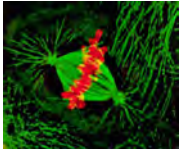


# MITOSIS PRESENTATION DR. SUSAN MASKEL (WCSU)

**MITOSIS**





Dr. Susan Maskel  
Western CT State University

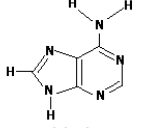
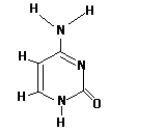
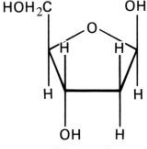
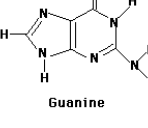
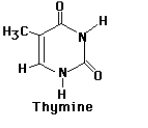
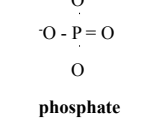
## Background Information

### CHROMOSOMES

<b>DNA</b>	<b>proteins</b>
deoxyribonucleic acid	interspersed with DNA
stores genetic info	controls processes

<b>DNA</b>
2 strands
double helix
sugars (deoxyribose)
phosphate groups
nitrogenous bases: adenine, thymine, guanine, cytosine

Purines	Pyrimidines	
 <b>Adenine</b>	 <b>Cytosine</b>	 $\beta$ -Deoxyribose
 <b>Guanine</b>	 <b>Thymine</b>	 <b>phosphate</b>

**Structure of Components of DNA**

### DNA


P	S	B	B	S	P	
	S	B	B	S		
P	S	B	B	S	P	
	S	B	B	S		
P	S	B	B	S	P	
	S	B	B	S		
P	S	B	B	S	P	

Key:

S = sugar

P = phosphate

B = base



sugar-phosphate backbone

nitrogenous bases form "rungs of ladder"

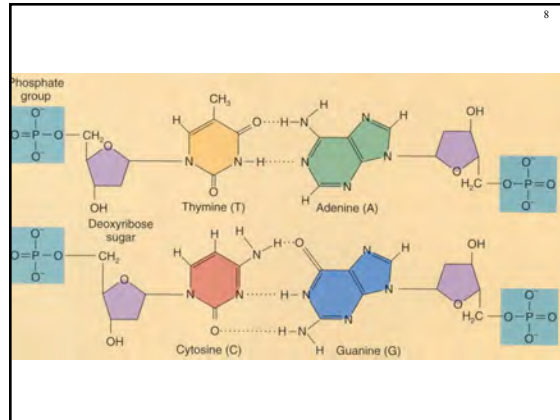
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## Nitrogenous Bases in DNA

- Adenine (A)
- Thymine (T)
- Cytosine (C)
- Guanine (G)

- Specificity of base pairing
- A - T
- C - G



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## DNA

**Key:**

- Thymine (T)
- Adenine (A)
- Cytosine (C)
- Guanine (G)
- Deoxyribose sugar
- Phosphate
- Hydrogen bond

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## Types of Chromosomes

unduplicated

(1 double stranded (ds)  
DNA + protein)

duplicated

(2 ds DNAs + protein)

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## Duplicated Chromosomes

centromere

sister chromatids

DNA

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**Humans have 46 chromosomes in their somatic cells (i.e., not sperm, not egg)**

**diploid number = 2N = 46**

**Humans have 23 chromosomes in their sex cells (i.e., egg or sperm)**

**haploid number = 1N = 23**

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## The Cell Cycle

At any given time,  
a cell is either:

not dividing

dividing

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### When NOT dividing: INTERPHASE

**G1 phase (growth phase 1)**  
normal cell metabolism  
synthesis of proteins not used in mitosis  
chromosomes are unduplicated

**S phase (synthesis phase)**  
normal cell metabolism  
DNA synthesis (DNA replication or duplication)  
chromosomes go from unduplicated to duplicated

**G2 phase (growth 2 phase)**  
normal cell metabolism  
synthesis of proteins needed for mitosis  
chromosomes are duplicated

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## DNA Replication

- DNA unzips
- New nucleotides (sugar-phosphate-base combinations) add according to specificity of base pairing
- 2 sister chromatids form; are identical
- each sister chromatid has 1 new & 1 old DNA strand
- semiconservative replication

Key:  
A = Adenine  
T = Thymine  
C = Cytosine  
G = Guanine

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### When cells ARE dividing:

**MITOSIS**  
division of the nucleus of somatic cells; 1 division maintains the chromosome number  
1 mother cell with 46 chromosomes gives rise to 2 daughter cells, each with 46 chromosomes

**MEIOSIS**  
division of the nucleus of sex cells; 2 divisions halves the chromosome number  
1 mother cell with 46 chromosomes gives rise to 4 daughter cells, each with 23 chromosomes

**CYTOKINESIS**  
division of cytoplasm  
occurs during mitosis & meiosis

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### CELL CYCLE

**INTERPHASE**  
G1: unduplicated chromosomes  
S: chromosomes duplicate  
G2: duplicated chromosomes

**MITOSIS (M phase)**  
start with duplicated chromosomes; end with unduplicated chromosomes  
4 phases:  
Prophase  
Metaphase  
Anaphase  
Telophase  
(cytokinesis occurs mainly during telophase)

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### INTERPHASE

before mitosis begins; NOT part of mitosis

cell is not dividing

includes G1, S, G2 phases

nuclear membrane visible

nucleoli visible

chromatin in nucleus

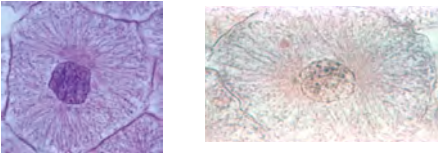
**NOTE:**

- nuclear membrane intact
- nucleolus visible
- chromatin not visible as individual structures

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Interphase

nuclear membrane present  
chromatin not visible



## MITOSIS

nuclear division of somatic cells

4 phases:  
Prophase  
Metaphase  
Anaphase  
Telophase

cytokinesis – division of cytoplasm –  
occurs mainly during telophase

### PROPHASE


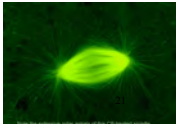
lasts 1 – several hours

nuclear membrane disappears

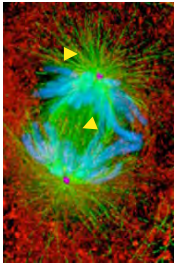
nucleoli disappear

chromatin winds upon itself to form chromosomes;  
chromosomes are duplicated

centrioles made of microtubules; (replicated to form 2  
pairs at end of G1); move to opposite poles of cell  
spindle and asters form

## Spindle & Asters




aster

probably anchors apparatus to cell membrane

spindle

helps organize chromosomes during mitosis

## Prophase



**NOTE:**

nuclear membrane disappears

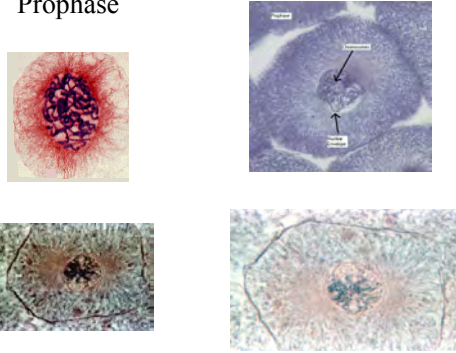
nucleolus disappears

chromatin → chromosomes

spindle & asters form

In this hypothetical cell, 2 N = 4.  
In humans, 2 N = 46.

## Prophase



# MITOSIS PRESENTATION


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**METAPHASE**

5 – 15 minutes

chromosomes line up in single file along center of spindle

chromosomes are attached to spindle fibers in area of centromere

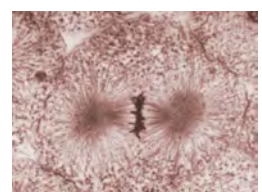
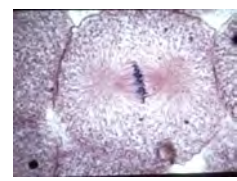
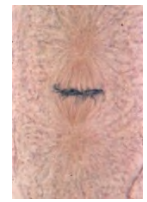


**NOTE:**

chromosomes lined up in single file in center of spindle

In this hypothetical cell,  $2N = 4$ .  
In humans,  $2N = 46$ .

### Metaphase


**ANAPHASE**

2 – 10 minutes

spindle fibers pulled toward opposite poles of cell

centromere splits

sister chromatids pulled toward opposite poles of cell


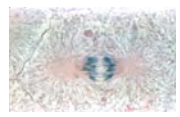
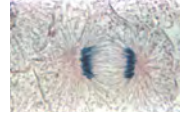
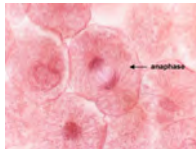


**NOTE:**

sister chromatids being pulled toward opposite poles of cell

In this hypothetical cell,  $2N = 4$ .  
In humans,  $2N = 46$ .

### Anaphase

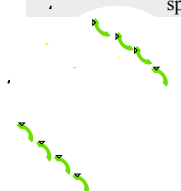





**TELOPHASE**

10 – 30 minutes

cleavage furrow forms & deepens until cell divides into 2 daughter cells (cytokinesis)

opposite of prophase occurs:  
nuclear membrane & nucleoli reappear  
chromosomes uncoil into chromatin  
spindle & asters disappear

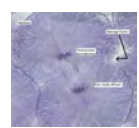
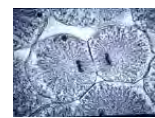
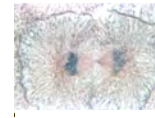
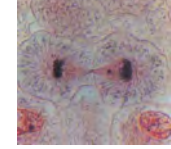


**NOTE:**

cleavage furrow forms; 2 daughter cells will form; the opposite of prophase will occur

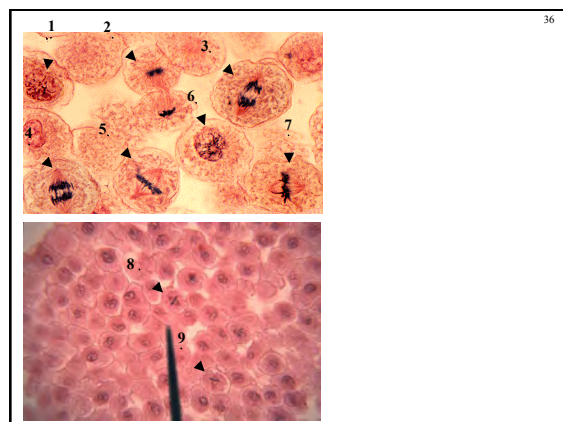
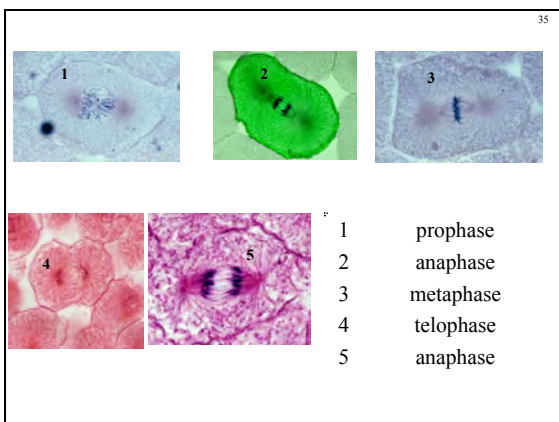
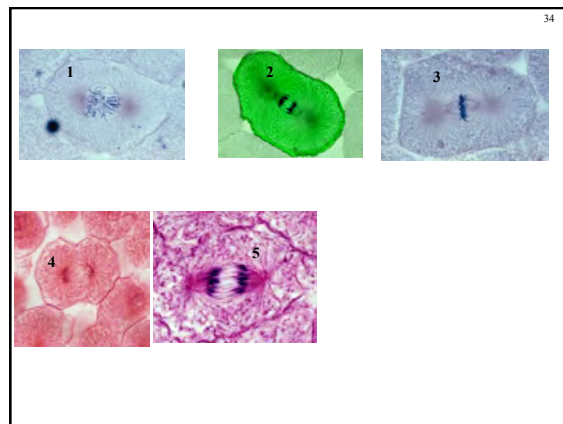
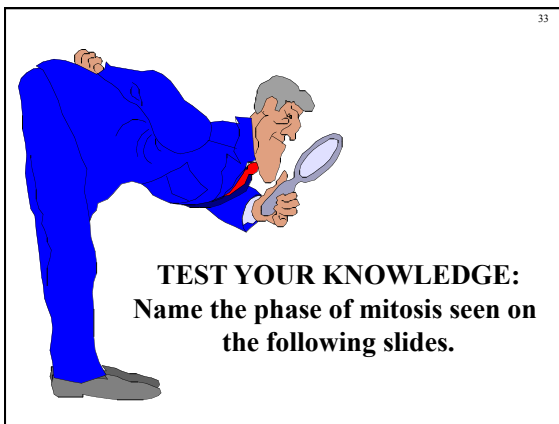
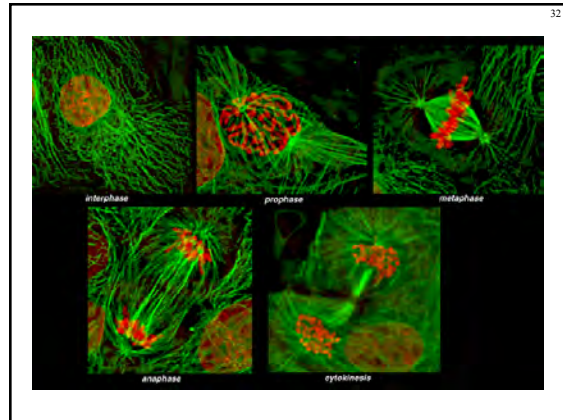
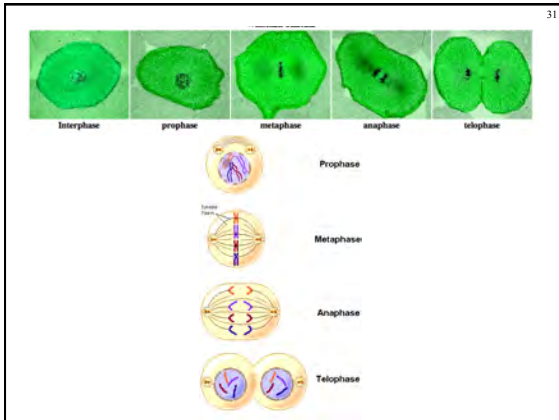
In this hypothetical cell,  $2N = 4$ .  
In humans,  $2N = 46$ .

### Telophase



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- 1 prophase
- 2 telophase
- 3 anaphase
- 4 anaphase
- 5 metaphase
- 6 prophase
- 7 metaphase
- 8 metaphase
- 9 metaphase

- 1 metaphase
- 2 telophase
- 3 prophase
- 4 anaphase
- 5 anaphase
- 6 prophase
- 7 metaphase

- 8 late anaphase/  
early telophase
- 9 anaphase
- 10 metaphase
- 11 anaphase
- 12 anaphase
- 13 metaphase
- 14 prophase

Now it's YOUR turn to identify stages of mitosis with a microscope!