

## GENETICS & DEVELOPMENT - Cell Division

Physical Basis of Inheritability...

Mechanisms of Cell Reproduction...

GENETICS asks....

DEVELOPMENT looks....

- 1.
- 2.

METHODS of CELL REPRODUCTION include...

Fission -

Budding -

Mitosis -

Meiosis -

**Mitosis - Asexual Reproduction Cell Cycle...**

the Life cycle of a Cell... is referred to as the "**CELL CYCLE**"...

**G<sub>1</sub>** =

**S** =

**G<sub>2</sub>** =

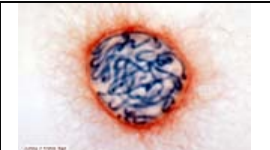




**M** =

When a cell is in any phase of the cell cycle other than mitosis, it is often said to be in **interphase**.

[3 Stages] - Cell Cycle is depicted as  
Interphase -

]

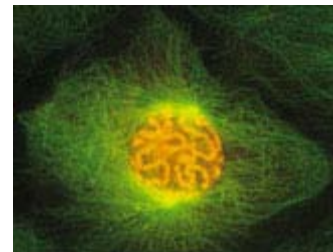
MITOSIS -  
Cytokinesis

Names and Numbers -

Chromosomes

Genes occur in chromatin of nucleus,  
 which condense into **CHROMOSOMES**  
 (colored bodies) visible only during **MITOSIS**

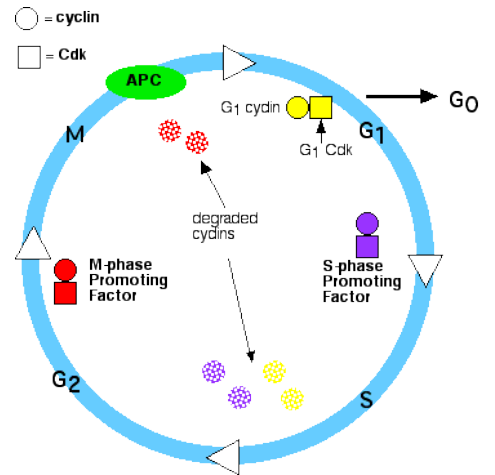


## Control of Cell Division and the Cell Cycle

Regulated by "Growth Factors" - proteins that promote cell division  
 Their levels in the cell rise and fall with the stages of the cell cycle.

- **Cyclins**

Cyclin-



MPF  
 MPF is

MPF

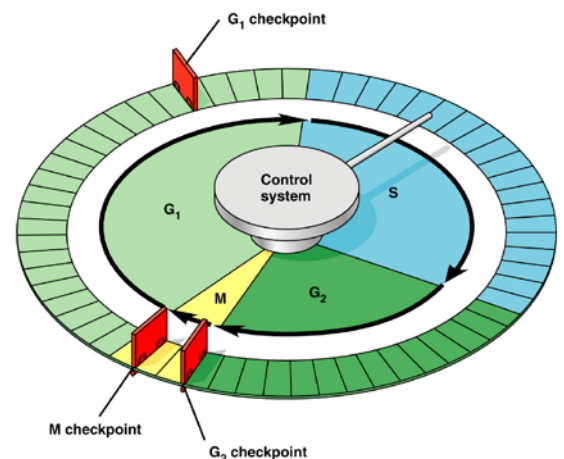
cdk -

cyclin -

### **Checkpoints: Quality Control of the Cell Cycle**

The cell has several systems for interrupting the cell cycle if something goes wrong.

- DNA damage checkpoints.



Copyright © 2005 Pearson Education, Inc. Publishing as Pearson Benjamin Cummings. All rights reserved.

- A check on the successful replication
- Spindle checkpoints.

SEXUAL CELL REPRODUCTION... "MEIOSIS"

The physical differences between nuclear divisions of MEIOSIS & MITOSIS so the Distinct Differences are:

meiosis =

mitosis =

meiosis =

mitosis =

meiosis =

mitosis =

Sexual Cell Reproduction (Meiosis)

Where does meiosis occur during sexual cell cycle?

Meiosis

Fertilization

Stages of Sexual Cell Division

Names of stages are same & have analogous functions

Meiosis I...

Prophase I = chromosomes condense

SYNAPSIS -

CROSSOVER -

Metaphase I =

Anaphase I =

Telophase I =

Meiosis I

Meiosis II...

Independent Assortment -

Crossing Over -

Summary of MEIOSIS

1. Briefly describe the **physical** differences between mitosis and meiosis.

<b>Mitosis</b>	
<b>Meiosis</b>	

**PART I: COMPARING PLANT AND ANIMAL CELL MITOSIS**

2. Click on link to obtain a set of Mitosis Pictures.
3. Examine the pictures comparing Plant and Animal Cell Mitosis
4. What are the major differences between mitosis in animal cells and mitosis in plant cells?

<b>Animal Cell Mitosis</b>	<b>Plant Cell Mitosis</b>

- Click on link for Mitotic Phase Identification Cards. Determine the phase represented in the picture and indicate if the cell is plant or animal.

Slide #	Mitotic Phase	Animal or Plant	Slide #	Mitotic Phase	Animal or Plant
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

## **PART II: TIME FOR CELL REPRODUCTION**

It is hard to imagine that you can estimate how much time a cell spends in each phase of cell replication from a slide of dead cells. Yet this is precisely what you will do in this part of the activity. You will count the number of cells in each phase and they infer the percent of time each cell spends in each phase.

- Examine the cells in Microscopic Field #1 of the Mitosis Pictures. Determine the cell cycle phase for each cell present in the field of view. Record the numbers in the Time for Mitosis Data Table.
- Repeat step 6 for each of the eight microscopic fields.
- Calculate the total number of cells in each phase and the total number of cells viewed. Record the totals in the Time for Mitosis Data Table.
- Calculate the percentage of cells in each phase.
- It takes, on average, 24 hours (1,440 minutes) for onion root-tip cells to complete the cell cycle. Using this information you can calculate the amount of time spent in each phase of the cell cycle using the percent of cells in that stage. (Percent of cells in phase times 1,440 minutes). Calculate the time spent in each phase and record your results in the data table.

### Time for Mitosis Data Table

Field	# of Cells in Interphase	# of Cells in Prophase	# of Cells in Metaphase	# of Cells in Anaphase	# of Cells in Telophase
1					
2					
3					
4					
5					
6					
<b>Total</b>					
<b>% of Total Cells Counted</b>					
<b>Time in Each Phase</b>					

11. Based on the data you collected, what can you infer about the relative length of time an onion root-tip cell spends in each stage of cell division?

---



---

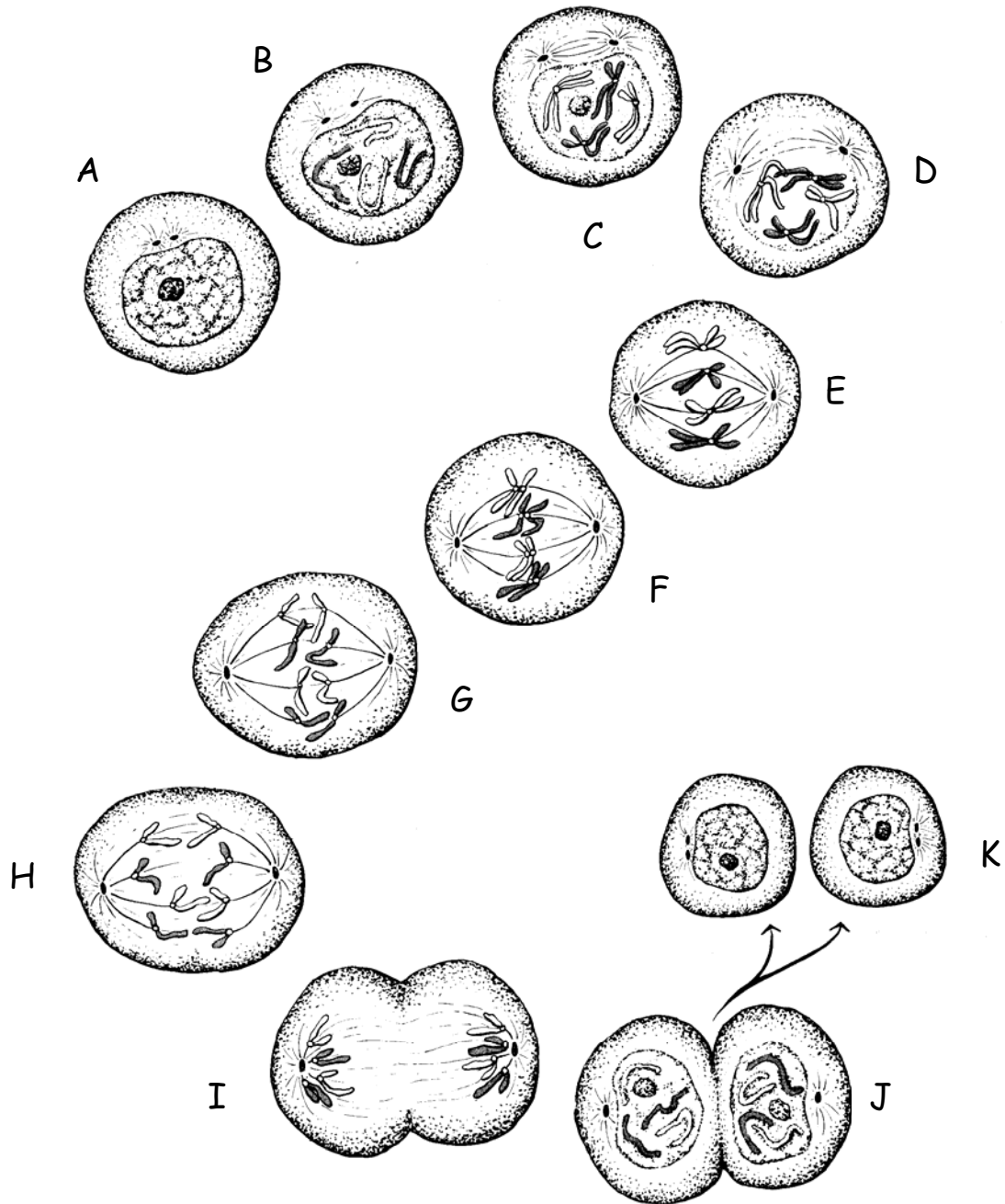


---



**PART IV: QUESTIONS**

12. Use the drawings below to answer the questions that follow.



- a. What phase is shown in cell A? \_\_\_\_\_
- b. What mitotic phase is shown in cells B, C, D, and E? \_\_\_\_\_
- c. What mitotic phase is shown in cell F? \_\_\_\_\_

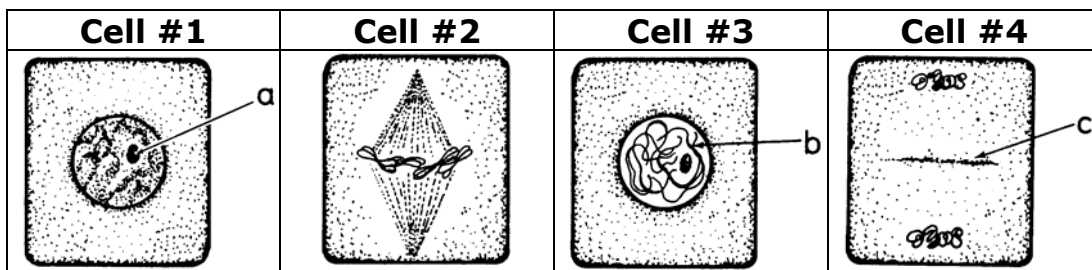
- d. What mitotic phase is shown in cells G and H? \_\_\_\_\_
- e. What mitotic phase is shown in cells I and J? \_\_\_\_\_
- f. What phase is shown in cell K? \_\_\_\_\_
13. Are the cells pictured in Question 23 animal or plant? \_\_\_\_\_
- How do you know? \_\_\_\_\_

14. In what way are the newly formed cells, which result from mitosis, similar to the mother cell?
- \_\_\_\_\_
- \_\_\_\_\_

15. How are the new cells different?
- \_\_\_\_\_

16. Why is it necessary for DNA to replicate before mitosis begins?
- \_\_\_\_\_
- \_\_\_\_\_

17. Examine the diagrams below.



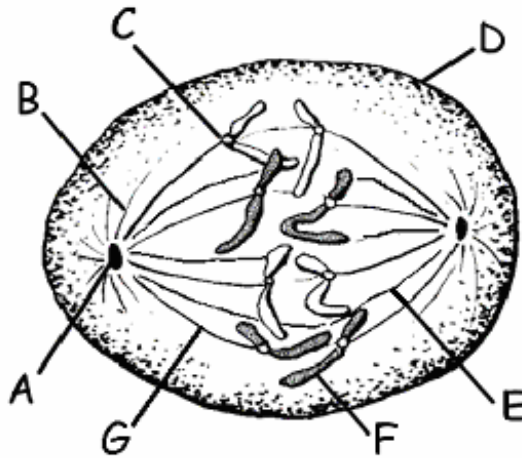
Name the structure indicated by letter a in cell #1. \_\_\_\_\_

Name the structure indicated by letter b in cell #3. \_\_\_\_\_

Name the structure indicated by letter c in cell #4. \_\_\_\_\_

What is the correct order of the diagrams? \_\_\_\_\_

18. Match the structure with the correct letter from the diagram.



- \_\_\_\_\_ Cell Membrane
- \_\_\_\_\_ Centromere
- \_\_\_\_\_ Centriole
- \_\_\_\_\_ Chromosome
- \_\_\_\_\_ Aster
- \_\_\_\_\_ Kinetochore microtubules
- \_\_\_\_\_ Nonkinetochore microtubule

19. Match the description/event with the correct mitotic phase. Use the key below to indicate your answers.

**A = Anaphase**

**P = Prophase**

**T = Telophase**

**M = Metaphase**

**PM = Prometaphase**

- \_\_\_\_\_ Nucleoli disappear
- \_\_\_\_\_ Chromatin coils & folds (condenses)
- \_\_\_\_\_ Mitotic spindle forms
- \_\_\_\_\_ Centrosomes separate and move to opposite poles of cell
- \_\_\_\_\_ Nuclear envelope fragments
- \_\_\_\_\_ Kinetochore microtubules attach to kinetochores
- \_\_\_\_\_ Chromosomes move to metaphase plate
- \_\_\_\_\_ Centromeres of each chromosome "break" and move apart
- \_\_\_\_\_ Sister chromatids separate and are referred to as chromosomes
- \_\_\_\_\_ Spindle fibers move the chromosomes to opposite poles
- \_\_\_\_\_ Nonkinetochore microtubules elongate the cell
- \_\_\_\_\_ Daughter nuclei form at each pole

\_\_\_\_\_ Nuclear envelopes form around each set of chromosomes

\_\_\_\_\_ Nucleoli reappear

\_\_\_\_\_ Chromatin uncoils (decondenses)

\_\_\_\_\_ Chromosomes line up along the metaphase plate

20. Match the event or description with the correct cell cycle phase.

\_\_\_\_\_ Mitosis

\_\_\_\_\_ DNA replication

\_\_\_\_\_ Cytokinesis

\_\_\_\_\_ Cell grows in size

\_\_\_\_\_ Organelles replicate

\_\_\_\_\_ Interphase

\_\_\_\_\_ Division of nuclear contents

\_\_\_\_\_ Division of cytoplasm

\_\_\_\_\_ G<sub>1</sub> (gap 1)

\_\_\_\_\_ G<sub>2</sub> (gap 2)

\_\_\_\_\_ S phase

\_\_\_\_\_ Cell prepares for cell division

\_\_\_\_\_ Prophase

\_\_\_\_\_ Anaphase

\_\_\_\_\_ Metaphase

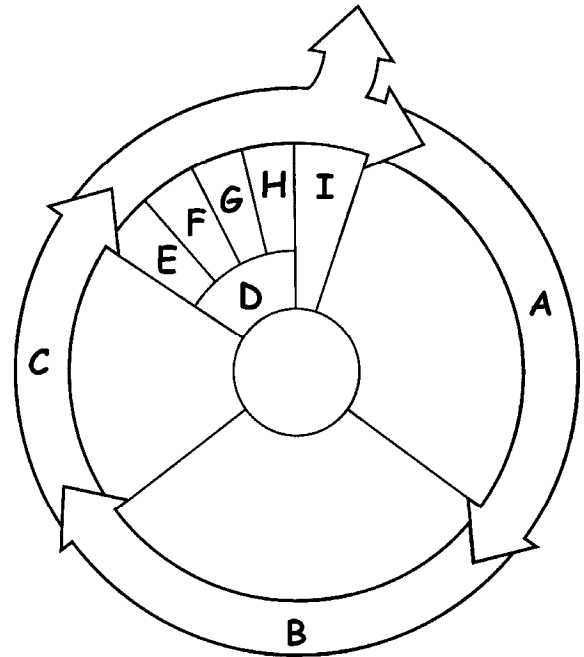
\_\_\_\_\_ Telophase

\_\_\_\_\_ Chromosomes condense (coil and fold)

\_\_\_\_\_ Chromosomes uncoil

\_\_\_\_\_ Chromosomes pulled to opposite poles of cell

\_\_\_\_\_ Chromosomes line up along the equator of the cell



21. What directs the sequential events of the cell cycle?

---

22. What is the significance or importance of the checkpoints in the cell cycle?

---

23. For many cells, what seems to be the most important checkpoint?

---

What happens to the cell if it meets the requirements of this checkpoint?

---

What happens to the cell if it fails to meet the requirements of this checkpoint?

---

---

24. Define or describe each of the following:

<b>Protein Kinase</b>	
<b>Cyclin</b>	
<b>Cdks</b>	
<b>MPF</b>	

25. Explain how MPF is involved in the control of the cell cycle.

---

---

---

26. Describe how the concentration of each of the following changes during the cell cycle:

<b>Cdk</b>	
<b>Cyclin</b>	
<b>MPF</b>	

27. What is the role of proteolytic enzymes in the cell cycle?

---

28. What internal and external cues help regulate the cell cycle?

---

---

29. Define or describe the following:

<b>Growth Factor</b>	
<b>Density-dependent Inhibition</b>	
<b>Anchorage Dependence</b>	

30. How are cancer cells different from normal cells?

<b>Cancer Cells</b>	<b>Normal Cells</b>

31. Define the following:

<b>Transformation</b>	
<b>Tumor</b>	
<b>Benign Tumor</b>	
<b>Malignant Tumor</b>	
<b>Metastasis</b>	