Functional Morphology with Joy Reidenberg
Ologies Podcast
October 1st, 2018

Oh Heeeyyy, it's that second cousin who tries to talk to you about sports stats and can't read that you don't care, Alie Ward, here with another episode of Ologies. Whooo, what a week, my friends. What a week. I'm recording this after a few days of being glued to live streams of government hearings, and I'm just… I'm hoping everyone's taking care of themselves, maybe going out to take a breather, talkin' to a frog, letting yourself buy the fancy salad dressing at the store, because sometimes you just gotta unwind.

This episode, hopefully, will help. It's so amazing! I think you will find it equivalent to, like, a bag of jelly beans that you've selected out of the bulk bins where there's not a single bean in a flavor you don't enjoy. It's just pure delight! And some of the best, long-form storytelling I have ever heard. I just set up the mics, I forced a world-respected ologist to talk into them, and I interjected occasionally with some gasps. She's amazing.

Before we get to that feast, let's do some formalities. Let's tuck our napkins into our collar, if you will. Thank you to all the folks who have logged into Patreon.com/Ologies to donate a buck or more a month to support the show. That helps me pay a wonderful editor - Hi Steven - and lets me continue doing this, which, it's my favorite thing to do, so thank you for that. Thank you to everyone who gets merch at OlogiesMerch.com. There's some really great fall college sweatshirts, backpacks are up, bird-patterned mugs, just a whole mess of awesome.

Thank you also to the amazing producers at Litton Entertainment, who make not one but two of the science shows I work on. And this Saturday… I'm just gonna plug it. I'm gonna plug it right now. October 6th, my very own solo science show premiers on The CW. It's called, *Did I Mention Invention? with Alie Ward*. And I don't know how to celebrate other than just, like, squealing into a jar and then running atop a mountain to release it like Yosemite Sam.

If you're hearing this before noon on Tuesday, October 2nd, I'm doing a Reddit AMA at noon Pacific time. So, just putting those things out there to celebrate this new show.

All right, thank you to listeners who rate and subscribe. You guys keep Ologies in the front of new eyeballs, and earholes, growing this, kind of, curious cult of Ologites. And especially thank you to the ones who take a minute to review because I am nothing if not creepy, and you know I read them all, and then I present you with a still-moist one, such as this review from VSKStark, who says:

This podcast is amazing in so many ways…

And then they say some nice stuff about me that I'm too embarrassed to read aloud, and then also say:

The editing is genius, and the content, I would say, is juicy, spicy learning. It brings a smile to my day when I commute. I highly recommend it.

Juicy, spicy learning! I think we might need a sweatshirt that says, Juicy Spicy Learning. Am I right? We'll work on it.

Okay, on to the Ology. Functional Morphology. That's a lot of syllables. What in the Sam Hill does it mean? Well, it pretty much means the study of form and function. So, the anatomy of an organism, and then what the hell that anatomy does. So, like, why do we have eyelashes? What's up with the lil' head-stool things on top of a giraffe face? Why do some animals get to have so many stomachs? And butts, why?

So, I originally heard of this Ologist and I thought, Okay, Whale Scientist. Her bio on Twitter says Whale Scientist. She is the foremost expert on carving up sometimes-explosively-decomposing whales on beaches, worldwide. But I learned, thrillingly, that she deals with so much more than whales.

This is not the cetology or whale episode. We'll get to that in the future, a different ologist. This one, functional morphology, we cover way more than that. So, she's an anatomist who compares all kinds of species to each other to see what's similar and what's different between them, why they work, and how, and how – maybe - it can help us.

She's a professor at the Center for Anatomy and Functional Morphology and Department of Medical Education at Mount Sinai in Manhattan, New York. She has appeared on *Sex in the Wild* on PBS, the British Channel 4 show, *Inside Nature's Giants*, which also airs on PBS, where she dissected a hippo, a giraffe, a fin whale, a crocodile, a giant squid, polar bear, so much more. And she's on *Mythical Beasts*, which is an 8-episode series premiering October 14th on Science Channel. It's all about the fabled creatures like cyclops, and vampires, and sea monsters, and dragons, and where we got the idea for them. She's amazing.

I met up with her at Mount Sinai Hospital in Manhattan, and we went through this labyrinth of halls. We headed through a door labeled Functional Morphology, to her office, and then set up shop in the breakroom, next to a tray of muffins I wanted to eat. So, you won't hear the muffins because muffins are silent, and I did not eat them, but you might hear the occasional din of a coworker chatting as they passed, which is kind of like you're right there in the breakroom with us but without access to the muffins.

This human person can spin a yarn. I loved it. Please sit back and enjoy tales that are porch worthy, like whiskey around a campfire legend-grade stories, as you also pick up the hows and whys of deconstructing animals that have passed into the great beyond. You'll hear about whale hands, and pickled primates, and run-institution with danger, and tarps, and tools, and art, and fainting, and the winding road that lead this Ologist to her perfect job. Prepare to be enthralled and inspired by Functional Morphologist, Anatomist, Dr. Joy Reidenberg.

Dr. Joy Reidenberg: I know you're recording and I'm…

Alie Ward: No worries. I do so much editing, so… You can pretty much confess to murder and I'll cut it out.

Now, in functional morphology, would you say that you're a functional morphologist, or would you say that you're a cetologist who studies whales?

Joy: I actually would call myself a comparative anatomist. So, I wouldn't use either word. That doesn't have the ology in the word… But, I do study anatomy of lots of different

animals, and whales are just one of my favorite animals to look at because they're so weird.

Alie: They are crazy weird. Let's go back. Tell me when you got so interested in animal anatomy, and are you also interested in human anatomy? Like, when did the bug of cuttin' stuff up and lookin' at stuff getcha?

Joy: So, that's a multi-pronged question so I'll have to give you a multi-pronged answer now.

Alie: Bring it ooon!

Joy: All right. First of all, I am interested in human anatomy or I wouldn't be in a medical center. It's definitely one of our most interesting animals we can look at in the world, are humans, because humans are so incredibly adapted for things that other animals can't do, starting with what we're doing right now, language, speech.

Aside: Heeeyy!

Joy: You know, the ability to produce those speech sounds is uniquely human. You get lot of animals that get close but they're not the same, they can't make the full range of vowels that we can make, so our anatomy in the area of the throat is really, spectacularly different from all other animals. And we can get into that if you want, but they are an interesting animal into themselves.

And the of course there's a whole range of other animals. So, how did I get into it? Well… How long is this interview? [Laughs]

Alie: [Laughing] Give me the CliffsNotes.

Joy: I'd have to say it really, probably, started before I knew that anatomy was a discipline. I had no idea that you could cut up things, look inside, and call that a career. That seemed to be the kind of thing that was relegated to horror films, you know?

So, it wasn't really thought of as a career for me, and probably that started with, when I was I kid I loved getting close to animals. I really wanted to learn as much as I could about nature. The problem was that animals ran away from you [*cartoon running and dashing sounds*] [laughing] so you really couldn't look at them up close unless they were your pets. Now, of course I'm not going to cut open a pet, I love pets! They have to have their place as a pet, and be alive, and be with you, so you can cuddle them and all that fun stuff.

But the animals in nature, they were also alive, and fun, and cuddly, but they wouldn't stay with you unless you tried to cuddle them, and they'd bite you, so that wasn't a great interaction. But every once in a while you'd have a chance to get really close to one if it was dead because it wasn't going to run away. So, one of the biggest arguments I used to have with my parents was whether or not I was allowed to touch the roadkill [laughing].

Alie: [Laughs]

Aside: I love this woman.

Joy: So, there I would be, you know, fascinated with whatever it is that fell on the ground, you know, dropped out of a tree, or got run over by a car, whatever I could find that was,

in some capacity, left where I could find it. I wanted to see it. I wanted to learn more about it.

Alie: Did you carry gloves with you as a kid?

Joy: Oh, I didn't know what glove were, are you kidding? My cat would come home with a chipmunk and I would take the dead chipmunk that it left on the front doorstep and I would hide it from my parents so they wouldn't know I was looking at it. And I took the skin off the chipmunk, and I saved it. I didn't know how to tan skin. I was like, I want to be like a Native American, I want to learn all about it. Back then there wasn't the internet to look it up and figure it out, so I'd, like, get books out and things like that.

I tried tanning the skin of this chipmunk and thought, this'll be awesome! It's got racing stripes on it, you know? It's really cool looking.

Alie: Yeah. It's already dead.

Joy: Yeah, I can't hurt it, it's already dead, right? And I had done a really great job, and I was, like, so excited because I was going to use this chipmunk as a saddle blanket for one of my toy horses.

Alie: That's pretty legit. Yeah.

Joy: I thought this was really legit. I hid it in a specific place, a wooden box in our yard, and I came out later to check on it a couple days later, and a racoon had taken it. I only know that because I saw the footprints, so I was like, oh man, so frustrated.

Aside: Side note – I just learned that racoons are incredibly smart. They remember tasks years after learning them, which is more than I can say for myself. And also, their name in Spanish is derived from an Aztec phrase meaning "the one who takes everything in its hands." So, next time you're making a tiny saddle out of a fresh, dead chipmunk, watch out for them because they are lurking in the trees at dusk waiting for your back to be turned. Don't freak out, though.

Also, if you wish there was a holiday to celebrate racoons internationally, well, boy howdy. Good news and bad news. You just missed it. It was October 1st. So now you have a whole year to make felted bandit masks, and learn how to scratch up palm trees using only your overgrown toenails. Okay, anyway, Joy's childhood…

Joy: So that's how my ventures would often go, but then I discovered fishing. I really liked fishing. I thought fish were really amazing-looking animals. They're so hydrodynamically shaped, and then they have all these interesting colors. Mammals are pretty boring when it comes to colors. Birds and fish, they've got it.

Alie: Yeah, they do have it going on. And they've got crazy mouths, and some of them have big lips. Some of them have, like, no lips.

Joy: Yeah, and the giant eyes that never close.

Alie: Yes!

Joy: And these fins that come out of nowhere that… They just open up like a Chinese fan. I loved that. I just really, really loved that. So, I would go fishing, and my dad would agree

to take me fishing because it was on the way to taking my brother to race go-karts, because it was at the same place, at the beach. I would hang out on the dock fishing while they would race go-karts, and I'd come home with all these stinky, smelly things. And he would tolerate it as long as I filleted all the fish. Later he would even take me out… We got a small boat, and we'd go out in the boat, and he would get madly seasick because he would sit there and read the newspaper the whole time, which is not what you do on a rocking boat.

Alie: No.

Joy: But again, he would tolerate all this as long as I would deal with all the fish. So, I was happy to do that because, you know, we were going to cook them, we weren't going to waste them. But I got very distracted filleting fish. I'd open up the fish and then I would be, "Wow, look at these feathery red things! What are these things?!"

Of course, they were gills but I didn't know what they were. And then the intestines, like, "Wow this spaghetti just keeps on going!" And the muscles were, like, in Ws. I thought that was the weirdest thing, how the muscle zigzag back and forth. And I'd sit there forever playing with this skeleton after I'd filet the meat off, like, Wow. And my mother would be screaming from the kitchen, "Get on with it, we want to eat!"

And that was my introduction to anatomy, but I didn't know that was a career at all. Sorry it's not the CliffsNotes version.

Alie: No, I love it. Are you kidding? Bring it on.

Joy: So, fast forward, I want to go to college but I don't really know what I want to do. And my dad and mom are trying to advise me, and my dad in particular said, you should really know what career you want so you can pick a college that's really tailored to what you want to do for your career. That was pretty sage advice coming from parents who hadn't gone to college. Again, it wasn't a thing where you could look up on the internet and find all this, so you had to wait for the brochures to come in the mail, and read them, and then write away for more material, or actually go and visit the places, which was really hard to do. Some of them were pretty far away. We didn't have the resources to go fly over to different places.

I remember reading about a lot of them and still being very confused, not knowing what I wanted to do, because what kid in the 11th or 12th grade knows exactly what they want to do? Some people may have a good idea. They want to be a firefighter, or police officer, or ballerina. I just wanted to play with animals. My dad would say, no one's going to pay you to play with the animals.

Alie: Cut to now and you're like, what's up!

Joy: So I kept thinking, maybe… I'm a smart kid too. I'm doing really well in school, I'm in the top 5% of my class, and I'm thinking, what am I going to do with all this information, right? I wanted to be a dog walker, but I had to do something more.

Alie: Besides, you can't see inside the dogs.

Joy: That's true. But remember, I didn't know seeing inside was the ultimate goal. It was just a way to get close to the animals, to understand more about them. I was just as

fascinated with the outside and behaviors too, it's just they didn't do that when they were dead, so… [laughs]. I could only do what I could do when I get that close. The rest of the time I'd spend glued to the window watching birds at the birdfeeder or wherever. I was always watching the animals, and catching snakes, and bringing them home, and catching polliwogs from the pond, and putting it in a tank and raising frogs out of that. I loved all of that nature stuff.

My mother thought it was crazy. I'd come home with a snake on each arm, "Can I keep them?"

"As long as it fits in the tank you can keep whatever you want." So, I had tanks all over the garage.

Alie: That's so dope. We would've been such good friends, are you kidding me? We once put a dead snake with a Ken head on it in the freezer to surprise my grandma. It did not go over well, but we loved it. Yeah, I get it.

Joy: Now it's starting to sound a little bit like that kid next door in *Toy Story* [laughing].

[*Clip from Toy Story, Woody saying, "Oh no! Sid! You guys don't get it, do you? Once we go into Sid's house, we won't be coming out!"*]

Alie: We didn't like my grandma very much, but we loved dead snakes.

Aside: My grandma was not a nice person. Anyway, back to her backstory, which I love.

Joy: So here I am talking to my dad about this, and he says, well, you really need to figure out your career. And he hands me the yellow pages of the phonebook. Back then it was actually a book and not a thing online. We had, up until then, used it as a highchair for me to sit on so I could reach the table. It wasn't really something we looked in very often. But that's where you'd find things like plumbers, and electricians, pizza joints, whatever. And so, I'm flipping through these yellow pages because, to him, every career was in the yellow pages.

Alie: That was a good resource back then!

Joy: It was. Because again, the internet, we couldn't look things up. This was the one place where everything was accumulated, as far as my dad knew, that was a career.

Alie: Or the classifieds, which is… I would look in the classifieds.

Joy: Which is even more boring, right?

Aside: Quick question, when was the internet invented? I didn't know so I did look it up. Now, in 1983, by a Connecticut chap named Vint Cerf. That sounds like what happens when you're playing a really shitty hand of Scrabble and someone bursts in and says, "hey, what should I name this king?"

Anyway, he is one of the main inventors of the infrastructure of the internet, but it wasn't until 1990 when Sir Timothy Berners-Lee (his friends call him Tim BL, no joke) invented the World Wide Web, and decided to just give it away for free, thus missing out of literally trillions of dollars of moneys. Like, he could've owned Earth, but he was like,

hey man, I just want people to pass around photos of moths who are randy for lamps during a time when justice seems out of reach. Thanks, Tim BL.

Anyway, Joy was leafing through physical paper and yellow pages, browsing for her future.

Joy: And I'm looking through, and what am I not seeing? I'm not seeing anatomist, I'm not seeing comparative anatomist, not seeing biologist, not seeing scientist, researcher, professor… I did see Doctor but only medical doctors, right? I did think eventually I was going to get to Z and I would be happy because I'd get to zoo. Maybe I'd be a zookeeper, right? So, I got a lot of pages to flip through.

I got pretty far along. When I got to veterinarian I thought, oh, okay, maybe that's a career for me because it's animals, and they don't have to be dead animals. I did have this thing about… Stuff didn't need to be dead for me to be interested in it, although I did collect a lot of things, you know. Shells, feathers, bones, rocks, whatever I could collect, nature stuff.

Alie: Teeth, nails. Sure!

Joy: Exactly. Everything. So I thought, veterinarian. I went to go intern for a vet, and my first day on the job there was a dog that had been by a car and they were going to do an operation. And he invited me to scrub in on this operation, and showed me how to scrub in, I was basically just observing. And I was really excited because I was going to get to see this dog fixed. I don't mean neutered, I mean fixed up.

The dog was… definitely had a terrible injury, and I thought, wow, I'm going to get to see the inside on this animal. That's pretty cool because it's a living inside. It's not like the dead stuff that I'd seen before. I was so fascinated. I was riveted. I was watching this, you know, wide-eyed and totally full of wonder. And I started to get lightheaded. I was like, what is happening?! I'm really interested in this, I'm not nauseous, I'm not squeamish, what is going on?! And I started getting more and more lightheaded. I was so embarrassed, but I didn't want to fall into the sterile surgical field, so I told the veterinarian I was getting a little light-headed. I thought, maybe the room is too warm, or maybe I didn't eat enough breakfast or something.

What I was having was called a vasovagal reaction, which is something absolutely can't control. It's essentially an autonomic discharge of your nervous system that no one can predict is going to happen, and no one really knows why it happens, and then it goes away almost as fast as it comes on.

Aside: I was so curious. Why does this happen? It happens, technically, when the vagus nerve is stimulated, and it causes this sudden drop in heart rate, and also maybe the dilation of blood vessels in your legs, which causes blood to pool there, away from your brain, causing you to pass out. It can happen from standing too long, or from heat exposure, stress, oooorrr the sight of blood. I like to think that watching a veterinary operation inspired this Pitbull-Ke$ha duet [*Song clip: It's going down, I'm yelling timber!]*

Joy: But whatever, it's pretty incapacitating. So, that was happening to me and I thought, I'm never going to be able to be a veterinarian if I pass out when I'm trying to do an operation! So, the veterinarian sent me out of the room, which I was very embarrassed

about, and later came to talk to me and said, you know, don't let this go to your head, don't let this deter you because it might just be a one-time thing. And he explained what it was, what I was going through, and I'm glad he gave me that second chance and asked me to come back because I didn't ever have that again.

Alie: Really?!

Aside: Oh man! This is, like, the blissful happy ending to a kid's movie. This is just the story America needed.

Joy: I never had it again. It was only once. And I still don't know exactly why it happened, but I think it has something to do with my brain trying to process the idea that this dog was not feeling pain because it was anesthetized, but clearly had enough injuries to feel a lot of pain. And I kept thinking, that's got to be painful, but no it's not feeling it, but it's got to be painful, but it's not feeling it… And that conflict kept going around and around in my head. Maybe that had something to do with why I couldn't process what was happening. But maybe I was just hyper-excited about it all because I got to see everything.

Alie: Yeah, that's like a big day. That's, like, a lead up of so many animal bones, and skeletons, and you've already done field work, pretty much, you know? Like, amateur field work. That's a big day!

Joy: It was a very big experience, and here I was going to get to see, it was going to be controlled in a setting where it was alive. There was just so much happening. But I thought, maybe I couldn't be a veterinarian, but he convinced me otherwise that I could. So, I applied to Cornell University because they had a vet school. I wasn't applying to vet school, I just wanted the undergraduate part first, which is the stepping stone you need to go to vet school. So, I got accepted to Cornell. I was very happy about that.

Alie: Yeah, that's a big deal.

Joy: It was a big deal, especially for my family where I was the first one to go to college.

Alie: Yeah, you're like, "Ivy League, helloooo!"

Aside: But Joy says, since it costs the same tuition, she enrolled in the Arts and Sciences Department because, frankly, she didn't know if she wanted to stay with science.

Joy: Because I'm also an artist.

Alie: Oh, you are?

Joy: There's another part of me that I haven't talked about, which is that I am an artist. And I didn't really know which career I wanted, because if I wasn't going to be a veterinarian I was definitely going to go into art. Not only an artist, but also a musician, so I'm definitely heavy on that side of the brain as well.

Alie: It sounds like both sides of your brain are very good.

Joy: That's why I can walk straight and not fall over, right? [Laughing]

Aside: Heads up. That was an anatomy joke [*drums, ba-dum-tshh!]* Thank you, Joy.

Joy: I majored in a science field but I minored in an art field, so I was kind of pursuing both in this college. As I got closer to graduation I was trying to think, what kind of a job do I really want? Do I really want to go to vet school? I thought that's what I was set on.

Aside: Joy was on track to be a vet. She took four years of classes to prepare her for it, but she started interviewing vets to ask about their lives and found, Nope! Nope. It was not what she wanted to do. Apparently it involved a lot of spay and neuter surgeries and euthanasia. But more complex medical procedures are usually declined by pet owners just because of cost. So, this bummed her out. She thought, maybe a wild animal vet? Nah, there's not a lot of job openings in that field, so she kept brainstorming.

Joy: Then I thought, what about farm vet work? And they said, well, most of that is vaccinating herds of cattle. I was, like, totally not into that. [Laughing] All right, so then there's this program called aqua vet. I thought, oh, that's where I belong, because I really love marine biology. I still never left that fascination on fish.

Alie: Right, of course.

Joy: I had actually, in the interim, worked for the National Fishery Service, I had worked for the National Oceanic Society, I'd spent a summer working at the Bermuda Biological Station for Research. I had done a lot of marine-oriented things, so I was very interested in that. I wanted to be an aqua vet. Now, this would be the veterinarian for all the aquariums or oceanariums, and you would take care of their fish, their dolphins… I was like, dolphins, totally, yeah, I want to do that. But there was one aqua vet.

Alie: One?

Joy: One, for the whole northeast coast.

Alie: What?!

Joy: That was it. There was one.

Alie: That's ridiculous! Even Pepsi has Coke! I mean, come one. You've gotta have a little competition.

Joy: So I thought, I'm going to have to wait for this guy to retire before I'm going to have a career, and he was still young at the time, so I was like, that's probably not going to happen in my lifetime.

Aside: She started exploring the art side and thought, maybe medical illustrator? So, she talked to a medical illustrator, who warned her that it was frustrating, as an artist, because you're for hire, you have to follow exactly what the client wants. Mega bummer for her. And, she didn't want to end up at, say, an ad agency drawing nature for wine labels or car ads. It wasn't her bag. Too removed from science. So, what was she to do?

Joy: But I still liked working with the anatomy. I'd started really loving my anatomy courses. I'd taken a comparative anatomy course, and then an advanced one at the vet school, so I thought, let me ask the instructor of that course about his job. And I thought he was a veterinarian, but it turned out he wasn't. I was totally surprised by that. How could the Chairman of Anatomy at the veterinary college not be a veterinarian?

Alie: Right? He's like, surpriiise! Nope.

Joy: Surprise, I'm a PhD! Now, I was really confused. I did not grow up in an academic family, so I really didn't understand what a PhD was. To me it was a Doctor of Philosophy, so that means you have to philosophize. So, why is somebody in science philosophizing? It didn't make any sense to me, so I really didn't get… in the science world, it didn't seem to make a lot sense unless you were just going to talk about the science. So like, my biology professor, okay, I get it. I didn't understand that until I spoke to him and realized that, yeah, there are opportunities in exactly what I love, which is anatomy. I didn't know that you could do more. I figured, it's all known. It's all there, right?

Alie: Oh god, no! And then you realize, they're still crackin' things open and being like, what does this little fahdoingydoing do??

Joy: There you go. So, he said, you really belong in a research career. But I didn't understand what that was. He said, well, why don't you do a summer work-study with me – because I had to do work-study to pay for college anyway.

So he had me working on this big jar of toadfish. I like fish, but these are ugly fish. But I thought they were interesting because they, kind of, look like a frog that didn't quite become a fish, you know? Or a fish that didn't quite become a frog.

Alie: [Laughing] It have up halfway.

Joy: They just have these giant, baby froggy eyes, and giant baby froggy mouths, and skin tags hanging off of then that make them look like seaweed. They were ugly-looking things.

Aside: Okay, I just looked these creatures up and they are gloriously unsightly. They have a wide, warty-looking face and a massive downturned mouth with the expression of, like, if Jabba the Hutt lost a lot of money playing the slots. Also, they are hooorny. A few years ago Monterrey residents were just puzzled by this low thrumming sound in the summer. It sounded kind of like someone farting into a vinyl diner booth [*sound of toadfish call, low thrumming farty sound*]. But to the toadfish that translates to just a sonnet of lust, and I applaud them. Anyway, Joy dug 'em too.

Joy: They had their own appeal to me. They had these beautiful pectoral fins that they'd splay open that looked like they had rainbows on them, and they were just gorgeous. Really pretty. These fish were fascinating and I spent forever drawing these fish. And he said, I want you to cut them open and draw what you see on the inside.

Alie: Heeey!

Joy: Oh, I was in pig heaven! I loved it. I was cutting open these fish, and I was making these drawings, and he was going to use them in a dissection manual. I thought, wow, it's like, even useful. I'm not just having fun.

So, I did that all summer long, and then I asked him, you know, is there, like, a career doing stuff like this? And he said, yeah, you could be an anatomist.

[*Angels singing Hallelujah! Hallelujah!*]

He said, that's what I am. I said, "That's what you are?? I thought you were a veterinarian this whole time." No, he's an anatomist. And then I discovered research, and that's when I really got into anatomy as a career because, he said, you should go to graduate school, you should become a researcher because as a research scientist you have the ultimate in creative freedom – which is what every artist really wants. And you can focus in on the animal stuff, which is what you really like. But the best part about being a researcher is that you have the ultimate creativity in that you can ask any question in the world, any question, and you get to design the experiment to answer it.

Aside: So this is what a functional morphologist/anatomist does. Joy had finally found her joy, and she was getting paid to poke at roadkill for the good of humanity [*heavenly music*].

Joy: And I have that now. I have that creative freedom. I can study anything. Anything! Any animal! Any part of any animal! [*squishy splat*] Anything that's interesting to me about that, I can delve into that and just get really down into the nitty gritty and figure out, how does it work, why does it work, what's useful about knowing how it works? That's when I'd said, I'm in, this is the career for me. That's when I realized that I was going to be an anatomist. Before that it was just, science?... veterinarian… animal… But anatomist really came in my senior year. That's when I realized that.

Alie: And what does it involve? Like, we're at a medical center, but as an anatomist, do people say, "hey, I need to figure out what is going on with this antelope, or this whale, or this person. Let's ask Joy, what's happening here?"

Joy: That does happen but not so much at a medical center for humans, of course, because I'm not in an area where people are saying, "how does this antelope work?" [laughing] That might happen more at a veterinary college, I think. And maybe that is a better fit for what I know, but in a medical center I feel like I've added another layer of importance to my work because I can take information from the animal world and bring it to people. That's essentially what I do.

Our lab, I joyfully call it the Animal Recycling Center, because we get everybody's leftovers. We don't have to go out and kill animals to get them. They're already dead, people give it to us. If something dies at a wildlife center, we get it. If it dies in the road, we can get it. If it dies on the beach, we get it. If it dies in a lab, someone's using it for an experiment, we can also get that too. We get all kinds of leftovers from wherever.

The more exotic, the more interesting the animal is to me, because exotic animals are adapted to unique environments, and these really weird environments, some of them mimic human diseases. If we can understand how these animals can survive in conditions that, for us, are harmful, we can copy that adaptation and we can bring it back to people as a treatment for their disease.

Alie: Like what kind of diseases?

Joy: For example, emphysema is something I'm now getting very interested in. We now call it chronic obstructive pulmonary disease, or COPD.

Aside: And COPD can also mean chronic bronchitis, sometimes asthma. Either way, if you enjoy breathing, it's not something you want. My uncle Ron has it, so of course I was all auricles (that's how anatomists say ears, are you impressed? I looked it up).

Joy: This is a disease that takes away the stretchability of the lungs. The lungs become too floppy. It's hard to get air back out of them. The elastic tissue is totally shot from exposure to whatever, smoking or whatever else. People who have that problem, they have trouble breathing out, as opposed to breathing in. They can breathe in but they can't get it back out again, because the way you exhale is your lungs recoil because they're stretchy. They're elastic like rubber bands. So, the only time you actually force your lungs is when you blow out birthday candles or blow up a balloon. The rest of the time you breathe out passively. Not so for someone with COPD. They can't breathe out passively.

Alie: I didn't know that.

Joy: Now, there are animals whose lungs have various abilities to change their compliance, which is their stretchability. We don't. We have fixed stretchability and if you lose it with a disease like this you can't get it back. There are animals that can change their flexibility, particularly diving animals like whales.

Alie: Ooh, that makes sense.

Joy: As they encounter different pressures they need different amounts of stretchability in their lung tissue, and their lungs have to respond to recoiling because of the high pressures around them without tearing, or distorting, and so on. There's a lot of interesting biology going on when you deal with pressure changes on the lungs or any gas-containing space.

But if we can understand how these animals' tissues respond to the pressure changes and they can change their compliance as they dive, maybe that ability to change the compliance is what we need to take from that adaptation and bring that into someone with emphysema.

Aside: So an anatomist, or functional morphologist, looks at structures and says, "That's tight. How can humans do that too?" Like, the animal kingdom's an influencer and we're like, "I love your shorts," and then we figure out how to DIY them with biotech. Joy cites another example, gastroesophageal reflux, which is also a Grade A bummer for those afflicted.

Joy: People who are burping, and regurgitating their food, and the acid is getting up in their throat, and it's irritating their larynx. It can even get down into the lungs and cause asthma, get into the back of the mouth and erode the back of teeth. Your molars can be eroded away from the acid. All kinds of bad things happen if you can't control that acid reflux. But there are animals that regurgitate all the time and don't have these problems.

Alie: Like ruminants?

Joy: Yes! Ruminants do it. Now, maybe they already got rid of the acid component because they're dealing with a multi-chambered stomach and the acid digestion is in another

part of the stomach. Okay, so they've deacidified what it is they're going to be brining up, but they also don't insult their larynx.

Aside: [*Old-timey snobbery voice*] Colonel Larynx, you're nothing but a nonsense-spewing throat accordion.

[*shocked*] Ah! [*angry cartoon, HOW DARE YOU!*]

Joy: Every time the food comes up it doesn't go down the voice box, down the wrong pipe, and end up in their lungs, and have the gagging, and coughing, and a sore throat kind of voice. But they divert it around that opening and they don't choke on it. How do they do that? They, essentially, have a splash guard in the back of their throat.

Alie: They have a splash guard?!

Joy: Yes! We don't have that, so if we regurgitate it goes right into the opening of the larynx and causes all kinds of problems.

Alie: I just love the idea of you looking starry-eyed at a cow, being like, [*girlfriends chatting voices*] "How do you not get acid down your thoooaaat? How do you do it! Tell me your secrets!" The cow's like, "Well, I've got a splash guard." So exciting.

Joy: These are the secrets that we try to find when we look at animals that are diverse. They don't even have to be all that exotic. Cattle are not that exotic, but if you're looking at something that different from a human, it's got something that makes it different. We want to know what that thing is, and is there something useful about that?

Sometimes, if you look at very weird animals, the weirder they are, the better, because the more likely they have some unusual adaptation that hasn't really been fully explored. And being at a medical center, I'm prepared by understanding the, you know, whole human condition and the various diseases that can happen or the various injuries that can happen. So, having that awareness – and most of that's through my medical colleagues teaching me about it – makes me better prepared, so that when I see an animal with a weird adaptation, I already know what that application's going to be.

Alie: Oh, that's smart.

Joy: So, I'm prepared to find the fun things in these animals that I then think can be developed into a protective, or a treatment device, for people.

Alie: In your knowledge you have a range of problems, so it's kind of like a puzzle piece. Like when you see the negative of that you can go, ah!, I know there that could fit.

Joy: I'll know it when I see it. It's one of those things.

Alie: Right. Just like pornography and obscenity. I'll know it when I see it, as they say.

Now, how many different animals are you dissecting and studying, like, on the daily or the weekly? Are you like, I'm on a real whale-kick, or is it like, you might get a racoon in later today?

Joy: Later today I'm expecting an aye-aye.

Alie: What in the hell is that?! What is an aye-aye?

Joy: It's a lemur from Madagascar.

Alie: Are you serious? Where is it coming from? From Madagascar?

Joy: It's actually from… This particular one is on loan from Cornell University, from a colleague of mine, who is the very same guy who gave me the toadfish to dissect, Dr. Howie Evans. He's in his 90s. He's loaned me this aye-aye to look at. We've just finished getting it MRI scanned, so it's supposed to come back up here later today after the scanning.

This aye-aye is a really, really rare lemur, and it was actually collected in 1875. It was, at the time, packaged in rum because they didn't have preserving fluids like we have today. That's how old and precious this particular specimen is.

Alie: Damn! And so it's pickled? Pickled in booze?

Joy: It's pickled. Pickled in booze. Now it's in alcohol, normal preserving alcohols as opposed to, you know, some rum that was on the ship.

Alie: Like, Bacardi, like Spring Break that lemur so hard. You're like, "we put him in a piña colada but he's holding up fine."

Joy: Yeah [laughing].

Alie: So you're going to look at an aye-aye later today, or later this week?

Joy: Well, we're going to look at the scans from it because we can't open it. We have to return it home, but we are going to look at the scans from this aye-aye.

Alie: Is there a particular problem that you're looking for, to solve with that? Like, does it have a crazy cranium structure?

Joy: No, I actually don't even know what we're going to find yet. When you look at a really exotic animal, to me, it's like getting a present.

Aside: I love her. How much do you love her? [*country music song clip: I love you this much.*]

Joy: I can't wait to open the wrapper and see what's inside the present. I don't know what I'm going to find, but I'm going to find something because otherwise it would look like everything else. If it doesn't look like everything else, that's what I want to know. I want to know why it doesn't look like everything else, and what can we learn from that? And maybe there's something in there that we can use for people.

Alie: How did you get… I've seen these videos of you scaling whales. I mean, the most badass you've ever seen. There's a whale on a beach. There are, like, a hundred spectators, and there's you in full yellow slickers with, like, a machete, scaling it like a tiny mountain, and just cutting it open, and blubber's everywhere…

Aside: I would like to play you a clip from *Inside Nature's Giants*, wherein Dr. Reidenberg has arrived on a beach on the predawn dead of night to lead a whale dissection. And as she carves into the abdomen with something that appears to be a chef's knife:

Dr. Reidenberg – It's really, really fresh. I don't smell anything. It's like walking down the butcher's aisle in the supermarket. All the meat's really fresh here. This animal, I think, is only around 24 hours dead – [loud, extended rumbling sound].

Uh, someone got a wipe? Give my face a wipe down around my lips. It's fine. The most dangerous thing is if you get it in your eyes or in your mouth. I know enough to keep my mouth shut but… [laughing].

I probably poked one of the intestines, and that was just all the gas in the intestines, just, pshhh, spraying me in the face.

Male Voice: How far—oh, that was probably better in than out, to be fair.

Dr. Reidenberg – [laughing]

The whale intestine has released a death fart into her face, and not only does she remain composed and professional, but jovial! How does she do it, and can she run for president?

Alie: You're like, oh my god. This is an art form. How do you get good at that, because it's amazing. [*sped up high pitched rapid questioning*] What does it smell like, how do you know where you're cutting, what do you do with the pieces, what happens???

Aside: Side note – That was a lot of questions.

Joy: Wow, that's a lot of questions [laughing].

Alie: I know. I'm sooorry. We'll start with the first.

Joy: I don't remember which was the first.

Alie: Howdoyouget… howdoyou… howdidyou…

What was the first time you dissected a whale on a beach? I imagine you gotta do it on site.

Joy: Ha, yes. The first time I dissected a whale, it wasn't a very big whale. It was actually a fairly small whale.

Aside: Buckle up folks! Hooo! This woman tells good stories.

Joy: It was a pygmy sperm whale, and it was about, I don't know, 15 feet long. It was on a beach, but not when I saw it. It was my very, very first whale dissection. I was a very excited graduate student at the time. I didn't have a car. So, I got the call, and I thought, if I don't go down there right away and get this specimen I'm never going to get another one because when are they going to call me again if I don't show up, right? They said, you've got to be here by nine o'clock because the Smithsonian is coming to take it away. So if you want to just get a piece out of this - they just want the skeleton - you can come get your soft tissues that you need for your research.

Alie: Whoa.

Joy: At the time I was very interested in how whales were making sound underwater, so I needed to get the voice box. So I rented a car. Car rental places in New York don't open 'til 8. And Brigantine, which is where this was, near Atlantic City, is about 2 ½, maybe 3

hours away. So, I was doing 'a very swift 55' out of New York [laughing], and I got pulled over by a police officer on the Garden State Parkway. I remember so vividly, I didn't know you're supposed to stay in the car. I got out of the car, because I thought I would, like, expedite this and get this over with. So, he was a little surprised I was already waiting for him on the shoulder.

Alie: You're like, I gotta sperm whale to cut up. I gotta move here!

Joy: Gotta move! So, he asked me, why are you going so fast? They always ask that question because maybe you're going to have a baby or something. I don't know, right?

Alie: Right. Like, where's the fire?

Joy: I wasn't going to have a baby, so I told him I was on my way to a stranded whale, which I'm sure is an excuse he'd never heard before.

Aside: [*corny, nerdy voice*] Uh, officer, I'm about to give birth, uh, to a baby whale that's, uh, also on fire… There's… there's a fire, too, uh, in me. Please let me go.

Joy: And I thought I was being all official. I put on my white coat, I had my ID tag, Graduate Student in Anatomy. I was ready for this, right? And then he looked in the back of my car. And I had put everything I thought I was going to need in the back of the car, because this was my first whale stranding. So, I had gloves, and I had plastic bags, you know, big, black trash bags. And I had scalpels, and knives, and bigger knives, and BIGGER knives, and I had machetes. And then I had all these things that, like, gardeners use because I thought I might need to clip ribs, so I loppers, and pruners, and big wood saws. I had all kinds of things back there.

Alie: In a rental car…

Joy: In a rental car. But the thing was, he was looking at this, and all of a sudden his face turned white. Now, he was white to begin with but he got whiter. He's looking at this stuff, and now I know why cops wear sunglasses, so you can't read what's going on with their eyes, right? He's looking at this, and he gets really quiet, and he says to me, "What's all that for?"

And I realized why he had turned white. I had heard on the radio the day before that the police had found a body that had been chopped into pieces in black plastic bags, floating down the Passaic River.

Alie: Noooo….

Joy: And I think he suddenly realized that I might be the murderer, because I had all the know-how, and I had all the equipment, and there it was in the car, and I was running away as fast as I could!

Alie: Oh my God, you fit the profile a million percent!

Joy: I know, and I was terrified that I was going to be taken in for murder! [Laughing]. So, I got really nervous, and that's not a good sign either because now you get nervous in front of a cop and they think for sure you're guilty, right?

Alie: Yeah. God, I hope you didn't get lightheaded.

Joy: I didn't have a vasovagal reaction. I didn't pass out, because that would've been really bad. So, I said to him, "well, that's if I don't get there in time." I didn't tell him that the whale was already dead. I just said it was a stranded whale. So, in his mind there's this flopping around whale on the beach, and if I don't get there before it dies I'm going to have to cut it up.

So, he went back to his car, and I thought for sure he's trying to figure out if I'm the murderer, right? We didn't have cell phones either so I couldn't call them and tell them what was happening this whole time. He radioed back to headquarters, I'm sure, to say what kind of crazy person he had found. And they gave him permission to escort me. I never got a ticket! He escorted me. He said, I'm going to escort you to the whale stranding. He must've called ahead to the cop at the whale stranding down in Brigantine who said, yeah yeah, we got a whale on the beach here.

Aside: Can you *even* with this story right now?

Joy: So, the cop down there held up the Smithsonian so they wouldn't leave, because it was well past 9 by the time I arrived, right? And I'm following him, and he says, "you have to pay all the tolls." Like, okay. We didn't have E-ZPass back then. You had to actually pay each hopper, you know, coins.

Alie: Did you have to pay the cop's tolls too?

Joy: No. He went right through them, but I had to pay each toll. He would go through and he would wait, and I'd have to pay, and then we'd go on. Sirens and everything, we were going really fast. And I arrived to my very first whale stranding with a police escort! With sirens, and lights, and everything! I made a big deal entry. It was very memorable on many accounts.

Alie: That is *the way* to arrive, dude. That's amazing. Did he stay to watch?

Joy: He did not. Once I climbed on top of the whale, he was done. He was like, okay I'm outta here, she's going to make blood and use those things in the back of the car that made him turn white.

Alie: OMG, what pressure, though!

Aside: I feel like in all of the fisherman's saloons in all of the seaside town, all over the globe, of all time, that's gotta be one of the best whale stories ever, right?

Alie: How do you… So, it's a 15-foot whale. How do you know to scale it, and where to start zipping into it?

Joy: Well, most vertebrates are built on the same body plan. So, whether it's a 15-foot whale, or it's a 65-foot whale like the one that maybe people have seen on TV where I'm dissecting for *Inside Nature's Giants*, the whale has a similar body plan to you and I. It's got a head, right? It's got a spine, a heart, two lungs, one liver, intestines, two kidneys. It's got all the same things we have as mammals. The only this it doesn't have is hind legs, but there are remnants of that too.

So, if you're looking for a particular organ, it's going to be in a predictable place because the body plan is pretty similar. So, I know I'm looking for a voice box. I know the voice

box is going to be in the neck. Whales don't have much of a neck, they kind of go from head to body.

Alie: They're kind of like dudes at the gym that are there a little too much.

Joy: Exactly. Very built up, right? And particularly considering those muscles are being used for movement, they are built up. So, the whale's neck doesn't really exist as a neck like it does in us, but that's where I'm going to find a voice box, and that's what I was looking for. So it meant go to the back of the jaw and cut it open! It's going to be somewhere near the back of the jaw and the front of the chest, which is a very small area in the whale. So, you know you have one little area to look in and that's where it's going to be.

Alie: What does a voice box look like in a whale?

Joy: Well, it's huge. It's really huge. Imagine if your voice box was as big as a whale's in proportion to your body, okay? Not absolutely big, okay. Absolutely big, I've seen voice boxes of whales that are, like, 12 feet long. They're huge, and they have a big sack under them that they use for recycling air that I could just climb into like a sleeping bag. That's a really big voice box. But, how big is that… Considering the whale is really big, it's just big because the whale's big right? No.

It's big even considering that, because the voice box of a big whale – and when I say big whale I mean like a fin whale, or a blue whale, or a humpback whale – that voice box is as big as a lung. Imagine your larynx, voice box, went from the top of your shoulder down to the bottom of your ribcage.

Alie: That's like having a saxophone in your body! Just talkin' through a saxophone!

Joy: And then you've got these animals that can make increeedibly loud noises. The power behind some of these noises have been equated to a jet engine.

Alie: OMG!!

Aside: Quick question, how loud is that? Well, a whisper [*whispering*] between humans is about 20 decibels. Normal speaking volume, about 50. SHOUTING IS 70. Jackhammers, about 100 decibels. Now, music starts to hurt at around 120, and a jet engine is about 140. Eardrums can rupture around 165 decibels. And at 185 the noise can *literally kill you.*

Whales? Louder than that! The lovelorn call of a lonely blue whale [*low, long, underwater whale call*] reaches up to 188 decibels. And sperm whales – like, hold muh beer – the clicks they use for echolocation *[underwater clicking*], are you ready for this? 236 decibels, which can be heard by other whales for *thousands of miles*. So, anytime you see a heavy metal band just *thrashing*, *crushing*, know that there is a big, wet, leather pickle in the ocean, munchin' squid, that is louder. And therefore, everything in this life is just ridiculous.

Alie: Now, when you are climbing inside, let's say, a whale, or another big animal, like, what is that like? How are you finding your way around? What does it smell like?

Joy: Well, first of all, it's a really good thing that Smell-O-Vision hasn't been invented yet, because I think most people would turn the show off, because the smell is really bad. I

mean, just imagine, you've got 65 feet of rotting flesh. You know how bad milk smells when it goes bad?

Alie: Yeah…

Joy: Now imagine you've got 65 feet of quarts of milk hanging out there, right? So, it's a pretty bad smell when it's rotten. But, like most things, you're into it after awhile… you know, like you put on perfume and maybe an hour later you don't even smell it anymore, but someone else walks into the room for the first time, they smell it, right?

Aside: I just looked this up and it's called olfactory fatigue, or olfactory adaptation. And our scent receptors, essentially, are just over it. They're like, "I'm looking for danger or food, and if I haven't eaten this or been killed by it, fuhgeddaboudit! I don't care, the stench is, like, sooo five minutes ago."

Joy: That's what it's like at a whale stranding. After the first hour you don't smell it anymore, but everybody who comes to visit smells it, and when you leave that stranding, everybody that you see smells it on you no matter how many showers you take. The oil gets under your skin. Even when you're wearing latex gloves it still gets under all that, and there's an aura about it. Like, when you're around someone that smokes cigarettes and your hair smells? It's the same thing. Your hair is gonna smell, your skin is gonna smell, your clothing… even if it was just in the vicinity, is gonna smell.

Alie: What do you do? Is there, like, a special soap that you're like, this linseed…

Joy: Time. You just have to wait for it to volatilize out [laughing]. You can wash off the snotty stuff that's stuck on your skin, yes, that you can do. You can get rid of the oil that's on the outside, but you can't get rid of it all that's moved into your skin. It's now part of you and you just have to wait for it to evaporate off.

Alie: How many whales do you think you've dissected?

Joy: Oh, gosh. I think I stopped counting a long time ago. It's a tough number to come up with because whales, to me, includes all whales, which means dolphins and porpoises too. So, if you start counting all of the cetaceans - whales, dolphins, and porpoises -oh, that number's going to be well over 300. Maybe more.

Aside: Quick quick on whale evolution. This is not the cetology episode, so I don't want to go into too much depth and spoil how bananas it is, but essentially, whales are very much mammals who started off as deer-like creatures who just hung out by water, and sort of gradually slipped into the abyss forever, and expanded. Just like, "you know what? I'm gonna dip out, land. Good luck with all your walkin' around. I'm gonna go sail through water like I'm flying and never have to brush my hair. Also, I'm louder than your quiet-ass metal music and we all know it. Peace. Ber-bye"

Alie: And when you're dissecting any kind of animal, or when you're mapping out the anatomy of any kind of animal, are you ever struck by similarities with humans? Do you notice certain things about the brain that you're like, that's a pretty human brain, that's surprising for this kind of animal, or, anything that makes you reflect on, kind of, your own morphology?

Joy: Absolutely, because humans are tetrapods, which is a type of vertebrate that has four legs.

Alie: That's so weird.

Joy: That's most of the vertebrates that we know, right? Even whales are tetrapods that used to have four legs. They still have hindquarters. They still have a pelvis, and they still sometimes have a remnant of a femur or a thigh bone on that pelvis.

Aside: How weird is that? Nubbins, but nubbins that are huge, and pointless.

Joy: Again, you're look at a body plan that's very similar, so if I look at a whale's flipper, I *am* reminded of a human, because inside that flipper are all the same bones that are in our upper extremity. There's a humerus, the arm bone. There's the radius and ulna, the two forearm bones. There's the carpal bones, all the little wrist bones. And there are, in fact, five fingers.

Alie: That's crazy!

Joy: And all the little bones of our hands are in a whale's flipper, except they've added a few extra little bones to the ends of the fingers to make them elongated, but that's about the only difference.

Alie: It's just like having acrylic nails under there, you know what I mean? Longer phalanges.

Joy: Exactly. Just very, very long fingers, but they're webbed, and that webbing has become very stiff. So, instead of, like, webbed feet like a duck has, you've got really stiff webbing in between those fingers, so when you look at the flipper it's a paddle. But it is supported by, essentially, a hand inside there, and a whole arm at the beginning of it. Yes, you start to see things that look like humans, but they look like other terrestrial mammals as well. It might not look like a horse because a horse, in its ancestry, used to have five digits too, but a horse has reduced that down to walking on its middle toe. In fact, just the nail of its middle toe. That's that the hoof is.

Alie: That's so weird.

Joy: If you look at cattle, they're walking on two of those toes. If you look at a bird, you'll see next time you eat chicken. Go get a chicken wing and look at it really carefully. You'll see all the same bones that we have in our upper extremity, except you won't find all five fingers anywhere. They're gotten rid of most of them, but you will see at least two, maybe three fingers there. Nature is pretty conservative. You take a body plan and you just tweak it. You modify it. You don't add something completely new. You take something that's there and you morph it, so it looks new, it's just really twisted and different. That's all.

It's not really new. Very, very rarely do you see something that's actually new, because that's really hard to accomplish. That's what we have a lot of fun doing, looking at a new animal for the first time, you don't really know necessarily what everything does. So, one of the questions is, what is this most like in a human? What is this most like in the next animal that is closely related to it? Where are the homologies, the things that have the same tissue origin but maybe have become different structures, like the wing of a bird and the flipper of a sea turtle.

Aside: So, what else does Joy's job entail?

Alie: Are you still getting to do a lot of drawing and sketching when you're doing this?

Joy: Oh, yeah. That's one of the best things about this career for me, is it's a perfect combination of my interest in art and science.

Alie: So, do you use, like, a Wacom tablet? Do you have your watercolors out? How are you capturing it?

Joy: I'm very old school [laughing]. Pencil and paper most of the time.

Alie: Is there any place people can see your drawings?

Joy: Usually the finished products can be seen in publications, because I'll take that pencil drawing and I'll flesh it out as a digital image.

Alie: But would it kill you to start an Instagram of sketches??

Aside: Will I convince her?

Joy: Yes, it would kill me. You know why? Two reasons…

Aside: [*silly voice*] Aww maaann!

Joy: One is, I don't have the time to think about putting stuff like that up. Secondly, I don't want to let out information before it's really solid information.

Alie: That's a good point. Strategic. Dangit!

Joy: That's what publications are for, so we've got to make sure that the information we're putting out is accurate, because will take… You know how people take stuff off the internet all the time. It's like, "oh, it's the truth! I found it on the internet!" I guess they'll have to follow my publications, then. That's my version of Instagram, right?

It's so important to make sure the public gets accurate science information. In fact, that's one of the reasons I do those TV documentaries, because as a scientist I feel that we have an obligation to give information to the public. After all, they're the ones that funded our work in the first place. Most work is done through grant funding, which is your tax dollars at work, or your donations if it's from a private foundation. But, most people don't get any return on their investment. How is the public learning about the science that we do?

What do scientists do? We don't have a normal job. We don't make a widget that you sell. We don't provide a service that you can purchase and have us come and do it for you, although there are some scientists for hire, of course, that do work for companies. But most academic scientists are not for hire that way. So, what is it that we do with our job? People really have no idea what we do because we don't sell anything and we don't provide a service.

What we do is, we make knowledge, and we're supposed to give that knowledge back to the public. But what do scientists do? They publish that knowledge in highly technical journals that only other scientists are reading. That's our ivory tower that we're stuck in, and we need to come out of that and get that knowledge back down to the public who pay for it in the first place. So, I feel an obligation to return that information to the

public, and one of the best ways to do that is through various types of public outreach. Public lectures, demonstrations, go to the schools, interact with the children.

Alie: Podcasts… TED Talks.

Joy: Podcasts, exactly. Interviews, TED Talks, and television, because all of these media are ways to engage the public in the science that we're doing so that they can learn. Why is it that I study whales in the first place? They're awesome animals. These animals are adapted to deep sea diving, they encounter huge pressure changes. If we can understand how they survive those pressure changes maybe we can build better flak jackets for our soldiers who are, essentially, exposed to a pressure wave every time an explosion goes off next to them. They don't do so well in those pressure waves.

Whales do great in those pressures as they change pressures voluntarily every time they swim up and down the water column. But they're doing something in their bodies and we don't know exactly what it is. How come they don't get decompression sickness? How do they avoid the bends? All of these are very interesting questions for us. There's so many things they do that we don't understand. How do they communicate underwater? How do they get those sounds out of their body when they're making them using an air driven system which is evolutionary baggage from having been a land animal?

They're still using air! That's a liability for an aquatic animal because now you've got to keep coming back to the surface to get more of it. And every time you dive down it shrinks to the tiniest little volume that you can barely work with. And if you have air in anything solid, like a sinus, it's going to crack. So, you've got to make adaptations that deal with the pressure changes.

When we crack that code, hopefully we can make better transmitters for sound underwater for communication devices or whatever. But there are all kinds of things that we want to learn. We want to learn how dolphins make their sonar. We know a lot about how they do it. We don't understand how they process it though.

Aside: [*cartoon dolphin: Snorky... talk… man.*]

Joy: And if we could, maybe we could make better sonar for ourselves. Dolphins can actually detect a mine buried under the sand.

Aside: Okay, wait, whatwhatwhat?? This is a thing. I just found myself on a wiki page entitled, Military Dolphins. What?! It says that dolphins and sea lions are trained by the Navy's Marine Mammal Fleet. Dolphins are trained as much as police and hunting dogs and are given rewards such as fish on correct completion of a task. So, dolphins are trained to detect underwater mines and enemy swimmers, and then report back to their handlers. How weird is it that there are dolphins who are like, "Yes, yes, I appreciate the fish salary but I also find my work very fulfilling. I'm good at my job and helping people."

Alie: Whaaaat?

Joy: Not only can they detect it through multiple materials… We can't. Our sonar reflects at the first density interface change. But they can tell you if that mine is flooded with water or air. If it's made of plastic or metal. If it's ticking. There's all kinds of things that they

can tell us. We can't see that. Our sonar's way too coarse. We can barely tell a school of fish from a whale going by. It's just a blob on the sonar screen. The dolphin is looking at a fish and goes, "Mmm, I know exactly what kind of fish that is. It's a butterfish, and I know how big it is, and when it's going to turn, and how many scales are missing on the right side, and where its swim bladder is." They can see all of that.

Alie: And how are they doing it?

Joy: What's the closest we've come? Ultrasound. We can look inside and see someone who's pregnant. I remember when I was swimming once off the coast of Florida, and two dolphins came over to check me out. I was pregnant at the time and I'm pretty sure that's why they came to check me out, because they could see what's going on inside with their sonar!

Alie: Oh, that's so nuts!

Joy: It was amazing. They stayed juuust out of reach. I could reach my hand out and aaalmost touch them, and they would stay juuust beyond the edge of my fingertips. As soon as I would reach them they would dive under and come up the surface behind me. I'd hear the *phhff* blow behind my head. I turned around, and they played the same game. It was always this game of keep away, but they were juuust close enough you could almost touch them.

Alie: They're like, "why's she got another little baby in there!"

Joy: That's right. I think they knew. I think they totally knew, and I think they were totally fascinated about why this extra little creature was on board.

Alie: Oh my God, that's so cool.

Joy: They were probably able to see so much more than we could see with our simple ultrasound, because our ultrasound, you see it in one dimension and it looks like static. If you don't see it as a movie you really get lost in the dots. I'm sure they're seeing things in 3D, and they've probably got all kinds of accommodations for the motion as well as the three-dimensionality of it. And they process it, interestingly, in their visual cortex, so they may be seeing it as an image even though it's sound coming back to them.

Alie: They're like, oh, it's a girl! And you're like, whoa, hey, how do you know!

Aside: Now I just want to evolve myself back into the sea in a land where dolphins are my doctors, and sea lions have my back [*bubbles bubbling*]. What is life? But since I'm land bound for now, I have a question that I feel Joy won't judge me about.

Alie: I have this theory that I always try to talk to biologists about, and you're the one person I feel like will definitely give me a heads or tails on this, but no pun intended. How do you feel about the automotive design and how much it's modeled on quadrupeds? I'm so fascinated by, like, we have the engine in the front, four tires, four legs, two headlights, and also genus and species like a make and model. Do you ever think about that, like, when you're driving around, how we model things in our lives with, like, bilateral symmetry, airplanes like birds? Does that ever… Is that just, like, such a duh for you?

Joy: I wouldn't say it's such a Duh, but I think biomimetics is a really important thing, modeling things on nature. The first airplanes were really modeled on birds. They even tried to flap the wings.

Aside: [*old radio clip*] *All-American Hank Fettis took a running start to fame and fortune with his version of what the latest birdman should wear, but his flyer went in the wrong direction. Down. Hard.*

Harsh bail, old-timey bird dude.

Joy: If you look at submarines and their rudders, it's really not all that different than a fish tail. And I think biomimicry is important. Why do we have four wheels on a car? You're right. It does, kind of, remind you of four legs. Why not two? Well, it's not as stable on two. Look how long it takes us to learn how to walk on two legs. We start out crawling. It's way more stable. It's just efficiency and design, it's based on nature. There are very few animals that walk around on two legs. It's not the most efficient design for stability. There are advantages, which is why we do walk on two legs, but again, it is unstable. So, yeah, I think about… I think more about things… When I think about cars I think more about, when are we going to have those driverless cars? That's what I'm thinking about.

Alie: I know. Every time I drive a car I'm like, we're going to look back and be like, "Wait, you put just a human being who can just sneeze can kill people in this machine? This is ridiculous."

So, two last questions. One is, what is the thing about your job that suuuucks the most?

What's the hardest part about your job? The most tedious? The most, like, oooh God.

Joy: Reading.

Alie: Really?

Joy: Believe it or not, reading. I hate reading. I think that's why I went to anatomy, because all the books have pictures in them. I think I'm mildly dyslexic in some way. I think decoding is more laborious for me than it probably is for the average person. I read very slowly. I can't read faster than I can hear the voice in my head saying the sounds as I read. Some people can read a lot faster. I just don't decode that fast. But I find reading really, really tedious.

I would say that's the worst part because as an academic you have to keep up with it. I'm on editorial boards, I have to read. I do really, really careful reviews of articles that are given to me, and I read every single word with intention, and I write the same way so I'm very slow at writing. So reading and writing, I would say are, kind of, my nemesis.

Alie: That's so impressive that you have the job you have, knowing that's a little bit of a struggle, or that's a little bit of a labor for you, and on top of that you've achieved everything you've achieved. It's like… That's even more inspiring.

Joy: Thank you. I don't know if I would've qualified for extra time back in the day. They didn't have a label for what I had [laughing].

Alie: What is the thing that you love about your job so much. I know there must be, like, 12 things.

Joy: There's so many things, but I think just the freedom to explore is the most amazing part of it. I can, like I said before, ask any question and answer it my way by doing the work. I love working with my hands. I love the exploration of something new, something exciting. And every time I get a new animal to look at it's like having a present show up in the lab. I'm like, wow, this is great! And I love doing field work. The whales, they have to be done as field work. They're just too big. You can't bring 'em into the lab.

Alie: That's not happening.

Joy: I love being outdoors, so fieldwork is great. Travelling is great. I love going to exotic places to see exotic animals.

Alie: It's so great that after going through yellow pages, going through all these different disciplines, you one-million-percent found the career that, like, is… like, you nailed it. You found the career where you get to draw, you get to learn, you get to help people… You figured it out. You must want to go back in time and be like, "yo, little Joy, you're gonna be fine."

Joy: Absolutely. I think the best way to sum that up is, I don't really feel like I go to work every day. I go to play. If you're going to do your job the whole rest of your life, that's… You only get one life to live! You don't want to spend it doing something you don't like. You want to go to work knowing it's not really work. Work's the wrong word for it. I'm excited about it when I come here. I'm here to play.

Alie: That's rad. And I love that later you're just gonna be like, "lemur… I got a lemur coming up."

Thank you so much for doing this. I'm just so excited to get to talk to you. Thank you so much for doing this!!

Joy: You're welcome. It's been fun. Thank you.

Alie: I loved it.

So, as always, ask smart people stupid questions, because you never know what kind of glorious stories may unfold. Now, to follow up on your new obsession with Dr. Joy Reidenberg, catch her on Science Channel's *Mythical Beasts*. That premiers October 14th. You can find her on Twitter @JoyReidenberg. You *cannot* find her drawings on Instagram, as discussed, but that's okay. She's also on Facebook as ReidenbergTV.

And Ologies is @Ologies on Twitter and Instagram. Do give us a follow. I'm alieward on both (Twitter or Instagram), and there are links in the show notes to all of this. There are also links to support even a dollar a month on Patreon.com/ologies. You can get amazing merch at OlogiesMerch.com. Feel free to tag or DM me photos of you in it with #OlogiesMerch. Mondays I repost them on Instagram.

Thanks Boni Dutch and Shannon Feltus for all of the merch help. You're amazing. Be sure to find them tagged, give them a follow. They're great.

Thank Erin Talbert and Hannah Lipow for adminning the internet haven that is the Ologies Facebook group.

And I owe a *whale* of thanks every week to editor Steven Ray Morris, who also hosts the kitty podcast, *The Purrrcast*, and *See Jurassic Right*, which is all about dinos!

Nick Thorburn made the music and is in a band called Islands.

Side note, if you enjoyed the melittology episode on Bees, Mandy Shaw now has her own bee podcast called *Beekeeper Confidential*.

Now, at the end of the episode, you know that I tell a secret. And my secret this week is that I had a dream I was dating Oprah. And in the dream I was like, "This rules. She's great." And I think about that now every time I see Oprah, and I'm like, "She's pretty great."

Anyway, keep asking smart people stupid questions. That's the only way anyone learns anything.

Berbye.

Transcribed by Emily White, actual nerd.

Links:

"Inside Nature's Giants" featuring a very dead sperm whale

The 411 on "Mythical Beasts"

First webpage everrrr

Sir Timothy Berners-Lee

Smelling salts stat plz

His Highness….uhhh, Vint Cerf

The whale will break your ears

Olde-timey sky flappers

Immune to your own stench

The Bends aka the scaries

Sergeant Dolphin reporting for duty

For comments and inquires on this or other transcripts, please contact OlogiteEmily@gmail.com