***That's Wild* Season 2**

More Than Mushrooms | The Secret World of Fungi

[00:00:00] **Elliott:** Hello and welcome to *That's Wild*, a podcast series brought to you by the National Parks Board. I'm Elliott, and I'll be your host for this series where we'll be talking to special guests from the nature community about topics surrounding biodiversity conservation in our City in Nature. In this episode, we'll be talking about fungi in Singapore. Now, fungi are all around us, or so they say. And today, we have Amy and Serena here to talk to us about this special group of organisms.

[00:00:33] **Serena:** Hi, I'm Serena Lee from NParks. I'm a Senior Manager at the Singapore Herbarium and one of the curators in the herbarium itself. So I deal a lot with the incoming fungi vouchers and specimens.

[00:00:46] **Amy:** Hi, I'm Amy Choong. I'm a senior lecturer at the Department of Biological Sciences, NUS. I teach fungal biology that's why I deal with fungi. But you know, plants and fungi are very very closely related, so I also teach two other courses on plants.

[00:01:01] **Elliott**: Now fungi are all around us, but many people tend to overlook it. Maybe we can start with asking how did you get into this field? How did you get into you know looking at fungi in Singapore?

[00:01:10] **Serena**: So for myself, it all started when I was a little kid. I read a lot of fairy tale books. Well, fairy tales have fairies, right? At the side of fairies, there are mushrooms and little, small green things and all that. In university, I only had the opportunity to study the green things, the tiny green things – bryophytes – with my then prof Benito Tan. So it was only natural years later, when I went to work and under NParks that, "Oh, there was an opportunity to do even more, like mushrooms." And, well, that was my interest. I mean, I could stare at green things for a long time before I learned their names. But mushrooms seemed magical, and it just goes in my head, the names yeah.

[00:01:49] **Elliott**: Right. And when did you get the opportunity to look into mushrooms a bit further? Was it research? Or was it..

[00:01:53] **Serena**: Yeah, it was only when I did my masters in Edinburgh, I actually linked up with the prof first to design my own project specifically on mushrooms, and at that time, we had this famous botanist a long time ago, called E. J. H. Corner. It so happens that in Edinburgh, most of his collections have been lodged there. So it was only natural that I studied the Singapore material over in Edinburgh at that opportune time.

[00:02:19] **Elliott**: Right. Cool.

[00:02:20] **Serena**: Yeah.

[00:02:20] **Elliott**: And so since then, have you seen any fairies or no?

[00:02:22] **Serena**: No lah! Hahaha

[00:02:25] **Elliott**: Haha, how about you Amy?

[00:02:26] **Amy**: For me, I was an undergraduate when, back then, it was the botany department, and then we had this professor from Germany, and he was Ingo Nuss, and he taught us fungi. So in his lecture, there were so many beautiful pictures of mushrooms, so the whole class was like, “Ooh... ah… ooh…” and it was so memorable. I remember when we all were doing our honours, we were walking past this field near NUS, and there was a Puffball. “Oh, this is the Puffball that prof Nuss mentioned!” So we collected it, and then we brought it back to the lab. And then we cut it up, put pepper and soy sauce, and we ate it.

[00:03:08] **Elliott**: Oh you cooked it. Haha.

[00:03:10] **Amy:** Hahaha. Microwaved. And then we shook each other's hand. Nice to know you. Hahaha. Yeah.

[00:03:17] **Elliott**: Yeah, I guess that's a lot of people's first like interaction with mushrooms, right? It's on the dinner plate. So before I guess, that lecture on mushrooms, did you have an interest already, or was it really just because of that?

[00:03:27] **Amy**: It was really just because of that. I mean, when I was growing up in Malaysia, the first encounter with mushrooms was when a mushroom came out of the bathroom door, right? Because wood and it was humid, and suddenly you had this mushroom come out. Haha. So that’s how it is.

[00:03:46] **Elliott**: Thanks for providing those introductions. And I think it’s really interesting to know how you guys both separately got into fungi. But maybe we can start with, what are fungi? What characterises, you know, fungus?

[0003:56] **Amy**: Fungi are not plants, not animals. They are their own kingdom. And then fungi cannot photosynthesise, so they have to take their food source from the external environment. When you see fungi, basically they are feeding off something. It can be wood, can be plastic, or your shower curtain, where there is some coating and moisture. So they really need moisture in order to grow.

[00:04:21 **Serena**: Let me start with the bigger aspects of their life where you can actually see them. Maybe Amy, you will start to talk about the micro ones, which you can't see, but they may be a bit more useful than the macro ones. But the macro ones are what bring attention to fungi in the first place. So say, if you're going out on your walk and you see this strange organism popping out from the ground and it doesn't quite look like an ordinary mushroom, and then that's where all the picture taking starts coming up. If it's colourful, it’s all the merrier. But in tropical

Singapore, actually, the majority of the mushrooms are quite brown. There are red ones, blue ones even, but the majority are brown, and you need to actually focus to look at it. But then after you get the hang of things, you will start to see more and more stuff. That's what the Mushroom Spotters, a Facebook group, is very good at, because a lot of people who join it, they go for daily walks and all that, and all these pictures start rolling in, and they start to ask, “Oh, can you identify this? What is this?” And you see more people join, which is very good for us.

[00:05:22] **Elliott**: Right. So you’re saying these are macrofungi, like the mushrooms you see—those are all considered macrofungi. How about microfungi?

[00:05:28] **Amy**: Just now, Serena covered those that you can see, and usually we identify them as macrofungi, but there are a lot that we cannot see. There are spores. There are bits and pieces of their body parts hanging around in the air or on our skin, between nails, on our scalp, dandruff, things like that, even in your aircon, the filters. They are actually everywhere.

[00:05:56] **Elliott:** Seems like they really are everywhere. So we have micro and macro fungi, but I think, maybe to give people a good idea of the range of different fungi that we have in Singapore, we mentioned that most of them are brown, but maybe there are a few more colours that we can see, but in terms of shapes and sizes also.

[00:06:13] **Serena**: So yeah, the more colourful ones could be in reds, in blues, in orange. But brown, as I mentioned, is the majority. Shapes… maybe the largest one of all would be, her mention, Giant Puffballs in Singapore. We have two species known in Singapore. They are very related to the giant ones in America, but it doesn't grow as big. They’re also edible but only if firm and pure white. Anything else, don't touch. The other thing is, size wise, they can grow as small as your eyes aren't *lao hua*, then you can see that small, but big like the puffball, that would be about the biggest. And the one that we found a couple of years ago, the *Amanita* sp. in Bukit Timah, that one can reach a cap of 28 cm, maybe 20 cm?

[00:06:56] **Elliott:** Oh, so like dinner plate size.

[00:06:57] **Serena**: Yes.

[00:06:58] **Elliott**: Wow.

[00:06:59] **Serena**: Yeah, it's big and it's very robust looking. So it can grow big. Big is not an issue. Small is as small as your eyes can see. Yeah, the range is there.

[00:07:07] **Elliott:** And like, are these different species available all the time? Or like available to be looked at all the time? Or do they have seasons?

[00:07:14] **Serena**: In Singapore, usually it coincides with the rainy season, but it has to be the kind of rain that drenches the earth and then no rain for maybe three to seven days, and then followed by more rain. If you get consistent heavy rains, they will be destroyed. So you also

don’t see them.

[00:07:31] **Elliott**: Right. Interesting.

[00:07:32 **Serena**: Like in the temperates, you get it in the October range. A lot comes up in October. But for us, it's year round, just depending on the rain. If rain comes at the appropriate time, you will have mushrooms, if not it’s just dry, then you’ll get nothing.

[00:07:44] **Elliott**: It's like plant blindness, right? You have to train yourself to develop the eyes to look at fungi.

[00:07:47] **Serena**: Mm, that’s right. That’s right.

[00:07:48] **Elliott**: What's the most interesting species of fungi that you guys have found in Singapore?

[00:07:54] **Amy**: More like reading about it. The oyster mushroom. Right? We always think that the oyster will have to emerge from a piece of wood or whatever that you'll try to grow it in. But in the wild, oyster mushrooms can also kill nematodes to get an extra source of nutrients.

[00:08:12] **Elliott**: Can we also explain a bit more about what nematodes are? For those that are not familiar with them.

[00:08:18] **Amy**: Nematodes are microscopic, worm-like organisms. They are in the soil.

[00:08:22] **Serena:** It’s a parasite of plants.

[00:08:24] **Amy**: Some are, not all.

[00:08:25] **Elliott**: So would we label some species of fungi as carnivorous?

[00:08:30] **Amy**: Some can be said as carnivorous.

[00:08:32] **Elliott**: But the majority would be feeding on, like decaying matter?

[00:08:35] **Amy**: Decaying matter or the human body, or anything that they want to feed on, right? You can make them eat new things also. For instance, they can break down oil also, the crude oil. They can break down plastics. They can destroy your clothes. Yeah. If they run out of their natural food, they will go after anything that they can feed on.

[00:09:00] **Elliott**: It seems like there's a lot of things that fungi could be useful for. Is there a lot of research that is going into this? I mean, particular uses for fungi, maybe to break down, like oil, plastics, especially because plastics are not biodegradable. Or is that something that's a gap, a research gap currently?

[00:09:16] **Amy**: Elsewhere, there are a lot of researchers. I would say, when compared to zoology, fungi is really, really understudied. If you think about food, fungi can be a food source. The meat replacements can be made of fungi. Then there are even fungi that mimic, or rather, look like ham, that kind of thing. Yeah, so they are out there. Then, tempeh is already being eaten. Tempeh is very, very nutritious. So yeah, there are a lot of things that can be done regarding food. In terms of myco-remediation, there's lots of room to research on and actually apply it, because we have a lot of pollutants in the environment. So if you release the fungi and then they can clean up the world, then we could live in a healthier world.

[00:10:09] **Elliott**: Let's talk a bit more about your research. What kind of aspects about fungi do you guys study, maybe any new or recent discoveries of new species of fungi in Singapore?

[00:10:20] **Serena**: My studies mostly pertain to the taxonomy of fungi, so more like the naming and the classification so that's what we mostly aimed to do in Singapore, because so little is known that a lot of things we may see have either been identified overseas or first described overseas, but we may have the species, or it may be something new completely, and it's never been recorded to science before.

[00:10:44] **Amy**: Because I supervise undergrads, we have projects. We have looked at how fungi interact with insects. How fungi interact with, let's say, Dipterocarps. How can we inoculate the seedlings, so when the tree grows, they will be healthy. We also have tried to use mycelium to make them into mycelium bricks, see whether they can be heat insulation, sound insulation, or even tried to use mycelium to replace PVC sheets. Yeah, there's a dream ah. Hahaha.

[00:11:20] **Serena:** My source of students is also from Amy and her colleague Chang Ying, so both of these people provide me project students who are more inclined towards the academic side rather than the practical side. So I give them little groups. They do sequencing, they do morphological identification, and we will try to see what we can make of that.

[00:11:39] **Elliott**: Any species that you guys have discovered recently that were quite interesting?

[00:11:43] **Serena**: If by recent you mean 2018? Yes, there was *Spongispora temasekensis*, which is a new genus to the bolete world. It has only one species, and it was described from Singapore, but we have since found it in Malaysia as well.

[00:12:00] **Elliott**: What does this particular mushroom look like? Any interesting characteristics, colour, shape, texture?

[00:12:05] **Serena**: If you buy the "Guide to Macrofungi in Singapore", it is on the cover page. It occurs mostly under the host *Hopea odorata*. It has been found in urban parks, as well as the Singapore Botanic Gardens, where it was described from, but only close association with this tree. So far, we haven't found it under any other tree.

[00:12:24] **Elliott**: Colour wise, is it quite plain, or…?

[00:12:26] **Serena**: Yes, it's rather plain. It's grayish brown, but once you've seen it, you probably can find it elsewhere again.

[00:12:31] **Elliott**: And I guess the effort to list and identify all the different species of mushrooms culminated in this book, “A Guide to Macrofungi in Singapore” that was written by the both of you. So how did the thought or interest in doing a book like this come up?

[00:12:44] **Serena**: I was actually torn between doing a checklist and a guidebook, but because if I had a checklist, and a checklist usually has no pictures, that wouldn’t serve anybody any good. Nobody would know what is what. So a guidebook was the first priority for Singapore, so that we can give names to what we see on the ground, common things we see on the ground. It started becoming a concern to me when people would post pictures and they’d attribute an European name or an American name, that’s where the trouble starts. Because as more and more of this information gets into our circle in Singapore, then you realise that everything we know here is not real, not that name. So this book had to come out.

[00:13:25] **Amy**: Fungal bio class, when we go on field trips, right? We see all kinds of fungi. Without a guidebook, it's actually quite difficult to identify them, so at least with the guidebook it's easier-And they can use the guidebook, at least as a first port of call to see, “Oh, this is a Bolete. This is an Amanita.” So, yeah, that actually increased their interest and appreciation.

[00:13:53] **Elliott**: And with a lot of checklists, you know, it serves as a, like, snapshot of the community of a certain group of animals or plants or maybe fungi that we see at a certain point in time. Do you see this book as something like that? Are there any fungi that face threats today and we might not see in the near future?

[00:14:10] **Serena**: So because of this book, we could actually do the Red Data for fungi. So it's the first assessment of Red Data for this group, actually, when before it was only plants and animals. So this is just the beginning, but we are taking baby steps, and we'll get more in sooner or later.

Nature Nuggets (Recommendations segment)

[00:14:28] **Elliott**: It's time for Nature Nuggets! In the spirit of our podcast title, *That's Wild*, we wanted to ask our guests to recommend something wild that they've come across or enjoyed and that you can check out yourself too.

[00:14:41] **Serena**: The Mushroom Spotters Singapore Facebook. Please be on it, because you guys already on it are providing a lot of citizen science information for our work.

[00:14:49] **Amy**: If you like to read, you can buy or borrow from the library, “Entangled Life” by Merlin Sheldrake. It's a very readable book. It talks about, what is a mushroom, what are molds, why are they important. So after you read it, you realise, wow, fungi are really underappreciated and they are very important to us. The next one I will recommend would be the “Molds, Mushrooms and Medicines” by. Nicholas P. Money, he's an eminent professor of mycology. One of the topics that he mentioned was when the mother delivers the baby naturally the fungi on her skin will go onto the baby and that actually gives them lifelong immunity. Their ability to fight against diseases actually are better versus caesarean.

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[00:15:47] **Elliott**: Going back to fungi in Singapore. How are these fungi spotted? How do you guys go about looking for fungi?

[00:15:53] **Serena:** Personally, I have a few friends in the Mushroom Spotters group, and sometimes we go out on field trips, and we focus more on the fungi aspects. Of course, the more people in the group, the more interests. We'll have people looking for animals and plants and everything else. But for mushrooms, since they're already in the Mushroom Spotters group, their eyes are already peeled, and they spot things more easily than the general public.

[00:16:15] **Elliott**: Right, and do you guys look in specific spots, where there's a lot of logs or leaf litter?

[00:16:20] **Serena**: Actually, no, you just have to be observant. They’ll just grow anywhere they're happy to. And depending on the weather, maybe some parts have more rain than others. And so you’ll have things that you’ve never seen before come up.

[00:16:32] **Elliott**: Maybe we could delve deeper into, you know, fungi that are underground. You know, we see the mushrooms, but there's a whole network of mycelium under the ground? So maybe we could delve a bit more into that. Tell us a bit more about mycelium.

[00:16:44] **Serena**: I'll leave Amy to talk about that, but I just want to talk about the fruiting bodies on top of the mycelium. They are more akin to the apples on the apple tree, rather than the apple tree itself. So when we do collection, even if we wipe off all the apples, the apple tree is still there. So it's not like, “Oh, am I taking them and then that's, that's the end of the species?” No, it's just the apples on the apple tree that's all.

[00:17:06] **Elliott**: Right.

[00:17:07] **Amy**: So below ground or inside a substrate, right? Substrate can be anything. Can be a branch, a log, even your bread, right? So once the spore germinates, then it will become like a strand of cotton wool. Then they will divide and grow and then become like cotton wool, right? So they are everywhere in the substrate. It can be below ground in the soil. They could be associated with the tree roots. Some others, which you cannot see, would be inside different

parts of the plant as well. So if they are below ground, sometimes if you dig right? so let's say, leaf litter right? You'll see all the fresh leaf litter on top, but when you just brush off the surface, you can really see the mycelia threads, some white spreading threads on the dead leaf. And then if you dig further below ground, then you can sometimes see the white cottony stuff between soil particles. So they are actually very common, and there are many in the soil that we don't even know what they are, because you can't identify a fungus based on the mycelium. You can do genetic work, but you may still not be able to ID it.

[00:18:26] **Elliott**: Right, yeah, that's really interesting. I think this is one of the things that the average person is not aware of, but we have certain preconceptions about mushrooms, right? There are certain things that people think of, for example, red mushrooms with spots are all poisonous. What are some common myths about fungi that need to be debunked?

[00:18:44] **Serena**: In Singapore we're not so concerned about the myths because we don't forage to eat. A lot of the myths that need to be debunked are usually food-related, whereas some countries, certain mushrooms are picked up because they look like another mushroom and because it wasn't identified properly, people have died either multiple organ failure or many, many other things that can come from eating wrong mushrooms because of toxicity.

[00:19:11] **Elliott**: What about health concerns? Like some people, if they have mushrooms growing in their house or mold growing in the house, they're very concerned about the health risk attached to that.

[00:19:19] **Serena**: That is certainly something to look into. I mean, if your aircon filter has mold, please do something about it. Don't breathe the air it discharges.

[00:19:28] **Elliott**: Right, are there any tips that you guys have for distinguishing between a harmful fungi and a harmless fungi?

[00:19:34] **Serena**: In terms of microfungi that grows in your house? If your house is over moist, please deal with it, because I've heard from friends, their toilet has mold. Everything has mold. All this, when the spores come up, it's all around you. And if you breathe, and if you're immune-compromised, you will get some sort of strange thing.

[00:19:56] **Elliott**: So definitely, a group of organisms to respect also.

[00:19:58] **Serena**: Yes, definitely.

[00:20:00] **Elliott**: Yeah. We've talked about how they can be a bit harmful, but why are fungi important to us, and what roles do they play in our local ecosystems and in our daily lives?

[00:20:08] **Amy**: I think in primary schools they would have learned that fungi are responsible for decomposition, but we take it for granted. "Yeah, decomposition, you know, have or not it's not important." But if you think about the Chernobyl nuclear explosion, where the radiation killed

everything, then all the dead things were lying around for decades, right? So then you start to appreciate the importance of decomposition. You don't want dead things to remain dead and intact. Then, in terms of decomposition, they release back the nutrients within the dead body, so that other organisms can use them. Other than decomposition, there's rain formation through their spores. There's also all the mycoremediation, cleaning up the environment, then providing a food source for organisms, not only humans, then also helping trees to grow better, like the mycorrhizal network, bringing in nutrients that they look for in the ground. They can break through rocks to release nutrients and pass it to the plant. They can also bring water to plants. So yeah, they're very, very important.

[00:21:22] **Serena**: Not to mention bread and beer!

[00:21:23] **Elliott**: Oh yes.

[00:21:24] **Amy**: yeah, if you like bread, there's the yeast that is very important. Beer, you can't make beer without yeast.

[00:21:31] **Serena**: That's it. Not worth living anymore. Haha.

[00:21:32] **Amy:** Hahaha

[00:21:35] **Elliott**: Haha true, yeah. Apart from that, both of you have mentioned separately that fungi are found on our bodies. Fungi that live on our bodies, do they perform any, very important functions?

[00:21:43] **Serena:** Not function, but you should get rid of them if you have any.

[00:21:46] **Elliott**: Oh right.

[00: 21:47] **Serena**: Yeah. I mean, like white spots?

[00:21:49] **Amy**: I mean ringworm, right, dandruff. But you also need a biodiverse fungi community within your gut, as well as on your skin. Otherwise, you can get sick quite easily.

[00:22:03] **Serena**: Yeah, usually it's like white spots. If your skin is constantly in contact with sweat, hence, it's also very moist all the time. That's why you get the growth of such things. But generally, if you are healthy, it shouldn't be an issue and you know, they have topical medication that you can just apply. But other than that, if your body is in a stable state of balance, you shouldn't be contracting all these.

[00:22:26] **Elliott**: Right, so I mean if you can visibly see fungi in your body, then that's something.

[00:22:30] **Serena**: Haha, their body is growing mushrooms.

[00:22:31] **Elliott:** That’s something of a concern right? But if you can't see it, there's a whole different group of fungi that's working to keep your body functioning.

[00:22:36] **Serena:** Mm.

[00: 22:37] **Elliott**: Is the process of identifying fungi any different from other, like, animals or plants, or is it a bit more complex or harder to do?

[00:22:45] **Serena**: That one I would need my plant people to debate with me. But it is a little bit harder, and yet a little bit easier, in a way, because we don't know so much. My first port of call would be to sequence them, because otherwise, it's trying to stab at a name in the dark. Because there's so many out there, and so many that have been described since it was properly studied in Singapore. By sequencing, the majority, if it already has a name, I can look up the name and see whether it matches straight away. So that's one thing ticked off. Then for the rest we have to do our background checks on. But the plant people don't necessarily have to do sequencing unless there’s a close relationship between two species that it’s so hard to differentiate that they don't know whether it's two separate species or one, maybe they want to do sequencing on it. So that's an extra effort for fungi.

[00:23:36] **Elliott:** What's the most interesting or the most fascinating thing about fungi that you both want people to know?

[00:23:42] **Serena:** There's only one cute one that I want people to know that if you happen to look from high grounds at perhaps a football field and you see a patch of greener grass than the surrounding grass, it is most likely a mycelial growth underneath. And when certain times come, there might be mushrooms in a ring. So that's really cool, because they draw in nutrients from the surrounding, and the grass within that circle is a lot healthier and greener.

[00:24:10] **Amy:** The tempeh is almost like mold la. It's just that this is the edible type, growing, inoculating, and surrounding, breaking down the soybean. Tempeh is very nutritious, full of vitamins. It is better than just eating the soybeans. Eating fungi products, first, they are zero fat, you get a lot of nutrients and it also increases your health, helps you with your mental health, as in slow down mental decline with dementia in an aging population. It’s a real worry. So my university, several departments, have studied that regular consumption of fungi actually helps with reduction of cognitive decline. So, yeah, eat mushrooms. Mushrooms are healthy. Of course, there are people who are allergic to mushrooms, right? Naturally, it can be anything, any mushroom, they are allergic. So please don't eat. Hahaha.

[00:25:10] **Serena:** Amy's bit on the Lingzhi. All that look like Lingzhi may not be Lingzhi. So for those of you who are harvesting from our nature, please don't. Go and buy from the TCM or something like that.

[00:25:22] **Elliott:** You know, in the TCM shops, they sell Cordyceps, right? I used to always think, “Oh, wow, they really look like bugs.” Then after I realised they are bugs, right? Like the Cordyceps that they sell in the TCM shop - it is a bug, right?

[00:25:32] **Serena:** Yes, it's the chong and the cao.

[00:25:34] **Amy:** Caterpillar.

[00:25:36] **Elliott:** Right? Yeah.

[00:25:37] **Serena**: Yes, my grandmother last time told me, “No lah, it’s grass.” I said, “No, leh, it looks like a bug leh, how does a bug look so much like a grass.” But now they sell the vegetarian version in the supermarket.

[00:25:47] **Elliott:** We're encouraging a lot of people to go out there and observe mushrooms in their natural habitat. Any guidelines as to how we should go about doing that, things that we shouldn't do, things that we should abide by.

[00:25:59] **Amy:** I would say, just admire them. Take photos, observe, but don't collect, because you need a permit, a researcher permit in order to collect. Now, if you think that no one is looking, then I collect, go home and eat. Well, you run the risk of being poisoned, because fungi are very, very good at taking in the poisons and then rendering them not poisonous to themselves, right? They just keep it in a compartment that doesn't bother them, right? But if we start to cook it and eat it, then the poison will be released. Poison, as in things like heavy metals. They can concentrate the heavy metals, and they are not bothered by it, but if we eat it, then we can be poisoned by the heavy metals. Or worse, if you misidentify a poisonous mushroom to be a non-poisonous one, you bring home, you cook, and you can die from the poison.

[00:26:59] **Serena:** And a few are neurotoxins also.

[00:27:02] **Elliott:** So these are toxins that shut down your whole…

[00:27:03] **Serena:** Mm. Whole system.

[00:27:05] **Elliott:** Very dangerous. So don't anyhow, go and collect mushrooms.

[00:27:09] **Serena:** Yeah, just go to the supermarket.

[00:27:12] **Elliott:** Thank you both for talking to us here today. I think I learned so much about fungi, and my head's just full of like thoughts about mushrooms now and all the different places that they can live in.

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Apple podcasts and YouTube, and if you like our content, don't forget to show your support by hitting the follow button and giving us a five star rating. See you guys next time, bye!

[00:28:39] **Serena & Amy:** Bye!