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## FOREWORD

### **Global sustainability and public understanding of science: The role of socioscientific issues in the international community**

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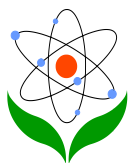
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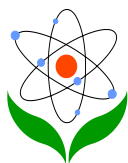
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## Introduction

The central message for this foreword is rather straightforward. I wish to advocate for and emphatically embrace a truly international worldview for the identity of science educators who possess any degree of accountability for the teachers and students under their tutelage. The platform on which I advance the notion of an international identity is one that connects to global sustainability and public understanding science. I suspect that the issue of sustainability, coupled with public understanding of science, is one that virtually all science educators would promote. We have a diverse field – note the array of topics represented by authors within our leading journals. But it seems to me that we do share common goals: scientific literacy for all, teachers who challenge their students' epistemological beliefs, and providing opportunities for students to become responsible citizens who will eventually give deliberate thought to the quality of the natural world in which they dwell.

In recent years, the socioscientific issues framework has provided researchers and educators with a viable means to connect students the with the world around them (Mueller, Zeidler, & Jenkins, Spring, 2011; Zeidler, Applebaum & Sadler, 2011), engaging them in the activity of science (Walker, & Zeidler, 2007; Zeidler, Applebaum, & Sadler, 2011), fostering evidence-based reasoning (Applebaum, Zeidler, & Chiodo, 2010), developing nature of science understanding (Eastwood, Sadler, Zeidler, Lewis, Amiri & Applebaum, in press; Zeidler, Sadler, Applebaum & Callahan, 2009), facilitating scientific literacy (Zeidler & Sadler, (2011), and fostering a sense of ethical caring and character about the social and natural world (Fowler, Zeidler, & Sadler, 2009; Zeidler, Berkowitz & Bennett, 2011; Zeidler & Sadler, 2008). These studies provide a basis to raise viable questions about whether a singular identity of scientific literacy (or at least what I will argue is the most important feature of any notion of what it means to be scientifically literate) is feasible in a pluralistic world.



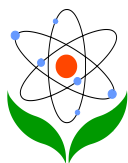
## **Sustainable Science Education in a Pluralistic World**

To begin, let us raise the obvious question that begs our attention: what does it mean to think in scientifically responsible ways? What does it mean to think globally and act locally if words and deeds are to be viewed in a global context? That we live in a pluralistic world with competing values is brute fact to be reckoned with. Defining what it means to think responsibly in a pluralistic community is both an academically interesting challenge and a task that is necessary to support the quality of our physical, organic and social world. Here, I wish to argue that if we hope to achieve a common vision of sustainability and facilitate public understanding of science, then we will find that thinking in scientifically responsible ways requires features of character, which in turn requires the formation of conscience. For this to happen, there needs to exist a sense of *community* in science education.

All of us recognize the need for future scientists to be insightful and well grounded in their respective research programs. But I am also concerned about the larger majority of students who will not seek scientific professions but who, nonetheless, need to be functionally scientifically literate and make informed judgments about decisions that impact the biological, physical and social environment. Character, at least in the sense that I am prescribing, matters. Character is intricately tied to virtue – a sense of being true to oneself and appearing to others in a manner that is transparent; we appear to be who we really are. Hence, our words and deeds are the signature of our character, and our character is bound up in the actions and perceptions of others in the world. The first step toward a degree of sustainable science education in a pluralistic world is recognizing that we are each linked to a pluralistic community of science education.

## **Scientific Literacy as Responsible Decision-making**

If the crux of making informed judgments about worldly matters depends on being scientifically literate, and the expression of scientific literacy is defined in terms of responsible decision-making, then we find ourselves in the mist of tautology. To clear the mist, let us consider the following conceptual distinction. We need to ask ourselves if we can imagine a world where one can be properly identified as being scientifically literate, yet bear no responsibility to subsequent decisions made about policy, research, community, family and the like. We would likely agree that such



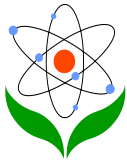
an individual would possess technical competence, but lack the *inclination* to enact that knowledge with due consideration of the world around them. In the alternative, can we imagine a scenario in which one makes consistently responsible decisions that impact the world around us and lacks scientific literacy? We would be hard pressed to imagine such decisions not being *informed* by knowledge of or about science. It would seem that some manner of scientific literacy is a prerequisite to making responsible decisions, though not a sufficient condition for such decisions to occur. While literacy may not require a moral compass, scientific literacy, in the sense that I am prescribing, does.

## A Worldview of Scientific Literacy in a "Free Market State"

The important tenet that bundles these ideas is that the *Scientific Community*, which mirrors the ‘free market’ state of Community proper (Gemeinschaft), is in its ideal form, *open* and *inclusive* to the free exchange of arguments and ideas (Tönnies, 1963/1887). Communities based on Gemeinschaft shared a common work or calling, kinship or neighborhood, spirit or mind – hence common beliefs, virtue, and morality could spontaneously arise. Thus, an artisan or professional could create and produce goods without calculation of units of time and compensation. (In contrast, Gesellschaft represented a process, as well as a state of affairs in which individual associations were guided by a network of legal and moral relations that were not naturally produced, but imposed with calculation to aggregate citizens into a type of polis based on instrumental economic utility.)

The claim that I wish to advance here is that when the scientific community reaches a degree of consensus that arises organically out of common interests, like the pursuit of knowledge through evidence-based inquiry, a state of Gemeinschaft is achieved. What unifies us, therefore, is the presupposition of personal utility and social value placed on evidence and the construction of knowledge. Such a *worldview* subsumes both the canons and orthodoxy of western science (i.e., positivism, scientism, etc.) as well as that which western science describes as *ethnoscience* (i.e., native science, indigenous ways of knowing, etc.)

I am keenly aware that some may see such an inclusive view of “scientific” knowledge systems as conflating. But I am suggesting that when the derivation of knowledge through persistent observation and exploration is coupled with clear reasoning, and the subsequent decisions that follow are based on known *evidence*,



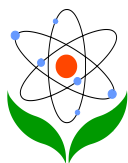
when one can provide justification and be open to criticism, revision or refinement, thereby reconceptualizing that knowledge, then an open, unfettered state of (scientific) community may be said to exist.

## **Avoiding the Bifurcation of Science Through Prudence**

My argument is also one that views the bifurcation of science into non-normative components (e.g., data gathering, observation, predictions, scientific methods and processes) and normative components (e.g., prescribing courses of action, choosing to create selected products, decisions about what ought to be done) as one that is fraught with peril. While such a distinction is, arguably, conceptually important, it can create a splintered view that allows for the abdication of any sense of *responsibility* during the practice of science.

That conscience is tied to a sense of prudence – a sense of acting in one’s own interest is a central point in connecting character to scientific responsibility. Here, a dynamic tension between prudence and scientific responsibility is an interesting notion as there is a kind of duality present:

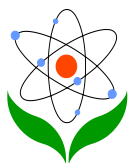
...prudence [is] associated with foresight; it entails planning and is evaluative or reflective in nature. To plan ahead, to plot one’s next move, form practical judgments about public affairs and do it well also requires a sense of looking backward; examining one’s prior experiences and understanding them in contextual hindsight is necessary to contribute to a collective, socially-shared ethic of memory (see: Margalit 2002). (This is the reason Aristotle thought it difficult to teach ethics to the young for they did not have adequate experience for establishing a sense of history.) The importance of a collective memory may be understood in at least two related forms: 1) it requires cultivation of empathy about past humanity – a necessary condition to form emotive ties to the present and future; and 2) it provides a foundation of moral commitments to humanity (in contrast to parents, friends, people directly in our affairs) on which a general sense of care and morality is built. Reflective foresight then cannot be achieved without the ability to look backward – without attention to its counter part of memory. Taken together, looking forward and looking backward are the yin and the yang of prudence (Zeidler and Sadler 2008, pp. 204-205).



In the conception of science education I am proposing, prudence is expressed by virtue of the fundamental function found in the deliberate choice of what works and makes sense with respect to the quality of life for each individual, as well as how it contributes in morally just ways to community survival. As decisions are evaluated in terms of their future ecological consequences and in terms of how the amelioration of historical wrongs may be leveraged, conscience may now be allowed to emerge. This describes a world, perhaps a best-case scenario, where the practice of science becomes *inseparable* from acts of responsibility. In such a world, we recognize prudence as the cultivation of scientific responsibility through the expression of social justice in the scientific community. While many scientific communities are loosely articulated around the world, I believe that we must view science and science education as a global endeavor, unified by conscientious scientific thinking and acting through the formation of character. In this world, the processes of science become causally linked with the products of science. And because so much of what we do scientifically has potentially global consequences, responsibility becomes even more ethically obligatory.

## Membership in Scientific Community

By encouraging responsible scientific thinking, I aim to foster conscientious scientific practices for all students. Within the scientific community, “conscientious” may be viewed as the attitudes and actions that demonstrate great care and attention to conducting any task. However, this requires not only technical competence, but *moral aptitude* as well. There must be present a sense of *rigor* that stands in contrast to what many engaged in “professional ethics” would think of as merely a “sense of right and wrong.” In contrast, I would like to suggest that science education, in the pursuit of rigor, focus on formation of what Green (1999) terms the *conscience of craft*. The metaphors typically used here include phrases like “hitting the mark” and “perfect practice” reflecting traditions of the classic Greeks who equated morality with skill and craft. It is in this sense that I would wish to advance rigor as the ability to skillfully craft judgments and initiate actions out of a cacophony of partial and often conflicting evidence. These are tools of virtue – crafted in such a way as to live skillfully and prudentially. To this, I wish to emphasize that membership in the scientific community – being part of a pluralistic world, carries with it moral obligations to the welfare of that community as well as other communities at-large. (It is interesting to note that the Greek word for “individual” was *idiotes* for someone who was disengaged from the polis and



all aspects of public and community life. Of course, contemporary etymological derivation gives us the word “idiot.”)

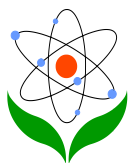
So, to avoid a sea of nattering nabobs of negativism and idiots (apologies to William Safire), a reasonable approach may be found in fostering responsible scientific thinking through agency. Sociocultural perspectives in science education have compelled those who recognize the power and potential benefits it holds for our students to mesh scientific literacy with a sense of personal identity. Equally important is the development of shared commitment to agency at the group and community level. To help realize this, pedagogy needs to be *transformative* in both formal classroom contexts as well as informal social settings.

## **Transformative Science Education: One Global Community**

Both identity and agency entail the ability to engage in reflective thought and apply one’s awareness of epistemic schemes to new contexts. It seems reasonable then, to use the construct of agency to foster responsible scientific thinking, and ultimately the development of character. Doing so is *transformative* in that it allows freedom of thought and the liberating power to engage in and be part of a wider network of niches in the social and natural environment.

As we strive to promote functional scientific literacy characterized by reflective judgment, the formation of conscience and the development of responsible scientific thinking that they together comprise, we find that the formation of character becomes a necessary component to foster responsible agency in the global science education community. This, to my way of thinking, is a fundamental precondition for any notion of global sustainability.

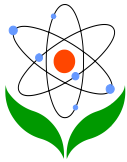
There is more work to be done and there are more questions to consider. International research in science education offers the opportunity to undertake to flesh out and explore these areas from multiple perspectives. These are, indeed, exciting times in science education! How fortunate we are to share this temporal cross section with one another! Let us continue moving forward to become one global community of science educators and researchers.



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