**Resource-Limited Growth Activity, Instructor Notes**

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Most students have seen an exponential model for population growth and know that it predicts unlimited growth.  Better models, such as the logistic growth model, should incorporate assumptions to account for limitation of resources.  In this activity, participants collect data from a physical simulation of resource-limited growth, prepare a variety of graphs to visualize the data, construct a verbal model based on their observations and the graphs, and (for those who want to go this far) construct a symbolic model from the verbal model.

**Purposes**

This activity has several broad purposes in addition to the narrow purpose of developing the logistic growth model from observation and experimentation: an experience of the process of science, a better understanding of models in biology, and experience using multiple ways to present quantitative data. Resource-limited population growth is a good topic to use for these broad purposes because it can be understood with no prior content knowledge.

Science progresses through a combination of theory and experiment. Experiment without theory results in a mere collection of observations and raw data; at best this can discover relationships, but it cannot explain such relationships in terms of fundamental principles. Theory without experiment is mere speculation. Science classes generally include both elements, but they seldom provide students with opportunities to experience the way theory is built from experimental outcomes. This population growth exercise gives students that experience, helping them better appreciate how science works.

Understanding of models is enhanced by combining several complementary representations. Modeling experience in mathematics courses generally works from a verbal representation to a symbolic one. Students’ understanding of the modeling process is enhanced when a verbal representation is motivated by experiential and graphical representations. This activity begins with a physical simulation experiment. Students collect data and plot it in various ways; then they use their observations and graphs to develop a verbal representation, which leads to the standard symbolic logistic growth model.

Graphs are a particularly good way to make sense of data, but some graphs are more valuable than others. The activity generates a set of population counts at increments in time. Plotting population versus time is one way to graph the data, but other choices can yield graphs that give a meaning that cannot be seen in the basic graph. In this activity, students produce additional graphs of population change versus time, population change versus population, and relative population change versus population. The latter two graphs help students understand the logistic growth model from a biological perspective.