Episode 1: Communicating Science
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Written by: Vini Mani, Matthew Sample, Warren Hagist, Amy Gilson, and Elizabeth Jaensch

Amy
Hi everyone, this is Amy, Vini, Elizabeth, Matthew, and Warren from Science in the News’ Sit’N Listen. You’re hearing some new voices today and that’s because we wanted to try something new. At the top of the show, we always say that “SITN aims to open lines of communication between scientists and the broader public.” But what about between scientists and philosophers, historians, or urban planners? We’re not the only ones thinking deep thoughts about science, so why do this alone.

Matthew
Hi I’m Matthew. I’m a scholar in science and technology studies (STS for short) and a fellow in the Harvard Program on Science, Technology, and Society. Science and Technology Studies analyzes the interactions of science and society.

Warren
And I’m Warren, an urban planning student at Harvard’s Graduate School of Design.

Elizabeth
You’ve heard from the rest of us scientists before, but never quite like this…

Vini
Today’s edition is part of a recurring series of podcasts on Science and Society, where graduate students and other experts across various disciplines- science, public policy, design, history, you name it- discuss a wide range of topics- from gender to climate change. After all, these are topics scholars in many disciplines are contributing to. This series is largely a collaboration between Science in the News and the program in Science, Technology and Society at Harvard’s Kennedy School of Government.

Our next two episodes of what we’re calling, for now, Sit’N Society are going to cover exactly those topics I just mentioned: gender and climate change. But for our first episode, we’re going
to do a little bit of navel gazing and talk about science communication, which is generally defined as the presenting scientific topics to non-scientists, also known as public dissemination of science.

Elizabeth
And which is what we do best here at SITN!

Amy
So I guess at the top of today’s show we can say “Sit’N Listen is a production of Science in the News, a graduate student organization at Harvard dedicated to opening lines of communications between scientists…and other scholars, and letting you in on the conversation.” We hope you like it.

Vini
My name is Vini Mani and I’m a PhD student in immunology at Harvard- studying how immune cells talk to each other and how we can harness these communications to create better vaccines and immunotherapies. My experience thus far with science communication comes predominantly from my role as a former director of Science in the News. I'll be telling you along the way a little bit about my perspectives and musings a la SITN.

Let’s dive right into the numbers here- as scientist scientists tend to do. According to a recent Pew Research Center survey, more than 50% US adults think great scientific research is being done in America and that 80% believe that science positively impacts society. However, in the past 5 years since their last study, disillusionment with science has been growing among US adults. What gives? We propose that this stems from a disconnect between most US adults and professional scientists. Check this out: according to that same study 90% of scientists surveyed think genetically modified foods are safe to eat. Yet ⅔ of US adults, excluding scientists, believe that GM foods are unsafe to eat, and think that scientists do not clearly understand the health effects of GM foods. So we apparently disagree pretty seriously about some facts. We also misperceive each other. 90% of scientists surveyed think climate change is real and caused by humans. I suspect that number would be even higher if only climate scientists had been surveyed. 40% of Americans think scientists actually don’t agree on on climate change.

Amy
These aren’t new divisions. So let’s start by reaching back into the 1800’s, an era that some consider the golden age of popular science, at least in Britain. Take it away, Matthew.

History of Communicating Science
Matthew
This is a short story, told from my own perspective in STS. Looking back, scholars have identified a cultural shift from thinking of science as knowledge to be transferred to thinking of science as a site of negotiation or interaction between scientists and publics. It’s a shift from
communication to participation. Here, I'll quickly sketch out that historical tale and end with the present-day.

In the 19th century, professional science was a relatively new thing. The term “scientist” itself wasn't around until William Whewell coined it in the 1830s, creating with it a new sort of scientist-layperson relationship in Britain. According to some historians, the difference between these emerging experts and the average person was perceived as one of degree rather than kind; media of the time portrayed scientific inquiry as an extension of common sense, which just happened to be progressing farther and faster than the average person could follow. With this idea of a lagging public, the corresponding solution was to close the gap through “popular science” materials. These took the form of easy to read journals, like *Nature* (which looks quite different today) and *Chemical News*, as well as museums and traveling exhibitions.

This model of science communication began to lose its hold in the interwar period of the 20th century. In many ways, science broke from common sense. Some of the most exciting things happening, like quantum physics, simply could not be explained in common sense terms or in weekly digests. It was in this period that science popularization turned to the less pedagogical enterprise of spreading inspiring but relatively uninformative images of science’s power and progress. Science writers penned heroic profiles of international men of science and invoked the ambivalent otherworldly feats of nuclear fission and atomic energy. We heard that cancer would be cured and hunger, a thing of the past.

In time, many people grew disillusioned with science, with both its applications and its lack of applications. In the 70s and 80s, we saw deadly effects of Agent Orange, prospects of a global environmental crisis (a “silent spring”), and bad tobacco research. These stood in stark contrast to the hopeful and aggrandizing messages of the previous decades. Science was no longer equated with progress and wasn’t trusted to be left autonomous. So it no longer made sense to simply disseminate expert knowledge. Simultaneously, citizens proved through activism and protest that they could effectively influence expert judgment, as when patient-activists rejected standard medical trials for HIV treatment. They successfully argued that their input was necessary not only to make clinical trials more fair but also to make them more reliable. Steve Epstein describes this as one of the few cases where the lay public has really participated in biomedical research.

These dynamics have continued into the 21st century, in the controversies around genetically modified foods and in the rejection of vaccines among some communities. There is a persistent temptation now to return to the 1800s and argue that these debates are caused by an ignorant, backwards public, but the most recent wave of science and technology studies defies this easy solution. STS scholars argue that we should reorient our thinking towards issues of democracy and participation. They’ve expended many pages trying to push our conception of science communication forward, debunking the common belief that public ignorance is the root of mistrust of science, that factual disagreement is the cause of controversy. One way they do this is by reminding us of the many ways in which lay people actually know quite a lot about their
world. People who experience a problem firsthand develop different but potentially powerful ways of understanding societal challenges, whether it is the environmental effects of fracking on tap water or the experience of living with AIDS.

**Vini**
That’s interesting and actually parallels my own naive experiences. When I first joined Science in the News, my school of thought on science communication was- well, perhaps the public is ignorant or does not have access to scientific information in an accessible format. That was actually the original premise upon which SITN was founded by another student, Liz Whalley, 17 years ago. We’re not alone: 84% of scientists surveyed in that study I mentioned before believe that it’s a major problem for science that the public isn’t well informed. Our remedy in SITN was: let’s put the information out there, and people will come around.

But as we just heard from Matthew, STS scholarship doesn’t back that up.

**Elizabeth**
And STS was ahead of the curve here: they began identifying that the disconnect between scientific experts and non-experts wasn’t caused by an information deficit since at least 10 years ago, but their scholarship hasn’t been widely circulated or acknowledged by the scientific community. In fact, it’s not until recently that scientists have begun coming to the same conclusion, but using different methods.

**Information vs Values**
Hey everyone, I’m Elizabeth and I’m a PhD candidate in Biological and Biomedical Sciences here at Harvard.

As scientific knowledge develops into consumer products and into policy, non-scientists become increasingly involved in debates alongside scientists (though for many of these instances debate among scientists is minimal). We would often like to think that just giving policy makers and the public more information would result in them agreeing with our conclusions and moving forward with appropriate measures. But there’s evidence more information doesn’t mean more consensus. One study in Nature Climate Change found that those with the highest levels of science literacy were not necessarily the most concerned with climate change. Instead they were the most polarized in their opinions on the debate. Their actual opinion lined up with those others who shared their cultural values- people with more egalitarian communitarian outlooks perceived climate change as a bigger risk than people with a hierarchical individualist perspective. Another study showed that people who were not familiar with nanotechnology similarly split into two camps upon receiving balanced information about its risks and benefits. The groupings aligned with the same cultural predictors as those that drew the dividing line between people who were concerned and not concerned with climate change. And nanotechnology is a less politicized debate! There’s actually a phrase for this: cultural cognition. Cultural cognition is the influence of group values on how we perceive things like the information presented in these studies. The theory is that due to cultural cognition, we are all more likely to
agree with information that supports the views we already hold. And I do mean all of us, not just “the other guys”.

This also relates to the type of experts certain people will trust, which is important in how well-received the message of a scientist or other authority figure is. Another study found that when pro or con statements concerning mandatory HPV vaccination were attributed to experts with different value sets, groups that agreed with them generally were more likely to shift their opinion according to their statement. Certain people are more likely to trust a suited white haired man, and others a bearded hipster type. It goes to show that people do rely on expert testimony, but mostly on that of experts they feel they can relate to. And that isn't always us.

And even if it is just us left to convince a varied group of people, we can take a lesson from this study and other research. People don’t want to be talked down to or have their concerns ignored. They want to hear from someone who understands where they’re coming from, and even if we aren’t a part of that group, we can do our best to listen and empathize and personalize our message in that way. We as scientists therefore have to sometimes figure out how to strike a balance in educating the public, and listening to concerns and information that they may have, which in some cases could lead to important practical insights that we may not have considered at a distance. But we must also stand firm in convincing people to come over to the side of science in a number of these debates.

Amy
We’ve been framing this episode around a disconnect between scientists and non-scientists, usually thought of as the average person on a street. But now that we’ve dug deeper, we’ve discovered another disconnect: between professors in science and professors in STS, just across campus from each other. Why? Maybe the STS scholars needed to share their findings, do some good ol’ fashioned STS communication for their colleagues. But I suspect that many scientists agree at least, a little, with scientism - the idea that science is the only real source of knowledge. So it could also be that the scientific community just didn’t value STS scholarship, they simply value different research methods. Even if scientists had been aware of the STS work showing that more scientific information does equal a more positive attitude towards science, they might have waited until quantitative, scientific studies reproduced the findings in order to believe it. Now, I’d say these new scientific findings are definitely getting attention among scientists, but I still don’t know many scientists who are aware of related STS work.

Vini
But if we go even further down this rabbit hole- maybe it’s just timing. We are straight-up baffled that years of trying to explain climate science hasn’t moved the needle on public belief in climate change, so someone finally decided to test the hypothesis that more information is the antidote- the results of that experiment don’t look good.

Matthew
So clearly a major use of science communication is with an agenda: to try to resolve scientific controversies. Another big agenda item for scientists when they talk about their research is procuring funding. Referencing the same Pew Center study again, 83% of scientists feel that it is now more difficult to acquire federal funding for scientific research than it was just a mere 5 years ago. Funding for science that has direct implications for society, such as medical research, though, can be easier to justify than the more foundational scientific research. The pressing need to secure funding has drastically influenced the way scientists talk about their work, bringing the focus to potential applications. These discursive and institutional interactions between funding agencies, scientists, and the public create an implicit social contract.

Amy I’m Amy Gilson, a PhD candidate in chemical physics. SITN has been one of my homes throughout grad school, as co-director and in various other positions. In my research, I’m working on understanding how the protein molecules encoded in our and every organism’s genomes evolve. This kind of work might help predict and counter evolution of antibiotic resistance.

See how I just did that? Pivoted from the topic of my research to its potential application? That was to quickly contextualize the work. But it was also because we’re used to justifying our work through its applications in order to win funding. If you want the dough, you have to promise to make bread with it, not just play with it. The term “basic science” was coined by Vannevar Bush in the 1940s to describe fundamental research that lays the groundwork for applied science which is directed towards a practical goal. He proposed that in exchange for giving scientists in universities and national labs funding and relative independence to work on what they want, society would reap the practical benefits that basic science can lead to. For example, Maxwell developed the theory of electromagnetism (by which cell phones, satellites, and radios transmit signals today) back in the 1800’s. If electromagnetism weren’t already kicking around, ready to be applied, it’s hard to imagine that an inventor would have hit on it while trying to make a better form of communication, they probably would have just tied two carrier pigeons together. The contents of this “social contract” between scientists and society as well as the terms basic and applied science are extremely widely used by scientists, so much so that it’s almost just in the air, taken for granted. Most scientists probably don’t know the history of these ideas- I didn’t, until I started trawling the STS literature for this episode. It was kind of embarrassing, like, I thought I was using my own words and thoughts, but I was indebted Bush’s work in the 50’s.

But anyways, the social contract comes with some problems. It creates a split between personal motivation and public justification for many scientists. It also presumes that public value of the research will only exist at practical, end product stage. When you’ve got that iPhone or that pill in your hand. What primarily motivates many research scientists is curiosity, desire to expand the limits of knowledge, and because research can be very enjoyable. Thus while “pure” science can have big practical payoffs, the reason why basic science gets done is the same reason that art and music gets made or why sports get played. Art, music, sports, science, they make you feel happy, they make you feel sad, they change the way you see yourself and the world around you, they connect you to something bigger than yourself. Now, while it’s easier to make a living
doing basic research than it is in art, music, or sports, all these professions have an advantage over us- stadiums, museums, galleries, concerts, spotify, fantasy football all connect fans with finished product, a song is meant to be heard and seen by as many people as possible. Out there, it can be enjoyed, ignored, parodied, analyzed and criticized. What’s my finished product in the lab? It’s a lovely scientific paper, tucked away in a scientific journal where it’s likely behind a paywall and definitely in language more technical than “Hotline Bling.” But why wait 10 years for a practical application of our work to have public value when we can make it valuable right now- this is where the science communication comes in- scoring the field goal or playing the “violins,” of basic science for anyone to see or hear.

Vini:
The way SITN is run, we show the process and methods behind scientific research as well as the result. This way you’re not just entertaining with “facts” but also being transparent with how scientific knowledge is produced. The attitude is eerily similar to the administration’s language on governmental openness, “to ensure the public trust and establish a system of transparency, public participation, and collaboration.” Science is powerful, and on principle, we think that powerful institutions must be transparent for a just democracy. But do we want to go so far as to advocate any more direct public oversight of scientific research (I’m pretty sure every scientist listening just had a tiny aneurysm at the thought of that as I just did), or informal open-access mechanisms such as SITN?

Anytime we talk about science communication it’s a useful exercise to ask to what extent the topic we’re examining, in this case, communicating science, has challenges and features truly unique to the sciences. In this spirit, let's take a look at how urban planners, coming from another powerful and specialized profession, have communicated their plans to the communities affected by them and ask could their model work for science?

The Changing Role of the “Expert” in City Planning
Thanks Vini. Hi, Warren again, the urban planning student at the Graduate School of Design. And as Vini alluded, the dilemma of how to constructively engage the public is not unique to the sciences. In fact, the design professions (architects, landscape architects, and city planners) spend a lot of ink and words trying to refine the best methods of engaging the public. Architects and planners look at everything that’s going on in a city, and try to navigate a way forward that optimizes certain outcomes: how much housing should be built, how many new roads and bridges are needed, where the parks are needed, etc; but without the public’s input and buy-in on these critical questions about our collective future, we wouldn’t know where to go. And so communication becomes important. However, it wasn’t always this way, and the design professions have seen their roles dramatically change over the past century and a half.

As Matthew mentioned with scientists, planners and architects used to be considered ‘experts’ whose opinions and plans for the future of cities and towns across the US and Europe were implemented without much question or resistance. This freedom of the profession from outside criticism was a reflection of the many urgent problems industrializing cities faced from the 1850s
to the 1950s as a result of rapid population growth and dirty industries: poor air quality, impotable water, non-existent sewage systems. Occasionally, whole cities would burn down from crowded, hastily-built buildings, such as Chicago in 1871 or Boston in 1872. New York suffered 3 yellow fever epidemics, and 4 cholera outbreaks.

To this urban chaos, land use zoning regulations, building codes, water and sewerage infrastructure, and mass transit brought a degree of order to the city. Urban experts cleaned up streets, sped up commutes, opened grand parks. Like doctors administering to a sick patient, the design professional’s diagnoses were seen as cutting edge, beyond reproach, at least up until the 1950s.

It was then - at around the same time the public began pushing back against exploitative scientific research - that city residents rallied against top-down planning practices, especially in reaction to so-called urban renewal plans. These schemes prioritized highways over people, clearing entire neighborhoods in the name of economic development: often times displacing thousands of poor, immigrant, or non-white communities in the process. Planning expertise had run amok: planners thought they were fixing cities, but tampered with systems that weren’t broken...

In response to protests and political pressure, planning embraced bottom-up approaches: the community’s voice became a paramount piece of any plan. Today, the community meeting is the cornerstone of the planning process, with members of the public interacting with planners and decision-makers, giving them feedback on proposed plans and projects. Planners recognize that residents will always understand far more about a community than even the most scholarly planner could ever know, and we are no longer vested with unrestricted powers to “improve” society as master visionaries; instead, planners are public advocates, gathering and magnifying many interests into a set of actionable goals, working hand in hand with city residents.

While the relationship between planners and the public is much improved, the two parties still clash. As Elizabeth noted earlier about scientific information, knowledge does not equate consensus. From the experience of urban planners, it’s not entirely clear whether more participation generates consensus either. New challenges have arisen that highlight the tension between the need for sweeping interventions and the need for community participation. Climate change is the biggest current example. In coastal cities such as Boston, adapting to sea level rise may require expensive protective infrastructures, perhaps even jacking up buildings and streets, or even retreating from the water’s edge altogether. Recent storms such as Hurricane Sandy - which flooded New York City’s subway and demolished neighborhoods - remind us that these measures are needed sooner, rather than later. That said, aligning various stakeholders - some of whom are skeptical of climate change - to agree on an adaptation plan has proven extremely difficult: especially for a threat that may not manifest in the near future. Some states, such as Texas, even refuse to fund climate change adaptation measures because of popular disagreement over its reality.
While the difficulty in implementing large projects can be frustrating, tension is just one part of consensus-building: and projects that stem from consensus are stronger than those that are perceived as imposed by an outsider. Indeed, difficult conversations about a community’s future in and of itself are a desirable outcome of city planning. Of course, planning by no means has solved its participation problem, and many voices are still left out. For the sciences, urban development doesn’t provide a crystal ball into a utopian, participatory future, but it does provide an example of a profession who has similarly seen the role of its experts questioned, evolved in a certain direction, and which now faces new challenges.

Matthew
Warren, while we were chatting about this before, you mentioned one of those challenges is that community meetings are arguably treated as formalities developers must go through seal the deal. From my perspective, there’s a really similar problem with the latest generation of science communication- Much of public participation is structured not necessarily to give citizens a role in science but to prevent their rejection of particular applications of science, whether vaccines or GM foods or some other controversy. But insights between academic fields and from citizens to university scholars need not be accidental or constrained to the “big controversies” like those over climate and vaccines. “Citizen scientists” contribute their observations of birds to ornithologists at Cornell. And self-taught researcher and Flint resident, LeeAnne Walters did a crucial investigation into the water there and communicating her findings to Professor Marc Edwards, which was crucial in exposing the water crisis in her city. Obviously the officials in her own state should have listened too- talkback is one way to make science more democratic. In STS terms, the question we now face is not “how to educate an ignorant public?” but rather “who gets to participate in knowledge production?” and how.

Elizabeth
We also need to consider how far these democratic ideals should go, though. Scientists are highly trained experts in specific fields, and we shouldn’t throw away their knowledge because it doesn’t match popular opinion. On the other hand we also can’t dismiss the knowledge people have about their community or society and its needs. That said, incorporating people’s voices and perspectives into the scientific process could greatly lengthen research times, just as participatory planning projects are implemented more slowly than autocratic projects. At the other extreme, it would be a very sad society in which a few experts speak for all citizens, deciding what counts as a societal problem and what doesn’t.

Matthew
What we need is a bolder, balanced vision of public engagement... and that DOES involve educating the public. But as Sheila Jasanoff has argued here at Harvard, it is not education in the sense of memorization of facts or reverence for the scientific method. To the contrary, it consists in giving people a capacity to think about of the place of science & technology in our lives, to judge when to use science and when not to.
Vini
The way we at SITN approach certain aspects of science communication, as it seems to have morphed, is to generate such a healthy dialogue between experts and non-experts. Humanizing scientists, as I like to say.

Amy ...and humanizing non-scientists for the scientists!

Vini
For 17 years, the model by which SITN has been furthering scientific training and communication has promoted adaptation and personalization to various audiences. Constantly evolving peer-peer and scientist-public feedback keeps the organization abreast of the times and allows young scientists to more effectively interface with the public. Initially, the organization developed primarily through in-person events such as two annual lecture series held through the course of the academic year at Harvard, and a day-long science conference, science cafes called “Science by the Pint”, held in a bar venue- all free and open to the public. While these flagship programs continue to run robustly with audiences of hundreds in the Boston area, many of our latest efforts have been shaped by the dawn of communication technologies and social networks, as SITN extends outside the Boston area by working online. This includes live-streaming the lectures, engaging the public in a Reddit “Ask Me Anything”, our online blog with a deep social media connection, and our newest endeavor, a podcast titled “SIT’N Listen!” which you are likely familiar with considering you’re tuned in right now.

Along with bringing insights into scientific developments to folks outside of the university, SITN is now more committed than ever to training graduate students to effectively communicate complex concepts to diverse audiences and to appreciate the rich social milieu in which research is embedded. We hope this dual mission will elevate discourse around issues of science and society while allowing graduate students to build essential skill sets for their future careers. In fact, when soliciting advice from former scientists/colleagues in various career paths from policy or venture capital- they all converge on the importance of science communication skills and activities.

Amy
Most of the lectures, articles, and discussions SITN organizes aren’t even on topics that aren’t controversial, they’re on the biomechanics of the human body or exoplanets. They’re fun and really aren’t aimed at resolving the big controversies. Now, stay with me, apes maintain their relationships by picking bugs out of each others’ fur, a practice known as social grooming. And some speculate that small talk is a modern version of social grooming. I don’t know how accurate these theories are, but as I’ve worked on this episodes I’ve starting thinking of SITN as a form of social grooming. We have lots science-related events to nourish social bonds between science researchers and the folks who come to events or read our blog posts. Perhaps these can keep us on the same page, diminishing the chance a destructive controversy arises, or perhaps the bonds can be activated in situations that might require group problem solving. It’s the difference between working with a friend and seeking someone out you’ve never met before
to solve a problem. You could call it “basic science communication”- curiosity, not application driven, but sometimes practical benefits do arise, at least that’s our hypothesis and aspiration.

**Vini**

If we were to try to summarize this whole episode it might go something like this: scientists thought that communicating more scientific information would lead the public to agree with scientists on climate change, vaccines, science funding- anything? But it didn’t work out that way, and now we’re finally starting to understand that the problem isn’t primarily lack of information, but something more social, lack or of trust or understanding each other on a human level.

**Amy**

But where exactly does that leave us? Philosopher Michael P. Lynch worries that “Without a common background of standards against which we measure what counts as a reliable source of information, or a reliable method of inquiry, and what doesn’t, we won’t be able to agree on the facts, let alone values. Indeed, this is precisely the situation we seem to be headed toward in the United States.” We’re worried too, but how to avoid this situation isn’t a scientific question, it’s a question for all of us.

**Vini**

In some ways, this exercise, or task of creating this podcast, is a social experiment encapsulating everything we set out to accomplish. Science in the News, then is not a rigid model, but rather an ever-adapting experiment in establishing social dialogue between scientists, other academics and the public. As scientists, it is only apt for us to find models, which can evolve with changing technologies, information, and ideas. This leads to a tricky balancing act that we still don’t quite know how to reach- or if there’s even an end-point to reach. As scientists maybe the best thing we can do is keep experimenting with different approaches and engaging other disciplines in this experiment…and hey that’s what we’re doing right now!

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