http://feeds.arstechnica.com/%7Er/arstechnica/science/%7E3/zoi2759SQ24/

"Neuristor": Memristors used to create a neuron-like behavior

The solid-state device has an output that looks like neural activity spikes.

by John Timmer - Dec 25 2012, 12:13am TST

Computing hardware is composed of a series of binary switches; they're either on or off. The other piece of computational hardware we're familiar with, the brain, doesn't work anything like that. Rather than being on or off, individual neurons exhibit brief spikes of activity, and encode information in the pattern and timing of these spikes. The differences between the two have made it difficult to model neurons using computer hardware. In fact, the recent, successful generation of a flexible neural system required that each neuron be modeled separately in software in order to get the sort of spiking behavior real neurons display.

But researchers may have figured out a way to create a chip that spikes. The people at HP labs who have been working on memristors have figured out a combination of memristors and capacitors that can create a spiking output pattern. Although these spikes appear to be more regular than the ones produced by actual neurons, it might be possible to create versions that are a bit more variable than this one. And, more significantly, it should be possible to fabricate them in large numbers, possibly right on a silicon chip.

The key to making the devices is something called a Mott insulator. These are materials that would normally be able to conduct electricity, but are unable to because of interactions among their electrons. Critically, these interactions weaken with elevated temperatures. So, by heating a Mott insulator, it's possible to turn it into a conductor. In the case of the material used here, NbO2, the heat is supplied by resistance itself. By applying a voltage to the NbO2 in the device, it becomes a resistor, heats up, and, when it reaches a critical temperature, turns into a conductor, allowing current to flow through. But, given the chance to cool off, the device will return to its resistive state. Formally, this behavior is described as a memristor.

To get the sort of spiking behavior seen in a neuron, the authors turned to a simplified model of neurons based on the proteins that allow them to transmit electrical signals. When a neuron fires, sodium channels open, allowing ions to rush into a nerve cell, and changing the relative charges inside and outside its membrane. In response to these changes, potassium channels then open, allowing different ions out, and restoring the charge balance. That shuts the whole thing down, and allows various pumps to start restoring the initial ion balance.

In the authors' circuit, there were two units, one representing the sodium channels, the other the potassium channels. Each unit consisted of a capacitor (to allow it to build up charge) in parallel to a memristor (which allowed the charge to be released suddenly. In the proper arrangement, the combination produces spikes of activity as soon as a given voltage threshold is exceeded. The authors have termed this device a "neuristor."

As it currently stands, the NbO2 neuristor uses too much power to put in large numbers on a chip. But there are other types of Mott resistors known, and the authors think that it should be possible to find one that's both low power and compatible with current chip-making techniques. They suggest there's a variety of ways the spiking behavior would be useful in existing applications. But I'm more intrigued with the idea that it might be possible to get more neuron-like behavior directly on a chip. *Nature Materials, 2012. DOI: 10.1038/NMAT3510*

http://www.sciencedaily.com/releases/2012/12/121224113349.htm

Ultrasound Diagnoses Appendicitis Without X-Rays

Patients were evaluated with an ultrasound scan, a safer option to confirm or rule out the need for surgery to remove the appendix

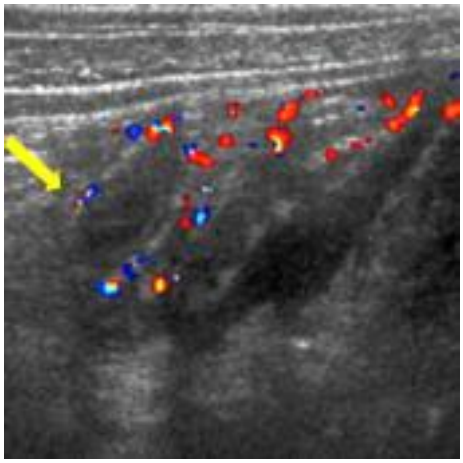
Michael C. Purdy.

Children suspected of having appendicitis are more likely to receive CT scans, which involve radiation, if they are evaluated at a general hospital, a new study by Washington University School of Medicine in St. Louis has shown. Similar patients who went to St. Louis Children's Hospital were more often evaluated with an ultrasound scan, a safer option that uses sound waves instead of radiation to confirm or rule out the need for surgery to remove the appendix.

Use of either scanning technique can potentially reduce the occurrence of unnecessary surgeries and expedite the diagnosis of appendicitis. But recent reports have suggested that the radiation exposures in CT scans can significantly increase children's lifetime cancer risk. As a result, researchers are reassessing the role of CT scans and seeking ways to reduce their use. The study appears online Dec. 24 in the journal Pediatrics.

"Appendicitis is a very tough diagnosis, because its symptoms overlap with viral infections and other problems," says first author Jacqueline Saito, MD, assistant professor of surgery. "We don't want to operate when the appendix is fine, but if we wait too long, an inflamed appendix can rupture or perforate, making recovery more complicated and much slower."

The appendix is a finger-shaped pouch that extends from the large intestine. Infection or blockage of the appendix causes appendicitis, which can lead to abdominal pain, vomiting and fever.



Saito and her colleagues analyzed case records of 423 children who had appendectomies, or surgery to remove the appendix, at St. Louis Children's Hospital. In 218 patients initially evaluated at Children's Hospital and 205 at general hospitals, researchers reviewed how the patients were evaluated for appendicitis and whether the surgery's results confirmed the diagnosis. CT scans, which take X-ray images from multiple angles, have been the primary diagnostic scan for detecting appendicitis for many years. About 85 percent of children initially evaluated at a general hospital underwent preoperative CT scans, and 45 percent of children initially seen at St. Louis Children's Hospital had CT scans. Using ultrasound to detect appendicitis has recently become more frequent, especially at St. Louis Children's Hospital; over half of children initially seen at St. Louis Children's Hospital, compared to 20 percent at general hospitals, had preoperative ultrasound.

***Colored areas on the appendix (whose tip is marked by the yellow arrow) indicate increased blood flow, a sign of the inflammation that characterizes appendicitis. This data helps doctors decide if surgery to remove the appendix is necessary.* (Credit: Image courtesy of Washington University in St. Louis)**

Only 7 percent were not scanned using either method, and 15 percent had both types of imaging.

While ultrasound scans are safer for diagnosing appendicitis in children, they must be performed and interpreted by personnel who have received specialized training and are familiar with pediatric diagnostics. "Ultrasound scans are difficult to perform correctly in this context, and what specialists can do at Children's Hospital may not be realistic or even available in a general hospital, which doesn't care for children as often," Saito says.

Saito is currently studying the outcomes of patients whose scans ruled out an appendectomy, looking to see if they had any additional symptoms or eventually had to have their appendixes removed.

"Ultimately what we'd liked to do is learn how we can reduce our use of CT imaging without compromising patient care," she says. "We want to find ways to identify the patients who really need these scans and those who can be effectively evaluated using other methods."

Funding from the National Center for Research Resources (award number UL1RR024992) and the St. Louis Children's Hospital Children's Hospital Children's Surgical Sciences Institute.Reprinted from materials provided by Washington University in St. Louis

http://nyti.ms/UpE6Um

Q & A: A Shot, or Not?

Q. Should a 65-year-old who has never had chickenpox be vaccinated against it?

By C. Claiborne Ray

A. In someone who has never had chickenpox, the vaccine would protect against a disease that is far more serious in adults than it is in children, said Dr. Mark S. Lachs, director of geriatrics for the NewYork-Presbyterian Healthcare System and professor of medicine at Weill Cornell Medical College.

After childhood chickenpox, the varicella virus is never eliminated from the body but lies dormant in nerve roots. Decades later, it may reactivate along the nerve pathway and cause the very painful rash called shingles, and later, in many cases, a persistent pain called postherpetic neuralgia, or PHN.

Therefore, for most people over 60, the Centers for Disease Control and Prevention recommends the shingles vaccine. It safely reduces (but does not eliminate) the risk of both shingles and PHN in those who have had chickenpox, Dr. Lachs said. In someone who never had chickenpox, he said, the concern is not shingles but adult chickenpox, which has “fatality rates 25 times higher than in children.”

Such a person should instead be vaccinated against a primary infection with the varicella virus, Dr. Lachs said. The vaccine differs in strength from the one for shingles and is given in two injections, a month apart.

http://nyti.ms/U4uKMI

Thousands of Children Are at Risk in Central Africa, Aid Agency Warns

A large measles epidemic is spreading in Central Africa, endangering the lives of thousands of children, the medical charity Doctors Without Borders warned last week.

By Donald G. McNeil Jr.

Since October, the charity has vaccinated more than 226,000 children in the eastern part of the Democratic Republic of Congo. The organization has also treated nearly 13,000 Congolese for the effects of the disease.

Measles is very contagious. In places where many children are malnourished and vitamin-deficient, it kills 1 percent to15 percent of those who don’t receive medical care, Doctors Without Borders estimated. (Even in the

United States in the 1990s, although cases were rare, the fatality rate was 0.3 percent, according to the Centers for Disease Control and Prevention. In AIDS patients, the rate is 30 percent.)
The eastern Congo basin has serious shortages of medical workers and of drugs. While there is no treatment for measles itself, antibiotics can save those who develop pneumonia, meningitis or other secondary infections. Measles can also cause blindness by scarring the eyeball.
The outbreak is taking place despite enormous success against the disease worldwide. According to a study released earlier this year, deaths from measles have dropped by almost 75 percent since 2000.
Most of the lives saved were in Africa and India. Measles shots are often cited as one of the chief reasons that deaths of children under age 5 around the world have fallen steadily.

http://bit.ly/Vl5raX

Early Childhood Obesity Rates Might Be Slowing Nation-Wide

Study of children from low-income families shows that in this group the wave of obesity might be receding

By Katherine Harmon | December 25, 2012

About one in three children in the U.S. are now overweight, and since the 1980s the number of children who are obese has more than tripled. But a new study of 26.7 million young children from low-income families shows that in this group of kids, the tidal wave of obesity might finally be receding.
Being obese as a child not only increases the risk of early-life health problems, such as joint problems, pre-diabetes and social stigmatization, but it also dramatically increases the likelihood of being obese later in life, which can lead to chronic diseases, including cancer, type 2 diabetes and heart disease.
Children as young as 2 years of age can be obese—and even extremely obese. Early childhood obesity rates, which bring higher health care costs throughout a kid's life, have been especially high among lower-income families.
"This is the first national study to show that the prevalence of obesity and extreme obesity among young U.S. children may have begun to decline," the researchers noted in a brief report published online December 25 in JAMA, The Journal of the American Medical Association. (Reports earlier this year suggested that childhood obesity rates were dropping in several U.S. cities.)
The study examined rates of obesity (body mass index calculated by age and gender to be in the 95th percentile or higher—for example, a BMI above 20 for a 2-year-old male—compared with reference growth charts) and extreme obesity (BMI of more than 120 percent above that of the 95th percentile of the reference populations) in children ages 2 to 4 in 30 states and the District of Columbia.
The researchers, led by Liping Pan, of the Division of Nutrition, Physical Activity and Obesity at the U.S. Centers for Disease Control and Prevention, combed through 12 years of data (1998 to 2010) from the Pediatric Nutritional Surveillance System, which includes information on roughly half of all children on the U.S. who are eligible for federal health care and nutrition assistance.
A subtle but important shift in early childhood obesity rates in this low-income population seems to have begun in 2003. Obesity rates increased from 13.05 percent in 1998 to 15.21 percent in 2003.
Soon, however, obesity rates began decreasing, reaching 14.94 percent by 2010. Extreme obesity followed a similar pattern, increasing from 1.75 percent to 2.22 percent from 1998 to 2003, but declining to 2.07 percent by 2010.
Although these changes might seem small, the number of children involved makes for huge health implications. For example, each drop of just one tenth of a percentage point represents some 26,700 children in the study population alone who are no longer obese or extremely obese. And if these trends are occurring in the rest of the population, the long-term health and cost implications are massive.
Public health agencies and the Obama Administration have made battling childhood obesity a priority, although these findings suggest that early childhood obesity rates, at least, were already beginning to decline nearly a decade ago
Some popular prevention strategies include encouraging healthier eating (by reducing intake of highly processed and high-sugar foods and increasing fruit and vegetable consumption) and increased physical activity (both at school and at home).
The newly revealed trends "indicate modest recent progress of obesity prevention among young children," the authors noted. "These finding may have important health implications because of the lifelong health risks of obesity and extreme obesity in early childhood."

http://www.wired.com/wiredscience/2012/12/st398-milk-uk/

Livestock MRSA Found For First Time In UK Milk

Livestock-associated MRSA has been found for the first time in milk in England

By Maryn McKenna

This paper almost slipped by me. It was published quietly a few weeks ago, and it's a little eyebrow-raising. From EuroSurveillance, the open-access peer-reviewed bulletin of the European Centre for Disease Prevention and Control (Europe's CDC): The ST398 strain of MRSA, better known as "livestock-associated MRSA" or just "pig MRSA," has been found for the first time in milk in England. (And therefore probably in cows, or at least on farms.)

Apparently there has been an ongoing study looking for any evidence of MRSA in UK cows, possibly because of this news from last year (of which more in a minute). Between last January and July, the program tested 1,500 samples of milk from farms' bulk tanks — that's the cooler in which milk from a number of cows is collected until it can be picked up by a truck for processing — and found seven of the samples were contaminated by MRSA. All seven isolates were MRSA ST398, the livestock-associated strain. Three came from one farm, so five farms had MRSA in their tanks. According to the paper, this is the first discovery of ST398 in the UK other than one finding in horses in 2009.

Some background: ST398 represents what I think of as the "third epidemic" of MRSA, dating from 2004 and following on hospital-associated (dating from the 1960s) and community-acquired (dating from the 1990s). I told the long story of its emergence and international spread in the book Superbug, but briefly: This strain was discovered in 2004 thanks to the care with which the Netherlands checks for MRSA in people about to be hospitalized; it was found in a toddler whose family were pig farmers, and subsequently in their friends, also farmers, and then in their pigs and their friends' pigs also. In the eight years since, it has spread into health care workers and hospitalized patients, into people with no connection to farming, and then into retail meat, in Europe, Canada and in the United States.

What makes ST398 distinctive is that it has a signature antibiotic resistance, to tetracycline, which is not present in hospital or community MRSA, and which is easily traced to antibiotics used in livestock raising and especially in swine agriculture. (For much more about ST398, you could look at my archives here and in this blog's former location; and you could also peruse the blog of Tara Smith, the University of Iowa professor who has been the sole US researcher to take this seriously.)

So, now, this news: The interesting thing is that this is not the first identification of MRSA in milk in the UK. That finding (which I referred to up above) was made 18 months ago, by the same team responsible for this new discovery. Having made that identification — of what was, at the time, a never-seen MRSA strain — this team from Cambridge and Denmark went on looking in milk for other MRSA strains, and found ST398.

As far as anyone can say, this is the first identification of the farming-associated strain in livestock in the UK (since the earlier identification of ST398 was in horses). But it is important to note that the UK agriculture authorities have been notably resistant to looking for ST398 over the years, despite sustained pressure from the rest of the EU and within the UK from the organic group the Soil Association, and even a raising of the issue in Parliament. What's curious — and the EuroSurveillance paper isn't clear — is whether it is absolutely certain that this is being carried by cows. (The samples tested were from the milk tanks, not from cows themselves, so I wonder whether it is possible that there could have been contact contamination of the cows by other livestock, such as pigs; or of the milk by farm workers who had contact with other livestock.)

The paper says, and this is narrowly correct, that there should be no concern over MRSA transmission via milk, because pasteurization will sterilize it. That may be true, but it does not account for the increasing appetite for milk sold raw, nor for raw-milk cheese.

But a larger issue is that the presence of ST398 on UK farms could pose the potential for spread from cows into other animal species, as well as to farm workers. That makes ST398 an occupational health risk for farm workers, who could become infected with this strain - but it also threatens to make farm workers the vector for carrying the strain off farms and into the wider world. ST398 spread from farms in the Netherlands because so many people in the densely farmed, densely populated southeastern part of the country had some tie to farming - a part-time job, a partner's job, a family member, a co-worker - that there was no hope of keeping it confined.

Despite its longstanding reluctance, it will be really important for the UK to start looking for MRSA on its farms now. Identifying it, and understanding how widely it has spread, might allow it to avoid the wide spread of ST398 that the Netherlands was not able to catch in time.

Cite: Paterson GK, Larsen J, Harrison EM et al. First detection of livestock-associated meticillin-resistant Staphylococcus aureus CC398 in bulk tank milk in the United Kingdom, January to July 2012. Euro Surveill. 2012;17(50):pii=20337. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20337

http://www.scientificamerican.com/article.cfm?id=unveiling-the-real-evil-genius

Unveiling the Real Evil Genius

Creative people are better at rationalizing small ethical lapses that can spiral out of control

By Ingrid Wickelgren | Tuesday, October 30, 2012 | 12

In 1940 Action Comics introduced a brilliant supervillain named Lex Luthor who tries to kill Superman to advance his plot to rule the world. These days news articles often portray Bernard Madoff as an "evil genius" because of his creative Ponzi scheme that siphoned some $20 billion from investors.

We think of an evil genius as someone who devises a clever plan for wrongdoing on a large scale. According to behavioral economist Dan Ariely of Duke University, however, the genius of the perpetrators often manifests itself not in elaborate planning of misdeeds but in almost the exact opposite: an unplanned escalation of a minor wrong they imaginatively have justified to themselves. I spoke with Ariely, author of *The (Honest) Truth about Dishonesty* (HarperCollins, 2012), about the true origins of evil genius.

Scientific American Mind: ***Creativity, or genius, is usually thought to be a positive attribute. What made you think it might have a dark side?***

ARIELY: There are two models of dishonest behavior. The economic model is one in which people do a cost-benefit analysis. You go by a store and ask yourself, "How much money do they have in the store, and what are the chances I'd be caught?" You then decide whether to rob the store or not. We found very little evidence that this is how people think.

What we do find is that lots of us are able to cheat a little bit and still think of ourselves as honest people. This suggests that dishonesty is all about rationalization. It's all about the small acts we can take and then think to ourselves, "No, this is not real cheating." Think about people who do accounting fraud. When they start, they say to themselves, "The rules of accounting are so unclear, is it really so bad?" Or they say, "I'll fix it in the next quarter." Or think about when Clinton said, "I did not have sexual relations with that woman, Miss Lewinsky." At the time, he likely redefined sexual relations, and in his mind he really didn't cheat.

So I wondered: What kind of people would be able to rationalize better than others? Creative people will be able to tell themselves better stories. Intelligence doesn't change anything, we found. It's not the smartness part. The creativity part lets you find all kinds of ways to convince yourself that what you're doing is actually okay.

Are all creative people more dishonest, or are other personality characteristics required?

It's very easy to think that dishonesty is only a function of the individual, but the reality is that the environment plays a big role. You cheat when the rules are flexible or not very clear and when you have a conflict of interest or a reason to have a biased perception of reality. Let's say you and I think of ourselves as honest people. But imagine we were on Wall Street in 2007, and we could get a $10-million bonus if only we could see mortgage-backed securities as a good product. With $10 million on the line, you could probably convince yourself these securities are quite good—or at least better than they are. But if the environment doesn't allow for dishonesty, creativity won't be such a big deal. If you put a creative person in a military academy, where he has no flexibility in his decisions, he will be perfectly honest.

When we think about evil genius, we imagine clever plots to take over the world. But most creative dishonesty isn't like that, is it?

It's important to distinguish between how acts of dishonesty start and how they end. I've been interviewing cheaters, people who are involved in all kinds of white-collar crime. I've tried to talk to Madoff—he refuses to talk to anybody—but I've talked to people who know him. He seemed like an incredibly smart guy. He took lots of money from people and yet didn't seem to think about the endgame. If you or I were going to steal $20 billion, wouldn't we find a nice island somewhere with no extradition rules and figure out how to get there when the time comes? I would speculate that when he started, he did not have a long-term plan. I suspect that in the first quarter, he said, "I'll just do this for one quarter, and then next quarter I'll make it up…." But then he fell more and more behind. I think evil geniuses start like all of us—they are maybe a little more creative, so maybe their acts are more frequent or extreme—but the vast majority get on a slippery slope, and at some point there's no way back.

What is the evidence that a creative personality can breed dishonesty?

In our first experiments, we took students and measured how creative they were using multiple methods. No matter the measure, we found that the more creative people cheated more on a math test.

Second, we tried to temporarily increase creativity in some people but not in others. There are all kinds of evidence that this works. [For tips on boosting creativity, see "Your Creative Brain at Work," by Evangelia G. Chrysikou; Scientific American Mind, July/August 2012.] Those in whom we increased creativity cheated a bit more. That's more causal, supporting the idea that creativity is the mechanism.

Then we went to a big advertising company and asked its employees questions that tested their moral flexibility in personal relationships, taxes, relationships with companies, and so on. If you were on a business trip, would you report a dinner you purchased after you got home on your expense report? We also asked the CEO which jobs have more or less creativity. The results showed that the more creativity in a person's job, the more moral flexibility the person reported in our survey.

How can the dark side of creativity be avoided or diminished?

Creativity is very helpful for lots of things, so we don't want to stamp it out. But if you take creative people and put them in a situation where they have a conflict of interest and where the rules are flexible, this is going to be a bad recipe. Wherever rationalization is easy, I would worry a lot about the rules, regulations and code of conduct—and then I would try to eradicate conflict of interest. In finance, you can make lots of money if you see reality in one way or another. In medicine, if a physician gets paid for prescribing a test or procedure, creativity can also play a big dangerous role. And there are cases where creativity exercises might not be beneficial. I would also worry about increasing creativity just before doing taxes or playing golf.

Are there instances in which lying is okay?

Not all dishonesty is bad. We all know about white lies and social politeness. Telling the truth all the time is a difficult thing to live with, which is why we often encourage some level of dishonesty.

http://www.sciencedaily.com/releases/2012/12/121226101227.htm

Eating Asparagus May Prevent a Hangover, Study Suggests

Amino acids and minerals found in asparagus extract may alleviate alcohol hangover and protect liver cells

Drinking to ring in the New Year may leave many suffering with the dreaded hangover. According to a 2009 study in the Journal of Food Science, published by the Institute of Food Technologists (IFT), the amino acids and minerals found in asparagus extract may alleviate alcohol hangover and protect liver cells against toxins. Researchers at the Institute of Medical Science and Jeju National University in Korea analyzed the components of young asparagus shoots and leaves to compare their biochemical effects on human and rat liver cells. "The amino acid and mineral contents were found to be much higher in the leaves than the shoots," says lead researcher B.Y. Kim.

Chronic alcohol use causes oxidative stress on the liver as well as unpleasant physical effects associated with a hangover. "Cellular toxicities were significantly alleviated in response to treatment with the extracts of asparagus leaves and shoots," says Kim. "These results provide evidence of how the biological functions of asparagus can help alleviate alcohol hangover and protect liver cells."

Asparagus officinalis is a common vegetable that is widely consumed worldwide and has long been used as an herbal medicine due to its anticancer effects. It also has antifungal, anti-inflammatory and diuretic properties.

B.-Y. Kim, Z.-G. Cui, S.-R. Lee, S.-J. Kim, H.-K. Kang, Y.-K. Lee, D.-B. Park. Effects of Asparagus officinalis Extracts on Liver Cell Toxicity and Ethanol Metabolism. Journal of Food Science, 2009; 74 (7): H204 DOI: 10.1111/j.1750-3841.2009.01263.x

http://arstechnica.com/science/2012/12/earthworm-guts-become-factory-for-nanoparticles/

Earthworm guts become factory for nanoparticles

Fed the right elements, worm "livers" make quantum dots.

by John Timmer - Dec 27 2012, 12:35am TST

Quantum dots are nanoscale-sized pieces of semiconductor. Their small size ensures that quantum effects, like the Pauli exclusion principle, influence the behavior of electrons within them. This gives the dots properties that a bulk material with the same composition lacks, and it makes them appealing candidates for things like tiny lasers, photovoltaic materials, and LEDs.

Another area where they've shown promise is medical imaging. In terms of absorbing and emitting light, quantum dots behave much like the fluorescent molecules we can use to label cells of interest. But, since their fluorescent properties depend on the shape of the particles rather than the chemical structure of a molecule, they are much less prone to undergoing reactions that destroy their fluorescence. The problem is that most semiconductors aren't especially biocompatible, meaning additional chemical reactions need to be performed before the dots can attach to or enter cells.

Some researchers have started to look towards making the dots in biological systems, figuring that the output would necessarily be biocompatible. After some successes with bacteria and yeast, they've moved on to a larger target: the earthworm. And it appears to work very well.

The authors were interested in creating CdTe quantum dots. Although CdTe is primarily used in thin-film photovoltaics, it could be useful for imaging, since it absorbs UV light and fluoresces in the green area of the spectrum. Both of the individual elements on their own are toxic, so organisms will typically remove them from their interior spaces and concentrate them somewhere harmless.

For earthworms, that means an organ called the chloragogenous tissue, which surrounds the digestive tract (conveniently labeled in the paper in a figure entitled "Schematics of the earthworm used"). This appears to be the worm's rough equivalent of the liver. Previous studies had shown that cadmium was detoxified by concentration into particles there, and the chemistry of this process suggested it should be able to handle tellurium, as well. With the right chemical reactions, a CdTe salt should be able to form.
The authors of the paper therefore spiked some soil with CdCl2 and Na2TeO3, and left earthworms in it for 11 days. At the end of this time, visible dots were present at the edges of the chloragogenous tissue. When checked, these particles glowed at the characteristic wavelengths associated with CdTe quantum dots.
The average particle was only 2.33nm across and appeared to be surrounded by a coating of organic chemicals, possibly proteins or amino acids from the earthworm. Without any further processing, these quantum dots were absorbed by cancer cells in a culture dish, after which the cells glowed green when exposed to UV light. Macrophages, white blood cells that swallow and digest foreign materials in the body, wouldn't directly take up the nanoparticles but would do so after the particles were given a further coating of polyethylene glycol (PEG). The quantum dots only appear to be good for several days when stored in water, so the mix as isolated isn't entirely stable. Still, it's entirely possible that researchers could identify a storage solution that would keep the dots viable for much longer. But what the authors appear to be most interested in is trying out different salts in order to see what other materials could be concentrated into useful products by the guts of earthworms.
Nature Nanotechnology, 2012. DOI: 10.1038/NNANO.2012.232 (About DOIs).

http://www.bbc.co.uk/news/health-20836083

Brain scan 'can sort dementia by type'

Scientists say they have found a way to distinguish between different types of dementia without the need for invasive tests, like a lumbar puncture.

US experts could accurately identify Alzheimer's disease and another type of dementia from structural brain patterns on medical scans, Neurology reports. Currently, doctors can struggle to diagnose dementia, meaning the most appropriate treatment may be delayed. More invasive tests can help, but are unpleasant for the patient.

Distinguishing features

Despite being two distinct diseases, Alzheimer's and frontotemporal dementia, share similar clinical features and symptoms and can be hard to tell apart without medical tests. Both cause the person to be confused and forgetful and can affect their personality, emotions and behaviour.
Alzheimer's tends to attack the cerebral cortex - the layer of grey matter covering the brain - where as frontotemporal dementia, as the name suggests, tends to affect the temporal and frontal lobes of the brain, which can show up on brain scans, but these are not always diagnostic.
A lumbar puncture - a needle in the spine - may also be used to check protein levels in the brain, which tend to be higher in Alzheimer's than with frontotemporal dementia.
A team at the University of Pennsylvania set out to see if they could ultimately dispense of the lumbar puncture test altogether and instead predict brain protein levels using MRI brain scans alone.
They recruited 185 patients who had already been diagnosed with either Alzheimer's disease or frontotemporal dementia and had undergone a lumbar puncture test and MRI scanning.
The researchers scrutinised the brain scans to see if they could find any patterns that tallied with the protein level results from the lumbar puncture tests. They found the density of gray matter on the MRI scans correlated with the protein results. The MRI prediction method was 75% accurate at identifying the correct diagnosis.
Although this figure is some way off an ideal 100%, it could still be a useful screening tool, say the researchers.
Lead researcher Dr Corey McMillan said: "This could be used as a screening method and any borderline cases could follow up with the lumbar puncture or PET scan."
Dr Simon Ridley, Head of Research at Alzheimer's Research UK, said: "This small study suggests a potential new method for researchers to distinguish between two different types of dementia, and a next step will be to investigate its accuracy in much larger studies involving people without dementia.
"While this method is not currently intended for use in the doctor's surgery, it may prove to be a useful tool for scientists developing new treatments. The ability to accurately detect a disease is vital for recruiting the right people to clinical trials and for measuring how well a drug may be working.
"Ultimately, different causes of dementia will need different treatment approaches, so the ability to accurately distinguish these diseases from one another will be crucial."
The only drug currently licensed in England and Wales for treating frontotemporal dementia is rivastigmine.
There are four licensed treatments for Alzheimer's - donepezil, galantamine, rivastigmine and memantine.

http://www.eurekalert.org/pub_releases/2012-12/eu-bsp122112.php

Birdsong study pecks theory that music is uniquely human

A bird listening to birdsong may experience some of the same emotions as a human listening to music, suggests a new study on white-throated sparrows, published in Frontiers of Evolutionary Neuroscience.

"We found that the same neural reward system is activated in female birds in the breeding state that are listening to male birdsong, and in people listening to music that they like," says Sarah Earp, who led the research as an undergraduate at Emory University.

For male birds listening to another male's song, it was a different story: They had an amygdala response that looks similar to that of people when they hear discordant, unpleasant music.

The study, co-authored by Emory neuroscientist Donna Maney, is the first to compare neural responses of listeners in the long-standing debate over whether birdsong is music.

"Scientists since the time of Darwin have wondered whether birdsong and music may serve similar purposes, or have the same evolutionary precursors," Earp notes. "But most attempts to compare the two have focused on the qualities of the sound themselves, such as melody and rhythm."

Earp's curiosity was sparked while an honors student at Emory, majoring in both neuroscience and music. She took "The Musical Brain" course developed by Paul Lennard, director of Emory's Neuroscience and Behavioral Biology program, which brought in guest lecturers from the fields of neuroscience and music.

"During one class, the guest speaker was a composer and he said that he thought that birdsong is like music, but Dr. Lennard thought it was not," Earp recalls. "It turned into this huge debate, and each of them seemed to define music differently. I thought it was interesting that you could take one question and have two conflicting answers that are both right, in a way, depending on your perspective and how you approach the question."

As a senior last year, Earp received a grant from the Scholars Program for Interdisciplinary Neuroscience Research (SPINR), and a position in the lab of Maney, who uses songbirds as a model to study the neural basis of complex learned behavior.

When Earp proposed using the lab's data to investigate the birdsong-music debate, Maney thought it was a great idea. "Birdsong is a signal," Maney says. "And the definition of a signal is that it elicits a response in the receiver. Previous studies hadn't approached the question from that angle, and it's an important one."

Earp reviewed studies that mapped human neural responses to music through brain imaging.

She also analyzed data from the Maney lab on white-throated sparrows. The lab maps brain responses in the birds by measuring Egr-1, part of a major biochemical pathway activated in cells that are responding to a stimulus.

The study used Egr-1 as a marker to map and quantify neural responses in the mesolimbic reward system in male and female white-throated sparrows listening to a male bird's song. Some of the listening birds had been treated with hormones, to push them into the breeding state, while the control group had low levels of estradiol and testosterone.

During the non-breeding season, both sexes of sparrows use song to establish and maintain dominance in relationships. During the breeding season, however, a male singing to a female is almost certainly courting her, while a male singing to another male is challenging an interloper.

For the females in the breeding state every region of the mesolimbic reward pathway that has been reported to respond to music in humans, and that has a clear avian counterpart, responded to the male birdsong. Females in the non-breeding state, however, did not show a heightened response.

And the testosterone-treated males listening to another male sing showed an amygdala response, which may correlate to the amygdala response typical of humans listening to the kind of music used in the scary scenes of horror movies.

"The neural response to birdsong appears to depend on social context, which can be the case with humans as well," Earp says. "Both birdsong and music elicit responses not only in brain regions associated directly with reward, but also in interconnected regions that are thought to regulate emotion. That suggests that they both may activate evolutionarily ancient mechanisms that are necessary for reproduction and survival."

A major limitation of the study, Earp adds, is that many of the regions that respond to music in humans are cortical, and they do not have clear counterparts in birds.

"Perhaps techniques will someday be developed to image neural responses in baleen whales, whose songs are both musical and learned, and whose brain anatomy is more easily compared with humans," she says.

Earp, who played the viola in the Emory orchestra and graduated last May, is now a medical student at the Cleveland Clinic.

So what music makes her brain light up? "Stravinsky's 'Firebird' suite," Earp says.

http://phys.org/news/2012-12-scientists-current-theories-natural-habitats.html

Scientists challenge current theories about natural habitats and species diversity

How can a square meter of meadow contain tens of species of plants? And what factors determine the number of species that live in an ecosystem?

Phys.org - Science journal has defined this as one of the 25 most important unresolved questions in science, both for its importance in understanding nature and due to the value of natural ecosystems for mankind. The value of goods and services provided by natural ecosystems is estimated to exceed the GDP of our planet.

For over 50 years, conventional ecological theories have predicted that the number of species that can coexist in a given area increases with the heterogeneity of the environmental conditions in the habitat. This premise was examined in a study conducted by research students Omri Allouche and Michael Kalyuzhny, guided by Prof. Ronen Kadmon from the Alexander Silberman Institute of Life Sciences at the Hebrew University of Jerusalem, in collaboration with Prof. Gregorio Moreno-Rueda and Prof. Manuel Pizarro from Universidad de Granada.

The researchers claim that in a heterogeneous environment - where there are many different types of habitats - there are fewer resources and less suitable area available to each species, making them more vulnerable to local extinction. This leads to the hypothesis that excessive habitat heterogeneity may actually reduce the number of species.

This hypothesis was examined using mathematical models and empirical analyses of natural ecosystems. Its predictions were examined with a meta-analysis of tens of datasets of plant and animal species from various localities worldwide. Both the theoretical results and the data analyses supported the researchers' hypothesis that habitat heterogeneity may increase the rate of species extinctions and therefore reduce the number of species that inhabit the ecosystem.

These findings are very important for the conservation of biodiversity, since the current practice is to conserve areas of maximal habitat heterogeneity and even to take measures to increase habitat heterogeneity. The study shows that this conventional approach may lead to negative results, especially in the case of landscapes of limited size, which is typical of nature reserves.

Ecosystems and the species they consist of are under increasing pressure of human activity. In these conditions, skillful and intelligent management of natural landscapes is vital. This study provides scientists and policy makers with important insights for the selection and management of areas for conservation.

The study, Area–heterogeneity tradeoff and the diversity of ecological communities, was published in the Proceedings of the National Academy of Science. It was funded by the Israel Science Foundation and by Israel's Ministry of Science and Technology. *Provided by Hebrew University of Jerusalem*

http://arstechnica.com/science/2012/12/permafrost-microbes-survive-conditions-similar-to-those-on-mars/

Permafrost microbes survive conditions similar to those on Mars

Relatives of bacteria found in vacuum-frozen meat handle low temps, pressures.

by John Timmer - Dec 27 2012, 11:00pm TST

If we assume that life got started during the warmer, wetter conditions of Mars' past, could it still be hanging on somewhere under its frigid, sparse atmosphere? Without a careful examination of hundreds of potential habitats around the red planet, that question is probably impossible to definitively answer. But we can get a sense of whether that's possible by examining life in extreme conditions on Earth.

In the latest effort of this sort, an international team of researchers have taken samples from deep in the Siberian permafrost and put them under conditions similar to those on Mars: freezing, low pressure, and devoid of oxygen. Despite the unpleasant environment, several clones of bacteria grew out. A bit of study showed that they were all relatives of a strain first found growing on refrigerated, vacuum packed meat.

Although this doesn't tell us about what might be growing on Mars, it does highlight a bit of danger. We can contaminate the red planet if we don't carefully clean the hardware we send there.

The approach of the study was quite simple: obtain samples of bacteria from the bottom of a patch of permafrost in Siberia that's been there for thousands of years. Grow them under normal conditions, then shift them to ever harsher conditions. Next, drop them to 0°C. Draw off most of the air, until all that's left is less than a percent of normal atmospheric pressure. Then replace what's left with CO2, getting rid of oxygen in the process.

Dropping down to low temperature didn't bother most of the microbes, which kept growing. But swapping Earth's atmosphere for carbon dioxide was enough to stop most of them. At that point, lowering the atmospheric pressure didn't seem to make matters worse, since so little was growing anyway.

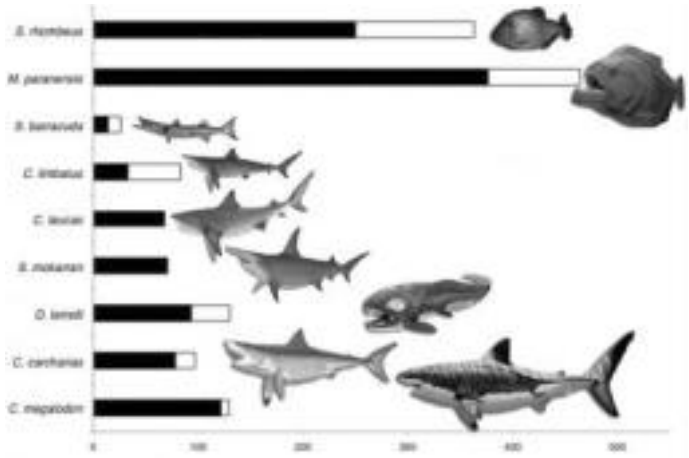
But so little didn't mean "nothing" in this case. In screening thousands of bacterial colonies derived from the permafrost, six different clones managed to keep growing through all the conditions. In fact, they grew better under the harsh, Mars-like circumstances than they did at room temperature and atmospheric pressure.
DNA sequencing revealed all of the growing samples were from the genus Carnobacterium, named for its ability to grow on refrigerated, vacuum-packed meat. But the genus turns out to be rather widespread, although it does have a tendency towards frigid circumstances. It's been isolated from both the Arctic and the Antarctic, and it has been pulled out of the waters of Lake Vanda (an iced-over, hypersaline lake in Antarctica).
Does this mean these organisms can survive on Mars? The authors are appropriately cautious, noting these conditions, while harsh, don't fully capture just how tough the conditions are there. "[These] conditions are only a subset of the total potentially biotoxic physical factors constraining the survival or growth of terrestrial microbes on Mars, such as solar UV, extreme desiccation, solar particle events, and galactic cosmic rays," they write. "In addition, the Martian regolith itself contains numerous potentially biotoxic factors, such as salinity, pH, and Eh of available liquid water; oxidizing soils created by UV-induced processes and soil chemical reactions; or the presence of heavy metals" In other words, we have only begun to approximate Mars.
But the fact some bacteria on Earth could adapt to at least some of the conditions seems like a promising sign. In fact, the researchers note, there may even be more species on Earth that can grow well under a cold, sparse, anoxic atmosphere. As part of their procedure, they required everything to grow for a short time at room temperature and a normal atmosphere. This means they actually selected species that could survive a huge range of conditions, including Mars-like ones. There may be some that can only grow in the cold and sparse atmosphere, but were killed by conditions we view as hospitable.
All of this should serve as a caution to any space agency considering sending hardware to the planet. We'd hate to go to study life on Mars, only to find out we were examining the descendants of life that was, until recently, from Earth. *PNAS, 2012. DOI: 10.1073/pnas.1209793110 (About DOIs).*

http://www.eurekalert.org/pub_releases/2012-12/uow-pkw122612.php

Piranha kin wielded dental weaponry even T. rex would have admired

Ancient relative of piranhas weighing about 20 pounds delivered a bite with a force more fierce than prehistoric whale-eating sharks

Taking into consideration its size, an ancient relative of piranhas weighing about 20 pounds delivered a bite with a force more fierce than prehistoric whale-eating sharks, the four-ton ocean-dwelling Dunkleosteus terrelli and – even – Tyrannosaurus rex.
Besides the force of the bite, Megapiranha paranensis appears to have had teeth capable of shearing through soft tissue the way today's piranhas do, while also being able to pierce thick shells and crack armoring and bones, according to Stephanie Crofts, a University of Washington doctoral student in biology.
"If our calculations are correct, Megapiranha was probably a bone-crushing predator taking bites of anything and everything," she said. Crofts is co-author of "Mega-Bites: Extreme jaw forces of living and extinct piranhas," published Dec. 13 in the online journal Scientific Reports.
The bite force of Megapiranha, which lived 10 million years ago, was extrapolated from the first field measurements of the biting force of Earth's largest piranha today, Serrasalmus rhombeus or black piranha. One 2 ½ pound fish delivered a bite with a force of 320 newtons, or about 72 pounds, which is 30 times its body weight. The force is nearly three times greater than the bite force of an equivalent size American alligator.
Based on the 2 ½ pound piranha and other specimens tested in the wild, the scientists calculate that Megapiranha paranensis, which weighed approximately 22 pounds, could have had a bite force anywhere from 1,240 to 4,750 newtons – or 280 to 1,070 pounds – and possibly more.
Other scientists have previously estimated that T. rex slammed its jaws shut with 13,400 newtons, or 3,000 pounds of force, but that's nowhere near 30 times its body weight.



Bite force quotients -- considering both bite force and body size -- compare the powerful bites of black piranha (S. rhombeus) and now-extinct Megapiranha (M. paranensis) with barracuda, blacktip shark (C. limbatus), bull shark (C. leucas), hammerhead shark (S. mokarran), the extinct 4-ton Dunkleosteus terrelli, great white shark (C. caracharias) and the extinct whale-eating Carcharodon megalodon. **Justin Grubich, et al/Scientific Reports**

Pound for pound, Megapiranha and black piranha have the most powerful bites among carnivorous fishes, living or extinct, the paper said. "For its relatively diminutive size, Megapiranha paranensis' bite dwarfs other extinct mega-predators" including the enormous whale-eating Carcharodon megalodon and the monstrous Dunkleosteus terrelli, a four-ton armored fish. The same was true when the scientists corrected for body size and made comparisons with today's barracudas, hammerhead sharks and great white sharks.

"We were surprised that in spite of their long history and infamous reputations that no one had ever measured their bite forces," said Justin Grubich, with the American University in Cairo, Egypt, and lead author of the paper. "When we finally started to get the data, we were blown away at how tremendously strong the bites were for these relatively little fish." As the paper says, "While anecdotes of piranha-infested waters skeletonizing hapless victims are generally hyperbole, the effectiveness of their bite is not."

Just how does one measure the bite force of a piranha living in the wild? Well, you get out your rod and reel and go fishing. Land a specimen, then hang tight to the tail with one hand and use your other hand to support its belly while offering the fish a chance to bite the plates of a customized force gage.

"Piranhas are ornery little fish so they bit down as hard as they could," Crofts said based on what she was told by those on the fishing expedition along tributaries of the Amazon River.

The black piranha's bite is so powerful in part because of its massive jaw muscles and rope-like tendons that together account for 2 percent of the fish's overall weight, the scientists found. Further the shape of their jaw has evolved into a powerful lever, "one of the highest jaw-closing mechanical advantages ever identified in fishes," the paper said.

Crofts' main contribution involved analysis of how Megapiranha teeth handled stresses and how breakable the teeth might have been. The scientists were particularly interested because Megapiranha's unusual teeth appear to do two things at the same time, one the piranha-like ability to shear soft tissues and the other an ability to bite like the nut-crushing pacu, piranha's close relative.

Based on a fossilized jaw and three teeth, Crofts conducted a computer generated "finite element analysis" for the team. "We found the Megapiranha teeth had the same maximum strength like you saw in regular piranha, but then the patterns of stress distribution within the tooth was also similar to fish able to eat hard-prey," she said.

The actual diet remains a mystery, but during the time when Megapiranha lived a lot of potential prey species were gigantic. "Thus it is reasonable to assume the food resources available to Megapiranha would likely have required jaw forces and dental weaponry capable of capturing and processing very large prey," the paper says.

Other co-authors on the paper are Steve Huskey with Western Kentucky University, Guillermo Orti with George Washington University and Jorge Porto with the Instituto Nacional de Pesquisas da Amazônia.

Funding came from the National Geographic and the Field Museum of Natural History.

http://www.eurekalert.org/pub_releases/2012-12/wcmc-dc122612.php

Doctors call for evidence-based appropriateness criteria for elective procedures

In New England Journal of Medicine, Weill Cornell researchers advocate the development and implementation of criteria for elective procedures, with joint replacement surgery as an example

Many of the most common inpatient surgeries in the United States are performed electively. These surgeries are expected to significantly increase with the enactment of the Affordable Care Act. In a new perspectives article, published in the Dec. 27 edition of The New England Journal of Medicine, a team of Weill Cornell Medical College researchers are recommending the nation's health care leaders and medical community join forces to establish evidence-based appropriateness criteria to determine which patients are most in need of elective procedures, such as joint replacement surgery, to slow the projected surge in demand and rising costs. Currently, there are no appropriateness criteria for most of the common elective procedures.

Total joint replacement surgeries -- such as hip and knee replacements -- are among the most common inpatient surgeries in the United States and are used as a prime example of elective surgeries that could benefit from implementing appropriateness criteria. Patients requesting joint replacement surgery vary from those disabled by their joint arthritis to those who do so to maintain an active lifestyle without pain. Total joint replacement surgeries are expected to quadruple over the next two decades in the United States, contributing to the rise in health care costs and increasing the risk of medical complications.

"The purpose behind establishing criteria is to use evidence-based metrics to prioritize patients most in need," says lead author Dr. Hassan M.K. Ghomrawi, assistant professor of public health at Weill Cornell and an outcomes research scientist at Hospital for Special Surgery. "We don't want to sacrifice necessary care when thinking of cost-containment."

There were more than 1 million total joint replacement procedures performed in 2009. Experts predict that the number of these surgeries will grow drastically, exceeding 4 million by 2030, with more than half the patients

younger than 65. The growing obesity epidemic, coupled with an aging population, is projected to fuel increased demand for total joint replacement surgery. These projections don't reflect the increase in the number of patients who will gain health insurance coverage under federal health care reform when the Affordable Care Act is fully implemented in 2014.
Current cost-containment proposals focus primarily on payment reforms, such as pay-for-performance and bundled payments. But in their perspective, titled "Appropriateness Criteria and Elective Procedures -- Total Joint Arthroplasty," the authors posit that developing and implementing evidence-supported criteria that identifies the appropriate patients who are most likely to benefit from surgery will also slow the growing costs of these procedures.
"Identifying patients who are likely to benefit the most from these procedures could help to combat increasing health care costs while enhancing access and quality," says senior author Dr. Alvin I. Mushlin, the Nanette Laitman Distinguished Professor and chairman of the Department of Public Health and professor of medicine at Weill Cornell and public health physician-in-chief at NewYork-Presbyterian Hospital/Weill Cornell Medical Center. "We believe that the case of total joint arthroplasty offers a prime example of the opportunities and challenges for appropriateness criteria."
"Although implementing appropriateness criteria for total joint arthroplasty has not succeeded in the past, there are reasons why it is more likely to work now," says co-author Dr. Bruce R. Schackman, chief of the Division of Health Policy and associate professor of public health at Weill Cornell. "Opinion leaders in the U.S. orthopedics community recognize the importance of such criteria, and health information technology has developed to allow more sophisticated appropriateness criteria to be integrated into decision-support tools."
According to the researchers, criteria will enable physicians to determine which patients' surgeries are medically necessary, which ones are elective, and which ones are inappropriate, and then tie reimbursement to the analysis. Procedures deemed truly inappropriate would then not be reimbursed by health insurers. The researchers believe this would decrease the number of inappropriate procedures performed, as only a minority of patients would be willing or able to pay out of pocket for them. A secondary, but just as important, result of appropriateness criteria is the potential to enhance the overall quality of care by increasing access to the procedure for those most in need and by preventing complications that might have occurred in operations that were inappropriate to begin with.
In order for the criteria to be successful and credible to physicians and patients and not limit necessary care, clinical opinion leaders and patient representatives must be involved in developing the guidelines, the researchers say. Also, although integrating appropriateness criteria into the reimbursement and care delivery systems could help "bend the cost curve," achieving savings will depend on acceptance of the criteria by physicians and patients. The researchers believe criteria generated for total joint replacement surgery could lead the way for other elective procedures, reducing their cost and enhancing quality of care.
"Evidence-based criteria, if applied wisely and fairly, may be the most powerful tool for controlling the cost and enhancing the quality of elective procedures," says Dr. Ghomrawi.

http://news.discovery.com/human/mysterious-itch-cells-found-121227.html#mkcpgn=rssnws1

Mysterious Itch Cells Found

A mysterious source of itchiness has been found.

By Tia Ghose, LiveScience Staff Writer

Certain nerve cells are specialized to detect itchy sensations, and those receptors don't detect painful sensations, according to a new study. The finding, published Dec. 23 in the journal Nature Neuroscience, helps resolve a long-standing debate over whether itchiness is just a weird form of pain. Additionally, now that they have pinpointed the responsible nerve fibers, researchers could silence those nerves to develop better anti-itch treatments, said Ethan Lerner, a neuroscientist at Harvard University who was not involved in the study.
"This is a very convincing piece of work," Lerner told LiveScience. Scientists "can perhaps target this particular type of nerve as a means of treating itch, but still allow you to experience the protective aspect of pain."

Itchy mystery

For decades, why we itch has been a mystery. While some pain nerves have been found to fire in response to itchy stimulants, nerves that responded solely to itch proved elusive. Some researchers even wondered whether itch and pain were always processed by the same nerve fibers, but interpreted by the brain differently, said study co-author Xinzhong Dong, a neuroscientist at Johns Hopkins University.
But the the urge to scratch seemed different in key ways from the experience of pain. For instance, when a mosquito bites, most people feel a powerful desire to scratch the bite, while the pain of touching a hot stove causes people to recoil, Dong told LiveScience.

Itch nerves

To identify cells that sense itch, Dong and his colleagues genetically engineered mice whose nerve cells glowed fluorescent green when firing. The researchers then exposed the mice to irritating compounds, such as histamine and the active ingredient in itching powder, and looked for nerves that fired (and glowed green) as a result. When the researchers burned out the nerves that lit up, the mice scratched a lot less, suggesting they were less itchy.

But that wasn't enough to prove that the nerves only sense itch, because in theory those neurons could also sense pain. Therefore, the researchers specifically activated just those itch-detecting nerves in the faces of the mice. The animals then scratched their faces with their back paws, which they only do when itchy. (When they are in pain, they wipe their faces with their front legs.)

The newly discovered itch nerves sit inside the spine, near the spinal cord, and only innervate locations within the skin. That explains why people feel the urge to scratch their skin, but don't feel itchy in internal organs, Dong said. "You can't have an itchy pancreas," he said.

Scratch that itch

The new findings are important because they provide a target for anti-itch medications. Current options, like anti-histamines or steroids, usually work by reducing inflammation, while many only eliminate the cause of itch for a narrow subset of problems, such as hives, Lerner said.

"Steroids are sort of a shotgun, and antihistamines, almost all the time, are hitting the wrong target," he said.

While the newly discovered nerves can't explain all itchiness (there are probably other nerves which sense both itch and pain), targeting these nerves could be a huge improvement over current treatments, Lerner said.

http://www.space.com/19044-alien-earth-exoplanets-2013.html

First 'Alien Earth' Will Be Found in 2013, Experts Say

The first truly Earth-like alien planet is likely to be spotted next year, an epic discovery that would cause humanity to reassess its place in the universe.

by Mike Wall, SPACE.com Senior Writer

While astronomers have found a number of exoplanets over the last few years that share one or two key traits with our own world - such as size or inferred surface temperature - they have yet to bag a bona fide "alien Earth." But that should change in 2013, scientists say.

"I'm very positive that the first Earth twin will be discovered next year," said Abel Mendez, who runs the Planetary Habitability Laboratory at the University of Puerto Rico at Arecibo.

Planets piling up

Astronomers discovered the first exoplanet orbiting a sunlike star in 1995. Since they, they've spotted more than 800 worlds beyond our own solar system, and many more candidates await confirmation by follow-up observations. [The Strangest Alien Planets (Gallery)]

NASA's prolific Kepler Space Telescope, for example, has flagged more than 2,300 potential planets since its March 2009 launch. Only 100 or so have been confirmed to date, but mission scientists estimate that at least 80 percent will end up being the real deal.

The first exoplanet finds were scorching-hot Jupiter-like worlds that orbit close to their parent stars, because they were the easiest to detect. But over time, new instruments came online and planet hunters honed their techniques, enabling the discovery of smaller and more distantly orbiting planets — places more like Earth.

Last December, for instance, Kepler found a planet 2.4 times larger than Earth orbiting in its star's habitable zone — that just-right range of distances where liquid water, and perhaps life as we know it, can exist.

The Kepler team and other research groups have detected several other worlds like that one (which is known as Kepler-22b), bringing the current tally of potentially habitable exoplanets to nine by Mendez' reckoning.

Zeroing in on Earth's twin

None of the worlds in Mendez' Habitable Exoplanets Catalog are small enough to be true Earth twins. The handful of Earth-size planets spotted to date all orbit too close to their stars to be suitable for life. [Gallery: 9 Potentially Habitable Exoplanets]

But it's only a matter of time before a small, rocky planet is spotted in the habitable zone — and Mendez isn't the only researcher who thinks that time is coming soon.

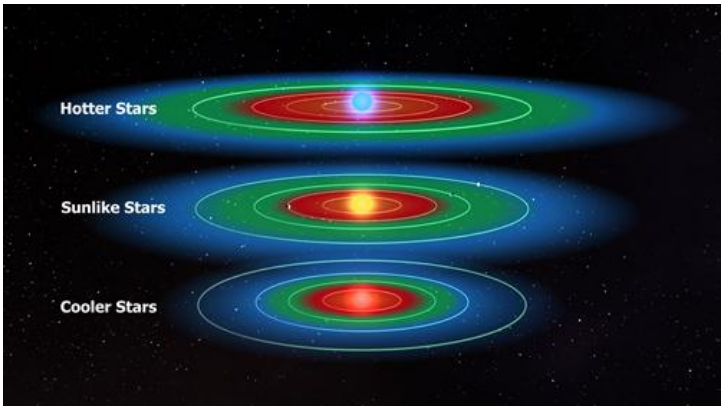
"The first planet with a measured size, orbit and incident stellar flux that is suitable for life is likely to be announced in 2013," said Geoff Marcy, a veteran planet hunter at the University of California, Berkeley, and a member of the Kepler team.

Mendez and Marcy both think this watershed find will be made by Kepler, which spots planets by flagging the telltale brightness dips caused when they pass in front of their parent stars from the instrument's perspective.

Kepler needs to witness three of these"transits" to detect a planet, so its early discoveries were tilted toward close-orbiting worlds (which transit more frequently).

But over time, the telescope has been spotting more and more distantly orbiting planets — including some in the habitable zone.

An instrument called HARPS (short for High Accuracy Radial velocity Planet Searcher) is also a top contender, having already spotted a number of potentially habitable worlds. HARPS, which sits on the European Southern Observatory's 3.6-meter telescope in Chile, allows researchers to detect the tiny gravitational wobbles that orbiting planets induce in their parent stars.



Habitable zones for different stars. An intelligent civilization could allow a planet outside the zone to still be habitable.
NASA

"HARPS should be able to find the most interesting and closer Earth twins," Mendez told SPACE.com via email, noting that many Kepler planets are too far away to characterize in detail. "A combination of its sensitivity and long-term observations is now paying off."

And there are probably many alien Earths out there to be found in our Milky Way galaxy, researchers say.

"Estimating carefully, there are 200 billion stars that host at least 50 billion planets, if not more," Mikko Tuomi, of the University of Hertfordshire in England, told SPACE.com via email.

"Assuming that 1:10,000 are similar to the Earth would give us 5,000,000 such planets," added Tuomi, who led teams reporting the discovery of several potentially habitable planet candidates this year, including an exoplanet orbiting the star Tau Ceti just 11.9 light-years from Earth. "So I would say we are talking about at least thousands of such planets."

What it would mean

Whenever the first Earth twin is confirmed, the discovery will likely have a profound effect on humanity.

"We humans will look up into the night sky, much as we gaze across a large ocean," Marcy told SPACE.com via email. "We will know that the cosmic ocean contains islands and continents by the billions, able to support both primitive life and entire civilizations."

Marcy hopes such a find will prod our species to take its first real steps beyond its native solar system.

"Humanity will close its collective eyes, and set sail for Alpha Centauri," Marcy said, referring to the closest star system to our own, where an Earth-size planet was discovered earlier this year.

"The small steps for humanity will be a giant leap for our species. Sending robotic probes to the nearest stars will constitute the greatest adventure we Homo sapiens have ever attempted," Marcy added. "This massive undertaking will require the cooperation and contribution from all major nations around world. In so doing, we will take our first tentative steps into the cosmic ocean and enhance our shared sense of purpose on this terrestrial shore."

http://phys.org/news/2012-12-lethal-weapon-bacteria-high-risk-suicide.html

Lethal weapon: bacteria's high-risk suicide strategy

New research shows how some bacterial cells keep a 'suicide complex' ready to hand at all times.

Phys.org - Research published today in the journal Proceedings of the National Academy of Sciences shows that some bacterial cells carry a molecular 'suicide complex' to kill themselves in the event of lethal infection by viral parasites. Such 'altruistic suicide' prevents or limits viral replication and protects the rest of the bacterial population from subsequent infection.

The new research demonstrates that bacteria accomplish this through a high-risk strategy in which their lethal weapon is kept to hand at all times, but is neutralised until viral infection of the bacterial cell triggers its release from inhibition. In the longer term, the discovery could be exploited to enable the development of new small molecule antibacterial drugs.

The mechanism was discovered in the bacterial plant pathogen Pectobacterium atrosepticum by researchers led by Professors George Salmond and Ben Luisi in the University of Cambridge's Department of Biochemistry. Their work shows that a suicide complex, ToxIN, is not induced but exists all the time in the bacterial cell; to avoid killing the bacterial cell, it is held in a suppressed, inert form until viral infection triggers the release of a protein toxin (ToxN) from an RNA antitoxin (ToxI) partner. The toxin then causes the death of both the bacterium and the infecting virus.

The success of the antiviral system therefore depends heavily on maintaining a very strong inhibition or suppression of the toxin by its RNA antitoxin, to ensure that the host cell is not damaged in the absence of invading viruses or other stresses. Small RNAs have multiple essential roles in bacteria, but examples of naturally occurring RNA molecules that act as direct protein inhibitors are rare.

Professor George Salmond, deputy head at the Department of Biochemistry, said: "The results present a picture of ToxIN as an addictive, self-assembling – and potentially lethal – molecular machine, which can drive remarkable adaptive advantages in populations of bacterial hosts, including those under threat from lethal viral predation."

The research, which was funded by the Biotechnology and Biological Sciences Research Council (BBSRC), explores the powerful ToxN-inhibiting activity of the ToxI RNA. It shows that the ToxI RNA 'neutralises' its toxin partner through the self-assembly of a triangular ToxI-ToxN macromolecular complex, previously observed by earlier BBSRC-funded crystallographic studies published in Nature Structural and Molecular Biology in 2011.

The 'suicide complex' ToxIN. **Credit: Francesca Short**

The assembly of the inhibited complex is driven entirely by the sequence of the ToxI RNA, and its interactions with ToxN. The study shows that ToxI RNAs are highly selective inhibitors, each active against only their own specific toxin partner. The structure of a second ToxI-ToxN complex, encoded by a plasmid (a small piece of circular DNA that is separate from the single chromosome of the bacterial cell) of the bacterium Bacillus thuringiensis reveals that this selectivity is a consequence of subtle, complementary structural variations in both RNA and protein – the precise molecular recognition needed to form an inactive complex cannot occur between mismatched partners.

In addition, the work shows that ToxIN systems promote their own maintenance on plasmids as selfish DNA that probably increases their spread, and retention, in bacterial populations. *Provided by University of Cambridge*

http://www.bbc.co.uk/news/health-20854461

Cases of the winter vomiting bug 'top a million'

Cases of the winter vomiting bug norovirus in England and Wales have topped a million, latest figures from the Health Protection Agency suggest.

It said there were 3,538 lab-confirmed cases up to 16 December - but that for each another 288 go unreported.

The figure is 83% higher than at this stage last year - but have not increased greatly since last week.

Norovirus is a highly contagious short-term illness and causes severe vomiting and diarrhoea.

It can be spread through contact with contaminated surfaces or objects, by contact with an infected person, or by the consumption of contaminated food or water.

The HPA's figures show that - so far this year - there are 83% more cases than there were at the same point in 2011 when there had been 1,934 norovirus cases reported. In addition, there were 70 hospital outbreaks in the two weeks up to December 23rd, compared with 61 in the previous fortnight.

'Unpredictable'

There has been an earlier start than usual to the outbreak this year - a pattern that has been seen across Europe.

Health Protection Scotland has also reported a rise in cases.

It could be there is simply an earlier peak in cases - or that figures will be higher overall this year.

The HPA stresses norovirus is unpredictable, and no two years are the same. The norovirus "year" - the date from which experts start to count cases - begins in July and runs to the following June.

Laboratory confirmed reports represent a small proportion of the actual number of cases because most people do not see a doctor - and therefore their case is not recorded.

John Harris, an expert in norovirus from the HPA said: "The number of laboratory confirmed cases has risen once again as it appears that we have seen the rise in cases that usually begins in January start a little earlier than we normally expect.

"Norovirus is very contagious, and very unpleasant."

He said the best way to prevent the spread of the disease was to wash hands and stay away from hospitals, schools and care homes if unwell because closed environments were particularly prone to outbreaks "which can cause severe disruption".

http://www.wired.com/wiredscience/2012/12/ticks-new-meat/

The Advance of Ticks: New Areas, New Diseases, and a Weird Allergy to Meat

New news regarding other diseases transmitted by insects and arthropods

By Maryn McKenna

Following up on last week's post about the advance of dengue: I've been keeping track of new news regarding other diseases transmitted by insects and arthropods, but haven't had a chance to write them up. So here's an end-of-year round-up. It's not cheery (are my posts *ever* cheery?), but maybe it will prompt some New Year's resolutions to wear repellents and long pants outdoors. These diseases are no fun.

The big player in tickborne illnesses is Lyme disease, and one of the most disputed issues within that condition is whether the infection can linger in a chronic form after treatment with antibiotics, and cause long-lasting symptoms. (This is separate from the problem of an unrecognized Lyme infection never being diagnosed or treated.) In one study in 2003, 10 percent of patients who got the standard treatment for Lyme still showed symptoms more than a year afterward; 4 percent showed symptoms at every follow-up visit; and 15 percent had a recurrence of the distinctive "bull's eye" rash that is a diagnostic signal for Lyme. The team who did that 2003 study decided to look further into those recurrences, and their results were published in the *New England Journal of Medicine* last month.

They chose a small group (17 patients) who experienced rash recurrences at least a year, and sometimes many years, apart, and analyzed Lyme bacteria isolated from their skin or blood during each episode. (The patients were enrolled in ongoing studies at New York Medical College, so years-earlier samples were available.) They analyzed a particular protein (outer-surface protein C, or ospC) that is expressed soon after infection takes place, and found that for any of the patients, the proteins were slightly different. Based on this, the researchers conclude that the patients they studied were not suffering from long-lasting infections and relapsing; instead, they were undergoing new infections — which happened to occur in the same time of year, and often on the same body part, as the original infection a year or more before.

At about the same time that paper was published, researchers attending the annual meeting of the American Society of Tropical Medicine and Hygiene in Atlanta were also discussing the spread of Lyme disease, along with the advance of less well-known tickborne illnesses (some of which you might have read about on this blog).

In one presentation, researchers from the Yale schools of medicine and public health reported on the interplay between Lyme and the emerging illness babesiosis, which is also transmitted by ticks, and which spends part of its life cycle in the same rodent, the white-footed mouse. They found that when rodents are infected with both organisms (the Lyme disease bacterium *Borrelia burgdorferei* and the babesiosis parasite *Babesia microti*), the levels of *Babesia* rise higher in the mice's blood than if they were infected only with babesiosis, and as a result the mice are more likely to transmit *Babesia* back to tick larvae. In other words, the Lyme bacterium somehow seemed to be intensifying babesiosis transmission.

That finding may explain, in part, why babesiosis is emerging so quickly, because the areas where the two diseases are common overlap. Another presentation by Yale researchers (this time with co-authors from Tufts University, the Connecticut Department of Public Health, and several private medical practices) described babesiosis' rapid rise: In 2000, cases were reported in 30 towns in Connecticut; by 2008, it was in 85 towns. At least 10 percent of ticks caught in northern Connecticut now carry the parasite, a rate as high as Nantucket, where babesiosis was first spotted and dubbed "Nantucket fever" decades ago.

Because Lyme and babesiosis are northeastern diseases, the other tickborne illnesses in the United States tend to not get much attention. Researchers from the CDC, University of North Carolina and North Carolina State University who also attended ASTMH said that lack of awareness is causing some under-appreciated risks. Forest, parks and wildlife workers in North Carolina were scheduled to take part in a trial of clothing impregnated with tick repellent — but to give the study a baseline, they agreed to be tested for evidence of prior tickborne-illness infection. To everyone's surprise, almost one-quarter of the workers showed serologic evidence that they had already been infected with at least one of several tick-transmitted organisms. (The organisms were *Rickettsia parkeri*, *Rickettsia rickettsii* and *Rickettsia amblyommii*.)

In that study, the outdoor workers also submitted for study any ticks that bit them. The vast majority were the lone star tick (*Amblyomma americanum*), which is common in the Southeastern US; its range is increasing, which is troubling because that tick transmits a different illness, "Southern tick-associated rash illness" or STARI. (Despite the name, STARI infections have now been found as far north as New York.) But, it turns out, infections carried by that tick are not the only concern — and this last item is probably the strangest tick-related story of the bunch.

In a presentation at a different scientific meeting happening at the same time as ASTMH — the ACAAI, or American College of Allergy, Asthma and Immunology — researchers revealed that the bite of a lone star tick can induce antibodies to a sugar, galactose-alpha-1,3-galactose or alpha gal for short. The problem: That sugar is present in most red meat — beef, pork, and lamb — and also in products made from meat, including gelatin. Once that antibody has been created, the result is a serious, and rapidly worsening — in fact, potentially life-threatening — allergy to meat and meat products. (The ACAAI abstract is no longer online, but the presentation is listed on p.55 of this conference program; ScienceNOW covered it at the time.)
So, to sum up: The geographic ranges of different tick species are expanding. Diseases caused by ticks are becoming more common, and they are serious. People don't understand the ways in which they might be at risk. And if you don't take them seriously, and you get bitten by the wrong tick, you might have to give up meat for life. So on that resolutions list: maybe some socks and DEET?

http://www.sciencedaily.com/releases/2012/12/121228130701.htm

Early Cognitive Problems Documented Among Those Who Eventually Get Alzheimer's

People on the road to Alzheimer's may actually have problems early on in processing semantic or knowledge-based information

People who study or treat Alzheimer's disease and its earliest clinical stage, mild cognitive impairment (MCI), have focused attention on the obvious short-term memory problems. But a new study suggests that people on the road to Alzheimer's may actually have problems early on in processing semantic or knowledge-based information, which could have much broader implications for how patients function in their lives.
Terry Goldberg, PhD, a professor of psychiatry and behavioral science at the Hofstra North Shore-LIJ School of Medicine and director of neurocognition at the Litwin Zucker Center for Research in Alzheimer's Disease and Memory Disorders at The Feinstein Institute for Medical Research in Manhasset, NY, said that clinicians have observed other types of cognitive problems in MCI patients but no one had ever studied it in a systematic way. Many experts had noted individuals who seemed perplexed by even the simplest task. In this latest study, published in this month's issue of the American Journal of Psychiatry, investigators used a clever series of tests to measure a person's ability to process semantic information.
Do people with MCI have trouble accessing different types of knowledge? Are there obvious semantic impairments that have not been picked up before? The answer was "yes."
In setting out to test the semantic processing system, Dr. Goldberg and his colleagues needed a task that did not involve a verbal response. That would only confuse things and make it harder to interpret the results. They decided to use size to test a person's ability to use semantic information to make judgments between two competing sets of facts. "If you ask someone what is bigger, a key or an ant, they would be slower in their response than if you asked them what is bigger, a key or a house," explained Dr. Goldberg. The greater the difference in size between two objects, the faster a person -- normal or otherwise -- can recognize the difference and react to the question.
Investigators brought in 25 patients with MCI, 27 patients with Alzheimer's and 70 cognitively fit people for testing. They found large differences between the healthy controls and the MCI and Alzheimer's patients. "This finding suggested that semantic processing was corrupted," said Dr. Goldberg. "MCI and AD (Alzheimer's disease) patients are really affected when they are asked to respond to a task with small size differences."
They then tweaked the task by showing pictures of a small ant and a big house or a big ant and a small house. This time, the MCI and AD patients did not have a problem with the first part of the test -- they were able to choose the house over the ant when asked what was bigger. But if the images were incongruent -- the big ant seemed just as big as the small house -- they were confused, they answered incorrectly or took longer to arrive at a response.
Patients with MCI were functioning somewhere between the healthy people and those with AD. "When the decision was harder, their reaction time was slower," he said.
Would this damaged semantic system have an effect on everyday functions? To answer this question, investigators turned to the UCSD Skills Performance Assessment scale, a tool that they have been using in MCI and AD patients that is generally used to identify functional deficits in patients with schizophrenia. The test taps a person's ability to write a complex check or organize a trip to the zoo on a cold day.
This is actually a good test for figure out whether someone has problems with semantic knowledge. Semantic processing has its seat in the left temporal lobe. "The semantic system is organized in networks that reflect different types of relatedness or association," the investigators wrote in their study. "Semantic items and knowledge have been acquired remotely, often over many repetitions, and do not reflect recent learning."

Dr. Goldberg said the finding is critically important because it may be possible to strengthen these semantic processing connections through training. "It tells us that something is slowing down the patient and it is not episodic memory but semantic memory," he said. They will continue to study these patients over time to see if these semantic problems get worse as the disease advances.
In an accompanying editorial, David P. Salmon, PhD, of the Department of Neurosciences at the University of California in San Diego, said that the "semantic memory deficit demonstrated by this study adds confidence to the growing perception that subtle decline in this cognitive domain occurs in patients with amnestic mild cognitive impairment. Because the task places minimal demands on the effortful retrieval process, overt word retrieval, or language production, it also suggests that this deficit reflects an early and gradual loss of integrity of semantic knowledge." He added that a "second important aspect of this study is the demonstration that semantic memory decrements in patients with mild cognitive impairment may contribute to a decline in the ability to perform usual activities of daily living."
Brady C. Kirchberg et al. Semantic Distance Abnormalities in Mild Cognitive Impairment: Their Nature and Relationship to Function. American Journal of Psychiatry, 2012; 169 (12): 1275 DOI: 10.1176/appi.ajp.2012.12030383

http://newsonjapan.com/html/newsdesk/article/100096.php

Japan in pole position to host particle smasher

International consensus forming that Japan is the only possible host for the International Linear Collider

News On Japan via nature.com -- Dec 15

As Europe and the United States struggle through the worst economic crisis in decades, Japan has emerged as the great hope for the future of particle physics. An international consensus is rapidly forming that the island nation is the only possible host for the International Linear Collider (ILC), a multi-billion-dollar machine that will sustain the next generation of researchers.
"Japan is it," says physicist Barry Barish, the head of the global design effort for the ILC.
At a ceremony in Tokyo today, Barish and other members of the ILC team will hand over the finalized design of the ILC to an independent committee of researchers. The blueprint is for a 31-kilometre-long track of superconducting cavities that can accelerate particles to energies of up to 500 gigaelectronvolts before colliding them. The energy of the collisions should provide a brief glimpse of heavier particles, which would then quickly decay inside one of two detectors.
It is a similar approach to that used at the world's current leading particle accelerator, the circular Large Hadron Collider (LHC), located at CERN, Europe's particle-physics facility near Geneva in Switzerland. Earlier this summer, researchers at the LHC discovered the Higgs boson, a central part of the mechanism that endows other particles with mass. But the LHC's view of the Higgs is obscured by the fact that the collider uses protons - composite particles that are made up of quarks - which produce a messy spray of debris. The ILC would use electrons and anti-electrons, which are fundamental particles and would give a much cleaner Higgs signal.

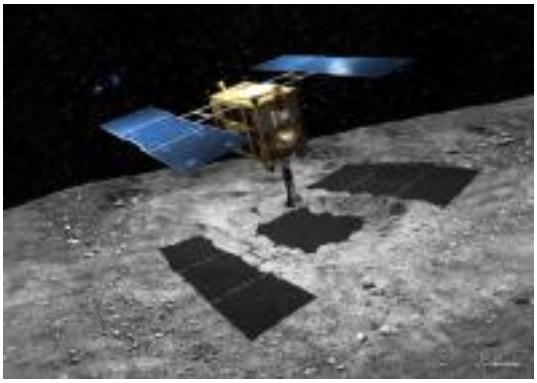
http://www.space.com/19064-japan-asteroid-sample-mission-hayabusa2.html

Japan Launching Ambitious Asteroid-Sampling Mission in 2014

Japan's space agency is readying a new asteroid probe for launch

by Leonard David, SPACE.com's Space Insider Columnist

Japan's space agency is readying a new asteroid probe for launch, an ambitious mission that aims to build on the victory of the country's first round-trip asteroid mission that sent the Hayabusa spacecraft to retrieve samples of the space rock Itokowa.
The new Japanese asteroid mission, called Hayabusa2, is scheduled for launch in 2014 and aimed at the asteroid 1999 JU3, a large space rock about 3,018 feet (920 meters) in length. It is due to arrive at the asteroid in mid-2018, loiter at the space rock and carry out a slew of challenging firsts before departing the scene at the end of 2019.
If all goes well, the Hayabusa2 spacecraft will return to Earth with samples of asteroid 1999 JU3 at the end of 2020. The probe's name is Japanese for "Falcon2."



Artist's concept of Japan's proposed Hayabusa 2 spacecraft, which would reconnoiter asteroid 1999 JU3 in mid-2018. Hayabusa 2 would hurl an impactor into the asteroid, sample the resulting crater and send pieces back to Earth for study. **JAXA/Akihiro Ikeshita**

Building on success

Officials with the Japanese Aerospace Exploration Agency (JAXA) said Hayabusa2, like its Hayabusa predecessor, will also involve a significant level of international cooperation. The initial Hayabusa mission

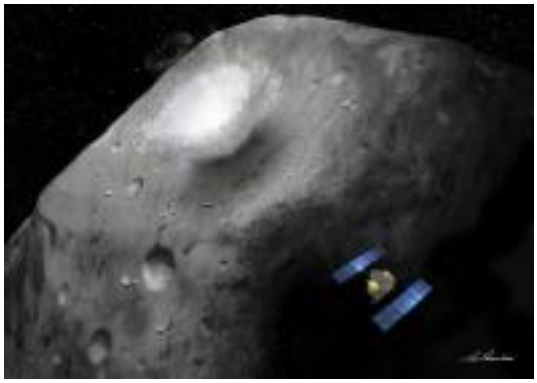
launched in May 2003 and returned samples of Itokawa — the first asteroid samples ever collected in space - in June 2010. Japan unveils the Hayabusa2 asteroid probe on Dec. 26, 2012, during an event at JAXA's Sagamihara Campus. The spacecraft will launch in 2014 to collect samples of the asteroid 1999 JU3.
Like that first flight, the Hayabusa2 mission will rely on NASA's Deep Space Network of ground stations to help track the spacecraft. The spacecraft's return capsule will also land in Australia, another similarity to the first flight.
Hayabusa2 is expected to stay with asteroid 1999 JU3 for more than a year, 18 months in all, thereby allowing ample time for observation and careful sample collection, according to the mission's project manager Makoto Yoshikawa of Japan's the Institute of Space and Astronautical Science (ISAS). Asteroid 1999 JU3 is of particular interest to researchers because it consists of 4.5-billion-year-old material that has been altered very little. Measurements taken from Earth suggest that the asteroid's rock may have come into contact with water. The C-type asteroid is expected to contain organic and hydrated minerals, making it different from Itokawa, which was a rocky S-type asteroid. Asteroid 1999 JU3 is also larger than Itokawa, which was 1,771 (540 m) long.

New and novel hardware

While the configuration of Hayabusa2 is similar to that of the first Hayabusa, the second probe will carry new and novel asteroid-studying hardware. For example, the antenna for Hayabusa was a single parabolic dish, but Hayabusa2 will sport two flat high-gain antennas to support faster communication speeds than its predecessor. Also, Hayabusa2 is to will fly through space with more propulsion power from its ion engines.
Another addition is a 4-pound (2 kilograms) "collision device" that will be used to create an artificial crater on asteroid 1999 JU3 during the mission. This human-caused dent is expected to be a small one, a few meters in diameter. But it will allow Hayabusa2 to acquire samples of the asteroid that are exposed by the smashing event, fresh specimens that are less weathered by the brutal space environment on the asteroid's surface.
Yoshikawa noted that during the first Hayabusa mission, the probe's MIcro/Nano Experimental Robot Vehicle for Asteroid (MINERVA) failed to reach the surface of Itokawa. "So for Hayabusa2 we have even greater motivation to succeed with our new version of the robot, MINERVA2."

Hayabusa2's MASCOT hitchhiker

For its part, the German Aerospace Center's (DLR) Institute of Space Systems in Bremen is contributing the Mobile Asteroid Surface Scout asteroid lander, or Mascot, to the JAXA mission. Mascot is being developed by DLR in collaboration with the French space agency and JAXA.
After Hayabusa2 arrives at asteroid 1999 JU3 in 2018, Mascot will be released from the main spacecraft. A spring-loaded mechanism will push the 22-pound (10 kilograms) lander clear of from Hayabusa2.
Mascot is a "hopping" lander packed with four separate instruments and is designed to move across the surface of an asteroid. Doing so will enable it to take measurements at different sites. As Mascot performs the near-asteroid maneuvers, a radiometer will measure the temperature of the asteroid and a camera will image the fine structure of the surface of 1999 JU3. The lander will be controlled from DLR's Microgravity User Support Center in Cologne.



An artist's illustration of Japan's Hayabusa2 probe crashing an impactor into the asteroid 1999 JU3 ahead of sampling the space rock in 2018. **JAXA/Akihiro Ikeshita**

Free-falling on an asteroid

"Mascot will free-fall to the asteroid from an altitude of around 100 meters [328 feet]," said Tra-Mi Ho, DLR's project leader for the device, in a statement. Sensors will then ensure that Mascot knows which way is up and down, so it can orient itself and, if necessary, correct its attitude. Once on the asteroid, Mascot is expected to automatically adjust itself and "hop" from one measurement site to the next.
"Mascot is due to take measurements of the regolith itself, which will provide reference data about the surface and enable the samples subsequently brought back by Hayabusa2 to be interpreted in the correct context," said Ralf Jaumann, a DLR planetary researcher and scientific spokesman for the experiments on the lander.
Mascot will work on the asteroid for a total of 16 hours, the equivalent of two days on asteroid 1999 JU3.

Up close with an asteroid

"We anticipate obtaining close-up photographs of the asteroid surface up to the order of centimeter-level resolution, something that Hayabusa1 was unable to capture," said Masanao Abe, Hayabusa2 project scientist at

ISAS. The experience gained from that first Hayabusa mission, in terms of asteroid sample collection and analysis technologies, is proving highly useful, Abe said.
"Japan is at the forefront of sample-return technology and execution," Abe added "and we are constantly thinking about how we can maintain our position and steadily working on things that will keep us at the leading edge."

New discoveries ahead

Akio Fujimura, an advisor in JAXA's Lunar and Planetary Exploration Program Group, said that in Hayabusa2's snagging of carbonaceous asteroid material, there is a high probability of gaining samples that contain organic matter — the fundamental building blocks of life.
"So, first, I expect Hayabusa2 to be a success. Then after that, I'd like us to proceed with an inquiry concerning where we came from and how life came about," Fujimura said. "It would be great to uncover the origins of the solar system, Earth, the other planets, and life itself by getting information that we can't obtain here on Earth. I'd like us to open up new lines of scientific inquiry that seek to discover these origins."
JAXA and the ISAS has learned a great deal from the first Hayabusa mission, said Michael Zolensky, a Hayabusa team member in sample analysis at the NASA Johnson Space Center in Houston, Texas.
"Although the second spacecraft is based on the first one, they have made significant upgrades and expanded the capabilities of the spacecraft for Hayabusa2," Zolensky told SPACE.com. "It should be a fantastic mission. No fooling."

Leonard David has been reporting on the space industry for more than five decades. He is the 2011 winner of the National Space Club Press Award and a past editor-in-chief of the National Space Society's Ad Astra and Space World magazines. He has written for SPACE.com since 1999.