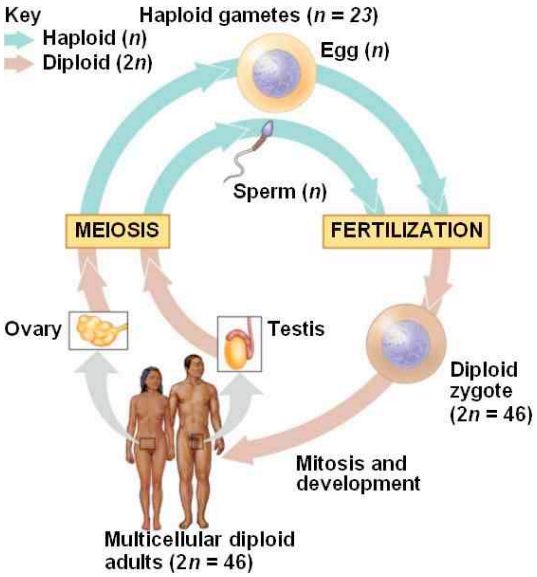
Meiosi

1

La meiosi riguarda esclusivamente le cellule germinali



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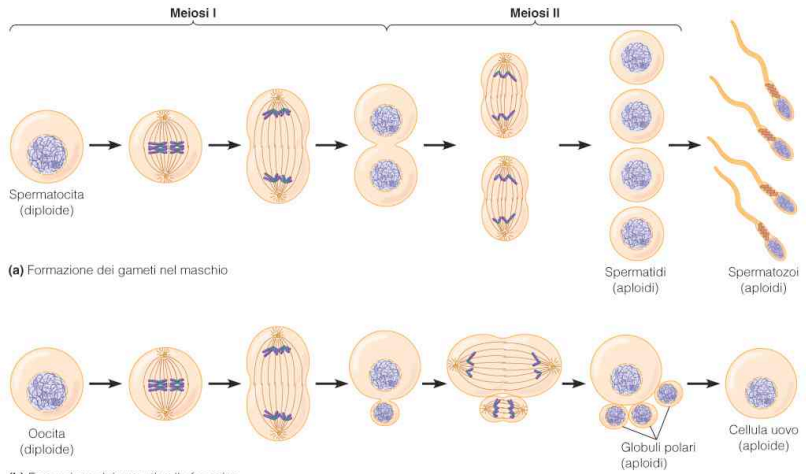

(a) Formazione dei gameti nel maschio

(b) Formazione dei gameti nella femmina

Figura 20-10 Formazione dei gameti. (**a**) Nel maschio, tutti i quattro prodotti aploidi della meiosi sono conservati e si differenziano in spermatozoi. (**b**) Nella femmina, in cui entrambe le divisioni meiotiche sono asimmetriche, si formano una cellula uovo grande e tre (in alcuni casi solamente due) cellule piccole, dette globuli polari, che non danno origine a gameti funzionali. L'uovo maturo, anche se nella figura non è indicato, è generalmente molto più grande dell'oocita da cui deriva.

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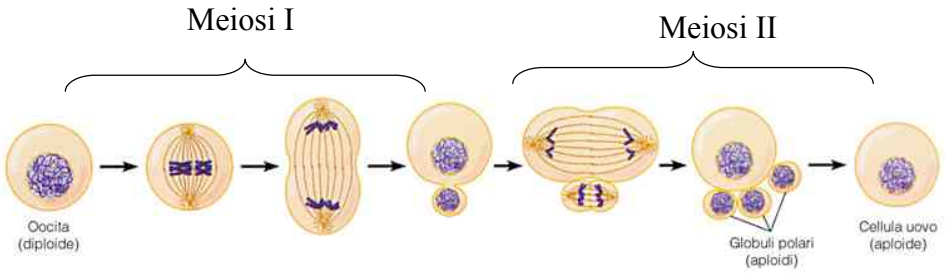
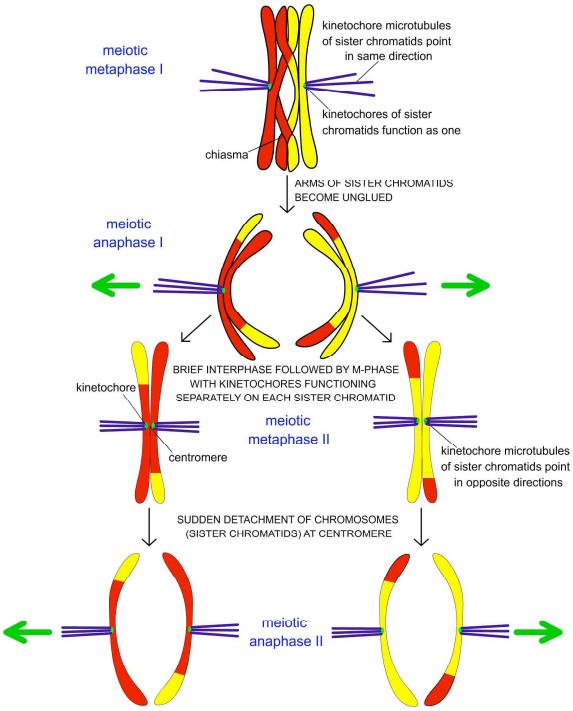


(b) Formazione dei gameti nella femmina

La meiosi nella femmina è asimetrica: un nucleo riceve quasi tutto il citoplasma mentre gli altri tre nuclei rimangono quasi privi di citoplasma. Da un ovocita deriva quindi un solo ouvo fecondabile. Il numero totale di uova prodotte durante la vita di una donna è piccolissimo in confronto a quello degli spermatozoi nell'uomo.



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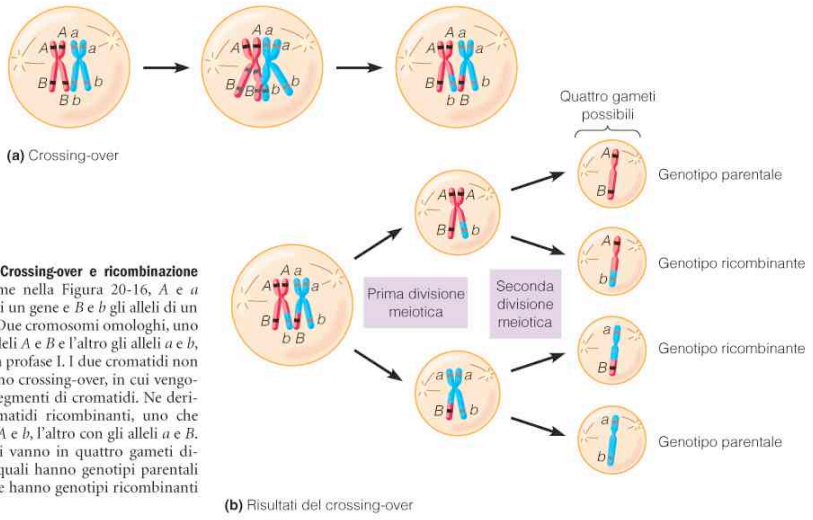

Figura 20-17 Crossing-over e ricombinazione genetica. Come nella Figura 20-16, *A* e *a* sono gli alleli di un gene e *B* e *b* gli alleli di un altro gene. **(a)** Due cromosomi omologhi, uno che porta gli alleli *A* e *B* e l'altro gli alleli *a* e *b*, si appaiano alla profase I. I due cromatidi non fratelli subiscono crossing-over, in cui vengono scambiati segmenti di cromatidi. Ne derivano due cromatidi ricombinanti, uno che porta gli alleli *A* e *b*, l'altro con gli alleli *a* e *B*. **(b)** I cromatidi vanno in quattro gameti diversi, due dei quali hanno genotipi parentali (*AB* e *ab*) e due hanno genotipi ricombinanti (*Ab* e *aB*).

6

Meiosis:

Two sequential divisions giving half the genome of the initial (somatic) cell and giving 1 (female) to 4 (male) daughter cells, chromosome of a pair (mother and father) **cross-over** (exchange a region of the chromatid with each other) during meiosis **to give genetic diversity**

-male has equal karyokinesis and cytokinesis (4 gametes) while female has 4 karyokinesis and unequal cytokinesis (1 gamete and 3 polar bodies)

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-phases: start with 4C DNA/chromosome from S/G2-phase cell

-meiosis I (reductional division = 4n DNA/chromosome to 2n DNA, 1n chromosome (either maternal or paternal)):

-prophase I:
- -leptotene
- -zygotene
- -pachytene
- -diplotene
- -diakinesis

-metaphase I : similar as in mitosis except maternal chromosome on one side and paternal on other (different side for each chromosome instead of splitting maternal and paternal chromosome, each chromosome segregates randomly), this further contributes to genetic diversity

-anaphase I: similar to mitosis

-telophase I: similar to mitosis

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-meiosis II (2n DNA, 1n chromosome to 1n DNA, 1n chromosome)
-prophase: same as mitosis
-metaphase: same as mitosis, that is the centromeres divide, halving the DNA giving the 1n DNA, chromatids of chromosome split giving cell with chromosomes from only one chromatid
-anaphase: same as mitosis
-telophase: same as mitotsis

-for male 2 cells divide into 4 and cytokenisis eventually completes giving spermatozoa, each gamete is now 1n DNA and 1n chromosome

-for female, cell divides giving the ovum and another polar body, polar body from meiosis I divides and gives 2 polar bodies, final result 1 ovum with 1n DNA and 1n chromosome that has most of the cytoplasm and is a true gamete and 3 polar bodies that are not gametes.

prophase of meiosis I

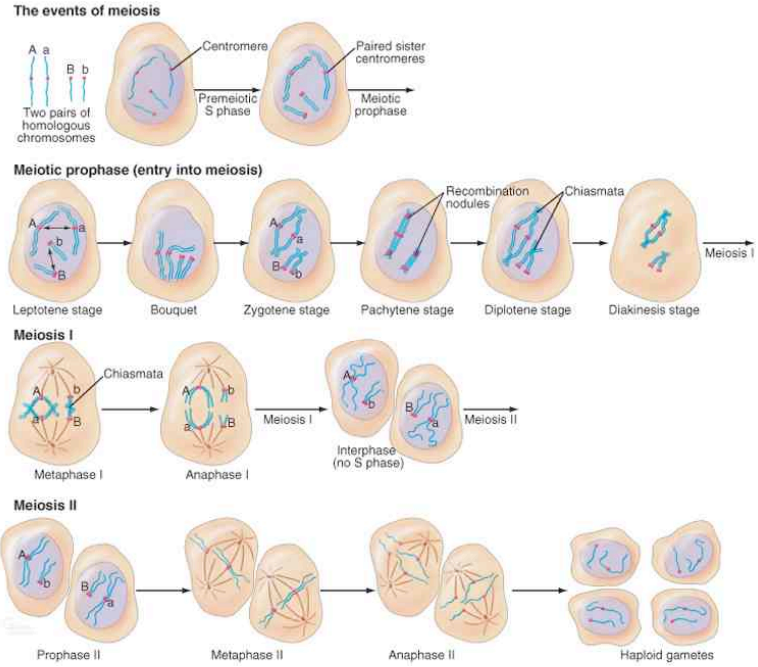
1-leptotene: chromosomes visible

2-zygotene: pairing of maternal and paternal chromosomes via the synaptonemal complex, this complex has 4 chromatids (1 chromosome from the mother (sister chromatids) and 1 chromosome from the father (brother chromatids?))

3-pachytene: formation of chiasmata (intimate contacts between maternal and paternal chromatids) facilitating crossing over of segments of chromosomes between maternal and paternal chromosomes

4-diplotene: breakdown of chiasmata and synaptonemal complex, crossing-over completed

5-diakinesis: nucleolus and nuclear membrane disappear



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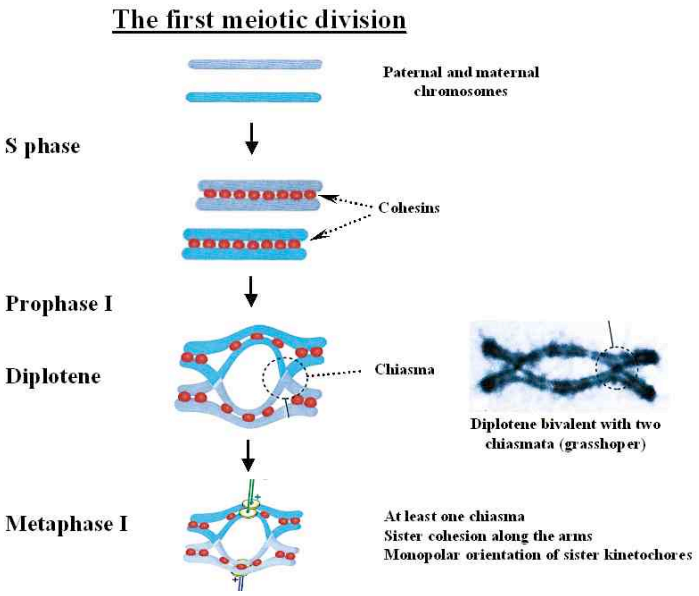

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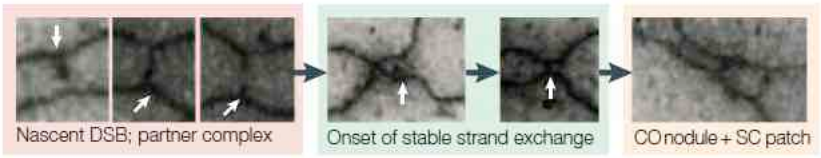

Figure 3 | **Visualization of chromosomal bridges in *Allium fistulosum* and *Allium cepa* (plant) meiocytes.** The sites of double-strand break (DSB)-dependent homologue interaction can be seen as ~400-nm bridges between chromosome axes[55,56]. These bridges, which probably contain a DSB that is already engaged in a nascent interaction with its partner DNA, occur in large numbers[9,57,58]. Their formation depends on the RecA (recombination protein) homologues that are expressed in this species. In the next phase of homologue interaction, these nascent interactions are converted to stable strand-invasion events. This nucleates the formation of the synaptonemal complex (SC). Reproduced, with permission, from REF. 119 © (1987) Springer.

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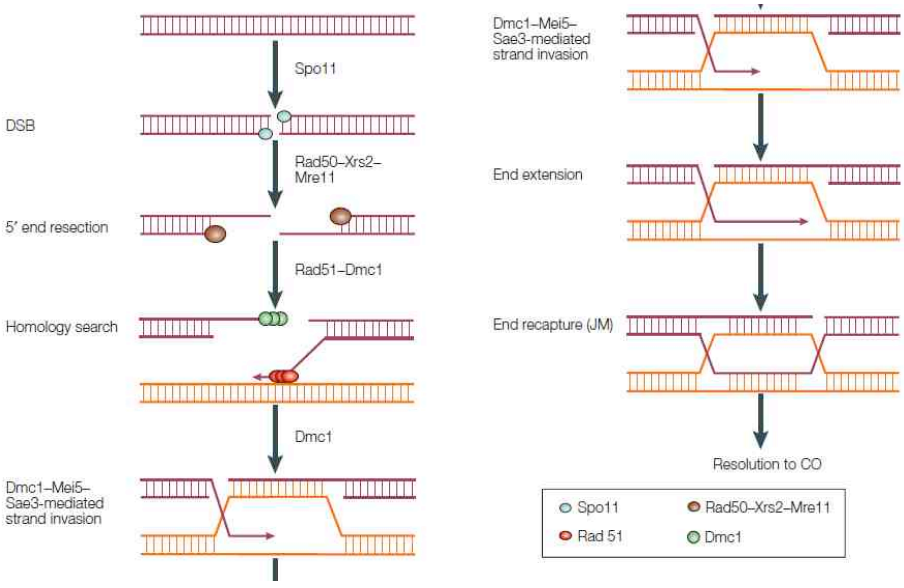
The molecular mechanism of meiotic crossover recombination



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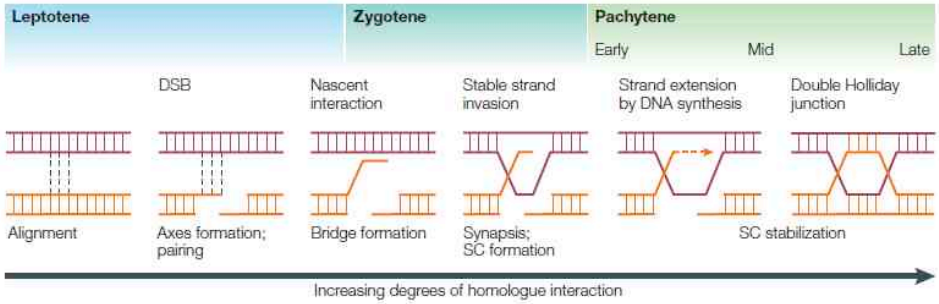

Figure 1 | **Homologue interactions during meiosis.** During chromosome pairing that is independent of double-strand break (DSB) formation (alignment), regions of local distortion might allow homology to be sensed. During DSB-dependent homologue interactions (pairing and nascent interactions), 3′ single-stranded regions engage in interactions with the homologous chromosome. During synapsis and synaptonemal complex (SC) formation, 3′ ssDNA ends stably invade the homologue. The synaptonemal complex, a proteinaceous structure, forms between homologous chromosomes. During this phase, the invading strand is extended by DNA synthesis. Once the strand is recaptured, a double HOLLIDAY JUNCTION forms. Adapted, with permission, from REE 9 © (2001) Elsevier Science.

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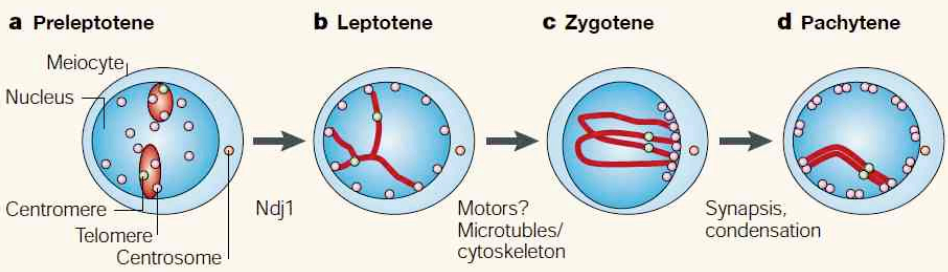
Box 1 | **Model of bouquet formation and resolution**



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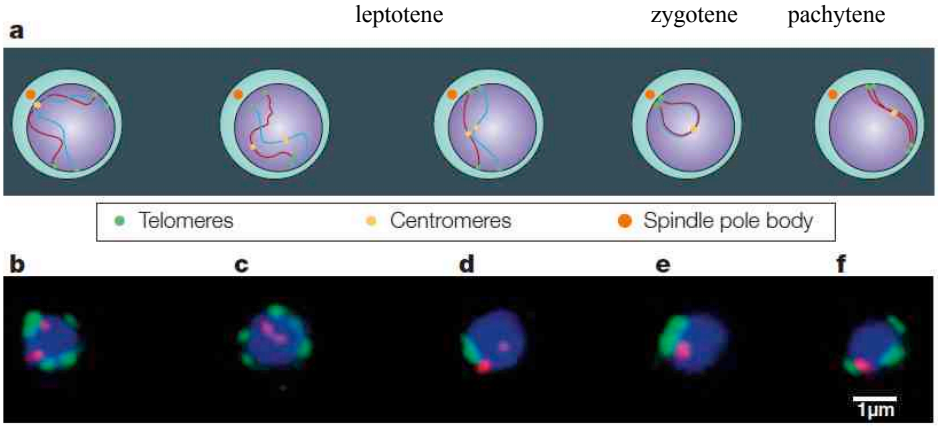

Telomere clusters during meiosis in budding yeast. a | A schematic representation of telomere configuration during meiosis in budding yeast. Through recombination initiation in the late leptotene, telomeres reattach to the nuclear envelope. At the leptotene–zygotene transition, the telomeres cluster tightly near the spindle pole body in a 'bouquet'. At pachytene, telomeres again disperse around the nuclear envelope.

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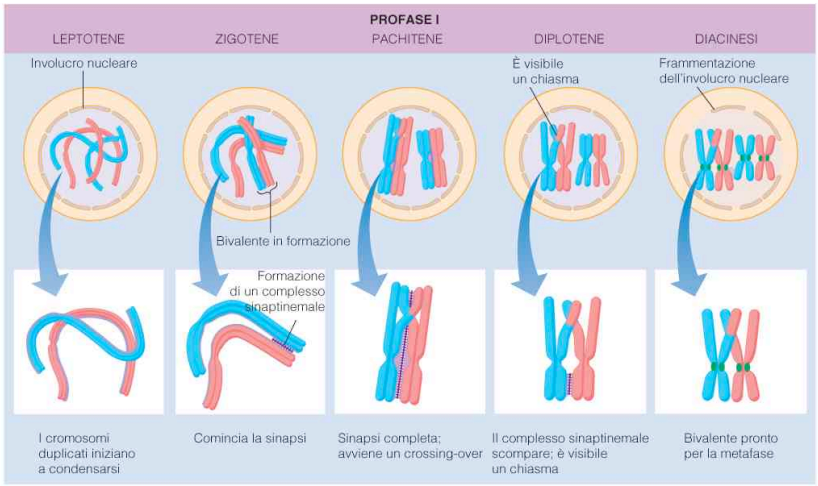
prophase of meiosis I



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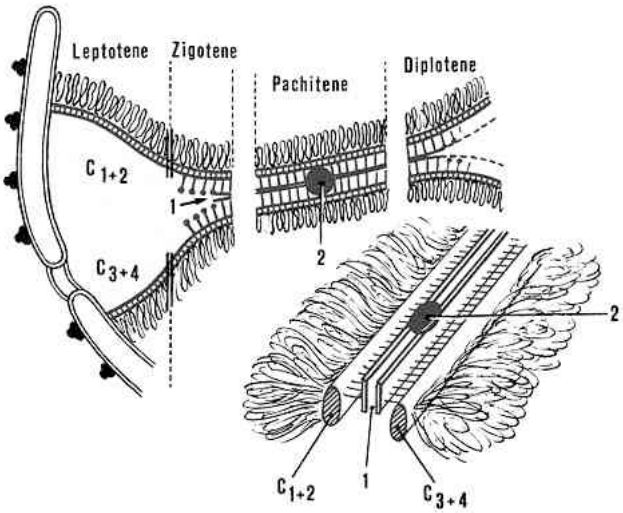
Evoluzione del complesso sinaptinemale durante la profase della meiosi.
C1+2 sono i cromatidi fratelli 1 e 2 - C3+4 sono gli altri cromatidi fratelli 3 e 4
1 formazione centrale interposta fra gli omologhi - 2 nodulo di ricombinazione

Involucro nucleare



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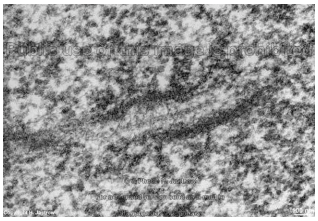
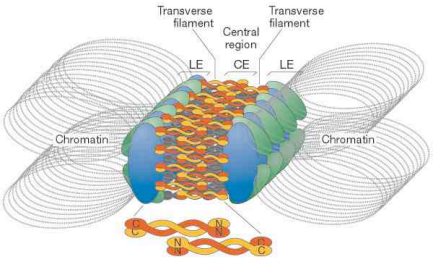
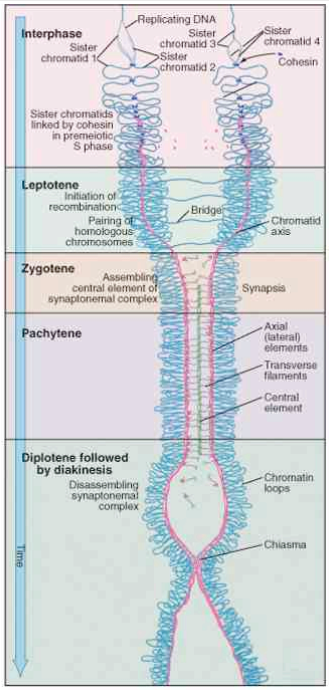
STRUCTURAL ORGANIZATION OF THE HOMOLOGOUS CHROMOSOMES AND SYNAPTONEMAL COMPLEX DURING THE VARIOUS STAGES OF MEIOTIC PROPHASE.







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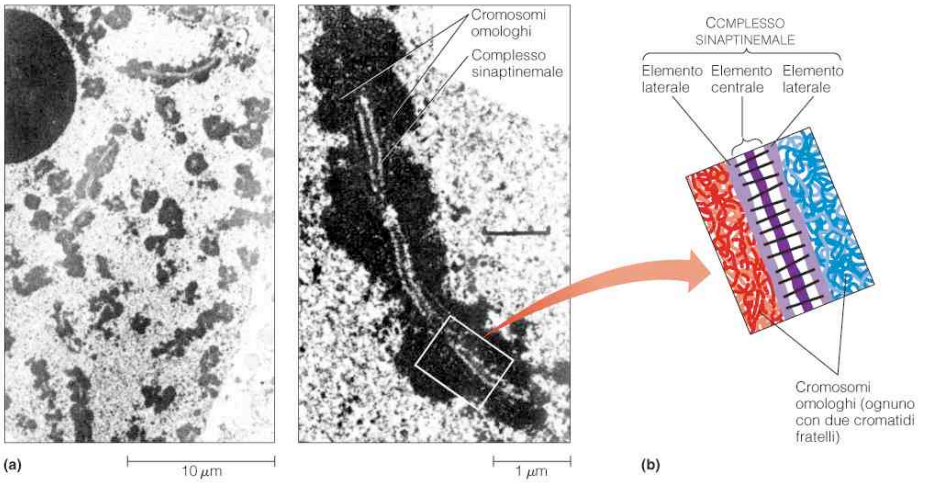

Figura 20-8 Il complesso sinaptinemale. (**a**) Queste immagini al microscopio elettronico mostrano, a due ingrandimenti diversi, dei complessi sinaptinemali nel nucleo di cellule di giglio. I nuclei sono allo stadio di pachitene della profase I (TEM). (**b**) Schema degli *elementi laterali* del complesso (viola chiaro), che sembra si formino sui cromosomi durante il leptotene, e dell'*elemento centrale* (o *assiale*) (viola scuro), che inizia ad apparire durante lo zigotene e aggancia insieme i cromosomi omologhi. Nella fase di pachitene, gli omologhi sono strettamente appaiati per tutta la loro lunghezza.

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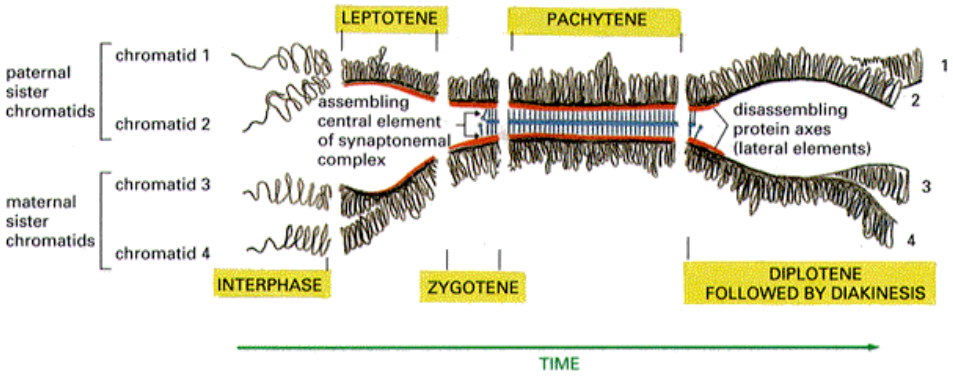

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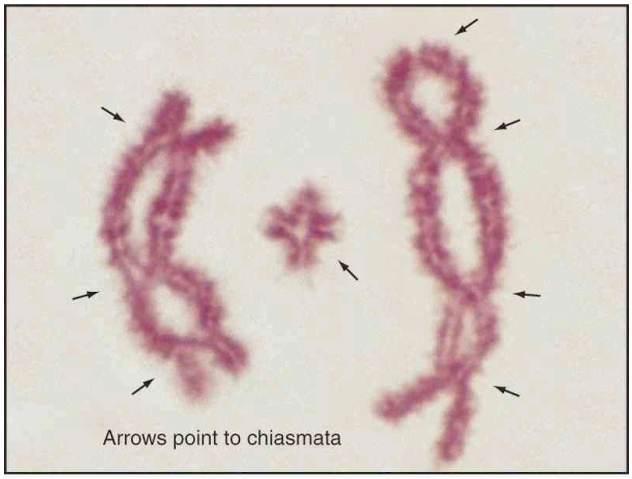
BIVALENTS (PAIRED HOMOLOGOUS CHROMOSOMES) ARE HELD TOGETHER BY CHIASMATA AFTER DISASSEMBLY OF THE SYNAPTONEMAL COMPLEX.

Here, three diplotene bivalents from the grasshopper species Chothippus jucundus are held together by three (left), one (middle), and four (right) chiasmata. The middle cross-shaped bivalent is telocentric; the other two longer bivalents are submeta-centric.



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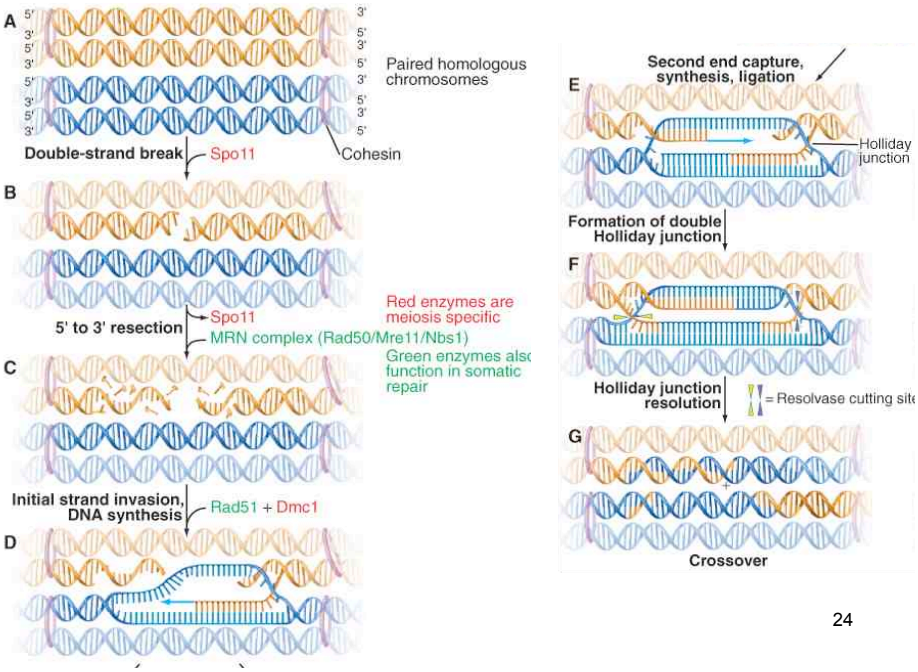

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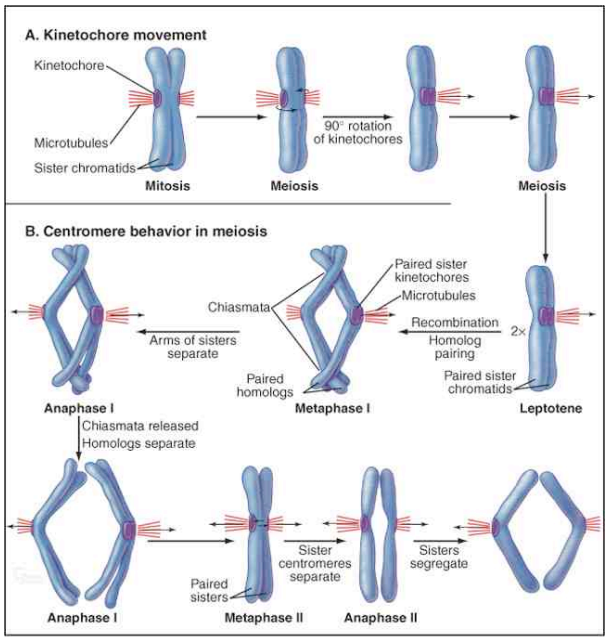
CHROMOSOMAL BEHAVIOR DURING MEIOSIS I AND II.

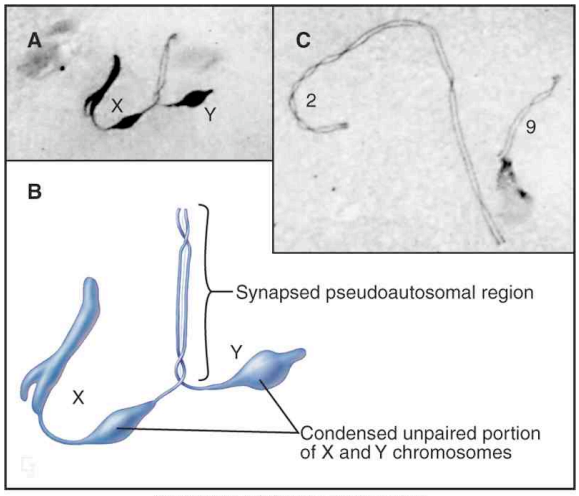
During meiosis I, sister chromatids are tightly paired along their lengths, kinetochore structure is altered, and homologs are held together at the metaphase plate by chiasmata. During anaphase I, loss of cohesion between the arms of sister chromatids releases the chiasmata and allows homologous chromosomes to segregate to opposite spindle poles. During metaphase of meiosis II, sister chromatids are held together at their centromeres. Release of centromeric cohesion at meiosis II allows the sister chromatids to segregate to opposite spindle poles.

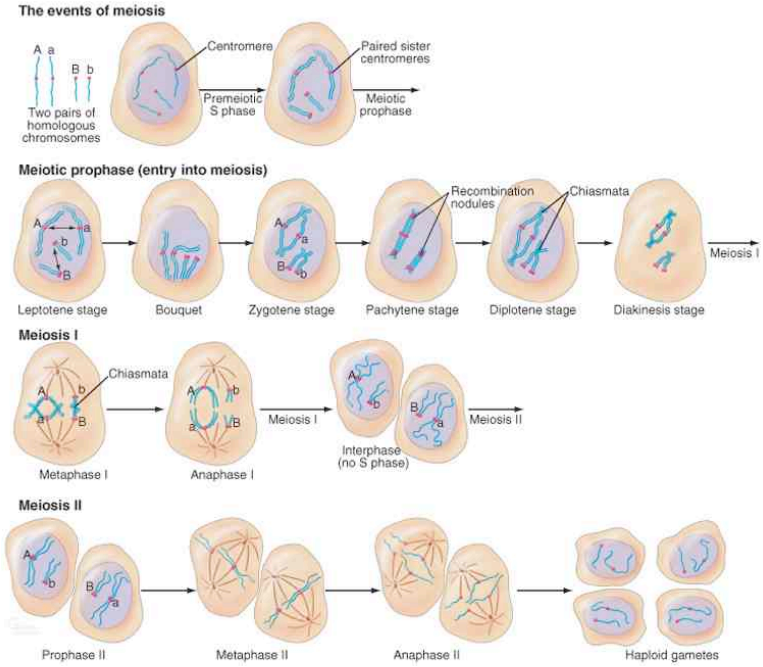


THE SEX CHROMOSOMES OF A CHINESE HAMSTER AT PACHYTENE.

A-B, The X and Y chromosomes are paired at the pseudoautosomal region. Elsewhere, the unpaired chromatin adopts a highly condensed morphology.

C, Autosomes are completely synapsed and show a lesser degree of condensation.





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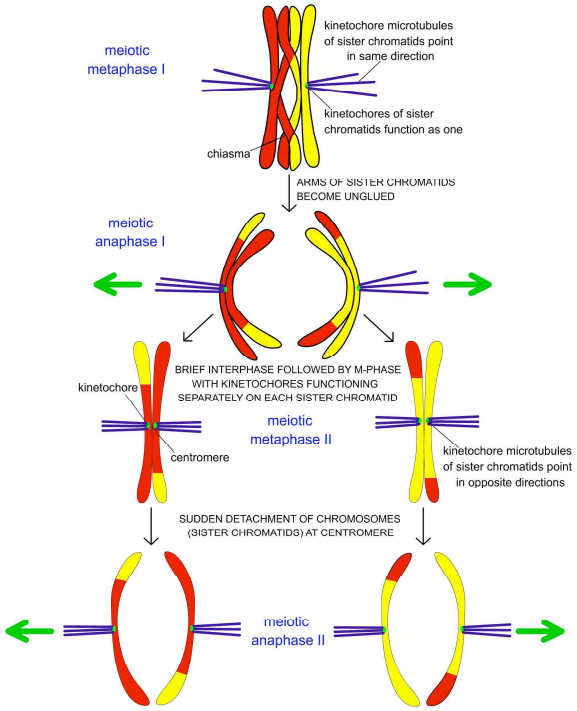

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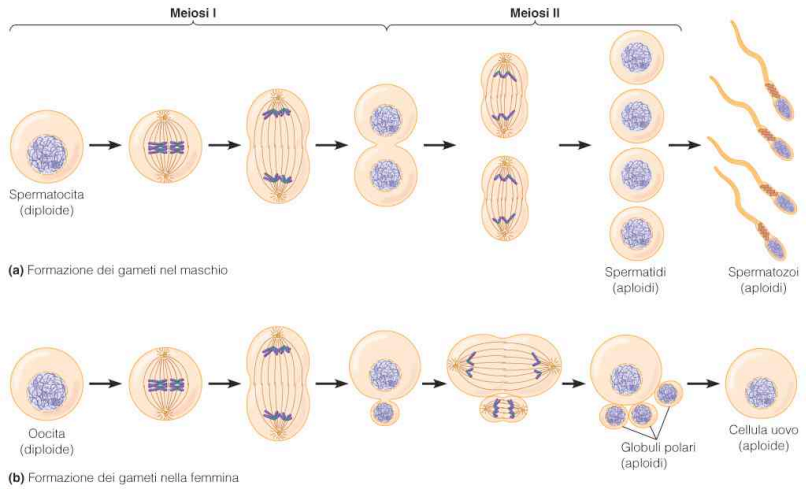

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