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Editorial

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Introducing the *Journal of Chemical Education*'s "Special Issue: Advanced Placement (AP) Chemistry"

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ABSTRACT: The College Board has released a new framework for the advanced placement (AP) chemistry course and exam emphasizing big ideas, enduring understandings, and science practices; concomitant instructional changes are underway. In response to a call for papers on the AP chemistry curriculum and assessment redesign, chemistry educators at the high school and college levels have contributed papers collected in the special issue on AP chemistry and briefly summarized here. Ideas for continuing this dialogue in the future are also provided. Papers in the "*Journal of Chemical Education* Special Issue: Advanced Placement (AP) Chemistry" have a designation that they are part of this collection.

KEYWORDS: *General Public, High School/Introductory Chemistry, First-Year Undergraduate/General, Curriculum, Laboratory Instruction, Inquiry-Based/Discovery Learning, Testing/Assessment, Standards National/State, Student-Centered Learning*

AN INVITATION

Two years ago, I invited[1] the *JCE* community to join the conversation about the first redesigned course framework for the College Board's advanced placement (AP) chemistry curriculum[2] in its nearly 60-year history. The restructured course represents the collective work of higher education and secondary school chemical educators taking the time to rethink how the fundamental principles that form the basis of our community's study of the natural world should be presented to introductory students. Shifting away from a paradigm that emphasized algorithmic problem solving and content knowledge on the lower end of cognitive taxonomies of learning toward an emphasis on enduring understandings and scientific practices required a level of reflection and risk-taking that I applaud. Decisions to change what and how we teach our students challenges us to consider what the goals of our teaching should be as well as the function of an instructor in an increasingly technologically advanced context in which so much information is readily available. The reform effort that we are highlighting in this issue is therefore relevant to all who are connected to the enterprise of education in chemistry, and we hope that through this collection of manuscripts you will be stirred to engage others who are wrestling with the ramifications for students and teachers alike.

In response to a call for papers on the AP chemistry redesign,[3] chemistry educators at the high school and college levels have contributed papers to the *JCE* Special Issue: Advanced Placement (AP) Chemistry to share ideas, best practices, perspectives, and recommendations for action. Prior to this call for papers, few resources in the professional literature were available[4] to offer those chemistry educators and students who considered the AP redesign ramifications on instructional practices, laboratory activities, and assessments in the thousands of classrooms worldwide affected by the reforms. I am pleased to report that the resource base has significantly increased, and I proudly share the contributions of the authors whose manuscripts are presented within this special issue. They include commentaries, articles, and laboratory experiments that represent a response to the redesigned AP chemistry course framework and are intended to inform, inspire, and empower its various stakeholders. Here, I briefly highlight some of the topics that are featured and suggest where future submissions might focus to encourage additional dialogue on these issues.

FRAMING THE CONVERSATION

Two papers in this issue attempt to provide the reader with a context for the history, magnitude, and scope of the AP chemistry course. Serena Magrogan traces its roots back to the middle of last century and discusses how it grew to touch so many educators and students across the globe.[5] David Yaron[6] picks up the story in the early 2000s as the College Board responded to a National Research Council report[7] on the state of the AP curriculum and sought external funding to gather experts from the K−12 and higher education communities for reflecting upon the current curricular and pedagogical paradigms. He also shares how the curriculum reform process unfolded, and in doing so, implicitly proposes a model for how our education community could think about our own teaching practices. Contributions from Richard Schwenz and Sheldon Miller,[8] and Christopher Kennedy[9] offer practical advice to those interested in redesigning their own courses to accommodate the shift in emphasis from topic-based to concept-based instruction. Schwenz and Miller walk readers through the course audit process, while Kennedy proposes a curricular structure that has helped him transition into a new way of thinking about how the nature of the discipline should be shared with his students.

TEACHING THE "BIG IDEAS" OF AP CHEMISTRY

Several authors have written about how to carry out the new expectations described in the framework within the AP chemistry classroom. Stephen Prilliman[10] and Erica Post-

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huma-Adams[11] propose how to integrate the new emphasis on models and modeling into their existing curriculum. Prilliman focuses attention on the particulate representation, while Adams describes how understanding just a few fundamental models of how matter behaves and interacts with other matter can capture the "big ideas" of chemistry. Jamie Benigna[12] offers a timely article to help those new to the ideas of photoelectron spectroscopy in understanding, teaching, and assessing this topic. Yehudit Dori and colleagues share a module that is aimed at elucidating some ideas about quantum theory through a visual−conceptual approach.[13] An empirical study by David Schultz and his colleagues[14] into how a blended learning ("flipping") instructional model positively impacted students' learning will be of interest to those trying to find the "extra" time to help students develop a rich, conceptual understanding of introductory ideas.

SHIFTING TOWARD GUIDED-INQUIRY LABORATORY EXPERIENCES

A prominent feature of the newly designed AP chemistry course is its emphasis on guided-inquiry approaches to laboratory investigations. Teachers seeking advice on how to make this transition will benefit from Kristen Cacciatore's account of how the College Board's first chemistry laboratory manual was designed and developed.[15] Carolyn Nichol, Amber Szymczyk, and John Hutchinson[16] describe a model-based approach to collecting and analyzing data before formal instruction is provided, consistent with the approach taken by the AP lab manual and the curriculum described earlier by Posthuma-Adams.[11] Other authors have shared specific laboratory investigations that are aligned with the AP's big ideas, including Laura Lanni's bag-inflation experiment,[17] Andrea Burrows and colleagues' biodiesel lesson,[18] and Prem Sattsangi's *n*-bottle problem.[19] Paul Matsumoto has developed an approach for using Mathematica in both the classroom and laboratory portions of the course and provides examples of each.[20]

EVALUATING STUDENT UNDERSTANDING IN THE AP CHEMISTRY COURSE

After decades of AP exams that followed a challenging but mostly predictable format, insights into how to think differently about assessment are both timely and much needed by many of us. Paul Price and Roger Kugel have served in key roles in both the design and scoring of the legacy ("old") and revised exams, and provide a perspective on how to move away from recall and algorithmic computation and toward concepts and data analysis when student learning is evaluated.[21] John Domyancich adds to this discussion by providing chemistry educators with guiding principles for developing multiple-choice items that are consistent with the AP framework,[22] and Tom Holme shares his perspective as co-director of the ACS Exams Institute on the relationship between the content assessed in its offerings compared to the College Board's.[23]

SUPPORTING AP CHEMISTRY TEACHERS THROUGH PROFESSIONAL DEVELOPMENT

One other contribution comes from authors with experience supporting teachers in the move from teacher-centered to student-centered learning environments. Ellen Yezierski and Deborah Herrington propose a framework and curricular resources[24] for providing the AP teacher community with a professional development structure that can influence both beliefs and practice consistent with the reforms advocated by the College Board.

THE PATH AHEAD

One of the outcomes regarding the AP chemistry special issue that I am most grateful for is how many of those in our K−12 schools and colleges and universities took the time to start a dialogue about how to design, enact, and assess a top-quality introductory chemistry experience for the nearly 140,000 students across 40 countries enrolled in this course every year.[5] My hope is that these conversations will continue, as will the contributions to our understanding of the gaps and shortfalls in how we serve our students. I suggest that potential areas of future inquiry include how we can recruit and support underrepresented minority populations, and those whose native language is not English, to be successful in AP chemistry.[25] We could also benefit from additional submissions to the *Journal* about how to support scientific discourse and argumentation in the AP chemistry classroom.[26]

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Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

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