



TRANSCRIPT

Key Conversations with Phi Beta Kappa

Amy Cheng Vollmer: The Unofficial Ambassador for Good Bacteria

In this episode, Fred Lawrence, Secretary and CEO of the Phi Beta Kappa Society, welcomes professor Amy Cheng Vollmer from Swarthmore College. A microbiologist whose research centers on how bacteria react to different types of stresses, discusses her ongoing fascination with bacteria, why failure is important in her field, the need for STEAM, not just STEM, and what it means to her to be a Chinese-American woman in the sciences.

Lawrence: Hello, and welcome to Key Conversations with Phi Beta Kappa. I'm Fred Lawrence, Secretary and CEO of the Phi Beta Kappa Society. This podcast features conversations with Phi Beta Kappa Visiting Scholars, who spend one academic year with us. They travel to up to eight Phi Beta Kappa-affiliated colleges and universities, partake in the academic life, and present a lecture on a topic in their field. Lectures are always free and open to the public. For a full schedule, and to learn more about the program, visit pbk.org.

Today I'm pleased to welcome Professor Amy Cheng Vollmer from Swarthmore College. Professor Vollmer teaches microbiology, biotechnology, metabolism, and introductory biology. Her research centers on how bacteria react to environmental stress. She has also helped promote adult science literacy and success in STEM fields for a diverse student population. Welcome, Professor.

Vollmer: Hi Fred. It's great to be here.

Lawrence: Amy, you've said it's a great time to be a microbiologist. Why on earth is it a great time today to be a microbiologist?

Vollmer: Well, there's a little history to that. So it was always great to be a microbiologist, and a few decades ago there was a surgeon general, who will remain nameless, who announced that microbiology was done as a field. And the reason he said it was done was because we had antibiotics, which meant that all the bacteria were going to be destroyed, and microbiologists would just have to find new jobs.



Now, none of the microbiologists who heard this were terribly alarmed, because we knew that the advent of antibiotics was going to bring with it a new era of antibiotic resistance, and that as microbiologists we were going to have to learn why the resistances arose, and how we could get around those for antibiotics 2.0.

As a result of that though, there were some universities that downgraded their microbiology departments, supplanted them with the departments of molecular biology, which was enjoying a new birth at the time, and maybe combining microbiology with immunology or something to keep those tendered professors somewhere.

But eventually, what happened was antibiotics resistance came about, just as we had predicted, just as Alexander Fleming had actually predicted when he announced the discovery of penicillin. Then new things started to happen in the area of microbiology that really has brought about its renaissance in a way that no one could have predicted.

Lawrence: You talk about looking for resistant strains, and how we're going to deal with bacteria. Now, this surprises me because I think of you as the ambassador for bacteria, and bacteria have had a bad, bad PR rap. So in fact, there are a lot of positive things that bacteria do, that you've worked on. Isn't that right?

Vollmer: Yes, that's absolutely right. I would call myself the unofficial ambassador. There are certainly many people more worthy to be real ambassadors. But here's what I would say about bacteria. It's the same thing that I would say about teenagers. So, when you hear about teenagers in the news, really it's always bad news. They vandalize something. They exercise what I would call a lack of common sense, or otherwise did things that are particularly newsworthy, but are certainly not representative of all teenagers.

And so I would say that bacteria have had the same PR problem, that we tended to study the bacteria that made us sick, because of course we're trying to heal people, and so all the bacteria that we know the most about in the earliest phases of bacteriology were the ones that made us sick, right? And so over the last few decades, we have discovered in fact there are many more bacteria that are beneficial, and some without whom we couldn't live normal lives.



Lawrence: Tell us some of the positive things that bacteria do, because I think for many of us, we are just used to thinking of bacteria from the bad PR, from the bad teenagers, and from something that has to be cured, not something that has to be grown or used, or even celebrated.

Vollmer: I think what I want to start with is that bacteria occupied this planet from nearly the very beginning. As soon as the earth stabilized, and stopped being bombarded by things that would vaporize the oceans, as soon as the oceans became stable, life arose on this planet, and life occurred in the form of single-celled organisms that are most similar to current-day bacteria.

So by the time plants and animals and macro-organisms appeared, bacteria had already been here for a while, and in fact, they gave rise to the larger organisms. So naturally, those large organisms became new niches for the bacteria that had been living in the rocks, and living in abiotic places, and being attached to a planet or an animal, or actually moving inside to a plant or animal host gave the bacteria protection.

I mean, think about it. The zoo that you carry on you, the microbial zoo that you carry on you, has a great gig. It's warm, slightly salty, moist in just the right places, and there's a fairly constant infusion of nutrients. So, not a bad gig, compared to living in the crevices of some rocks, where you don't know where your next meal is coming from.

Lawrence: So bacteria in a sense take us back to the beginning of life on earth.

Vollmer: Absolutely. We share a genetic code with bacterial cells. Our cellular composition and the basic mechanisms by which we copy DNA, repair it if it's damaged, all of those things are pretty much the same. There really isn't that much new under the sun. What macro-organisms observe and enjoy is the ability to do really complicated things, and that's based on the fact that they are macro-organisms. They have organs and storage places to store a lot of energy, and that energy then fuels complicated behaviors, mating, development and differentiation, in a manner that microbes just can't do, because they don't generally have so many energy stores. But all of those fantastic new processes are basically variations on themes that were developed in bacteria.



Lawrence: Want to talk a little more about bacteria a little later on in our conversation. We've been talking origin stories. Let me talk about your origin story a little bit. You were the first in your family born in this country. Is that right?

Vollmer: Yes. Correct. My parents immigrated from China in the late 1940s and early 1950s.

Lawrence: How did that affect your childhood?

Vollmer: Well, it affected my childhood because I came to be born in the United States, not something my parents had planned. They had planned to come here, finish their graduate degrees and go home. So they raised me and my three sisters to speak Chinese first, that Chinese was the primary language in the home. My dad didn't want us picking up on their accent, so he said, "I want you to learn Chinese from people who speak Chinese fluently, and then you can go learn English from people who are native English speakers."

He also said to us, "As long as we're living in this country, I want you to try to derive the best parts of the Chinese culture, and the best parts of the American culture, and recognize there are parts of those cultures that are not good, and shed those, and really try to be the best of both worlds." And he acknowledged in that statement that we lived kind of in between two worlds.

Lawrence: What was the path that led to biology? Looking back, how obvious was it, how early, that you were going to be a microbiologist?

Vollmer: Well, you know, only when you look back does it look like a direct route. The arc of my career I think was far less than an arc. It looked more like squiggles on an Etch A Sketch screen. And I'm grateful now, when I look back, for all of the twists and turns that happened, that allowed me to arrive at this point. If I had tried to draw a master plan, I think I would have gone off-course very soon.

I only had one female role model in all the professors in STEM at Rice, and she was a biochemist. And she became my mentor, along with, so Kathleen Matthews at Rice University. She is still one of my mentors, all these years later, and her colleague, the late Fred Rudolph, who was actually my undergraduate advisor.



And between the two of them, they nurtured my interest in chemistry, but in the special environment that a cell provides; that only certain kinds of chemistry is allowed under these watery circumstances. And I absolutely loved learning biochemistry from them.

Lawrence: How important was it to have a woman mentor and a woman role model? There weren't all that many women scientists at that point at top-flight universities.

Vollmer: It was profoundly important. At a time when, this was the early '70s, mid '70s, so we were talking about the Equal Rights Amendment, and my classmates and I were determined that we were going to be successful women, and therefore we were not going to have children, because we really had zero role models for that.

Lawrence: Can you tell us some of the early challenges you had in your career?

Vollmer: I think the early challenges in my career were trying to figure out where to go to graduate school, and then once I got to graduate school, whose lab I was going to join, and I must say that I made the decision about whose lab I was going to join less about the science and more about the person.

So my doctoral advisor was Dr. Robert Switzer at the University of Illinois Urbana-Champaign, and first-year grad students were invited to come to a chili party. And I remember being on the patio and all the professors were walking through and introducing themselves to us, and Bob Switzer was the only man, the only professor, who introduced his wife to all of the students. "Hi, I'm Bob Switzer, and this is my wife, Bonnie." Every single person was introduced to her, and that made a huge impression on me. And I chose him as my advisor, and when I look back, that was probably one of the best decisions I made.

Lawrence: How do you think of yourself as an instructor in the classroom, in the lab? What excites you about the teaching part of our business?

Vollmer: Well, I have the best job in the world. I teach a group of students who are so incredibly motivated, and I have the privilege of sharing with them stories. Frankly, they could read the textbook on their own. I can't say it any better than the textbook says it, in terms of the factual information, but what I'm able to do is tell them stories about how these discoveries were made, that



some of them were completely accidental or incidental to the path that people were taking. That science is done by people.

We would like to think that scientists are objective and impartial and all that, and we certainly try to design our experiments to be that way, but we are people. We're driven by passion. We're biased by our own experiences. And so telling the stories is really what makes the lesson memorable. I have students who've said that to me. "Well, Amy, you know, I remember that concept, because of that funny story you told about what that person looked like when he made his discovery."

So I think of myself as a tour guide through this journey of "Here's microbiology." If you have a week to spend with me, I can show you three highlights. If you have a semester to spend with me, I can show you more, and if you want to join me in my lab, we'll take our own adventure through it. So you try to come up with the highlight reel. And depending upon the student, and depending upon the times that we live in, that highlight reel changes, so I rarely give the same lecture twice.

Lawrence: You're a tour guide. You're obviously supportive of your students. You have that enthusiasm that apparently first resonated with that high school teacher experience.

Vollmer: Yes.

Lawrence: And yet you've also said that real learning starts with discomfort. Why would someone nice like you want your students to be discomforted and uncomfortable?

Vollmer: Yes, I am known for being the person who provides uncomfortable moments. So I'm a biologist, and in biology, what is a very important characteristic of living organisms is that they grow, and when living organisms grow, that growth is characterized by discomfort. So if you're a student in my class and you're growing, you're experiencing discomfort. I'm literally taking you out of your intellectual comfort zone, the stuff you know, and we're going into an area where there's stuff you don't know.

My job as a teacher and a mentor is to present students with circumstances where they are uncomfortable intellectually, and much as a coach will say, "I think you can shave one second off of your time," or, "I actually think you can



clear that bar in the high jump", and you're looking at the coach going, "Are you kidding me? I'm giving you everything I've got, and you want me to do more?" And intellectually, that's exactly what I'm doing in the classroom. And the reason I'm doing it is because I know they can. I wouldn't be pushing them if I didn't think they could. But until they get pushed, Fred, they're not going to know.

Lawrence: Tell us about the wonderful Swarthmore Summer Scholars Program, and some of the success stories you've had in that.

Vollmer: Oh, thanks for asking about that. It's one of my favorite things now. The Swarthmore Summer Scholars Program, S3P is what we call it, was set up and first launched in the summer of 2015, and I was proud to be one of the participating faculty. So this program invites students who've already been admitted, and accepted Swarthmore's invitation, to come to campus the summer before they matriculate in the fall.

And the students who are invited are incoming freshmen who have expressed an interest in STEM, and of course by STEM, I mean science, technology, engineering and mathematics. But also, these students that we're inviting are ones who are traditionally from underrepresented minority groups in STEM, or students who are first from their family to go to college, or come from low-income families, or who have graduated from under-resourced high schools.

In studies it's been shown that these students are intellectually completely capable of majoring in STEM, but often leave because they feel like they're behind compared to their peers, who come from better-resourced families and communities. So what's been really fun is to engage with them for five weeks, in residence on campus, in three courses, a lab science course that changes every year, math, and writing.

And so faculty are involved in interacting with these students, but we also make a commitment to continue to mentor them for their four years at Swarthmore, regardless of what they end up majoring in. And our early results are quite promising, that the majority of these students stay in STEM majors, or in majors very closely aligned with STEM, such as psychology, which on some campuses is actually in the STEM umbrella.

And compared to a matched cohort of students who could have been in the program but were not, the majority of those students have left STEM. And so



what I tell the scholars is this, “If you find another disciplinary area that you love, that you have developed great passion, I will escort you over to that department chair. I do not want you leaving STEM because you don't feel like you belong.” And I think the Summer Scholar Program has had early success, and hopefully we can sustain that success, in retaining students who belong in STEM to stay.

Lawrence: We're talking a lot about success, but you have also spoken very eloquently about the role of failure in education.

Vollmer: Science research is over 90% failure. Most experiments don't work, or don't come out the way we thought they were going to come out. And we of course learn the most from that. I think with our emphasis throughout primary and secondary education of success at every step, of checking all the boxes, and moving onto the next step, we have not emphasized enough the importance of failure and feedback, learning from that.

I hearken to the examples of athletes. Certainly athletes learn about improvement from failure, and musical performance. Certainly not all musicians make every audition they've tried out with, or in a recital play some errant note that they never thought they would ever play, and learning from those mistakes those individuals develop mastery.

And while we accept that that's normal and to be expected in those fields, we somehow don't allow our students the opportunity to fail brilliantly, and learn from those failures and improve. Instead, students often don't want to try because they're afraid they're going to fail. And so encouraging students to fail and giving them stories about how we have failed, and the importance of resilience is something I'm really working on.

Lawrence: Have you ever used a specific story of failure to inspire your students?

Vollmer: Well, I suppose I could come up with lots of different ones about failure. One story about failure that I like is you never know when you're going to be somebody else's role model, by picking yourself back up. My favorite story is about my dad. My dad was a postdoc at Princeton, and he had never ice skated in his life. Now I need to tell you, my dad was quite an athlete, and so he figured he could nail this ice skating stuff.



So he borrowed some ice skates, and his friends taught him how to skate, and one morning, he went out by himself. He thought, "I'm not going to have anybody watch me. I'm just going to do this." And so he was doing fine on the pond, out at Princeton, and he really thought he got the hang of it, and then he hit a patch, and he ended up on his butt, seeing stars.

And he thought to himself, "Well, nobody's watching me. I'm just going to sit here for a while, and just kind of recover both my physical strength and my pride." And he heard a lady saying, "Now Suzie, stop crying. Get up. See that gentleman over there? He's a lot bigger than you are, and he just fell down, but you watch. He's going to stand right back up, and he's going to start skating again."

And my dad said, "Oh, of all the time that I have to be a role model." And he said, "Okay, but you never know, little Suzie could grow up to be an Olympic skater, so I'm going to pull myself back up and start skating." I will never forget that story. He told it many times, and each time he told it, I could just imagine how he didn't want to do that, but he realized he was called on to be involuntarily a role model for this little girl.

Lawrence: We don't always get the chance to pick when we want to be a role model, and when we don't want to be a role model.

Vollmer: No.

Lawrence: So, as a Visiting Scholar, you will go to a number of different colleges and universities all across the country, and that's an opportunity to be a role model. Can you give us a couple of examples about how you've been able to be a role model as a Visiting Scholar?

Vollmer: Well, first of all, I'm really honored to have been chosen to be a Phi Beta Kappa Visiting Scholar. It's really been a great pleasure for me to visit campuses. One of the things I've tried to communicate when I'm on campuses is the importance of communicating about science. Those of us who are doing science need to be part of the team that talks about science.

And the metaphor I use there is in sports broadcast, you have the play-by-play journalist who does their job very well, but then the color commentary comes from the player or the coach who has been involved for so long, and it's really the combination of the two that brilliantly allows us to feel like we're on the



playing field. And I would like for more of that kind of collaboration to be done in the area of science communication.

The other thing that I've been really happy to be able to represent is my passion, not just about STEM. I told you about STEM earlier. But I like to insert an A into STEM and call it STEAM, and the A stands for arts. The arts are very much a part of what I care about. I've raised two musicians, and I think that the art part of their learning has been as important as all their other learning.

Lawrence: I guess it makes sense that a microbiologist would be infectious, and your enthusiasm is clearly infectious. Thanks so much for being a Visiting Scholar, and being with us today.

Vollmer: It's my pleasure.

Lawrence: Thanks for listening. This podcast was produced by Lantigua Williams & Co. Our theme song is "Back to Back," by Yan Perchuk. To learn more about the Phi Beta Kappa Visiting Scholar Program, please visit pbk.org. I'm Fred Lawrence. Until next time.

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