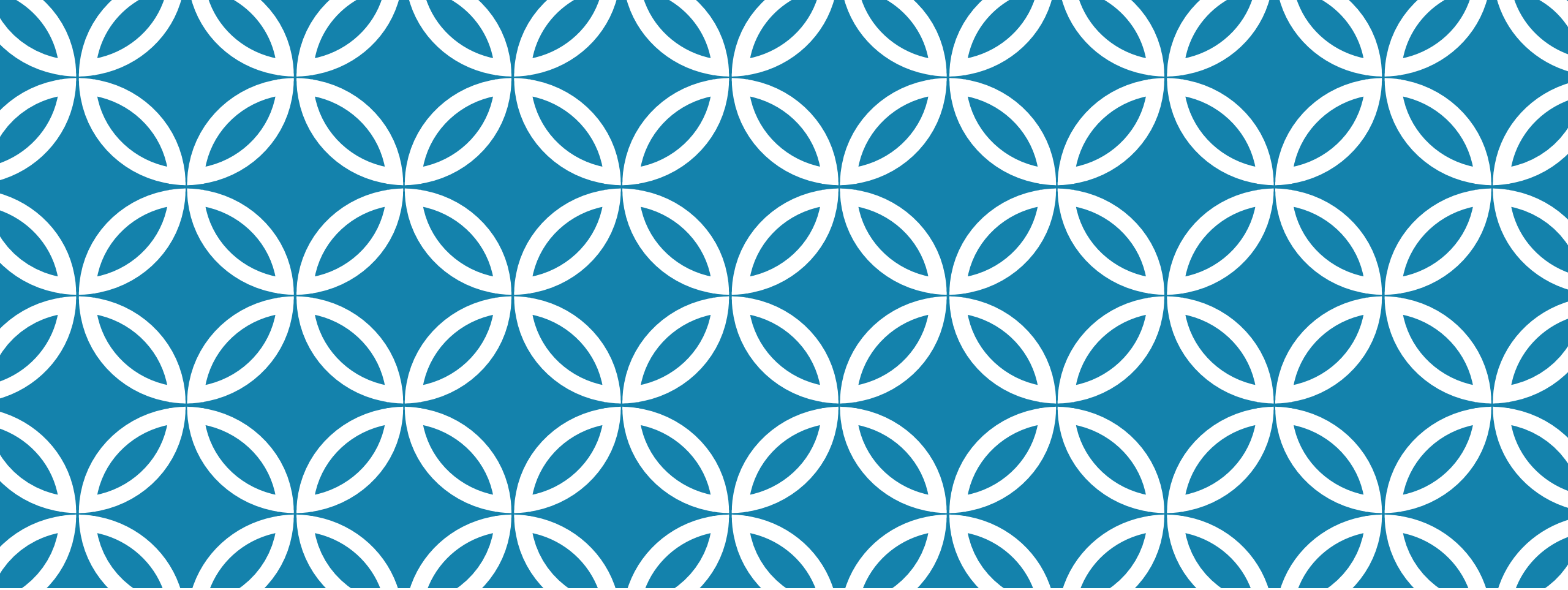


CHAPTER 3.2

Chromosomes

ESSENTIAL IDEA

Chromosomes: carry genes in a linear sequence that is shared by a member of a species

REVISION: ORGANIZATION OF DNA

DNA = double stranded molecule → genetic material of a cell.

- Composed of nucleotides with 4 distinct bases (A, T, G, and C)
- Order of these bases → gene sequence → code for specific proteins

A single double-stranded DNA molecule = chromosome

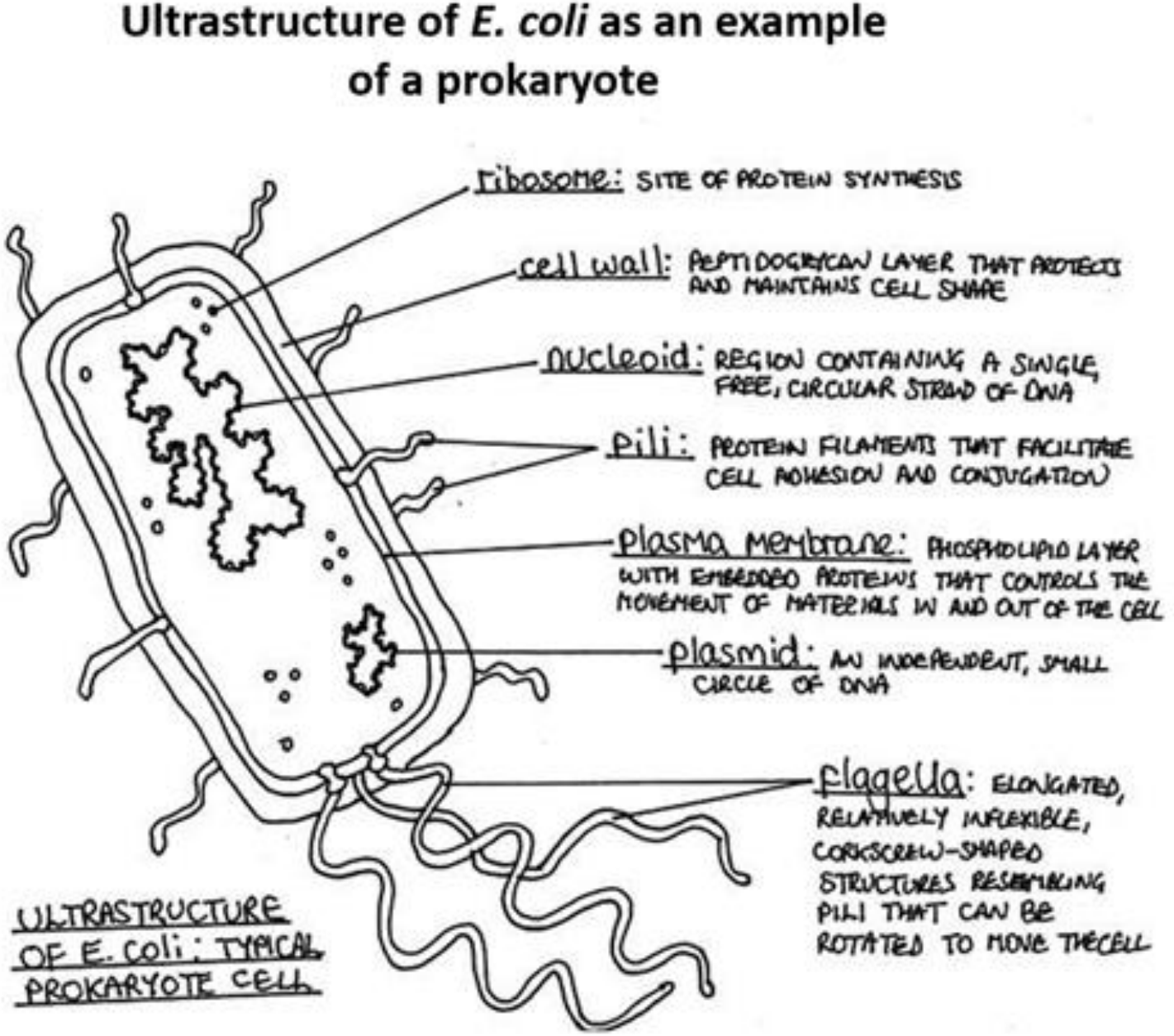
- A single chromosome → thousands of unique genes

Chromosomal structure differs between prokaryotic and eukaryotic organisms

REVISION E. COLI

E. Coli = model organism. Some strains are toxic to humans.

Cell parts or ultrastructure of prokaryotes → not organelles



PROKARYOTIC CHROMOSOMES

Prokaryotes – no membrane-bound nucleus

- DNA in a region called nucleoid

Prokaryotes only have a single chromosome (genophore)

- DNA is circular and naked (not protein bound)

- genome is more compact (usually no introns)

Some eukaryotic organelles also have circular DNA (chloroplast, mitochondria) indicating prokaryotic origins

Circular genophore

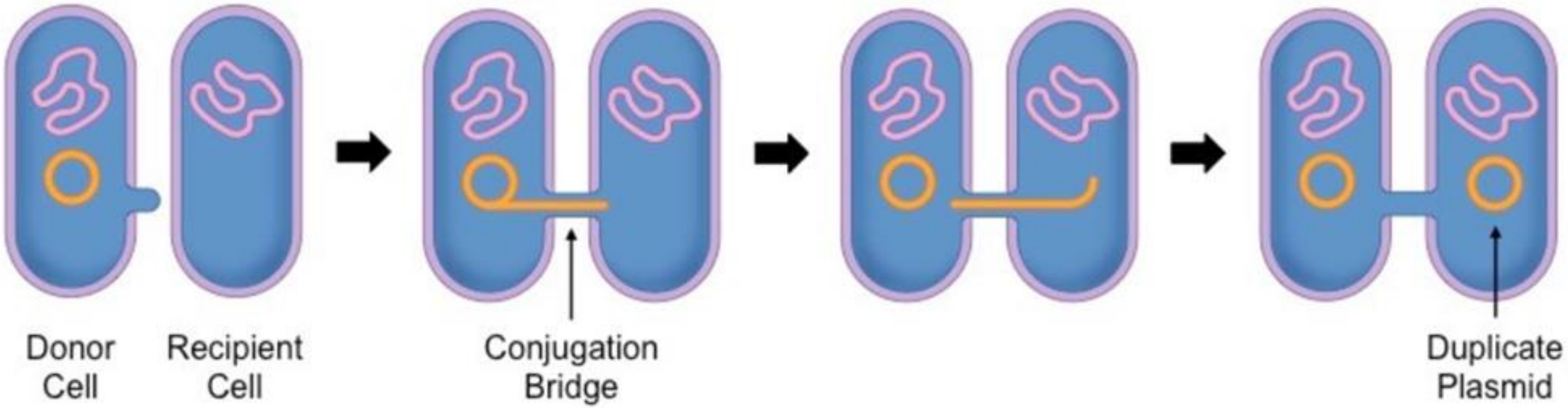
PLASMIDS

Prokaryotes may also contain extra DNA molecules – plasmids

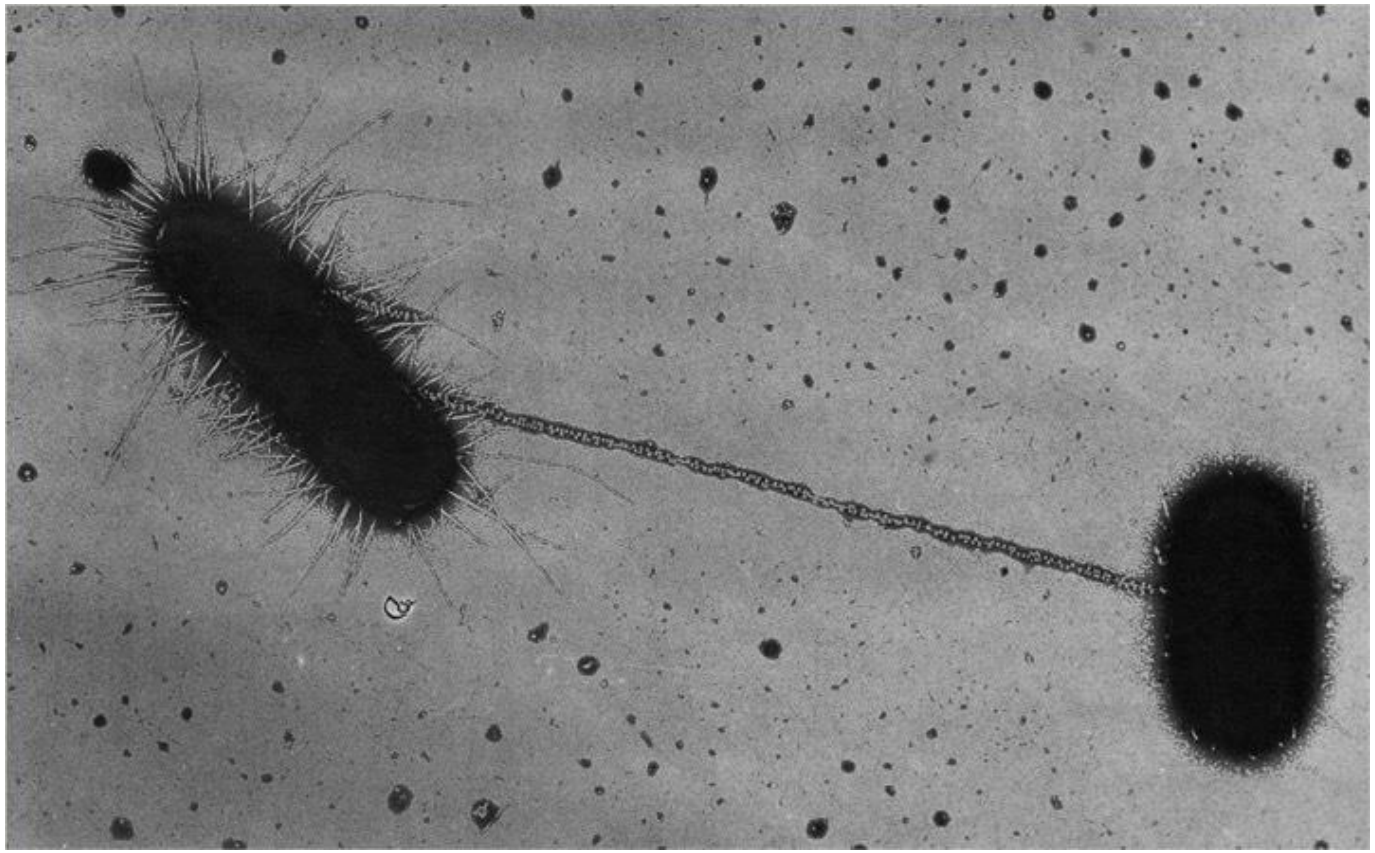
- autonomous function
- may be excanged via conjugation (&sex pili)

Eukaryotes do NOT have plasmids

HOW DO BACTERIA EVOLVE NEW FEATURES WITHIN A GENERATION?



BACTERIAL CONJUGATION



EUKARYOTIC CHROMOSOMES

Eukaryotic DNA = stored in membrane-bound nucleus

- nuclear pores → transport RNA to cytosol

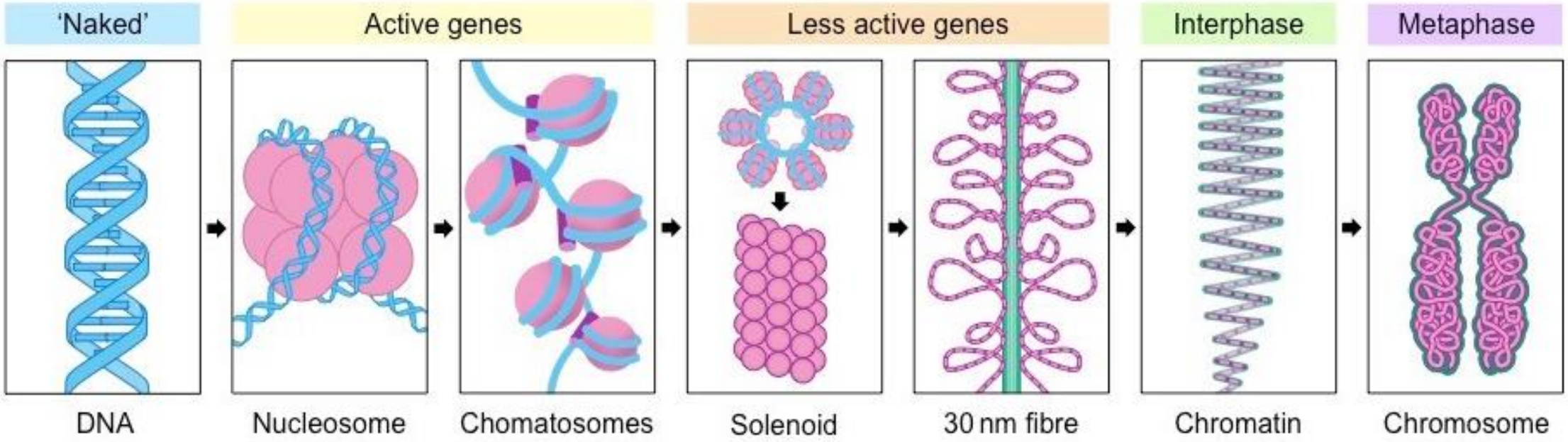
Eukaryotes multiple linear chromosomes

- DNA is bound to histone proteins to form chromatin
- genome is less compact (many introns)

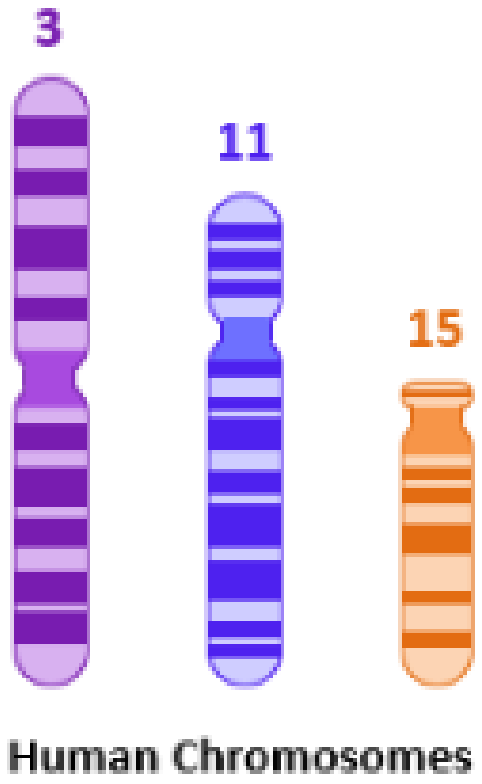
Uncondensed chromatin vs chromosomes

linear DNA (condensed)

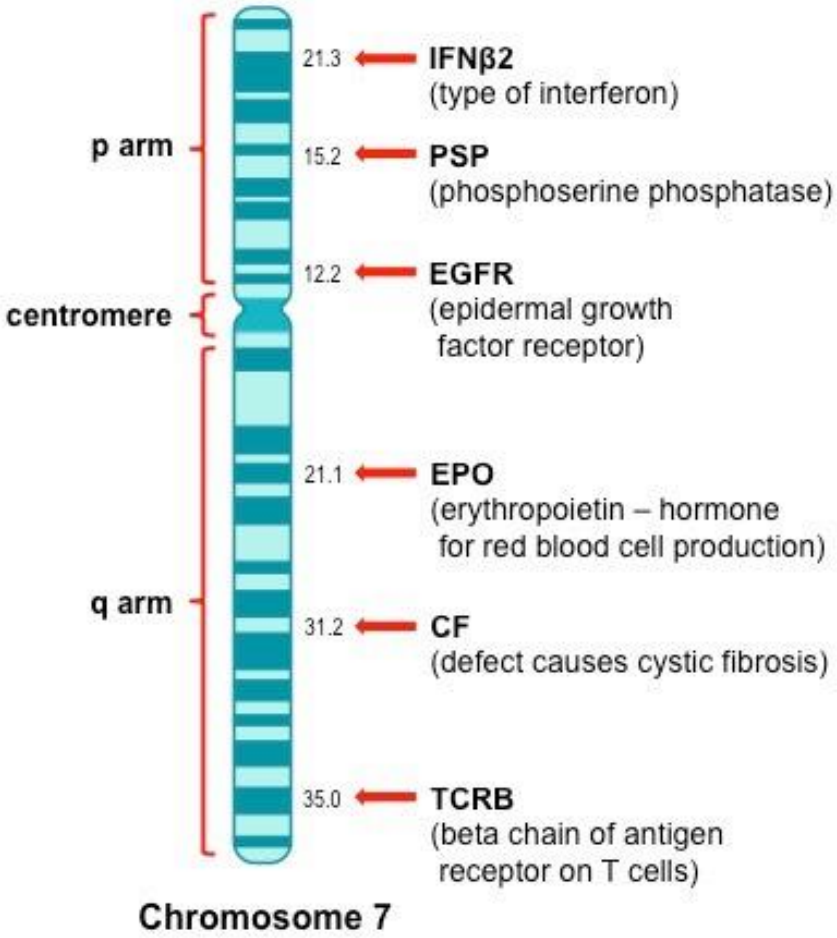
ORGANISATION OF DNA IN EUKARYOTIC CHROMOSOMES



CHROMOSOME COMPOSITION



CHROMOSOME COMPOSITION

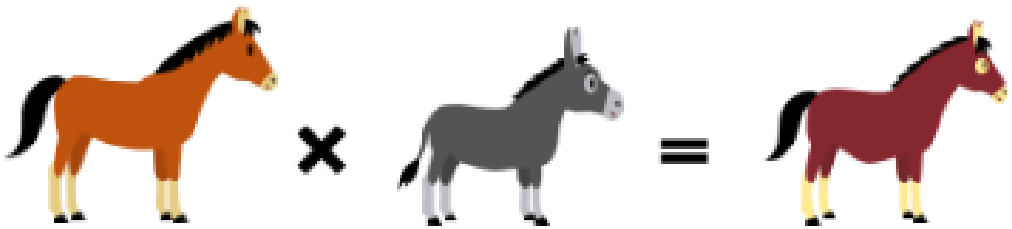


CHROMOSOME NUMBERS

Number of chromosomes = characteristic feature of a species

Different species → different chromosome numbers and gene distribution

Different species – cannot sexually reproduce (because genetic content not complementary)



Hybrid species *can* sometimes occur, but are always **infertile**

HAPLOID VS DIPLOID

Species that reproduce sexually → offspring genetic info (chromosomes), from both parents

two copies of each chromosome = **diploid** (2n)

Sex cells (gametes) one of each pair.

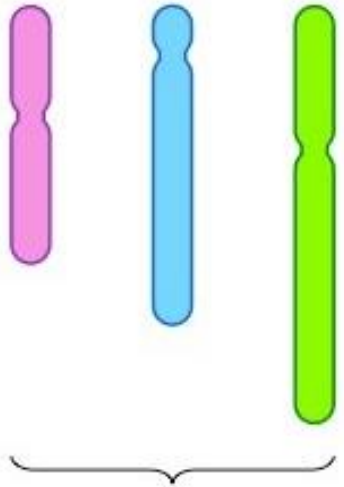
one copy of each chromosome = **haploid** (n)

Organisms that only reproduce asexually → haploid

HAPLOID VS DIPLOID

Haploid (n)

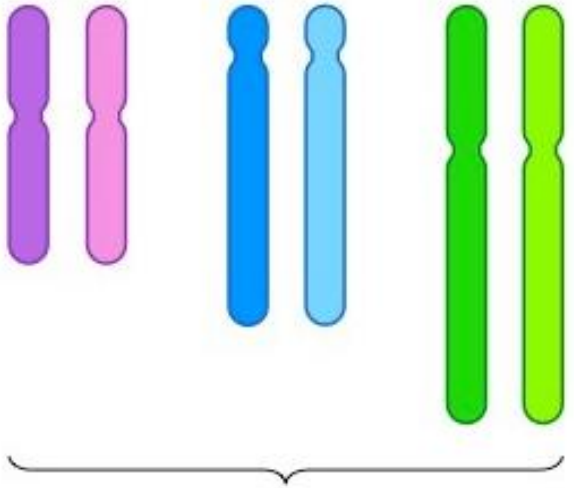
One copy of each chromosome



Three non-homologous chromosomes

Diploid (2n)

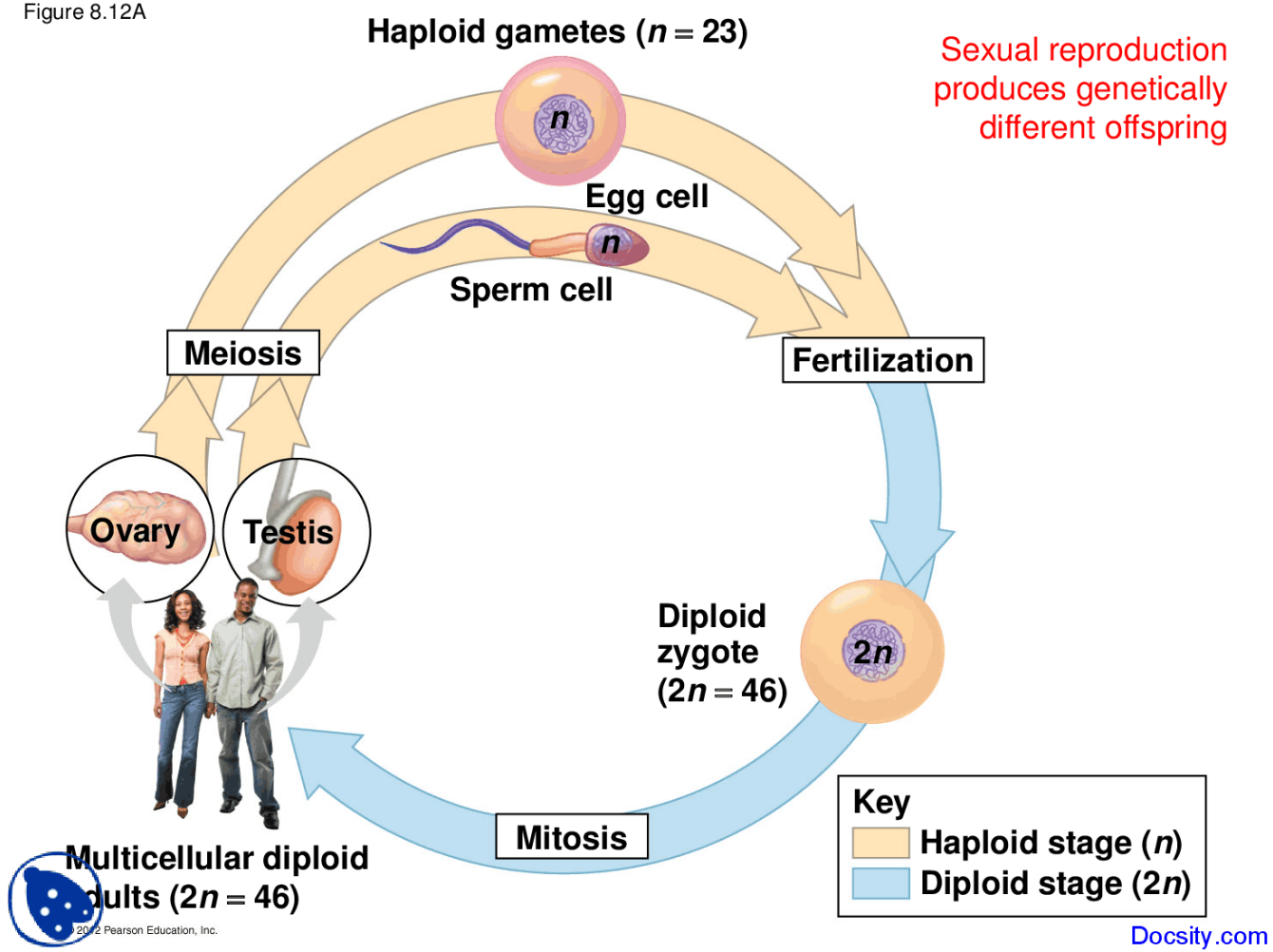
Two copies of each chromosome



Three pairs of homologous chromosomes (of maternal and paternal origin)

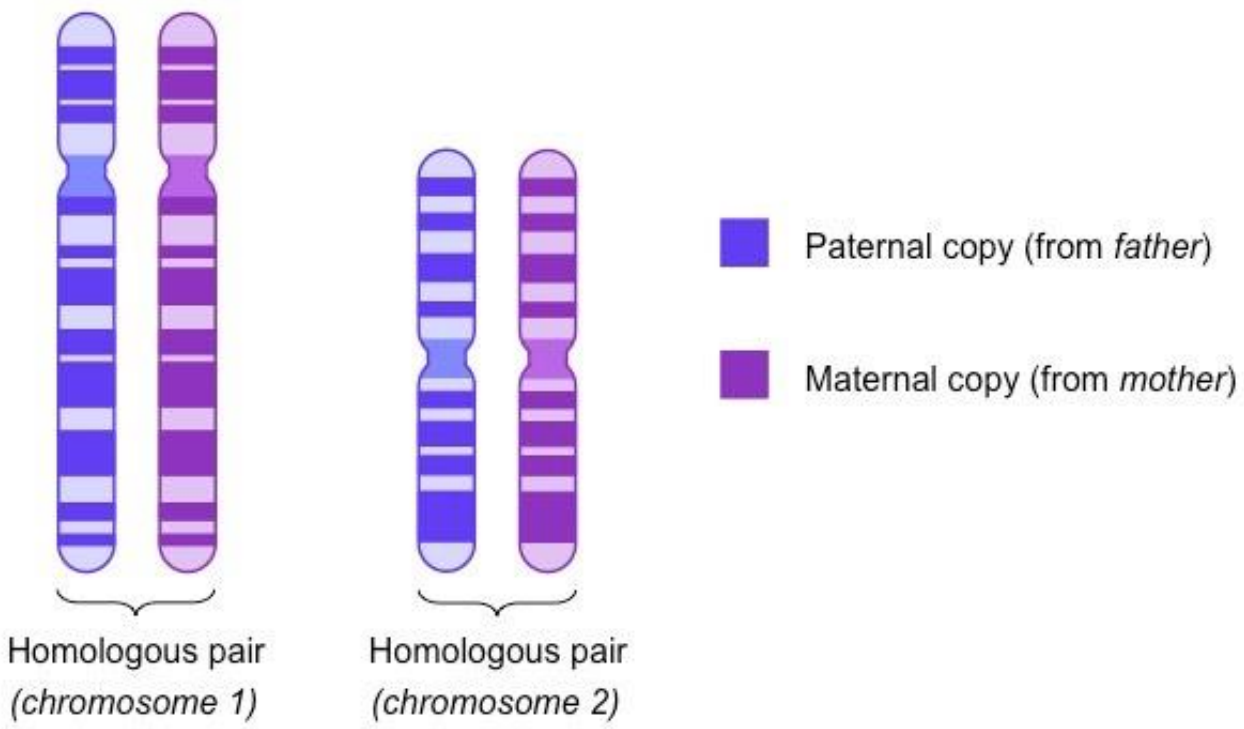
HAPLOID VS DIPLOID

Figure 8.12A



Sexual reproduction produces genetically different offspring

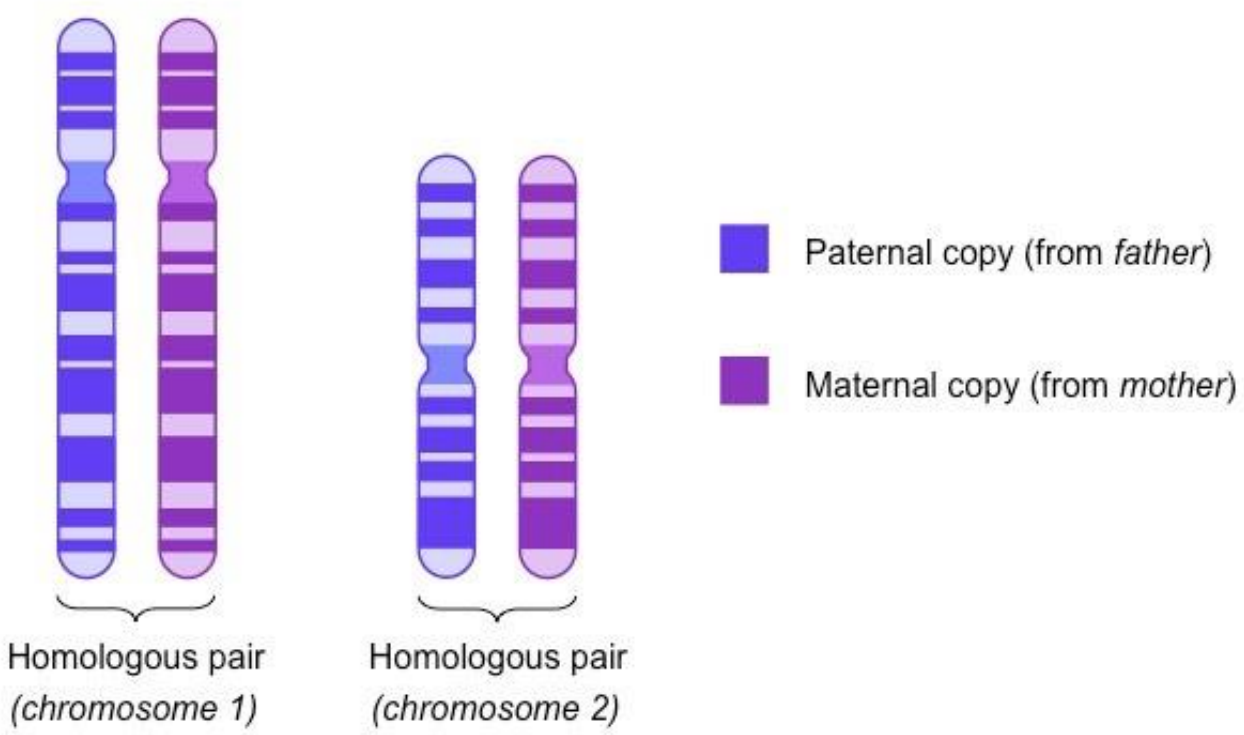
HOMOLOGOUS CHROMOSOMES



Which features will homologous chromosomes share?

Could there be any differences?

HOMOLOGOUS CHROMOSOMES



- Same: size, band patterns, centromere positions, same genes at same loci
- Different: alleles may be different

AUTOSOMES VS HETEROSOMES

Not all chromosome pairs in diploid cells are homologous

- Sex determination requires distinct chromosomes

Humans have 23 pairs

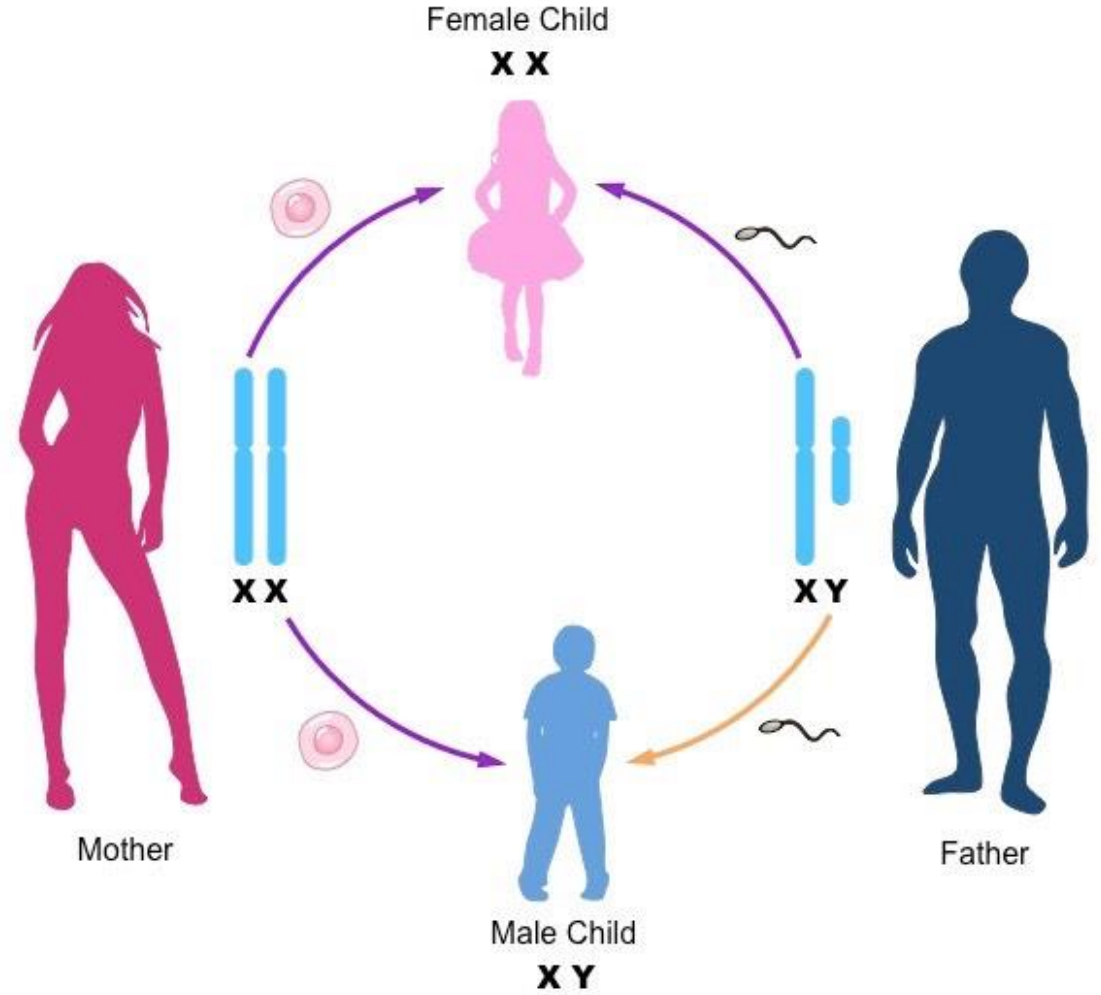
- 22 homologous autosomes (autosomes do not determine sex)
- the 23rd pair = sex chromosomes (heterosomes)

In males sex chromosomes are different (XY)

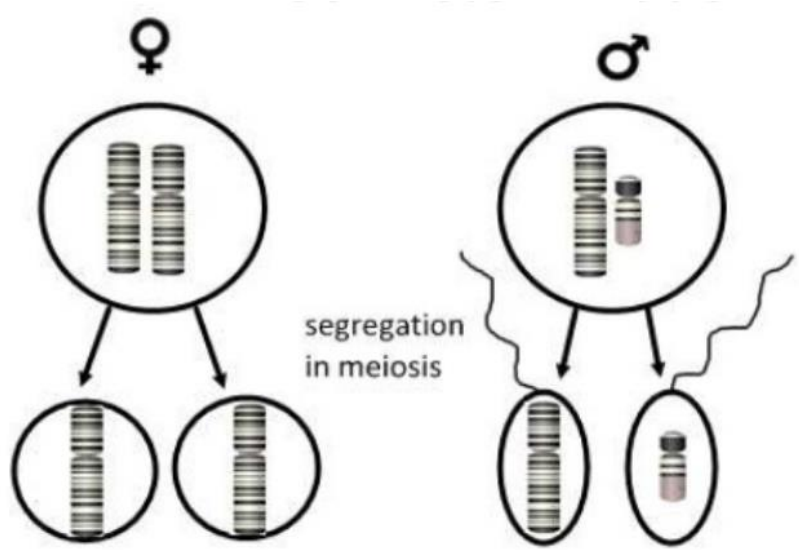
In females they are the same (homologous)

Sex chromosomes

SEX DETERMINATION IN HUMANS



SEX DETERMINATION



Segregation of the sex chromosomes in meiosis.

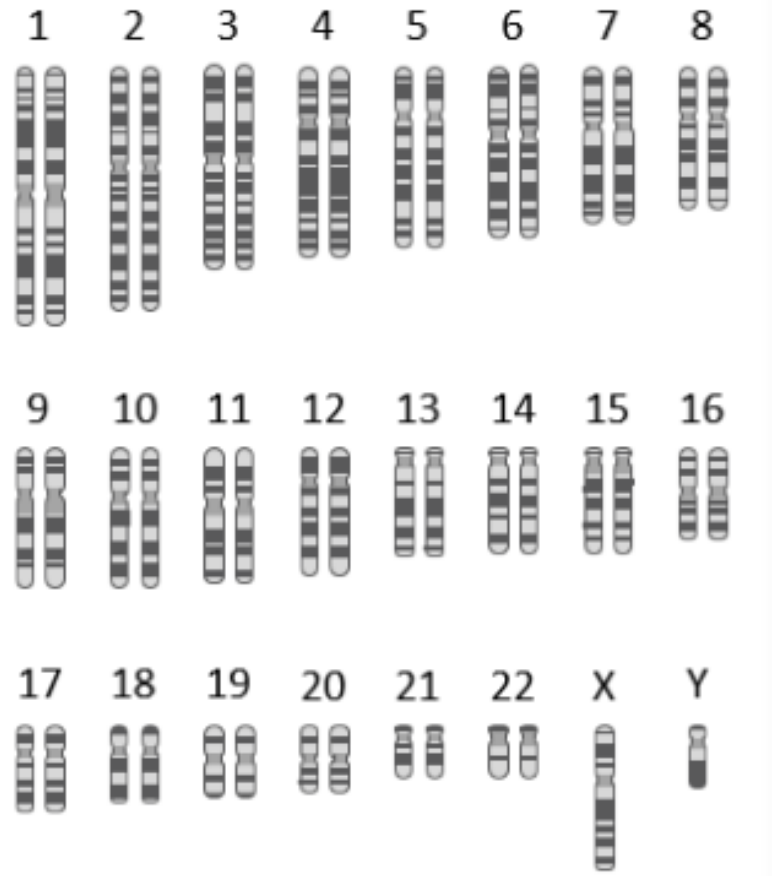
gametes	X	Y
X	XX	XY
X	XX	XY

KARYOGRAMS

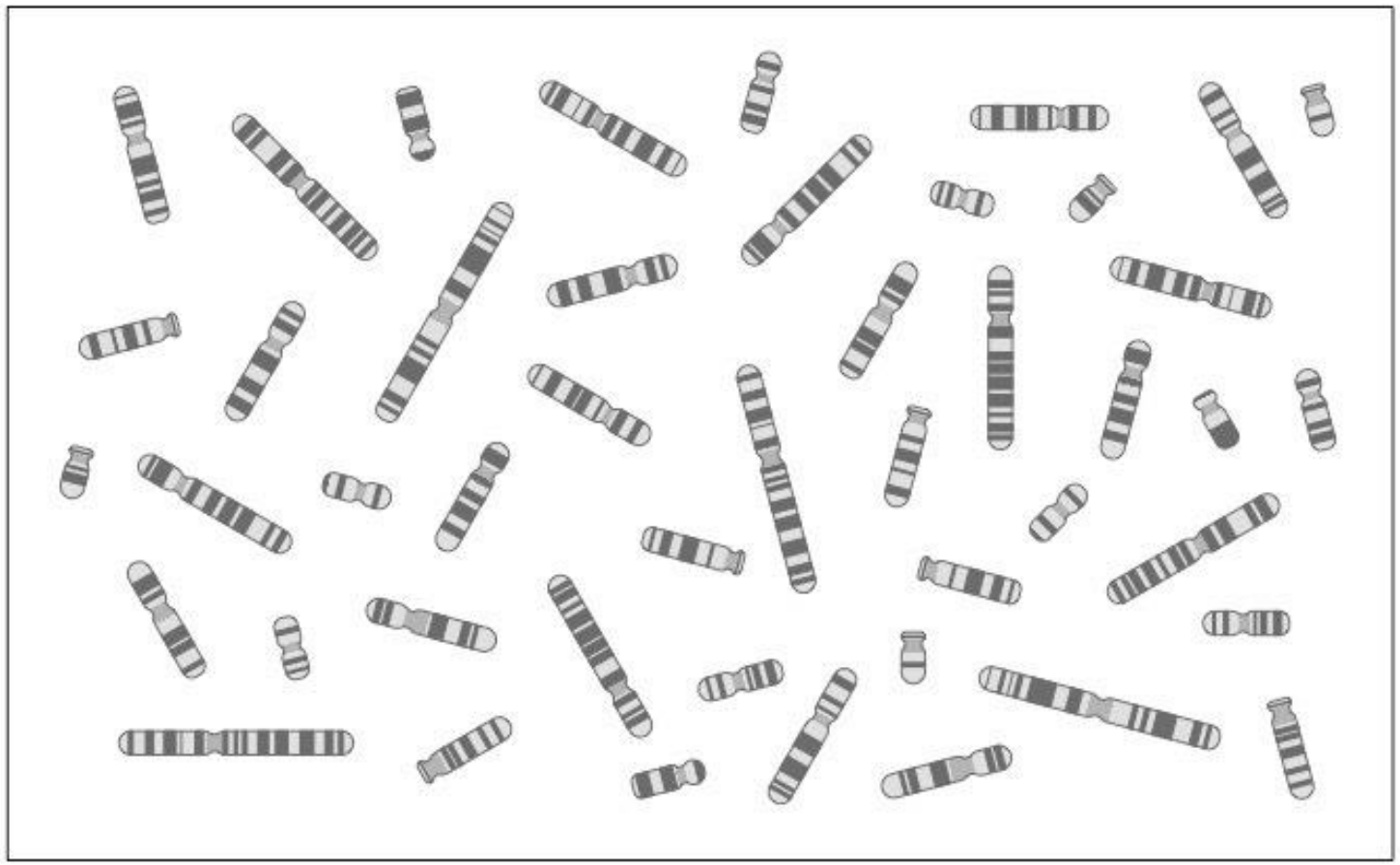
Chromosome profile of an individual organism → karyogram

Cells have been arrested during mitosis (chromosomes visible)

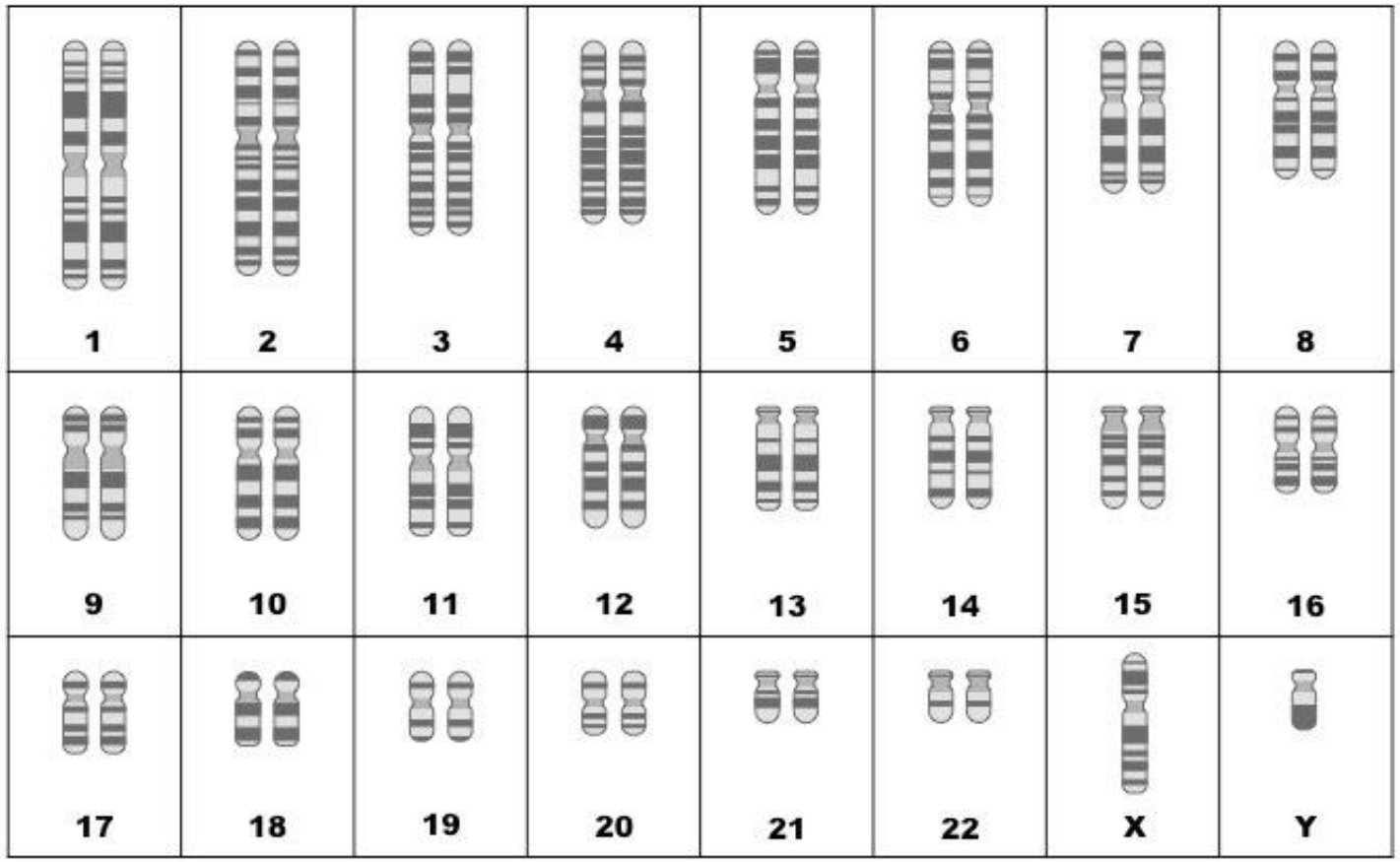
Usually to identify sex or chromosomal abnormalities (aneuploidy)



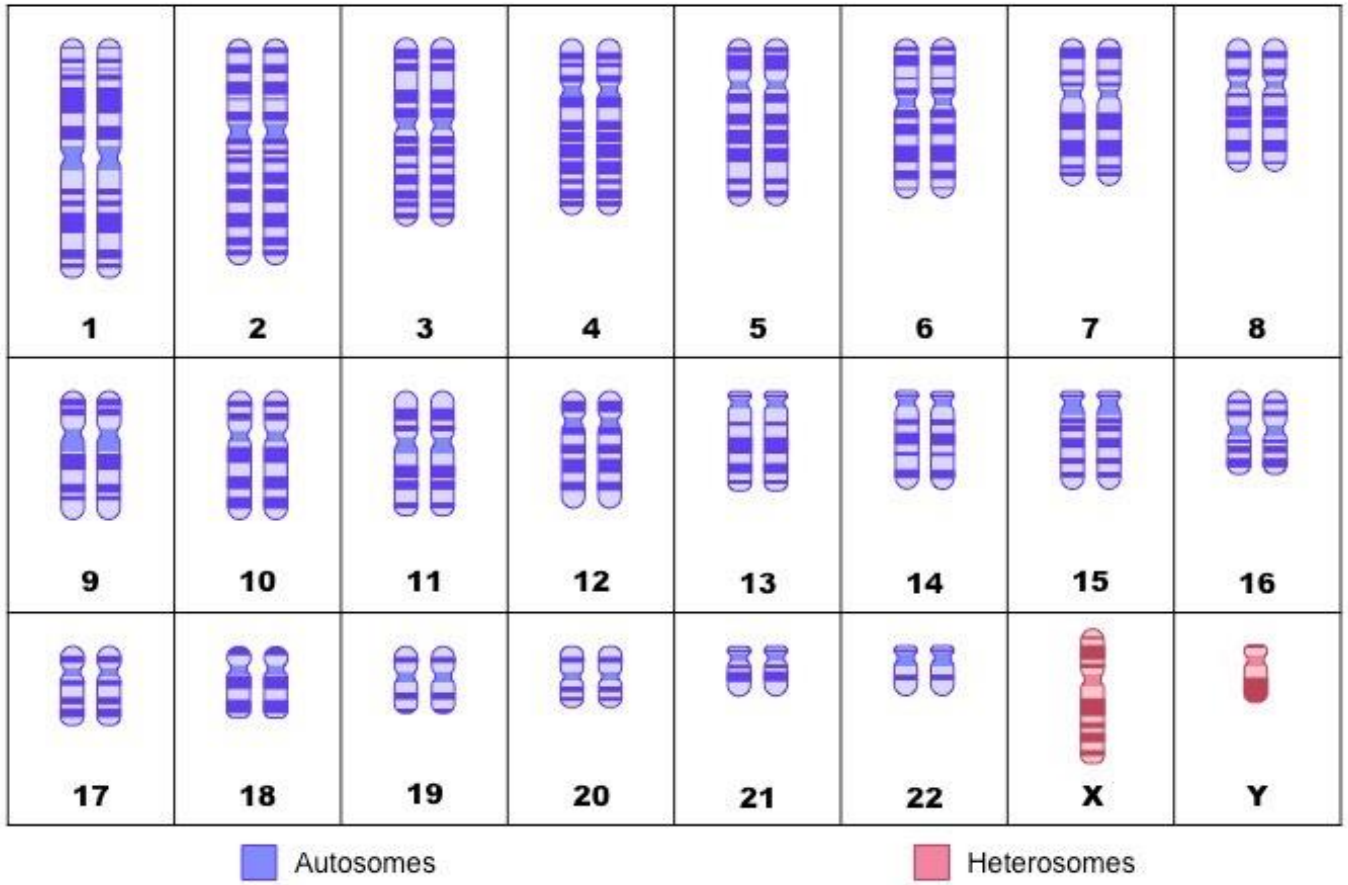
KARYOGRAMS



KARYOGRAMS



KARYOGRAMS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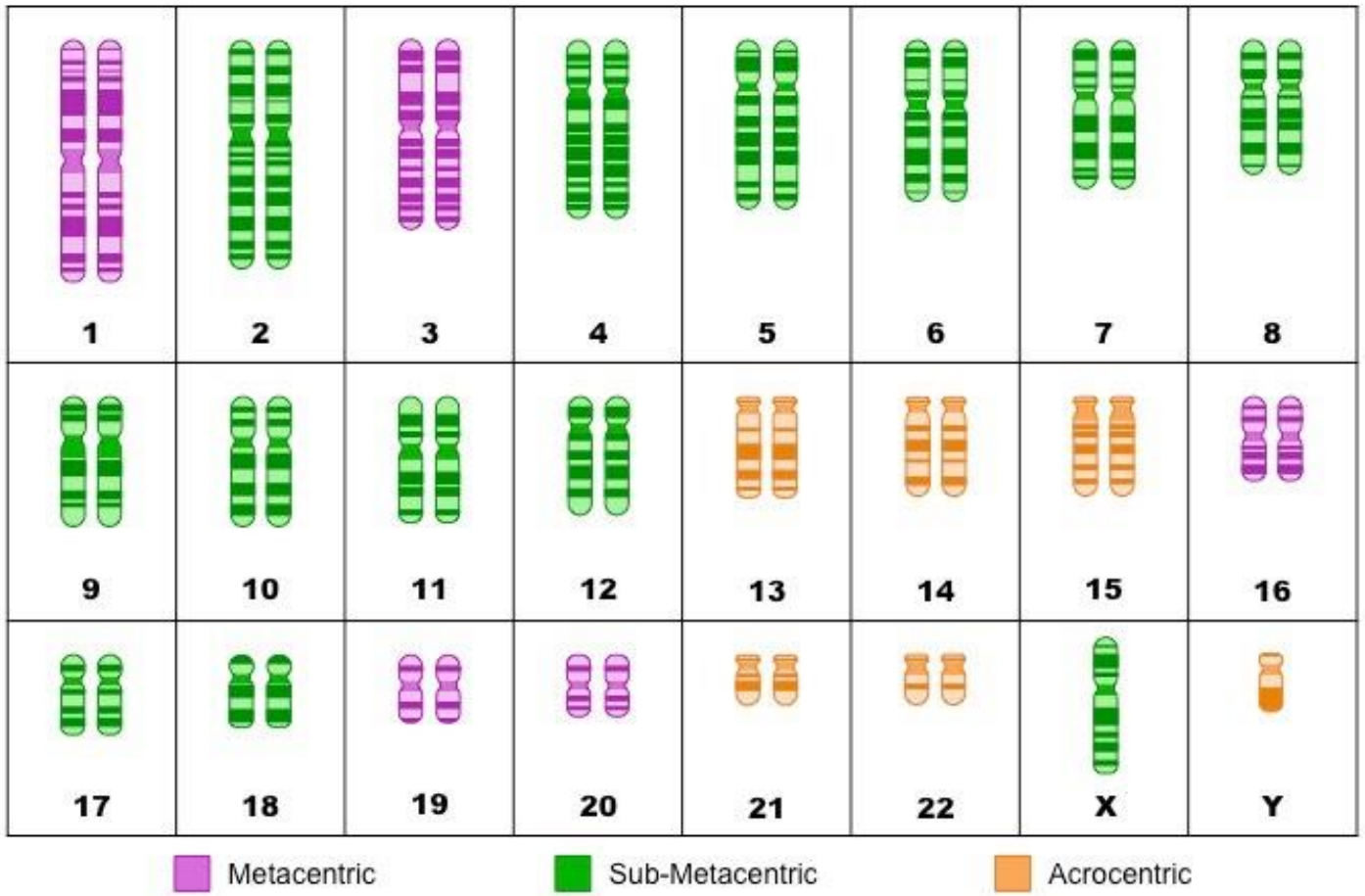
X
Y
Autosomes
Heterosomes

KARYOGRAMS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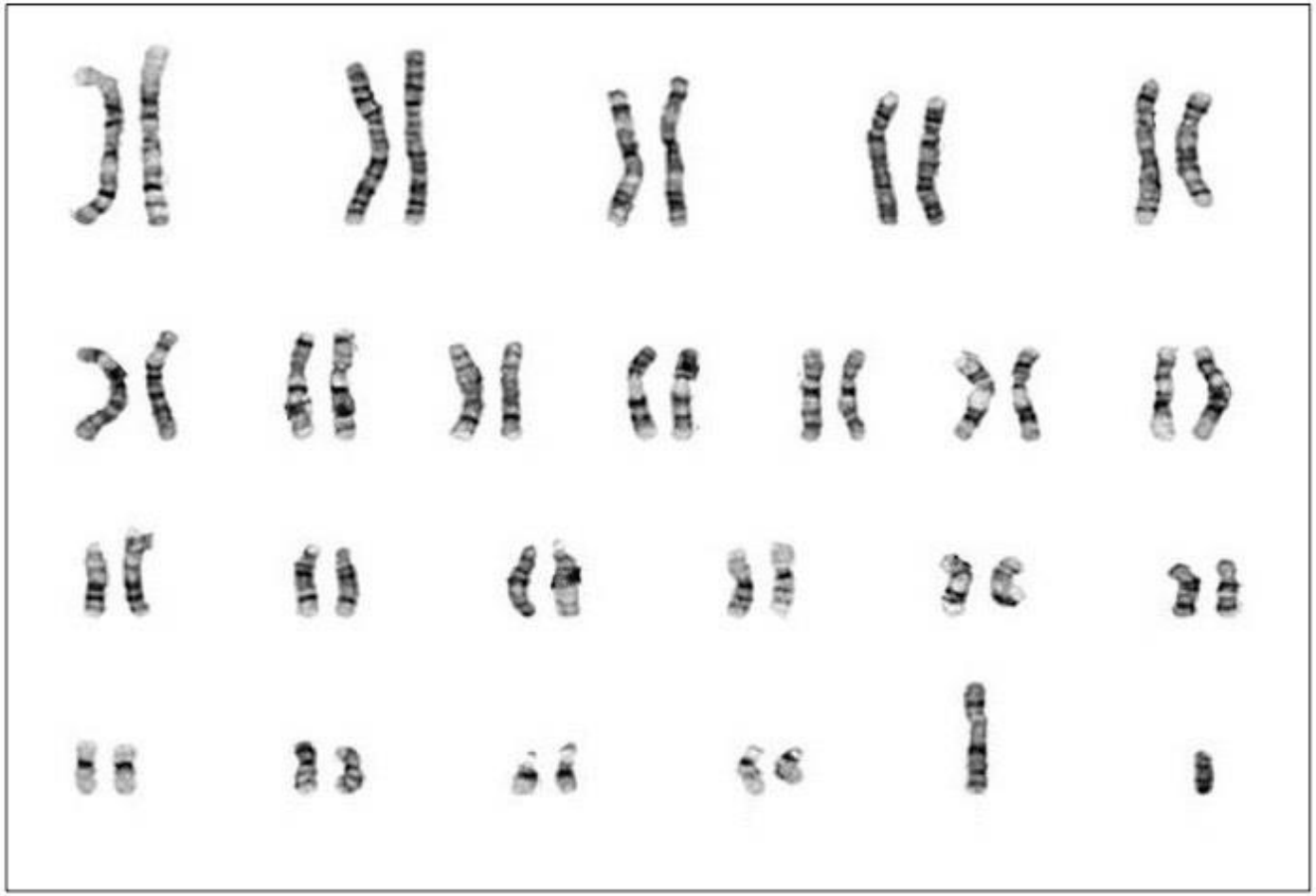
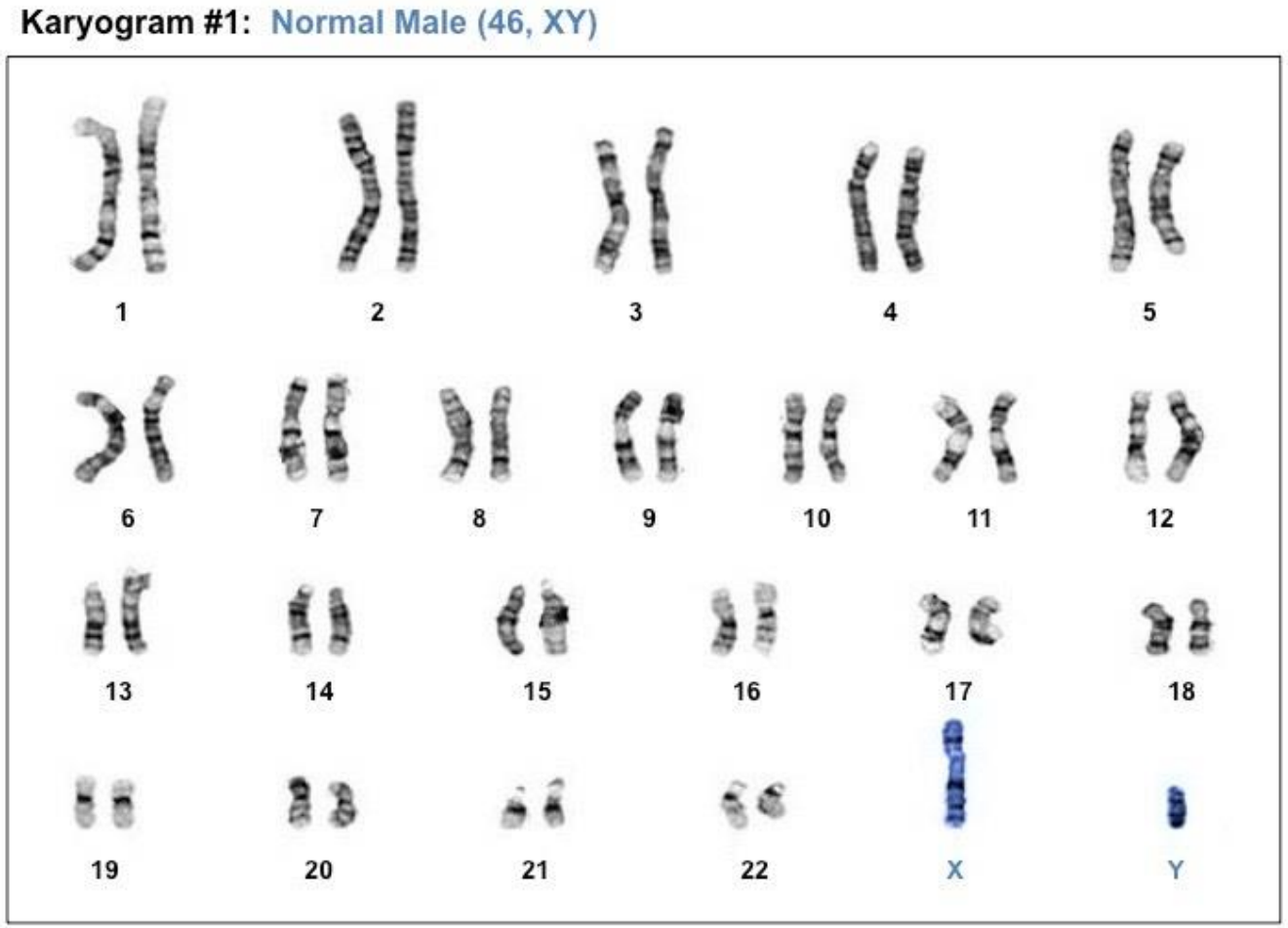
Metacentric
Sub-Metacentric
Acrocentric

EXERCISE: KARYOGRAMS

Karyogram #1:

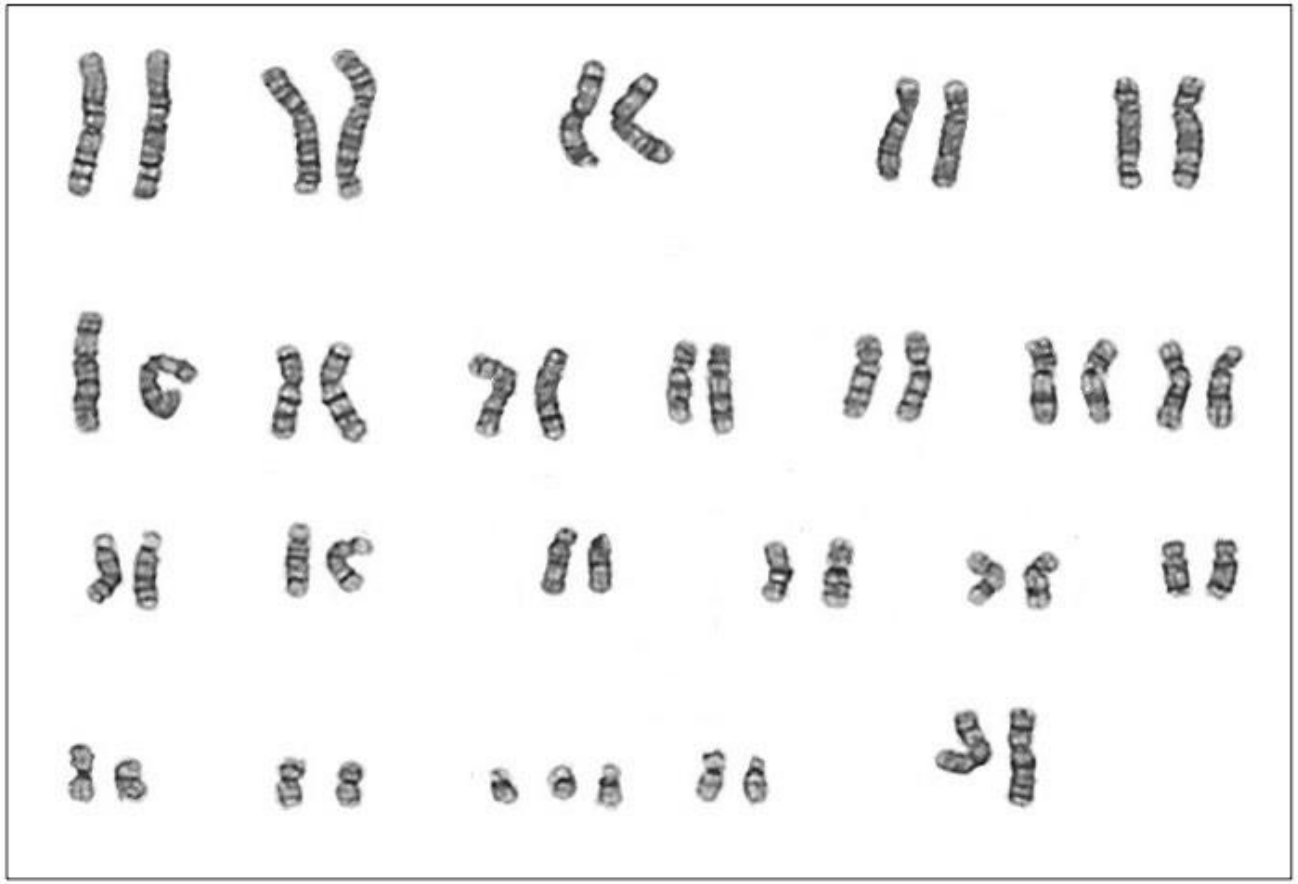


EXERCISE: KARYOGRAMS



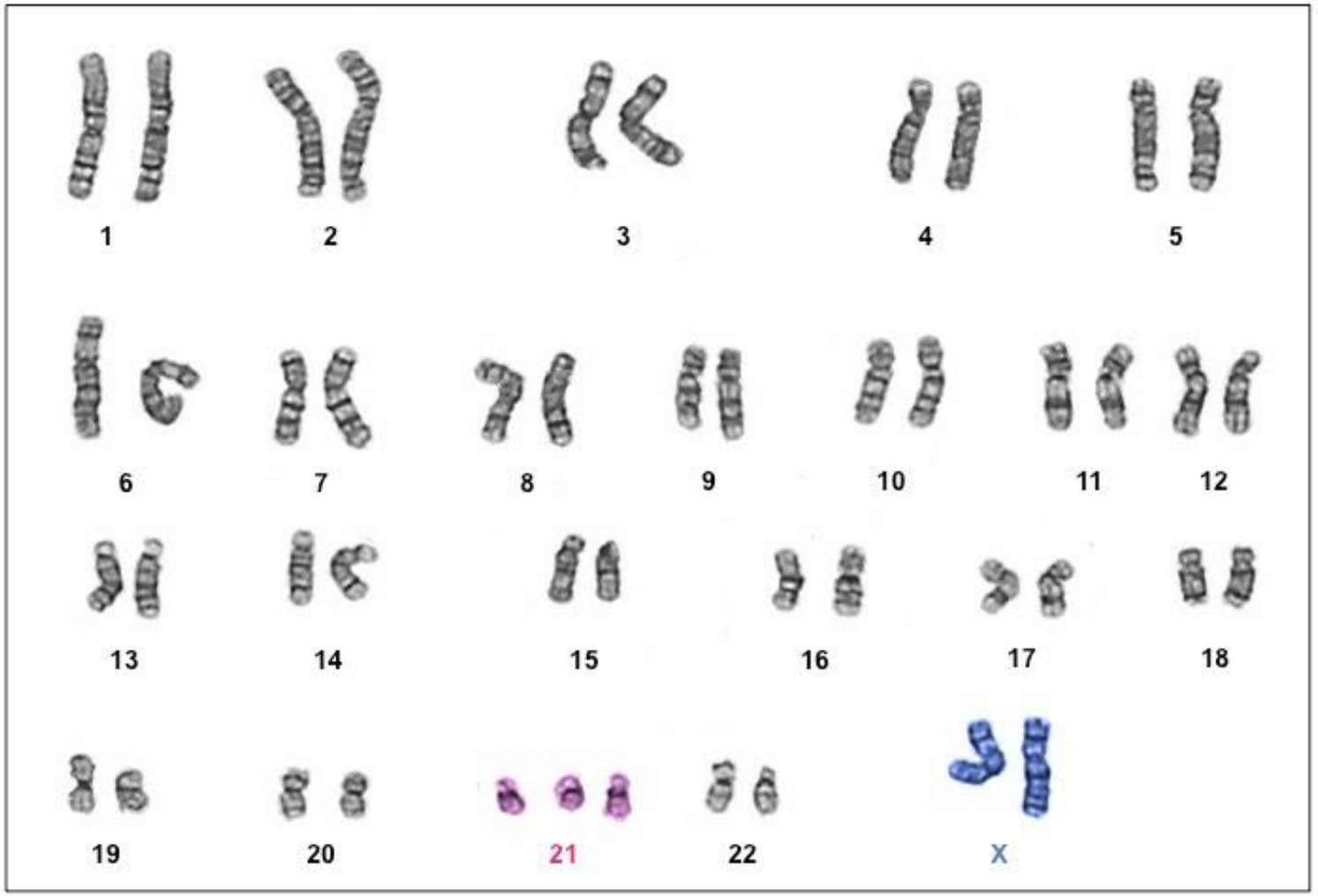
EXERCISE KARYOGRAMS

Karyogram #2:



EXERCISE KARYOGRAMS

Karyogram #2: Female with Trisomy 21 (47, XX)



MEASURING LENGTH OF CHROMOSOMES

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