Project Year
Summer 2010

Project Title
Lab-on-a-Chip Simulation

Project Team
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Audience
Undergraduates in the classes Transport Phenomena II (540.306.01) and Separation (540.304.01), along with students in high school STEM courses

Pedagogical Issue
It is difficult for students to visualize the dynamics of microfluidic systems because they are so small (nanometer level), along with the concept of scaling which explains how two systems with disparate dimensions (micro and macro) exhibit similar behavior.

Solution
Students will learn about fluid mechanics and microfluidic systems from short tutorials, form a hypothesis of the experimental outcome, and carry out the experiment themselves or watch a video of the experiment to verify and adjust their hypothesis. Unlike any previous study-aid, the unique design of the experiment will provide students with a hands-on experience of abstract concepts, and introduce them to the complex behavior observed in relatively simple systems.

The experimental station will be created with LEGOs, steel balls, and an aquarium on a rotating board to permit the balls to roll through the LEGO geometric pattern immersed in fluids at different angles. Similar “LEGO experiments” have already been very successful in attracting the attention of undergraduate students and popular science websites. Our model will mimic the fluid behavior inside a “Lab-on-a-Chip,” a relatively novel technology used as portable DNA sequencers, bacterial, or blood testers.

Online interactive modules will accompany the experimental model to allow students to change key parameters while simulating microfluidic environments. The modules will be created with a combination of PowerPoint tutorials, Flash, and Blackboard quizzes.

Technologies Used
Experimental station: LEGOs, steel balls, aquarium, fluids
Accompanying Online Tutorials: Flash, Blackboard

Project Abstract

The goal of this project is to develop an interactive on-line and on-site tutorial for two undergraduate courses: Transport Phenomena II (540.306.01), and Separation (540.304.01), with an additional venue for the demonstration at the USA Science Fair in Washington, D.C. The aim is to provide students with a holistic appreciation of the microfluidic dynamics with a model for a state-of-the-art microfluidic separation technology. The plan is to devise the experimental model along with an electronic module to teach important concepts in the chemical engineering curriculum (such as dimensional analysis). The experimental model will consist of everyday objects such as a Lego board and an aquarium. Online tutorials will complement the physical experiments.