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A Reflection on the Changing Reality of Science

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Point Of View

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From liquids on Mars to CRISPR, significant scientific discoveries are being made each year. These are just the flashy front-page innovations; there are thousands of scientific journals that continually publish discoveries and advancements in our knowledge. Were he alive today, I think Copernicus would be awed by how scientific knowledge has grown and changed over time. He may also agree that the nature of science has remained quite constant. The Nature of Science is a fundamental construct in science education, serving as a pillar in the *Next Generation Science Standards (NGSS)* for K–12 education. According to the *NGSS,* the key ideas regarding the nature of science are:

- Scientific knowledge is based on empirical evidence
- Scientific knowledge is open to revision in light of new evidence
- Scientific models, laws, mechanisms, and theories explain natural phenomena
- Science is a way of knowing
- Scientific knowledge assumes an order and consistency in natural systems
- Science is a human endeavor
- Science addresses questions about the natural and material world (NGSS Lead States, 2013)

Just as scientific knowledge evolves, the reality of science has shifted, is shifting, and will continue to do so. In 2000, Paul Hurd wrote a *JCST* commentary highlighting how science has changed from a disciplinary practice to a broad interdisciplinary network, with dimensions in social sciences, economics, communications, philosophy, and law (Hurd, 2000). Scientists are increasingly working on large-scale projects and in distributed teams, requiring synchronization, project management, and knowledge integration (Cummings & Kiesler, 2014). By default, this approach to science breaks down disciplinary silos. For example, Dr. Prashant Mali's team at the University of California, San Diego, combines expertise in synthetic biology, regenerative medicine, instrumentation, and materials engineering to explore how genes influence human disease (University of California San Diego, 2020).

Despite the nearly 20 years that have passed, Hurd's commentary is still relevant. He stated "It will be necessary to reinvent science curricula, both goals and subject matter" (Hurd, 2000). To align with the shift toward interdisciplinary knowledge, science education began increasingly inclusive of nonscience perspectives, seen first as STEAM initiatives and now with a growing interest in humanistic STEM. Just as there is no one scientific method, there is no one single problem-solving method across disciplines. An integrated approach—with fewer disciplinary boundaries—teaches students not just how to think like a scientist but to apply scientific literacy to personal, social, and civic problems.

The *NGSS* standards adapt to the new reality of science by moving beyond the core content, identifying crosscutting ideas and emphasizing application and integration. While the *NGSS* were not developed for higher education, these standards are still relevant to university-level science education. We cannot expect our students to embrace this shift in the reality of science if we ourselves are not modeling this shift to integration, application, and teamwork. As science educators, we can incorporate the language and crosscutting ideas from the *NGSS* into our classroom. Small changes to the framing of our assignments can shift from content mastery to application and practice of the key transferable skills necessary for scientists, including critical thinking, communication, project management, and teamwork. We can look for opportunities to infuse perspectives from other disciplines into our "hard sciences." At the curriculum level, we can evaluate our degrees to ensure coherency of the crosscutting ideas. Within our research activities and departments, we can take action to make our professional teams more interdisciplinary. Through all of these changes, we can better prepare our students for the reality of science, improving their scientific literacy, which is a key skill regardless of whether they seek a career in the sciences.

The philosopher Heraclitus expounded the theory that "life is flux" (Stanford University, 2016). As scientists, we can appreciate this idea, with the tentativeness of scientific knowledge being a pillar of the nature of science. Embracing this as a science educator, we must recognize that our work to embrace the reality of science is never finished. How will the reality of science change in the coming decades? And how will science education adapt to that new modern reality of science?

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References

Cummings, J. N., & Kiesler, S. (2014). Organization theory and the changing nature of science. *Journal of Organization Design, 3*(3), 1–16.

Hurd, P. D. (2000). The changing nature of science. *The Science Teacher, 67*(9), 1.

NGSS Lead States. (2013). *Next generation science standards: For states, by states.* Washington, DC: National Academies Press.

Stanford University. (2016). Heraclitus. Retrieved from https://plato.stanford.edu/entries/heraclitus

University of California San Diego. (2020). Faculty profiles: Prashant mali. Retrieved from https://jacobsschool.ucsd.edu/faculty/faculty_bios/index.sfe?fmp_recid=374