Name _____ Date _____ Period _____

MODELING MEIOSIS

PURPOSE:

In this investigation, you will model the various phases of meiosis in animal cells. By completing this activity, you will review the phases of the cell cycle and identify ways that meiosis is both similar to and different from mitosis.

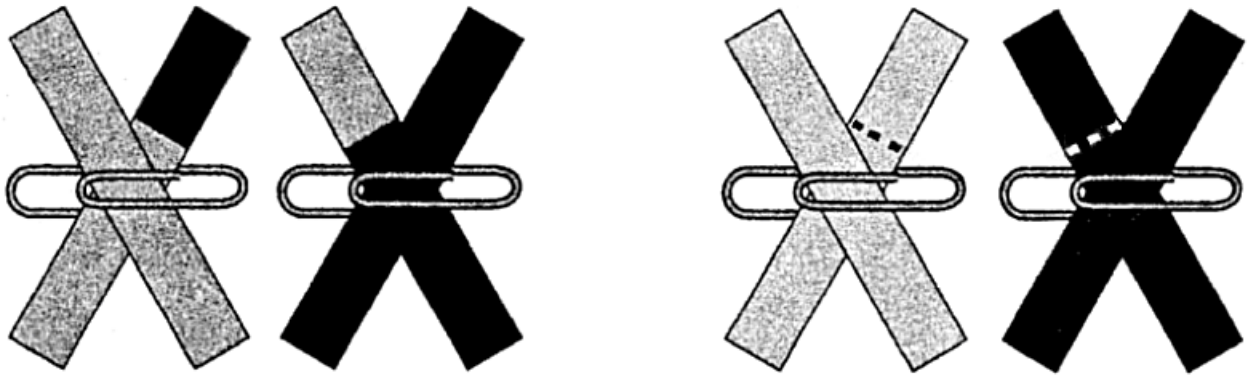
HYPOTHESIS:

If an animal cell performs meiosis, then _____ (a) _____ (b) _____ (c) cells will be formed.

WORD BANK FOR HYPOTHESES:
(a) one / two / three / four
(b) identical / non-identical
(c) diploid / haploid

MATERIALS:

- 6 different strips of construction paper
- 6 paper clips
- 6 pieces of clear tape
- 1 piece of chalk
- cell phone camera



PROCEDURE:

1. **INTERPHASE – G_1**: Draw a large oval on the lab table using the chalk. Place the six strips of construction paper within the oval and draw a smaller circle surrounding the papers. **Take a photo of the cell.**

   - The large oval represents the _____ _____.
   - The six strips of paper represent the unreplicated _____.
   - The smaller circle represents the _____ _____.

2. **INTERPHASE – S**: Carefully fold each strip of construction paper in half lengthwise. Tear the pieces apart from each other. Arrange them in the shape of an X and attach them with the paper clips. **Take a photo of the cell.**

   - The paper clips represent the _____.
   - The X-shaped structures represent the _____ _____.

3. **EARLY PROPHASE I**: Erase the nuclear envelope and scatter the six chromosomes. Draw in centrosomes at opposite ends of the cell. Arrange the homologous chromosomes next to each other and place the pairs *randomly* throughout the cell.

   - A centrosome consists of two _____ at a right angle to each other.
   - Homologous Pair #1 Colors: _____ and _____
   - Homologous Pair #2 Colors: _____ and _____
   - Homologous Pair #3 Colors: _____ and _____

4. **LATE PROPHASE I**: Rip off a small piece of one chromatid from EACH chromosome of homologous pair #1. Using a piece of tape, switch the pieces of chromatids and secure them onto the homologous chromosome. Repeat for homologous pairs #2 and #3. **Take a photo of the cell.**

   - This process is called _____ _____.
   - This process is a major source of _____ _____.

5. **METAPHASE I**: Arrange the homologous pairs at the metaphase plate. Draw lines using the chalk to connect the centrosomes to the centromere of each chromosome. **Take a photo of the cell.**

   - The lines represent the _____ _____.
   - The homologous pairs can line up in many different ways at the metaphase plate. This is a second example of _____ _____.

6. **ANAPHASE I**: Slide the chromosomes along the spindle fibers until they are close to the centrosomes. Erase a portion of the spindle fibers to show that they have pulled away from the metaphase plate. **Take a photo of the cell.**

7. **TELOPHASE I**: Draw a nuclear envelope around each set of chromosomes. There should be one nucleus and one centrosome at each end of the cell. **Take a photo of the cell.**

8. **CYTOKINESIS I**: Using the chalk, draw a new cell membrane surrounding each nucleus. **Take a photo of the cells.**

   - A _____ _____ is formed when the cell membrane pinches inward during cytokinesis in an animal cell.
   - Each of the two new cells formed is _____. (haploid/diploid)

9. **PROPHASE II**: Erase the nuclear envelope. Draw in centrosomes at opposite ends of the cell. **Take a photo of the cells.**

   - Crossing over _____ (does/does not) occur during prophase II.
   - Homologous chromosomes _____ (are/are not) found in the same cell during prophase II.

10. **METAPHASE II**: Arrange the chromosomes at the metaphase plate in each cell. Draw lines using the chalk to connect the centrosomes to the centromere of each chromosome. **Take a photo of the cells.**

11. **ANAPHASE II**: Remove the paper clip from each chromosome. Separate the chromatids and slide them along the spindle fibers until they are close to the centrosomes. Erase a portion of the spindle fibers to show that they have pulled away from the metaphase plate. **Take a photo of the cells.**

12. **TELOPHASE II**: Draw a nuclear envelope around each set of chromatids in both cells. There should be one nucleus and one centrosome at each end of both cells. **Take a photo of the cells.**

13. **CYTOKINESIS II**: Using the chalk, draw a new cell membrane surrounding each nucleus. If you are a male, draw a flagellum on each cell. **Take a photo of the cells.**

14. To clean up, return the paper clips and chalk. Throw out the chromatids. Use the cleaning spray and paper towels to clean your work area.

RESULTS:

There should be three data tables for this lab. The first should include the two photos from interphase. The second data table should include the five photos from meiosis I. The third data table should include the five photos from meiosis II.

POST-LAB QUESTIONS:

1. At what point in meiosis do the cells become haploid? Explain using CLAIM → EVIDENCE → REASONING.

2. What two aspects of the meiotic process increase genetic variation? Explain both of them using CLAIM → EVIDENCE → REASONING.

3. How would the photo of the chromosomes at the end of meiosis look different if the cell went through mitosis instead?

4. Why is it so important that gametes (sperm and egg cells) become haploid? Explain using the phrases **n = 23** and **2n = 46**.

5. If there are 3 sets of homologous chromosomes (such as in this lab), then there are 8 different combinations of chromatids at the end of meiosis II. This does not even include any of the variants created during crossing over. Calculate the number of possible gametes produced by a human using the following formula:

   Number of Gametes = 2^n

6. Use your answer from question 5 to calculate the number of children that two parents would have to have in order to produce two identical twin babies during two separate pregnancies. Your answer should exclude any variation due to crossing over. **Be sure to model or explain how you arrived at your answer.**

7. Suppose that the chromosomes did not separate correctly in the production of a human sperm cell, causing the sperm to have an extra chromosome. Predict the number of chromosomes that would be found in the cells of the baby if it fertilized a normal egg cell.

QUESTIONS TO HELP YOU WITH YOUR LAB REPORT:

1. Was your hypothesis correct? Explain using CLAIM → EVIDENCE → REASONING.

2. Identify 1 or 2 sources of error for this lab. Explain your answer(s).

3. Identify 1 or 2 ways to improve this lab. Explain your answer(s).

4. What conclusion(s) can you draw regarding the production of sperm and egg cells?