Baker's Dozen Lab 7: Meiosis in Sordaria

Objectives

Before doing this lab you should understand the process of crossing over in meiosis.
After doing this lab you should be able to recognize when crossing over has occurred and how to calculate the map unit distance between two genes.

Introduction

Sordaria fimicola is an ascomycete fungus that can be used to demonstrate the results of crossing over during meiosis. *Sordaria* is a **haploid** organism for most of its life cycle. It becomes **diploid** when the fusion of the mycelia (filamentlike groups of cells) of two different strains results in the fusion of two different types of haploid nuclei to form a diploid nucleus. The diploid nucleus must then undergo meiosis to resume its haploid state.

Meiosis, followed by one mitotic division, in *Sordaria* results in the formation of eight **haploid ascospores** contained within a sac called an **ascus.** Many asci are contained within a fruiting body called a **perithecium** (ascocarp). When ascospores are mature, the ascus ruptures, releasing the ascospores. Each ascospore can develop into a new haploid fungus. The life cycle of *Sordaria fimicola* is shown in Figure 7.6.

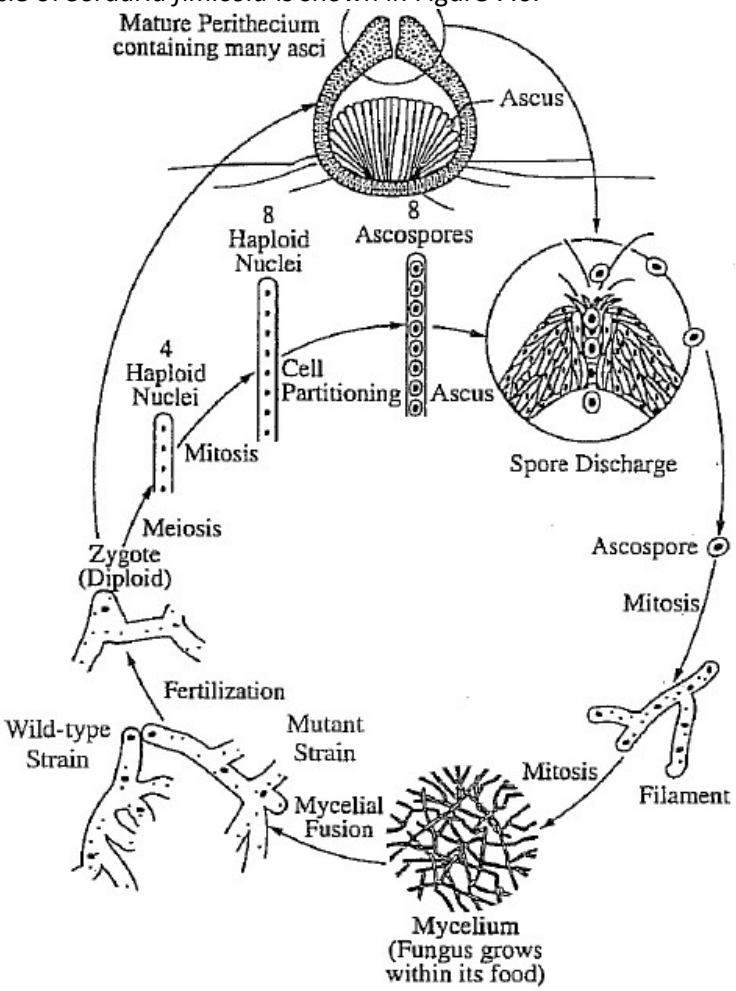


Figure 7.6

To observe crossing over in *Sordaria,* one must make hybrids between wild type (black ascospores) and mutant strains (tan spores) of *Sordaria.* When mycelia of these two different strains come together and undergo meiosis, the asci that develop will contain four black ascospores and four tan ascospores. The arrangement of the spores directly reflects whether or not crossing over has occurred. In the figures below, you can see the differences in the ascospores with crossing over and without crossing over.

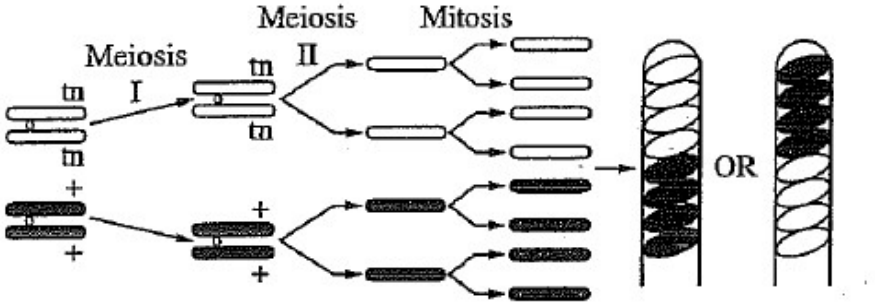


Figure 1

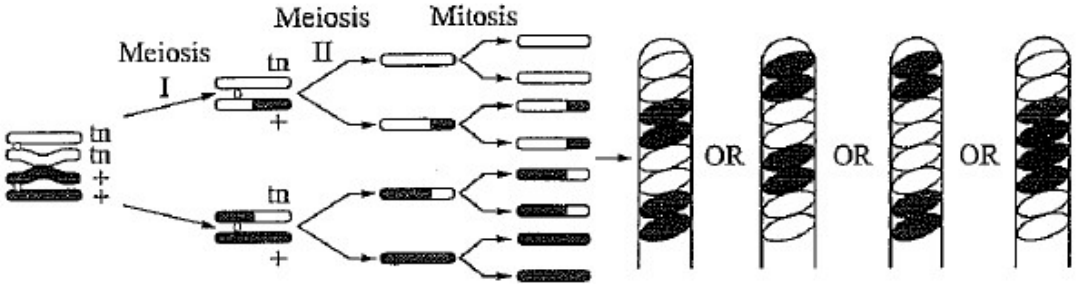


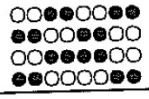
Figure 2

The frequency of crossing over appears to be largely governed by the distance between genes, or in this case, between the gene for spore color and the centromere. The probability of a crossover occurring between two particular genes on the same chromosome (linked genes) increases as the distance between those genes become larger. The frequency of crossover, therefore, appears to be directly proportional to the distance between genes.

A **map unit** is an arbitrary unit of measurement used to describe relative distances between linked genes. The number of map units between two genes or between a gene and the centromere is equal to the percentage of recombinants. Customary units cannot be used because we cannot directly visualize genes with the light microscope. However, due to the relationship between crossover frequency and distance, we may use the map unit.

Exercise 7D: Observing hybrid asci of *Sordaria fimicola*

Observe the pictures taken of *Sordaria* ascospores. Count the number of ascospores that indicate crossing over has occurred and record that number in the data table below. Count the number of ascospores that indicate no crossing over has occurred and record that number in the data table below.

Number of 4:4 	Number of Asci Showing Crossover 	Total Asci	% Asci Showing Crossover Divided by 2	Gene to Centromere Distance (map units)

Analysis of Results

1. Using your data in the table above, determine the distance between the gene for spore color and the centromere. Calculate the percentage of crossovers by dividing the number of crossover asci by the total number of asci and multiplying by 100.
2. To calculate the map distance, divide the percentage of crossover asci by 2. The percentage of crossover asci is divided by 2 because only half of the spores in each ascus are the result of a crossover event. Record your numbers in the data table above.
3. The published map distance between the spore color gene and the centromere is 26 map units. How did the class data compare with this distance?

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4. What could account for any discrepancy between class data and the published data?

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5. Based on your knowledge of mitosis and meiosis, fill out the data table below.

	Mitosis	**Meiosis**
Chromosome # in Parent Cell		
# of DNA Replications		
# of Divisions		
# of Daughter Cells Produced		
Chromosome # in Daughter Cells		
Purpose/Function		