

An introduction to DNA Painter

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My goals for this lecture:

- Explain what DNA Painter is and how it can help you
- Provide an introduction to the concept of chromosome mapping for beginners
- Show you how to use the site, presenting real-life examples of how to interpret the results of chromosome mapping
- Highlight and surface DNA Painter features you might have missed

Origins of DNA Painter

I took my DNA test in December of 2016 and got the results in early 2017. Like many people, I wasn't particularly focused in advance on what I wanted to get out of the test. I was just a family history obsessive who wanted to use any means possible to discover more about my forbears.

As you'll know if you've tried, interpreting the results isn't as easy as you might have hoped. The information provided about our matches varies hugely:

- Sometimes we'll have the data showing which segments of DNA we share, along with a well documented family tree and a list of shared matches that indicate where this person fits in
- Other times we might have as little as an assumed name and the amount of DNA shared

Once I got my results, I was as overwhelmed as most people. However, I was able to figure out my connection to two matches.

But I wondered how I could most effectively harness these discoveries. I had uploaded my raw DNA to other sites and I had the segment data – the coordinates on each chromosome where we matched – but I didn't really know what to do with that information.

My goals as a genealogist were quite typical:

- Connect and learn about unknown branches of my family tree
- Break through brick walls and solve genealogical puzzles

But at this point I had some way to go before my DNA test results could help me do that.

So I decided to build a website. I had two clear aims:

- To help me figure out my connection to my matches
- To help me learn the concepts of genetic genealogy.

What is DNA Painter?

DNA Painter is a website that you can reach at dnapainter.com

Right now the site breaks down to two areas:

- Relationship prediction based on the amount of DNA shared
- Chromosome mapping

This presentation will focus on **chromosome mapping** since relationship prediction could be a presentation in its own right.

First, I'll introduce the concept of chromosome mapping for beginners, going back to basics on how we inherit DNA

After that I'll delve as deeply into the site as time allows, trying to surface features that regular DNA Painter users might not have noticed.

Introduction to Chromosome Mapping

We all have a family line, whether or not we know the identities of the people in it. By that, I mean we all had a biological mother and father, and they in turn had a mother and father, and so on, back in time.

Also, we all have chromosomes. We don't necessarily have to have a thorough understanding of the science underlying chromosomes in order to accept that we each have 23 chromosome pairs. We inherited one of each pair from our father, and one from our mother.

So in the same way we all have a family line, we all have a "chromosome map." What I mean by this that when each of us was created, we inherited a specific subset of our parents' DNA, and they in turn inherited a specific subset of **their** parents' DNA,

and so on. The result is that each of us has a distinct selection of genetic material that we've inherited from our ancestors. If you happen to have an identical sibling (e.g. twins, triplets), then they will likely have the same chromosome map as you, but otherwise it's your very own "personal blend" – and it exists in your cells whether or not you choose to abstract it into a chromosome map.

Chromosome mapping is the process of assigning segments of your DNA to specific ancestors or ancestral couples. Once you've started to map your chromosomes, you can begin to use this information to identify new matches more quickly and efficiently.

To explain how this blend comes into being, I'm going to take you through an example of inheritance on just one chromosome, chromosome 11.

Chromosome pair 11 example

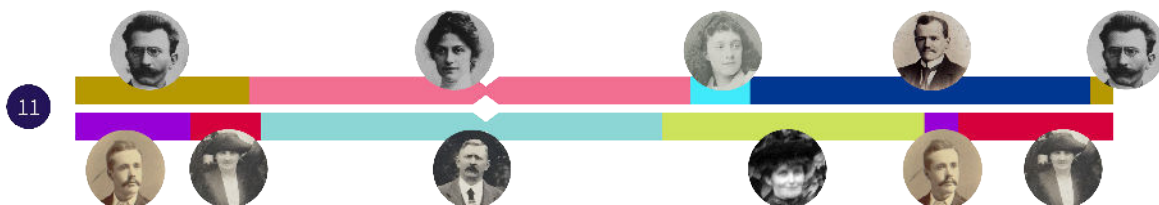
I have two copies of chromosome 11. I inherited one copy from each of my parents

Each of them in turn inherited one copy of their chromosome 11 from each of **their** parents.

So in fact my chromosome 11 pair is a mix of DNA from each grandparent.



And each of these 'grandparent' segments was passed on from one or both relevant **great**-grandparents



What do you need in order to be able to map your chromosomes?

You need to have taken an autosomal DNA test and received the results.

You need to have access to segment data for matches. The more segment data you have access to, the better. This means you might need to transfer your DNA to additional databases in order to proceed, since some testing companies (e.g. AncestryDNA, LivingDNA) do not currently provide segment data.

Tour of a DNA Painter profile

Glossary

Profile	A set of chromosomes, normally representing one person, the test taker.
Match	Someone who a testing site has identified as sharing DNA with the test-taker
Segment	A single continuous piece of DNA that the test-taker shares with a match
Group	A set of DNA segments that display in their own color, such as all the segments you've identified as coming from a specific ancestral couple

Basic usage

To create a profile, go to dnainter.com, log in, and go to the Profiles page. You'll see a button 'create a new profile'.

Once you click this button you'll be taken to your "blank" profile. This is a set of chromosomes that represent you (or another person of your choice). They aren't really "blank," since as you've learned, we inherit one copy of each chromosome pair from our mother and one from our father – so this is the starting point.

Next you need to choose a match to paint. An ideal place to start would be a known relative who is related to just one of your grandparents, such as a first cousin to one of your parents, or a 2nd or more distant cousin.

To paint a match you need to compare yourself to them on a site that provides segment data, such as MyHeritage, 23andme or FamilytreeDNA, or Gedmatch/Gedmatch Genesis. The comparison result consists of a table showing which chromosomes and positions you match on.

Click 'Paint a new match' and paste in this data. Once you click 'Save match now', you can enter the information about this match and save them to your profile. The key piece of information is the ancestor or group. You need to ask yourself 'how did this DNA that I share with this person reach me', and enter the name of the ancestral couple who are your common ancestors (or if you prefer to label with an individual, enter the name of their child who is your ancestor).

Repeat this process with other known matches. Now, when a new unknown match emerges, you will potentially be able to harness your chromosome map in order to identify them.

A note on Target Testing

Target testing – selecting a known relative and asking them to test – is a great way to boost your chromosome mapping project.

- The most useful people will be those who are related to one of your parents but not the other
- Or even better someone who is related to one of your grandparents but none of the others
- Or even better one of your great grandparents but not the others

If you offer to pay for the test, many relatives will oblige.

Other DNA Painter functionality

- You can click on a chromosome number to expand it and show a stacked view of segments
- The controls area above chromosome 1 allows you to expand all chromosomes, search for a match, and also access the settings cog with access to:
 - Actions - including
 - Sharing a profile
 - Import ethnicity segments from 23andme
 - Duplicate a profile

- Options – including
 - Show centromeres on the chromosomes
 - Hide unknown groups (those groups that haven't been identified as being for a known ancestor)
 - Show a keyline when the cursor hovers above an expanded chromosome
- Reports - including
 - All segment data – allowing you to download, filter and back up your data
- The key/legend.
 - Dragging and dropping groups within the key adjusts the layer order – segments that are in groups higher up the key will appear on top of those that are in lower groups.

Clearing up some common misunderstandings

- Not everything is magical and automated! DNA Painter helps visualize the data you enter so you can draw better conclusions.
- You can't use AncestryDNA matches unless you can persuade them to upload elsewhere
- Unless you've identified maternal and paternal relatives, your testing site probably doesn't know if a match is maternal or paternal, and neither does DNA Painter, although comparing matches can help you figure it out.
- DNA Painter can't talk to the testing companies to see if people match each other; you have to do this yourself

Interpretation

- Narrowing down the connection to a match can be a multistage process
 - Maternal or paternal
 - Narrowing down to a grandparent
- If two match segments overlap significantly (as a rough guide, by at least 3,000,000 base pairs), and if you're able to compare them directly and confirm they match each other, then there is likely a common ancestor, but beware:
 - The segment might be much older than the genealogical timeframe, particularly if it's under 15cM in size

- The segment may have reached you via a completely different relationship than the one you're aware of. Beware of confirmation bias and be prepared to be proved wrong when you assign DNA to specific ancestors!

Challenges

- Endogamous ancestry and/or multiple relationships between you and your match can make it harder to answer the question 'how did this DNA reach me?'
- Any assignment is an assumption and you should be prepared to be proved wrong

Subscriber-only features

Subscriptions are available on a 6-month and 12-month basis. For current costs, please see <https://dnainter.com/help/how-much>

Subscriber-only features are as follows:

- The option to create additional profiles beyond the first
- The option to perform a bulk import of matches.

Import tool

- The import tool allows you to import all your matches at once from a download of segments provided by your testing company.
- If you import too many segments, your profile is likely to become very slow. It's therefore suggested:
 - Make a copy of your profile before you start
 - Make sure you pay attention to thresholds. Particularly if you have any endogamous ancestry, it makes sense to use a higher segment threshold and perhaps a higher match threshold (e.g. you can import only matches with whom you share at least 20cM)
- The import tool can help you see your coverage – the areas of your chromosomes where you have the most and least matches.
- It can also be invaluable for identifying personal pileup areas – sections of your chromosomes where you seem to have more matches than expected, potentially indicating a very old segment.

Useful links

DNA Painter

<https://dnainter.com>

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

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

Transferring your DNA

<https://thednageek.com/how-to-transfer-your-ancestrydna-test-to-other-databases/>

How-to articles

<https://dna-explained.com/2018/03/28/dna-painter-chromosome-sudoku-for-genetic-genealogy-addicts/>

<http://ultimatefamilyhistorians.blogspot.com/2018/01/using-dna-painter-to-reconstruct.html>

<http://www.jmhartley.com/HBlog/2018/04/11/playing-with-dnainter/>

<https://medium.com/@dnainter/painting-your-dna-with-inferred-matches-28718a3da44c>

Video tutorials

https://www.youtube.com/watch?time_continue=1&v=wycJxywTZI

<https://vimeo.com/283126987>