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Kevin R. Sanft* (kevin@kevinsanft.com), St. Olaf College, 1520 St. Olaf Ave., Northfield, MN 55057. *Turn down the volume, turn up the noise: a course module in discrete stochastic modeling and simulation.*

Many biological processes are driven by random interactions between molecules present in small populations. These processes are discrete and stochastic, and display behavior that cannot be captured with traditional ordinary differential equation (ODE) approaches. Gillespie's Stochastic Simulation Algorithm (SSA) provides a method for modeling and simulating biological systems in a way that captures this inherent randomness. The SSA is derived as a Monte Carlo method for approximating the solution to the Chemical Master Equation (a high-dimensional ODE). The SSA is simple enough to be implemented in an introductory course. However, advanced algorithms, numerical considerations, and the StochKit software package are also explored. The ODE model is shown to arise in the large population limit through intuitive transitions, first to a Poisson approximation, then to a Gaussian approximation, that arise as the system volume is increased to the thermodynamic limit. Models from the biology literature, including genetic toggle switches and stochastic oscillators, are used to demonstrate the concepts and highlight the impact of discrete stochastic modeling and simulation in biology. (Received September 25, 2012)