Chapter 8: The Cellular Basis of Reproduction and Inheritance

Guided Reading Activities

**Big idea:** Cell division and reproduction

Answer the following questions as you read modules 8.1–8.2:

1. This diagram represents one cell dividing to give rise to two new daughter cells. Each new daughter cell will be **identical** to each other and the parent cell.

   ![Diagram of cell division](image)

2. Complete the table that compares asexual and sexual reproduction.

<table>
<thead>
<tr>
<th></th>
<th>Asexual reproduction</th>
<th>Sexual reproduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires egg and sperm?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Requires one parent?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Produces genetically identical offspring?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Produces genetically different offspring?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

3. Cell division will accomplish which of the following functions in your body?
   a. Growth and development
   b. Production of gametes
   c. Cell replacement
   d. All of the above
Chapter 8: The Cellular Basis of Reproduction and Inheritance

4. True or false: Binary fission is considered asexual reproduction. If false, make it a correct statement.
   True

**Big idea: The eukaryotic cell cycle and mitosis**

Answer the following questions as you read modules 8.3–8.10:

1. True or false: When chromatin is in its diffuse form, you cannot see it with a light microscope. If false, make it a correct statement.
   False, it would simply look like a large mass in which you could not distinguish individual chromosomes.

2. A common student misconception is about the relationship between chromatin and chromosomes. Briefly explain the relationship to a student who doesn’t understand it. A chromosome is an individual piece of chromatin. In other words, a chromosome is made of chromatin.

3. Briefly explain why the chromosome in this diagram has been duplicated.

   ![Diagram of duplicated chromosome]

   You can tell this chromosome has been duplicated because it consists of sister chromatids connected by a centromere.

4. True or false: Certain cells in the adult human body do not undergo cell division. If false, make it a correct statement.
   True

5. Match the following terms with the best description: interphase, s-phase, cytokinesis, mitosis, and mitotic phase.

   Division of the cytoplasm: **cytokinesis**

   DNA replication occurs: **s-phase**

   The chromosomes divide: **mitosis**

   The cell is performing normal functions: **interphase**

   Accounts for only 10% of the cell cycle: **mitotic phase**
6. Every person starts off life as a single cell called a zygote. An adult human consists of trillions of cells. Briefly explain why it's so important that the zygote undergo mitosis properly. Because all cells come from the zygote, any mistake in the zygote during mitosis would get transferred to every cell descendant from it, which is all of them.

7. Place the following stages of mitosis in the correct order: metaphase, prometaphase, prophase, telophase, and anaphase.
   Prophase, prometaphase, metaphase, anaphase, and telophase

8. Use the generic cell outline provided to sketch a cell with five chromosomes in metaphase. Your drawing should include the following labeled terms: metaphase plate, mitotic spindle, and spindle microtubules.

9. A drug is known to freeze microtubules in place after they have fully formed. Which stage of cell division would most likely be affected? What critical process would be inhibited?
   Anaphase; separation of the chromosomes

10. A shallow groove in the cell known as a(n) **cleavage furrow** indicates that cytokinesis has begun.

11. A drug is known to inhibit the formation of the cell plate during cytokinesis. Would this drug affect human cells? Briefly explain your answer.
    No, because human cells do not have a cell plate; plant cells have a cell plate.

12. True or false: Cells that exhibit anchorage dependence divide only if they are in contact with a solid surface. If false, make it a correct statement.
    True
13. Growth factors are necessary at certain times for proper growth and development. Can growth factors ever have an unintended negative effect? If so, briefly explain your answer. Yes, overproduction of certain growth factors has been known to lead to and exacerbate tumors.

14. The most important checkpoint of the cell cycle control system appears to be the __________ G1 checkpoint.

15. An adult human cardiac muscle cell does not undergo cell division. As such, this type of cell
   a. does not need to replicate its DNA.
   b. does not need to leave G1.
   c. is never found in G2.
   d. All of the above are correct statements regarding an adult human cardiac muscle cell.

16. Refer to Figure 8.8B on page 134 for help answering this question. Assume this cell has a mutated receptor protein that no longer binds the growth factor. Further assume that this is the only growth factor to which this cell responds. Briefly explain how this cell's progression through the cell cycle would be affected. This cell would be inhibited from performing cell division.

17. Cancer can be described as loss of control over the cell cycle. Briefly explain how a car losing its brakes is a good analogy to describe the loss of protein checkpoints of the cell cycle. Because the brakes represent the cell checkpoints; if you lose the cell checkpoints, you lose control of the cell cycle (your car).

18. List three treatments for malignant tumors.
   Surgery, radiation, and chemotherapy

19. Complete the Venn diagram that compares benign and malignant tumors.
20. A new cancer drug is administered to a patient with prostate cancer. It is found to have no effect on the cancer. Does this mean the new drug is useless? If not, briefly explain your answer. No, because certain people have mutations in their DNA that can make certain drugs more or less effective in treating cancer.

**Big idea: Meiosis and crossing over**

Answer the following questions as you read modules 8.11–8.17:

1. Are the two chromosomes in this diagram homologous? Briefly explain your answer either way.

   ![Chromosomes Diagram](image)

   No, they are clearly not homologous simply because they are not the same size.

2. True or false: All humans have 23 pairs of homologous chromosomes. If false, make it a correct statement.
   False, women have 23 pairs of homologous chromosomes, but a male's 23rd pair is not homologous (X + Y).

3. Briefly explain why your chromosomes come in pairs.
   Your chromosomes come in pairs because you get one chromosome of each pair from each parent.

4. Complete the following diagram by labeling it with the following terms: gamete, zygote, n and 2n (some terms may be used more than once).

   ![Zygote Diagram](image)

5. A cell has 22 autosomes and an X chromosome.
   a. The cell could be a human sperm.
   b. The cell is a human somate.
   c. The cell could be a human egg.
   d. A and C are both possible.
6. List the process that cells undergoing meiosis perform. It is the same process as that in a cell undergoing mitosis.
   Cells that perform meiosis undergo a round of DNA replication prior to division. It is the same process as in a cell undergoing mitosis.

7. Meiosis is necessary to maintain an organism's proper diploid number across generations. What would happen to an organism's total number of chromosomes every generation if mitosis produced gametes?
   The chromosome number would double.

8. Use the generic cell outline provided to sketch a cell with six chromosomes in metaphase I. Your drawing should include the following labeled terms: metaphase plate, spindle, and spindle microtubules.

9. Complete the following table that compares mitosis with meiosis.

<table>
<thead>
<tr>
<th>Rounds of DNA replication</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rounds of cell division</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Separation of sister chromatids?</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>Yes, second round</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Separation of homologous chromosomes?</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes, first round</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Result</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 genetically identical diploid cells</td>
<td>4 genetically different haploid cells</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Uses</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cell replacement and growth and development</td>
<td>Production of gametes</td>
</tr>
</tbody>
</table>