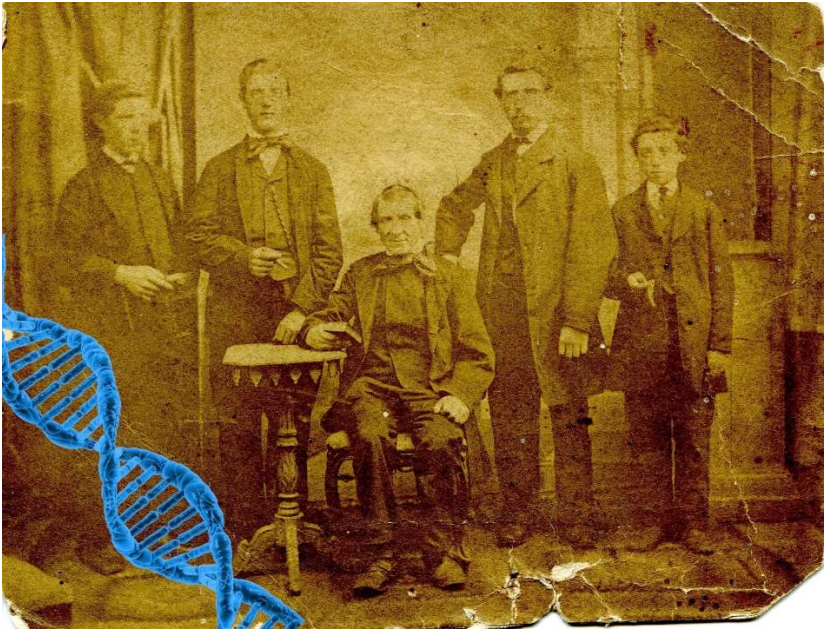


# An unbiased Genetic(DNA) Genealogy textbook



Erik Mols, MSc, BEd  
January 2021



## Contents

1	Introduction.....	5
2	The Origin of DNA.....	8
2.1	The Cell.....	8
2.1.1	We are built of cells.....	8
2.1.2	The Cell.....	9
2.1.3	Nucleus.....	10
2.1.4	Mitochondria.....	13
2.2	DNA.....	15
2.2.1	DNA.....	15
2.2.2	DNA copy process.....	17
2.2.3	Introns and exons.....	20
2.3	Evolution the base for DNA(Genetic) Genealogy ...	23
2.3.1	Introduction.....	24
2.3.2	SNP.....	25
2.3.3	Indel.....	27
2.3.4	STR.....	28
2.3.5	GCN.....	29
3	Genetic (DNA) Genealogy.....	30
3.1	Mapping our DNA.....	30
3.1.1	Chip testing.....	31
3.1.2	Full genome sequencing.....	32
3.2	Ethics and Genealogy.....	35

3.3	Starting with research.....	37
3.4	Results .....	37
3.4.1	Ethnicity and Health results .....	38
3.4.2	cM .....	45
3.4.3	Family Tree, Family Web.....	48
3.4.4	Chromosome browser and clustering.....	50
3.4.5	Haplogroup.....	52
3.4.6	aDNA or Ancient DNA .....	55
3.4.7	Phasing.....	55
3.4.8	Filin DNA Genealogy Framework.....	57
4	Doing research .....	65
4.1	Autosomal research .....	65
4.2	Your parents are probably related, the family Web..	71
4.3	Leeds method explained.....	72
4.4	yDNA research .....	80
4.5	mtDNA research.....	82
4.6	Going beyond 1700 .....	84
5	My personal voyage.....	86

## 1 Introduction

Before starting about Genetics and Genetic(DNA) genealogy, lets introduce myself. My name is Erik Mols, born in the city of Tilburg in the Netherlands in the year of 1970. After high school I studied biology and bio-informatics. Got a BEd degree in biology from “De hogeschool katholieke leergangen” and a MSc in bio-informatics from the “Wageningen University”. Currently I am working as a free scholar, working for multiple different commercial Universities, teaching and writing in a range of subjects, from software engineering, databases to IT architecture and Data science, but also subjects like molecular biology and DNA. During my studies and during my career, I participated in multiple DNA scientific projects which mostly where not publicized. In the Netherlands its common that researchers in universities of applied sciences (like me) have no publications, because they are focussed on teaching and not on researching. This doesn't mean that lots of my students didn't have publications in which I advised them.

I'm married with Lena and have two children, Maksim and Karina. We live in the village of Biezenmortel, which is part of the big city Tilburg (210.000 inhabitants) in the southern Netherlands, close to the Belgium border.

This textbook is written as an introduction for people to get in to Genetic Genealogy, to help them with their own research. This book is called 'unbiased' because I am not affiliated with any DNA testing company. Everything in this book is based upon my own knowledge through study and research.

But first let's start with a good academic discussion about the term Genetic Genealogy, some readers who might know me already, know that I don't like the term Genetic Genealogy.

Why?

Well during my studies I was taught Genetics was a very broad field, it consists from all kind of omics: Genomics, Transcriptomics, Proteomics and Metabolomics. When looking at this broad field only Genomics is used in the field of Genetic(DNA) genealogy. So why they chose the name Genetic genealogy is a big riddle to me.

Genomic Genealogy would be a better term, or DNA Genealogy.

The pictures used in this book are all released under Creative Commons licences. The rights on the picture on the cover are unknown, also the author of this picture is unknown. We do know its taken in Tilburg around 1880. In the middle (man sitting), you see Petrus Franciscus Mols my Great Great Great grandfather. To his right his eldest son Johannes (my Great Great grandfather) and to his right Petrus Franciscus Mols my great grandfather. All men with whom I share DNA, though I have never met them.

Biezenmortel, January 2021

## 2 The Origin of DNA

In this chapter I am going to explain what DNA is, and which DNA mechanisms/processes are important for DNA genealogy. All other DNA/RNA processes are out of scope, not that they are not important, but they are not important to DNA genealogy. Next to that it's not my intention to write a Genetics textbook.

We have DNA in our entire body. Our DNA of interest manifests itself in our Cells. So the Cell is where we start.

### 2.1 The Cell

#### 2.1.1 We are built of cells

As you probably know, your body consists of many organs: brain, heart, lungs, stomach, intestines and many more. Your skin and bones are also organs of course, with your skin being the biggest organ of all. When you look at your organs through a microscope you will see a lot of cells. The cell is the primary unit of our body, it's our main building block. In our body are approximately 37,000,000,000,000 cells. So that's a whole lot of cells.



All our cells contain a copy of our DNA, except our reproductive cells which only have the half package. The total amount of single source DNA in a cell is called a genome. So you would expect we have one Genome. But that assumption is wrong, we have two genomes. Our autosomal/heterosomal genome and our mitochondrial genome, but this will be explained in later paragraphs.

### 2.1.2 The Cell

In the last subject we spoke about the human body consisting of organs, with organs consisting of cells. When you look at a cell through a microscope you will be a bit disappointed. This is because the different parts of the cell are so small that you need a very strong microscope to see all the details. Such a microscope we call an electron microscope. When studying the image of a cell, made by an electron microscope you will see the many parts which are the building blocks of the cell. These parts we call cell organelles, they have a, or multiple roles in all the cell processes. For Genealogy there are only two organelles interesting: the nucleus and the