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Teaching Genetics with *Aspergillus nidulans*

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Aspergillus nidulans is a filamentous Ascomycete fungus ideal for teaching in the genetics laboratory. It has a rapid asexual life cycle. Spores inoculated onto a plate of medium grow into a colony that produces new spores (conidia) in just 2 days at 37° C. As *Aspergillus* is a eukaryote, it can be used to introduce students to meiosis as well as recombination. Because it is a microorganism, only simple microbiological techniques and media are needed for students to carry out the following experiment demonstrating gene linkage. The experiment also introduces other concepts of genetics and fungal life cycles.

The Experiment

In the experiment, 2 strains of *Aspergillus* are crossed. To conduct the cross, inoculate the 2 strains near each other on a plate of medium. After 2 days, transfer the area where the 2 strains are growing together to another plate of medium. In 2 weeks the cross is ready to analyze.

Isolate the ascospore-containing cleistothecia (Fig. 1) under a stereomicroscope and burst them in sterile water. You can then analyze the progeny by spreading drops of this ascospore suspension onto plates of media. Because the 2 strains used in the cross are haploid, they carry only a single copy of each gene. If a strain of *Aspergillus* has a recessive mutant allele as its only copy of a gene, the strain shows the mutant phenotype. (In contrast, a diploid organism must contain 2 copies of a recessive mutant allele in order to show the mutant phenotype.) The 2 strains carry different alleles of 3 genes, and the different alleles produce phenotypes that are easily distinguished: yellow OR green conidia, and growth OR no growth in the absence of a particular nutrient. Mutant strains that require a particular nutrient (vitamin or amino acid) in the growth medium are called auxotrophs, whereas prototrophs do not require the nutrient. The *Aspergillus* strains used in the experiment illustrate this important genetics concept.

During the cross, diploid ascus (the cell type that gives the Ascomycete class its name) cells are formed (Fig. 1). Following diploid ascus formation, meiosis occurs, producing many haploid progeny (ascospores). Then the progeny are analyzed to determine if the 3 genes are linked.

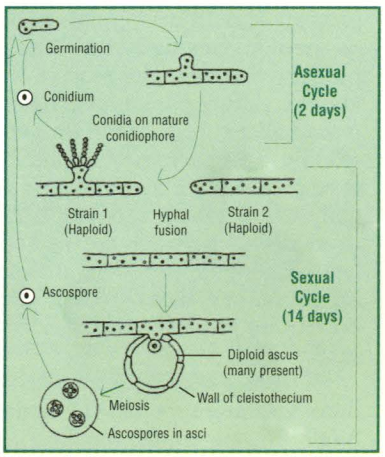

Figure 1 Asexual and sexual life cycles of *Aspergillus nidulans*.

Results

Because meiosis occurred, the progeny contain a mixture of chromosomes from the 2 parental strains. Additionally, because genetic recombination (crossing-over) occurred between like chromosomes, the progeny contain a mixture of the parental chromosomes (Fig. 2).

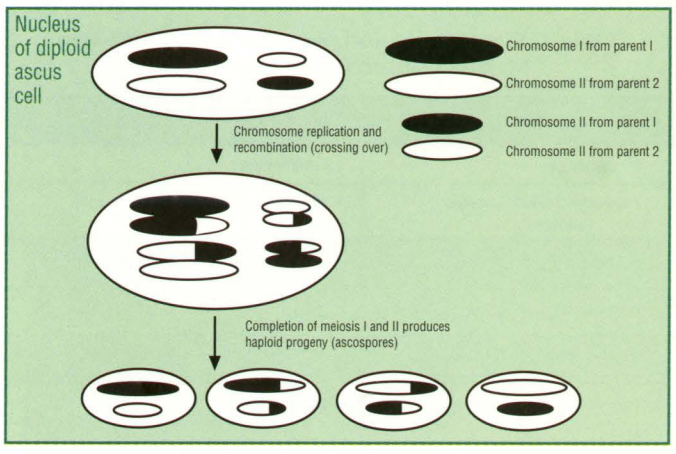

Figure 2 Meiosis produces haploid progeny (ascospores) that contain a mixture of parental chromosomes.