Basics of chromosome structure
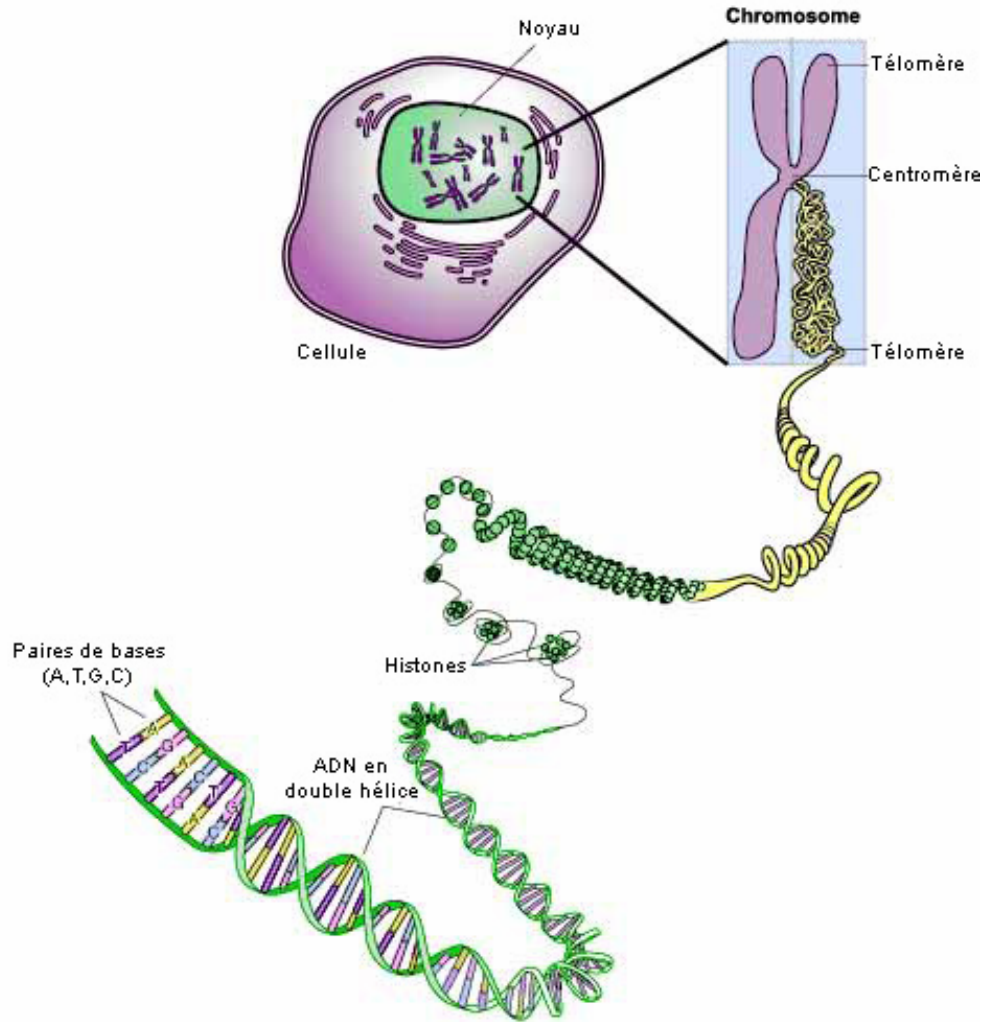
Eukaryotic chromosomes

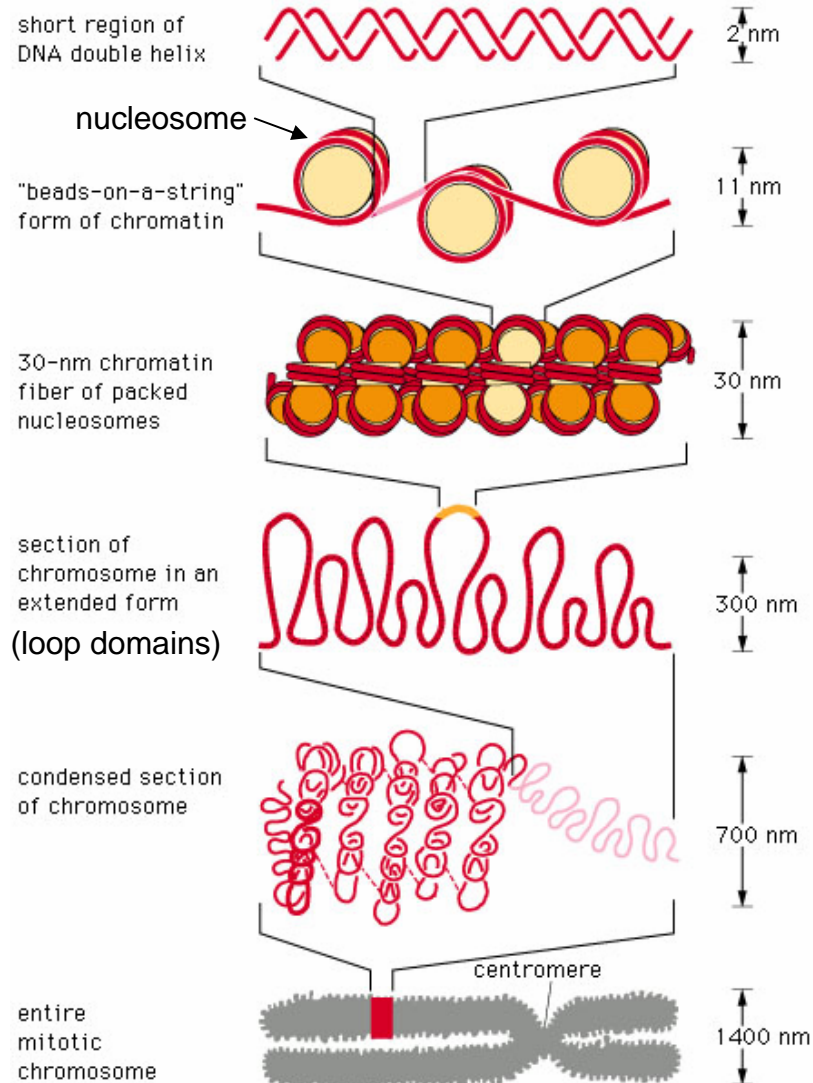
- Usually linear

- Variable in number

- DNA interacts with proteins to form chromatin

- <u>Centromeres</u> ensure segregation

- <u>Telomeres</u> cap ends

- Must be compacted to fit in nucleus

chromatin
(DNA & proteins)

- highly coiled DNA

- histones

- non-histone chromosomal proteins (DNA & RNA polymerase, transcription factors, topoisomerases, histone modifying proteins)

Chromosome packing

short region of
DNA double helix

2 nm

nucleosome

"beads-on-a-string"
form of chromatin

11 nm

30-nm chromatin
fiber of packed
nucleosomes

30 nm

section of
chromosome in an
extended form

(loop domains)

300 nm

condensed section
of chromosome

700 nm

centromere

entire
mitotic
chromosome

1400 nm

NET RESULT: EACH DNA MOLECULE HAS BEEN
PACKAGED INTO A MITOTIC CHROMOSOME THAT
IS 50,000x SHORTER THAN ITS EXTENDED LENGTH

Chromatin structure and gene expression

- Chromatin compaction limits or enhances access to transcription factors

- Accessible chromatin is referred to as euchromatin and is active

- Inaccessible chromatin is called heterochromatin and is generally inactive

heterochromatic bands

Scheme of plant chromosome (after Haslop-Harrison)
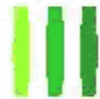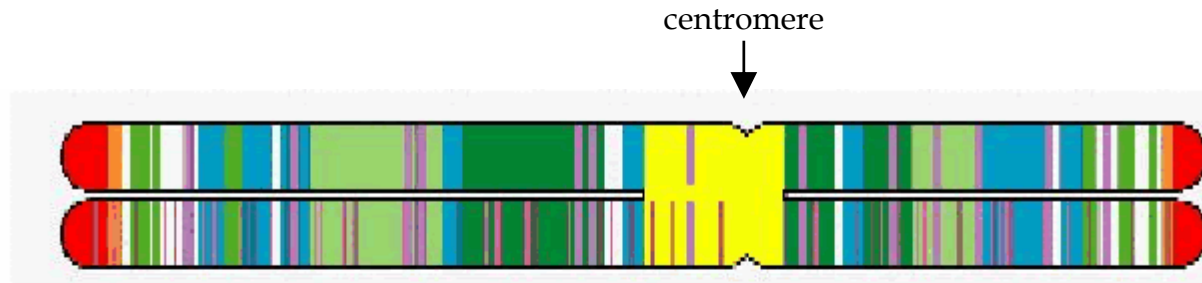
centromere

	Intercalary tandem repeats		Dispersed tandem repeats
	Centromere associated tandem repeat		Dispersed Ty-1-copia-like retroelements LTR and microsatellites
	Telomeric and sub-Telomeric repeats		Single and low-copy sequences Including genes

Arabidopsis chromosomes
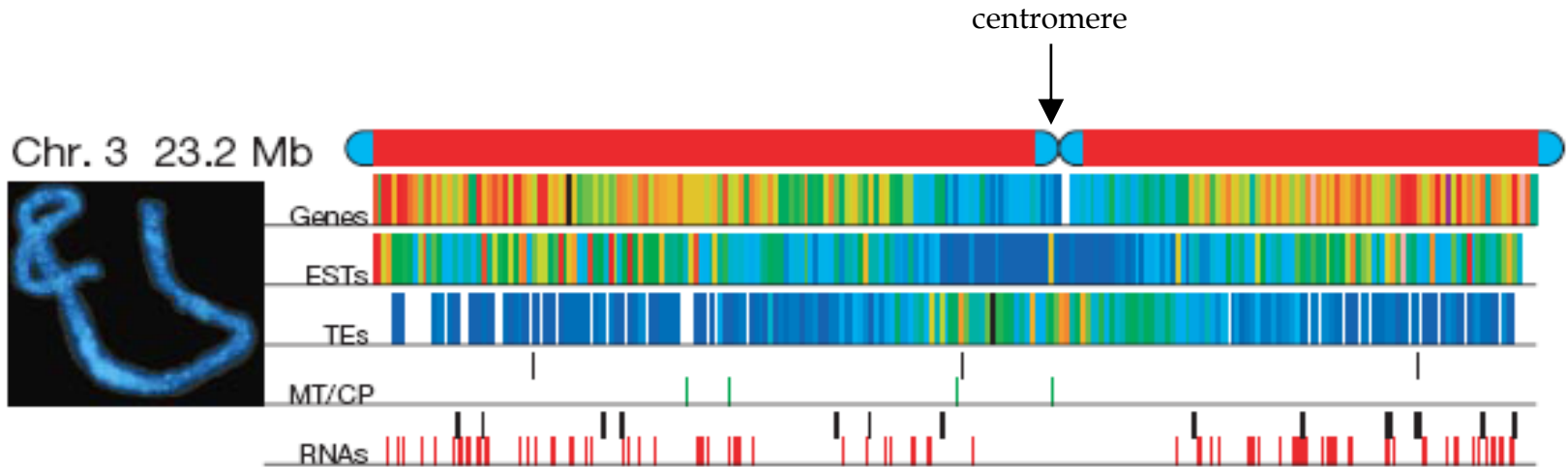
The frequency of features was given pseudo-colour assignments, from red (high density) to deep blue (low density).

Gene density (`Genes') ranged from 38 per 100 kb to 1 gene per 100 kb; Transposable element densities (`TEs') ranged from 33 per 100 kb to 1 per 100 kb.

Arabidopsis Genome Initiative, Nature 408, 2000
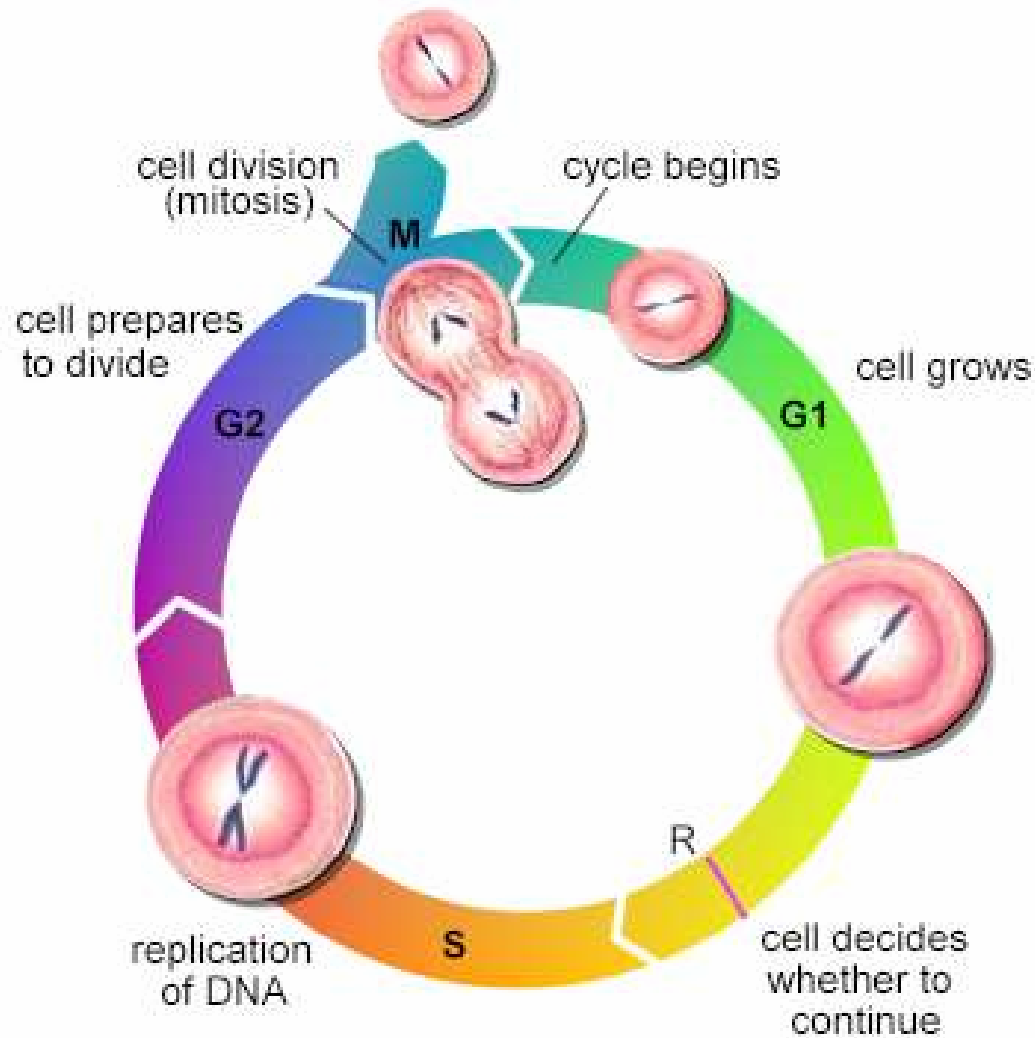
Mitotic and meiotic chromosomes

mitotic chromosomes of *Pinus*
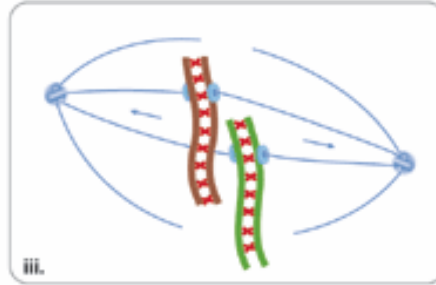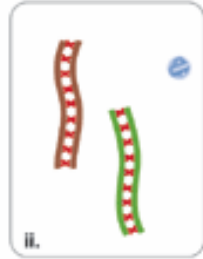

meiotic (pachytene) chromosomes of *Antirrhinum*

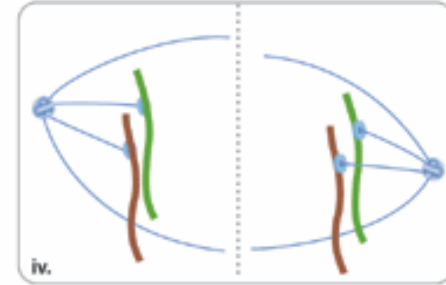# Cell cycle, chromosomes and chromatids

Chromosomes and chromatids during mitosis and meiosis

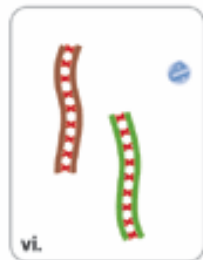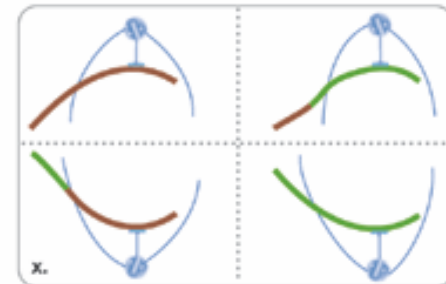1 chromatid   2 chromatids   1 chromatid

Mitosis
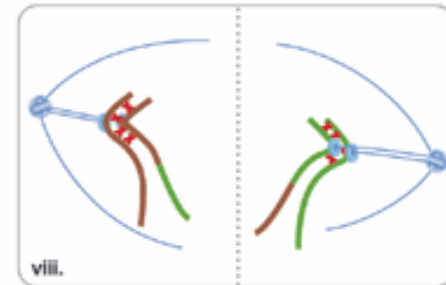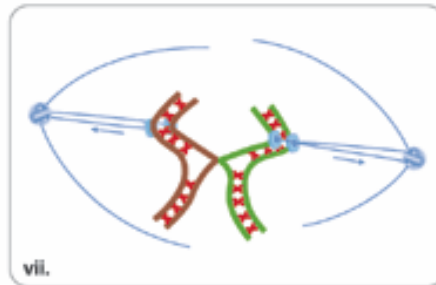
1 chromatid   Meiosis   2 chromatids

Centrosome
Spindle microtubule
Kinetochore
Cohesin complex
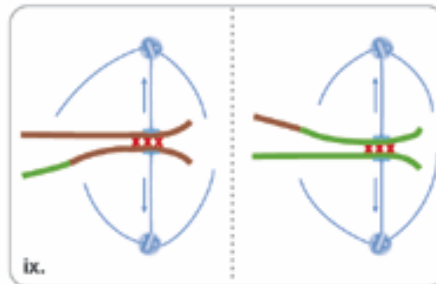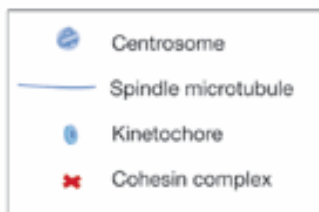
2 chromatids   1 chromatid

meiosis, DSBs and chromosome rearrangements (next lecture)