

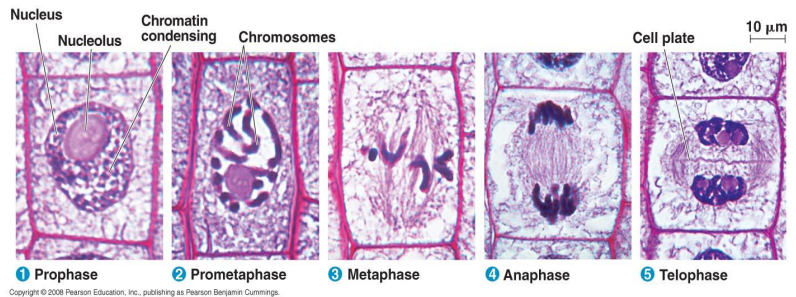
**KEY CONCEPTS:**

- Most cell divisions results in genetically identical daughter cells
- The mitotic phase alternates with interphase in the cell cycle
- The eukaryotic cell cycle is regulated by a molecular control system
- Cloning of organisms showed that differentiated cells could be “reprogrammed” and ultimately led to the production of stem cells
- Abnormal regulation of genes that affect the cell cycle lead to cancer

**READ:**

- Chapter 12 (228- 245) – The Cell Cycle
- Chapter 20.3 (415) – Stem Cells
- Chapter 18.5 (374- 376) - Cancer

**KEY TERMS:** Here is a list of key terms and concepts you will hear about and see during the chapter readings. Get to know them!



<i>Cell division</i>	<i>Interphase</i>	<i>Prometaphase</i>	<i>Cell plate</i>
<i>Cell cycle</i>	<i>Mitosis</i>	<i>Metaphase</i>	<i>Checkpoint</i>
<i>Chromosomes</i>	<i>Cytokinesis</i>	<i>Anaphase</i>	<i>Cyclin-dependent kinases (Cdk)</i>
<i>Somatic cells</i>	<i>Meiosis</i>	<i>Telophase</i>	<i>MPF – (M-phase promoting factor)</i>
<i>Gametes</i>	<i>G<sub>1</sub> (first gap) phase</i>	<i>Kinetochores</i>	<i>Cancer</i>
<i>Chromatin</i>	<i>S (synthesis) phase</i>	<i>Centriole</i>	<i>Benign tumor</i>
<i>Sister chromatid</i>	<i>G<sub>2</sub> (second gap) phase</i>	<i>Spindle</i>	<i>Malignant tumor</i>
<i>Centromere</i>	<i>Prophase</i>	<i>Cleavage furrow</i>	<i>Metastasis</i>
<i>Oncogenes</i>	<i>Proto-oncogenes</i>	<i>Tumor suppressor genes</i>	<i>cloning</i>
<i>p53</i>	<i>Stem cells</i>	<i>Totipotent</i>	
<i>Embryonic vs. Adult</i>	<i>Induced Pluripotent (iPS)</i>	<i>Pluripotent</i>	

**QUESTIONS FOR YOUR BILL:**

**Most cell divisions results in genetically identical daughter cells**

1. Define *genome*.
2. Distinguish between *somatic cells* and *gametes*.
3. Distinguish between the different stages of DNA folding known as *chromatin* and *chromosomes*.
4. Make a sketch of a replicated chromosome to illustrate a *sister chromatid* and *centromere*.
5. Distinguish between *mitosis* and *cytokinesis*.
6. Explain how the goal of mitosis differs from the goal of meiosis.
7. A chicken has 78 chromosomes in its somatic cells. How many chromosomes did the chicken inherit from each parent? How many chromosomes are in each of the chicken’s gametes? How many chromosomes will be in each somatic cell of the chicken’s offspring?

## The mitotic phase alternates with interphase in the cell cycle

8. Make a color-coded drawing of the cell cycle, list the phases of the cell cycle, and **describe** the sequence of events that occurs during each phase:
9. Explain why some cells enter a *G<sub>0</sub>* phase and provide at least TWO examples of human cells that do so.
10. Why does the DNA condense from chromatin into chromosomes during cell division?
11. Make a “cartoon strip” that illustrates the stages of mitosis. Start with a parent cell that has SIX chromosomes. Use **SIX** different colors to represent each of the chromosomes. In your drawings list the phases of mitosis and describe the events characteristic of each phase.
12. Make two drawings that compare and contrast cytokinesis in animal cells and plant cells.
13. If a cell has 12 pairs of chromosomes in G<sub>1</sub> of interphase, how many chromosomes does it have during each of the following phases of the cell cycle?
  - a. G<sub>2</sub>
  - b. Metaphase
  - c. Immediately after cytokinesis.
14. How many chromosomes are shown in the drawing in Figure 9.8? Are they duplicated? How many chromatids are shown?

## The eukaryotic cell cycle is regulated by a molecular control system

15. On your drawing of the cell cycle you did for a previous question; identify THREE major cell cycle checkpoints.
16. Create a drawing that explains the roles of *checkpoints*, *cyclin*, *cyclin-dependent kinases (Cdks)*, and *MPF* in the cell cycle control system.
17. Describe how *density-dependent inhibition* and *anchorage dependence* influence the cell cycle control system.
18. Explain how the abnormal cell division of *cancerous* cells escapes normal cell cycle controls.
19. Distinguish between *benign*, *malignant*, and *metastatic* tumors.
20. Certain chemotherapeutic agents used to treat cancer such as vincristine act on the formation of microtubules. Explain what would happen to a dividing cell treated with vincristine during metaphase.

## Abnormal regulation of genes that affect the cell cycle lead to cancer

21. Distinguish between *proto-oncogenes* and *oncogenes*.
22. Describe THREE genetic changes that can convert a proto-oncogene to an oncogene.
23. Explain how mutations in *tumor-suppressor* genes can contribute to cancer.
24. Explain why a mutation knocking out the *p53 tumor suppressor gene* can lead to excessive cell growth and cancer.
25. Describe THREE ways that *p53* prevents a cell from passing on mutations caused by DNA damage.
26. Explain the *multistep model of cancer development*.
27. Explain how inherited cancer alleles can lead to a *predisposition* to certain cancers.

## Cloning of organisms showed that differentiated cells could be “reprogrammed” and ultimately led to the production of stem cells

28. Describe the use of nuclear transplant in cloning animals.
29. Distinguish between embryonic, adult and iPS stem cells. Discuss the pros and cons of each.
30. Discuss the potential benefits of stem cell research.

**SUPPLEMENTARY RESOURCES:** Click the links below for more information to help you learn more about this lesson.

- **Pearson's BioCoach Activity:** [Mitosis and the Cell Division Cycle](#)
- **McGraw-Hill 3D Animation:** [Cell Cycle & Mitosis](#)
- Arizona Biology Project Activities: [Cell Cycle, Mitosis, and Cancer](#)
- Utah Learn Genetics: [Stem Cells](#)
- Cells Alive: [Interactive Animal Cell Mitosis](#)
- Principles of Life Companion Website: [Chapter 7 Resources](#)
- Kimball's Biology Pages: [Tumor Suppressor Genes \(p53 gene\)](#)
- Harvard: [Checkpoints and Cell Cycle Control \(Animation\)](#)
- Scitable: [Cell Cycle and Cell Division](#)
- Scitable: [p53—The Most Frequently Altered Gene in Human Cancers](#)
- Nobelprize.org: [Control of the Cell Cycle Game](#)
- Nobelprize.org: [2001 Nobel Prize in Physiology/Medicine awarded to Leland Hartwell, Tim Hunt and Sir Paul Nurse "for their discoveries of key regulators of the cell cycle."](#)
- The Biology Project: [Onion Root Tips—Determining Time Spent in Different Phases of the Cell Cycle](#)
- Rebecca Skloot: [The Immortal Life of Henrietta Lacks](#) (about the woman from whom HeLa cells are derived)

#### Lectures

- Bozeman Biology's "[Cell Cycle, Mitosis and Meiosis](#)" video.
- Bozeman Biology's "[Mitosis](#)" video.
- Crash Course Biology: [Mitosis—Splitting Up is Complicated](#)

HYPERLINK "[http://www.youtube.com/watch?v=L0k-enzoeOM&list=PL3EED4C1D684D3ADF&index=12&feature=plpp\\_video](http://www.youtube.com/watch?v=L0k-enzoeOM&list=PL3EED4C1D684D3ADF&index=12&feature=plpp_video)"