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A Yeast Competition Lab for Teaching Mathematical Biology

This presentation will report on our work to develop a teaching exercise for undergraduate students in an upper-level mathematical biology course. Significant amounts of teaching materials have been created for mathematical biology courses at an introductory level, but more are needed at the upper-level. The goal for the exercise is to expose junior/senior-level students to the complete modeling experience from bench work to the analysis of the mathematical model. To this end, we chose to adapt the classical experiment by G. F. Gause (1934), examining the effects of competition on the growth of two species of yeasts – *S. cerevisiae* and *S. pombe* – in a limited nutrient environment. During growth and proliferation of these two yeasts, the different species must compete for nutrients while also being exposed to byproducts produced by either species. Such competition between two species vying for the same niche can be modeled with a system of two differential equations. Protocols were developed and simplified for students with limited molecular biology experience. Pure and mixed cultures of the yeasts were grown until stationary phase was reached in each culture. For the in-class bench experience, media conditions can be modified so teams of students may push species domination toward one or the other. Work is also underway to establish a pair of yeasts with required media conditions for co-existence. Having gathered biological data, students perform the mathematics portion of the lab by fitting the differential equations model to the experimental evidence and characterize the growth of the populations. Students should gain understanding in analyzing parameters and classifying equilibrium solutions.