
00:44 SC: First up, we have Daniel Clery, he's here with some watery news from Mars. Up until now, there's been evidence that liquid water once flowed on the red planet, but that was long, long ago, billions of years. These days, water on Mars seems to be locked up as ice or boiled away in the air, but now researchers are reporting a strong evidence that there is liquid water on Mars. Daniel Clery is here to talk us through what's going on. Alright, so water on Mars, yes or no, Daniel?

01:14 Daniel Clery: Well, it seems so but it's not gonna be full of fish.

01:19 SC: Okay, there we go, yeah, maybe not even microbes. [chuckle]

01:23 DC: No, not even microbes, so it looks like, it looks like it's gonna be very cold and very salty. People aren't getting super excited that there's gonna be bugs in there but if there's water in one place, there might be water elsewhere. So we might be finding lakes very deep that could have things in them but people are still looking.

01:44 SC: Let's talk about this singular lake that's been found under one of the polar ice caps, how is this discovered?

01:50 DC: Well, there are two satellites orbiting the planet which have radar on them, so they beam down radio waves and then they pick up what gets reflected. And they can see deep below the surface with these radars, and they get reflections from changes in the rock or if there's a layer of ice. And so, using these, they found ice, but this is the first time they've seen a layer of liquid water using this radar.

02:20 SC: Liquid water on Mars, is the temperature really right for that? How cold is it, where they're saying this water is?

02:26 DC: It's way below normal, freezing point for pure water. But what they think is happening is that this water is very, very salty. They found these perchlorate salts all over in the soil in Mars. And if you have salty water, the freezing point is reduced. So they think these are pools of brine, so that you get a much reduced freezing point. So that's why it's under the ice cap is where they found it for the first time.

03:00 SC: And that parallels something that happens on Earth with Antarctica where there is ice on top of pools of water that are very, very cold, but the pressure of all that ice is keeping it liquid.
03:11 DC: On Earth, they don't think it's salt but they think it's a combination of the pressure of all the ice on top which reduces freezing point. But also, there's some geothermal heat on Earth which warms things up. But on Mars, there's not so much geothermal heat and also there's not so much pressure so they think the prime candidate for what's happening here is salt.

03:36 SC: How deep under the ice is this lake? And what are its dimensions?

03:42 DC: It's 1 1/2 km below the ice, and from what they can tell, it's about 20 km across, so it's a sizable bit of water but still very cold and very salty.

03:56 SC: So, you mentioned at the outset that this gives hope for finding other bodies of water on Mars, but does the math work out? Could you have something salty enough somewhere else on Mars for it to be liquid?

04:07 DC: Yeah, certainly, you could find them elsewhere on Mars. The radars can only look down to a maximum of 3 km. So, the fact that they found a lake suggests they could find one somewhere else.

04:21 SC: One thing I was wondering is, if there could be any direct measurement of this salty water, how impossible would it be to try to get a sample of this?

04:30 DC: It's certainly possible, people are talking about doing that on moons further out, where they think there might be liquid water. But I think at the moment, people wanna know a bit more, if it's that cold and that salty, it might not be worth going and trying to drill down into that lake, but this is just people hope the first detection of water, and if we can find it there, maybe we can find it somewhere else in a place that might be a bit more friendly to life.

05:01 SC: This is something that we haven't even been able to do here, like dig through Antarctic ice and get to the lakes underneath.

05:07 DC: Yes, that's right. We haven't been able to do it here because people are so super careful about not contaminating the lake. The thing you're drilling down with is gonna have microbes from the surface on it. So people have been really, really tentative and they would be super tentative on Mars. One of the people I spoke to said, "Even when they put a land drone on Mars, they're not allowed to go to the areas where life is most likely to be because they don't wanna contaminate it. There's a lot of planetary protection stuff tied in with this.

05:43 SC: The mission that detected this has been at Mars for a long time.

05:48 DC: That's true, since 2003, I think. So it's been looking for a long time and people had hoped it would be easier to find water. So, there are various mysteries as to why they haven't found any sooner, but it's a big relief. In fact, they have found at least some, and they hope they'll find a lot more.
06:09 SC: What could they do to find out or confirm this further?

06:12 DC: They can send more radars. There's not many radars' forecast at the moment. There's a Chinese mission that is going up a few years' time, 2020 I think, which they think has a radar on it. The details are a bit sketchy. Yeah, other things they can do are seismic studies. There's one in Mars' InSight lander, which is going on its way, I think, at the moment. So, there are things coming up, but nothing really imminent so people are gonna be a bit frustrated, I think.

06:46 SC: Daniel Clery, thank you so much for talking with me.

06:48 DC: Thank you.

06:49 SC: Daniel Clery is a Staff Writer for Science, you can find his story and links to the research at sciencemag.org/podcasts.


[music]

07:08 SC: This week's episode is brought to you in part by LifeProof Backpacks. Whatever the action, whatever the destination, no matter the weather, LifeProof Backpacks keep you optimized, organized, prepared, and protected. Check them out at lifeproof.com/sciencemag and receive 15% off any pack. LifeProof Backpacks are made with water-repellent Cordura fabric to shed rain during those summer afternoon showers. Special tech pockets are sealed against the elements and lined with soft fabric to protect phones and other small devices. Select backpacks also have an ingenious side access laptop pocket, ideal when you're going through airport security. And speaking of security, most LifeProof Backpacks are equipped with a super secret stash pocket for when you need to hide away a passport or some cash, and they're all outfitted with front tie-downs to hold oversized stuff outside.

08:01 SC: With four sizes, there's a LifeProof Backpacks for any outing. Grab the Quito 18-liter for day trips. Up your carrying capacity with a Squamish 20-liter. Go with the Goa 22-liter for tons of pockets or max out on space with the Squamish XL 32-liter. Get your LifeProof Backpack now at a 15% discount by going to lifeproof.com/sciencemag. LifeProof Backpacks. Carry on.

[music]

08:30 SC: In this week's feature, science journalist, Katherine Kornei, writes about how transitioning genders can affect an athlete's physiology and performance. Hi, Katherine.

08:39 Katherine Kornei: Hi.

08:40 SC: So how did you come across this story? It's focused on a person, a researcher, a person who herself has transitioned but then also has been deeply involved in this type of research?
08:50 KK: I read about Joanna Harper's work in a publication of the American Physical Society. And Joanna is trained as a physicist, and the article mentioned a little bit about what she worked on and also mentioned that she was a local to Portland, Oregon, which is where I live.

09:05 SC: Okay.

09:05 KK: I thought it was a fascinating story and wanted to dig into it deeper.

09:09 SC: One of the things that Joanna faced when she was considering transitioning was the fact that she was an athlete and did not want to face scrutiny in that area, if she decided to transition to being a woman. What are some of the problems that have arisen over the years with this idea that certain kinds of sports are for certain genders?

09:31 KK: There's definitely this idea that men and women have different attributes when it comes to being an athlete and for someone who chooses to transition genders, that can really be a hotbed of controversy in terms of, how do you ensure fair competition, how does somebody who had exposure to previous hormones, in this case, male testosterone levels; how does that person then compete fairly when she then transitions to a female gender? And Joanna was really an amazing resource for me, I learned so much by talking to her. She was extremely candid in all of our interviews, and I was really able to ask those tough questions of, What has been your experience as a scientist, as a runner, and as a transgender person?

10:11 SC: What are some of the ways that, I know in the past they used to actually just inspect people's genitals to say you're a woman and you belong on this side of the sports teams. They got rid of that, and now they do some chromosomal analysis sometimes. Is that still going on?

10:27 KK: Yes, that is sometimes used, but what the trend is nowadays it's really going towards analyzing hormones. So looking at the levels of an athlete's testosterone and basically saying if somebody has testosterone in this certain level that they're then permitted to compete in either the male category or the female category.

10:45 SC: Joanna Harper. Her research has focused on the correlations between performance testosterone levels and transitioning. Can you talk a little bit about how she started doing that?

10:55 KK: It was really motivated by obviously, her background as a scientist, she's intensely curious, she wants to know what the data show. She was very motivated also by her own transition. She realized that as she transitioned, her race times became slower and there was a lot of controversy about how if somebody transitions from a male gender to a female gender, does that person still have so-called relic advantages of the previous levels of testosterone in that person's body? And what Joanna was able to show using a sample of athletes is that, no, that actually after you transition hormonally that you're running very much on the level with other people who were raised female their whole life and had female hormone levels their whole lives.

11:45 SC: So there's this measure that's used in these studies that it compares across a band of
runners, that's called age grade. Can you describe what that is?

11:53 KK: So an age grade refers to comparing an athlete's performance to the very best race time that's run by an athlete of the same age and the same sex.

12:03 SC: How does that show up in this data looking at transgendered athletes?

12:08 KK: She compared race times from athletes before their transitions and after their transitions, and what she showed is that their age grades remained about the same. So, a runner who ran a certain level relative to his male peers, he also ran at that same level compared to her female peers after that person transitioned. So in other words, that runner wasn't faster than her new peer group.

12:36 SC: That's a little bit surprising considering that some of the advantages that people were concerned about, there's a greater height issue, there's longer bones and that really didn't seem to play out once transitioning happened.

12:49 KK: No, that's correct. So, what Joanna was able to show is that hormone level really has an enormous impact, that that's really seemed to be dictating performance. And after these athletes, after they've regulated their hormone levels, after they've transitioned to a female gender, and there doesn't seem to be a relic advantage that even though previously they had much higher levels of testosterone.

13:12 SC: This finding actually had an impact on the world of sports directly. So, the way people regulate sports and gender, can you talk about that?

13:21 KK: Major sports governing bodies like the International Olympic Committee have really taken these data into account in the sense that they've realized that hormone levels, specifically testosterone, very, very indicative of performance. So, by enacting these regulations saying if you are transgender athlete, you need to have specific hormone levels, that's really able to ensure more fair competition.

13:45 SC: And so, the number came down. Initially, it was what? Two years from transition that transgender women were allowed to compete but then after some of Joanna's results, it was reduced to one year.

13:58 KK: Both Joanna and other researchers have shown that hormone levels and performance, therefore, basically plateau after one year of hormone therapy. So after one year, someone is ready to compete, for instance in this case, in the female category.

14:16 SC: And are we talking only about running? Or are other sports also included in this research?

14:20 KK: Joanna's work has focused largely on runners. She's also looked at athletes in other sports, but most of the controversy has thus far focused on running.
There are still a lot of unknowns about the physiology of an athlete that's transitioned. What are some of the questions that are still unanswered that these researchers are gonna be looking into?

These studies that have been done so far have largely looked at athletes before their transition and after their transition, and what Joanna and other researchers are really focused on now is following athletes during their transition, to understand what changes, may be cardiac health, maybe bone density, what are some other various medical quantities that are also changing.

We haven't mentioned transgender men yet. Is there a similar concern about what happens with their physiology during transition or after transition?

There's a lot less controversy about transgender men. Of course, there are various ideas as to why that is. Females are generally viewed as a "protected class" so when somebody wants to enter that class, there's always a lot more controversy.

There are some benefits to being female such as long life, is that something that is also gonna come out in these kinds of studies?

Definitely. So, certainly looking at those medical aspects of, as your hormones change, what changes about your, perhaps, life expectancy or bone density? Cardiac health is definitely a big issue that several researchers are looking at, that, yes, there are certainly correlations of certain diseases with gender and researchers are very eager to know if those change as well when somebody transitions.

Okay, Katherine Kornei. Thank you so much for talking with me.

Thank you.

Katherine Kornei is a science journalist based in Portland, Oregon. You can find a link to her story at sciencemag.org/podcasts.


Hi, everyone. I'm Jen Golbeck and welcome to this month's book segment. We're reading The Secret Token: Myth, Obsession, and the Search for the Lost Colony of Roanoke by Andrew Lawler. I'm joined by the author and I'd like to start with some background. In the 1580s, voyages began from England to Roanoke. Why were they trying to establish a colony there?

The purpose of the Roanoke voyages was several fold, one was that the English wanted to establish a pirate base on the coast of North America where they get to tax
Spanish ships. The other was that the English really eager to get the resources that the Spanish and Portuguese had been pulling out of the New World. And finally, the English actually believed that by settling on the coast of North Carolina, they would have access to China because they really believed for a time that the outer banks which are these thin barrier islands, actually were a demarcation between the Atlantic and Pacific Oceans. So, the purpose of the Roanoke voyages was to try and get Spanish gold, try and find good resources, pharmaceuticals, as well as metals on the North American continent and also to access China.

17:33 JG: So then, settlers began coming from England essentially buying right to land and passage to the New World. How did we discover that they were lost?

17:41 AL: So, in 1587, these people arrived on the coast of North Carolina. At that point, ore was breaking out with Spain. So when the governor returned, Governor John White returned to England for supplies and colonists, he was trapped in England for three years. By the time he returned in 1590, the colonists had vanished.

18:01 JG: And what happened to them?

18:02 AL: The key clue that we've known about for a long time was found by Governor John White when he returned in 1590, three years after he had left the colonists behind. He discovered that the settlement had been taken down, that the houses had been dismantled, but there was no sign of violence or mass graves or any graves at all. He did find on a tree the word Croatoan. Now, that was not a mysterious word. He knew full well the Croatoan was the name of an island about 50 miles south of Roanoke Island. And so, he fully intended to go and visit Croatoan and see if he could get more information and find the settlers. However, a storm blew up blowing back to England, and he can never return. Oddly enough, archaeologists didn’t really begin to study Croatoan, which is today's Hatteras Island, in great detail until the 1990s.

18:54 AL: And then around 2012 and ’13, a team from the University of Bristol began to dig with a focus of looking for this early contact period between the English and Native Americans, and sure enough, they found an incredible array of artifacts that appear related to Elizabethan times. However, when you look more closely at these artifacts, it turns out they were discovered in a layer that dates to after the 1650s. So that’s about 60 years or more after the colonists were on Roanoke Island. So the question is, are these artifacts that had been passed down by generations of lost colonists who had become assimilated with the Native Americans? Or, are they materials that were shipped over to Jamestown for example, which was created in 1607 and then worked their way south on the trading pass to the Indians who lived on Croatoan? So, these are the questions that archeologists are trying to resolve, but it’s very hard to get the dating down to within 50 or 60 years in order to determine if these are really artifacts of the lost colonists or if they come from later English settlers.

20:02 JG: What kind of science is being used to solve the mystery?

20:05 AL: Archaeology has been done on Roanoke Island for over a hundred years, and over the course of this time, nobody has yet found where the colonists started from, that is, where they lived
on Roanoke Island, much less where they went. Now, a lot of new methods are being employed, which can give us better clues. For example, there's OSL dating going on on Roanoke Island that might tell us about certain features that archeologists had found provide more exact dates that you can't get, say, from a piece of pottery. So these new dating techniques could be really helpful because determining the difference between a 1580 artifact and a 1680 artifact is still really hard when you're dealing with this period. So, it looks like there will be new advances that will allow us to close in on those dates and be able to say what belonged to lost colonists versus later English settlers.

21:00 AL: And then, of course, there's the promise of DNA, which at first I thought was going to be a way to really resolve this issue. You find some bones, you do some analysis, you compare it with living descendants of the lost colonists and you get an answer of what happened to them. However, we have yet to find any bones that clearly belonged to lost colonists, and we don't even have any direct descendants of lost colonists in England that we've been able to pinpoint. So DNA holds great promise but at this point, it doesn't really add much to the story.

21:34 JG: Beyond the murder mystery, I wanna talk about Virginia Dare, the so-called first white child born in America. She has a lot more significance to people than just the fact of her birth.

21:44 AL: Well, Virginia Dare is the one American about whom we know so little but is so famous. We really just know that she was born and she was baptized in 1587. Beyond that, it's all made up, it's all a legend and what this legend reveals is the anxiety Americans were feeling in the 19th century about slavery of African-Americans, enslaved African-Americans as well as the increase in immigrants who were coming from places like Germany and Ireland, and later from Italy and Spain and other places in Europe that really made Americans worry about the change in the composition of our population. So, Virginia Dare became a symbol of the white girl surrounded by dark savages, which was really a metaphor for the fear Americans had about the influx of people who weren't Anglo-American into the country during that century.

22:41 JG: And she's still used as a symbol by groups today with those same fears.

22:45 AL: Absolutely. She was a very important symbol of white supremacy in the late 19th century, and well into the 20th century and actually into the 21st century. There's still groups that see her as an example of the kind of white person we want to have as a model American citizen as opposed to the brown people who are increasingly making up a larger part of our population.

23:10 JG: Beyond Virginia Dare herself, this mystery really feels incredibly relevant as to the way it speaks to our country right now.

23:17 AL: I set out to do a book that focused on the science of how we could answer America's oldest murder mystery using archeology and history and other scientific methods, but I realized that the story actually goes much deeper, that the story is really about the way we see race and immigration. So, I was quite surprised actually when I realized that this topic is very current and that it has a lot to say about who we are as Americans today, and who we wanna be, and who we imagine ourselves to have been. So, that's where I moved beyond the hard science and went into the
social sciences and discovered in doing so that there's a lot to learn from these colonists that doesn't have much to do about with Elizabethan England, but it says a lot about what's going on in our country today.

24:05 JG: Well, Andrew Lawler, thank you so much for joining us. The book is The Secret Token: Myth, Obsession, and the Search for the Lost Colony of Roanoke.

24:13 JG: And that's it, for this month. Next month, we're doing something a little different. We're going to read a book that's already published and give you the chance to send us your questions that we'll ask the author. Our book for August is The Book of Why: The New Science of Cause and Effect by Judea Pearl and Dana Mackenzie.

24:28 JG: In science, the rule that correlation does not imply causation is pervasive, but this book argues that there should be a new science of causation. It discusses how this plays out logically, the implications for society and science, particularly in the light of artificial intelligence and big data. You can get the book now and we'd love for you to contact the podcast with your questions, which will form the basis of our discussion next month.

24:52 JG: You can contact us by email at Science Podcast at AAAS, that's aaas.org. Or send us a Tweet to @sciencemagazine, we hope to hear from you. In the meantime, thanks so much for listening.

25:06 SC: And that concludes this edition of the Science Podcast. If you have any comments or suggestions for the show, write to us at SciencePodcast@aaas.org. You can subscribe to the show on iTunes, Stitcher, many other places or listen to us on the Science Site. On the site, you can also find research and new stories discussed in each episode. That's sciencemag.org/podcast.

25:29 SC: This show was produced by Sarah Crespi and edited by Podigy. Jeffrey Cook composed the music. On behalf of Science Magazine and its publisher AAAS, thanks for joining us.