Women at Warp Episode 155: Viruses and Pandemics in Star Trek

Aliza: Hi and welcome to Women at Warp: a Roddenberry Star Trek podcast. Join us on our continuing mission to explore intersectional diversity in infinite combinations. I am Aliza Pearl, and I will be hosting this episode where we're talking about viruses and pandemics, and I'd love to have our guests introduce ourselves, starting with Sherri.

Sherri: Hi, my name's Sherri. I'm so excited to be on the podcast Women at Warp. It's one of my favorite podcasts. Well, I've been a Star Trek fan since I was a young child, and I grew up watching the Next Generation and it was definitely an influence on my decision to pursue both my education and my career in the sciences.Now, as far as my education goes, I hold a bachelor of science degree with a double major in biology and biotechnology and a master's degree in biochemistry. Over the course of my research studies I generally worked in the field of molecular genetics, where I used different recombinant DNA technologies to alter the genetic makeup of different organisms and then study their effects.
And once I completed my academic studies, that's when I began working for the Canadian federal government. Initially I did work in a research lab, but I quickly moved to my current area of work, which is in the regulatory sciences. So I work as a scientific evaluator where I review the manufacturing and the quality control data that is submitted by pharmaceutical companies to support the approval of vaccines and other biologically derived drugs for sale in Canada.
So for those of you from the U S, essentially I work for the equivalent of the U S FDA. And that's me in a nutshell.

Aliza: Amazing. So, yeah. Sherri is, if you couldn't tell, Sherri is our resident scientist for this episode. All right, Grace, tell us who you are.

Grace: I'm Grace. I've been podcasting for about 10 years now. I love Star Trek, and one time in science class, I dissected a chicken wing.

Aliza: Fantastic. Sue, tell us about yourself.

Sue: Well, I'm Sue and I think my last biology class was sometime around 1996 so-

Aliza: Perfect. Yes, this is going to be really fun. I'm also not a scientist. I'm an artist who loves science. We're just going to talk about these episodes as fans and as people living through a pandemic, because you know, we're not experts in pandemics, but now we know what it's like to live through one. So before we get started in our discussion topic, here's the housekeeping we have to do. Our show is made possible by our patrons on Patreon and starting in January of 2021 we're adjusting some of our tiers and adding some new rewards. So visit us over at patreon.com/womenatwarp to check out those new tiers. You can also support us by leaving a rating or review on Apple podcasts or wherever you get your podcasts.
And finally, we're regularly curating new designs for our Tee Public store. You can find t-shirts, hoodies, mugs, masks, and more at Teepublic.com/stores/womenatwarp. And so now let's start talking about viruses and pandemics. So Star Trek has explored stories with viruses and

pandemics many many times before, but now that we're living through a pandemic we thought we would revisit those episodes and talk through them with an expert.
Of the viruses and pandemics and Trek we'll discuss today, there's basically three categories that emerged. So we have medical mistakes, bio weapons, and survival tactics. Of course there are, there might be some viruses and pandemics in Star Trek stories that are organic or naturally occurring in nature. We actually thought of another episode this morning that has an organic virus. But we're not going to talk about those today. So this is not a comprehensive episode on all the viruses and all the pandemics and Star Trek. I hope to do another episode where we just keep digging into these. Just so you know, we didn't forget your favorite episode. Hopefully we'll get to it in another episode. So to start us off before we get into the specific episodes Sherri, I want to know, and we want to know as co-hosts, what does the general public and the media tend to get wrong the most about viruses, pandemics, and vaccines?

Sherri: You know, that's a tough question. Kind of what I see is confusion around different terms that are used when we speak about viruses, pandemics, and vaccines. And it's evident in the episodes we're going to be talking about today. So, you know, we hear terms like antigen, we hear terms like a vaccine or an antiviral medication and sort of understanding the differences between those can be difficult, I think, for the general public. So, you know, one example, and it comes through in one of the episodes here, is where they talk about using an antigen to kill a virus. So an antigen cannot kill a virus. An antigen is something that activates your immune system and helps you to develop antibodies that then can bind the virus and help you clear the infection. So that's a general, I think, a common mistake that is made in the broader media around the pandemic. I think the other top category would be the mode of transmission of a virus. And we are also going to be talking about this I think. You know, it's this idea of an airborne virus versus a virus that's transmitted through droplets. Through respiratory droplets. So an understanding of the difference between those, I think, is important. And is often, you know, Mixed up.

Sue: Isn't that the case though, too, with vaccines? I feel like a lot of people think about a vaccine as a cure. But in my memory a vaccine is something you get when you're healthy to train your immune system how to fight the virus, if it comes in contact with it.

Sherri: Yeah, you're absolutely right. The vast majority of vaccines are prophylactic vaccines, meaning that you have to be administered the vaccine before your body encounters the virus. And typically you need, you know, several days to several weeks to develop the immunity after you receive the vaccine. And often you need multiple doses of a vaccine in order to develop that immunity. So you're right. Once you've become infected with the virus, administering a vaccine at that point is not likely to help you fight off the infection. We do have a few examples of vaccines that can be administered very early on in an infection that do have a benefit. An example of that would be the rabies vaccine.

Grace: Interesting.

Sue: Is there such a thing as a cure for a virus? I guess, I mean something that our scientists could create in a lab that we then administer to someone who is ill, that does the killing of the virus for them.

Sherri: Yeah, absolutely. So we have what's called convalescent plasma therapy. So this is where we take the blood of individuals who have successfully fought off the viral infection and in their blood is contained antibodies that they developed, which helped them to fight off the viral infection.And so what we do is we purify out the plasma component of the blood of those individuals. And we infuse it into individuals that have a current infection. And so those antibodies from that other person are then infused into their system and able to bind the virus and clear the infection for them. So this is a therapy that is used for many different viral diseases.

Aliza: Cool. And is that something that could happen or will happen for COVID 19?

Sherri: It is being used for COVID-19. I know it is being given to patients with very severe disease. And I know here in Canada, our Canadian blood services has ads out on our local radio stations, asking for people. "Have you been infected by COVID-19?" And they're looking for people to donate their blood so that they can purify out the plasma and use it to help treat people with active infections.

Aliza: Yeah. I just realized, I have seen those in the US. I've seen some TV ads.

Sherri: So that's a different category. So when we talk about vaccines, that's considered active immunization. When we talk about the use of convalescent plasma, that's called passive immunization. So it's not long lasting because you're just transfusing the antibodies from another person into another individual. And those antibodies will not remain in your system. It will not create any sort of immune memory. So, that individual if they were to encounter the disease a second time, they would not be immune to it

Sue: Because their body didn't create those antibodies.

Sherri: Exactly.

Sue: I feel smarter already.

Grace: I'm already learning so much today.

Aliza: Yep. This is amazing. Cool. Let's jump into these episodes and see how much technobabble is actually based in real science. So the first episode we're going to talk about is the TNG episode Genesis, which has a virus that is officially called Barclay's Proto-Morphosis Syndrome, AKA the De-evolution virus. So I'll do a quick summary of this episode to refresh people's memories. Lieutenant Barclay has a mild case of the Urodelon flu. Which Dr. Crusher treats using a synthetic T-cell to activate a gene in him that will help his body fight the flu

naturally. Then strange symptoms and behaviors start popping up all over the rest of the crew. Things like aggression, lethargy, hyperactivity, temperature dysregulation, and brain fog. And then, of course, we all remember the crew starts devolving into various animals. And-

Grace: How could we forget?

Aliza: How could we forget the visuals of this episode? There's proto-humanoids, there's insects. There's arachnid versions of people. Data and Picard then return to the ship from an away mission. And they find the crew all not-the-crew. Data analyzes Rikers data, and discovers that the synthetic T-cell has invaded his genes and activated latent introns, new word for me, which are genetic sequences that have been long dormant. So Data uses amniotic fluid from the pregnant nurse Ogawa to create a retrovirus that will then re neutralize the synthetic T-cell and reverse the de-evolution. He administers this treatment by flooding the ship with a gas that contains the retrovirus. Special thanks to Memory Alpha for helping me summarize this concisely.

Grace: God bless you memory Alpha. What would we do without you?

Sue: A lot more research. *all laugh*

Aliza: We'd do a lot more work. *laughs* So the first question I have for Sherri here is what type of treatment would the retrovirus Data creates here be called?

Sherri: Okay, so Data's retrovirus. So it would most likely be classified as a gene therapy. So what a gene therapy does is it can replace a gene that is causing a medical problem with one that doesn't, it can add genes to help the body fight or treat a disease, or it can be used to turn off a gene that is causing a problem. And retroviruses are a really great vehicle for delivering genetic material into human cells. And we do have several approved gene therapies that use retroviruses as the vector to deliver the genetic material. So, you know, my best guess at what information is provided in that- in the episode is that, you know, Data's retrovirus is a gene therapy and it likely does two different things. First, I think it needs to contain the genetic sequence that codes for the antibody from nurse Ogawa's amniotic fluid. Right? So then this would allow the person that receives the retrovirus to then express that antibody and fight off the infection. The other thing this gene therapy would have to do is it would need to contain a series of genetic sequences that would effectively turn off the activated introns. So in a way to stop the disease process.

Aliza: So in real life, how long would creating something that does that take? Because you know, they do it within the course of an hour or two in the episode.

Grace: Got to wrap it up for prime time.

Sherri: The clinical development of a new therapy can take a decade.

Aliza: Wow.

Sherri: The, you know, because there's the research and preclinical development components, and then you move into clinical trials where you're looking at safety. You're also looking at proper dosing. And then finally, you're looking at the efficacy of the therapy so that, you know, that can take anywhere from five to 10 years to go through that for vaccines, it can be much longer. And then we talk about just the manufacturing time. So once you have a product that works, now we have to think about manufacturing and a lot of these products take weeks to months to manufacture. So, you know, a standard vaccine, you know, would typically take, say six months from the start of the manufacturing process to a finished vial containing the vaccine.

Grace: Thank God Data has that super speed then.

Aliza: Right?

Sue: Yeah, I think, I mean, in the Star Trek universe, we don't have to worry about funding. Because of replicators, we don't have to worry about manufacture time. Unless it's one of those substances that for some plot reason can't be replicated. But I mean, we never do see anybody, any of the doctors talking about like, "well, this should go to trials first." They just distribute it to the entire ship.

Grace: That was something that I was weirdly really cognizant of while doing the rewatch, just for this episode. And each of these just stopping and being like, "okay, well, how many hoops are they needing to jump through to make this happen?" In the point between knowing there's a problem and being able to implement something to fix it or help that problem, because we've all been seeing a lot of that in the news. And it's been at the forefront of all our minds the past couple months.

Aliza: Right. Totally. I think we all have just this new awareness of how these things work. And so revisiting these virus and pandemic episodes, I hope listeners will also rewatch these, because it's amazing to see how cognizant we are of like, how pandemics work now.
And when we originally watched these episodes, we're like, "Oh, yep. Okay. That's how it works." It's like, "Oh no, this is kind of different than-" it's not even just the scifi element that's different. It's also like, The mechanics of living through a pandemic. We now see where the writers were just kind of creating the fiction of that. The other science-y question I had about this episode, Sherri, was about introns. That was a word I didn't know existed. *laughs* Rewatching this episode, I was like, "Oh, Introns" I thought it was technobabble, but it's not. Introns are a real thing. And so there are these genetic sequences that are dormant in DNA.
So is it really possible in real life to activate introns?

Sherri: Yeah. So the short answer is "yes,"-

Grace: What?! *all laugh*

Sherri: You can quote unquote “activate” introns.

Sue: What IS an intron?

Grace: We need an intro to introns.

Sherri: Okay. So in some genes, not all of the DNA sequence is used to make the end product, which is a protein. Okay? So you have introns are the non coding sections of the gene.
So the sort of initial steps of gene expression, the first thing that's going to happen is transcription. You're going to transcribe your DNA into RNA, and that's going to contain both the coding sequence for the protein, as well as the introns. And so what happens is in this messenger RNA in its premature state, it contains both the exons, the coding regions, as well as the introns. And then before that messenger RNA is translated into a protein, it undergoes a process called RNA splicing. And this is a process that involves removing or splicing out those intron sequences.

Aliza: Ooooh!

Sherri: Okay? And so, you know, it occurs in several different steps and it is catalyzed by a spliceosome complex, which is a complex of many proteins and RNA. And so, you know, to quote unquote "activate" an intron, the sort of mechanism to do this would be to disrupt or mutate the genetic sequences involved in splicing. So there are within both exons and introns there are the splicing sites, which target the spliceosome to perform that cut. And so you could effectively mutate those and that would result in those introns being maintained in the final messenger RNA, which would then be translated and produce a mutated protein.

Aliza: Wow. Okay so the thing is though, are there introns in us that like if they were expressed they would make us turn into frogs? *all laugh* That's my question. Final question.

Grace: And if so, do we get to have any say over whether we turn into a frog, or a puddle, or a giant spider Barclay critter?

Sherri: Yeah. So that part of it is pretty far-fetched.

Aliza: Okay. Just checking, just checking.

Grace: I'm still gunning for spider creature!

Aliza: I think I would want to be a frog. For real. Like, seems just kinda chill. Uh, as long as you have enough water to live in.

Grace: That's true.
Sherri: I would go for bird. I want to fly.

Aliza: That's a good call. Yeah.

Grace: I don't think they had the budget for any one to devolve into a bird though.

Sue: I think it's really interesting though, what the very science fictiony aspect of the de-evolution implies for our characters. Right? It implies that Betazoids were at one point amphibious or that, I guess, Barclay is not fully human? Because he is an arachnid while, I guess, Riker is supposed to be Neanderthal? And I mean, the Klingon de-evolution just is like a scarier Klingon it seems. *laughs* but I mean, the speculating on this is truly just speculation because what a ridiculous virus. *all laugh* I mean, wouldn't we be able to assume that the de-evolution, if you can call it that, is at the same rate? So like at the time in supposed history, like length of time ago, that this is what all of our Star Trek races evolved from? Am I even making sense?

Grace: Yeah, I think so.

Sue: Like if it's 20,000 years ago, right, that Betazoids were frogs, wouldn't it also be 20,000 years ago that Barclay was whatever Barclay is, if not fully human than was an arachnid?

Grace: That one of Barclay's ancestors was bitten by a radioactive spider.

Sue: Right. Totally!

Grace: Calling it now. It's cannon! *all laugh*

Aliza: He's spider-Man. Barclay is Spiderman.

Grace: Yes. The Parker family tree goes way back.

Aliza: Yeah.

Sue: So I mean, I guess in a more concise way: members of the same species wouldn't necessarily be de-evolving to different points along the evolutionary chain.

Aliza: Well that makes me think that in the science fiction of this episode they're basically saying that humanoids have multiple introns from multiple various proto versions of humanoid. Right? Cause like, yeah, I think I hear what you're saying.

Sue: So different ones could be activated in different people.

Aliza: Exactly! So Barclay, he might have the proto-humanoid AND the arachnid, but the arachnoid is the one that got activated.
Sue: That's interesting.

Sherri: That's the sense that I got. That it was sort of the activation of the entrons wasn't specific, it was more of a random event. And so that's how you got the de-evolution to different species between the different crew members.

Sue: I like this explanation way better than what my brain was doing. *all laugh*

Aliza: This is why we science the science fiction. It's very satisfying. Okay, so let's move on to the next virus. And this is actually a virus that has had a life that spans many episodes and multiple series. This is the infamous Klingon mutagenic virus, AKA the Klingon augment virus. This was, I think, a pretty spectacular ret-con of the original series having smooth forehead headed Klingons that don't look like the ridged foreheaded Klingons of the future, of TNG, DS9, Voyager era.

Sue: If I can play devil's advocate. *Aliza laughs* I kind of wish they had left it alone. Because I thought, you know, in Trials and Tribblations Worf just saying "we don't talk about it" was much funnier. *all laugh*

Aliza: That is also wonderful. I love that moment. Yeah. I love both. So I hear you, but I also still love this ret-con.

Sue: Fair. That's fair. *laughs*

Grace: I respect the Moxie of the ret-con.

Aliza: No, that is a very brilliant moment. "We don't talk about that." So here's a little bit of info from Memory Alpha for those of you who need a refresher. "The Klingon augment virus was a hybridized form of Levodian flu" another flu coming into play here.

Grace: So many flus

Aliza: Right?

Grace: Space has a flu problem.

Aliza: Right? Oh my God. Space flu. Space flu is reckless. "Levodian flu threatened to wipe out the Klingon race in the mid 22nd century. It was inadvertently created by Klingon researchers who were attempting to bioengineer enhanced warriors using DNA from genetically modified human embryos left over from Earth's eugenics Wars." So that's a mouthful basically just saying Klingons created this by mistake. And throughout this story arc, so we have like the TOS Klingons established with smooth foreheads, and then Enterprise does two episodes in season four, which are Affliction and Divergence, episodes 15 and 16, where they show what happened and why Klingons then got this mutation of smooth foreheads. Okay. We talked about how we all feel about this retcon. Although, actually, I don't know if we heard- Sherri, what do you think about this retcon? Do you think it was worth it? Should they have just left it alone like Sue says?

Sherri: Yeah, I think they could have just left it alone. I don't know that we needed the explanation. It was a fun, you know, science fiction episode.

Aliza: Yeah. What about you, Grace? What are your thoughts

Grace: Again, I appreciate the moxie of the retcon. There's so many things that Enterprise has attempted to change the canon on, or the continuity on. And this is one that I was actually like "Okay. You're actually trying to put a solid explanation behind that. I respect that a little bit." The episodes themselves get pretty silly, I will say. Especially the part when Tripp is on like a rope connecting two separate spaceships, that was kind of like, "why is this happening? Is the main plot not interesting enough?"

Aliza: Yeah. I think my only major critique of these episodes is that there was just a little bit too much going on.

Grace: Yeah. They turned this primary concept into their kind of their B plot. That felt weird.

Aliza: Yeah, exactly. Yeah. You're right. It felt like a B plot. And then there was also Malcolm being put in the brig because he's getting contacted by his old secret Starfleet- I guess it was section 31 contact and yeah, it was just a lot. It was just a lot going on in these episodes.
But anyway, going back to the science of it. My first science question, Sherri is so mutagenic viruses do exist. So, so yeah, I guess then that means it's possible for a virus to change our genetic makeup enough to change our appearance?

Sherri: No. *all laugh* So, you know, to change our appearance that drastically, I would say no. So when I say, you know, do mutagenic viruses exist? What I mean is there are viruses that can cause mutations as a result of us being infected by them. You know, we don't really see any real life examples where, you know, as a result of a viral infection we have, you know, visible change in our appearance. Sort of the only one I can think of is mumps. So when you get sick with mumps, you know, you get the characteristic sort of bulge in the neck area. But that's as a result of the infection, the virus isn't, you know, Altering your bone structure or, you know, pigment in your hair or your skin to create an altered appearance,

Sue: Right. And the opening scene of Affliction, like, you see the changes happening in the one Klingons forehead, which we're led to believe like those are bones. *laughs* So his bones are reshaping themselves-

Aliza: Rapidly.

Sue: -as we watch.

Grace: Just melting a little bit in front of us.
Aliza: Yeah.

Sherri: And then what really confused me was when they infected Archer and the reverse happened.

Grace: *laughs* He's got just a little itty bitty ridges now.

Sherri: Yeah. So I did not understand how the same virus, which would cause the elimination of ridges in a Klingon, but then in a human would cause the appearance of new ridges.

Grace: Bakula wanted to wear makeup that week. Who knows?

Aliza: Yeah, that is confusing. And I didn't even realize that it doesn't make much sense. Huh. Kind of similar to the last virus we talked about in Genesis. This is one that's rapidly changing genetic- not just appearance, but like the genetic expression. And I know we already kind of talked about this in Genesis, but do you know of any other real life examples of things that change our genetic expression? And even if it's like over time, you know. You have this virus and then your DNA gets passed down and your grandkids now have pointy ears a little bit, or I don't know, something like that?

Sherri: I mean there's absolutely, you know, real-world examples of viruses that are capable of altering our gene expression. You know, some examples include the herpes simplex virus, the Epstein-Barr virus, and actually the influenza A virus. So if we, you know, take a look at herpes viruses well, you know, they encode multiple proteins that can alter our whole cell gene expression and it's normally, you know, more transient in nature. So these viral proteins, they interfere with different aspects that affect gene expression. So they will interfere with the stability of our messenger RNA. So cause degration- degradation, sorry, of the messenger RNA. They can interfere with splicing, which we talked about previously. And so all of these things have the end effect of altering the way our genes are being expressed with not being translated into proteins.

Aliza: Wow. So it's all true. *all laugh*

Sue: But I mean, what kind of expression are we talking about? Like is it gonna, I don't know, change someone's hair color? Is it gonna- what are we expecting to see different?

Grace: How long til I get gills? *Sue laughs*

Sherri: Yeah. So I think, you know, you're not going to see anything different. And we see this, you know, all of the different viruses that infect humans there's- other than mumps, like I explained, there's really no outward changes to a person's, you know, physique or physical appearance when we're infected with a virus. So that aspect is not so plausible.

Sue: Okay. So it's not a visible expression in someone's appearance, but it's like how our cells, our genes, are working.

Sherri: Yeah. Usually what the virus is doing is it's hijacking your cells' machinery to make copies of ITS genetic material instead of your own. So it's happening at the cellular level. Right? So that individual infected cell is no longer expressing the genes it normally would. Instead it's expressing the virus's genes for it.
And once the virus is done with it, it exits the cell and essentially lyses or kills that cell.

Sue: Got it.

Sherri: But something, you know, I wanted to talk about was for this episode what I really appreciated was, you know, it was the only time we heard, you know, and it was Phlox where he was kind of pushing back saying "I'm going to need time to come up with a cure."
He talks about having to test the cure for the virus. And, you know, that's rarely discussed in Star Trek.

Aliza: Yeah. And I mean, that kind of also goes along with what Enterprise was supposed to be, or at least in my thought like what Enterprise is, it's like the bridge between modern humans and what we know Starfleet to be. So there's just like- just that tad bit that's still rooted in our like more everyday human existence, or I guess Phlox is not human, but you know what I mean?

Grace: No, but I will say that Phlox definitely gets some good moments in this series of episodes.

Aliza: He rocks it.

Grace: Now, why didn't they treat that more like the A plot?

Aliza: Yeah. Yeah. Well, we'll be sure to give those notes to them in the past. But I wanted to move us to our next category of viruses in this episode, which is bio weapons. So we have a couple of different examples of viruses in Trek being used to hurt people, or prevent people from doing something, trying to hurt the enemy, or stop the enemy in some way. One of the episodes we're going to talk about is Deep Space Nine Babel. So that's season one episode five, where they talk about the aphasia virus. So this is a virus that was planted by a Bajoran scientist years before, like back when the station was built. So I think they said something like 18 years ago. But Bajoran scientists planted this little piece of tech that when attached to the replicator will basically create a virus into the replicated food. It ends up being reactivated by O'Brien when he fixes that replicator. And it affects almost the entire population of Deep Space Nine, causing a lot of people to lose the ability to communicate clear thoughts and connect those thoughts with the proper words. So they just start speaking jibberish. From Memory Alpha, "the virus resided in the temporal lobes of infected individuals and had an adaptive synaptic inhibitor. Its symptoms included speaking in jibberish and the inability to understand language. The virus disrupted the brain's processing of oral and visual stimuli." So what's interesting to me about this episode is like I, you know, I'm a member of the chronic illness community. I have a chronic illness that affects my brain sometimes and the way my brain works. But I know for other people in the chronic illness community with similar symptoms to me, like brain fog and cognitive

dysfunction, theirs is caused by viral infection. So I guess my first science question, Sherri, is are there real life viruses that acts like the aphasia virus and like, they go straight for the brain function?

Sherri: There are real life examples of viral infections that induce aphasia. And so, you know, an example is the herpes simplex virus, which causes encephalitis. So swelling in the brain. And it's as a result of that that you then start to see the signs of brain dysfunction. And so that can manifest as, you know, fever, headache, and confusion. So these are all, you know, the idea around the confusion is, you know, it is characteristic of aphasia. So it's not the virus itself moving to a specific target in the brain and causing the aphasia. It is the overall sort of physiological impact of the viral infection.

Aliza: Yeah. So once again, it's like there's a core scientific truth in this episode. And this sounds like what it is. Like it actually could be that a virus could cause these types of symptoms.

Grace: This episode always gets to me because it's not technically virus related, but because of the way my brain is hardwired when I'm overstimulated or overwhelmed, I do lose the ability to verbalize. And that is the first thing that goes when I'm going into an overwhelmed spiral. So, while I laugh at this episode and Avery Brooks's incredibly intense delivery of the word "BREAD", it does hit home a little bit. And the one thing that I don't feel like when you're losing the ability to properly verbalize or express what you're thinking or feeling is that they don't- they could've brought across better in my personal opinion, is how incredibly frustrating it is and how that can lead you to come off as like belligerent and angry. And that's just kind of a by-product of that, that you have to deal with as kind of a secondary characteristic of losing the ability to verbalize.

Sue: One of the things I remember reading about this episode, and I did not double-check it so forgive me if I get some small details wrong, but either the writers or the actors sat down and figured out what the characters were trying to say so that they could deliver their quote unquote jibberish lines more effectively. And I found that really interesting. But also like I've seen a few, I'm going to say "medical shows" *laughs*, but I think also documentaries on aphasia and it's just it's very interesting to me that like, you know, at some level, you like, know what you want to say but your brain is pulling out a different word that for some reason is related to how that word is stored in like the language part of your brain. I don't know. I obviously can't explain it well. *laughs* Look up aphasia. It's fascinating.

Grace: That's the irony of aphasia. It's already really hard to explain. *all laugh*

Aliza: So my second science-y question about this episode is this: the virus in this episode is spread through food from the replicators at first. But then when it has infected a lot of people on the station, it becomes airborne. So this is a two part question Sherri. In real life what is the determining factor of whether a virus becomes airborne or when it becomes airborne?
And then the second part of the question, which I'll just tack on, is there really any difference in a virus like COVID-19 that travels via aerosols versus something that's airborne? I still don't

quite understand why we're not just saying COVID-19 is airborne if it travels on aerosol. So what is the difference?

Sherri: Okay. So we can talk about that first then, the difference. You know, droplet transmission versus airborne transmission of viruses. So droplet transmission, which is you know, the way the flu is transmitted and the way that COVID-19 is transmitted. You know, this occurs when a person is in close contact with someone who has the respiratory symptoms, so coughing or sneezing, and therefore are at risk of being exposed to those respiratory droplets. So this really has to do, you know, it's where size matters. So airborne transmission is different from droplet transmission because what it does is it refers to the presence of viruses in particles. So droplet particles that are smaller than five micrometers in diameter, and because the virus is able to survive in particles that small it can remain- those particles can remain in the air for long periods of time, even after a person has left the room, and can be transmitted to other people over distances much longer than a couple of meters. So that's the difference. It's the ability of the virus to survive on droplets of a specific size and how far those droplets can travel and how long they can remain suspended in the air.

Aliza: Oh, okay. That's- thank you so much. That is the most sense it has made in my brain. And that also makes, you know, it makes sense as to why masks are effective and important. Because even if it's not airborne, it's still being spread through droplets that traveled through the air from our bodies.

Sherri: Yeah. That's exactly right. And so, you know, we can take the- I think the other part of the question was around the fact that this virus was initially spread through food from the replicators. And then once, you know, it infected a lot of people it became airborne. So, you know, what we're talking about here is viral tropism. So, this is the ability of a virus to infect different tissues and different cell types. So usually a foodborne virus is being transmitted through the oral route and is going to infect the cells of your gastrointestinal system. For an airborne virus, a virus needs to be able to infect the cells of your respiratory system.
So for this virus, it would need to acquire a series of mutations that would allow it to infect the cells of the respiratory system. That would be sort of the first step to becoming airborne. The next step would have to be the improved survivability of that virus in smaller and smaller droplet sizes. So, you know, typically we see a lot of viruses that spread through that large droplet transmission. So this is where someone- you have to cough or sneeze in close proximity to transmit the virus. But we would need to see, again, another host of- a whole suite of mutations in this virus for then it to also now be able to survive in these very small droplets and move to an airborne transmission.

Aliza: Wow. And so, thankfully it seems like that doesn't happen a lot, like *laughs*, is that a fairly rare occurrence for a virus to hit all those mutations perfectly and then become airborne?
Sherri: Absolutely. There needs to be a genetic advantage to the mutations, right? So if a virus is, you know, perfectly happy and transmitting easily through food or through, you know, direct contact, then there's really no evolutionary pressure on the virus to acquire a mutation, to

become airborne. You know? And then even if there is a mutation that happens in a, in a single virus, it needs to then become the dominant form of that virus to out-compete it's predecessor. This is amazing. Like, I feel like my brain just broke open in a new way. *Grace laughs*

Sue: I think I'm mostly amazed that anything ever really truly becomes airborne, because it's very evident that "spread through aerosols" is pretty effective, right? At least this year, it is.

Sherri: You know, something that I wanted to talk about that I think is- was never addressed in any of these episodes is this whole concept of disinfection and sanitization. So, you know, you're on a space station or you're on a star ship, it is a confined space in outer space. We have all sorts of chemical disinfectants that we can apply to hard surfaces, that we can apply as a fog- a chemical fog to inactivate viruses. And this was something that was never considered in any of the episodes.

Aliza: Wow. Yeah.

Grace: Geez.

Aliza: And it's such a- it's amazing because it has been such at the forefront for us. Yeah. That's a great point.

Grace: I guess they don't have Lysol wipes in the future.

Sue: Well, Data in Genesis, they do release the retrovirus as a gas through the environmental systems.

Sherri: Right. But they could have just released a chemical through the systems that would just inactivate the virus. You know viruses- chemical- we cross-link the proteins, cross-link the DNA. It can no longer infect the cells. So this is a really fast way of inactivating virus in the environment. And it's something that is used sort of in the manufacture of vaccines. You know, they involve growing a virus in a manufacturing facility, and to clean up afterwards and make sure there's no residual virus in the environment. There's many different decontamination strategies that are employed currently. So the idea that this didn't come up in, you know, Phlox didn't think about this, Bashir didn't think about this. It's surprising. And to me, it's kind of a big gap.

Aliza: Yeah. Another thing that I feel like I'm hyper aware of now, because of living through this pandemic is back in the episode, the DS9 episode Babel, Quark doesn't want to shut down his bar.

Grace: Yeeeah.
Aliza: Yeah. And now, Oh my goodness. Watching that episode now. You feel that. That hits different. Like, because literally we're living through this moment where we can't get on the

same page, in the U S at least, about whether the economy should keep going at the risk of people or we should, you know, definitively try to contain these outbreaks before reopening. And so Quark not wanting to shut down the bar, was like "Oh, of course he doesn't. "

Grace: Ugh.

Aliza: Dang it. Dang it Quark!

Grace: Quark!

Sherri: And then there's everybody on DS9 going to Quarks.

Aliza: Yeah. Yeah!

Grace: Cause they assume if it's open, it's okay to be there.

Aliza: Right.

Sherri: Yeah. And they were under quarantine order to remain in their personal quarters. But everybody's out on the promenade shopping. Well, no, the shops were closed down. They were all at Quarks.

Sue: I just want to start screaming. *Aliza laughs* I- someone I know actually posted a photo on social media today, eating out at a restaurant.

Grace: Oh my God.

Sue: I don't understand. I don't- I don't understand. That's all I can say. I don't understand. *laughs*

Aliza: Yeah. Well, I mean, when you rewatch Babel again, this is it. That's what it is. We have Star Trek, it's canon in Star Trek that people don't want to comply to help shut down a virus pandemic.

Sue: They sure got that right, but got the science wrong.

Grace: "How dare you minorly inconvenience me."

Aliza: Yeah. And then, I mean, also it is very funny that Quark is the reason why the virus spread so quickly, because he was using the replicator that was affected. Like, it's just *laughs* There's so many ways that they just chef's kiss. They totally nailed it in this episode.

Sherri: Well, they also had, well again for Babel the idea of travel restrictions, right?

Aliza: They certainly did. Yeah.

Sherri: Where they weren't going to permit anyone to leave or board the station. And then you did have the freighter captain who, you know, is making the argument that his cargo was perishable and he needed to leave the station. So he was fighting the travel restrictions.

Aliza: Yeah.

Sue: And "Everybody on MY ship seems fine."

Aliza: Right. "This doesn't affect US. Why do WE have to follow these rules?" Yeah. So that was the biogenics category that we're going to discuss. And now the next category is just very hyper-specific to like survival tactics, viruses that are created to help a species survive or avoid extinction. So just really quickly, we're going to touch on these episodes. These are also mutagenic viruses, which we now know what that means. The Enterprise episode Extinction, season three episode three, and Voyager episode Favorite Son, season three episode 20. And of course the Voyager episode predates the Enterprise episode. They do have a similar core scientific thing that happens. Which is- once again, thank you Memory Alpha for helping to summarize this. A mutogenic virus is created in the Enterprise episode by an alien species called the Loque'eque because they faced the threat of extinction. And the point of this virus is to mutate the DNA of any humanoid visitors to their home world and turn them into that species, and make them want to stay there, make them have this strong desire to visit the home city. And want to basically repopulate and that's how they tried to repopulate. But of course sadly, sorry spoiler, they don't. And then, also from Memory Alpha the Voyager Favorite Son episode, this other species called the Taresians "would lure unsuspecting humanoid men to their world by infecting them with a mutagenic retrovirus that turns them into Taresians." So same thing, "and plant memories of the Teresian Homeworld in their minds." So just touching on these really briefly. So my question is about genetic memory and- cause I know- I have heard as an African-American woman I have done some reading in the past about like generational trauma. And how that's not just passed down in like our behavior in our cultures and the way we raise our children and things like that. It's also like a genetic thing that gets passed down. So I guess my question is: we have this lovely scifi story of memories being implanted via genetics via the genes being changed. But is there some level- like what is the real world equivalent of that?

Sherri: Okay. So I can speak to it a little bit. It's not my area of expertise, but what we can talk about is a field called epigenetics. And so what this is is changes to your DNA. It's not changes to the DNA sequence, but it's changes to, for example, the methylation of your DNA. And it can be as a result of an experience, a traumatic event, for example, can alter your DNA methylation. And that, you know, certain epigenetic changes, not all, but some of them are heritable. So that means they can be passed down to your children. So there is a whole field of study that looks at this. It's not my area of expertise, but you know, absolutely. There are these types of changes, where it sort of gets improbable is the idea of specific memories being implanted. Like the idea of, you know, for Extinction, the idea of remembering what the city looks like. That, I have a hard time wrapping my head around how that would be encoded genetically.

Aliza: Cool. So yeah, once again like with most Star Trek and with all these episodes, there's this core bit of actual science that they extrapolate from, and in this case it's epigenetics. Like, that's the thing. Cool. Okay. So wanting to round out our conversation with an episode that I absolutely love *laughs* because it's ridiculous. It is the giant virus in the Voyager episode Macrocosm, season three episode 12. Y'all this is one of my favorite episodes. *all laugh* So as a refresher for listeners, in this episode there's a virus that has the ability to grow large and it spreads all over the ship. So from memory alpha, "A unique form of virus that could use its victims' own growth tissues to increase in size so much they could be seen with the naked eye." And that is an understatement my friends, it is like three feet tall.

Grace: If I can reiterate the plot, "What about virus? But big?" *Aliza laughs*

Sue: It can be seen without your glasses.

Grace: *whispers* My god.

Aliza: It's so wonderful. I love it!

Grace: And it makes a weird buzzing noise. Like a giant bee

Aliza: It does! It is so wonderful. So here's the science question, and this is like- I also love this question because I actually have talked to kids about this, like nieces and nephews in the past always ask things like this. So the question is, why are viruses tiny? Why don't they ever grow larger?

Sherri: Well, viruses are tiny because they are built to infect an individual cell. So they have to be able to enter your body and come into contact with a single cell in your body, which you cannot see with the naked eye. So of course the virus has to be even smaller than the size of a cell to be able to infect and attach to a single cell. So that's the short answer around why viruses are tiny.

Aliza: Cool. And so Sherri once a virus *laughs* in this episode these viruses get bigger, would they still behave like a virus would or would they then just become not a virus? Like at what point does the virus not become a virus?

Sherri: I mean, I would say at the point that it's able to fly through the air. *all laugh*
I don't- you know, gravity's a thing. Viruses don't- aren't self-propelling. You know, they have to be carried in droplets or in some kind of vehicle. So you know, that is sort of the big thing. The other thing is that, you know, at that size the virus is not going to be able to attach itself to a single cell and inject its genetic material.
It's just not going to happen. So, you know, for me thinking about this episode, how could this be plausible? I say, "okay, well, the virus would have had to mutated or adapted such that internally it contained also copies of the micro virus. So if that giant virus is floating around and we saw it,

you know, it impales its victim. So impaling your victim, you're not going to be able to inject your genetic material into a single cell. But if through that needle-like projection, you're delivering the micro version of the virus then you could be successful in infecting. So, you know, that's the only sort of plausible way that this large size virus would still be able to infect somebody

Sue: Almost like a parasite that's actually laying eggs metaphorically when delivering the virus.

Sherri: Absolutely. And that, you know, that was my thoughts watching the show. I was like, "this is. Behaving more like a parasite." And when we saw, you know, the abscess on the necks where it would then come out, you know, this is- yeah, definitely more like a parasite than a virus.

Sue: One of the things though that's, I mean, I guess a little bit sciency that I really love about this episode is that like in a way, it's almost like a Voyager meets Magic School Bus. *all laugh* The whole ship is infected and in a way reacting like a body would. Like Janeway is a white blood cell, right? Going to attack this virus or whatever. I don't know if white blood cells do that.

Grace: A white blood cell by way of Ripley. It's pretty great.

Sue: Seriously, and like I just-when she gets all sweaty and hot and takes off the main- the outer part of the uniform, like is that like the ship running a fever? You know? Like this and seeing how the ship is fighting the infection in the way that a human body would fight an infection. Or maybe I'm just taking the allegory too far.

Aliza: No, that's brilliant. I feel like that's what it is! That makes total sense

Grace: "on my old ship this would've never happened."

Sherri: I think here in this episode, again, we have sort of confusion between science terms. Because we had Janeway throwing this antigen bomb, right? To kill the macro virus. And again, you had the Doctor in sick Bay inject a virus with the antigen and you see the virus explode. So again, an antigen will not kill a virus.

Grace: Was anyone else hoping we'd get to see her like, with a super soaker full of penicillin or something?

Sue: Inject it with bleach guys. *group groans*

Grace: It's wacky.

Aliza: It's so wacky. I love it!
Sue: I think it's a really good interesting idea, but like, obviously not plausible.

Aliza: Yeah. This is one- I think the reason why I love this one so much is because, like I keep saying you know, Star Trek episodes have this core bit of science and then extrapolates from there into the scifi. This episode is like "here's a tiny speck of science, and boom! We're just going to make something happen." I love that. I just love how bold it is. It is a little silly, but it's just great. Star Trek is great y'all.

Grace: You could say we're fans.

Aliza: Yeah, we're fans. Thank you so much, Sherri. You are amazing. And thank you so much for lending us your brain, and your fandom, and sharing all this amazing info with us on viruses and pandemics.

Sherri: Oh, you're welcome. You know, thanks so much for inviting me to be on the show. I had a great time watching these seven episodes and trying to read up and research to see how plausible some of the science was in these episodes. It's been a lot of fun.

Aliza: Yay! Well, that's about all the time we have for today. Sherri, is there a place that people can find you on the internet that you would like to share?

Sherri: Sure. People can find me on Instagram and Twitter @anchoredPisces.

Aliza: Wonderful. Grace, where can people find you?

Grace: You can find me on twitter @bonecrusherjenk.

Aliza: Awesome. And Sue, where can people find you?

Sue: I'm on Twitter as Spaltor. That's S P A L T O R.

Aliza: I'm Aliza Pearl. You can find me @alizapearl on Twitter and Instagram, and APizaLiza on Twitch. To learn more about our show or to contact us, visit womenatwarp.com or find us on Facebook, Twitter, or Instagram @womenatwarp. You can also email us at crew@womenatwarp.com and for more Roddenberry podcasts visit podcasts.roddenberry.com. Thanks so much for listening! Bye! .