

Toxinology with Anna Klompen

Ologies Podcast

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Oh hey, it's that ceramic frog on your porch who always makes you think it's a real frog, even though you put the ceramic frog there, Alie Ward, just sayin', "Hi, what's up? Another episode of *Ologies*." This is a partner episode to last week's belly full of jellyfish, Medusology.

Thank you to everyone on Patreon for submitting your great questions for this episode. You can join for as little as a buck a month. Thank you to everyone who rates and reviews, it actually really matters and keeps the podcast up in the charts for other people to find. And also, I read all of your reviews. Like this week's from rogueavocado, who says:

I love hearing how passionate each ologist is. It really makes you think about what gets your own heart fluttering in life.

Sweet! That's why I love making this podcast so much! Okay, so thank you for the reviews.

Now, let's go to Kansas for toxinology, shall we? So, toxinology... It's a word which means poison, toxin means poison. It comes from Old French and Latin words for poisoned arrow, which came from an *older* word meaning a yew tree from which the bows were made. So toxins, toxic, poisons, it's got some tree roots. Now it means the study of biological toxins produced by venomous animals, or plants, or microorganisms like bacteria, or for example, jellyfish - which if you listened to last week's Medusology, you now know are cnidarians. Cnidarians is a silent c-word. Those are related to sea anemones and corals. For more on jellyfish gossip and primer and a rocking-good time, just listen to this past week's Medusology episode with Dr. Rebecca Helm about the basics of jellyfish. She is amazing. You can also listen to last year's Cnidariology episode with Shayle Matsuda about coral.

This ologist got her Bachelor's in Biology and Chemistry and is a grad student at the University of Kansas, getting a PhD in Ecology and Evolutionary Biology, studying jellyfish venomics in the Cartwright Lab. Her social media handle just shows a jiggly, burning commitment. It's @GelatinousSting. She. Loves. This. Job. When I initially let folks on Patreon know I was doing a jellyfish episode, I asked if I should put both ologists in one interview and everyone emphatically said, "Two episodes! We need them. We need them in succession." Your wishes are my commands.

We hopped on the horn early in the morn, and we chatted allllll about stingers, and tentacles, and clear jellies, and less-clear jellies, which ones deliver the most pow for the punch, and what's it like to swim through a sea of stingers, what to do if you're stung, how small are the barbs, her favorite jellies, and her most memorable moments as a scientist to-date. So, enjoy the medusa musings of self-described professional jellyfish nerd, venom scientist, and toxinologist, Anna Klompen.

Alie Ward: ... just so that we don't miss anything. Thank you so much for doing this! And you are a toxinologist, which is not a toxicologist, right?

Anna: [*laughs*] Yeah. I would say... I would call myself a budding evolutionary biologist, but yes, I'm a jellyfish toxinologist, I guess. At least trying to be.

Alie: That's so exciting!! Oh my god!

Anna: But I was certainly always a jellyfish fan. I've wanted to study jellyfish for a long time, and I got really interested in their venoms too, probably around high school, but really in depth when I went to my undergrad. And the questions I'm interested in are how venoms change, and how they're related to different ecological contexts in jellyfish.

Alie: And pardon the question, are there jellyfish in Kansas?

Anna: There's probably freshwater jellyfish somewhere. A lot of people on the Patreon I saw were really interested in these freshwater jellyfish. [*Bucca di Beppo...*"]

It's called *Craspedacusta*, and we actually have them here in the lab. They're an invasive freshwater jellyfish and they're probably all over the United States in freshwater quarries. So we probably have those. I know they're in Missouri, pretty close to us too. Otherwise no, [*Anna and Alie laugh*] there are no jellyfish anymore. When Kansas was underwater, I'm sure there was plenty, but not as much anymore. Our lab probably has the most jellyfish diversity here in the state. [*Anna and Alie laugh*]

Alie: Do jellyfish leave fossils or are they too squish-squish?

Anna: No, there are some jellyfish fossils. It's very rare. Actually, my advisor was part of a lead paper on jellyfish fossils. Somewhere in here there's probably a jellyfish fossil. It's very rare, but in Wisconsin there is a whole plain where an entire bloom of jellyfish was fossilized.

Aside: Anna's current PhD advisor, Dr. Cartwright, helped describe a five million-year-old jellyfish fossil found in Utah, which used to be a freakin' ocean! I looked at a picture of this jellyfish fossil, and it was the spitting image of a nine-year-old's drawing of a jellyfish, if it were also a cave painting. But also hauntingly beautiful. As long as we're going way back in time...

Alie: What was your first experience with a jelly?

Anna: During, I believe, freshmen orientation. I was... we'll say driven was the word for it. I emailed a bunch of labs during freshmen orientation saying, "Hey, I want to be in a lab right now." And I believe the phrase I used for the lab I ended up in is, "I want to study cnidarian venoms with implications in human health." Pretty verbatim. Yeah, I was... Yeah, that's a pretty good look into my life.

Alie: Yeah! Like the nail on the head there! [*Anna laughs*]

Aside: Anna started out in undergrad working with marine flatworms in Chesapeake Bay that are devouring mussels and oysters. What a nuisance! But no one saw these marine flatworms eat in their early life. No one witnessed it, until Anna observed them with guts full of bivalve mush in the lab. She even published her first paper along with her advisor. As an undergrad!

Anna: And then I got a NOAA fellowship to go work at the Smithsonian with Dr. Allen Collins, who I knew about in high school because I googled 'jellyfish biologist', at some point, I'm sure. I said, "Hey, I want to work with you, I want to do venom. Now I have this fellowship. Can I come work there?" And he's like, "Absolutely!" So I did my first stint in jellyfish venoms there and... Yeah, that's how it kind of began. He's the one that told me about the lab here, which I'm very grateful for.

Alie: Where did your interest in science start? You are so driven. [*Anna laughs*] What was it about jellyfish, and marine life, and toxinology that kind of grabbed you with its stingy-ness?

Anna: Yeah, what a story. Both my parents are biologists. My dad studies mice and ticks. I was in the Museum of Biological Diversity since, probably, age two. Throughout my time there I really loved being there and looking at collections, microscopes... My mom has a master's in small mammal behavior, so she studied parasites in chipmunks. She was always taking me to the zoo, taking me outside, doing all this stuff. But in my childhood angst I said, "I am not going to study the same thing as my parents. I'm going to move away from terrestrial stuff."

I loved marine biology. I was just fascinated by the idea that we didn't know very much about marine science. And the one piece of advice I took from my dad was, "Find a field that's very small if you want to discover really new things." So I was like, "Perfect, deep ocean." So I really started looking into deep ocean stuff, probably in middle school, actually. I think I did presentations *[laughs]* in deep sea biology for stuff. So nerdy.

Alie: That's so great!

Anna: When I was looking at that stuff, I was really into bioluminescence. Bioluminescence kind of led me to a little bit of chemistry. The chemistry kind of led me to venom. Bioluminescence also kind of led me to jellies. The more I learned... Actually, the more I learned we didn't know... We didn't know very basic natural history facts about jellyfish stings, and what their venom looks like, how they're using their venom, and things like that, and yet they're so powerful! Some jellyfish can be really dangerous, but we just didn't know enough and not a lot of people were working on it. So that's kinda where I hooked on and just kind of held on! *[laughs]*

Alie: Okay, are you talking to me from the lab right now?

Anna: Yeah, I am. This is kind of my... The lab has always been my comfort zone. Normally we feed our jellies three times a week. I'm sure they would love more, but yeah, I'm here feeding, mostly brine shrimp and some mussels, to all the different ones. Eventually some of the jellyfish we have we may feed pieces of other jellyfish. They like to eat other jellies. They're probably gonna get a few of those at some point.

Alie: Do you have to pick a jelly from one tank to be like, "Sorry, dude, it's not your lucky day,"?

Anna: *[laughs]* I feel like I do that. That's one of the things that is really kind of sad, in a way, about working with jellyfish is they're so good at making jellyfish that yeah, you end up having to just put them in the freezer or feed them to other jellies. Yeah, that's always been kind of one of the harder things for me.

Alie: I bet! Have you ever gotten stung by one?

Anna: Oh, probably every day I get stung a little bit because I stick my hands right in the tank to move some of our jellyfish polyps and things. But most jellies are too small to really hurt you. Our skin is pretty thick compared to most jellyfish. In terms of bad stings I've gotten, I just got stung by a lion's mane jelly when I was taking a class in Washington State.

[clip from Step Brothers: Derek, "So, yeah, they're pretty big."]

A small bit of tentacle on my wrist, probably hurt for about two hours. That wasn't fun. I've been stung by sea nettles and I've been stung by upside-down jellyfish.

Alie: What are those?

Anna: Those are awesome. That was also something I worked on recently. Upside-down jellyfish look pretty much like a normal jellyfish, except they sit with their bell, the round part at the

top, sitting on the ground and their tentacles and their oral arms facing up. They actually have symbiotic algae.

Aside: P.S: For a good base on corals, once again, Shayle Matsuda's Cnidarology episode from last summer... So good.

Anna: Shayle was talking about how corals have this symbiosis with different algae. These jellyfish have that too, and the upside-down jellyfish gets a good bit of its food and energy from the symbionts sitting in the sun. It also eats other plankton and small things that come around as well. But the amazing part of the upside-down jellies is they not only can sting you, and their sting isn't really that bad, but they will actually sneeze this mucus up into the water and *that* will sting you.

Alie: Oh god!!!!

Anna: Yeah.

Alie: Mucus poison is a nightmare!

Anna: It's awesome. They gather in these huge groups and people will snorkel over them. They're beautiful jellyfish, all these different colors, and then you'll just start feeling this tingling. And if you're not wearing a mask or if you have cuts or anything, I'm sure it can feel pretty bad. I just had my hand in tanks and so they were just spewing mucus everywhere, so it caused a little tingle for me.

A team of us were just asking the question, "Why does this mucus sting?" No one had actually gone and formally looked at the mucus to see why it stung. And we actually discovered that they make these stinging cell balls that we call cassiosomes. They're tightly-packed, little mobile balls of stinging cells and they release hundreds of them into the mucus. [*Alie shudders*] We did experiments where we put them in with brine shrimp and those things *destroy* brine shrimp, [*Alie groans*] very, very quickly. They seem to be very powerful and that's probably what's getting ya.

Alie: Oh my god!

Aside: P.S: If you heard the Rhinology episode all about noses and nassholes, you know that mucus is my *least* favorite substance and therefore word, and I bleep it in some episodes, but that also got really annoying, so I stopped bleeping it. But I have not stopped silently cringing throughout my whole body. Let's get away from mucus and get down to basics.

Alie: Basic question. Why do jellyfish, which are otherwise pretty simple creatures... Why do they have this amazing venom?

Anna: They probably have it because they... So, they are, morphologically, pretty simple. They have the two basic layers to them, they don't have any organs, anything like that. So this chemical weaponry that they've evolved is what has kinda, probably, allowed them to survive for the hundreds of millions of years they've been around. The structures that they make, they're called cnidocysts. Those are these little organelles within these larger structures called cnidocytes, so those are the cells that hold onto these. Inside there's a capsule, the nematocyst, that has this hollow little tube and has all this venom and other secreted stuff.

And when it touches either a chemical or mechanical signal, it fires this tubule at - the estimates are... It's certainly less than a millionth of a second. One report was 700 nanoseconds, they're firing these things at about 5 million Gs of force, just punching into

predators or prey. And then it's delivering this mixture of toxins that we call venom, plus probably a bunch of other stuff that's working synergistically with that venom to make it work. And it's definitely worked for them.

Aside: She didn't say 5 million, right? Or she said it, but she didn't mean it, right?

Alie: And did you say... Did I mishear you? Did you say 5 million Gs of force? How many...?

Anna: Yeah, yeah, no, 5 million Gs of force. Yeah, this is what was reported. So it's an intense amount. So, it's because there's so much osmotic pressure. There's so much pressure being built when these stinging cells are being formed, and then the release of that much pressure in such a small container. Yeah, it makes it a huge amount of force. So, 5 million Gs is what I keep reading about. *[laughs]*

Alie: Oh my god. I feel like the Department of Defense is like, "How could we possibly co-opt this? Make better missiles." That's insane.

Anna: Yeah, there are some efforts to actually turn stinging cells into a medicine. So, you take the venom out, you put a medicine in, and it's essentially like a hypodermic needle, but it's not a large needle. It's a bunch of tiny needles.

Alie: Ohhh! You know, I remember when I did an episode on sea turtles, I don't know if we addressed it, but how do some animals just munch these things like popcorn and not feel its effects?

Anna: For sea turtles and for fish that eat these, like the sunfish, they have really thick skin where they're coming into contact with these. So I believe for sea turtles it's that they just - their throats, their terrifying, spiny throats are just thick, and jellyfish are still very, very delicate, and so they're just ripping them apart. And then all those leftover stinging cells just can't penetrate through there. A lot of things too, like penguins - penguins were just featured - and a lot of other kinds of fish and birds, also will just chomp on the top of jellyfish. Some of them have stinging cells up there, like little packets of stinging cells on the top, but normally they don't. And so they'll just chomp on the top part, which is maybe the tastiest part, I don't know.

Alie: *[laughs]* It's like a muffin top! And then they just leave the rest *[Anna laughs]* They're like, "Later!"

Aside: Okay, real quick. Speaking of chomping on mesoglea. Last week I mentioned some jellyfish recipes and noted that if you have an immediate aversion to eating jellyfish, just know that chicken nuggets, in reality, are way grosser, hands down, tentacles down. And I thought I kinda made my point there, but I wanted to follow up this week by mentioning that in a lot of countries around the world, in a lot of Asian countries in particular, jellyfish is a delicacy. So good!

And one listener named Mady sent me this message telling me that they grew up eating jellyfish and, in Hong Kong, it's a delicious appetizer. It's often served in small portions for everyone to share, and they say, "like a healthy alternative to a bloomin' onion appetizer shared for the table." And they also said that in their experience, Chinese Americans are often made to feel ashamed of the foods that they eat and that their ancestors have consumed for a millennia, and I think that's a great point. And so always, if a food seems "eh," just compare to the things you already eat and chances are, you just haven't acquired a taste for it yet out of a lack of exposure.

So, don't knock something until you have tried it. Also, do not google 'nuggets'. Just don't do it. Also, there are some really great videos of people preparing jellyfish straight out of the sea, and you can see how fast these chefs are at stripping the tentacles and getting right down to the good, proteiny mesogleal part. And oh, speaking of venoms of course, Anna says that one of her research goals is to see how venom changes over the various life stages of a jellyfish; from the planula, to the polyp, to the strobilating polyp, to the ephyrae, which is an immature jellyfish, to the jellyfish, which is that bell-shaped, medusa form.

And Anna says that there is some good evidence that some box jellyfish change their venoms going from younger to older jellyfish as they change their diet from plankton to eating fish! She also says that male box jellyfish use their stinging cells to attach jizz packets to ladies, kinda like a glue made out of poison barbs. It's cute. Now, okay, for the sake of science, what are some other ways to obtain the stuff?

Alie: How are you capturing the venom, and are you keeping it in, like, test tubes or anything? Is that difficult?

Anna: Yeah, so the problem with studying jellyfish venoms, for the most part, it is the matter of size. So for a big Australian box jellyfish, or some sea nettles, or a man o' war, which is also pretty large, what people have done is essentially cut the tentacles off and then either put them in some sort of separating solution or just otherwise try to isolate stinging cells from everything else. And then you get the stinging cells to fire, and then you take the contents of the liquid that you've gotten the stinging cell to fire into, be it water or something else.

That's great if you have large animals and access to a lot of animals, but that's - even with these larger ones - that's not always... that's restricted to certain seasons, and your yield of venom is still really never going to be that high. So what I do, because my jellyfish that I work on are maybe a millimeter in size, sometimes a little less, sometimes a little more...

Alie: Sooo cuuute!!

Anna: [laughs] Yes, very tiny! I use genomic and transcriptomic. So I use genes, essentially, to tell me what their venoms may look like. Then some of my work is also using molecular tools to see if I can find where those genes are being expressed, and if I can figure out what the ecological role of that particular venom may be based on those two and if I could synthesize it, which some people also do. They will take the gene of that toxin and then put it into *E. coli* or something else to try and synthesize that toxin themselves, and then test it. Those are kinda the methods being used right now.

Alie: What are the toxins made of? And are they different from species to species, or are they pretty basic chemically?

Anna: No, they're definitely different from species to species. There's some similarities in terms of function. So most of the venom in jellyfish are proteins and peptides. And there's a few, like, basic categories. So jellyfish normally have some sort of porin, or pore-forming toxin, so something that interacts with the cell membrane and either just punches a hole in it and kinda leaks all the contents out, specifically or nonspecifically; as in, it'll target specific cells or might just punch holes in a bunch of random cells. [Alie makes pained noise]

Then there's neurotoxin. So those are kinda... I think that that was previously talked about for the scorpion episode, too. So there's neurotoxins that interact with different channels in your body, so sodium and potassium channels, and they'll either make them leak everything out or they'll block them. Those are more common in sea anemones and corals, but there might be some in all jellyfish. And then there's just some other enzymes, things that are

breaking down various bonds and fats and other proteins, that might also be all kinda working together to make pretty bad things happen for most things that get stung by these.

Aside: Now, Anna says that it is very, very, very unlikely that anyone listening to this will die by jellyfish. Few can do more than just cause some discomfort. But there is something called Irukandji Syndrome, and it's caused by box jellies named Irukandji jellies, who were named for a local Australian Aboriginal tribe. So these small, itty bitty box jellies are about the size of an earbud, and their stings feel manageable initially, and then, in Anna's words, it erupts into a series of symptoms, including intense pain - "11 out of 10 on the pain scale," she says - constant vomiting, sweating, anxiety to the point of becoming a sense of impending doom, and, potentially, severe hypertension.

If you're like, "Hmm, good thing I'm not from Down Under," they're also in Florida and Hawaii. So if one of these little powerhouses gives you a love tap, please get some medical attention ASAP. Now, speaking of hospitals, what medical attention can we give the venom itself?

Alie: Has the venom been used, like, historically, or maybe in the future, to cure any ailments? Or is anyone looking to see if, I dunno, jellyfish venom can knock out a coronavirus or something? What's happening?

Anna: *[laughs]* There have been efforts, mostly with sea anemones, because of those neurotoxins. Those are used in drug discovery efforts. The probably most famous - I think it's in phase 2 clinical trials - there's a sea anemone toxin called ShK. It's a modified toxin that works on potassium channels, I'm pretty sure, and it's being used for things like autoimmune diseases, like lupus. So that one I think is in phase 2. There might be a few more. I think there's in total 10 drugs on the market that are derived from venoms. Most of them are from snakes, there's some from scorpions, there's one from a cone snail. None that I know of are totally from jellyfish.

Alie: And then what about the actual venom? I know that just like a drop of rattlesnake venom is a billion dollars or something, but is anyone trying to synthesize venoms or capture them and use as antivenoms or anything like that?

Anna: Oh, my goodness, yes. I'm pretty sure. Two places that I know that are actively working on either antivenoms or ways to really prevent pretty bad jellyfish stings. In Australia, there is an antivenom for the Australian box jellyfish, which is widely renowned as the most venomous animal on the planet. *[Alie gasps]* Yeah, so there's an antivenom available, but depending on how bad you're stung, it's not going to be fast enough. And I'm not sure... I think it's been used before to good success.

The other one is in University of Hawaii, there's a researcher there, a biochemist, Dr. Angel Yanagihara, who is very, very active on trying to prevent box jellyfish stings. Not just the Australia box jellyfish, but this group of box jellyfish that cause problems kind of all over the world. And she also works on developing treatments, not necessarily antivenoms, but various different kinds of treatments.

Alie: Can you die from a box jellyfish sting?

Anna: Oh, yeah!

Alie: Really?! Oh my god!

Anna: *[laughs]* Oh, yeah. So the Australian box jellyfish, it's called *Chironex fleckeri*, hopefully I'm saying that right. This jellyfish can have tentacles that are a few meters long. If you get 2

meters of tentacle on you, you have about 2 minutes, and then you go into cardiac arrest. And you're... you're not coming out of it. [*Goodbye! Goodbye!*]

Alie: [*shocked gasp*] Oh, my god! And how far out from the shore are they? Can you be, like, paddle boarding and then just take a fall off the shore? What's the deal?

Anna: No, you can. So the lab that works on these actively goes and collects these by hand sometimes if not in nets. And it's kinda badass, to be honest. But the water that they're in, that I've seen them collecting in, they're standing in it.

Alie: Oh my god!! How are they hand collecting them? Are they wearing a suit of armor??

Anna: Yeah, so you can wear protective gear. Jellyfish, these can swim pretty quickly actually, but the way that you would collect them is probably how would collect almost any jellyfish if you're doing it by hand, for whatever reason. If you're kind of following the direction that the jellyfish is going, or that the waves are going, it's gonna pull the tentacles kinda in that way. And so you just try to and kinda cradle the jellyfish and then lift it up that way. Yeah.

The head of that lab, Dr. Jamie Seymour, so he's a very well-known venomologist of many different venomous animals. He's been stung a few times. You get permanent scarring pretty easily. And I believe that not many people die, certainly, from jellyfish. It's probably more than we think, but not as many as snakes, for sure. But there are people that have died in Australia from these. There's people from the United States that reportedly have died, not from box jellyfish, but from the Portuguese man o' war. You can die from a jellyfish sting. But again, not many jellyfish can really hurt you.

Aside: So Anna says that the folks who tend to have more adverse reactions are those who might be immunocompromised, asthmatic, or allergic to the tentacles themselves. Also sidenote; I'm going to have to have Dr. Jamie Seymour, Venomologist, on in the future right? There's so many venoms.

Alie: And what's the difference between a venomologist and a toxinologist?

Anna: [*laughs*] So venomologist, I think, is anyone who's studying the venom or venomous animals, very generally. Toxinology is the study of toxins, very specifically. So you could be studying toxins in poisonous animals, you could be studying toxins just produced by either other animals or plants. Venomologists are just for venomous animals.

Alie: Ooh so is venomology kind of a subset of toxinology?

Anna: I think so, yeah.

Alie: Oh that's interesting! And the more ologists, obviously, the better, because that just means, "Oh that's *another* episode..." [*giggles*]

Anna: Yeah! I would fully endorse a venomology episode because there are some amazing venomologists that have done some really cool work. Jellyfish is just, there's just a few people...

Aside: I asked Anna if all the jellyfish people know each other and she said, "There are whole Cnidarian conferences," like Cnidofest, which is in California, and got cancelled this year, which is a bummer because I was going to crash it by hiding behind a plant in the hotel lobby.

Anna: It's half really intense, amazing science and the other half is basically a dance party. I highly recommend crashing Cnidofest, there's going to be awesome people there.

Alie: That's amazing! And what happens if you get stung by a jellyfish? I was in Hawaii, someone in our group got stung by a jellyfish. I was like, "What's going to happen? Who's going to pee on him? What do we do? What happens?"

Anna: *[laughs]* Wh-what - uh ... please don't pee on them. Nobody should pee! Yeah that's a very common flimflam I get. So, let me start from, when you're stung by a jellyfish what's happening is you've either touched the tentacles or something and hundreds, to maybe thousands, of stinging cells have now, kind of, punctured, and are sticking to you, and injecting venom through your skin. I am in no position to give medical advice, I want to say that right away, but I can definitely tell you things you should not do.

Alie: *[laughing]* Okay!

Anna: You definitely should not pee on it and, in the same vein, you should not put fresh water on it. I actually use fresh water to *discharge* stinging cells in the lab. And your urine is basically fresh water. At the same time, actually peeing on someone, the pressure from peeing on them will make them fire.

Alie: Oh no!

Aside: It's like throwing kerosene on a fire, only it's pee, and it's venom filled cells firing into a skin inferno. Now, if you have ever had the insult of pee being added to the injury of a sting, I am so sorry for the emotions this is bringing up in you. So other than see a therapist later, what should you do?

Anna: So one of the best things that you can do, is to try and get... if there's any pieces of tentacles, which is very possible, you want to get that off and you want to try and get as many stinging cells off as possible. And one of the better ways to do that, if you have tweezers, you can try and pick them off with tweezers. Tweezers aren't always available. So going back into the ocean, wherever you were when you got stung, and using salt water... So salt water will not activate the stinging cells to fire anymore, and you very gently, as much as you can, try and use saltwater to wash away the tentacle and any of the stinging cells in that area. [*"Gentle."*]

Alie: Oh smart, okay, so... go back to the scene of the crime?

Anna: *[laughs]* Yeah! But be careful you're not like... there's not more jellyfish or what not.

Aside: So Anna says that Dr. Angel Yanagihara of the University of Manoa does amazing work in venoms as well, and she got into the field after sustaining a near-fatal sting herself during a morning ocean swim decades ago! But her 2017 study showed that sea water could worsen the stings if the pressure of the rinse is too hard, like it would be with a robust stream of pee...

Anna: Then the next best thing... a lot of places recommend vinegar. Vinegar will actually prevent more... if there are stinging cells left will prevent them from firing. So, it kind of deactivates them, but there's some controversy that for some species, it might make them fire more. But for box jellyfish, I should say; box jellyfish and places that you know there are box jellyfish; vinegar definitely helps.

Alie: Okay.

Anna: Like a good citizen, before you go out into the ocean, check if it's jellyfish season and what jellyfish will be there.

Alie: Oh you can do that? Is there, like, a jellyfish forecast?

Anna: Yeah! My family will go to South Carolina fairly often and they do have reports on when jellyfish season is, which is usually the warmer months. But it varies, again, between species. They will have the most up to date for that area precautions.

Aside: So, do some googling. What else?

Alie: Is there anything you can do to prevent being stung by a jellyfish?

Anna: Yeah, so I believe, Diana Nyad, when she did her long, record-breaking swim she wore pantyhose or something? So in some case, something just like pantyhose, or anything like that, that's mildly protective, is enough. If you use gloves, often you're not going to get... if you're picking up a jellyfish for some reason, gloves... I wouldn't recommend it, but gloves for the most part will keep you from getting stung.

So the researcher I was talking about in Hawaii, Dr. Yanagihara, has developed something called, Sting No More, and that's designed, essentially, to stop the sting. Pain, the other kind of consequences of being stung afterwards, that's something that, in places where that's a concern, I believe in lifeguard kits and various places, that is available. And it's commercially available.

Aside: So get yourself some of that. And if you're like, "Dang! I guess I need a full body nylon bodysuit," you could always go that direction. Now, I want you to know I went down a real rabbit hole looking into marathon swimmer Diana Nyad's jelly troubles. And her incredibly inspiring feat of swimming between Cuba and Florida. I didn't know much about this, but midway through what was to be a 50-hour swim, she encountered box jellies. And this is a clip from her 2013 TED Talk, describing the experience, which you should definitely go and watch in its entirety. It's so compelling.

[clip of Diana Nyad's TED Talk:]

Two hours in -WHAM- never in my life! I knew there were Portuguese men-o'-war, all kinds of moon jellies, all kinds of things... but the box jellyfish from the southern oceans, is not supposed to be in these waters. And I was on fire! Excruciating, excruciating pain! I don't know if you can still see the red line, here, and up the arm? Evidently a piece this big of tentacle has a 100,000 little barbs on it. And each barb is not just stinging your skin, it's sending a venom. The most venomous animal that lives in the ocean is the box jellyfish. And every one of those barbs is sending that venom into the central nervous system. So first I feel like boiling hot oil, I've been dipped in, and I'm yelling out, "Fire! Fire! Fire! Fire-help me! Somebody help me!"

And the next thing is paralysis. I feel it in back and then I feel it in the chest, up here. And I can't breathe! And now I'm not swimming with a nice, long stroke, I'm sort of crabbing it this way. Then come convulsions. Young man on our boat is an EMT; he dives in to try to help me, he's stung! They drag him out on the boat and he's, evidently, I didn't see any of this, but lying on the boat and giving himself epinephrine shots.

So Diana Nyad attempted this swim four times and finally had to wear a full body stinger suit, is what they're called. They're made of nylon and elastane. She also had to wear a hood and a mouth guard, so that no part of her body was exposed after that. So after hiring a team of scientists, including toxinologists, she finally completed the swim in 2013 at the age of 64. And in the water, she says she kept repeating to herself, "Find a way. Find a way. Find a way."

Ah! Also, how bananas is it that her last name is Nyad and in Greek and Roman mythology, a Naiad is 'water nymph; deity,' and it comes from the Greek word for 'to swim'?! Anyway, I

watched footage of her scrambling out of the water onto the sand of key West, [*cheering, clapping, whistling, screaming, "Dianna!"*] swollen, and dazed, and thronged by supporters chanting her name, and I cried my face off. I have never been so happy to watch cell phone video of someone stumbling and delirious on a Florida beach.

Alie: What does it feel like when you get stung?

Anna: Um, a fiery, burning pain. Normally, for the bad ones... So the lion's mane, that was for sure... sea nettles, which a lot of people I'm sure have been stung by, for sure! I hear for a man o' war and a box jellyfish, it's this really intense burning pain initially, and that's probably coming a bit from the venom actually attacking your skin. So there's, a lot of times, a dermonecrotic component of the venom, which is what will leave that scarring. It's also probably just your response of your body to these toxins coming in, which might either be by making holes in various cells, or those neurotoxins are making things fire, saying it's pain. So that's kind of the immediate thing.

And that's normally the thing that certainly scares people and makes them then, kind of, freak out for the most part. It's just that really intense pain, but normally, it'll go away in an hour, maybe two. There's not often going to be many long-term effects. Now that being said, if you're stung by something, and you start having trouble breathing, or you start, otherwise feeling more like anxious than normal, or you start sweating those, those are signs that maybe you're having an allergic reaction. Or if you have any sort of anything that's kind of out of normal from just that pain that's when you want to, kind of, think about going to the hospital to get treated for those. So that can happen if you're particularly prone to those sorts of things.

Alie: Oh my god. Could you imagine being allergic on top of just getting venom injected into you at 5 million Gs?

Anna: Yeah, that's... Actually the discovery of anaphylaxis, the Nobel prize for that, was based on studies for jellyfish venom, which I think is pretty funny.

Alie: Ahh that's amazing!

Aside: It's true: the 1913 Nobel Prize went to Monsieur Charles. R. Richet for his toxinological efforts. *Magnifique!*

Alie: Jellyfish in movies. Jellyfish on TV. Anything really strike you?

Anna: Oh... Yeah! So I've been trying to figure out the name of this... so it's *Seven Pounds* with Will Smith.

Aside: I love that she wrote this all down! I love how much she loves jelly venom!

Anna: So he tosses a box jellyfish in there, and then at the end he goes into a bathtub of ice. And then releases some box jellyfish - that somehow he's been caring for and are very happy - into the bathtub of ice. And it stings him, and he dies, but somehow his organs - he's using it to preserve his organs.... So, multiple issues here!

Alie: Oh! [*laughs*]

Anna: What was being depicted was, certainly, that the Australian box jellyfish - I just watched a clip of this - that apparently he had seen at Monterey Bay Aquarium. They have a *fantastic* jellyfish facility there, and they are able to grow many kinds of jellyfish that other people can't grow. I do not think they have ever had the Australian box jellyfish there in tanks. Certainly not in the numbers they had in there. Those animals are also tropical. They like

warm water. If you put them into an ice bath, which was probably also have fresh water, they would disintegrate, they would die almost immediately. Probably curl into a little, sad ball. Somehow he was also keeping them in a tank that... Jellyfish need very specific tanks that are round and have no corners or else that will rip them to shreds.

Alie: How will a corner rip them to shreds?!

Anna: So when they get in the corner, or in, like, filters, they just kind of get caught or stuck and then they will rip themselves apart..

Alie: Oh no!

Anna: It's ... yeah. I've tried to construct some other kinds of tanks. It's happened probably, uh, more times than I, as a jellyfish biologist, care to share... But yeah, they often rip themselves. That's why jellyfish researchers often only keep polyps. You don't normally keep jellyfish because they're really hard to take care of once they're actually jellyfish. You keep them as polyps.

Aside: Hence Dr. Rebecca Helms's Polyp Parlor from the Medusology episode.

Alie: What about Patreon questions? Can I ask you a million of them?

Anna: Yes! Go for it!

Alie: Hehehehe!

Aside: But before we get to your questions, a few words about sponsors of the show, who make it possible for us to throw some cash at a charity of the ologist's choosing each week. This week Anna would like it to go to SkypeAScientist.org, which is a nonprofit, educational organization that enables scientists to video conference with students in classrooms. They are great. They're run by squid expert Dr. Sarah McAnulty, who you heard in Teuthology. They also run science trivia over Zoom on Thursdays. They have so many videos with experts up, so that went to SkypeAScientist.org at Anna's behest. That was made possible by a few sponsors of *Ologies*.

[Ad Break]

All right! Your venomous questions.

Alie: Natalie Perkins wants to know: Can they feel pain? Can they sting each other? CAN THEY STING THEMSELVES?

Anna: They might be stinging themselves, but it doesn't seem to affect them. We have jellyfish here that eat other jellyfish, and they hit each other all the time and nothing seems to happen. But there are several jellyfish that eat exclusively other jellyfish, or eat mostly other jellyfish, and it is also unclear if they are stinging them and actually injecting some venom that is doing something to either sedate, or paralyze, or otherwise inhibit that jellyfish. But the stinging cells have little hooks on them, and probably what's happening is they're stinging them, hooking onto the jellyfish, and then reeling them in. There's a beautiful jellyfish called an egg yolk jellyfish that you can watch do this. I've gotten to see those in person and they are amazing. And they just reel in moon jellyfish like no one's business.

Alie: Wow. I think I saw that on your Twitter.

Anna: Oh, I loved that IG of jellyfish so much.

Aside: This tweet was a link to a BBC documentary in which Sir David Attenborough narrates what appears to be a sunny side up breakfast using silly string to catch some

floating parasols. And by the by, Anna says there are roughly 25 different types of stinging cells which are called cnidocytes, and these cnidocytes have various sizes and shapes; they've got barbs, they've got spines. And the cnidocyte cells themselves can be really, really tiny, like as small as a red blood cell, or 1/5 the thickness of a sheet of paper. Teeny tiny! So that means each tentacle can have hundreds to thousands of these very small, barbed li'l babies.

Alie: Davy R wants to know: Do those barbs dissolve, or does your skin just push it out?

Anna: That I'm not totally sure. I'm assuming that they probably fall out. The structural stuff in those stinging cells is collagen and chitin. And those tend to not react well in your body, so I think that probably parts of it get pushed out and then maybe a little bit of the internal parts dissolve too. I'm guessing they get pushed out, but I don't know. Good question.

Aside: By the by, Patrons, if you submitted a question for this episode and it didn't get it answered, huge surprise: Anna amaaazingly went back to that Call for Questions post on Patreon and answered *every single one of them!* Personally. Like, 300 questions. I have no words. I need to send her a fruit basket.

So in regard to dissolving barbs she followed up to say: Eventually the cells will degrade but likely your skin tries to push most of that debris out. She believes some people might actually have allergic reactions to the really complex proteins that make up stinging cells and not just the venom itself. So her guess is that they could remain long enough to irritate your skin, and the best is to try and wash the area very gently with saltwater or vinegar, and eventually hot water, to remove all the stinging cells and tentacles bits. Urgh! Okay, so what else helps?

Alie: Rachael Dashiell wants to know: Is it true that rubbing limes on jellyfish stings can help relieve pain?

Anna: I'm gonna go with nah. No. I've also heard meat tenderizer - don't do that either. *[laughs]* That's probably bad.

Alie: And also you can get a skin burn by getting citrus acid on your skin in the sun. I know that that apparently happens a lot when people are drinking margaritas, if you spill a margarita on your skin, you get a really, really bad sunburn. I forget the name for it. I will include it in aside. But yeah. So maybe don't do that.

Aside: P.S. I looked it up and it's called phytophotodermatitis, which is not only a very large word but also hella gnar-gnar. So if you know anyone who's been slinging drinks on a beach, tell them to wash their mitts, because it can give you blisters and it looks like you've stuck your hand in scalding Wesson oil. Also, scientists say that vinegar is a fine potion to apply to the sting, but don't really waste your time with lemon juice. It's too bad you can't keep the venom... or can you?

Alie: First-time question-asker Rhiannon Schembri says: What is up with mollusks that eat jellyfish and then recycle their stingers?

Anna: Yeah, a lot of nudibranchs do this thing, it's called kleptocnidae, and they eat jellyfish. The blue sea dragon nudibranch eats man o' war tentacles, ingests the stinging cells, keeps them intact, and then uses those stinging cells on their predators.

Alie: Oh my gosh. *[clip from When Harry Met Sally: "I'll have what she's having."]* That's amazing. That's so like, "I'm rubber, you're glue." That's awesome. That's so cool.

Anna: I like to say this to people that say that jellyfish are just simple, “They don’t even have a brain.” They’re so good at making these little chemical weapons that other animals are stealing them. They’re just too good. So yeah, that happens a lot.

Alie: Oh my god. Those are really beautiful nudibranchs too, right?

Anna: Yeah, oh yeah.

Alie: I think I’ve seen pictures of them. I’ve got to do a whole nudibranch episode now because they’re so pretty. Jason Enoch wants to know: Why do they love Florida so much? Do you have any idea why there are so many jellyfish in Florida?

Anna: I don’t know the exact numbers, but I would guess that jellies just like really like warm waters, at least ones that we can see. The ones that I work on, which are hydrozoans and hydroids, you can find those kind of everywhere, they’re just smaller. The big ones probably just really like warmer water, if they have symbiotic algae or they’re just trying to get larger food items, that’s probably part of it too. So because there’s more biodiversity in those warmer areas, that means more fish and more plankton, or whatever they’re eating, so they can get bigger. That’s probably a part of it.

Aside: Anna also noted though, that there are giant jellies in the chilly depths of the sea, and even the lion’s mane, which is *huge*, is in the icy northern Pacific waters. So, she says it’s likely that in tropical areas like ‘Florida’, there’s more marine biodiversity, and jellies may have adapted to the food available there, but jellyfish are truly everywhere. She says from the equator, to the Antarctic, to the deep sea, they come in all flavors and sizes. Speaking of regions...

Alie: Michelle Neer has a great question: On the east coast I’ve heard that the ones with colors inside sting while the clear can’t. Is that true? And is there a reason why?

Anna: Wow. That person has just simplified the difference between the jellyfish I study and other jellyfish. [*laughs*] There’s multiple groupings of jellyfish. So there’s scyphozoans, which are true jellyfish. These are like the upside-down jellyfish, moon jellyfish, sea nettles. There’s box jellyfish that are related to those. There’s about 50 species of box jellyfish; cube shaped, some have eyes, they usually have pretty bad venom. True jellyfish, there’s like 200 species. Box jellyfish, about 50. I study hydrozoans, which there’s a little over 3,000 species, and their medusae, their jellyfish stage, is often very clear. For true jellyfish and box jellyfish, they’re translucent. Some of them are clear, but they’re often chunkier, they often have some sort of color and are much more bulbous, and they’ve got more of a heft to them. Whereas hydromedusae might only live for a week or two, maybe less, and are often very clear.

I don’t know that it’s a good general rule that clear jellyfish can’t sting you and colorful ones can, but probably most hydromedusae are too small and otherwise probably too weak to really sting people. Now that being said, the Portuguese man o’ war is a hydrozoan. So there are exceptions, of course. That’s probably what they’re looking at - the difference between a hydromedusae and a true jellyfish.

Alie: Nice.

Aside: So scyphozoans tend to be more colorful ones and hydrozoans are the watery clear ones. Very *very* big generalization, of course, because every jellyfish and their venom is personal.

Alie: Erin Ryan has a personal story: One time I got stung and the sting looked like a red lightning bolt pattern all over my thigh. What's up with that?

Anna: That's probably both inflammation, your body just reacting negatively to that venom, and, depending on the jellyfish, there were skin-attacking components as well, that maybe could leave some scarring. But that's probably the same as when you're stung by a wasp or a bee or anything, if you get those really big red welts like I do, because you're particularly allergic, that's probably the same thing that's happening with the jellyfish thing.

Alie: And is it the pattern of the tentacle? Like if someone slapped you across the face and you had a handprint?

Anna: Yeah. *[laughs]* If it's made an intricate design of the tentacle on your arm, that would be really intense. But yeah, it'd be in that pattern, I suppose.

Alie: Now I have to find out if anyone's ever gotten a tattoo in that pattern. Taken it straight to the shop, like, "It already hurts! Tat me up!"

Anna: They'd probably be a little bit of my hero. That would be awesome.

Alie: Yeah. I'm going to look it up. Don't think I'm not.

Aside: If you think this will be the only jellyfish tattoo discourse in this episode, *au contraire*. Keep listening, my friends.

Alie: Miranda Martin needs help. Miranda Martin says: Jellyfish are wackadoodle creatures, and I'm so scared of them because I was stung two different times as a kid. How can I overcome this fear? As someone who's been stung literally daily, have you been stung yet today?

Anna: I put my hands in there, so I'm sure they tried. I had to poke my moon jellies a little too, but they're not too bad.

Alie: What should Miranda Martin do?

Anna: So again, whenever you go to a beach or somewhere, look at when is jellyfish season, have there been reports of major blooms, large groups of jellyfish? You can look those up. And know what kind of jellyfish they are probably going to be now. If I remember just from me being on the beaches, when the waves are really heavy and there's a lot of tide, jellyfish might not go as close to the shore. But then again, they might get washed close to shore. So seeing kind of what the patterns are where you are, too, that might help. But also just knowing that most jellyfish are not trying to hurt you and they're not going to do any lasting damage unless they're a box jellyfish. And even then you need to get stung pretty intensely.

I was also very scared when I first got stung by a jellyfish. I didn't go in the ocean for a long, long time. I will say, jellyfish are not your worst concern if you're going into the water. It's unlikely they're going to do anything really lasting to you, but I also recognize, yeah, it hurts and you can't see them, and there's not really much you can do in terms of getting away from them. But I would just say, do your research, know what you're getting into when you're going into it, and then just try and let it go. Try and enjoy being out there because it's really unlikely that you're going to get smashed too hard with them.

Alie: Maybe invest in some full-body pantyhose.

Anna: Yeah, you could always get a protective wetsuit, some protective equipment, booties, then you're good to go.

Alie: I say do it. Maria Jouravleva wants to know, first-time question-asker: How many stings does it take from a red lion's mane jellyfish to kill you? Any idea?

Anna: [*laughs*] Lion's manes are pretty bad. They are one of the largest animals on the planet, let alone the largest jellyfish.

Aside: How large are the lion's mane jellies again? They are much larger than a lion's mane, for sure. Up to several meters across, with these trailing, Muppet-like, wispy tentacles up to 30 meters long, which, America, is 120 feet. *120 feet!* Which is like 4-5 Macy's Parade floats tall, or the length of approximately 23 Alie Wards, head to toe. That's a lot of tentacular action.

Anna: Often with stings, amount really matters. I guess if you got, like, a full wallop, full body coverage, maybe that would be enough. But I don't think anyone's ever died from a lion's main sting. So I don't know.

Aside: This next [*spookily*] ghostly question was asked by Patrons: Cheryl Kolatorowicz, Aleah, Jolie Brown, Rachel Henderson, and Shannon Ball.

Alie: How can they sting you after they're dead or if the tentacles aren't even attached? What's going on?

Anna: They're synthesizing stinging cells all the time, all throughout their life. And those stinging cells are more or less independent. So once they've created those stinging cells and moved them to where they're going to be, either the tentacles or other structures, once the jellyfish has died the stinging cells are still pretty much intact. Even if the animal itself is not making any more, they've already made a bunch. And so when you touch a dead jellyfish or a piece comes off... When there is big blooms of man o' wars, often what is happening is their long tentacles are breaking off in the water. So even if you're keeping away from the large sail of the man o' war, a tentacle might just come and wrap around your ankle and it will still sting you.

Alie: [*painfully horrified*] Aaah!

Anna: So, I often tell people: even if you see a dead jellyfish on the beach, unless you know what it is – which it's still really hard to know what it is – do not touch it. Even if you know what it is, sometimes their tentacles, like, flop around to the top of the bell of the jellyfish, so even if you touch the top of the bell it can still sting you. I would give it, like, a day or maybe just a few hours. It also depends on how fast they degrade. If a jellyfish dies in a tank here, it's gone in, like, 12 hours, and probably a lot of its stinging cells with it. On the ground, I think it would just depend on the temperature, what kind of sand, if a bird comes and nibbles at it. I just wouldn't touch it.

Alie: Don't do it! And if you do, don't pee on yourself.

Anna: No! If anything comes out of this: Please do not pee on your friend, or yourself, or strangers. Please don't do that. [*"So, when nature called, I--" "Don't answer that!"*]

Alie: Is there a jellyfish that you really want to work with, or one that you're always, kind of, curious about? Like other species that you don't work on?

Anna: I think what I'm most hooked on right now, it's called the bell jelly, or the redeye jelly. The scientific name is *Polyorchis penicillatus*. I fell in love. Large hydrozoan medusae, up to 100 tentacles, it has these tiny red, very basic sensory organs all around the bell. Massive stinging cells. And they hunt, like, crabs and shrimp. We actually don't even know what their

polyp looks like. There's never been a successful collection of their polyps or getting them to spawn in tanks despite many people who are experienced with this trying to do it. I would *love* to figure out what's going on in there.

Aside: Ooh! Okay, these bell jellies, they are cute-as-hell-jellies. They are diaphanous with a little ring of red spots at the bottom of their bell, kind of like a darling little belt. Anna spotted one while taking a marine biology class up in Washington State, and she made a lifelong commitment to the species.

Anna: That was my first tattoo, was of the bell jelly. I *love* it.

Alie: Oh my gosh! Wait, how many tattoos do you have?

Anna: I have two right now.

Alie: Is the other one also a jellyfish?

Anna: [*laughs*] Yes, it is. [*DJ airhorn!!*] It's a little upside-down jellyfish.

Alie: That's amazing! What prompted you to get them?

Anna: Honestly, this class that I got to go to changed my life in so many ways. This is a pretty famous place for jellyfish biologists. It's called Friday Harbor Labs. There's this wealth of different kinds of jellyfish that get moved up from the deep sea. Otherwise, it's such a beautiful place with all these different marine inverts. This bell jellyfish, at one point, was actually the icon for Friday Harbor.

Aside: And it was there that Anna got a chance to work with famed jellyfish researcher Dr. Claudia Mills.

Anna: She would go out in a rowboat, I believe, every day, and collect jellyfish. She's described new species, she's described the behavior, she's done all this amazing work for jellyfish. And I got to meet her while I was there – which is amazing – and actually jellyfish with her off the dock, which is where she catches all these jellyfish.

Aside: Jellyfishing – a verb. Now we know. [*"The More You Know" jingle*]

Anna: So when I was there collecting jellyfish with her, I looked out into the water and I saw this, kind of, little white round thing, and I looked at her, and I looked back at it, and then I started seeing the tentacles. And I looked back at her, like, "Did you just find this and put this back in the water?" And she's like, "No! I didn't see it!" So I scooped it up and it was one of these bell jellyfish. At the time she was, I think, giving a tour with someone who had young kids, so I got to show the kids this beautiful jellyfish. Got to hear her talk about it. It was such an awesome moment.

Aside: At the time, Anna's old undergrad advisor, Dr. Jon Allen, also happened to be visiting. *And then* – Are you ready?? – she saw *another* bell jelly the same day! That's like walking into 7-Eleven and seeing Beyoncé, and then later, at Trader Joe's, there's Bill Murray! What a day!

Anna: And again, I looked out, I saw a little round white thing, and I'm like, "Could this be something?" Then I saw the tentacles and I just... I probably started screaming. So, I quickly tried to use my hands, and I got it into the plastic bag, and then I got to show my undergrad advisor's kids this beautiful jellyfish. Such an awesome moment in science, where all these things came together. It was such a beautiful animal that has this weird natural history we still don't know much about. I just love everything about it, so that definitely was going to be my first tattoo. I just wanted to look at it whenever I'm in a grad student slump, or I'm just

angry at data not doing what I want. I can remember that there was this awesome thing out there.

Alie: What hurts more, a jellyfish sting or a tattoo?

Anna: *[laughs]* Honestly, the lion's mane sting on my wrist was pretty bad. Not great. I think that was on my birthday too.

Alie: Was it really?? *["I got you this."]* Oh my god. So, apart from stings, or maybe it is the stings, what sucks the most about your job?

Anna: Oh, there's all the, like, writing grants, working through difficult data, and that jellyfish... because not many people know about them, a lot of stuff is hard to do because sometimes you're the first person doing it. That all can get to you at times. But I have to say, making saltwater, for me, is just awful. I don't know what it is, because it's not hard, but I get tense... because if you make it wrong and you accidentally give it to your jellyfish they're just going to die in front of you. And you have to do it all the time, and it takes... Yeah, I'm not a fan.

Alie: If you were on a coastal lab, would you just go scoop up saltwater, or do you need to saltwater to be very specifically... like, certain salinity, and without a lot of different critters in it?

Anna: That kind of varies. My labmate is originally from France, and the lab he worked in there, they used saltwater that was just lightly filtered, I think, directly from the Mediterranean. I know they do that in the Chesapeake Bay too, though that needs a lot more filtering. But for some of these, you do need very specific salinities, salt concentrations, and sometimes you just want it to be very clean. I think I would still have to make saltwater even if I was near the coast. I feel like it's such a petty thing, but it really gets on my nerves. *[laughs]*

Alie: It's not. What sucks is you can't go home and, like, relax in an Epsom salt bath. That's just rubbing salt in the wound.

Anna: *[laughs]* I know! I don't know why I've done this to myself. I have jellyfish at home too, so I have to make saltwater there. So it's not even... Ugh!

Alie: How many jellyfish do you have at home?

Anna: I have a few polyps. I probably have, maybe, 30 or 40 polyps. It's really easy to keep polyps. You just keep them in Pyrex dishes, the \$10 or \$15 Pyrex dishes you get at Target. That's what we keep our jellyfish in, some of the polyps. Then, right now I have a small fish tank which I'm using to raise a few - maybe 60 - jellyfish.

Aside: By my calculations, that is 90 pets and a Polyp Parlor. This is the dream! It's the dream.

Alie: Now what about your favorite thing about what you do or about jellies?

Anna: I was really trying hard to think of this. There's two big parts of it, I would say. One of them is that I am just so lucky, I think, to have gotten into a lab with an advisor, and a labmate, and a department that are just amazingly supportive and knowledgeable. Even here in Kansas, they're doing amazing marine biology, and just biology in general. I'm very lucky that I have that. Also, the jellyfish community and the venom community have both been extremely supportive of what I'm doing and what other students are doing. I really feel very lucky because I know that's not always the case for many people in science.

But the other part of it is, I love that I can go out almost anywhere, whether I'm talking to Girl Scouts, or other people around Skype a Scientist classes or whatnot, and I ask them,

“What do you know about jellyfish?” And they’re like, “They sting you.” Cool. That’s probably about all we know. We know that they sting things, but we don’t know what it is, we don’t really know how that venom is working. We don’t always know what they’re eating, or what’s eating it. It’s such fundamental, natural history questions on such cool animals that we just don’t know, and I get to help find that out. I think that’s so cool. I love finding new things.

Alie: That’s so cool that you are, like, a natural history detective and you might be the first person in the world to understand how something works.

Aside: Do you remember how she discovered that baby flatworms actually fed, which led to her first paper as an undergrad? She lives for those moments in science!

Anna: Then we put one of the flatworm larvae up on the scope and we saw food in its guts. I think I fell to the floor and just, like, started weeping quietly because I was so... I was like, “No one has seen this before!”

Alie: Oh my god! That’s awesome. You get all these mysteries and all these discoveries. That’s so great. I love it. I love that you’re also talking to me *from your lab*, that you’re surrounded by jellies right now.

Anna: I am. It really is a comfort.

Alie: Thank you so much for doing this.

Anna: Of course! Thank you so much for the opportunity to talk about it.

Alie: Yay! You did it! Do you feel like you just got done with an exam?

Anna: In a way. I had my oral exam in the fall, and I got married in the fall, and really, the feeling right before this was right on par. Very nervous! *[laughs]*

Alie: Really?? Oh my god. That’s amazing! Just the fact that there are thousands and thousands of people that are going to know not to pee on each other...

Anna: That’s a win!

So as smart people stupid, sting-y questions because their skulls are just bowls of cocktail party facts, and they love to share. Follow Anna Klompen on [Twitter](#) and [Instagram](#). She is on both @GelatinousSting. Her science website is [GelatinousSting.com](#), and her personal website is [AnnaKlompen.com](#). We are @Ologies on [Twitter](#) and [Instagram](#). I’m @AlieWard on [both](#). Links to all of this stuff and more are in the show notes as well at [AlieWard.com/Ologies/Toxinology](#).

Ologies merch is available at [OlogiesMerch.com](#). There are hats, and t-shirts, and totes, and visors, so please feel free to put *Ologies* on your person and find other ologites in the wild. Thank you to Shannon Feltus and Boni Dutch for managing all that. They are sisters who host the comedy podcast *You Are That*. And thank you to Emily White and all the *Ologies* transcribers for heading up transcript efforts. Those transcripts for most episodes are free and available at [AlieWard.com/Ologies-Extras](#) for anyone who is deaf, hard of hearing, or just would like to see how these hilarious transcriptionists describe sound effects. Caleb Patton also bleeps episodes so they’re kid friendly. Those are that the same link.

Thank you Noel Dilworth for helping manage scheduling, and to Erin Talbert for adminning the [Ologies Podcast Facebook](#) Group, full of wonderful people. Thank you to assistant editor and pro

boyfriend, Jarrett Sleeper. And the bell to our tentacles, Steven Ray Morris, lead editor who also hosts *The Purrrrcast* and *See Jurassic Right*. Nick Thorburn wrote and performed the theme music.

If you stick around in our tentacles until the end of the episode, I tell you a secret. This week's secret is pretty fresh. It's only, maybe, 15 minutes old. I just cooked my parents dinner, and the marina jar I used came in this, like, tall, skinny jar, and I'm unreasonably excited to wash it out and put a koozie on it and use it as a to-go cup. And I don't know why it's so thrilling! Because I have real reusable to-go cups, but it's just, like, something about the thrill of immediate recycling, and like, I could put the top on and throw it in a bag... I don't know, I see a lot of promise in this jar. Maybe I'll name the jar Paul or something, and maybe I'll post an Instagram photo of us. I'll let you know how it's working out. Maybe I'm going to break him. Maybe it won't work out. I just... I think this marinara jar's a really good to-go cup.

That's enough out of me. Berbye.

[*Alie turns to her dad*] Do you want to say anything?

Alie's Dad: Hello. Yes, I would like to say something. Alison cooks too much dinner.

Alie: [*giggling in the back*] That's your complaint? I make too much dinner? [*laughs*]

Transcribed by:

Wendy Fick

Emily Stauffer

Ruby-Leigh

Elinor Austin

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