INSTITUTO BUTANTAN

Escola Superior
Instituto Butantan

Introdução à Biologia Celular e Molecular (aula 01)

Curso de Especialização na Área da Saúde – 2025/2026
Bases Técnicas em Vacinas e Biofármacos

PhD Flavio Lichtenstein

Bioinformatics, Systems Biology, and Biostatistics

Instituto Butantan – CENTD - Bioinformática

centre of excellence in new target discovery

maio/2023

Constituição de um organismo eucarioto

- O corpo é constituído de órgãos
- Os órgãos não são homogêneos e dividios em diferentes tecidos
- Os tecidos são constituídos de células
- Há diferentes tipos de células
- As células têm vários organelas
  - Núcleo
  - Mitocôndria
  - Retículo endoplasmático
  - Lisossomo
  - Endossomo
  - Vacúolos
  - Golgi
  - etc

A célular de um eucarioto e a membrana plasmática

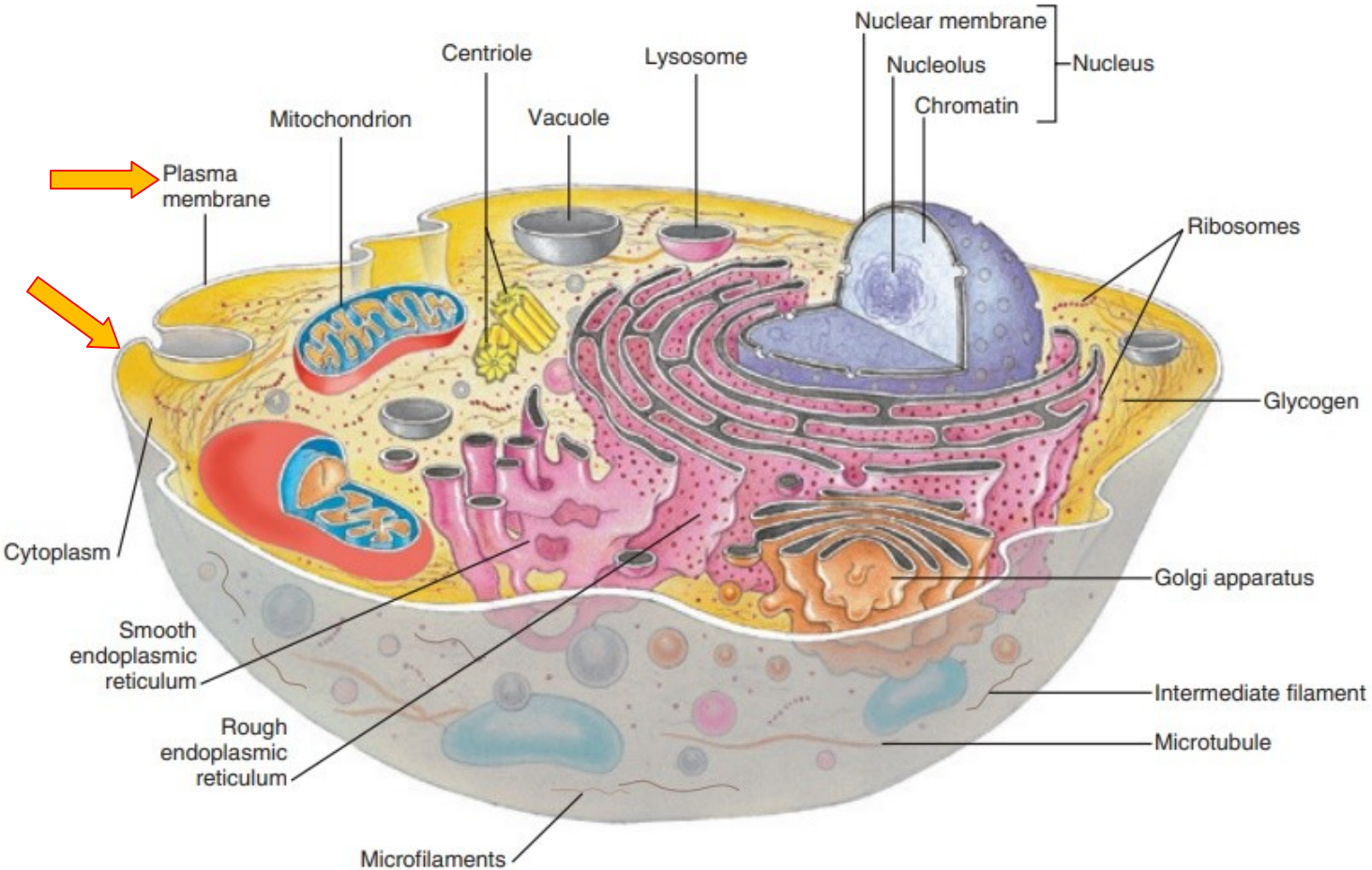
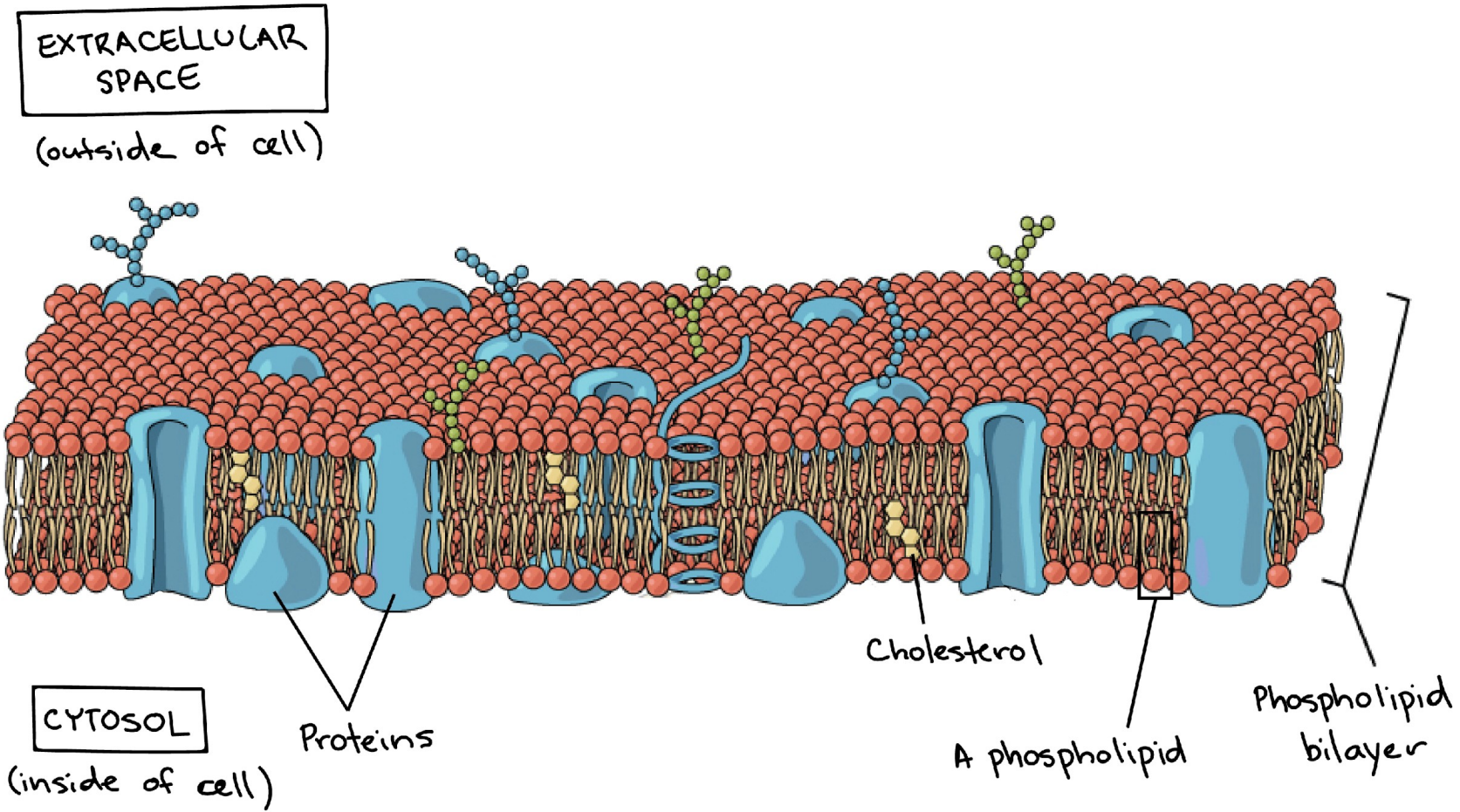


FIGURE 3-1 The cell.

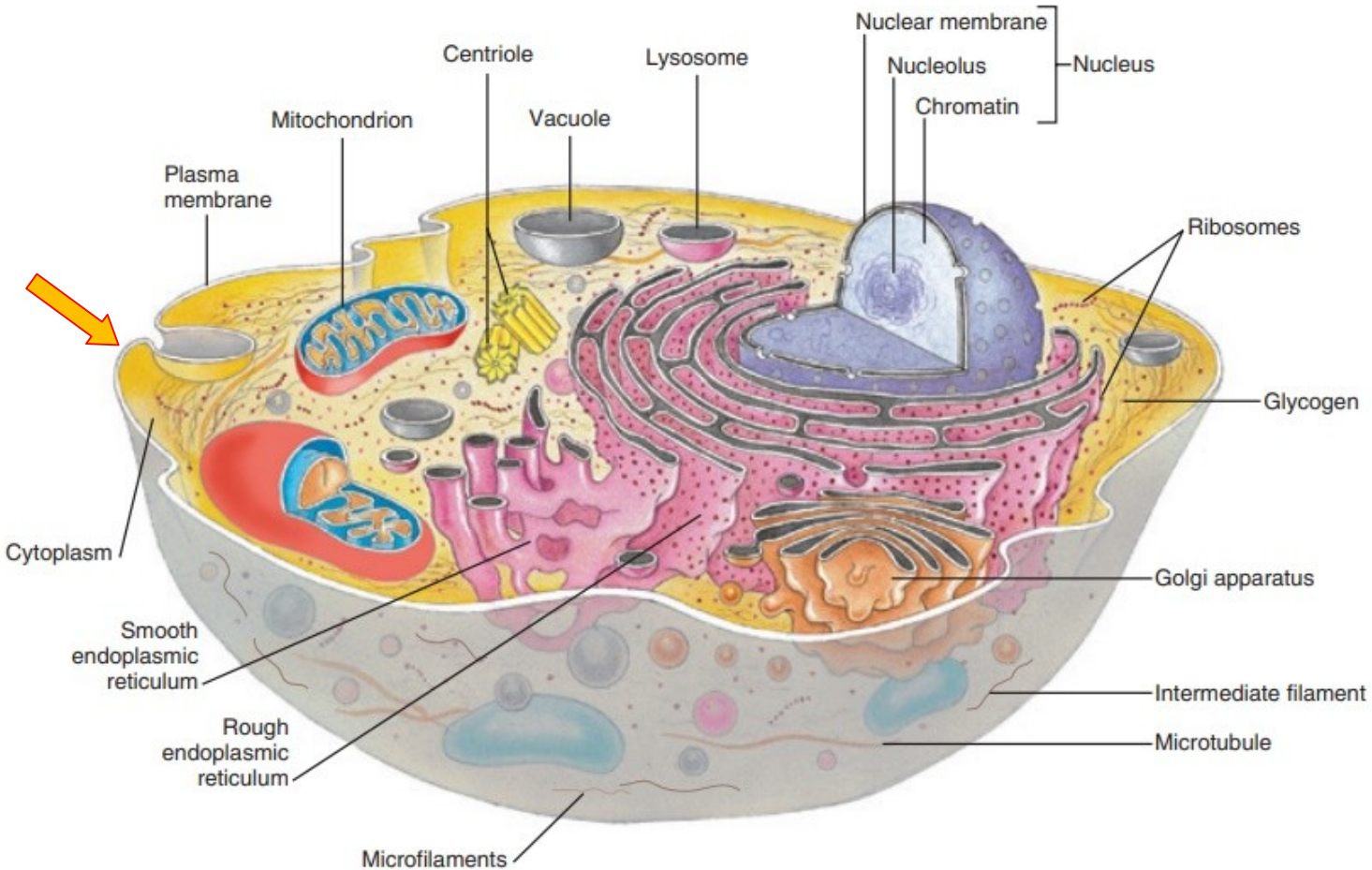
https://www.pharmacy180.com/article/cell-membrane---structure-of-the-cell-3434/

Plasma membrane ~ Membrana plasmática ~ 10 nm



https://www.khanacademy.org/science/biology/structure-of-a-cell/prokaryotic-and-eukaryotic-cells/a/plasma-membrane-and-cytoplasm

Vários organelas tem membrana bilipidica



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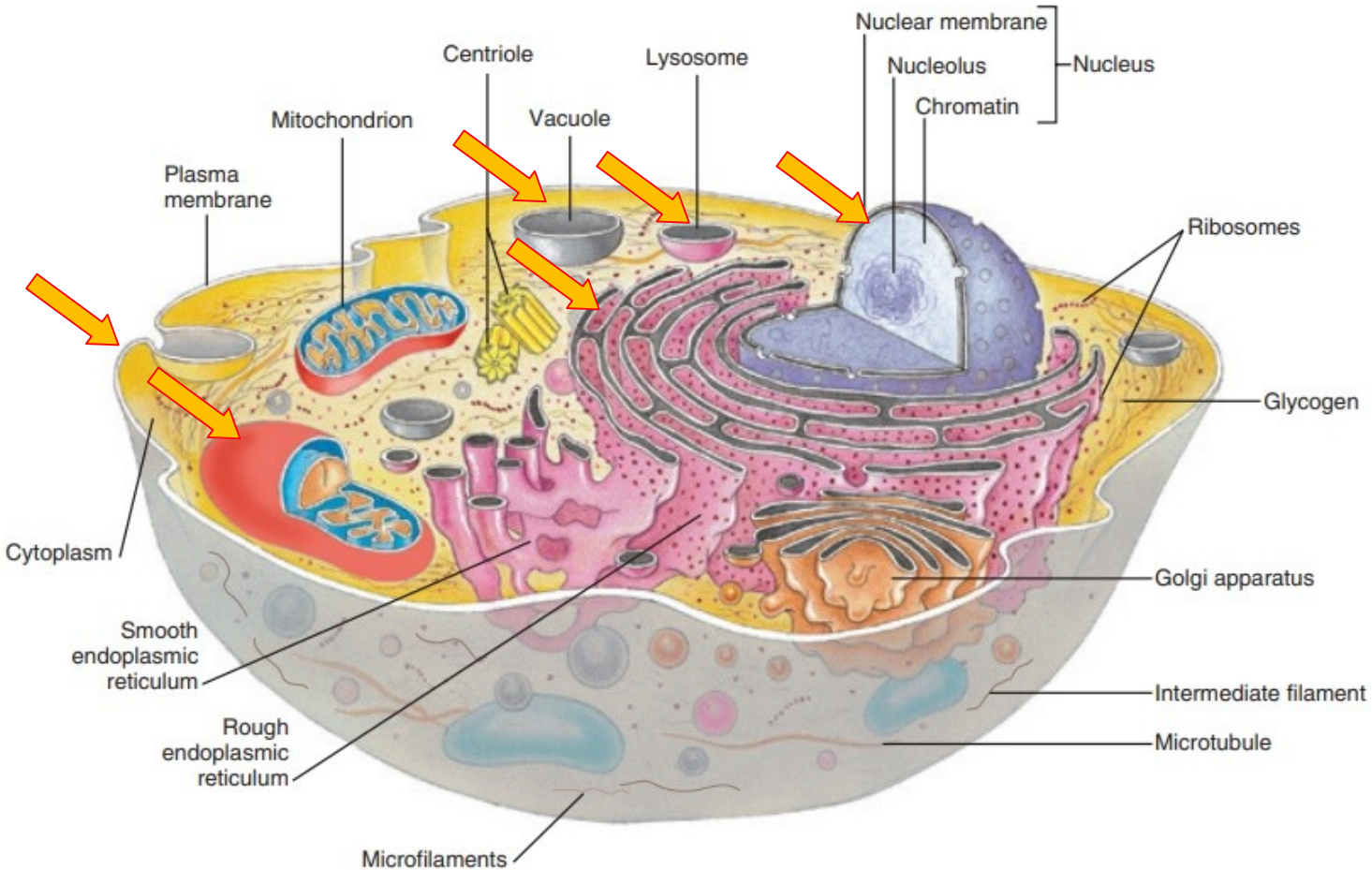

FIGURE 3-1 The cell.

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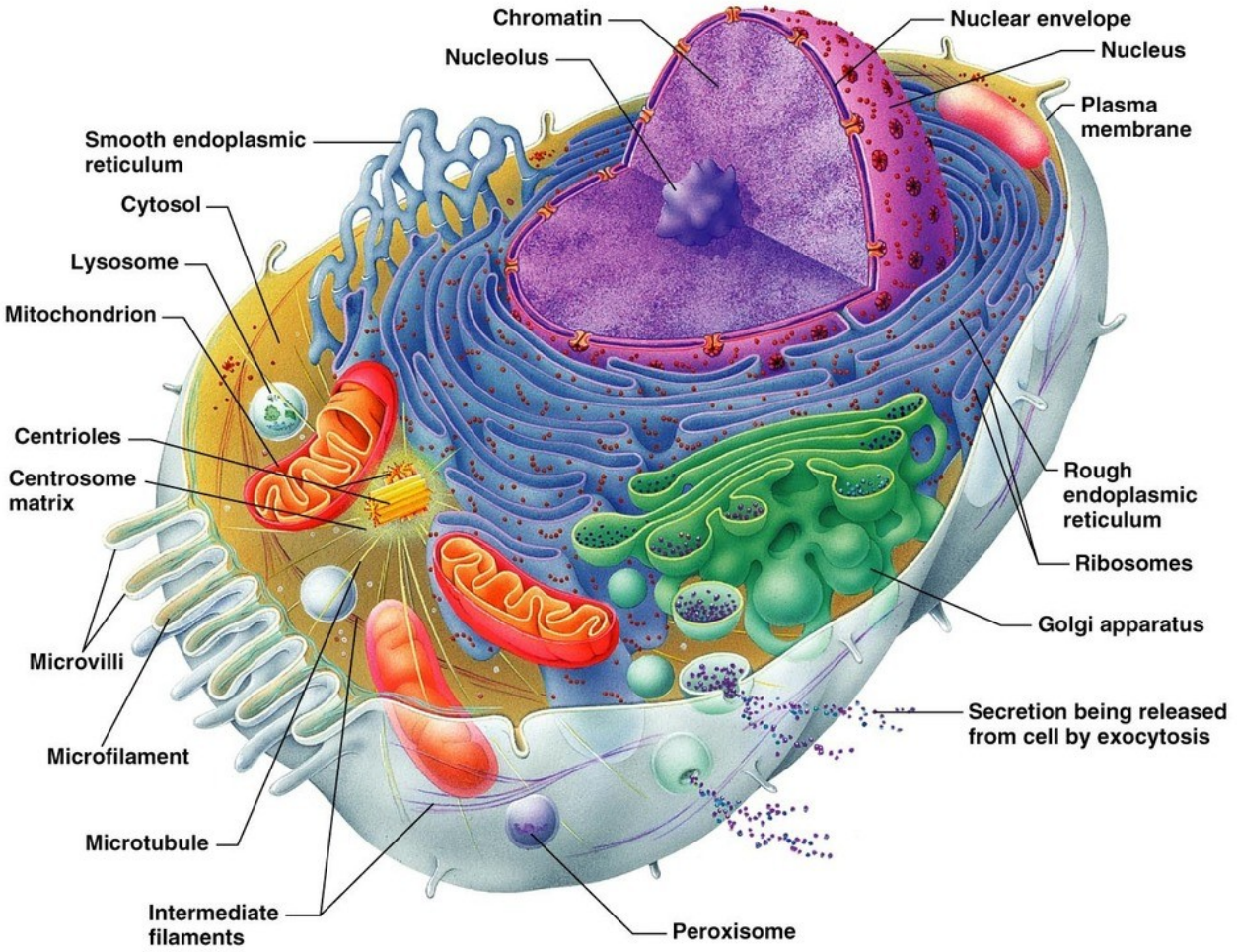
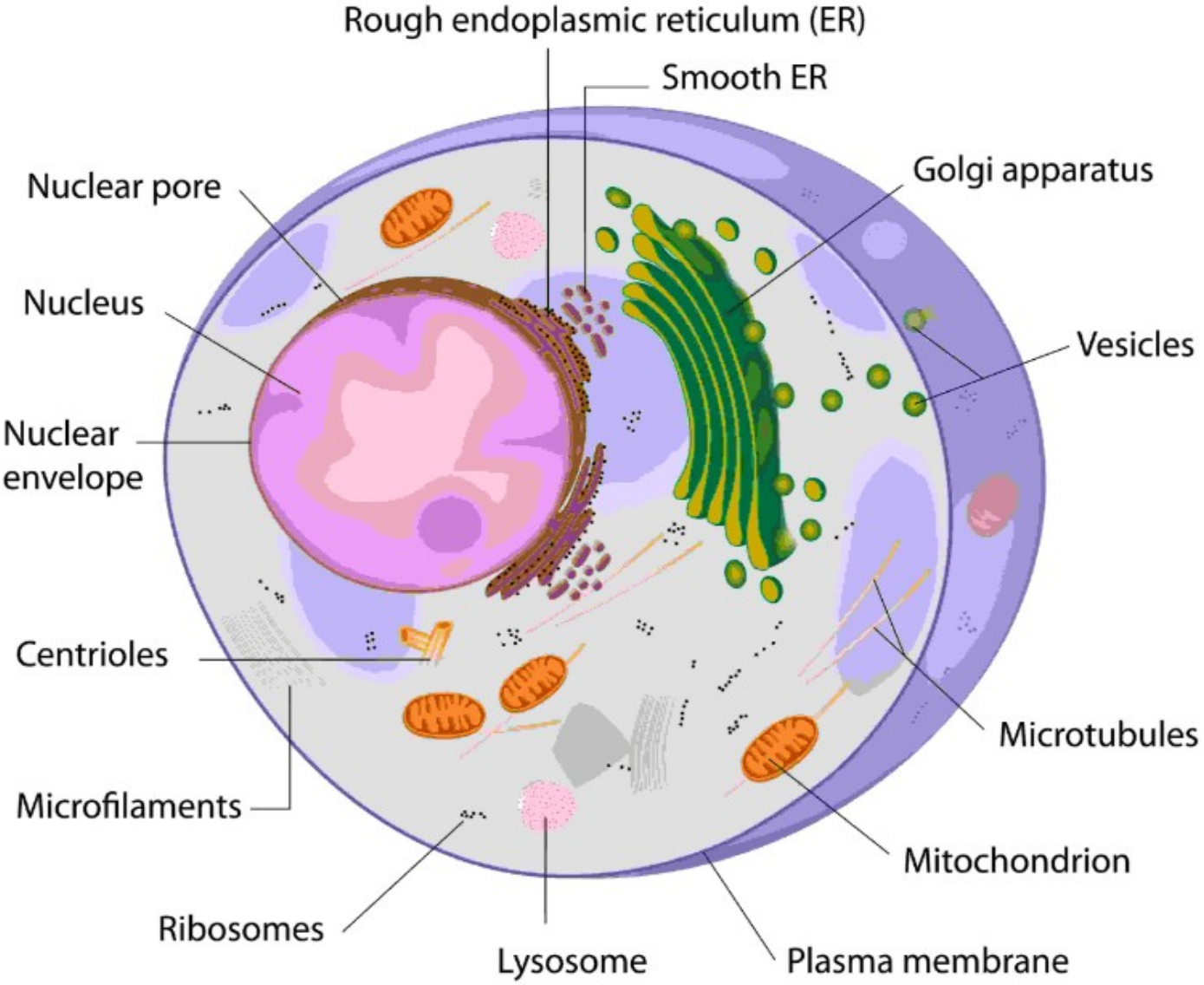
A célula



https://quizlet.com/316605229/human-cell-diagram/

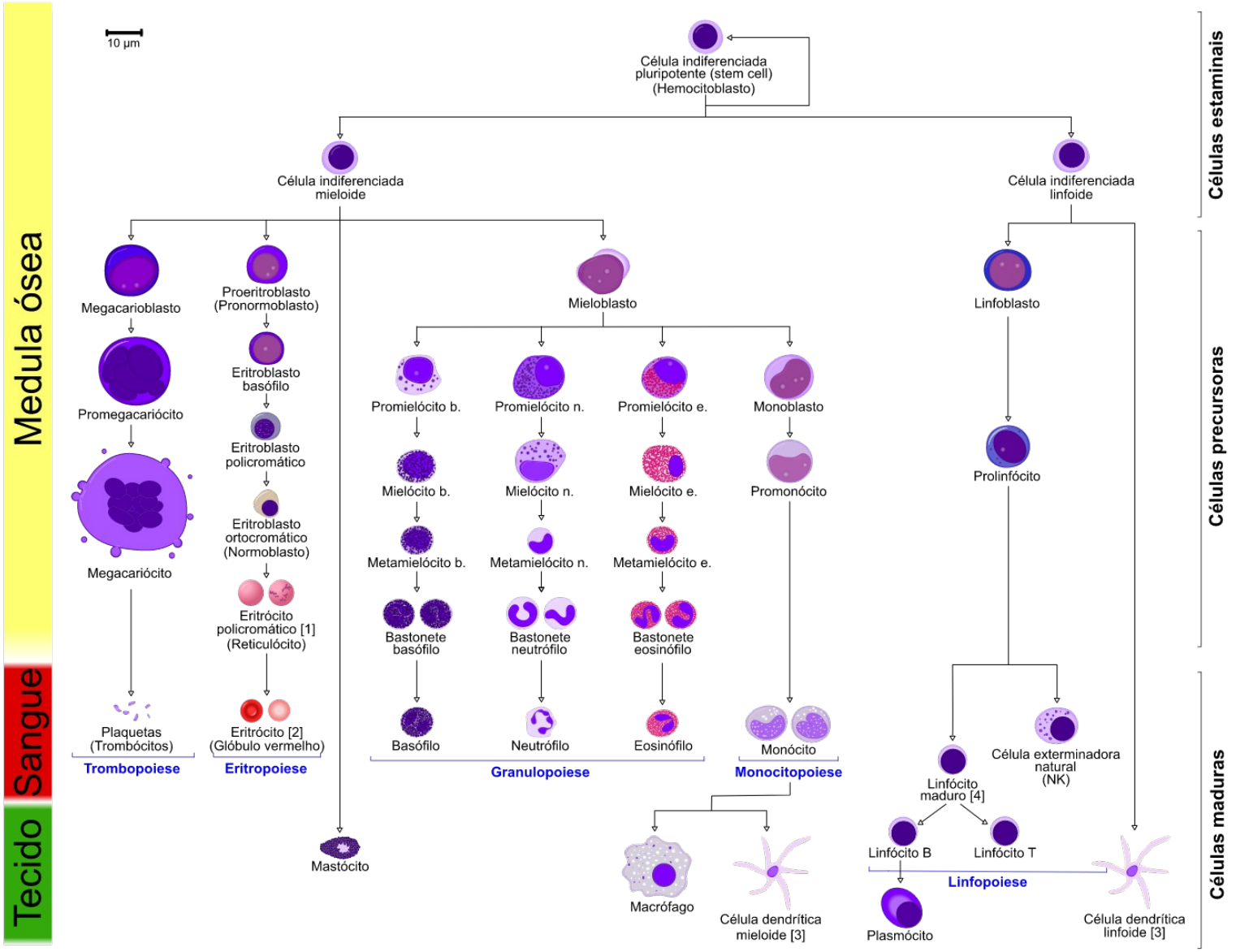


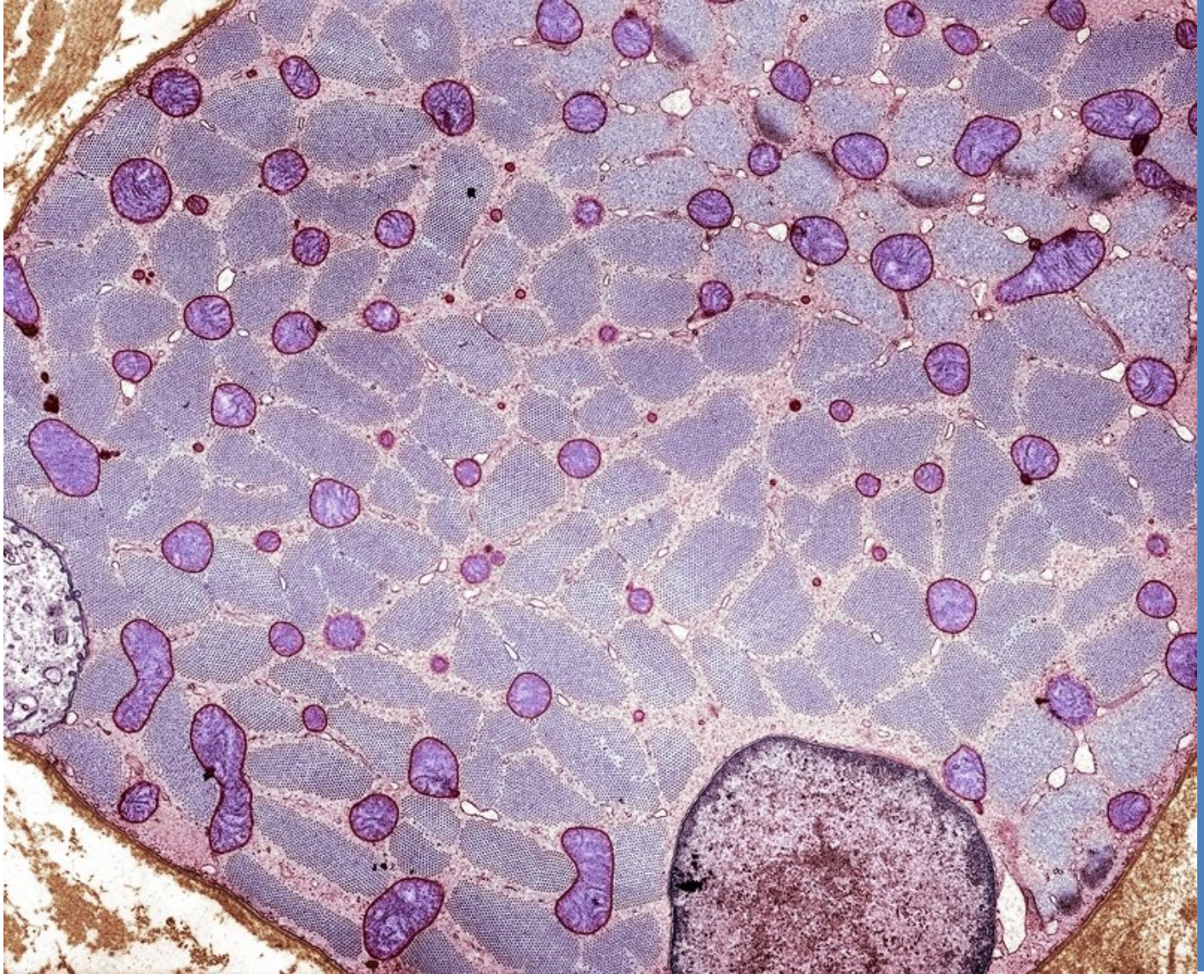
As células são entidades especializadas

Mas o cromossomo “é um só”! Como?

Hematopoiese

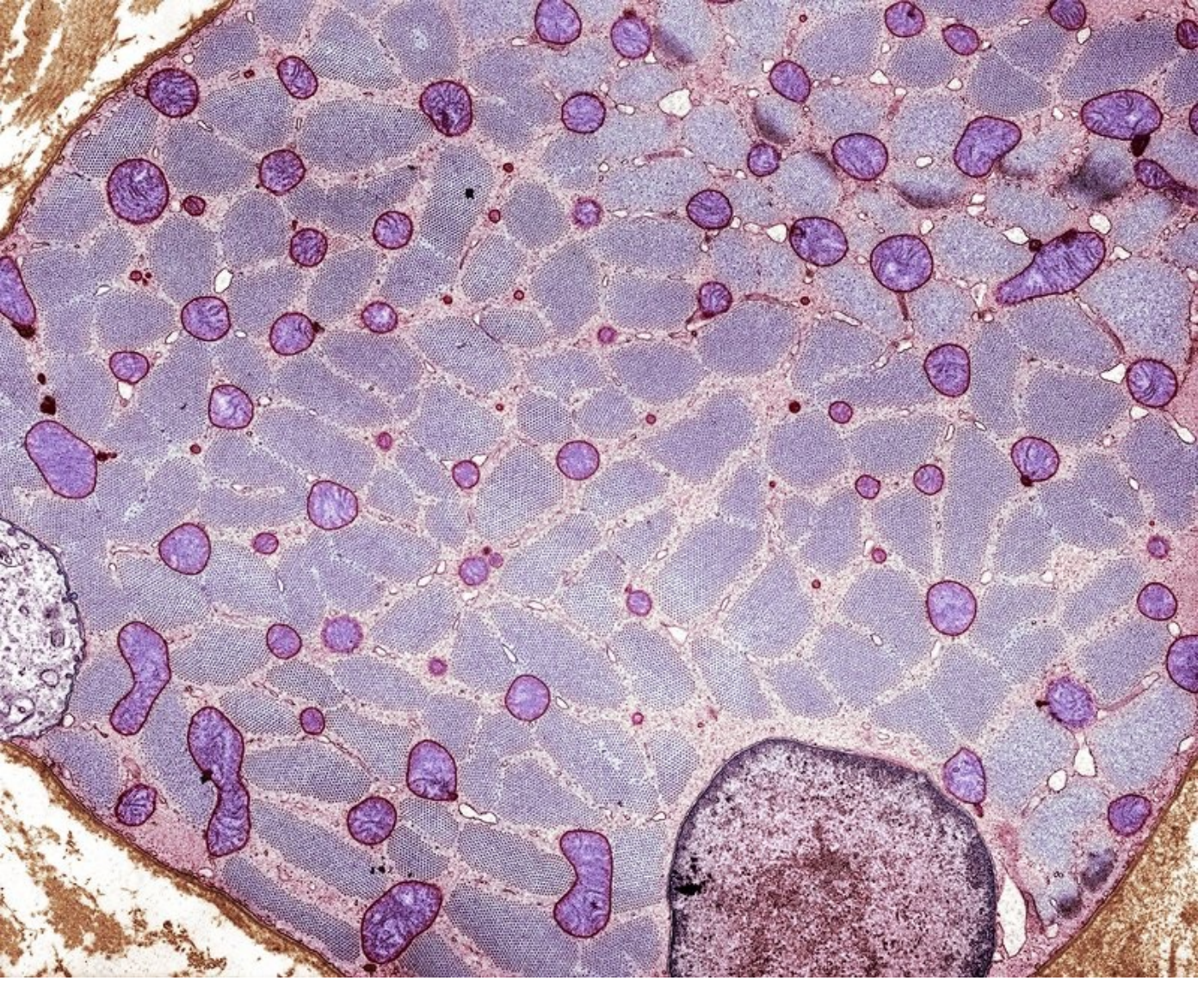
https://pt.wikipedia.org/wiki/Hematopoiese





O que é isto???

https://www.sciencephoto.com/media/303254/view/skeletal-muscle-cell-tem



Skeletal muscle cell, coloured transmission electron micrograph (TEM).
>> The nucleus (bottom right) is displaced to the edge of the cell
>> by the abundant supply of bundles of contractile myofilaments (purple).
>> Myofilaments are proteins consisting of myosin and actin. When the cell is stimulated to contract, the myofilaments interact and slide past each other, resulting in a shortening of the cell.
>> An abundance of mitochondria (dark purple), which produce

https://www.innerbody.com/image/musc01.html

exercício

Na mitose, obviamente, ocorre a duplicação dos cromossomos. Em que fase?

exercício

Na meiose ocorre a duplicação dos cromossomos?

exercício

Quantas vezes ocorre a duplicação de material genético na mitose e na meiose?

Mitose: duplicação celular (com erros!)

Actively dividing eukaryote cells pass through a series of stages known collectively as the cell cycle: two gap phases (G1 and G2); an S (for synthesis) phase, in which the genetic material is duplicated; and an M phase, in which mitosis partitions the genetic material and the cell divides.

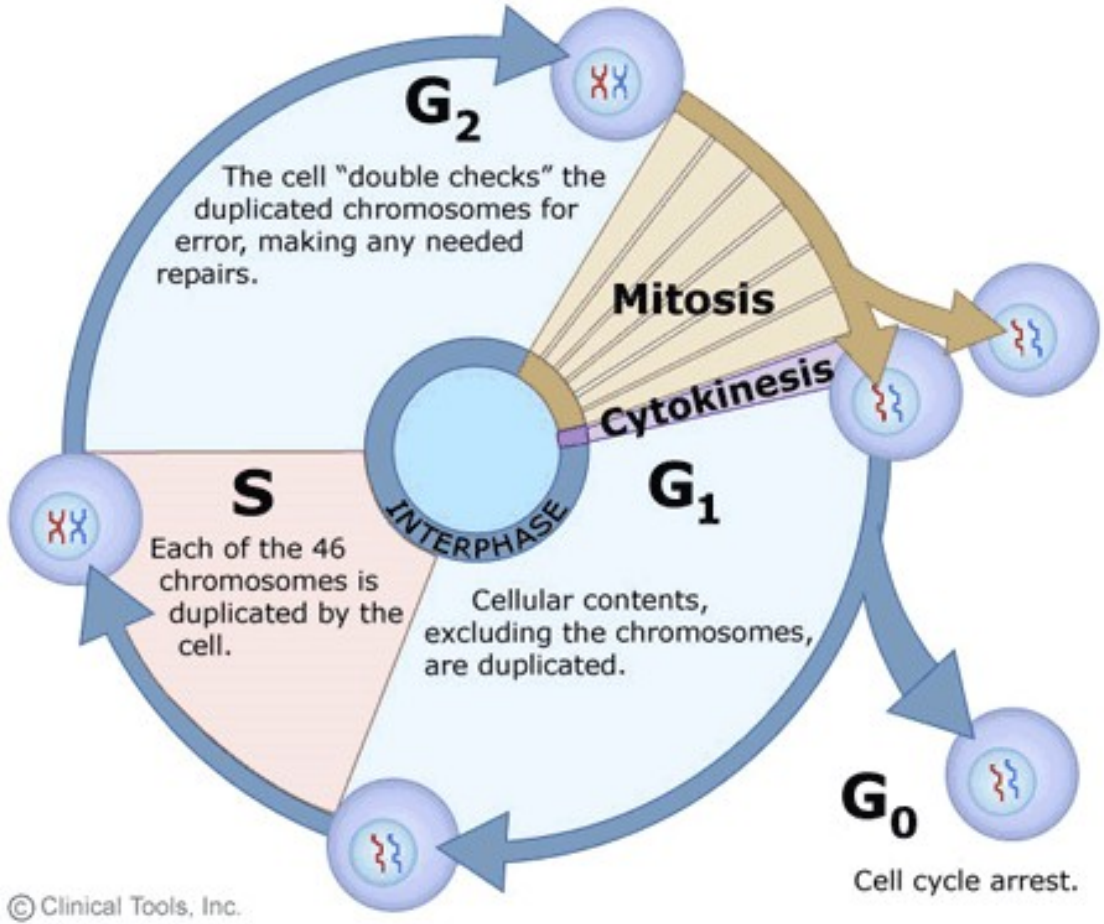
G1 phase. Metabolic changes prepare the cell for division. At a certain point - the restriction point - the cell is committed to division and moves into the S phase.

S phase. DNA synthesis replicates the genetic material. Each chromosome now consists of two sister chromatids.

G2 phase. Metabolic changes assemble the cytoplasmic materials necessary for mitosis and cytokinesis.

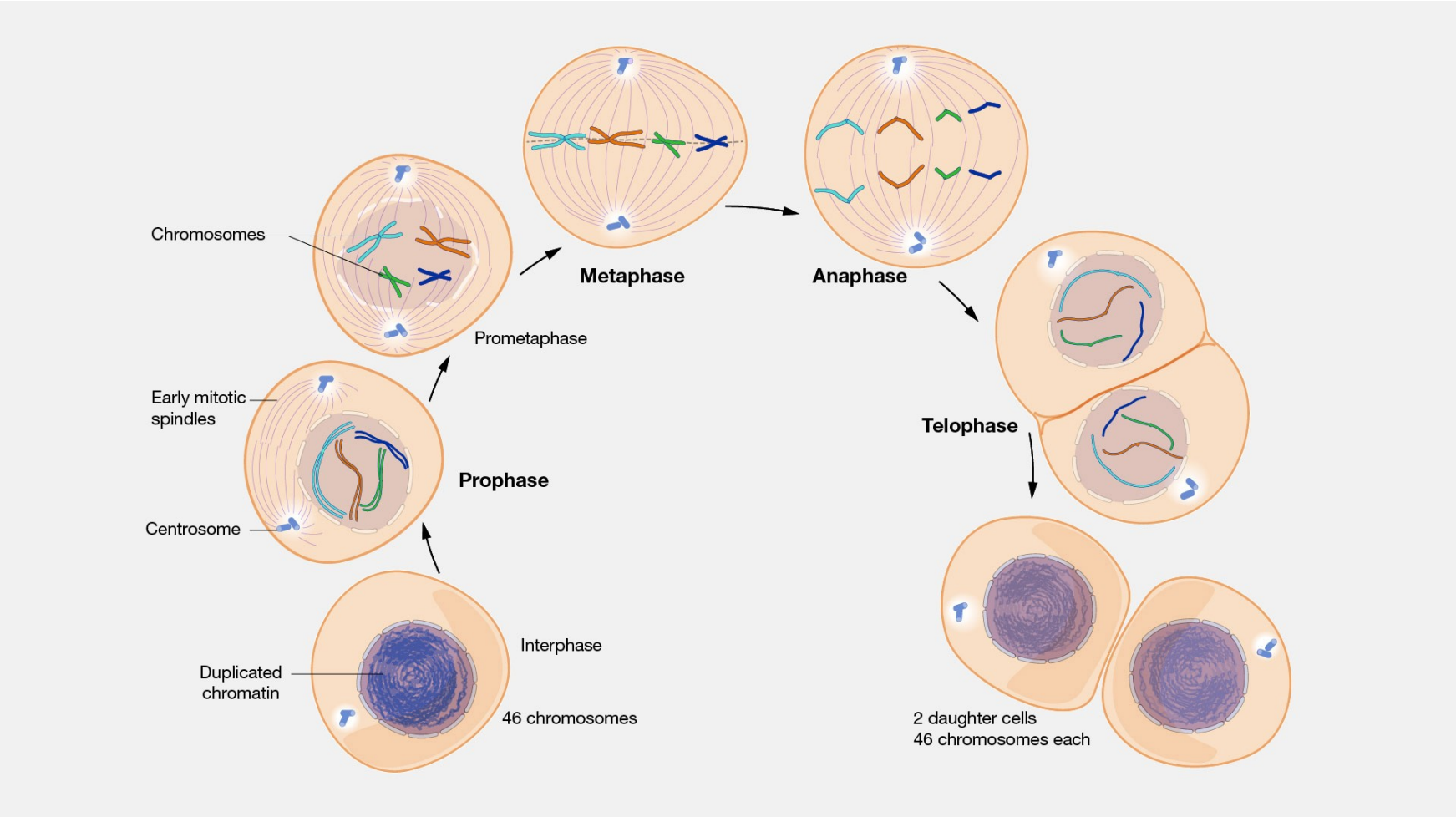
M phase. A nuclear division (mitosis) followed by a cell division (cytokinesis).

The period between mitotic divisions - that is, G1, S and G2 - is known as interphase.



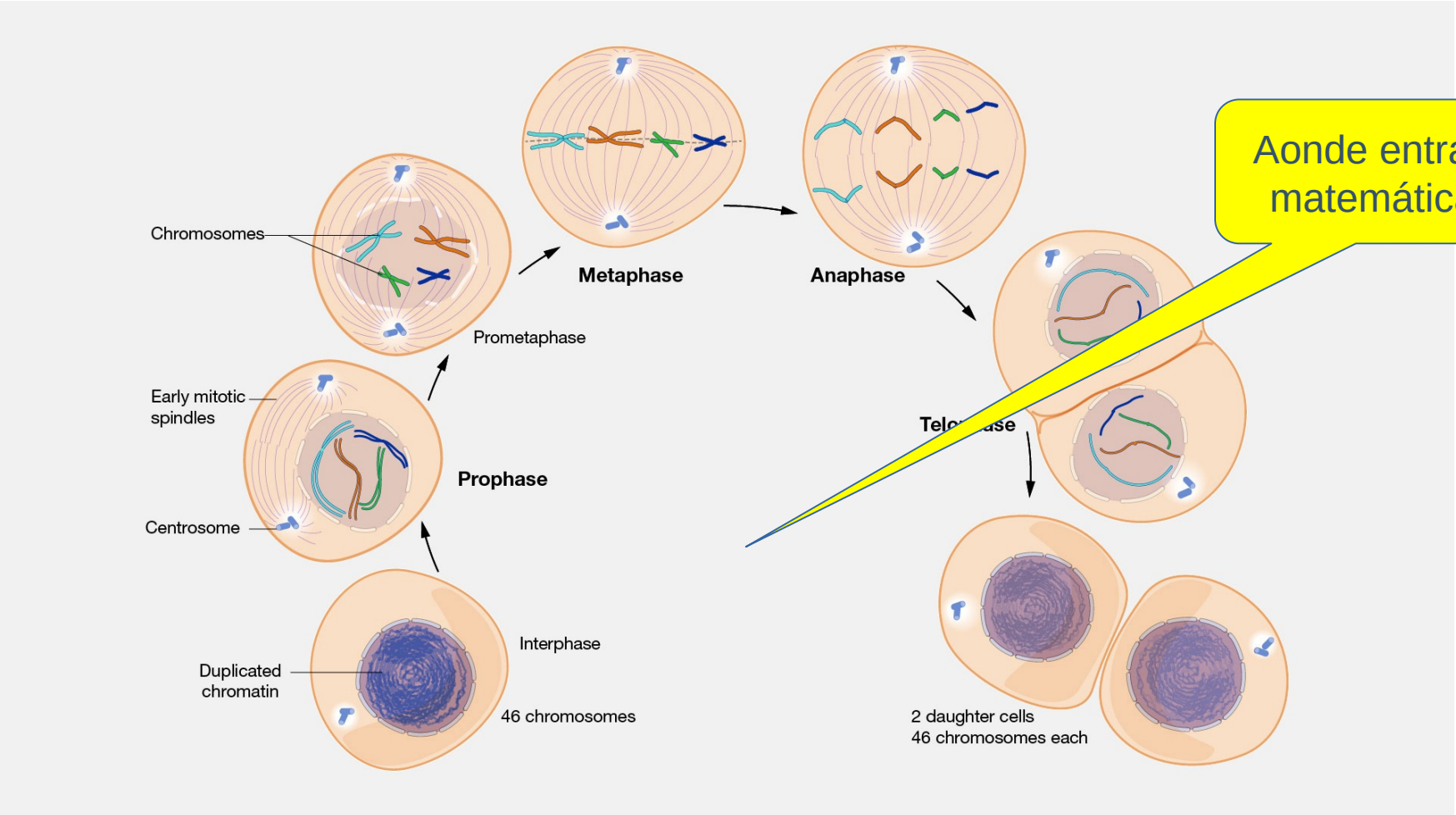
https://le.ac.uk/vgec/topics/cell-cycle/the-cell-cycle-higher-education

Mitose: duplicação celular (com erros!)



https://www.genome.gov/genetics-glossary/Mitosis

Mitose: duplicação celular (com erros!)



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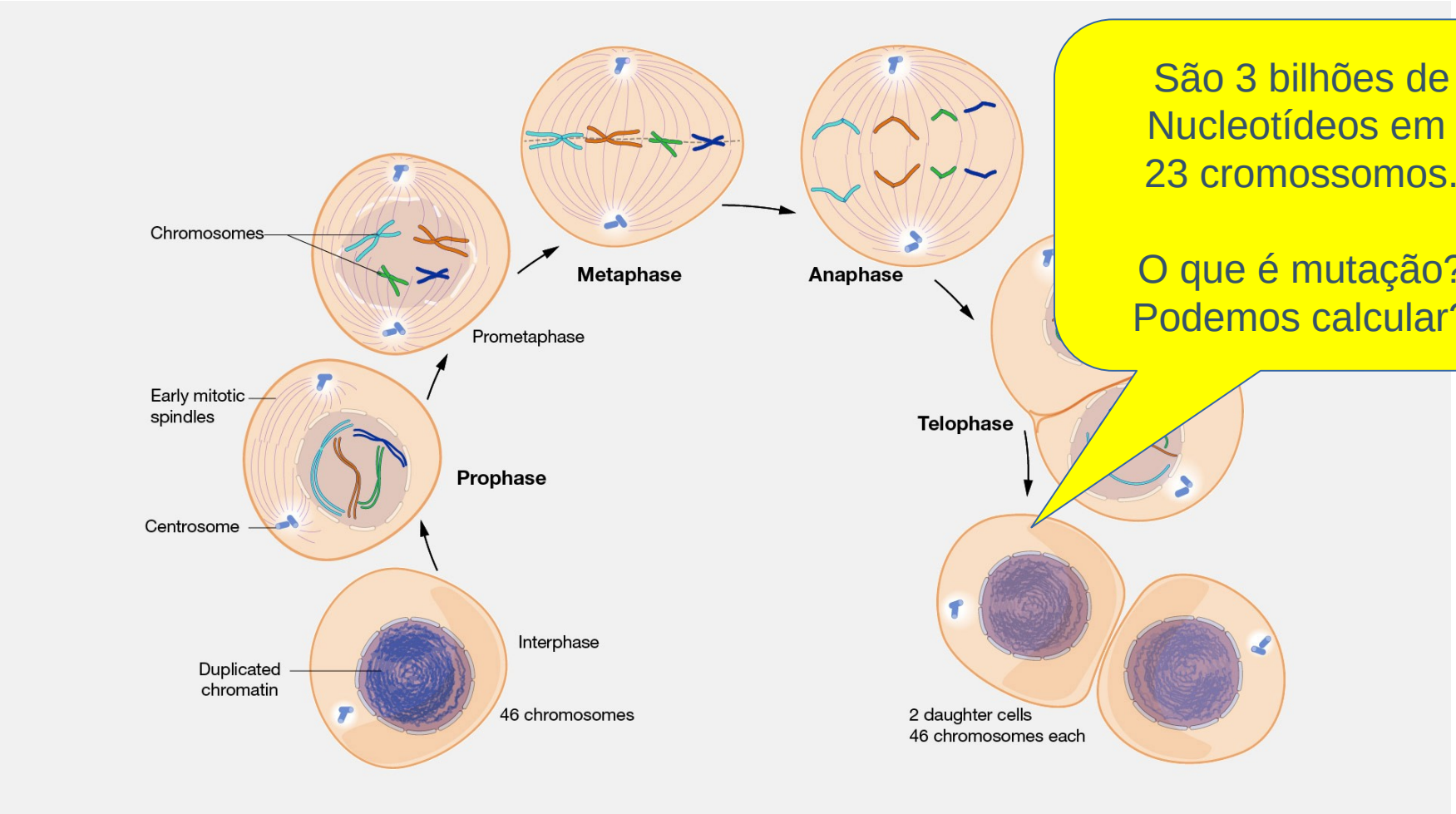
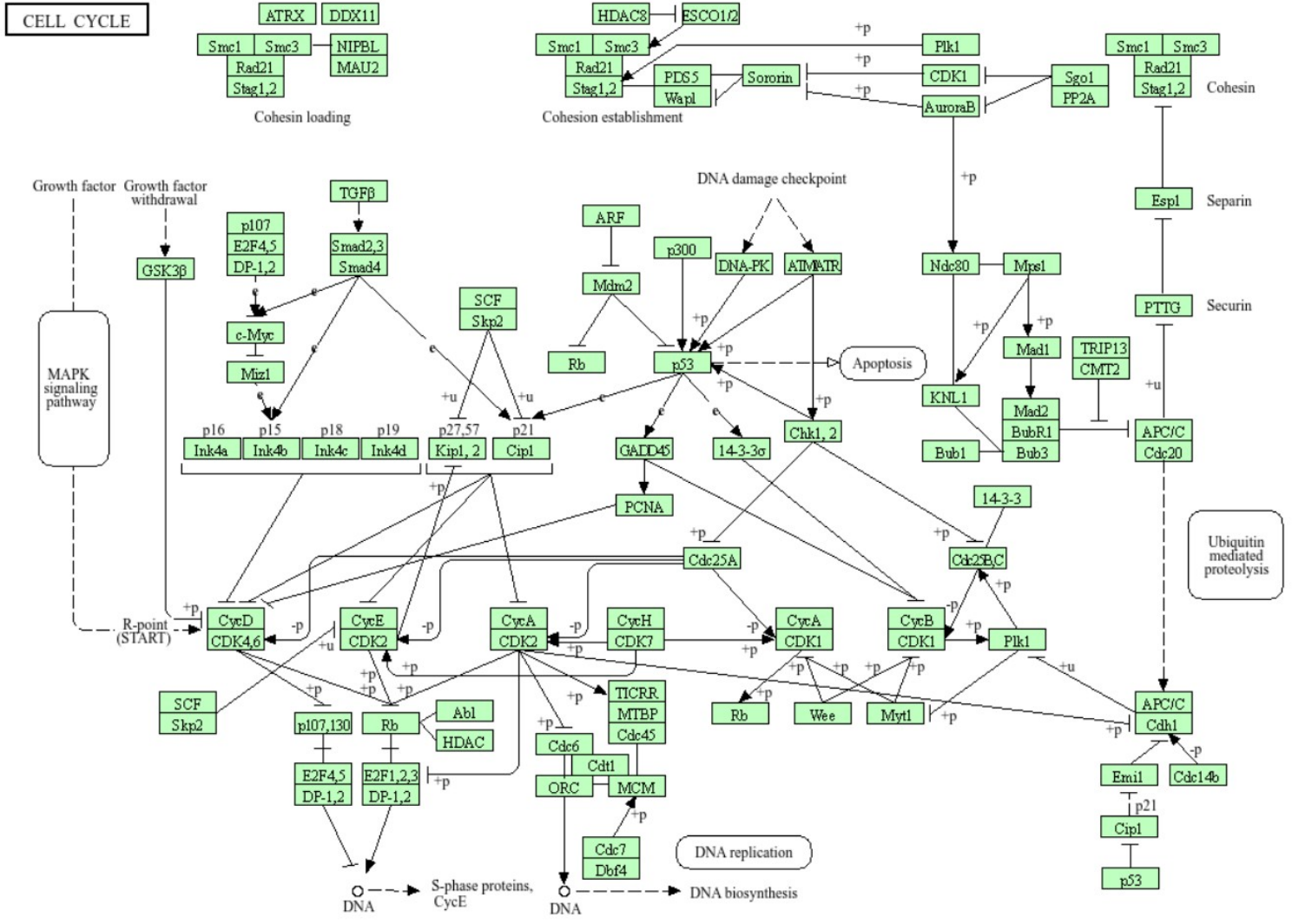
Mitose: duplicação celular (com erros!)



https://www.genome.gov/genetics-glossary/Mitosis

Pathway: Cell Cycle - KEGG

https://www.kegg.jp/pathway/hsa04110



Na meiose ocorre a duplicação dos cromossomos?

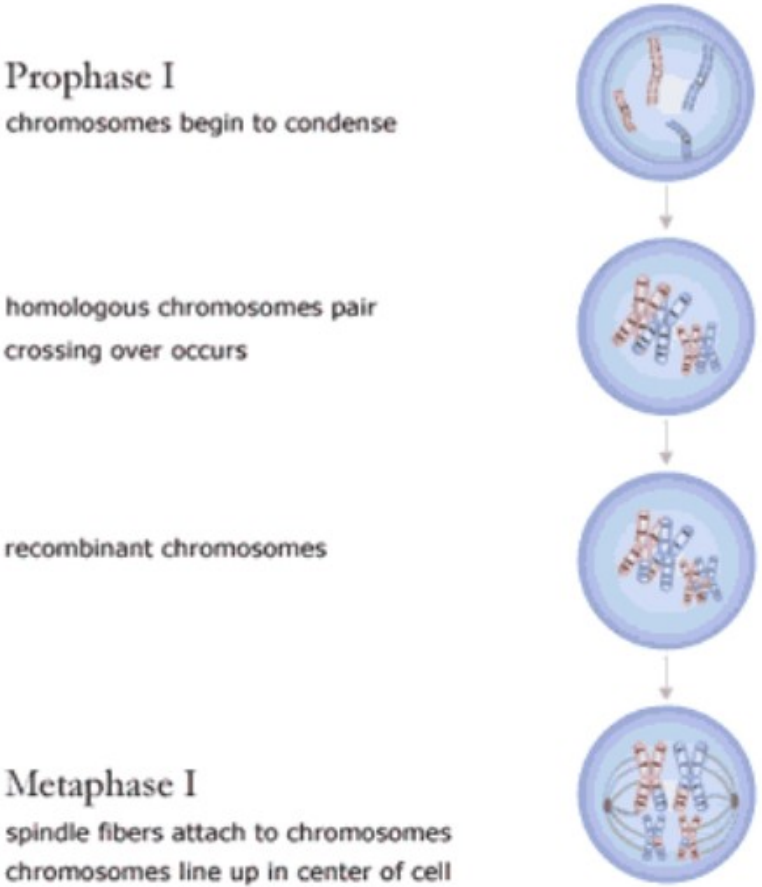
Meiosis

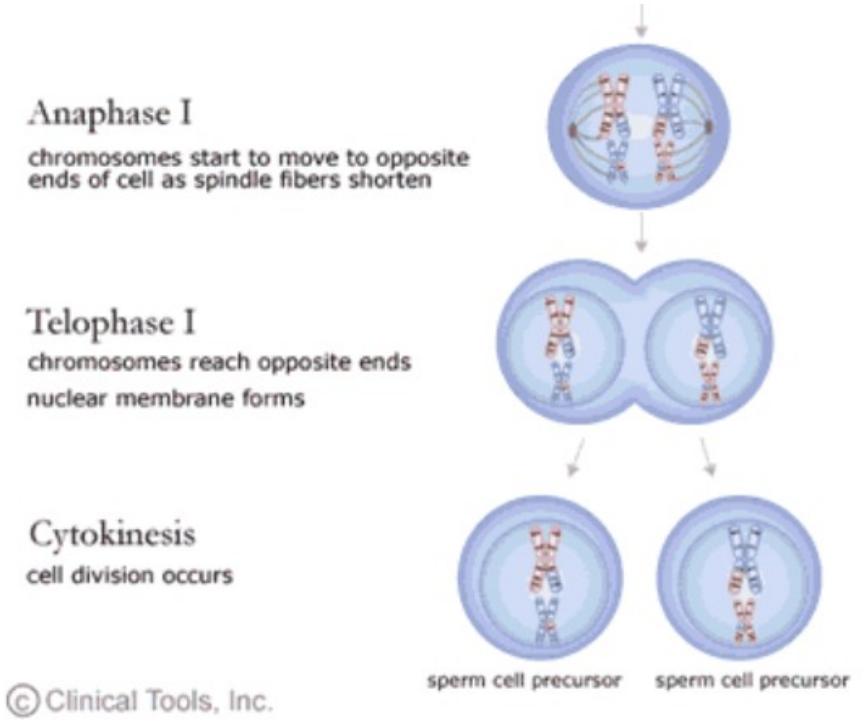
Meiosis is the form of eukaryotic cell division that produces haploid sex cells or gametes (which contain a single copy of each chromosome) from diploid cells (which contain two copies of each chromosome). The process takes the form of one DNA replication followed by two successive nuclear and cellular divisions (Meiosis I and Meiosis II). As in mitosis, meiosis is preceded by a process of DNA replication that converts each chromosome into two sister chromatids.

https://le.ac.uk/vgec/topics/cell-cycle/the-cell-cycle-higher-education

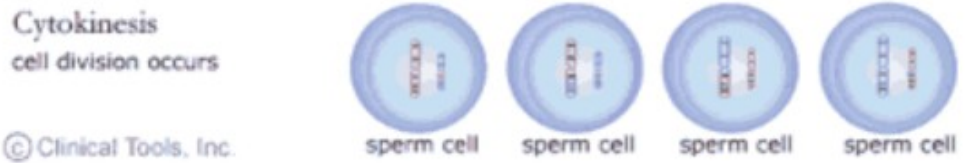
Meios em machos

Meiosis I





Meiosis II



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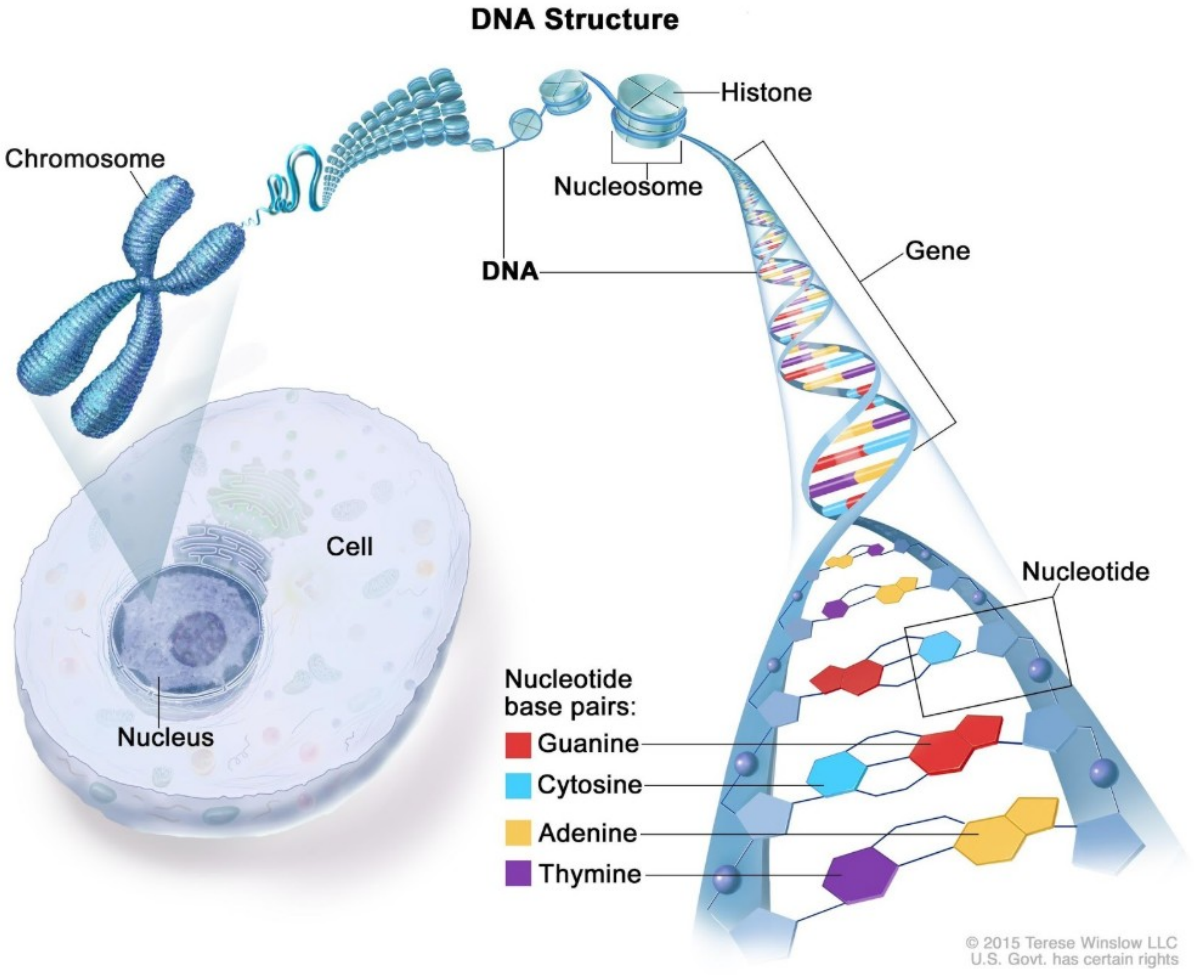
Para duplicar o material genético
se faz necesário

Abrir a cromatina, abrir o nucleossomo,
acoplamento da polimerase e proteínas assistentes

Cromossomo

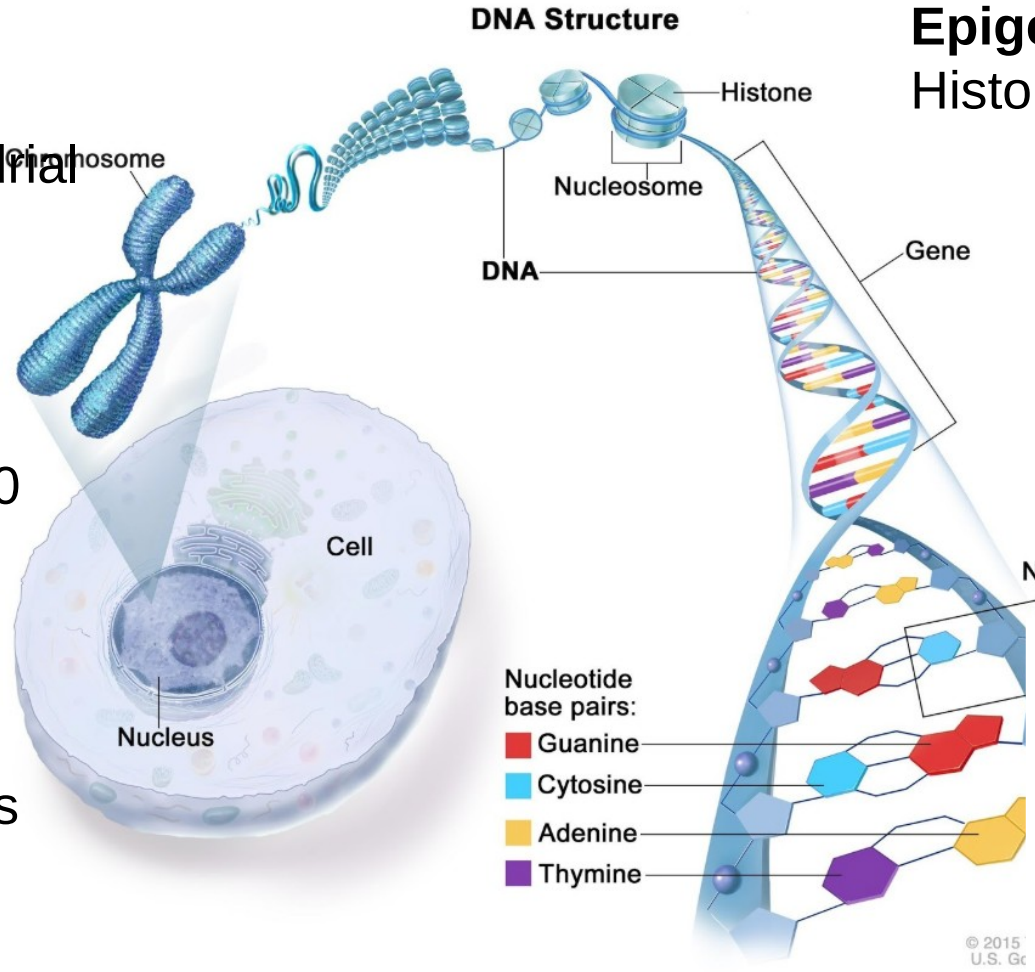


https://project8p.org/chromosome-101/

Cromossomo

Genoma
Nuclear e Mitocondrial

Genes
H sapiens ~ 24.000 genes
3 bilhões de nucleotídeos
< 2% do genoma representam genes

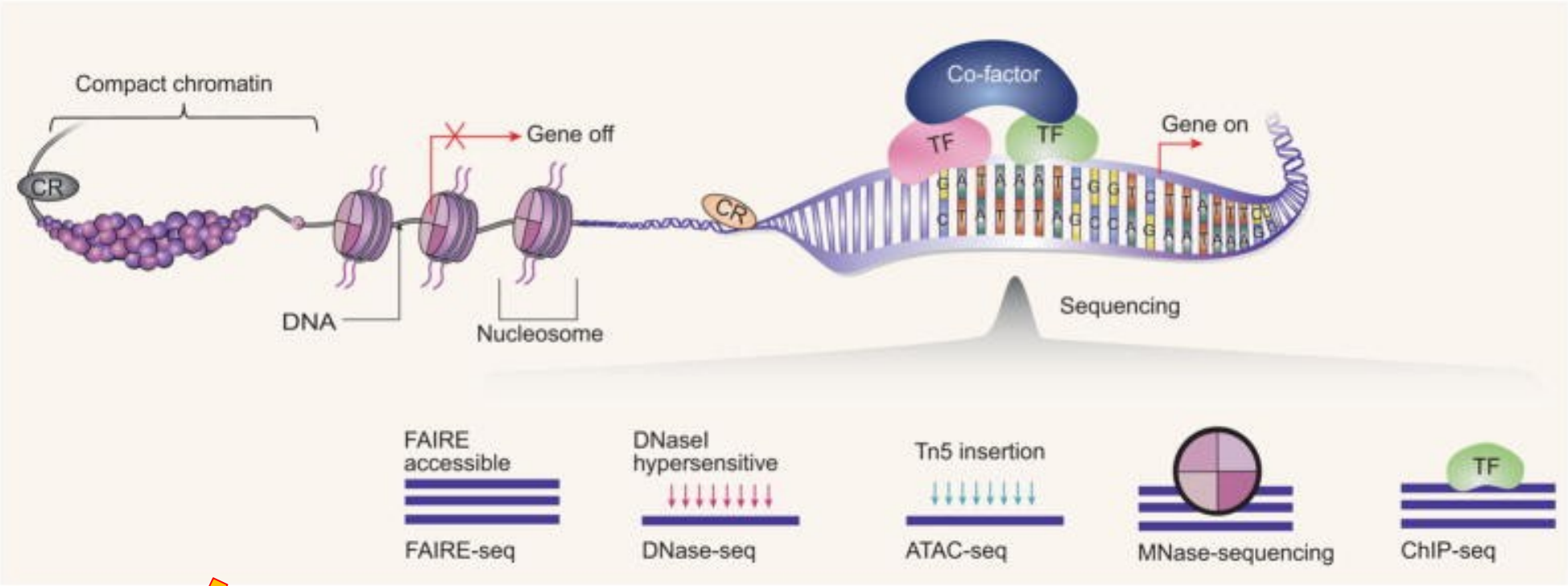


Epigenética
Histonas e Metilação

Enovelamento do Cromossomo nuclear
Estudar: inativação cromossômica e abertura da cromatina para transcrição

https://en.wikipedia.org/wiki/Human_genome

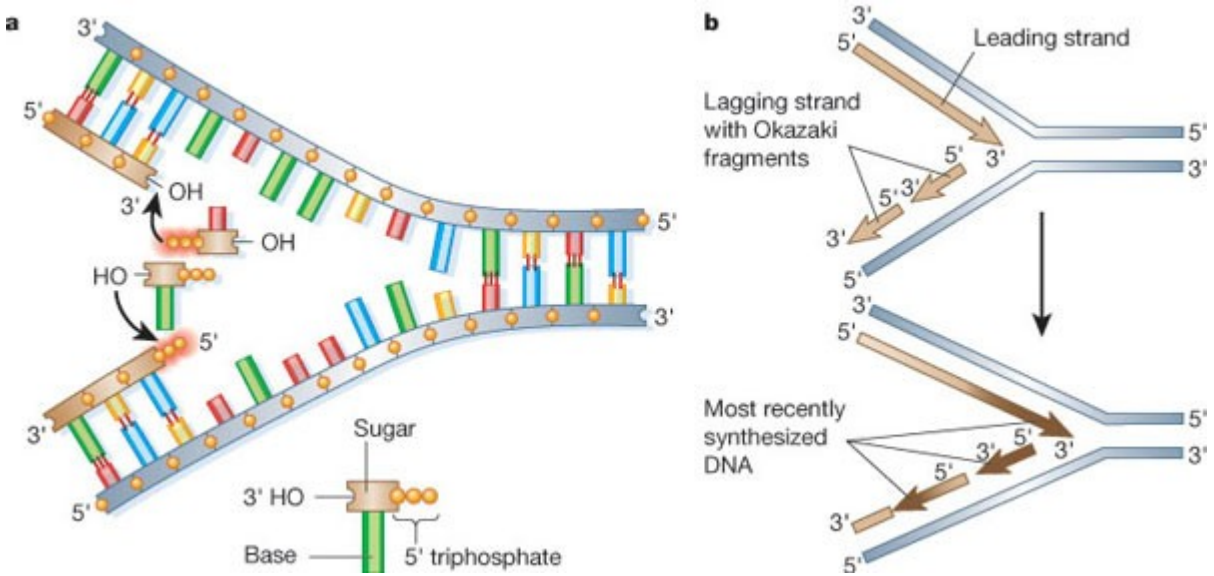
Abertura da cromatina



Wang Y, Jiang R, Wong WH. Modeling the causal regulatory network by integrating chromatin accessibility and transcriptome data. Natl Sci Rev. 2016 Jun;3(2):240-251. doi: 10.1093/nsr/nww025. Epub 2016 Apr 19. PMID: 28690910; PMCID: PMC5501464.

Xu J, Liu Y. Probing Chromatin Compaction and Its Epigenetic States in situ with Single-Molecule Localization-Based Super-Resolution Microscopy. Front Cell Dev Biol. 2021 Jun 10;9:653077. doi: 10.3389/fcell.2021.653077. PMID: 34178982; PMCID: PMC8222792

Duplicação do material genético



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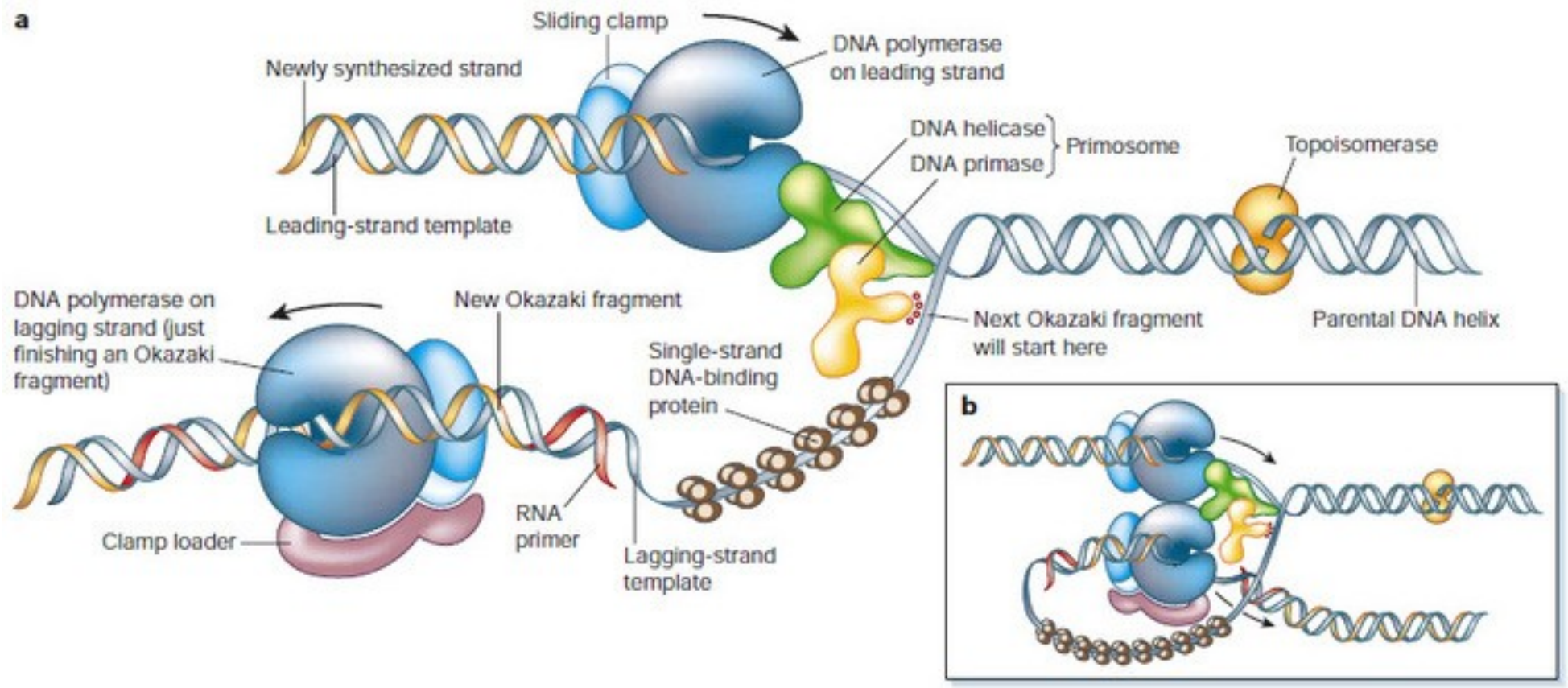
Duplicação do material genético

The Key Proteins at the Replication Fork: Polymerases, Primases, and Helicases



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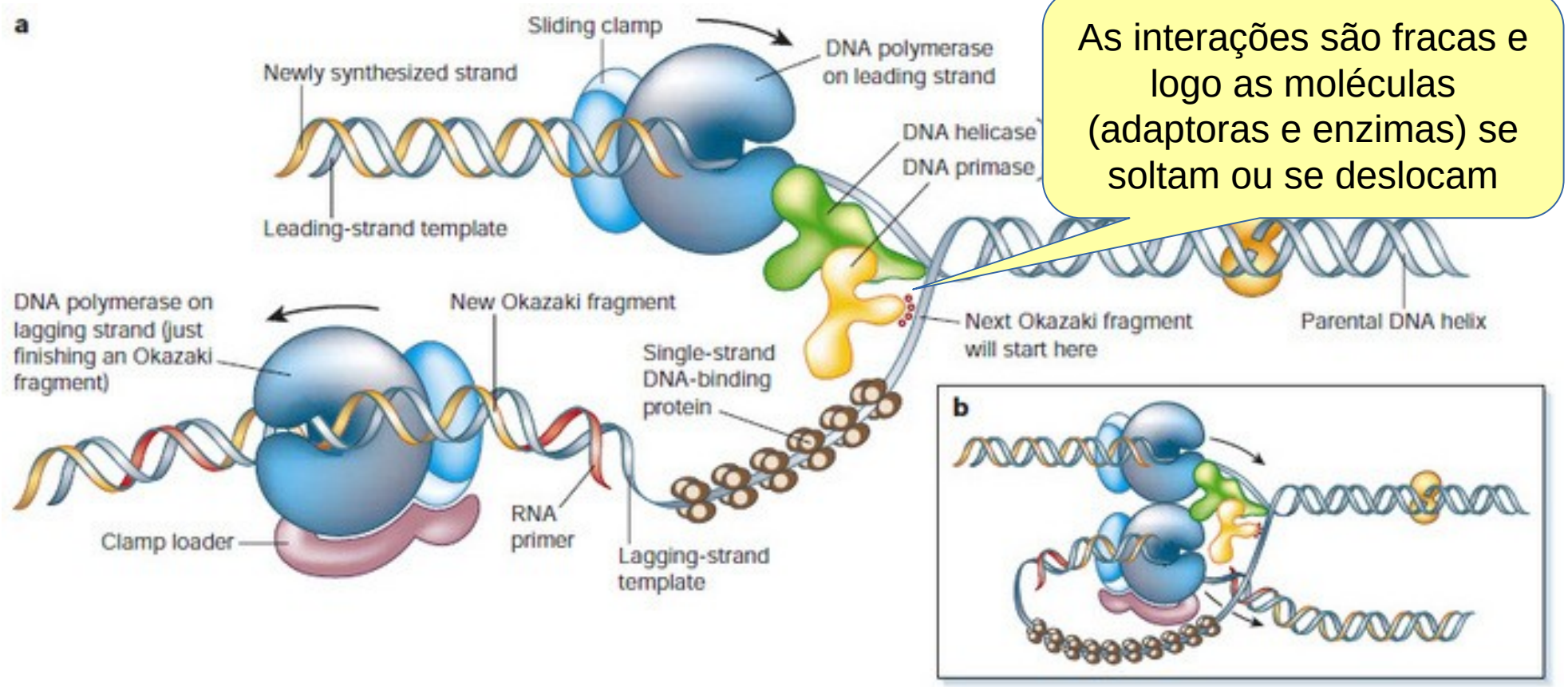
Duplicação do material genético

The Key Proteins at the Replication Fork: Polymerases, Primases, and Helicases

As interações são fracas e logo as moléculas (adaptoras e enzimas) se soltam ou se deslocam



https://le.ac.uk/vgec/topics/cell-cycle/the-cell-cycle-higher-education

exercício

Assista o vídeo

Polimerase (visão molecular)

https://www.youtube.com/watch?v=N6zcsSTV2Ew

https://www.youtube.com/watch?v=6hcK--4S68U

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abril/2025 e maio/2023