Science Magazine Podcast
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Music

Host – Kerry Klein
Welcome to the *Science* Podcast for May 11th, 2012. I'm Kerry Klein.

Host – Sarah Crespi
And I'm Sarah Crespi. This week: the oldest Mayan calendar [00:44], messages from the asteroid belt [11:32], and a fossilized forest in danger [23:07]; plus, a few stories from our online daily news site [30:54].

Promo
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Music ends

[00:44]
Host – Sarah Crespi
The oldest written book from South America is the Dresden Codex—named after its final resting place—and it dates to the eleventh or twelfth century. This accordion-style book was key to deciphering Mayan hieroglyphics and their complex astronomical calculations. In 2011, William Saturno and colleagues found a previously unexplored room in a Mayan site dating to the 9th century. Excavation of the room revealed unusually well preserved wall paintings and the earliest known calendrical writings. I spoke with Saturno about the find from his office in Boston.

Interviewee – William Saturno
We began working in this particular structure merely to address why we had paintings preserved in it at all. It was certainly not a structure where one would anticipate that you would have murals preserved. It's very close to the surface. Murals, in and of themselves, are incredibly delicate and don't tend to preserve in the Maya lowlands. So the fact that we had evidence for preserved paintings in this small room located right at the surface, that was entirely unexpected. One of the things that's remarkable about these paintings is that the Maya actually filled in this room through the doorway. Most commonly, when the Maya are finished using a building, they collapse the roof and they might build over the top of it. They essentially use the roof materials themselves to fill in the empty space, level it all out, and then use it as a platform for building something else. In this instance, that's not what they did. They actually filled in the room through the doorway, backing themselves out until the entire space was essentially preserved. And looters had opened up the space into the room looking for a tomb, which they didn't find,

and so that when we arrived and saw small remnants of painting, we thought, okay, we should just follow it out and see what's left. And if nothing is left, which is what we assumed, we'd at least know how big the room was when it was painted, because that was really all we expected to find. In the end, we found that three of the rooms' four walls were well preserved, and that the ceilings were also in good shape, in terms of the paintings on them. So we got an awful lot more than we bargained for.

Interviewer – Sarah Crespi
Wow! Well, can you give us a tour of the room where these paintings were found?

Interviewee – William Saturno
The room is actually very small. It's only about six and a half feet wide and six feet long. It's about 10 feet tall, and it has a vaulted roof. The whole room is filled with a bench, a masonry bench, where the ancient Maya would have sat in this space. All around you are paintings. As you come through the doorway, you're facing the north side. So when you look in through the doorway of the room, you look along a series of figures seated on the west wall. And all of those figures are painted in black. They all wear the exact same costume. They have only a white loincloth, and they wear a large sort of black – it looks like a bishop's miter – it's this large black headdress with a single red feather that comes off the top of it. And all three of these black characters look upward and towards the north wall.

Interviewer – Sarah Crespi
And how tall are these figures?

Interviewee – William Saturno
They are about life-size.

Interviewer – Sarah Crespi
And what are they looking at on the north wall?

Interviewee – William Saturno
On the north wall, there is another figure painted in orange. It has a slightly more elaborate costume, both a headdress and sort of jade wristlets. And he has his hand outstretched with what looks to be like a stylus in his hand. And that hand stretches towards another seated figure, and that seated figure was the King of Xultun.

Interviewer – Sarah Crespi
How old are these paintings?

Interviewee – William Saturno
The paintings date to the early part of the 9th century A.D. There are a number of hieroglyphic texts that date them specifically to 813 or 814 A.D.

Interviewer – Sarah Crespi
What would this room be used for?

Interviewee – William Saturno
We think that this room was used as a writing room, actually, that the room is part of a complex associated with the work being done by Maya scribes. And we think that, both because of the image on the north wall of that man with the stylus in his hand, but also from the repeated use of many, many Maya hieroglyphs on the east wall.

Interviewer – Sarah Crespi
And so, I guess I want to ask a little bit about the presence of a calendar, or astronomical chart. You mentioned it in your paper. Does that relate to the use of the room as a place for scribes?

Interviewee – William Saturno
Certainly. The finding of astronomical charts and ephemeral calendrical writing that we see all over the east, and some parts of the north wall, demonstrates that the room was repeatedly used for these writings, that they're not really associated with the main artistic platform, right? These sort of seated figures that we see around them are involved in some narrative in which the king is being portrayed impersonating a Maya deity, and these guys are in attendance at that impersonation.

Interviewer – Sarah Crespi
So, going back to the tables, can you describe how they might compare with other charts?

Interviewee – William Saturno
They're really our very first tables of this kind from the Classic period. The only place that we've seen similar materials from the ancient Maya come from the preserved codices that date to the post-Classic, I mean, they date to centuries later. And, so, those few preserved Maya books, one of them the Dresden Codex, contains tables very similar to the ones that we found at Xultun. But there really isn't a comparable body of material from the time in which they're painted. The charts themselves are very similar to what we see in the Dresden Codex. They're different in certain predictive ways. The ones in the Dresden Codex were used – the lunar charts in particular – were used to calculate eclipses, and this tally of days is a simpler tally in that regard. The way the math works out - because the period of the moon is about 29-1/2 days, that's not great to keep track of. I mean, in terms of calculating cycles, multiplying 29-1/2 is sort of a pain, and it doesn't really jibe well with observation because you can't count half days to observe the moon. But if you group them together into semesters – which is what the Maya did – if you package them into periods of 177 days, that's a very close estimate to what six lunations is. It's not perfect, but it's close. But if you add in – every five or six times – you add in 178 days, sort of like a leap day, right? Then it really tracks remarkably close to how the moon works. And the Maya figured out that if you, instead of adding that 178 days, you added 148 days, just took those 30 days away, that that was a predictor of eclipses, and so that in later texts, we get to see that 148 being added in.

Interviewer – Sarah Crespi
So this kind of predates that correction.

Interviewee – William Saturno
And this predates that particular correction.

Interviewer – Sarah Crespi
Very cool. So the paintings aren't that unusual, but the charts are.

Interviewee – William Saturno
It's odd for them to be preserved in this house. It's odd for us to find them. But the actual rendition of the painting, they wouldn't blow you away. But these writings are just spectacular and unlike anything that we see from the Classic period.

Interviewer – Sarah Crespi
And what do they say? What are they talking about?

Interviewee – William Saturno
They're mostly talking about the calendar. There are texts dealing with the simple count of days. You know, if we start at this day and we count forward this many days, we end up at this date. We start here, we count forward, we end up at this date. So there's not a lot of sort of historical action going on. The lunar table is simply a count of numbers; it's an accumulating total of numbers that are recorded along the wall. And the heading of each column of numbers is accompanied by a hieroglyph of a lunar patron, right? So the moon glyph and also one of the three patrons of, you know, the lunar cycles. And so this really is just a table of days used to track the cycle of the moon.

Interviewer – Sarah Crespi
Oh, very interesting. And so, is there more to do at this site? Are you expecting to uncover new things there?

Interviewee – William Saturno
Yes. Our work is not yet completed at the site. Certainly, there is more information to be teased out of the walls of this room. The analysis that we've been able to do is a very preliminary analysis, and it is based only on the material that's well preserved and can be seen with the naked eye. There's certainly more information preserved in the plaster of this room that we can't just see as it stands. And so from this point on, we're trying to conduct analyses to reveal some of the other hidden detail, perhaps.

Interviewer – Sarah Crespi
Great. Okay, William Saturno, thanks for talking with me today.

Interviewee – William Saturno
Happy to do so.

Host – Sarah Crespi
William Saturno and colleagues write about ancient Mayan calendars in a Report this week.

Music

[11:32]
Host – Kerry Klein
After a three-year journey through the cosmos, the Dawn spacecraft has reached Vesta—one of our solar system's largest asteroids and oldest survivors. Dawn's primary objective was to determine if Vesta was the parent to a common type of meteorite, but its observations have also shed light on the origins of the solar system. Chris Russell of UCLA spoke with me about Dawn's visit to the asteroid belt, and its next stop.

Interviewee – Christopher Russell
The Dawn mission is a journey in space and time. We're going out to the asteroid belt to seek intact survivors from the earliest days of the solar system. And we do this with a spacecraft that uses ion propulsion. We went out and we picked two members of the asteroid belt to explore from orbit. The two that we picked were the most massive bodies out there, but they were also the most interesting. Vesta is our first object of interest. And it's moderately dense – it's about 530 kilometers in diameter. It's covered with basalt – this is lava just like in Hawaii. And it's associated with a common meteorite type called the HEDs, standing for howardites, eucrites, and diogenites. The other body is Ceres. It's less dense, but it's much bigger. It's just under a thousand kilometers in diameter. It's much darker, and it's got clay-like material on the surface. It's rounder and most probably contains a lot of water. There's no known meteorites associated with Ceres, so we don't have anything here on Earth to study that would prepare us for the Ceres mission.

Interviewer – Kerry Klein
Now you refer to these two, Vesta and Ceres, as intact survivors of the earlier solar system, I believe. What do you mean by that?

Interviewee – Christopher Russell
These guys have been around for the entire time since the early solar system. There was a lot of collisional processes going on in the early asteroid belt, and there's a lot of rubble out there. But these two bodies were able to survive with approximately their original material intact. Now with Vesta, which is basaltic and solid rock, we expect and we're seeing that there's evidence on the surface for all of the processes that occurred, going back, we believe, to the very beginning of the solar system. We haven't gone to Ceres yet, but because it's water-rich, we expect that the surface has been renewed many times over its history. So I don't expect that we're going to get that sort of record of impacts and other, you know, debris coming in, et cetera, on Ceres as we're getting on Vesta. So it will really stretch our understanding back to the beginning of the solar system, but it's going to not do it in exactly the same way as Vesta did by just keeping a record there on the surface.

Interviewer – Kerry Klein

So let's focus on Vesta a little bit. Before we had sent a spacecraft there, we were able to estimate its mass, its volume. But since Dawn has arrived on Vesta, what new information have we learned from it?

Interviewee – Christopher Russell
Well, we knew a lot about Vesta, as you say, and these observations then led us to associate Vesta with the HED meteorites. And the HED meteorites come in two types, and then one mixture – one called eucrite, which is the lightest; diogenite is a little heavier; and then we have a third type called howardites, which is a mixture, sort of smashed up mixture, of eucrites and diogenites. And we looked at those meteorites and we tried to figure out how they came to be – you know, how were they made? And that told us that we must have a very small body with, you know, a weak gravitational field, that it must have melted because the iron that should have been in those materials had left them. And when we looked at Vesta, it said, hey, that fits. You know, that gives us the right gravity, it gives us the right, you know, surface, and we bet that the meteorites come from Vesta. So we were going with a hypothesis in flying this mission that Vesta was the parent body of the HEDs. And that's probably our number one result, is that we can then verify and confirm that this hypothesis was right and therefore, that the work that the geochemists had done in putting together a scenario of the early solar system – what happened first, what happened second – they were confirmed. That was, perhaps, our number one result thus far. The reason for going to Vesta, also, was not just to check out the geochemistry story, but these bodies are supposed to be the building blocks of the terrestrial planets. By that we mean that there were a lot of these smaller bodies out there, and then they came together and built up Mars, and the Earth, and Mercury, and Venus. And another thing that we were looking for is about this segregation of iron – the melting of the material and the forming of a core. And when we got to go into orbit around Vesta, we found that there was an iron core inside. So we've done a lot of verifying as our first step, but that was important to do because we had one line of evidence, but we needed to get a different line of evidence to confirm the story.

Interviewer – Kerry Klein
And how else has this influenced our understanding of the early solar system?

Interviewee – Christopher Russell
Well, there's several things that we had in our mind that we learned from the moon that we're unlearning from Vesta. And one of them is the collisional history. When we looked at the moon back in the Apollo days, we saw that we could identify things on the surface of the moon that went back to about 3.8 billion years ago, which is a long time. But we know from the geochemistry arguments from the meteorites that the solar system began about 4.6 billion years ago. And we lost part of that history by something that they term "the late heavy bombardment." Late in the evolution, you know, in the initial evolution of the solar system, there was a lot of collisions hitting the moon and certainly the Earth at the same time. At Vesta, we don't think that – or at least most of us don't think; there's still always a few holdouts – most of us think that from the evidence we've seen, that there was a much lower and more constant rate of bombardment than we inferred at the moon. And that points to the inner edge of the asteroid belt as the source

of the material that bombarded the moon and the Earth, so that the material was not coming from outside the asteroid belt, but from within the asteroid belt, and therefore, Vesta did not get hit. We also got a surprise on planetary activity. There's a diversity of surfaces. It's colorful, although the eye might not see quite as much variation. When you amplify the variation that's there, the surface is quite varied in its color, which indicates that the different regions on the surface have different minerals, have come up from beneath the surface. So Vesta was building new materials. It was melting and differentiating and moving that material around, much like the Earth does, but perhaps not as active as the Earth is today.

Interviewer – Kerry Klein
So there are still some mysteries to be solved.

Interviewee – Christopher Russell
Yes. That's what we're going to be working on when we analyze all the high-resolution data that we've been getting most recently. Speaking of high-resolution, that wasn't the only surprise in the high-resolution data. We see some other features on the surface that look a lot like some of the features we've seen on Mercury and on Mars and also on the moon. So that Vesta, in our minds today is a transitional object, one in which it started to have some of the processes that the larger planets have, yet it has this tiny size, but that size was great enough to start these processes that we see on the other planets.

Interviewer – Kerry Klein
Now Vesta is not Dawn's final destination, as you said, it'll be moving on to Ceres. So what else is in the itinerary for Dawn? What is it going to be doing at Ceres and beyond?

Interviewee – Christopher Russell
We haven't quite finished with Vesta yet. We have some surface we haven't seen yet, and we'll be observing that. And then in late August, we will depart. It'll take us a little under three years to get to Ceres, and we'll arrive in 2015. Then we will repeat a series of investigations similar to what we have done at Vesta, but we may modify it because, you know, Ceres is a different size and different shape and there's different lighting conditions. But it'll be analogous at least.

Interviewer – Kerry Klein
Well, great. I look forward to reading more about it later on.

Interviewee – Christopher Russell
Okay. We promise that we'll write articles in 2015, just like we've been writing up our results now.

Interviewer – Kerry Klein
Well, Chris Russell, thank you so much.

Interviewee – Christopher Russell
Oh, you're welcome.

Host – Kerry Klein
Chris Russell and colleagues report on Dawn's observations of the asteroid Vesta. The paper is part of a package of six articles from the asteroid mission published in this week's issue.

Music

Host – Sarah Crespi
Fungi infect billions of people every year, but the contribution of these pathogens to illness is often overlooked. *Science*'s Meghna Sachdev spoke with Gordon Brown, one of the authors of this week's Editorial on tackling fungal infections.

Interviewee—Gordon Brown
So one of the big contributing factors to the mortality statistic is the fact fungal infections are often diagnosed too late. And so if we had better diagnostics we'd be able to diagnose fungal infections far quicker. And if we were able to do that, I think we'd be able to save a lot more people.

Host – Sarah Crespi
You can listen to the whole interview by visiting this week's Editorial at www.sciencemag.org.

Music

Host – Kerry Klein
In the walls of blood vessels, endothelial cells and smooth muscle cells work together to regulate the diameter of the vessel. This partnership is facilitated by calcium signaling, but the exact mechanism has been tough to pin down, because only the minutest signals are needed for these adjacent cells to communicate. In the May 8 *Science Signaling* Podcast, Mark Nelson talked about his group's recent *Science* paper on resolving tiny calcium signals.

Interviewee – Mark Nelson
And so we were actually able to see sort of the real world of what's going on in calcium at the sub-cellular level in a native preparation. And what we saw -- then to our surprise, now not to our surprise -- was that calcium didn't go up in a uniform way in all the cells, we just saw little flashes of calcium in different parts of the cells and we call these "sparklets."

Host – Kerry Klein
That was Mark Nelson on the *Science Signaling* Podcast, talking about detecting sparklets of calcium. You can find the paper and the full podcast online at stke.sciencemag.org.

Music

[23:07]
Host – Kerry Klein
Deep in the wilderness of northern China lies a lush, pristine forest. Deep, as in underground. This isn't your typical forest—it's 298 million years old, and it's fossilized under a thick bed of ancient volcanic ash. Its rocky remnants are a wonderland for geologists and paleobotanists, but it lies inside a coal mine—and the very operation that alerted researchers to this ancient treasure is threatening to destroy it. Mara Hvistendahl spoke with me about visiting this "Chinese Pompeii."

Interviewee – Mara Hvistendahl
What we have here is a forest from the early Permian Era, so 298 million years ago, that's been discovered in a coal mine in Inner Mongolia in Northern China. And it's extensive, it covers roughly 20 square kilometers. And the ecology of the forest is nearly intact because it was so well preserved, and it's the first such forest in Asia. So for geologists, this is really a great finding, and it's allowed them to reconstruct the ecology of this ancient forest.

Interviewer – Kerry Klein
So let's, before we go more into the forest, let's just sort of set the scene here. So where exactly are we in China, and what does the landscape around this forest look like?

Interviewee – Mara Hvistendahl
So Wuda's in the southwest corner of Inner Mongolia. It's a pretty bleak scene. The forest is in a coal mine – and this is actually my first Chinese coal mine that I've visited, but it was extremely bleak, so black dust everywhere. It's an open-pit mine, so there are sections where the land has really just been kind of gutted. Almost no people, just a few people driving around on motorcycles, and a few dogs running around covered with dust from the mine. But this is where the geologists that I profiled have been working.

Interviewer – Kerry Klein
Now how was the forest preserved?

Interviewee – Mara Hvistendahl
It was preserved when a volcano erupted and blanketed the region in ash – so the eruption would have been 298 million years ago, give or take – and kind of like the city of Pompeii was preserved when Mount Vesuvius erupted, so pretty complete preservation. For a geologist, preservation in volcanic ash is much better than what happens if fossils are preserved by wind or water, so where they could be carried downstream and broken apart before they eventually fossilize. And what we have at this site – which is called Wuda – by contrast is an almost complete forest.

Interviewer – Kerry Klein
Now what makes Wuda, this forest, so special?

Interviewee – Mara Hvistendahl

Well, because it was preserved by a volcano, you have excellent preservation. The other thing is that the layer of tuff – or hardened volcanic ash – is remarkably thick there, so it's 66 centimeters thick. That means that Wang Jun – who's one of the geologists who's written about this and researched this forest – has found almost complete trunks of trees from the early Permian Era. And also the forest is very accessible. It's relatively close to the surface of the land, and because of mining, the geologists basically have to walk around the site and they find fossils.

Interviewer – Kerry Klein
And as you said, this was the first preserved forest of its kind found in China. What has that meant for these researchers?

Interviewee – Mara Hvistendahl
That's another reason it's significant. So it allows geologists and paleobotanists to reconstruct the climate for North China – the continent that existed at the time. It allows them to understand the plant species that inhabited the land, as well as understand the ecology. So it's very significant, in that sense.

Interviewer – Kerry Klein
Well, so, amongst all of these fossils, have researchers found anything significant, interesting, surprising…?

Interviewee – Mara Hvistendahl
Well, one key finding concerns an order of small trees related to ferns called Noeggerathiales. And this group has been poorly understood until now, with just a few examples found at other sites throughout the world. And at the Wuda site, they've found these trees nearly intact. So that solves a lot of puzzles. They've theorized that it was a wetland tree that covered probably more than 60% of the forest. And previously it had been thought that Noeggerathiales was relatively sporadic, that it would just occur in patches of forest.

Interviewer – Kerry Klein
Now a big part of your story is that this forest is being threatened. Describe what's threatening this forest and what its future looks like.

Interviewee – Mara Hvistendahl
Well, part of the issue is the coal mining – so this is still an active coal mine. Wang Jun estimates that maybe only 10% of the original forest – so of those 20 square kilometers – is left now. And they're continuing to mine, so it's a major issue. The other issue, which was brought on by mining primarily, is that there is a project now to extinguish coal fires between the coal seams in the mine. And as part of that project, the government has brought in, at various points, hundreds of excavators to just remove the coal in one fell swoop. And, unfortunately, the fossils and the remains of this forest have gone with the coal.

Interviewer – Kerry Klein

And so this site sounds like it's incredibly precious to these geologists and botanists who have been studying it. Has there been any sort of dialog between the scientists and this coal mining company about what to do about the forest?

Interviewee – Mara Hvistendahl
Well, Wang Jun has actually spent a lot of his time talking to the local government. And he's been working with a geologist named Hermann Pfefferkorn at the University of Pennsylvania, and the two of them together have really tried to make the case for preserving what's left of the forest. They've had some luck in that there's a local government official who's a fossil enthusiast who, at one point when the excavators were brought in, said, you know, we need to put this project on hold, and you'll have two weeks to do what you can with the fossil remains of the forest. So that was one step in the right direction. But they're now hoping to preserve what's left of the forest.

Interviewer – Kerry Klein
And how do they hope to do that?

Interviewee – Mara Hvistendahl
Well, this has been done at similar sites in the Czech Republic and Germany that were preserved by volcanoes, volcanic ash, where an area will be set aside for research. And their proposal in this case is quite small, just one square kilometer, I believe. And then they'd also like to set up a museum so that the general public can understand the story behind this forest. And it's already been all over the local press, and there is a lot of fascination with it, so they're hoping that they can tap into some of that to interest the government in preserving the site. But unfortunately, the local economy still depends very much on coal mining.

Interviewer – Kerry Klein
Right. Well, Mara Hvistendahl, thank you so much.

Interviewee – Mara Hvistendahl
Well, thank you.

Host – Kerry Klein
Mara Hvistendahl is the author of a News Focus on a fossilized forest in Inner Mongolia in this week's *Science*.

Music

[30:54]
Interviewer – Sarah Crespi
Finally today, David Grimm, online news editor of *Science*, is here to give us a rundown of some of the recent stories from our daily news site. Okay, first up, David, we have a story that seems to be an expansion of the hygiene hypothesis, the idea that dirt is good for us because it challenges our immune systems.

Interviewee – David Grimm
Right, Sarah. Well, this story is dealing with the biodiversity hypothesis, which is sort of a takeoff on the hygiene hypothesis. It basically suggests that the more contact we have with nature and specifically, the more contact we have with biodiversity in nature – so the more species we have contact out there in the wild with – it's better for us from a health standpoint. It may decrease the incidence of inflammatory and autoimmune diseases. Now it's just a hypothesis, but this new study's all about trying to show whether it actually holds water.

Interviewer – Sarah Crespi
Okay. So what kind of biodiversity did they measure?

Interviewee – David Grimm
This study was actually conducted in Finland, and they looked at 118 teenagers in Finland that were living in various parts of the country. And the biodiversity they were looking at was some of these kids lived in very rural environment farm-type settings where there's a lot of plants, and a lot of trees, and a lot of other stuff, whereas other kids had a lot less biodiversity, so they lived in larger towns – more urban environments, a lot less biodiversity around them. And what the researchers found was that, first of all, in what seemed to confirm the biodiversity hypothesis, was that the kids that lived in these more rural environments had less incidence of allergies. And allergies is one of these sort of autoimmune things that we deal with when we're sort of our immune system is sort of overactive. But it wasn't just the allergies. The researchers actually dug deeper. They actually took samples of the microbes living on these kids' skin – and, you know, we all have actually millions of microbes living on us, as unpleasant as it might be to think about – and they found that the kids that had less allergies and those that were living in these more rural environments had a larger number of microbial species on their skin. And specifically, they had a group of bacteria called gammaproteobacteria, which includes a member that's often found in soil. It's been linked to high levels of an anti-inflammatory marker in the blood, which means that these bacteria may actually be helping suppress the immune system enough to have it ignore allergens that would cause sneezing, itching, watery eyes, things like that.

Interviewer – Sarah Crespi
So it might modulate an overreaction.

Interviewee – David Grimm
Exactly.

Interviewer – Sarah Crespi
So is there anything that we should do in response to this study? Should we all move to a farm in Finland?

Interviewee – David Grimm
Well, the authors say – I was going to say the farmers say – but the authors say we all shouldn't become farmers just based on this study. It's not really practical for most of us.

But they do say it suggests that, you know, when we develop in the environment, when we knock down forests and plants, and we put up much more urban settings, we actually might be hurting ourselves in the long run because we're reducing the biodiversity that's around us. And this biodiversity may have a really important role to play in terms of our health.

Interviewer – Sarah Crespi
That's a good point. Next up we have a tale of an angry chimp and his contributions to science.

Interviewee – David Grimm
Right. Sarah, this is a chimp named Santino. And Santino is a very famous chimp, at least in Sweden, where he lives in a zoo. Santino is kind of a bad boy. As far back as a few years ago, scientists observed him gathering stones into piles in his enclosure, and when visitors would come up and take a look at him, he'd go for his piles, grab some stones, and start hurling them at visitors.

Interviewer – Sarah Crespi
Why? He didn't like to be observed?

Interviewee – David Grimm
You know, they don't really know. You know, some chimpanzees are very territorial. They have, you know, these rigid hierarchies that they live in in the wild, so it could be some sort of dominance display. One way or the other, he just wasn't very fond of visitors getting too close to his cage. While this sounds funny, it's actually hinted at something much more significant that scientists wonder about, which is whether other animals are capable of planning ahead. Now when we say planning ahead, we're not thinking of things like squirrels hiding nuts for the winter. That's sort of more of a instinctual behavior. It doesn't really suggest that the squirrels are actively thinking about, well, it's going to be cold in six months, I've got to store these nuts and in six months I'll know where to get them. And it's also a very repetitive behavior. It doesn't really hint at very complex cognition, whereas what Santino was doing sort of did, because he seemed to be gathering these stones in different places every time. And so it suggested sort of more of a flexibility that he was actively thinking, you know, "Hey, if I hide these stones in this certain place, then I can sort of come back later and throw them at somebody."

Interviewer – Sarah Crespi
Maybe I'll get the jump on someone.

Interviewee – David Grimm
Exactly.

Interviewer – Sarah Crespi
So what's the new news on Santino?

Interviewee – David Grimm
Some scientists have sort of taken issue with this idea that Santino actually displaying sort of a human-like ability to plan ahead. There's a lot of scientists out there that say, you know, we tend to ascribe all of these human traits to animals, you know, even our cats and dogs, but we really don't know what's going on inside their head. They said, you know, just the fact that Santino's gathering a few piles of stones and throwing them at people isn't really good evidence that he's really thinking ahead and planning ahead the same way that we do. They really wanted more evidence.

Interviewer – Sarah Crespi
He might not have intended victims, for example, when he put those stones together.

Interviewee – David Grimm
Exactly. So this new study, the researchers who conducted the earlier experiments went back, they observed Santino again. And they observed something different this time that they hadn't seen before. Santino would do the same thing where visitors would come and he would have these piles of stones, but he was also hiding these piles of stones in certain places, which the researchers hadn't seen before. When they looked through his enclosure, they discovered that he had 15 stones hidden under hay heaps that he had sort of moved around, 18 stones he had hidden behind logs, two behind a rock structure on the island. And a lot of these things he was sort of moving around so he could actually hide his stones underneath it. So it wasn't just that he was collecting stones, but he was perhaps putting these stones in specific hiding places based on, you know, maybe getting a better shot at somebody.

Interviewer – Sarah Crespi
Sounds very strategic.

Interviewee – David Grimm
Exactly, a very sort of more strategic type behavior than they had seen before. And they say this is really much stronger evidence that Santino is really planning ahead, he's really thinking about, you know, the next time these visitors come, then the next time they come to this certain part of my enclosure, I'm going to get the stones that I hid under the hay pile, or I'm going to get the stones that I hid behind a log – just a lot more sort of more human-like planning ability.

Interviewer – Sarah Crespi
So does this study convince the skeptics about animal advanced planning?

Interviewee – David Grimm
Unfortunately, the skeptics who actually sometimes refer to themselves as "killjoys" are actually continue to be killjoys here. They say that while the study is provocative, they're still not convinced that what Santino is doing is actually evidence of the type of planning that we engage in.

Interviewer – Sarah Crespi

I guess we'll never know his intentions.

Interviewee – David Grimm
We may never know.

Interviewer – Sarah Crespi
So last up, we have a contagion that can jump across species.

Interviewee – David Grimm
Right. This isn't a virus or a microbe, Sarah. This is the contagion of yawning. And you've probably sort of observed this in real life. If you are next to somebody who's yawning a lot – I know you're doing it right now and you're making me want to yawn – but this is actually a pretty common behavior in people. You know, when we see somebody else yawn, we want to yawn. And what's even more interesting is we're more likely to catch a yawn from somebody if they're somebody we're close with – you know, friends, relatives, things like that. And that's led researchers to suspect that this yawning contagion is a form of empathy. We're somehow sort of empathizing with somebody else, in a way, and when they yawn, we want to yawn, too. And it's not just seen in people. In fact, baboons do this with other baboons, macaques do this with other macaques, and chimpanzees – we don't know if Santino does this – but chimpanzees do this with other chimpanzees. And it turns out dogs do this, too. But what's unusual about dogs is dogs are the only animal we know of that do this across species. In other words, when dogs see us yawn, they also yawn.

Interviewer – Sarah Crespi
And that doesn't happen with primates.

Interviewee – David Grimm
That doesn't happen with primates, at least as far as researchers have documented. And so this seems to be evidence – talking again about, you know, what sort of thinking animals are capable of – this seems to be evidence that dogs are capable of empathy as well. But, you know, just like there were skeptics with the Santino paper, there's skeptics here too that say, you know, we want stronger evidence. And that's what this new study is about.

Interviewer – Sarah Crespi
So how do they study dog empathy in yawning, the yawning behavior?

Interviewee – David Grimm
Well, in previous research they had just sort of looked at dogs looking at people yawning. But they said, well, let's try to get a little bit more nuanced here, let's really try to figure out what dogs are really responding to. So they wanted to test whether the mere sound of somebody yawning would cause dogs to yawn. To keep the dogs kind of not stressed out, they actually visited the dogs in their own home, they picked a few dozen dogs. And they recorded sounds of their owners yawning, of strangers yawning, and this control sound of a yawn sort of being played in reverse. And what they found is that when they

tested the yawning on all the dogs, about half of the dogs they looked at yawned when they heard the human's yawn. And they were five times more likely to yawn when they heard human beings that they knew yawning versus when they heard a stranger yawn, or when they heard the control sounds.

Interviewer – Sarah Crespi
That sounds like pretty good evidence, but what's the killjoys' take on this one?

Interviewee – David Grimm
Well, the killjoys take on this one is sort of similar to what they had with Santino, which is that, yes, this does seem to be stronger evidence, but, again, we really can't get ourselves inside another animal's head. Maybe it's just some sort of learned behavior. The special things about dogs is they've been with us for tens of thousands of years, at least 15,000 years, and actually probably longer. They've developed these very close relationships with us. A lot of things that dogs do, we sort of think that they're really smart – and, of course, they are very smart – but sometimes it could be subtle imitations, just things that having been around us for so long they pick up on. They're not necessarily thinking the things we're thinking, even though it seems like they are.

Interviewer – Sarah Crespi
Very cool. Alright, David, what else is on the site this week?

Interviewee – David Grimm
Well, Sarah, for *Science*NOW, we've got a intriguing new type of gene therapy that may more aggressively target a very aggressive type of brain cancer. Also a story about why social jetlag is a health hazard. And you'll have to read more about that to figure out what social jetlag is. For *Science*Insider, our policy blog, we've got a story about some changes in the United States' national ocean policy. Also a story about an investigation into the mysterious death of a scientist in California. And finally, for *Science*Live, our weekly chat on the hottest topics in science, this week's *Science*Live is about the political brain. Why do conservatives and liberals view science differently? And next week's chat is tied to a special issue in *Science* about conflict, and the chat is going to be all about why do we fight? So be sure to check out all of these stories on the site.

Interviewer – Sarah Crespi
Thanks so much, David.

Interviewee – David Grimm
Thanks, Sarah.

Interviewer – Sarah Crespi
David Grimm is the online news editor for *Science*. You can check out the latest news, and the policy blog, *Science*Insider, at news.sciencemag.org, where you can also join a live chat, *Science*Live, on the hottest science topics every Thursday at 3 p.m. U.S. Eastern time.

Music

Host – Kerry Klein
And that concludes the May 11th, 2012 edition of the *Science* Podcast.

Host – Sarah Crespi
If you have any comments or suggestions for the show, please write us at sciencepodcast@aaas.org.

Host – Kerry Klein
The show is a production of *Science* Magazine. Jeffrey Cook composed the music. I'm Kerry Klein.

Host – Sarah Crespi
And I'm Sarah Crespi. On behalf of *Science* Magazine and its publisher, AAAS, thanks for joining us.

Music ends