

Scatology with Rachel Santymire

Ologies Podcast

March 3, 2020

Oh heey, it's your ol' internet dad, here with an episode you've all just been chompin' at the bit for: will she go there, you wondered? She went there. Boy, howdy, did she. But don't worry, this one doesn't get too gross. [*whispers*] I don't know. What am I talking about? It's so gross. It's an entire episode on animal poo, and sometimes ours, because we are, after all, animals. But I tried to keep it as informative, and as illuminating as an entire episode on animal excrement can be.

But before number two, number one: I want to let you know, everyone, I will be at CalAcademy on March 5th — that is this Thursday in San Francisco — I'll be at First Fridays in LA on March 6th for their Secrets from the Vaults series, South By Southwest EDU on March 11th. Thank you to everyone at Patreon.com/Ologies for submitting your questions and for supporting the show — it's as little as 25 cents an episode to get into that club — each person out there wearing *Ologies* merch and hashtagging it #OlogiesMerch so we can repost you, thank you. And of course everyone rating and making sure that they're subscribed, and telling a friend, and of course leaving reviews to freshen up my crappy days, like this one from Maxenesunshine, who says:

I am a zookeeper with a cranky kookaburra (that's a bird, I looked it up) named Cookie who cackles at compliments, finds music miserable, and whose whooping is only silenced by the soothing voice of Alie Dad Ward. The Ologies podcast has given my ears peace during the hour I spend with Cookie daily, and we have both learned so much. Cookie's favorite episode is, of course, ornithology.

So Cookie, this one's for you!

Let's roll up our sleeves and just dive right into it. Scatology: it comes from the Greek for feces, you're welcome. Scatology is the scientific study or the chemical analyses of feces, while caprology is... scatology. What? Okay, so both — same. Also both can mean toilet humor, or 'a special interest in poops', in a sexy way. Okay!

For this scatology episode, we talk a lot about zoo poos, and in fact, I got a VIP tour, in which I saw a freezer that was like a Porta Potty on Noah's Ark.

Pre-Interview Tour

Rachel: [*voice sounds far from microphone, touring the lab*] The coolest thing about our labs, maybe, is our freezers.

Alie: Yaaaas!

Rachel: So this one might be locked... [*tinkers with lock*]

Alie: You've gotta lock up your poop?

Rachel: Uh — yes! We keep our freezers locked. [*flipping through pages*] So we've got black rhino, pigmy hippo, red river hog poo, we have some of our octopus stuff in here. We have our Grévy's zebra, Bactrian camel, our giraffe, our black bear, our Japanese macaque, pygmy slow loris, Diana monkey, pied tamarin, polar bear —

that's just what lives in *this* freezer. I have thirteen others, but we're going to go all around the zoo, we're gonna go through each one for you.

Alie: [*laughs*] It's a real poo party! I love that it's like, "Hey, no food or drink in here," and it's like, "Don't worry about it."

[*cut to*] So what's the word I'm thinking of, it's like a shawarma? It just looks like a lot of rolled up shawarma.

Rachel: We have mountain gorillas from Rwanda in here... You never know what we have in our freezer.

Alie: Wait, that was... was it geese?

Rachel: Yep, goose poop.

Alie: Goose poop!

Rachel: I don't know if that's in here or not, but we definitely do goose poop.

[*cut to*] Eastern massasauga rattlesnakes. Snakes poop, yes!

Alie: [*delighted*] Ah!

Rachel: Not very often, but they poop. [*continuing to flip through pages*] Snow leopards, lots of snow leopards. Israeli gerbils, yes.

Alie: Gerbil poo!

Rachel: Yes, very small. Lab mice poo.

Alie: Tic Tacs, really.

Rachel: We have Congo... There are probably gorilla samples, lowland gorillas. And we have Mount Graham red squirrel samples, that is probably... that's even more rare than a black-footed ferret. I think there's only 30-40 left in Arizona.

Alie: That's amazing. It really looks as if Marie Kondo kept a refrigerator full of shit. Like, it's beautiful in there.

So this ologist has earned the nickname Dr. Poop. She wears it with pride. She got her bachelors in pre-vet science and her Master's in Animal Physiology at Clemson University, and then her PhD in Environmental Science and Policy at George Mason University. She is the Director of the Davee Center for Epidemiology and Endocrinology at the Lincoln Park Zoo in Chicago. The motto of her program, she says, is "If it defecates, we will study it!"

We took a seat and talked all about tiny poos, giant poos, pebble poos, pet poos, whale poos, famous otters, French confections, glitter pills, wombat bricks, what poo says about you, and how and why this animal scientist and conservationist *anal-yzes* the feces of countless species and loves it, so please curl up for the scoop on this rare science with Scatologist, Dr. Poop, aka Dr. Rachel Santymire.

Dr. Rachel Santymire: ... so shy, I'm like, [*trapped in throat sound*] "nngg!"

Alie Ward: Just pretend it's not there. Pretend it's an ice cream cone. If you could tell me your first and last name?

Rachel: Rachel Santymire.

Alie: Got it. AKA [*high pitched voice*] Dr. Poop! How long have you been Dr. Poop?

Rachel: I've been Dr. Poop for 13 years, I guess. Yeah. My parents are so proud.

Alie: [*laughs*] Hey, doctor in front of anything is great. You're doing great. Literally Dr. in front of anything.

Rachel: Yeah, in theory, yes. I guess they don't really talk to their bridge club about what I do. They just say I work in the zoo, so... [*"This place is a zoo!"*]

Alie: Now, how did the nickname Dr. Poop come to be you?

Rachel: You know, it was really our learning staff trying to get kids excited about the science, and oh man, kids love poop. Parents not so much, until they start to hear the science and they realize how cool it is. And then they eventually start getting really excited about the poop.

Alie: It's a great marketing strategy for real.

Rachel: [*upward inflection*] Yeaah —except for my mom said I was full of shit, so...

Alie: [*laughs*] She's got you there.

Rachel: She said that to me today. I was just like — she laaaaughed, she laughed. Thanks, Mom.

Alie: You've got to get just the best puns in your email inbox.

Rachel: Yeah. You know, one of my favorite titles of my talk is How Feces Save Species. [*audience clapping*]

Alie: Do you think that there's a big difference culturally between poo and poop?

Rachel: Hmm. [*thoughtful, high-pitched*] No...? I don't think so. Maybe poo sounds more cute than poop. 'Cause poop is more like an action and poo is kind of like the emoji.

Aside: I looked this up and poop used to mean 'to softly break wind' — it was onomatopoeitic in nature — but my guess is that enough people had unhappy accidents and *whammo*, boom!, language changes. In this case, from a gas to a solid. Also, poo is a relatively new word. It first appeared in the 1950s, just in case you're wondering about the... movement... of the term.

Alie: And so tell me about your journey to the queen of poop.

Rachel: They also call me the poop hoarder, 'cause I don't throw any poop away. I keep it. And I... my strategy is just to buy a new freezer every year, and I have like 14 around the zoo. And the animal care staff are so nice, they make room for my new freezers. The facility guys add new electrical stuff for me. But you know, classic story; I loved animals. We had dogs and cats growing up. In middle school I started riding horses, so I love horses. And I love to ask people what their favorite animal is because I don't have one. I love all animals. Feathers, fish, you know, I love rodents... And so I just loved all animals, and my room actually was sort of a zoo because I had parakeets, I had hermit crabs, I had gerbils, you know, I just had all these animals in my room and I cared for them. I love caring for animals.

In fact, if like the zombie apocalypse happened, that's the only skill I have. I cannot do anything else but shovel poop, basically. And maybe that's also why I'm Dr. Poop. But I started off thinking that if you loved animals, you became a veterinarian. And so in high school I worked at a vet's office. In college I was in pre-veterinary science, animal science, at Clemson university. And so my goal was to become a veterinarian and I worked at vets' offices, I cared for animals, and I applied to vet school. I got an interview at Tuskegee university in Alabama. And literally one person in front of me changed the course of my career. I didn't get in. [Alie gasps] I didn't get in and I didn't know what to do because that was my whole plan. That was everything I had done built up to that career. I panicked because, you know, I had student loans, you have to start paying these things off in six months when you're out of school.

And what happened was this scientist came down from the National Zoo, his name was Dr. David Wildt, who unfortunately has just passed away. He talked about how he was an animal scientist and how he's applying all these technologies, particularly assisted reproductive technologies like artificial insemination, semen collection and evaluation, and cryopreservation, to wildlife, to endangered species like cheetahs and clouded leopards. And I thought, "That's what I want to do! I want to do that!"

And it just so happens... in the zoo field, we're a little inbred and I somehow connected through Clemson and Smithsonian institution where Dave Wildt was from and started my master's at Clemson and did a zoo project on black howler monkeys. And then I got hired by the Smithsonian to work in their endocrinology lab. And then I started to do my PhD there and got to work on one of the rarest mammals we have here in North America, the black-footed ferret.

Aside: Just a quick FYI on black-footed ferrets, the ferret endemic to North America. Because they munch on prairie dogs, and prairie dog habitat is now largely, like, shopping centers, the species got down to only 18 individuals at one point. So for her PhD, Rachel studied their reproduction and *still* works with breeding programs to get their numbers up. There are only about 700 left on the planet. So think of your local movie house's dome theater, and then fill each seat with one North American black-footed ferret — just a li'l weasel, just a li'l sock with a face, maybe sitting there watching a costume drama. Imagine that. There are less of those ferrets on planet Earth than would be in a dome theater, because we saw a bunch of North American prairie land and we were like, you know what this needs? A parking lot for a Hobby Lobby.

Alie: Did your work with the black footed ferret... did that kind of introduce you to analyzing poop to find out about endocrinology of a species?

Rachel: It did, yeah. So you know, the ferret is a mustelid, which is a very stinky species. So you can imagine their feces. Yes, they are pretty stinky. I started in 1998 at the Smithsonian to work on black-footed ferrets, looking at reproductive hormones and seeing how they change seasonally and how they're related to age. And then the other species I started with was the fishing cat. So, I don't know if you have a cat, but you know, cat poop really stinks.

Alie: Not a good smell. Nope.

Rachel: And then you combine it with eating only fish.

Alie: [loud retching sound]

Rachel: So in the Smithsonian, we had the fecal lab. People would *leave* the fecal lab when I pulled out the fishing cat samples, it was so bad. I mean like, you know it's going to smell in the fecal lab, but when Rachel pulls out those fishing cat samples, people *LEAVE*. They just can't take it. ["*I'm outie.*"] I'm very tolerant of poop, so I didn't mind so much. But yeah, it was really a privilege to work on one of the rarest mammals we have here in North America also another species like the fishing cat. I mean, what's more unique? You know, this cat that can dive into water to eat fish, you know, that's pretty cool. Not many cats would do that.

Aside: This. Woman. Not only does she merrily work with poo, she calls it a *privilege*. So y'all, find what you love, bloom where you're planted, just make sure you're covered in fertilizer.

Alie: And why do you think you are so tolerant of feces?

Rachel: Because I've always taken care of animals. Whether it was bird poop, gerbil poop, dog poop, cat poop, you know, it's all about the poop — fish poop. And horse poop man, yeah. Just very tolerant now. The thing, probably the least favorite thing of my job has been saliva.

Alie: Oh, really?

Rachel: Yes. Saliva. So let me tell you about our pygmy hippo: We have a breeding recommendation for our two pygmy hippos. And they wanted to see if they could time when to pair them together because they're generally solitary animals. And so we try to look at hormones and unfortunately with a pygmy hippo, they like to poop in the water. And that pretty much ruins my sample because there's hormones in the water maybe from the fish, from everything else. So I needed, you know, a good fecal sample from them, and we actually tried saliva.

And the way we do that was we had our female and we would show her corn, and she *looooved* corn. So she would start to salivate and just drool would come out. They would take a pipette and they would pipette it off the ground and they put it in a test tube for me, and then it would come to the lab, and I'd have to pipette it out of a test tube, and it literally would just string from one tube to the next, like [*disgusted*] yuck.

Alie: I love that *that's* the thing that grosses you out.

Rachel: But you know, I'm a mom now. This was before I was a mom, and now I'm like, *pshtt*, "Whatever!" I can tolerate anything. But yeah, before that, I was like, "Gimme poop, please. This saliva is pretty gross."

Alie: Somewhere there's a Dr. Spit who just doesn't understand you at all.

Rachel: [*laughing*] Probably!

Alie: I'm going to have to look that up.

Aside: Okay yes I looked this up and there *is* a Dr. Spit! Missouri News Station KY3 interviewed this local legend, who is a blues harmonica player: [*clip from interview, Dr. Spit Blows into Town: harmonica plays, narrator: "His name is Dr. Spit." Dr. Spit: "Something like that. You do not get to pick your nickname. Somebody inebriated in the*

bar decides what your name's gonna be." So I did a little more digging and found out, sadly, Dr. Spit, AKA Ron Alexander is no longer with us. So blues fans have a little more reason to be blue. But yes, in the wisdom of Dr. Spit, the nickname chooses you.

Alie: And now, broadly speaking, what is poop? Who poops? Plants don't poop. Animals do. What's happening? What is it?

Rachel: Yeah, there's a book, *Everyone Poops*, right? Everyone poops! What happens is, we're looking for... In wildlife endocrinology, we're looking at these steroid hormones and these hormones are related to reproduction. We can determine pregnancy; we can determine when the female's receptive or in estrus. And then we can also look at stress, right? And we always think stress is a bad thing, but really stress is a necessary response that we and animals have to deal with situations. And then we have *distress*, which is the negative stress. It could be bullying or something that really is upsetting. And there's also *eustress*, which is like riding that roller coaster, being super excited, you know, for animals it's getting enrichment. Stress is very important.

So we use these steroid hormones to look at that. And what happens is there's some kind of response, either a stress response or a reproductive response. So like this time of year, the days are starting to lengthen, so a lot of species are long day breeders, like horses for example. So they're going to start coming into estrus, right? They're going to start getting ready to breed. And so these cues signal the hormones to be released and they circulate in the blood.

But for something like stress, I can't really get a blood sample from animals, even from people, because that causes stress itself, right? So we look for alternative samples. And what's nice is the liver actually functions in the body to make these steroids, which are made from cholesterol so they're oily, they're hydrophobic. They add a compound to make them hydrophilic, so they can be excreted in urine and feces.

Alie: So when we're done with our stress hormones, we're like, "Get outta here! Take the backdoor. I'm done with you!"

Rachel: Yeah, or we'd continually be responding. That's not a healthy thing, right? They have their purpose, their job, and then the body gets rid of them. And so we take advantage of that. You know, with human pregnancy tests, you can use urine, right? And that's actually a protein hormone that you're looking for. But in feces, we're looking at these steroids and it's just really convenient that we can get it from poop because then we don't have to stress the animals out. It's like we're poop detectives. Especially here at the zoo, the animal care staff has to pick up the samples and now they can simply put it in a Ziploc bag, put it in the freezer, and I can come along, we can pick it up, we can thaw it and we can figure out what's going on inside the animal.

And that's so important because, yes they have behaviors, but if you've had a cat or a dog, you know that they hide certain things from you. Um, well sometimes they can't hide their guilt, [*clip from Denver Official Guilty Dog Video: Sad music playing in background "Wha— you got into kitty cat's treats? While I was gone?"*] but for other things, when for example, they're in pain or anything else, you can't really understand sometimes, maybe they're hiding more. And so we integrate animal behavior with

endocrinology to really look at the physiology, the response that they're having so we can interpret the behavior better, and vice versa, too.

Alie: And so the zookeepers, as long as they're poop scooping, they get in there, they take a little handful, if you will... And then put it in a Ziploc — what, just like, roll it up like a sausage? And pop it in the...

Rachel: Yeah, well they usually invert the bag and grab it, you know, just like you do with your dog.

Alie: And how many samples of poop do you think you have in your 17 freezers?

Rachel: Don't let anybody at the zoo know this. I probably... We do about... We changed some of our science recently, but in general we do about 8,000-10,000 samples a year.

Alie: [Gasps] Oh! [*"So much."*]

Rachel: So that's about 130,000 samples. If anybody wants to support biobanking, please send us money. Lowes, we use your freezers, donate to us! Yeah, but I can't throw them away because you can't go back in time. And if you want to see how things have changed, which is really important for zoos... We monitor our animals continuously and we want to see how they change over time. And so it's important to keep those archived samples. And then I also have lots of other questions, as scientists we are always asking questions. We get them answered and then we have like ten more that go with that. And yeah, so I just hoard it.

Alie: Good!

Rachel: But now we switched to... We use hair now for hormone analysis and it gives us a slightly different perspective. There's actually some debate about whether the steroids in the hair, the hormones in the hair, are telling you about what happened when the hair was growing or a what-happened-yesterday kind of thing, more of an acute response. Because unlike most wildlife species, their hair doesn't continually grow like ours. In a lot of the human literature, they're able to cut up the hair and kind of get a timeline of either chemical abuse, or poisoning, you know, all the forensic stuff out there. It's really cool. And so we took that science and are applying it to wildlife and looking at stress levels so we can really see what's going on. And then the hormones in the feces are telling you what happened yesterday. Hair might be telling you what's happened last week, or two weeks, ago or last month.

Aside: So yes, both hair and dropping are non-invasive, relatively, and they can give you different data. But with turds, you know it's pretty recent. Also, let's get gross! Let's zoom in and discuss what doo-doo really is, other than something you usually do not want to look at closely.

Alie: And now, you've had your hands in every kind of poo, I imagine, from geese, to hippos, to cheetahs... What are some commonalities and what are some differences? Like, what is stool? Is it mostly bacteria? Is it mostly fiber? What is it??

Rachel: Yeah, it's a combination of everything, right? It's just the waste product of what we ate and what's in our system. So yeah, it has lots of bacteria, which are sort of our enemy for hormones because it continues to break down the hormones if we don't get it in the freezer fast. When you look at all these different species, like elephants or black rhinos,

which we have here at the zoo, it's like all fiber. You're like, "Is there any POO in this sample?? Or is it just, like, cut up hay?" Same with zebras and horses. It's really, like... it look like hay with some poop smeared around it.

But we can actually look at the poop... When we get so familiar with our animals here at the zoo, our staff can see the poop samples and know when the staff have accidentally mixed up the bags because, you know, they all look like a certain - sometimes- food item, or not.

Like, takin poo kind of looks like little olives. Our different females had, like, different-sized and shaped olive, so we knew when they mixed them up. The camels, they have, like, golf ball poos. But the rhinos of course have the bowling ball. So, we don't necessarily get the bowling balls. We get part of the bowling balls. But yes, very fibrous.

Aside: This imagery will stay on my mind... for a while.

Rachel: And then, you know, the apes and the primates, that's just a whole 'nother story.

Alie: Is that more like human?

Rachel: Yeah, it's more like human. It's definitely more...well, I can't say that because the male black rhino, the feces is pretty stinky. They use a lot of pheromones and odor cues for communication because they're solitary animals. I think one of the worst samples I've had in my lab was actually my own dog's poop.

Alie: Oh no!

Rachel: He's just really... *woooow*. You know, the doors get closed [*Alie laughs*] from the staff that work on their computers versus the fecal lab staff. Or when we do the polar bear, it eats a lot of fish and stuff. That is pretty stinky.

Aside: In a herd of giraffes, or a pride of lions, or a party of orangutans (I don't know, I'm just going to hope that a group of orangutans is called a 'party'). Actually, hold on. I just looked it up, and it's a 'congress' of orangutans. Which, wow. I wish our congresses worked like that. But anyway. How do they figure out who left what behind?

Rachel: The fecal marker study—this is one of the best papers I've published, I think—it's very practical. What do you do when you have a whole bunch of individuals together, and you want to sample each individual? We either have to have a staff member or volunteer that sits there and *waits* for them to defecate, which could be a long time depending on the species.

So we devised a way to mark the feces. You can give them food coloring and make their feces green. Usually green and blue come out green, so it's kind of hard to find different colors. We fed glitter to our animals—nontoxic glitter, of course—nontoxic beads, all these different things... seeds, blueberries will have seeds, anything that has seeds. There's a couple issues with this. When you feed them bird seed, like millet, to mark their feces, the house sparrows come and eat it out of the feces before you can...

Alie: [*anguished noise*]

Rachel: [*shaking-a-fist voice*] Uhhh, the house sparrows! Yeah, they eat the seeds out of there. So that's not a good marker. And then the chimpanzees are probably the worst because...

Aside: [megaphone voice] Hang on to your stomachs; gag triggers ahead.

Rachel: ...they see that pretty green feces that someone just defecated, and then they go eat it.

Alie: [sad, disappointed voice] Ohhh no, chimps.

Rachel: And they all eat it, so then everyone has green feces. So you cannot mark a chimpanzee's feces. Just because everybody else eats it, and then everybody else's feces is marked.

Alie: How did the glitter experiment go?

Rachel: It went pretty well. You know how the nontoxic glitter has different colors? Well, when we fed it to our lions, they basically pooped out silver glitter no matter what color we gave them. But I had a graduate student, Chris Schell, that worked on coyotes. The coyotes, they actually would still poop out the color of the glitter. Their system didn't eat off the color of the glitter, so he could use multiple glitter colors to mark the different coyote feces, which was awesome.

Aside: Side note: Of *course* you can purchase glitter-filled capsules, and of *course* people sell them on Etsy as "Shitter Glitter" pills. But according to reviews, you gotta take a lot of 'em. And also, some glitter is actually just tiny plastic pieces. So let's just make a pact to not. Also, speaking of canines... I'm sorry, I had to ask:

Alie: I have a question. What was your dog's poop doing in the lab? Was that just tracked in on a shoe, [Rachel laughs] or... were you comparing?

Rachel: I use all my animals to develop our methods. We were studying domestic dogs in and around the Serengeti National Park in Tanzania. The domestic dogs are used for service; they help protect the livestock from predation. The problem with domestic dogs is that they give diseases like canine distemper or rabies to the wildlife, but also rabies to people. So we started up a vaccination campaign to reduce distemper, which was affecting the lions, and then reduce rabies, which affects a lot of species, including people.

So I had to sort of develop the field methods to take to the Serengeti so that we could extract the hormones from the dog feces. So then I was using my dog's feces. I've used my cat's feces, I use my dog's hair, my dog's toenails (we'd do toenails). [Alie laughs] We haven't done horse poop yet, but we've done horse hair. Because I just have it, and if we're just kind of trying to develop the methods in the lab, we just need a product. We need something to work with. So, yeah. We use all my animals.

Alie: Use what you got! Do you ever have any humans come to you and say, "Hey, Dr. Poop, can you see if I'm doing all right?"

Rachel: Uhh, no. We don't do any human service stuff. Though it's been accidental where we've tried to develop some controls for our hormone assays and used human urine to do that. At the time, my technician was pregnant and didn't know it and... you know, wow. We had some progesterone controls there. That was accidental.

Alie: Did you let her know?

Rachel: Oh she found out, yeah. She was doing it and she found out and she didn't tell anybody, because you have to wait for a while, of course.

Alie: What a way to find out.

Rachel: Yeah. What a way to find out. Mhmmm, yep.

Alie: Just a busy day at the office!

You mentioned a little bit about bowling ball rhino [*low-pitch, slowed down voice*] poo, which I'm still boggled by. Does it really come out like a bowling ball?

Rachel: It does. Yes. And then...I don't know if you've ever seen a dog do this, where they scrape their back legs after they go the bathroom?

Alie: Yes.

Rachel: That's a sign of territoriality. They're marking their territory. And rhinos do that, but they purposely step in their feces and then they walk away. Because that's how they mark their territory. They have these little latrines, called middens, where they come by, they defecate, they stomp in it, they scrape in it, and they walk away.

Alie: Rude.

Aside: Wow, wow. Wow. I don't know what your phone's data plan is, but if you get a hot second, feel free to google 'rhino pooping,' and you will find we are in good company with hundreds of thousands of people who have also wanted to watch rhinos shitting in their middens, which, by the way, is a word which comes from the Scandinavian for 'muck heap'.

One video by YouTuber Vagif Zeynalov shows the moment that a San Diego Zoo rhino turns its posterior to the crowd, lifts a tail, and averts its floopy pink poop shoot...

[*clip from YouTube video: voice behind the camera, "Oops;" crowd of people yelling and chattering in joyful disgust; voice over a loudspeaker, "and thank you for that."*]

... letting rumble forth a dozen wet cannonballs of mashed and digested hay, and a little liquid trickle at the end, kind of like a delicate bow. When Vagif Zeynalov took this vacation video, I highly doubt he knew that it would be getting nearly 800,000 views. But here we are. And, he's in good company with professional poop doctors.

Rachel: Actually, we're the rude ones because we put camera traps on the latrines, because we wanted to get them in the act, because it's very important - of course, this is all for science - to know when they defecated. How long has that sample been exposed to the environment? And I already told you that bacteria breaking down the hormones is our nemesis. We want to stop that from happening.

So we put the camera traps, and it takes a picture of the rhinos when they're "in action." [*Alie laughs*] And then we have also the time and date stamp when that sample was left, so we can study them. We were studying black rhinos in South Africa, and we rarely ever saw rhinos. They're so elusive. Those elusive poopers are really challenging, so you have to get stealthy, and you have to get these camera traps and figure out where to set them.

Alie: That's so illegal if it's humans. But if it's rhinos, it's fine.

Rachel: That's right. Exactly.

Alie: When it comes to smells, why are some so distinct?

Rachel: [laughs] It's because of what they eat! So, I don't know what I'm feeding my one dog. It may also just be the bacteria in their gut microbes that are causing this smell. But yes, it's definitely related to food and bacteria.

Alie: When you're doing your lab work, I've seen pictures of you: you're swabbing, you're cutting things, you're stirring them with what looks like a tiny immersion blender. [laughter] Is that correct?

Rachel: I call it a special test tube blender. Yes, a homogenizer.

Alie: A homogenizer, yes, is the science word for it. But it's really like if you were going to froth up, like, a latte... [disgusted laughing]

Rachel: Exactly. I tell people that's our field methods. I said, "Do not use this to make mixed drinks! This is just for feces." [Alie laughs] Let's keep it separate. Yes, totally.

Alie: Feces only.

How are you running those assays to figure out what kind of hormones are in there? How do you deal with all the data, I guess, is my question?

Rachel: [sigh] One day at a time. It is overwhelming, because conservation is a crisis science. We are losing species so quickly. So we all want to work together, we all want to get things done, but it gets overwhelming with all the data. Here, every month we're collecting samples from our zoo animals. When we have questions, we're analyzing them, we're graphing them, we're sending them to the managers so that we can work with the managers. I'm helping them manage their animals. It can just be overwhelming. But I have a lot of graduate students, so it's their responsibility to keep the data all organized, and graph it, and show it to me, and analyze it. So that helps having students, and staff members, too.

Alie: What's your Purell routine? Do you have a hand sanitizer preference, or do you become desensitized, like, "Poo's poo! It's fine."?

Rachel: You have to be careful, because there are diseases in feces: parasites, viruses. We have to periodically remind people that this is feces, and you have to be careful. We have lots of protocols. You *never*, even in your office, eat anything that's hit the ground. There's no five second rule around us, for sure! [Alie laughs] We have a dirty lab, and we keep feces in a certain place, and it has to be either zip-locked in a bag to be in another place, or it's in the fecal lab. We have these strict rules to make sure that we don't have any contamination, any spread of diseases and stuff. So it's really important, actually, because it still is poop, though we're pretty desensitized to it.

Alie: Do you think that's where the kind of wiring for shame around number two happens? Because it's easy to be like, "I gotta go pee!" But you would never be like, "I'm gonna go take a dump!" You would never announce that. Are there certain animals... Does it happen more with primates, or social animals, that seem more embarrassed about taking a dump?

Rachel: I don't know about embarrassed, but there are what I call the elusive poopers, like cats, who bury their feces. They hide their feces, unlike some ungulates, like deer, that may walk and poop at the same time. Rhinos have a specific location

where they're going to go; they're going to their midden, they're going to defecate there. Dogs are just kind of, you know... [*low-pitched, bark-like woof*].

I mean, there might be some personalities that may be a little bit more shy than others. But typically, the feces, they're either trying to hide that they're there and so they're going to cover it up, or they're advertising that they're there. Or they don't care. So it just kind of really depends on the species.

Aside: P.S. I asked the internet why humans are ashamed of their own poops and got back everything from our innate desire to avoid parasites - because even deer, and sheep, and cows do not graze where they plop - to the Bible. Deuteronomy 23:12, anyone? [*old timey snobbery voice*] "You must have a place outside the camp to go and relieve yourself. And you must have a digging tool in your equipment so that when you relieve yourself you can dig a hole and cover up your excrement." So, yes. Even God politely asked that you drop all deuces downwind, and away from the camp kitchen, okay? And when I say you, I'm including raccoons.

Alie: I think I have a raccoon latrine in my backyard.

Rachel: Ooh. That's not good.

Alie: I know. Roundworms, right?

Rachel: Yes.

Alie: In the brain. Luckily, it's down the hill for me.

Rachel: Yes.

Alie: But I was like, "Who's been poopin' in the yard?" And I looked it up, and I think it might be a raccoon toilet.

Rachel: Yes. That's not good.

Alie: I've been cursed with a raccoon toilet.

Rachel: Yes, yes.

Alie: You should call a professional for that, right?

Rachel: I would definitely either avoid it, or try to bury it, or something. Yeah.

Alie: [*heebie jeebies noise*] I got so excited about having raccoon parties and then I was like, "I don't want a brain parasite!"

Rachel: Yeah. I mean, there's some reasons why there's human-wildlife conflict. And then some other things that we should appreciate nature and engage with nature, but we also have to make sure that we stay healthy and the animals stay healthy, too. Some of our habits, too, are bad for them. Like leaving trash out.

Alie: Oh, for sure. Yeah, we don't want to leave a Vegas-style buffet for a raccoon.

Rachel: [*laughs*] No, exactly.

Alie: I wanted to ask - and I ask this of a lot of ologists - is there a movie or a TV show that deals with this type of science, or poo in general, that you feel like really gets it right or wrong? How is the poo emoji? Is the poo emoji on point, apart from the eyes?

Rachel: [laughs] No. It depends on the species, right?

Alie: Right!

Rachel: That's more kind of a primate poo, than a... it's not a ball, it's not an olive, it's not a golf ball, or a bowling ball, so...

Alie: Yeah, that's kind of insular of us to choose a primate poo.

Rachel: Yes.

Alie: Primates tend to have like the chocolate soft serve. Do you have a problem going to soft serve yogurt places?

Rachel: [laughs] No! In fact, I make these awesome chocolate mint cookies every Christmas that are shaped like poo, like a little round poo. [Alie laughs] And they come from the fecal lab. You know, "Happy Holidays from the fecal lab!" I put some powdered sugar on there, so less like *poo* poo. Yeah, no. I think it's funny.

Alie: I think it's great.

Rachel: Yeah!

Alie: Which species does it most resemble?

Rachel: It's probably more like a camel than anything else. Yeah. Because it's just like a little ball.

Alie: It's a golf ball?

Rachel: Uh-huh.

Alie: I have so many questions from listeners that I'm holding off asking some of them, because I know listeners want to ask them. So can I ask you Patreon questions?

Rachel: Sure!

Alie: Okay, good.

Aside: But before your burning poo questions, a quick break. Each episode we donate to a charity of the Ologists' choosing, and the Lincoln Park Zoo of Chicago funds so much great conservation work and remains *free* to all visitors. Which rules! So Rachel, aka Dr. Poop, would like a donation to go to them. It's a really beautiful campus, so do take a stroll around next time you're in the Windy City. That donation was made possible by sponsors of the show, who you may hear about now:

[Ad Break]

Okay, let's get to your questions.

Alie: Okay. Questions from patrons. We got close to 300 in 24 hours. People want to know about poo. Sandro Abate made a comment and just said, "What a shitty subject" with a poo emoji and also a tongue out emoji, which is not a good pair if you ask me, visually.

But the most popular question I would say we got, it was asked by Joe Weinhoffer, Sid, Rachel Weiss, Haile Hullings, Paul Hancock, Jeffrey Doyle, Madelyn Winter, Schmitt Thompson, Toby James, and then first-time question askers Karen Ellyatt, Bennett Gerber, Kylie Torres, and JJ Pierce. Everyone wants to know.

Karen Ellyatt says: Wombat poop square. What the hell is that about? How? Why? What?

And Paul Hancock said: How do they make a square poop with what I assume is a round bum hole?

Rachel: [*laughs*] Wow. I actually had no idea that it was square, because we don't have a lot of Australian species here.

Alie: They shit a brick!

Rachel: Yeah!

Alie: It's so weird. I think something must have gone viral on the internet, like a few months ago, because I did not know that wombats poo square!

Rachel: Yeah! Wow.

Alie: I'll look it up. Isn't that crazy, though?

Rachel: Yeah, that is crazy. Because ouch, those corners!

Alie: I know. [*Rachel laughs*] I know! There's no way that they can have a rhombus butthole.

Rachel: And it doesn't form when it hits the ground and be like [*wet thwap*]?

Alie: I don't know! I don't know. But I thought people were joshing. I thought they were shitting me, but apparently they're not.

Aside: Of course I'm going to have your back(side) with an explanation here. This is a pretty new finding. In the 50 million years that wombats have been waddling around the planet, these large, potato-shaped marsupials have shit mysteries. Until November 2018, when Georgia Tech scientist Dr. Patricia Yang, a fellow scatologist, lead authored on a paper titled, "How do wombats make cubed poo?"

They took the intestines of two wombats who died from vehicular wombicide, and as another author David Hu told *Science News*, quote, "We opened up those intestines like it was Christmas." They found, by blowing up balloons, that in the last 8% of the intestines, water is absorbed, and the lumps get dry and are shifted around in a way to compress one side and then the another, and then boop! A very dry, square peg shoots out of a round hole. They can pop out up to 100 of these 2-centimeter suckers a night, and they stack them up in piles to communicate to other wombats. What is life?!

Also: Color-wise. Let's talk about it. Stercobilin is what browns it down, and it's the product of metabolized blood and bile. More pale, floaty, and, 'offending' stool might mean higher fat concentration and faster transit time. It may indicate a pancreatic issue, y'all. And super dark and/or bloody could be signs of internal bleeding or a tumor. So take a peep, and then talk to a doc. Probably not a Dr. Poo at the zoo, though.

P.S. If yours has ever been like a St. Patty's shade of green, and I'm looking at you, Patrons Tara and Janna, it was likely - you ready for this?? - from eating something with blue food coloring, which breaks down into this very concerning verdant hue. Drink a few liters of Purplesaurus Rex Kool Aid. Get back to me. [*megaphone voice*] Actually, please don't.

Alie: A lot of people: Megan King, Grace Lauren, Joe Ferrentino, Logan K, Dawn Zwart, Ryan Clark, and Emily Crook, first time question askers Emily and Joe, they want to know why dogs love to snack on poo.

Rachel: Ugh.

Alie: What? Why?

Megan King says: Why do dogs enjoy eating cat poop so much? They treat them like I treat nonpareils. Like candies [*laughs*].

Aside: Also: nonpareils are those flattened chocolate kisses with sprinkles on one side. Even though actually the little round sprinkles are the nonpareils, and in French that means “without equal.” But they look like a pile of colorful, hard-shelled deer droppings on a microscale.

But yes: Why do dogs eat cat turds like they’re candy?

Alie: Do they know something we don’t?

Rachel: [*laughs*] Well, first of all, cat poo is really stinky and pretty much they're supposed to be straight carnivores. It’s all about what they're eating, right? And it smells so good - to the dog, of course. [*laughter*] I think it's just odor. And then, you know, dogs maybe like to be a little bad sometimes.

But there is some evolutionary history to feces-eating. Especially with a female - a bitch with her litter - because they want to conceal their litter. So they'll actually eat the feces. Before the pups can really do anything on their own, they lick their hiney to cause them to urinate and defecate, and then the moms eat it. I don't know if more females do it than male dogs, but there is a reason why they would eat feces.

Now, the other species... Like, my dogs eat horse poop, they eat rabbit poop, they eat dog poop. I mean, it's terrible. It's just really gross. Especially when they burp, you know, you're just like [*grossed out*] ohhhuhuh. But anyway, there is a reason why. The evolutionary history of it, it's to conceal their den.

Alie: Other patrons had the question, and I will list their names later...

Aside: ...Okay, now is later, and first-time question askers Kyle Wilkinson, and Ashley Curtin, and Elliott Warden want to know:

Alie: Why do some species of animal eat their own? Like twice? Like lagomorphs, rabbits and certain animals are like, “Mmm, let's have at it again!”

Rachel: Yes, so, rabbits have two types of feces. They defecate out vitamins and minerals, and so they have to actually eat that in order to absorb it. I don't know the whole biology behind it. Their body has to break it down a little bit before they can actually ingest it. So they have to eat it. Then they have another kind of defecation, which is like the waste product.

Alie: [*gasp*] Man. I wonder if they're excited because they are their own vending machine, or if they're like, “*Why* do we have to eat our own shit? No one else has to eat their own shit other than some of us!” I wonder.

Rachel: “It's a good thing we're so cute.”

Alie: I know.

Rachel: Right? I mean, ugh. I don't know why that would be, except for their digestive system maybe is not as efficient, or able to absorb some of those nutrients. So they have to eat it.

Alie: Yup. Leftovers!

Rachel: Yeah!

Alie: You know, my mom calls leftovers, 'French cooking.' She calls it, 'déjà vu.' She's like, "We're having French tonight!" So I guess they just have a lot of leftovers.

Rachel: Yes.

Aside: Wow, this episode. Learning a lot, folks. Such as: the little nugget that rabbits don't just eat their poo, they eat special hindgut-fermented and very nutrient-rich poos, called 'cecotropes', which usually are dark, and lumped together, and look kind of like a blackberry, but made of dark poo. According to one rabbit care site, cecotropes are "soft, sticky, and pungent, and usually eaten directly from the anus, so you won't often see them." Out of sight, out of mind. Please, dear Lord.

Alie: Abigail Ervin-Penner, first-time question asker, asked: Why do different species have different-scented poop? Like a cat-poop candle would smell so different than a dog-poop candle than a human-poop candle. But all cat smells the same, and all dog poop smells the same.

Is that just dietary, do you think?

Rachel: I definitely... I can tell which dog left the pile. [*Alie laughs*] There's definitely an odor difference. But yeah, again, it's about the microbes in the gut and what they're eating. For sure.

Alie: God, I hope no one ever makes a cat poop candle.

Rachel: Oh, God.

Alie: Do not want. Never, anyone.

Rachel: There's a reason why they bury it, right? [*laughs*]

Alie: Yeah.

Ahmad, first time question asker, wants to know: How full of poop are we, exactly, at any given point in time, do you think?

Rachel: Wow.

Alie: How much poop is in us?

Rachel: I just think about those colonoscopies and how much liquid you have to actually drink to clear it out. I mean, that's a lot!

Alie: Yeah.

Rachel: I can't remember how long the intestines is. It's like 120 feet, or something ridiculous. So if you're not eating a lot of [*slowed down, low-pitch*] fiber, that could be in there for a while, I think.

Alie: Isn't it crazy to think whenever you're just like sitting at a party that there's a ton of poo there, but it's just in bodies?

Rachel: I just... I try not to think about it. Especially on the airplane, when you're all stuck.

Alie: Oh, yeah. I was on an airplane this morning.

Rachel: Yes.

Alie: Ohhhh, thought about that.

Aside: P.S. I looked this up, and for every 100 pounds of body weight you make about a half pound of solid waste a day. But I saw one Reddit post - I mean, let's be honest, I looked for one - from a guy who, per doctor's orders, was taking a pre-colonoscopy, what he called "military grade" laxative. And, though fully hydrated, he says he offloaded 8 pounds of cargo.

Now, this next question was also asked by Jennifer Tran.

Alie: A few people had questions, including Karen Ellyatt, about civet-poo coffee. Like, what happens in seeds when coffee beans have to pass through an animal?

Rachel: Some seeds... I don't know much, but they have an outer coating that has to be broken down. So I guess the digestive system of some of these species is really necessary for, a lot of plants actually, to have their seeds ingested and then defecated. So, it breaks apart the outside to help them germinate.

Alie: Oooh. A lot of people had questions about positioning. Monica Schneider said: I've heard that squatting is the optimal position for our digestive system (I'm picturing my dog). How did toilets evolve to be so upright? Or, should we, as primates... should we be squatting more?

Rachel: It's a cultural thing, I think. Because if you go to Africa, you're squatting. It's a porcelain squatter, but you're squatting. So, I've heard that you're supposed to squat.

Alie: Do other primates, chimpanzees, apes... Are they squatting?

Rachel: Yeah, they're squatting. Yep.

Alie: They're definitely not sitting on a ceramic bowl reading a phone for 20 minutes.

Rachel: *[laughs]* No, they're not.

Alie: Sid Gopujkar wants to know: Does any animal have nice-smelling poop?

Rachel: Actually, yes. *[DJ airhorns played to a party song tune with upbeat bass]* The Giant Panda has poo that smells like tea. They're eating bamboo and it literally smells like tea. Here we were... We freeze-dry poo sometimes, and some lucky scientist was freeze drying his Giant Panda poo while I was freeze-drying my fishing cat poo *[Napoleon Dynamite: "Lucky!"]* So, yes, Giant Panda. Smells like tea.

Alie: Did that change your relationship to tea?

Rachel: No, but I really kind of despise the Giant Panda, for all these certain things about them. Even though they've been a very successful program, right? They dropped their endangered species status, and so... But yeah, it's just like, one more thing where, you know, Giant Panda got a lot of funding because of the way they look, and they're an icon

for wildlife conservation, and then something like a fishing cat or a black-footed ferret, which is smaller and less known, they tend to get less funding. So I was like, *[frustrated]* "UGH! Even their poo smells good!"

Alie: I love that Pandas got haters. It makes sense. They get so much attention.

Rachel: Oh no, this is going to be broadcasted. *[laughs]*

Alie: No, it's hilarious. Vin Reddy wants to know, and several people asked this question: The Bristol stool scale, have you heard of it? Where it's like, I guess, certain consistencies...

Rachel: Yes.

Aside: This was also asked by Hailey Temple, who called the Bristol Stool Scale, "The Best Thing in the Universe." And while that might be a little hyperbolic, Hailey, it's a great guide for people with IBS or problem poos to communicate to doctors, or friends in the group chat. None of my business. But it features types 1-7 in turdly-firmness.

Number 1 is separate, hard lumps, like nuts; 2 is sausage-shaped but lumpy. 4 is snake-like. We've also got some soft blobs, some fluff, and finally, number 7, entirely liquid. Ah, yes. The Bristol Scale. Who was this genius Dr. Bristol? Well, sadly, he exists only in our mind's brown eye. This iconic piece of medical communication was the brainchild of Drs. Stephen Lewis and Ken Heaton, who drew it up at a teaching hospital in Bristol, England. And I don't know why they didn't jump on the PR opportunity to name it the Lewis-Heaton Stool Scale.

Alie: Is that the same for different animals or is that just a human thing?

Rachel: It depends on the animal, what their normal texture should be, right? And then, yes, any kind of variation from that, you know, is it dietary, is it illness? It's definitely an indicator of health.

Alie: Do other species check out their poops?

Rachel: Well, their buddies do. The rhinos are coming in to check out everybody's poop, in particular. And then the chimpanzees are coming to check it out, and so they're eating what's in it. Don't ever put corn in there.

Alie: *[disgusted]* Actually, I'm glad you mentioned it. Definitely had a corn question or two... KC Newhaven wants to know: What's up with corn, and why don't we properly digest it? Another person had the same question, which is hilarious. Melissa Croce had that question too.

Rachel: A lot of species... I don't know if it's just, like, the fiber, the cellular nature of corn that makes it not as digestible without being processed, but we use it to mark a lot of feces. Not a lot of animals can digest corn.

Alie: Really? So if you see kernels, there's nothing wrong with you?

Rachel: Yeah, there's nothing wrong with you at all.

Alie: Allison Hughes wants to know: What is up with fecal transplants? Is this just a fad in humans, or are other animals getting these done too? Like, do animals eat others' poop to get the microbiome?

Rachel: I think this actually came from the cattle industry, because they have what's called fistulated cows. And it's actually, like, a porthole. They've sown on the cow... Because the rumen bumps up right to the body wall, and you can do a surgery, and then you have a hole right into the rumen.

Aside: The rumen is the first of four stomach chambers in ruminants. And in cows – ready for this? – it can hold up to *40 gallons* of sloshy, chewed-up grass that ferments like your roommate's kombucha experiment. And at vet schools like UC Davis and Rachel's alma mater, Clemson, they'll often have cows with an open porthole in its belly into which you can insert a gloved arm.

Rachel: They make the cow swallow a pill and you have to catch it as it comes into the rumen.

Alie: [*grossed out and confused vocalizations*]

Rachel: So, you're reaching in there, and all the rumen fluid is churning, it's like, squeezing. They have to digest the forage that way. So it's, like, coming out in your hair, and you're like [*thppp thppp*] and like, "AhahHaAaA!" And you're reaching because you could get an A if you catch this pill coming through.

So when they give... The cattle, and other ruminants in particular, really need those bacteria, those microbes, to digest their food. And so, if you give them antibiotics that wipes it out. So they literally will take it out of the rumen from the fistulated cow, the healthy cow, and put it into the others.

I think they'll put it in a pill. They'll have them swallow it like we would too, but they're learning so much. This is not my science, but microbial ecology and the relationship between our health, even our stress responses with these gut microbes, it is really important. And they're learning all this information. I think it's really valuable. It's not just a fad. It's something we're going to learn more and more about because we're learning how these microbes control a lot of our responses.

Aside: See the Microbiology episode with UCLA professor Dr. Elaine Hsiao, who is a leader in studying how our guts and butts affect our brains.

Alie: Do you find that studying cortisol and stress hormones in animals... do you ever find yourself relating that at all to your stress response? Or if you're looking at how certain animals might be stressed when they're lonely, or when they change habitats?

Rachel: Yes, we look at that because we want to make sure we minimize stress, and we look at... What I've found is transportation is one of the highest stressors. Maybe you can relate to that today.

Alie: Literally have been on a plane all day! [*laughs*] Got up at three in the morning to catch a flight in the snow. Oh god.

Rachel: It's very stressful. Even though we have the Brookfield Zoo close to us, and it's less than 20 miles away, but of course there's Chicago traffic. But even coming from that short distance is a stressor. So, we learn about when animals are particularly stressed during this process because we *have* to bring in new individuals. We have to share them between zoos in order to maintain the genetic health of these species.

Alie: And you mentioned that you live in Indiana, 60 miles from the Chicago Zoo. Do you ever think about that during your commute?

Rachel: It's like my time by myself, because when I get home, the dogs want me, the ponies want me, the cat... Well, the cat... Yes and no, the cat wants me too. And my six-year-old son wants attention. They all want attention. They all want food. And they all want it now, so I'm like, go go go. So the hour and a half I spend in the car is, like, my alone time. I knew what I was getting into when I moved that far, but if you want to have your ponies in the backyard you have to live so far away from the city.

Alie: I think it's great that you have a balance of both.

Rachel: My job... You know, as you get more and more advanced in your career, you tend to get further away from what you loved about it in the beginning. Like, I love working in the lab, I love working with the animals, and so to get my animal fix I get it at home, even if it's just shoveling poop, which I do a lot of.

Aside: This next one was asked by Isabelle B Holper, M Wing, Christina Weaver, and Joe Weinoffer.

Alie: Why do animals have such different shapes? Why do rabbits poo pebbles and others are bigger ones? What's going on there?

Rachel: I've been asked that question before. I should've looked it up, but yeah, they all have their different shapes. And like I said, even individuals have their own special, kind of, shapes. Like horses have the kidney-bean shape, and then there's pellets, and it must be related to their diet that causes them to do that, and the passage rate through the gut system.

Alie: It's so funny, if you ever see, like, a goat shit. It's just like a sock full of pebbles turning inside out. Like, "WHAT?! HOW?!"

Rachel: Yeah, and they just drop it and keep going like nothing happened and no one else thinks anything happened.

Alie: I know! Just not a big deal at all!

Aside: I looked this up, and one theory of pebble poos is that the more likely an animal is to be prey, the more risky it is to go take a drink of water, and the more water their body wants to conserve, producing 'Number 2s' that are Number 1's on the Bristol Stool scale; separate hard lumps, like nuts. Isn't that nuts?

Alie: Laura Springer wants to know: What is the coolest or more fascinating thing you've ever found out about an animal from looking at its poop? Any, just, bananas discoveries that you've made that really surprised you?

Rachel: A lot of times, particularly with our animals here at the zoo... like our hairy Sichuan takin, it's a giant goat-like species from Asia, it's very hard to tell when they're pregnant. So I am, like, the first one to know at the zoo when animals are pregnant. That is the coolest thing! We're like a doctor's office. We're all, like, hush hush. Even when people have, like, no clue. And I of course immediately tell them because when an animal's pregnant you can't give them certain medications and stuff so they need to know immediately what this is what happens. It's often that we are learning things that no one

else has learned before, and that keeps your job exciting, and fresh, and willing to work with poo every day.

Aside: For aquatic animals and amphibians, Rachel also has pioneered ways of measuring hormones with skin secretion samples, which she calls 'frog swabs'. And she says that's much easier than hanging onto a toad, waiting for it to unload on you.

Alie: I've seen a video of a toad dropping a log, and woooooow!

Rachel: [*laughs*] Toad poop is pretty big.

Alie: Giant!

Rachel: But the problem is they don't do it often enough, or sometimes, for us, they're doing it in water, so then I'm just like [*dismissive*] *psh!*

Alie: Yeah, who knows what's in there! Speaking of water, Heather Densmore wants to know: When we're in the ocean or a lake, are we just swimming in a bunch of fish poop? [*clip from Little Mermaid song, Sebastian sings: "Under the seeeeaaaa..."*]

Rachel: Yes, they definitely poop in the water, so you are swimming with poop, but it's hopefully diluted out, and then it becomes sediment. It drops to the ground. That's called marine snow. After a while it may, kind of, swirl around a little bit, so don't swallow water, but then it's eventually going to go to the bottom, and then other things are going to eat it.

Alie: Dinner is served!

Rachel: Yeah, it's a food cycle, right?

Alie: It's just like lunch confetti.

Rachel: Just like your dogs eatin' other poo.

Alie: Have you seen any of those videos of whales pooping? Ooohhh boy!

Rachel: Yes!! And actually, we published a poo picture in our latest paper on sea otters. Sea otters do the same thing. It's, like, a bloom of poo. So, how can we study the stress of a sea otter? It's really difficult.

Aside: This professional, published, academic paper about using whisker, and hair, and blood samples from otters features a full-color photo of a Monterey Bay Aquarium otter just, kind of, chillin', looking like a stoned guy in an oceanic jacuzzi. But if you look closely, with the discerning, scientific eye of a scatologist, you will notice a yellowish cloud off to its right. Again, this photo appears in Dr. Poop's *published* paper.

Rachel: Yeah, we totally have a poop picture. [*squishy splat*] How cool is that! Who gets to do that anymore, putting a poop picture in their publications?

Alie: Not enough people. Not enough people could grease the wheels with a little shit pic.

Rachel: [*laughs*] Well, we had to get our point across that it's very hard to get feces from sea otters, so here you go.

Alie: You're like, "This is why we're tapping otter veins. We *have* to." Last question I always ask: Shittiest about your job? This is a question I ask of everyone, but for you I actually do mean it. Like, what is the hardest, or most annoying, or irksome thing? What's one thing about your job that just sucks?

Rachel: Besides the saliva, stringing from one tube to another, I mean, I think the challenging thing is trying to do our science non-invasively, you know, because we want to understand stress physiology and you can't, obviously, stress them out for that. And so, that's why we develop all these different tools to study their stress physiology. So, that is very challenging. And then finding funding for these lesser-known species that really need the attention. Like the black-footed ferret, they really... We have 600-700 left in the world, you know? Some of that is very challenging when the Giant Panda gets, like, lots of money.

Alie: Right. You've got, like, Winnie the Pooh in a Halloween costume versus a weasel. Not easy!

Rachel: Exactly.

Alie: Is a ferret a weasel??

Rachel: Yes, it's in the weasel family.

Alie: Okay. I gotta do a... Would that a mustalotologist? What would that be?

Rachel: Yeah, I guess.

Alie: We gotta find one.

Aside: Anyone? Holler!

Alie: Hook me up with a weasel person! I want to learn about weasels. But yeah, getting funding, I hear from a lot of scientists that it's not their favorite part of the job.

Rachel: Yeah, and we write a lot of grants here at the zoo because we're a non-profit. We're a free zoo, and so we have to get creative with where our funding comes from.

Alie: I didn't realize that you guys are a free zoo.

Rachel: Yes.

Alie: So yeah, you've got to make it up other ways. That makes sense.

Rachel: Yeah.

Alie: And what do you love about your job as a feces researcher, the most? Dr. Poo...

Rachel: The most... I love about my job... It's really that I can say I'm making a difference. We're making a difference with conserving wildlife. Whether it's, you know, small amphibians that don't get a lot of attention, or ferrets. This is, like I said, one of the rarest mammals we have here in North America. And I work on a couple of those, and it's just like, we are figuring out... we're finding out why they're having issues breeding, or... Even here at the zoo when our animals are... it's just very difficult to put them together. Working with the managers to help them understand their animals better, understand what's going on inside their animal so they can respond and take care of their animals, or put them together when they're ready to breed. That's really rewarding, when we're successful and we have a baby rhino or two coming out.

The Black Rhinos in particular, they are a critically endangered species. There's a little over 5,000 in the wild, and here we've produced two in the last... I'm going to say, since

2013. And that is really cool, and I was part of that, and it was really rewarding to see those.

Alie: So feeling like being a poop detective lets you have a little bit more context for what the animals are going through, what's best for them.

Rachel: Yeah, because you can look at them but you don't necessarily know what's going on inside. And that is, you know, my skill. Poop Detective. And that's what's great about physiology, you can really understand how animals are responding to their environment.

Alie: So our hearts aren't on our sleeves, they're in our poo.

Rachel: *[laughs]* That's right!

Alie: That's amazing. Thank you so much for all the hard and not-always-great-smelling work that you do.

Rachel: It's my pleasure.

So ask smart people crappy and you're going to learn so much about yourself, and others, maybe too much. Dr. Rachel Santymire is a Lincoln Park Zoo, and you can follow them @[Lincoln Park Zoo](#). We are @Ologies on [Twitter](#) and [Instagram](#). I'm [Alie Ward](#) on [both](#). Do come be our friends. Ologies merch is available at [OlogiesMerch.com](#). Thank you, Shannon Feltus, and Boni Dutch of the podcast *You Are That* for managing that. Thank you, Erin Talbert, for managing the [Ologies Podcast Facebook Group](#). Emily White and her amazing group of transcriptionists work to make sure these episodes are available for free. They are at [AlieWard.com/Ologies-Extras](#). There's also bleeped episodes if you want to listen with kids, or a class, or with my parents. And there's a link to that in the show notes.

Thank you to Jarett Sleeper of the podcast *My Good Bad Brain* for assistant editing. And of course, lead editor Steven Ray Morris for all the piecing together each week. He hosts the podcasts *See Jurassic Right* and *The Purrrcast*, and just generally he's the shit. Nick Thorburn wrote and performed the theme music.

If you stick around past the credits, you know I tell you a secret. And this week, I'm going to keep it on theme. Don't get too excited, but as a kid I had a hamster named Bacon, and she was just skittering across on the kitchen counter, she dropped a few little gifts. I had only seen hamster droppings, like, way after the fact, and I just ass-umed that they came out as hard, dry pellets. So I tried to brush them into the sink, not realizing that they would just be mushy. And so anyway, that's about the time I smeared poo confetti all over the kitchen counter and learned, "Wow, hamsters, comes out just like us." Also, I scrubbed the counter pretty hard. I never told my family though. Sorry, guys!

Okay, berbye!

[clip from Jurassic Park, Dr. Ian Malcolm: "That is one big pile of shit."]

Transcribed by

Your Canadian pal Aska Djikia and her beloved furry poop-machine, Lenjamin.

Clara Chaisson, Cambridge, MA

Emily White

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