

Mycology with Dr. Tom Volk

Ologies Podcast

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Oh heeey, it's straight-up your weird internet Dad, just sniffin' candles in a blissfully empty aisle of a discount HomeGoods store, Alie Ward, back with another episode of *Ologies*. One that you have requested, rather, you have begged for since the inception of this podcast. I keep hearing, "Dad Ward. Mycology. When?" And I keep saying, "Settle down. I have a plan. Please trust me." All this time, the mycelia have been growing and it's finally time to enjoy my dirty bloom. That's... gonna make more sense later.

But first, okay, a little bit of business. And by business, I mean thank yous. To all the folks on Patreon supporting this podcast for as little as 25 cents an episode, thank you so much for making this whole thing possible. And thank you to anyone who makes sure that they are subscribed and have rated the podcast. Special tip of the ol' hat to those who leave reviews, which I read when I'm sad. And then I pick a fresh one each week to read you, such as this one by MPostLigator, who says:

Alie approaches each scientific subject with the eagerness of a toddler meeting kittens.

MPostLigator, I feel seen. And also attacked. And I like you for it.

Okay, mycology, what is the etymology of mycology? Let's start with it. How did this word burst forth from our brains and out of our mouths? So *myco* comes from the Greek for fungus. And little bonus points for you, the word fungus itself has its roots in the word for spongy.

So, this mycologist – oh my word, whoo! – has been on my list for well over a year and he is a major reason why I took a Midwest road trip a few weeks ago. I wanted to find the best mycologist out there, and I asked Eugenia Bone, author of the book *Mycophilia* (thank you to *Talk Nerdy's* Cara Santa Maria for that intro) and she told me that this ologist is "a mycologist of the utmost charm." I had to meet him!

So, on a rainy spring morning I headed to the University of Wisconsin-La Crosse, and I stayed in a charming B&B that was apparently a castle built by a lumber baron. Whatever! I navigated to the campus, up some old elevators, [*elevator ding*] down a linoleum hallway, right to his office, [*clip from the visit: Alie, "I found you! Hi, I'm Alie!" Dr. Volk, "Great, hi! How're you doing?"*] Which was this thrilling jumble of mushroom knick-knacks, and maps, and hard-bound dissertations of his former students, and he himself stood up. He has gauged ears and salt-and-pepper hair which he streaks with purple or pink. He stood up to greet me, he was wearing a short-sleeved shirt that was screen-printed with mushrooms and ferns. Both of his arms are heavily decorated in fungus-themed tattoos. He's the best! And having run a mushroom and fungus webpage for nearly 25 years – when the internet was just a squirmy baby – this guy has been cool since before you were born.

He's been a Professor in the Department of Biology at the University of Wisconsin-La Crosse since 1996 and teaches general mycology, medical mycology, not to mention he's helmed some classes in food and in industrial mycology, also classes in Latin and Greek for scientists. Ahh!! He seems like the kind of guy I would have gone to concerts with in my goth days and then spent all night talking about cell division in a Denny's while our friends smoked cloves in the parking lot. This is truly the highest compliment I could give a person.

Anyway, he let me pepper him with questions for an hour, and we cover: what the hell is a fungus, foraging under the forest canopy, fairy rings, magic mushrooms, being blindfolded in the woods, the tastiest mushrooms. Plus, mildew, fungal infections, and how having a part of you replaced can

change the way you live your life. Hm! So prepare for a budding fungus obsession with a mushroom expert of the utmost charm, mycologist Dr. Tom Volk.

Alie Ward: I would love to know, when did you start getting interested in mushrooms? When did they become captivating for you?

Dr. Tom Volk: So, I took a course in mycology in 1978 at Ohio University and I found out that you can get free food! [*Alie laughs*] And that was good, and it was pretty different. I'm sort of a different kind of person, and so that appealed to me, that it was something unusual and not very many people studied and knew about, so when it came time to go to grad school that's what I decided I would study.

Alie: Did they give you free mushrooms to eat?

Tom: Well you can find 'em in the woods, they're all free.

Alie: [*laughs*] But there's always the risk of foraging; you have to get really good in order to get free food out of the woods.

Tom: Absolutely. Well, there's a few you can learn right away that are pretty easy, but then it gets trickier after that because you could get sick or even die if you eat the wrong thing.

Alie: So knowledge has to be on your side?

Tom: Absolutely, that's true for everything, right?

Aside: So on the topic of knowledge, Dr. Volk got his Bachelor's in Botany from Ohio University and his PhD in Botany with a minor in Genetics from the University of Wisconsin-La Cross, where he teaches now. And he studied, among other things, the life cycle of the coveted and delicious morel mushroom, which are the ones that have a spongy-looking honeycomb texture and sell (fresh) for upwards of \$60 bucks a pound! If you're like, "Where, pray tell, can I get me some of that?" Hang tight, there's gonna be some foraging secrets in a bit. But first, let's ask a smart person something pretty stupid.

Alie: And this is such a basic question, but what *is* fungus? What is a fungi? Why does it have its own kingdom? It's neither animal nor plant... What's happening?

Tom: Yeah, remember in the olden days when you were in school, you probably learned about the two kingdoms – the animals and the plants – and fungi were included with the plants because they didn't move, and they have cell walls and all that. But it turns out that fungi are more closely related to animals than plants, so physiologically and genetically, they're much more similar to animals than plants. But they're really different than animals, obviously. The cell walls of chitin... They share the chitin in common with some animals. Arthropods, insects and such, have chitin exoskeletons, and so that chemical is in common.

Aside: What is chitin, you ask? It is a word that looks like 'chitlins' but minus one 'l'. Fungus, hog guts... all things that seem dicey to eat but are a delicacy if sourced and prepared right. So, chitin, the thing that makes up the cell walls of your favorite mushrooms, is technically a long-chain polymer and a derivative of glucose. But the important aspect is that it gives arthropod skeletons and fungi cell walls some rigidity (and a little chew, if you've ever eaten bugs). So, how varied are fungi? There are an estimated 5.1 million species of fungi. Now, that's about 13 times as many species as plants known to science.

More importantly, how do you pronounce 'fungi'? Because Tom said "funj-eye" and I think I said "fun-guy".

So I asked my good friend, Wikipedia, and they said this is how you pronounce it in the US – definitively, it's this way: [*clip from Wikipedia, "funj-eye"*] Got it. Okay. Oh wait, there's another audio clip. You can also pronounce it this way: [*"fun guy"*] Okay... Oh, there's a third way. What? [*"fun-gee"*] [*big sigh*] Okay... or.... [*"fun-jee"*].

Oh my god. Okay. So just, say it however your mouth wants to say it. Let's get back to kingdoms.

Tom: But they put the fungi and the animals in this group called the Opisthokonta, which refers to the rear flagellum. Some of the fungi, the primitive ones, have rear flagellum, and of course human males have the sperm with the flagellum, so that's one of the things that link them together.

Aside: Okay, so PS: Yeast possess 23% homologous genes to human beings. So you're walking around, you're wearing pants, you're driving a car, and you're like 23% kinda the same as a single-celled fungus. So, I don't know, go dance in public. Tell someone you're in love with them. Nothing matters! What even are we? What is life? That which humbles, liberates. So, tattoo that on a pillow. Embroider it on your butt. I don't care.

Alie: Can you tell me a little bit about the structure of fungi? I know a lot of people think fungi is just mushrooms, but that's just essentially looking at their gonads, right?

Tom: Right, so you're looking at their reproductive structures most of the time [*clip from 1981 movie Porky's: "Their private parts!"*] but what you don't see, most of the time, are the hyphae that are underground. So these are hyphae on my arm, and so you can see, if you were here – which you are – you could see the mycelium, the hyphae growing, and that's how they feed.

Aside: So, their "reproductive areas" are their most PUBLIC parts! It's kinda like if you wore a full-body spandex jumpsuit all the time, but it was crotchless. It's just the fungus way!

Tom: And so, when fungi feed, they can grow through the ground, they can grow through the wood or whatever they're growing on – through your brain – by dumping their enzymes to the outside of their body, and they digest outside of their body, and then they take in the small molecules and use them in metabolism. And so, it's totally different. They digest their food first and then ingest it, whereas we ingest our food and then digest it inside our bodies.

Alie: Yeah! And that's how they're breaking down substrates?

Tom: And that's how they can push through the soil or push through the wood.

Aside: Also, the fungus way: barfing on your lunch and absorbing a sandwich through your arm. It's casual, it's effective.

Alie: And now, you also mentioned our brains... just casually? [*laughing nervously*] What are some places that fungi live, and also I want to hear about our brains and how they might live there.

Tom: Yeah, I teach a course in medical mycology as well as mycology, and so there are fungi that will infect your brain.

Alie: Which kinds??

Tom: There's one called *Cryptococcus*, it's famous for that. It's a yeast and it usually gets the meninges – the lining of the brain – not so much in the brain. But there are some that will get in there as well.

Aside: Cryptococcosis, by the by, is what this is called, and oooohhh it's a nasty bugger. So, these *Cryptococcus*, the yeast form, their name means 'hidden sphere'. They're found

worldwide in soil, but for those with compromised immune systems, like folks with HIV, it can be fatal. Cryptococcosis accounts for 20-25% of the HIV-related mortality in Africa. So, it's no joke. Now, if you've ever lurked around on Goop, chances are you've seen scary articles like their [*valley girl affectation*] "The Insidious Yeast Infection We All Have."

Alie: And what's the latest on *Candida* yeasts, and whether or not they can cause the leaky gut syndrome? Has that been debunked by medical science?

Tom: There's a lot of things... If you look on the internet, every single disease that's possible is caused by *Candida*, this yeast. I think there's something to some of it, but there still needs to be a lot more research done with that. Yeah, there is *Candida* that passes through the digestive system because this is part of the normal flora of your body. You've got *Candida* in your mouth as part of the normal flora, keeping the bacteria in check. You swallow some of that and it goes through your digestive system, and some of it remains intact and goes through...

Aside: Okay, so I did a little digging on this, and systemic candidiasis can spread to the blood, where it's called candidemia, and the CDC estimates about 25,000 folks in the US a year will have a *Candida* overgrowth in their blood, but that the total number of candida overgrowth may be twice as high if other organs are the site of the primary overgrowth and it doesn't just show up in the blood. So yes, it does happen. [*skeptically*] Mmhhhh, in the millions-per-year? That we don't know.

But leaky gut syndrome isn't recognized as a medical diagnosis. Doctors call it 'increased intestinal permeability', which is kind of like how if your family calls you Scooter but you're like, "Don't call me that in front of my boss!" So it's pretty much the same diff.

Tomato/tomahto.

Now, speaking of food, if a *Candida* overgrowth diet – which suggests cutting out gluten, and dairy, and sugar, and alcohol – makes you feel better, there could be a number of reasons why.

Alie: And now, can you tell me a little bit about where fungi like to live? I know we think about them in dark, damp places.

Tom: Fungi are anywhere where they have enough moisture to grow and enough heat. They need a room temperature they like. Although there are some that will grow at very low or very high temperatures, most of them like this middle ground where they can do well. But you can find fungi in just about any environment where there's enough water to support their growth.

Alie: Why do you think they like darkness?

Tom: Well they don't like darkness, that's just where the food is.

Alie: Oh!

Tom: They don't necessarily need to be in the dark. They grow inside of things because that's where they can get in and that's where all the food is. Their main competition is bacteria, and bacteria can only grow on the surface, they can't push their way through the wood, or whatever they're growing in, and so the fungi can escape the bacteria by growing into the wood.

Alie: I always figured that they must be photophobic or something, but really it's just they're pro-food.

Tom: So, when they're in the log and they're growing, they just start growing their hyphae, their mycelium, to eat the food, but then at some point they reach the surface of the log again and the light is their signal to make the mushroom. [*clip from Contact: Launch technician, "All systems are go."*] And so, that tells them that they're outside of the log and that it's okay to make a mushroom. There's also more oxygen outside of there, so that's another signal for them to make the mushroom on the outside of the log.

Alie: And can you tell me the difference between the mycelia, the hyphae, and the mushroom? For anyone who's just like, "What? There's more to fungi than the mushroom?!"

Tom: Yeah, so there are these hyphae that are underground or in the wood – I'll just talk about wood for now – and they're not particularly dense, they're growing through the wood. But when they send up the fruiting body, the fruiting body of the mushroom is still composed of hyphae. And if you tear one apart and look under the microscope, they're still the same kind of hyphae, but they're all stuck together in such a way that they're very strong and they can put this thing up above the wood to make this mushroom so that they can release their spores and get somewhere else. [*"Wanna get out of here?"*] And so, the mushroom is made up of hyphae, but they're really dense in that form, rather than more spread out as they are down in the wood.

Alie: And then, where are these spores getting made?

Tom: So the spores are made on the gills of the mushroom. If you have a typical mushroom, you can see when you look at the gills that they kind of undulate up and down; they have a huge surface area. The spores are born on the external areas of the gills, things called basidia, these club-shaped things. Then the spores drop off of there and they're usually caught in the air and spread somewhere.

Aside: Awww, spores, they grow up so fast! And before you know it, they're just a huge web of underground hyphae, forming a mycelium and barfing onto their lunch, before just exposing their reproductive structures to the sun! Where does the time go?

Tom: So, they have to make this enormous number of spores because otherwise, the chances of landing on something they can actually use is pretty small if you're just randomly being spread by the wind. So they produce huge numbers of spores so that by chance some of them will survive.

Alie: It's just a numbers game? It's just a gamble? [*laughs*]

Tom: Absolutely. And so, you think about the gilled mushroom, but you also have some that have different ways of increasing the surface area, with pores underneath or even small teeth, or some of them are wrinkled. Some of them are smooth but they can dry out and revive, so they increase their surface area over time rather than by space.

Aside: If you like variety, may I suggest a mushroom obsession? There are cup fungi, and puffballs, and bracket fungi, and toadstool shapes, and lattice-types. Glow in the dark ones! Ones that look like they're bleeding terrifying human blood! And ones named after dicks! On and on and on! Now, with 5 million species, there's a whole lot of selection going on.

Tom: And so, there's a lot of different strategies that fungi use.

Alie: Do you have a favorite mushroom?

Tom: Favorite for what? [*laughs*]

Alie: I know, it's such a stupid question... When have you been out, lurking around, you're looking for mushrooms, and you come across one that's like [*angelic choral music*] Ta-da! Like, angels singing...

Tom: [*angelic music continues*] So, if it's food, then I'm talking about chanterelles. Chanterelles are, I think, the most delicious. They're bright orange, they can have these folds on the outside, and they smell like apricots. So they're fruity smelling, they're pretty dense, and they're usually not contaminated with bugs and stuff. [*Alie laughs*] That's just extra protein anyway.

Alie: When you go to the farmer's market and you see the mushroom stand, are you like, "Nice, but I can get 'em myself," or are you excited to see what their variety is?

Tom: I'm excited to see that people are promoting mushrooms, so I'm happy that the growers are finding a way to exploit the lifecycle of mushrooms so that people can try different things.

Alie: Does it help the mushrooms to get picked because then their spores go more places?

Tom: There's a lot of controversy about that; that's a whole different thing. But maybe. If you're taking them somewhere else, the chance of the spores landing further away might be good, and might be good for their genetics, but... You know, that's a half-hour conversation that you don't want to have. [*Tom and Alie laugh*] [*"Why don't you just shut up!" "No, you shut up!"*]

Alie: I trust you!

Aside: Okay, I looked this up. Boy howdy, whoo! This is a topic of fierce debate, but most hardcore mushroomers observe some basic fungal decency, and when they encounter pairs of mushrooms, they leave one and they leave behind the smallest 50% of the mushrooms they find. They try to identify mushrooms without picking them first, and, as you'll see if you google 'mushroom hunt', each mycologist collects in an adorable li'l picnic basket! Not just because it's cute as hell and looks like an outtake from a period piece set in the English countryside, but because the baskets allow for the spores to catch on the wind and go out and make more fungus babies. So, step 1, start basket shopping; step 2, send out a press release letting everyone know how goddamn adorable you have just become. Okay. And then, what's next?

Alie: How would you advise people if they are interested in maybe starting to forage, or starting to catalog mushrooms, or also want to make sure they don't eat the wrong ones?

Tom: The best way to learn is to have friends who will help you, or if you don't have any friends, you can make friends at any of the... I think there's 120 mushroom clubs in North America. So, you can join one of those and they go out on forays, which are little mushroom hunts.

Aside: PS: a foray is different from a forage. A foray is when you're looking at aaaaalll the ding-dang mushrooms, but a forage is when you're out specifically looking for edible yum-yums. So, Ta-daaa! We just learned that together.

Tom: You can learn a lot from people in the woods. They say, "Oh look, this is where you look for this one. There's a morel there, and look, there's an elm tree right there, so that's where you need to look." Everything is better in 3D. So if you're doing this with people, and you go on these big mushroom forays, you go out and find mushrooms, and then they lay them out on a table. You can look at them side-by-side, and find which ones are poisonous, edible, the things that look alike. You can distinguish between them much more easily if they're sitting there in 3D, so you can touch them, and feel them, and smell them, and everything else. There are really wonderful mushroom clubs that are fantastic.

Alie: Have you met some of your favorite friends, mushroom hunting?

Tom: Absolutely, yeah.

Alie: You have? What's the vibe like on a mushroom hunt?

Tom: There's a lot of different vibes on a mushroom hunt, depending on how competitive people are. [*Alie laughs*] Morel hunts are really different because that's really competitive. Sometimes people are, like, "Oh we found this, come and look at it!" Whereas on a morel hunt, they'll be like, "I found this, don't tell anybody."

Alie: Woah... because... will they come back and look for more later?

Tom: They might, yeah.

Alie: And then, what's up with pigs and dogs finding truffles?

Tom: You can train a dog to find anything, but the pigs are trained to it because it smells like a pig pheromone, [*Miss Piggy, "Oh Kermy!"*] so they immediately try to find that.

Alie: Do they eat them when they find it?

Tom: They can, yeah.

Alie: Have you ever been truffle hunting?

Tom: Yes, but not with dogs or pigs. I would like to do that.

Alie: How do you do it without a dog or a pig?

Tom: You look for where the squirrels have been digging, and the squirrels are digging them up, they eat them, and then poop the spores out somewhere. That's their method of dispersal.

Alie: Oh! It seems like, in the knowledge of mushrooms, you also have to have a good knowledge of soil systems, and animals, and trees, and substrates. Is that true?

Tom: Yes. In order to really understand fungi you need to understand the whole environment around them. And so, as a mycologist, I have to know about plants, and in order to know about plants you have to know about animals, and then all the other stuff in the soil. I've been studying fungi since my class in 1978 and only in the last couple of years do I think I have an understanding of what goes on under the soil. But I don't know it well enough to tell anybody. So that's what I'm working on, is being able to explain, or have a diagram, or have something, a diorama, that explains what I think is going on under the soil. It's really complicated.

Alie: Do you ever dream about fungi?

Tom: Always.

Alie: You do? What kind of mushroom dreams do you have?

Tom: Usually finding some big load. [*Alie laughs*] They say, when you go to Mushroom Hell, they replay your life and show you all the mushrooms you missed. "If you'd gone 10 feet further on this trail, you would have seen this," or "If you had turned left here instead of right, you would have seen this."

Alie: Do you have a favorite mushroom in pop culture? Do you ever see some and you're like, "That is *not* what that species looks like"?

Tom: The most common one, of course, is the red mushroom with the white dots on it. That's *Amanita muscaria*, and that shows up in all of the artsy-fartsy kind of depictions of

mushrooms, [*Alie laughs*] with the elves dancing around; which is kinda funny because it's a hallucinogenic mushroom, so to get those elves dancing around... And these mushrooms are red with white trim, and there's Santa, and reindeer flying, and there's elves dancing around and things like that. So, you know, the reindeer do actually eat these mushrooms to hallucinate.

Alie: Do they really?! What happens when a reindeer's shroomin'?

Tom: I don't know how you tell for sure, but they do. They guard their little cache of mushrooms under the snow.

Alie: Oh my god!

Aside: Oh boy, okay, so, without falling down a real *Alice In Wonderland* mushroom crevasse, I'm going to briefly relay that this is just a widely circulated "no doi!" I had no idea. So, the Sámi – Indigenous people of Northern, *Nooooorthern* Scandinavian regions – are like, "Yeah dudes! Guy from the North Pole, he's being pulled by a sleigh of reindeer? We do that. Comes to your house in winter, tripping balls on red and white mushrooms. Hmm? Red and white? And then gives you the gift of advice from another dimension. Duh!" And the reindeer – also tore up on shrooms – are like, "Woo! Check me out man, I'm flying! I'm a reindeer and I'm flying in the air! Oh shit, man." Look, even the BBC has reported on this.

[*male narrator from BBC:*]

In autumn, reindeer seek out the mushrooms, even under an early fall of snow. [magical bells, and reindeer digging at the ground] No one knows whether the reindeer are affected, but in the past, Sámi shamans took fly agaric in their visionary rituals. They even drank urine from reindeer believed to be under the influence.

Red nose. Red toadstool mushroom. I'm starting to like this story more than the age-old one about indentured elves and leaving a frosty cola out for your winter Sugar Daddy. Hmm?

Alie: How long have humans been aware of the hallucinogenic properties of mushrooms?

Tom: Oh, probably for millennia, yeah. They've been used in shamanistic rituals in Siberia for many years, and different mushrooms in central South America for millennia, probably.

Alie: And where are we at in terms of psilocybin trials and therapies for humans?

Tom: There's actually quite a bit of research being done right now on psilocybin mushrooms at very prestigious places such as Johns Hopkins and such. They're looking at, especially, treatment for end-of-life psychological kinds of treatments, using them to treat symptoms of PTSD, and obsessive-compulsive disorder (OCD), and cluster headaches. So, there's really a lot of research that's being done in terms of psilocybin.

Now, it's a much more mild hallucinogen than the *Amanita muscaria* that the reindeer eat. Usually you have to have someone to lead you through this psychological journey, as physiologically this thing is making neurons fire in your brain, so that's making connections and reconnections that were lost or you never had.

Alie: Really? So, is that how it might have a lasting impact after the actual experience?

Tom: It seems to be. There is some evidence that one large dose of psilocybin can have an effect for many years after that.

Alie: Wow.

Aside: This is a whoooooo other puffball of wax, but quickly: there have been trials for psilocybin effects on anxiety, on depression, OCD, anorexia, and end-of-life existential depression and anxiety. What happens – very, very simply – is that psilocybin converts to psilocin, which has a chemical structure similar to the neurotransmitter serotonin, so it binds to those receptor sites in your noggin.

But why do so many mushrooms – over 200 species – make psilocybin? Recently, some evolutionary fungal geneticists at Ohio State University (what’s up, Jason Slot!) came up with a theory that, when sprouting from dung, there are a lot of insects that want to munch a mushroom, so the ‘shrooms evolve to have mind-altering effects, which might reduce the appetites of the bugs that want to eat them. Also, if you listened to last week’s Bufology episode – which completely coincidentally included some info on smoking toad poison – the basic premise is for an organism to evolve a defense that essentially communicates, “Can you NOT? Thanks!”

Alie: Is it our body, maybe detecting something like a poison and reacting to it? Or... What's happening?

Tom: I don’t know if it’s really a poison. It’s an analog to chemicals that we already make. So it’s doing the same thing as those chemicals but in a slightly different way and in larger amounts.

Alie: I know that it’s legal in some places, not legal in others.

Tom: In the United States it’s not legal anywhere, but it’s on the ballot in... I think Denver will be the first to have it on the ballot, and I heard something about California, and I heard something about somewhere in Iowa is proposed, so you know...

Alie: That’s surprising! I would think Washington would be that third state.

Aside: In the two weeks since recording this episode, Denver did indeed decriminalize it. Laws are a little sticky. So, Vietnam, Samoa, the Netherlands, Jamaica, Brazil, and the British Virgin Islands are like, “Meh, go for it, it’s legal here.” Austria’s like, “Ehh, you can grow it... but I guess not for drugs? I don’t know. Everyone just chill out, have some schnitzel, yodel it up, it’s cool.”

Also, in some states, because the spores don’t have any psychoactive ingredients, you can own them, but just not to grow them for drug purposes. Just like barfing your way through a substrate of manure, it’s all a little dim and murky.

Tom: Yeah, it certainly is... You know like cannabis, it’s the same idea. It doesn’t belong in Schedule I. There are medicinal uses for it that should be explored.

Alie: If you have someone who comes to you asking about that, is that something you try not to give them advice on? Or give them advice on?

Tom: I give people advice. It’s not legal but I’m not opposed to it.

Alie: Yeah. I always hear people being afraid of having some sort of ‘bad trip’. Is that just if they’ve taken too much?

Tom: I mean, you can have a bad day if you’re not taking anything... [*woman crying, “So piiiissed!!”*] [*Alie laughs*] But that’s one of the reasons why there’s usually someone to lead you through this process. It’s the ideal way to do it. In Central America there were shaman-type people who would lead you through these rituals to speak to your dead relatives or help you to accept something that happened to you.

Aside: So, given its technical US illegality everywhere but, I guess, Denver, Tom and I didn't talk too much on the record on this. I, myself, have never tripped on 'shrooms, partly because I had a boyfriend who had a super bad trip in college, which he referred to for years as "The Incident," but I'm super curious about its future potential in mental health fields, so there'll be more on this topic in a later episode.

There are some top-notch docs in LA doing trials on MDMA and psilocybin, so I just have to figure out if that would be Psychopharmacology? Mycopsychopharmacology? Anyway, to be continued.

But, outside of a lab, Tom says, common 'shroom species are pretty chill to cultivate.

Tom: It's actually one of the easiest ones to grow. My old professor used to grow it in grad school. And you know, he stopped growing after a while. He just used it for an example and it had really good spores on it, but it kept getting stolen so he stopped growing it.

Alie: *[laughs]* He's like, "Well... If you need it, I guess you need it." And now, what is the difference between molds and slime molds? I understand that they're very different. And mildew? What's the difference between mold and mildew?

Aside: Oh man, that was so many questions.

Tom: Mold and mildew are basically the same thing. They usually use 'mildew' for something that looks wetter, but they're all just fungi. And usually they're fungi that are reproducing asexually. With mitosis, if your listeners know that. They are reproducing without having sex. So they can produce enormous numbers of spores. It's really cheap, so they can grow on just about anything and produce tons of spores, almost literally.

These molds are pretty common, you're breathing them in and out right now. Whoever is listening is breathing in spores, and most of the time they come back out. Sometimes they stick in your body, and if something's wrong with your immune system you can have problems with fungal infections in your body.

Slime molds are a totally different thing, they're not related at all. They're related to the amoebae, and they climb around and they have these – essentially giant amoeba *[Alie gasps]* – that can be a meter or more across, and climb around, and engulf their food, and eat it in a different way.

Alie: But they're still fungi?

Tom: No, no.

Alie: They're not at all?!

Tom: No, we threw them out.

Alie: You did! *[laughs]* *[cartoon man yelling, "Yerrrr out!"]* Was there a ceremony? *[laughs]*

Tom: There was not a ceremony but there should have been.

Alie: At what point did you realize, like, "You're not even a mold!"?

Tom: Yeah, I mean, we always knew that they were really different, but when people started talking about the five kingdoms and slime molds were clearly not fungi... Just as an aside, in my organizational biology class we talk about 25 kingdoms now.

Alie: Twenty-five kingdoms?! Really?

Tom: At least. *[laughs]*

Alie: Is there a process for getting those validated?

Tom: Well, that's what molecular biology has done. DNA sequencing has allowed us to be confident about our placements of fungi and other organisms into different groups.

Aside: Okay, so quick check, and right now it looks like there are: two superkingdoms, seven kingdoms, eleven subkingdoms, eight infra kingdoms, and six superphyla. Please don't quote me on that in case it's changed, and please don't ask me to make up a more detailed mnemonic than "King Phillip Came Over For Group Sex" because that just sounds messy, sounds confusing. Also, what is the fungus evolutionary backstory?

Tom: The fungi and animals shared a common ancestor a very long time ago, probably in the ocean. And the fungi went one way and the animals went the other way. And so, the fungi probably diversified before the animals did.

Alie: Can hyphae... can a big web of mycelium... Can they talk to each other? What is happening, communication-wise?

Tom: There have been reports now, and we always suspected that the fungi underground are in communication with one another – not quite in the same way that we do it. But they have chemicals that transfer back and forth between them. Many of these fungi are forming an association with the roots of trees and other plants in and the soil, and so these trees are giving their sugars to the fungus, while the fungus is picking up more water and minerals for the tree to use.

So, there's evidence now that these mycorrhizae, as they're called, are shared between different plants. Usually the same species, but not necessarily, and there are chemical signals going back and forth between them, and food being traded. Especially with a large forest where you have this mother tree that's very big and maybe shading all of her offspring, she's actually feeding some of them through her mycorrhizae, and when the mother tree eventually dies, the offspring are there to take her place.

Aside: Imagine a baby, growing out of your corpse foot, and then just try to be casual about that. You can't! Fungus will out-freak you every time.

Alie: How do they figure out which is the same organism?

Tom: *[laughs]* That's a different story. With animals, it's very clear what an organism is because it's something that gets up and goes somewhere else. With fungi, what is an organism? Most of it is underground, we can't see it, and it turns out that some of these underground fungi are very large. You might have heard of the Humongous Fungus." *[Alie laughs]* This was maybe, it's been 20 years now since 19.... I don't remember exactly when, but a 37-acre honey mushroom was found underground in the upper peninsula in Michigan.

Alie: Oh my god!

Tom: And then everybody else started looking for big ones, and there's a 1,500-acre one in Washington and a 2,500-acre one in Oregon. So, they're quite large organisms.

Alie: I can't even... How much weight do you think that is?

Tom: That's been published, I don't remember the exact numbers, but it's thousands of tons.

Alie: Oh my lord! Are these big, humongous fungus all the same species, or are they totally different species of fungi?

Tom: All of the three that I just talked about are all the same genus, they're different species of the same fungus. When all that happened, there was an argument about, "what is an organism?" And people started talking about aspen groves. So aspen groves, the trees are just clones of one another. You start with one tree and it suckers from the roots and you get another tree, coming up from the roots next to it, and so you can get these 10,000 stems that are above ground, but they all share the same exact root system.

Alie: I had no idea.

Tom: There's something called the Pando grove that's supposed to be the world's largest organism.

Alie: Oh my god. I had no idea about aspen trees! That's wild, I had no clue.

Tom: You can pick out which of them have the same clones, they change color in the fall at the same time, they leaf out at the same time because they're all the same individual.

Alie: Oh, that's bananas!

Tom: Bananas are clonal too.

Alie: Oh yeah, that's right! *[laughs]* The Cavendish, right?

Tom: Bananas are going to change in the next ten years because they're all susceptible to this fungus that's been introduced. So we'll see what happens. And they're all clones, so they're all susceptible to the same fungus.

Alie: And how do you feel when you hear about a fungus, say, threatening a population, like a white-nosed fungus, or these banana fungi? Are you like, "Go, fungus, go!" Or are you like, "Why are you doing that, fungus? There's so many other things to eat!"

Tom: I mean, it's hard to root for the fungus when you're talking about food to feed a lot of people. You know, it's interesting, you mentioned the bat white-nose syndrome, that's certainly something to worry about. That fungus grows optimally at 4°C, which is around 40°F, so that's the reason it's growing on the hibernating bats. It makes them wake up early, and there's no food, and then they die. *[high-pitched echoing voice, "Nooooo!"]*

Alie: Are we seeing different kinds of fungus blights as climate changes, or as the population gets more dense? Or is that just part of the cycle; you're gonna have a blight when you have a blight?

Tom: There's predictions that climate change will cause more infections; because things are now limited by a low temperature that they can't survive at. If that low temperature is different, they may be able to survive the winter at these other temperatures.

Aside: Tom says that most of the fungal blights are invasive species. So they were in control in their home country because exposed organisms likely had evolved some defense or resistance, but they kind of pop up when you're unprepared. They're like in-laws coming over, or Ashton Kutcher popping out from behind a Ficus on *Punk'd*.

Tom: So that's why you have the broccoli police at the border, so we don't bring in these pathogens.

Alie: Ha, the broccoli police... *[laughs]* I've never heard of them called that. Is it hard to kill a fungus, and why?

Tom: It is hard to kill fungi because they're so big, and they're so diverse in what they do. In terms of a fungal infection in humans, it's hard to kill the fungi because we're so closely related, so there are very few targets to kill the fungus without killing us.

Alie: Oh my god!

Tom: So then, killing things that are on crops, it's a matter of size, these massive amounts of spores, and the spores are resistant. They thought they were killing off the black stem rust of wheat, and they found out that the spores were actually migrating on the winds to Mexico for the winter and then coming back.

Alie: [*under her breath*] Oh my god! That's quite a journey! How do they even do that?

Tom: Yeah, it's just the wind, and the way the wind blows. [*clip from Bohemian Rhapsody: "Any way the wind blows."*]

Aside: Tom noted that grad students in his lab can work on whatever they like, so long as it's fungal, and is something he's interested in. And he's had students work on medical mycology, finding new species, ecology...

Tom: I had one student who did hardcore nuclear physics on fungi, so I've learned a lot from my students. [*Alie laughs*] I don't really have a specialty. I've worked on decay fungi for a long time, so I know a lot of different things about a lot of stuff I guess.

Alie: My eye just caught a VHS tape that says, "Counseling Patients with Vaginal Yeast Infection." You're like, "Oh, that's another one." [*laughs*] Among all of the species and things up there.

Tom: That's what you picked out in there? [*laughs*]

Alie: [*laughs*] Yeah, I just happened to see it and I was like, "Oh! Well, you know." I'm sure at least half of our listeners have been familiar with that!

Tom: Well, they say that three out of every four women will get a yeast infection sometime during their life. That's a very high number.

Aside: I'm no doctor, but I estimate that 1 out of every 4 persons with a vagina has lied about never having a yeast infection, but okay.

Tom: There's a lot of research and money, doctor bills, and everything else, based on all that. And you know, it's hard!

Alie: Yeah. It is crazy to think that they're so close to us that it's hard to kill them. I never even thought about that. Systemic antifungals can do quite a number on your liver and... yeah.

Tom: Right, that's because they're targeting this substance called ergosterol in the membranes, which replaces cholesterol. Ergosterol and cholesterol are very close, so you have to target the ergosterol in the fungi without affecting the cholesterol in the humans. There are a lot of folk remedies that probably work, but I think it's pretty variable.

Alie: I guess, these chitinous membranes, they're pretty tough. They're the same thing that arthropods use as an exoskeleton, right? Is that their main source of protection, then?

Tom: So that is the physical protection, yes. But most fungi also produce chemicals to deter their competitors. Some of these are useful to us, like penicillin; that's trying to kill off the bacteria in the surrounding environment.

Alie: As someone who has all of this backdoor knowledge about fungi, has it made you live your life any differently?

Tom: Yes. And the reason is that 13 years ago I had a heart transplant. Actually, my heart is in that recycle thing right there.

Alie: Is it really?!

Tom: If you wanted to have a look at it, you could. *[laughs]*

Alie: Of course I do! Can I look at it now, or should I look at it later?

Tom: Yeah! Go on.

Alie: Oh my gosh. It's in here? I knew your heart was in here. *[rustling noises]* Oh my goodness! It's in a Tupperware?

Tom: My friends made a heart cozy for it.

Alie: Oh my gosh! I'm gonna pick it up.

Tom: Yeah, please.

Alie: *[more rustling]* I've read about it, and I've seen pictures. OH! How beautiful!

Tom: So that's all made with wool that's dyed with mushrooms, and then felted.

Aside: So, right now I was holding something, about the size of a Kleenex cozy. It's this wooly box that's kind of like a golden yellow with these felted mushrooms and mycelia crafted, almost woven, into the surface. And inside of it is a clear Tupperware, and inside the Tupperware is a Ziploc bag. Inside the Ziploc bag is another Ziploc bag, and inside of that is Tom Volk's heart, kind of blanched looking, drained of blood, and dissected into thick slices. It's bathed in about a cup of liquid preservative, and the woolen box keeps it aaalll contained.

Tom: So my dear friends in Seattle made that for me.

Alie: May 22, 2006?

Tom: That's the date of my transplant, yeah. So it's gonna be thirteen years pretty soon.

Alie: So, it's in a Tupperware...

Tom: It's been dissected, yeah. You can take it out and hold it if you want.

Alie: Oh my goooshhhh! Oh, it's your heart! Wooooowwww!

Tom: Yeah, you're holding my heart in your hands. Sometimes I wear it on my sleeve.

Alie: Haaaaaa, oh my gosh! This must be so surreal for you.

Tom: I'm kind of used to it after all these years, but you know...

Alie: What was it like the first time you saw this on the outside of your body?

Tom: I was in the doctor's office and I asked to see it. So they brought it to me, and I cried, of course, because it's just really weird.

Alie: *[whispered]* Yes!! Did you have to petition to keep it?

Tom: I asked them for it after about three months, and they said they were still studying it. Then about a year later I asked for it and they said I could have it. They knew I'm a biology professor, so I would find a use for it.

Aside: Tom, of course, has to be really careful, because his immune system is compromised, and he went through so much before the transplant. He had Hodgkin's disease, cancer of the lymph nodes, and the radiation from that therapy damaged his heart. Then he got flesh-

eating bacteria in his foot, and his pacemaker was shocking him every 90 seconds at some point. He says he was the most interesting case at the Mayo Clinic's ICU, which is NOT a good thing. But after the transplant, except for the gash in his chest, he said he felt immediately better.

Alie: Oh my gosh! And now, obviously, you're doing well, post-transplant.

Tom: Yeah, so because of the transplant, I'm on anti-rejection drugs that suppress my immune system, so I have to be careful about what kind of fungi I encounter. We have to be really careful when I teach medical mycology because we're working on actual pathogens, and I have to be careful about that. And I have to be careful about... everything. "Who touched this before me and were they clean?"

Alie: Right! Oh, and I see you have hand sanitizer, which is very smart.

Aside: To my left was this hefty pump-top bottle of Purell. I put his heart back in its cozy. Tom hasn't found out who his donor was, but he wrote a letter to the family thanking them for the gift, telling them all the places he's lectured, the 1,500 students that have learned from him since the transplant, the dozens of master's theses and PhD students that he's been able to supervise, all because he got that new heart. I put his original one back in its cozy little koozie, where it remained on my lap for the rest of our chat.

Alie: [*addressing the heart in its koozie*] It's so nice to meet you! I've heard so much about you! [*Alie and Tom laugh*] When you are looking at medical mycology, what are some of the things that you're looking at the most? The therapeutics, or the antifungals?

Tom: We look at everything. We're looking mostly at the fungi that infect people. It's not medicinal mycology, which would be getting drugs from fungi, but we're looking at *medical* mycology, which is fungi that infect people, mostly. We look at everything from... You start on the outside of the body, there are things that are really superficial, and you go into the dermatophytes that are in the cutaneous layer, and there are some that are below that that have to be inoculated by a trauma, and then some that are inhaled into the lungs and go further than that.

Aside: This was going to be an aside describing some of the "gnar-gnar" fungal infections you can get, from inner-ear sludge, to jock probs, to some toenail goblins, to the fungal lung-ball that is Valley Fever. My friend Tegan had part of her lung removed because of it! Aah! But things started getting a little too real when the words "ice-cream scoop" appeared in a paragraph about excising infected flesh, and I was like, "Okay I'm good! We're good here."

Alie: I did get a rash on my face when I was living in a house with black mold. Do you have people who ask about black mold on the walls or under the carpet? Is that a problem?

Tom: There are a lot of studies trying to figure out... This fungus you're talking about is a black mold, *Stachybotrys*, and *Stachybotrys* is found... kind of rarely. Usually, if it's a black mold it's *Cladosporium* or something else, but there are people trying to prove that *Stachybotrys* causes these things, and there's been a distinct lack of proof of it so far.

There are known mycotoxins on the spores that could be inhaled, and if you inhale them in large amounts, hypothetically there could be something that happens. So, it's an interesting time. I had to spend a couple of months in Rochester, Minnesota, where the Mayo Clinic is, and get used to that.

Alie: Psychologically, when you look back on it now, how has it changed the way that you look at life, or look at the things that you want to do?

Tom: You know, psychologically, I had trouble adjusting because I knew somebody had died and I had their heart inside of me, and so that's some survivor guilt. But also, there were changes in the way I thought about things. I don't let the little stuff bother me anymore, and it turns out that everything is little stuff. So, you just go with what you've got, and you just do what you have to do.

Aside: He did a TED Talk called "A Change of Heart" about his experience, and he shared a thought that brought me to tears:

My mother grew up during the Depression, and whenever we got some new dishes or new clothes, or new furniture, or something, she would say, "Save it for good," and put it off in a closet somewhere, or put plastic over the couch and things like that. We were saving it for some "good." It turns out that every day is good. Every day is good. I use the good china now, I sit on the good furniture, I wear the clothes I want to. Every day is good, and there's no reason to save it for a good day. Use it now, while you can.

Tom: So, I have a very different attitude to life. I just turned 60, and so while some people have this crisis, I said, "I made it! I made it!" Because there was a time when I didn't think I was going to make it to 50, so the birthdays are a bonus instead of something to dread, I guess. And I have a Heart Birthday every year. The people in my department have a little party for me, so that's kinda cool.

Alie: Ooh! Is there a heart-shaped cake on May 22nd?

Tom: Usually!

Alie: Do you get mushroom-shaped cakes the other times of the year? *[laughs]*

Tom: Sometimes! I've had mushroom-shaped cakes, yes.

Alie: Does it change the way that you interact with your students, or how you guide students to working on things they want to work on?

Tom: Yeah, I think I'm better with students now than I was before. I'm friendlier, I'm not as uptight as I was. So I'll talk to anybody about anything.

Alie: I have to say, I was running 15 minutes late and you were like, "Okay, no problem!"

Tom: Yeah! Whatever. That's a little thing.

Aside: Every day is good in some way. So, instead of saving all your stupid questions, ask them now! Patrons get to submit questions beforehand so we're about to ask them after a quick few words from some sponsors of the show. But before the sponsors, *because* of the sponsors, each episode we get to make a donation to a cause of the ologist's choosing, and Tom is a big supporter of DonateLife.net.

Donate Life America is a nonprofit organization dedicated to increasing awareness of the need for organs and tissue donation. They want to help develop a culture where donation is embraced as a fundamental human responsibility. There's 114,000 people in the US waiting for a donation of some kind, so to find out more about making your wishes known, you can visit DonateLife.net. And an additional donation was also made to the Mycological Society of America – MSAfungi.org. And thank you to the following sponsors who I like so much for making those donations possible:

[Ad Break]

Okay, back to your questions.

Alie: Can I ask you some questions from listeners?

Tom: Sure!

Alie: They know that I'm meeting you specifically, of course, because I've been telling them forever.

Zoë Bagger wants to know: I've not asked this question here before, and this subject has wreaked some havoc on our home recently. I would be very grateful if this was asked of the mycologist. Why do psilocybin mushrooms react to blacklight?

Do psilocybin mushrooms react to blacklight?

Tom: There are actually a lot of fungi that react to black light. You see my little poster up there is a blacklight poster, which is an homage to that. But there are people who bring black lights to mushroom forays and you find all the mushrooms laid out, you turn the lights out, and you find out which mushrooms glow in which colors. That's a consequence of having different kinds of pigments that happen to glow under UV light. So far as we know, it's just happenstance that this happens. There may not be any value to it, to the fungus, to do that. It just happens. There are some fungi that glow in the dark without any UV light.

Alie: Which ones?!

Tom: There's one called the Jack O'Lantern mushroom that's actually bright orange and glows in the dark.

Aside: I looked this up and they're bananas. They're this beautiful, soft, goldenrod color. They look a little bit like chanterelles, however, they're poisonous. Please don't eat them. But at night, they glow this acid, alien green. So, orange and glowing at night, hence, Jack O'Lantern. Spooky, cute, I approve of this branding.

Also, I'm going to take a moment to read off some other glorious names of mushrooms, because, frankly, you deserve to hear them. Okay, ready for this? There's: the pear-shaped wolf-fart puffball, there's witch's butter, butt rot fungi, the bearded hedgehog mushroom, octopus stinkhorn, bearded tooth mushroom, the devil's cigar, the bleeding tooth fungus, hair sedge smut, destroying angel, powdery piggyback, barometer earthstar, the gassy webcap, dewdrop dapperling, the humpback, the pretender, the drumstick truffle club, bug sputnik, cinnamon jelly baby, pink disco, lemon disco, midnight disco, hairy nuts disco, weeping tooth crust, King Alfred's cakes, hot lips, pancake crust, dead molls fingers, scurfy twiglet, plums and custard. Literally, any one of those mushrooms could be playing Coachella next year.

Alie: Do mycologists have, just, a hell of a time naming these mushrooms? Are they good at naming mushrooms?

Tom: There's challenges to doing that. We use all Latin as the best way to do it because there are no standard common names for mushrooms like there are for birds. You know, there's only nine thousand birds in the whole world, and there's probably, you know... in this room right here that we're sitting in probably has around 500 species of fungi in it. There's probably more like 1.5 million species of fungi. So, things that glow under UV are, I think, just coincidence.

Alie: Bronwen Rice wants to know: How much decomposition are they responsible for, and what would happen if they suddenly disappeared?

Tom: Ooh, that's a good question. I talk about that in my class, and I tell them if there were no fungi, we would be knee-deep in everything. Probably over our heads in wood and in feces.

Alie: [*woman crying, "Oh god, nooo!"*] [*Alie and Tom laugh*] Goodness me!

Tom: So, the fungi and the bacteria are the degraders in the environment, and they break everything down so that other organisms can use that material again.

Alie: Just knee-deep in feces...

Aside: So, a ton of people asked about psilocybin, which again, I'm not a doctor, and I can offer no advice on if anyone should seek it out. I'm just relaying questions here.

Steven Hoffman, Michael Novak, Lacy Gilbert, Zoe Jane, Diana Zhou were all like: What is up with them? And Jerry Davis specifically asked:

Alie: Which native ones are the most magic and easiest to find? Asking for a friend. ;-)

Tom: Asking for a friend... [*Alie laughs*] It depends on what part of the country you're in, so you know, in the South there's different ones than there are in the Northwest. The Northeast and Midwest are not very resplendent in magical mushrooms in the wild. They actually turned out to be really easy to grow, as I said, but in the wild there are special places where they're showing up. I don't know where he's from so...

Alie: He's gotta join a mushroom club!

Tom: He has to join a mushroom club. Some of the mushroom clubs kind of frown upon the psychedelic things, but I think people are coming around. We're showing that there is actual medicinal value to them. Sometimes they call them 'nutraceuticals' because there are many fungi that are eaten for their healthy properties. Especially in East Asia, they've been using nutraceuticals. They've been using mushrooms as medicine for thousands of years, probably. Unlike Western medicine, where we want to take a pill and suddenly everything is better, they eat these mushrooms over a long period of time and that leads to a healthy condition.

Alie: And is this like, *Cordyceps*, reishi..?

Tom: *Cordyceps*, reishi, yeah, all those kinds of things. Shitake...

Aside: *Cordyceps* may be familiar from the myrmecology episode about ants because it infects insects' brains and turns them into zombies. Ever played the video game, *The Last of Us*? Yeah, that's real life for some insects. Real life!

Now, shiitake mushrooms are being studied for the possibility for tumor growth inhibition as well. Now, side note to the side note: If you eat raw shiitake you might get something called shiitake dermatitis, which looks like raised whiplash marks or claw scratches on your skin. I urge you to google it because I am positive that in times of yore, village doctor healers were like, "Yes, I know science, and you've been attacked by a poltergeist. Put a leech on it. Your bill comes out to 1 goat. Buhbye now."

Also, this next question was asked additionally by Emily Hoban and Heather Densmore.

Alie: Jared Frandson wants to know: Where can I find me some morels?

Tom: Haha! Um, the usual answer is, "Out in the woods under some trees." [*Tom and Alie laugh*]

Alie: There you go!

Tom: If you have a good friend, they might take you to their spot. They might blindfold you as they take you there.

Alie: Does that happen?

Tom: Yeah, yeah.

Alie: *[laughing]* Oh my god!

Aside: This is so petty. And I love it.

Tom: Another way to do it is to steal the GPS coordinates after someone posts their pictures online.

Alie: *[gasp]* Nice! And then you know exactly where to find it! Is it true that they sprout out more after forest fires?

Tom: There are certain species of morels that come up after forest fires in the West, yes. So you would look for fires there. In other places, you look for dead Elm trees, and in the South you might look under Tulip Poplars or Ash. So, in different parts of the country there are different species that have different ecological habitats.

Alie: So you've got to get in, also, with a tree person. Know your trees!

Okay, Dionne Dabelow wants to know: What are your thoughts on *Star Trek Discovery's* mycelial network? Have you any?

Tom: Um, I haven't seen it, so I don't really know. I don't know the answer, but that's based on these trees talking to one another. And there's *Avatar*, that's not a bad way to think about these underground things, looking at that movie.

Alie: Josh Fry wants to know: What's the best resource for someone who wants to start mushrooming at home? Growing and harvesting – not trippin'.

Although I'm sure that maybe some could apply. So if someone wanted to start growing their own mushrooms, any advice?

Tom: There's plenty of places online that will kind of guide you to that. There's Facebook pages and chat rooms, and all sorts of things to help you to grow. You can buy some books that will help you too. Very often these mushroom clubs have cultivation classes, so you can join one of those. And very often someone will do, "Make your own bags and grow your own oyster mushrooms." They're pretty common things to do at a mushroom foray.

Alie: Dylan Ring wants to know: Do mushrooms have seasons the same way that plants do?

Tom: Yes. They're not as obvious because they're just showing their fruiting bodies during certain seasons. So, you look for morels in the spring. In my area you look for chanterelles in the summer, you look for boletes in the summer. Then you start to get a frost and you get honey mushrooms and chicken of the woods and hen of the woods and things like that. So yes, they're seasonal fruiters but they're growing all the time. And then in our area, they go dormant in the winter.

Alie: Oh, they do?

Tom: Yeah, so they're living inside the log in some sort of suspended animation that is unclear as of yet.

Alie: Are they typically under the frost line when they're underground?

Tom: Sometimes, but not always. These mycorrhizal ones are usually in the top meter of soil.

Alie: April Meehan wants to know: If my dog eats a mushroom, how do I know if it's poisonous or not? What would some symptoms be?

Tom: Yeah, so you have to know what the mushroom is. It's the same thing if a child has eaten a mushroom. I'm on the call list for the Wisconsin Poison Center Minnesota as well. We often get calls for dogs that have eaten something or kids that are grazing in the yard and Mommy finds something in their hand and is worried about it. Usually it's not anything, but dogs do die from it. There haven't been any kid ones that I know of, but the dogs are out eating the stuff, and sometimes it's just rotten things.

I had a dog case where the dog ate a rotten mushroom, it happened to be the Amanita muscaria, the hallucinogenic one, but it was certainly way past what it would have been and it probably died from the bacteria that it was eating with all this old junk. There is actually a really interesting Facebook group where you can post your pictures and they'll help you identify a poisoning.

Alie: That's great. I mean, before that it's not like you can just send out an APB to the world.

Tom: Yeah, well the Poison Center is available for human cases and they usually don't deal with dogs.

Aside: Claire Kimbley and Jacklyn Snoek had the same question, as Chris D, whose syntax was perfection.

Alie: Chris D asked: Do you have any mushy book recs?

Tom: Mushy book recs. [*Alie laughs*] Wow. This is the time of the internet. [*Tom laughs*] There are some really good mushroom keys in books. There's been a whole ton of books coming out in the last 10 years that are really good. It depends on which part of the country you're in, which kind of books you want to get. And there's plenty of web pages as well that are identification pages.

Alie: They have to start with yours! Duh, of course!

Aside: His site is linked in the show notes. By the by, also a group of folks wanted to know this next question, including Michelle Grondine, Forrest Stotts, MissKitti, Thomas Beckett...

Alie: Laura Kinney wants to know: I read that there was a mushroom that could break down plastic. Is this true, and can we use it to help clean up the sad plastic nightmare that the Earth is becoming?

Tom: The sad plastic nightmare. I like that. Yes, but it needs a lot of development. Actually, in 2006 we published a paper about breaking down phenolic resin plastics of bowling balls, and brake linings, and things like that. We showed that they could break down, but they break down into something toxic. There have been several of these papers since that are working on different plastics and different kinds of fungi. I haven't critically evaluated what's going on with those and how far along they are in developing this for actual use.

Alie: But they're working on it? That's great.

Tom: Absolutely, there's plenty of things to work on.

Alie: Megan Luschen says: My boyfriend has texture issues and refuses to eat mushrooms. He's a vegetarian though so I'd really like to get him eating them since they are a great substitution for meat. Which mushrooms have the least "mushroomy" texture?

Tom: [laughs] So, you should try some mushrooms called chicken of the woods and hen of the woods, which have the texture of chicken. If you were to put those in a stir-fry or a stew you probably wouldn't know the difference between that and the meat. Those are both very good. Chicken of the woods – *Laetiporus* – is not available commercially. No one's quite figured out how to grow it successfully, but the hen of the woods – *Grifola frondosa* – are available commercially, and they're pretty good!

Aside: So yes, hen of the woods and chicken of the woods – totally different mushrooms, and I feel for them because they probably get each other's mail ALL the time.

[clip from *Broad City*: Ilana, "Hen of the woods are literally like... WHAT?"]

Alie: Are mushrooms a pretty good substitute for meat, in general?

Tom: They are. They're pretty high in protein, they have a very good component of amino acids, better than beans. They have a lot of B-vitamins in them, and considering where they grow, they have lots of minerals, of course.

Alie: Right. Do you think that they hurt when we pick them? I guess we're really just kind of picking their gennies. I mean we're really just getting the fruiting bodies, right? [laughs]

Tom: [chuckles] Their gennies. Yeah.

Alie: Okay, Will Plewa asks: Should we be looking for new antibiotics in fungi?

Tom: Absolutely. A few of my students have worked on looking for new antifungal and antibiotic drugs on fungi. There was actually a whole group here that was looking for those kinds of things in fungi and other things, so, yes. We need more antibiotics because of the over-prescription of antibiotics and various other problems that are causing drug-resistant bacteria and such. So yes, we need more of that.

Alie: So, get in it! If anyone wants to go study it, sign up! Get on it!

Tom: Yep. Even the drug companies are looking for new things, but you know, making a new drug is really expensive. Billions and billions of dollars. [Dr. Evil, "Billions?"]

Alie: Cranilation asks: I love mushrooms and I love fairy circles. What can I do to invite mushrooms to live in my yard?

Tom: Aw, that's nice! If there's some particular mushroom you want, you can collect it and spread the spores in your yard. There are some fairy ring mushrooms that you probably don't want in your yard. A fairy ring comes from a spore landing somewhere and it grows out in a circle, because you have a pretty homogenous environment in your lawn, and so then it just fruits on the edges of that. The Middle-English people thought that there were fairies dancing in and out of it and things like that.

The most common one that's in lawns is actually the most common cause of poisoning in America. It causes projectile vomiting and projectile diarrhea at the same time, which is not as pleasant as it sounds. [Alie laughs] This *Chlorophyllum molybdites* is toxic, so that's one of the more common ones that's growing in fairy rings.

Alie: So maybe, not that one.

Tom: Maybe not that one, but there are others. There's one called *the* fairy ring mushroom, *Marasmius oreades*, which is edible. That's common as well.

Alie: Okay, so obviously one would be the better choice.

Aside: So, green light on the scotch bonnet mushroom, not to be confused with the tongue-searing scotch bonnet pepper. Let's all agree, also, to avoid the other one, which is called a false parasol, or simply The Vomiter.

Alie: Okay, one more question. Bob Ogden wants to know: I'm allergic to mushrooms, I don't know anyone else who is. How common is this?

Tom: There's a lot of people who are allergic to mushrooms. Some people develop an allergy because they ate too much. I know at least ten people who are allergic to morels, who ate them for many years, and then one year over-indulged, and now they can't eat them at all. [*Homer Simpson, "D'oh!"*]

There are people allergic to anything. You can be allergic to strawberries, or coconut, or whatever, so it's not surprising that some people are allergic to some mushrooms. There are some mushrooms that people are allergic to touch. I know several people that this happens to with something called the chicken fat mushroom.

Aside: Okay, so from what I understand, the chicken fat mushroom is a little slippery, kinda greasy, and can have what's been described as an "organy flavor." Not for everyone, particularly the allergic.

Tom: But it's an allergy, like everything else.

Alie: Last two questions that I always ask: What is one thing that is very annoying about mushrooms, or your job in general?

Tom: [*laughs*] Annoying? I love my job!

Alie: Anything that suuuucks.

Tom: [*laughs*] Some of them are difficult to work with, they don't cooperate and do what we want. But other than that, mushrooms have been pretty good to me. [*Tom and Alie giggle*]

Alie: Anything as a mycology professor that's annoying?

Tom: No, not really. You know how the little stuff doesn't bother me! [*Alie laughs*] So it's not easy to annoy me. There are a lot of different kinds of things, I teach General Mycology every fall and it's fun! We go out and collect stuff, and I recommend it as a good hobby for anyone to go out and collect mushrooms and make new friends!

Alie: Yeah! And you're out in nature, you're wearing, probably, rubber boots? The last question I always ask is, what is your favorite thing about mushrooms, or your job?

Tom: I like the people. You know, I like the mushrooms, but the people are really interesting. There's some really interesting people in mycology. They tend to be smart, they're interested in science, the amateur mushroomers are from all walks of life and they're interested in fungi for all kinds of reasons. I think that's one of the most interesting things about it.

Alie: I hope there'll be a bloom of new budding mycologists.

Tom: Budding. I get it. [*Tom and Alie giggle*]

Alie: How many times are you introduced as a fun guy?

Tom: Almost never. [*laughs*]

Alie: What?! No one's like, "You need to meet Tom Volk, he's a fun guy!"

Tom: Yeah, that's very common.

Alie: *[laughs]* Okay, I'm sorry.

Tom: It's fine, I pretend to laugh every time. I'm good at that.

Alie: That's so nice of you. But you ARE a fun guy, so that only compounds the problem, I think.

Tom: Yeah, I suppose.

Alie: Thank you so much for letting me talk mushrooms with you and letting me hold your heart in my lap as I did it.

Tom: Yeah, for the last half-hour. *[laughs]*

Alie: I know! Thank you so much! *[laughs]* I can't wait for this to come out, you're the best.

So, ask smart people stupid questions. Join a mycological society! Make some lifelong fungus friends. You can find Dr. Tom Volk with an easy google, and his Wisconsin.edu mushroom site will pop up. And if organ donation is now something you're interested in, that site was DonateLife.net. Links to those and to the sponsors are in the show notes, they're also up at AlieWard.com/Ologies/Mycology. We are @Ologies on [Twitter](https://twitter.com/Ologies) and [Instagram](https://www.instagram.com/Ologies), so do follow there! I'm [@AlieWard](https://www.instagram.com/AlieWard) on [both](https://www.instagram.com/AlieWard). Come say hello.

Thanks again to the patrons on [Patreon.com/Ologies](https://www.patreon.com/Ologies) where you can submit questions and support the show for as little as \$1 a month. And you can find other Ologites by wearing merch from [OlogiesMerch.com](https://www.OlogiesMerch.com). You can tag photos on Instagram with #OlogiesMerch so I can repost you on Mondays.

Thank you Boni Dutch and Shannon Feltus for managing that site. Thank you, Erin Talbert and Hannah Lipow for being moderators on the wonderful Ologies Podcast [Facebook Group](https://www.facebook.com/OlogiesPodcast). Thank you, Jarrett Sleeper of Mindjam Media, for assistant editing and helping with some research. *[whispers]* I stole his Coachella joke and he said it was okay. And to the magical mushroom that is Steven Ray Morris for editing all these clips and drops together, stitching them together each week. Nick Thorburn wrote and performed the theme music.

Now, if you listen to the end of each episode, you know I tell you a secret, and this week's secret: I have one of those shower doors that you need to squeegee so it doesn't get spots on it. And I was late to the airport and I took a shorter shower than the amount of time it took me to squeegee the shower door. Wow. I spent more time cleaning the shower than myself. But the squeegee works, what can I say?

Okay, berbye.

*Transcribed by your little sister who only wants to eat what you're eating, only when you're eating it;
Rika Eringa.*

Edits by Wendy Fick

Some links which may be of interest:

Donations were made to [DonateLife.net](https://www.DonateLife.net) and [The Mycological Society of America](https://www.TheMycologicalSocietyofAmerica.org)

Dr. Tom Volk's [TED talk: A Change of Heart](https://www.ted.com/talks/Tom_Volk_A_Change_of_Heart)

[We got yeasty genes](https://www.WeGotYeastyGenes.com)

[Cryptococcus](#)

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[Scotch Bonnet mushroom fairy rings](#)

[Shiitake dermatitis aka a poltergeist attacked you](#)

[“The Last of Us” aka fungus horror video game](#)

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[Jack O’ Lantern mushrooms](#)

[Chicken fat mushrooms](#)

[Toxic fairy ring mushrooms](#)

[Non-toxic fairy ring mushrooms](#)

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