

Task 2

Modeling Chromosome Inheritance

In this task, you will model chromosome inheritance from parent to offspring for the species you created in task 1. You will use the genotypes you developed for the two parents in task 1.

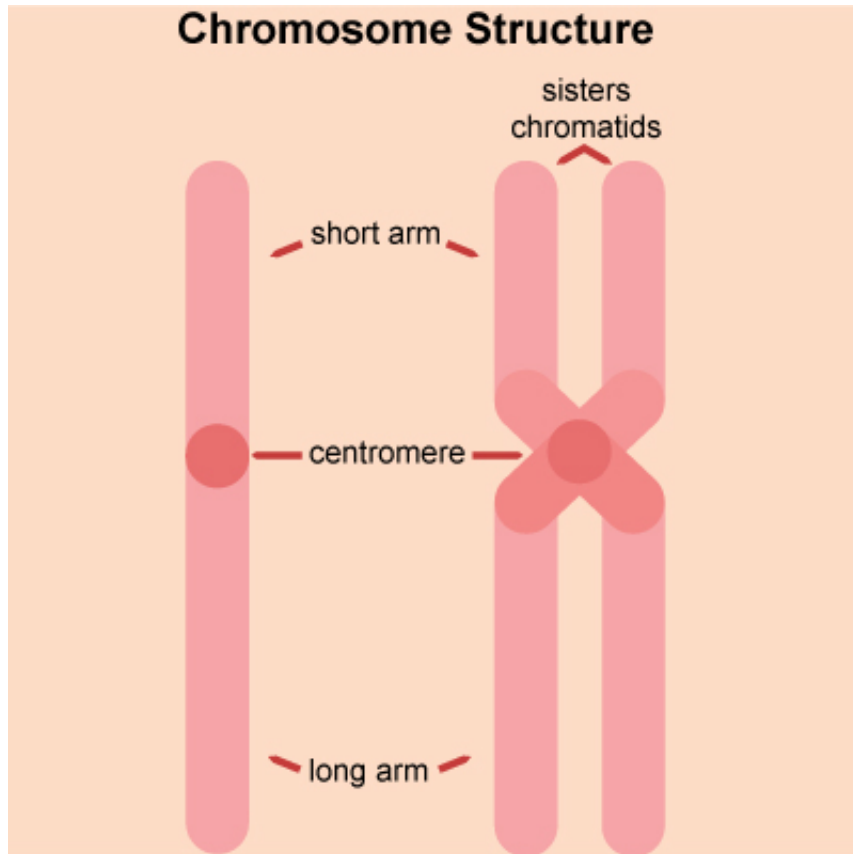
 Estimated time to complete: 60–90 minutes

 You will need these materials:

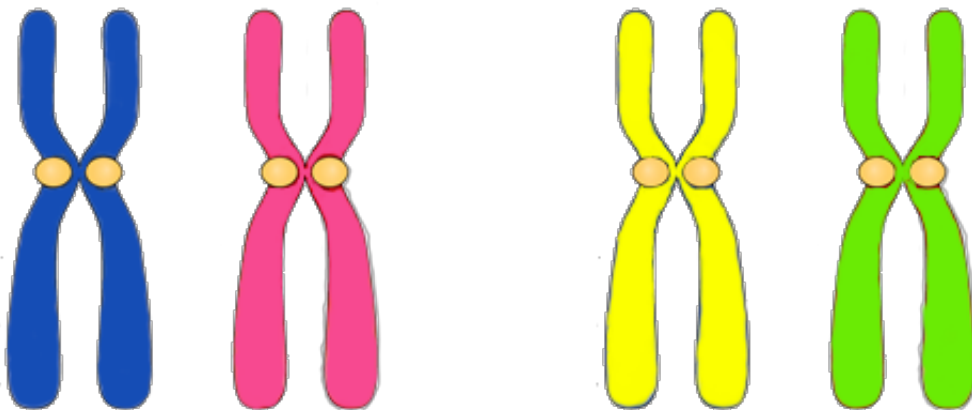
- 4 different colors of construction paper (about 2 sheets of each color) or white paper
- 4 pens or markers of different colors
- scissors (optional)
- tape (optional)

 Stay safe! Be careful when using scissors.

Recall that meiosis is the type of cell division that forms gametes, sperm, and eggs. Each parent has a pair of homologous chromosomes, and each chromosome carries one allele for a particular gene. At the beginning of meiosis, these homologous chromosome pairs have two identical sister chromatids, which contain the same genetic information.



To get started on this task, cut eight strips of paper—two of each color (or eight strips of white paper). Each color will represent one chromosome with its sister chromatids. Each parent will receive two different colored chromosomes. If you're using white paper, use four pens or markers of different colors to write your genes—one color for each chromosome.



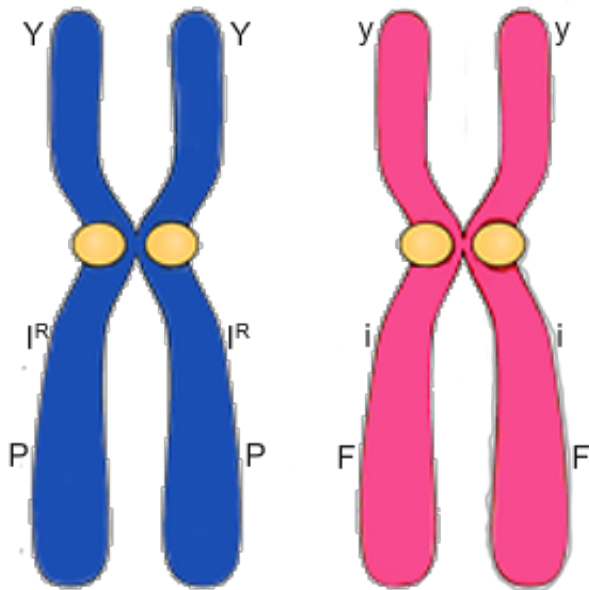
Start with one parent, and separate its four pieces of paper into two chromosomes with its two identical chromatids. Using your genotypes from task 1, write down one gene on each chromosome as shown in the following image. Remember that

depending on the genotype you choose, homologous chromosomes can have matching or unmatched chromosomes. The two sister chromatids in each pair have identical alleles.

For example,

Mother genotype: YyI^RiPF

Mother

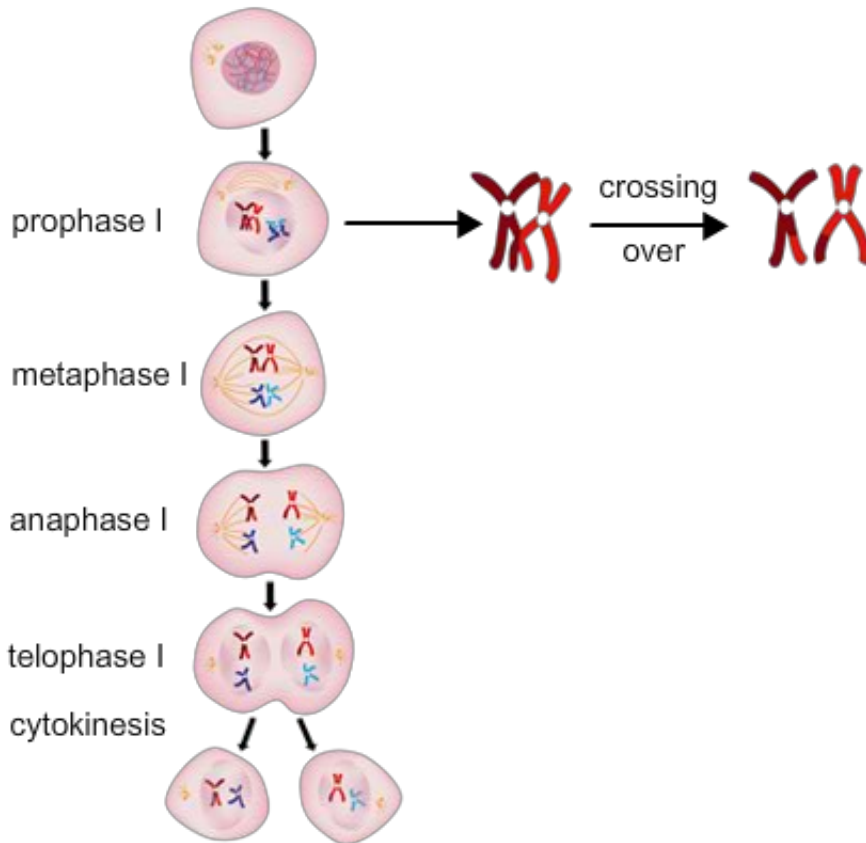


Make your chromosome pairs for the mother and father using the image as a guideline. At the end, you should have two pairs of chromosomes—with two identical chromatids each—for each parent.

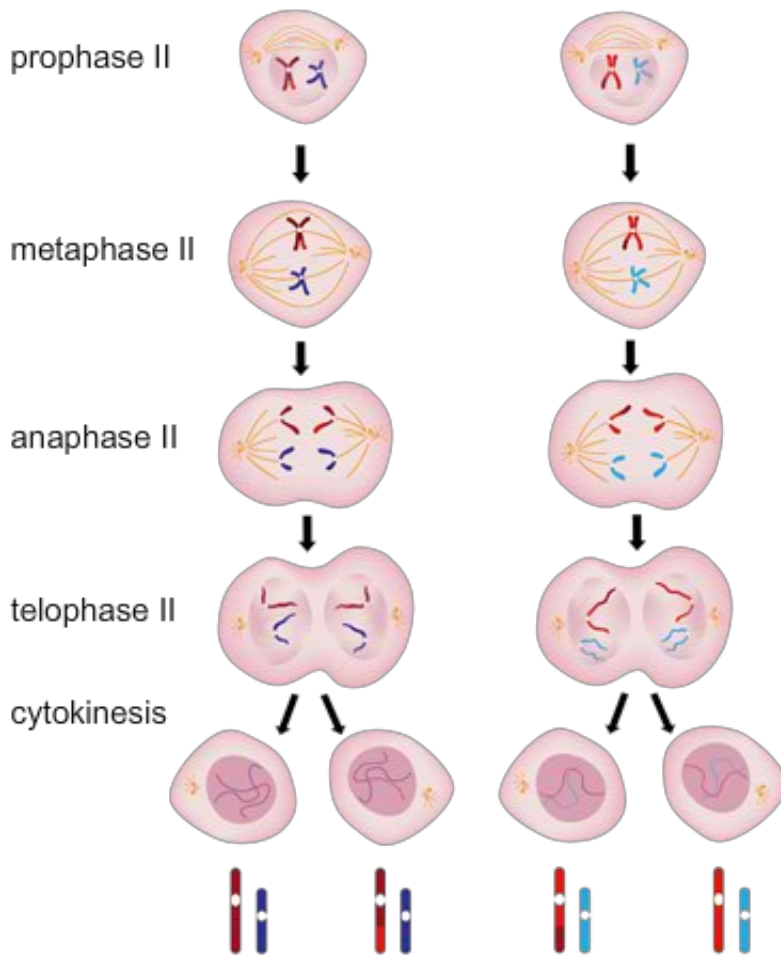
Part A: Modeling Meiosis

In meiosis, crossing over occurs, where homologous chromosomes synapse and their chromatids exchange genetic information. At this point, the sister chromatids are no longer identical. When the chromatids split from each other, there are four unique haploid sperm or egg cells.

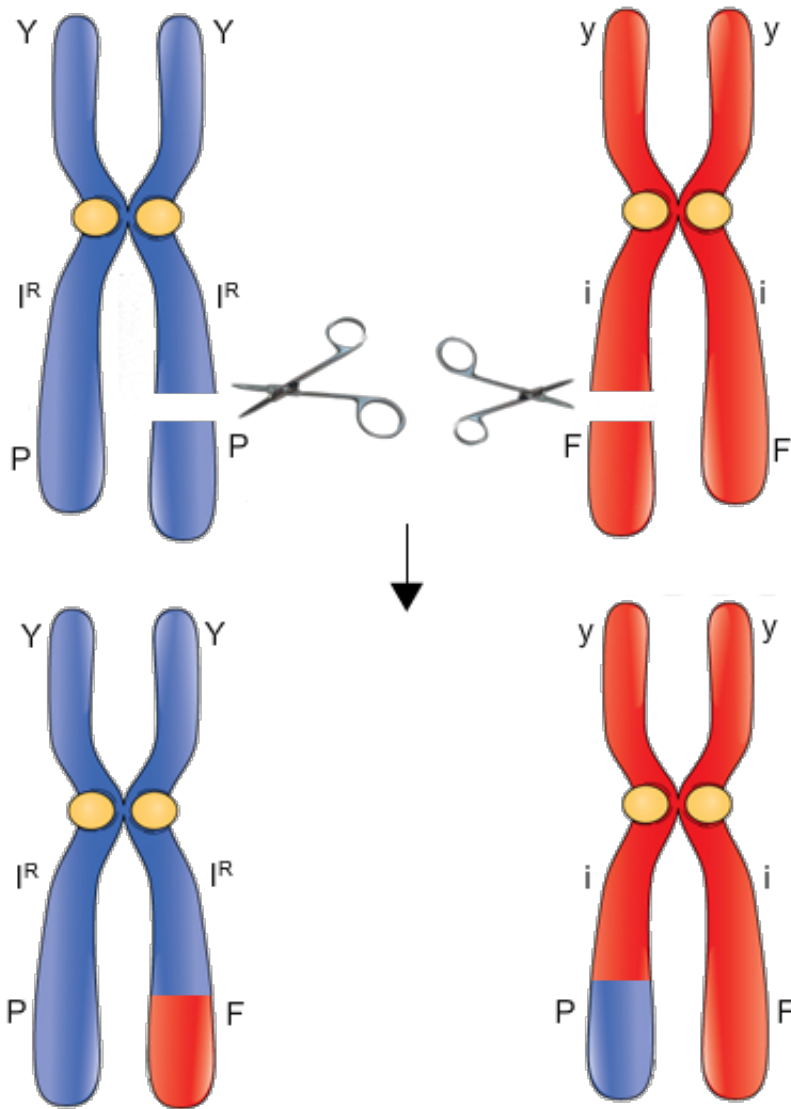
Meiosis I



Meiosis II



In your paper model, simulate the process of crossing over in the two parents by cutting or tearing the chromatids to swap genes. Be sure to swap the same type of gene. For example, the allele for trait 1 should swap places only with the other allele for trait 1 of the chromatids of the homologous chromosome. Tape your new chromatids together.



Now separate out the four single, crossed-over chromosomes to model four haploid cells from each parent.

Next, make at least four genetic matches of offspring by moving a chromosome from a sperm and egg cell together to form a diploid offspring. In the table, record the genotype and phenotype of each offspring as shown in the example.

Genotype (genes inherited)		Phenotype (outward traits)
Offspring 1	YyI ^R i ^r PpFf	yellow pods, red and white speckled flowers, long flat pods

Answer:

	Genotype (genes inherited)	Phenotype (outward traits)
Offspring 1		
Offspring 2		
Offspring 3		
Offspring 4		

Characters used: 113 / 15000

Part B: Evaluating Results

Question 1

Explain why your model demonstrates how crossing over is important to genetic variation in a species.

Answer:

Characters used: 0 / 15000

Question 2

Look at the offspring you created in your model. Have any of the offspring inherited a more beneficial genetic combination than the others? How could this affect their survival? Explain your reasoning.

Answer:

Characters used: 0 / 15000

Question 3

Why is it impossible to predict the phenotype of the offspring by observing only the phenotype of the two parents?

Answer:

Characters used: 0 / 15000