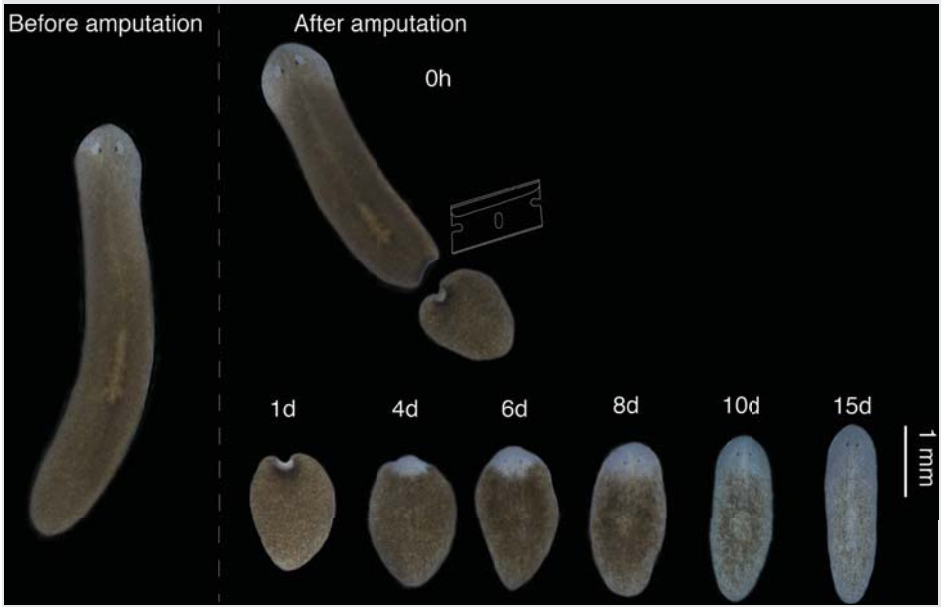
Lesson Self-Check

CAN YOU EXPLAIN IT?

FIGURE 17: A planarian can regenerate removed body parts or their entire body.



Scientists study organisms that can regenerate parts of their body or their entire body, such as planarians, newts, and salamanders. Scientists have discovered that planarians have stem cells throughout their body. One of the reasons planarians are of such interest to scientists is that, even though they are a very simple organism, they have a centralized nervous system that they can restore to full function during the regeneration process. They can even regrow brain tissue from stem cells! The size of the planarian fragment does not matter. Even a piece that is 1/279 of the original animal can be restored to a full-sized planarian, which would be similar to growing another human from someone's cut-off nose.

Explain Construct an explanation for how cell division and differentiation help organisms such as planarians to regenerate parts of their body. Your response should answer the following questions.

1. What is the role of mitosis in regenerating tissues?
2. How are stem cells involved in the process of regeneration?
3. What is the role of cell differentiation in the development of the organism?
4. How could knowledge of this process be used to help humans?

CHECKPOINTS

Check Your Understanding

1. Which of these statements can be used to describe a chromosome? Select all correct answers.

- **a.** A chromosome is a long, continuous strand of DNA.
- **b.** Histones are proteins that are only present during mitosis.
- **c.** Chromosomes are tightly packed during mitosis.
- **d.** Chromosomes float freely around the cell of eukaryotes.
- **e.** Telomeres are chromosome regions that lack genes.
- **f.** Each chromosome contains only one gene.

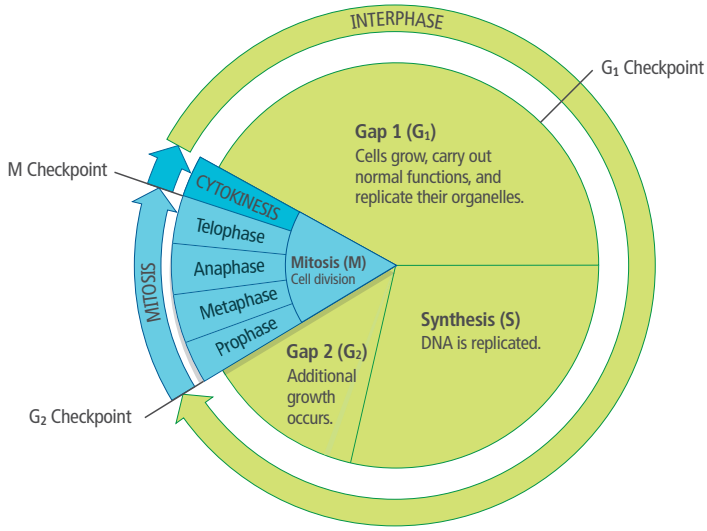
2. Place these steps in order to describe the changes that occur in the organization of the chromosome as the cell progresses into mitosis.

- **a.** The chromosome coils more and more tightly, forming supercoiled DNA.
- **b.** Condensed, replicated chromosomes attach at a pinched region called the centromere.
- **c.** DNA is wrapped around histones at regular intervals, forming chromatin.
- **d.** Interactions between parts of histones compact the DNA.

3. In which of these scenarios would the rate of mitosis most likely increase? Select all correct answers.

- **a.** A tissue is damaged and requires repair.
- **b.** A tissue needs to decrease in size during embryonic development.
- **c.** A person has a "growth spurt" and grows taller.
- **d.** A tissue loses a large number of cells due to wear and tear.

FIGURE 18: Phases of the Cell Cycle



4. Identify the phase of mitosis described in each step, and then put the steps in the correct order.

- **a.** Cell membrane pinches inward, dividing the cytoplasm and its contents.
- **b.** Nuclear membrane reforms and chromosomes uncoil.
- **c.** DNA and histones condense; nucleus begins to break down.
- **d.** Chromatids separate and move to opposite sides of the cell.
- **e.** Chromosomes line up along cell equator; spindle fibers attach to each chromosome.

5. Which events take place during mitosis but not during binary fission? Select all correct answers.

- **a.** duplication of organelles
- **b.** division of the cytoplasm
- **c.** separation of chromosomes
- **d.** formation of a mitotic spindle

6. Explain the relationship between embryonic cell layers, gene expression, proteins, and cell differentiation.

7. Use Figure 18 to construct an explanation for how the cell prepares for cell division. Which events take place before mitosis, and how do these prepare the cell to divide?

8. Use the following terms to complete the statement:

endoderm, ectoderm, mesoderm

As an embryo begins to organize, it first develops into a hollow ball with a flattened cluster of cells at one end. The outer layer is called the ____ and will become an organism's skin and nervous system. The cluster of cells forms a tube through the center of the ball that will become the inner lining of the digestive tract and other organs. This layer is known as the ____. As the tube forms, some cells from the cluster migrate into the cavity of the embryo to become the ____. This layer will become muscle and bone and organs such as the kidneys.

9. Draw a diagram showing how mitosis produces a multicellular organism. Explain how differentiation completes the organism's development.

10. What would happen if mitosis took place in a cell but cytokinesis did not?

11. Draw a model to illustrate how the steps of mitosis ensure that each daughter cell receives an identical set of chromosomes. In your model, include at least three sets of chromosomes and add color or shading to differentiate the different sets of chromosomes. Include text explaining how each step of mitosis contributes to the process of separating the duplicated chromosomes in an orderly manner.

12. Use these terms to complete this statement about stem cells and cell differentiation:

    genes, neuron, proteins, differentiate

    Stem cells are a unique type of body cell that can _____ into a variety of specialized cell types. A stem cell can either divide into two new stem cells or it can can divide to produce one stem cell and one specialized cell, such as a _____. New advancements in science have allowed researchers to convert human skin cells to embryonic stem cells. This requires altering segments of DNA called _____. When these segments of DNA are expressed, the cell produces _____, which carry out specific functions within the cell.

13. Refer to Figure 19 to explain why stem cells are of great interest to researchers studying therapies for human diseases.

MAKE YOUR OWN STUDY GUIDE

In your Evidence Notebook, design a study guide that supports the main ideas from this lesson:

Chromosomes are long strands of DNA that condense as the cell prepares for cell division.

Mitosis and cytokinesis result in two daughter cells with identical genetic material.

Cell differentiation is a process in which cells take on specialized roles within the organism. Different genes are expressed in different types of cells.

Remember to include the following information in your study guide:

- Use examples that model main ideas.
- Record explanations for the phenomena you investigated.
- Use evidence to support your explanations. Your support can include drawings, data, graphs, laboratory conclusions, and other evidence recorded throughout the lesson.

Consider how models of the cell cycle can be used to illustrate the process that allows one cell to divide into two genetically identical daughter cells.

FIGURE 19: Stem cells can differentiate into a variety of cell types.