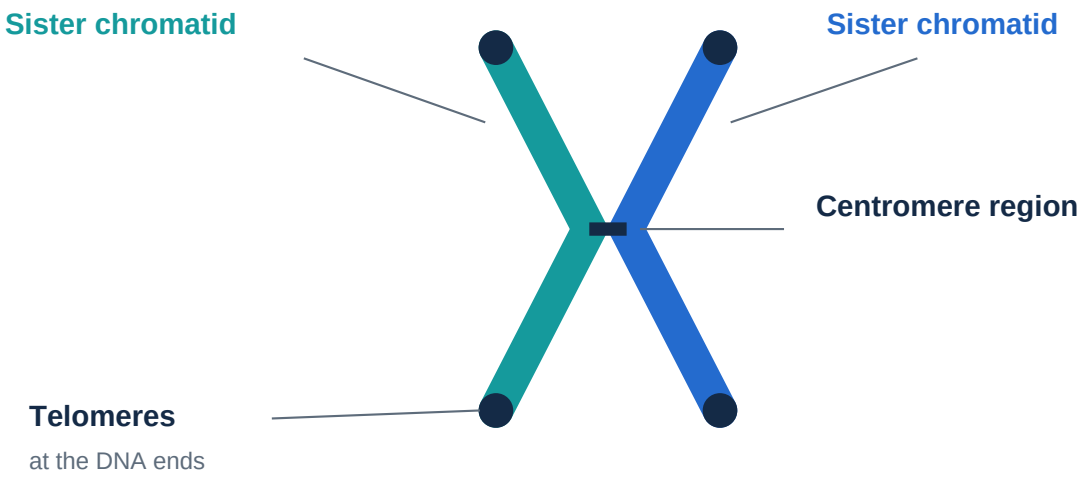
Recognise the parts of a chromosome

A nuclear chromosome is DNA associated with proteins, including histones. The familiar X-like drawing shows a replicated, condensed chromosome, not its permanent shape.

1. ONE REPLICATED CHROMOSOME



Each coloured half contains one long, double-stranded DNA molecule.

Dark tips mark telomeres; colours distinguish copies, not different genes.

2. SISTER CHROMATIDS ARE COPIES

DNA replication produces two sister chromatids with the same DNA base sequence, barring copying errors. They remain associated until separation. Each full coloured half is a chromatid, not merely one arm of the X.

3. THE CENTROMERE IS A REGION, NOT THE WHOLE CENTRE

The centromeric region is where sister chromatids are most closely joined. Spindle attachment occurs at specialised structures assembled here during division. A centromere need not lie halfway along the chromosome.

The diagram separates the sisters slightly so both are clear. Chromosomes also exist when their DNA is less condensed and no distinct X shape can be seen.

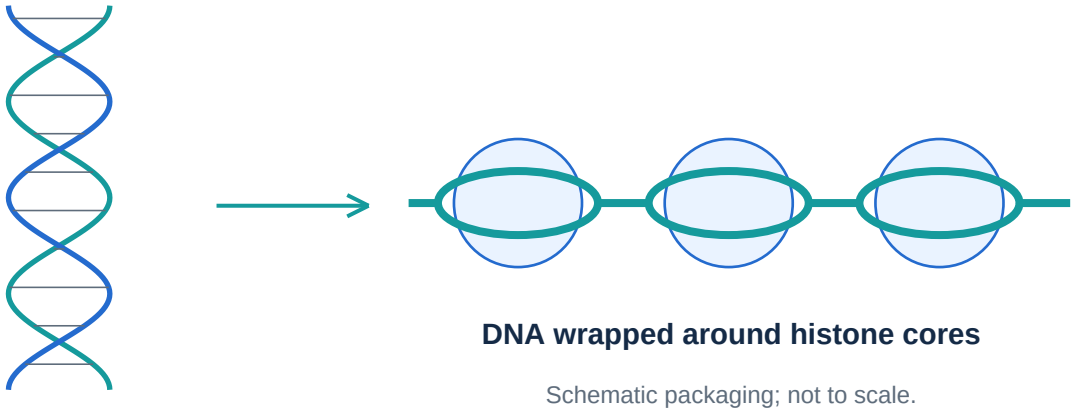
Sister chromatids and centromeres: NHGRI genetics glossary.
Centromere location and chromosome shape: MedlinePlus Genetics.

Scope: Cambridge Biology 9700 syllabus, section 5.1, outcome 1, p. 23.

DNA information, histone packaging

Keep the levels separate: DNA is the molecule, histones are proteins, and a chromosome is an organised DNA-protein structure.

1. FROM A DOUBLE HELIX TO PACKAGED DNA



DNA double helix

DNA wrapped around histone cores

Schematic packaging; not to scale.

Teal loop = DNA path; blue circle = a group of histone proteins.

2. HISTONES HELP ORGANISE LONG DNA MOLECULES

DNA wraps around groups of histone proteins. This supports compact packaging within the nucleus. Further folding and condensation produce the short, thick chromosomes visible during nuclear division.

3. PACKAGING IS NOT REPLICATION

Condensation changes how tightly the DNA is packed; replication copies its base sequence. A chromosome does not gain a second DNA molecule just because it becomes shorter and thicker in a microscope image.

Useful supporting term: chromatin means DNA with its associated proteins. It is the material of chromosomes, not a different genetic substance. The detailed stages of packing are beyond this lesson's required scope.

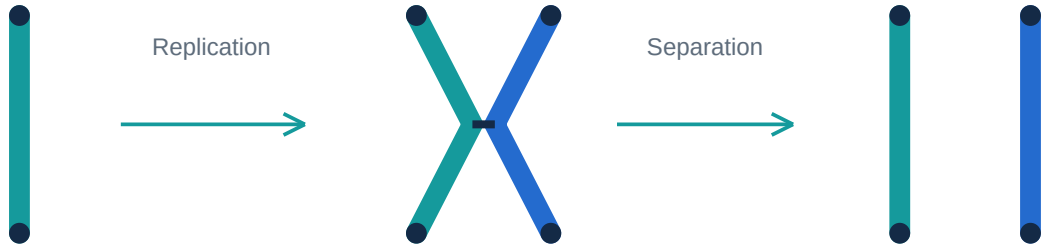
DNA packaging and chromatin: OpenStax Biology 2e, section 10.1.
DNA and histone proteins: MedlinePlus Genetics, What is a chromosome?

Scope: Cambridge Biology 9700 syllabus, section 5.1, outcome 1, p. 23.

Count chromosomes, not visible arms

Follow one chromosome through copying and separation. The compact shapes are schematic; DNA replication occurs before the chromosomes become fully condensed for mitosis.

1. TRACK ONE ORIGINAL CHROMOSOME



BEFORE COPYING	AFTER COPYING	AFTER SEPARATION
1 chromosome	1 chromosome	2 chromosomes
1 DNA molecule	2 DNA molecules	1 DNA molecule each

2. CHROMATIDS BECOME CHROMOSOMES WHEN THEY SEPARATE

Replication doubles DNA content but not chromosome number. Once sister chromatids separate, each is counted as a daughter chromosome. The two shown at the right are destined for different daughter nuclei.

3. TELOMERES PROTECT CHROMOSOME ENDS

Telomeres contain repetitive DNA at each end of a linear chromosome. They protect ends from damage and inappropriate joining. Each chromatid has two ends, so the replicated chromosome on page 1 shows four telomeric tips.

Do not confuse sisters with homologous chromosomes: sisters are copies of one chromosome; a homologous pair consists of two corresponding chromosomes, usually one from each parent. The two sides of one X are sisters, not a homologous pair.

Replication and chromosome organisation: OpenStax Biology 2e, section 10.1.
Chromosome-end protection: NHGRI, Telomere.

Scope: Cambridge Biology 9700 syllabus, section 5.1, outcome 1, p. 23.