Communication & Language at Work (2019) Vol. 6(1), 16-24

COMMUNICATION &LANGUAGE at work

The assembly and circulation of science: An analysis of the necessity (yet lack) of narrative strategies in STEM curricula

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Abstract

This article positions narrative as a needed, but often lacking, communicative resource for science technology engineering and mathematics (STEM) professionals. While STEM curricula is quite effective at teaching students discipline-specific knowledge and preparing future generations of scientists to communicate within collegial discourse communities, there has been little attention paid to the importance of communicating effectively with public audiences—despite the fact that the public is a major stakeholder in scientific innovation. This article takes up this gap in current STEM curricula in order to provide a comprehensive understanding of best practices in communicating science, as well as the ways that these practices can be incorporated into academic programs. In achieving this goal, this article draws upon current pedagogical and curricular models in communication studies in its examination of the ways students at a leading American undergraduate STEM institution are taught to engage with public audiences. Of specific importance are the benefits of narrative in building bridges between academic and public stakeholders, particularly the ability of narrative to increase comprehension, interest, and engagement when communicating science to non-expert audiences.

Keywords

STEM, Citizen-Science, Narrative, Rhetoric and composition

"It is difficult to avoid the conclusion that scientists' willingness to listen to public concerns is proportional to the anger and threatening tone in which those concerns are expressed." (Thompson, 2007, p. 290)

1 Introduction

In the current socio-political media-driven climate there is a growing public distrust for those in positions of power, in the last several years we have seen a significant decline in the public's trust in government, business organizations, and journalistic media (Edelman, 2018). Another facet of distrust lies in the publics' perceptions of scientific innovation and research, and while this distrust is not a new phenomenon, it is one that we need to work vigorously to combat rather than maintain the current path of acceptance and deference. This article argues that the most effective way to shift

this public attitude is not to better educate the layperson on scientific topics, but to better prepare future scientists to engage with non-expert audiences. In essence, this article argues that post-secondary institutions, at the both undergraduate and graduate levels, need to rethink the work that novice scientists engage with inside the academy in order to ready these student-scientists to transition into professionals that realize and uphold "scientific citizenship." In the words of Alan Irwin, "Scientific citizenship requires an open dialogue between science and citizens and transparency in information and knowledge exchange" (Nerlich, 2014). Unfortunately, the ability to have an "open dialogue" is extraordinarily challenging when the two sides are unable to communicate effectively. This article, then, offers the genre of narrative as a tangible solution to this ever-growing problem, and provides suggestions for implementing narrative approaches within STEM curricula. This implementation is positioned at the intersection of curricular revision and pedagogical development, and is informed by the discipline of rhetoric and composition.

Most students who have chosen to study within a field of science, technology, engineering, or math often do not encounter the genre of narrative beyond their liberal arts general education requirements, and in many of these classes the benefits of narrative when communicating to non-expert, or public, audiences is rarely a point of consideration. While I do not contend that it is singularly the role of liberal arts faculty to prepare future scientists to communicate effectively, and concede that this task must be taken up at all levels of academic preparation, I hold firm in my position that core, general education curriculum is the place to start. Quite simply: scientists have more often than not been effectively trained to engage with the public, so we cannot expect undergraduate and graduate science faculty to be able to teach this skill—yet.

One of the first things educators across disciplines need to address in order to combat this failure in our current educational model are the major challenges in communicating science, which have been outlined by the American National Academies of Science, Engineering, and Medicine (NASEM). NASEM recognizes the four major challenges as: difficulty in engaging the public, converging influences, science-related controversy, and media (National Academies, 2017, p. 4). While all of these challenges must be addressed if we are to better prepare scientists to be engaged citizens, this article focuses on the first of these: engaging public audiences, which I position as an inherent condition of the other three challenges. In examining this obstacle, this article puts into conversation what may seem disparate perspectives, including the work of scholars spanning the disciplines of science education, communication studies, rhetoric and composition, narrative genre theory, and second language writing.

2 Literature Review

In order to engage all sides of this conversation, this article will begin with an interrogation of the basic tenets of scientific communication and narrative genre as envisioned through the lens of a generic public discourse community. We will begin with an examination of the "citizen-science partnership," explore the ways that narrative can bolster this relationship, and bring these two perspectives together in a discussion of what a STEM curricula that values these alliances would include.

Hayden (2017) has argued towards the cultivation of a "citizen-science partnership" that is informed by "a narrative-based approach to science communication." In such an approach, there must be a framework for information and knowledge exchange; scientists need to understand the needs of lay audiences, and citizens need to acknowledge and value the role of science in their daily lives. Central in this assertion is the role of narrative, which responds to Dalhstrom's (2017) findings that "audiences are more willing to accept normative evaluations from narratives than from more logical-scientific arguments" (p. 13616). However, it is not enough to realize that narrative has a role in the "citizen-science partnership," it is also necessary to foster and encourage scientist-students, and later scientist-professionals, to take up and employ narrative strategies in their communications, which in itself is an often overlooked pedagogical goal in post-secondary curricular. While leaders in STEM fields are steadfast in claims that communicating science effectively is a "complex task and an acquired skill" (National Academies, 2017, p. 1) there has been less attention paid to "the approaches to communicating science that will be most effective for specific audiences and circumstances [which] often are not obvious" (National Academies, 2017, p. 1). Perhaps the implementation of narrative is "not obvious" to those in STEM discipline; however, to scholars in various liberal arts disciplines, including my home discipline of rhetoric and composition, the value of engaging with narrative genres, such as storytelling, in the communication of science is strikingly apt.

Narrative, particularly in the form of stories, offers a means to disseminate complicated information, allowing those in this partnership to grasp often obtuse concepts. Noddings and Witherall (1991) explain, "we learn from stories...we come to understand—ourselves, others, and even the subjects we teach and learn. Stories engage us...[and] can help us to understand by making the abstract concrete and accessible" (p. 279). While we often associate stories with childhood, it would be shortsighted not to acknowledge that even in adults the ability to tell stories is viewed as a

talent and asset across various social and professional situations. Whatever the circumstance, stories have been recognized as a tool to help "illustrate abstract concepts, and motivate the learner" (Klassen, 2010, p. 305). For this reason, I will now turn to the aspects of narrative and storytelling that are most important in reimaging STEM curricula, with an eye towards fostering Hayden's "citizen-science partnership."

2.1 Science Communication

The broadest definition of "science communication" as offered by NASEM (2017) is "the exchange of information and viewpoints about science to achieve a goal or objective such as fostering greater understanding of science and scientific methods or gaining greater insight into diverse public views and concerns about the science related to a contentious issue" (p. 2). Central to this definition are the pillars of what would constitute a mutually beneficial citizen-science partnership; namely, using science in "fostering greater understanding" and "gaining greater insight" for both scientists and citizens. In essence, this definition is linked to ideas of dialogue and the communicative exchange of ideas; while current STEM curricula does always encourage the exchange of ideas, these exchanges are regularly modeled for students within the confines of discrete disciplinary communities (e.g. electrical engineer-to-electrical engineer, rather than electrical engineer-to-lay citizen). NASEM does, however, offer five goals of this imagined science-to-citizen dialogue: "to share the findings and excitement of science," "to increase appreciation for science as a useful way of understanding and navigating the modern world," "to increase knowledge and understanding of science," "to influence people's opinions, behavior, and policy preferences," and "to engage with diverse groups so that their perspectives about science related to important social issues can be considered in seeking solutions to societal problems that affect everyone" (National Academies, 2017, p. 2). Moreover, what is implicit to these five goals is the assumption "that a lack of information or understanding of science fully explains why more people do not appear to accept scientific claims or engage in behaviors or support policies that are consistent with scientific evidence" (National Academies, 2017, p.3). As such, the onus for comprehension is placed decidedly on the shoulders of the citizen. This is not a new perspective, a decade earlier science philosopher Paul B. Thompson warned that "while one should not underestimate the public's capacity for both unwarranted fear and unwarranted enthusiasm, it is questionable whether anything more than the most basic kind of literacy is a prerequisite for beginning a discussion" (2007, p. 5). Fundamentally, this is why teaching narrative as a tool to engage public audiences is a shift that needs to happen. Narrative is a genre that citizens and scientists are already familiar with, despite any sort of inquiry-based formal education in this area, which is one reason why it is advantageous to recognize the benefits of narrative as a learning tool within STEM curricula. Bruner (1986), for instance, offers two ways that humans order experience: paradigmatic, which is logico-scientific and based on reasoning, and narrative, which is, as stated above, the creation of stories based in shared experience. This article pushes for a pedagogical shift in our usage of narrative, arguing that STEM students should be versed in both types of learning and communicative sharing—not one or the other.

2.2 Paradigmatic science communication vs. narrative storytelling

Scholars in science communication understand a major feature of communicative exchange to be an "excision of the personal" (Avraamidou & Osborne, 2009, p. 1684). Conversely, storytelling is dependent upon the personal and "aims to provide reasonable depiction of individual experience" where legitimacy is often based on situation (Dahlstrom, 2014, p. 13615). In this way, paradigmatic science communication "aims to provide abstract truths that remain valid across a specified range of situations. An individual may then use these abstract truths to generalize down to a specific case and ideally provide some level of predictive power regarding that specific," while storytelling "provides a specific case from which an individual can generalize up to infer what the general truths must be to permit such a specific to occur" (Dahlstrom, 2014, p. 13614), and as such the personal is centralized. However, just as we encounter astute scientists and astute storytellers, we cannot forget that both these talents are learned and practiced. While Avraamidou & Osborne (2009) are correct in their assertion that "the discourse of science requires a long and arduous apprenticeship" (p. 1684), I would add that to be a keen storyteller is also a laborious skill to acquire. Thus, rather than hold the two types of communication, paradigmatic and narrative, against each other it would be more resourceful to understand how they can work together in fostering a citizen-science partnership.

For instance, instead of disregarding stories as unscientific, curricula can shift its focus to engage with and consider the benefits of storytelling within a scientific topic or discourse community. Namely, there is a need to recognize within our curricula that stories are a part of our daily lives, which allow citizens "to make sense of the world" (Avraamidou & Osborne, 2009, p. 1686), enable scientists "teach or convey" information (Avraamidou & Osborne, 2009, p. 1687), and provide "a familiar structure" for (foreign) information (Avraamidou & Osborne, 2009, p. 1688). To put it simply: stories are a benefit to scientific communication because—unlike paradigmatic

communication—"narratives are easier to process and generate more attention and engagement than traditional logical-scientific communication… [and] already represent the format with which most non-experts receive their information about science and narratives are intrinsically persuasive (Dahlstrom, 2014, p. 13617). What these definitions indicate is that there are inherent benefits to communicating science via narrative because these communications are arranged and situated in ways that non-expert audiences are not only familiar with, but also trusting of. As stated, it is the lack of trust between citizens and scientists—often propagated by impervious linguistic choices—that leads to breaks or barriers in communication. Thus, in providing best practices to overcome these impediments, it is necessary is to examine current work in science education to fully define how science communication is understood by those in the fields of STEM, as well as how current educational models of science communication engage with non-expert public audiences. In the following section we will move to a more pedagogical frame, taking into account the perspectives of disciplines that are more focused on classroom and curricular practices.

3 Discussion & Findings

The following section offers a glimpse into the initial stages of rethinking narrative strategies within STEM coursework. The institutional experiences provided are used to inform this curricular reimagining, and are positioned as the current norm in STEM education. I contextualize these experiences via a liberal arts lens and as an educator whose scholarly background spans both the sciences and humanities—my graduate degrees are in areas of the rhetoric, language, and literature; however, I also have an undergraduate degree in biology.

The structure of experiential education at my home institution relies on a heavily integrated cooperative education program; this educational model is central in shaping my own impressions on the integration of narrative in STEM curricula. For example, this institution is unique in that it is structured on a quarter system, where students move from course-work to work-term regularly until graduation. In this institution, students do not need to "imagine" their future workplaces, or what it means to be a professional, because they embody this reality every three months; however, this does not mean that their academic classroom experiences and their technically-driven co-op experiences align. In order to understand pedagogical and curricular shifts that could better prepare these (and other STEM) students to be professionals, this article moves to consider some basic narrative strategies that are aimed at (a) engaging students in communicative work that extends outside their liberal arts classrooms, and (b) engaging students in communicative work that extends into the public domain, with emphasis on citizenship and public engagement. First, however, I will provide a contextual background for my home institution, which will offer a description of the undergraduate programs available to students, as well as an analysis of how courses in rhetoric and composition surface within these programs.

The university where I am employed is a leading undergraduate STEM university in the midwest United States. It offers thirteen undergraduate degree programs in the areas of science, engineering, and mathematics; in contrast, while there is a liberal arts department, there are no humanities or social science degree programs. The undergraduate curriculum, for the majority of students (roughly 60% of the student body are mechanical engineering majors) requires only two general education courses in communication (writing and speaking), one in their freshman year and one in their junior year. Moreover, these courses—as currently designed[1]—are more concerned with teaching students technical and academic writing rather than public writing and narrative. Beyond these two courses students may choose to take upper level electives in communication studies, however there is no guarantee that these electives will engage students with citizen-science ideologies. And, while there are STEM faculty who assign communicative projects (most often presentations and research papers), there is no significant interdisciplinary, cross-curricular work being done to prepare students to communicate with citizens who live outside the mores of the academy. Thus, in this institution (like

[1] The current Communications courses have been on the books for almost three decades with little to no revision. The communication faculty (all with rhetoric and composition degrees) are, however, in the process of reimagining these courses so that technical and academic writing, while still taught, will be less pervasive components of the curriculum. The new curriculum will place value on public writing and narrative, as well as work to put all four genres of communication into conversation with each other.

many)[2] the out-dated status quo remains, with faculty focused on creating STEM-savvy professionals who are part of an elite—and in the words of Avraamidou & Osborne "disconnected"—discourse community.

Over the past decade in the U.S., however, there has been a slow movement away from STEM towards STEAM (where "A" stands for the Arts) education (Beal, 2013). Those who champion STEAM argue that "more abstract ideas of rights, values, and meaning—core elements in our study of the humanities" are missing in current STEM education (Lackman, 2018). At my own institution, for instance, the once separate departments of sciences and arts were amalgamated two years ago under the College of Sciences and Liberal Arts. This new structuring encourages interdisciplinary collaboration similar to the European Commission's recommendation that "[w]orking across disciplines helps build deep and diverse relationships, which are important for work and for life [and] fosters comparison, exchange and synthesis of different systems of knowledge" (2015, p. 21). However, within my broader institution, which is also home to a much larger College of Engineering, many faculty and student views on the "A" can be described in terms of the larger phenomenon of liberal arts education were "[t]he humanities are reduced to a service role where they work under the direction of the sciences. Rather than producing knowledge of their own, they exist merely to make the sciences seem more human" (Willis, Castell, & Wattington, 2018). This is evident in the eight core general education requirements the majority of STEM majors must complete, with at least two of these (the rhetoric and composition courses) being identified as service courses that have been designed to teach students technical and professional discourse conventions, rather than respond to the gap in their abilities to communicate with non-experts outside of their classrooms and professional lives.

This article, through emphasizing the benefits of narrative-based pedagogies and experiences works to move beyond the current status quo in STEM education and articulate best practices for engaging STEM students in the cultivation of citizen-scientist partnerships. In efforts to accomplish this, I draw upon narrative research in my home discipline of rhetoric and composition and consider ways that curricular redesign both within these courses and across the STEM curricula can foster citizen-scientist communicative partnerships. The discipline of rhetoric and composition offers a unique approach to science communication because scholars have expertise in a broad range of fields, including: narrative, technical communication, composition pedagogy, public writing, writing in the disciplines, and writing across the disciplines. Put simply, scholars in this area are a useful resource because their work engages a number of aspects of science communication across various audiences and purposes.

For instance, one way to align the work of science educators and those in my home discipline is through emphasis on, attention to, and valorizing of the personal voice, which is an important characteristic of narrative-based communication. Jane Danielewicz, a rhetorical genre theorist, has argued that because narrative is both expressive and tied to ideologies of personal voice it is a useful starting point for engaging undergraduate students with communicative projects (2009). Similarly, Gere (2001) acknowledges the importance of the expressive nature of narrative, when she explains, "there is general agreement that personal writing is prose that gives significant attention to the writer's experiences and feelings" (p. 204). Both these perspectives align with researchers in the area of science education and communication who have noted that in order to disseminate scientific knowledge (to novice students and public audiences) we need to deliver "science stories that involve real people (with real feelings and motivations) solving real problems, in ways ordinary people can empathise with" (Gilbert, Hipkins, & Cooper, 2005, p. 13). In other words, we need to pay attention to expressive "experiences and feelings," despite the fact that these attributes are not inherently "scientific." In this way, I suggest that we need to move away from paradigms that position scientific discourse as a singular entity, and instead shift to prepare STEM students for future communicative experiences where "the context moves from data collection to the communication of science to non expert audiences, [in these situations] stories, anecdotes, and narratives become not only more appropriate but potentially more important" (Dahlstrom, 2014, p. 13614). It is this perspective that is missing from current STEM curricula; moreover, the failure to include such varied perspectives within our current teaching practices is a primary reason why the citizen-science divide continues to expand. This is where the work of rhetoricians and compositionists can be used to inform STEM curricula. It is

[2] A survey of the three largest and prominent post-secondary institutions in this region of the U.S.—Michigan State University, University of Michigan, and Wayne State University—indicate that their approach to science communication within STEM curriculum mirrors the curriculum at my home institution. For instance, the mechanical engineering curriculum at Michigan State University requires one four-credit (one semester) communications course (Michigan State, 2016); the mechanical engineering curriculum at University of Michigan requires no specific communications courses, but does require one three-credit (one semester) course in humanities (Mechanical Engineering, 2018); and the mechanical engineering curriculum at Wayne State University requires one three-credit (one semester) communications course, as well as two technical communications courses each three-credit (one semester, each) (Wayne State, 2018).

accepted amongst rhetoric and composition scholars that when students enter into the university personal narrative, due to its reflective expressionism, is a straightforward writing assignment. Thus, at this academic moment, personal narrative is a genre many students are familiar and comfortable engaging. This article suggests that instead of working to erase this ability in our drive towards creating scientists we need to hold on to and cultivate it. Following this reasoning, personal narrative and reflective writing need to be reconsidered as tools that can help advance STEM perspectives rather than hinder them.

To reiterate: current configurations of STEM curricula, where we value only singular scientific discourse communities, are impeding students communicative proficiency and literacy in other areas—areas that will be important to them as professionals. As such, we need to rethink ideas of literacy development in STEM curricula and consider the benefits of biliteracy—adeptness in multiple discourse communities—because positions of multiplicity enable students "to draw from across the whole of each and every continuum," and therefore increase "the chances for their full language and literacy development and expression" Hornberger and Link (2012, p. 243). In this way, curricula that values multiple literacies—the ability to move between discourse communities—holds ideologies of continuity and connection as central to communicative negotiation, which I argue concretizes the foundations of citizen-science partnerships. Such an approach, which requires students to engage in multiple literacies, positions students to better understand the usefulness of all discourse communities and worldviews throughout their communicative processes.

It is worthwhile to note that Hornberger and Link's research is grounded in multilingualism and second language writing pedagogy. However, this research is a valuable point of inquiry for science education and communication research due to the reality that scientific discourse communities are quite closed off and insular. Consequently, second language scholarship proves useful because in many ways scientists are translating ideas and concepts to a "foreign" audience. In this way, the same moves that second language students make in their efforts to communicate in a target language are quite similar to the moves that scientists must make as they work towards fostering a citizen-science dialogue. Accordingly, Hornberger and Link's (2012) contention that "pedagogical practices where students hear or read a lesson, a passage in a book, or a section of text in one language and develop their work in another… foster language and literacy development" (p. 242) are also important skills for STEM students to develop and practice. This approach is echoed in Avraamidou & Osborne's (2009) suggestion, "[t]he technical nature of the language of science (i.e., use of scientific vocabulary, definitions, terms, theories) not only makes it hard to understand scientific concepts but it also reflects specific messages about its nature and, in particular, that science is for the experts—the scientists, as only they are the ones that can understand this language" (p. 1684). In this way, the work of scholars in areas of multilingualism, second language writing, and translation studies (among others) is advantageous in considering the citizen-science divide due to the ways this research centralizes pedagogies that favour linguistic negotiation between two disparate groups while promoting end goals of creating shared meaning, understanding, and knowledge. As Guillaume Gentil, another scholar in biliteracy and second language writing, notes "[as] people use a language, they realize some of its meaning potential by making linguistic choices among possible options in specific contexts" (2011, p.13). In regard to science education and communication: science cannot be effectively communicated if scientists are not able to realize the shifting nature of their audiences and audience contexts. Further, if we don't encourage and teach our STEM students to practice communicating scientific discovery to a diverse array of audiences we are also negatively affecting their own literacy development. In essence, paying heed to narrative-based choices in the STEM classroom—choices that surround meaning, understanding, and knowledge-building within a citizen-science partnership—also work to better develop scientific learning within future STEM professionals.

Consequently, the primary problem that must be solved is how to break down the barriers, namely static science-based linguistic choices, between insiders (scientists) and outsiders (citizens) because these are what cause "exclusion and creat[e] inaccessibility" (Avraamidou & Osborne, 2009, p. 1684). Scientists need to rethink the medium of their message. And, as suggested by this article and the variety of scholars cited, the best medium for this message is the genre of narrative. We are still left, however, with "the challenge for science communicators," which "is to decide when and how narratives can effectively and appropriately help them communicate to non experts about science" (Dahlstrom, 2014, p. 13614). The solution I propose is that, as educators, we must consider the work of those outside the disciplines of science communication to see the ways that their research can overlap with ours. For instance, my earlier attention to multilingualism, while not recognized in current science communication scholarship is alluded to in the work of Avraamidou & Osborne (2009) who note that "an expanding industry of knowledge intermediaries or science communicators has developed to provide 'translations' between the discourse of science and the language of the public" (p.1684). The problem here, however, is that the intermediaries—most often media outlets—cannot help but change the message, to some extent, because they are not the experts, they are the translators, which is problematic because translation is always an imperfect act. Yet, there seems to be no check and balance in place because of our current pedagogical failures to train experts in communicating with non-experts.

To summarize, this article contends that STEM programs need to move away from communicative goals that are tied to discrete academic and professional discourse communities; it is short-sighted to imagine that future scientists will not engage with a wider range of audiences throughout their professional lives, particularly at this moment, when many of the world's problems are seated in scientific discovery and innovation. This article has argued that there is a strong relationship between curricular change and developing students' communicative abilities, which has been supported through a review of research across the fields of rhetoric and composition. The current curricular models of STEM education, as noted herein, do not emphasize the importance of recognizing and connecting to non-expert audiences, and, thus, new curricular approaches need to be implemented if we truly want the lessons of science to be disseminated into the communities we live in. One way this actualization can occur is through shifting STEM to STEAM; emphasizing the need and usability of narrative storytelling within science communication. Moreover, this article positions that students who are able to engage with multiple communicative strategies that honour and validate narrative story-telling, such as the integration of personal voice into dense scientific material, will be positioned to cultivate citizen-scientist partnerships. Ultimately, the need to integrate narrative into science communication and science education lies within ideologies of trust, especially with non-expert audiences. Consequently, there is a growing need within STEM curriculum to rethink the work that novice scientists engage with inside the academy so that these student-scientists are prepared to transition into professionals that realize and actualize the necessity of building and maintaining trust within "scientific citizenship."

4 Conclusion

Throughout this article I have argued towards the need to integrate narrative storytelling within post-secondary science programs, and that it is the responsibility of the academy, particularly those in the STEM fields, to recognize and dismantle the current obstacles that threaten the citizen-science partnership. Again: the most effective way to diminish public distrust of science within society is to better prepare future scientists to engage with non-expert audiences in ways that are meaningful to regular people. This task is not in the hands of any one academic department, but is instead interdisciplinary in nature, which is perhaps one reason why this shift in pedagogical practice is such a complicated endeavor. In the words of NASEM, "the diverse disciplines that study aspects of science communication and science-related controversies are…disconnected. Researchers in these various disciplines need opportunities and mechanisms for working together to develop more unified theories, concepts, and definitions of the factors that matter to communicating science (National Academies, 2017, p. 9). Indeed, we need to work together for these changes to occur. To conclude, I outline three possibilities for future research and pedagogical development, all of which are based in NASEM's major challenges for science communication:

1. Create interdisciplinary, team-taught courses. These courses should occur throughout all stages of undergraduate and graduate degree programs. Such courses would bring together and explore the converging influences on science communication across disciplines in order to best prepare students to engage with competing perspectives on scientific topics.

2. Create STEM courses that value public audiences. These courses will be primarily discipline-specific in scope; however, they would also include communicative assignments that require future students to not only engage formally with the public about science, but also use personal writing to reflect upon the successes and failures of these interactions.

3. Engage with the media and controversy in our classrooms. Require students to follow science stories in the media. Prepare STEM students to practice linguistic negotiation across a variety of audiences, with attention to the ways that the media translates complex, dynamic, and competitive topics for mass consumption. Moreover, invite students to unpack these controversies rather than dismiss them, and work with STEM students to better understand the social forces behind science-related public controversy.

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