CHROMOSOME THEORY OF INHERITANCE: MITOSIS AND MEIOSIS

1/00/92, read 1/99/95, 1/5/96-, 1/00/97, 7 Jan 00, 8 Jan 01, 9 Jan 04, 7 Jan 05, 11 Jan 08, 9Jan09
SGMI., 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 and de Vries	1900	rediscovered Mendel's work
Sutton & Boveri	1902	Saw Mendel's particles act just like chromosomes during gametogenesis:

CHROMOSOME THEORY OF HEREDITY (*a la* Mendel's laws)
1) occur in pairs in adult (diploid sporophytic stage)
2) segregate equally
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

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: **reduction division** (2N to 1N) and **equational division** (1N to 1N)
video: http://www.youtube.com/watch?v=D1_-mQS_FZ0

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.
DIPLOTENE (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...
DIAKINESIS (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