

CHROMOSOME THEORY OF INHERITANCE: MITOSIS AND MEIOSIS

1/10/92, rvsd 1/9/95, 1/5/96, 1/10/97, 7 Jan 00, 8 Jan 01, 9 Jan 04, 7 Jan 05, 11 Jan 08, 9Jan09, 01.11.10, 7Jan11, 9Jan12
 SGML, p. 40.-49, 7th, pp. 67-73 (to 99??), 9th: 42-

Mendel's laws led to chromosome theory: 1) equal segregation; 2) independent assortment

CHROMOSOME THEORY HISTORY:

| | | |
|-----------------------------------|-------|--|
| C. Nägeli | 1842 | first observed chromosomes |
| W. Waldeyer | 1888 | first named chromosomes |
| Walther Flemming | 1870s | documented behavior of chromosomes during cell division: mitosis. |
| Correns, von Tschermak & de Vries | 1900 | rediscovered Mendel's work |
| Sutton & Boveri | 1902 | Saw Mendel's particles act just like chromosomes during gametogenesis: |

CHROMOSOME

1) occur in pairs in adult (diploid sporophytic stage)

THEORY OF

2) segregate equally

HEREDITY (a la Mendel's laws)

3) assort independently of other pairs

meiosis thus generates variation (one of two genetic determinants)

But are chromosomes identical, or different?

[omit?:]

Elinor Carothers, 1913 studied grasshopper chromosomes: one pair **heteromorphic**. (not identical). Could use as visible markers, showed non-homologous single assorted independently to these

Alfred Blakeslee, 1922 studying *Datura* (12 chromosomes normally) found 12 different phenotypes of fruit, each with different extra chromosome, suggested each chromosome different.

REVIEW OF MITOSIS: Division of somatic cells, produce clones (P 47), only equatorial division

Remember from Cell: Cell cycle, M, G-1, S, G-2 Mitosis only 5-10% of cycle, DNA synthesis in S phase

videos: <http://www.youtube.com/watch?v=DD3IQknCEdc&feature=related>

<http://www.youtube.com/watch?v=aDAw2Zg4IgE&NR=1>

<http://www.youtube.com/watch?v=0oJZDKdperU&feature=related>

PROPHASE: Chromosome become distinct, condense, two halves = **two chromatids**

(joined at **centromere**, nucleolus disappears)

METAPHASE: **spindle** appears, chromosomes moved to **equatorial plane**

ANAPHASE: move to end of cell propelled by microtubules of spindle

TELOPHASE: membrane reforms, nucleoli reappear

This elaborate mechanism suggested that chromosomes are very important

MEIOSIS: (p 48-49) two divisions:

I. reduction division (2N to 1N)

II. equational division (1N to 1N)

video: http://www.youtube.com/watch?v=D1-mQS_FZ0

Another: <http://www.youtube.com/watch?v=MqaJqLL49a0&feature=related>

PROPHASE I, critical stage where recombination occurs:

LEPTOTENE (weak, fine; ribbon): slender chromosomes appear with **chromomeres** (beads on necklace)

ZYGOTENE (join) homologous pairs synapse, first by **telomeres**, zip up together

PACHYTENE (thick) chromosomes in **full synapse**, chromomeres produce distinct pattern, some DNA synthesis occurs here.

DIPLLOTENE (double) nature of chromosomes becomes apparent, each bundle consisting of four **homologous chromatids (tetrad)**. Pairing is less tight, **chiasmata** apparent. At least one cross over per chromosome is required...

DIKINESIS (apart; move) Further contraction, ease anaphase, more maneuverable.

METAPHASE I: move to equatorial plane, centromeres DO NOT DIVIDE

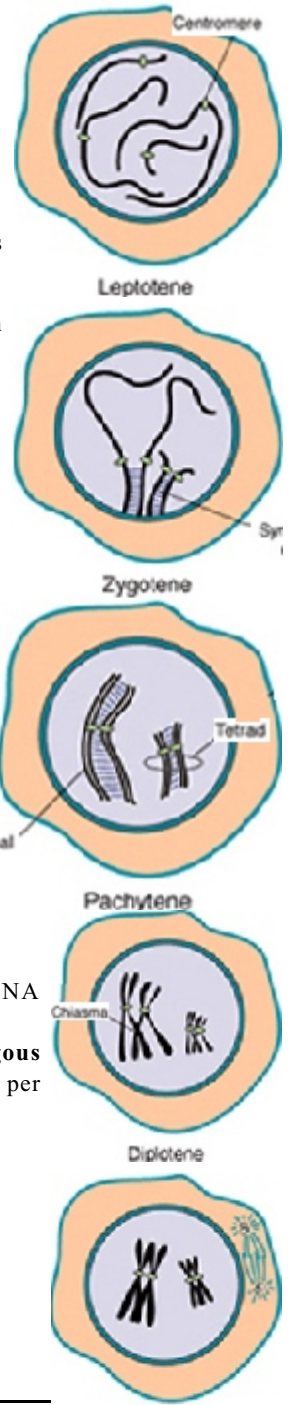
Anaphase I, telophase I, as expected possibly followed by interkinesis, NO DNA synthesis.

(confirm haploidy by counting centromeres)

Second phase of meiosis essentially like mitosis, produce 4 haploid gametes from single diploid progenitor cell

Compare mitosis and meiosis using fingers as on p 76:

| | chromatid formation | orientation | anaphase (or Ana I) | anaphase II |
|---------|----------------------------|--------------------|----------------------------------|------------------------------|
| Mitosis | two sets joined chromatids | no synapsis | separate hands, fingers separate | -- |
| Meiosis | two sets joined chromatids | both hands aligned | hands separate, fingers closed | fingers separate, both hands |



Diakinesis

