ep 59

Wed, Sep 21, 2022 11:49PM • 1:04:57

**SUMMARY KEYWORDS**

bats, observatory, star, space, called, question, telescope, buzz lightyear, astronomer, stars, bears, halloween, home, energy, built, kepler, thought, robot, haunting, moans

**SPEAKERS**

Noah Guiberson, Moiya McTier, Em Costa, Rob Frawley, Audience

**Em Costa** 00:00

Galactic greetings, celestial salutations, and welcome to Facts Machine Live. My name is Emily Costa, and I'm joined by my stellar co-hosts Noah Guiberson, Rob Frawley, and our out of this world special guestm Dr. Moi-- Wait, what? Where's Moiya?

**Noah Guiberson** 00:14

Didn't she come with you?

**Em Costa** 00:15

No, I thought she was coming in with you. Oh shit, do we have to summon her?

**Noah Guiberson** 00:16

Right she did say occasionally she gets sucked into like an infernal demi-plane? That might have been what happened.

**Em Costa** 00:31

So yeah, sometimes we have to summon Moiya from the great astronomical beyond because she exists on like a whole other plane of awesomeness. It's just a thing we got to do. You know. That's all right. Okay, so we're gonna need your help. Guys can we get in? We're gonna get into a circle. Okay, here we go at some point figure out what's happening with it. There we go. And yeah, it's a seance, you know how this goes.

**Noah Guiberson** 01:41

Moiya, Moiya, Moiya... (over audio of "O, Fortuna")

**Rob Frawley** 01:41

Moiya, Moiya, Moiya...

**Em Costa** 01:42

Moiya, Moiya, Moiya...

**Moiya McTier** 01:42

I'm impressed that summoning worked. It only has like an 80% success rate. Yeah.

**Noah Guiberson** 02:27

What happens the other 20%?

**Moiya McTier** 02:28

Sometimes I come out inside out.

**Em Costa** 02:30

Oh, so we did well enough. Excellent!

**Moiya McTier** 02:32

Yeah, thank you! That would have been super traumatizing for everyone here.

**Noah Guiberson** 02:37

A whole different movie, Inside Out.

**Em Costa** 02:40

Yeah we're looking for a scary show, but not in that particular way. So, Moiya. Oh my gosh, thank you so much for joining us. We're so excited to have you. So Moiya has an astrophysics PhD from Columbia. You're a folklorist, you run an awesome podcast and Caveat show called Exolore where you build fictional worlds informed by real facts and science. You're writing a book. You're a Facts Machine alumna. I mean, I had to write all this down because I could not keep track of it otherwise.

**Moiya McTier** 03:07

I can't keep track of it either!

**Rob Frawley** 03:09

I like that we're calling past guests alumni now. It really earned something with us.

**Moiya McTier** 03:15

It's the Facts Machine school.

**Rob Frawley** 03:17

That's it!

**Em Costa** 03:20

Enrollment is open. Um, so I was just wondering, straight from your brilliant science, storytelling brain, what's the space fact that still blows your mind whenever you think about it?

**Moiya McTier** 03:32

So we talk about the universe, but we don't often specify that we usually mean the observable universe. The universe is only like 13.8 billion years old and super young. And that means that there isn't enough time, there hasn't been enough time for light that's more than like, 14 billion light years away to reach us. So there is this whole part of the universe that we have never seen. We never will see it, and that's just gonna get bigger. Yeah, eventually, it's going to get to the point, if it isn't already at the point, where we only can see like a small fraction of the universe, and that is sometimes hard to wrap my head around.

**Em Costa** 04:15

So tonight, in the umbra of All Hallows Eve, we are swapping the spookiest space stories and confronting the most frightening facts of the final frontier in a show we're calling: Dark Matters. After we complete our oratorical orbits, wherein each of my co-hosts will share an extraterrestrial tale, we'll conclude our voyage with a pub-style trivia quiz loosely inspired by the theme. And with that, Rob, you have permission to launch.

**Rob Frawley** 04:47

So, this week, I'm going to be recalling a terrifying tale from the deepest depths of space about the unfathomable power of an energy vampire. So we'll get to that. But in order to get there, I want to start with something slightly more familiar. Is anyone here familiar with a brave astronaut named Buzz? Who is it? Who said Aldrin, you nerd, it's Buzz Lightyear! He's a hero. He's an action figure. He, we've met him in the 90s as part of the Toy Story franchise. This guy right here is a Space Ranger friend of Woody, nemesis of Emperor Zurg, sworn enemy of the Galactic Alliance. He's a child's play thing. Okay. But most of all, we know him from this franchise, right? He is a toy in Toy Story. They had four movies. Did you know about the fourth one? It happened, I cried. And, in reality, well sorry, in the Pixar universe, he's based on a television show in that world, and he watches the Buzz Lightyear show. And that's why they're action figures. And it's a pretty interesting show that we're never really introduced to, except in Toy Story Two, there's a whole store shelf of Buzz Light Years, and we meet Emperor Zurg, his enemy, and they have this kind of epic combat. And this is the first time we kind of get the backstory about what's going on, who is Buzz Lightyear? What's this dark, gritty past? In an elevator shaft, very Die Hard, I really liked it. So we meet Emperor Zurg, we learn a little bit about why they are enemies and what Star Command is. And this was in 1999. Now, I distinctly remember as a child coming home from swim practice flipping on the TV. And there was, for years, this show called Buzz Lightyear of Star Command. It was an animated show that told the story, it was the show from the movie, it was the show within a movie that we actually got to participate in. And I just came home and enjoyed it so much before I went to bed, and my memories are strong, and they fill me with joy, and they are largely incorrect. So here's what really happened. First, Disney did create a movie, and it was called Buzz Lightyear of Star Command: The Adventure Begins starring Tim Allen, the voice from the movie, and this was it and it was like the launch into this universe. And after that, they did in October of 2000, begin the series Buzz Lightyear of Star Command. And they had 60 episodes, 62 episodes, but they released one a day, and it ended in January of 2021. And so this show was on for four months. And at this point in my life, I hadn't begun swimming, so I did not come home from some practice to watch it.

**Noah Guiberson** 07:39

When did it end?

**Rob Frawley** 07:40

January of 2001.

**Noah Guiberson** 07:42

Dude that, you said 2021.

**Rob Frawley** 07:44

Oh, yeah, no, that was, I probably binged it this year and forgot about it. But so yeah, it was on for three months on UPN and ABC and just wasn't what I thought it was. But luckily, upon further research, most of the plotlines I remembered were still there. And also help, I'll point out this show this show right here, won a Daytime Emmy Award. Yeah. So it was like, it wasn't that bad. But so this was the show 62 episodes about Star Command right, going out, saving worlds, being a hero, flying spaceships, and starting to meet this universe of Buzz Lightyear. So the reason we've taken this walk is because there's a brilliant literary and engineering reference that I am obligated to tell you about from this show in our Dark Matters episode of Facts Machine. So, Emperor Zurg, being an evil warlord kind of business by Cooney guy, he creates this device that will suck energy, that will steal it from Star Command, incapacitate them, get them out of the way so he can take over the galaxy. This whole thing. He makes this evil robot voiced by Craig Ferguson, an interesting and very dated choice, and it's going to sneak into Star Command. And this device had the designation "serial number s four a two." That's "number s for a two". That's no. s for a two. That's nos for a two. That's Nosferatu, so...

**Noah Guiberson** 08:06

Wow. A few people are loving this. I can hear them waking up.

**Em Costa** 09:20

They're on the wavelength.

**Rob Frawley** 09:21

Maybe if I just say it again. So it's Nosferatu, so yeah, there we go. This is a super deep cut as an 11-year old so I go to college. And one of my friends is like, "oh for Halloween. I'm gonna do some like Nosferatu-inspired like costume" and I was like "you watch the Buzz Lightyear show?!" Not the case. If you're like me until like college, Nosferatu was a film you probably didn't hear about. It came out in 1922. It was a silent German movie that was a cheap knockoff Dracula. And that's not me being like critical. That's how they billed it. It was like "did you like Dracula but didn't want to pay for the book? come to this cheap knockoff movie!" and it was a hit. People enjoyed it at the time in the 20s. It was problematic for many reasons in 1920s Germany we won't get into but like, what happened was a judge was calling, they sued basically Bram Stoker's family said, "you ripped this off Dracula" and they were like, "yeah." And so they had to pay the family and destroy all copies of the film. So the few surviving copies became an absolute cult classic. And that's why it's such a big deal and so Werner Herzog in the 70s, in 1979, he remade it drew more heavily on Dracula, but kind of kept the name and the myth alive. And now it's this like really like old school reference like cinematic Dracula thing. And I'm none of those things. I am not German or cinematic and so I hope that's all correct. But basically, this was a reference I did not get. But who was nos-four-a two? Well that's this character. And...there he is, right? This asshole. And for the listeners at home, he is...he is a threatening arrangement of triangles? He's a beetle in a satin pyramid? He's a robot with a monocle? Like, therre's a lot you can say about, about this asshole. And you can imagine the writing room they're like, "okay, so it's a vampire, great, great, and he's he's also a robot, nice, I like it, so he's got legs...no." "How's it get around? I don't know." Wings. Yeah, like very afterthought wings. But he is a big villain in this Buzz Lightyear show. And so his thing is he steals energy from other robots or from, yeah, from robots, machines, anything he can suck the energy out of them. And then the robots turn into zombies, which is not really canon, but they obey him. But they can also be cured, I guess rebooted. So like, it fits nicely in like a 25 minute cartoon show.

**Moiya McTier** 12:03

If the zombie robots bite something do, does that become a robot?

**Rob Frawley** 12:09

See, that's the thing. They don't have teeth, so they can't, so they're just zombies...

**Noah Guiberson** 12:13

But it could still be transmitted by a virus. Hey, Oh,

**Rob Frawley** 12:18

Hey-o! They were, they had really, I'm pretty sure...

**Moiya McTier** 12:20

Virus humor doesn't do very well anymore.

**Noah Guiberson** 12:22

No!

**Rob Frawley** 12:23

Star Command, I think had McAfee updated. So like, they were fine. I imagined that's what that does. But so in one episode, he just bites a lot of other robots, and they all turn into zombies. In another episode, he bites a human, which we didn't know was a thing. But there's also an energy beam and that guy turns into a "wirewolf"? Which is again like clever nicely done. It's a mechanical robot human werewolf and it only becomes a wirewolf in the light of a specific moon. And actually because Moiya you're here, I just wanted to run this physics question by you because...

**Moiya McTier** 12:59

Yes, I'm so ready.

**Rob Frawley** 13:00

Yeah, so if you got to a wirewolf that is only going to become a wirewolf in the moonlight, but it's a guy that works on a space station, how do you, what would you do? What steps might you take as a physicist to address this problem?

**Moiya McTier** 13:17

Is the problem that we want him to to wireolf out or don't want?

**Rob Frawley** 13:22

We would prefer him not to during work hours. Weekends, it's, that's his thing.

**Moiya McTier** 13:27

But then, well, then you would just have to put your spaceship in an orbit so that it's always on the opposite side of the Earth from the moon.

**Rob Frawley** 13:38

Okay, and what if we had like ships and space stations that could go like millions of light years per second? Is, would this be a problem

**Moiya McTier** 13:45

Just get it away from the moon? Yeah, you can do that.

**Rob Frawley** 13:46

Yeah, this seems like an easy problem to fix.

**Moiya McTier** 13:49

But, I mean, if it's if it's just like based on the the specific pattern of photons that you get from reflecting our sun's light off of our moon, there are enough solar system stellar systems out in the universe, observable or not, that they would happen upon another moon that gave you that specific pattern of photons.

**Rob Frawley** 14:09

Nice. So also, identifying that moonlight is just reflected starlight.

**Moiya McTier** 14:13

Yes.

**Rob Frawley** 14:14

Yeah. So lots of ways, I think. Around this panel, do we have any other like...?

14:19

I was gonna say the same basically. Same. Yeah, moonlight, etcetera.

**Em Costa** 14:24

Yeah, we have a quorum over here.

**Rob Frawley** 14:27

So the astronomers and astrophysicists at the Disney daytime TV studios, they blew up the planet.

**Moiya McTier** 14:35

That's one way to do it!

**Rob Frawley** 14:37

They though that would solve it, right? So there's that. But then the moon rocks, which are not luminous, also turn him into a wirewolf in a future episode. So basically, the storyboard is a mess, but it's a delicious mess, and you should dig into this because if you can find this on YouTube, it's so worth it. Okay, Buzz Lightyear has to fight this energy vampire over and over again, actually in five separate episodes, and he's the only villain in this whole series to ever die on screen. Like, they've invested a lot into the life and death of this character. And again, like 11 to 15, I don't know how old I was, but like this young, impressionable version of myself, like really remembers this strongly. And my real question is, is this is, this possible? Could we do this?

**Noah Guiberson** 15:26

The first trivia question of the night? Yeah.

**Rob Frawley** 15:28

Check your sheets, please write your answer.

**Em Costa** 15:31

Write on the back, there's plenty of room.

**Moiya McTier** 15:33

So the question is, could we make an energy-sucking, vampire robot?

**Rob Frawley** 15:38

100% question.

**Moiya McTier** 15:39

Yes. 100% yes. Yeah. That's the thing...

**Noah Guiberson** 15:43

What are we doin' here?!

**Rob Frawley** 15:45

So actually, it is super, super easy to do this. Did you know that in 2014, Samsung made a charging cable that you could plug into a charged phone and steal the energy onto your phone? This is a thing that's already been made! And if they didn't, they stopped at some point, but like, energy flows from high potential to low potential like, done! Like this is not a hard concept. Making it sentient or like, pretty or triangles, that's probably harder. But like, yeah, so I'm just not thinking big enough. But you know who is thinking big enough?

**Noah Guiberson** 16:18

Samsung.

16:22

Yes Samsun, very nice. I heard a few other good answers from the audience. But no, I'm thinking of Dan Hooper. Yeah. Yeah, that guy, you know him?

**Moiya McTier** 16:29

The astronomer who studies gyrochronology?

**Rob Frawley** 16:32

Yes! So, Dan Hooper?

**Noah Guiberson** 16:37

Really? Aw nice, ok cool.

**Rob Frawley** 16:39

Yeah. Okay, so I thought you might, but I didn't know that you would like, target and nail him perfectly.

**Moiya McTier** 16:46

Oh, this is your, for sure...

**Rob Frawley** 16:47

This is Dan Hooper, the senior scientist at Fermilab...

**Noah Guiberson** 16:49

This is Dan Hooper? The triangles?

**Rob Frawley** 16:51

...and the astrophysicist from the University of Chicago? Are we friends with Dan Hooper? Or do we not want to talk about Dan Hooper?

**Moiya McTier** 16:57

Dan Hooper's nice.

**Rob Frawley** 16:59

He's a great guy, he wrote this paper...

**Em Costa** 17:00

Sorry, Dan!

**Rob Frawley** 17:01

He said "Life versus dark energy: how an advanced civilization could resist the accelerating expansion of the universe." And in this paper, he lays out a couple of theories, one of which is we should go out to stars and steal their energy. This is thinking big, this is Dan Hooper energy we got right here. And the whole premise of it is, "yo, like stars are like really good at making energy." And he doesn't want to like power a microwave or like take over, like Star Command, he wants to like preserve life in your solar system as long as possible. So, go to a faraway star, steal its energy, and then he proposes, turn it back on the star and push it against the the expansion of the universe so it stays close to your solar system, so then in the eventual heat death of your solar system, you've still got a star hanging around while everything else is gone. And I think he actually says, and sorry, this is the, this is the most technical line (in a dweeby-sounding voice): "we argue that in order to maximize its access to usable energy, sufficiently advanced civilization would choose to expand rapidly outward, building Dyson spheres or similar structures around encountered stars and use the energy that is harnessed to accelerate those stars away from the approaching horizon and toward the center of civilization."

**Noah Guiberson** 18:13

I'm sorry, Dan.

**Moiya McTier** 18:15

Spot on!

**Em Costa** 18:16

I didn't know the show was a roast, but okay!

**Rob Frawley** 18:22

If you're watching, because now I guess it's possible, I apologize, Dr. Hooper, and I love your work.

**Noah Guiberson** 18:27

He's in the chat right now in the live stream, going apeshit.

**Rob Frawley** 18:31

"Like, what the hell Rob?" But, okay in closing, I think about how alien races and their billionaires are flying out to these faraway stars to construct their fancy Dyson spheres, which is a thing that I'm going to just say and not explain, sorry. And they're gonna like go out and do this and steal energy from stars to combat the heat death of their solar system, and my only thought is, I'd really rather be thinking about like a Scottish robotic Dracula goofing around with robots on a Saturday morning cartoon show because that's not a bummer. So, so thank you, Dan Hooper for your contributions to science, but the only energy that's going to be stolen is going to be through the fangs of Nosferatu out of XR, the cutest little robot in the Buzz Lightyear series. And in closing, just because you're an energy vampire, doesn't mean you have to suck.

**Noah Guiberson** 19:34

Because it is Halloween, or at least Halloween is fast approaching, I have been learning more about bats. The bat, I believe, is the quintessential Halloween animal. Spiders and toads can fucking @ me. Although there is a species of dragonfly called the "Halloween pennant", that should definitely be a bigger part of this conversation going forward. Number one though, still bat. And since this is a Halloween slash space-themed show, naturally I googled bats in space. And when I did that, what I got was a page of results for "alien space bats". And it turns out that, that alien space bats are not just bats from another planet. It is a trope within science fiction, in which writers who want to create an impossibly unrealistic alternate history do so by invoking an impossibly unrealistic intervention, such as alien space bat. They, you know, alien space, minutes might land on Earth, and start bossing everyone around, and that's why the Lincoln Memorial now has a bat in it, right? It's really similar to deus ex machina, in which an implausible event outside of the context of the narrative is introduced in order to resolve a plot conflict. Alien space bats can sort of either resolve or set up a story, depending on the way you think about it. But if you scroll to the next page, past the alien space bats, you'll get to some really cool general facts about bats. For example, I learned that the order of mammals that contain bats is called Chiroptera, from the Greek for "hand wing". Pretty cool. You can really see how that makes sense, right? Because bats wings are essentially just webby little hands, that sometimes go all the way down the sides, their bodies and attached to their legs. And of course, bats use these hand wings to fly, which distinguishes them from all other mammals, as they are the only mammals capable of what is known as true and sustained flight. But something that really amazed me and changed the way I think about flight as a feature of mammals, is that according to the National Wildlife Federation, the well over 1,000 species of bats make up about 25% of mammal species. A quarter of mammal species are bats. That's crazy to me. Which means that, honestly, it seems like there's a legitimate argument to be made that if you had to describe mammals to say, some visiting alien space bats, you should include that they can often fly. Bats take this very seriously, this flight stuff. And frankly, I imagine that there's quite a bit of rivalry between bats and birds, when it comes to who does it better. In fact, you'll find as you scroll even farther down that Google results page, is that the flying rivalry has gotten so serious that birds and bats have begun a space race. Birds struck first in 1979, when the USSR sent quail eggs into orbit, and again in 1990, when cosmonauts were able to hatch quail eggs aboard the Mir Space Station. This is one of my favorite pictures, because this is, and you can't quite tell there's a really cool video that just wouldn't really work with the PowerPoint, but you can see them basically, it's not really touching the hand and it's actually floating above the egg, and it's blast like, it's basically just sort of running in midair and like can't really right itself. It was very funny. Meanwhile, at NASA in 1986, they were working on an experiment on basically chicken egg development that was designed actually by a middle schooler named John Vellinger who, and I swear this is true, got corporate funding to send chickens into space from KFC. This, this is the mission patch. You can see it says its "CHIX in Space, C-H-I-X, Kentucky Fried Chicken". And in 1989, after considerable delays in orbit, a chick was hatched and it was named "Kentucky", who, upon returning to Earth, after serving one week as an astronaut was in turn served at a Kentucky Fried Chicken franchise.

**Audience** 23:26

Noooooo!!!

**Noah Guiberson** 23:29

Just kidding, goddamn! Kentucky actually lived out his life at the Louisville Zoo. I got really worried there for a second.

**Em Costa** 23:38

Aw, so he came home to roost?

**Noah Guiberson** 23:39

Yeah!

**Rob Frawley** 23:41

The attachment you all had to a bird just because it went to space is fascinating. I just want to--

**Moiya McTier** 23:47

I'm glad that it didn't come home to roast.

**Noah Guiberson** 23:52

Ohhhhhhhh!

**Moiya McTier** 23:52

That's my first pun I've ever made on this!

**Noah Guiberson** 23:54

Wow! Well, we all know that chickens can actually fly, but this is one chicken who didn't fry. Your groans tell me where to snip this in the edit. So, I feel like there are some echoes of the human space race here because you have birds who are kind of like the USSR achieving an early lead, but later on bats, like NASA, make their comeback. To this point, birds had only gone to space as study organisms. Bats saw that the next step was to go as an astronaut. But would you believe that NASA wouldn't let bats into the astronaut corps? So bats had to come up with another plan and that plan was riding on the goddamn space shuttle. So in 1996, an enterprising bat flew toward and docked with, by which I mean landed on, the space shuttle Endeavor, but due to failing an unknown mission parameter had to scrub its launch, by which I mean fly away. In 1998, the same bat, I assume...

**Em Costa** 24:34

That's bat shit.

**Moiya McTier** 24:56

They can live for like 40 years.

**Noah Guiberson** 25:02

Yeah, so it's 1998. We've established this as the same astrobat. Batsronaut. Nice. Batstronaut returned to try again on the space shuttle Columbia, docking procedures were nominal. But again, atmospheric complications force the bat to be grounded, that is ironically, to fly away again. The mood at the bat space program was tense. Some bats felt that too many bat resources were being spent on the space bat program, that surely they can be used to solve problems back on Earth before being wasted on yet another space bat misadventure. And as a result, the space bat program was tragically put on hold...until 2009, when the same astrobat from the 90s, I assume, was given the green light for another launch. The bat grabbed on tight, and despite NASA's best efforts to scare them off, including loud sirens, they held on through the launch and after they left the tower, NASA lost sight of them as they rocketed toward the stars and into history. Now, NASA consulted a bat expert who believes that the bat had actually injured its wing and was unable to fly away, and that during the ascent, the bat would have likely been shaken off and burnt up in the engine exhaust. At least that's the official story... Fast forward to 2020: the Hubble Telescope has captured an image of a star called HVC672. This star was remarkable in that it appeared to cast a long shadow in two directions pointing slightly down, if you will. However, this wasn't the first time that they had captured this star and this time, they noticed something different. The shadows had changed slightly, now pointing a little more up, if you will, again. What's going on here? NASA scientists believe that the star is surrounded by a roughly saddle-shaped ring of gas dust and rock, and as the saddle rotates, it's, it's really more of a Pringle, as the Pringle rotates, it changes the shape of the shadow that is cast by the star's light. So now we have a 404-day image sort of time lapse of this star. And it looks something like this. And due to the appearance of flapping wings, NASA nicknamed HVC672, "bat shadow." At least that's the official story. Now look, I know the odds are grim. It's deeply improbable that our bat friend would have survived the ascent itself, much less being in space without a space bat suit. But I believe our friend is out there, sending us a beacon, like a cosmic bat signal, telling us they're okay and that they'll come home as soon as they can. Do you ever wonder whether or not all stories are best told through the medium of PowerPoint-based science comedy? I wonder that sometimes. So in order to do our space-faring bat friend justice, I wrote a little song. (A man carrying a guitar walks onto the stage.) So, yeah, thank you. (The man hands Noah the guitar.) Oh, thanks. Oh, yeah, good. Okay. So, one of my goals over the pandemic was to learn to play guitar. Unfortunately, I never quite got around to it. (Noah hands the guitar back to the man, he starts playing.) (Singing) Can I tell you a story about my life to date thus far, a life spent chasing glory and how I sought to touch the stars? They said I'm just a bat, they called me a bat influence. The world is not so bad, that you have to seek out space. But I'm not satisfied to just flap up in the sky. Somehow it never seemed enough to merely fly. I want to reach further, to be more than just an Earther. The world's just another cave I will escape. Is it so odd to want to touch the face of God, to slip the surly bonds and go beyond? Is it so wrong to fly like a bat right out of hell, stretch toward the stars above and reach the heavens? The plan at first was simple, I'd latch on and ride to orbit. The first two times I lost it and let go before the launch. Then at last I got my chance, a day in June 2009. I evaded NASA's traps, and I latched and held on tight. And now that I'm really here, I am paralyzed with fear. Have I really worked this hard to give up now? There's no time anymore, the engines come to life and roar. The whole shuttle starts to shake, or is that me? Is it so odd to want to touch the face of God, to slip these surly bonds and go beyond? Is it so wrong to fly like a bat right out of hell, stretch toward the stars above and reach the heavens? When at last the sound had ceased and I had opened up my eyes, I saw the earth below me. And I finally realized at the end of all my yearning, was the distant sight of home. As I floated high above it, feeling nothing but alone. God dammit, I'm so sorry, to my parents, and to my friends. If ever I make it home, I promise that I'll make amends. As my breath begins to thin, and the cold starts to creep in, the last thing that I see is a winged shadow move above me. Alien Space Bats! We have come to save the day. Alien Space Bats! Now we all will be okay. Alien Space Bats! We're the way this all works out. Alien Space Bats! Loose ends are what we are all about. Alien Space Bats! They're the answers to our woes. Alien Space Bats! That's just how the story goes. Alien Space Bats! To criticize our ending. Alien Space Bats! No matter how, it is world-bending. The question you are left with, is did this really happen? Am I frozen up in space or living happily in Austin? All I'll say is that they're out there, leaving breadcrumbs in the stars. So if you dream of getting off Terra, you may meet space chiroptera. Alien Space Bats! Alien Space Bats! Alien Space Bats! Alien Space Bats!

**Moiya McTier** 33:32

I am so upset that people listening to the podcast can't see my amazing outfit. Thank you, Andre. This is all because of you. So this is Dark Matters. We are talking about spooky space facts. So obviously, the first thing that came into my head was: hmm, I wonder if there are any haunted observatories? So I googled "haunted observatories", and I did find some stuff. So today, I'm telling you that I learned this week about Perkins Observatory and the haunting that happens there. Thank you for the sound effects in the audience. Hiram Mills was born in Ohio in 1833. He...it's already spooky. He was born in Ohio in 1833. He moved around a little bit. His parents eventually owned a pig farm or started a pig farm. And he grew up to be a mathematician and astronomer working at Ohio Wesleyan University. In the 1860s when the civil war broke out, by this point, he was a professor. He was the chair of the math department, big nerd energy there. And by the time the civil war broke out, he was a young man in his 20s and he thought that it was his duty to go and aid the Union efforts. So he was on the right side, so we can cheer for him.

**Noah Guiberson** 35:01

Real hometown crowd.

**Moiya McTier** 35:05

So he went to go sign up for the war effort. But Hiram Perkins was a six foot four man who weighed 97 pounds. He was very slender. He had the nickname "Skeleton Man". So when he went to sign up for the Union effort, I imagine that they just laughed in his face and told him, "no, obviously you cannot fight in a war because if you tried to hold a musket, you would just fall over", so they did not let him join the war effort. But he thought that it was still his duty to support the Union army, so he quit his job at Ohio Wesleyan University, decided not to teach math anymore, but to use math to make his parents' pig farm even more efficient, even more effective, started raising more and more pigs, so that he could sell salted pork to the Union army. And this made him super rich, because when you are selling things to the army during times of war, you make mega bucks. And at the end of the Civil War, he was in today's standards, a multimillionaire. Okay, so Hiram Perkins is now a multimillionaire living in Ohio after not fighting in the Civil War. And he is a devout Methodist; he believes that it is fundamentally wrong to profit from war time. So, he decides to give his money away and to spend it on noble pursuits. So he builds he spends much of his own money at the time, it was something like $250,000, which in today's money is like over a million, on building the student observatory. At the time, it wasn't called that, but he used it to teach. He was teaching astronomy, he was teaching math, he was educating the youths. This man is just a good person. So he formed this student observatory, teaches at Ohio Wesleyan until 1907 when he retires, and you can do the math to figure out how old he was. At the time, he still had a lot of money. I guess he was saving it for his children's inheritance, or his sister's inheritance, maybe. But he had no children. He married but had no children. His sister also had no children and like died before he did. So at the end of his life, he realized, "oh, I still have all this war money, and I don't want to die with it, so I'm going to give more of my money to the university." And he did. He gave money to the university and sought out other funding sources so that he could build a better observatory, one that could actually be used to do research instead of teaching. They started building that university in 1920...something? 1920-something...it, no 1924. Yes. Which was just before he died, so he saw them great browned on... Did I say "great browned?" Okay, they saw him break ground on this observatory, and he unfortunately died before it was completed in 1931. So he didn't get to see this observatory come to fruition and actually be used for the research that he wanted to help fund. Later, after he died, much later, this observatory was actually a very impressive one. In 1931, when it opened, it was furnished with a 69-inch telescope. At the time, it was the third largest telescope in the entire world, and the biggest, like single mirror in all of the United States. 69 inches is quite large.

**Em Costa** 38:41

Nice... Someone had to!

**Moiya McTier** 38:46

They did, they did. It was like an interesting time, right? Because it was right after multiple wars, it was right after wars in Europe, and a lot of the glassmaking factories had been destroyed, so there weren't many places where you could get giant, smooth mirrors made. So they had to go to some government organization, the Bureau of Standards and Measurement, and have them make this giant-ass mirror. So this was an impressive observatory. Later on, after going through many ownership phases, like it was started at Ohio Wesleyan University, went to Ohio State University, the telescope itself eventually made its way to Flagstaff, Arizona, and then made its way back to Ohio Wesleyan University. It's a whole journey. But it was a very impressive telescope, but wasn't really good for research because Ohio has terrible weather. It's a very low elevation, and it's right next to a bunch of cities where people light things and then you can't see the sky, which is why the telescope was taken to Flagstaff, Arizona. But you know what kind of telescope doesn't care about light pollution? Radio telescopes! Yes, smart crowd. So they built a radio telescope at the Perkins Observatory and it was nicknamed the "Big Ear" telescope. This thing was bigger than multiple football fields put together. I actually use this sometimes in talks about telescopes where I play a game called "Telescope or Not?" And most people don't look at this and think it's a telescope because it's just a big flat sheet on the ground with wires sticking up out of it on the sides, for those of you who are listening to the podcast. The Big Ear telescope is a big deal in astronomy. It was responsible for detecting the "WOW" signal in 1977. Radio telescopes are often used in the Search for Extra Terrestrial Intelligence, SETI and the Big Ear telescope, until it was destroyed in 1998 because the university again fell on hard times and had to sell it to some land developers, before 1998 It was responsible for the longest running continuous SETI research project. It was put in the Guinness Book of World Records. And this "WOW" signal discovered in 1977 is like a little bit over a minute long. It's this weird fluctuating signal that we observed somewhere in the direction of Sagittarius, the constellation Sagittarius. And to this day, we don't know what caused it. And it's a remaining mystery for astronomers. It's kind of embarrassing for us. But some people say that this is the best evidence we have that there are aliens out there. I will just lay that claim there. You can do what you want with it. So the Big Ear telescope, destroyed in 1998, but let's let's get back to this haunting thing, the point of the fact. So, for several decades since the Perkins Observatory was built, people have claimed to see a creepy old man just standing outside the observatory watching people as they walk in or every once in a while they'll see like a faint old male figure just staring through the telescope. And also sometimes they hear like creaking of the floorboards at night or, or low moans like (makes moaning sounds).

**Noah Guiberson** 42:14

That's just grad students.

**Moiya McTier** 42:16

No but they don't they don't do research there!

**Rob Frawley** 42:18

I appreciate the moan, that you're like, "this is the type of moon that it was."

**Moiya McTier** 42:22

Well I guess because there are so many types of moans, you know, and I don't want people getting the wrong idea about the type of moans that you hear in this observatory.

**Noah Guiberson** 42:31

Let's hear a few. Rob, what do you got?

**Rob Frawley** 42:35

(Makes a silly moan) Was that a moan? That's not a moan. I'm sorry, I didn't prepare.

**Moiya McTier** 42:45

Any other moans, any other moans you want to go through?

**Em Costa** 42:49

I'll reserve my moans for another time.

**Moiya McTier** 42:50

Okay, great! To look this up, I wanted to try and find claims of this haunting at Perkins Observatory. And I found a few scattered recordings around the internet, including one from Facebook in a post from 2015. If you are ever around the Delaware, Ohio area--that is not the state of Delaware, that is a town in Ohio called Delaware, for some reason...

**Noah Guiberson** 43:17

I did not catch that at all. But it was like the Delaware, Ohio, whatever... I completely went, just assumed that that they had a border. That's troubling.

**Rob Frawley** 43:26

Noah doesn't believe in Pennsylvania.

**Moiya McTier** 43:30

So in the town called Delaware in the state of Ohio, there's a ghost tour company called "Boos (like alcohol) and Booze" (like ghosts), like boos and booze. So go, go check out their tours.

**Noah Guiberson** 43:44

Not a booze cruise?

**Moiya McTier** 43:45

It's not! I'm sorry, Noah. But that is where I found this Facebook post from 2015 that laid out a bunch of the haunting sightings at Perkins Observatory This is described by ghosts.fandom.com, which I'm pretty sure is the most reliable site I could find for ghost information, it's reported as a "level one haunting". This means that it only has unexplained sounds and or shadows, so not a very scary haunting, which is, which is good, right? There are lots of different types of ghosts and the type of ghost you are, this is science, depends on the, on a few different things. So maybe you're a ghost because you just have some unfinished business. Maybe you're a ghost because you died a super tragic or sudden death, and that tends to be like a scarier ghost. Maybe you're a ghost because you have like revenge plans. You know, like there are lots of different types of ghosts, which is why ghost.fandom.com has five levels of haunting. And like level five is like "oh, you're about to be possessed or blood is coming down the walls, like get the fuck out of this building." I feel like those are from the movie Casper. I don't think there are any ghosts in Casper that go above like a two or three.

**Rob Frawley** 45:08

No, they're pretty tame. Yeah.

**Moiya McTier** 45:11

Because you can't scare the children too much. Yeah.

**Rob Frawley** 45:14

I agree.

**Moiya McTier** 45:14

Thank you. So after learning about Hiram Perkins and his haunted Perkins Observatory, I wanted to learn if there were other haunted observatories, and an article came out five days ago, which was very timely for this show, talking about the haunting at the Drake Municipal Observatory at Drake University in Iowa. So this man, the strapping man over there, is Daniel Morehouse, who went to Drake University in Iowa and developed a love for astronomy, grew up, became the president of the university, and insisted that they build an observatory. He was like, "look, if you just get funding from the state, Drake University, I will staff this observatory, I'll fund all of the telescopes that go in it, I just really want a place where people can look at the night sky." And they did, they built it for him. It was built sometime in the 1930s. And he became the director of this observatory. I don't know anything else about his life, but I do know a lot about what happened after he died. His, his ashes...what level haunting? This is like a one or two. So after he died, he was cremated and his ashes were placed behind a masonry stone behind a plaque in the observatory. He is interred in the observatory like so like when you enter, there, this building doesn't have like, what's the word, the keystone? Like the stone that tells you when the building was finished... The cornerstone, it doesn't have one of those. But this plaque has an image of the solar system that tells you like the date that it was finished, which is cool. But also, there's this dude's ashes behind it. And then like 20 years later, when his wife died, her ashes were also put behind this plaque. And people over the last 100 years since this observatory was built have talked about again, seeing a creepy old man walking around the observatory. I don't know if you've ever been in an observatory, but there are a lot of creepy old men walking around, so I don't know how reliable these claims are, but--

**Noah Guiberson** 47:28

They're called pre-ghosts.

**Moiya McTier** 47:29

Pre-ghosts! So people claim to see creepy old men, even the director of the Drake Municipal Observatory, who is you know like a PhD astronomer, has talked about how one night when he was in the observatory, he, this was a cold winter, it was like a February night in Iowa, and he was the only person in the observatory. And he heard the door open. And he felt a rush of wind. And it was cold, like, went through his body and gave him shivers. Then he went out, out the door he checked if there were any footsteps in the snow and there weren't, it was just him. So that's. that's a PhD astronomer thinking that he had a ghost encounter. So thank you, Daniel, Morehouse for haunting yet more observatories. I couldn't find any other claims of actual haunted observatories, but I did find this book that was published just like this past June or last June, by David Lee Summers called Astronomers Crypt. He is an astronomer and he wrote this horror book so if you like scary stuff, check that out. And if you yourself Google "haunted observatories", you will probably come across this book by Richard Baum called The Haunted Observatory. DO not get sucked into it, it is a textbook about astronomy! And this dude decided to call it The Haunted Observatory because it talked about the spirits of the heavens or whatever. I'm SO mad that this man had the GALL to put the words "haunted observatory" on a book that doesn't talk about any ghosts! I have very strong feelings about this. Yeah, very strong feelings. Um, that's it that's all I have. I'm gonna end on my strong feelings. If you're ever in Ohio, please go visit the Perkins Observatory and let me know if you see any spooky old men around.

**Em Costa** 49:36

Alright folks, so we have now reached the last phase of our journey which is...THE QUIZ! So the audience has completed and submitted a quiz that I will now put up on the screen, share with my co-hosts. It is up to you three to with each question, discuss amongst yourselves and deliver me your kind of consensus for the right answer. But audience, you're not passive observers, in this case. They might need a little assistance, just putting it out there. So, just, just be ready for a call out, just in case. Okay, we're off. Question one. Yeah, there we go. What planet's moons are named the ancient Greek words for fear and dread...

**Rob Frawley** 50:24

Ding ding ding!

**Em Costa** 50:25

Wow, I didn't even finish the question. Overachieving!

**Rob Frawley** 50:27

Sorry...

**Em Costa** 50:28

That's okay! I did pause, that was on me...after the mythological twin gods who represent a soldier's experience in battle? Okay, go ahead.

**Rob Frawley** 50:36

Mars? Phobos and Deimos.

**Em Costa** 50:38

Yeah! Nicely done.

**Noah Guiberson** 50:41

I too, knew that.

**Moiya McTier** 50:43

Wouldn't it be such a trip if I didn't know that?

**Em Costa** 50:48

Just the surprise of the evening. So yes, Mars is the Roman god of war. The equivalent to the Greeks was Aries, and Deimos and Phobos were Ares and Aphrodite's sons. So the idea is that you know, Aries would go into war, and Deimos and Phobos were always with him because their emotions were ever present in war as well.

**Moiya McTier** 51:12

I just want to point out that they were bastard love children. Aphrodite was married to Hephaestus and then had a bunch of affairs because she thought he was too ugly.

**Noah Guiberson** 51:22

Hits close to home.

**Rob Frawley** 51:24

Check in next week on The Real Housewives of Olympus!

**Em Costa** 51:29

So there's a lot of mythology in this quiz. Please jump in with like all the hot goss. I need it, I need it! Okay.

**Noah Guiberson** 51:36

The Real Housewives of Olympus: where we stop telling myths and start getting real.

**Em Costa** 51:42

We only deal in truths here. Yeah, so that's that. All right. Question two. So in the calendar, cross quarter dates are the days that fall midway between an equinox and a solstice. What is the closest cross quarter date to today?

**Noah Guiberson** 52:01

October 27th.

**Rob Frawley** 52:03

And I feel like that's gotta be, because it's September 22nd and then December 21st, and so we're looking like 45 days in between.

**Em Costa** 52:12

So I'll point out a tidbit that was mentioned to the audience in their papers, but not to you. The theme of the quiz is the sort of intersection between Halloween lore and astronomy.

**Rob Frawley** 52:24

Could it just be Halloween? Like?

**Em Costa** 52:27

It's Halloween! Nicely done, folks.

**Rob Frawley** 52:34

Save me the math!

**Em Costa** 52:37

So yeah, there are four cross quarter dates throughout the year, and each one is a minor holiday. So Halloween, Groundhog Day is one, May Day is one, and Lammas Day, which I don't think is celebrated anymore. But it's also Loafmas Day, and let me tell you, I celebrate that every day because bread is delicious.

**Noah Guiberson** 52:54

Is the Groundhog Day? I'm sorry, well, we can go on to that next, but is Groundhog Day...is that on that sort of, I don't know, some sort of astrological day for a reason? Because that seems like it's...

**Rob Frawley** 53:04

Six more weeks of winter is halfway through!

**Em Costa** 53:08

Exactly. So it's actually the relationship of like the date of Halloween and it's sort of like, actual date in relation to the sun's excursions has a lot to do with its origins and its meaning. So the idea that Halloween falls in between the fall equinox and the winter solstice, that kind of is this metaphorical time of transitioning from the summer to the winter. And then likewise, the ancient Celts it had significance for or recapitulated the transition from life to death. So that's why that particular day was thought to be the day when those who passed away in the previous year could come back and maybe get their last kicks on Earth amongst the living. So thanks, astronomy, for Halloween. All right, question three. What do you call the sexual phase of the jellyfish life cycle and the beastly namesake of the star Algol?

**Noah Guiberson** 54:05

I think I know it. Does everyone know what it is?

**Rob Frawley** 54:08

Go for it.

**Em Costa** 54:09

Yes! Yes, yes, yes. And I suspect we may have some jellyfish scientists watching on the Zoom, and if you're there, I see you and this is for you and I'm very happy for you. They're always sensing. So ah, yes. So Algol, also known as the "Demon Star", is in the constellation Perseus, and it comes from the Arabic word for ghoul. And it's so named because Perseus was the guy who slayed the Gorgon Medusa by slicing off its head. And in the constellation, Algol is the star that represents the severed head of Medusa that Perseus is holding. So there you go. Algol is a variable star, meaning that it looks brighter in the sky sometimes than others, which also fed into its lore of just being like an unlucky star to a lot of ancient civilizations. And in fact, I read that medieval Arabic commanders tried to make sure that no important battles were happening when the star was dim. So basically, the Mercury in Retrograde of antiquity is my analogy to it. Question four. So long before lending his name to a Milky Way surveying space telescope, who paused his astronomical studies to prevent his mom's execution for witchcraft? So I realize that this is tricky, but the focus is...

**Noah Guiberson** 54:09

Medusa?

**Moiya McTier** 55:30

This is history stuff.

**Rob Frawley** 55:33

Space telescopes first...so I think Hubble's mom was not in trouble. She's clear.

**Em Costa** 55:39

Hubble trouble!

**Moiya McTier** 55:40

Herschel? Herschel is a telescope, but I don't know if if their mom was a witch.

**Noah Guiberson** 55:47

Kepler...

**Moiya McTier** 55:49

Kepler is a telescope.

**Noah Guiberson** 55:50

But is it old enough? Is Kepler old like, from long enough ago that his mother could have been accused of being a witch?

**Moiya McTier** 55:56

Like when did Kepler live?

**Em Costa** 55:58

The Enlightenment! Yeah, and what was Kepler into? Like, just curious. Something about planets and motion...

**Moiya McTier** 56:06

Like 1700s?

**Rob Frawley** 56:07

Herschel was more, was he late 18...

**Moiya McTier** 56:09

Herschel was 1800s, yeah. So Kepler, I think. All right.

**Em Costa** 56:14

Consensus achieved and consensus correct! So yes, Johannes Kepler, of laws of planetary motion fame. So basically, Kepler was excommunicated. And then he wrote a story where the narrator's mother consulted a demon to travel to space, and then his mom Katarina was accused of witchcraft and imprisoned. Oops! Who could have seen that coming? So he actually moved his whole family to the town that she lived in to lead the defense in her trial, which they won, so she wasn't executed. But just to say, we think work life balance is challenging nowadays. Imagine just like shit! I have to put everything down and run home, my mom's being tried for witchcraft. Like I needed this today. Okay, question five.

**Rob Frawley** 56:58

Some facial hair on Kepler.

**Em Costa** 57:00

Which of the following is not a moon of Pluto? Charon, Triton, Hydra, Cerberus, or Styx?

**Rob Frawley** 57:10

Triton, right? Yeah, the others are underworld references.

**Em Costa** 57:16

That's correct. And that's exactly what it was. So yeah, Triton is the largest moon of Neptune. Pluto is named for the Greek god of the underworld, and all of its moons are named for figures or elements associated with the Greek mythological underworld. So the name Pluto itself is kind of an interesting story. It was suggested by an 11-year old English school girl to her Oxford librarian grandpa, who then told his astronomer friend at Oxford, who then telegraphed it to his American astronomer friends who were like, "yeah, sounds good." But it was ultimately chosen because of Percival Lowell. So he was the guy who built the Lowell Observatory where Pluto was discovered, even though he actually built it to look for proof of alien-made canals on Mars, which explains the old saying, "shoot for Martian canals and you might end up discovering Pluto."

**Moiya McTier** 58:02

I have heard that before.

**Em Costa** 58:03

Yeah, it's a classic.

**Rob Frawley** 58:05

But she also picked from like a short list of names, right?

**Em Costa** 58:08

They had lobbed a bunch back and forth, and none of them stuck. And this was kind of publicized around the world like, "there's a new planet and astronomers don't know what to call it!" And she was like, "I like Pluto. I'll tell Gramps." The rest is history.

**Moiya McTier** 58:20

They already had their names and the other planets were named after mythological figures too. So it was constrained in that way probably

**Em Costa** 58:28

It was, and I forgot the list but a bunch were floated and just, I don't know they didn't like them.

**Rob Frawley** 58:34

Hephaestus would be a dumb planet.

**Em Costa** 58:36

Yeah. Callisto? No, too basic. Question six. Pallas is the third largest asteroid in the solar system, the daughter of Poseidon and the likeness on a bust in what famous poem about a pessimistic uninvited guest? Remember, Halloween theme? It's the Raven--ahhhh why am I telling you the answer?!!

**Noah Guiberson** 59:01

I did, I did I was going to say that--

**Em Costa** 59:05

I was just too excited!!

**Noah Guiberson** 59:09

Because we didn't get a chance, I will offer you one tidbit about Edgar Allan Poe. My partner and I met in the bar that was the last place Edgar Allan Poe was seen alive.

**Rob Frawley** 59:20

Whoa!

**Moiya McTier** 59:21

Did you see any spooky old men?

**Noah Guiberson** 59:24

Oh loads.

**Rob Frawley** 59:26

And Noah was there.

**Noah Guiberson** 59:27

Yeah!

**Rob Frawley** 59:30

There's a line in The Raven about "on the Plutonian shore", right?

**Em Costa** 59:34

Yes! Yeah, that's yes. Wild. Also, relevant. Yes. But yeah the stanza in question, "perched upon a bust of Pallas just above my chamber door / perched and sat and nothing more," for some reason, that phrase has been emblazoned in my mind since like middle school. So, I know, you've met me, c'mon! But it turns out you can also purchase a bust of Pallas, raven included, on Amazon to ensure that you're invited to Yankee swaps nevermore.

**Moiya McTier** 1:00:08

That's how you ensure that you are invited to my Yankee swaps.

**Em Costa** 1:00:12

Question seven. What red supergiant became unexpectedly dim in early 2020, inciting speculation that it might soon undergo a supernova?

**Moiya McTier** 1:00:22

Betelgeuse Betelgeuse Betelgeuse!

**Em Costa** 1:00:23

Ohhhhhh!!! Sorry for yelling into the mic. It was Betelgeuse. Yeah. So Betelgeuse is expected to go supernova sometime in the next 100,000 years. So you know, keep your watch to it. But in late 2019 to early 2020, it became markedly dim and got everybody real excited, and then astronomers looking through the Very Large Telescope, an actual telescope, not just any very large telescope, figured out that it was actually just a cold spot on the star and a big dust cloud blocking our view of it together that made it look more dim. In hindsight, they could have done what Moiya just did, and saved us all a lot of trouble, because it just would have come back. Question eight. The Arctic gets its name from a pair of northerly constellations, which themselves are named after what mammal? And as a hint, proto-Germanic tribes were so fearful of this mammal that its name was taboo. Facts Machine throwback!

**Noah Guiberson** 1:01:19

Yes. 1-2-3 bears!

**Em Costa** 1:01:22

Where?! Don't scare me like that.

**Rob Frawley** 1:01:25

Ancient people were terrified of DA bears.

**Moiya McTier** 1:01:31

I'm so glad we got that all right, that would have been so embarassing.

**Em Costa** 1:01:37

"Dolphin! Shit!" Yeah, so Ursa Major and Ursa Minor are the two constellations in question. Ursa is Latin for bear and the Arctic is named for the ancient Greek word for bear, which is arktus. So yes, this is a throwback to an earlier episode of Facts Machine, in which basically, I talked about how the English word for bear is thought to have its etymology in Proto-Indo-European word for "the brown one," and to be an example of taboo language. And the idea here is that Proto-Indo-European speakers were so afraid of bears that they instead chose to refer to them as brown ones, and not say the name "bear" out of fear that they might summon the bear by doing so.

**Moiya McTier** 1:02:17

The Arctic is called the Arctic, because that's where the bears are. And then the Antarctic is just where there are no bears.

**Em Costa** 1:02:25

No bears.

**Noah Guiberson** 1:02:27

Noooo bears.

**Em Costa** 1:02:30

I just have one more small aside here, because I'm trying to get this slide together, you know I wanted to find a cool picture like this that showed the arrangement of the stars in the constellation Ursa Major with the bear overlaid, and a lot of them show the tail and I was like, what the f-- what? Did, was there some kind of like rapid evolution where bears lost their tails that I wasn't aware of? And apparently, so in some cultures, Ursa Major, that cluster of stars forming the tail, is instead cubs or some other explanation is given. But the Greek Roman version does have the tail and the explanation for that is, speaking of Greek mythology drama, Zeus had a side piece who, I think her name was Callisto at the time but then she became Ursa. Basically, Hera found out, was pissed, and he was like, "I gotta protect my side piece," so he turned her and her son into a bear, then she became Ursa, grabbed them by the tails, swung them around and launched them into space! And the tail is still stretched from that ordeal. So that's, that's the explanation. That's how that happens. You know, mythology shit. Um, okay, so that was our quiz. I think you would have gotten them all right had I not answered one of them for you. Just pure excitement about the answer. I think you would have gotten it, you would have, so you did, and the audience did really well, too. So well done! Okay. All right. Thank you so much to our wonderful teams and competitors, and to everyone who came into trivia! All right. So we'll do a little outro for us here. So first of all, check out Exolore the podcast at Exolore.com and wherever you listen to podcasts, and follow Moiya on Twitter @goastromo, so you can get updates on her upcoming book and her very ridiculously cute cat Cosmo.

**Moiya McTier** 1:04:13

I tweet a lot about Cosmo.

**Em Costa** 1:04:15

He's so cute. And speaking of Caveat shows, you should also dip into Science 101, produced by our very own Noah. And if you want to check out more content from Facts Machine, you can find us on Instagram and Twitter @factsmachinepod and on Facebook at Facts Machine Podcast. And with that, thank you to Moiya, Caveat, all of you in the audience and at home on Zoom, also in the audience. That's all we've got, but you know, if you still have energy and time, hang out, we'd like to meet you. We just want to hang!