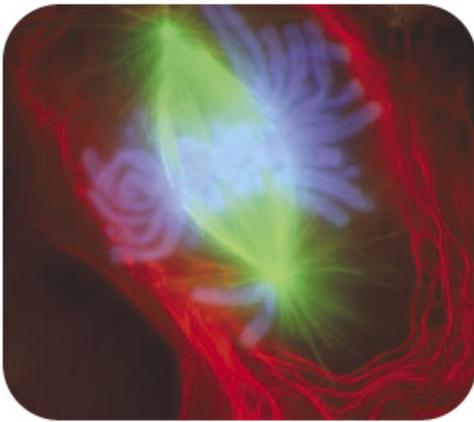


# Chapter 5

## The Cell Cycle, Mitosis, and Meiosis Worksheets



(Opening image courtesy of Conly Rieder and the National Institutes of Health, <http://commons.wikimedia.org/wiki/File:Mitosis-fluorescent.jpg>, and under the public domain.)

- Lesson 5.1: Cell Division and the Cell Cycle
- Lesson 5.2: Chromosomes and Mitosis
- Lesson 5.3: Reproduction and Meiosis

# 5.1 Cell Division and the Cell Cycle

## Lesson 5.1: True or False

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Write true if the statement is true or false if the statement is false.*

- \_\_\_\_\_ 1. Cell division is basically the same in prokaryotic and eukaryotic cells.
- \_\_\_\_\_ 2. Cytokinesis is the division of the cytoplasm.
- \_\_\_\_\_ 3. Mitosis is the process in which the nucleus of the cell divides.
- \_\_\_\_\_ 4. DNA replication results in identical chromosomes.
- \_\_\_\_\_ 5. A cell spends most of its life in growth phase 1 of the cell cycle.
- \_\_\_\_\_ 6. The S checkpoint, just before entry into S phase, makes the key decision of whether the cell should divide.
- \_\_\_\_\_ 7. The correct order of phases of the cell cycle is  $G1 \rightarrow S \rightarrow G2 \rightarrow M$ .
- \_\_\_\_\_ 8. Interphase consists of mitosis and cytokinesis.
- \_\_\_\_\_ 9. In prokaryotic cells, all organelles, such as the Golgi apparatus and endoplasmic reticulum, divide prior to cell division.
- \_\_\_\_\_ 10. Bacteria divide cells by binary fusion.
- \_\_\_\_\_ 11. A mass of abnormal cells is called a tumor.
- \_\_\_\_\_ 12. Organelles are made during growth phase 2.
- \_\_\_\_\_ 13. In eukaryotic cells, DNA is replicated during the S phase of the cell cycle.
- \_\_\_\_\_ 14. If the cell cycle is not regulated, cancer may develop.
- \_\_\_\_\_ 15. Mitosis occurs in both prokaryotic and eukaryotic cells.

# Lesson 5.1: Critical Reading

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

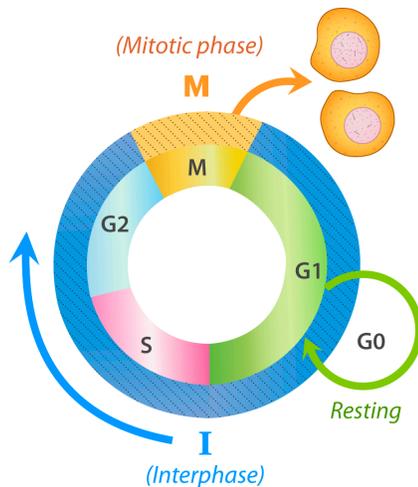
Read these passages from the text and answer the questions that follow.

## The Cell Cycle

Cell division is just one of several stages that a cell goes through during its lifetime. The **cell cycle** is a repeating series of events, including growth, DNA synthesis, and cell division. The cell cycle in prokaryotes is quite simple: the cell grows, its DNA replicates, and the cell divides. In eukaryotes, the cell cycle is more complicated.

## Eukaryotic Cell Cycle

The diagram in the figure below represents the cell cycle of a eukaryotic cell. As you can see, the eukaryotic cell cycle has several phases. The mitosis phase (M) actually includes both mitosis and cytokinesis. This is when the nucleus and then the cytoplasm divide. The other three phases (G1, S, and G2) are generally grouped together as **interphase**. During interphase, the cell grows, performs routine life processes, and prepares to divide. These phases are discussed below.



Eukaryotic Cell Cycle. This diagram represents the cell cycle in eukaryotes. The G1, S, and G2 phases make up interphase (I). The M phase includes mitosis and cytokinesis. After the M phase, two cells result. (Image courtesy of CK-12 Foundation and under the Creative Commons license CC-BY-NC-SA 3.0.)

## Interphase

Interphase of the eukaryotic cell cycle can be subdivided into the following three phases, which are represented in the figure above:

- **Growth Phase 1 (G1):** During this phase, the cell grows rapidly, while performing routine metabolic processes. It also makes proteins needed for DNA replication and copies some of its organelles in preparation for cell division. A cell typically spends most of its life in this phase.
- **Synthesis Phase (S):** During this phase, the cell's DNA is copied in the process of DNA replication.
- **Growth Phase 2 (G2):** During this phase, the cell makes final preparations to divide. For example, it makes additional proteins and organelles.

## Cancer and the Cell Cycle

**Cancer** is a disease that occurs when the cell cycle is no longer regulated. This may happen because a cell's DNA becomes damaged. Damage can occur because of exposure to hazards such as radiation or toxic chemicals. Cancerous cells generally divide much faster than normal cells. They may form a mass of

abnormal cells called a **tumor**. The rapidly dividing cells take up nutrients and space that normal cells need. This can damage tissues and organs and eventually lead to death.

*Questions*

1. What is the cell cycle?
2. What are the phases of the eukaryotic cell cycle?
3. In which phase does a cell spend most of its life? What happens during this phase?
4. What is cancer? What may cause cancer to occur?
5. What is the S phase? What happens during this phase?

## Lesson 5.1: Multiple Choice

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Circle the letter of the correct choice.*

- Which cells undergo cell division?
  - prokaryotic cells only
  - eukaryotic cells only
  - cancer cells only
  - both prokaryotic and eukaryotic cells
- Cell division in eukaryotic cells is a complex process because of
  - the multiple chromosomes.
  - the nucleus.
  - the many organelles.
  - all of the above
- Most routine metabolic processes occur during which phase of the cell cycle?
  - growth phase 1
  - the S phase
  - growth phase 2
  - the M phase
- The correct order of the eukaryotic cell cycle is
  - $G1 \rightarrow G2 \rightarrow S \rightarrow M$ .
  - $S \rightarrow G1 \rightarrow G2 \rightarrow M$ .
  - $M \rightarrow G1 \rightarrow S \rightarrow G2$ .
  - $G1 \rightarrow S \rightarrow G2 \rightarrow M$ .
- The correct order of prokaryotic cell division is
  - cytokinesis  $\rightarrow$  DNA replication  $\rightarrow$  chromosome segregation.
  - DNA replication  $\rightarrow$  chromosome segregation  $\rightarrow$  cytokinesis.
  - growth  $\rightarrow$  DNA replication  $\rightarrow$  mitosis.
  - DNA replication  $\rightarrow$  mitosis  $\rightarrow$  cytokinesis.
- Which cell cycle checkpoint determines whether the DNA has been replicated correctly?
  - the cell growth checkpoint
  - the DNA synthesis checkpoint
  - the mitosis checkpoint
  - the G2 checkpoint
- What happens during mitosis?
  - The nucleus of the cell divides.
  - The cytoplasm of the cell divides.
  - The cell divides.
  - The DNA replicates.
- Cell division in prokaryotic cells is called
  - binary fission.
  - binary fusion.
  - mitosis.
  - cytokinesis.

# Lesson 5.1: Vocabulary I

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Match the vocabulary word with the proper definition.*

## Definitions

- \_\_\_\_\_ 1. the process in which one cell divides to form two daughter cells
- \_\_\_\_\_ 2. the process in which all of the nuclear DNA is copied
- \_\_\_\_\_ 3. a repeating series of events that describes the life of a cell
- \_\_\_\_\_ 4. phase of the cell cycle that includes the G1, S, and G2 phases
- \_\_\_\_\_ 5. the process by which bacterial cells divide
- \_\_\_\_\_ 6. phase of the cell cycle in which the cell's DNA is copied
- \_\_\_\_\_ 7. occurs when the cell cycle is no longer regulated
- \_\_\_\_\_ 8. phase of the cell cycle in which the cell grows rapidly and performs many metabolic processes
- \_\_\_\_\_ 9. phase of the cell cycle in which the cell makes final preparations to divide.
- \_\_\_\_\_ 10. division of the cytoplasm, resulting in two daughter cells
- \_\_\_\_\_ 11. an abnormal mass of cells
- \_\_\_\_\_ 12. the process in which the nucleus of the cell divides

## Terms

- a. binary fission
- b. cancer
- c. cell cycle
- d. cell division
- e. cytokinesis
- f. DNA replication
- g. growth Phase 1
- h. growth phase 2
- i. interphase
- j. mitosis
- k. synthesis phase
- l. tumor

## Lesson 5.1: Vocabulary II

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Fill in the blank with the appropriate term.*

1. Cancer is a disease that occurs when the \_\_\_\_\_ is no longer regulated.
2. During \_\_\_\_\_, the nucleus of the cell divides.
3. \_\_\_\_\_ consists of the G1, S, and G2 phases of the cell cycle.
4. During the \_\_\_\_\_ phase, the cell's DNA is copied in the process of DNA replication.
5. Cell division in \_\_\_\_\_ occurs by binary fission.
6. During mitosis, the \_\_\_\_\_ are sorted and separated to ensure that each daughter cell receives a complete set.
7. During cytokinesis, the \_\_\_\_\_ divides.
8. \_\_\_\_\_ in the cell cycle ensure that the cell is ready to proceed before it moves on to the next phase of the cycle.
9. After cell division, the new cells are referred to as \_\_\_\_\_ cells.
10. Chromosome \_\_\_\_\_ refers to the two chromosomes separating and moving to opposite ends of the cell.
11. In eukaryotes, the first step in cell division is \_\_\_\_\_, and the second step is cytokinesis.
12. The cell cycle is controlled by regulatory \_\_\_\_\_ at three key checkpoints.

## Lesson 5.1: Critical Writing

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.*

Describe the eukaryotic cell cycle, listing and discussing the main events of each phase.

## 5.2 Chromosomes and Mitosis

### Lesson 5.2: True or False

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Write true if the statement is true or false if the statement is false.*

- \_\_\_\_\_ 1. A chromatid is made of two identical chromosomes.
- \_\_\_\_\_ 2. There may be thousands of genes on a single chromosome.
- \_\_\_\_\_ 3. Prophase is the first phase of mitosis.
- \_\_\_\_\_ 4. Female human cells have 23 pairs of homologous chromosomes.
- \_\_\_\_\_ 5. Mitosis occurs in the following order: prophase - metaphase - telophase - anaphase.
- \_\_\_\_\_ 6. The process in which the cell divides is called mitosis.
- \_\_\_\_\_ 7. During mitosis, DNA exists as chromatin.
- \_\_\_\_\_ 8. A gene contains the instructions to make a protein.
- \_\_\_\_\_ 9. Chromosomes form during metaphase.
- \_\_\_\_\_ 10. Mitosis is the phase of the eukaryotic cell cycle that occurs between DNA replication and the second growth phase.
- \_\_\_\_\_ 11. Sister chromatids are identical.
- \_\_\_\_\_ 12. Chromatids separate during anaphase.
- \_\_\_\_\_ 13. Chromosomes are coiled structures made of DNA and proteins.
- \_\_\_\_\_ 14. Human cells have 64 chromosomes.
- \_\_\_\_\_ 15. Cytokinesis is the final stage of cell division.

## Lesson 5.2: Critical Reading

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

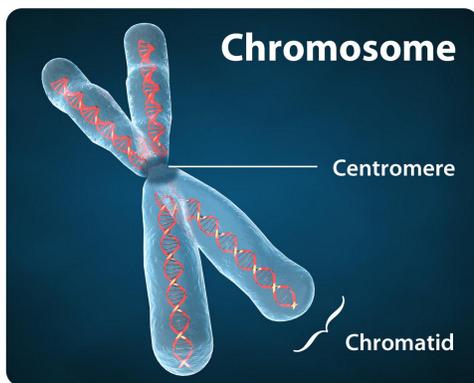
Read these passages from the text and answer the questions that follow.

### Chromosomes

**Chromosomes** are coiled structures made of DNA and proteins. Chromosomes are the form of the genetic material of a cell during cell division. During other phases of the cell cycle, DNA is not coiled into chromosomes. Instead, it exists as a grainy material called **chromatin**.

### Chromatids and the Centromere

DNA condenses and coils into the familiar X-shaped form of a chromosome only after it has replicated, as seen in the figure below. Because DNA has already replicated, each chromosome actually consists of two identical copies. The two copies are called sister **chromatids**. They are attached to one another at a region called the **centromere**.



Chromosome. After DNA replicates, it forms chromosomes like the one shown here. *(Image copyright Cre8tive Images, 2010. Used under license from Shutterstock.com. Text added by CK-12 Foundation.)*

### Chromosomes and Genes

The DNA of a chromosome is encoded with genetic instructions for making proteins. These instructions are organized into units called **genes**. Most genes contain the instructions for a single protein. There may be hundreds or even thousands of genes on a single chromosome.

### Human Chromosomes

Human cells normally have two sets of chromosomes, one set inherited from each parent. There are 23 chromosomes in each set, for a total of 46 chromosomes per cell. Each chromosome in one set is matched by a chromosome of the same type in the other set, so there are actually 23 pairs of chromosomes per cell. Each pair consists of chromosomes of the same size and shape that also contain the same genes. The chromosomes in a pair are known as **homologous chromosomes**.

### Questions

1. What is a chromosome? What is it made out of?
  
  
  
  
  
  
  
  
  
  
2. What are homologous chromosomes? How many homologous pairs are in a human cell?

3. What is the main difference between chromatin and chromosomes?

4. Why do chromosomes look like an “X”?

5. What is a gene?

## Lesson 5.2: Multiple Choice

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Circle the letter of the correct choice.*

- Why is it necessary for the DNA to replicate prior to cell division?
  - so that each daughter cell will have 23 chromosomes
  - so that each daughter cell will have a complete copy of the genetic material
  - so that each daughter cell will have 46 homologous chromosomes
  - so that each daughter cell will have 2 sister chromatids
- Why do chromosomes have an X-shape?
  - because they are made of two sister chromatins
  - because they are made of two sister centromeres
  - because they are made of two sister chromosomes
  - because they are made of two sister chromatids
- Chromosomes form during what part of the cell cycle?
  - prophase of mitosis
  - the end of the G2 phase
  - right after S phase and DNA replication
  - during cytokinesis
- The correct order of phases during mitosis is
  - telophase→prophase→metaphase→anaphase
  - prophase→anaphase→metaphase→telophase
  - prophase→metaphase→telophase→anaphase
  - prophase→metaphase→anaphase→telophase
- How many chromosomes are in a normal human cell?
  - 23
  - 32
  - 46
  - 64
- When do the sister chromatids line up at the equator of the cell?
  - metaphase
  - anaphase
  - prophase
  - telophase
- Which of the following statements concerning cytokinesis is correct? (1) cytokinesis occurs in both prokaryotes and eukaryotes, (2) cytokinesis is when the cytoplasm splits in two, (3) in plant cells, cytokinesis involves the formation of a cell plate.
  - 1 only
  - 2 only
  - 1 and 2
  - 1, 2, and 3
- During which phase of mitosis do the sister chromatids separate?
  - prophase
  - telophase

- (c) anaphase
- (d) metaphase

## Lesson 5.2: Vocabulary I

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Match the vocabulary word with the proper definition.*

### Definitions

- \_\_\_\_\_ 1. division of the nucleus
- \_\_\_\_\_ 2. region of the chromosome where sister chromatids are attached
- \_\_\_\_\_ 3. division of the cytoplasm
- \_\_\_\_\_ 4. phase of mitosis in which spindle fibers attach to the centromere of each pair of sister chromatids
- \_\_\_\_\_ 5. coiled structures made of DNA and proteins
- \_\_\_\_\_ 6. phase of mitosis in which sister chromatids separate and the centromeres divide
- \_\_\_\_\_ 7. a segment of DNA with the genetic instructions to make a protein
- \_\_\_\_\_ 8. two copies of replicated DNA that make a chromosome
- \_\_\_\_\_ 9. the first and longest phase of mitosis
- \_\_\_\_\_ 10. uncoiled DNA
- \_\_\_\_\_ 11. a pair of the same chromosome
- \_\_\_\_\_ 12. phase of mitosis in which the chromosomes begin to uncoil and form chromatin

### Terms

- a. anaphase
- b. centromere
- c. chromatid
- d. chromatin
- e. chromosome
- f. cytokinesis
- g. gene
- h. homologous chromosomes
- i. metaphase
- j. mitosis
- k. prophase
- l. telophase

## Lesson 5.2: Vocabulary II

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Fill in the blank with the appropriate term.*

1. Chromosomes are coiled structures made of \_\_\_\_\_ and proteins.
2. \_\_\_\_\_ is the division of the nucleus.
3. During \_\_\_\_\_, sister chromatids line up at the equator, or center, of the cell.
4. \_\_\_\_\_ is the division of the cytoplasm.
5. There may be hundreds or even thousands of genes on a single \_\_\_\_\_.
6. A \_\_\_\_\_ contains genetic the instructions for making proteins.
7. During anaphase, sister \_\_\_\_\_ separate and the centromeres divide.
8. The four phases of mitosis, in order, are \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_.
9. Human cells normally have \_\_\_\_\_ chromosomes.
10. A new nuclear membrane forms during \_\_\_\_\_.
11. The \_\_\_\_\_ fibers ensure that sister chromatids will separate when the cell divides.
12. When a chromosome first forms, it actually consists of two sister \_\_\_\_\_.

## Lesson 5.2: Critical Writing

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.*

Describe the structure of a chromosome, using proper vocabulary. Discuss when and why a chromosome forms.

## 5.3 Reproduction and Meiosis

### Lesson 5.3: True or False

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Write true if the statement is true or false if the statement is false.*

- \_\_\_\_\_ 1. The basic types of reproduction are asexual reproduction, binary reproduction and sexual reproduction.
- \_\_\_\_\_ 2. Sexual reproduction always involves two parents.
- \_\_\_\_\_ 3. Asexual reproduction always involves two parents.
- \_\_\_\_\_ 4. Meiosis starts with one cell and ends with four.
- \_\_\_\_\_ 5. "Crossing-over" can occur in meiosis I but not meiosis II.
- \_\_\_\_\_ 6. Prokaryotes go through meiosis I and eukaryotes go through meiosis II.
- \_\_\_\_\_ 7. A zygote is the first cell of a new organism.
- \_\_\_\_\_ 8. Meiosis I and mitosis are very similar.
- \_\_\_\_\_ 9. In humans, a gamete will have 23 chromosomes.
- \_\_\_\_\_ 10. In binary fission, parent and offspring are identical.
- \_\_\_\_\_ 11. In sexual reproduction, parents and offspring are never identical.
- \_\_\_\_\_ 12. Gametes are diploid, a zygote is haploid.
- \_\_\_\_\_ 13. Egg and sperm are diploid gametes.
- \_\_\_\_\_ 14. Meiosis is involved in the production of gametes.
- \_\_\_\_\_ 15. Starfish can reproduce by fragmentation - that is, a whole new fish can grow from just a single arm.

## Lesson 5.3: Critical Reading

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

Read these passages from the text and answer the questions that follow.

### Meiosis

The process that produces haploid gametes is meiosis. **Meiosis** is a type of cell division in which the number of chromosomes is reduced by half. It occurs only in certain special cells of the organisms. During meiosis, homologous chromosomes separate, and the haploid cells that form have only one chromosome from each pair. Two cell divisions occur during meiosis, and a total of four haploid cells are produced. The two cell divisions are called meiosis I and meiosis II.

### Phases of Meiosis

Meiosis I begins after DNA replicates during interphase. In both meiosis I and meiosis II, cells go through the same four phases as mitosis. However, there are important differences between meiosis I and mitosis.

### Meiosis I

1. Prophase I: The nuclear envelope begins to break down, and the chromosomes condense. Centrioles start moving to opposite poles of the cell, and a spindle begins to form. Importantly, homologous chromosomes pair up, which is unique to prophase I. In prophase of mitosis and meiosis II, homologous chromosomes do not form pairs in this way.
2. Metaphase I: Spindle fibers attach to the paired homologous chromosomes. The paired chromosomes line up along the equator of the cell. This occurs only in metaphase I. In metaphase of mitosis and meiosis II, it is sister chromatids that line up along the equator of the cell.
3. Anaphase I: Spindle fibers shorten, and the chromosomes of each homologous pair start to separate from each other. One chromosome of each pair moves toward one pole of the cell, and the other chromosome moves toward the opposite pole.
4. Telophase I and Cytokinesis: The spindle breaks down, and new nuclear membranes form. The cytoplasm of the cell divides, and two haploid daughter cells result. The daughter cells each have a random assortment of chromosomes, with one from each homologous pair. Both daughter cells go on to meiosis II.

### Meiosis II

1. Prophase II: The nuclear envelope breaks down and the spindle begins to form in each haploid daughter cell from meiosis I. The centrioles also start to separate.
2. Metaphase II: Spindle fibers line up the sister chromatids of each chromosome along the equator of the cell.
3. Anaphase II: Sister chromatids separate and move to opposite poles.
4. Telophase II and Cytokinesis: The spindle breaks down, and new nuclear membranes form. The cytoplasm of each cell divides, and four haploid cells result. Each cell has a unique combination of chromosomes.

### Questions

1. Define meiosis.

2. Is the DNA replicated after meiosis I? Why or why not?
  
3. Describe the main difference between metaphase I and metaphase II.
  
4. State the phase where each of the following processes occurs: (a) sister chromatids separate, (b) homologous chromosomes form pairs, (c) two haploid cells form.
  
5. What is final product of meiosis?

## Lesson 5.3: Multiple Choice

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Circle the letter of the correct choice.*

- After meiosis there are
  - two haploid cells.
  - two haploid gametes.
  - four haploid cells.
  - four haploid gametes.
- Which of the following is a form of asexual reproduction?
  - fragmentation
  - meiosis
  - binary fusion
  - bubbling
- Which of the following is true about a zygote? (1) A zygote is the first cell of a new organism. (2) A human zygote has 23 pairs of chromosomes. (3) A zygote is produced through fertilization.
  - 1 only
  - 1 and 3
  - 2 and 3
  - 1, 2, and 3
- Differences between meiosis I and meiosis II include:
  - how the chromosomes line up at the equator of the cell during meiosis I or meiosis II.
  - the pairing of chromosomes in meiosis I but not meiosis II.
  - the amount of DNA in a cell at the end of meiosis I or meiosis II.
  - all of the above
- Because of when the chromosomes pair up during meiosis, crossing-over must occur during
  - prophase II.
  - metaphase II.
  - prophase I.
  - anaphase I.
- Homologous chromosomes separate during
  - metaphase I.
  - anaphase I.
  - anaphase II.
  - telophase II.
- A life cycle in which organisms switch back and forth between diploid and haploid stages
  - is a haploid life cycle.
  - is a diploid life cycle.
  - is an alternation of generations life cycle.
  - does not exist.
- The random distribution of homologous chromosomes during cell division is known as
  - meiosis.
  - independent assortment.
  - genetic variation.

(d) crossing-over.

## Lesson 5.3: Vocabulary I

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Match the vocabulary word with the proper definition.*

### Definitions

- \_\_\_\_\_ 1. the process in which two gametes unite
- \_\_\_\_\_ 2. the swapping of genetic material during meiosis
- \_\_\_\_\_ 3. a type of cell division in which the number of chromosomes is reduced by half
- \_\_\_\_\_ 4. series of life stages and events of a sexually reproducing organism
- \_\_\_\_\_ 5. involves a single parent
- \_\_\_\_\_ 6. involves two parents
- \_\_\_\_\_ 7. having half the number of chromosomes
- \_\_\_\_\_ 8. having twice the number of chromosomes
- \_\_\_\_\_ 9. a diploid cell
- \_\_\_\_\_ 10. a haploid cell
- \_\_\_\_\_ 11. the development of haploid cells into gametes
- \_\_\_\_\_ 12. reproductive cells that unite to form an offspring

### Terms

- a. asexual reproduction
- b. crossing-over
- c. diploid
- d. egg
- e. fertilization
- f. gametes
- g. gametogenesis
- h. haploid
- i. life cycle
- j. meiosis
- k. sexual reproduction
- l. zygote

## Lesson 5.3: Vocabulary II

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Fill in the blank with the appropriate term.*

1. When cells divide during meiosis, homologous chromosomes are randomly distributed to daughter cells, and different chromosomes segregate \_\_\_\_\_ of each other.
2. Crossing-over is the exchange of \_\_\_\_\_ material between homologous chromosomes.
3. A human egg cell has \_\_\_\_\_ chromosomes.
4. Binary fission, fragmentation, and \_\_\_\_\_ are types of asexual reproduction.
5. Meiosis is a type of cell division in which the number of chromosomes is reduced by \_\_\_\_\_.
6. A human zygote has \_\_\_\_\_ chromosomes.
7. The \_\_\_\_\_ life cycle is the simplest life cycle.
8. Meiosis begins with one cell, and ends with \_\_\_\_\_ cells.
9. Male gametes are called \_\_\_\_\_, and female gametes are a(n) \_\_\_\_\_ cell.
10. During \_\_\_\_\_, spindle fibers attach to the paired homologous chromosomes.
11. Organisms that have a life cycle with \_\_\_\_\_ generations switch back and forth between diploid and haploid stages.
12. Sexual reproduction involves \_\_\_\_\_ parents.

## Lesson 5.3: Critical Writing

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

*Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.*

List three significant differences between meiosis I and meiosis II.