2. *The kids are actually producing new results, and do make "real" contributions to the minister.*

3. *They are asking open-ended questions.* They determine that green energy is practical and they learn about the disadvantages that they can explore further in other parts of the exhibit. They discover that . the world is not only made for "yes" and "no" answers.

4. *Students know their work is important.* The results of each player's App are being stored and can be analyzed by teachers later in their classrooms.

Teachers Opinion: The App is Very Useful in the Exhibition and Afterward

This is feedback we have received from teachers, who took their classes to the workshop, and who evaluated the work with the App. They felt that the App:

•Raised the motivation of students considerably
•Was the student's preferred media
•Contributed to surprisingly high concentration in the exhibition
•Was easy to use, compared to paper and pencil
•Allowed better content understanding
•Made the exhibit personal and relevant
•Created ownership
•Created a bridge between work in the exhibition and work afterward

And What about the Work Back in the Laboratory? What Did we Learn?

•Students wanted their own contributions to be presented
•Their work was taken seriously, which is essential, when you are asked to work

Kids engaged in the exhibit using the new App on their smart devices

•80% of teachers claimed that the App did add value which could not have been obtained by the exhibition or the workshop separately

Conclusion

It was possible to create an App-tool, which could stimulate inspiration from the hands-on exhibition and bring it into the more classic instructor-students workshop environment. The power of modern handhold technology gives more patience to study, more ways of dialogue and more self-made products to bring further.

Celia Ekelund Simonsen is a PhD fellow at the University of Southern Denmark, DREAM, Odense. She may be reached at Celiasi@dream.dk. Poul Kattler is an exhibition designer at the Experimentarium, Copenhagen, Denmark. He may be reached at poulk@experimentarium.dk.

The Science of Science Communication II

By David A. Ucko

Findings from the "science of science communication" continued to emerge at the second National Academy of Sciences Sackler Colloquium (September 23-25, 2013) addressing this topic. Although the focus remained "communication" rather than "learning" per se, those engaged in informal learning would do well to follow this growing body of social science research (Ucko 2012). Research in this field has been stimulated in part by challenges in communicating such topics as climate change, where simply providing more or better information may prove inadequate or counterproductive (Kahan et al. 2011). When addressing such complex issues, communication must take into account perceptual filters and "motivated reasoning" shaped by values, ideology, and other factors (Nisbet and Scheufele 2009, Scheufele 2013). Science communication research also has been stimulated by the Internet and social media, which have enhanced the ability of scientists to reach the public directly (de Semir 2010).
The following are selected remarks from the Colloquium, highlighting those most relevant to aspects of informal learning (with apologies to the presenters for any misinterpretation).

Audience and Society

1.Science communication must be informed by the target audience's culture, which shapes its cognitive processes (e.g., how the world is perceived and knowledge gets organized). A mismatch or outsider perspective may undermine engagement and alienate. The term "public" is homogenizing. [Doug Medin, Northwestern University]

2. People are not idiots. Effective science communication requires both respect and trust. People trust others like themselves, who share the values of the group. Society's images of various groups can be characterized on a grid with the dimensions of warmth and trust. Scientists are stereotypically viewed as competent but cold, and therefore not trustworthy. Groups in this category of high competence/high status and low warmth/competitive are viewed with envy and jealousy. (In the same group are rich people, female professionals, lesbians, feminists, Asians, and Jews.) To overcome this bias, scientists should seek to form a warm relationship with the audience and share why they do science (not just for money,which is often viewed as their motivator). In addition, scientists should impartially communicate the science, including uncertainty, and avoid attempting persuasion on particular policies. In contrast to "cold" researchers, teachers are trusted because they are viewed more favorably as warm, so scientists should embrace a more 'teacherly' mindset [Susan Fiske, Princeton University]

3. Scientists should try to place themselves into the minds of a skeptical audience by connecting through simple stories that combine evidence with narrative; overcomplication often reduces credibility. Communicate "this is what we know" and how we reduce uncertainty. Tell the audience why you went into science to make your motivation explicit. Don't tell the audience what to do. [Bill Hallman, Rutgers University]

4. Social context matters. Affect and values influence beliefs, supporting the illusion of overconfident understanding and fostering an unconscious allure of in-group positions. As a result, minority views are often overweighted; "unpacking" can reduce their support. [Craig Fox, University of California, Los Angeles]

Social Networks and Media
1. Social networks can provide leverage to make possible scaling of science communication. Information obtained from media gets spread through opinion leaders. It is not only what you know that is important, but who you know (as well as what others think you know and who they think you know). Not all nodes in a social network are equal; seek to reach the touch points who serve as brokers or disseminators. [Noshir Contractor, Northwestern University]

2. The internet has made possible "mass personal communication" through platforms such as Twitter, which provides an observable flow of data for analysis. Nothing just goes directly "viral." Rather, those with many followers (e.g., celebrities, media, organizations, bloggers) can serve as "seeds" having a multiplier effect. Bloggers tend to do the most retweeting. One communication strategy is to target these intermediaries to reach large numbers of followers. [Duncan Watts, Microsoft]

3..The Internet has fostered a new ecosystem with flexible, software-based communication vehicles (in permanent beta mode), whose use evolves over time. Communication can be strategic with segmented messages that are targeted (e.g., Twitter). Twitter provides the social "soundtrack" of life in the moment. It is a social amplifier that provides a shared, dynamic, synchronous experience reaching large numbers that creates new connections and communities. Tweets are live, conversational, and public. Twitter can also point to deeper content and deliver targeted pieces of media. It can expand the experience of live events and change public perception. [Deb Roy, Twitter]

4. Based on research studies, the following are ways in which scientists can influence whether their research gets noticed and shared: highlight why it's useful; use emotional language (e.g., awe, anger, excitement); focus on what is interesting or surprising (to the public, not to other scientists); emphasize the positive. The research most widely shared is generated by social scientists; chemistry is the science least likely to be shared. The influence of peers, such as through Facebook friend "likes," creates social pressure to conform that can result in herd behavior. Differentiated use of social media can result in knowledge gaps, rather than "democratizing" information. [Katherine Milkman, University of Pennsylvania]

5. A breast cancer support network on Twitter (#BCSM) is an example of science communication that provides the latest research to a defined audience with highly motivated personal interest. [Xeni Jardin, Boing Boing]

Politics and Public Engagement
1. Science cannot be separated from politics in science communication. Most reality is constructed by media acting as a filter, setting the agenda and "priming" its audience. There is no such thing as unframed information; science is ambiguous and can be framed in various ways. Everyone uses "motivated reasoning"; the same information means different things to different people. Potential directions: connect science to everyday lives; provide accurate information; encourage diverse social networks; foster a new kind of "literacy." [Dietram Scheufele, University of Wisconsin, Madison]

2. Scientists comprise a Knowledge Generation community,

while science communicators are part of the Knowledge Transfer community; both inform the Policy Making community. Self-correction by scientists and science communicators help preserves integrity. Scientists should respect their audience, positioning both it and themselves as non-partisan. They should find common ground with their audience, building on what they already know using evocative narratives and clarifying metaphors. Scientists should disclose sources of funding and establish the integrity of the scientific methods used. They should inoculate the audience against partisan claims and discuss consequences of the science, but not make recommendations regarding implementation. [Kathleen Hall Jamieson, University of Pennsylvania]

3. The public should be engaged "upstream" on emerging science and technology, but doing so entails many challenges. They include lack of knowledge about the science, the risks, and the uncertainties. Determining who represents the public and how to frame the issue are critical. Ethical and social issues need to be addressed. An unanswered question is whether carrying out early engagement serves to prime the opposition. [Nick Pidgeon, Cardiff University]

4. Nanotechnology is not that different from other issues. The public asks the same questions: Who are the winners and losers? What are the risks? Who makes the decisions? Ethical, legal, and social issues are important to the public, not just risk. [Julia Moore, Pew Charitable Trusts]

Narrative

1. Narrative is a format of communication using a causally linked, temporal sequence of events involving specific human-like characters. The default human mode of thought, narratives are processed by a brain pathway that encodes situation-based exemplars vs. a paradigmatic pathway that encodes evidence-based arguments. Narratives are context dependent and begin with specifics rather than abstract generalizations. They are intrinsically persuasive and twice as likely to be recalled. Use of narrative raises ethical issues because they can be manipulated by presenting only one side of an issue. [Michael Dahlstrom, Iowa State University]

2. People are "suckers for narrative"; scientific discourse can't compete (e.g., drug ads that tell a people story vs. their boring technical medical disclaimer.) [Marty Kaplan, University of Southern California]

3. Narrative used in media can take advantage of vivid imagery and create immersion. Use of narrative can lead to a general understanding of a topic more likely to be remembered than isolated information. [Julie Downs, Carnegie Mellon University]

Science Communication

1. Less than $1 billion is spent annually on science communication, compared to more than $1 trillion overall for communication. To extend limited resources, transparent partnerships are needed with governments, NGOs, and corporations. Citizen science activities can foster "bottom-up" engagement of large numbers through use of smartphones, for example, to carry out relevant science related to one's body or environment. [Davis Masten, Quantified Self and Peter Zandan, Hill+Knowlton]

2. Most science communication is not actionable. If action is intended, it should be feasible, easy to visualize, remember, and do. The communication should be motivational and embed a trigger that specifies when to take action. An example is the "half a plate with fruits and vegetables" nutrition message. [Rebecca Ratner, University of Maryland]

3. What's new in science communication: social science research, network analytic methods, access to large data sets, computational infrastructure, greater networking. [Katherine Milkman, University of Pennsylvania]

4. Science communication research is "messy." Public opinion is difficult to determine; how each question gets asked affects the response. The public readily offers opinions on fabricated issues. It is also hard to know whether the public employs motivated reasoning or enlightened preference. [Patrick Sturgis, Southampton University]

For Further Information

The Colloquium agenda and videos of the presentations can be found at the following web site:
http://www.nasonline.org/programs/sackler-colloquia/completed_colloquia/agenda-science-communication-II.html.

Published articles from the previous Sackler Colloquium are also available online:
http://www.pnas.org/content/110/Supplement_3.toc.

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David A. Ucko is president of Museums + more LLC in Washington, DC. He may be reached at ucko@MuseumsPlusMore.com.

Funny Genus and Species Names

Abra cadabra (clam)
Agra vation (beetle)
Aha ha (wasp)
Ba humbugi (snail)
Colon rectum (beetle)
Enema pan (scarab)
Gelae baen, Gelae belae, Gelae donut, Gelae fish, and Gelae rol (fungus beetles)
Heerz lukenatcha, Heerz tooya, Panama canalia, Verae peculya (braconid wasps)
Ittibittium (mollusc) These are smaller than molluscs of the genus *Bittium*.
Kamera lens (microorganism)
La cerveza (moth)
La cucaracha, La paloma (pyralid moths)
Lalapa lusa (wasp)
Leonardo davinci (moth)
Oedipus complex (lungless salamander) Since renamed *Oedipina complex*.
Ohmyia omya (syrphid fly)
Phthiria relativitae (bombyliid fly) Since reclassified in the genus *Poecilognathus*.
Pieza deresistans, Pieza kake, Pieza pi, and Pieza rhea (mythicomyiid flies)
Pison eu (wasp)
Verae peculya (braconid wasp)
Villa manillae, and Reissa roni (bee flies)
Vini vidivici (lorikeet parrot)
Ytu brutus (water beetle)
Zyzzyva (beetle)