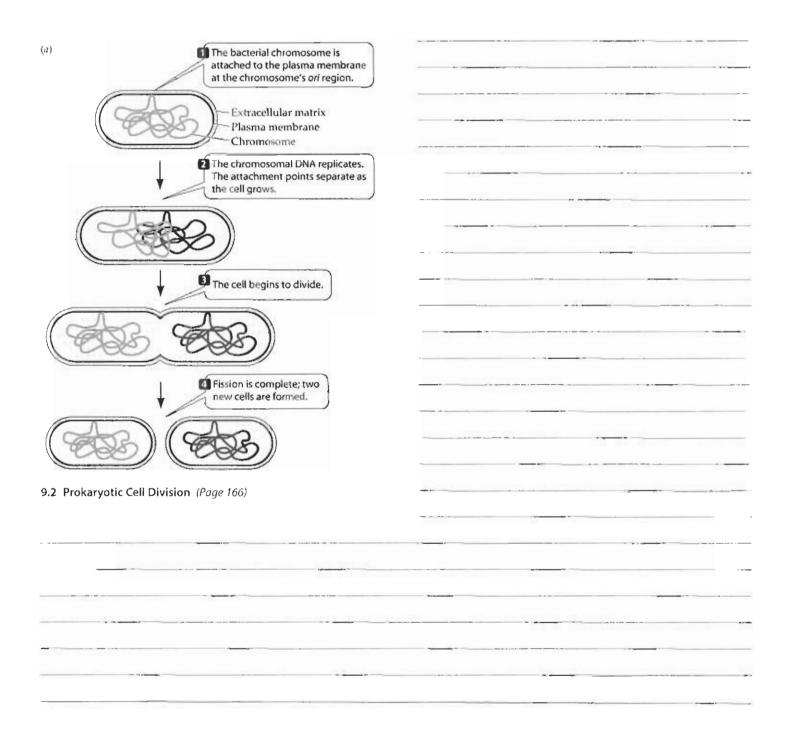
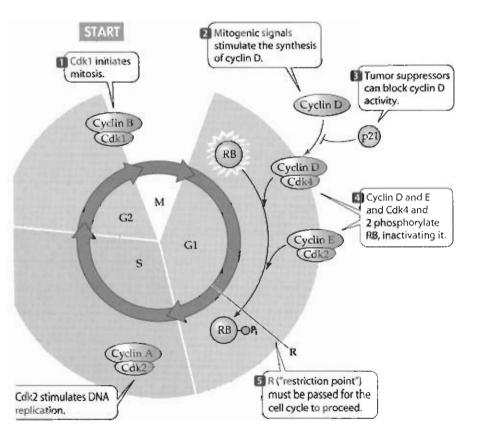
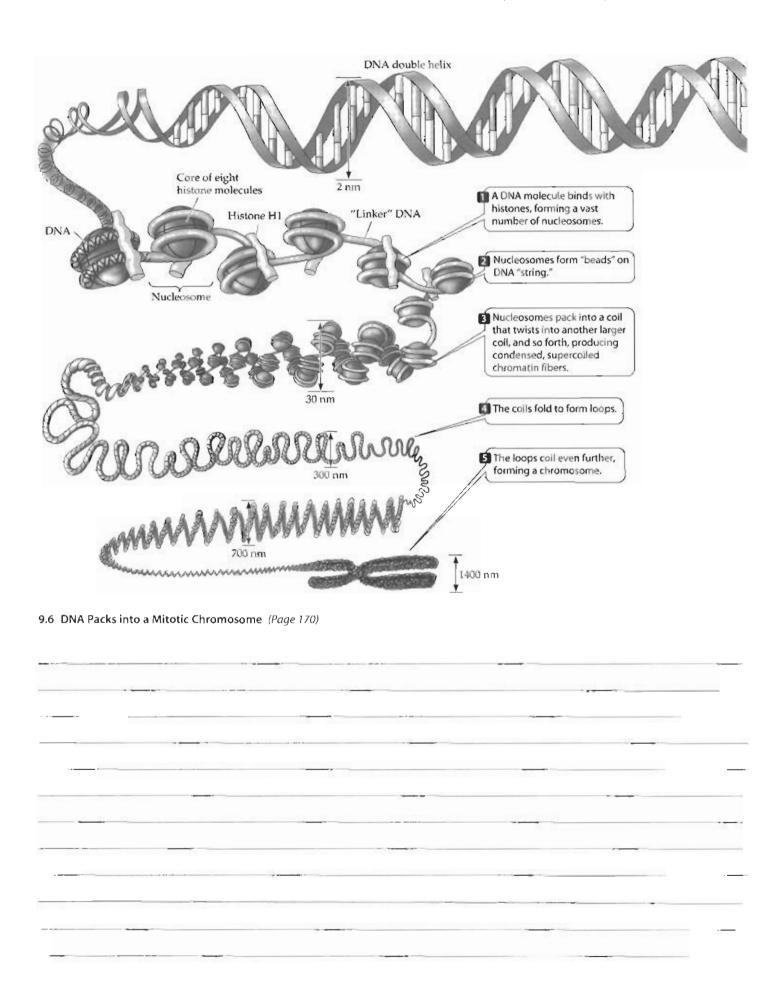
# Chromosomes, the Cell Cycle, and Cell Division





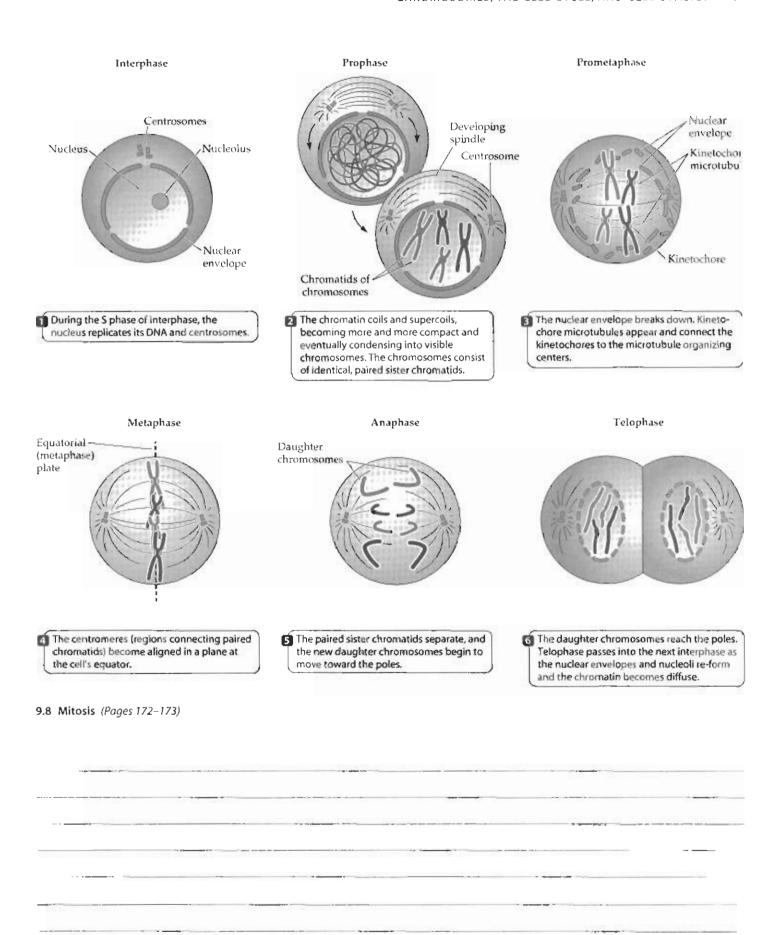


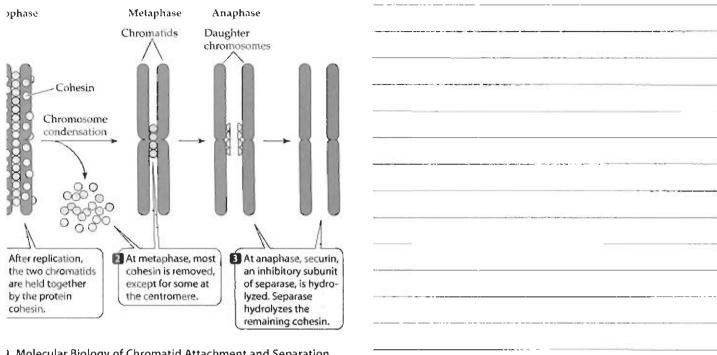
Cyclin-Dependent Kinases and Cyclins Trigger Transitions in the Cell Cycle (Page 168)



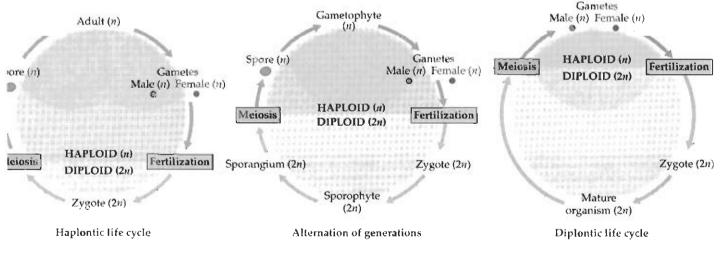
# O CHAPTER NINE

Kinetochore microtubules attach to the kinetochores and to the spindle poles.	
etochore	
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otic center	
ntrosome)	
ntriole	
ar	
Polar microtubules extend from each pole of the spindle.	
The Mitotic Spindle Consists of Microtubules (Page 171)	
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(Mark 1977)	
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• Molecular Biology of Chromatid Attachment and Separation *ige* 173)



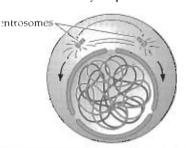
2 Fertilization and Meiosis Alternate in Sexual Reproduction (Page 176)

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V-V	*			
		<u>,</u>		

Numbers of Pairs of Chromos Some Plant and Animal Spec  COMMON NAME SPECIES  Mosquito Culex pipiens	THE STATE OF THE S	
Mosquito Culex pipiens	NUMBER OF CHROMOSOME PAIRS	
1100quito Cinex pipiens	3	
	6	
Toad Bufo americanus	11	
tice Oryza sativa	12	
rog Rana pipiens	13	
Alligator mississippie	ensis 16	
Thesus monkey Macaca mulatta	21	
Vheat Triticum aestivum	21	
Iuman Homo sapiens	23	
otato Solanum luberosum		
	24	
Oonkey Equus asinus	31	
Horse Equus caballus	32	***
Oog Canis familiaris	39	
Casp Cyprinus carpio	52	
		W
nge 177)		
		*

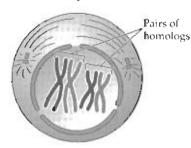
#### EIOSIS I

#### Early Prophase 1



The chromatin begins to condense following interphase.

#### Mid-Prophase I



Synapsis aligns homologs, and chromosomes condense. Homologs are shown in different colors indicating those coming from each parent. In reality, their differences are very small, usually comprising different alleles of some genes.

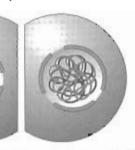
#### Late Prophase I-Prometaphase



The chromosomes continue to coil and shorten. Crossing over results in an exchange of genetic material. In prometaphase the nuclear envelope breaks down.

#### EIOSIS II

Prophase II



The chromosomes condense again, following a brief interphase (interkinesis) in which DNA does not replicate.

# Metaphase II



8 Kinetochores of the paired chromatids line up across the equatorial plates of each cell.

# Anaphase II



The chromatids finally separate, becoming chromosomes in their own right, and are pulled to opposite poles. Because of crossing over in prophase I, each new cell will have a different genetic makeup.

#### 14 Meiosis (Pages 178-179)

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# Metaphase I Equatorial plate

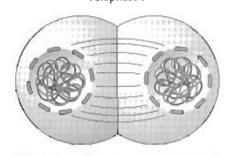
The homologous chromosomes line up on the equatorial (metaphase) plate.

## Anaphase I



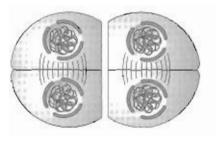
The homologous chromosomes (each with two chromatids) move to opposite poles of the cell.

# Telophase I



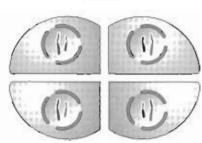
The chromosomes gather into nuclei, and the original cell divides.

## Telophase II



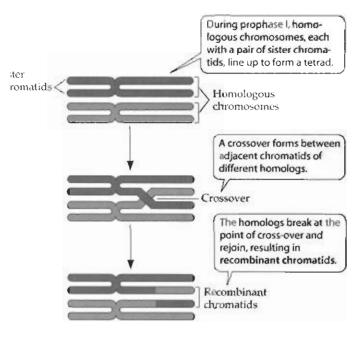
The chromosomes gather into nuclei, and the cells divide.

#### Products

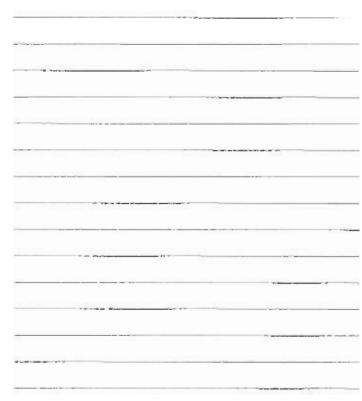


Each of the four cells has a nucleus with a haploid number of chromosomes.

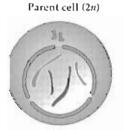
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16 Crossing Over Forms Genetically Diverse Chromosomes 1ge 180)





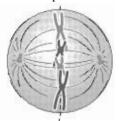


Prophase



No synapsis of homologous chromosomes

Metaphase



Individual chromosomes align at the equatorial plate.

Anaphase



Centromeres separate. Sisten chromatids separate during anaphase, becoming daughter chromosomes.

#### **EIOSIS**



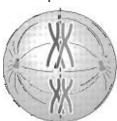
Prophase I

Homologous chromosome pairs

Crossover

Synapsis and crossing over of homologs

#### Metaphase I



Homologous pairs align at the equatorial plate.

#### Anaphase I



Centromeres do not separate; sister chromatids remain together during anaphase; homologs separate; DNA does not applicate before subsequent prophase.

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		- S	

Two daughter cells (each 2n)



Mitosis is a mechanism for constancy: The parent nucleus produces two identical daughter nuclei.

Telophase I



Metaphase II

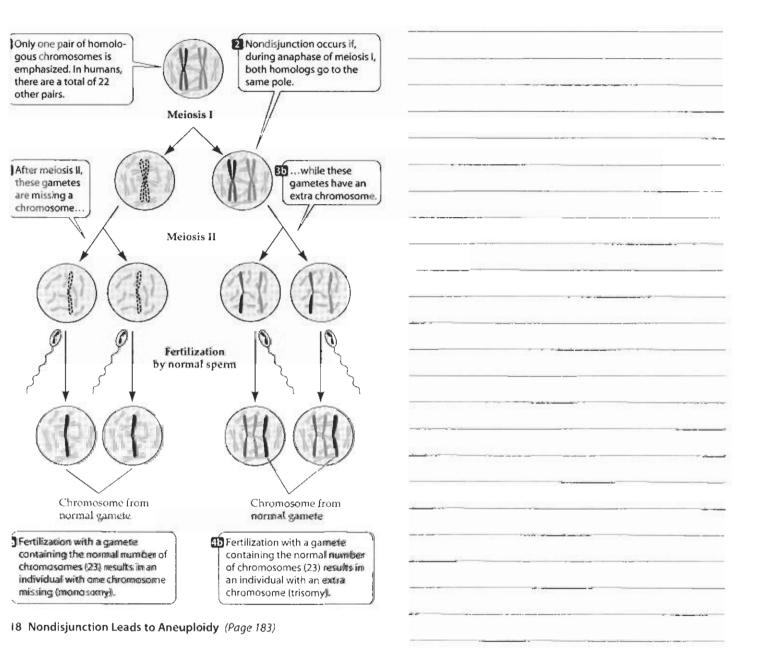


Four daughter cells (each n)



Chromatids separate.

Meiosis is a mechanism for diversity: The parent nucleus produces four different haploid daughter nuclei.



2 Two Different Ways for Cells to Die				
	NECROSIS	APOPTOSIS		
itimuli.	Low O <sub>2</sub> , toxins, ATP depletion, damage	Specific, genetically programmed physiological signals		
ATP required	No	Yes		
Tellular pattern	Swelling, organelle disruption, tissue death	Chromatin condensation, membrane blebbing, single-cell death		
JNA breakdown	Random fragments	Nucleosome-sized fragments		
lasma membrane	Burst	Blebbed (see Figure 9.19)		
ate of dead cells	Ingested by phagocytes	Ingested by neighboring cells		
leaction in tissue	Inflammation	No inflammation		