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Understanding Statistical Mechanics and Biophysics Using Excel

PETER NELSON, Benedictine University — A new approach to teaching statistical mechanics and biophysics is presented using the classic two-box system from statistical mechanics as an example. This approach makes advanced physics concepts accessible to a broad audience including undergraduates with no calculus background. Students develop a simple Excel spreadsheet that implements a kinetic Monte Carlo (kMC) simulation algorithm "from scratch". The students discover for themselves the properties of the system by analyzing the simulation output in a directed, activity-based exercise. By changing the number and initial distribution of the particles, students see how the system approaches equilibrium and how system variability changes with system size. A finite difference solution is also implemented in Excel, and students compare its predictions with the kMC results. This approach is quite different from using "canned" computer demonstrations, as students design, implement and debug the simulation themselves – ensuring that they understand the model system intimately.

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