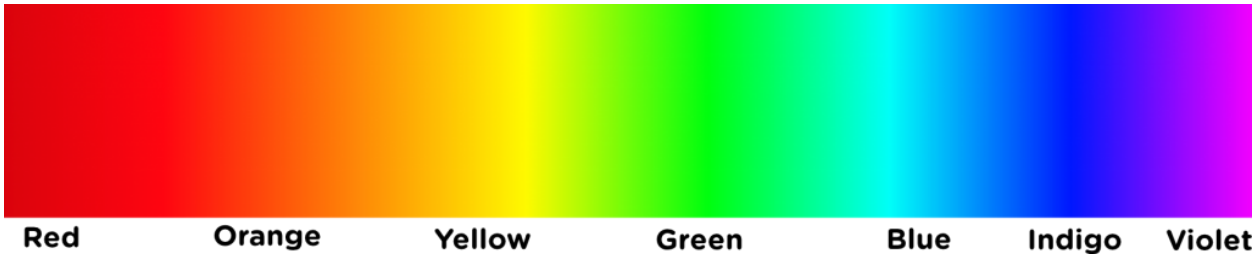
Why you should dump the Rainbow

Recently, MATLAB® has changed the default colormap from ‘Jet’ to ‘Parula’. On the surface, this may seem like a minor change, but I’d like to argue here why this an important change. In short, Jet is a perceptually non-uniform colormap, creating and masking gradients in data.

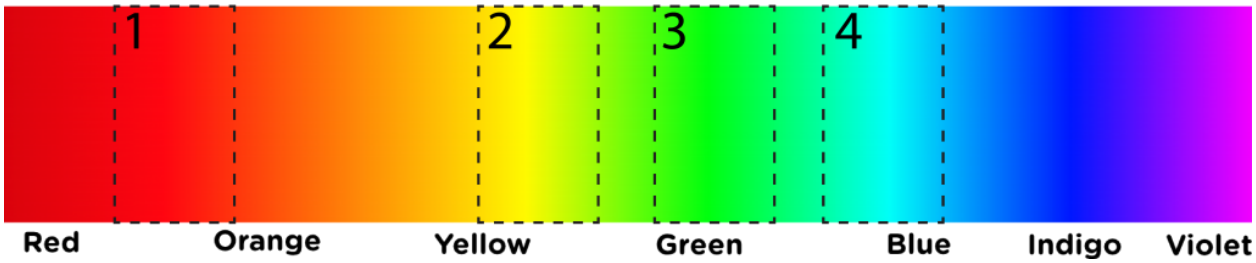
The Problem

Jet (also called Rainbow) colormap is based on spectrum of visible light.



It’s quite pretty to look at, right? Jet being pretty is probably the reason it so frequently finds its way into plots and figures in presentations, papers and posters. It draws the eye in quickly and is familiar. Despite how bright this colormap is, it has a dark side.

I’ve drawn a few boxes, which are **equally spaced** on the spectrum. Pay attention to the colors left and right side of each box.



Notice anything? Let's look at the color change from the **left side** of each box to the **right side.**

BOX 1: barely perceptible change

BOX 2: complete color change

BOX 3: barely perceptible change

BOX 4: complete color change

This example illustrates the main limitation for the jet colormap: it isn't perceptually uniform. When looking a figure or plot with a jet colormap, it is incredibly easy to be deceived into seeing gradients in the data that aren't present, and even worse it is possible to miss gradients that are present.

The solution: perceptually uniform colormaps

MATLAB® has now changed their default colormap to Parula. This a perceptually uniform colormap and good change.

Color changes in this colormap are more uniform and doesn't mislead the viewer into perceiving gradients in the data the aren't present (or mask real gradients in the data). There are a wide variety of perceptually uniform colormaps and you can find many that will suit your needs.

Looking for more perceptually uniform colormaps?

I'd recommend Cynthia Brewer's Colorbrewer version 2

MATLAB® scripts for Colorbrewer

Distinguishable linecolors for MATLAB®

Want to read more?

How The Rainbow Color Map Misleads by Robert Kosara

Rainbow Colormaps – What are they good for? Absolutely nothing! by Noeska Smit

Rainbow Color Map (Still) Considered Harmful by David Borland and Russell M. Taylor II (behind paywall)

Student Post: The First Day of Class

Robin Banner is an oceanography graduate student studying nearshore sediment dynamics. Her primary goals are to determine how coastal environments are changing geologically and to provide accurate and valuable information to coastal communities so that they can adapt to these changes.

I walked into the Engage classroom for the first time yesterday not really knowing what to expect. I mean, I knew that I would learn how to “communicate science to the public” and eventually give a talk at town hall, but I definitely wasn’t expecting being uncomfortable (and actually kind of enjoying it) for the next three hours.

Before any introductions were made, I watched as our teacher set up a video camera in the back of the classroom. I knew exactly what it was for…. We would be videotaped while we gave our two minute descriptions of our research to the class. My heart began to pound and my hands immediately became clammy. What a great way to make an uncomfortable situation even more stressful.

We started off the class by playing a name game involving all of us standing in a circle and making funny body movements. Good way to loosen up…. But my mind never left the video camera sitting in the back of the room… it wasn’t turned on yet… but it was still there.

Next came the inevitable two minute talks. I went second just to get it over with, and it went about as I expected. All of the great things I had planned to say never came out of my mouth. I never mentioned why my research was important, and all of the jargon I meant to avoid automatically flowed out of my mouth. But as I sat and watched all of the other students as they stood in front of that video camera, I was impressed by the diverse way that they presented their research. My own speech wasn’t perfect, but I got some great ideas on how it could be improved next time- get passionate, get the audience involved, make them laugh, don’t be such as scientist.

After many more improv games and casual class discussion, I became less uncomfortable and more excited about getting involved. When I was asked to get up in front of the class once again and tell them a story about my winter break, my nervousness was accompanied by determination and excitement. The story flowed easily and the entire class actually laughed at my climax/punch line.

I thought back to the survey that I filled out before class started and remembered answering that I did not think it was very important to form public scientific talks as stories. Gee was I wrong… and I

happily expect to have even more of my preconceived notions of public speaking proven wrong in the future.

Student Post: Let's Talk About Science

Julie Weicheld is a Masters student in the Department of Environmental and Occupational Health Sciences. She studies the mosquitoes around Seattle and other areas of Washington state, specifically how they are affected by climate and other environmental factors.

I have been interested in science communication for a long time. Luckily as part of Engage I am getting a chance to do something about it, and it's nice to see I'm not alone. On the first day of the Engage seminar, I found myself surrounded by a group of other young scientists who were equally as interested in communicating their research in a way that could be understood. It was refreshing to see students from a variety of science backgrounds: Biochemistry, oceanography, public health, chemical engineering, physics…

As an undergraduate I double majored in environmental biology and communication studies (we had no public affairs or policy options). I loved both disciplines, but couldn't help but notice some conflicting notions between the two. In Comm 100, we were taught to grab our audience's attention and use mostly pictures if using PowerPoint. In Biology 101, we were taught to be straight to the

point and present informative slides with words and figures. In Survey of Mass Media we were encouraged to use buzzwords and flowery language, in Cell Biology we lost points if our lab reports contained too many of them. I remember thinking , “Why has everything I’ve learned in communication gone to waste?” I knew I wanted to be a scientist, but I also wanted to reach out to the public and show them how fun science can be. However my biology agenda didn’t seem to really cover that at the time. I just didn’t get it back then. And to be honest, I still don’t really get it now.

So on the first day of our Engage seminar, I was happy to see us go back to some of my Communications teachings. We learned about storytelling, such as how to transform a research project into an interesting tale complete with protagonist and plot twists. We watched a video of Neil deGrasse Tyson (one of the few people with the title ‘Celebrity astrophysicist’) enthralling his audience with a story about movies and the night sky. Needless to say, we are only at the start of this science communication process, but I am interested to see where it will take us all. I’m looking forward to improving my speech-giving technique, learning how to utilize analogies to convey complex information, and perhaps most importantly learning about the science other people are doing. Let’s talk about science!

Student Post: “Scientists are Not That Smart”

Shivani Gupta is a 4th year PhD student in bioengineering. Her interests include proteins, stealing ideas from nature for cool new biotechnology, reading, and for those precious leisure moments: skiing, ballroom, swing, and salsa dancing, hot yoga and (if lucky) traveling.

In the past two sessions of the Engage seminar, we talked about jargon. Specifically, we talked about avoiding jargon when speaking to anyone outside our field. Most of it made sense to me; I don't expect anyone outside my field to know what 'allosteric regulation' or 'ribosome-display selection' mean. The idea that people may not know what 'quantify' means or what a scientific model might be surprised (saddened?) me a little, but I understand. You want to speak to your audience conversationally, on par with them, to encourage their interest. You don't want to talk down to them with big words, or lose them with many seemingly simple words attached together to describe complicated ideas. People want to know that they understand the science you're speaking.

This exercise got me thinking of the many times I had to describe my thesis work to a friend, or a family member, or just anyone who isn't a scientist. Most of the time, I wish I could see into their mind and know whether or not they remember any high school biology; otherwise, I go with an exceedingly simplified and idealistic version of my work. Even when I've given what I hope is the simplest and most exciting pitch of my work, I sometimes get met with a blank stare or a slow nod, followed by: "Wow, you must be so smart."

Sometimes, that line comes just after they ask me what I do: "A PhD in bioengineering? Wow. I can't even…! You must be *so* smart."

It's at that point that I either try to tell them that I'm *not* that smart and it's all very difficult for me too, or I just let the conversation die.

This topic was recently described in an article, whose title I've borrowed for this blog post:

http://nymag.com/scienceofus/2014/12/scientists-are-not-that-smart.html

The author argues that thinking of scientists as 'so smart' is more isolating than complimentary. He sums it up pretty well in this paragraph:

"While the idea that scientists are uniquely smart and capable is flattering to the vanity of nerds like me, it's a compliment with an edge. There's a distracting effect to being called "really smart" in this sense — it sets scientists off as people who think in a way that's qualitatively different from "normal" people. We're set off even from other highly educated academics — my faculty colleagues in arts, literature, and social science don't hear that same "You must be really smart" despite the fact that they've generally spent at least as much time acquiring academic credentials as I have. The sort of scholarship they do is seen as just an extension of normal activities, whereas science is seen as ***alien and incomprehensible****."*

I can sympathize with this. I'm sure most of us can.

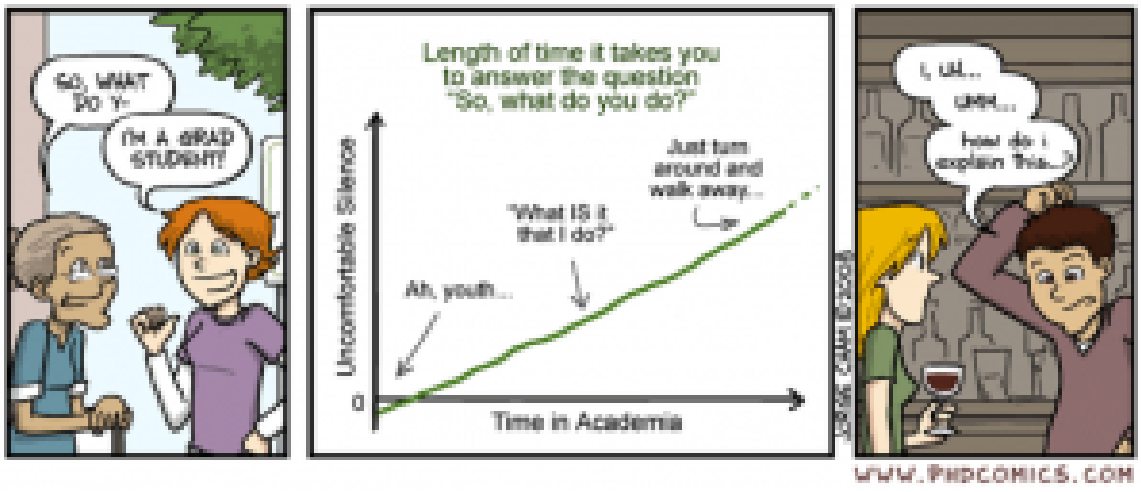
This is partly why we are in this class, learning how to speak to the public so that they might understand us and so that we hold their attention long enough to get them excited about science.

This is why jargon is so discouraged, because it only confirms to them that we are different and incomprehensible. We even speak a different language!

My favorite part of the article, though, is how he mentions that the broader skills scientists have and use every day—thinking analytically, solving problems, constructive curiosity—are skills that anyone can have, no matter their job or interests. Most people *do* have them. They might not have the specific skills of pipetting tiny amounts of liquid, feeding cells, programming on a computer, or performing statistical analysis. But I don't have the specific skills of a professional athlete, or an artist, or an investment banker either. Does that mean those people are alien to me, that I never play sports or draw casually? Of course not, and in the same way, people can be scientists too. As the author of the article says, everyone has "an inner scientist".

That last part highlights why we speak science to non-technical people, even though it's difficult. With probably a few exceptions, when we share our work with others, it's because we are excited about it, and want them to be involved in our excitement too. We are learning to speak to the public because we really feel that everyone can be interested in our branch of science, maybe even our specific thesis. When we get a blank stare in response to our excited pitch, we're not frustrated because they were not impressed with us. We're not frustrated because they aren't absolutely gung-ho about our thesis. Generally, we're frustrated because we've failed to include them, and they've inadvertently excluded us, and any possibility of sharing science has ended.

I guess I have to remind myself of this every time someone asks me "What do you do?" or "What's your thesis?" When I first read the above article, before the Engage class, I was mostly filled with indignation that people think scientists are so far removed from them. But the responsibility falls on us to change the image of scientists as incomprehensible. Hopefully one day the idea of having to explain my work to someone won't make me want to fake an emergency phone call or awkwardly change the subject to the weather. After all, what is the point of studying something for years and years if you can't share it with anyone?



Student Post: Start from the Head, Deliver From the Heart and Gut

Dan Grinnell is a Masters student in the Department of Environmental and Occupational Health Sciences. He studies how workplace hazards affect the health of dairy farm workers in Washington State. He is particularly interested in how these hazards may disproportionately impact undocumented Hispanic workers.

Scientists. Many are known to be unemotional, analytical automatons who collect seemingly arcane information that is only shared when it is published in obscure scientific journals. Scientists are content to “spend their entire lives in their heads, even if that means staring at the wall all day,” describes Randy Olson PhD, author of “Don’t be such a scientist.” Unfortunately, “living in your head” all day can make for a dull personality, lacking emotion or spontaneity. And as we learned this week in our Engage seminar discussions, it turns out that spontaneity and emotion are very important qualities of an effective communicator. Emotion connects the audience with the speaker. It pours out of the heart and makes the audience experience the emotion alongside the speaker. Spontaneity creates an element of danger. It reaches down into the gut and induces a twinge of fear or laughter which can bring excitement.

Recently the science community has begun to develop some awareness of their inability to bring an element of emotion and excitement into the communication of their work. There are famous examples of great scientists such as Gregor Mendel (the father of genetics) and Alexander Fleming (inventor of penicillin) whose work could have added to scientific knowledge or saved countless lives decades earlier if they had done a better job promoting and communicating their work in a captivating fashion. The problem with many scientists is that they would like to remain as objective as possible. It's what they are "most comfortable with" as the author Olson explains. From the scientist's perspective, when they interject their own emotion and excitement into their work it immediately becomes more subjective and less accurate or credible.

Constantly living in the objective world is not much fun however. So how do we get around this? By engaging the gut and heart through analogies and stories. With analogies we can use basic examples to explain more complex topics. If scientists can find an analogy that is familiar, understandable, and maybe somewhat humorous they can produce that laughter or fear that brings excitement. Through stories an audience can be taken on a journey that makes them experience the emotion occurring in the story plot. In this way the objective work moves out of the head of the scientist and into the hearts and guts of his audience.

Student Post: Improv Games

Nancy is a 4th year graduate student in Oceanography and she studies the marine carbon cycle. Outside of school she stays busy by biking, backpacking, fishing, cooking, gardening in her P-Patch, and urban exploring.

Had you walked into our classroom at just the right moment last week you would have seen 15 graduate students standing like silent statues arranged in a scene that resembles either a bar fight or a baseball game gone wrong. This scene was the result of one of our 'improv games' that we

regularly play to practice loosening up and thinking on our toes. This particular game starts with one student who chooses a pose, and then one by one we add ourselves to the scene in whatever way we like. There is no right answer, and likewise there is no wrong answer, which basically turns my scientist brain upside down! I have to admit that on the first day of class when during another game we were asked to combine random sounds to make a fake word, and then make up definitions for these fake words, I was really struggling. I took the game too literally and made up definitions such as '_____ is the sound that a _____ makes when _____.' Some of the other students were able to think outside the box and made up off-the-wall definitions that were hilarious and left me wondering 'how did she come up with that on the spot?' Scientists are often literal-minded people, and throughout our education we are carefully trained to be even more literal and to think about everything long before we say or do it. While this training makes for good science, it does not always make for good conversation and science communication.

I was relieved to hear that many of the other students have been struggling with these improv games, as well, and I am also relieved find that I am getting better at them! Our reading for the week was from Randy Olson's *Don't Be Such a Scientist* and hearing about his students felt like looking in the mirror. The students tended to mess up the improv games when they tried to have a canned answer that they thought up long before it was their turn. They weren't thinking on their toes. The first day of class I had found myself doing this: making up an answer so that when it was my turn I would be ready. Turns out, whatever you can come up with on the spot is usually way better than what you planned a minute in advance. Often times by the time it's your turn the improv game has taken a 180 degree turn and your canned answer no longer makes any sense! This plays right into Olson's description of the experience of being interviewed by a journalist. If you go into an interview with an exact script of the things that you want to say, it will be a disaster. Instead, have an idea of just a few things you'd like to get across and let the conversation evolve naturally. You don't always have to get into the exact detail of your exact contribution to the field, but instead make sure that the audience can learn something, no matter how seemingly simple that 'something' is. Allowing for a natural flow of conversation will make you come across more like a 'real person', and less of a 'scientist,' which is the real end goal of communicating science to the public.

Student Post: Connecting to Your Audience

Jillian Pintye is a PhD student in the Nursing Science program at the University of Washington and a research assistant in the Department of Global Health. She holds an MPH in Epidemiology and is a registered nurse. Her research focuses on the prevention of HIV and STIs and maternal and child health.

"If any man were to ask me what I suppose to be the perfect style of language, I would answer, that in which a man speaking to five hundred people, of all common and various capacities, idiots or lunatics excepted, should be understood by them all, and in the same sense which the speaker intended to be understood." –Daniel Defoe

Daniel Defoe, who gained enduring fame by authoring *Robinson Crusoe*, also stands as a notable and prolific pamphleteer whose political essays on social injustice were quite controversial and momentous in 17th century England. It is fitting that presentation expert, Nancy Duarte, chooses a pamphleteer's quote to highlight the importance of knowing the diversity of your audience whilst communicating. After all, pamphleteers aimed to capture what their wide audience cared about and link it to their own ideas to provoke discussion and incite change.

Scientific communication can also capitalize on this approach. Our assigned reading this week by Nancy Duarte recommends uncovering similarities among your audience members and focusing on commonalities to bolster credibility. Although extensive research on audience members is not typically possible for public talks, scientists generally know the "types" of people invested in their respective topic areas. One of our assignments this week is to consider potential audience members

that might be at our Town Hall talks. In doing so, I (and most likely other students) have uncomfortably asked myself, “Is my topic polarizing? Will an audience member’s perspective challenge the very premise of my talk? If so, what I am going to do during the Q&A!?”

In these moments of anxiety, Duarte’s advice to “focus on commonalities” resonates. Although audiences at our Town Hall talks will be diverse, finding the common thread will help us be understood and convey our “take home” messages. As Duarte notes, our audience will temporarily assemble and share at least one thing in common: our presentation. It is our responsibility to design a presentation experience that is relatable and interesting for our audience.

While musing on a “common thread” applicable to a popular, controversial topic, my mind lands on vaccine hesitancy—an exemplar case of a contemporary, contentious scientific issue. If the benefits of immunizations are so clear and understandable, why was there a measles outbreak in Disneyland just last week? (check it out: http://www.npr.org/blogs/health/2015/01/22/379072061/disneyland-measles-outbreak-hits-59-cases-and-counting). Vaccine hesitancy persists and the public health implications are real. This makes considering the vaccine hesitant audience important when communicating scientific evidence supporting childhood immunizations. We hope the common thread on any side of the vaccine discussion to be caring about the health of children—from individuals to populations (here’s something fun, on the contrary: http://www.theonion.com/articles/i-dont-vaccinate-my-child-because-its-my-right-to,37839/). Using Nancy Duarte’s advice in this example, perhaps one method for reaching across an audience is focusing on the vast improvements in child health over the last century and how vaccines have been instrumental to those achievements. By focusing on the positive commonalities and shared values and experiences, we will more effectively reach our audience members. In preparation for my Town Hall talk, I definitely plan on outlining some clear commonalities in advance since my presentation topic is considered somewhat controversial to some (no spoilers!).

Designing a scientific talk that is understandable to the public is challenging. Our weekly readings and exercises help reframe this task as surmountable and fun. I look forward to discovering the common thread with my audience members and using Nancy Duarte and Daniel Defoe’s advice to effectively connect my audience to my message at Town Hall.

Student Post: Focusing on the Who instead of the What

John Fullmer is a 2nd-year PhD student in the Department of Earth and Space Sciences. His research investigates the modern formation of continental crust by volcanic activity.

As scientists we've been molded to follow a strict pattern of thought. For better and worse, we're trained to portray our science in a methodically detailed and accurate manner. The unfortunate result of this training is that we often come across as arrogant, boring, or we might even be ignored. What is it then that makes Bill Nye, Carl Sagan, and Neil deGrasse Tyson able to resonate with their public? The answer might be that they all understand the audience.

"Designing a presentation without an audience in mind is like writing a love letter and addressing 'to whom it may concern.'" Nancy Duarte, author of Resonate and our assigned reading, argues that the key to communication is to understand and relate to your audience by segmenting them into groups. It's impossible to appeal to an entire audience and capture them. Instead we should focus on connecting with individual groups, empathizing with them, and building a human connection. It's easy for us to group people by their professions, ethnicity, or sex. However, Duarte suggests that we dig deeper and try to find out what really makes them tick "After all, it's tough to influence people you don't know". Duarte suggests that we strongly consider the audience's: background, knowledge,

motivation, values, influence, and how to obtain their respect, before deciding how to speak with them.

Our class practiced relating to our audience during a roleplaying game. In this half of the class acted as various potential audience members of our presentations meeting at a cocktail party. Roles spanned from a retiree to elementary-school students. Some persons were easier to reach to than others, but I found the key was to communicate as a person, instead of focusing on presenting the science. The young Amazon techie was similar in age an interested in the technology and we discussed different programs used in my research. The elementary student was more interested in science in general and asked a barrage of questions from “How long does it take to get to the moon” to “What else explodes?”, neither of which is part of my research. I found the experience surprisingly frustrating. I knew I wasn’t communicating my science that I came to talk about.

Reflecting on the experience, the class found that by empathizing with the audience, our conversations went more naturally and ended on a positive note. By toning down the conversation and talking with the elementary student about what she wanted to talk about, I would have been able to empathize and communicate with her on a personal level. If the secret to resonating with the public is to empathize and communicate with them as a person, then maybe we should focus on *who* we’re talking to, instead of putting the emphasis on *what* we’re talking about.

Student Post: Nationwide Needed to Know Its Audience

Jennifer McCreight is a 5th year PhD student in the Department of Genome Sciences. When she's not busy studying human evolution, she enjoys playing strategy games, getting lost in a good book, and cooking while pretending she's on an episode of Chopped.

If your goal is to communicate something, you have to know your audience. A group of middle schoolers is going to have different background knowledge, vocabulary, and interests than a group of retirees, and that clever Pokemon joke you thought up may not always be appropriate. While our class focuses on communicating science to the general public, I'd like to highlight a recent Failure To Know Your Audience that my classmates were likely to see this past weekend. This is based on my assumption that a bunch of people in Seattle were pretty darn likely to be watching the Super Bowl, so hopefully I properly identified my audience.

Let's move on before this gets too meta.

One of the best parts of the Super Bowl is watching the commercials. But watchers were collectively horrified by this Nationwide Insurance ad, instantly filling social media with complaints about how it ruined the Super Bowl:

http://youtu.be/dKUy-tfrIHY

When I first saw this ad, I couldn't quite hear what the kid was saying, given that I was in a noisy bar like many other fans. I thought it was some cute commercial of a kid doing all sorts of fantastical kid things. Then I heard, "I couldn't grow up, because I died from an accident," and my jaw literally dropped in horror. Given the slew of articles and memes this commercial instantly birthed, I'm not the only one who was shocked.

I think we can all agree that it's a noble cause to communicate information that could prevent accidental deaths of children. With an audience of 114 million, the Super Bowl is a great place to have your message reach a huge amount of people. The problem is that Nationwide completely failed to know their audience.

So who's the audience? The Super Bowl is basically a national holiday in the US. People are gathered at parties or bars, drinking profuse amounts of beer, stuffing themselves with chicken wings and guacamole, and generally trying to have a good time. Everyone is having fun with their friends

and family, including their children. So having a commercial like this come out of nowhere felt like someone just pooped in the punch bowl. One second you're cheering for the Seahawks, the next you're filled with paranoia that your kid can die at any moment.

Now, this isn't to say the Super Bowl should be void of ads with serious messages. But how you deliver your serious message matters. I can imagine a commercial where two parents are wearing football gear, trying to defensively block their kids from getting into the chemicals under the sink, or stop a TV from falling on them. It would be somewhat cute and funny, then fade to black with "You can't always be there. Learn how to prevent accidents at makesafehappen.com." It would fit the mood much better but still prompt people to stop and think. With the commercial Nationwide put out, it seemed more successful in making people hate Nationwide and creating a lot of memes.

Scientists can learn from this example, even if we're presenting at Town Hall instead of making a Super Bowl commercial. Even if your message is hugely important and completely factually correct, you still have to know your audience. In class we discussed Randy Olson's book *Don't Be Such a Scientist*, where he summarizes part of John Steinbeck's *The Log from the Sea of Cortez* to illustrate this:

> *"A sea monster has washed up on the beach of Monterey, and a wave of excitement has swept the town. People have thronged to the beach to see this monster, tantalized by the chance to catch a glimpse of the unknown, the*

monstrous. When the crowd arrives at the beach they find the monster, a note pinned to its head saying "Don't worry about it, it's a basking shark" signed by Dr. Ralph Bolin of the Hopkins Marine Station."

Was the scientist right? Of course. And he had good intentions, trying to dispel some of the fear around the monster. But the way he communicated this made him come off as a stodgy party pooper, ruining everyone's fun and excitement. That's a sure fire way to turn people away from your message. So try to know your audience better than Dr. Bolin or Nationwide if you want people to actually hear what's so important.

Student Post: Speak to Your Audience, They Won't Judge

Vinayak is 6th year Biochemistry PhD student. His research is focused on how human proteins recycle and repair cells.

I know you've probably heard this one before, but let's revisit it anyway. A 2014 survey from Chapman University polled Americans on what they fear most. Coming in at #5, just below "*Being the victim of a mass/random shooting*", was public speaking. Let's think about that for a moment. A great majority of Americans are nearly as worried about being gunned down at random as they are about getting on a stage and saying a few words. Just to be clear, I was one of these people, but think I'm turning a corner.

What is it about being in front of an audience, and more generally, a group of strangers that scares the bejeezus out of us? It's a question I've been trying to figure out over the past few weeks, so let's dive a little deeper.

What I'm about to describe, some of you will immediately understand.

1. You know it's your turn to get up on stage and your heart starts beating approximately 2.3x faster than it should be.
2. You look at whatever notes you may have in front of you, but you don't actually comprehend any of the words on the paper. That doesn't stop you from looking at them at least four more times.
3. Hands begin to sweat.
4. Stomach begins to make slight side-to-side motions in your body, and maybe even some unexpected sounds.

Next thing you know, you're walking up to the stage. You get to your spot, you look up, and BOOM! It's go time.

How we handle the next few moments is what sets apart a great presentation from a mediocre one.

Let's step back for a minute and talk about the other half of your presentation, the more important half. The audience. I've started to realize that the panic some of us face while public speaking is driven by a fear of judgment. We're almost as scared of being judged as we are of guns. We're scared of what other people think of us, because they might shoot us down with their thoughts. What makes this even more frightening is that the culture of judgment (the dark side) is at the peak of its powers. Social media allows anyone to make a judgment at any time about anything they see fit. In some ways, judgments make us accountable to other people, which is one of the foundations of a successful and progressive society. But in countless others it's an unnecessary burden, frivolous, and inconsequential, especially when you're trying to communicate on stage.

Something that's become clear to me over the past few weeks is that most of the time an audience is not making judgments at all. Think about how you feel when you go to a seminar, presentation, or

play. You're going because you want to be entertained, or learn, or both. My instincts as audience member are rarely to judge. As the person on stage, it's easy to forget this.

Let's get back on stage, and this time let's act like we're not being judged. The people in front of you want to hear what you have to say. So tell a story, be passionate, and practice your material, but not so much that it sounds rehearsed. Try to connect with them, and teach them, and entertain them, or both. I'm not sure I'll ever be able to avoid steps A through D before I get up on stage, but I know once I'm in my spot, I won't be scared to get shot down.

Student Post: Walking the line between factual and boring

Kelsey Pullar is a second-year MPH student in Health Services who is interested in the connection between public health, the built environment, and transportation policy. For her practicum, she worked with the policy director of a statewide bicycling and active transportation organization, and for her master's thesis, she is working with researchers to conduct a program evaluation of a local bicycling and youth development program.

For those of us who have chosen to and have had access to pursue higher education and advanced degrees, academic integrity is a big deal. Being as correct as possible is the gold standard. However, the flip side of this is details and facts at the expense of an opportunity to effectively share information. Although being hyper-focused on accuracy and detail is a boon for researchers publishing articles in scientific journals, it turns out to be an impediment to effective public communication.

While reading Randy Olsen's chapter, "Don't be such a poor storyteller," I was reminded of the language in the 2004 presidential race between John Kerry and George W. Bush (which Olsen also mentions in his discussion of "gut vs. head"). Kerry, in attempting to convey the nuanced nature of the complex issues Commanders in Chief face, came across to many in the electorate as an arrogant, elite product of the ivory tower in contrast to the more folksy nature of his opponent, who was able to simplify topics and communicate in a familiar, accessible manner. Although the substance and content of their communication was different, it was the medium more than the message that seemed to resonate with voters. Olsen offers a similar example through describing the different impacts Al Gore's *Inconvenient Truth* and HBO's climate change films had. Despite the slight loss of accuracy, the impact of Al Gore's film propelled the topic into viewers' consciousness in a way that the extremely fact-laden HBO film did not.

Although this tradeoff between accuracy and impact may frustrate those who have excelled in their careers through attention to detail and commitment to the scientific method, there are ways to bridge the gap. RadioLab's segment on animal cognition and spindle cells offers an example of an effective presentation of complex scientific concepts in an accessible, interesting way. Through sound effects, the simplification and explanation of scientific jargon, and relatable examples of animal behavior, RadioLab journalists broke down a complex topic into a memorable segment.

Melissa Clarkson presented additional ways to create meaningful, accessible content using design concepts in class on February 4th. These included setting the context before jumping into details, comparing and contrasting information so viewers can mentally contextualize, and isolating visual elements to explain more complex figures. Other crucial considerations are establishing a hierarchy of ideas and considering the audience and their potential reaction. Ultimately, Clarkson emphasized asking yourself how an audience member, after viewing your presentation, would respond to the question, "What was the talk about?"

These ideas provide concrete ways to walk the line between factual accuracy and a mind-numbingly boring presentation. Although we may have the urge to provide as many details as we can and be as accurate as humanly possible, it helps to remember that this may be counterproductive and end up obscuring an audience member's ability to answer that crucial question of what the talk was actually about.

Student Post: Seeing results (like eating chocolate cake) feels great

Paige Northway studied lunar dust at the University of Colorado and followed her interest in space to become a graduate student in the Earth and Space Sciences department at the University of Washington. She is currently involved with the UW rockets program and hopes to expand the university's involvement in the production of small satellites.

At this point in the quarter, it's actually possible (and really interesting) to see how many of the things we have worked on and talked about in class are contributing to our speaking skills. Specifically, we did the second filming of our research descriptions, or elevator pitches, in class on the 11th. The improvement from the practice elevator pitches given in previous weeks was impressive. The improved confidence in presentation was one thing, but more exciting was the transformations from dry/technical/confusing descriptions to two minutes of engaging speech filled with analogies, examples, and personal insights. Members from the Engage Board of Directors attended the talks, and many commented that they left the class wishing they could hear more about our work.
On a more personal note, I've noticed improvements in my work outside of class as well. Last week, I had to give a talk without any notes in a stressful environment. I drew on what we learned in the first weeks from the Amy Cuddy about power poses and "faking it till I make it" and came across as more confident and competent as a result. I was also careful to acknowledge that, while my

audience was composed of intelligent scientists, they weren't all familiar with my field. I therefore made sure to explain the background of any space specific concepts and jargon, and I believe the audience was better able to follow and thus better pleased with my presentation as a result.
Another theme for the week was the use of analogies. As a space scientist, I find analogies and comparisons are a very important tool in helping people relate to concepts that are literally "out of this world." At this point I feel compelled to shout-out to 2014 Engage student Ian Johnson, who uses and encourages others to use comparisons and analogies to make our lab tours more interesting. One example, which usually gets a laugh, is comparing thrust from chemical propulsion to thrust from electrical propulsion: chemical propulsion is like 6 swimming pools worth of apples hitting you on the head, while electrical propulsion is like a small scrap of paper hitting you on the head. When tours are given without these analogies that students can connect to, it is painfully obvious that their attention starts to wander very quickly.
After seeing improvement in the rest of the class and in myself, and looking more closely into the use of comparisons to connect to the audience, I'm excited to see how people incorporate what we've learned into their practice talks in the coming weeks.

Student Post: Addressing Science Deniers: Communicating

With Differing Worldviews

Kelly is a 5th year chemical engineering PhD student at the University of Washington. Her research focus is molecular simulation of reactions important for biofuel processing and adsorption of organic molecules on surfaces for coating agents in the aviation industry. Outside of research, she runs the UW Science Policy Committee, writes a science blog, and writes for a Denver Broncos Blog called the Mile High Report.

Scientists must reevaluate how we approach the way we disseminate our findings to the public in an age when scientifically established facts like climate change, the effectiveness of vaccines, and evolution are still publicly debated. A well-defined line is drawn defining whether people agree with scientific consensus on certain controversial issues, regardless of their education. What makes these issues more controversial than others, and how can we more effectively reach the “deniers”?

The Internet has been a powerful catalyst of the polarized stance on scientific issues; information, or misinformation, is only a click away. This pattern is so well observed, that scientists are now studying *why* people seem to doubt established scientific facts. Research shows that people choose which scientific evidence to believe based on whether it supports the side of the line they are on. This phenomenon is called confirmation bias, and stems from personal beliefs and experiences.

A recent article in *National Geographic* explains that people, scientists and nonscientists alike, rely on their personal experiences to form stances on issues, including counterintuitive scientific observations. A study at Occidental College gave a timed true/false questionnaire to students with advanced science degrees. Students were asked if the earth orbits the sun in one question and whether the moon orbits the earth in another. All the students correctly answered “true” to both questions, however, they were slower to answer to whether the earth orbits the sun. This is because we cannot observe the earth’s movement while on earth, but we can more intuitively grasp the

moon's movement around the earth (and may also explain why some people still don't believe the earth is orbiting the sun).

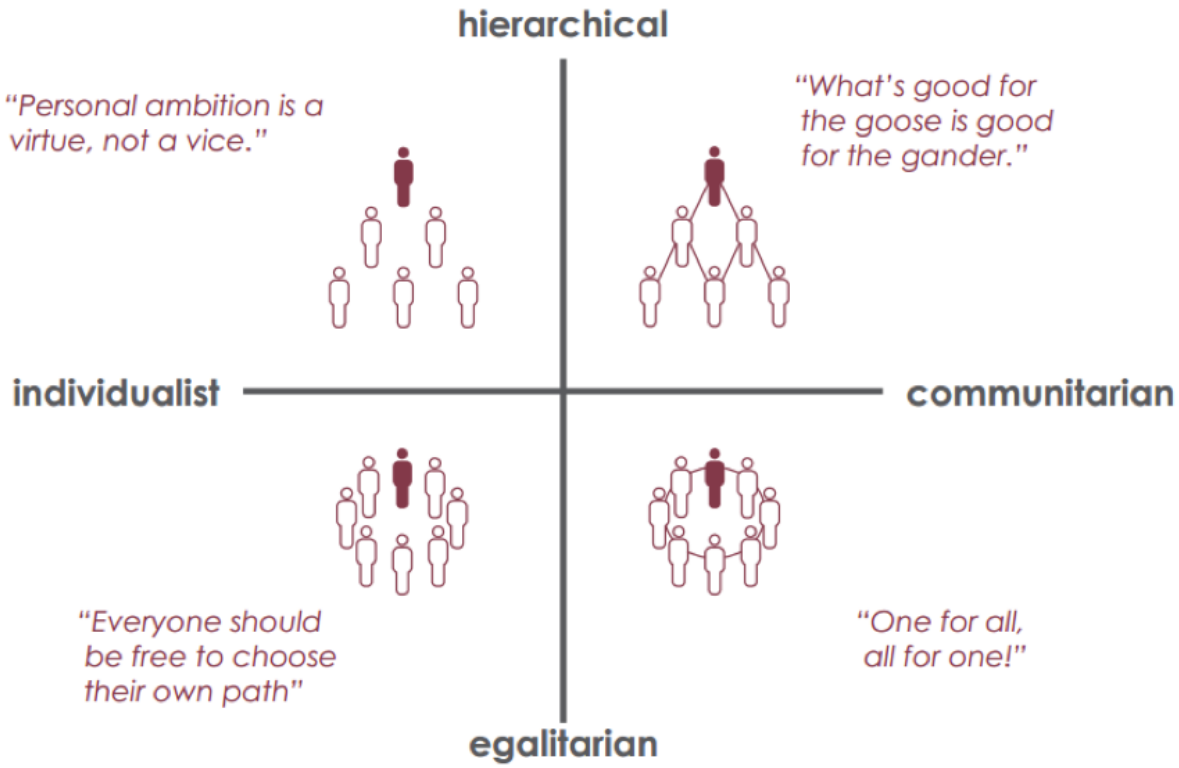
Image Credit: Kevin Gill via Flickr

Jumping to the conclusion that people who deny scientific fact are uneducated or not worth speaking to is damaging to science and innovation. We need to find a better way to empathize to their stance and figure out why they believe what they do. Instead of assuming that people are in denial, misinformed, or irrational, scientists and policymakers should frame their findings and recommendations in a specific way for their targeted audience's personal experiences. The same way that we rely on personal experiences for what we can more easily accept scientifically, people's political and cultural values are shaped from their personal experiences.

These notions were echoed at the American Association for the Advancement of Science (AAAS) National Meeting last week, where I went to a lecture by science design expert Jennifer Briselli. Her talk focused on "cultural cognition," a system developed by social psychology researchers at Yale Law School. The concept suggests that people interpret scientific information and assess risk based on whether supports or threatens their personal cultural values. Who we trust as an expert and how we determine consensus is influenced by our cultural values, which are based on personal experiences.

The Yale group developed a social grid showing how people's values differ, described as their "worldview," shown below. People who fall in the hierarchical/individualist portion of the grid might find things like vaccines and gun control threatening to their personal values, which are described by personal freedoms with little interference from others and distributed wealth according to personal differences. On the opposite end of the spectrum, people who fall in the communitarian/egalitarian

portion of the grid find things like climate change and nuclear power threatening to their values of a large collaborative community.



The Cultural Cognition worldview grid from jenniferbriselli.com.

Not surprisingly, scientists generally are described as communitarians, which is also how their research is generally communicated- as a benefit to the community at large. Unfortunately, that doesn't necessarily appeal to an individualist, which can create social and political divide among controversial research implications.

Communication by scientists and other experts should be designed around this grid to reach multiple worldviews. Instead of assuming our audience is in denial, we need to realize that "people *do* trust scientists, but their values shape *who* they trust." Instead of assuming our audience is misinformed, we should see that others' "cultural worldview influences *how* they process information." And instead of calling our audience irrational we should remember that they are "willing to consider new information when it affirms their *values*."

Briselli used an example of her research on communicating about vaccines. She designed different ways to communicate to each worldview about the risks and benefits of vaccines. Her strategy is shown in the figure below.

Jennifer Briselli's design strategy based on worldview from jeniferbriselli.com

Instead of throwing information at the audience about how dangerous not vaccinating is, or the scientific facts about how effective vaccines are, present it in a way that speaks to the audience's values broadly.

Because scientists tend to be more communitarian, vaccines are widely touted as a social **responsibility**. Stating to individualists that they have a responsibility to do something like vaccinate threatens their personal freedoms by taking away the choice aspect

Instead of framing vaccines as a responsibility, they could be presented as a **right,** a **responsibility**, and as a **privilege**. The information and facts are unchanged, but the design and frame are targeted to the worldview. The way to encompass each worldview, Briselli answers the questions: “Why should I?” “Why would I?” “Why shouldn’t I?” and “Will I?” when communicating about issues like vaccines.

Answering the question “Why should I?” specifically addresses the communitarian/egalitarian worldview by communicating that vaccines are a social responsibility which benefits the entire community. Answering the question “Why would I?” addresses the hierarchical/individualist worldview by framing vaccines as a privilege and right, and why it is appealing to each individual. Addressing “Why wouldn’t I?” addresses myths and widely accepted incorrect facts for each audience. And finally addressing the question “Will I?” maintains that vaccines are a choice, but a good choice.

Shifting the way we communicate science, specifically on controversial or “threatening” issues, is imperative to progress science, scientific integrity, and the overall goal of science: to improve life.

Jennifer Briselli’s lecture can be found here.

Student Post: The balance between

being right and being interesting

Ashley Mihle is a graduate student in the School of Environmental and Forest Sciences and the Evans School of Public Affairs and she analyzes potential roadblocks to creating a biofuels industry in Washington State, specifically how water, climate change, and water policy challenge the development of biofuels. She plans to do water resource management and policy analysis for a local government when she graduates.

In the past few weeks, we read more of Randy Olsen's book, "Don't Be Such a Scientist." One section discussed the trade-offs between being 100% factually correct (and often boring) and being very interesting, but perhaps not exactly right about all the details. At first, I felt a bit offended by this. Why isn't it possible to be correct AND interesting? What happens if we start communicating false information!!!

But the more I thought about this, the more I realized it's less about being wrong or right, and more about leaving out pieces of information in order to effectively communicate an idea. This happens all the time. In science in lower school, when students are taught about photosynthesis, no one teaches a 3rd grader about the complex chemical reactions that occur. Instead students are taught that plants take in carbon dioxide, make sugars, and release oxygen. This isn't wrong – it just isn't the entire story. And that's ok.

This point really became clear to me when I sent my friends my "new" elevator pitch to critique. It still needed (and needs) some work, but it was incredibly different from the SO BORING AND SO LONG, super technical speech I gave the first day of class. My friend, who has no science background, said she finally understand what my research was about. I've been working on my research for an entire year, and we are close friends, and I talk about it all the time. And I realized that most people have absolutely no idea what I'm talking about and/or do not care at all what I'm talking about, because it's boring. And that if I leave out some details that seem critical to me, no one

else even notices, and yet all of a sudden my story becomes more understandable, and more interesting.

I've seen this happen in class with my peers. Everyone's new elevator speeches leaves out a great deal of information that used to be there, but their funny analogies, their stories, and their excitement makes their ideas stick. I actually remember what every single person's research is about, and I could explain it to someone else. I've realized that having research stick, and making people want to talk about it to others, is often much more important than explaining every last detail. This gets the public excited about science, allows knowledge to spread, and can help rally support and publicity for your research.

There is a balance between being right and being interesting. And sometimes it's far more important to be right. But it's often more important to be interesting, and this class has taught me that you can do this without sacrificing the core of your science. You just have to keep things simple.

Student Post: Dealing with Stage Fright

Emily Youngblom is a doctoral student in the Institute of Public Health Genetics at UW. She studies how legal and social workers use genetic tests to figure out whether a child has been abused or if the child actually has a genetic condition that makes it appear as though they were abused.

According to Mark Twain, there are two kinds of speakers in the world: the nervous, and the liars. Most of us can relate to at least some level of stage fright: fear of messing up, being judged, and/or looking foolish. This might be true even after spending hours preparing and rehearsing a speech in front of friends, family, colleagues, and maybe even the random poor soul who got stuck next to us on a plane. We can practice a hundred times and still be nervous about the delivery of our speech.

Worse yet, we don't always have the opportunity to prepare for our speeches. Perhaps a friend's surprise engagement that demands an immediate toast, or an unexpected award calls for an acceptance speech, or when that one distant relative sneers and says contemptuously, "So you're vegan now. When is that foolishness going to end?" These impromptu speeches can pop up anywhere and can grip us with fear. Scientists regularly find themselves dealing with this issue when they are asked questions during or after a talk, and they need to be able to answer the question succinctly yet thoughtfully, and not let the question derail them.

There are a handful of different available frameworks that can help serve as a guide to people giving impromptu speeches. One of the most popular frameworks for impromptu speeches is called PREP:

Point

Reason

Example

Point.

In our Engage class last week, each student was asked to give two 2-minute impromptu speeches using the PREP method, on a subject just presented to them. For example, my first prompt was "Why do you want to be president of the United States of America?" After stating the point of my speech ("I should be president of the United States of America because American heads of state should be more inclusive of various genders and race than they have been in the past"), I needed to state a reason for making this point, ("The reason I say this is because all previous US presidents have been male and most have been 100% Caucasian, so there is little diversity among appearance. Diversity in leadership positions is important because the American population is diverse, and people should have role models, leaders, and representatives that are as diverse as the population they serve.") For the next part of our speech, we were encouraged to use a personal example, rather than a general example. Unfortunately, the personal example I gave in class was so immaterial to my speech that it isn't worth repeating here, but at least I was able to end on target by restating my initial point (In summary, my point is (see above)).

After our speeches, we were critiqued by our instructors and classmates, mostly on our stage presence and our unnecessary use of um or so. We were encouraged to try pausing instead of using filler words, which is a lot harder to execute than it seems, and talked a bit about how pauses in speech can actually be used for dramatic effect. Mark Twain (who you can probably tell by now I'm a

fan of) said, “The right word may be effective, but no word was ever as effective as a rightly timed pause.”

While the PREP system is helpful and effective, it is certainly difficult to be able to think through the four progressive steps in an organized fashion while also simultaneously coming up with sage ideas and synthesizing all your thoughts on the topic at hand into a single reflective and sophisticated response, and all in front of an expectant audience. It doesn’t come easily to very many people; most of us require an abundance of practice and many initial failures before it finally starts to sink in. To end this post, I’ll leave you with one last Mark Twain quote that my classmates and I can probably all now identify with: “It usually takes me more than three weeks to prepare a good impromptu speech”.

Student Post: Squint at Your Slides

Stella Stylianidou is a physics PhD student at the University of Washington pursuing research in Biophysics. She studies the traffic paths of molecules inside bacteria and how bacteria manage to send those molecules to specific locations before they split into two cells.

The last few weeks I have been walking around scientists holding a book with the title “Don’t be such a scientist”. I have received some stares and comments such as “Stella, you don’t want to be a scientist anymore?”. I explained to my scientist friends that I don’t want to be “such” a scientist; one

that can not captivate the audience's interest because she speaks from her head to the other heads. I want to be a scientist that can communicate her science in such a way that the audience will be sitting at their edge of their seats hanging from every word.

Most of them understand immediately what I am talking about. It is no secret that a lot of scientists lack the ability to communicate with clarity and engagement. And that is understandable. Communicating is hard, and we scientists hardly get any training in it. I am lucky enough to be in the Engage seminar and be learning so much the last few weeks. My science turned into a story, got salted and peppered with some humor, emotions, analogies. I am slowly turning from "such' a scientist, to the scientist I want to be.

In the last class, we had a graduate student from the Design school, Abigail Steinem, talking about slide design. Slide design reminds me of how overwhelmed I feel at houses filled with excessive junk and decorations. On the other hand, a house that has a clean and more minimal design has a much more calming effect. Cluttered slides with a huge amount of information, pictures and text, have the same effect on your audience: stress. The result will be nobody remembering any of that information. Instead, if you focus on the necessary content and images and follow a simple design there is a better chance your audience will remember the 'so what' of your talk. We need to remember that we are the presentation and the slides are an aid, and not the other way around.

The other thing that we learnt was the 'squint test'. What is this? You guessed it right, you squint at your slides or poster, until they become blurry, and an element pops out. That element is what your audience will look at first. If that is not the most important element, you may need to rethink of your design. There are different ways to draw attention to the most important elements, and they usually involve using contrast, such as changing the color (red usually draws attention), the size (bigger than the rest) or the orientation of the most important element.

Time to make some non-cluttered slides for my practice talk and squint at them!

Fake It Until You Become It: The

Transition from Engage Student to Engage Instructor

My stomach knotted as fifteen fresh new Engage students wandered into the classroom at the beginning of the Winter 2015 quarter. I wanted to cross my legs, crouch my shoulders, and make myself small. Just the year before I was one of them, oblivious to the fact that what I learned over the next quarter would overturn any previous notions I had about being a good science communicator. Now, I was the instructor, the expert, and I sure did not feel like one. I'm a third year graduate student, have probably have had less research experience than many of my students, and certainly do not have any sort of degree in science communication. I could not help wondering whether I really had the expertise to teach my new students how to be better communicators. But somehow, I had to step up.

If you have not watched the Ted Talk by Amy Cuddy, "Your body language shapes you are," you should. It is inspiring and wonderful. Cuddy says that you shouldn't just fake it until you make it, you should fake it until you *become* it. And over the course of winter quarter that is exactly what I did. I became an Engage instructor.

The first day of class I just went for it. I stumbled through my lesson plan, and luckily my co-instructor Juliana was there to fill in what I left out. During that class period I realized a couple things: (1) I learned a heck of a lot from the Engage course last year, and (2) my students had hardly thought about anything I was teaching them before signing up for this course. With those realizations my confidence shot up. I actually had important, new things to teach my students!

In his book *Don't Be Such a Scientist*, Randy Olson criticizes scientists for being too cerebral. Scientists are exhaustively thorough and always think things through. But while those qualities make for good research, they do not always lead to good communication. Have you ever been to a seminar where the scientist spends more time explaining their methods than the cool things they actually discovered? That is dull for other scientists let alone for someone outside of academia.

When I started the Engage course in Winter 2014 I was a cerebral scientist. I struggled with jargon and wanted to include *way* too many details. I wanted to talk about what *I* wanted to talk about and not necessarily what my audience wanted to hear.

In one quarter, the Engage course ripped me out of my own head. It taught me to stop thinking about every in and out of my science and step back and look at my science from a broader perspective. If my science was a digital photo, I stopped looking at it on a pixel-by-pixel basis, and began to actually look at the picture as a whole. From this view I could ask myself, what i*s* the overall story? Which parts stick out the most and are particularly bright and interesting? Where is the tension? These are the parts that non-scientists are most interested in, and therefore are worth communicating.

After the course I gave a talk at Seattle Town Hall that I was proud of, but I definitely did not think of myself as a “pro” science communicator. It was not until I began teaching the Engage course, and could compare my science communication knowledge to that of my students, that I realized just how much I had actually learned! For example, on the first day of class we had each student give a short description of their research. While the students were talking Juliana and I frantically wrote down all the jargon words that they used. Once everyone was done, we read the jargon back to the students. It felt like we were turning their world upside down. Many students knew that a complicated scientific term like “thermodynamic” is jargon, but not that a simple word like “model,” which we use all the time in the scientific community, is jargon as well. When a non-scientist hears the word “model” they might think of a fashion model or a model airplane, not a complicated computer program that predicts future climate.

Each class this quarter brought my students new surprises. And each time I saw them processing the most recent lesson I realized that, while last year I was in their exact shoes wondering why we were doing so many improv games or thinking it was odd that we were trying to fit our science into that same type story structure that Star Wars follows, I get why we do what we do in Engage! I believe in the Engage curriculum, AND I actually taught it effectively! During my first year of the Engage course I went from being a cerebral scientist to a science communicator, and during my second year of the Engage course I became a science communication instructor! The transition makes me proud of myself.

Anyways, I just want to finish by saying that the Engage Seminar has been fantastic this quarter! I have had so much fun teaching this year’s group of students! Thank you Juliana for getting me through each class and thank you students for working hard and being open minded! The Town Hall talks are going to be awesome, so stay tuned!