

# Potterology with Dr. Rebecca Lai

## Ologies Podcast

### September 9, 2019

Oh heeey, it's your neighbor who's always out vacuuming his car and you're like, "Is he really clean? Or is he so dirty that he always needs to be vacuuming it that much?" Alie Ward, back with another episode of *Ologies*. Okay, so today, one half of a two-parter on Potter. Are you ready for this? Have you *been* ready for this since 1997? Were you even born in 1997?

Now, whether you've read all seven books in the *Harry Potter* series, or you've just seen a movie or two, or all you know is that *Harry Potter* is about a charming adolescent member of the occult who has, I guess, pretty bad vision, this episode is about chemistry and the science behind the spells. It's just dang magical and fun. Also, it's kid friendly. I'm not gonna swear. I've managed not to swear. It was difficult. You are welcome.

But before we board the Hogwarts Express, a really quick bit of business prior to leaving the station. Thanks are in order to everyone who supports the show by signing up on [Patreon.com](https://www.patreon.com/Ologies) for as little as 25 cents an episode, which lets you submit questions to the ologists. Thank you, everyone sporting *Ologies* wares from [OlogiesMerch.com](https://www.OlogiesMerch.com). We have brand new merch up – including some stickers! – to help you find all the ologites around you. Thank you also to everyone who rates and subscribes to *Ologies* and shares episodes on social media. Y'all keep it up there in the science charts. And especially to the folks close to my heart who leave reviews. You know I creepily read each one and I pluck a fresh one each week, such as for example, Cupeater, who said:

*If you ever thought about the movie Legally Blonde and are like, 'Gosh, I wish Elle Woods had an awesome podcast about science and creativity and fact-based thinking in general that I could listen to every week', well, that is an oddly specific request, but also what this podcast is.*

Thank you Cupeater. I will take that with a bow. Also, Sarah Jean Horwitz, your secret is safe with me, and anyone else who reads every single review.

Okay. Potterology. Come the frick on, DadWard! I've gotta be making up Potterology right? Listen. My standard is: the ology has to have been used previously by a person not involved with this podcast in an educational or an academic setting. And yes, Potterology does count. It does exist. There are book clubs called Potterology, there's an Instagram [@Potterology](https://www.instagram.com/Potterology), it has like 50,000 followers and it serves up some hot Harry Potter memes. Even Urban Dictionary, which is a terrible website, affirms 'Potterology' as "the study of all things in the wizarding world of Harry Potter." So, Potterology. It's in the lexicon.

And one cold January day a letter fell from the gray sky... Just kidding. It was in my email inbox and it was from a real witch. Just kidding. It was from a PhD student in Nebraska, Channing Thompson, who works with a professor who has created a 7-week course for exploring the science behind each *Harry Potter* book. She teaches it to local middle schools as an after-school program and even has an honors class at the undergraduate level at the university. Her college course is called A Muggle's Guide to Harry Potter's Chemistry. Her mission: to prove to Muggles, aka non-wizards, humans like you and me, that science and technology are Muggle magic and to highlight all of the real-world chemistry, botany, and alchemy, and love potions, and stun guns, and hybrid animals that we love from the wizarding world.

This ologist is a chemistry professor who works on the development of electrochemical biosensors that could be used to diagnose disease. She's been an author on papers such as "Use of Thiolated

Oligonucleotides as Anti-fouling Diluents in Electrochemical Peptide-based Sensors.” I needed to meet her.

So I road tripped. I made a special stop, my first ever visit to Nebraska. And on a rainy morning, I made it to the chemistry building at the University of Nebraska, Lincoln, to meet up with her. She is small in stature, wearing fashionable black pants, black boots, a polka-dotted black blouse, and we popped into her office, past a rustic-looking Sorting Hat and a life-size cutout of Daniel Radcliffe, aka Harry Potter, and she slipped on a pair of circular Potter-esque glasses. We sat down at her desk where she proceeded to demonstrate disappearing ink before I really even had recording levels set or handed her a mic. Just wait.

You’re gonna fall in love with this genius human person, but I don’t need to *spell out* how charming she is. [*lightning, magical sparkles*] So without further ado, get ready to blast through Platform 9  $\frac{3}{4}$  into the world of chemistry professor, honorary wizard, and Potterologist, Dr. Rebecca Lai.

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**Dr. Rebecca Lai:** And you can see it will eventually fade away again because the chemistry... What happens is that this ink is made in a basic pH, such as pH 11 to pH 13, so the color is blue. But when in the presence of exposed air, with CO<sub>2</sub> in it, the carbonic acid neutralizes with the base, which is the sodium hydroxide that is in the ink, dropping the pH to around pH 9 or so, when that indicator at pH 9 is actually colorless.

**Aside:** Yes. We hit the ground running. We blasted through a brick wall and straight into her showing me a muggle’s way to simulate the spell *Aparecium*, attempted by Hermione in *Harry Potter and the Chamber of Secrets* to read hidden writing from one Tom Marvolo Riddle’s diary.

Not a wizard caught in a struggle of good and evil? No worries. That special blue ink is basic but neutralizes in air to be invisible on the paper. So she swipes a liquid .05 molar solution of sodium hydroxide, raising the pH again to very basic, and the message pops back up on the paper. Chemistry lesson. Magic. Intrigue. Hidden messages in a diary that Professor Lai gifts me to take home. This is literally before the interview even began and I got to ask her anything about her classes. And I swear, we pick up the microphones like normal in a minute.

**Rebecca:** It’s great because I’m having a real class about it, and I remember students seeing this class on the website catalog. Someone actually wrote me, “Are you sure this is a real class that you can receive a credit for?” and it’s like, “Yes, absolutely. You have an exam; you have a group project that you have to work on. Yes, absolutely.”

**Alie Ward:** Oh my gaaawd!

**Rebecca:** This class closed really fast. It’s only got 16 slots. It’s not a big class. Honors classes only have 16 slots. And it always ends up that the class will close very early because it’s just full. And some people also mention that they would like to take the class just to have that on their transcript.

**Alie:** A Muggle’s Guide to Harry Potter’s Chemistry.

**Aside:** Okay. Alright. Let’s get into this.

**Alie:** Tell me a little bit about your background with chemistry. When did you realize that you loved chemistry?

**Rebecca:** *[laughs]* I started to like chemistry when I was in high school, but I do have to tell you that it is a bit of an unusual path that I took. I've always liked arts. In my first year in college I was still going for fashion design or a fashion merchandising major. In my second year I switched to biochemistry.

**Alie:** How did that happen?!

**Rebecca:** So in my whole life I've always been into arts and actually really wanted to be a fashion designer. And what happened was that I took a chemistry class in my first year; I went to Cal State Los Angeles. I realized that I really liked chemistry and I think there's a little bit of a pragmatic reason or lazy reason (I should not have my students hear about that), but the fact is, I thought that I did well without needing a lot of study. *[laughs]* I just thought, "Well, maybe I do actually get this, I get chemistry. Wow." I just ended up doing well in the class. And I thought, "Well, okay, I should try to think about this. It could be a career option."

**Aside:** This career hunch was confirmed when she was getting her Bachelor's in Biochemistry at California State University and met her undergrad research advisor Dr. Zhou.

**Rebecca:** Dr. Feimeng Zhou. And I really learned about the transformative ability of research. So he basically taught me a lot about how it is to do research and also how to be a scientist, basically, to have a scientific mindset. I think that's a very important idea, is to how to approach a scientific question. That's really the time, when I looked at research and said "Wow, you can actually do so much with research." And that's when I decided to switch to a biochemistry major.

**Alie:** And what do you think is a scientific mindset? How would you describe it?

**Rebecca:** A scientific mindset is, of course, first, you have to figure out what's the question, and then you have to think about how you're going to approach it. And there are multiple ways to approach it. You can't be all like, "I want to try all of them at the same time." It's not possible. In some cases it might be possible, but it's more ideal to systematically isolate one part of the question because some scientific questions are really, really broad and really complex. But how to isolate small chunks, small parts, and attack small chunks at a time and be able to get to a conclusion. You can think of it like a network of questions. They're all related.

So how am I going to prioritize which part I want to address first? And you have to think about the amount of time, the resources, and all the others. Simplify the question or at least address one part of the question at a time. And even within that one part of the question you would like to address, there are multiple approaches to address a question. It's very difficult to try to address everything at the same time, no matter how big the lab is, in general. I think I always would say the scientific process is doing things systematically rather than trying to go, "I like this, I like this, I like all of them." Well, how much time do you have? If you have a Time-Turner, *then...* *[Hermione, "This is a Time-Turner, Harry."]* okay, you might. But even Time-Turners can only go back one hour. So I don't know, you still can't address too many problems. You'll keep turning it back another hour- "Oops, go back." Right?

**Aside:** Did Rebecca have a necklace nearby that looked like Hermione's Time-Turner pendant? I'm gonna let you guess. Also, before getting her bachelor's, she studied at a British school in Hong Kong, but for her PhD in chemistry she went to the University of

Texas at Austin and then did post-doc at UCSB. So what sparked this interest in lab work?

**Alie:** Was it like solving puzzles as you go? What did you like about it?

**Rebecca:** I consider that... It's not as good as the Veritaserum; it's not truth serum, but it is a truth finder. You know, in the end there is a truth to all these things that are happening in science, in different chemical reactions. Even at this moment, I may not know all of them. There's always an answer to it. I think there's always a truth in science, whether we can, at this moment, know it or we're not technologically advanced enough to be able to understand it. Whether it's about a pathway in the human body with diseases or just new technologies, we may not be able to understand all of them. But I like chemistry, or science in general because it's truth-finding. I really think it is. Even if I don't know and understand it all right now, slowly and surely I'll get there. That's how I look at it.

**Alie:** Oh, that's a beautiful answer.

**Rebecca:** It's just my humble opinion. It could be entirely wrong.

**Alie:** [laughs] I think it's right. And when you were getting your PhD, what exactly were you studying? Ions, correct?

**Rebecca:** I studied electrochemistry. So then when I decided to go to graduate school, I wanted to continue on with that.

**Aside:** Rebecca said that she had great mentors like undergrad advisor Dr. Feimeng Zhou and PhD Dr. Allen Bard. So if you have academic dragons to slay, it's good to have a posse. I'm guessing both of them were more Hermione and less Weasley. Now, Rebecca herself seems like a kind, excitable, Hogwarts professor.

**Alie:** When it came to teaching, you got to design a syllabus, and you are clearly a Harry Potter fan...

**Rebecca:** Yes. [laughs]

**Alie:** Yes. [laughs] Let's actually go back to that. When did you read your first *Harry Potter* book?

**Rebecca:** Oh, it's been such a long time. Actually, I would say it was roughly the time that the first one came out, in 2001 I believe. *The Sorcerer's Stone*. That's the time that I was like, "Oh, it's a really cool book." I had that book then, but I didn't really get into seriously studying it, completely digesting the books, and learning all about it until later on, for sure.

**Aside:** Okay. Quick aside. A little background on the books. The first in the series was *Harry Potter and the Philosopher's Stone*, published in 1997 in the UK. *Harry Potter and the Sorcerer's Stone*, in 1998, was the US version, a name change which was suggested by the publisher. Rowling says that she regrets it; we'll talk about that more later. Also, fun fact, the initials JK were to sidestep any issues with young boys who bristled at reading a female author. Now, J stands for Joanne, K stands for Kathleen. She didn't actually have a middle name, but she made it up.

Now, the first imprint of the book was a scant 500 copies and 300 of those were sent to public libraries in the UK, which means that a rare, signed, first imprint, complete with a few typos and some misnumbered pages, has fetched nearly \$90,000 at an auction earlier this year. So, *Evanesco* your life savings. (That means it disappeared.)

**Rebecca:** It's a very old book, and it's very used-looking because I've read it so many times. I think that book is probably the one that I read the most number of times. I think the others, at least around seven or eight. That one's probably ten.

**Alie:** Oh, I love that!

**Rebecca:** I cannot say that I remember everything, but I definitely have read it many, many times. It's also quite short, compared to the other ones.

**Alie:** *[laughs]* And so, what was your impression when you were reading it? What really hooked you?

**Rebecca:** I just thought it's really amazing. I wasn't thinking about having this class yet or chemistry when I first read it, but I was just more so really amazed by how intelligent, how creative, how awesome JK Rowling is. I thought, "Wow, she basically came up with a world, a world that is new, unique, and all her own." There are other ideas, you know, or books that could be similar, but yet at the same time I think generally she really has this niche right there, generating a whole world that I think is uniquely hers. And I was really amazed at her writing ability and just being able to generate and come up with a world like that because I've always been into arts.

Actually, I wrote short stories myself, never to anyone. But you know, I've always been interested in writing stories, and also sci-fi, and things like that. So I think it's actually quite amazing to be able to come up with an idea like that because there's a lot of internal logic. You have to make it consistent. Yes, you can generate all sorts of sci-fi worlds, whether it is for books, or for Manga, or animation, anime, like Japanese animations. A lot of them got based on some really unique sci-fi ideas. But you really have to maintain that logic throughout the series. And I think she thought about it a lot even when she first wrote *The Sorcerer's Stone*. So therefore, how to tie everything to be consistent. And I'm still very amazed by that and it's very inspiring.

**Alie:** And it's kind of like how chemistry is consistent. It's predictable because of certain chemical laws and physical properties, right?

**Rebecca:** Yes, absolutely. I think so too. You learn how one concept could be applied to other systems or other reactions as well. It is very, very much the case. Learning from what's previously been done and you start to advance what you are going to do or what you are currently doing is very important in chemistry, in science, as in writing as well, I think, in creative writing and storytelling. It's analogous in some ways.

**Alie:** When did it first strike you, as a chemistry professor, that hot damn, I can do a whooole class on, essentially, Potterology? Were you like, "Wait a second, can I... *[squeals]* do that? Will they let me do that??"

**Rebecca:** Exactly!

**Aside:** *[whispers]* I'm sorry I squealed.

**Rebecca:** Absolutely correct what you just said there. And actually the idea, I was talking to my friend who's another professor here, Dr. Barry Cheung. And I always thank him when I have these podcasts and when I talk about this class because he really helped me and encouraged me. At that time I basically asked him, "I would really like to do this honors class, but will the university allow these types of things? I mean, this is really... I just worry they'll say, 'Are you nuts?'" *[laughs]* But he said, "Well, there's nothing to lose. Just

try it. Ask them if they will let you. If they don't let you, then the answer is no. At least you tried. If you don't try, you don't know."

And that's what I did, and I was entirely surprised the university allowed it, and so that's how it happened. Then I was like, "Great!" After the class showed up in the catalog that the students look in, a student actually wrote me and asked me about whether the class is legit or not. [*laughs*] "Will I actually get the credit for it?" I was like, "Yes, you absolutely will. You have to pass it and do a good job, but still you will get one."

**Aside:** So while Rebecca also teaches the curricula in much simpler form for high school and elementary after-school programs, her university class was for honors students and it met 15 or 16 weeks in a row. Pre-reqs? Having read all seven of the *Harry Potter* books. That is over 4,000 pages; it's over 1 million words. Posers need not apply.

Now, I wish we could've made this a four-hour episode because she covers everything from the science of invisibility cloaks to the spells *Petrificus Totalus*, which freezes your foes, and chemicals in nature that can simulate it, like Haitian zombie powders from plants and the deadly pufferfish neurotoxin that blocks the conduction of nerve impulses along fibers and axons. It comes from a bacteria in the pufferfish, not the pufferfish itself. So, not a wizard, can't cast any spells? That's fine. Just get yourself a dirty pufferfish. This class is amazing. Anyway.

**Rebecca:** So that's how it started. And I think it was just great, just trying to come up with the syllabus of what I would like to talk about. And it's good fun, setting up the class and thinking about how to run this class to make it fun but still educational. I think that's always going to be the case because, after all, it is a chemistry class, and it will be graded, and they should learn things. Right? As a chemistry professor, as a scientist, I cannot just say, "Oh, I'll have a class of just all good fun." Fun is great. But they have to learn things. They have to put effort into it.

And at the end, we have students' evaluations for our classes, and definitely a few students mentioned that "Despite that it seems like it's a fun class and whatnot, I've learned a lot." It's actually a lot of science material. They learned a lot about not just chemistry but science and technology as well. But the most important part I would like to mention about this class is their homework. There's also, of course, attendance points because there's class participation. They need to answer questions and participate in class discussions as well. So these are all part of it. But before I want to get there, I would like to mention that the first thing I did in my first class was that I sorted them into houses.

**Aside:** Quick aside. For those who have never read the *Harry Potter* series in totality, Hogwarts is Harry Potter's wizarding school, and it has different houses, kind of like fraternities but for cool witches.

[*Professor McGonagall: "Ravenclaw."*] Ravenclaw mascot: eagle. Colors: blue and bronze. Values: creativity, wit, intelligence, and learning. Ravenclaws kinda seem like the guy at work who's always reading books on his lunch hour and you're like, "Good on you."

[*Sorting Hat: "Hufflepuff."*] Hufflepuff mascot: the badger. Colors: yellow and black. Values: loyalty, justice, hard work, and patience. I feel like Hufflepuffs are the friends who help you move.

[*Professor Dumbledore: "Gryffindors."*] Gryffindor mascot: lion. Colors: red and gold. Values: bravery, gumption, chivalry, and courage. Harry Potter himself, along with his buds Hermione and Ron Weasley, all Gryffindors. Gryffindors: Ultimate wingmen.

And finally, [*Hermione: "Slytherin."*] Slytherin mascot: the snek. [*"I'm a snaaaaaake"*] Now, colors: green and silver. Values are leadership, cunning, resourcefulness, and ambition. They seem kinda like hedge fund account managers of tomorrow. Like, "Mm, congrats. You drive a Benz. But do you need to also pop your collar? I dunno if I like you, but I admire you."

Now, at Hogwarts, the talking Sorting Hat bellows your house before a packed hall of students, but in Rebecca's class, she fills it with slips of paper and then lets fate decide.

**Rebecca:** I pass the hat around. They all pick one. If they pick the green snake logo, Slytherin's logo, they're Slytherin. If they get the Raven, the blue logo, they're Ravenclaw, and then et cetera, you know, Hufflepuff and Gryffindor. After that for the rest of the semester, they will sit with their house.

**Alie:** [*excited whisper*] Yes! [*Professor McGonagall: "Before you can take your seats you must be sorted into your houses."*]

**Rebecca:** So in the beginning there were three friends who took the class together, but I split them into three houses. Not me, actually. The hat did it. That's why I put those little pieces of papers inside and then seal it with a piece of paper and I left it out overnight on that desk right over there to let the hat make some decisions that night. [*Alie laughs*] And it's got the night to decide, okay. And it's not related to me. [*Harry Potter, pleading: "Not Slytherin."*]

You got sorted into Slytherin? That's the hat's problem. [*Harry, "Then Slytherin house will have gained a wonderful young wizard."*]

So it was quite funny too, in another class, I think in 2013, one of the students was saying, "But I'm a Gryffindor! I got sorted into Slytherin," and she was very unhappy about it. Really was very unhappy about it. But what's cool was that towards the end of the semester, she actually learned more about the Slytherins, and learned more about the class, and worked with the other students because I sorted them into teams. She actually had a great time still, despite the fact that she was truly unhappy. I could see her face was like, "You just sorted me into Slytherin," and I was like, "The *hat* sorted you into Slytherin."

But towards the end, independent of... they came into the class wanting to be in one house or another, and they all ended up learning something about different houses and enjoyed it, and made new friends too, by working together for the rest of the semester with each other.

And why I mentioned that is because of our house points. I have four jars full of Swarovski crystals. Four colors of them: the sapphires, the emeralds, the rubies, and then the yellow one I ended up choosing something that's more like a topaz, right? For the Hufflepuffs. And I have bags of these crystals, and then in the beginning they are all empty, all four jars, and then when they answered the questions correctly- [*Professor Dumbledore: "I award ten points"*] Basically it's mimicking what they have at Hogwarts, right? Because they have these four big jars. They're not really jars but columns, and you can see how many house points they gain. They'll open it, open the valve, and then be like, "Ooh, six rubies just dropped to the bottom. Gryffindor got six points."

So that's also what I do as well, the four jars. I have never seen so many hands going up, because usually you would think of college classes... Most people, you'll ask a question and they're like, "I don't want to answer your question, I know the answer but I just don't want to." *[laughs]* I'm just kidding. But you could see that no matter at what level, college or K-12 level, everyone likes to win.

**Alie:** Yes!

**Aside:** In the college-level class they also have final projects in the form of a presentation and everyone in each house has to participate. No ducking behind the loud person in your group, wallflowers. Now, Rebecca had me guess the last two winners and they were Hufflepuff and Gryffindor. And I was dead wrong guessing both times. Literally the last house I guessed each time. I might as well get 'muggle' tattooed on my neck.

PS: I checked around and yes, there are people out there with muggle tattoos on their necks and I sadly salute them.

**Alie:** *[shrieking]* How did this happen *twice*? Ohhhh myyy goooooo! *[laughs/sobs]*

**Rebecca:** *[laughs]* Magic is not on your side today, sorry.

**Alie:** *[wailing]* I'm such a muggle!

**Rebecca:** I need to give you some potions.

**Alie:** *[wailing]* Oh noooo!

**Rebecca:** *[laughs]*

**Alie:** And I do want talk potions. So, tell me about the lessons that you run through. I want to hear about the chemistry lessons on your syllabus that you relate to the books. What are some big takeaways that you're able to give people based on the book?

**Rebecca:** Yes. So first I start with talking about the sorcerer's stone and about gold because the sorcerer's stone has the ability to basically touch anything and turn it into gold. I talk about the history of gold and the chemistry of gold, why gold is something that's so sought after back in medieval times, why gold is such a unique metal compared to other metals and lesser metals, et cetera. So I talk about gold, I spend two lectures talking about gold. And I think, based on the student evaluation, the gold portion ends up being actually the most well-liked lectures.

**Alie:** What are some lessons about gold? What are some takeaways? I'm dying to know.

**Rebecca:** Well, we talk about macroscopic gold versus microscopic gold, like gold nanoparticles and how macroscopic gold looks gold in color compared to microscopic gold, when the gold nanoparticles, which are very, very small, it has a reddish color. And how it ties to many other things including arts. If you go to a cathedral or places like that, basically red stained glass contains colloidal gold.

**Alie:** *[whispers]* Wooow.

**Aside:** Did you know that about gold nanoparticles? I did not. So teeny tiny gold particles less than 100 nanometers show as an intense red color, while larger particles, or nanorods, absorb and scatter light differently and they present as blue or purple. Gold is like, "Hey! Just coz I'm called gold doesn't mean I'm gold. How dare you."

**Rebecca:** So I talk about the chemistry of gold or what it means. And I talk about other gold objects in Harry Potter's world, and talk about European alchemy, about Roger Bacon and



Albertus Magnus, and how they also thought that gold was the perfect metal and therefore the others are just not as perfect. And they also thought about this idea, how it ties to the sorcerer's stone (and JK Rowling used this idea), which was an idea that was real, that people thought about. "Can we make something or discover something that is so good, so much more perfect than gold, that it could be used to transform or change other base or metals, such as iron or lead or anything else, to reach the perfection of gold? Convert them into gold?" So this idea of the philosopher's stone, I would say it's not JK Rowling's original idea, but she utilized this idea very well in her books, but it is an actual idea.

**Aside:** Side note, for those who aren't up on centuries-old alchemy gossip, a philosopher's stone was a real thing folks were looking for. A philosopher back then didn't necessarily mean someone in a turtleneck writing essays about nihilism, but literally a lover of wisdom, aka a scientist.

Who was Albertus Magnus, or the Big Albert? He was a 13-century friar, perhaps an alchemist, although scholars disagree about the degree to which he dabbled in gold making, but he did believe in the occult powers of rocks. So, if Big Albert wore a bra, he'd have a crystal tucked in it, we both know it.

Now, Roger Bacon was a contemporary of Biggy Albert and he had a reputation as a wizard. He also reportedly owned a mechanical bronze face that could answer any questions you asked it. This was called a brazen head, kind of like a magic 8 ball, but metal, and looked like a decapitated head. So, knowing all of this backstory about real philosopher wizards, and stones, and gold, I see why JK was bummed she let the publisher change it to 'sorcerer' for us Americans.

Who was it who urged the change? It was one Arthur Levine at Scholastic Books who thought 'philosopher' just wouldn't grab us audiences and he suggested instead the title *Harry Potter and the School of Magic* and JK was like [warped] "Mm... no." But she compromised with *Sorcerer's Stone*. Did I look up Arthur Levine? I did. He's @ArthurALevine1 on Twitter. He lives in New York. He owns his own publishing company now. He has about 2,400 followers. So, if you were to tweet at him and say, "Wow, dude. That was all you, huh?" he might even see it and reply. But be nice though. Because that is quite a dual triumph and a burden to carry.

Okay. Back to the wizard Roger Bacon, who, I'm sorry, wizards named *Roger*? The best. As far as I knew, Roger is just a name for stepdads, or the guy in accounting who wears Dockers but must have a wild, dark, magical life outside the office.

**Rebecca:** Roger Bacon, the alchemist, actually thought that gold dissolves in something else. It's called the elixir of life. And that's something called aqua regia, which is nitric acid and hydrochloric acid, which is something that no one should be drinking at all. There's no way of lengthening anyone's life whatsoever, drinking that. [laughs]

It's also interesting, in a way, how JK Rowling also used this idea. I mentioned this elixir of life related to the sorcerer's stone, but this idea of the elixir of life was around as well for the European alchemist Roger Bacon. But of course, it's a different chemical, but yet at the same time, I find it kinda interesting why 'aqua regia'. I do not know why he would consider that as the elixir of life and giving this solution this name, but it could be because aqua regia is known to be able to dissolve gold.

If you just add the HCL, you put the gold wire right there, you do not see any dissolution. Now, if you just add the nitric acid right there, you don't see the dissolution, but as you combine them together, you can see it's generating a beautiful, dissolved-gold solution, which is a golden color, yellowish color, solution. And what happens is that the aqueous, the Gold (III) right there, is going to eventually form this gold chloride, which is also soluble. And that's what you see in this yellow solution right there. So, these two reaction equations basically are telling exactly the story going from here, with the solid gold, right there, solid. There's gold wire to become this gold chloride, which is aqueous, basically, in the liquid form. That's basically the transformation from his magic from here to here.

I'm sure at that time, for people at Roger Bacon's time, that must be quite magical when you just add some stuff and, like, "Whoa, look, it's all dissolved," you know, and it's really amazing. But why the other on its own cannot do that? Why does it need that type of combination to be able to do that?

**Aside:** So while aqua regia might be three parts hydrochloric acid and one part nitric acid – not exactly the philosopher's stone that Harry is trying to protect – it does look, in a beaker, kind of like a glowy, orange Aperol Spritz cocktail, which can be magical in the right amounts and caustic if too much goes down the hatch. So, what if your gold has been cursed into a sloshy jar and you need it dry and solid and, like, gold again? What if you're going through TSA?

**Rebecca:** What we can do is that we can actually convert it back again. And that's the magical part about gold. And I wouldn't say only gold. Many of them you can dissolve it from a solid form to a solution form, and then you can precipitate out. We just mentioned that we use aqua regia to dissolve the solid gold wire or gold ring into the solution and then we can actually precipitate it out. You see, that's what one could do.

Now, if the aqua regia solution contains only gold, this beautiful yellow solution, and we want to collect these powders back so that it's more portable... You can't walk around with this caustic solution everywhere, right? You want to take it everywhere, so you want to bring it back into its powdery form. So what happens is that you can boil off the excess aqua regia and remove residual nitric acid by repeatedly heating with hydrochloric acids. You will be able to obtain the solid tetrachloroauric acid, so you end up getting the salt right there.

So now it's back into this powdery form that you can take everywhere. At that time, I'm sure it was very magical to think about. You can go from something shiny, beautiful, solid, and then go into a yellow solution, and then, by doing some chemistry right there, be able to transform it back into a powdery form so that you can take it everywhere.

**Aside:** Rebecca had pulled up some PDF slides to show me a pile of powdered gold, which surprisingly looks less like a glitter bomb and more like desiccated mustard. So, chemically, in a muggle-y way, how do you completely reverse the spell?

**Rebecca:** If you want the beautiful shiny gold again, you can selectively reduce it with sulfur dioxide or hydrazine. You can get back to the shiny gold and then you can make your gold rings or any other thing. So just think about the gold cycle from solid to liquid to the powdery form, and then reduce it back to the elemental gold or the shiny gold, and then use it again and go through the cycle. I really do believe that if I were living at that time... I don't know how many female scientists there were in medieval times. There might be

some female scientists. I'm sure there were. But to be able to see that and work on that would be very magical.

**Aside:** Side note. First chemist ever? Tapputi, a perfume maker in Babylonian Mesopotamia 3000 years ago. *She* was not a man, folks. Now, the first woman to win a Nobel prize? Madame Curie. Speaking of Nobels, and spells, and gold, and sorcery with aqua regia...

**Rebecca:** But it was actually used with the Nobel medal.

**Alie:** It was?

**Rebecca:** Yes, it was used on that during World War II, two of those gold medals. At that time Germany prohibited the export of these Nobel medals outside the country. Nazi Germany did not allow people to do that. And yet the two Nobel laureates would not like their medals to become something other than what they really wanted. So, they actually went through this process and ended up having them converted into powder and then shipped out. And then after the war was over, it was recast back as the medal.

**Alie:** [*whispers*] Oh my god.

**Rebecca:** So you can see the process I mentioned here was clearly useful. It was a chemist who helped them out, two physicists not wanting their medals to be destroyed or wanted them to be shipped out. But how can you disguise it? In what form can you ship precious metal out when it's clearly prohibited and illegal to do so? So, I think these types of methods could be useful.

**Aside:** A little 'Nazis are the worst' trivia. The golden Nobel prizes belonged to Max von Laue and James Franck, and Hungarian chemist George de Hevesy dissolved them in a beaker of aqua regia as the invading forces were literally marching the streets of Copenhagen. This dissolved gold remained on a shelf for years despite the laboratory getting ransacked by Nazis, who left the beaker untouched because Nazis represent extreme ignorant evil.

PS: If you're like, "Man, can you imagine being smart enough to win a Nobel prize? I will never be that perfect." I just want you to know that on the official NobelPrize.org site, on the very website that affirms this story, there's an easy-to-miss typo, so... let that be a lesson that perfection doesn't exist, but perseverance through obstacles and failure does.

**Rebecca:** Of course, we as scientists, chemists, physicists, we like to talk about the Nobel prize; who doesn't want to have one? I mean, I know most people will not have one. I'm sure we're all aware of that, but that doesn't mean we don't have a small amount of hope. I think most would like to have one. Before the 1980s, they were made of 200 grams of 23-carat gold, and 24-carat gold is pure gold. So that's a lot of money. But later on it changed. Now it is just 175 grams of 18-carat gold, plated with pure gold, but actually it's green gold, so basically, it's a silver-gold alloy. If you haven't heard of what green gold is, it's basically silver-gold alloy.

**Alie:** So they've made it a little bit cheaper.

**Rebecca:** Yes, correct. The Nobel prize is beyond... The value of a Nobel prize to the person who received it; it's a lifetime's work beyond that worth of \$5,380 US dollars.

**Alie:** Which is I think what my 2007 Prius is worth, so it's much more than that.

**Rebecca:** *[laughs]* Exactly, it's the honor. And the amount of work that goes into continuing to believe your own idea... Because a lot of times when people first start, even if you were to ask a few of them, a lot of them perhaps thought, "Oh, I didn't think the idea would work out. In the initial trials things were not working. I could have given up, but I persevered again and again," and eventually believing their own idea and eventually being able to get there. I think there are a lot of that kind of story. If you interview different Nobel laureates, I think not every single one's career just sailed through, like, "Okay, I came up with this idea and I tried it and it worked. It continued to work, work, work." It's not always like that.

Of course, there are cases that are like that, but there are also cases in which people truly have to persevere, who have a lot of challenges, but they did not give up. They just continued to work at it and ended up becoming successful in doing what they set out to do.

**Alie:** Including JK Rowling, who started this book on a napkin in a coffee shop.

**Rebecca:** I know! JK Rowling's writing brought an impact on so many people. And I think it's amazing. She is amazing. I do hope one day to meet her. Maybe you can help me with that!

**Alie:** Um, yeah, I feel like enough tweets...

**Aside:** With enough tweets, perhaps one Rowling will learn of Dr. Lai's homages to her. Do you think? Also, on the topic of napkin drafts, I've looked into this further, and Rowling says she had the first ideas for the Harry Potter series while on a train from Manchester to London, which had been four hours delayed. Also, JK Rowling's parents met on a train. Two reasons, perhaps, why trains and terminals might make such *charming* appearances. PS, Train nerds: Please see the *Ologies* episode Ferroequinology for more shockingly kid-friendly train information.

Anyway, JK started writing the books by sketching the characters, perhaps on a napkin, and then wrote much of the rest of the books in cafés as a single mom, herself nursing one cup of coffee for hours while her newborn slept in a stroller nearby. It seems that the scientific method of a hunch, followed by trial and error, plus determination, works not only in the lab but also while staring at a blank page. On Rowling's website, she shared her struggles and advice and she says it took her seven years to write and publish her first book because she was convinced it was rubbish.

She continues, just giving the pep talk of the century, writing:

*Fear of failure is the saddest reason on earth not to do what you were meant to do.*

*Ultimately, wouldn't you rather be the person who actually finished the project you're dreaming about, rather than the one who talks about 'always having wanted to'?*

*Ultimately, in writing as in life, your job is to do the best you can, improving your own inherent limitations where possible, learning as much as you can and accepting that perfect works of art are only slightly less rare than perfect human beings.*

Pop quiz: How much did I cry while working on this episode? I'm so inspired by her. If you guessed "A truly embarrassing amount, and thank god you were alone," *[microphone effect]* Five points to your house!

As long as we're getting mushy, each week we donate to a cause of the Ologist's choosing, and this week Rebecca chose PBS.org. PBS provides content and experiences that inspire, inform, and entertain over the air, online, in the community, and in the classroom. Nearly 50% of their funding comes from donors and viewers. So a donation went to PBS.org in Rebecca's name. That donation is made possible by having sponsors, and here are a few words about them before we talk about spells and technology.

[Ad Break]

All right. Let's get back into it.

**Alie:** And now, what about spells and technology?

**Rebecca:** Yes! Spells and technology. Even though I ended up not picking all the spells that are the most commonly used, I picked the ones in which I can talk a lot about the science.

**Alie:** Give me some of them.

**Rebecca:** For example, like *Impervious*. *Impervious* is a spell that is used to make sure that substances such as water will not affect something. Of course, it was used very much when Harry was playing a Quidditch game. So *Impervious* basically makes sure that my glasses will stay perfectly fine in the rain, just like Harry's glasses when he was playing Quidditch in the third year. In *Prisoner of Azkaban*, he was playing in the storm.

**Aside:** Okay, side note. If you haven't seen or read it, Harry is being pummeled by rain. It looks like CNN hurricane coverage, just lightning, chased by ghostly dark Dementors in the sky. I do not know what kind of liability insurance Hogwarts has but it cannot be cheap.

**Rebecca:** *Impervious* is actually used in other occasions as well in the book, but I think the most famous example that people relate to is the one I talk about, Harry's glasses. Hermione, always the smartest one, is like, "*Impervious!* Your glasses are fine. Go and win the Quidditch magic, okay? Don't complain. Stop it."

**Alie:** [laughs] And how do you get your glasses from fogging up?

**Rebecca:** For me? Exactly. That's what I was going to say. Rain-X or Aquapel. I will not recommend that for glasses. But Rain-X is very good for your car, right? For the car windows, the windshield. And same with Aquapel. It's basically they have these polysiloxanes that have functional groups that bind to the OH group on the glass surface and therefore making the surface chemistry difficult for polar solvents, such as rainwater, to wet the surface.

**Aside:** So products like Rain-X have compounds called polysiloxanes that have functional groups that bind to the glass surface, and that changes the surface chemistry making it harder for solvents like water to wet the surface. And Aquapel is another product that has fluorinated compounds and that binds with the glass surface. So windshield wizardry with magic for muggles. Now, another way the *Impervious* spell could work via chemistry? Rebecca says to turn your eye – or rather your SEM (scanning electron microscope) toward lotus leaves.

**Rebecca:** The lotus effect is that if you think about looking at a lotus leaf up close, it's beautiful and green. But if you look at it under an SEM you will see that they have these little tufts sticking out. So it's actually not flat, it has these little tufts sticking out. And that's one of the reasons why you never really look at lotus leaves being super dirty is because they

have this nano-structuring effect that enables the water to just roll off and taking the dirt, the soil particles, and whatnot with it. So you can see the rain, water will just go away. And that's due to the nanostructuring, the unique surface of that lotus leaf.

From afar we cannot see that, but that's research, right? You know, the fact is that people first of all have to build a powerful microscope to be able to see it. If not, you wouldn't know. So by seeing that, they're like, "Wow, okay, why, how does that happen? Having these small little nanostructures, these little tufts sticking out, how could this be a self-cleaning technology?" So, once people figure out the science behind that, they use it to do a lot of things.

I think they have a paint called Lotusan. We actually got some samples in the lab that they gave us for free because I mention that I'm using this for outreach and for education. You can paint the wall and then when it dries, it will have these little spikes and nano features or micro-features sticking out so that dirt and all these things will not stick. Especially for the outside of the house, it's very important. So it's paint that's derived from information people obtained when they studied a lotus leaf.

**Aside:** When water drops on these ultra-hydrophobic lotus leaves (these are nelumbo plants, lotus plants), it beads up and it looks kinda like a ball is just sitting on the surface. And it turns out that the more boingy and ball-like the water droplet looks is an indicator of how hydrophobic the surface is. So, imagine the difference between a bowl overturned on a countertop, versus a partly deflated basketball on the countertop, versus a pretty much fully inflated basketball. So the angle of contact between the droplet and the surface even has different names. 'Wenzel' is the kinda deflated ball shape, and 'Cassie-Baxter' is the rounder droplet.

So, does anyone need a pen name for a fantasy or sci-fi novel you're newly-inspired to write? May I suggest Cassie-Baxter? Okay.

Side note, that lotus technology exists in hydrophobic shirts, which is perfect if you're a proud slob who can't do an *Impervious* spell, or if you just want to google hydrophobic shirts and watch people intentionally spilling barbecue sauce on themselves then marveling in wonder. Rebecca explains:

**Rebecca:** And they also have a nanostructure shirt as well. We actually have a shirt in the lab where if you spray water on it, or your coffee, it will completely not absorb, which is, again, because of the texture of that shirt, and how they actually make that fabric is utilizing the lotus effect as well.

**Alie:** And so that's like *Impervious*.

**Rebecca:** Absolutely! And that's how I look at it, actually, not just *Impervious* because they have a few spells such as *Scourgify* and *Tergeo*, which are also about self-cleaning in Harry's world, when things get dirty. [*Professor McGonagall, "I've always wanted to use that spell!"*] You can see that we also have self-cleaning technology. So which one's actually better? I have to say, I think ours actually quite up there, you know. Not bad, right? *Aparecium* versus sodium hydroxide. So that's one of the spells that I cover quite a bit.

**Aside:** *Aparecium*, by the by, would be the incantation behind that invisible ink from earlier, and that can be used to reveal invisible writing or invisible illustrations. Hermione attempted to use this charm on Tom Riddle's diary, to no avail as there was nothing written in it.

Also, Rebecca is the best. She gave me the pen with the invisible ink and the base to revive it, and I kept it as a keepsake in my purse all through my road trip journey. Weeks later I was home taking measurements for a new refrigerator and I took the paper with me to the appliance store and the paper was blank. So. Muggle trubs. Now, what other spells does Rebecca cast through chemistry?

**Rebecca:** I have the Conjunctivitis Curse. It's basically a curse that causes great pain to the victim's eyes. So that was used by Viktor Krum during *The Goblet of Fire* Triwizard Tournament and he used this curse to affect the dragon's eyes. It was also mentioned in other books as well, but what we have is, of course, pepper spray, oleoresin capsicum. So I spend time talking about them having the Conjunctivitis Curse to affect people's eyes and we have one that's even better. It'll cover your nose and mouth as well.

**Alie:** [laughs] How does that work?

**Rebecca:** Actually, it's a mucus membrane. It's basically capsaicin. Capsaicin is a compound from chilies. Basically, all the pepper sprays have different concentrations of capsaicin; some could be pretty high, most will have around 2–10% of oleo capsaicin. But it doesn't mean the higher the merrier. Actually, you want the fluid to be really light so that it could penetrate the membranes of your nose and eyes quicker. At the end, this is a defense and perhaps offense. You want it to act and work very fast. I'm sure Viktor Krum would try it on that dragon. You really would like that to be fast. Seriously. [*Ludo Bagman, "Chinese Fireball."*]

We talk about the ingredients, which are called OC, or oleoresin capsicum. You could see if you have one, I have quite a few... I don't have one with me, but I have pepper spray and different concentrations of that as well. I spend time describing what capsaicin is and how people have done a lot of work to even isolate it. I mean, I'm sure at the start of human time when we knew how to eat some sort of jalapeno, they realized, "Wow, this thing is spicy." [*lower pitch, repeated: "Wow, this thing is spicy."*]

And, you know, it takes a lot more science and chemistry to actually figure out what the compound is, to isolate a molecule that is responsible for this feeling. I've actually gone through a lot related to analytical chemistry. I'm an electrochemist, but I'm also an analytical chemist because I like to analyze what's in food or different types of complex samples. I want to know what's in there.

**Aside:** PS, if you have not ever scorched your own eyes or your mouth on a hot pepper, you may not know that Scoville units measure hotness, with a bell pepper being a zero, a jalapeno going up to 3,500 Scoville units. A habanero, which has reduced me to tears, ranks on average, 250,000 Scoville units.

So what is the wizardy Dragon's Breath pepper rated at? 2.5 million Scoville units! Nearly doubling the Scoville units of former record-holder PuckerButt Farms' Carolina Reaper pepper, which itself has sent people to the hospital. So, Dragon's Breath peppers must be the muggles' answer to the Conjunctivitis Curse. Yes? Not so fast.

PuckerButt Farms takes the lead again with owner Smokin' Ed Currie cultivating a new, not even commercially available, Pepper X that hits the 3-million-mark, surpassing Dragon's Breath.

Why does capsaicin hurt so much? Oh, it triggers the same pain receptors that think you're literally burning alive, which is why you start sweating. Also, you release

endorphins and dopamine, so in lieu of a spell that keeps you chipper, just pack hot sauce in your bag. Now, how do they know how hot is hot? Ask a chemist.

**Rebecca:** So they compare it to ghost pepper, habaneros, and Scorpion peppers and all sorts. So you can see that in order to obtain this information, they have to analyze them, mostly using chromatography to be able to separate and then quantify when they make a mixture of these chili peppers. They have to first of all digest the sample, and then they have to clean it up, and then inject it into an instrument, and then look at it, separating these different species. Because the fact is, food samples are very complex, right? It's got tons of things in there. Or you can do that for buffalo wing sauce. [laughs]

**Alie:** And that's all analytical chemistry?

**Rebecca:** Yes, absolutely. And I would like to mention that two years ago, or maybe more... I teach a class called Analytical Chemistry. It's an instrumental analysis class. Two years ago or so one student actually studied the amount of capsaicin in different types of chilies. He likes eating chilis. He eats spicy food and also he grew this chili and he wanted to study the chili pepper that's from home and when he processed it differently, dried in an oven versus other methods, will it change the amount of capsaicin in it? And also when it's grown in a different environment, like certain different types of soil, will it affect the same chili plant? Will it affect the fruits, which are the chili peppers, and the amount of capsaicin in there? So it's actually really fun when the students in my class do a project like that.

**Aside:** Rebecca kind of hooks people into chemistry by letting them study things that they already love. And in her analytical chem class, one student is studying what makes Chanel No. 5 perfume smell like Chanel No. 5 perfume. And why imitations are a little off. The nose knows but the analysis shows, I suppose. [ding!]

**Rebecca:** So that's why analytical chemistry and analytical science are very important. And that's why in this class that I'm currently teaching, the students get to spend half of their semester analyzing things that they're interested in, whether it's about real perfumes versus imitation. So it's really fun, especially when you have 12 students and each one comes up with something that's drastically different.

**Aside:** Another student is testing a different olive oil to see if the amount of antioxidant polyphenols correspond to better taste, although they're not allowed to lick anything inside the lab itself. Now, if this episode has taught you anything, don't drink a beakerful of Aperol for so many reasons.

Speaking of eating, one thing about the *Harry Potter* series I find challenging is that I end up slowly reading the feast scenes, and even though I don't even know what treacle is, I'm starving and I'm taking a break to go stir pudding mix with a splash of coffee creamer and toss in some corn pops. I am a kitchen dragon, and my fuel is carbs.

Now, Rebecca said one aspect of the course is, of course, food science. Starting with none other than the kaleidoscope of flavors in a bag of jellybeans.

**Rebecca:** Yes, we actually have that. I talk about the process of how jellybeans are actually made. I talk about how in food science 1:1 may not equal 2:2. So if you mix a few flavors together, you will actually taste a different flavor. And the Jelly Bellies people, they know that. They absolutely know that. I think everything is top secret, very proprietary. It's because they did a lot of work.



For example, I looked up their process when I talked about jellybeans for my food chemistry lecture. Like for example, making the pomegranate jellybean. They really analyze the juice from the real pomegranate, and they use separations. They use separation techniques such as chromatography. They use mass spec to analyze what's in there and they want to know what's the concentration of each of these compounds, what's the components of this pomegranate juice, and see if they can recreate that in the lab into this jellybean. So, you can see the scientific process to make a flavor that is so close to the real thing. It's a lot of work.

**Aside:** Okay, side note. I fell into a deep badger hole and I think this would be otolaryngology? But I believe a man by the name of Ambrose Lee heads up Jelly Belly flavor science. Boy howdy, would I like to ask that smart person stupid, disgusting questions. Meanwhile, Rebecca explains:

**Rebecca:** As they design new flavors, they will have people actually hold and maybe have a bite of the real thing and then taste that bean. And they've got to be the same. I think it's a really rigorous process in terms of food science. It's amazing, I think, to really understand what's in there, so as to recreate it.

Ah, jellybean chart! Okay. Here. You can see they actually encourage you to eat a chocolate and then a couple more, you know? And then something like the strawberry and blueberry becomes something else. And then if you want a honeydew melon, you go with a cantaloupe and green apple.

**Alie:** You can eat a whole banana split if you do it right.

**Rebecca:** Exactly, if you do it right. I think it's really amazing. I mean, I could see why people would think Jelly Bellies are not the cheapest jellybeans you could find around, but yet if you think about the kind of process and creativity these people put in, it's very amazing. And I think I could see creativity and amazing science in anything. I really can see that. I think that's how I can correlate *Harry Potter* and some other books to science because you can see that, in terms of food chemistry and food science, that has gotten people to think about these types of combinations. Each of them takes a lot of time to actually develop that bean, this bean, and then try it out under conditions of how human's perception of tastes works. It's amazing.

**Aside:** Okay. Chew on this. Some people have more taste buds than others but each taste bud has receptors for salty, sweet, sour, bitter, and umami. So that notion that only certain parts of your tongue can taste things? That is flimflam, friends. That was very Hermione of me. I'm sorry.

**Alie:** And so what do you do in the class?

**Rebecca:** I have small little bags for each student and have them identify the beans without looking at the chart. Can they say, "This is Dr. Pepper. This is island punch."? Because if they can, then Jelly Belly has done a great job because that's the ultimate goal, right? To be able to eat and realize that, "Oh, that's peach, that's not mango." It was quite fun, but more so I really want them to understand getting something from an idea to a product. It takes a lot of work and a lot of times they'll go through a lot of steps to get to what they want finally, and a lot of science is involved.

It's simple jellybeans, but think about the time that people put into analyzing those spectra, whether it's the mass spec or the HPLC, the chromatograms. They really have to put effort into analyzing that so as to be able to get a product that is so well received.

Even though I really disliked some of those flavors. I think I'm okay with the soap. The vomit was pretty bad. The earthworm is very okay. Actually, I like pepper, it's perfectly fine. I can eat tons of those. But some of them, I just left at the bottom and I think I chucked it.

**Aside:** So non-wizards, you'll have to learn yourselves some mass spectrometry that measures the mass-to-charge ratio of ions. Or HPLC, high-performance liquid chromatography, if you don't have a magic wand handy. Oh, which left me *wand*-ering...

**Alie:** Where does the wand wood come in? Chemistry-wise?

**Rebecca:** Oh, wand wood! Lots actually. Because you think about the wand wood. Okay, do you want to guess what this is? Of course it's not wood, but Harry's wand is made from holly wood, really. [*clip of Doris Day: "Hooray for Hollywood..."*] The elder wand and different types of elder trees, and we also ended up talking about different types, like a willow because willow is also a wand wood. I believe that Harry Potter's mother's Lily wand is made from willow, and then there are other ones such as Lord Voldemort himself's original one (not the Elder Wand) is from yew trees.

There's a lot of folklores related to it. But people also study these unique types of plants and, again, go through the analytical process to obtain chemicals that could eventually be useful for fighting cancers or other things. There's a lot of researchers doing research with different types of plants. They're trying to look at a new plant to derive anti-cancer drugs or at least try to understand it, right? Very simple things such as methyl salicylate or salicylic acid. You think about willow bark and people used to make teas out of willow bark back in the day without knowing about salicylic acid compounds.

**Alie:** Isn't the Pacific yew tree used in breast cancer research, but that's a Voldemort wood?

**Rebecca:** Yes.

**Alie:** Voldemort wand's cures cancer?? My mind is blown right now. How do you explain that?

**Rebecca:** It's because it's related to death and things like that. Yews are usually planted... In the mythology, yew trees are related to death and they are planted usually in cemeteries.

**Alie:** [*whispers*] Wow. Oh my god, that's amazing.

**Rebecca:** Pieces of yew buried with the body can protect the soul on this journey to the other world so there's a lot of mythology that JK Rowling, clearly an expert, incorporates in her books.

**Alie:** Oh my god, that is so great!

**Rebecca:** So that's more Divination, you know, the myths and rituals. And of course, this is what you're talking about.

**Alie:** Yes, Taxol!

**Rebecca:** Yes. Exactly. Paclitaxel. They are poisonous but we can get something out of it. A lot of things that you look at as being poisonous, it's also dose response. It depends on how much you use. Basically, therapeutic windows are very limited, very small. So therefore, you have to be very careful. It is not telling people, "Oh, let's get some yew bark and then chew on it." No, that's not a good idea. Everything has to be well controlled.

But nonetheless, if you look at how many people are trying to really study what nature is offering, and then see what one could use to improve human life., whether it's as cancer

drugs or other types of medications. That's one of the main parts, Taxol, because everybody knows it. So it's kind of neat and easy to see it.

**Alie:** Oh, that's so fascinating!

**Aside:** For more on how the Pacific yew treats cancer, specifically its discovery in breast cancer therapies, see last October's surgical oncology episode. I promise it'll leave you hopeful. Will you cry? Maybe. Will it be worth it? Definitely. Okay. Back to wands.

**Rebecca:** So these are the wand woods. The elder wand, holly, elm, yew, vine, hawthorn, willow, walnut. Of course, the cores are things that we don't have, but at least we can talk about the different wand woods. So it's all related to the Celtic tree calendar as well. Basically, Harry's wand is because he was born July 31st and actually matches to holly. And then Hermione was born between September 2nd and September 29th and she has vine wood. So you can see these other things that JK Rowling used. It's not random how she chose what type of wand wood she chose for the trio, the three main characters.

**Alie:** So would you be birch cause you're a Capricorn?

**Rebecca:** Yes, that is correct. Birch is all right. Willow's also nice. And so I talk about the holly tree, the name comes from holy, it repels evil, while yew, which can achieve astonishing longevity, can symbolize both death and resurrection. The sap is also poisonous. And that's actually a quote from JK Rowling when people ask why she ended up choosing yew for Voldemort and holly for Harry, because the word comes from holy.

**Aside:** Okay, real quick. I was reading about how Professor Dumbledore had an elder wood wand and McGonagall had a fir wand, Hermione had vine wood and I, a grown woman who hasn't even finished all the books, was like, "Oh, I need a wand. I need to carry a polished, foot-long piece of wood in my purse at all times. This is the new me." Also, if you're curious about types of wood and haven't listened to the dendrology episode, I honestly feel bad for you. That Ologist is amazing, so listen to that while you kill time waiting for the second part of this Potterology episode to come out next week. Yes. Okay. Tree chemistry.

**Alie:** And so, when you're teaching this in your lectures, is there any kind of chemistry that goes into analyzing what a wood is?

**Rebecca:** Oh, in terms of like the rings and the growth? I wanted to, but I want to focus more on the chemistry. This class, when I first started... I was hoping that eventually there'll be other professors in the school who would be interested in a Muggle's Guide to Harry Potter's Plant Science, or a Muggle's Guide to Harry Potter's Linguistics, because many of the spells are Latin based. And then you can also have a Muggle's guide to Harry Potter's Biology or Zoology because you have all these fantastic beasts, right? So, I'll do the chemistry portion and have other people do that.

It would be wonderful if it's within the university, but of course everyone's busy and, as you can see, it's quite a bit of work to get to your research. You have to research both the science part and the non-science part to get people to correlate the two things. So that was actually what I hoped; that it would be great to have this type of synergy, to have Nebraska UNL be *Harry Potter*-related educational courses because I cannot do all of them. I mean, I've been talking a bit about *Fantastic Beasts*, looking at being able to talk about biology and things like that. But, linguistics, I can't do that. I don't think I'm an expert in plants either. You see, there are no plants here because I kill them all.

**Alie:** *[laughs]* You've got a leaf over there!

**Rebecca:** It's not alive. *[laughs]* That's why I only have plastic stuff because the real ones are long gone.

**Alie:** Can I ask you some questions from listeners? *[record scratch]*

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But, before we ask the smart person your smart and maybe, hopefully, at least a few blissfully stupid questions, you're just gonna have to wait a week. I'm sorry. Yes, this chat was so long, I had to divide it in two. Meanwhile, you can listen to the dendrology, or surgical oncology, or ferroequinology episodes, or you can spend the time reading all the *Harry Potter* books, or watch all the movies, or start your own novel. Next Tuesday we'll learn more about her courses and we will field your questions to Dr. Lai.

You can also spend the week saying hi on [Twitter](#) or [Instagram](#). We're @Ologies on both and I'm also on [both @AlieWard](#). And stickers and shirts, even some back-to-school-inspired merch and backpacks are at [OlogiesMerch.com](#). Thank you to Shannon Feltus and Boni Dutch for that. They're also hosts of the comedy podcast *You Are That*, which is wonderful. Thank you to Hannah Lipow and Erin Talbert for adminning the [Facebook group](#), which is full of wonderfuls. Hello to all the Subredditors out there.

Thank you to assistant editor Jarrett Sleeper of the podcast *My Good Bad Brain*. And he whose name *shall* be spoken, Steven Ray Morris, who also hosts *The Purrrecast* and *See Jurassic Right*, thanks for editing all these clips together. All *Harry Potter* films are Warner Brothers, so do go treat yourself to those films. Binge 'em all at once, tell your boss you ate bad shrimp and you're out for the week. Also, the theme music for this podcast was written and performed by Nick Thorburn who's also of the band Islands, which is a very good band.

If you stick around to the end of the episode, I tell you a secret. And this week's secret is that I still have not bought a garbage can. And also, every time I walk into a bookstore or a library, I get so excited I immediately have to pee. Okay, next week: Potterology Part 2. Get stoked.

Berbye.

*Transcribed by Saira Manns, your Australian friend who is living proof that wit beyond measure is Manns' greatest treasure.*

### **Some links you may enjoy:**

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