **23ANDYOU** <www.23andyou.com>

[23andyou.com](http://www.23andyou.com): This free website isn't affiliated with 23andMe, but provides information about that service, links to third-party tools, and a list of genetic genealogy blogs and websites.

■ **ISOGG** <www.isogg.org>

The International Society of Genetic Genealogy offers a newsletter, beginner information, the ISOGG Wiki <www.isogg.org/wiki> and the DNA-NEWBIE mailing list.

PROMETHEASE

<snpedia.com/index.php/Promethease>

This free software uses test results from 23andMe, Family Tree DNA and other testing companies to report additional health and trait information. The analysis is performed using SNPediea, a growing database of information about the links between disease, genetics and physical traits.

Y-CHROMOSOME GENOME COMPARISON

<daver.info/ysub>

This free tool is a collaborative effort to learn more about the Y-DNA family tree. If you took your Y-DNA test through 23andMe, you can submit your results for inclusion in a set of spreadsheets containing results from more than 1,000 males, with more added weekly. Genetic genealogists use this publicly available information to further refine the global Y-DNA haplogroup tree.

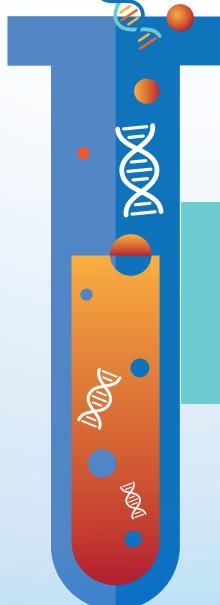
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