Leaky Bucket Lab
Laboratory Experiences in Mathematical Biology

Overview: Students measure and record the height of fluid remaining in a container as it exits through a small hole over time. Torricelli’s law is used as a base model to illustrate simple concepts (quadratic polynomials and their roots) for college algebra students, as well as complex concepts (modeling container shapes mathematically and integrating separable differential equations) for more advanced students. At all levels, students are encouraged to explore alternate models since the classic model performs poorly in comparison with data.

Lesson Outline: Students attempt to explain and predict the time trajectory of fluid exiting a container through a small aperture. In algebra and statistics classes, the lab requires students to complement and parameterize the classic Torricelli model. More advanced students must also formulate an alternative model of flow to replace drainage by surface. See Pedagogical Resources for additional teaching and scaffolding suggestions.

Lab Setup: Students cut an aperture of approximately 0.25 cm$^2$ and inscribe horizontal marks every centimeter above. Bucket is filled to twelve cm while the hole is covered with duct tape; students remove the tape and time the bucket’s drainage recording the dynamics of changing height.

Data and Examples: Data along with some student approaches are presented to illustrate the range of student creativity and to help prepare instructors to scaffold student thinking.

Background and Extensions: A brief discussion of leaky buckets in nature and Torricelli’s Law is presented here.

Assessment Items: Primary assessment of student learning is taken from students’ written reports. Additional assessment items targeting lab objectives are included here.