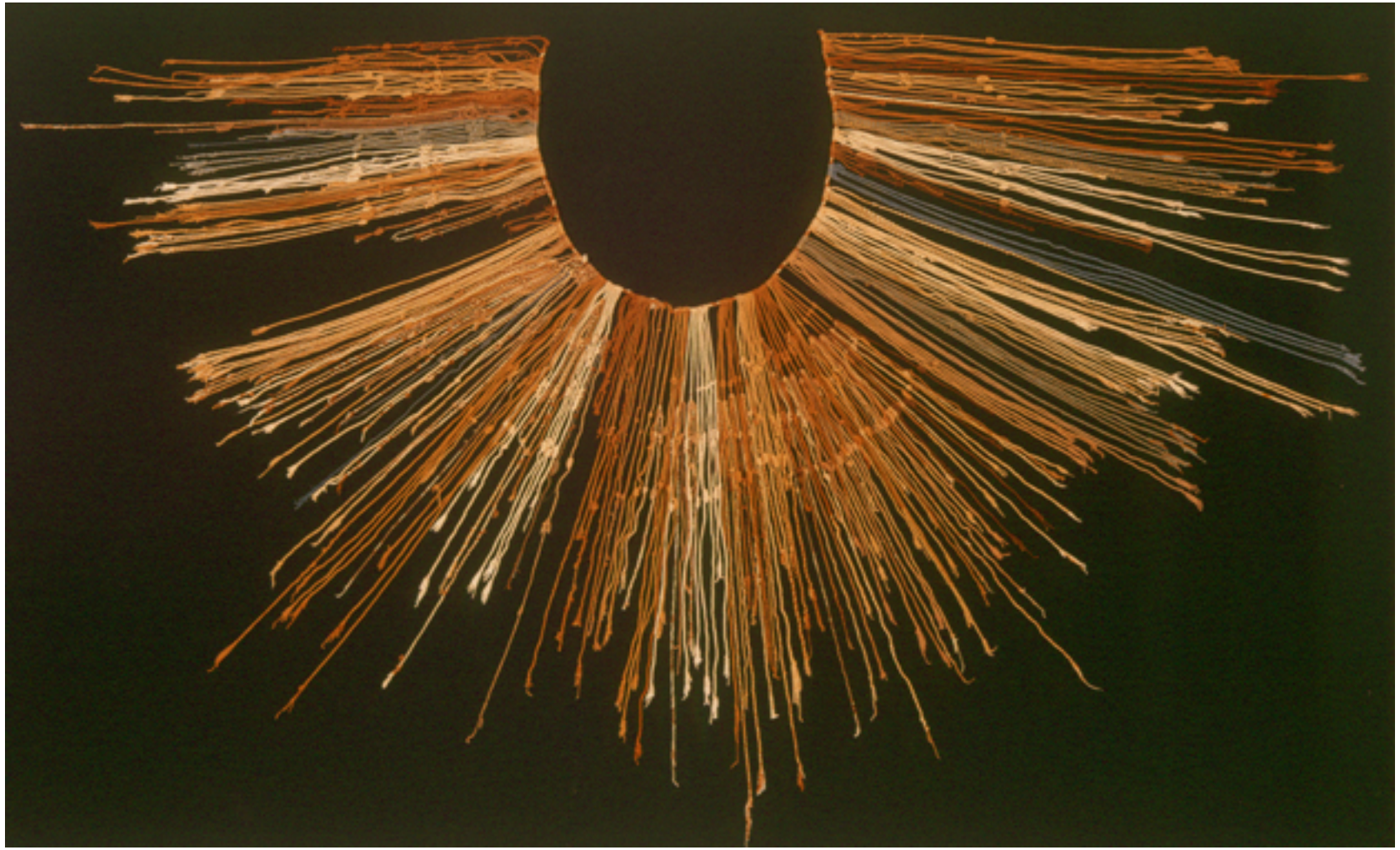
Gene Basics

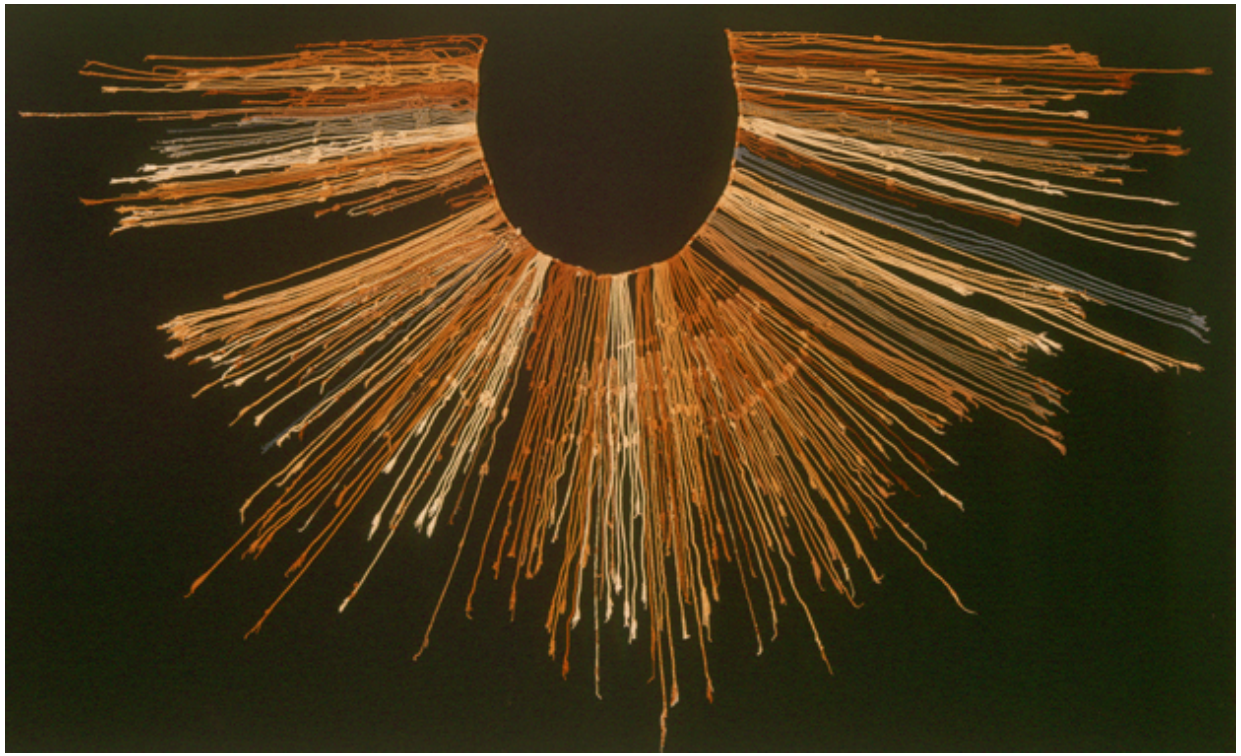
Molecular biology Introduction

What is this?



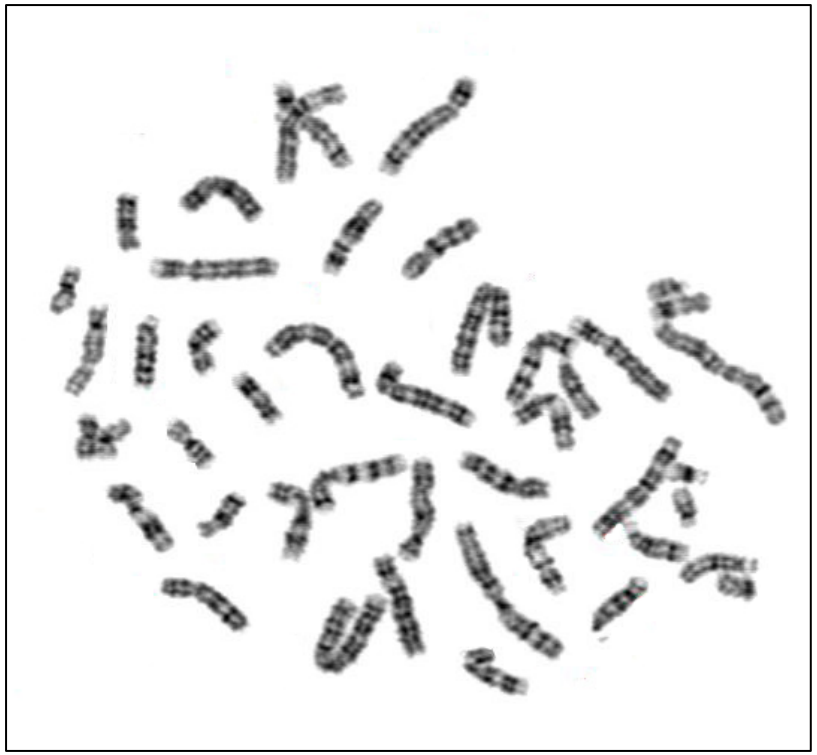
Claus Ableiter nur hochgeladen aus enWiki - enWiki, hochgeladen von User Lyndsaruell; siehe http://en.wikipedia.org/wiki/Image:Inca_Quipu.jpg
An Inca quipu, from the Larco Museum in Lima

Quipu



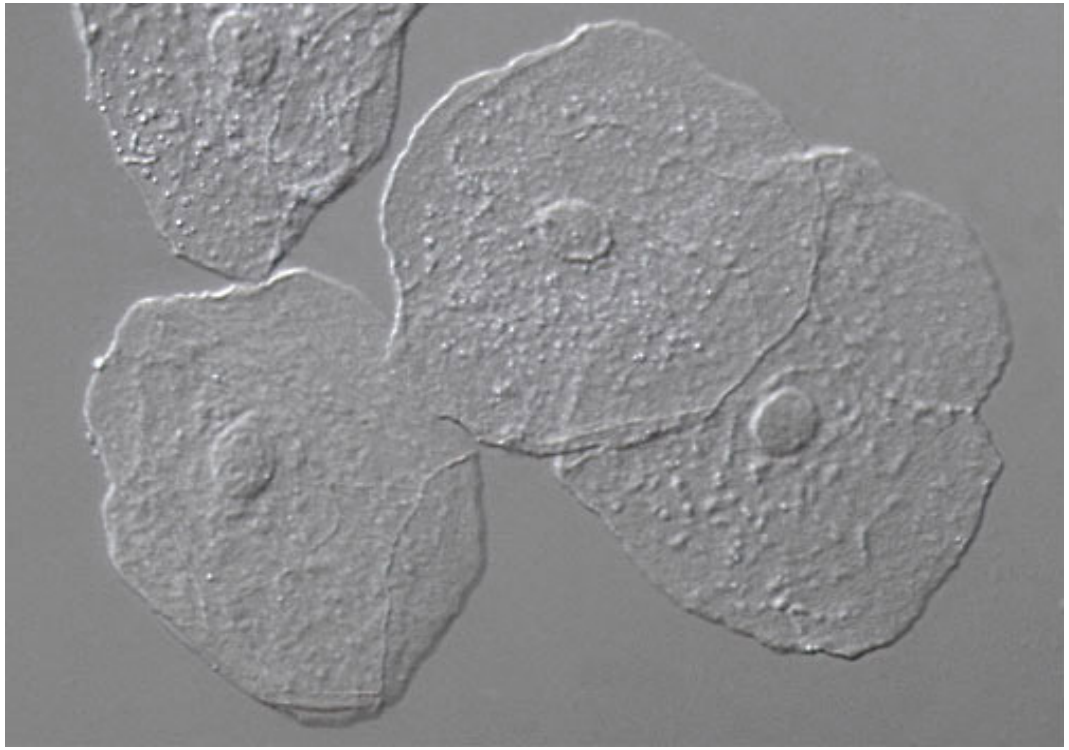
A quipu usually consisted of cotton or camelid fiber strings. The Inca people used them for collecting data and keeping records, monitoring tax obligations, properly collecting census records, calendrical information, and for military organization. The cords stored numeric and other values encoded as knots, often in a base ten positional system.
– en.wikipedia.org/wiki/quipu

DNA – Nucleus



https://www.geneticcentre.org/FACILITIES_CYTOGENETICS.html

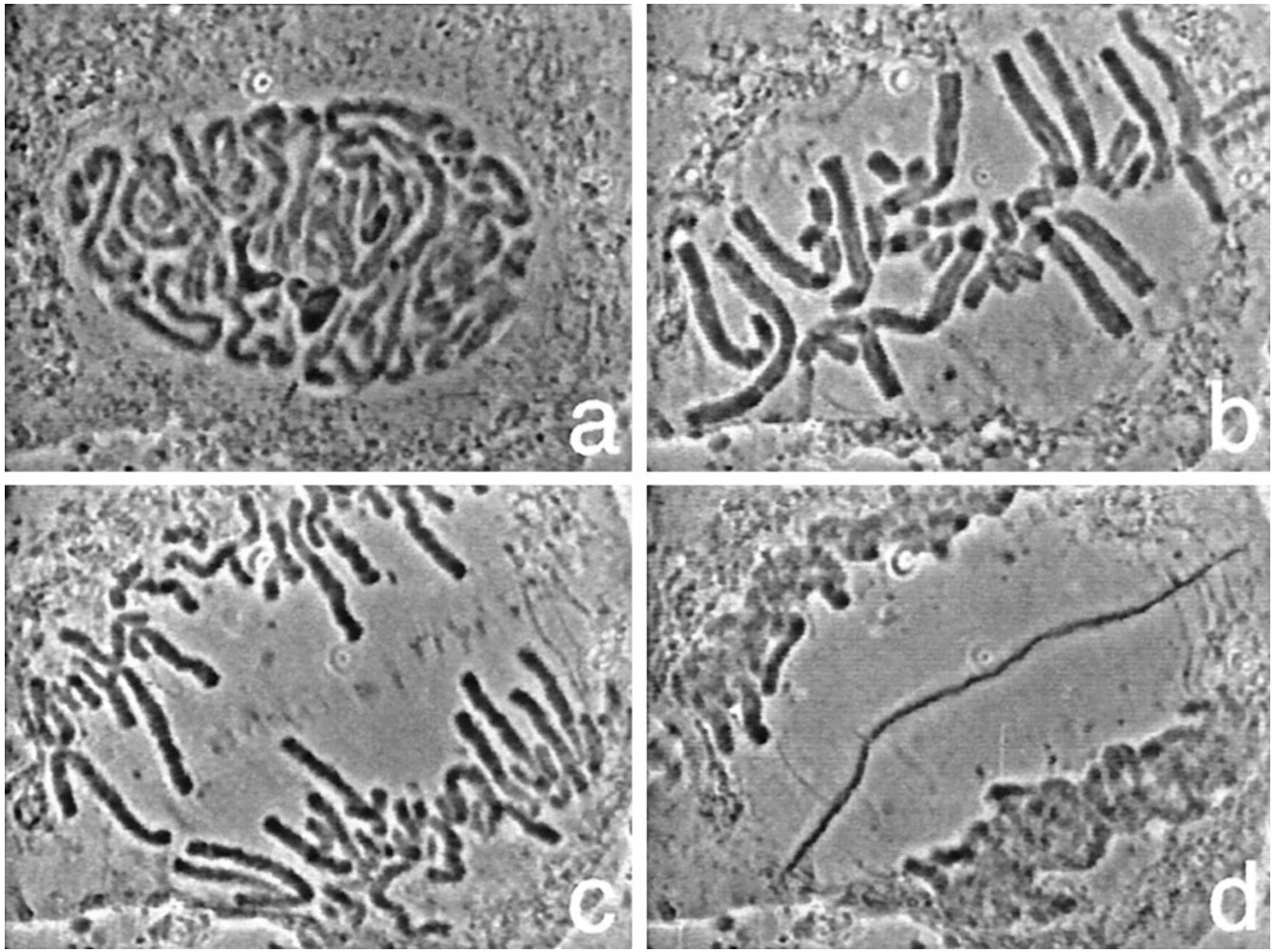
Human metaphase chromosomes



https://www.microscopyu.com/assets/gallery-images/Comparison/DIC_cheekcellsdic.jpg

Human cheek cells

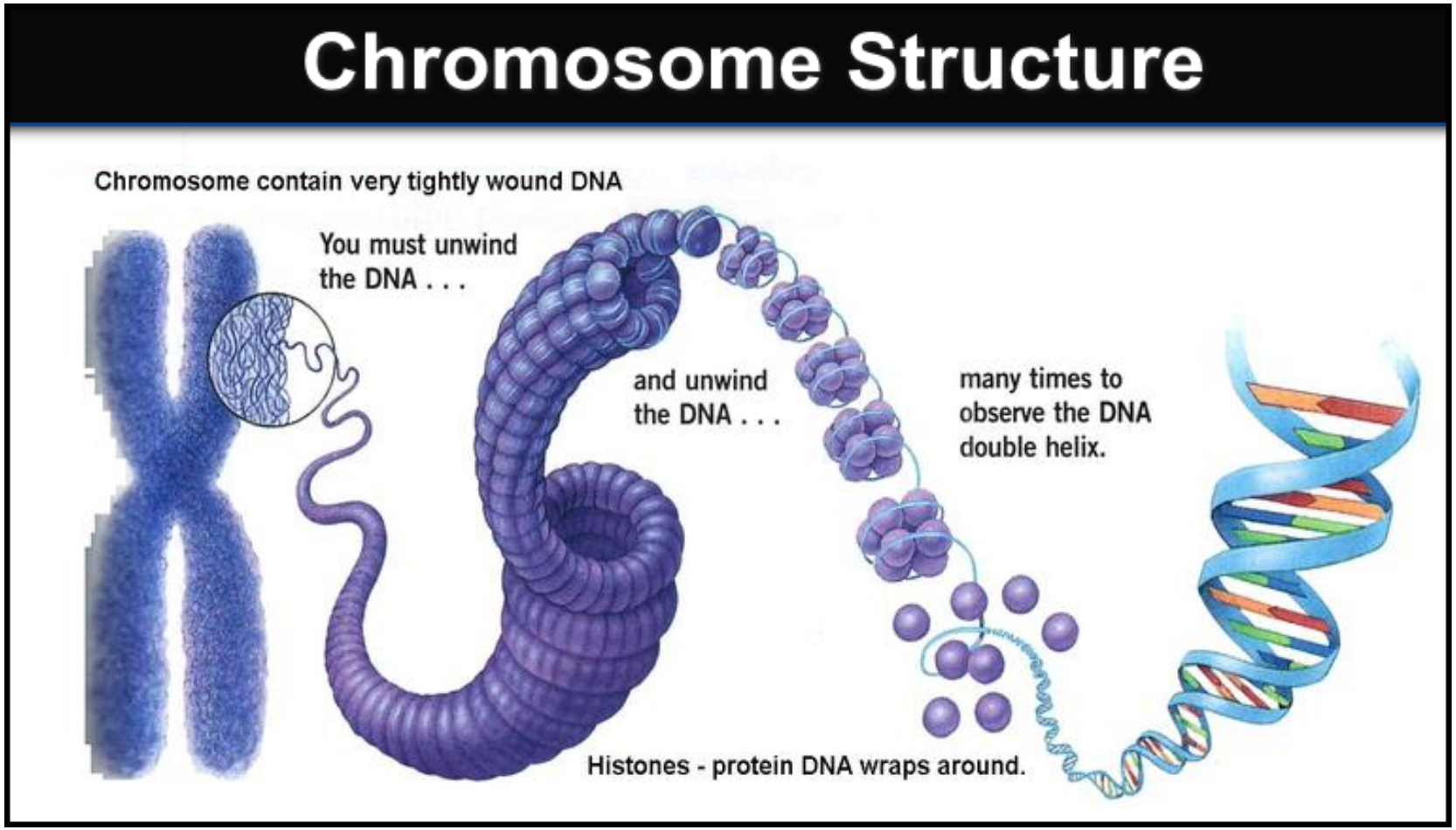
DNA - Chromosomes



http://iramis.cea.fr/dna2006/mitosis.html

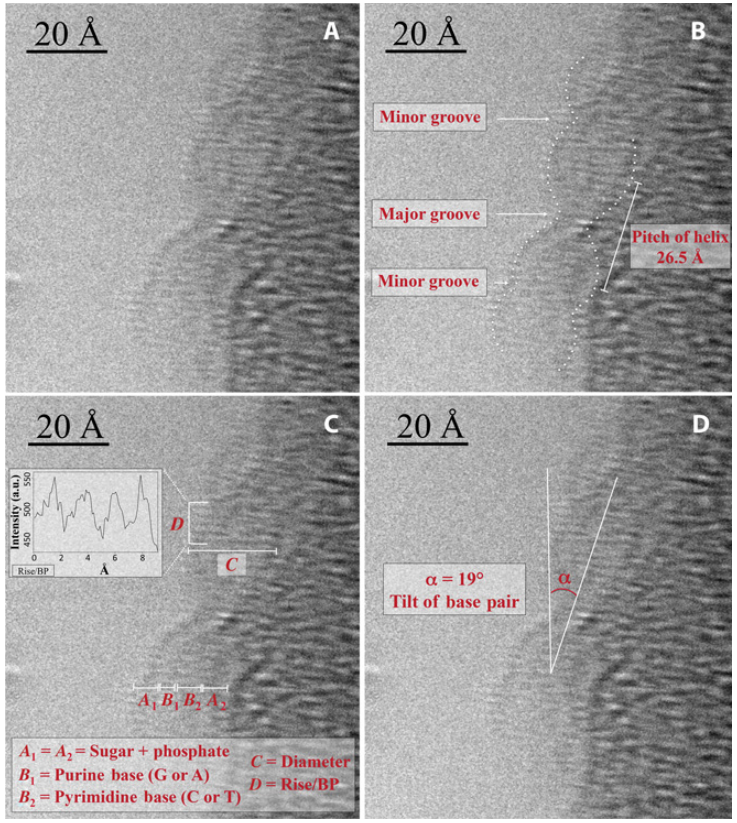
Mitosis and cell plate formation in a flattened endosperm cell of the African blood lily, *Haemanthus katherinae*, observed with phase contrast microscopy. (a) prophase, (b) metaphase, (c) anaphase, (d) telophase.

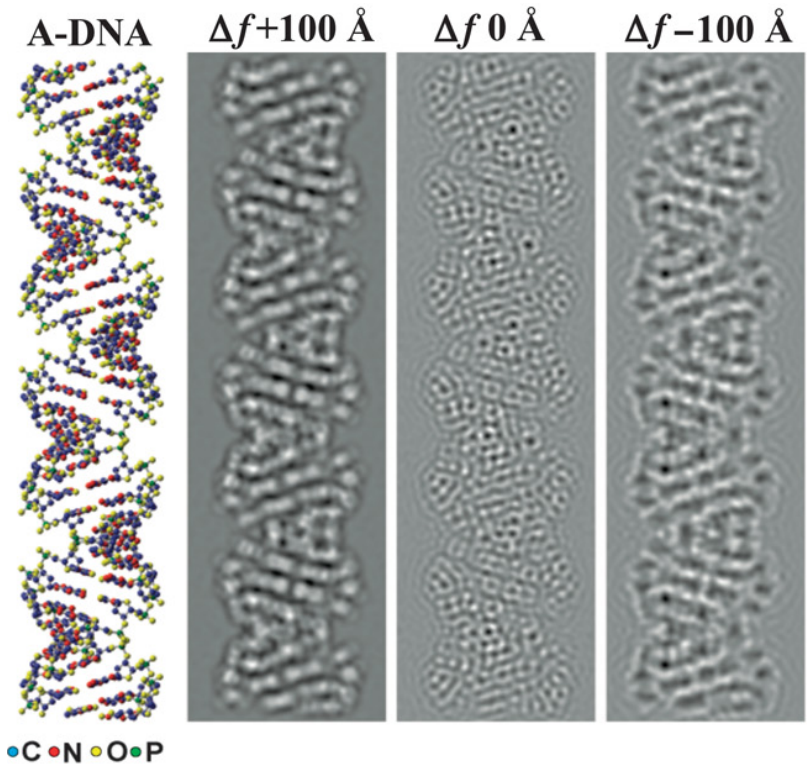
DNA - Structure

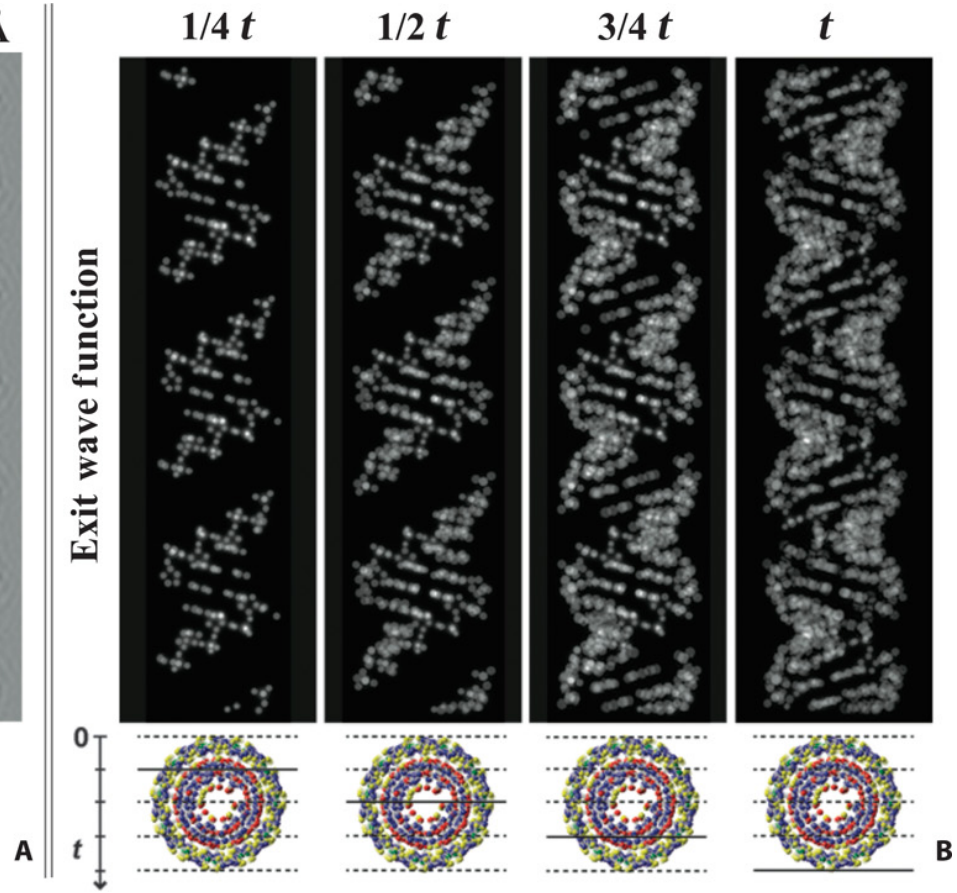


https://www.golifescience.com/structure-of-chromosome/

DNA – Electron microscopy

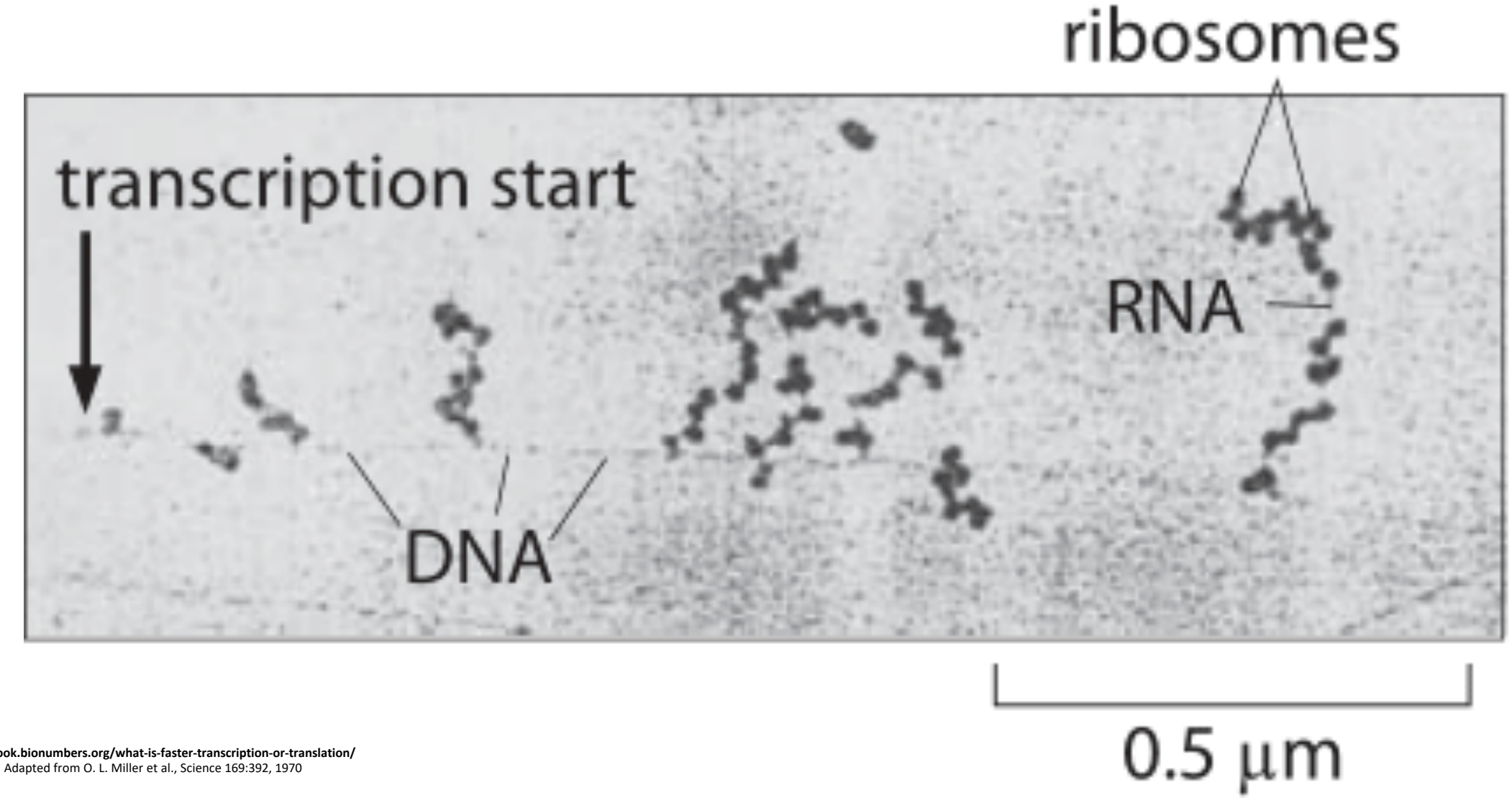






The structure of DNA by direct imaging
Science Advances 28 Aug 2015:
Vol. 1, no. 7, e1500734
DOI: 10.1126/sciadv.1500734

DNA – Electron microscopy



http://book.bionumbers.org/what-is-faster-transcription-or-translation/
Adapted from O. L. Miller et al., Science 169:392, 1970

DNA Sequence

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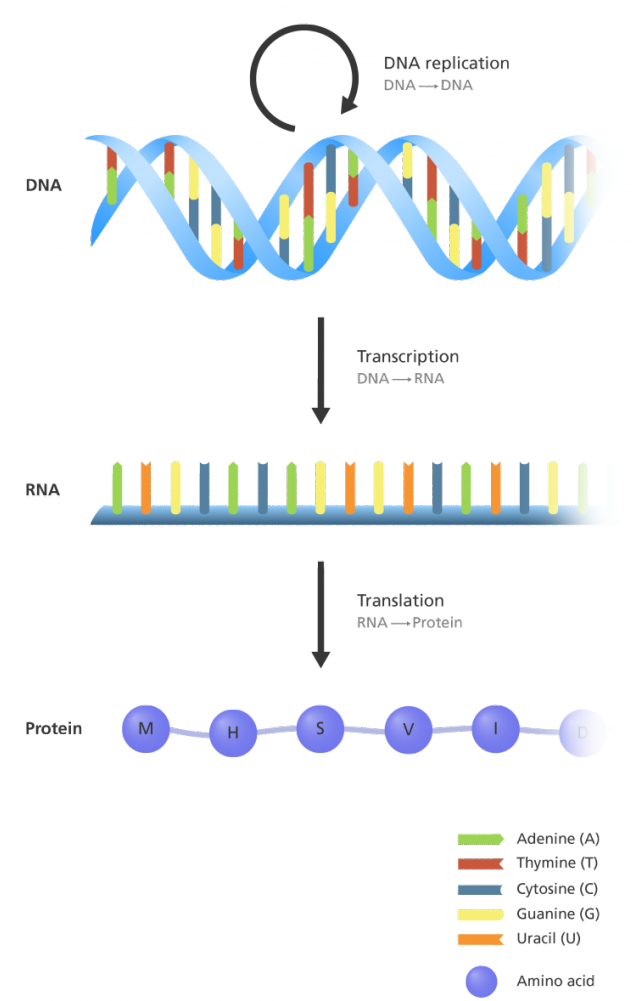
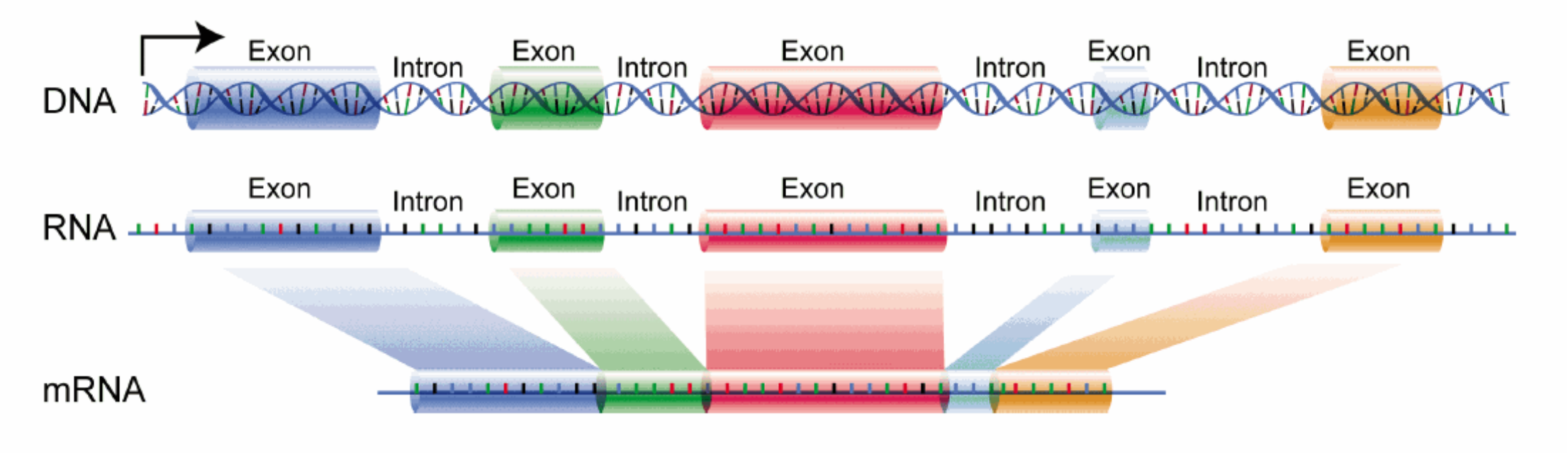
https://embnet.vital-it.ch/CoursEMBnet/Exercises02/day4b_files/contig.seq

Genes contain useful information

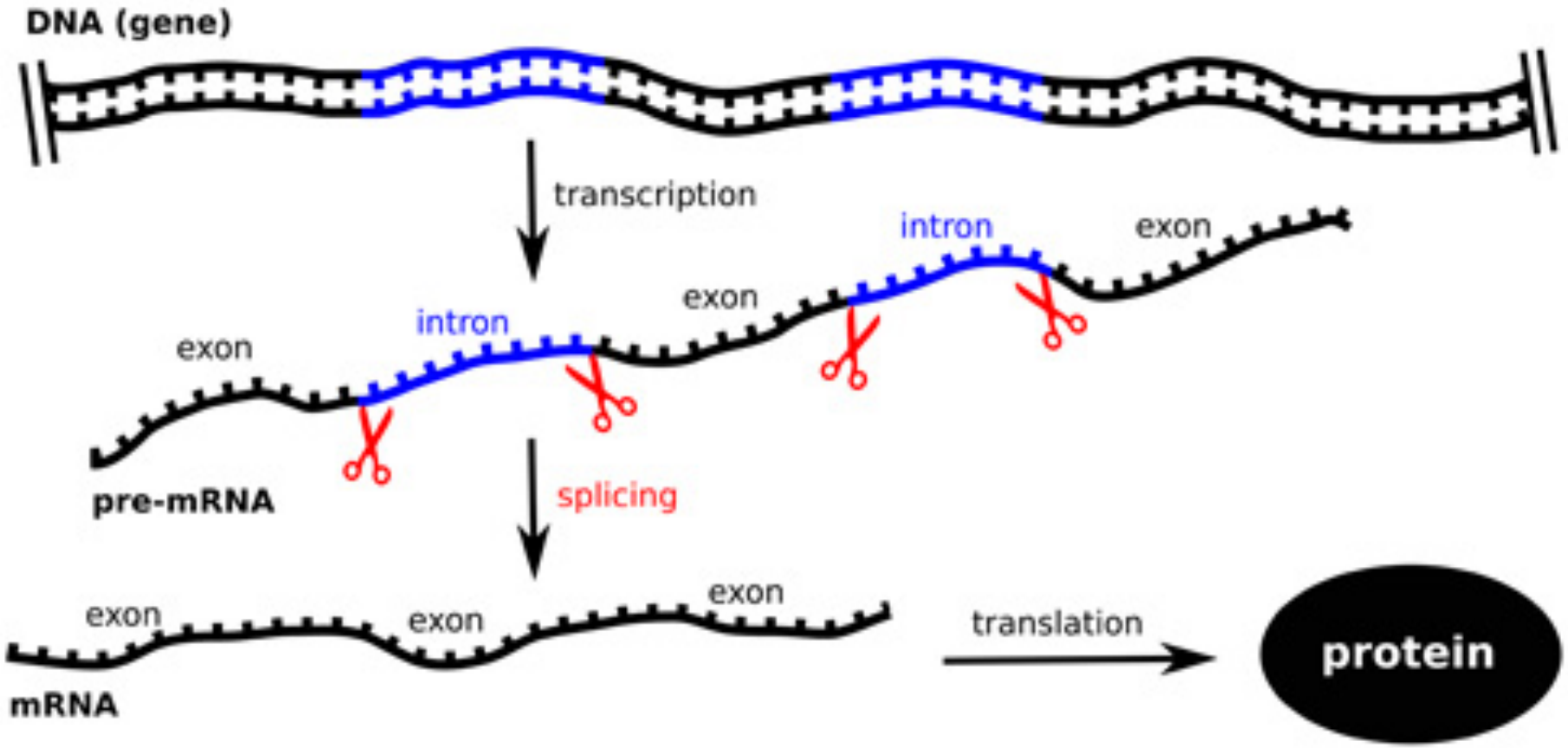


Gene Structure



https://www.zmescience.com/medicine/genetic/intron-retention-cancer-25012016/

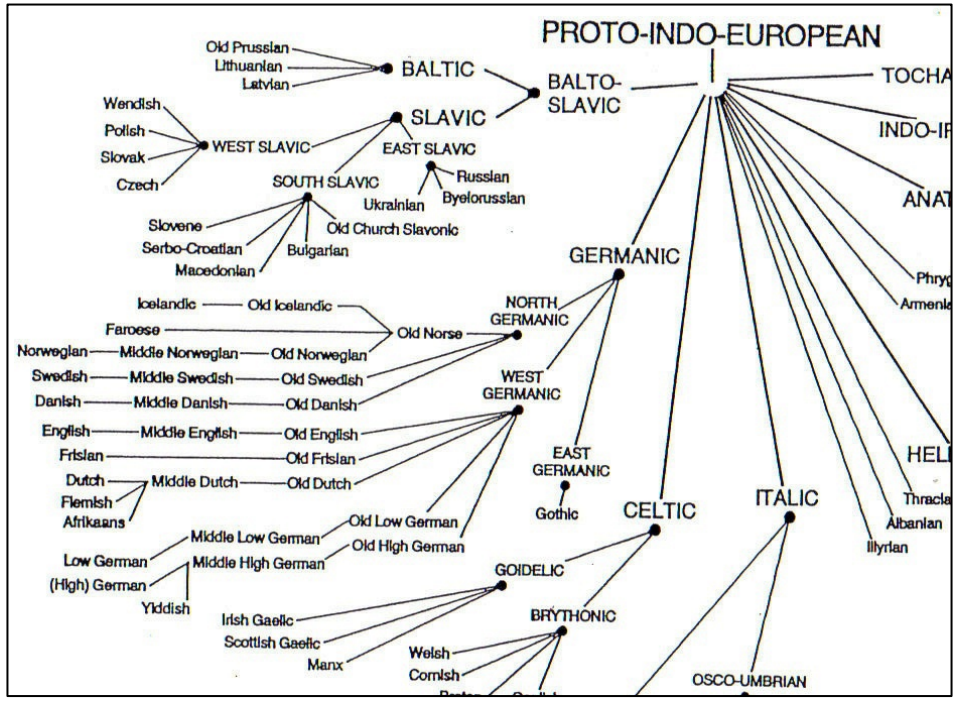
DNA Splicing



https://socratic.org/questions/what-is-the-difference-between-an-intron-and-an-exon

One way to find information is to make comparisons

Words can be conserved



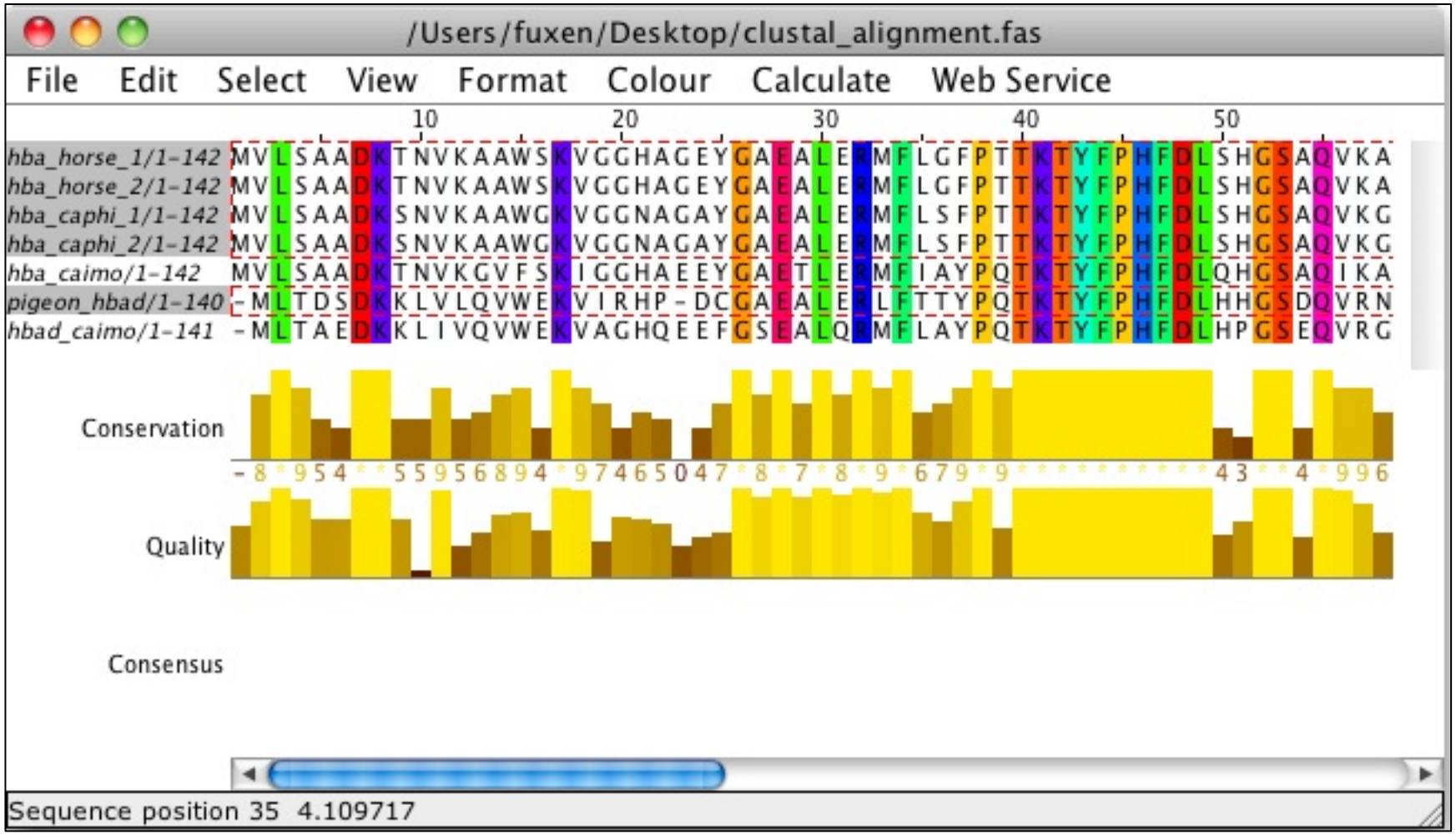
English	Dutch	German	Danish	Norwegian	Swedish	Icelandic
book (n)	boek	buch	bog	bok	bok	bók
come (v)	komen	kommen	komme	komme	komma	koma
drink (v)	drinken	trinken	drikke	drikke	dricka	drekka

What can you change?

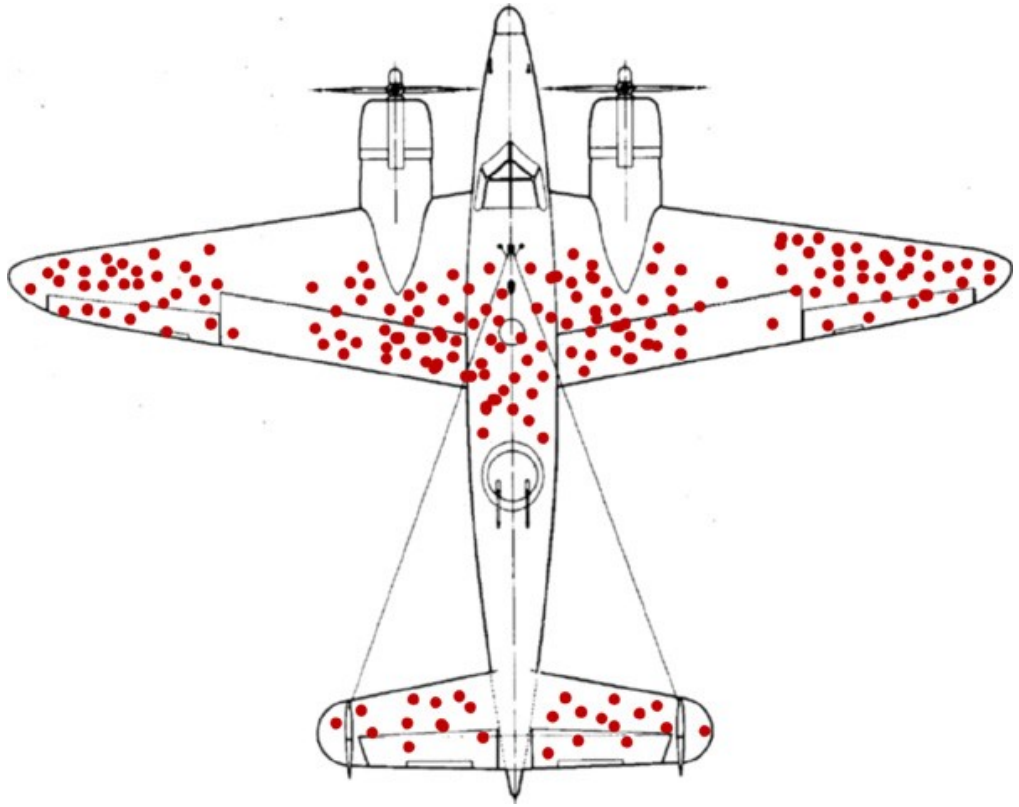
Ingredients

- 1 cup white sugar
- 1/2 cup butter
- 2 eggs
- 2 teaspoons vanilla extract
- 1 1/2 cups all-purpose flour
- 1 3/4 teaspoons baking powder
- 1/2 cup milk
- Add all ingredients to list

Genes can be conserved



Genes with essential functions are heavily conserved



Survivorship bias

We can categorize these changes (mutations)

Transitions

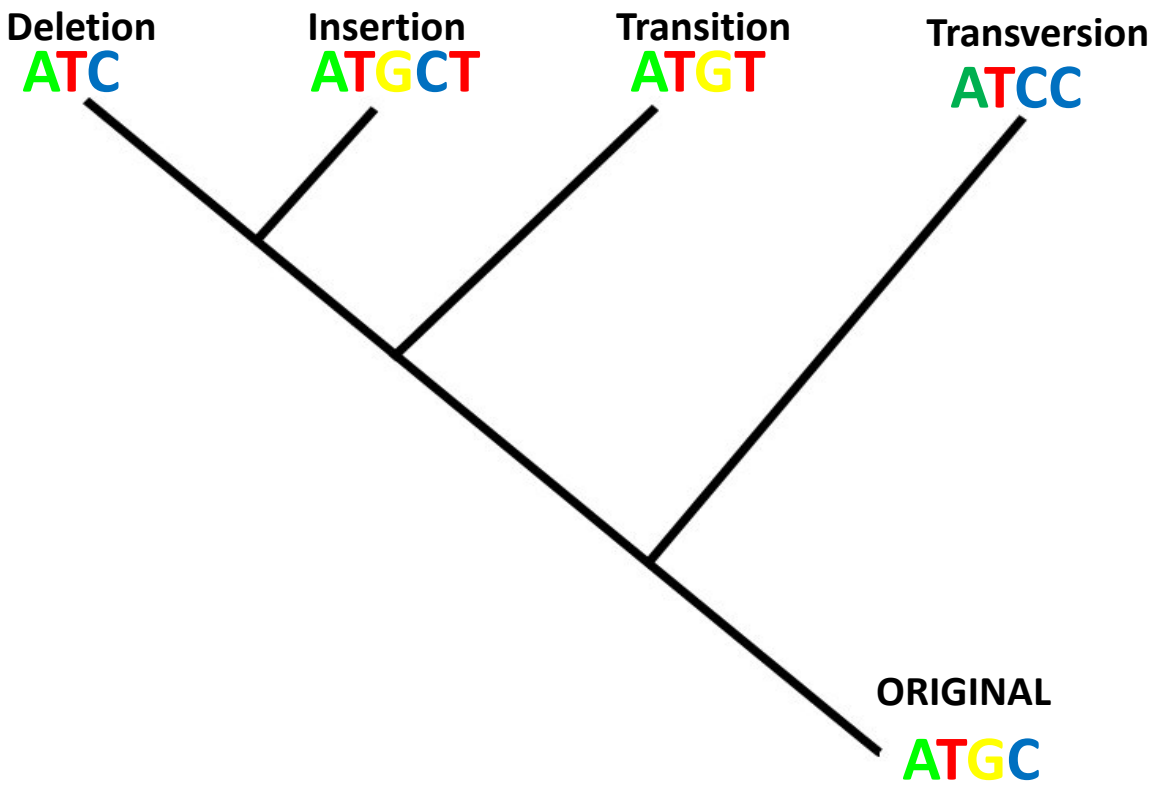
Purines(A/G) mutated to Purines
Or
Pyrimidines (C/T) mutated to Pyrimidines

Transversions

Purines (A/G) to Pyrimidines (C/G) or vice versa

Indels

Gain or Loss of Nucleotides



Summary points

- Mitochondrial DNA contains genes (and non-genes, more on this later)
- On any given stretch of a chromosome, DNA may either contain useful information (gene) or not contain any information
- Genes that are “important” (have a function essential to life) tend to be conserved
- Changes in genes (mutations) can either be insertions/deletions (indels), transitions, or transversions