

## The Arts Are Essential to STEM Progress

(Originally titled “The Art and Craft of Science”)

In this *Educational Leadership* article, Robert Root-Bernstein and Michele Root-Bernstein (Michigan State University) argue that the arts aren’t a curriculum luxury; they are integrally involved in scientific thinking and deliver the biggest bang for the buck when it comes to improving test scores in areas unrelated to the arts – and the benefits persist well beyond high school. In fact, Nobel Prize winners are 15 to 25 times more likely than the average scientist to engage as adults in painting, sculpting, print making, wood- and metalworking, performance arts, photography, music, creative writing, and poetry. Einstein attributed some of his most important insights to his violin and piano playing.

Why? Because the arts develop observation, visual thinking, the ability to recognize and form patterns, and manipulative ability, and habits like practicing, persevering, and trial-and-error problem solving. “For these reasons,” say the Root-Bernsteins, “finding ways to foster arts education alongside science education – and, even better, finding ways to *integrate* the two – must become a high priority for any school that wants to produce students capable of creative participation in a science-dominated society like ours.” Here’s how:

- *Observation* – Drawing enhances seeing, say the authors, and other forms of sensory observation hone students’ powers of observation. It’s not surprising that doctors who have had musical training are much better at understanding what they hear through a stethoscope.

- *Visual thinking* – “It turns out that one of the best predictors of success in scientific subjects in grades K-16 is visual imaging ability,” say the Root-Bernsteins. “Conversely, students who have poor visual memory and imaging ability often do poorly in science and mathematics.” The good news is that these abilities can be developed by drawing and painting classes.

- *Recognizing and forming patterns* – Every scientific and mathematical hypothesis involves seeing a pattern, say the authors. “For this reason, artists, choreographers, and musicians, whose works invariably invent and play with patterns, have a great deal to teach scientists.”

- *Manipulative ability* – Craftsmanship and fine motor control are vital to scientific success, especially when working with experiments. “As fewer and fewer students take art, music, and crafts classes in school, with some students even failing to learn cursive writing, fine motor control and simple manipulative skills that were taken for granted 50 years ago are today increasingly absent,” say the authors. “Many of our students are truly ‘all thumbs’... We teachers need to remember that implementing knowledge, even in the information age, must still be accomplished through inventions first constructed by hand.”

“The skills, knowledge, techniques, models, concepts, and inventions that artists and craftspeople develop sculpt the imagination, making new sciences and technologies possible,” conclude the Root-Bernsteins. “The best scientists have always known this.” In fact, Max Planck, a Nobel Prize winner and accomplished pianist, said, “The creative scientist needs an *artistic* imagination.”

“The Art and Craft of Science” by Robert Root-Bernstein and Michele Root-Bernstein in *Educational Leadership*, February 2013 (Vol. 70, #5, p. 16-21), [www.ascd.org](http://www.ascd.org); the authors can be reached at [rootbern@msu.edu](mailto:rootbern@msu.edu) and [rootber3@msu.edu](mailto:rootber3@msu.edu).