

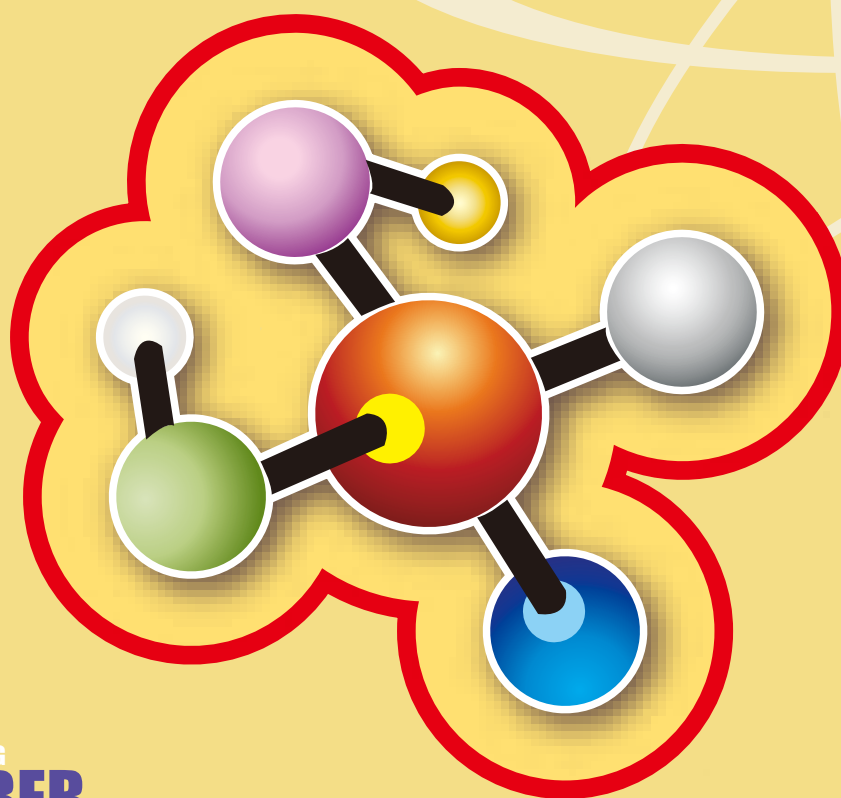


SCIENTIFIC AMERICAN

60-SECOND SCIENCE

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September 1, 2008

Spray-On Explosives Detector

A polymer spray lets minimally trained workers detect explosives residues on surfaces. Steve Mirsky explains, with reporting by Harvey Black

[The following is an exact transcript of this podcast.]

[Spray sound.] Killing bugs? No. [Spray sound.] Deodorizing the bathroom? No. [Spray sound.] Checking for explosives, yes. Because chemists at the University of California, San Diego have come up with a spray-on polymer film that can spot residue from nitrogen-based explosives such as TNT. It works in as little as 30 seconds.

When ultraviolet light is shined on a safe, sprayed surface, it glows blue. But when the surface shows traces of a nitrogen-based explosive, it stays dark. Because the explosives soak up the electrons that would emit the blue glow. The researchers describe the synthesis and properties of their polymers in the *Journal of Materials Chemistry*.

A single layer of the polymer, about one-thousandth of a gram, is enough for the test. And the polymer is so sensitive, it can detect explosive residues on the order of a few millionths of a gram. Often more than a thousand times that amount is left on surfaces. The method is so promising, it's already been featured on an episode of CSI: Miami. Chemists know that's a technology's acid test.

—Steve Mirsky, with reporting by Harvey Black



September 2, 2008

Beating Neglected Tropical Diseases

Malaria gets headlines, but a host of lesser known tropical diseases are also a burden to a billion people around the world. Creative treatments in some places are finally fighting these conditions. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

We've all heard of the fight to combat malaria in mostly poor, tropical countries. But a whole host of other tropical diseases exist that leave their victims alive, but maimed. One is lymphatic filariasis, also known as elephantiasis. It causes limbs or sexual organs to become grossly enlarged. People can't work or feed their families and often become social outcasts. Another one is called trachoma, or river blindness. A range of these so-called neglected tropical diseases affect about one billion people in the world.

But there's some good news. Efforts by the Global Network for Neglected Tropical Diseases and other agencies have nearly eliminated those two diseases in some developing countries. For lymphatic filariasis, patients receive a drug treatment for five years. This is known as preventative chemotherapy, and it effectively kills the parasite. In the case of trachoma, surgery and drug therapy are combined with improved access to sanitation. Morocco announced that trachoma has nearly disappeared there. These are success stories, but there's much more to be done. Researchers are working on expanding these programs and on developing vaccines and treatments to eliminate neglected tropical diseases worldwide.

—Cynthia Graber



September 3, 2008

Listen to Lingo to Learn

Exposure to a particular discipline's jargon—in this case, hockey—increases the brain's ability to process that language. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

[Sports announcer:] “Hello and welcome to Sports Update. In NHL action: with two seconds left in OT, Penguins’ winger Jean Jejeune nailed a wrist shot from the point that sent the puck skidding through the five-hole.”

Now, if you were a fan of the Pittsburgh Penguins, you’d be whooping with delight. If you don’t like the Penguins, you might be shaking your head in dismay. If you don’t follow hockey, you probably have no idea what I’m talking about. That’s because immersing yourself in a sport actually makes your brain better at processing language—language that relates to that sport.

We all know that practice makes perfect, whether you’re polishing your slapshot or your vocabulary. But in the September 2nd issue of the *Proceedings of the National Academy of Sciences*, psychologists show that playing hockey, or even listening to a broadcast, can enhance comprehension of words that describe ice-hockey action. In their study, fans and players who heard sentences that relate to the sport showed increased activity in brain regions associated with planning and performing physical actions. That extra activity may give them a jump on parsing the lingo. Even if we’re talking about slipping one through the old five-hole—otherwise known as shooting the puck between the goalie’s legs.

—Karen Hopkin



September 4, 2008

Prions Cross Species Barrier in Lab

Mad cow disease is caused by prions--misfolded proteins. Lab tests with mouse prions show that they can affect normal proteins from another species. Humans thus need to be on alert against the potential for new prion diseases. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

Conditions such as mad cow disease are caused by abnormally shaped proteins, called prions. Prions spread by causing other, normal proteins to misfold and adopt the abnormal shape—no genetic material like DNA is involved. Prion diseases affect the brains of a number of mammals, including humans. Although humans can get mad cow from beef, these unusual diseases rarely jump between species. Still, scientists say new forms of prion diseases have arisen lately, and there's concern that they could hop to humans. So researchers want to understand the species barrier better.

A study published in the September 4th issue of the journal *Cell* investigates that issue. Scientists from Texas, Spain and Chile took normal hamster proteins and mixed them with misfolded mouse ones. And the mouse prions were able to change the hamster proteins into a new kind of prion that infected both healthy hamsters and mice. The test tube is obviously an unnatural situation, but it shows that prions can leap the species barrier without the aid of any other infectious agent. Scientists hope to learn more about how this process works so they can keep prions in their place—away from humans.

—Cynthia Graber



September 5, 2008

Drugs Move Slowly through Development Pipeline

A study in the journal *Science* finds that it takes an average of 24 years between the first finding of a chemical compound's potential usefulness and the first publication showing clinical effectiveness. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

Open a newspaper any day of the week and you're likely to read about a "promising new treatment" for one disease or another. But according to a study published in the September 5th issue of *Science*, it can take decades for those cures to make it to the clinic. Researchers from the U.S. and Greece combed through the scientific literature to see how long it actually takes for compounds that look good in the laboratory to get through clinical trials and get used on patients.

The scientists focused their attention on a handful of interventions that were widely hailed as being clinically effective. And they found that, for the average drug, the time that elapsed between its initial discovery and the first paper to show its clinical effectiveness was about 24 years. Some drugs moved much faster. One of the protease inhibitors used to treat HIV made it from patenting through clinical trials in only four years. Maybe that's because the team studying that drug included experts in both basic and clinical sciences. The researchers say that such multidisciplinary efforts could help future treatments get to the clinic sooner. In the meantime, they note, scientists should avoid making promises about quick cures.

—Karen Hopkin



September 8, 2008

Incoming M.I.T. Freshman Creates New Vehicle

Ben Gulak, who's starting college this semester at M.I.T., has already created a new vehicle--an electric cycle you operate with body movement. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

It's not often that an incoming college freshman is already starting his own multimillion dollar business. But that's what's happening to Ben Gulak. He's a 19-year-old Canadian who's just starting at M.I.T. Gulak's was inspired by the overwhelming smog he saw on a trip to China two years ago. He thought there should be something better than all the polluting scooters. He spent two years tinkering and came up with a contraption he calls the Uno. It's an electric vehicle that looks like a cross between a motorcycle and a unicycle.

There are actually two wheels, but they're side by side, not front and back. And the controls consist of a single on-off switch. You balance by simply sitting upright. You accelerate by leaning forward. Leaning backward activates the brakes. And you turn by simply leaning to the left or right. The computer control system is similar to that of the sidewalk Segway, but this device is designed like a scooter to be ridden on the street. Gulak has already won a number of prizes and gotten funding for his new Cambridge-based business. And he's planning to balance a double-major in mechanical engineering and business at M.I.T. Which should help him get people to balance on Unos someday soon.

—Cynthia Graber



September 9, 2008

Not-So-Free Medication Samples

A study finds that free drug samples induce physicians to prescribe brand-name medications over generic. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

Everybody loves a freebie. Especially those “samples” you get at the doctor’s office, with the latest, greatest brand-name cures for your headache or your heartburn or whatever it is that ails ya. But a study published in the September issue of the *Southern Medical Journal* finds that those freebies may cost you in the long run. Because doctors who use those samples wind up prescribing the more costly brand-name medications more often than the cheaper generic.

The researchers tracked the prescribing habits of one particular group of 70 physicians. What made this practice ideal is that at some point it moved from one space to another. In the new place, there was no room to store all those samples. So no more free-flowing freebies. What the researchers found is that when the physicians were no longer under the influence of the free samples, the number of prescriptions they gave their uninsured patients for generic drugs rose from 12 percent to 30 percent. That means that when the office was filled with brand-name samples, the docs tended to write more brand-name ‘scrips. Which their patients had to pay for. So, in the end, there’s no such thing as a free drug. Which, deep in your heartburn, I think you already knew.

—Karen Hopkin



September 10, 2008

Bicycle Safety in Numbers

For a city to improve bicycle safety, the prescription actually is to put even more riders on the streets. Adam Hinterthuer reports

[The following is an exact transcript of this podcast.]

There's a new prescription for communities that want to make their streets safer for bike riders: just add more bikes. A team of international researchers looked at cities from Australia to Denmark to California, and found that more riders meant fewer run-ins with cars. The researchers presented their findings to a cycling safety seminar on September 5 in Sydney, Australia.

What's surprising, the researchers say, is that biker safety doesn't seem to correspond to a city's efforts to cut down on accidents. Run-ins between bikes and cars had little to do with miles of bike lanes or lower speed limits. But if the number of bike riders in a city doubled, the rate of bike-car accidents dropped by a third.

Apparently, motorists learn to share the road better when they have to deal with more bikes on their daily commute. Also, more cyclists means more drivers who also bike, which makes them better aware of fellow bikers. The researchers call it a virtuous cycle—run-ins with cars drop with more bikes on the road. And safer cycling means more people strap on a helmet and join the revolution.

—Adam Hinterthuer



September 11, 2008

Amateurs Help Pro Astronomers Sort Galaxies

One-hundred-fifty-thousand amateur astronomers are taking part in the Galaxy Zoo project (GalaxyZoo.org), helping professionals sort through a million telescope images to characterize galaxies. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

A year ago astronomers sent out an invitation. A robotic telescope called the Sloan Digital Sky Survey had produced almost a million images. Researchers wanted more than extra computer power to sort through them. So they welcomed citizen scientists to, well, look at the photos. Few people ever get the chance to peer at the universe from the world's top observatories. So 150,000 amateur astronomers jumped at the chance to explore undiscovered galaxies. The project is called Galaxy Zoo. A story on the success of the project was published in the September issue of *Physics World*.

Participants were first invited to go online in their spare time to characterize the shape of galaxies and the direction of the rotation. And the amateur astronomers out there RSVP'd with 50 million responses so far. For about a third of the galaxies on-line, there's close to an 80 percent agreement in characterizations. Scientists say this gives them a good starting point for research. And that having 150,000 collaborators is strong motivation to get that data published.

—Cynthia Graber



September 12, 2008

Listener Anticipates Speaker's Word Choice

Functional MRI shows the brain in action, anticipating the next word a speaker will say based on context and the first part of the word sound. Steve Mirsky reports

[The following is an exact transcript of this podcast.]

While I'm talking, you're not just passively listening. Your brain is also busy at work, guessing the next word that I will sa...vor before I actually speak it. You thought I was gonna say "say", didn't you. Our brains actually consider many possible words—and their meanings—before we've heard the final sound of the word in quest...of being understood.

Language comes flying at you at up to five syllables per second. So it was thought that listeners keep pace by anticipating a small subset of all words that the listener is familiar with. Think of how a Google search anticipates words based on the first few letters you type in. But now scientists have used functional magnetic resonance imaging to actually watch the brain consider different words. They report in the *Proceedings of the National Academy of Sciences* that you narrow the choices by considering words that begin with the same sound. So if I say, "I tasted the sweetest can...your brain might already be priming itself to hear candy. Or maybe cantaloupe. But not candle. Who needs the Game Show Network? You're always playing Match Game in your head.

—Steve Mirsky



September 15, 2008

Less Choice Fixes Traffic Flow

Some traffic jams could be alleviated by actually closing down key roads. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

If you spent any time in your car this summer you probably sat in some traffic. Maybe you're in a jam right now. If so, a study in an upcoming issue of *Physical Review Letters* might help pass the time. According to scientists, building new roads won't make traffic any lighter. It could even make things worse. What might help, though, is shutting a few streets down.

Imagine that there are two routes that take you to work: one a long wide freeway and the other a short, narrow bridge. In this example, everyone's drive time would be minimized if half the motorists took the bridge and the other half the highway. Of course nobody cares about minimizing the collective commute. Every driver wants to get there first. So some of the highway drivers will switch to the bridge, thinking that'll be quicker. When the bridge backs up, some will head for the highway. The upshot of all this back-and-forth is that everyone's commute takes longer—in real life, up to 30 percent longer, the physicists find. The solution, they say, is to close off a few carefully selected avenues to limit all that to-and-fro. With less choice, and less chaos, everyone moves faster. It sounds counterintuitive. But it could be worth a try.

—Karen Hopkin



September 16, 2008

Copper Knocks out Fish Bacteria

A traditional Korean copper bowl apparently helps remove disease-causing *Vibrio* bacteria from seafood. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

There's a traditional bowl in Korea that locals say makes food safer. And they might be right. The bowl is made of almost 80 percent copper. Copper ions can escape into the food. That's a good thing, according to a presentation at the Society for General Microbiology's autumn meeting. Korean scientists showed that copper ions can destroy bacteria in raw fish and shellfish.

The researchers were concerned about a specific seafood bacteria called *Vibrio*. It causes about 12 percent of food poisoning cases in Korea. The scientists placed a brass plate—brass is a copper alloy—at the bottom of a fish tank. Copper ions diffused into the water. The bacteria absorb the copper from the water. They die and fall from fish gills and flesh to the bottom of the tank. They're even flushed out of fish organs. After almost two days, the copper had destroyed 99.99 percent of the *Vibrio* bacteria in those living fish and shellfish. The scientists recommend placing a brass plate in all tanks that contain fish destined for consumption – and, of course, that Koreans keep using traditional kitchenware.

—Cynthia Graber



September 17, 2008

Sun May Be an Immigrant

Computer simulations of the galaxy's formation and evolution show that the sun may have originated far from where we find ourselves today. Steve Mirsky reports

[The following is an exact transcript of this podcast.]

We live in a nice neighborhood. Of the galaxy, that is. The sun is about halfway toward the outer edge of the Milky Way. But the sun may have migrated vast distances through the galaxy to wind up where we are today. That's according to computer models published in the September 10th *Astrophysical Journal Letters*.

By about nine billion years ago, the material for the galactic disk had mostly come together, but the actual disk formation hadn't started. Scientists simulated the formation and evolution of the galaxy from that point, using over 100,000 hours of time on a University of Texas supercomputer and a computer cluster at the University of Washington.

Turns out that while a star is orbiting around the center of the galaxy, a spiral arm can intercept the star and radically alter that orbit. Which would explain a long-standing problem—the stars in our region have a much more varied chemistry than would be expected. Stellar migrations could thus be responsible for making our neighborhood within the Milky Way a much more diverse and interesting place.

—Steve Mirsky



September 18, 2008

Superstitious Behavior Makes Evolutionary Sense

The tendency to develop superstitious beliefs was probably selected for during evolution, because it's much better to be safe than eaten. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

Breaking a mirror means seven years bad luck. So does spilling salt or meeting a black cat. We've all heard such silly-sounding superstitions. Of course why anybody would believe that stepping on a crack could break your mother's back is a mystery. But according to an article in the Royal Society journal *Biological Sciences*, superstitious behaviors are a natural product of evolution.

Imagine an animal living in an environment where, over the course of a day, he might hear some rustling in the leaves or maybe in the grass. Now, movements in the grass could signal a predator attack, whereas the breeze in the trees is probably just the wind. Still, the animal has a choice: he can ignore all this rustling and go about his business, or he can run and hide.

The most logical response would be to hide only when he hears the grass move. But what if it's hard to tell whether the noise came from the grass or the trees? "I could've sworn that was the trees" could be his final thought. So the animal learns to bolt at the sound of the breeze, because it could foretell certain doom. That better-safe-than-sorry attitude is essentially a superstition. One that that cautious critter will likely pass on to his young. Knock on wood.

—Karen Hopkin



September 19, 2008

Management System Could Keep Tuna on Table

A system called "catch shares" seems to keep fisheries from being overfished, while at the same time improving incomes for fishermen. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

It's fairly well known that fish stocks are collapsing around the world. But there's a management method that appears to offer long-term environmental and economic success, according to a study published September 19th in the journal *Science*. It's called catch shares, and it works like this. Each fishermen—or fishing cooperative—receives a percentage of the total catch. Scientists determine the catch for the year. And the fisherman is guaranteed his fixed percentage, year after year. He thus has a direct financial stake in the future of the fishery.

The researchers evaluated data for more than 11,000 fisheries. Less than 1 percent had implemented catch shares. But in addition to higher incomes for fishermen, those systems had half as many collapses as other fisheries. And researchers think that number will improve further, because the catch shares may have been only recently implemented. Catch shares have been around for awhile, but they've been slow to catch on. One reason has been a lack of data on whether they do any good in the long run. With this study, maybe that will change. That's a good thing for the fishermen, the consumer and especially the fish.

—Cynthia Graber



September 22, 2008

Fish Gave Us the Finger

Fish from almost 400 million years ago appear to have bones in their fins that predisposed future animals to the development of fingers. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

Fingers are pretty nifty. They let you to grab a latte, type on a keyboard, even pull up your pants. But did you ever wonder: where do fingers come from? In the 1990s, scientists gave this problem a lot of thought. And they concluded that fingers were pretty much invented by the first tetrapods: that is, critters with four limbs. One reason they thought that is because a fossilized skeleton of an ancient fish didn't appear to have any fingers. Or at least any distinct digits in its pectoral fin. But tetrapods, which evolved from fish, did.

Now scientists writing in the September 21st online issue of *Nature* say that that thinking was...a little fishy. Because they've unearthed evidence that suggests that that ancient fish did indeed have fingers in its fins. The researchers did a CT scan on a specimen about 380 million years old. And they found that the fish's right fin, which was unusually well-preserved, does appear to have digitlike bones. The reason other researchers previously missed them, they think, is because in their samples the fingers were hidden behind marks left by the fish's scales. So fish, too, seem to have incipient fingers. A finding we give two thumbs up.

—Karen Hopkin



September 23, 2008

Good Bacteria against Type 1 Diabetes

**Treating diabetic mice with a cocktail of friendly intestinal bacteria cured the disease.
Karen Hopkin reports**

[The following is an exact transcript of this podcast.]

Sometimes a bit of bacteria can be just what the doctor ordered. If you prize yogurt for its “active cultures,” you know what I’m talking about. Now a new study, published in the September 21st online issue of *Nature*, suggests that good bugs might even hold diabetes at bay. Type 1 diabetes is caused by an immune system malfunction. Basically, the immune cells that usually chase after bacteria instead attack the pancreas, wiping out the cells that produce insulin. So researchers decided to see what would happen if they reigned in the immune response in mice that are prone to diabetes.

As expected, they found that the animals were less likely to develop the disease. But the effect depended entirely on the critters having a normal complement of friendly bacteria in their intestine. Mice that were raised in a totally sterile, germ-free environment were rampant diabetics. But simply treating those mice with a cocktail of bugs found in most mammals’ bellies cured the disease. How bacteria in the intestine can stave off diabetes is not yet clear. But the finding could lead to some interesting new treatments. In the meantime, remember that we can’t live without the stuff that lives in us.

—Karen Hopkin



September 24, 2008

"Fort" Actually Ancient Aqueduct

What had been thought to be a Native American fort in what is now Ohio was actually a complex water management system. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

There's a Native American site in Ohio that appeared to be a fort. But recent discoveries by archaeologists at the University of Cincinnati show that's not the case. Instead, it's a two-thousand year old Shawnee water management system. It stretches out almost six kilometers. That's much larger than what had been thought to comprise the so-called fort. It's one of the largest such sites in the country.

What had been thought to be gates for military protection are actually a series of dams and irrigation canals. There are logs and clay bricks for damming; raceways for flowing water originate in far-off springs. The water was stored and channeled for irrigation. Drill cores show water sediments and clay.

The site demonstrates a sophisticated knowledge of engineering—which archaeologists did not realize that Native American communities might have. The site also reveals an emphasis on public works, rather than on war. So this discovery might rewrite a bit of history. Another interesting note: Shawnee remains from the time are typically of petite, graceful men—and robust, muscular women. So it was probably the women who built the water system. Which means even more history to rewrite.

—Cynthia Graber



September 25, 2008

Steroids Enhance Athletes for Years

Even years after an athlete tests clean for anabolic steroids, he or she may still be benefiting from their past use. Steve Mirsky reports

[The following is an exact transcript of this podcast.]

Athletes have obviously been tempted to use performance enhancing anabolic steroids. Drug testing may discourage such use. But a new study finds that some of the performance benefits of steroid use may persist years after an athlete stops doping. That's according to research presented this week at a conference of the American Physiological Society.

Swedish scientists looked at power lifters, a pure strength sport. Steroids can increase muscle fiber size and the number of cell nuclei in the fiber. The researchers found that even years after steroid withdrawal—and with little or no current strength training—muscle fiber density and increased number of cell nuclei were comparable to drug-free athletes currently doing high-intensity strength-training. The additional cell nuclei could give a big advantage to former dopers—more nuclei means more protein synthesis, which means more muscle. So steroid use can still offer a competitive advantage years later. Which means that a clean ballplayer can still hit a dirty home run.

—Steve Mirsky



September 26, 2008

Auction Self-Control--Going, Going, Gone

Tests using bonuses for winners show that people overbid at auctions to avoid the agony of defeat more than to experience the thrill of victory. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

If you've ever gotten sucked into a bidding war on *eBay*, you know the feeling. With one minute left in the auction, the bidding is fast and furious as everyone tries to come out on top. Higher and higher you up the ante, each click of the mouse a painful reminder that you've already bid more than you wanted to spend. But why do we do that: overbid at public auctions? Now a team of neuroscientists says that, rather than the joy of winning, it's an aversion to losing that drives such economic misbehavior.

In one experiment, the scientists set up a series of auctions. They told half the subjects that they would start the auction with a \$15 bonus, which they got to keep if they won. The other subjects were told that, when the auction was done, if they won they'd get an extra 15 bucks. Either way, the winners would get the same bonus. But the researchers found that people bid more when they were afraid they might lose the money they already had, results that appear in the September 26th issue of *Science*. Of course, it could also be that people get possessive when they have money in their pockets, even if it's just a fake \$15 that you can't even use to buy an experimental cup of coffee.

—Karen Hopkin



September 29, 2008

Speech Storage Could Reduce Writing

Cheap audio storage combined with searchable audio files could make reading and writing specialties. Karen Hopkin reports

[The following is an exact transcript of this podcast.]

We humans love a good story. We tell stories to entertain, to inform, even to pass the time. And we've been telling tales for, oh, the past 50,000 years. Then came the written word. Writing stuff down has its benefits. It's more permanent and doesn't depend on anyone's memory. And it allows you to take in information at your own pace, whenever and wherever you want. So writing has shaped our culture. But the spoken word may be making a comeback.

Recording and digitizing speech has become easy, which is why you're hearing me now. It's also pretty cheap. For example, in the September 26th issue of *Science*, a researcher at the University of Maryland notes that with about \$100 worth of disk storage you can record everything you speak or hear this year. Although he doesn't say why you'd want to. And now that voice recognition software has gotten better at interpreting speech, we should soon be able to search audio like we do text to find what we want to listen to. Who knows what this might mean for society. Maybe 100 years from now, we'll finally have a good answer for why Johnny can't read: because he no longer has to.

—Karen Hopkin



September 30, 2008

Rocks from Earth's Origins

Researchers think that some rocks from Canada may be the oldest whole ones yet found. Cynthia Graber reports

[The following is an exact transcript of this podcast.]

The Earth's crust is old. Billions of years old. So old that it's nearly impossible to imagine. And now scientists have discovered what may be the oldest whole rocks ever known. Geologists at Carnegie Mellon University published the results of the research in the September 26th issue of the journal *Science*.

The rocks come from an area of the Hudson Bay in northern Quebec. In 2001 the geologists identified the site as a possible repository of very old rocks. It is made up of folds of volcanic and what are called metasedimentary rocks. And it's surrounded by three-and-a-half-billion-year-old tonalite.

Researchers collected rocks and measured minute isotopic variations in rare earth elements called neodymium and samarium. According to dating techniques, the rocks could be 4.28 billion years old. It's rare to find rocks that date back to when the Earth's mantle was forming. It was quite a tumultuous time, and most rocks were smashed up into tiny pieces again and again. Learning more about these whole rocks could help us gain a better understanding of the very beginnings of our planet.

—Cynthia Graber