Chemical Biology 03

Dec 2, 2009

Inheritance I

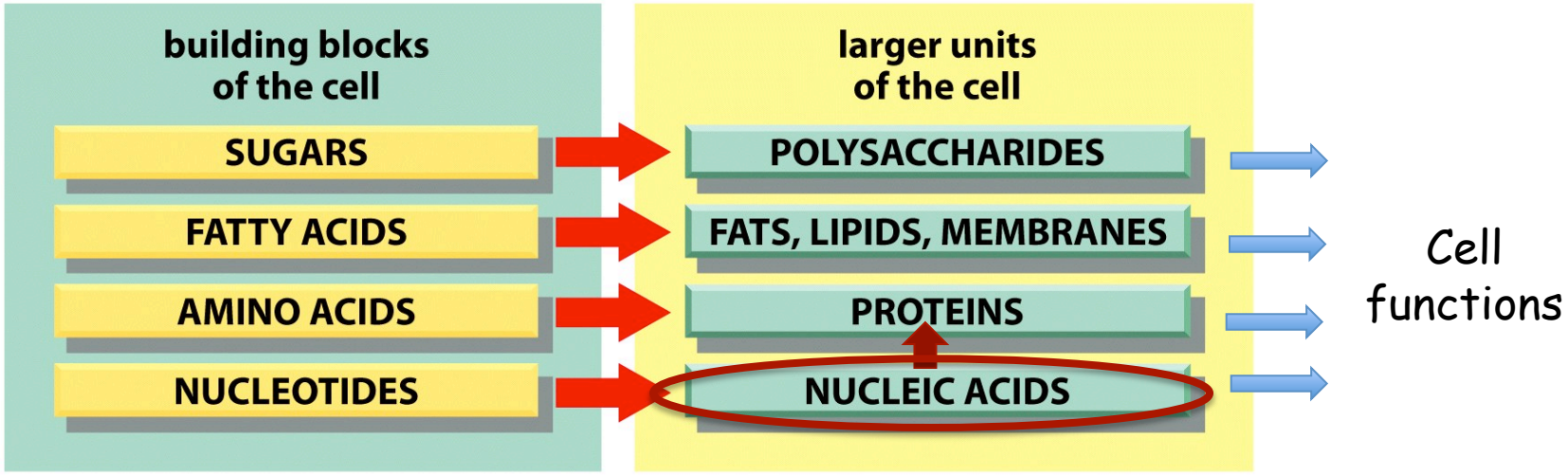
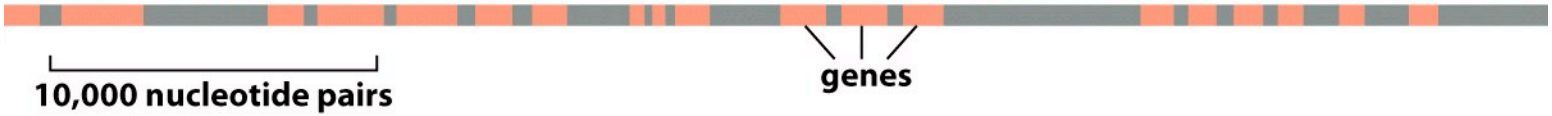


Figure 2-15 Essential Cell Biology 3/e (© Garland Science 2010)

- What is the genetic material?
- How does it influence all aspects of the cell's function?
- What drives those red arrows?

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")

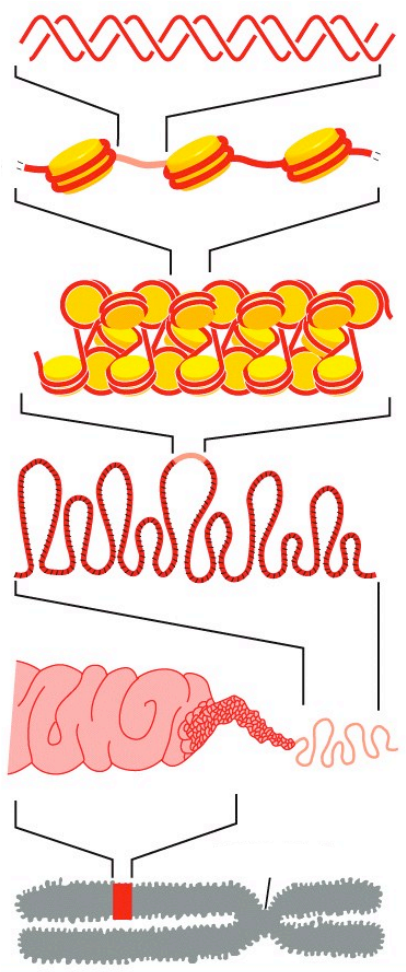


How is the genetic material passed on so completely from one generation to the next?

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

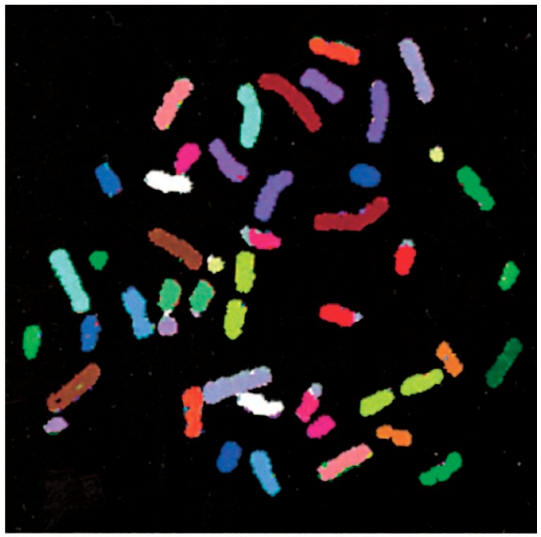
Study of Heredity: how genetic instructions are passed through generations

Genetic material packed into convenient packages



1 chromosome

…Each cell has 46 such packages



Karyotype:
46 "packages" = 23 distinguishable chromosomes
2 of each (1 maternal, 1 paternal): "homologous pair"

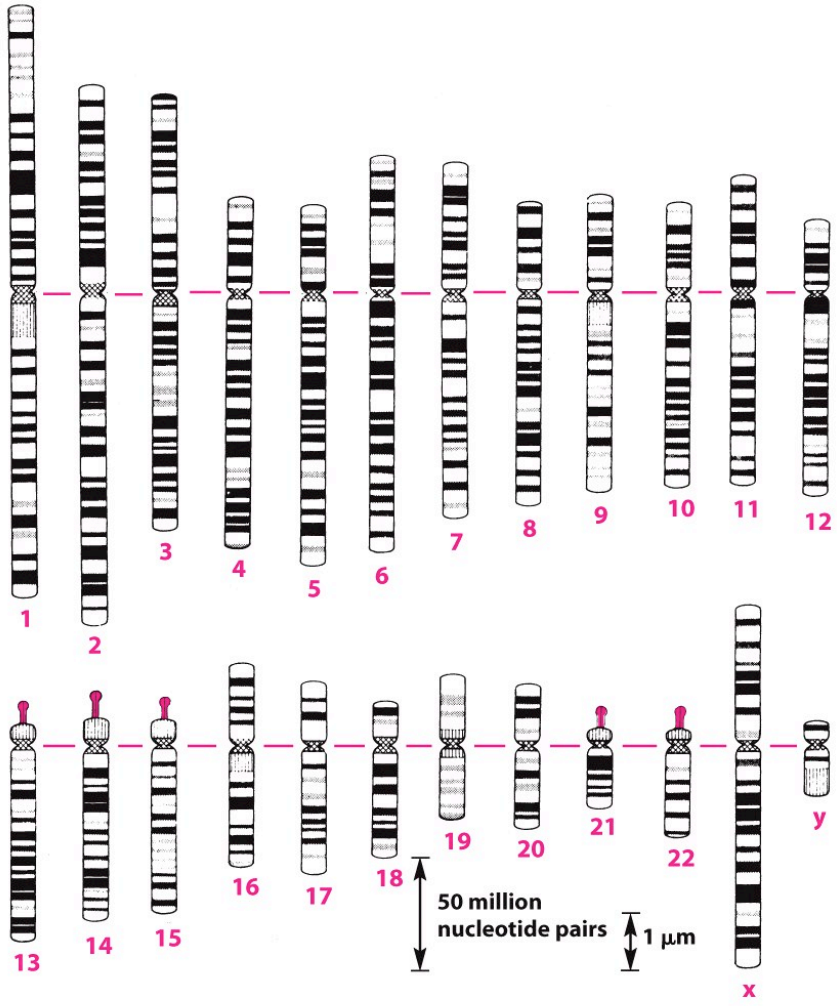
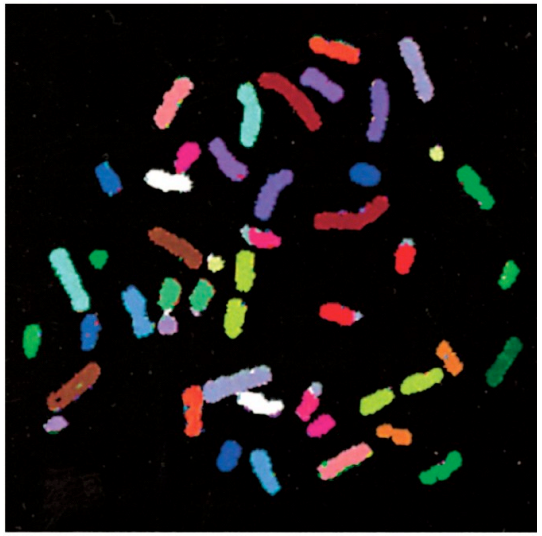


Figure 5-11 Essential Cell Biology 3/e (© Garland Science 2010)



Chromosomes duplicate (via DNA replication) before every cell division

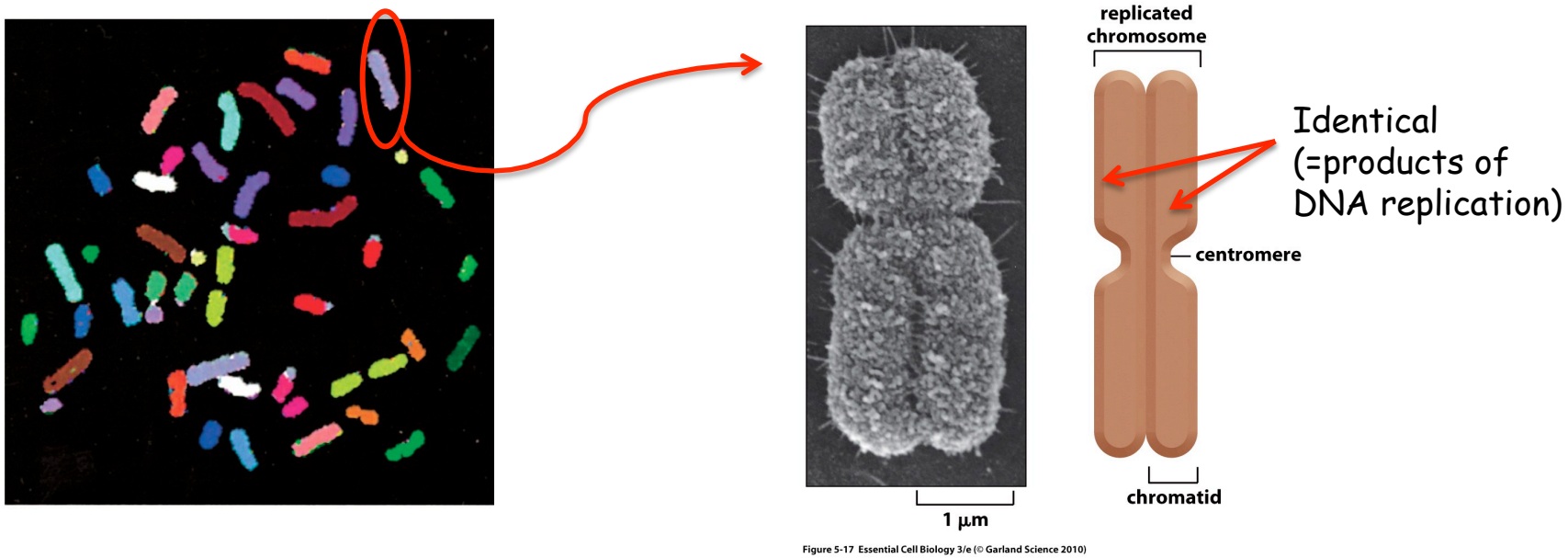
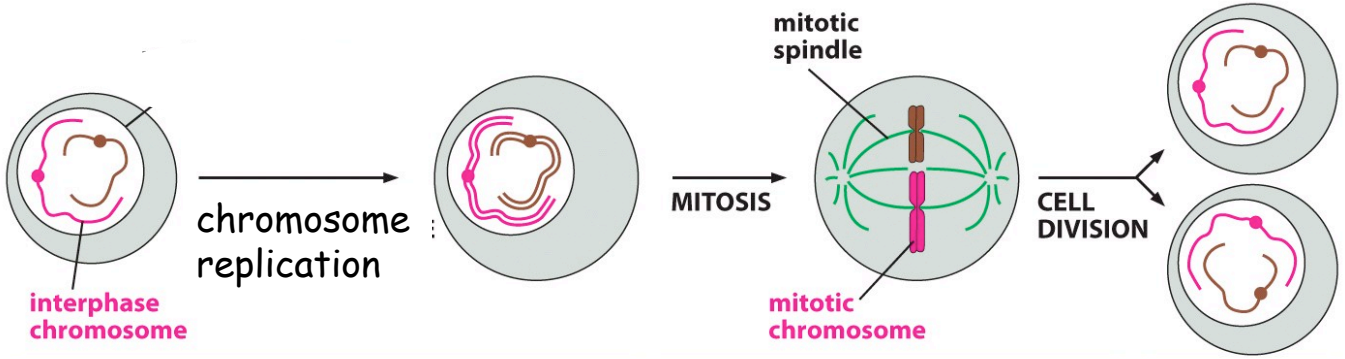
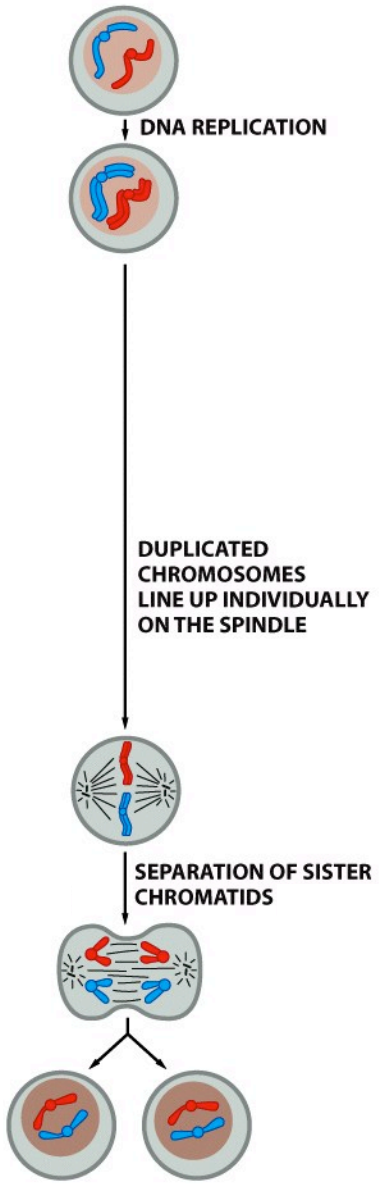


Figure 5-17 Essential Cell Biology 3/e (© Garland Science 2010)

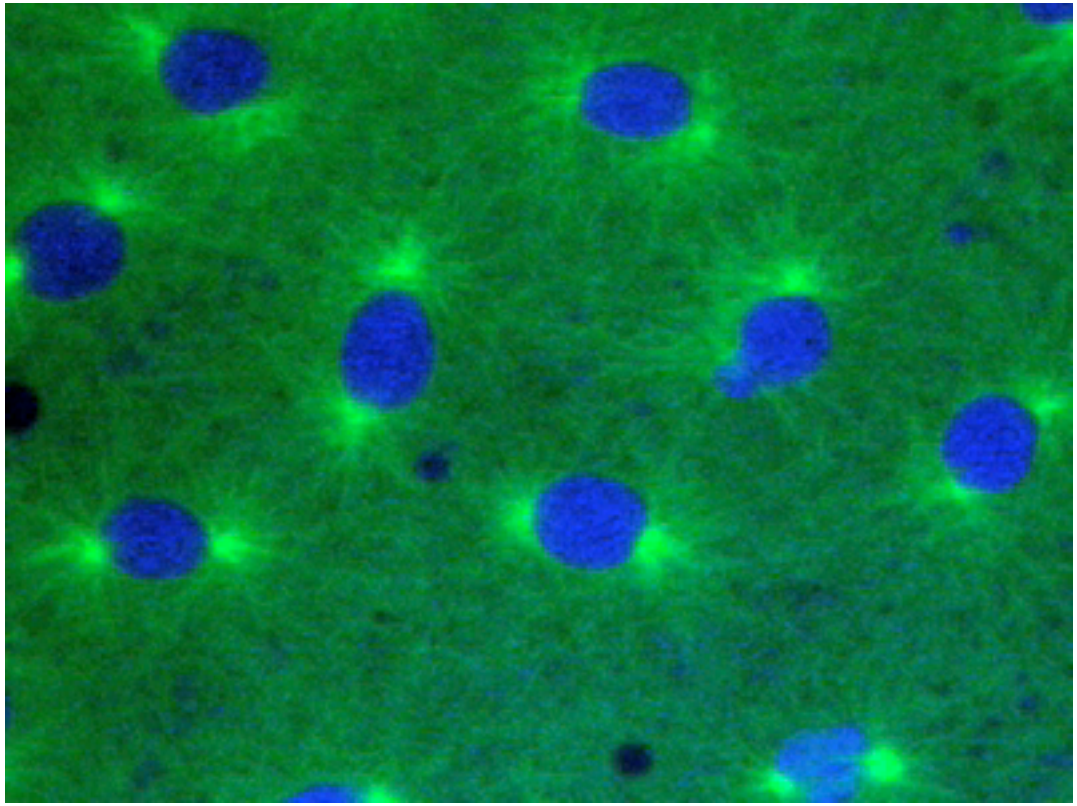
At every cell division (mitosis),
all of the genetic material is equally split between the two daughter cells



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



Movie vault 18.3-6



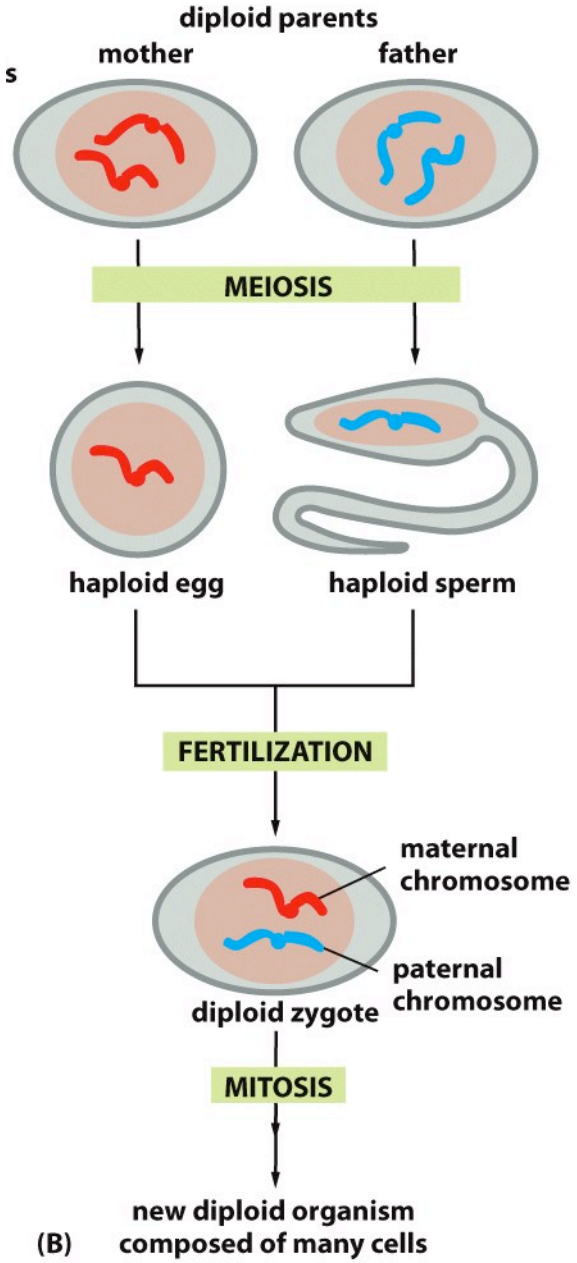
Passing of genetic material to next generation through sexual reproduction necessitates generation of special "germ cells" (egg/sperm) that have only half the number of chromosomes

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

Regular ("somatic") cells are DIPLOID (2n)
Germ cells are HAPLOID (1n)

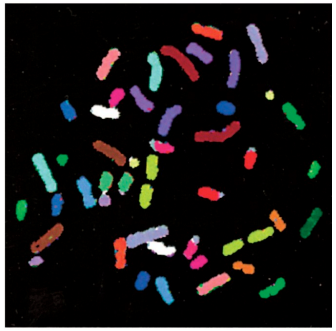
where n = 23 for humans
n = 20 for squirrels
n =32 for guinea pigs
n= 16 for alligator
n= 39 for chicken
n = 4 for fruit fly
etc.

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



How is this done precisely?

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



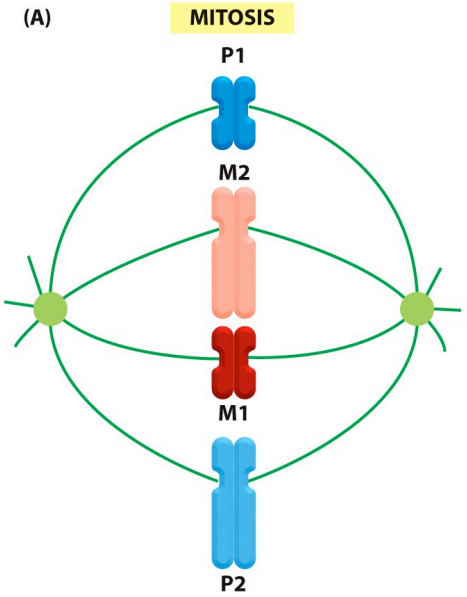
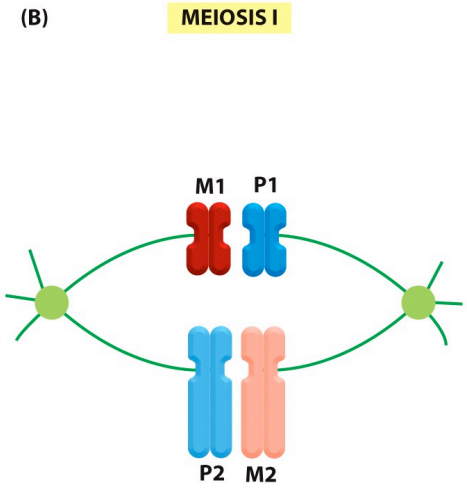
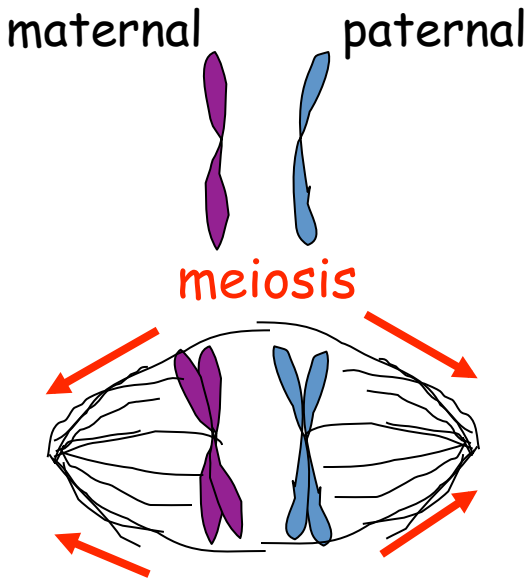


Figure 19-6 Essential Cell Biology 3/e (© Garland Science 2010)



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

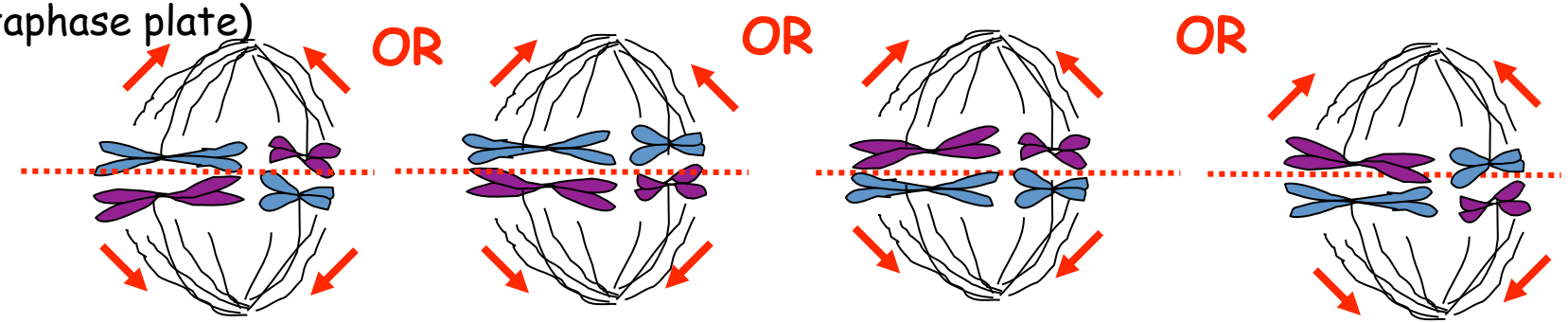
Chromosome Behavior through Meiosis



two homologs of each chromosome; one from each parent

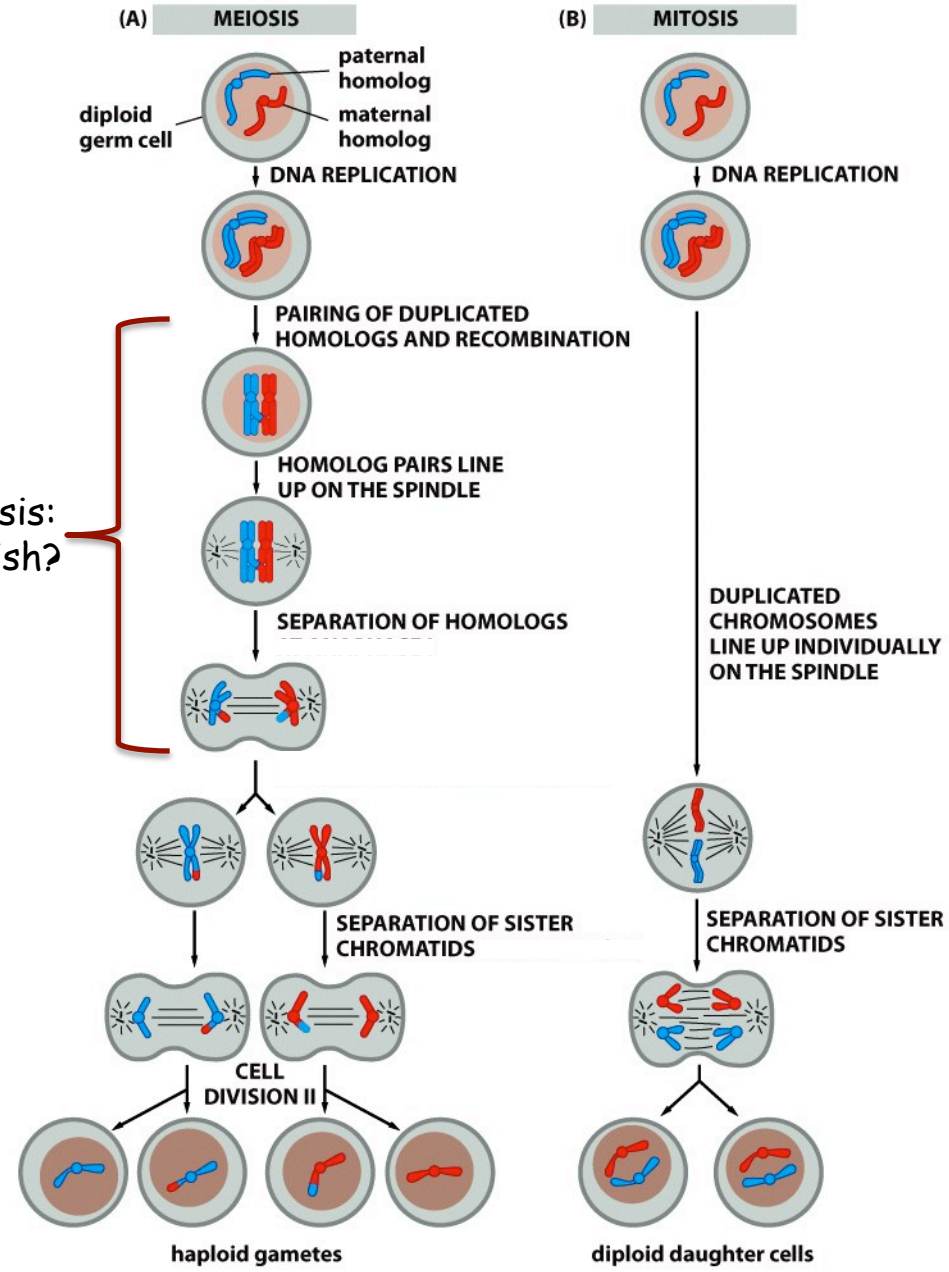
homologous chromosomes segregate equally into gametes

Follow two chromosome pairs: they act independently (random assortment at the metaphase plate)



Because the line up of chromosomes is **random**, we can talk about **probabilities**:
What are the chances that this egg will receive the large paternal chromosome?
What are the chances that this egg will receive both paternal chromosomes?

Unique steps for meiosis: what do they accomplish?



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