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Lab 14: Illustrating the Phases of Meiosis

Introduction: There are two types of cell division: mitosis and meiosis. Mitosis results in 2 daughter cells that are exact copies of each other and to the parent cell. The purpose of mitosis is growth and development in multicellular organisms and asexual reproduction in unicellular organisms. Meiosis is the cellular division that occurs to form gametes (sperm and egg cells). The daughter cells that are formed in meiosis have half the number of chromosomes as the parent cell. Meiosis produces eggs and sperm. Simulating the events of meiosis using beads will help you to see the phases of this process.

Materials:

White links (centromeres)	Pipe cleaner pieces (centrioles)	
Green beads (genes of female parent)	Large piece of paper	
Blue beads (genes of male parent)	Green colored pencil	Red colored pencil

Setup Chromosomes:

1. First collect your materials: a large piece of paper with a meiosis diagram (one parent cell dividing into four offspring cells), a plastic cup with red and green beads, and white links.
2. Next build your chromosomes. The "organism" that we are observing has THREE HOMOLOGOUS CHROMSOMES. Each bead on the pipecleaner represents a gene.
   RED genes are from the male parent, and GREEN genes are from the female parent.

   Chromosome 1: 14-gene Chromosome
   - Select the four longest pipecleaner pieces
   - On one pipecleaner piece, put 5 RED genes/beads on one end & 9 RED genes/beads on the other end
   - Bend the pipecleaner between the 5 and 9 genes
   - Do the same thing with red genes/beads to make the sister chromosome
   - Repeat the above using 5 GREEN genes/beads and 9 GREEN genes/beads to make two homologous chromosomes
   - To attach sister chromosomes together use the white link.

   Chromosome 2: 9-gene Chromosome
   - Select the middle length pipecleaner pieces
   - Repeat all the steps listed under chromosome 1, EXCEPT on one end of the pipecleaner put 6 genes and 3 genes on the other end
   - Continue until you have four chromosomes: two male (red) and two female (green)

   Chromosome 3: 4-gene Chromosome
   - Select the smallest length pipecleaner pieces
   - Repeat all the steps listed under chromosome 1, EXCEPT on one end of the pipecleaner put 2 genes and 2 genes on the other end
   - Continue until you have four chromosomes: two male (red) and two female (green)

Procedure for Meiosis:

A. This imaginary organism's cells are DIPLOID cells that have three chromosomes. Green chromosomes are from the female parent of this organism, and red chromosomes are from the male parent. Place one red 14-gene

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chromosome, one green 14-gene chromosome, one red 9-gene chromosome, one green 9-gene chromosome, one red 4-gene chromosome, and one green 4-gene chromosome (so six chromosomes total) in the parent cell on the diagram paper. Answer questions 1-6.

B. Simulate Interphase I by "replicating" each chromosome. To do this, use a white link to pair a sister chromatid with its match. Answer questions 7-8.
C. After Interphase I, this cell will go into Prophase I. Answer questions 9-10.
D. During Prophase I, the cross-over event occurs. Pair your homologous sister chromatids to form tetrads with the arms of the homologous chromosomes overlapping each other. During the cross-over event, genes are exchanged between homologous arms. On all three sets of chromosomes on your diagram, exchange at least 1 gene (bead) per chromosome arm. Answer questions 11-14 about this event during Prophase I.
E. After Prophase I, this cell will move into Metaphase I. Arrange the chromosomes into Metaphase I. Answer questions 15-16.
F. After Metaphase I, this cell will move into Anaphase I. Arrange the chromosomes into Anaphase I. Answer questions 17-18.
G. Then the cell moves into Telophase I. Arrange the chromosomes in the two new daughter cells on your diagram paper. Answer questions 19-22.
H. The cells will now move into Prophase II. You don't need to arrange your chromosomes for this phase, but do answer question 23-24.
I. After Prophase II, the cells move into Metaphase II. Arrange the chromosomes in the two daughter cells into Metaphase II. Answer questions 25-26.
J. Now the cells are prepared to undergo Anaphase II. You'll have to "unlink" the sister chromatids! Arrange the chromosomes in the two daughter cells to demonstrate Anaphase II. Answer questions 27-28.
K. Finally! The cells will move into Telophase II. Separate your chromosomes from the two cells into the four new daughter/offspring cells. Answer questions 29-30.
L. Lastly, before you clean everything up, answer the last few questions, 31-33.
M. To clean up, remove all beads from the pipecleaners and put everything in the plastic cup. Return to the front lab bench. Also return your large Meiosis diagram sheet. Turn in your lab sheet!

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Green beads (male) total = 972 Blue beads (female) total = 927

White beads (centromeres) total = 216

Centromeres

White or other color beads 12 total: 1 for each chromosome

Chromosome 1

Male 14 genes total: 5 + 9

Male Sister 14 genes total: 5 + 9

Female 14 genes total: 5 + 9

Female Sister 14 genes total: 5 + 9

Chromosome 2

Male 9 genes total: 6 + 3

Male Sister 9 genes total: 6 + 3

Female 9 genes total: 6 + 3

Female Sister 9 genes total: 6 + 3

Chromosome 3

Male 4 genes total: 2 + 2

Male Sister 4 genes total: 2 + 2

Female 4 genes total: 2 + 2

Female Sister 4 genes total: 2 + 2

Bowls for each group of 2-3 students = 18 total