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Abstract	Life can be complicated and manifest problems, and associated opportunities, abound. Whereas challenges can be occasions for gnashing of the teeth and wringing the hands, they also are resources for forging new pathways. Differences often can be a resource for disagreement – sometimes violent in a world that competes for energy and resources needed for myriad products for purposes such as construction of buildings, machines, weapons, transportation, communication, computation, and entertainment. Because the Earth's resources are finite there is competition to obtain what is needed to produce high-quality living. Inequities arise because of very uneven distributions of resources, including money and power. As problems arise they are fixed to the extent possible. However it is now time to take a close look at science and its relationships with the universe – identifying ways to sustain harmony and wellness. Respecting difference and collaborating with (different) others is a priority for science educators if they are to have relevance on the road ahead.	

Chapter 18
Section Editorial – Ponder This: Science Education in Times of Challenge | Opportunity

Kenneth Tobin

Life can be complicated and manifest problems, and associated opportunities, abound. Whereas challenges can be occasions for gnashing of the teeth and wringing the hands, they also are resources for forging new pathways. Differences often can be a resource for disagreement – sometimes violent in a world that competes for energy and resources needed for myriad products for purposes such as construction of buildings, machines, weapons, transportation, communication, computation, and entertainment. Because the Earth's resources are finite there is competition to obtain what is needed to produce high-quality living. Inequities arise because of very uneven distributions of resources, including money and power. As problems arise they are fixed to the extent possible. However it is now time to take a close look at science and its relationships with the universe – identifying ways to sustain harmony and wellness. Respecting difference and collaborating with (different) others is a priority for science educators if they are to have relevance on the road ahead.

Consistent with a goal of enhancing literacy of the world's citizens, science educators might review their priorities to embrace goals such as harmony, wellness, and sustainability of the living and nonliving universe. As the chapters of this book attest, there is an urgent need for transformation on a global scale to reverse deterioration of the conditions necessary to support comfortable human lifestyles. Human initiated problems such as global warming have catalyzed changes in ecosystems that are deleterious to equilibria and patterns of life, not just for humanity, but for other organisms as well. A plethora of scientific reports suggest that human life will change for the worse because of human induced changes to ecosystems, with a possibility that mass extinctions could occur (Kolbert 2014).

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Reporting in the Age on March 31, 2014 Deborah Snow and Peter Hannam used an eye-catching headline (Climate change could make humans extinct, warns health expert) to attract my attention to their article and a (then) soon-to-be-released United Nations report published by The Intergovernmental Panel on Climate Change (http://www.ipcc.ch; IPCC). I read with interest and growing concern about an interview with Helen Berry, one of almost 30 authors of Chapter 11 of the report, representing scientists from numerous disciplines and 15 countries. The newspaper article drew on ~~the~~ a chapter from the IPCC report and a co-authored "Conversation" involving three Australian contributors to the chapter (McMichael et al. 2014). In contrast to most of the IPCC report, the Conversation focused on the threat that climate change posed to the life-support system. Anthony McMichael, Colin Butler, and Helen Louise Berry discussed climate change in relation to well-being, health, and human survival, connecting the consequences of climate change, and associated environmental conditions to human health. There was even a suggestion that humans might risk extinction unless corrective actions are taken, immediately, and globally.

If progress is to occur toward goals such as harmony, wellness, and sustainability, the public needs to alter its practices and values. In a context of public education seeking to produce and maintain literate citizenry to sustain the living and nonliving universe, we appear to have a long way to go. It is dubious that the best way is to focus on pre K-12 curricula since those who have participated in formulating goals for science education more often give higher priority to goals aligned with providing the United States economic and militaristic edges over other nations, and obtaining manpower needed for the growth of science to thereby attain the edges being sought (Tobin 2011).

What a person values, notices and regards as salient reflects the frameworks s/he uses to make sense of social life (Tobin 2008). These frameworks constitute a standpoint, and everyone has one, even if it is often difficult to articulate in its entirety (Harding 1998). Developing new standpoints can alter what a person experiences, notices, and values. For example, I regard knowing science as cultural enactment, which consists of schemas and dialectically related practices. Accordingly, I experience culture as patterned action, having thin coherence and associated contradictions, which I regard as resources for transforming social fields. To teach and learn about what happens in a field, it makes sense to emphasize schemas (i.e., discursive knowledge) and associated practices. Such an approach, which contrasts with traditional approaches that privilege discursive knowledge over its enactment, provides equal attention to both and explicitly focuses on what to do, when and how to act, and why practices need to be changed. Thinking about teaching and learning in terms of enactment raises serious questions for educational reforms which target only or mainly the ~~pre-K-12~~ population. There is no doubt that citizens spend much more time out of school than in it, and there are fewer restrictions to constrain what can be taught, how it can be taught, when it can be taught, and how learning can be assessed. It seems like a no-brainer! It is a priority for science educators to embrace the production and maintenance of literate citizenry, birth through death.

The K-12 curriculum revolutions of the 1960s and beyond did not make much of a difference to what was taught and how it was taught (e.g., Tobin 1987). Innovations occurred, flourished for a time, and died out as macro forces mediated science education. Somewhat ironically, macro forces, including a tendency to commodify learning, assess all students on specified standards, and hold individuals accountable for student achievement, appear to have sustained a status quo that has reproduced familiar problems associated with equity, declining standards, too few people in the science, mathematics, engineering and technology (SMET) pipeline, and failure of the US to attain the highest ranking in tests of international comparison. Problems such as these have preoccupied science educators who mostly have operated within a prevailing theoretical (mainstream) framework consisting of crypto-positivism, monosemia, scientism, and competitiveness focusing on using science education to bring out the best in individuals (Kincheloe and Tobin 2009).

In making an argument for expanding the number of science educators who focus on science education for public literacy, I acknowledge a need to continue to emphasize science education in pre K-12 schools and what some refer to as free choice institutions (e.g., museums, zoos). In a specific context of ecojustice and a larger framework of sustainability, I call for more science educators to change their professional practices to undertake scholarly activities focused on the public understanding of science. What this call implies is that more science educators will explore ways to educate through persuasion – situating their research in an increased number of fields in the lifeworlds of citizens, 7 days × 24 hours, as largely unexplored *opportunities* to educate the public.

What are the appropriate ways to educate citizens about science? Approaches will likely vary from country to country and within a country from location to location. Also, many demographics will make a difference to the resources considered salient. For example, I access and learn science through print magazines (e.g., Science, and National Geographic), the World Wide Web (e.g., sites such as CNN, BBC, the Age, and the New York Times). Also, more than occasionally I use Wikipedia and Google to identify science oriented pages that are of interest to me, and I purchase and access books electronically on my iPad. Other resources that contribute to my science education, to a lesser degree, include email, television media, print newspapers, social media (e.g., Facebook), and billboards. It seems important that science educators ascertain which resources different demographic groups from around the world consider salient for science education. Landscape studies are an essential next step so that ~~parallax~~ research agendas can be formulated concerning how best to educate citizens of the entire world about harmony, wellness, and sustainability.

What Counts as Science

[AU3] Western modern science (WMS) has flourished and the explosion of science knowledge has been exponential in many fields of science. As science has expanded its bounds other ways of knowing and being have been supplanted and devalued.

Embracing parsimony and the mindset that science was a pursuit of truth, advances in science were seen as replacements for inferior ways of knowing and being. Science has expanded in many ways, possibly because of it being connected to economic development, defense capacity, comfortable lifestyles, and medical advances. Private and public resources support the expansion of big and little science to reflect global priorities of governments, global corporations, and wealthy philanthropists. Accordingly, the expansion of science is ideologically driven, focused on the priorities of neoliberalism and globalization – which still dominate many macro aspects of being in the world. Rather than WMS being accepted as a complement to traditional knowledge, it was seen as a substitute and viable ways of being and knowing were marginalized, discredited, and lost. The process of marginalizing and losing knowledge systems is connected to scientism and it is possible that their loss has contributed to some of the major problems that now confront us.

Monosemia can be thought of as a condition whereby one system of social truth is accepted as a viable referent for social life. Under such conditions there is little wiggle room for difference and deviations from accepted canon are regarded as errors. Right and wrong can be ascertained by referring to the canon. Scientism holds science as a superior knowledge system that is universally applicable, gradually evolving toward truth, its legitimacy being upheld by stringent peer review and adherence to established norms. What counts as science is often rigidly defined and efforts to accept other knowledge systems as scientific are frequently met with hostility. In contrast, polysemia is multilogical, embracing multiple knowledge systems as referents for viable conduct of social life. From this standpoint different knowledge systems can provide alternative ways of looking and experiencing social life. From a polysemic standpoint different knowledge systems would not have to cohere with other accepted knowledge systems since contradictions are expected and are viewed as resources to potentially improve the quality of social life. Hence, different knowledge systems are regarded as complementary rather than alternative.

Consistent with the promise of enhanced potential, science educators might engage in recovery research whereby they identify lost knowledge systems and study the viability of those aspects that seem applicable to present-day social life. For example, in our research on teaching and learning science in urban schools we have identified a high priority for developing a toolkit for all people to ameliorate intense emotions when and as necessary. As we have developed interventions as part of a dynamic toolkit we have noted that knowledge systems that have been in existence for hundreds and perhaps thousands of years are salient. For example, numerous practices derived from Jin Shin Jyutsu (JSJ) can be used to ameliorate emotions unobtrusively as social life is enacted. As we explored the vast JSJ knowledgebase it was apparent that its foundations could be regarded as complementary to medical practices grounded in WMS. Throughout social life there were possibilities to educate the public on self-help procedures to address specific health problems and maintain wellness.

Given the long history of JSJ it is no surprise to note that almost every medical problem can be addressed using well-documented practices. Since JSJ is not seen as replacing WMS, questions about what to do should not be couched as either/or choices to be made. This is an area in which science educators could take a lead. As we are finding in our research on emotions the use of breathing meditation to

heighten mindfulness has many positive aspects, including changes in the structure and function of the brain, producing antibodies to fight sickness, and changing aspects of physiology such as body temperature, blood pressure, oxygenation of the blood, and pulse rate. We are now in a position to test whether meditating on holds and flows from JSJ can promote higher levels of wellness in the community. For example, to what extent can the application of practices from JSJ address successfully every day wellness problems such as high blood pressure, variations in body temperature, seasonal allergies, tinnitus, common colds, headaches, hemorrhoids, and sore backs, wrists, shoulders, and legs? It is possible that JSJ practices, which do not involve the use of pharmaceuticals, would have lower impact on global warming and deterioration of ecosystems. The dual challenges of undertaking research on the uses of JSJ procedures and educating the public about self-help possibilities are legitimate and high priority components of science education in the foreseeable future. A fertile field for science education involves the retrieval and reconstruction of lost knowledge systems, testing the viability of tenets that are applicable to social life, making desirable adaptations, and educating the public on how to enact healthy lifestyles using complementary knowledge systems.

I do not underestimate the difficulty of educating the public. Recently, a well-educated neighbor complained to me about ongoing problems he was having with tinnitus. After expressing my sympathy I inquired whether it was a problem at the moment. He said the problem was with him always and it was a source of annoyance and distraction. It was particularly bad during social occasions such as the one we were attending. I told him I might have a possible solution for this problem. He was both incredulous and interested. I explained how JSJ recommends at least four practices that are relatively straightforward – but one he could use immediately was to wrap the fingers of his right hand around his left ring finger. I instructed him not to squeeze too hard and to concentrate on feeling the pulse that can be felt during this hold. After about 10 min he could exchange hands, wrapping the fingers of his left hand around the right ring finger. I advised him that adopting this practice would minimize problems of ringing in the ears and might even eliminate them. He assured me he would give it a shot. “Do it now!” I urged him. With a laugh he grabbed his left ring finger and as I walked away I wondered – “how long will he do this?” I checked back with him over the next 90 min and every time I looked he was not holding his finger. Of course I chided him and he immediately grabbed his finger with a laugh. He did not expect it to work and felt that the practice was simplistic, especially in the light of a decade of failed pharmaceutical treatments. He was expecting to have to take something rather than accept an old way of thinking about wellness in terms of harmonizing energy flows.

Transforming Roles of Science Educators

Even though the production of knowledge in many fields of science is growing exponentially there is dire need to provide the public with access to this knowledge. Customarily scientists focus [redacted] eminating their work to peers and relevant

professional and academic groups. Most citizens cannot, and do not access what scientists write for other scientists. So there are some important questions to be answered – what scientific knowledge should be disseminated to the public? What resources should be used to disseminate contemporary science knowledge to the public? Should scientists communicate directly to the public, or should intermediaries also be involved? Questions such as these need answers if the community is to understand contemporary advances in science and adjust lifestyles to address wellness, sustainability and harmony.

Structure of the Chapter

In this chapter I focus on harmony and sustainability as requisites for wellness and the health of the universe. In my response to ways in which science educators can engage today's major challenges I address global warming, extinction of species, problems of dichotomizing matter as living and nonliving, and learning science from the media. In so doing I address the themes of expanding the roles of science educators to improve public understanding of science, increasing the focus of science education scholarship to cover the lifespan from birth to death, making sense of disagreements among scientists, and learning science from the media. If bold ventures of enhancing public understanding of science and right conduct are to succeed it is essential for learning to incorporate meaningful dialogues of all people using multiple discourses – not just WMS. For example, assigning different priorities to different forms of life have obvious connections to ethics and religion and extend far beyond science. Having said that, essential conversations must be multilogical and polysemic. After all, decisions about which organisms are considered food have obvious implications for harmony, wellness, and sustainability.

Global Warming

Is there a greater indictment on the failure of science education than global warming? It is striking to me that every political leader and politician is a product of science education. They all studied science at school and in many cases went on to take university level courses as well. However, it seems clear that their education fell short of providing them with the understandings needed to act decisively to minimize the buildup of carbon dioxide and associated rises in temperature. The release of the fifth report of the Intergovernmental Panel on Climate Change (IPCC) raises numerous challenges for science education. For example, throughout the world there have been dramatic headlines in the media concerning implications ranging from the extinction of humanity as temperatures rise by 4 °C in the next 100 years, thereby providing insufficient time for humans to adapt to global changes that impact the quality and harmony of the universe. As a whole the research emphasizes that

humanity has adversely impacted equilibria within complex networks in ways that cannot be reversed and will greatly impact life as we know and experience it.

A chapter of the IPCC report summarizes the health risks of relatively rapid global warming on humanity, predicting severe hardship as a function of social class and related social categories such as nationality and race. Of course, not all of the many scientists who authored and edited the IPCC report accept its findings. For example, an economist resigned from the committee, arguing that the conclusions are exaggerated and overblown.

Extinction is certainly a dire prediction and it seems self-evident that humanity has never faced a more pressing priority for education and transformation. Can the situation be reversed? For that matter, what is meant by reversed? Obviously it is impossible to return exactly to an a priori set of conditions – so what is meant when reversal is contemplated? Clearly, appropriate action has ethical dimensions because even at a global level there are more living species to be considered than just humans – or just Americans – as the case might be. Accordingly, to make a claim that reversibility is not possible or that irreversibility is inevitable is in many ways trivial. The more important thing is to consider, when actions are planned, what macro conditions are being sought, in which parts of the world or universe are they applicable, and what are the benefits and harms of making efforts to re-create identified conditions? At the very least all citizens need to be educated to understand problems and how to enact new lifestyles that will not exacerbate global warming and myriad associated conditions. Furthermore, politics has to lead the way in ensuring that the entire community is reconstructed in ways that are fair and equitable. The solutions, if they exist, would have to transcend national boundaries and the divisiveness of self-interests, political parties, and international competitiveness.

How might science education respond to critical issues such as those I have addressed here? It seems self-evident that such a response needs to be immediate and yet we seem to be decades away from being ready to respond proactively. Science education is immersed in what it has traditionally focused upon. In order to be responsive and proactive, science educators will need to rid themselves of the shackles of the past! There are at least two broad components to be addressed – to understand the problem in ways that lead to commitments to personal and collective transformations. Learning needs to extend beyond language to embrace ongoing, continuous, never wavering change to sustain the universe. This must be associated with a moral value associated with sustainability and an abhorrence of deviations from pathways leading to sustainability. An important ingredient of what is learned is responsibility for all humans to act in ways that foster harmony across networks/ecosystems. Acting in ways that acknowledge interdependence of all living and nonliving components of the universe seems central to social life and an overarching goal for science education.

The scientists who authored the chapter of the IPCC report examined the implications for humanity of extreme weather events, the loss of habitable land, and changes in factors such as infectious disease, and mental health. In a separate article three of the chapter authors emphasized the necessity for pervasive and immediate

change warning: “Of course, none of this matters if human well-being, health and survival means little to us. In that case we can emit all we like, then suffer, dwindle or even die out as a species and leave this planet to recover and thrive without us. One way or another we will then emit less” (McMichael et al. 2014, p. 5).

A question for science educators to ponder is what steps might be taken to afford levels of critical literacy that would allow all citizens to make sense of the problems we face and then to address them appropriately for the constituent individuals and communities? In conjunction with the planning and enactment of a curriculum for literate citizenry there are associated research priorities that take account of citizens knowing in ways that support appropriate and timely action. It is not just a case of being able to read, write, and talk about problems, but also of appropriately acting in the world. In this particular example appropriate action includes seeking other perspectives, understanding them, and examining their affordances. That is, seeking alternative perspectives rather than dogmatically adhering to a personal perspective. Being willing to listen and learn is important and so too is speaking in ways that expand the conversation rather than converge toward a narrow set of conclusions. On the other hand when inequities and unethical conduct occur, it is important for individuals to be courageous, speak up, and act in accordance with the motive of social justice.

Prioritizing Humanity

In a context of ecojustice, Heesoon Bai (2014) discussed implications for harmony of the tendencies of scientists to dichotomize matter as living and nonliving and thereby to create a hierarchy of values that prioritized living over nonliving and within each category to assign higher value to living and non living and then to give more weight to humans than other life forms.

Bai convincingly showed that animism is a way of thinking that does not distinguish between life and non-life, preferring instead to acknowledge the networks associated with different aspects of social life. For example, since life can only be sustained in a balanced ecosystem in which it is adapted it makes little sense to separate human self from the structures (i.e., resources) that sustain it. Significantly, it is not just what is present, but also the connections, networks, and strengths of relationship. Harmony cannot be taken as infinitely self-adapting and reproducing. Indeed, it can be argued that a human science might seek to understand how social life, as part of an ecosystem, would adapt to sustain harmony. Continuous exploitation of the ecosystem to benefit humanity may have extinguished networks and changed connections and bond strengths, forging new equilibria and types of harmony. In so doing new systems evolve and unknowable futures might emerge. The point is not to argue for a status quo, but to acknowledge the fragility of the equilibrium associated with harmony within ecosystems and to focus science on hermeneutic – phenomenological pathways that value wellness, sustainability, and

harmony. Such a focus would assume re-visiting the historically grounded misfortune of dichotomizing living and nonliving and defining selves in terms of solitary bodies rather than all bodies in their sustaining networks: the failure of models to acknowledge inseparability of selves and non-selves may have supported the development of science as focused on a value system that distorts the emerging canon and its appropriation by institutions such as politics, medicine, media, and militia.

Educating the Public About Disagreements Among Scientists

Although disagreements among scientists are common, the public rarely sees them as a sign of strength. Instead, difference is seen as weakness and often is regarded as a pathway away from difficult choices. However, educating the public about disagreements and difference is a priority that extends far beyond science and science policy. Arguably, the public needs lots of practice at listening to and understanding different perspectives, especially perspectives that differ from their own. Also, as is the case considered in this section on epigenetics and in the next section, on global learning, it is important to be able to weigh options in terms of their potential to improve social life. It comes down to much more than deciding right and wrong. What is not so clear is what disagreement means for the different publics that consume and produce science (operating from a theoretical foundation in which each act of production is both reproductive and transformative). Science educators might address this issue as a priority so that programs can be planned to educate different people about how to make sense of difference and how to act in the wake of difference.

Michael Skinner asserts that chemicals can catalyze changes to gene expression that persist across multiple generations of animal species (Kaiser 2014). If this assertion applies to humans there are obvious implications for human health and the maintenance of an ecosystem that supports harmony. Many skeptics and opponents have strenuously resisted his claims, which are supported by an ongoing program of research. At the same time others enthusiastically endorse Skinner's research. Despite the salience of Skinner's research to all living things, there has been what Jocelyn Kaiser describes as "bumps in the road" (Kaiser 2014). These include the necessity to redact a paper published in 2009 because of inadequacies that Skinner perceived in the work of one of his postdoctoral associates. Also, his ongoing research has been funded through political earmarks, supported by Congress, through the Department of Defense. These studies have looked specifically at chemicals that soldiers might encounter – such as insecticides, jet fuel, dioxin, and plastic additives such as phthalates. This funding source ceased when the Congress banned earmarks.

There are many questions associated with literate citizenry that relate to the situation involving Skinner's research. For example, to what extent does research conducted with animals such as mice and rats extrapolate to humans? Whereas it is

important not to expose any animals to a toxic environment, it is reasonable to assume that most will want to know the extent to which Skinner's research applies to humanity. Should citizens understand why Skinner's research was funded through the Department of Defense using earmarks rather than the National Institute of Health or the National Science Foundation? Does this pattern of funding represent the controversial nature of the research and the difficulty of it being funded because of peer review? Is it cause for concern that the research is no longer receiving government funding? Questions such as these pertain to sustainability of life because toxic environments can catalyze changes in the characteristics of offspring, which can then be passed on from one generation to the next. Skinner's research suggests that after three generations the implications of toxicity were evident in offspring.

The implications of epigenetics extend beyond whether Skinner's research is or is not funded by government sources. If polluted environments can change the biochemistry of offspring across multiple generations the implications for all organisms are profound. Just as global warming is a priority for harmony, well-being, and sustainability, so too are the implications of epigenetics.

Science in the Media

Science is well represented in the media and for that reason alone there is a pressing need for serious research to examine the representations of science in the media and ways in which the media educates the public about science. For example, the CNN home page has many links to science-related articles, often containing video clips and photographs that are related directly and indirectly to science. As is the case with reporting of the news on TV channels like CNN, particular reporters and shows reflect standpoints and associated ideologies that extend far beyond reporting news. Headlines on the website are designed to attract attention, lure readers to engage in the stories, and come back for more. Not only does the content of the CNN website reflect a political ideology, it also reflects macrostructures such as neoliberalism and capitalism. The checks and balances on the curriculum that might apply in institutions associated explicitly with educating children and older youth (e.g., pre K-12 schools, museums, zoos) are not in place when it comes to educating the public through the media.

Very different standpoints are incorporated into the science-related stories on the CNN home page (www.CNN.com) on May 8, 2014 when I accessed the website for the purposes of including examples in this chapter. In a story about shark attacks in Western Australia there is a strong sense that inappropriate and ineffective state level policies were enacted to address a perceived increase in human fatalities due to shark attacks. The evidence provided in the report is biased towards a conclusion that there really was not a significant increase in the rate of human fatalities due to shark attacks, draconian solutions trapped and killed many sharks, and trapped sharks were not of the same species responsible for the deaths of swimmers.

Précis 1: 172 Sharks Caught, 50 Killed

In Western Australia a government-sponsored program has caught 172 sharks and killed 50 of them as part of a culling program to protect swimmers. In the past 3 years, sharks have killed seven people. The report explained that the 3-month program, which ended last week, used baited lines attached to floating drums to catch sharks off popular beaches in Western Australia. When sharks were caught on hooked drum lines the policy permitted Tiger, Bull and Great White sharks longer than 3 m in length to be destroyed. However, none of the sharks captured were Great White sharks, the species associated with the recent human fatalities. Most of the captured shark species were Tiger sharks, which had not been involved in human fatalities for decades. Furthermore, in excess of 70 % of the captured animals (e.g., stingrays), were not large enough to be considered a threat to humans. The report noted that many of the sharks released alive from the hooks on the floating drums were found to be in a "state of shock" and sank to the ocean floor.

Presumably the public that reads this article has a great deal to ponder relating to ways in which humanity interacts with sea life. Questions emerge concerning the extent to which human recreation does and should impact the harmony of the marine ecosystem. Educating the public about the science related issues in this report might be a focus for scholarly activities of science educators. Obviously the research would extend far beyond CNN and its homepage and probably would involve the role of media in science education.

For example, on May 6, 2014 the White House announced the National Climate Assessment (http://nca2014.globalchange.gov), providing evidence of human-made climate change. The report emphasized that human action is needed immediately. The comprehensive report is a call to action and highlights a challenge that is central to this chapter and expanded roles of science educators, perhaps to research the efficacy of teaching schemas and practices in an integrated way to all citizens and, in research and evaluation, assign equal priority to both.

Précis 2: Bill Nye Battles with CNN Host

A contrasting example that typifies science-related reports in the media involves the TV personality Bill Nye the Science Guy. Because of the US national report on climate change Bill Nye was invited to appear on Crossfire, a political show designed to be volatile and argumentative, pitting the political left against the right in often-heated debate. It is not unusual for speakers to interrupt one another, raise their voices, show anger, disrespect, and disdain for others' perspectives. The viewing audience expects this format and probably accesses the TV version of the program to be entertained by the heated and controversial nature of the arguments. With this in mind guests are invited to appear on the show to present different standpoints. To receive and maintain a turn of talk a speaker needs to understand the genre and

participate accordingly. Usually it is necessary to expect interruptions and be prepared to speak quickly, fluently, and at times loudly and audaciously.

People who connect to excerpts from Crossfire that are published on the Internet would probably be attracted by the headline "Bill Nye battles with CNN host." Although the headline is accurate it relies on the name recognition of Bill Nye to draw an audience. Presumably those who access this report know about Nye, his high profile TV series, and its contributions to science education. I accessed the report expecting to see Nye triumph over a bumbling CNN host, science trump non-science, and well-argued positions defeat political rhetoric related to self-interests. To my surprise the CNN host represented science and scientists as bullies, accusing Nye and people like him of shoving science down the public's throats with little success. A short video clip selected from the television program began with a female reporter describing the report as "scare tactics." Nye objected and endeavored to speak. However, the reporter insisted he remain silent while she presented data to the effect that only 36 % of Americans considered global warming a serious threat to their lives. She concluded with the query: "Don't you need public consensus to move the needle on this?"

Probably flustered by the format of Crossfire, Nye resorted to rapid-fire talk and, rather than good science, he used economic rationalism to support his arguments. He spoke quickly, presumably to maintain his speaking turn. He mentioned Oklahoma and its recent tornadoes, Alaska with no particular reference to anything, New York City, and Super Storm Sandy – all the while focusing on economic effects and costs of rebuilding infrastructure because of global warming. Nye then turned to crop failures, and the economic costs of continued drought in California. A person selected to represent a counter view interrupted him, noting that he accepted the science: "but …" His speedily put argument was that the science was not solid and there were signs that the problems associated with greenhouse gases and burning of fossil fuels were being remedied already. He argued we should not disrupt good business with costly programs such as those being enacted through Democratic policies to reduce emissions and minimize the carbon footprint. Green practices were regarded as economically unviable – reducing international competitiveness. In an effort to move to a debate format Nye noted that: "we disagree on the facts." This was not going to work. The politically right guest commented that not all scientists agree and the politically right reporter concluded the way she started: "it is a problem when science guys bully other people… The science guys have tried to shame anyone who disagrees with this – and it is not working with the public."

Opportunities to learn science from the segment from Crossfire were limited to say the least. On another level the political nature of interactions reinforced a perception that what is and is not scientific fact is decided by a polling of public opinion. The debate over the facts was adversarial, superficial, and rapid. My thoughts were that the political left would identify with Nye and the viewers on the right would align with the argument of the host and her guest. This type of program might be a major setback for educating the public about science. The demographic that watches CNN is hardly representative of the citizens of the world, or for that matter the citizens of the United States. Science educators need to ask and seek answers to the

question – what media resources provide an appropriate science education for literate citizenry? The examples I provide here, concerning two programs from CNN, can whet the appetite of science educators seeking to engage in meaningful scholarship.

Making Progress

My experience with transformations is that changes in practice always seem momentous when plans to change are enacted and, when viewed historically, they appear to be small steps from the prior trajectory. Accordingly, moves toward harmony, wellness, and sustainability will seem like giant strides when they are enacted and history will view them as tiny, but hopefully a turn in a better direction. What is to be accomplished? In even seeking to answer this question the cautionary bells are chiming loudly. Goals can be hegemonic and panoptic. Labeling is reductive. It is impossible to represent full meaning with words. The bells are tolling. Right action is needed now. More than seven billion humans need to change direction to make changes that are both individually and collectively appropriate with the umbrella goals of harmony, wellness, and sustainability as a guiding framework. Compassion appeals as a referent for reviewing what is happening, why it is happening, and what needs to be done next. But, more is needed and I would add to the mix, cogenerative dialogue, which includes right speech, mindfully speaking, and mindfully listening.

What research in science education in the past 60 years has led to significant improvements in the field? I am sure any science educator could generate a short list of studies that would reflect his/her epistemology, ontology, and axiology. Sitting with others to dialogue about their lists might be a good place to start in terms of listening and learning from others as they explain their lists and identify how they can be expanded to connect with harmony, wellness, and sustainability. Maintaining the status quo cannot be an option because from almost any perspective the stakes are high and there is work to be done. Individualism and competition are failed referents for producing the best in science education and commodification is inappropriate. Authentic inquiry is needed to produce individual and collective benefits that are global in scope, and involve a broad vision of the universe and the dynamic equilibria needed to sustain high-quality continuous being.

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