00:05 Sarah Crespi: Welcome to the Science Podcast for February 21st, 2020. I'm Sarah Crespi. First up, this week I talk with science news writer Robert Service about bacteria engineered to make bricks and keep the indoor environment clean. Next we hear from Paul Davids about his research into making electricity from waste heat emitted by cars. Finally, we have a special segment featuring online news editor David Grimm and producer Meagan Cantwell, they give us a run down of the news published at the AAAS meeting in Seattle. Now we have staff writer Robert Service, he's here to tell us about engineered living materials. Things like exponentially replicating living bricks and instant runways. Hi Bob.

00:49 Robert Service: Hi Sarah.

00:50 SC: Okay we're talking about engineered living materials. Can you break these terms down for us?

00:56 RS: It's basically just using organisms, mostly microbes to make materials. The idea of using organisms to make materials in any form has been around forever. Of course, we use trees to make wood, we use cotton plants for the cotton to make textiles. So in the last couple of decades there's been many, many examples where synthetic biologists have been using genetic engineering tools to tweak the genes of mostly microbes to get them to make all kinds of different molecules. They might be medicines, they might be improved production of ethanol or probably hundreds of examples. But what folks have been doing in the last couple of years, have now been trying to use some of those same genetic engineering tools to get microbes to make materials. So think of things like replacements for bricks, wood-like materials or something like that.

01:49 SC: The metaphor of coral that you use in your story was really helpful for understanding this.

01:54 RS: So there are organisms that do this all the time. Coral organisms secrete a form of bio-cement that makes the coral reef. People are just trying to take advantage of some of that building prowess and put it to use in new ways.

02:08 SC: In this case, engineers are using microbes to build things like bricks. So how would that work? What do you do with the bacteria to make it grow a brick for you?

02:18 RS: There is an example of a Riley North Carolina company called bioMASON. They use bacteria to essentially synthesize calcium carbonate which forms the cement around granules of sand and so you can basically make a bio-cement. The reason why you might wanna do that is normally when bricks or cement for concrete is made, it takes a vast amount of energy to do that. You have to have kilns to heat the bricks to a 1000 degrees, you have to fire them for long periods of time. By going through a different route with engineered living materials, you can think about
doing this at room temperature and therefore potentially reduce your cost quite a bit.

03:00 SC: And your carbon footprint, right?

03:02 RS: And certainly your carbon footprint. Yup.

03:04 SC: Yeah, do you have to keep the bacteria alive inside a brick if the bacteria grow the brick?

03:09 RS: Normally, the way they do it is they start with sand and some nutrients for the bacteria and water. And they form this slurry and then the bacteria grow, then after a few days they begin to allow the bricks to dry out. And as they do, then the bacteria will die.

03:27 SC: If these cells stay alive, if these microbes stay alive, could they keep making bricks?

03:32 RS: Now, there is one example that we wrote about some researchers at the universe of Colorado who were taking this same idea to another level. And they, in a way, they create like a sour dough starter in bread making. In a sour dough you keep a starter that has your yeast or whatever, and you use some of it to make a particular loaf for bread and then you add a little more of the starter material and then you get that to reproduce and you just keep doing that. And people keep their starters for years and years. In the same way, what they're doing is they're getting bricks to reproduce themselves. So they again, do that slurry of the nutrients and the sand and they make a brick. They keep it in a state where it's... The organisms are still viable, and then they divide the brick in two and then they add more nutrients and more sand and things like that to make two bricks, which happens in a matter of hours.

04:24 SC: Wow.

04:25 RS: And then they can do that generation after generation. So, you can go one to two to four to eight.

04:30 SC: Oh, it's exponential. Exponential bricks.

04:32 RS: Right.

04:33 SC: That's cool.

04:33 RS: So they're growing bricks. Yeah.

04:35 SC: What about this runway that you mentioned in your story?

04:39 RS: In this case, a group made a very large prototype of a full-scale runway. The idea there is, if you're the military and you wanna set up an expeditionary runway in some hotspot around the world, you don't wanna have to carry all the sand and aggregate with you and everything else you would need to make a runway. You can just use a local material, bringing in some drums of the bacteria that will do the job and you give it some water and you're off to the races.
There's also this idea that you might use living bricks in your walls to purify the air?

You could just make surfaces that harbor bacteria to get them to do different jobs you want them to do. And one of those jobs people are considering is to purify the air. So get rid of any toxins in the air or contaminants or something like that. We write about a group from China and the US that started with a bacteria called Bacillus subtilis. And that bacteria secretes a protein once it's outside the body of the bacteria, it links up with lots of other members of its own kind and creates a matrix that the bacteria then can live on. And they use that to make what it's called a biofilm. And there's lots of these biofilms out there in the real world. Bacteria colonize our teeth that way, that's how ship hulls get colonies on them. In this case the folks tweaked this protein in order to bind different enzymes. And they did two different things.

One, they bound an enzyme to this matrix that makes this biofilm that breaks down a toxic compound and then they went on to show that it worked, the enzyme remained viable. In fact, degraded that toxin. And then they went one step beyond that and they said, "Okay, well, can we culture a mix of bacteria that do more than one chemical job at a time?" So in this case, they did a two-step reaction to break down a pesticide. And in that case, in order to break it down, the first bacteria had to do its job with one enzyme to do the first reaction, and then a second bacteria had to generate another reaction to do a second job, and that worked. It's the idea that you can create a mix of organisms to detoxify things that could be in your environment.

We talked about the build environment, but now we're gonna talk about the medical world. So how might these engineered living materials work in medicine?

One way in which that might happen is through the use of these biofilms again. So, another group that we write about from Northeastern University in the US, what they are doing is they are engineering a different matrix-forming protein, and it also helps bacteria form biofilms. And in this case, they're getting it to find the cellular lining of your gut in order to allow the bacteria, which there are already many healthy kinds of bacteria that help line the gut. So what they're trying to do is for patients with inflammatory bowel disease, in which part of that lining breaks down and can cause painful ulcers, they're trying to restore that by making a natural environment conducive for these bacteria to then go in and set up a new biofilm to offer protection for people with the disease.

So you would introduce these engineered bacteria that are really good at making a biofilm.

Correct. You can also engineer bacteria to work inside materials to do other things. So we write about another example where researchers at MIT have come up with a way to 3D print bacterial spores. So, spores are the dormant form of a bacteria. And so put these in a 3D printer, they print them on to a plastic matrix, under the right conditions, the spores would germinate new bacteria. Those bacteria are then engineered to synthesize an antibacterial compound, which fights a microbe called "staph aureus", which is a dangerous hospital infection. So in that case, you could have materials designed to sort of perpetually fight off hospital-acquired infections.
08:53 SC: So a self-disinfecting surface for hospitals.

08:57 RS: Potentially. That's kind of the way it's going.

09:00 SC: I wanna just add a little note here at the end about regulation. So most of this stuff is probably not gonna fall to the Food and Drug Administration or the EPA to regulate, but are there some areas that might need to have some oversight when it comes to engineering engineered living materials?

09:19 RS: The way that most researchers in the field are thinking about it, they're trying to keep all this in mind, all of the regulatory issues in mind as they begin these experiments. If you have, for example, are making bio-cement, in which you're using a natural organism, there's not really any problems with that from regulators going forward 'cause you're not doing anything nature doesn't do already. It's really just the question of, "Are you gonna be introducing an engineered organism into the environment?" And in that case, there will certainly be scrutiny from regulators. And the FDA is perhaps the example where if you're doing something that might have a medical use, there's already a very well-trodden system set up to regulate foods and medicines and drugs. So, I think people are pretty comfortable with understanding how that regulation is gonna roll out, but if for example, if you wanna make engineered walls that detoxify the air, it's less clear how the process is gonna unfold to get some of those technologies approved.

10:21 SC: Alright, Bob, thank you so much.

10:22 RS: You're welcome, Sarah.

10:24 SC: Robert Service is a staff writer for Science, based in Portland, Oregon. You can find a link to his article at sciencemag.org/podcast. Stay tuned for an interview with Paul Davids about harvesting waste heat and converting it to electricity.

[music]

10:45 SC: Waste heat, it's all around us. Created in factories, power plants, even our homes, and it's just released into the ether. Is there a way to capture it and make it do useful work? Paul Davids and colleagues published a paper this week on a way to convert waste heat into electricity. Hi, Paul.

11:04 Paul Davids: Hello, Sarah.

11:05 SC: So, let's talk about waste heat. What sources are you targeting with this new technology?

11:11 PD: We're talking about essentially data centers where they generate lots of heat, and that has to be managed actually by air conditioning. We're also talking about cars. The temperatures of exhaust fumes in the car are roughly 40C.

11:25 SC: Oh.
**PD:** So you can imagine converting that into electrical power and maybe charging a hybrid type of car.

**SC:** Well, how much waste heat do we make? Is there any estimate out there for that?

**PD:** I think on average, people believe that we waste about 20% of the energy that we consume.

**SC:** To just keeping the environment around us?

**PD:** Yes, it just goes off into the environment.

**SC:** Oh.

**PD:** And so, that's carried away by three different types of mechanisms. There's atmosphere around us, so a lot of it is convectively removed. It's also conducted away and they type of energy that we're trying to recover is the type that is radiated their way through light or infrared light.

**SC:** Right. So you just think about it as another part of the spectrum where the waves are longer. That's what you're target area is.

**PD:** That's right. So, I hate to say something that is topical as this, but people are screening people that have viruses by looking through infrared cameras and they're emitting heat. So you can tell the temperature of a person without ever having to touch them. And so, that's the type of heat that we're trying to get. We're trying to convert infrared radiation which is this invisible part of the spectrum into electrical power.

**SC:** Immediately when you talk about this, this is light, this is part of the electromagnetic spectrum. So, I think this is like solar power. You could use something like a solar cell which takes photons and makes electricity. But here, you're targeting a very specific part of the spectrum, the infrared part. So, is the idea you started with? Something like a solar cell?

**PD:** That was kind of the model that we followed.

**SC:** Yeah.

**PD:** The problem is, is that, like, with a solar cell you're dealing with the sun, and the sun is an exceptionally hot object; it is roughly 6,000 degrees C, so then it's like, in the visible range and so there's ways of converting that based on semiconductor-types of conversion and photovoltaics, which is common. So what we tried to do was find a way that we could scale it to the invisible part, or the lower energy photons, in the solar spectrum. You can't do it the exact same way, so we came up with a new mechanism that uses essentially an artificially structured device that kind of mimics the same type of response.
13:43 SC: What happens to a photon when it enters your device?

13:46 PD: The device is actually two devices; it's really a photonic device and an electronic device. The photonic device is used to kind of concentrate the infrared radiation and to resonantly couple it into a really teeny-tiny gap, so the photonic device confines it. And what does is, it now has it in a region where we can use quantum mechanical tunneling in the electronic conversion part to essentially shuttle charge back and forth, and pump charge in a one-way type of, like a ratchet and a pawl, if you will and charge wells, and that creates essentially a voltage. It's very similar to what happens in a photovoltaic, but it's using this tunneling instead of absorption of the photon in a semiconductor material.

14:33 SC: Quantum tunneling is this quantum effect that is used in some kinds of electronics, but it hasn't been typically used in photovoltaics, right?

14:41 PD: That is right. So the normal photovoltaic has a band-gap, a region of forbidden energy. And you absorb photons in this region, and then you can split them in an electric field, and the electrons and the absence of an electron called a hole, go and charge essentially the photovoltaic, so they create a voltage across the device.

15:04 SC: Even though you're using a different mechanism here to get electricity out of photons, the device still uses the framework, the same materials, as traditional photovoltaics, right?

15:16 PD: Yes. One of the things that we tried to do is stick with a set of materials like silicon and standard silicon processing so that we could make it scalable. 'Cause one of the problems is, is that when you're looking at the solar spectrum, there's a lot of energy in that spectrum, especially in the visible light. But as the temperature of the object goes from 6,000 C down to 100 C or 200 C, then it comes way, way down in terms of output power. So that's one of the reasons why we wanted to essentially make a scalable technology so that we could surround our thermal source.

15:51 SC: You're using a framework that's already available at scale, and then you can have a lot of it because you're gonna have to convert a lot of heat to get electricity. So what is the temperature range here that this can operate? What are the limits? Is it harder to go to higher temperatures and get that electricity out of that? Or is it harder to go to lower temperatures and get the electricity out of that?

16:12 PD: The lower the temperature, the less power is in a fixed band, so that's one of the issues. But the other thing is, as I said, this is a resonant device, and we require that the photons get confined in this thin gap. So we're really limited by essentially a material resonance that we're using to get this huge field enhancement in these sub-wavelength gaps. So we use silicon dioxide, which is the standard material that they use it for gate oxides in silicon fabrication facilities, and that has this material phonon resonance that is roughly at eight microns, so that's where the 400 degrees C comes from.

16:50 SC: Oh. So your material is kind of picking the temperature for you?
16:55 PD: Right. And so we can use other materials in the gate oxide and scale it out to longer wavelengths, which would be lower temperatures.

17:02 SC: Could you put those all in the same device?

17:04 PD: You could, and we're actually examining that. In the future, what we would like to be able to do. There's techniques which allow you to grow these films very precisely, and we want to start looking at stacks of these types of thin oxides.

17:18 SC: Very cool. Let me ask you some number questions here. How could we quantify the amount of electricity that could come out of this system? Could you give me some numbers on that, and maybe some context for that?

17:29 PD: Right now, the temperature and the emission of the thermal source really limits the amount of power that is incident on the device, and that really sets the ultimate limit for conversion, which is related to also kind of Carnot-type of arguments, which are these arguments on limits of efficiency of a perfect engine.

17:48 SC: Right.

17:48 PD: But as it stands right now, the incident power is remarkable in the sense that moderate temperature sources, let's say at 400C, have roughly hundreds of milliwatts per square centimeter that are available for harvesting. And that's a fairly reasonable amount of power, provided you can harness it over many, many square centimeters. Clearly as the temperature goes down, the amount of power goes down; so roughly we are looking at, for some of our better devices, about 0.4% conversion of that power into electrical power, so it's really not like a grid-scale power option yet, but we're working on improving the efficiency through those things that we discussed.

18:31 SC: But it would never make sense to be like, "My roof gets really hot; I'm gonna put this kind of cell on the roof."

18:36 PD: That's right.

18:37 SC: You said it was a 0.4% conversion?

18:39 PD: Yes.

18:39 SC: But solar cells are, what, 13? Is that where they're at?

18:45 PD: 13-20 for like a silicon solar cell. We think we can get to 4%, which makes us competitive with thermal electrics, which are roughly 6%. But thermal electrics are really, really hard materials to work with. It's a very mature technology, and it is the technology to knock off.

19:06 SC: Do you see this as more useful in going after, like, giant sources? Like, things that are really, really hot? Or do you see it more useful as sliding into all these different places in our lives,
be it cars, the back of the oven, wherever we're heating things up incidentally?

19:22 PD: It's not going after the hot sources; we're trying to scale to lower temperature sources. And one of the key applications we see is potentially as a thermal electric replacement, so when you have something like an exhaust pipe, you could essentially recover an energy from that. One area that motivated this work was for deep space exploration.

19:45 SC: Yeah.

19:45 PD: And so you could have small power supplies that power electronics that last forever.

19:51 SC: Mm-hmm.

19:51 PD: That's kind of the advantage of doing these thermal electric generators, or making this essentially a power supply.

20:00 SC: Alright, thank you so much, Paul.

20:01 PD: Oh, you're welcome.

20:02 SC: Paul Davids is a principal member of the technical staff and applied photonics and micro systems at Sandia National Labs. You can find a link to his science paper at sciencemag.org/podcasts. Stay tuned for a round up of stories from the AAAS annual meeting in Seattle.

20:18 Meagan Cantwell: Hi everyone, this is the Science Magazine podcast. We're a weekly podcast, we usually have two segments a week that cover research or news on the site and in print and I'm Meagan Cantwell, one of the producers for the podcast. I also work on videos at Science and I'm here with Dave Graham who's the online news editor at Science and we're gonna just go over a few of the stories that Science has been covering at annual meeting. We picked three of them, and there are several others in the works, that will most likely be published as well, thanks so much for joining me Dave.

20:48 Dave Graham: Yeah, yeah, glad to be here.

20:49 MC: Alright, so we're gonna start with a story about wildfire smoke which has been in the news a lot, not only in Australia, but in California, more locally too. What exactly are the risks of wildfire smoke, why is it so hazardous?

21:01 DG: We tend to think, Meagan, like of smoke being hazardous, but the question is, is there something particularly hazardous about wildfire smoke versus just smoke from a burning building, or something else? And this what researchers are trying to figure out and it turns out when wildfires spread, they can pick up a lot of particulate matter from trees and plastic and other debris and they can create these fine particulate matter. When this matter into our lung, it can actually cause a lot of problems. And so there seems to be something maybe especially insidious about wildfire smoke.
21:29 MC: And we're seeing a lot of recurring wildfires recently as well like in California, it seems like every week, we're hearing about a different... Are there studies right now into the effects of long-term exposure to multiple wildfires? People inhaling the smoke multiple times?

21:41 DG: Yeah, that's a good question. So, we know short-term, wildfires can cause things like asthma. But there was this interesting almost accidental study where there were monkeys that were exposed, monkeys that were living in a enclosure that were supposed to wildfire smoke during one of the wildfire seasons. And researchers were actually able to study them for about 10 years and what they found was the young monkeys that were born around the time of the fires, their lungs tend to be smaller and stayed small and tend to be stiff as well, even throughout their lifetime. And some of these effects seem to actually be passed down, especially harmful immunological effects seem to be passed down to their offspring, and so though it's not in humans, but it's some of the first evidence in animals, the first solid evidence we have that wildfires can cause potentially not only long-lasting damage, but damage that could be passed down theoretically generation to generation.

22:26 MC: And these were in younger monkeys. There's also more vulnerable populations that we know in human populations that are impacted more greatly by wildfire smoke as well.

22:35 DG: Right. We know that old people, pregnant women, children, just like these demographics tend to be susceptible to other things as well, they tend to be particularly susceptible to wildfires.

22:43 MC: What are the best ways, I guess, if there is a wildfire in your area, how do you stay safe?

22:47 DG: Yeah, it's tough, and the researchers say stay indoors, which may some kind of obvious, but also things like turn on your air conditioning, because your air conditioning will sometimes be able to filter out some of these particulates. Avoid exercise. This is one of the few times where a health expert is telling you not to exercise.

23:01 MC: Don't do it. Hold off.

23:01 DG: But actually, exercise can make you be breathing a lot more, which can cause you to inhale a lot more. And avoid candles, incense, smokey cooking, anything that's gonna add to the smoke that you might already be inhaling.

23:12 MC: That makes sense. Alright, and moving on to another session that Science has covered at annual meeting which is about the crime rate in sanctuary cities. This study specifically focused on California, can you talk about what the law is that they were studying? SB-54?

23:25 DG: Well, right. So there was this kind of government mandate from the Trump administration that really put a lot of severe restrictions on immigration and really what police could do in terms of trying to ferret out supposedly illegal immigrants. And California, in 2017, made itself what was called a sanctuary state, which basically pass local and state laws, that
basically blocked a lot of these federal laws. And a lot of critics said, "Oh, now California is gonna be overrun with crime, because there's gonna be immigrants all coming in and you don't wanna know what their background is gonna be, and the police aren't gonna be able to force them," so this study is really the first to determine, "Is that really true? Does a state or a municipality that makes itself a sanctuary place, is it more susceptible to crime, than a place that doesn't do that?"

24:07 MC: And ideally, they would be able to have two study groups, one that where the law's enacted, and another where it isn't, but it's enacted all across California, so they weren't able to do that and instead they made a simulation of what the crime rate in California would have been like if there was no SB-54, what were the results of that comparing this simulation versus what the actual crime rate has been since 2017?

24:29 DG: Right, they needed a control. So they created this virtual California by looking at very similar parts of the country in other places other than California, and comparing them over a couple of years, to what was happening in California and what they found was they found really no effect of the sanctuary state, the crime did not increase, it basically stayed the same. So their conclusion is that if a state makes itself a sanctuary state, it's no more susceptible to crime and crime is certainly not gonna increase, at least according to this preliminary study, versus something that does not make itself a sanctuary state.

25:00 MC: And California isn't the first to pass a law of this sort, there are other cities as well that had made themselves sanctuary cities. Does this support what other cities have also seen in their crime rates, maybe studies that's in-depth.

25:10 DG: Yeah, I don't know if other studies have been done, you know, one caveat here is that because this is so preliminary, and you mentioned sort of creating a virtual California, right?

25:18 MC: Yeah.

25:19 DG: And we don't have a whole lot of data now. And so, what experts are saying is, "This is really interesting, it's very suggestive, that making something a sanctuary state is not gonna necessarily open it up to crime," but it does suggest that what you really wanna do is be able to gather more data before you pass any policies. Like you wouldn't wanna enact a policy based on just this one study, and the researchers themselves are actually trying to gather more data right now.

25:41 MC: And since it is from 2017, it's not very long and steady yet.

25:44 DG: That's right, exactly, exactly.

25:45 MC: Alright, and moving on to the last story we're gonna talk about that's been published, is a little bit meta, kind of what we're doing, communicating science.

25:54 DG: Right.

25:54 MC: And what really influences whether people trust science. So this researcher looked at a
bunch of different categories to see if it influences whether they trust science or what they perceive science to be. So let's start first with what exactly the scientific topic being discussed is, does the topic influence how people perceive the information and whether they trust it?

**26:13 DG:** Yeah, the scientific topic is one of these five factors that matters most, and it turns out, there's actually topics that scientists and the public agree upon. So if you ask a random sample of the public or a scientist, do you think the International Space Station is a good idea? In fact, the majority of both groups, the public and scientists say it is. But then if you choose a different topic like GM foods, that's when you start to see a big split. So, for example, only 37. About a third of the public says GM foods are safe to eat versus almost 90% of scientists. So it really depends on the topic, how close the scientific consensus is to what the public thinks about a particular issue.

**26:49 MC:** Gender and culture also play a role in how people perceive this information as well.

**26:53 DG:** For sure, yeah, one of the things that some of these surveys found is that men, overall, tend to perceive themselves as more knowledgeable about science than women do, but it really varies by country. So, for example, in Northern Europe, we saw one of the highest disparities. So there, men are about 17% more likely than women to say, they know some or a lot about science, regardless of whether they actually do.

**27:14 MC:** Right, it's their perception.

**27:15 DG:** It's their perception, right. Whereas in North America, it's actually pretty close, the gap's only about 7%, and places like the Middle-East the gap is only about 3%. So it really depends on what part of the world you're in.

**27:26 MC:** So culture is kind of also impacting gender too in that way.

**27:28 DG:** Culture is important. For sure, yeah.

**27:30 MC:** And then there's also the influence of political parties.

**27:33 DG:** For sure, yeah.

**27:33 MC:** On how you perceive information. And I thought it was... It wasn't exactly what I expected it to be. Can you go into that?

**27:37 DG:** Yeah, I think we have some stereotypes about Republicans believe this and Democrats believe that. I think a lot of the stuff does play true. But one of the things that I thought was really interesting is that among Republicans and Democrats with a low amount of scientific knowledge, there's a lot of distrust among both groups or misperceptions about science. And when you talk about more educated of Republicans and Democrats, that's when you see a bigger split where the Republicans are saying, "Oh you know, science can be used to just say whatever you want it to say."
28:04 MC: Interesting.

28:04 DG: Where Democrats are usually saying, "No, we should believe science. We should trust that what science says is actually what it is." And so it really depends on not just looking at the Republicans versus Democrats, but what kind of educational background, what kind of scientific background they have can really make some differences, even within political parties.

28:21 MC: Yeah, it's the opposite of what I thought it would be...

28:22 DG: For sure.

28:22 MC: That more education would mean there's more agreement that we believe in science but it's the other way around.

28:25 DG: Of course, yeah and I was really surprised about that too, for sure.

28:28 MC: Lastly, one of the things they talked about was who's delivering the message. That impacts how people are perceiving the science as well. So who do people trust, when it comes to who's delivering the information?

28:37 DG: And this one isn't as surprising. So for example, if a doctor or healthcare worker were to tell you something scientific, people are much more likely to believe that than if a politician tells them something. That one wasn't as surprising, but it still was one of the big factors that the researchers say people need to keep in mind. You need to kind of keep all of these factors in mind when you're trying to communicate with the public when you're trying to get a sense of where they're coming from? Because if you wanna try to meet them halfway or understand what biases they might be coming in with, it's really helpful to know what their background is, culture, gender, political party, that can maybe help to build some more bridges between scientists and the public.

29:11 MC: So I guess that's the next step, is incorporating this research and to actually communicating it.

29:14 DG: Exactly, for sure.

29:15 MC: Telling it to the right audience. So that kind of wraps the three stories we were gonna talk about. But there's also a bunch of other stories that are gonna be published soon. Do you wanna maybe talk about a few that are in the works?

29:25 DG: Yeah, I'll just mention a few. So we've done a story about how you can donate brain tissue while you're still alive.

29:30 MC: That sounds scary.

[laughter]
29:32 DG: Also about your digital afterlife, what happens to all of your tweets, your Facebook posts, Instagram, everything, how does that follow you after death? And that's really interesting, and we're hoping to do a story on that towards the end of the meeting. And also, should you compost your body, and how might you do that, and why might you do that?

29:49 MC: Do you have any answer to that yet?

29:50 DG: Not yet, no.

[laughter]

29:51 DG: I have not seen that story yet, but it is a story we have planned. So there's still more fun stuff coming and anybody who's interested should check out the new site in science for all of our coverage at the meeting.

30:01 MC: That's awesome, yeah, it's sciencemag.org if anybody's interested in checking out the stories we've talked about.

30:05 DG: That's right, that's right.

30:05 MC: Thank you so much, Dave.

30:06 DG: Thanks, Meagan.

30:08 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/podcast. There you'll also find links to the research and news discussed in the episode. You can subscribe to the show 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 its publisher AAAS, thanks for joining us.