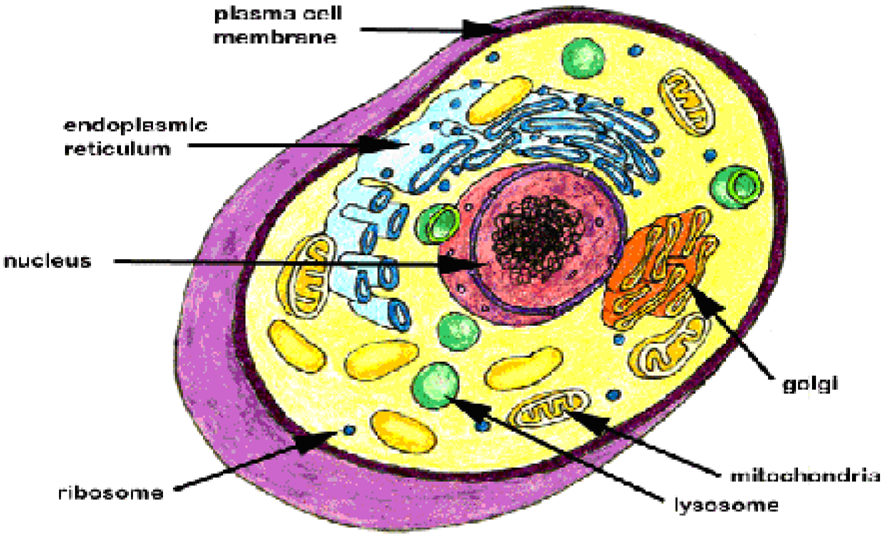
Analysis of mitochondrial DNA (mtDNA)

The human cell consists of a core surrounded by a fluid (cytoplasm) in which many cells and organelles are located. The liquid is surrounded by a membrane. An important organelle is the mitochondrion. In each cell are certainly hundreds and possibly thousands of mitochondria present. The mitochondria provide the energy of the human body.



The nucleus of every cell contains the DNA, the genetic material of humans.

DNA (desoxyribo nucleic acid) is the large collection of genetic information in the cell. A DNA molecule consists of two strands in the form of a double helix linked by weak base pairs of nucleotides, each two of four bases: adenine (A), cytosine (C), guanine (G) and thymine (T). The sequence of bases in DNA is the code for specific information about the genetic blueprint of the individual.

Part of a strand looks like this: **gatcacaggtctatcaccctattaaccactcacg**

DNA is found not only in the core of the cell but also in a mitochondrial. We cut it down to mtDNA.

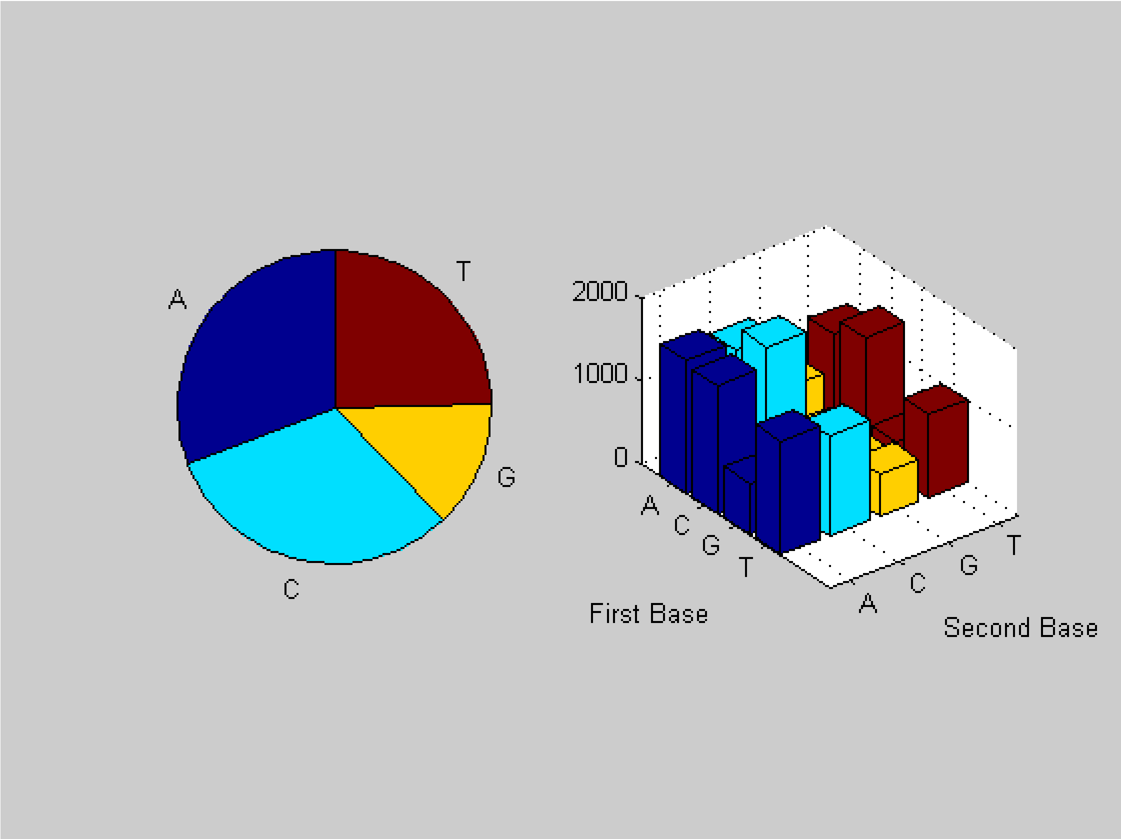
See: http://www.mitomap.org

The ‘Human Mitochondrial Genome ‘ consists of 16,568 nucleotides (base pairs).

An analysis of the total quantity provides the following breakdown:

A (5124 = 30.9%), C (5181 = 31.3%), G (2169 = 13.1%) and T (4094 = 24.7%).

Map of breakdown mtDNA (first and second Base)



With an equal distribution of the four bases every 4142 base (25%) would occur once. T is true that about. A and C are each approximately 6% more than average and G is almost 12% less.

The question is how these differences with an equal probability distribution can be explained.

The following analysis concerns the question what is the maximum number of successive equal bases and how often such a string is present. The maximum number of consecutive bases is equal 8. This occurs one time and concerns A.

The list is as follows.

	8 times	**7 times**	**6 times**
A (adenine)	1	7	12
C (cytosine)	0	1	10
G (guanine)	0	0	1
T (thymine	0	1	4

Although the numbers of A and C are almost equal (C is even slightly more than A) it is particularly striking that a string of 7A much more frequently occurs (7 times) than a string of 7C (1).

The question is how these differences can be explained.

Finally, an analysis of the committed number of times a particular combination of four different bases occur.

With an equal distribution of A, C, G and T is the probability of 1 of 4 (ie the probability of A) is ¼. The chance of drawing eg ACGT will be: ¼ x ¼ x ¼ x ¼ = 1 / 256

Of a total of 16,567 bases, the number of times eg ACGT occurs on average 1 / 256 x 16 567 = 64 times.

Four elements have 4! different combinations. 4! = 4 x 3 x 2 x 1 = 24

The frequency of reality is as follows.

ACGT	21 ATGC	37 AGTC	38 ACTG	39 ATCG	46 AGCT	63 Totaal	244
CGAT	23 CGTA	30 CATG	48 CAGT	49 CTGA	69 CTAG	97 Totaal	316
GATC	23 GTCA	32 GTAC	35 GACT	49 GCAT	56 GCTA	64 Totaal	259
TCGA	29 TACG	37 TGCA	37 TCAG	38 TGAC	54 TAGC	95 Totaal	290
	96	136	158	175	225	319	1109

Again the question is, how it is possible that such differences may arise in actual presence of a certain combination compared with the theoretical possibility.

Solution.

To all appearances, there is a **Fractal distribution**. In 3 articles the Fractal Analysis of mitochondrial DNA are discussed.

http://biocomplexity.indiana.edu/jglazier/docs/student_dissertations/cheryl_thesis.pdf

http://www.ozy.com/fast-forward/the-motherlode-mitochondrial-dna/3328

http://www.fractal.org/Fractal-Research-and-Products/Fractal-Structure-mtDNA.pdf