

COMPARING MITOSIS AND MEIOSIS

17

Your body carries out two different kinds of nuclear division. One is called mitosis and results in formation of new body cells for growth and repair. A second process is called meiosis and results in formation of reproductive cells only. There are several important differences between mitosis and meiosis.

In this investigation, you will

- (a) compare the process of mitosis with meiosis.
- (b) use model diagrams to show changes in cells during mitosis and meiosis.

Materials

pages of cell outlines
4 wool strands (18 mm long)
4 wool strands (30 mm long)

Procedure

Part A. Mitosis

Your teacher will supply you with outline diagrams for Part A of this experiment. Use only diagrams A, B, and C for Part A.

- Place the diagrams one below the other in proper order on your desk.

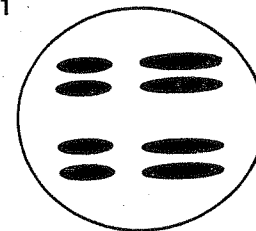
- Diagram A represents the outline of a cell before cell division or mitosis begins. Chromosomes are present inside the nucleus (but usually cannot be seen). Use wool strands to represent chromosomes. NOTE: A cell may contain many chromosomes. You will use only 4 chromosomes to help simplify this study.

- Place two long and two short pieces of wool (chromosomes) onto diagram A.

1. What is the total number of chromosomes present in this cell before mitosis? _____
2. How many long chromosomes are present before mitosis? _____
3. How many short chromosomes are present before mitosis? _____

- Before the cell begins mitosis, each chromosome makes an exact copy of itself. This process is called chromosome replication.

FIGURE 17-1



chromosome replication

- To show chromosome replication, match new strands of wool with each original. Long should match with long, short with short (Figure 17-1).

- Transfer your chromosomes to diagram B, and position them within the dashed outlines. During mitosis, doubled chromosomes line up along the cell's center.

4. What differences (if any) are there between the original and replicated (copy) part of each chromosome? _____

Doubled chromosomes now separate, and each part is pulled toward one end of the cell.

- Move those chromosomes lined up along the left side toward the cell's left. Move those chromosomes lined up along the right side toward the cell's right. Use the arrows as guides.

- Once the doubled chromosomes separate, the original cell begins to pinch in half down the center. This process forms two new cells.

- Move the chromosomes on the left side of diagram B to the left side of diagram C.

- Move the chromosomes on the right side of diagram B to the right side of diagram C.

5. What is the total number of chromosomes present in each cell after mitosis (diagram C)? _____

6. How many long chromosomes are present in each new cell? _____

7. How many short chromosomes are present in each new cell? _____

8. Compare your answers in questions 1-3 to those in questions 5-7. Are the two new cells just formed the same in chromosome makeup

as the original cell? _____

In summary, some important things about mitosis include:

- every new cell formed has the same chromosome number,
- every new cell formed has the same chromosome number as the original cell,
- mitosis occurs in all body cells (somatic cells), and
- mitosis is responsible for growth and cell repair.

Part B. Meiosis

- Your teacher will supply you with outline diagrams for Part B of this experiment. Use only diagrams D, E, F, and G for Part B. Place the diagrams one below the other in proper order on your desk.

- Diagram D represents the outline of a cell before meiosis begins. Chromosomes are present inside the cell. Place two long and two short pieces of wool (chromosomes) onto cell diagram D.

9. What is the total number of chromosomes present in this cell before meiosis? _____

10. How many long chromosomes are present before meiosis? _____

11. How many short chromosomes are present before meiosis? _____

12. Check back to questions 1-3. Are there differences so far between mitosis and meiosis?

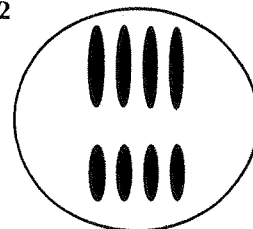
Before meiosis begins, the chromosomes replicate.

- Match new strands of wool with each original. Long should match with long, short with short. Before transferring your chromosomes to diagram E, one important step that is different in meiosis now occurs. One doubled long chromosome now pairs with the other doubled long chromosome.

- Place the four long chromosomes together.

- Do the same for the four short chromosomes which also pair at this stage. Each group of four is now called a tetrad (tetra = 4) (Figure 17-2).

FIGURE 17-2



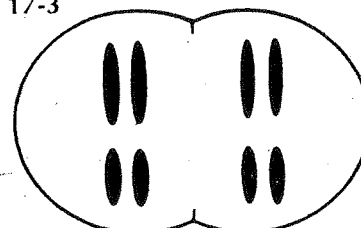
chromosome tetrads

13. Did this step occur in mitosis? _____

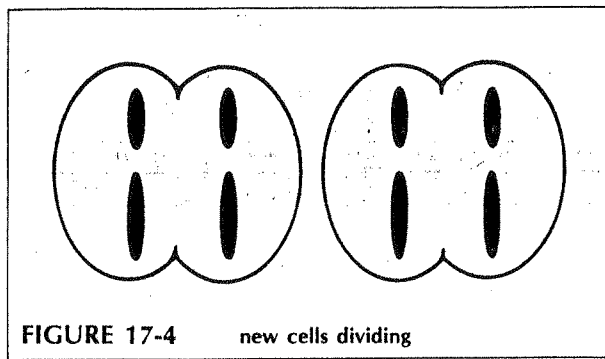
- Place your chromosome tetrads onto diagram E. Use the chromosome outlines to properly position them. During meiosis, the chromosome tetrads line up along the cell's center.

Chromosomes now separate and are pulled toward opposite ends of the cell. They separate, however, in a certain way. Each tetrad separates into the two original doubled chromosomes (Figure 17-3).

FIGURE 17-3



separating tetrads



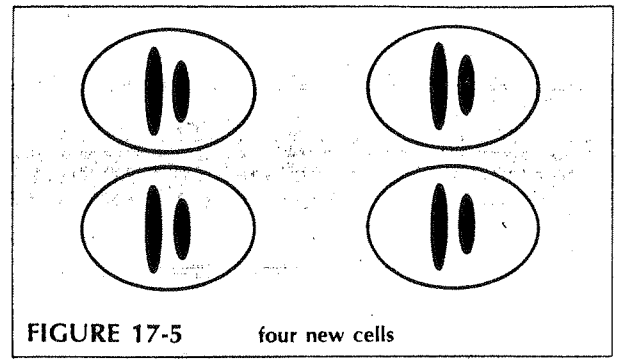
• Move the doubled chromosomes toward opposite cell ends. Move those pairs lined up along the left center toward the left side of the newly forming cell. Follow the arrows as guides.

• Move the pairs lined up along the right center toward the right side of the newly forming cell. Follow the arrows as guides. Two new cells are formed as the original cell (Figure 17-3) pinches into two.

• Transfer those chromosomes on the right side of diagram E to the right circle of diagram F and position them within the dashed lines. Move those on the left side of diagram E to the left circle of diagram F and position them within the dashed lines.

14. (a) How many chromosomes are now present in each cell? _____
- (b) How many chromosomes were present in the original cell? _____
- (c) Is this step different from that which occurs after two cells form in mitosis? _____

Each new cell just formed, quickly begins to divide again into two new cells (Figure 17-4). This step results in four new cells being formed from the original cell (Figure 17-5). The doubled chromosomes then separate leaving each new cell with a reduced number of chromosomes.



• Move your chromosomes from diagram F to diagram G. Position the chromosomes within the dashed lines.

15. (a) How many new cells are formed from one cell by meiosis (diagram G)? _____
- (b) Does this step differ from mitosis? _____
- _____ Explain. _____
16. (a) What is the total number of chromosomes present in each new cell after meiosis? _____
- (b) Do any of the four new cells contain two long or two short chromosomes? _____

In summary, some important things about meiosis include:

- (a) every new cell formed by meiosis has half the number of chromosomes as the original cell,
- (b) no paired chromosomes are present,
- (c) meiosis occurs only in reproductive organs, and
- (d) meiosis is responsible for forming egg and sperm (gamete) cells.

Analysis

- How many pairs of chromosomes are in each human body (somatic) cell? _____
- How many pairs of chromosomes are in each egg or sperm? (Be careful.) _____

3. In the exercise just completed,

- (a) are the chromosomes in pairs in the new cells? _____
- (b) how does this differ from the process of mitosis? _____

4. In humans, 46 chromosomes are in each body (somatic) cell, and 23 chromosomes are in each reproductive cell. In the chart below, fill in the chromosome number and process for each cell type.

CELL TYPE	NUMBER OF CHROMOSOMES IN CELL	PROCESS USED TO MAKE CELL (MITOSIS OR MEIOSIS)
stomach		
liver		
sperm		
heart		
egg		

5. Complete the following chart by checking the process of cell division in which each step occurs.

	MITOSIS	MEIOSIS
Two new cells are formed from each original		
Four new cells are formed from each original		
Replication of chromosomes occurs		
Doubled chromosomes pair to form tetrads		
Cells with a reduced chromosome number are formed		
Cells with the same chromosome numbers as original are formed		
Results in forming egg or sperm cells		
Results in forming somatic or body cells		
Each original cell divides only once		
Each original cell divides twice		
Tetrads are not formed		
Chromosomes move to the cell's center		

DIAGRAMS FOR INVESTIGATION 17, "COMPARING MITOSIS AND MEIOSIS"

DIAGRAM A

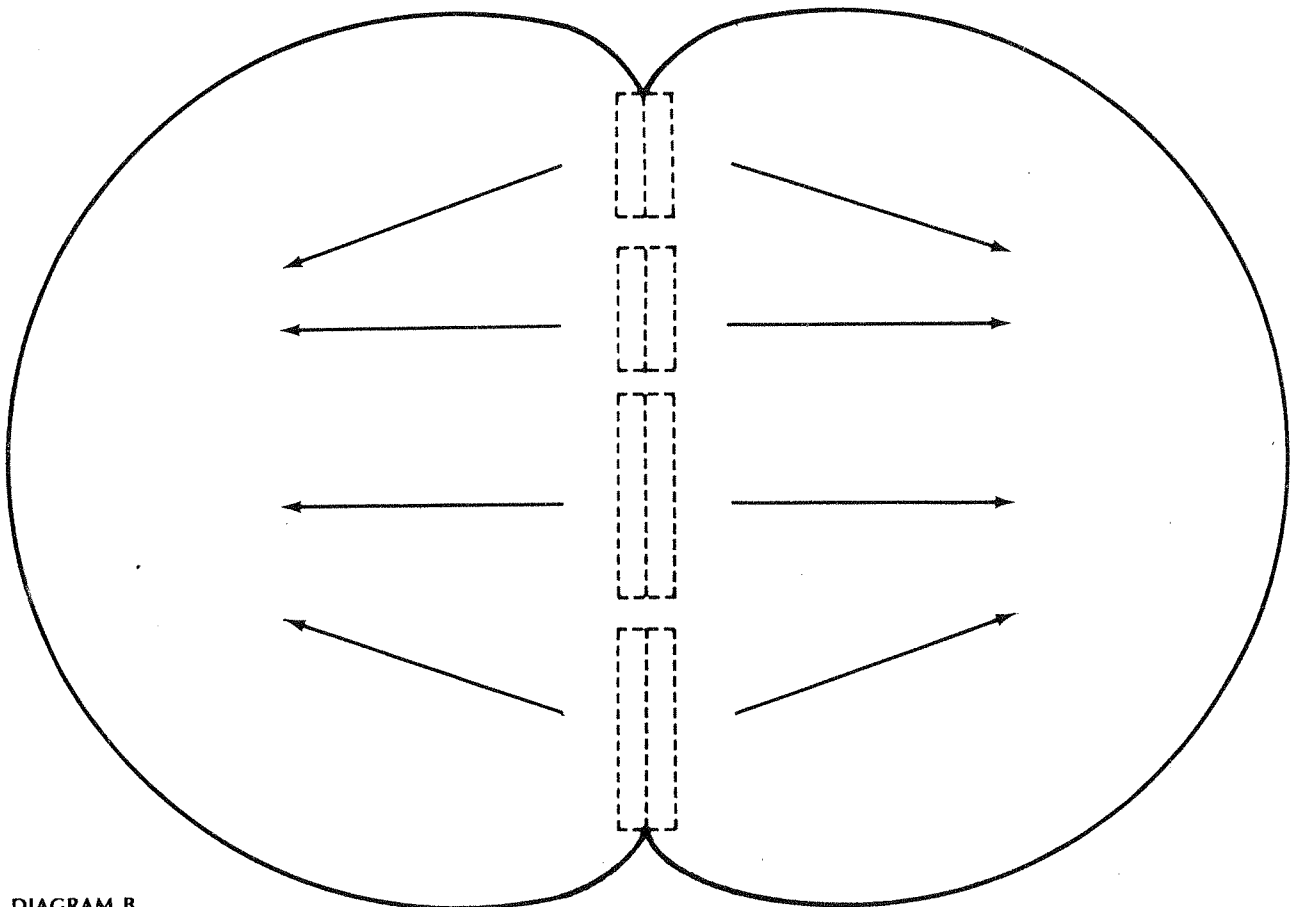
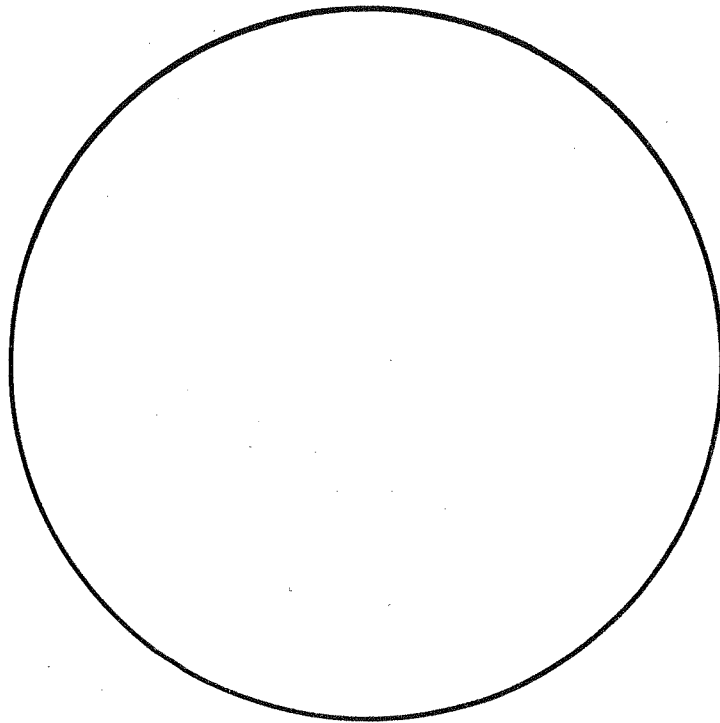


DIAGRAM B

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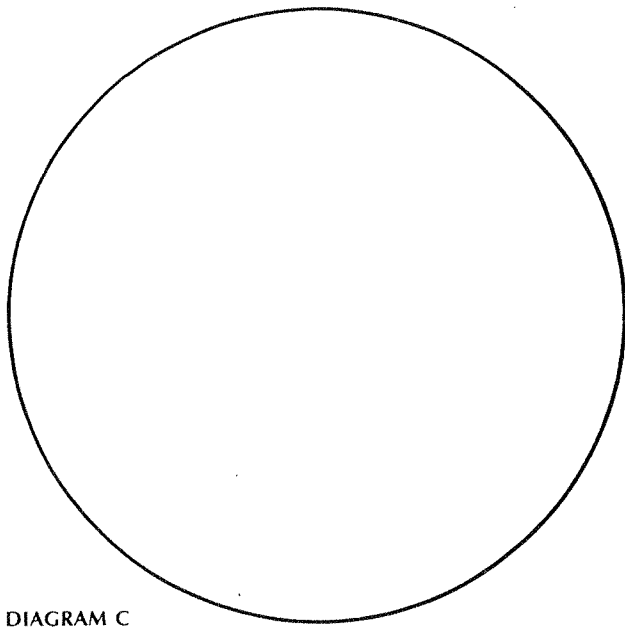
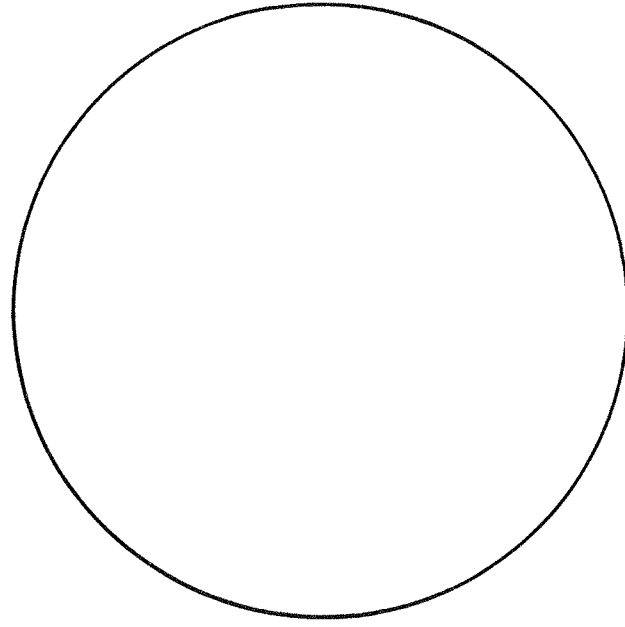


DIAGRAM C

new cell



new cell

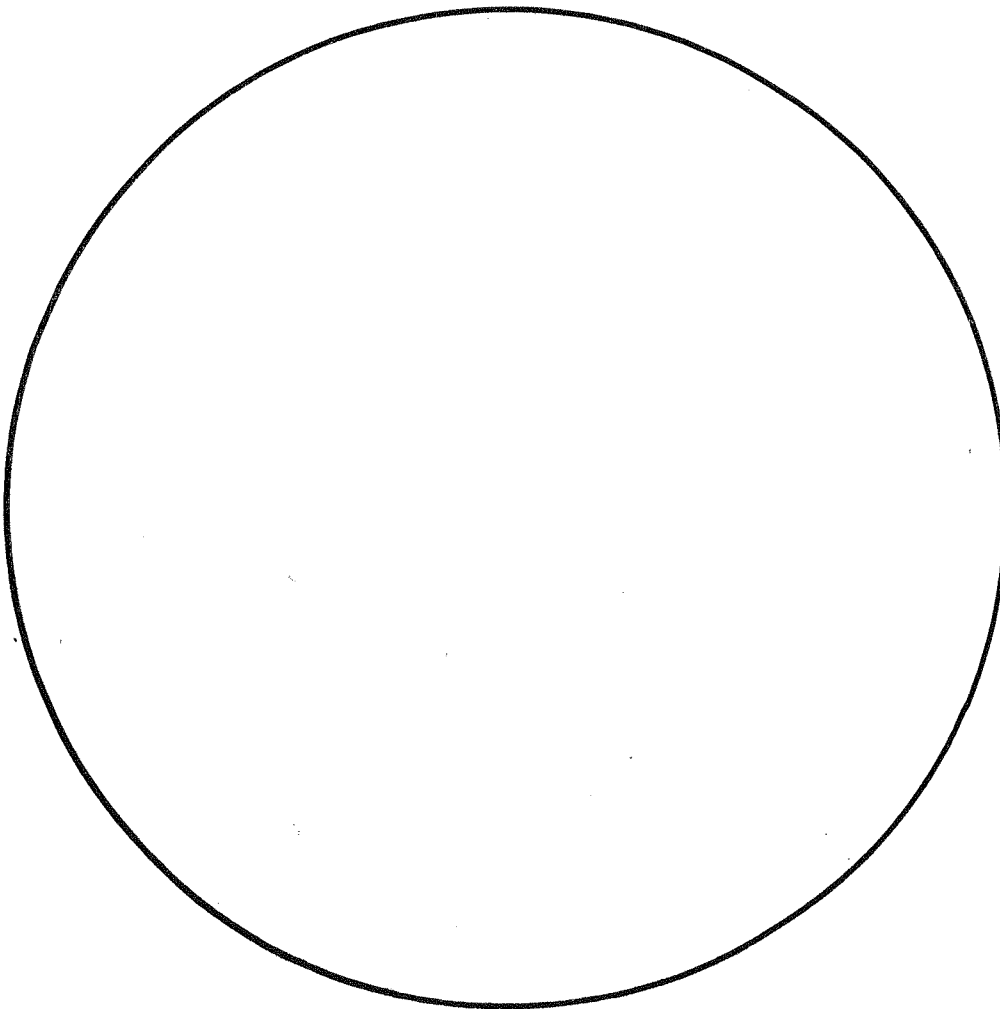


DIAGRAM D

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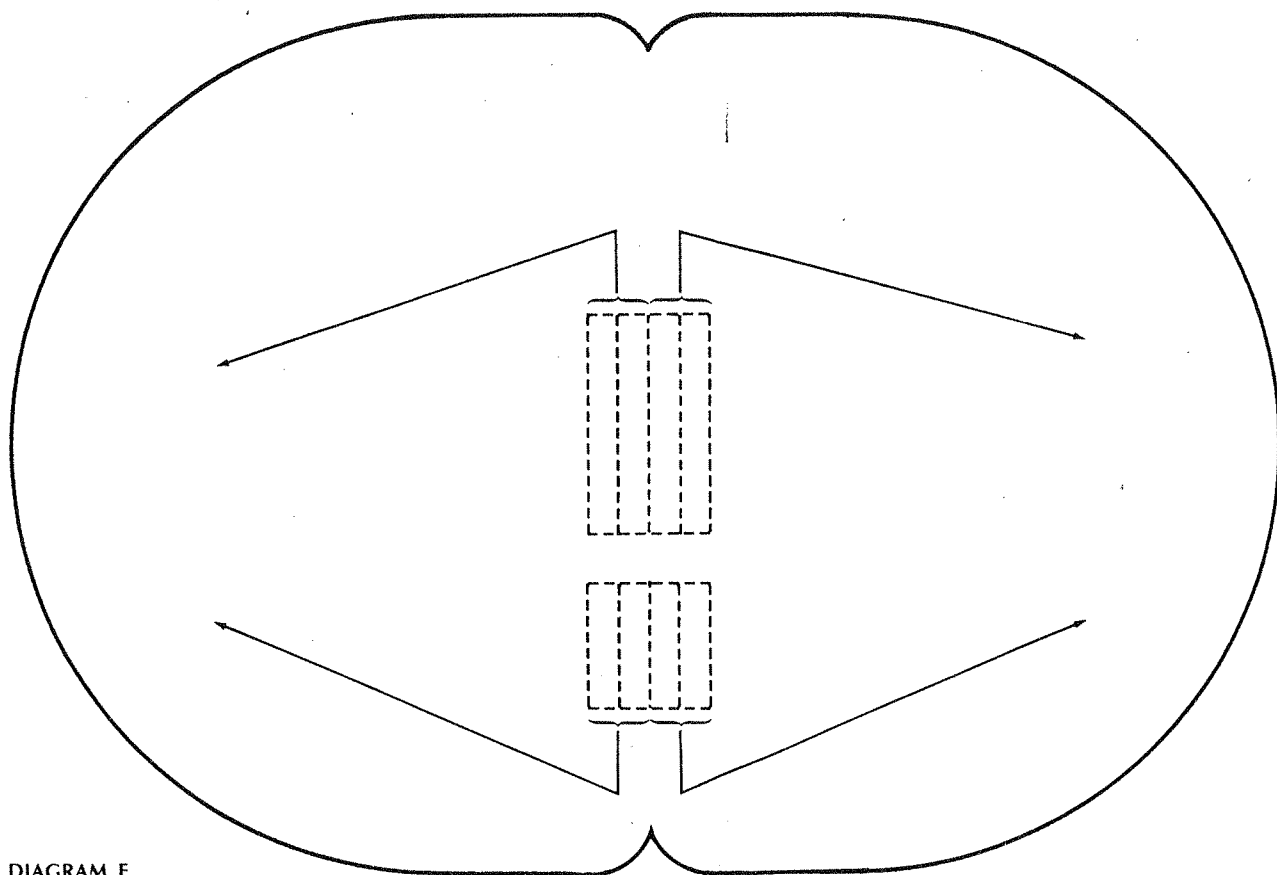


DIAGRAM E

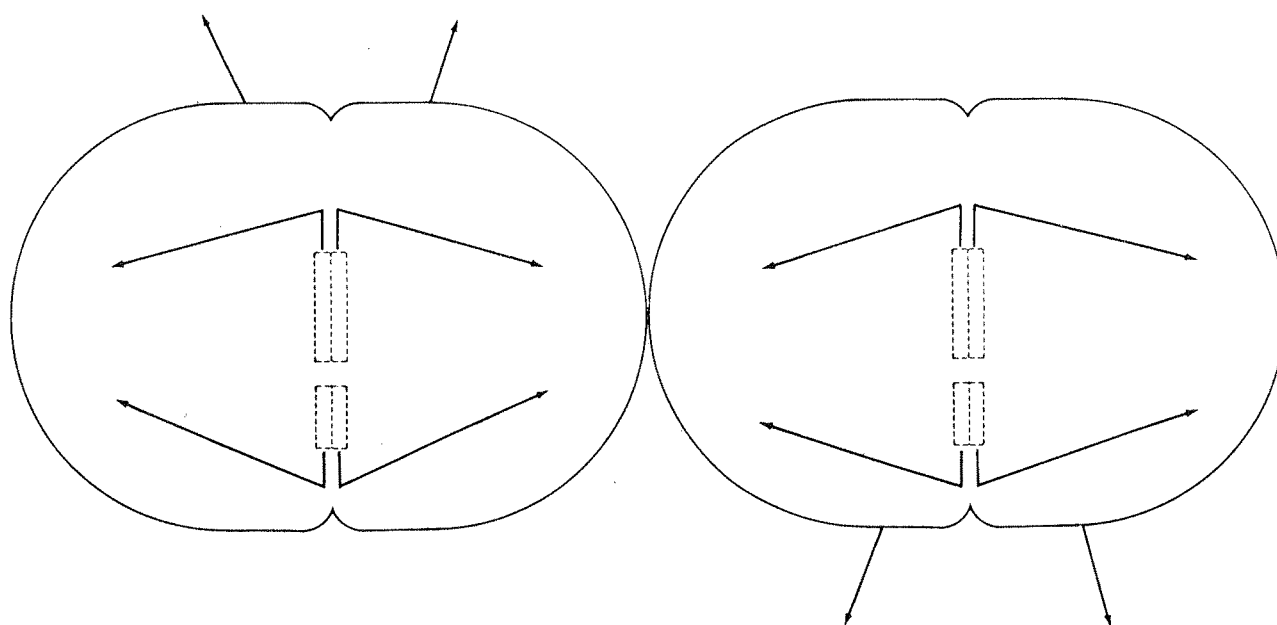


DIAGRAM F

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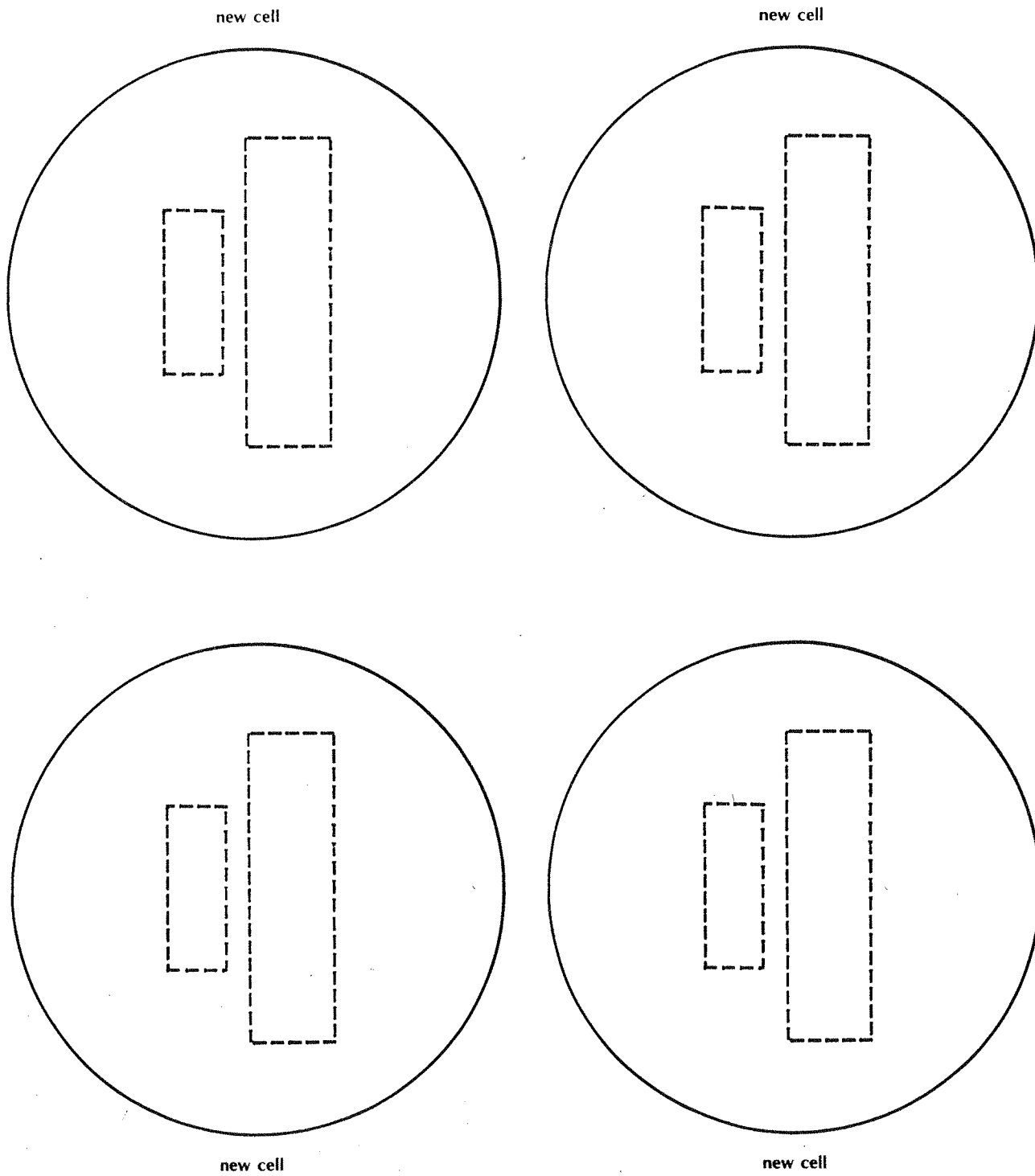


DIAGRAM G