



# Some Basics of Molecular Biology

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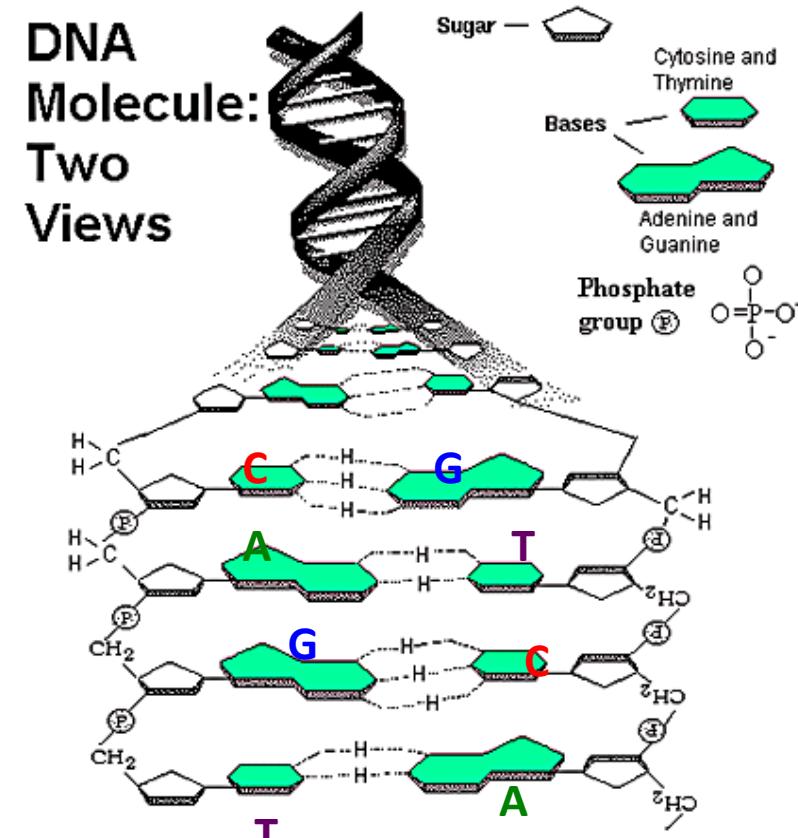
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**ETH**

Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich

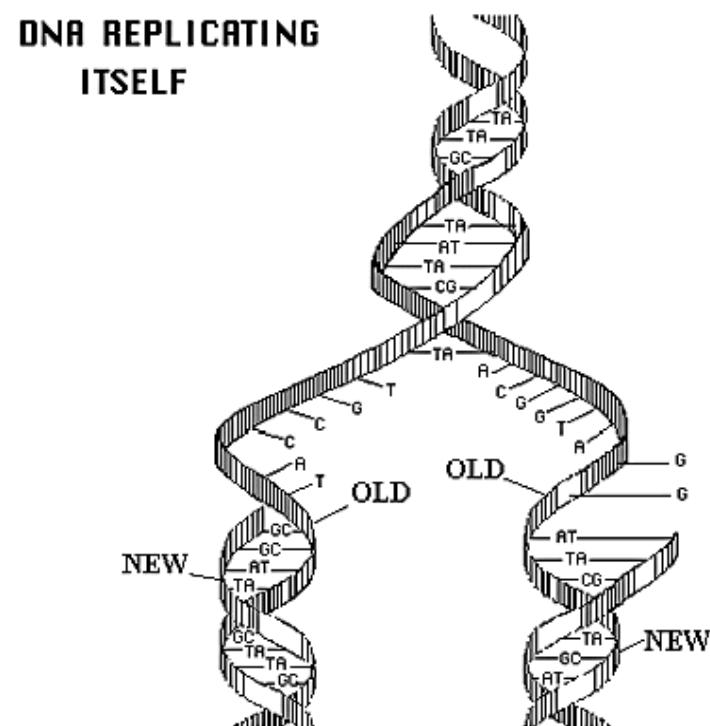
# What is DNA?

- A long backbone of sugars with nucleotides attached
  - Adenine (A)
  - Guanine (G)
  - Cytosine (C)
  - Thymine (T)
- It can form a self-complementary **double helix**
- In living organisms, the DNA is the carrier of the hereditary information, it is the source code of life

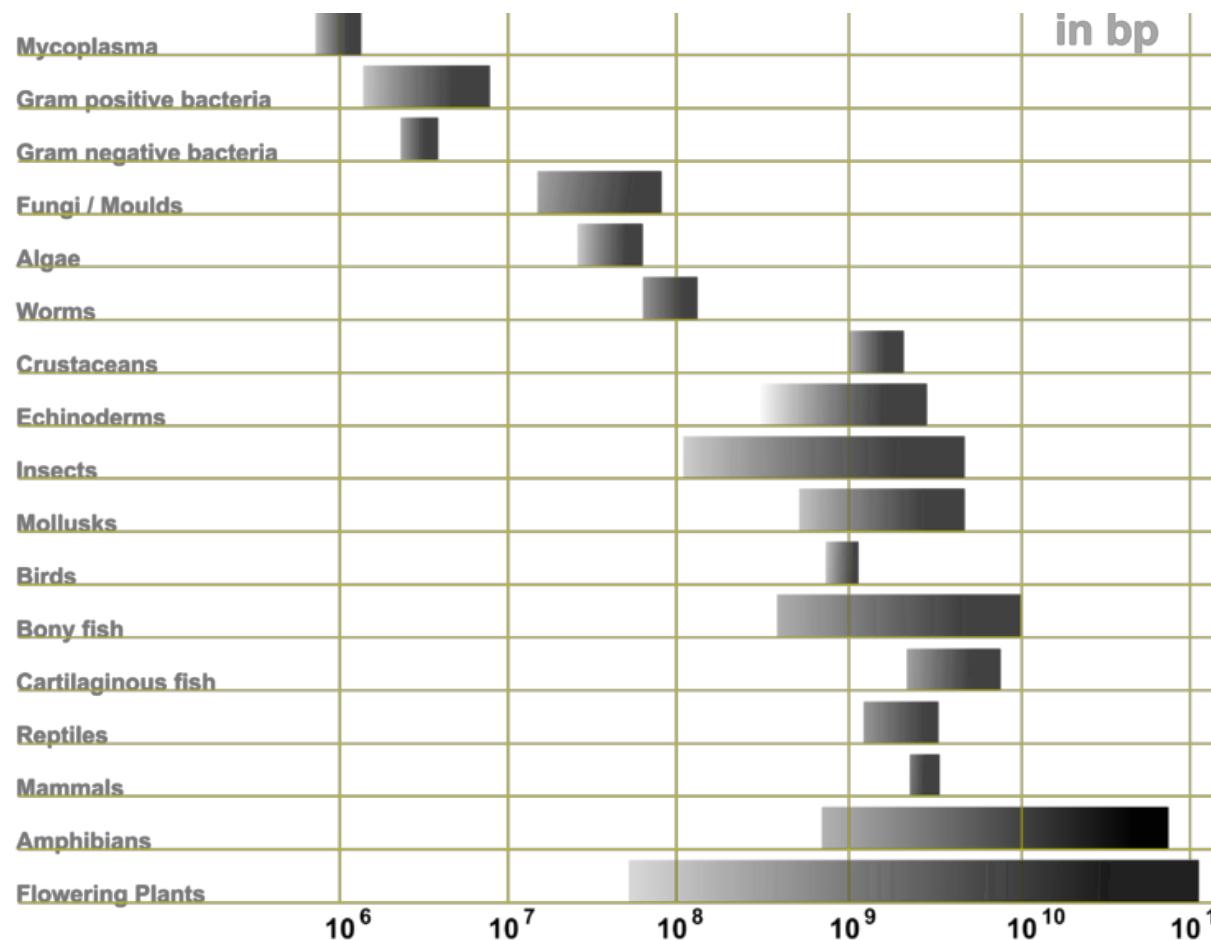


# DNA replication

- The helix becomes unzipped and each strand acts as a template for a new complementary strand of DNA



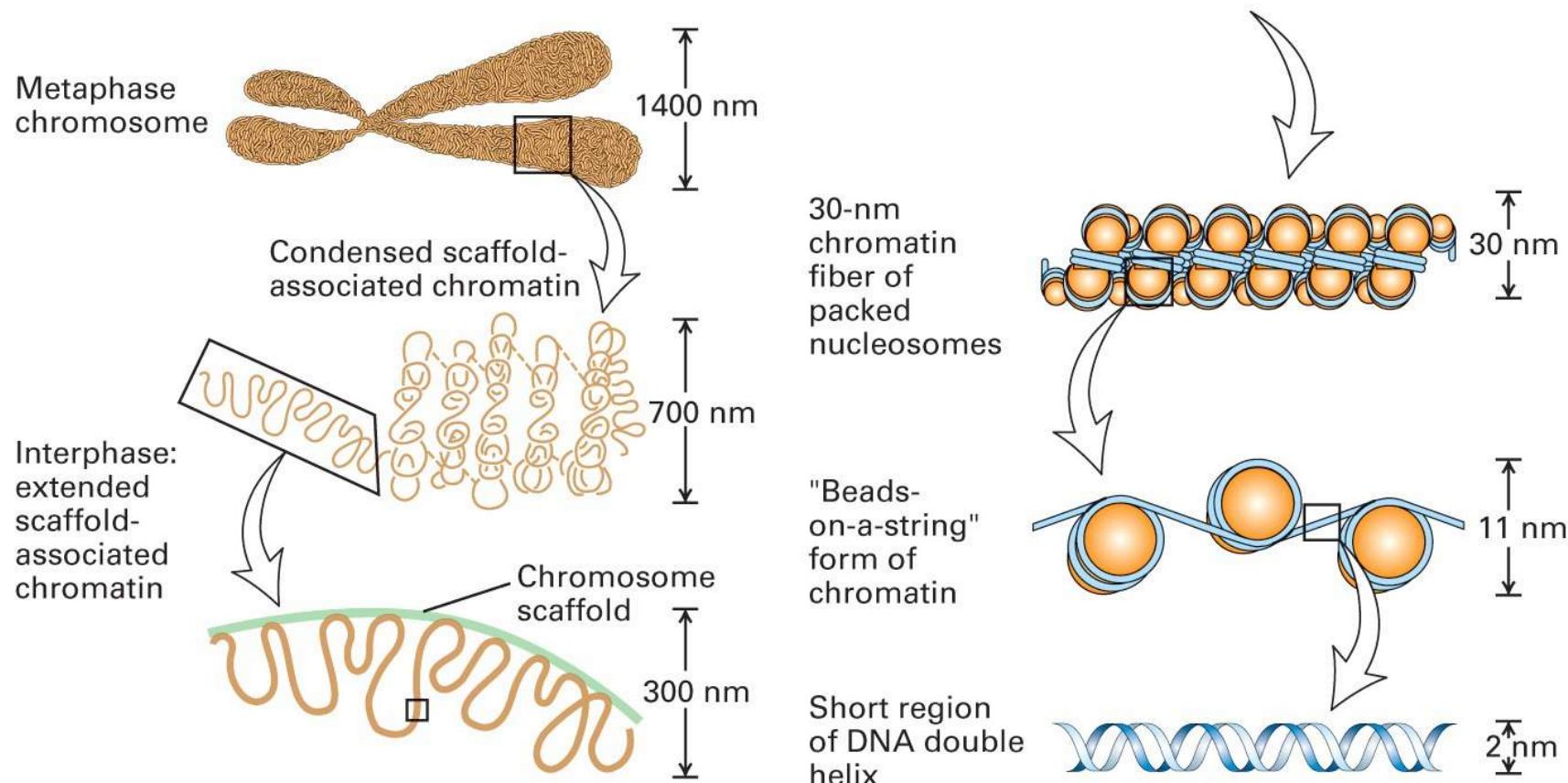
## Genome Sizes



The size of the human genome is 3.2 billion base pairs. The length of this DNA string is approx. 2m.

[http://en.wikipedia.org/wiki/Genome\\_size](http://en.wikipedia.org/wiki/Genome_size)

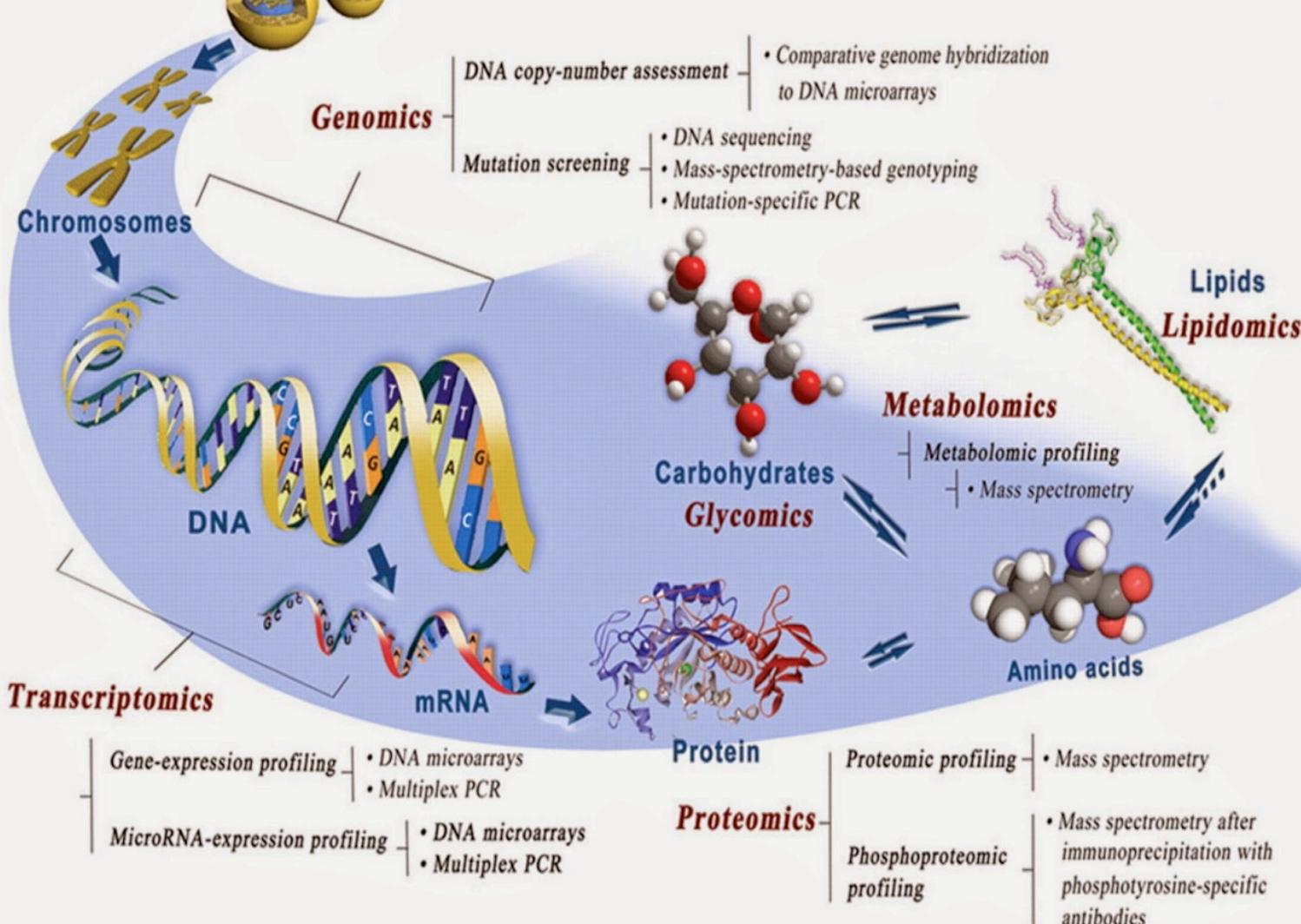
# DNA Superstructure



Lodish et al. *Molecular Biology of the Cell* (5<sup>th</sup> ed.). W.H. Freeman & Co., 2003.

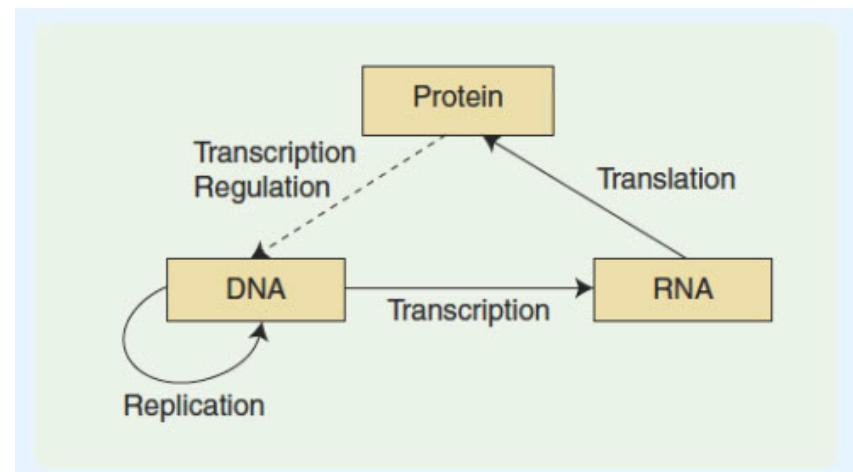
## Tissue/Cell Lines

<http://intro2res2014.blogspot.com/2014/10/omics-technologies.html>

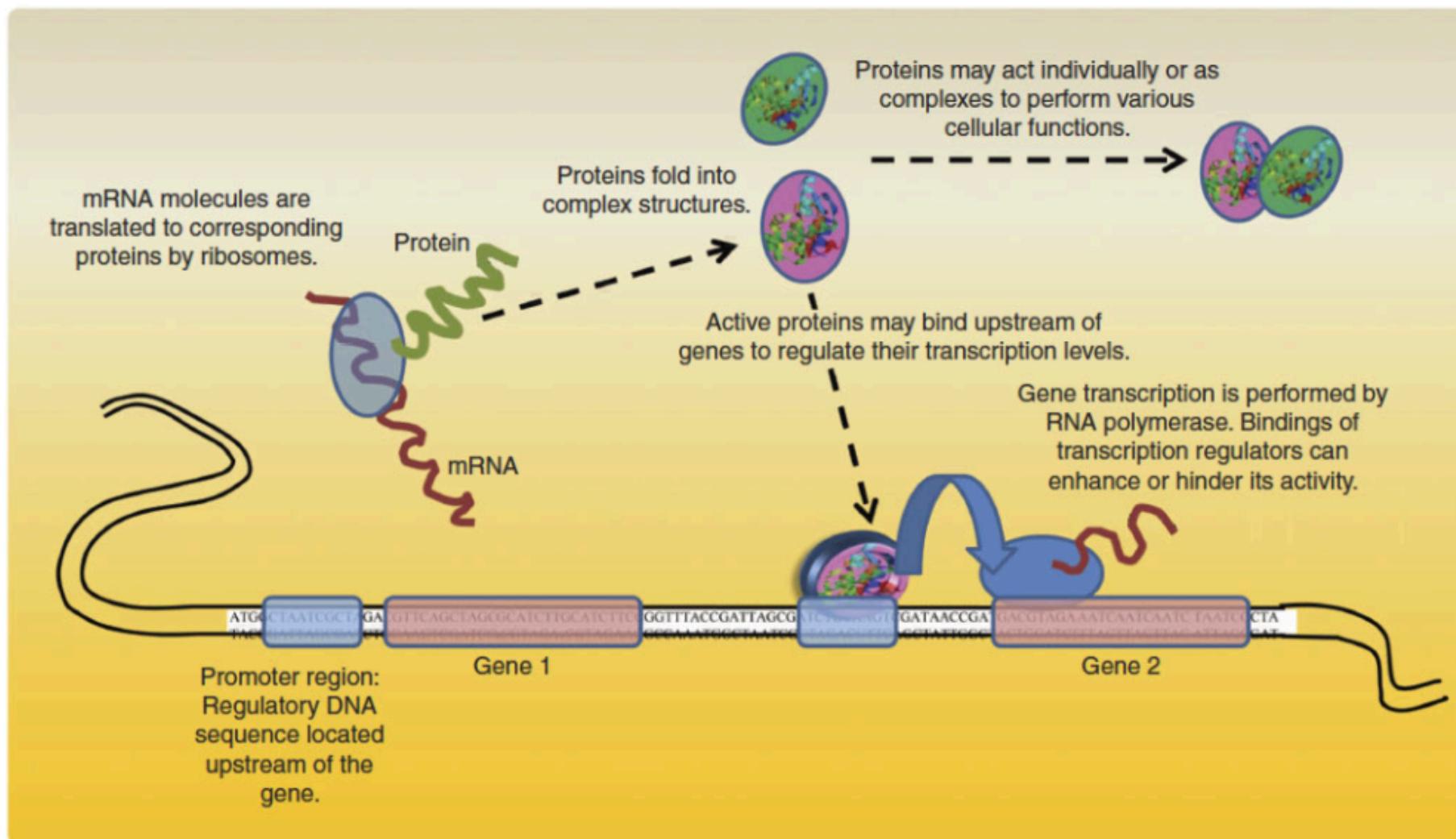


## Genes

- A gene is a region of DNA that controls a hereditary characteristic
- Usually a gene is transcribed into a messenger RNA which is then translated into a protein.
- In humans genes constitute only ~3% of the human genome



# The Central Dogma



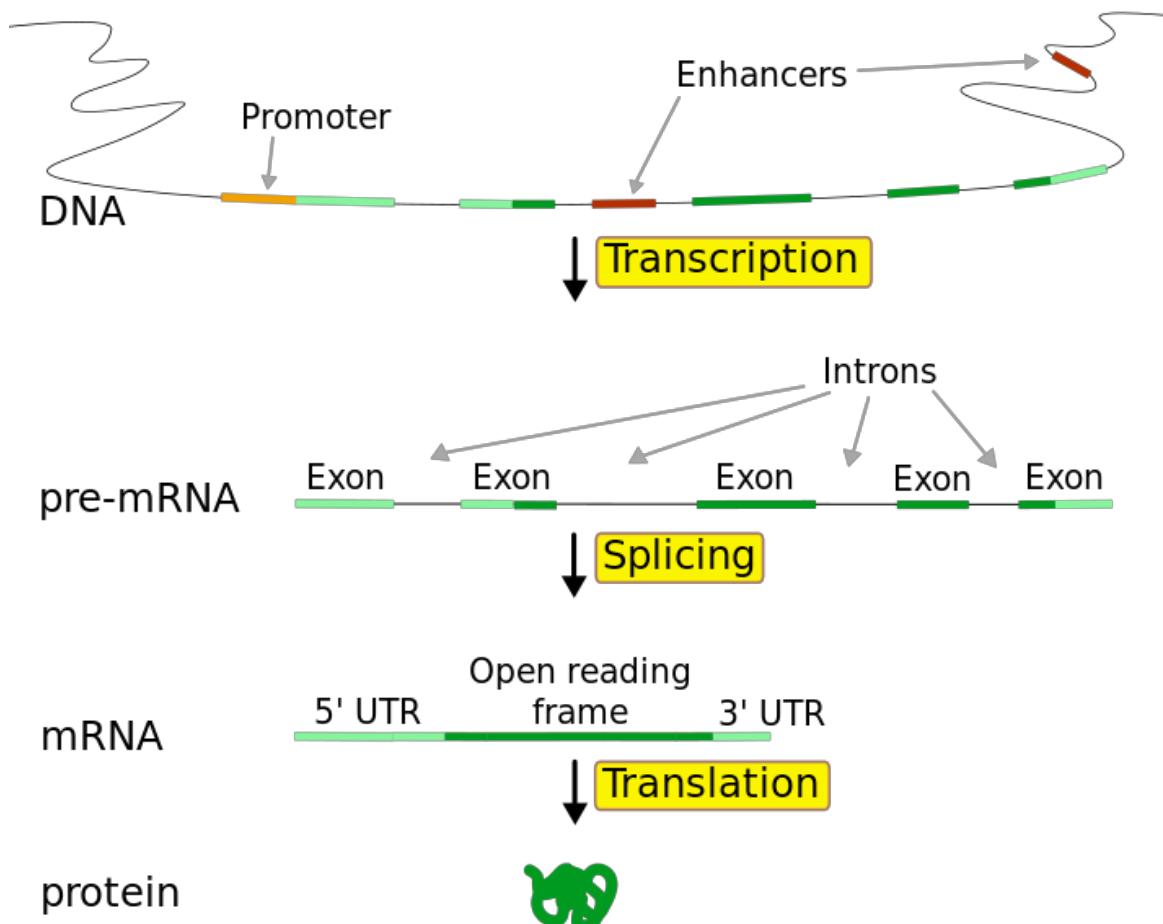
# Transcription

The transcription process generates a messenger RNA molecule from a gene region.

RNA is like DNA but

- the sugar-phosphate is different: ribose instead of deoxyribose
- In all places where the DNA has a T the RNA has a U (uracil)

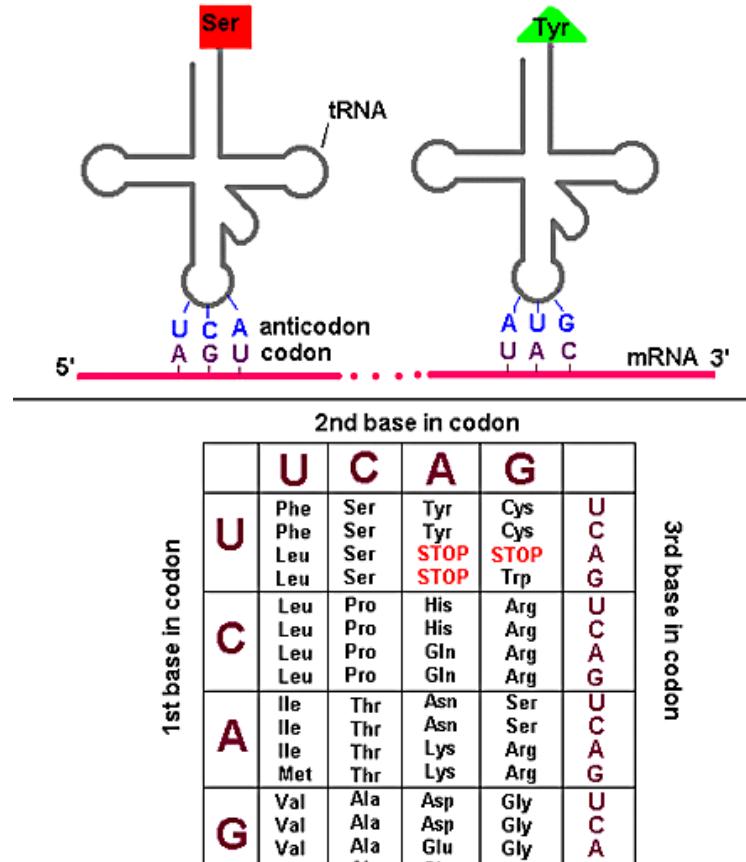
In higher organisms the protein coding sequences (exons) are interspersed by non-coding sequences (introns) which are spliced out.



# Translation: The Genetic Code

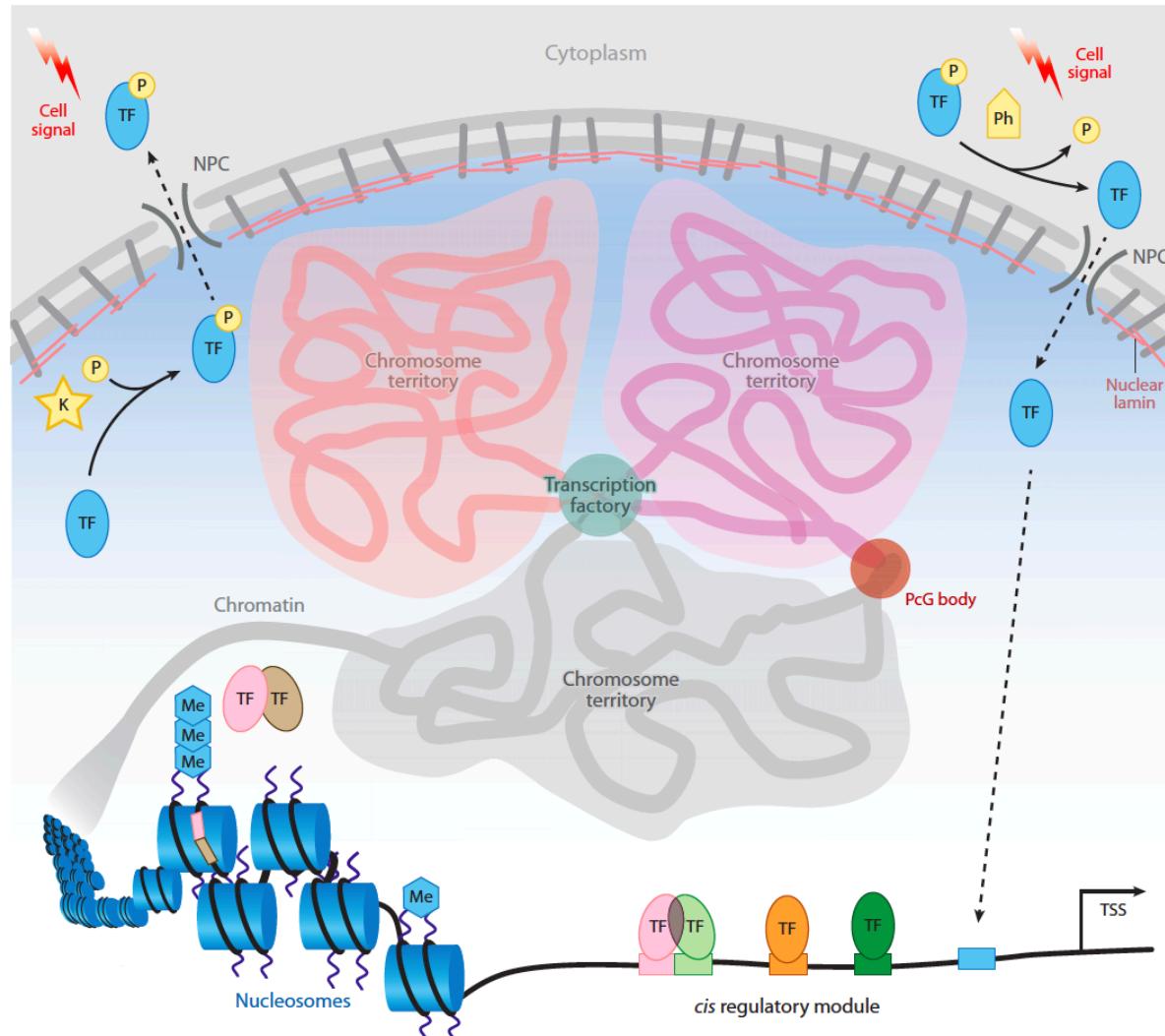
The translation process generates a protein based on the information in the messenger RNA

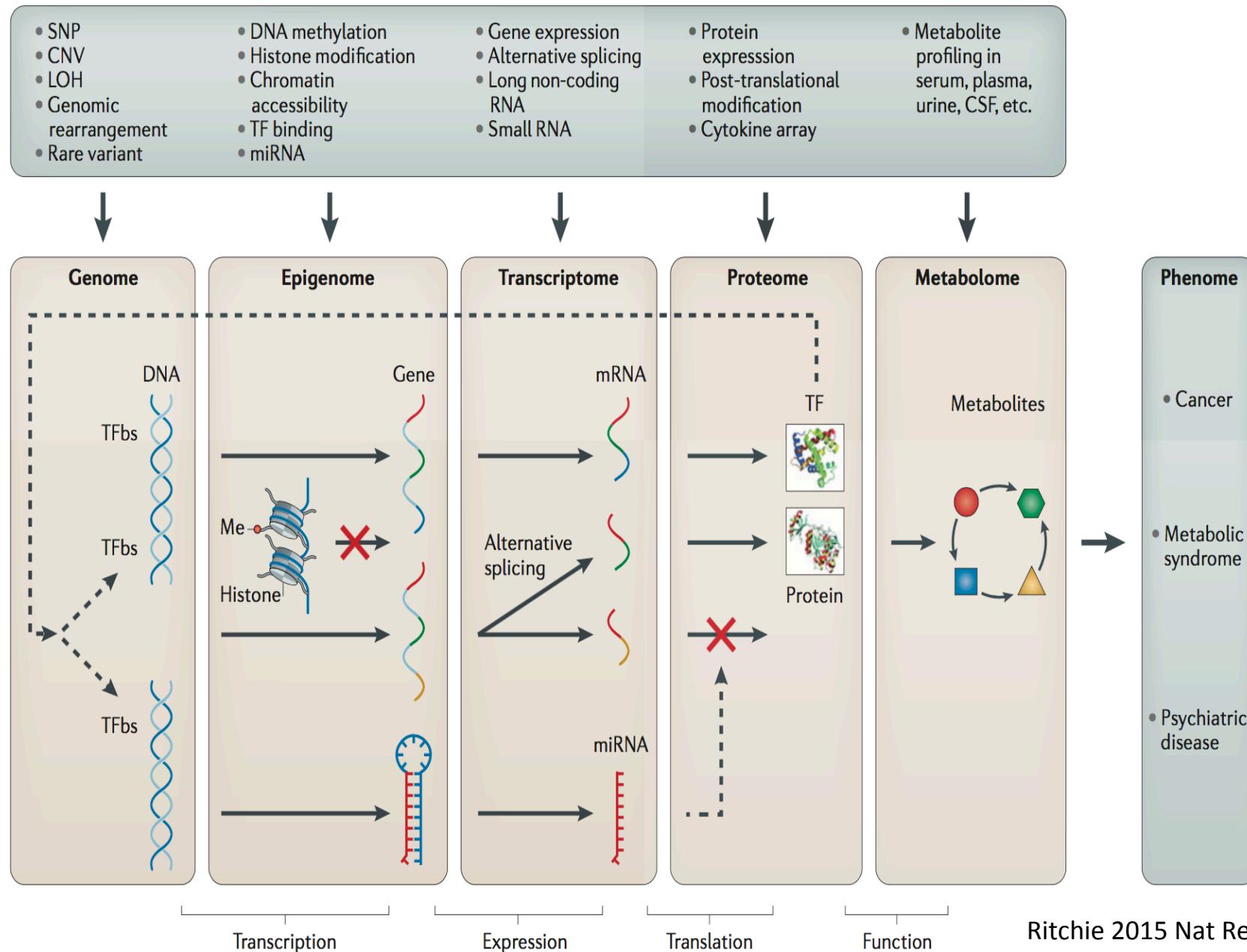
- A protein is a linear polymer of amino acids linked together by peptide bonds.
- Proteins are the main functional chemicals in the cell, carrying out many functions, for example catalysis of the reactions involved in metabolism.
- Proteins have a complex spatial structure



The Genetic Code

# Transcriptional Regulation

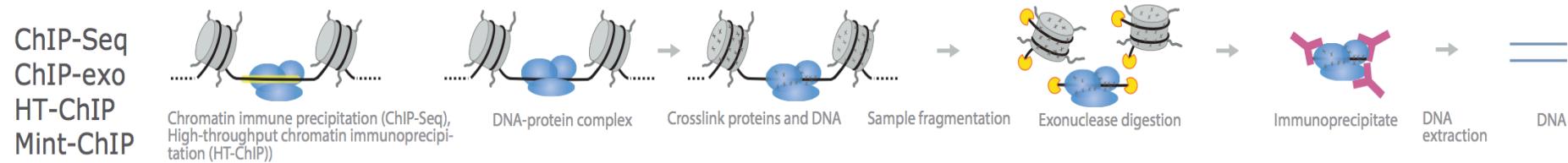




## NGS Protocols

- Example: Preparation of DNA for a ChIP-seq experiment

### DNA-Protein Interactions



- The preparation determines how sequenced reads have to be interpreted

