Title: Genetic Crosses

Abstract: To dissect genetic processes or create organisms with novel suites of traits, scientists can perform genetic crosses, or the purposeful mating of two organisms. The recombination of parental genetic material in the offspring allows researchers to deduce the functions, interactions, and locations of genes.

This video will examine how genetic crosses were influential in developing Mendel’s three laws of inheritance, which form the basis of our understanding of genetics. One genetic crossing technique that was first developed for single-celled organisms such as yeast, known as tetrad analysis, will then be presented in detail, followed by some examples of how this classical tool is used in genetic studies today.

Application videos:

1. BEST: Barcode Enabled Sequencing of Tetrads **(51401 Thumbnail @ 1:35 – 96-well plates with pink, orange, and blue spots)**

Description: While tetrad analysis is a powerful technique for studying the result of genetic crosses in yeast, individually dissecting and plating spores can be labor- and time-intensive. Here, researchers present a high-throughput method for performing tetrad analysis that allows for large-scale processing, made possible by transforming yeast cells with a library of plasmids each containing unique “barcodes”.

2. The Green Monster Process for the Generation of Yeast Strains Carrying Multiple Gene Deletions **(4072 Thumbnail @ 3:06 Vortexing with “Green Monster” sign in the background)**

Description: Scientists in this video used genetic crosses to generate yeast strains with multiple gene deletions. Using traditional crossing techniques, it is difficult and time-consuming to generate yeast strains with numerous mutations, but the combination here of sexual cycling with fluorescence-based quantitative selection allowed researchers to combine multiple gene deletions into a single strain.

3. Protocol for Production of a Genetic Cross of the Rodent Malaria Parasites **(2365 Thumbnail @ 6:33 – Mosquitoes feeding on a mouse tail, remove text overlays)**

Description: For particular organisms, such as the obligate intracellular parasites that cause malaria, genetic crosses require specialized conditions. In this protocol, all crossing steps had to be performed in mice or mosquitoes, the intermediate and primary hosts for the parasite. Following initial growth in mice, parasites were transferred to mosquitoes via blood-feeding, where sexual mating and genetic recombination could occur. Offspring were then matured and selected in mice.

4. Mating and Tetrad Separation of *Chlamydomonas reinhardtii* for Genetic Analysis **(1274 Thumbnail @ 9:05 – Growth of Chlamydomonas colonies on a plate)**

Description: *Chlamydomonas reinhardtii* is a single-celled green algae which can be used for genetic crossing experiments similar to yeast. In this article, culture techniques and mating procedures are presented. Tetrad dissection is then performed, followed by analysis of individual colonies derived from each tetrad spore.

5. Mapping and Application of Enhancer-trap Flippase Expression in Larval and Adult Drosophila CNS **(2649 Thumbnail @ 7:45 – Close-up comparison of fly eyes)**

Description: A well-established resource for studying gene expression in the fruit fly *Drosophila* is the Gal4/UAS system, where a gene of interest is driven by tissue-specifically expressed Gal4 proteins. However, researchers may desire even more targeted gene expression than this system can provide. In this video, a Gal4/UAS strain was crossed with another set of mutants with tissue-specific expression of the Gal80 protein, which represses Gal4 expression. In the resulting cross progeny, expression of the target gene would thus be specifically excluded from where the expression zones of Gal4 and Gal80 intersect.

Related Videos

5041 – Introduction to Light Microscopy

5097 – Yeast Reproduction

5093 – *Drosophila* Development and Reproduction

5540 – Genetics of Individuals and Populations