Medusology with Dr. Rebecca Helm
Ologies Podcast
July 30, 2020

Oh Heeey, it's that podcast that you *thought* dropped on Tuesdays, and it does, I promise, it's just been a wacky couple of weeks and thank you for bearing with me. It's Alie Ward back with another episode of *Ologies*. Also yes, last week's AMA went up on a Tuesday night but it just mysteriously unpublished itself, and I was on the road to my folks' house on Wednesday not knowing this, so apologies that it wasn't republished until Thursday; we got it up on Tuesday for you. Anyway, technical goblins, so thank you for bearing with them.

A lot has happened since last week. My Pops is on the mend and hopefully will be sprung from the hospital soon. Yesterday, though, I left his hospital room to check into the ER myself for an infected spider bite… and found out that I might have something called blood poisoning. So, it's been an eventful couple of days, but I have some antibiotics, thank you for everyone on Twitter and my friend Mike Natter for your medical guidance. Yes, I'm doing a little bit better but it's been a rough couple of days.

But on Sunday I won an Emmy for writing for *The Henry Ford's Innovation Nation* with Mo Rocca. If you're like, "What?! You're on a show?" I'm very bad at self-promotion, but yes, every single Saturday on CBS, and also I host my own show on CW, *Did I Mention Invention?*, so if you need science shows to watch with your kiddos, there are a few Emmy-winning programs with your weird ol' DadWard.

Okay. So this episode - Whew! I don't know how to prepare you for what you're in for because it's so, so, soooo good. First, let's thank everyone on Patreon.com/Ologies for making this show possible. You can join for a dollar a month and submit your own questions for the Ologists. Thanks to everyone rating, and subscribing, and word-of-mouthing me. All the folks that write the reviews - thank you, I read them in their entirety, and as proof I thank a reviewer every week.

Captain Nemo the 3rd says they're our number one fan, and also SpaceApples wrote that the show:

> *…highlights how beautiful, fascinating, and just frickin' weird our world around us is and really brings a sense of positivity and appreciation during times where things are, honestly, pretty rough.*

Thank you for those reviews, thank you for bearing with me on a couple of rough weeks here. We should be back on our Tuesday scheduling next week. I promise.

Okay, all I want to do is get to this episode, we're going to get into it! So, Medusology, it *is* a word, it's the study of jellyfish and it comes from Linnaeus, who named jellyfish medusae after the Greek Gorgon who had snakes for hair and turned men into stone and, according to many scholars, is a symbol for female rage. I don't know what kind of complex feelings Linnaeus had about women, or jellyfish, but perhaps hell hath no fury like a taxonomist stung. So either way, there are over 2,000 species of jellyfish, some in forms that are teeny tiny and others like the lion's mane are over 3 feet in diameter at certain points in their life. This Medusologist is about to become your favorite medusologist. She got her Bachelor's in Marine Science, her Master's and PhD at Brown in Ecology and Evolutionary Biology, a post-doc at Woods Hole, and is currently an assistant professor at the University of North Carolina Ashville *and* a National Science Foundation post-doc fellow at the Smithsonian - no big deal.

And as if this episode isn't exciting enough, it's also part of a twofer with next week, in which we will address Toxinology, the study of jellyfish venom. Mother lovers, are you excited? Yes you are. Hang tight for all of that with another Ologist next week. Oooh! But for this one, get ready to deep dive on everything from mouths, to butts, to space aliens, to swimming in the bubble of your captive stomach, to peeing on yourself, to pool noodles, flimflam, if eating jellies is her jam, and more with the world's most charming Medusologist Dr. Rebecca Helm.

Dr. Rebecca Helm: You know what? I mean, if it's just on my end, like if my internet is just being a little bit *ish…* because we do have, like, a massive storm happening outside…

Alie Ward: Oh you do? Oh my god.

Rebecca: Mm-hmm… Yeah, I know, it's so fun. It's like, oh, an adventure! [*laughs*]

Alie: Oh that is exciting. You're in Asheville?

Rebecca: I am. Yes.

Alie: Hence the storm.

Rebecca: Yes.

Alie: Okay, that makes sense.

Rebecca: Before we get rolling to… is this, like, a one-shot thing or, you know, like if I have to cough, can that be edited out?

Alie: Oh my gosh, I edit the shit out of things, so please…

Rebecca: [*laughs*] Okay, great!

Alie: I don't know jackshit about jellyfish, so I'm a blank canvas over here. You're going to have to tell me everything.

Rebecca: Oh, good!

Alie: A *doctor* of jellyfish. Do you know that you're a medusologist?

Rebecca: I didn't. No, I was just telling a friend that, you know, "I'm going to have this interview and it's on medusology," and she was like, "What? WHAT?" I was like, "I know! A medusologist!" I'd never thought about it that way.

Alie: You gotta change your business cards, man…

Rebecca: *Immediately.* Yeah. I mean, frankly, I need to get business cards so… Do people even… are we even going to *do* business cards anymore? You know?

Alie: I don't think so. How long have you been studying jellyfish?

Rebecca: Gosh, I mean, I think professionally… Like how long have I been doing a job of studying jellyfish? Probably ten years. And then probably another five years of, like, working for free at jellyfish, like as a student, or as an intern, or whatever. Yeah.

Alie: What was your first free job working with jellyfish?

Rebecca: Oh my god, it was so much fun. I went up to Friday Harbor, which is in Washington State in the San Juan Islands. It was in the middle of the winter, no one was there, it's a very seasonal place, and I just went out on the dock and counted and catalogued all the jellyfish that floated by. Magical!

Alie: How do you do that? Do you have to shine a light in the water? How are you detecting them?

Rebecca: This is a legit question. Yeah, there are tricks. So, cloudy days are no-go. Sunny days are the best. You don't want any cloud reflection off the water because these things are transparent, they're like crystals floating through the water, right? So you need that strong, intense light from the sun to, sort of, shine a light on the side of their bodies. They stand out ever so slightly from the water around them. Most of these are really clear, you know, so you really have to be looking.

You can go out at night and, like, drop a light in the water and find a ton of great stuff. So, any type of light that can be submerged, a dive light, whatever you have on a rope. Then you just sit with a cup on a stick, [*laughs*] and wait until you see one that you want, and then you just, like, very gently scoop it into the little cup, and then pull the little stick in, and then very gently put it in the bucket, and that's your day.

Alie: Or your night, I guess.

Rebecca: Yeah!

Alie: What is it about jellyfish? Did you accidentally become a medusologist or did you have a fascination with them forever?

Rebecca: I loved them. So I'm from Arizona, which is veeery dry. And I knew I wanted to explore, I love exploring, and for a lot of my childhood I thought I wanted to be like, a *space* biologist, which is not *really* a thing. We haven't found aliens yet, but I was like, "Oh you know, by the time I'm 20 we're totally going to find them. This'll be great." And then at one point I saw a documentary on jellyfish and I was like, "Why even *go* to space? These are so weird!"

Alie: Ahhhh, that's so truuuuue! They're sooo weird. [*"I want to understand you."*]

Rebecca: So that was really, like, what catalyzed my interest, and then it just sort of snowballed. You know, like, you've got a million interests when you're a kid, and some of them stick, and most of them don't, and this one just kind of stuck. Things kept popping up, and I kept finding jellyfish and just falling in love even more, so now I get to study jellyfish for a living. It's wonderful.

Alie: Do you have a lab full of jellyfish? What does the work involve?

Rebecca: Oh my gosh, so yes, usually… [*cricket noises*] No, phone! How dare you? Sorry, my phone is ringing.

Alie: [*laughs*] The crickets are out!

Rebecca: Editiiing! Yes.

Aside: I'm sorry. I did not edit that out because it was endearing as hell, and also I was like, "Could there be a jellyfish ringtone? Do jellyfish even make a noise?" And I did learn that millions of jellyfish coming up from the depths at night to feed on phytoplankton make a low frequency hum. [*underwater white noise hum*] So if you want a ringtone that's legions of hungry, soggy, apparitions, I guess just download some static. Anyway, what does her work, or her jellyfish look like?

Rebecca: So, under normal circumstances I have a lab and I have a bunch of jellies, but they're not in the jellyfish form, so they don't look like jellyfish. They actually look like little, sort of, proto-jellyfish and they stick on the bottom. At the moment they're all living in my house.

I've got maybe 20 species of jellyfish in my house right now. [*"Well, it's a paarrtyyy…*] But then, when conditions are right or when you as a scientist want to like get some medusa jellyfish - the big, charismatic kind that you know, that you're *used to* like thinking about when you think jellyfish - you can add a chemical and that will induce them to go through this metamorphosis and then you'll get your big jellyfish.

Alie: What is the chemical? Is it just puberty hormones?

Rebecca: We don't know! That's such a great question because it's this synthetic drug that people take for, like, upset stomachs. But when you add it to jellyfish they metamorphose!

Alie: [*gasps!*] How did they figure that out?!

Rebecca: So this is was like… This was me being in grad school and panicking and needing to find a way to get jellyfish to metamorphose. I think the original study was done on this panel of, like, 200 different chemicals. You just call up a store, one of these chemical suppliers, and be like, "I want a mini sample of every chemical you have," and then you can just test them.

The original study was done in Japan on moon jellyfish, so just one species, and then when I was in grad school I was like, "Oh my gosh, I'm in year three and I don't have any data, and every day I feel like I want to cry because I don't have any data." And so I just start testing all these different chemicals on a broad range of species, and this one just happens to work, like, across tons of different species. It's amazing.

Alie: Oh my God. Did everyone lift you up on a chair and carry you around? Did all the medusologists of the world say, "Dr. Helm, how did you do this?"

Rebecca: [*laughs*] All, like, 100 of us, yeah. Well, it was published eventually, and I think people are happy. I think the biggest feedback I've gotten is from people who work at public aquariums because, you know, you need jellyfish all the time, and if your polyps just don't feel like it, then what are you going to do? So now you can be like, "Here's a little dab of this chemical," and then they just go through metamorphosis. Before, people were putting them in refrigerators… you can like put them in little, like, heat containers… It's like a whole voodoo science. I think it's a little better now.

Alie: What was it like when you realized that this chemical did that? What kind of a reaction did you have?

Rebecca: Oh my god, I wrote so many bad words of excitement in my lab notebook. I still have it, but it was just like…

Alie: What does it say??

Rebecca: "Uhhhh… Oh my god I did it, this is amazing!" I cried; it was this whole big thing.

Alie: Of course!

Rebecca: It's dark, it's 11 at night, you're in this cold lab by yourself with just the light of the microscope to keep you warm, right? And then I was looking at these animals and realized it was working and I was just so, so happy. No one else was around, so I didn't get to celebrate, or have a eureka moment, or walk into the room and be like, "I did it!" It was just me and the jellyfish, but it was still great.

Alie: Who do you call first in that situation? Like a Eureka contact number. Who's first on the list? How do you explain that moment?

Rebecca: I think the anybody that you've been excessively bitching to about how everything isn't working, right? The people that are in trenches with you and watch you suffer, because they're just like, "Oh thank god she's done complaining about everything!" I don't know. [*laughs*] They were really excited for it too. It was awesome.

Alie: [*laughs*] And so, tell me, what exactly is a jellyfish? You've already tossed around some terms. Some polyps, we've got some medusas. Like, what is a jellyfish, exactly?

Rebecca: A jellyfish is the last step in this complex life cycle of animals that collectively we could call medusozoans.

Aside: [*in awe*] Medusozoans!

Rebecca: Medusa, like, you know, lady with the crazy snake hair, and then *zoa* because they're animals. So we've got these medusozoan, and they have this three-part life cycle which is, honestly, why I love them so much; one of many reasons. But one of my favorite reasons is that they look like three totally different animals at different parts of their life cycle. So the first part is called a planula, and it's like this little, itty bitty, grain of sugar-sized, swimming, fuzzy pill. It just looks like this little, kind of, moldy pill floating through the water with all these little hairs sticking off of it. And it can live like that for a while, and it's just, like, the larva that forms when an egg and a sperm meet and fuse. So it's very tiny. Sometimes if you get swimmer's itch, that's a bunch of little babies getting stuck in your swimsuit.

Alie: [h*orrified, grossed out*] OHHHHH AHHHH Noooooo!

Rebecca: Very sad, yes.

Alie: Oh god. Can you just imagine if there was a Godzilla that just took a dip and then just had a ton of tiny human babies in its pants?

Rebecca: I know, right? Exactly! I don't even know who to feel bad for! It's tragic for everybody, you know what I mean? Like, you've got itchy little jelly babies but they're getting, like, smushed on your stomach. That's so weeeeird! It's a very bad day.

Alie: So, those are the babies, and what's stage two?

Rebecca: Right. So, stage two would sort of be like - if we're going to continue this analogy of, like, human little babies flying around… Stage two would be when they settle and they form what's called a polyp. Basically, in the case of a jelly, it looks like a jellyfish that got flipped upside down and is stuck to the sea floor. It's got a little mouth and a little ring of tentacles around the mouth. Then it's got this little body column. And it sort of sticks to the seafloor. It's very small like a bread crumb. The polyp is really the stage that lasts for, like, decades. So, polyps can live a super long time. It would be like a human baby finds a nice place to settle down and grows into a person. Polyps are really, like, that stage. They're the persistent long-lived stage.

Aside: Okay, a planula is the moldy green pill-looking, teeny-tiny baby, and then they grow a little bit more, and they become these bread crumb-sized polyps that look like Sideshow Bob in a tube dress. But what are they doing on the sea floor? What are they doing? Are they having orgies? Are they playing pinochle? Shootin' the shit?

Alie: And they're not reproducing?

Rebecca: Not sexually. No, they might clone themselves. They have some cool cloning tricks that they do where they split themselves in half, like, a little cell dividing. They can split in

half. Or they can leave little footprints of cells behind them. They don't crawl very fast. Maybe a step every week. Really slow. [*"Take your time."*] But every time they do they leave a footprint of cells, and those cells are like little polyp seeds, and they can actually hatch into new polyps at some later date.

Alie: This is happening on the ocean floor, typically?

Rebecca: It's all happening on the ocean floor.

Alie: Wow!

Rebecca: Typically. You're right, typically is the perfect word because biology is in love with exceptions. But yes, typically it's happening on the ocean floor.

Alie: Oh my god. Then when do they decide that it's time to grow up and get sexy?

Rebecca: So, they don't really grow up and get sexy so much as they bud part of themself off. So they bud the reproductive part off. Some jellyfish will actually fission down the side of their bodies. You can sort of imagine, like, whenever we go back to wearing hard pants and belts again, it's probably going to look kind of look similar, for me, when you're wearing pants that are too tight and you got a little ponch. They sort of look like that, polyps get a little ponch…

Aside: I mean, we are all literally falling in love with this person's brain right now… right?

Rebecca: … like they're wearing a belt that's too tight. Then the top of that ponch will grow into a little jellyfish and pop off. Others will bud little jellyfish off the side.

Alie: And then what do those do?

Rebecca: They're the reproductive stage. So, I guess to continue our terrifying analogy, it would be like your ovaries or testes just, like, sprouted wings and popped off. That's what jellyfish are. They're this reproductive stage that has the gonads that sail into the sky, or in this case the ocean, and reproduces.

Alie: Unbelievable. Just like, "Bye-bye nards have a good life." Are there more than one sex or is it just, like, a blanket one type of gonad?

Rebecca: We are like learning so much about this right now. It seems like polyps are male or female much of the time. In a lot of species, it's like 'either this or that'. But there are some species where they start male and as they get bigger they become female.

Alie: Cute. Do they have to eat more in order to go from a little tiny bread crumb to these fluffy, stinging, long Medusa-hair creatures?

Rebecca: They do. They usually munch on plankton that are in the water; lots of little swimming shrimp, and crabs, and fish, and things like that. Some pull this cool trick, kind of similar to their coral cousins where they actually have algae living in their body, in their cells.

Alie: Oh, that is so fancy.

Rebecca: That is so awesome. I'm so jealous. Sincerely. Can you just imagine like, "I'm just going to go eat lunch," and then you walk outside and sunbathe for like two hours?

Aside: Medusozoans, of course, belong to the phylum Cnidaria, as do corals. For more on their coral cousins you need to treat yourself to the Cnidariology episode from summer

2019 with Shayle Matsuda, and then just go hug a reef. JK-JK do not hug the reef. It is live, it does not want you to hug it. You do not want to hug it either.

Alie: They have to go to the surface, obviously, for that? So their gonads just fly up, up, up, until they get to the surface, and they can get the plankton, and get floating stuff, and get the sunlight?

Rebecca: Exactly. Some of them will go deep. The ones that don't have luscious algae, they might go deep. They might already be deep. Different species of jellyfish, they like different places. Upside down jellyfish will actually swim down to the bottom and just hang out on the bottom in, like, a shallow lagoon and just sunbathe 24/7.

Alie: Oh my gosh. What a life! How are they functioning? Because they're transparent, you don't see any brains or stomachs. How are they pulling any of this off? What do they even have in that little umbrella?

Rebecca: I know. They're so inspiring minimalist.

Alie: They Marie Kondo'd all their organs.

Rebecca: They did. Just none. None left. Just gonads. They don't even have a butt; they just have one hole. So, it's just like, "Forget this anus! We're just going to do everything using this one hole.!" So, they've just got this central 'mouth-anus', this 'manus' in the middle. They'll take in food, and they'll digest it in this big body cavity that sort of acts like a stomach but it's also a circulatory system. They're like, "We don't need two things for this. This can be done together."

Alie: What happens in this vascular-gastro circulatory gut situation??

Rebecca: They digest their delicious food. So, if you were caught by a jellyfish, like if you were a tiny fish, you would be stung. Hopefully it would just kill you because of what I am about to tell you. Let's hope you just die and you're not caught by one of those species that just paralyzes its prey.

Alie: Oh GOD! Oh, what a nightmare. Okay. I'm dead. I'm dead as fuck. Okay, great.

Rebecca: So, you're reeled up to the mouth-butt, to the mouth-anus combo hole, and sucked inside. Some of them have these really long, frilly tendrils coming off the mouth. We call them oral arms. They sort of look like streamers, they're nice. You'll get sucked into the mouth, and then they have… some jellies anyway, have inside tentacles. So, they have outside tentacles, and then you might have these tentacle-like gastric cirri on the inside that are *also* covered in stinging cells, and they just kind of churn around. So, if you are paralyzed then you're just being stung over and over, and churned around, and slowly digested by all the enzymes in the stomach.

Alie: [*horrified*] Oooh my god. Do you ever see a meal in digestion? After a jellyfish eats can you see a partially digested shrimp in there?

Rebecca: Everything. And it's terrifying. For the ones that don't fully kill their prey, like, they'll swim around... [*Alie still horrified*] So, you kind of watch them, and they're trying, and they're struggling, and you can't get them out and they're slowly disintegrating. It's pretty upsetting. [*audibly upset*]

Alie: Do they breathe?

Rebecca: They don't have lungs, but they do breathe. Most jellyfish breathe. There's one really weird species of parasitic medusozoan that lives in caviar. It lives inside the eggs of a

sturgeon. They might not actually breathe. They might be the only animal that doesn't need oxygen.

Alie: Are most jellyfish usually transparent? What kind of array are we talking, aesthetically?

Rebecca: Every color of the rainbow. All over the place.

Alie: Oh! Okay.

Rebecca: So, we've got our white jellyfish like moon jellyfish. They're kind of opaquey-milky white. We've got some really not-transparent super white jellyfish. One of my favorite jellyfish in the whole world is called the barrel jellyfish.

Aside: Okay, just a quick aside, the barrel jellyfish is a larger jelly, and it can grow to be 2.5 meters across. It's got these eight frilly tentacles and a big mushroom helmet top. It looks kind of like an oceanic version of the Scrubbing Bubbles commercial, which - side note to an side note - happened to be my favorite cartoon as a child and my mom had to break it to me that it wasn't an actual show, it was just a toilet cleaning commercial. Anyway, the barrel jelly is also known as the dustbin-lid jellyfish or the frilly-mouthed jellyfish. Can I read you this weird sentence from its Wikipedia page? Okay, I will. "In European populations, barrel jellyfish evoke unpleasant and disgusting feelings."

It seems like a generalization, but Rebecca loves barrel jellyfish and goes on to describe them a little as well as other jellyfish varieties.

Rebecca: They are white with this bright blue ring around the side. So pretty. [*"You're gorgeous."*] Then we've got, like, purple, blue, red. Red's pretty common. Black. Sometimes you'll see black jellyfish, but not that common.

Alie: BLACK JELLYFISH!!! I didn't know there were black jellyfish. That sounds so goth. Gooey and goth.

Rebecca: They're deep sea too. So, they're cold, and dark, and black.

Aside: PS: I looked them up and they look like a jellyfish wearing a crushed velvet dark purple cape, like jellyfish who refuse to donate their Cocteau Twins CDs to Goodwill. Now black jellyfish are also called black sea nettle or the sarlacc jellyfish. Yes, the sarlacc jellyfish. No, you're not imagining that jellyfish names are just up there in taxonomy treasures with mushrooms names in terms of zany creativity.

As long as were here let's just bloop through a tiny sampling of jellyfish names. Flower hat jellyfish, blue blubber, cauliflower jellyfish, the fried egg, which honestly looks like breakfast and a caramel flan had had a baby. There's also the pink meanie, who will absolutely shit-talk you in its burn book. Then there's bloodybelly comb jellies, which aren't really jellyfish but they look like if your heart got lost and ended up on the outside of your body, but in the ocean, and was also filled with blinking disco lights. Now, why is there such variety?

Alie: Why do some of them have really long colorful tentacles and some don't? Are there different types of jellyfish?

Rebecca: Yes. There are four types. Four, plus or minus types. Scientists, we fight. So, we've got the box jellyfish which is shaped like a square. They've got tentacles and four little corners. You do not want to get stung by one of them.

Alie: I've heard bad things.

Rebecca: Very bad. I mean, I love them. They're really clever, as far as jellyfish go. They're quite smart. They can navigate around obstacles. They have these really well-developed eyes that sort of look at you when you're looking at them and it's a little unnerving. They're great. So that's one group.

Then we've got the very poorly known but very endearing star jellyfish, or staurozoans. They're actually jellyfish that sit on the bottom all the time. Not like an upside-down jellyfish that's like, "I just like to be here." They *have* to be there. They're stuck to the bottom. Stalked jellyfish is another name for them. They're really cute. They're maybe the size of your thumb. They don't really sting. They have these really great little tentacle pom-poms. They're shaped like little wine glasses but if wine glasses had little pom-poms on them.

Alie: Oh, aw! What little sweeties!

Rebecca: They're very cute. Yeah. I love them. They do little summersaults too, to get around. So, they'll live on, like, a blade of sea grass, and think to themselves, "I want to be at the top of this blade of sea grass." They'll bend over and use their little pom-poms to, sort of, stick to the blade of sea grass, and they'll flip their little stalk over to the other side, and attach, and do that over and over again.

Alie: Oh, they sound like a creation of Dr. Seuss.

Rebecca: Yeah. I think that they would be perfect. Then we've got our water jellyfish, or hydrozoans. Biggest diversity of jellyfish. Very, very poorly known by, like, the average person. There's like 2,000 species but they're all pretty small, like maybe your fingernail size, maybe a bottle cap, and they're all pretty clear. They usually don't really sting. So, it's like they don't bother people, people don't really bother them. Ships in the night.

Alie: Under the radar.

Rebecca: Exactly.

Aside: To recap those types so far: there's box jellyfish, stalked or star jellyfish, and hydrozoans. I would also like you to know that a group of jellyfish is called… a smack. You're welcome. What about when we think of jellyfish? Those flowing, vengeful, Medusa locks, that thrumming, quiet, majesty, the danger…

Rebecca: And then the last group is called scyphozoa, and these are your big, charismatic, aquarian jellyfish. They've got little frilly arm parts, and have their little tentacles out, there are lots of different colors. And these are the ones that also will ruin your beach vacation. They've got two modes. They've got the frilly long-tendrils-coming-off-the-mouth mode. So that's one group. And then the other group is like this filter-feeding group that has, like, a cauliflower to the back of them.

Alie: Oh! What are they doing with that?

Rebecca: Filtering out seawater. So they're like filter feeders. They're these very peaceful, beautiful filter feeders. And that big cauliflower-looking thing is actually a complex of a thousand little mouths that just suck in food from the water.

Alie: Oh my god! What about brains? Do they have brains?

Rebecca: They don't really have brains.

Alie: How do they do anything?

Rebecca: They're like cloud computers. They think like a cloud computing system might, where they've got these central regions of concentrated neurons at various points along the edge of their bowl or bell-shaped body, like right on that margin. Every couple inches there'll be this little spot. It's called a rhopalia, and it has a very simple eyeball, and a very simple up-down, 'where-am-I-in-the-world' sensory structure, and then a little cluster of neurons. Each one of those takes in its little wedge of the world that it sees and sort of reports back to every other one. And then collectively they all make decisions together.

Alie: [*gasps*] But they are one single organism, right?

Rebecca: Yes. Oh yes. But it would be sort of like if you had, like, a quarter of your brain on one hand, a quarter on the other, a quarter on one foot, and a quarter on the other foot, and no one was the boss, everyone has equal say. But when one is really screaming, like, "There's food over here, we should go over here," everyone's like, "I also love food! I'm going to go there as well."

Alie: When we see them in the ocean or in an aquarium, we are typically seeing them in their reproductive phase because that's when they're kind of the most attention-getting?

Rebecca: Yeah. They're sort of in their flower phase, if we just want to throw around a million different metaphors. It's a very showy, attractive phase, very bizarre, hypnotic phase. Polyps - I love polyps. All I have at home right now are polyps, and they're very low maintenance, but they're not charismatic, at all.

Aside: Remember, the polyp is the kind of tween jelly, somewhere between a baby planula and a hornball medusa.

Alie: How long can they live? If the polyp can live for up to a decade, how long can the medusa form of it live?

Rebecca: In the wild, a lot of jellyfish are seasonal. These are the questions where I'm like, "That *sounds* like a simple question. Let me talk for 45 minutes." In the wild, they are seasonal. And they seem to mostly, if not completely, all die off in the fall, for example, or whatever their favorite season is. And then the polyp kind of hangs out on the bottom until conditions are right, and then turns out some new jellyfish whenever times are good again. But I've kept jellyfish for, like, two years. And there are jellyfish that live in Norwegian fjords where you can kind of track who's who by how big they are. So maybe not like, "That's Tom the Jellyfish." Maybe not *that* detailed, but you can be like, "That's a boomer jellyfish. This one's a millennial jellyfish." You can kind of tell based on how big they are what generation they're from, and people think they might be 20 years old.

Alie: Really? You can't tag them, can you?

Rebecca: People are working on it, and you can do short-term tags. You can now tag a jellyfish, and let it go, and then just follow it around.

Alie: Oh, just behind it in a canoe, like, "Hey, buddy!" Are there aquariums that can tell you, like, "Oh yeah, we've had Phil for six seasons now," or…?

Rebecca: Probably! When I had jellies for two years, they all had names. None of them were supposed to be named, you know, because they're science jellyfish and you don't want to get attached, but eventually, you just end up naming them on accident. So it was like, Big Guy, Little Guy, Middle Guy - except Middle Guy became the big one. So then it was like Middle One, but he's the biggest one… They lived a really long time, and they had their ups and downs, you know. It's a complicated life with injuries, and there was one time

where everybody accidentally ate a bunch of paper towels that fell into the tank. I'm sure there are aquarists that could tell you the same thing. Like, "We've had these jellyfish for five years, and that one wasn't doing so great this fall, but he's really picked up now."

Aside: They all got sick from eating paper towels! I love them.

Alie: Did you ever notice different personalities? Like, are there some that are more hyper than others?

Rebecca: It's so hard to say because you're like, "How are you feeling today?" I just don't know. Maybe you're just having an off day. Maybe you're having an off month. Maybe you have a jellyfish migraine and I just can't tell. I never really noticed a ton of difference, but again, it was like, "I know you lost five of your tentacles the other day on the little on the little Swiffer mop I used to clean your tank. Maybe that's why you're behaving differently. I just don't know."

Alie: And how do they get it on? [*song begins: "Let's talk about sex, baby!"*]

Rebecca: They do a bunch of different things. So most jellyfish have the standard ocean sex thing. Like, don't even worry about meeting someone, just release everything into the water and hope for the best. You know… just dribble some eggs out as you're munching and then, "Good luck, I hope you're fine!" [*squishy splat underwater*] With some jellyfish the female will keep the eggs in her body, and then essentially, sperm will just swim up her mouth and find them.

Alie: Oh my god! Up her mouth-butt?

Rebecca: Up her mouth-butt! One day, you're just like, "Oh, I got fertilized! I don't know when that happened."

Alie: Oh my god. You just get knocked up while you're trying to munch on a plankton. You don't even know about it.

Rebecca: Totally. Yeah. "I have a million babies now."

Alie: Oh that's romantic.

Rebecca: She'll keep all of her little babies in little special pockets, in the long frills on her mouth-butt.

Aside: [*Twilight zone theme and dramatic voice effect*] Imagine, if you will, a science fiction program about an extraterrestrial alien that has a mouth-butt lined with poison arms and holds babies in its pockets.

Rebecca: Some jellyfish, like moon jellyfish, they've got all those beautiful loofa-like tentacles around their mouth. For females, they're just pockets full of babies.

Alie: [*warped*] Oh my god! It looks like a kangaroo. It's like a very slimy kangaroo.

Rebecca: Yeah, but millions of babies and they're all crammed together in these little stomach pockets. You can see them! If you go to an aquarium with a jellyfish biologist, which I 100% recommend, we'll give you all the dirt. Like, "Oh man, that female, she's got a lot of babies. Check out all the little white streaks: millions of babies!"

Alie: When does she kick them out?

Rebecca: Good question. I don't know if they get kicked out or if after a while they're like, "I am so sick of my 99 million other siblings, I'm just gonna swim out into the world and do my

own thing." I don't really know when that happens. Usually I just, kind of, put a moon jellyfish in a bucket, and kind of give a little shaky shake, and I get, you know, a couple of thousand.

Alie: If only human birth were that easy, just go in a hot tub — boom. Birth.

Rebecca: **"**I'm done!"

Alie: Just jostle me gently and have a baby fall out.

Rebecca: **"**I didn't even notice that they were gone."

Alie: What about myths? What about flimflam about jellyfish? Is there any myth that you just cannot stand?

Rebecca: Oh man. Well, you know, they're not fish.

Alie: Right! Should we be calling them jellies?

Rebecca: I don't know…. You know, I kind of just decided I'm going to lean into it because everybody knows what I'm talking about, more or less. When I say jellyfish, you get a mental picture, even if you think it's a fish, at least we're kind of on the sort-of-same page, and we can correct that later. Whereas if I say sea jellies, it's like, "What do you mean? What is that?" I don't know. I mean, maybe it's a good idea. And fortunately, I don't work at an aquarium, so I don't have to really make this distinction, but yeah.

Alie: You don't have to change signage.

Rebecca: Yeah, exactly. I go back and forth. I'm just like, "Okay, whatever." But I will say that for me, and for a lot of scientists I know, a jellyfish is a Medusazoan. And there are lots of other things in the ocean that also look like floating boogers and they are *not* jellyfish. So you've got your comb jellies, and you've got your larvaceans, which are basically like little tadpole animals that make these giant snot cars that they drive around. You've got your salps, which are little barrel shaped animals, and they just eat tons of algae all the time. None of these are jellyfish even though they all look like jellyfish.

Alie: So a comb jelly is not a jellyfish.

Rebecca: Yes.

Alie: I didn't know that! Okay.

Aside: More on comb jellies in a bit, but one thing it DOES have…

Rebecca: It has a butt! [*"THICK!"*]

Alie: What about the wind-of-the-sails or… what are those ones with the blue mohawk?

Rebecca: Oh, By-the-Wind sailors! Those are fancy polyps. They have jellyfish.

Alie: They do!

Rebecca: They do. So those are fancy polyps that live on the ocean surface instead of on a little rock or something.

Alie: Oh, okay. Do they do they metamorphose - metamorphosize? Meta-mmm…

Aside: Me, casually trying to say the word metamorphosize to a scientist I desperately want to be friends with. Cool, cool. Also I did look it up and apparently you can say metamorphosize *or* metamorphose, so now we all know that. Also the Velella are indeed jellyfish, and they are these inflatable blue little wedges, but you can call them [*airy voice*]

By-the-Wind Sailors, even though it sounds like a Hemingway book you're required to read in sophomore English. Rebecca says [*airy voice*] *B*y-the-Wind Sailors are like a jellyfish factory underneath. Can you imagine if someone's like, "Oh wow, yeah I looked at their butt and they are just a baby factory." Oozing babies.

Rebecca: If you flip one over, you'll see it's got a little brown ring on the bottom and that's where all the little jellyfish bud off. The brown is from the algae that live in the jellyfish. They just hang out in the sun.

Alie: Oh my god. Okay, because I've seen those all over the beach. If I see those on the beach, should I be tossing them back into the water? Are they there for a reason?

Rebecca: Oh my gosh. Well, first of all, I love them and I'm studying them. So please, if you ever see some - serious moment - I would love it if you would report them on iNaturalist or JellyWatch, which is this citizen scientist jellyfish community of jelly watchers.

Aside: Citizen science, sidenote, is also called community science and YOU can be a part of it. Yes, you. Everyone.

Rebecca: Because we don't really know why they roll up on beaches when they do. We think it's maybe something having to do with currents, but who knows? I mean, I will say, by the time they're on the beach, it's kind of been a pretty bad day already. So you could try to toss them back and they might do okay, or they might just be eaten by fish.

Alie: Oh, man. In your particular research - what are you researching now? Or are you researching like 10 different things about jellyfish?

Rebecca: Yes. I'm researching two or three different things about jellyfish. I'm looking at the jellyfish life cycle. How does one stage switch to another stage? What's really happening in there? Is it jellyfish puberty or is it more dramatic than that? We don't really know. That's one thing I'm looking at. And then the other thing - of the three – is: how do open ocean jellyfish… get there? You know, because most jellyfish, they have this polyp. It's very important, does a lot of really good things. Kind of helps you weather the bad times, you know, just hanging out in the bottom. But some open ocean jellyfish, they've just lost that part of the life cycle. They just go directly, like one egg becomes a little planula, becomes a jellyfish, skipping the whole middle part. And it's like, how do you skip a… it's development. How do you just cut out the middle part and still look normal?

Alie: Oh my gosh. So you're trying to find nature's riddles out?

Rebecca: Yeah. I love that. Yes! It's very perplexing to me. How can you do that? That doesn't seem fair. That would just be like us skipping puberty. Like you just woke up as an adult one day.

Alie: So confusing. So hairy, all at once!

Aside: And the third aspect of what she's studying is: how does the environment inform this process? But let's move on to a hard-hitting question.

Alie: How do you feel when it's Halloween and you see a lot of jellyfish costumes?

Rebecca: Love them!

Alie: You do love them? The clear umbrella with the streamers? Have you ever done that?

Rebecca: I do. Yes, of course, I did that back in the early 2000s, it was at the beginning of it. I was so into it. Yeah. I love it. I mean, when trick-or-treaters come to my house, I always have little info packets that I give with the candy about some cool animal.

Alie: Oh my god that's amazing!

Rebecca: I'm not sure how the kids feel about it, but I love it. So yeah, whenever I see a jellyfish, I'm like, "You get *every* info packet! You get *all* of them!"

Alie: What are the info packets on?! Do you make the info packets?

Rebecca: I do, yeah! [*"Noice!"*] They're just little leaflets. Last year I was a baby snail for Halloween. Baby snails are like the most amazing snail lifecycle stage to me, because they have fairy wings, like they have these huge angel wings and they just swim around the ocean being little baby winged snails. [*Alie exclaims "Oh"!*] They're called veligers, baby snails are called veliger larvae. My Halloween costume was a big shell with little angel wings on it, and I handed out little veliger info sheets. [*laughs*]

Alie: *Oh my god!* Have you ever had neighbors come up to you and say "Hey, thanks a lot for that. Melissa's now really into…"?

Rebecca: [*laughs*] No, but that's mostly because I give out info packets at my friends' houses. Just like bomb education, and then leave rapidly before anyone is like, "Oh my god! Did you really just hand my child a little info packet on baby snails?" I'm like, "Yes, yes I did."

Alie: I love that! Can I ask you Patreon questions?

Rebecca: Yes, of course!

Alie: Okay. They submitted like 300 questions. People have *so* many jellyfish questions. They're pumped!

Aside: But before your questions: a few words from sponsors who make it possible to donate to a cause of the Ologist's choosing, and this week *Dr. Jellyfish* chose the Vancouver Aquarium, which has had a rough go of things with the pandemic closures. They've just re-opened with a limited number of ticketed reservations, but they've put out a statement that said, "Although our doors are open, we still need your help to secure the future of the Aquarium. We can't survive without you and your donations."

The Vancouver Aquarium - if you've never been - is home to thousands of incredible ocean species and aquatic life. It's also Ocean Wise headquarters; where scientists, educators, and conservation experts do all their work to not only to protect the oceans but to inspire others to join them. The Vancouver Aquarium opened in 1956 and it's connected more than 40 million people from around the world to oceans and all the wonders within them.

You don't even have to be in Canadia to enjoy the aquarium! I just went on their site and lost my marbles realizing they have a live otter cam, penguin cam, underwater otter cam, and a baby otter cam. I just watched a baby otter with a pacifier! Don't be jealous, just go on their website. They also have [*Alie does a drumroll with her mouth*] a live jelly-cam featuring billowing medusa jellies gliding by like someone in a ruffled 1980s prom gown. It's *devastatingly* beautiful. So, a donation went to them and you can go check out their jelly-cam while you listen to the rest of this. That donation was made possible by Ward-approved sponsors of the show, who you may hear about now.

[*Ad Break*]

Alie: Okay, are you ready for Patreon questions?

Rebecca: Yes, please!

Alie: Lightning round. Here we go. So many questions. We're just going to blaze through as many as we can. Sound good? Okay.

Rebecca: I'm ready!

Alie: Anna Thompson wants to know: Can they control their tentacles or are they at the mercy of the current?

Rebecca: They *can* control their tentacles. They can contract them and relax them. When they contract, it's like one of the fastest muscle contractions in nature.

Alie: Really?!

Aside: Okay, so next week's episode we're going to learn all about how fast the venom comes out. So, for the next 6 days you'll have to wonder: Does it dribble like fresh blood? Is it ejected out like tiny harpoons?! Ohhh stay tuned. Shit gets weirder.

Rebecca: I will say, for slow drifting animals, they have their moments of being really fast.

Alie: Mhmm, yeah, badasses.

Rebecca: Their tentacles contract really quickly, and their stinging cells fire really fast.

Alie: Ooh! Okay, Natalie Perkins wants to know: Can they feel pain? Can they sting each other? And can they sting themselves?

Rebecca: I don't know if they can feel pain. That's actually a really hard philosophy question that even fish biologists can't agree on. Can fish feel pain? No one really knows. They definitely do not like things and avoid things. So, if you poke a jellyfish, they'll be like, "Ugh!" and swim away. [*Alie laughs*] Interpret that how you will. Jellyfish of different species *can* sting each other and sometimes do *eat* each other. They're called 'medusavores'. So, jellyfish that eat other jellyfish. [*clip from Silence of the Lambs: Anthony Hopkins, "I ate his liver with fava beans and a nice chianti."*] But they can't sting themselves as far, as I know. They seem pretty comfy with themselves.

Alie: Oh, that's really good to know. Starr - simple question, I didn't ask, glad they asked it – asks: What is the clear part that looks like the top of a mushroom made of? What is it?

Rebecca: The technical term is called 'mesoglea'. It's kind of like cartilage. It's got a ton of collagen in there. If you ever find yourself in an Asian market, you can actually buy them and eat them.

Alie: Oh, you can?! Do you cook them first or do you just raw dog it like an oyster?

Rebecca: [*laughs*] Noooo, you gotta… So, there's this whole preparation process that they go through, so you can actually buy them packaged, like pre-prepared, and then you sort of soak them, and soak them again, and then you slice them up into, like, little rubber bands and then can make a salad or you can fry them. Some different options. But they kind of have the same texture as cartilage. If you've ever gotten that gristle at the end of a chicken bone.

Alie: Yeah. Hmm. Have you eaten them?

Rebecca: Yeah… Not a fan. I mean, morally, and also culinarily. It's not good.

Alie: Little chewy? Do you put it in barbecue sauce or something? You get like a honey mustard?

Rebecca: There is a really nice… I don't know if it's, like, a soy sauce base… The sauce tasted good. Aside from my deep sadness at eating my favorite thing, I was kind of like, "You know, flavor-wise, not terrible, but texture-wise it's like *blech*."

Alie: Yeah, you're gonna go ahead and pass on that.

Rebecca: Yes. Hard pass.

Aside: Just a side note, I did look up mesoglea preparation and first off, if you have ever been frustrated that you can't eat a breast implant, boy howdy have I got good news for you. The mesoglea is about 95% water, the rest protein, and it makes a hydrostatic skeleton of jelly that holds things in place. But when it comes to inserting this substance in our mouths, I scoured food blogs and YouTube videos, and I saw its texture described as 'slimy leather'. Some folks said it had a mouthfeel somewhere between a cucumber and a glass noodle. One taste-tester described it as a 'shrimp-flavored gusher'.

In Rebecca's own blog entry from 2013, she says, "My restaurant jellyfish tasted like soy sauce and a balloon. The soy sauce flavor came from soy sauce, with the jelly adding that scrumptious balloon-y quality." But she also adds that they're better deep fried. As is pretty much everything. But remember: fear is the mind-killer. Don't be afraid of jellyfish because chicken nuggets are so much more terrifying if you saw them made. Don't look that up.

Rebecca: That's what the little clear mushroom top is. It's called mesoglea. It's just lots of cartilage and water. No cells! No real cells to speak of. There are maybe a couple of little wandering cells, that float through the mesoglea – or really, they crawl, because it's kinda thick and Jell-O-y – but it's mostly not cells.

Alie: [*exasperated*] What?! How is that… How does it exist if it's not made of the things that alive things are made of?!

Rebecca: [*laughs*] It's just got the two! It's got two layers of cells and that's it! It has the outside layer and then it's got the layer around its stomach vascular system. That's it! All the middle stuff is just, like, cartilage.

Alie: Wow. That is absolutely nuts… I didn't… I would never have thought… I would have thought that that was all just goopy stuff made of animal cells. Oh, that's crazy. Oh my god.

Rebecca: Right?! Honestly, though, it is the way to go. They can just not eat for ages because they've only got two cell layers to take care of. I mean, how much food does a layer of cells need? Not that much.

Aside: So many Silicon Valley biohackers probably have holographic notes in their brain implants that say, "Convert flesh to mesoglea…"

Alie: I didn't realize that they've really figured out life. Pretty much.

Rebecca: They're so Zen. [*Alie laughs*] So simple, so Zen.

Alie: Chelsea Premeau wants to know: Do jellyfish have any control over their lives? Or are they like me, and just at the mercy of the ebb and flow of the tides of life?

Rebecca: [*chuckles*] I mean, yes. Yes and no. I think we're all kind of in the same boat right now. Some jellyfish, like those box jellyfish, they can totally control where they're going. They've got a mission, they're on it. That being said, it's not like they're really good swimmers. If the current's even just a little bit strong, then they're probably going to get swept away. That's true for most jellyfish. Most jellyfish kind of have an, "I would like to go up," or "I would like to go down," or maybe, "I would like to go this way or that way;" but they're also kind of at the mercy of the currents.

Aside: This next question was asked by Stephanie Hancock, Lily Sagers, Roxanne Parker, Andria Marsh, Melissa Huston. First-time question-askers Kristen C, Mercedes Maitland, and Adam Weaver – who says about this topic: Can we talk about how weird it is for a minute?

Alie: Let's talk about… A lot of people had this question, which I had *no* idea this existed before I put this up on Patreon and asked for questions. You were talking about currents. What about freshwater jellyfish? [*high pitched*] What the?! *Who* are they?! Where do they live?! How are they not salty?!

Rebecca: [*laughs*] They're beautiful. They live all over. These little buddies are called 'Craspedacusta', that's the fancy science term. They are probably, maybe… we're not 100% certain, but until more science is done, we'll say, from around the Yangtze region in China. At some point maybe a hundred, 200 years ago, someone was like, "I really love this aquatic plant. I'm going to bring it back to Europe." And there was a little jellyfish seed stuck on one of the plants from those little polyps when they leave their little footprints behind. That then grew into a polyp which started making jellyfish in one pond and then seeds spread to other ponds. Now they're all over. We have them in the U.S., they're in almost every state, and they love to live in cool, calm water. They can be transported between ponds on shoes, or kayaks, or if a bird steps on a jellyfish seed and then swim to another pond.

Alie: Ohhh my god! And then is that screwing up a lot of freshwater ecology?

Rebecca: Who knows. I mean, they've been there for a while. Not a lot of pre-freshwater jellyfish pond studies. We're kind of pushing it in terms of American naturalism. It doesn't go back so, so far. So, sort of hard to say, but they've been there for a while now, so hopefully it's not so bad. As far as I know, they eat little pond animals, like little shrimp, and water fleas, and things like that. They will usually show up for like a month or two at the end of the summer, beginning of the fall, at least where I live. I saw some in of all places, Walden Pond, like Thoreau's pond.

Alie: And how did you see them? Did you have to really focus or were they pretty apparent?

Rebecca: The narrative for this was, like, someone saw one, and so of course it made the paper because, like, so weird, right? And then I read the paper, and was like, [*excitedly*] "Oh my god!"

Aside: I looked this up and they were first spotted in September of 2010, and headlines in Boston papers read: "Walden Pond Invaded by Jellyfish," and, "Mystery Blooms on Walden Pond." In one story, an aquarium representative was quoted as saying the freshwater jellies were "wickedly cool," which is the most 2010 Bostonian way to comment. Anyway, Rebecca describes the wicked cool nickel-sized floating water bags.

Rebecca: They were all concentrated in one side of the pond. So, we get to this pond, it was beautiful, all the leaves were turning. It was really cold. My friend who was with me was carrying all my gear, and I snorkeled out into the middle of a lake.

Alie: Holy shit.

Rebecca: After swimming in circles and getting frustrated and chilly, I eventually ran into someone who was swimming laps across the lake, and they were like, "I saw them over in that corner over there." So, I swam over to that corner and sure enough, it was like, "No jellyfish, no jelly, no jellyfish." And then it was just jellyfish everywhere.

Alie: Oh my god. Did you take some back to study at all?

Rebecca: I did. I took some back and my goal was like, "I'm going to start my own freshwater jellyfish culture in the lab. This is going be so great. I just need one boy jellyfish and one girl jellyfish and that's it. I'll be ready to go." I collected like 300 jellyfish and [*frustrated*] *every one* was female! [*clip from The Office: Angela Kinsey, "Girls only."*] Every single one.

I think what happened in Walden Pond - and what happens in a lot of ponds - this is not an unusual thing for freshwater jellyfish, is that like only one of those little jellyfish seeds will get into the pond, and then the polyps will just split themselves, and split themselves, and split themselves. Eventually you'll get hundreds of thousands of jellyfish, but they're all genetically identical.

Alie: Did you have to run any DNA on any of them?

Rebecca: I didn't get to run any DNA, but that's sort of my suspicion because people have tracked ponds over the years to try to figure out, like, is it temperature, what is it, and just get one potential clone line. It would be really cool if someone ran some DNA to see. As far as I know that hasn't been done yet. So, if there are any undergrads or grad students listening that need a project…

Alie: [*laughs*] Also, who's doing laps when it's that cold?!

Rebecca: So cold. I guess if you're like a triathlete, maybe? They had a wetsuit, and I did not, and I was so jealous.

Alie: Oh, okay. When you said you had scuba gear, I pictured you in the wetsuit and that person in a Speedo.

Rebecca: I wish. No, I had snorkeling gear. I had my little swimsuit and some pool noodles. Because I was like, "I'm going to need to stay afloat and I don't want to have to swim to stay afloat." Yeah, really sexy science right here. October in Massachusetts with me and my snorkel gear, floating on a pool noodle in the middle of the lake.

Alie: Nope. How big of a hot chocolate did you have after that?

Rebecca: Huge, huge. I was so cold. It took most of the drive for me to warm up. It's like an hour drive. [*Alie shocked*] For jellyfish! Some things are worth the sacrifice.

Alie: Wow. Oh my god. I'm going to send you a wetsuit.

Aside: Floating on a pool noodle in October? *Outside?!* I wouldn't swim out to see my boyfriend in those conditions. Even if there were thousands of clones of him bobbing around nude in the water. I'm sorry, Jarrett, it's just too wicked chilly. Man, this woman *loooves* jellyfish. Now from ecological pests to pets? Who among the Patrons had captivity questions, or wanted to domesticate one, and to love it and squeeze it and name

it George? Karen Burnham, Diana Wueger, Mark Sweeney, first-time question-asker Kylie Torres, and Suspiciously-Asking-for-a-Friend- wink emoji - Jen Athanas; as well as Mariah McGregor, who says jelly pets sound wonderful but also like it might be illegal.

Alie: Mariah McGregor wants to know: Are there jellyfish that people could reasonably and responsibly own? [*high pitched*] Like a little home aquarium?

Rebecca: Like little pets? Yeah! There's a whole aquarium industry for people that want to start home aquariums. Moon jellyfish are the ones to go with. They're pretty tough. They can tolerate your moments of forgetfulness. They're tough in terms of, like, they don't mind so much if their aquarium is a little bit dirty. A lot of jellyfish are such divas and as soon as it's a tiny bit dirty they're like "Imma die. I don't want to be here anymore. There's a spot, I'm dead." Moon jellyfish are better for that, for sure.

The one thing I will say is, if you get a pet jellyfish, just like with any other pet, don't let it go, because there are some moon jellyfish from Japan that are now all over. They're in California, and Washington, and Oregon – they're spreading. And so whatever moon jellyfish species you bought, because there are tons of moon jellyfish species, you just want to make sure that it doesn't get out and then compete with whatever your local, beautiful moon jellyfish species is.

Alie: Right. So don't pull a Florida python situation.

Rebecca: Totally. But even more important, because they have these really tiny embryos, don't even throw the water out. When I work with jellyfish and I'm close to the ocean, when I clean their water I'll dump the extra water on the dirt.

Alie: Don't even put it in the drain?

Rebecca: Maybe in the drain is probably fine because it's going to get diluted and mixed with a bunch of soap and other weird things that put down the drain. But if you're at the ocean and you have a jellyfish tank, maybe you've put a little sea anemone or some fish in there, and you're just going to toss some water out, make sure you don't toss it anywhere close to where it could get into the ocean.

Alie: Ooh, good to know, just toss it on the dirt. Okay, B. Abbott has a question from Lauren who's 9 and Clark who's 7 - sorry for the swearing, number one. But they want to know if jellyfish poop. What's the deal?

Rebecca: Well they don't really have butts, exactly, so it's more like… this is not the official scientific term, but among my jellyfish and sea anemone friends we call it throoping, because they kind of throw up poop that they do not digest.

Alie: Oh no. [*laughs*]

Rebecca: Yeah, so they throop out of their manus.

Alie: Their manus! [*laughs*] Is it like gelatinous, or is it just like fish poop?

Rebecca: It's more like leftovers… it would be like if you peeled a shrimp.

Alie: Okay, that makes sense.

Rebecca: So it's not really like a pellet of poo, it's sort of like if you peel a shrimp or de-bone a fish - that stuff comes out of the mouth again.

Alie: Ooh, that's one way to do it, man.

Rebecca: Yeah, so simple.

Aside: Y'all, they throw up poop from their mouth-anus! You sauntered into this episode not having any idea you'd be walking a lap round the park, or harvesting radishes in the backyard, or filing paperwork, hearing the term, "throoping out my manus." And yet, is there anything more efficient, more aspirational, than a manus throop? Sounds clean and easy.

Also, this next question we will cover in great detail in next week's venomous toxinology episode, with real-life toxinologist, but here is a topical preview with Rebecca.

Alie: Have you been stung?

Rebecca: Yes. I've been stung maybe half a dozen times.

Alie: How bad is it?

Rebecca: It depend on the species. Some species kind of tickle and are itchy. The moon jellyfish I was stung by, it felt like I was being very mildly electrocuted. I wouldn't put it on the pleasant end of the spectrum, but it wasn't terrible. It wasn't an, "I'm never doing that again" moment. It was just like, "I'm going to think harder about next time I touch a moon jellyfish." There are stinging nettles, and they stink. I would not ever recommend grabbing a stinging nettle. And I totally made this mistake and it was so embarrassing.

Most of the time when I grow jellyfish, for whatever reason we grow them in the lab, they don't really sting that bad. I don't know if it's because they're happy and well-fed, or if they're just not eating the right stuff, but it's fine. So this one time I was on a boat with a bunch of people, and it was my first time out collecting jellyfish in the wild, and I was trying to be all cool, like I knew what I was doing. I saw a jellyfish and just plunged my hand in the water and grabbed it.

Alie: [*pained*] Oh!

Rebecca: Instantly regretted it. But it was sort of like when you take a bite of too-hot soup, it's not clear what the best solution is. Do you swallow it? Do you spit it out? You don't really know. And so I had this jellyfish in my hand and I was like, [*panicked*] "Bucket or ocean?? Bucket or ocean??" And I put it in the bucket, kind of tried to pretend it wasn't that big of a deal, but everyone was looking at me like, "I thought you were a jellyfish biologist?? What's wrong with you?"

Alie: Oh god!

Rebecca: I was like, "This looks really bad but I promise I know what I'm doing."

Alie: So what did you do? Did you throw it in the bucket?

Rebecca: In the bucket, yeah. I thought, "Okay, I've already been stung, I might as well get something from it." So I put the jellyfish in the bucket, but it bruised. It bruised for a *while*. I will say, the third time I was stung I was kayaking by myself, and afterwards I was like, "I've heard this pee thing and I don't know if it's true but I want to try it." And I can personally and professionally tell you that it does not work.

Alie: Yep. Yep. Oh no. Where were you stung?

Rebecca: Hands, always on the hands.

Alie: Okay, so that's easy to pee on. If it was your neck it'd be like, "Good luck with that."

Rebecca: I know! I was honestly thinking about when I was having this really weird moment of peeing on myself, like, "How do people do this when they're stung on like the abdomen? Does someone else have to pee on you?"

Alie: I guess it's like a splash bath, like a sink bath. I don't know, I'll look into it.

Rebecca: How bad would it have to feel to pee on yourself like that? It's one thing to be peeing and, like, *boop*. But it's another thing to be like, "I'm going to collect this pee and splash it on my body." That must be… I'm so sorry for the people who've been stung that bad, because that takes thought, and effort, and energy. Even worse, it's not really that effective, so now you're covered in pee and it still hurts.

Alie: [*wincing*] Bad day at the office a little bit?

Rebecca: Though it turns out that warmth – warm, hot, but not so hot that it burns – really helps inactivate some of those bad jellyfish venom proteins that make it hurt so bad. The pee itself is not necessary, but the fact that it's warm might be a part of why people keep peeing on themselves.

Alie: Take a thermos with you instead.

Rebecca: Make some tea, yeah.

Aside: Hold on to your manuses because there will be so much more on this next week.

Alie: This was a great question. Edward Rice wants to know, first-time question-asker: Do they sleep?

Rebecca: Maybe. There is some evidence that they sleep - and I actually learned this too when I read the paper - there are lots of different criteria that you have use to determine whether something is sleep or whether is part of what we call a circadian rhythm, which is basically that natural cycle of, "I don't want to do anything" and "I want to do things" that happens to all animals. For us, it's like jet lag. You don't really think about the fact that you have this natural cycle of 'doing stuff' and 'not doing stuff', but we do. And we feel it when we get jet lag and we're suddenly like, it's three o'clock in the afternoon and you're like, "I just don't want to do anything right now."

Aside: Okay side note: for more on this see the Chronobiology episode that went up with now *Dr.* Katherine Hatcher. It'll change your life and probably your bedtime.

Rebecca: Even things that don't sleep, like plants, have this circadian rhythm. And so it's hard to figure out if something is sleeping or something is just having the same natural day/night cycle rhythm. Jellyfish do show some additional signs that they might be sleeping. Like if you disturb them a bunch during the night, then their next rest period will be longer. But they don't show *all* the signs. So, I think there's some compelling evidence that they have a sleep-like thing going on, but you know, are they dreaming? Do they drool? Right? How sleepy is it? No one really knows.

Alie: Ah okay. And obviously they don't write in their diaries that you can read or anything.

Rebecca: Right, exactly. So they know, it's so obvious to them, and we're just desperately trying to figure it out.

Alie: Okay. [*excited exhale*]

Aside: Jellyfish experts, figure it out! This is the blobby gossip the world needs. Also, this next question was asked by Aarie Liebreich, Ford Gonzales, Emma Hendrickson, Ellen Skelton, and Elena Clemencon-Charles.

Alie: We had a bunch of people who asked about their population explosions with ocean acidification. What is happening with jellies? Are they having a good time? Bad time?

Rebecca: They're kind of like everybody else, they're sort of having a mixed time. So, think about jellyfish the same way we talk about mammals – it's a huge category. Most jellyfish, people never see, so it's kind of like if the only mammals people saw were rats and squirrels. We would be like, "Oh my god, like mammals are going to take over the world!" If you live in a big city, you know these are everywhere. The future is just going to be like nothing but rats and squirrels, you know?

But actually, a lot of mammals are having a tough go of it. It's not been great for tigers. Elephants are sort of plus/minus, right? They're not having the best century. And it's similar for jellyfish. Some jellyfish are, like, the rats and squirrels of jellyfish - moon jellyfish are a great example. We'll call them squirrels because squirrels are really cute and moon jellyfish are really cute. But they're prolific. They seem to be doing well in a wide variety of conditions. But then there are a lot of jellyfish that are like the tigers, that are really having a rough time. This whole changing ocean thing, and tons of ships suddenly parking where my polyps used to live, that kind of thing. It's not been great.

So, the narrative from 10 years ago was that it seemed like the jelly fish were taking over. But it turns out that they were really just looking at this squirrel and rat equivalents of jellyfish. And now that we've taken like this much closer look, we've realized that some jellyfish aren't doing great. Some seem to be doing better. I don't think any single jellyfish is going to take over, because they're part of a food chain, right? Tons of things love to eat jellyfish. There are tons of fish that love eating jellyfish; birds love eating jellyfish. Jellyfish are never going to be that abundant because whatever eats them is then going to become more abundant and just eat more.

Alie: Just a buffet of jellies.

Rebecca: Exactly.

Alie: I thought this was a great question. Leah wants to know: Are they ticklish?

Rebecca: Are they what?

Alie: Ticklish.

Rebecca: [*laughs*] I was like, "I thought she said ticklish but that can't be right!" I've never really thought about that before. I love that! That's so great. I mean, possibly? I could see some things tickling. [*clip from The Simpsons: "Goochie goochie goochie goo!"*] On the scale of things jellyfish Do to Do-Not like, they seem to be not too terribly offended by a gentle boop, so that might be the equivalent of a tickle. Whereas a more aggressive poke, they're just like, "Urgh no!" and they'll swim away. So maybe, maybe you could just give a little boop. But I don't know if they're ticklish, you'd have to ask a jellyfish.

Aside: Hey, any jellyfish listening, please let us know. Just come forward and make a statement with your mouthbutt. Our ears are open for it.

Alie: Last patron question. Davis Borne wants to know: What is the cutest jelly and why is it the sea walnut?

Rebecca: What is the cutest jelly?! There are so many cute jellies. Ugh! Gosh, this one is hard. So first of all, *any* baby jelly. And my favorite cute baby jellies are from a species called the mauve stinger. The scientific name is *Pelagia noctiluca*.

Alie: [*impressed*] Well!

Rebecca: I know, very fancy. And they are, as adult jellies they're very fancy, but their babies look like little Pac-Man ghosts.

Alie: [*gasps*] Stop!

Rebecca: They're like the size of a sugar crystal, and they're shaped like little Pac-Man ghosts, and their little ghost arms actually do pulse, just like little jellyfish.

Alie: Oh my god.

Rebecca: Those are *so* cute.

Aside: Okay, of course I looked up *Pelagia noctiluca* and yes, as adults, they are wearing a Marie Antoinette dress of elegant ruffles, and tendrils, and gorgeousness, and excess. But as little bebe blubs, yes, they look like little, awkward Pac-Man ghosts with no brain but tiny weapon legs. Also, Google Image search pulled up a whole bunch of jellyfish sting scars and I just want you to know that if you're out there listening to this and you have a jellyfish sting scar, I think that is rad as hell and very badass. I say this as a person who was legit maimed by a department store escalator. Own those jelly ribbon memories. Also, I kind of want to see a picture, provided it's not in your bathing suit area.

Alie: And then what is a sea walnut?

Rebecca: A sea walnut is a comb jelly, and I'm just so impressed… whoever looked at that thing and said "walnut," I would love to talk to them about how they came to that. I can kind of see it? Maybe I just don't spend that much time around walnuts.

Aside: I looked these up too - warty comb jellies or sea walnuts - I could not find the history on who was responsible for these names, and they do not resemble a walnut to me. I mean, honest to frogs, a sea walnut kind of looks like if you ate a papaya and then its 3-4-inch ghost haunted your kitchen. But instead of seeds, it had a few glow sticks that, when agitated, began to blink at you. Also, these rainbow-hearted papaya ghosts are not even actual jellyfish, and they do have a butthole, and it's called a transient anus, because when their gut fills up, it just balloons out and it forms a poop shoot through its skin that then vanishes like it never happened! Which is how most boys think girls poop. Oh, speaking of!

Alie: And now… shittiest thing about a jellyfish? What's the most annoying thing about your work, other than swimming in Walden Pond, in October, in a bikini? What sucks the most?

Rebecca: [*laughs*] I think the two things that are really frustrating are that you just never know if you're going to find them when you go on your jellyfishing expedition. Which is not a huge deal if you live by the ocean, but I don't and a lot of jellyfish biologist don't. So you're like, "I'm going to go to Florida in June, and I'm going to get some jellyfish. They're there every year! It's going to be great." And then you go, and they're just not there that year! That is always such a bummer. Always.

Alie: And why is that? Just weather? Tides?

Rebecca: We don't know! So like with those, By-the-Wind Sailors, which is sort of the last big research project I have going, I just got so frustrated that I actually started working with a collaborator who studies ocean currents to see if we could figure out, "When do they show up when they do?" It's been so fun! I've learned so much. It turns out, like, I know about things that live in the ocean... I do *not* know a lot about the water of the ocean. So it's been really fun! It could be tides, it could be currents, it could be - in the case of those little By-the-Wind Sailors - they have the little sails on top, so they seem to be concentrated by wind.

But it could be seasons. I remember the first time I went jellyfishing in graduate school. [*warped: "Jellyfishing"*] I was in Rhode Island, and so I was like, "I'm going to go to Cape Cod and I'm going to go jellyfishing." Keep in mind... I'm from Arizona, I went to college in Florida. I'm sort of a warm climate person at that point. And so this was like December, January... So I got my bucket, and I got my net, and I drove to Cape Cod, and it just didn't even occur to me that the ocean froze!

Alie: Oh my god!

Rebecca: And so I walk out on the dock and the entire dock and, like, all the water around the dock for, like, 30 feet, is frozen!

Alie: I don't even know that it did that, I'm going to be honest with you. Born and raised in California.

Rebecca: I was so upset!

Alie: I didn't even realize that! I thought it was vodka in the freezer, I thought there was too much salt to do that!

Rebecca: Oh my gosh! Me too! Thank you, thank you! Because when I told people what I was trying to do, they were like, "Hello! Duh, the ocean freezes!" I did not know that though!

Alie: I didn't know that! I've never seen a frozen ocean.

Rebecca: Like conceptually, I guess, that's kind of like what the arctic is.

Alie: Yes, yes I suppose, but that's the arctic!

Rebecca: It's really far away!

Alie: Yeah I would not… that's so funny! So obviously, you didn't go walking out there?

Rebecca: No, I didn't get any. It was an unsuccessful mission. So that is probably, like, frustrating thing number one. You don't know where they are, when they are, and I feel like that's probably how a lot of people feel. Like, if you knew that jellyfish were going to be at the beach during your beach vacation, you'd just reschedule.

Alie: Yeah that's a good point. So use the iNaturalist app, and if you see jellies, if you see something, report it to iNaturalist, you'll help people like you - or go to JellyWatch.org, right?

Rebecca: Exactly, thank you so much! And we're working on these questions, so there are people who are like, "I'm going to make a jellyfish predictor." And for some places there are jellyfish predictors, and they're pretty darn good!

Alie: Nice!

Rebecca: So the more people report when they see jellyfish - and also just as helpful, when you don't see jellyfish - that just makes it so much easier for scientists to then try to come up with, you know, the fancy math algorithms and stuff the fancy predictive biologists do to figure out when and where jellyfish are going to be.

Alie: Right. But how do you say like, "I didn't see this thing that's literally clear and invisible."? [*laughs*]

Rebecca: I know! [*laughs*] Well, on JellyWatch there is a little option of like, "All clear today!" and you just click the little box and you're like, "It was a beautiful empty day at the beach."

Aside: Wait she said two things! What was the second sucky thing about the jellies? Oh, Rebecca says it's that they do not make great pets; the older, sexier ones.

Alie: Why are they so hard to keep?

Rebecca: They are very fragile. They're just very fragile. Some of them are a little bit easier than others. They spend their whole lives out in the middle of the open ocean. If we went to their habitat, like, we would be so screwed, right? So they're really adapted to live in this world that's just so different from ours that even hard surfaces, is like, "Too much! I've never had this happen to me before, I've never bumped into a thing in my life. And I just can't handle it!"

Alie: Oh! I've heard that even on corners of tanks - it can just rip them up.

Rebecca: Ugh! Corners are *the worst*! Yes. They just don't know what to do in a corner. [*laughs*] You just watch them and they're just perpetually swimming in this corner. And you're like, "Do you not know this is, like, a thing that you can't get past?" But they don't because they've never had a corner!

Alie: Oh no! And that's why they have to be in bowls or in cylinders?

Rebecca: Exactly. You want a constant current, kind of keeping them in this pretend 'open ocean' environment, where they, sort of, feel like they can go in any direction, because if they get too close to the wall then the current will kind of sweep them back in the middle.

Alie: And then what about keeping polyps? Can you just do that easy peasy?

Rebecca: Oh polyps are so great! Yes, you can keep them in a little Tupperware, and you just feed them sea monkeys once a week, and they're very happy. I've moved all over the place and I'll just put my little polyps in the footwell of my car.

Alie: [*laughs*] You said you had 20 species. How many polyps do you think you have in your home right now?

Rebecca: Like, individual polyps?

Alie: Yeah, if you had to just wing it?

Rebecca: Maybe a thousand?

Alie: Oh my god!

Rebecca: I know, babies! And a cat. So I've got, like, a thousand polyps, and some plants, and a cat. And a fish tank. Yeah, it's a strange, new world we live in!

Alie: [*laughs*] Oh my god what a party! That's like a rave. That's a monster polyp rave right there!

Rebecca: For sure! And they're just like, "What is even happening right now?" They've got their own little room, so it's like the polyp room, and then there's the bedroom, and the living room, and the bathroom, but they get their own whole place.

Alie: I love that you're like, [*fancy voice*] "We have a jellyfish den down the hall." like *MTV Cribs*.

Rebecca: I know! I realized when I said it… There are only two rooms. It's not like I'm living in a mansion with 80 rooms. They got one room and, you know, the cat and me and the plants get everywhere else.

Alie: That's amazing, you have a Polyp Parlor, is what you have!

Rebecca: [*laughing loudly*] Polyp Parlor! From now until the end of time that is what it will be called. That room is forever the Polyp Parlor. I love it!

Alie: [*fancy voice*] Every modern home should have one. Now, this is going to be such a difficult question: what is your favorite thing about jellyfish? Do you even know?

Rebecca: [*sigh*] You know… I love that no matter how much I know about jellies, I'm almost always surprised by something new every time I go to the ocean. It's like, there's constantly something weird, or unusual, or bizarre that you're just like, "I didn't even think… What's it doing? How's it happening? Wha- Huh- Who- Uh?!" Right? I love that! And you know, not a lot of people have studied jellyfish, right? There are certain things that if you're like, "I really want to study this," it's like, "Well, okay you and 50,000 other people."

Like, "I really want to study fruit flies." Well, there is *a lot* of work done on fruit flies, which isn't to say that there's not new stuff to be done - there's always new stuff to be done - but you have to, like, really dig deep. Whereas with jellyfish, you just kind of look at it and you're like, "Huh… I don't what that is, do you know what that is?" "No I don't know what that is either, let's study it!" So, that's awesome. I also feel like jellyfish are very much my aspirational, like, state of being. I'm so neurotic and they're just so, so chill.

Alie: They are so soothing to look at! I wonder if they've ever done, like, human physiology test while looking at jellyfish, like if heart rate and respiration rate slows?

Rebecca: I will… I will volunteer! If someone is doing a study, let me know, I will sign up because I feel very, very calmed by jellyfish. And I think… I don't know, I feel like a lot of people seem to get, kind of like, a li'l zoned out.

Alie: I hope you know, this has been one of the most delightful interviews I have ever done! You are amazing!

Rebecca: This has been so much fun! Also, I have a friend who has been asking me for, like, a year. Like, "Have you reached out yet?"

Alie: [*gasps*]

Rebecca: "Have you talked to Alie? I think you should really go to *Ologies*," and I'm like, "I'm too scared!" Because I also listen to your podcast!

Alie: No! This has been so fun! You are just amazing. I'm a huge fan! This has been so awesome! Oh my gosh!

Rebecca: Yay!

So ask smart people silly, jelly questions because we're all just a bunch of talking heaps of meat. Nothing matters. Anyway, now that you are firmly, thoroughly obsessed with Dr. Rebecca Helm, please find more of her work at JellyBiologist.com. She is also on Twitter and Instagram @RebeccaRHelm. You gotta love a consistent handle across multiple platforms! Do follow her!

Also, thank you to Rebecca's friend, science illustrator Julie Johnson, for urging her to tweet at me about being on. Julie Johnson's science illustration website is LifeScienceStudios.com, FYI. The world owes you both a debt of gratitude. The world owes you both a debt of [*deep voice*] gelatitude.

We are @Ologies on Twitter and Instagram. I'm on both @AlieWard. You can find more links to sponsors and the places we donate to in the show notes for each episode at AlieWard.com. *Ologies* merch is also available at OlogiesMerch.com.

Thank you to Shannon Feltus and BIRTHDAY GIRL Boni Dutch for managing that. They are sisters who are hilarious, they host the comedy podcast *You Are That*, which you should definitely listen to; you will love them. Thank you to Erin Talbert who admins the wonderful Facebook group. Thank you to all the transcribers and professional word recorder, Emily White, for all the transcript work. I love you all. Thank you Caleb Patton for bleeping episodes. Transcripts and bleeped kid-safe episodes are at AlieWard.com/Ologies-Extras. There's a link to that in the show notes.

Thank you to Noel Dilworth for keeping my schedule on track, Kelly Dwyer who makes my website, and assistant editor Jarrett Sleeper who, upon further reflection, yes I would absolutely swim in Walden Pond in October if it were filled with thousands of your clones; even without a pool noodle. And to the peanut butter to our jellies, lead editor Steven Ray Morris, who also hosts the kitty-themed podcast [*"meow"*] *The Purrrcast* and the dino-themed, *See Jurassic Right,* for stitching these episodes together. Nick Thorburn did the music; he is in a band called Islands. A very good band. Also a special shout out to Sarie McCarthy, and her mom Beth. Beth, I hope you see Sarie in all the wonders of nature around us.

Now, if you sit through the whole episode, I tell you a secret. And this week, my wonderful Pop is in the hospital, and when he goes to the hospital he leaves his trusty gold Timex behind, and I have this secret pleasure of cleaning it for him because it's a very sweet item that he wears every day and I want to somehow care for him in that way. But also, because those metal wristbands gather kind of a lot of gunk and it's just fun as hell to sit there with a toothpick and scrape off in between the links, like in a, 'watching Instagram videos of steam cleaning carpets' kind of way, and just shine it up!

Thank you for all the well wishes *and* the congrats *and* the patience this past week. You're a bunch of sweeties! Okay next week; venom toxinology!

Okay, berbye.

Transcribed by:

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More links you may enjoy:

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Rebecca's big discovery: How to grow jellyfish in captivity!

Millions of jellyfish ascend to feed

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Species of jellyfish

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"Mystery Blooms on Walden Pond"

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Jellyfish: it's what's for dinner

Jellyfish: Rebecca gives 'em a try

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