

## Teaching Nonlinear Dynamics to Biology Freshmen Improves Math Interest and Physics Performance

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Since Fall 2013, UCLA has been offering a two-course sequence, Life Sciences AB (LS 30), which students can complete for major credit instead of the traditional Calculus for Life Sciences curriculum, Math 3A-C. The LS30 courses focus on modeling biological systems using differential equations. Mathematical topics include state spaces, vector fields, trajectories, Euler's method, equilibria and stability, nullclines, bifurcations, limit cycles, chaos, linear stability analysis and optimization. The fundamental concepts of calculus and linear algebra are also covered but computation is not emphasized. In addition, there is a computer lab component in which students learn programming and use simulation to study biological models.

LS 30 dramatically increases students' interest in math. While 81% of students say their interest in the subject was low to medium before an LS 30 class (A or B), at the end of the class, 92% say their interest is medium to high. We also monitored student performance in subsequent physics courses, for which math is a prerequisite. 30.5% of students who took LS 30 received an A or A+ in physics, compared to 13.5% of students who completed Math 3. Only 2.8% of LS 30 students received a C- or lower in physics, compared to 12.4% of Math 3 students. After adjusting for student preparation and demographic characteristics, we still find LS 30 students scoring 0.4 grade points higher than Math 3 students in physics. We hypothesize that this effect may be attributed to LS 30 students' extensive exposure to modeling.