Science-telling through art

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The stakes for responsible, compelling science art have always been high (an illustrator better get the number of chambers in the heart right) but in recent years they have grown higher. Global environmental challenges require our research to move beyond journal pages and poster halls, while outside these venues (eg on Twitter) the noise-to-signal ratio has steepened. Every figure, whether a thoughtfully rendered close-up of mycorrhizal partners at root tips or a misleadingly binned histogram, now has the potential to reach hundreds of thousands of readers and decision makers. Art can boost science's signal.

But what kind of art cuts through the noise? The tension between offering a figure that instructs and one that inspires has shaped scientific illustration since before Galileo sketched the Moon's craters, or Vesalius published his anatomical drawings challenging Galen's doctrinal human skeleton. This tension still animates our community's approach to communicating our science. In contrast to many visual experiments in which science and art collide, generating an artifact of serendipity, we believe today's science art can – and should – both instruct and inspire, especially when images are grounded in empirical knowledge and brought about by iterative, collaborative engagement between artist and researcher.

In our ecology-driven research center, much of our work focuses on large, invisible phenomena: landscape-level nutrient fluxes, long-term climate change, deep unplumbed permafrost layers, and vast but hidden microbial communities. Through art, we present these systems as one-act plays in miniature that often rely on visual metaphor. For example, microbes don sneakers in footraces or struggle unshod over rough terrain to illustrate how growth rate depends on environmental context (WebFigure 1). Evocative, thoughtful metaphor helps translate science into a language more people can understand, and helps a science story stick by engaging other ways of knowing.

These images are the yield of sustained collaboration between artist and researcher, a process as intensive as the science itself. The researcher brings concepts and a framed objective, deep background knowledge, and an open mind. The artist brings fluency in science, and a commitment to delving into the literature each project requires. Early napkin sketches become more explicit drafts. Like writing, once pencil (or pen tool) is activated, ideas become both crystallized and criticizable. As the details of the art are made available for scrutiny, the researcher obtains a new model on which to test their assumptions. Researcher and artist can then consider the impact of the concept: will it strike the viewer as intended? Or does it have unintended messaging? An overload of accurate detail may need to be pruned, or a simplification may need to be reinforced because the researcher spots a missing nuance that now seems essential. Every cycle can heighten credibility and legibility of the artwork, because emergent properties come into play through prototyping and testing. Rinse, repeat.

As with writing a manuscript, this process takes many drafts and more person-hours but the payoff – a distinctive image that can be shared – is well worth the investment. Because we believe this process improves our science, we offer a course in science visualization that empowers students to create their own visual art. We've found that furnishing scientists with artistic tools at any level creates immediate practitioners who add value to science communication.

Where does one find a science artist collaborator? Search #SciArt on Twitter and you will find a strong community of diverse artists specializing in portraying science. Before our center was able to offer a permanent science artist position, we supported our science–art collaboration through grants (eg US National Science Foundation proposals focusing on the "broader impacts" criterion). Sustained, iterative creation of science art is made easier by having artists and writers embedded in the center or department. While this is not always possible, the two-way iteration we propose can yield similar results in the freelancer model. Further, empowering researchers to become their own science communicators and visual artists can be done in any curriculum.

When Vesalius printed his ground-shifting anatomical textbook *De Humani Corporis Fabrica* in 1543, he knew that his illustrations – accurate, challenging, beautiful – would go viral (via piracy). Vesalius planned on this, and asked his printer to help prevent careless appropriation but offered to share with "any diligent printer" the plates, "made with so much labor for the general use of students". It's this kind of science art we need more of now: images crafted to travel, to cross boundaries; images to be talked about, studied, remembered, and mimicked. Doing so will result in a cultural multiplier effect on how we tell our science stories better in the years to come.