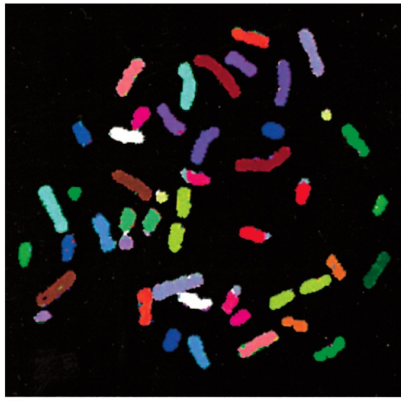
BioChem 03

Dec 6, 2010



Inheritance I:

chromosome behavior

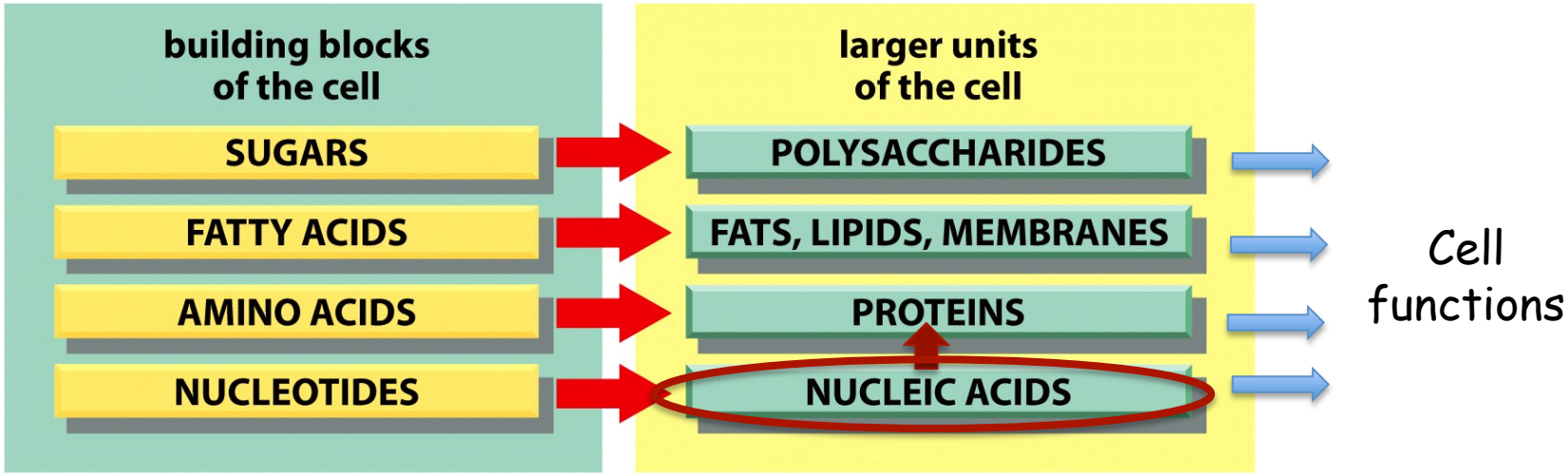
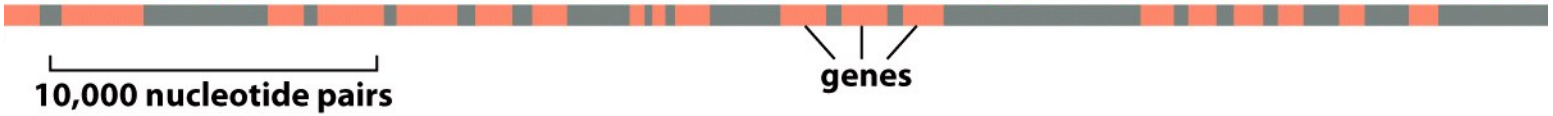


Figure 2-15 Essential Cell Biology 3/e (© Garland Science 2010)

- What are the instructions that drive these processes?
  - All instructions present in almost every cell
  - Instructions are heritable
  - Instructions are mutatable

  } allows evolution!

Our genetic instructions consist of ~25,000 genes
spread out over 3.2 x 10^9 DNA nucleotides
We inherit one full set from Mom ("maternal") and one full set from Pop ("paternal")

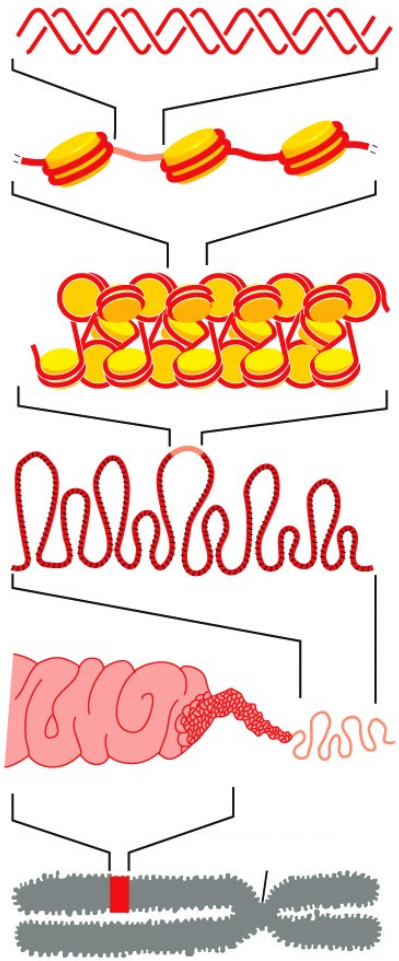


<u>Study of Heredity:</u>

How is the genetic material passed on to *every* single cell AND from one generation to the next?

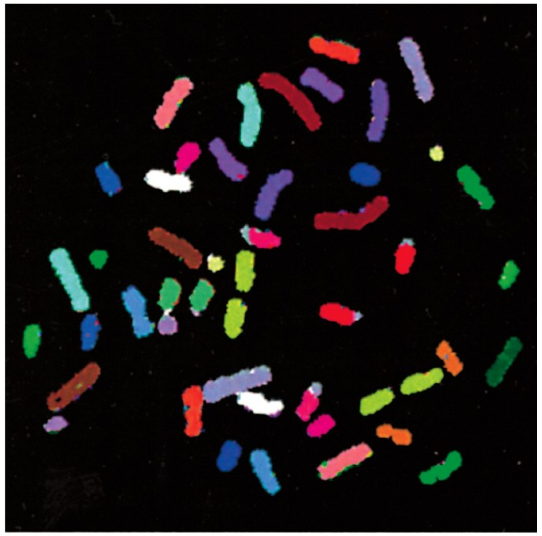
How is variation introduced?
(ie. Why are you not identical to all your siblings, or to either of your parents?)

Genetic material packed into convenient packages



1 chromosome

…Each human cell has 46 such packages



Karyotype of human somatic cell:
46 "packages" = 23 distinguishable chromosomes
TWO of each (1 maternal, 1 paternal): "homologous pair"
thus every gene exists in TWO copies

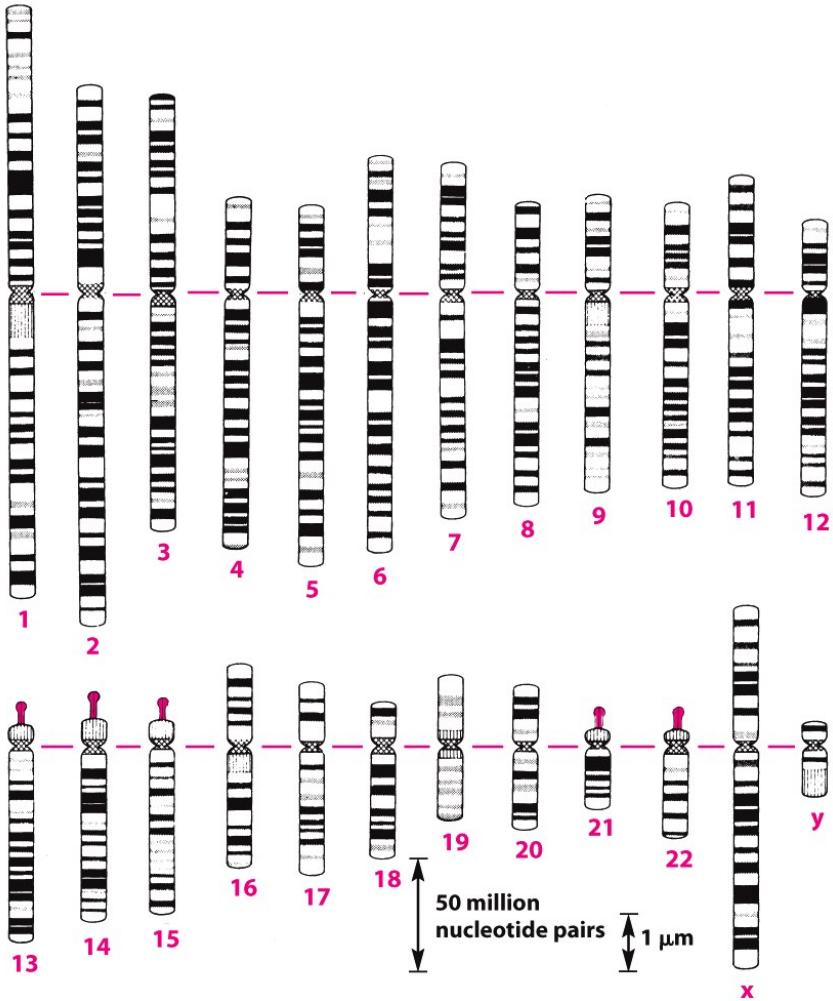
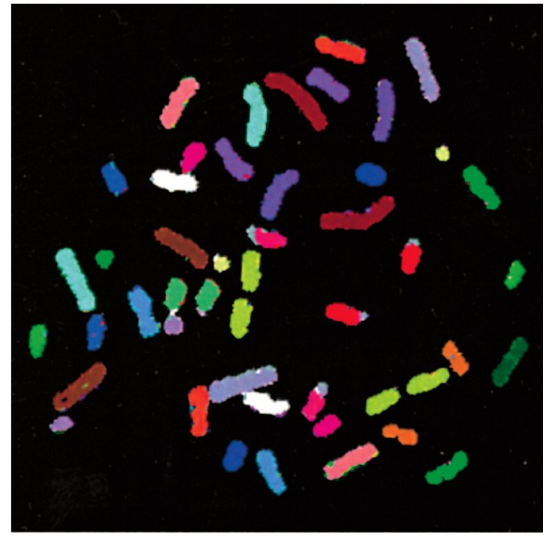


Figure 5-11 Essential Cell Biology 3/e (© Garland Science 2010)



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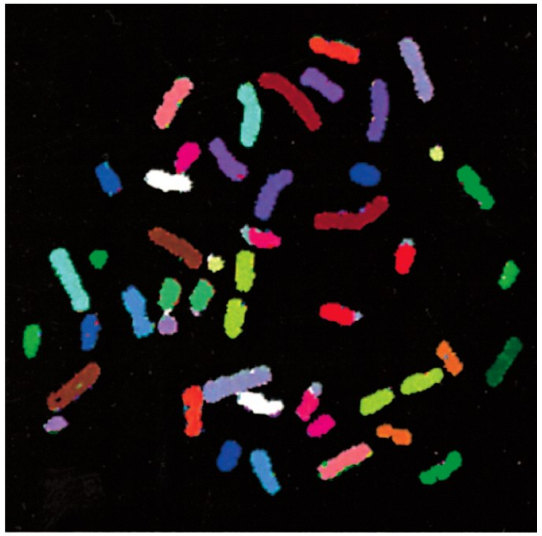


Somatic cells are DIPLOID (2n)
Germ cells are HAPLOID (1n)

where n = 23 for humans

n = 20 for squirrels
n = 32 for guinea pigs
n = 16 for alligator
n = 39 for chicken
n = 4 for fruit fly
etc.

Chromosomes duplicate (via DNA replication) before every cell division

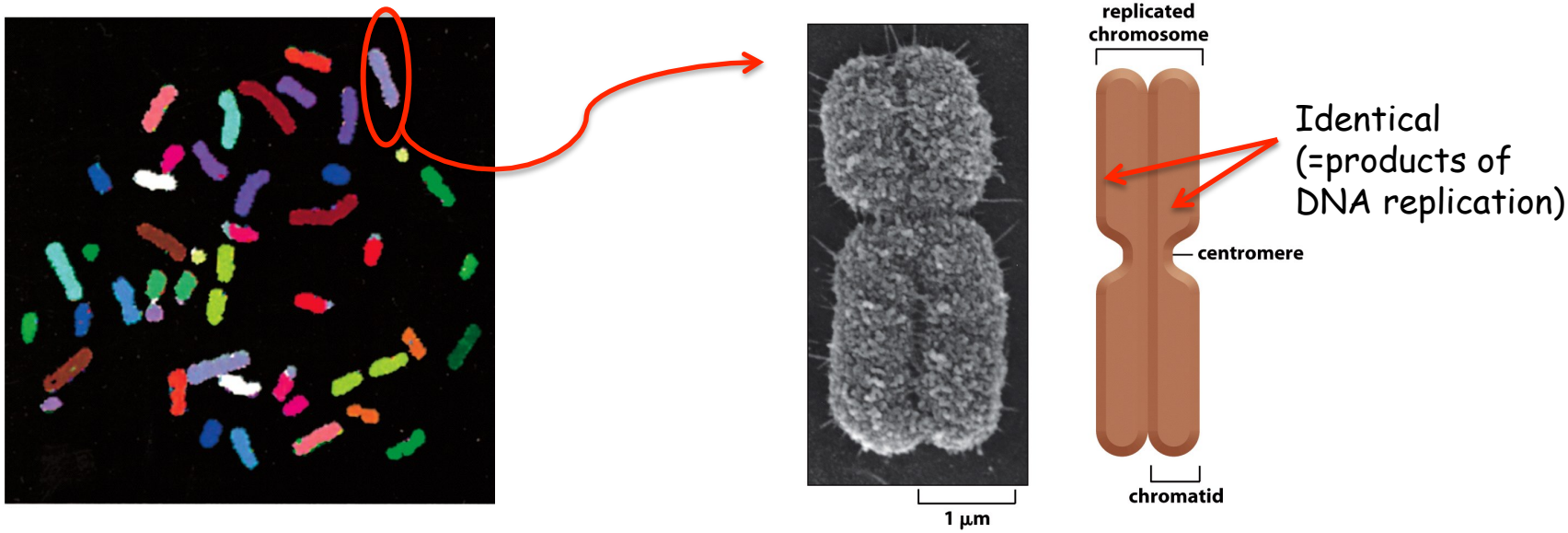
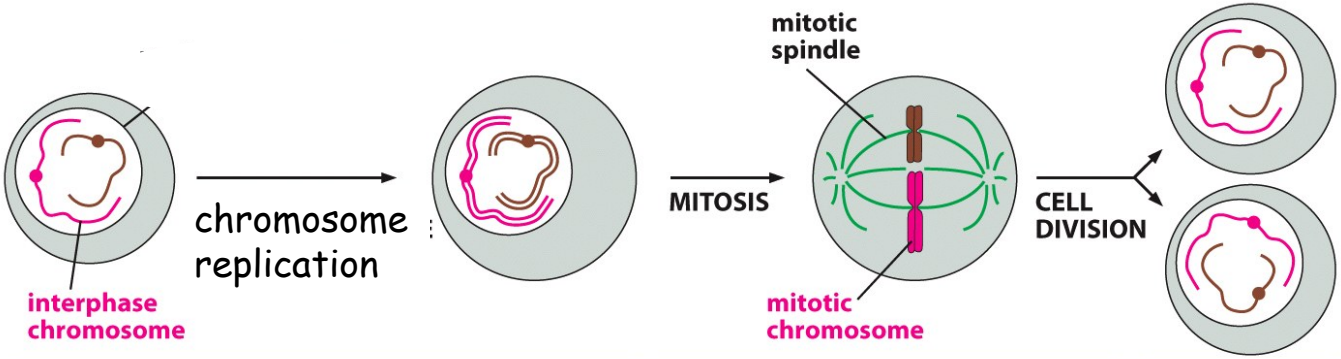
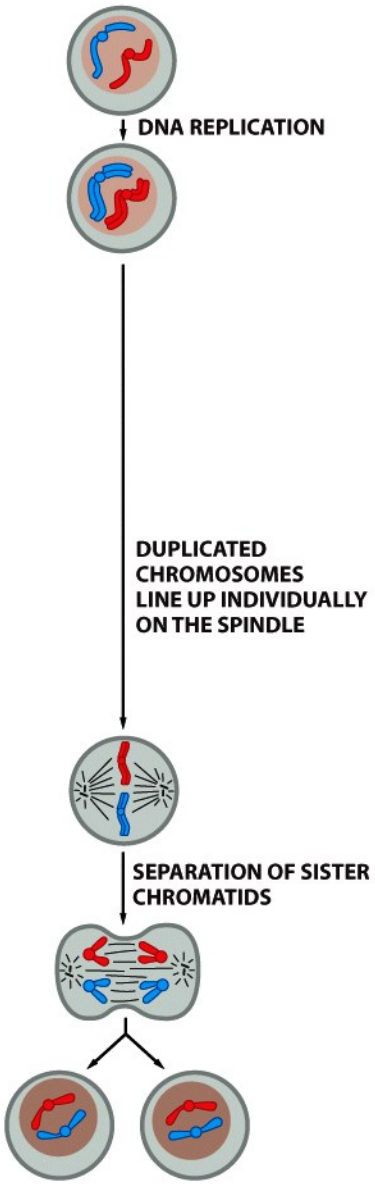


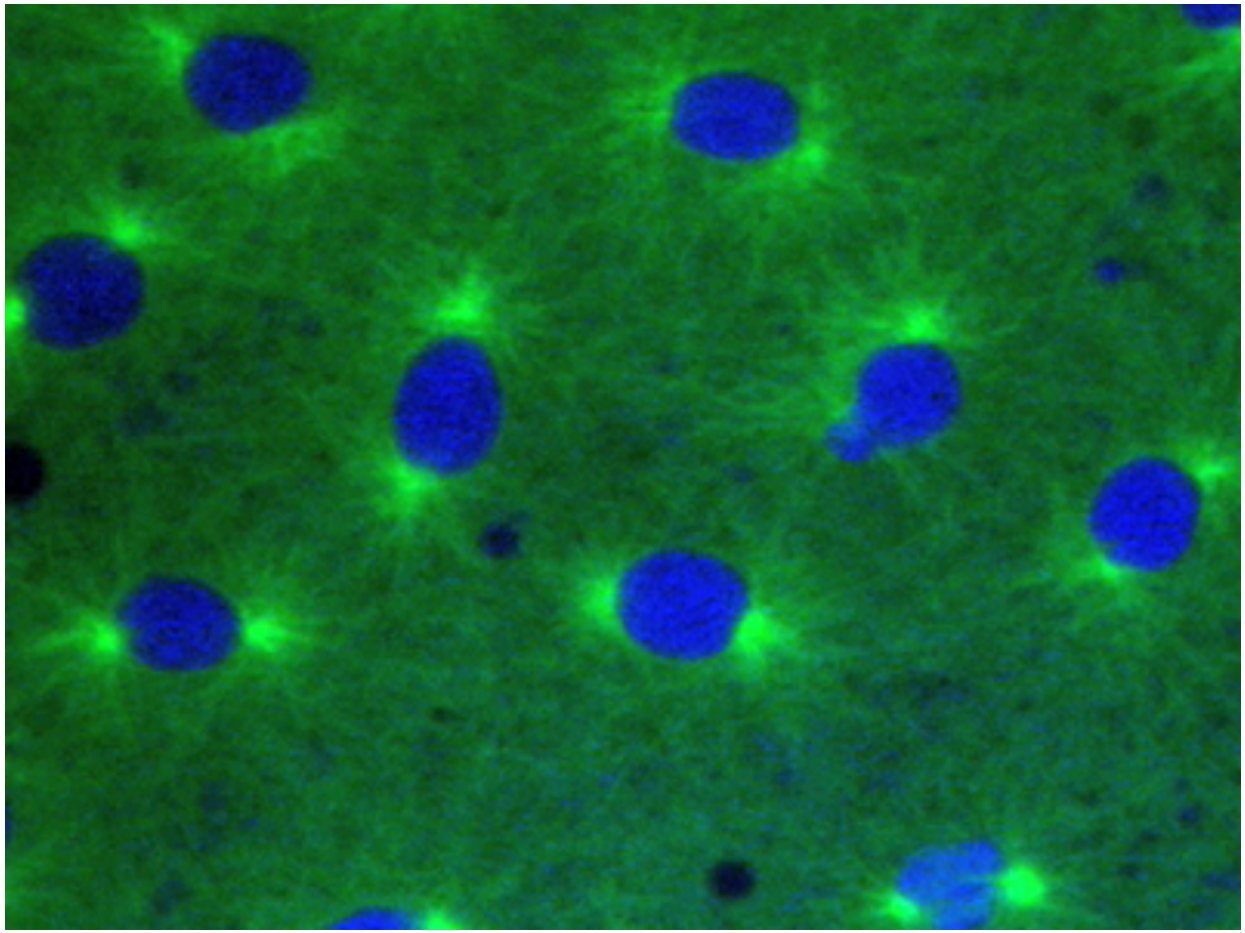
Figure 5-17 Essential Cell Biology 3/e (© Garland Science 2010)

At every cell division (mitosis),
ALL of the genetic material is equally split between the two daughter cells



Regular cell division (mitosis)
Produces cells with same number of chromosomes as starting cell





Cells in a Drosophila embryo
DNA in blue
Spindle in green (tubulin protein fibers)

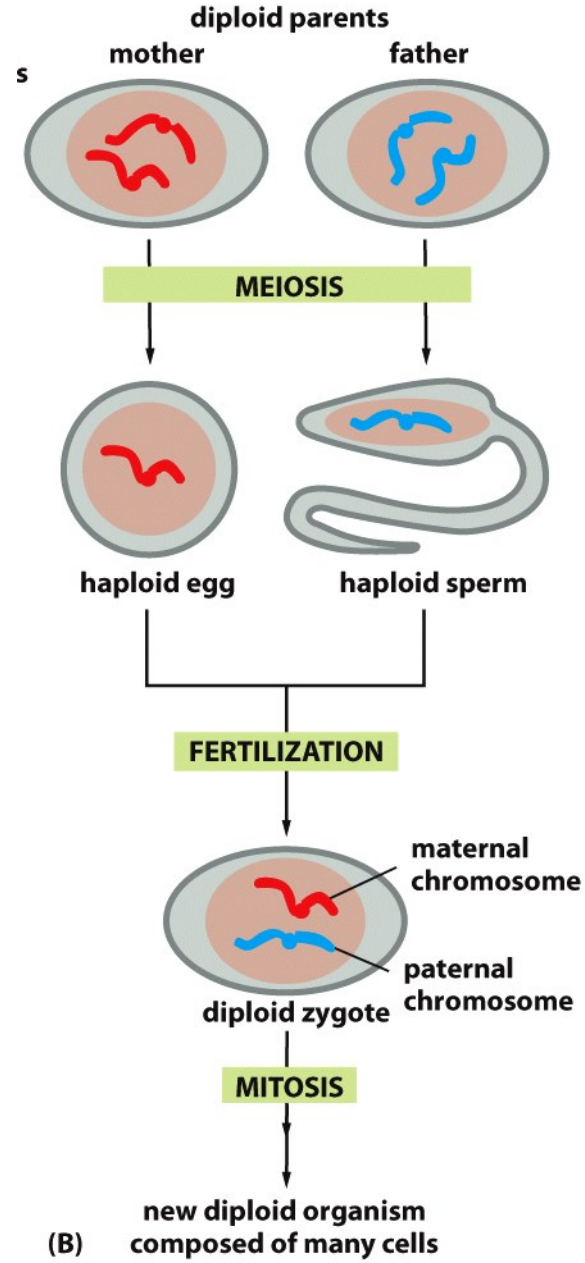
Passing genetic material to next generation through sexual reproduction necessitates generation of special "germ cells" (egg/sperm) that have only half the number of chromosomes

HAPLOID cells (1n)

Mom passes only half of her genetic material
Pop passes only half of his genetic material

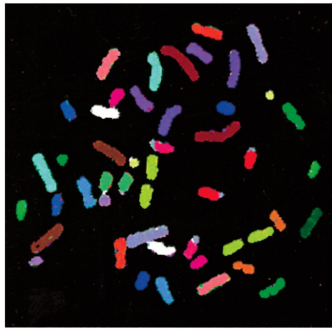
How is this done precisely?
How is this done differently every time?

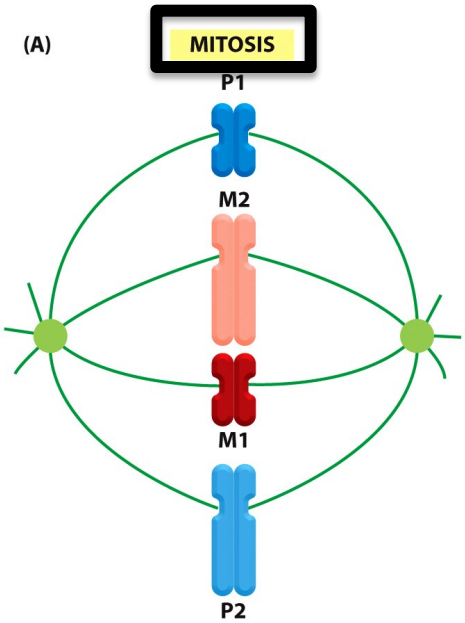
Fertilization: egg(1n) + sperm(1n) = 2n
Diploidy is restored



How is this done precisely?

Regular cell division (mitosis)
maternal and paternal
chromosomes do not interact

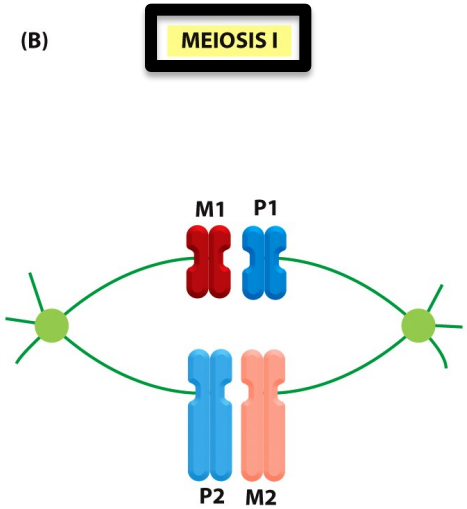




homologous chromosomes
line up at the metaphase plate
independently

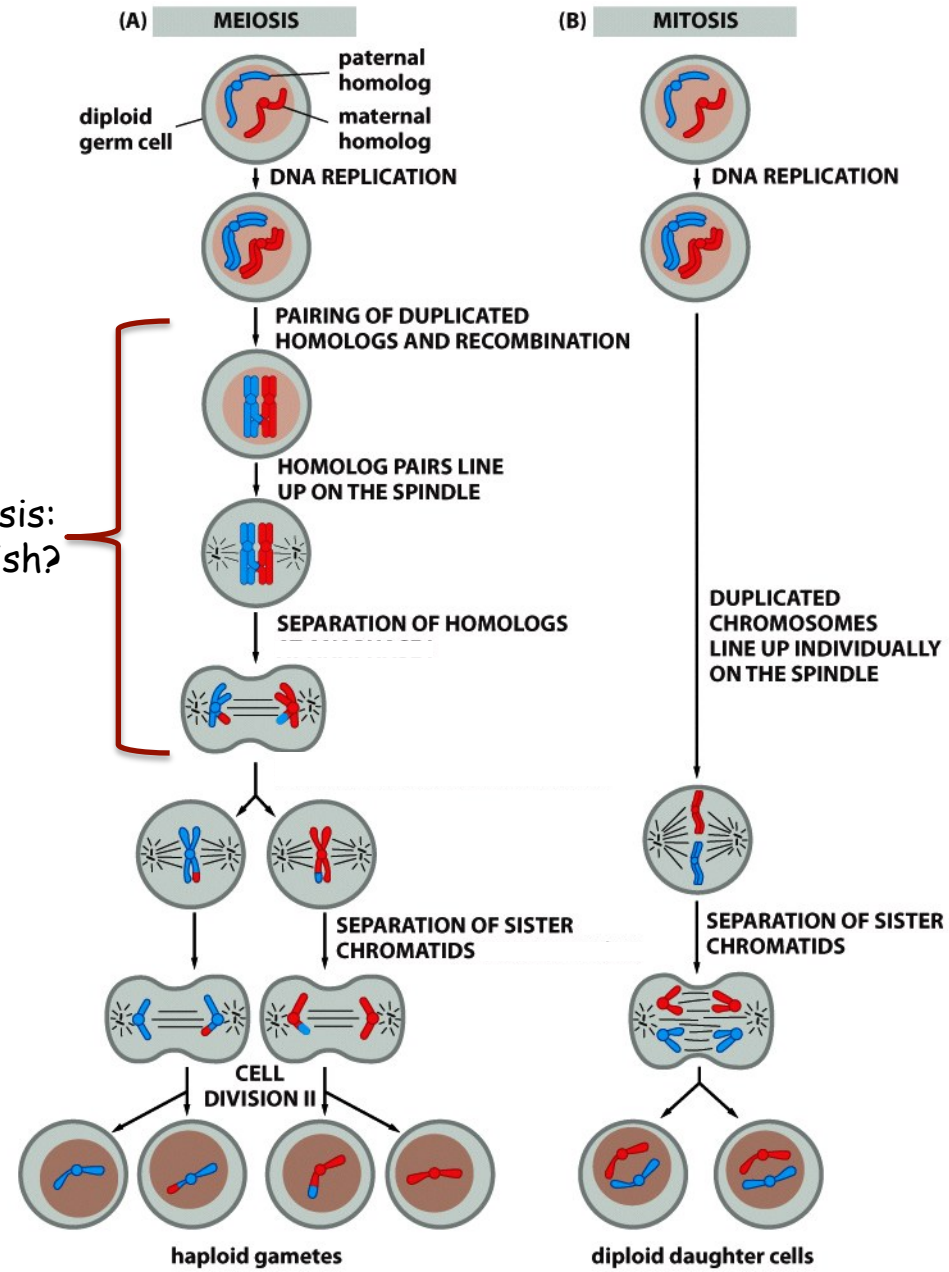
Figure 19-6 Essential Cell Biology 3/e (© Garland Science 2010)

Generation of germ cells (meiosis)
maternal and paternal
chromosomes DO interact



homologous chromosomes
are paired at the
metaphase plate

Unique steps for meiosis: what do they accomplish?



19-12 Essential Cell Biology 3/e (© Garland Science 2010)