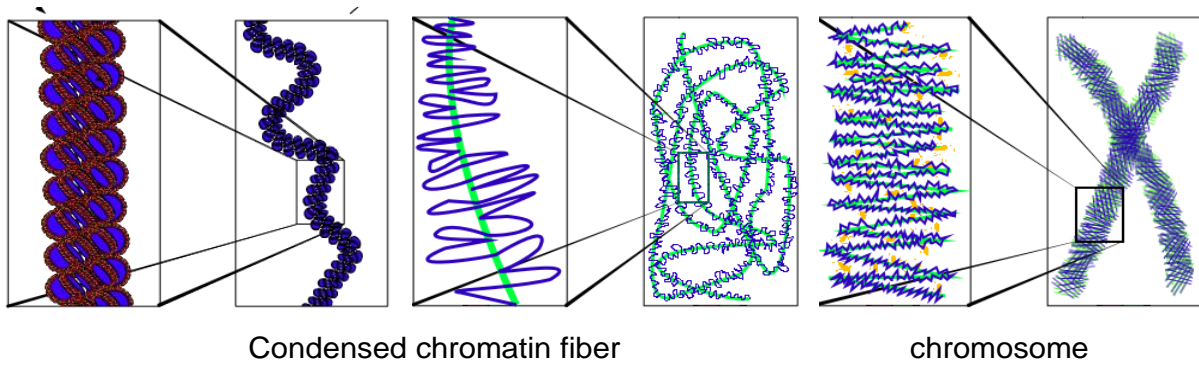
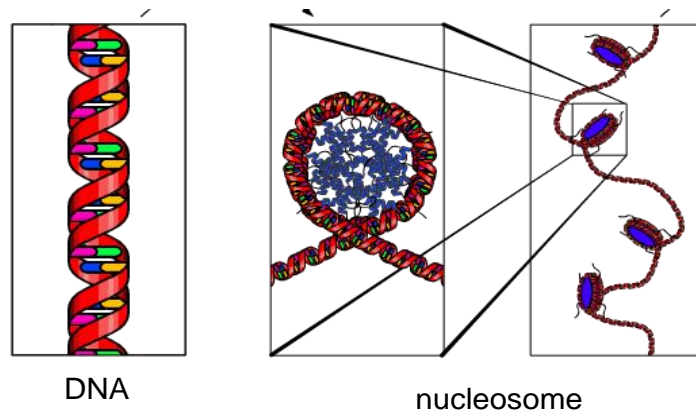


**ORGANISATION OF THE GENETIC MATERIAL**  
**CHROMOSOMES, CHROMATIDES**



- Genetic material in prokaryotes and eukaryotes is the DNA.
- In eukaryotes proteins are attached to the DNA. That is called chromatin.
- Chromatin is located in the cell nucleus.
- The major proteins involved in chromatin are histone proteins, but there are many other important chromosomal proteins (non-histone proteins).

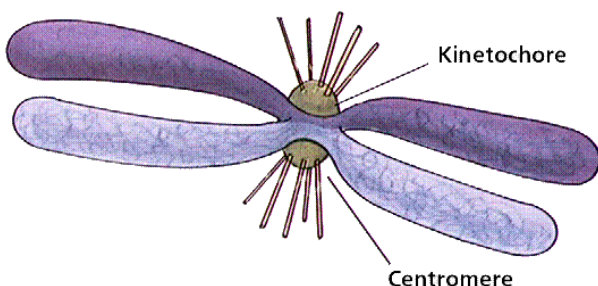
**WHY DO EUKARYOTES HAVE CHROMATIN?**

- Chromatin is a packaged form of the DNA into a smaller volume to fit in the cell,
- Proteins of the chromatin strengthen the DNA and allow mitosis and meiosis. During mitosis and meiosis, modification of the chromatin is called condensation.
- Proteins of the chromatin serve as a mechanism to control gene expression.

**CHROMATIN CONDENSATION**

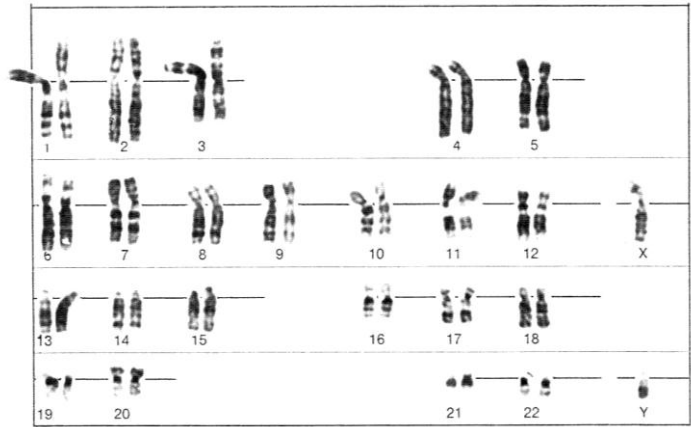
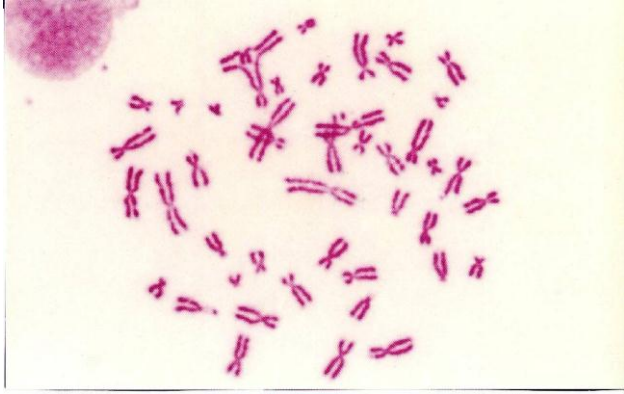
- During chromatin condensation DNA and the attached proteins are going to be more compact. It means that the chromatin is condensed.
- The most condensed (the most compact) form of the chromatin is the chromosome.
- For cell division, chromosomes must be formed, because the DNA divides in form of chromosomes.

**CHROMOSOME, CHROMATID**



1 chromosome consists of 2 **chromatides** (dark purple, light purple)  
The 2 chromatides attach to each-other at the **centromere** of the chromosome.  
Proteins that attach to the centromere are called **kinetochores**.  
Microtubules of the mitotic spindle-apparatus bind to kinetochores.  
The ends of the **chromosome arms** are the **telomeres**.

Set of human chromosomes (46, XY)



- The number of the chromosomes is different in various species. For example humans have 46, dogs have 78, cats have 38.
- In humans the 46 chromosomes consist of 22 pairs autosomes and 2 sex chromosomes.
- The sex chromosomes in females are the same (XX), in males they are different (XY).

### KARYOTYPE

- In human autosomal chromosomes are present in two identical copies
- The chromosomes are arranged and displayed (often on a photo) : in pairs, ordered by size and position of centromere for chromosomes of the same size.
- Normal karyotypes for women contain two X chromosomes and are denoted **46,XX**;
- Normal karyotypes for men have both an X and a Y chromosome denoted **46,XY**.
- Karyotypes are used to study chromosomal aberrations. (for example diagnosis of Down syndrome, which is trisomy 21).

### DIPLOID / HAPLOID CELLS

- Sexually reproducing species have somatic cells (body cells), which are diploid [2n] having two sets of chromosomes, one from the mother and one from the father.
- Gametes, reproductive cells (egg, sperm), are haploid [n]: they have one set of chromosomes.
- Gametes are produced by meiosis of a diploid germ line cell.
- When a male and a female gamete merge (fertilization), a new diploid cell (fertilized egg) is formed. From this cell a new organism develops.

### THE CHEMICAL COMPOSITION OF THE CHROMATIN

- Histone + nonhistone proteins
- RNA : mRNA, tRNA, rRNA and the own RNAs of the nucleus (e.g. snRNA)
- Ions ( $Mg^{2+}$ ,  $Ca^{2+}$ , etc.)
- Chemical modification of histones → structural changes of chromatin (e.g. condensation or loosening)
- Nonhistone proteins: e.g. structural proteins, transport proteins, proteins influencing transcription, protein and DNA chaperones