

Blind students learn to think like scientists with revolutionary traveling toolboxes

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Source: Society for Integrative and Comparative Biology (SICB)

Education for the blind has lagged because science classrooms predominantly rely on visually-based materials. However, innovative new toolboxes on evolutionary biology, set to be released next year, may revolutionize science education for more than 60,000 blind K-12 students, allowing them to collect data through their fingertips and incorporate their findings into a scientific framework. "This work is important because it helps teach students to think like scientists, aiming to instill in these students enthusiasm for lifelong learning," explains Dr. Colleen Farmer of the University of Utah, the leader of the project.

Farmer and her colleagues have been developing evolutionary toolboxes for blind and visually-impaired K-12 students in collaboration with the Utah Museum of Natural History and the National Federation of the Blind. The toolboxes contain audio and Braille lesson plans, three-dimensional models, tactile games, graphics, and maps, all incorporated into comprehensive lesson plans that address key concepts in evolutionary biology, anatomy, and conservation biology. This initiative, funded by the National Science Foundation, has already produced two prototype toolboxes.

The lessons in the toolbox are designed to give students a hands-on, tactile learning experience and to engage them in the scientific process through personal observation and discovery. "This allows students to, rather than passively reading about evolution, observe it for themselves," explained Robert Cieri, a second-year PhD student who is helping with development. The box for younger students includes 11 clay models of vertebrate skulls, which allow children to literally feel the differences in the skull shape among different animal groups. Students are also provided with plastic figurines of three foot and hand models from humans, chimps, and gibbons so they can retrace human evolution through anatomical form.

Students will learn about the evolutionary concept of adaptive radiation by exploring models of giant tortoises on the Galapagos Islands. As tortoises colonized different islands, their shell changed shape in response to natural selection imposed by food availability. To create the box, Cieri digitally photographed turtle specimens in museum collections and used a 3D printer to print out replicas of the carapaces. Students are able to tactically explore each shell and feel the different shell shapes. Cieri has already noticed that students are visibly more engaged and excited about the science. "For many of them, it's the first time they have actually felt a tortoise's shape. It allows them to engage with biological shape," he explained.

Each toolbox encompasses 3-4 hours of classroom work and activity, but teachers can choose to tailor the box for their own classroom needs. The boxes cost \$300 to \$800 each, related to the cost of 3D printing of the models, making it economically prohibitive for each school to have its own box. Instead, toolboxes will be available for teachers across Utah to rent, free of charge, and are stored at the Utah Museum of Natural History. "The schools can simply rent the material rather than having to buy one" explains Cieri. The team also plans to develop an auditory box, so students can also learn to gather data from audio as well as tactile clues.

"It is terribly unfair for some members of our society not to have the opportunity to gain a deep understanding of the scientific method and to experience the joy and the beauty this understanding and set of skills can bring to one's life." explains Farmer. The team hopes the program will expand nationally and even internationally so that visually-impaired students from across the globe can benefit from the program.

The evolutionary boxes for the blind will debut at the 2015 annual conference of the Society for Integrative and Comparative Biology in West Palm Beach, Florida.

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