

Scientists and public school teachers team up to transform science education

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A research paper published online this month in *Academic Medicine* highlights the successful development, implementation, and effects of an infectious disease curriculum that has now been piloted in five Boston Public Schools. Student engagement and interest in the infectious disease material increased after the curriculum was implemented. Based on pre- and post-tests, student understanding of the course content more than doubled regardless of gender or ethnicity, also attitudes and self-efficacy toward the material improved compared to other students.

The [curriculum](#) is part of the Great Diseases Project, a collaboration between researchers at Tufts University School of Medicine and teachers at Boston Public Schools, designed to teach teenagers about real [scientific methods](#) and health-related concepts, with the goal of increasing scientific and [health literacy](#).

The study reports that the infectious disease curriculum increased [student engagement](#), [science literacy](#), and critical thinking in the 11th and 12th grade students who participated in the [pilot program](#) in Boston schools. Importantly, it also developed the teachers' knowledge and self-confidence with the new course material and strengthened the researchers' [science communication](#) skills. By the end of the 2013 academic year, the Great Disease modules will have enrolled close to 850 students from schools in Massachusetts, Virginia, and Ohio.

In its 2011 framework for science education, the [National Academy of Sciences](#) reported that science education standards must change so that

students are exposed to authentic scientific ideas and practices. While the national effort to refine standards is ongoing, the success of the Great Diseases Project contributes to models for development and implementation of [science classes](#) to meet the improved standards.

"How science is taught in high school differs greatly from how it is carried out in a real-life laboratory. Our curriculum teaches critical thinking, based on scientific inquiry as it is actually practiced in laboratories around the world," said Karina F. Meiri, Ph.D., professor at Tufts University School of Medicine, and member of the Cell, Molecular & Developmental Biology; Pharmacology & Experimental Therapeutics; and Neuroscience program faculties at the Sackler School of Graduate Biomedical Sciences at Tufts. "Not only that, but health science is usually taught as part of the physical education curriculum. It is not surprising therefore that high school students lack the up-to-date information that would help them make health-related decisions."

"Our approach is effective because researchers and teachers partnered to develop life-relevant content that engaged students, and because it provides teachers with intensive support as they themselves learn to teach this very novel content," she continued.

The infectious disease curriculum, which takes a full semester of class time, was designed by biology teachers from two Boston Public Schools teaching students at very different paces, along with Tufts faculty, postdoctoral researchers, and medical students. The group met regularly to identify the core concepts for the infectious disease curriculum, based on national and state science education standards.

After core concepts were determined, the Tufts team developed an intensive series of seminars to prepare the teachers to develop the infectious disease course. The teachers, with support from Tufts researchers, then worked together to create individual lesson plans and

activities targeted to the 11th and 12th grade biology students at Boston Latin School and at Madison Park Technical and Vocational High School.

"A major issue in the high-stakes testing environment of high schools is the tension between covering a wide range of topics (breadth) and learning deeply about each topic (depth). Most high school biology textbooks don't teach infectious disease in a way that students can apply it to their lives. Our new curriculum helps students at all academic levels to understand what causes disease, what causes diseases to spread, and how our bodies fight these diseases," said Gene Roundtree, M.Ed., a biology teacher at Madison Park Technical and Vocational High School, who used the curriculum in his remedial MCAS classroom. "I believe our curriculum is successful because every lesson is a unique challenge— students participate in labs, debates, competitive card games, and even an auction as part of the curriculum."

"One of the goals of the Great Diseases curriculum is to create and maintain teenagers' interest in science as it relates to medicine and disease," said co-author Kathleen Bateman, M.Ed., director of mathematics and science at Boston Latin School. "We created interest by selecting subjects that are reflected in the students' lives – colds, flu, MRSA, and other [infectious diseases](#). The students stay engaged because they work in teams to formulate questions and critically evaluate data, much as they would in an actual laboratory. The new curriculum, organized around diseases, combines best practices in science education with the hands-on experience of medical school and laboratory researchers."

"One of the challenges of making curricula effective is creating a system of teacher support that will ensure implementation. When content and lesson materials are novel and complex, teachers need to have confidence in their understanding of the new material. We created a

comprehensive support system for the teachers and avoided embedding concepts and pedagogy into materials that we did not fully explain," said first author Berri Jacque, Ph.D., a 2010 graduate in immunology of the Sackler School of Graduate Biomedical Sciences at Tufts and research assistant professor at Tufts University School of Medicine.

The comprehensive support system involved pairing teachers with Tufts specialists for mentoring. Tufts researchers provided models that enabled each teacher to visualize how classroom discussions could evolve and provided video of teachers implementing the curriculum in a classroom. The comprehensive support system increased teachers' self-efficacy and their knowledge of the course content. The Tufts medical and Ph.D. [students](#), and postdoctoral fellows, improved their understanding of how to transfer scientific knowledge through the process of developing the seminars and the related material for the teachers.

The infectious disease curriculum is the first of four health-related curricula in the Great Diseases Project that also include other "great diseases" relating to neurological disorders, metabolic disease, and cancer. Each module uses a range of teaching strategies, including labs, case-based studies, and multimedia presentations.

More information: Jacque B, Malanson K, Bateman K, Akeson B, Cail A, Doss C, Dugan M, Finegold B, Gauthier A, Galego M, Roundtree E, Spezzano L, Meiri KF. (May 2013). The Great Diseases Project: A Partnership Between Tufts Medical School and the Boston Public Schools. *Academic Medicine*, 88(5), 620-625. [doi: 10.1097/ACM.0b013e31828b50fb](https://doi.org/10.1097/ACM.0b013e31828b50fb) . Published online 21 March 2013.

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