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00:06 Sarah Crespi: Welcome to the Science Podcast for March 6, 2020. I'm Sarah Crespi. First up this week, I talk with online news editor David Grimm about how dogs noses may be able to detect heat. Next, we have international editor Martin Enserink, and he's gonna tell us about the latest news on coronavirus. Finally, in an interview from the AAAS annual meeting, producer Megan Cantwell talks with Jill Charter about the latest technologies being used to search for alien life.

00:37 SC: Now, we have online news editor David Grimm, and he's here to share his favorite online story from the week. Hi, Dave.

00:44 David Grimm: Hey, Sarah.

00:45 SC: Okay, so I think I know why this is your favorite.

[laughter]

00:49 SC: It involves animals.

00:51 DG: It doesn't just involve animals, Sarah. It involves one of my favorite animals, which is a dog.

00:55 SC: Oh, domesticated animals.

00:57 DG: Domesticated animals, yes.

00:58 SC: Yeah.

01:00 DG: So, yes, so we love to do dog and cat stories, or as much as we can. And this is a really cool one, because we sort of feel like we have figured everything out about dogs and even cats. We've lived with them for 10,000, 15,000 years, so it doesn't seem like there would be any more surprises. But this study says there's at least one surprise left with dogs that we didn't know about.

01:18 SC: Right. So, if your dog is sitting there looking at you funny, tilting its head, and you're like, "What? What is it?"

[laughter]

01:24 SC: It might be sensing an odd heat signature in the room.

01:28 DG: We already know dogs noses are super amazing. Their smell sensitivity is about 100 million times more sensitive than ours. What this new study is showing is that actually dogs don't just detect sense, they can actually detect heat as well.

01:43 SC: They detect heat with their nose.

01:45 DG: That's right. They're sensing weak thermal radiation. And so dogs, like a lot of mammals, they have this naked smooth skin on the tips of their noses and around their nostrils. Our noses aren't wet and cold, [chuckle] and as quite as innovative as dogs are. And so, this coldness is actually kind of a clue. Because in order to sense heat, you can't be hot, right? Otherwise, you wouldn't be able to tell if something's hot. It's like if you have a fever, or if you have a warm hand and you touch somebody with a fever, you're not gonna be able to sense it very well. But if you spend five minutes outside and it's really cold and you touch somebody on their head, even if they're normal temperature, it's gonna feel really warm to you. And that's sort of the similar idea with dog noses. Because it's cold and wet, it's able to be able to detect stuff, even just sort of marginally warm. It doesn't even have to be super warm.

02:31 SC: Dogs have cold and wet noses. And I actually have a hard time thinking of another animal that has a nose like this. But I know there are other animals that can sense thermal signals. Do they have the same kind of thing going on?

02:43 DG: Right. So, vampire bats can actually sense thermal radiation, certain species of snakes can do that. And they also... Both these also have colder noses. And so the fact that dogs also have these sort of legendarily cold noses. [chuckle] Sort of gives a hint. And so that's what researchers wanted to test in this study. We want to see, "Well, can dogs actually do this?"

03:04 SC: This is something that's always tricky, testing the senses of an animal, their ability to perceive something. How do they set it up in this study?

03:12 DG: Well, luckily, they work with dogs who aim to please. So this was mercifully not an experiment done on cats. We'd probably have a much different outcome. But in the first experiment they have three pet dogs and they had them to choose between a warm object. And by warm, we mean about 31 degrees Celsius. So, slightly warmer than room temperature. And then a room temperature object. And they place these objects about 1.6 meters away from the dogs. So the dogs weren't touching these objects. They actually had to be able to sniff out this heat at a distance. And though the objects looked and smelled exactly the same.

03:45 SC: How did they know they smelled the same?

[laughter]

03:49 DG: I assume they controlled for that. I assume. These are basic objects. I don't think we described it in the story, but these are pretty bland objects. I think it's a couple of boards with a heat thing in the middle of it. So these are not very olfactorily interesting objects, and they are exactly the same, except for the...

04:07 SC: But Dave, when you heat something up, it does smell different. How do we know that the dog isn't keying in on that? They have this amazing sniffers.

04:16 DG: Well, the researchers did another set of experiments, this time with 13 dogs, and they were able to get them in an fMRI scanner, which measures brain activity. And they saw that when the dogs were sniffing out these objects that were slightly warmer, there were areas of their brain that were activating that were not the same as areas that activate when they smell something. So it was a specific region of the brain that seemed to be lighting up. But again, it was only when the dogs were detecting thermal radiation. They did not see these regions light up when the dogs were just trying to sniff out an object that was just room temperature. So that combined with the previous experiment, it is not conclusive, but it really adds up to this idea that dogs really do have this... Can actually kinda sniff out warmness, and not just sense with their noses.

05:00 SC: Why might that be useful for dogs, or their ancestors?

05:03 DG: Well, we know that these other animals like the vampire bats, snakes, they use it in hunting. So they're not just hunting by looking at things, by sensing motion, or smell. Heat, especially for snakes, is really important. And so what this suggests is that dogs, and we all know dogs are descended from grey wolves, who were very effective hunters, and grey wolves need to be able to sniff out prey. And you can imagine that if they're just relying on smell alone, they may be missing something that's maybe hiding, or may be covered up by other odors. But if they can sense heat as well, especially heat at a distance, that's gonna make them much more effective hunters of any warm-blooded prey. And so, the feeling is that dogs may have inherited this ability from their ancestor the grey wolf.

05:43 SC: I guess they can try to test that out next.

05:46 DG: They can. They can try this experience with wolves. It will probably be a little trickier. [chuckle]

05:50 SC: Thank you so much Dave.

05:51 DG: Thanks Sarah.

05:52 SC: David Grimm is the online editor for the science news site. You can find a link to this story and the related research at sciencemag.org/podcast. Stay tuned for an interview with international news editor Martin Enserink, with the latest on coronavirus.

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06:12 SC: We're gonna talk coronavirus today. One thing that's really struck me is that, oftentimes when we see an international story and, there'll be this conversation in the news room, what's the science angle here? There's no question about the science angle in this story. There are so many things going on, from the science of the virus itself, to how scientists are working through quarantines and travel restrictions. So I asked our international news editor, Martin Enserink, who's been handling most of our coverage, to give us a bit of an overview of their reporting. We recorded this interview on Monday, March 2nd. Let's start with what's going on right now.

06:52 Martin Enserink: We're in a really pivotal phase in the epidemic or pandemic as some people would call it by now. We now have the virus reported in 61 countries. I think it doubled in a week or something like that. It's really spreading in many countries and many countries discovered that they have community spreads which means the virus is already there. It's not just in people who came from one of the affected areas, or people who were in touch with them, but, there's people now for instance in the US that we don't know how they got the virus, which means it's been spreading unnoticed for a while.

07:28 SC: Right. West Coast and the East Coast of the US, both have had cases.

07:31 ME: That's right. Yeah. In many countries in Europe, huge outbreak, it looks like in Iran, and, there have been cases reported from Africa, only a handful so far, but many people think there must be more there that just hasn't been discovered. So this is really going global at the moment, and, it seems unstoppable. It seems very difficult to get this virus back in the bottle. So now the question is, how do we mitigate it, and how do we slow it down? How do we soften the blow? How do we make sure that the mortality remains as low as we can? Those are the really important questions now.

08:02 SC: The silver lining so far has been that the mortality has been relatively low compared to previous coronaviruses that have spread rapidly.

08:12 ME: Yeah, it is lower than SARS for instance, which had a mortality rate of 10%. We don't know exactly what it will be for this disease. That's one of the key questions that scientists are trying to answer right now, and part of the reason is that we don't know exactly how many mild cases there are. If you only focus on the people who have a disease and you missed the ones with maybe just a cough or slightly flu-like symptoms that they don't go to the doctor with, you may miss those cases and you may over-estimate mortality. But even if it's only one or 2%, that's a lot of people, if you're talking about a disease that's going all around the world.

08:49 SC: Right.

08:50 ME: What may happen is that, because there's so many cases in a short period of time, then it overwhelms hospitals and the whole health system.

08:57 SC: I know there's been a lot of talk about testing, especially issues with the availability of tests in the US, what's going on with that?

09:05 ME: There are several problems with testing. The US had a peculiar problem in that the tests that were sent to labs around the country by the Centers for Disease Control and Prevention, were not working well, there was a problem with them, so the CDC recalled them. On the whole, the US has done very few tests. Local and state labs have been clamoring to do more testing but they couldn't, because the CDC had to do all the tests. So, it was really a couple of weeks that were lost, and, as a result of which many cases were probably missed. They're starting to do more tests now, but many other countries have problems with testing as well. I'm now working on a story about Indonesia by our correspondent there. Indonesia just reported its first two cases, but many people think it must have more cases already. And again, one problem is that there's been very little testing. This is an issue that we're seeing in many countries.

10:00 SC: This test itself is not super difficult to make, if you can produce primers and run PCR, which is something that, yeah, diagnostic labs can do, but, it turns out it's still been really difficult to get these tests deployed and to get people tested.

10:14 ME: It's the logistics. If you look at a country like Indonesia, for instance right now there's one lab in Java that can do it in Jakarta, but, it's a vast country so all those samples have to be shipped by plane to Jakarta, that's a big obstacle. There are many countries that don't have good labs at all, or very few and far between. And another really, really key issue with testing is that, the current tests look only for the virus. They detect the viral genetic material, but what we really want to have also is a serological test, that means that you test for antibodies. And that allows you to find people who were infected in the past, but no longer have the virus. And that's really important because that will fill epidemiologists much more about who has been infected, how many people already have had the virus, how many perhaps were infected without even noticing it, or, with just very mild symptoms. So that's going to be very important, and those are expected to come online fairly soon, but they're still in development at this moment.

11:16 SC: We've published a lot of stories on the coronavirus in the past couple of months, how has it been trying to keep on top of all the announcements, all the breaking science, all of the different cancellations of all these different things? How has that process been for you and your reporters?

11:33 ME: It's been pretty crazy. You're right, there's so much happening, and there are stories everywhere we look, and questions everywhere we look. Whether it's about the diagnostic drugs, about vaccines, about the epidemiology. Yeah, and things like the impact that it's having on scientists. But we have some really good reporters who know viruses and know outbreaks really well. John Cohen in San Diego and Kai Kupferschmidt in Berlin. We also have Dennis Normile who's in Tokyo at the moment who is covering things as they happen in Asia, and we may even add more reporters. We may ask other people to join in as well, because it's becoming such a huge, huge story that we wanna stay on top of.

12:13 SC: What are some of the big scientific questions related to this virus? What kind of research is going on?

12:19 ME: There's still a lot that we don't know about the virus and the disease it causes, for instance, the exact mortality rate. What is the role of children? We know that children rarely get sick from this virus, it's even less for them to get very sick. We don't know why that is, if we understand it might tell us something about the disease as well. We also don't know the role that they play in the epidemic. For instance, Japan has closed all of its schools, but we don't know if that really helps, because we don't know whether children transmit the disease. So that's another key question that needs to be answered. So lots of questions about the disease and the virus, and then from there on, other things, you know, diagnostics are really important. People have started clinical trials to see if existing drugs could do something against this virus. They've also just started working on vaccines. That's gonna be a long time, at least a year or 18 months. It's not like in the movies where you can just develop a vaccine in a couple of weeks, but that's obviously maybe very crucial as well.

13:21 SC: Has there been any early success with using drugs or medication or anything to treat this?

13:26 ME: As far as I know there's a whole bunch of clinical trials going on, especially in China where they had the vast majority of patients so far. I don't think any of those have produced any results yet. And of course what you wanna do is to have rigorous clinical trials, which means you have a placebo arm and a drug arm. You randomize your patients so that you know that any effect you think you see is really due to the drug. So WHO has been working on that to make the trials rigorous and to make sure that they have reliable outcomes. I don't think we're there yet.

13:57 SC: One thing came up in a meeting on the other side of the house, on the research side is that there are people on deck to peer review coronavirus papers as they come through as quickly as possible. So is that something that's happening at a lot of journals? I know there's a lot of activity on the preprint servers as well.

14:18 ME: That's right, yeah. We had a really interesting story last week about how this outbreak is really changing the way scientists communicate. You're right, the journals are working overtime. They've published hundreds of papers already in just six weeks. We know a lot about the virus already compared to previous outbreaks. And you're right, the so called preprint servers which will post un-peer-reviewed manuscripts, they are becoming really important in this outbreak. There've been hundreds of preprints as well. It's a good way for scientists to share findings immediately without journals reviewing them, without editing them. So you have to take them with that caveat that there sometimes raw, unedited data. But it is a really important way of sharing data fast. And obviously speed is of the essence.

15:07 SC: So that's the science behind the virus, but the rest of science, scientists going about their lives, going to their labs, going to the field, going to meetings. There's definitely been some disruptions there. What have you seen and what have we been reporting on?

15:22 ME: A lot of science has been disrupted, especially in China, of course where many labs, many universities have closed down. Scientists couldn't go to their work only to do the most essential functions or to keep their animals alive. For instance, many experiments have been halted. Fieldwork has been disrupted. Scientists don't travel to China anymore, and what you're seeing now is lots of scientific meetings have been canceled as well. Just the past weekend the American Physical Society decided to cancel a huge meeting in Denver really at the last minute. A lot of people had already arrived in Denver when they said, "We're not going to do it."

16:00 SC: Well, what are you going to be keeping an eye on from here on out? What are the main threads that you're gonna be following?

16:06 ME: A key question is, of course, what is this virus going to do? You see it's spreading very rapidly in many countries, but interestingly, the Chinese seem to have found a way to slow it down, almost to a crawl. There was a mission the past couple of weeks by the World Health Organization together with a couple of Chinese scientists who went to five cities in China and very carefully looked at epidemiology, what had happened, what the counter measures were. They came back saying, "Yeah, China did effectively almost bring it to a halt." China reported only 200 new cases yesterday. And the rest of the world had many more. The measures that they took were completely draconian. People had to stay at home.

16:48 ME: There was electronic surveillance. Every meeting was canceled, there was very little travel, but it turns out you can slow it down that way. So now the big question I guess is what will other countries do in Europe, in the US? Will they take these really draconian measures? Is that acceptable or does that violate, for instance, the US constitution to lock people in their homes like that? That's going to be, I think, a really important and interesting question. The other thing that I think many people are worried about is what will this virus do in lower and middle income countries that are far less prepared, where health systems are much weaker. We've seen only a few cases in Africa, people suspect there are many more, but what happens when a virus like this goes on the loose in in a mega city like Lagos for instance? That's very difficult to even think about.

17:39 SC: What is it like to have this disease? What are the symptoms and the general course, do we know that?

17:45 ME: About 80% has only mild to moderate disease, which could be anything from cough and sneezing, flu like symptoms. And then about 14% had severe symptoms and 6% had life-threatening episodes, for instance, of respiratory failure, septic shock or organ failure. And the interesting thing, only 5% of infected people had running noses, which is something you normally associated with flu and flu like illnesses. We also know that children may only make up 2.5% of the cases and they don't usually get severely ill. Very, very rarely in fact, so that's the good news that this disease seems to be very benign in children.

18:27 SC: What are some good trusted sources of information to go to? I know that we have expert reporters well versed in public health and virology and epidemiology and what are other good places for people to keep an eye on?

18:40 ME: As journalists, we get a lot of our information from the World Health Organization. Their site has a ton of information about this virus and how the situation is developing. I think people should also check sources in their own country, most likely the public health service or the ministry of health to stay aware of what the situation is and what they should do and how they can reduce their own risk. I think that's really important.

19:04 SC: Absolutely. All right, thank you so much Martin.

19:05 ME: Sure. Thanks for having me on.

19:05 SC: Martin Enserink is our international news editor. You can find a link to our ongoing coverage of coronavirus at sciencemag.org/podcast. Don't touch that dial. Up next we have producer, Meagan Cantwell and Jill Tarter on the hunt for extraterrestrials.

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19:31 Meagan Cantwell: I'm here at AAAS annual meeting with Jill Tarter, Emeritus Chair for the SETI research at the SETI Institute. She gave a talk today on a panel about the Search for Extraterrestrial Life and Technologies. Thanks so much for your time Jill.

19:43 Jill Tarter: Oh, it's a pleasure to be here.

19:45 MC: So I wanna start with discussing the different ways to look for life and extraterrestrial intelligence. I wanted to start with the search for bio-signatures. Can you talk about what researchers are looking for?

19:55 JT: In the search for bio-signatures, our Astrobiology colleagues are looking within the solar system for some kind of marker that we would say, "That had to be produced by biology. That's not a geological feature." And we have the opportunity in the solar system when we can actually go there with robots or humans to probe, for example the oceans under the icy crusts of the moons of Jupiter and Saturn. For example Enceladus, a tiny pipsqueak moon has an ocean and it also has cryo-volcanoes. It's actually spewing out this ocean as a plume and so there's an opportunity to fly through that, collect material and concentrate it and look for products of life.

20:43 MC: And what would make for a particularly compelling bio-signature?

20:47 JT: Well, I think the biomolecules that we could find. On this planet, we go to places like the desert in Atacama and we don't actually find organisms, but we can do mass spectroscopy which shows us the various molecules that are probably indicative that life was there. It's not like, you go with a microscope and look and see a little creepy crawly worm. It's really biochemistry that's going to indicate life in these systems. And beyond our solar system where we can't go, you use large telescopes. Currently, we're waiting for James Webb which will be able to look at the transmission of light through the atmospheres of some very few nearby exoplanets, as the light from the star goes through the atmosphere of the planet which is in front of the star absorption lines occur in the spectrum, due to whatever chemicals are in the planetary atmosphere.

21:50 JT: Right now given the capabilities of the telescope, we're only gonna be able to look for a few, and those are primarily what we often call hot Jupiters. They're not likely to be good habitats for techno-signatures. Now we can look much farther and when we say we're looking for intelligent life, we've actually just taken technology as a proxy for intelligence. And so we're looking for evidence that someone has used technology to modify their environment. So they could be sending radio signals or optical signals, we've been looking for those for a while. But also with the new telescopes, the generation beyond Webb which will be able to image, directly image, these exoplanets, then the astrobiologists have a much better chance of looking at the spectra from the atmospheres of those exoplanets and finding disequilibrium chemistry that might be indicating life. And for us, we can be looking for evidence, seeing it with your eye of some large scale astro-engineering.

23:04 MC: So are there current advances that are allowing for greater probability that these techno-signatures are significant and mean something?

23:13 JT: Yes, there is technological improvements in the recent past, and we're looking forward to more in the future, that will actually let us do this. We can't do it now, we need bigger telescopes to be able to image these planets. We need better computing, faster computing. We need access to more telescopes on the ground and space telescopes and we need to incorporate machine learning and artificial intelligence into what we're doing. So in the search for electromagnetic radiation that could be technologically generated, we've been historically looking in the radio for frequency compression for a narrow band signal that shows up at only one frequency.

23:54 JT: And in the optical, we've been looking for time compression, a bright very fast pulse, something that lasts on the order of a nano second. Because both of these things are things that nature can't do, but we can. Now, as we incorporate machine learning, instead of asking our computers, "Gee, is there a narrow band signal in that radio data or has there been a bright optical flash that was very fast"? The machines can in fact get smart enough to look for any kind of information signal in the data instead of us telling the machine, "Look for this", the machine can tell us there's information in there. Right? That's a real change and I'm very excited about getting this to work.

24:40 MC: Yeah, one interesting thing that came up in your talk is the potential that you detect this signal, but the civilization might not exist.

24:49 JT: That's right, the technology might well outlast the technologists who created it or the technologists might become machines that might be an evolutionary path. And it would be kind of like the sort of conversation that we have currently with Shakespeare or the ancient Greeks. Information is transferred in one dimension only. You can't ask them to answer a question, but you could still learn a great deal about who they were and what their values were by the printed material that has passed to us from past generations.

25:27 MC: And we have signals on Earth that can potentially long surpass humans?

25:27 JT: We do, we have transmitters that might in fact keep operating if the technologists were no longer there. We have space craft that we have launched that are particularly long-lived. The two satellites LAGEOS 1 and LAGEOS 2 are in very high orbits and these are spherical, there's not much drag. They will be there for the next 8 million years no matter what happens to us. So, potentially there could be something like that, remnants of a technological civilization that doesn't exist anymore.

26:09 MC: Once you have these signatures in hand, the next step is sharing with the public the news, but also communicating what exactly are the implications of this signal. And you worked on a scale that tries to communicate whether this signal is significant or not. Could you talk about that?

26:27 JT: Sure, it's a little better now that everyone is clued into extremophiles and exoplanets, and now they're beginning to get much more familiar with the idea, "Well, we might find life, and we might actually find intelligent life." So, it's not as fringy as it used to be. So, when and if we detect something and make an announcement, we have to provide a lot of evidence that we're not just crazy. That this is real, that it can be reproduced, and it can be observed by others. And the thing is that in SETI life Astrobiology, there could be false positives, things that we think are engineered, but turn out to be geological or natural. But SETI has this extra piece, which is, it also could be a deliberate hoax.

27:16 MC: Which has happened before?

27:18 JT: It has happened before. So, we wanted a way quickly to be able to inform the public about the importance and the impact of what we have discovered as well as the credibility of the detection. So, we built a scale, runs from zero to 10, it's not a linear scale, it's pretty complex.

27:42 MC: More like the Richter scale for earthquake?

27:44 JT: That's exactly what we were going for. If you say that was a 3.5, California is hardly gonna notice it, but if it's a seven, that's a huge, huge event. The public understands that. Being able to say, "Okay, this discovery rates a score of seven or eight on a scale of 10, as opposed to zero for a hoax," I think will be helpful.

28:07 MC: Yeah. So, one on the scale is considered insignificant. Has there been anything that surpassed one yet?

28:14 JT: Not since we built this scale.

28:16 MC: Okay.

28:16 JT: Okay?

28:17 MC: You've been working in this field for more than 40 years. I'm curious how the interest and support for this kind of research has changed throughout the past few decades.

28:27 JT: Oh, it's changed. It's changed radically. And it's because of the work that's been done to detect extrasolar planets. We now know there are more planets than stars in our galaxy, and we didn't know about any other planets than our solar system when we started. And we found life in the most unlikely places, like at the bottom of the ocean around a black smoker, right? There's this whole ecology. When we started, we were told by wise people that life could only exist where there was sunlight and the temperature was not too hot, not too cold, couldn't be a lot of radiation.

29:04 MC: A lot of parameters. [chuckle]

29:06 JT: Right. And just, they were describing what's good for humans, right? We've gotten beyond that. We understand that life is far more adventurous and diverse than us, humans. Life lives in the cooling waters of nuclear reactors. Life lives in boiling battery acid. Life lives in ice. Life lives kilometers below the surface of the Earth and in deep gold mines. So, we've actually taken off our blinders and are now open to the vast possibilities of life. Today, there's potentially more habitable real estate beyond the Earth than we ever thought of before. And of course, it just begs you to ask the next question, "Is there any intelligent life out there?"

29:55 MC: Thank you so much, Jill.

29:56 JT: No, it's a pleasure.

29:57 MC: Jill Tarter is the Emeritus Chair for the SETI Research at the SETI Institute. You can find a link to her session from the 2020 AAAS Annual Meeting at sciencemag.org/podcasts.

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30:10 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 listen to the show on the Science website at sciencemag.org/podcasts. There you'll find links to the research and news discussed in the episode. And of course you can subscribe to the Podcast on iTunes, Stitcher, Spotify, Pandora, and many other places. The show was edited and produced by Sarah Crespi with production help from Podigy, Meagan Cantwell, and Joel Goldberg. Jeffrey Cook composed the music. On behalf of Science Magazine and it's publisher AAAS. Thanks for joining us.