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Introducing the *JMBE* Themed Issue on Science Communication

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How would you define science? Many dictionaries define science as a systematic process of gaining knowledge through observation and experimentation. Reference to communicating this knowledge is not mentioned, yet science does not exist without telling another human what was discovered. Additionally, the skills needed to effectively converse with the public about scientific discovery are often not learned, taught or practiced. Fortunately, thanks to professional organizations such as the American Society for Microbiology and a growing number of universities that teach communication skills within their science curricula, scientists are getting better at presenting to all types of audiences.

Following a call for papers in 2017, scientists and educators submitted a wide variety of articles for this issue of the *Journal of Microbiology & Biology Education* (*JMBE*) that address a broad range of communication resources, perspectives, and information. The authors reminded us it is our responsibility to facilitate the understanding of scientific information for colleagues, students, and the general public, and to engage listeners in meaningful conversations, not lectures. This *JMBE* thematic issue enables scholars and practitioners to share their knowledge broadly and encourages all of us to have some fun as we dip our toes into the waters of science communication. (An interesting discussion about metaphors can be found in the article by Taylor and Dewsbury.)

This special issue dovetails nicely with other *JMBE* thematic issues such as Scientific Citizenship (March 2016) and Scientific Ethics (Dec 2014). We have an obligation to communicate science responsibly, without exaggeration or intent to deceive. We must engage the public in scientific conversations that clearly explain what has been discovered, how it was done, and who did it. However, this is not enough. Scientific messages need to get into the head, heart, and gut of all audiences in order to inform and inspire others and move them to action. How we present material matters. What cultural references we use matters. How we engage students matters. As researchers and educators, we communicate science on a daily basis. Whether we're writing a manuscript for publication or giving a lecture in a biology class, we need to convey information and listen carefully to disparate groups of people. This *JMBE* issue impacts on our ability to do this.

While reviewing manuscripts for this issue, we were drawn to papers that made us think differently about these important issues. We were drawn, too, to papers that pushed traditional academic boundaries. Papers that especially piqued our interest were Aune *et al.* (Using Nonfiction Narratives in an English Course to Teach the Nature of Science and Its Importance to Communicating about Science), Taylor and Dewsbury (On the Problem and Promise of Metaphor Use in Science and Science Communication), Todd *et al.* (Fostering Conversation about Synthetic Biology between Publics and Scientists: A Comparison of Approaches and Outcomes), and Bankston and McDowell (Changing the Culture of Science Communication Training for Junior Scientists). These papers caused us to think more intentionally about three aspects of science communication. First, we are reminded that the language that we use in the classroom and in our presentations and writings matters. Second, these papers tie in very nicely with the inclusive pedagogy conversation that is ongoing at many institutions and make us consider how information is conveyed to and from diverse audiences. Third, these papers show the value and necessity of interdisciplinary training. There is great value in sharing expertise across academic departments, and

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numerous opportunities exist for teaching science communication skills in collaboration with other academic sectors.

The journal's editors have divided the 37 papers in this issue into seven sections. Note, however, that these are operational designations—papers could often fit into multiple sections. Every section contributes a wealth of information about the role of communication in science and how to become better communicators.

Writing skills

The ability to write clearly is central to the preparation of science research papers, seeking funding for research or training, impacting policy, and interacting with the public through the news media and opinion editorials. Papers in this section report how a strong scientific literacy background can enhance student success in advanced science courses, as well as give students the tools to write science succinctly in simple terms understandable to any reader.

Oral skills

Oral presentations are typically made at professional conferences, laboratory meetings, job interviews, and when teaching classes and talking with family and friends. The key is to talk about science as if involved in a conversation with the audience, speaking clearly, concisely, and with interest. Tools and exercises for improving science talks can be found here.

Posters

Poster presentations are often used as a major communication venue at professional conferences. Posters are unique in that they combine visual, written, and oral presentation and are often the product of collaborative research.

Professional development

Professional development in science depends on opportunities to learn and practice the principles of good science communication. Papers in this section provide unique ways to teach science communication to researchers at various career levels. Presenting science to non-technical audiences is essential for all scientists, and there's no better time to start to learn than early in a science career.

Public engagement and outreach

This is when the theoretical become real. Once techniques to improve our science communication have been learned, the only way to get better is to practice in the real world. The nine papers in this section provide fascinating (and sometimes delicious) ways to tell people about your science and who you are.

Resources & Collaborations

The papers in this section report ways we all can incorporate science communication into our academic curricula. Often universities with great communication and education infrastructures fail to recognize existing tools and resources to teach communication in, for example, biology courses. Collaborating with other institutions, departments, and experts in other fields (theatrical arts, journalism, literature, history) can provide an exceptional opportunity for science communication instruction.

Cultural change

Finally, papers in the Cultural Change section remind us that all scientists must continually improve as communicators. Lectures that are boring collections of PowerPoint slides filled with data that can't be seen, read, or understood by the audience are no longer acceptable. Bad communication hurts all of us in science. Good communication makes you, your lab, your department, and the entire university/company look good.

We are reminded in nearly every paper that the best way to communicate is through storytelling. Science can be told through stories using many forms of communication: written reports, pictures/cartoons, videos, blogs, webinars, songs, and dance. Stories explain who we are, what we value, and what we have discovered. Stories tie the speaker to the listener, resulting in elevated credibility, acceptance of the message, and an ability to persuade.

Stories connect the scientist with the audience through the use of human emotions, such as happiness, anger, fear, surprise, disgust, or mystery. Regrettably, the inclusion of even modest human emotion in science presentations has been rejected in the past because of a misconception that it shows a lack of objectivity or professionalism. If scientists are going to continue to have social/political impact, we must emotionally connect with our audiences. Let's learn from our past mistakes. As promulgated in many of the papers in this issue, communication must become an integral part of the training of all scientists. Continued improvement in skills such as storytelling should be a goal within every scientist's career development plan.

With the papers presented in this issue, readers should be able to 1) implement the techniques described into their curricula and training, 2) understand important concepts in science communication, and 3) acquire the knowledge and understanding to evoke change at their institutions, which can lead to the implementation of better scientific communication training for current and future scientists.