***SCIENCE* MAGAZINE PODCAST -- 8th February 2008**

Music

Host -- Robert Frederick
Hello and welcome to the *Science* Podcast for February 8th, 2008. I'm Robert Frederick. This week: how biofuels could lead to an increase in greenhouse gases, reproducing in cities, the 2009 U.S. science budget, and good mentoring relationships. All this and more, plus our usual round up of stories from our free, online daily news site, *Science*NOW.

Promo
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Music ends

Host -- Robert Frederick
While biofuels may reduce the need of many countries to import oil, they may increase greenhouse gas emissions beyond those produced by using oil, at least for the next few decades. In a paper published online by *Science*, Timothy Searchinger and colleagues model the land use changes that occur when existing cropland is converted to biofuel production, whether from food crops, such as corn, or from non-food species, such as switchgrass. In both cases, the team found that the land use changes lead to higher, not lower, greenhouse gas emissions. I spoke with Searchinger, and began by asking why previous models of biofuels leading to fewer greenhouse gas emissions were wrong.

Interviewee -- Timothy Searchinger
The basic problem is that previous models counted the benefit of using land to grow biofuels, but they didn't count the cost. In other words, the basic reason people think that biofuels can reduce greenhouse gases is that when you grow the feedstock for the biofuels, whether its corn or switch grass, you take carbon out of the atmosphere. And that is different from gasoline, which takes carbon out of the ground and puts it in the atmosphere. Unfortunately, when you dedicate land to growing a biofuel, which is how most biofuels are produced, you're actually using that land to produce the biofuel, but you're not using that land to produce something else. So if that something else was a forest or grassland, and you end up plowing up that forest or grassland, you get a huge release of carbon. And that huge release of carbon is carbon that's been stored over decades, and according to our calculations, greatly exceeds the carbon benefit that you get per year of using biofuels. So you get, you have a long time before you pay off that debt. But if instead you use existing cropland, for the most part farmers around the world have to respond by making new food to replace the food that's no longer being grown on that cropland. And again, you get a large carbon release. And to some extent, if you

have growing forests, you don't get the benefit of the carbon that they would absorb year after year.

Interviewer -- Robert Frederick
Now, this paper is specifically targeted towards the U.S., and doesn't the U.S. export a lot of its foods? So if the U.S. is converting some of its food lands to fuel lands, what other countries would feel the impact?

Interviewee -- Timothy Searchinger
Well the answer is a lot of other countries, and here's why. What actually happens is when we divert our grain to fuel, we're increasing the demand for that grain, and the price goes up. And essentially, every farmer around the world sees a higher price, in fact, right now, much, much higher prices than are typical. And because the price has gone up, people try to make more of whatever the price went up, in this case grain. So they will plow up additional lands if they have the opportunity to do that. Now, who plows up the most land depends on who can produce it most cheaply, and who has the most abundant land. Brazil would be the largest alternative producer, and a lot of that will come from the Amazon or the Serrano. Argentina will produce some more. China will actually produce some more. A lot of countries around the world will produce a little bit more. The U.S. will also produce some more and will plow up some additional land in response to the increased demand. So, it occurs in a number of ways, and we had to have a method, we had to have a complicated agricultural model to try to estimate precisely which countries would produce how much more, and then we had to have a way of estimating in those countries, what are the kinds of forest or grassland that are most likely to be plowed up, which we based on data on what kinds of lands have been plowed up most recently as 'ag-lands' expanded in those areas. But the key point is that almost whatever lands you plow up, you get a release of carbon that is much, much higher than the amount of benefit you get from an acre of biofuel.

Interviewer -- Robert Frederick
Now, we're talking about a comparison always against oil and gas. Isn't converting land to biofuel production eventually a better way to produce fuel than digging up gas and oil?

Interviewee -- Timothy Searchinger
Well, one of the things we calculated was how long you would have to use a biofuel before you paid off the loss of carbon that you start off with. In the case of corn, our best analysis is it would take 167 years. And even if you altered the assumptions to be as favorable as you could possibly be to biofuels, you end up with a payback period that is significantly more than 30 years. The problem is, of course, we need to start reducing greenhouse gases today. So what that means is that these biofuels are indirectly actually increasing greenhouse gases in the near term, and that means we're going to increase global warming in the near term in the hope that in the very long term you might get some reductions. And the long term hopefully will also have a much better technologies than biofuels as a way of reducing greenhouse gases.

Interviewer -- Robert Frederick

So is there some scenario for biofuels that would cut greenhouse emissions in the near term?

Interviewee -- Timothy Searchinger
The key is you want to avoid using productive land because for the most part that productive land is either producing a lot of carbon benefits, carbon savings right now or food that has to be replaced. So that means, for example, if we make biofuels out of waste products, we don't have that land conversion problem. And that's a pure benefit. There is also some thought that you might be able to find really degraded, marginal cropland and use that to produce biofuels on. That may, in fact, be true in some cases, but it's going to be very, very specific because if it's degraded, not producing a lot of crops, the question is whether it will produce a lot of biofuels.

Interviewer -- Robert Frederick
Are there any assumptions that your team makes that those doing the next study might find questionable, turning the whole thing back again and showing that converting lands to biofuel production is again good for the greenhouse gas emissions?

Interviewee -- Timothy Searchinger
Well there inherently are a number of assumptions, and the reason we feel relatively confident about our results is because even when you vary those assumptions a great deal, it's still hard to get a result where these crop-based biofuels or biofuels that use cropland, which includes switch grass if you grow it on cropland. It's very hard to get a result that actually shows that they are even better than using gasoline or diesel fuel. Now, having said that, one of the assumptions that we make that could turn out to be high is we assume that, for example, that yields will continue to go up as they have been, but that if you use biofuels and increase the price, yields will not go up, on balance, more because there's some things that reduced those yields as well. However, we analyzed the alternative under different assumptions, and we still got the same results. But there are also many assumptions that we made that I think probably tend to underestimate the impacts of biofuels. For example, we assumed that outside of one region there would be no conversion of wetlands. Now, the conversion of wetlands tends to cause a much larger release of carbon than we calculated. We also actually assumed that you could get rid of a lot of forest grasses that are actually producing a lot of food without those in turn being replaced in a kind of a second-order conversion. So there actually are plenty of factors or assumptions that we made that were conservation. On balance, I tend to think that we were probably low in our estimate of biofuel emissions rather than high. But having said that, there will certainly be people out there trying to make the case and trying to show that we're wrong.

Interviewer -- Robert Frederick
Timothy Searchinger, thank you very much.

Interviewee -- Timothy Searchinger
Thank you.

Host -- Robert Frederick
Timothy Searchinger is lead author of a paper on how using croplands for biofuels could increase greenhouse gases. Read the paper, as well as another, independent paper on the topic of carbon debt, at www.sciencexpress.org.

Host -- Robert Frederick
Also this week in *Science*: harnessing the power of the step. Max Donelan and colleagues have created a device that generates energy from walking, with little effort. The device works by using a knee-mounted brace with a generator. Gears convert the low velocity and high torque at the knee during walking to high velocity and low torque for the generator, creating electricity. The design allows the device to harvest energy through the full swing of the step or just through the reverse swing. And walkers could produce about 5 Watts, or enough to power about 10 mobile phones simultaneously, without breaking a sweat. Read all about it in this week's *Science*.

Music

Host -- Robert Frederick
It used to be that children born in cities would have a hard time surviving to adulthood. But even though infant mortality rates have fallen along with the pressures of disease and pollution, people in cities still tend to have fewer children than their rural counterparts. As part of a special section on cities in this week's *Science*, Ruth Mace argues in a Perspective that parents in cities are having fewer children because they are pressured to invest more resources into each child. That investment enables the children to better compete with other children in cities for education and job opportunities. I spoke with Mace from her office at University College London.

Interviewee -- Ruth Mace
Well, this paper is really thinking about why it is that people in the recent century, really, have started to have fewer and fewer offspring, particularly in cities. And the main argument that I want to make is that this is very much to do with cost benefits although perhaps not in an obvious way because often the very poorest people are those living in rural areas who have quite large family sizes, even though we would expect poorer people possibly to have smaller family sizes. But, in fact, what's happening, I'm arguing, is that in cities, once you're free from infant mortality, which was obviously a very big problem in the early days of cities that's now no longer a problem, we are investing more and more in children because they are in competition with each other. So, it's almost become a runaway process of parental investment by which I mean ever-escalating levels of investment per child are necessary in order for them to compete with each other.

Interviewer -- Robert Frederick
What are some of those costs?

Interviewee -- Ruth Mace

Well, there seems to be quite a lot of evidence that siblings are competing with each other for things like their parents' time, their parents' money. The more children you have the less time you spend with them, the more difficult it is to get them through good education and training and work opportunities. So the whole cost/benefit has changed. When we used to live on farms, children were actually quite helpful with the whole enterprise of how to produce everything you needed to survive. And therefore, at an individual level, each child probably didn't cost so much. Whereas now, there's fewer opportunities for children to pay back, but more opportunities for children that have had high levels of parental investment to do well. And therefore, these processes can lead us to children now competing for the same jobs, you know, there's a shortage of opportunities for those without much skill. So there's more and more emphasis on, if you like, what biologists sometimes call a quantity/quality tradeoff in terms of pushing towards small numbers of highly invested offspring rather than large numbers of offspring with lower educational levels or wealth levels or whatever it is.

Interviewer -- Robert Frederick
So is wealth the common denominator here or is it cities?

Interviewee -- Ruth Mace
Well, I think it's the opportunities to gain wealth. And there's something about modern lifestyle, which obviously started with the industrial revolution and industrialization that has led to different kinds of opportunities for people to make money, generate wealth, generate status. Although it's true to say that this phenomenon has now spread throughout sort of postindustrial wealth, so particularly in Europe the distinction between cities and rural areas is obviously increasingly blurred. Whereas there's some places, for example, we've done a study in Addis Ababa, Ethiopia where rural fertility is still very, very high, whereas urban fertility in Addis Ababa is still, very, very low. So it just really depends on the context.

Interviewer -- Robert Frederick
Are there particular characteristics of poorer cities that are causing people to have fewer children?

Interviewee -- Ruth Mace
Well, in our study in Addis Ababa had a lot of the characteristics, which characterized why children are quite costly in cities. So, for example it's very difficult to find housing. People might be traveling long distances to work. People might be not paid very much so there're working very long hours. And it's just very, very difficult to raise children and get them educated at the same time. And really the only way out of poverty in some of these areas is to try and hope that you can give your child some skills so that they can take the next step up onto the next rung of the ladder. And these can be quite extreme in some situations. But it's actually very, very common now throughout the world. And then we hear about in China, even though most people are only having one child or so in cities, there's a big trend of sending children, you know, back out to grandparents who live in rural areas to be looked after because it's so hard to look after them in the city. Or in European, you know, areas, accommodations are extremely expensive and difficult to

get a hold of just as it is maybe in Africa or Asia or Mexico City or wherever you're talking about. A lot of these problems of shortage of space, high cost, and an emphasis on education being the only way out, are common to cities all over the world.

Interviewer -- Robert Frederick
Ruth Mace, thank you very much.

Interviewee -- Ruth Mace
Okay, thank you.

Host -- Robert Frederick
Ruth Mace writes "Reproducing in Cities." It's part of a special section on cities in this week's *Science*. You can see a complete list of articles and special news, plus an accompanying video, at www.sciencemag.org/cities.

Music

Host -- Robert Frederick
The United States spends more on science than any other country. But each year there's a back-and-forth between the President and Congress on which science agencies get what. How that money is distributed affects decisions large and small: from whether NASA plans for a trip to Mars to whether a biomedical professor has enough funding to sponsor any more graduate students. In this week's *Science*, several news articles present analysis of the President's 2009 budget. I spoke about it with deputy news editor Jeffrey Mervis.

Interviewee -- Jeffrey Mervis
The President has once again asked for a lot of money for certain kinds of scientific research, specifically in the physical sciences, and hasn't asked for any more money for the biomedical sciences. So, that means that depending on what kind of scientist you are, and where you get your money, this budget could be either very good news or bad news. Now, the one thing you have to keep in mind is that this is not a budget, this is a budget request. The President asks Congress to give him this much money, and then Congress spends the next nine months deciding what levels to give each agency. And the numbers always change. The President never gets the request that he asked, and sometimes Congress waits until the very last minute and then wraps everything up into one big bill.

Interviewer -- Robert Frederick
Were there any surprises in this year's budget?

Interviewee -- Jeffrey Mervis
One surprise was that the administration did stick to its commitment to try to balance the physical sciences with the biomedical sciences. And that was very good news for the National Science Foundation, the Department of Energy's Office of Science, and the National Institute of Standards and Technology. They have been promised double-digit increases for the last three years -- Congress has not delivered that -- but the administration said, 'This is our priority, and even though the overall federal budget is not

going to go up, we are going to ask for very large increases for a few agencies.' The problem with that is that the nail that sticks up often gets hit down in the end. And so a very large increase for one agency is often cut down when Congress tries to feed all the mouths that have been left hungry by the administration's request for cuts in other areas.

Interviewer -- Robert Frederick
But physical sciences this year didn't include much for NASA, did it?

Interviewee -- Jeffrey Mervis
No. NASA and the Department of Defense, even though they fund a lot of science in the physical sciences, in mathematics and engineering, haven't been part of what the administration calls its 'American Competitiveness' initiative. A lot of scientists don't understand that, and they have lobbied hard for increases. For the Department of Defense, that seems to have worked this year. Basic science at the Department of Defense received a very large requested increase this year, even though it's only a tiny part of the Defense Department's overall budget. But NASA has pretty much been told to make do with the same amount of money that it has been getting for the space sciences. Earth sciences, earth observing received more, but planetary sciences did not. And so there's going to be a lot of hard choices that the community in NASA are going to have to make.

Interviewer -- Robert Frederick
Is the increased level of funding for the Department of Defense much surprised given the war in Iraq and Afghanistan?

Interviewee -- Jeffrey Mervis
It's a surprise because most of that money goes for weapons and troop support. Basic research is a billion and a half dollars out of a five-hundred billion dollar budget. So it's 'pocket change,' as they say in Washington, but it's a significant impact for that community that depends on defense money, and so an increase would be very good news for them if it comes to pass.

Interviewer -- Robert Frederick
What's the hit going to mean for the NIH?

Interviewee -- Jeffrey Mervis
That's a very good question. Lobbyists have been saying for the last 3 or 4 years that all the momentum from a 5-year doubling of the budget that ended in 2003 has been lost. And in fact, it's been more than lost. By not keeping up with inflation, NIH has had to cut the number of grants, the size of grants, they're worried about what the impact will be on the next generation of scientists, whether graduate students and postdocs will move into other fields if they don't see their prospects improving over the next few years. And so they're going to push very hard in Congress. And Congress is receptive to that argument, but there's only so much money to go around.

Interviewer -- Robert Frederick

Beyond the next 9 months where this back-and-forth process will happen with Congress, and then the budget eventually will be decided, what can we expect to see in the future?

Interviewee -- Jeffrey Mervis
Well, that's another good question, and no one knows the answer. The budget is supposed to be decided by October 1st. But Congress has missed that deadline and is almost certainly going to miss it again given the November elections. That could mean no action at all on this budget until the next President is decided in November and takes office in January. And then it's anyone's guess what he or she will decide to make a priority in science.

Interviewer -- Robert Frederick
But that's not with this budget, that's with the next year's budget. Is that right?

Interviewee -- Jeffrey Mervis
Well, no. It could affect what's called the fiscal 2009 budget, because the year starts in October. It could be left to the new President and the new Congress to decide how much each agency will get for the year that begins in October, much less for future years.

Interviewer -- Robert Frederick
So, we'll be holding our breath.

Interviewee -- Jeffrey Mervis
Well, I would breathe, but we won't know the answers probably until after the election.

Interviewer -- Robert Frederick
Jeffrey Mervis, thank you very much.

Interviewee -- Jeffrey Mervis
Thank you.

Host -- Robert Frederick
Deputy news editor Jeffrey Mervis on the 2009 science budget for the United States. Read all about it in this week's *Science*.

Music

Feature Writer -- Kate Travis
The qualities of a good mentor read like a personal ad: good listener, considerate, available for regular get-togethers, and passionate about science.

Host -- Robert Frederick
Kate Travis talks about this week's Science Careers feature on good mentoring relationships.

Feature Writer -- Kate Travis

But why would you be in the market for a mentor? Why place that ad?

Interviewee -- Brian Kay
I think that everyone needs mentoring. I have blatantly said I need mentoring.

Feature Writer -- Kate Travis
Brian Kay is a professor and head of the biological sciences department at the University of Illinois at Chicago.

Interviewee -- Brian Kay
I think it's a troubling time as an academic scientist, and so I think not only do you need mentoring, you need a peer group to talk about options and directions and to you, know, applaud your successes and to encourage you in the face of failure.

Feature Writer -- Kate Travis
That type of feedback is valuable for people at all career stages, whether you're a student, postdoc, or early, mid or late-career scientist. Rachel Tobbell says it's particularly important for minorities and for women, for whom there may be few role models. Tobbell is the manager of services for women at the U.K. Resource Centre for Women in Science, Engineering, and Technology.

Interviewee -- Rachel Tobbell
Sometimes it's just really comforting to talk to somebody who looks like they're doing really well, they're doing really successfully, and just to hear them say, "Yes it's really tough, isn't it, just keep going, keep going." You know, just sometimes to hear that from somebody who knows what it's like who's been in your shoes is really powerful and inspirational.

Feature Writer -- Kate Travis
But before you start looking for a mentor, you should know that you've got some work ahead of you. Jan West says it's your job to push a mentoring relationship forward. West is the strategic manager of MentorSET, a U.K. program for women in science.

Interviewee -- Jan West
The mentee leads the partnership. They're the ones that have to do the legwork, the ones who have to be proactive. So, the mentor's position is that they are there as an older, wiser person who can provide support and advice if asked for. But the mentee is the one that runs the partnership.

Feature Writer -- Kate Travis
If all goes well, both mentor and mentee will benefit. Again, Brian Kay.

Interviewee -- Brian Kay
You'd like to think of it as developing a friendship where you have a common goal: the success of the mentee.

Feature Writer -- Kate Travis
So what do you do first in a mentoring relationship? Jan West says building trust is a good place to start.

Interviewee -- Jan West
Well, I think the first thing that's very important is to actually build up a proper relationship between you and your mentor. You've got to get to know each other and to understand each other. And certainly from the mentee's point of view, the mentee has to know that they can trust that mentor, trust them with their secrets.

Feature Writer -- Kate Travis
Rachel Tobbell adds that you have to be honest, too.

Interviewee -- Rachel Tobbell
I think honesty is really important, because again, I don't think a mentor can be as useful to a mentee if they're not being honest, if they're not giving honest feedback. And a mentoring relationship should be a safe place for a mentee. It should be a place where a mentee can talk about the things they find difficult, maybe things they've done wrong, mistakes they've made, because the whole point of mentoring is it's a learning relationship.

Feature Writer -- Kate Travis
And Brian Kay says you have to listen, whether in asking for advice or giving it.

Interviewee -- Brian Kay
A good mentor is somebody who listens, who has a lot of experience both positive and negative. I tell people I'm a good troubleshooter because I have failed often. I know what things can go wrong.

Feature Writer -- Kate Travis
Learning to listen, be honest, and trust in a mentoring relationship is important whether you're seeking your first mentor or are further along in your career. Brian Kay recently started a mentoring program in his department to pair new and mid-career scientists with established professors. He says this kind of mentoring is often missing in academic science.

Interviewee -- Brian Kay
In academia, there's a tremendous amount of respect for individuality and privacy. And so once someone's been promoted, you have a party, you pop the champagne, and then you hope that that individual then continues on with that same momentum, the same drive. But you stop mentoring them, and that's a mistake.

Feature Writer -- Kate Travis
Though, it is possible that a mentee will outgrow his or her mentor. When that happens, Rachel Tobbell says the mentor should be proud.

Interviewee -- Rachel Tobbell
What you're hoping for is that one day the mentee turns around, shakes you by the hand, and says, "Thanks ever so much for your support, it's been great, but I just don't think I need you anymore." And fantastic, because what you're trying to do all the time in mentoring is create an empowered, independent mentee who has learned everything that you can give them, and who has developed and who has moved forward, and who either may be ready for a different mentor or who might be ready to go it alone for a while.

Feature Writer -- Kate Travis
But the relationship doesn't necessarily stop there. There's a good chance your mentor will continue to be a colleague, an advocate, and perhaps even a friend. For Science Careers, this is Kate Travis.

Host -- Robert Frederick
This week on Science Careers, read the stories of several mentees and their mentors, and how they benefited from their mentoring relationship. Find them online at ScienceCareers.org.

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Music

Host -- Robert Frederick
Finally today, David Grimm, editor of *Science's* free online daily news service, *Science*NOW, joins us to talk about the latest science stories. Hi David.

Interviewee -- David Grimm
Hey, Rob.

Interviewer -- Robert Frederick
So what stories do you have for us today?

Interviewee -- David Grimm
Well, Rob, we're going to talk about why soccer is not for the faint of heart, how salmon dredge up their streams, and finally, what makes brown eyes blue.

Interviewer -- Robert Frederick
Well my heart's pitter-patter. Soccer is not for the faint of heart?

Interviewee -- David Grimm
Well, Rob, that's right. It turns out that soccer can actually be very bad for your heart. At least according to this study, which, where researchers looked at the effect of World Cup soccer on German men during the World Cup event in the summer of 2006. And what they were interested in is there's been other events like earthquakes and terrorist attacks seem to cause a spike in heart attacks. And these researchers wondered do sports have the same effect because sports can be very stressful especially if the people that are watching them are very invested in the outcome.

Interviewer -- Robert Frederick
Waiting for the announcer to call "Goal!"

Interviewee -- David Grimm
Exactly. And so what these researchers did was they looked at the hospital admissions for about 4,000 Germans, both men and women, some of these admissions occurring during the day of these soccer matches, and some of them the week before and the week after, just as controls. And what they found was that during the games, men in the Munich area of Germany experienced over three times as many cardiac events, and that means things like heart attacks, chest pains, and palpitations, than they did during the control period.

Interviewer -- Robert Frederick
So how did that compare to the incidences of heart attacks during earthquakes or the terrorist attacks?

Interviewee -- David Grimm
Well, at least for earthquakes, one study showed that there was about a five-fold increase in cardiac events during a Los Angeles earthquake in 1994. So, this isn't too far from that. And what's also interesting is women weren't as affected as the men were, their cardiac event rate was about double what it was during control periods, but not nearly as high as the men's' was.

Interviewer -- Robert Frederick
Does that suggest they're not as invested in the game?

Interviewee -- David Grimm
Well, the researchers don't speculate.

Interviewer -- Robert Frederick
Well, I remember they got rid of the sudden-death overtime way back when because it also had been positively correlated with higher incidences of heart attack. What makes this study different?

Interviewee -- David Grimm

Well, you're right, Rob. There have been other studies that have shown associations between soccer and even other sporting events and heart attacks, but they've been in conflict. Some have actually shown decreases in heart attacks, some have shown increases. What's different about this study is that they're actually able to be very precise in their timing. They looked at hour by hour when the spike in heart attacks occurred. And it turns out they occurred about 2 hours into the match. And this shows that whatever is triggering these cardiac events is occurring about 1 or 2 hours before the symptoms actually appear. And what's more, 2 matches in particular, really caused a really big spike in heart attacks. And that was a hard-fought victory between the Germans and an Argentinean team and also an important loss to Italy, which these researchers say proves that the heart attacks aren't necessarily occurring because of the outcome of the game, but rather it's because of the excitement of the game.

Interviewer -- Robert Frederick
Well, from the life and death excitement over World Cup soccer matches to the life and death struggle of salmon as they swim upstream. Is that what's causing the dredging up of the streams?

Interviewee -- David Grimm
Well, in a way, yes, Rob. As most people know, salmon spend most of their lives at sea, but when it comes time to lay their eggs they really do face a life and death struggle. They have to swim upstream, and they have to avoid bears and fisherman as they make their grueling way upstream. And once they get there, the females lay their eggs. But to do this they actually dig out a significant part of the stream bottom to lay their eggs. And this is called a redd. And it may not seem like a big deal just to have a little salmon tail digging out a hole for it to lay its eggs, but when you multiple that by millions of salmon, the results can be pretty dramatic. And so a team of researchers were wondering, "Well, how dramatic?" So the researchers used sediment traps and magnetized particles, all this fancy stuff, and also just maps of these streambeds, and they studied salmon in the mountain streams in British Columbia. And what they found is salmon account for as much as 50% of the annual amount of sediment migration in these streams, which means the salmon are a huge force in reshaping these streams and dredging up sediment in these streams, even more so the researchers say than annual spring floods do.

Interviewer - Robert Frederick
Well, that sounds like a dramatic effect. Are there any positive impacts of this dredging?

Interviewee - David Grimm
Actually, it seems like there are. When the salmon dredge up all the sediment, they're actually increasing the oxygenation of these streams, and that improves the health of the entire ecosystem. So, not only are the salmon really reshaping these streams, but they're actually very vital for the entire ecosystem of the stream.

Interviewer - Robert Frederick
Well, from the vitality of streams to the vitality of the gene that turns eyes blue. Why do some people have blue eyes?

Interviewee - David Grimm
Well, it's a question that researchers have been trying to figure out for decades, literally. And it's been really frustrating because researchers have found a gene called OCA2, which is implicated in a variety of eye colors. This is the gene that in its "normal" form makes your eyes brown. But if its mutated it can make eyes green or hazel. And researchers just assume, "Well, there must be another mutation on the gene which makes eyes blue." But, despite years of researching they've never found this mutation. So a team of researchers wondered, "Well, hey, maybe there is something going on in a different gene that's making eyes blue." So what they did was they examined members of a large Danish family, and this allowed them to trace individuals over several generations. And they also compared this to people from Jordan and Turkey, so they got this very large genetic data set. And by investigating all of these people's genes and trying to trace what causes blue eyes, they found a mutation on a gene called HERC2. And what's interesting about HERC2 is it's nearby to OCA2. And what the researchers think is it's acting as a sort of genetic switch, so that normally your body makes your eyes brown, but when there's this mutation in HERC2, HERC2 somehow switches off this brown coloring in your eyes and allows blue eyes to shine through.

Interviewer - Robert Frederick
Do researchers have any idea how long this mutation's been around?

Interviewee - David Grimm
Yeah, well, one of the groups that published this finding says because blue eyes are predominant in people of European descent, they feel that they were able to trace back the first blue eyed person to somewhere around 6,000 to 10,000 years ago. Now a couple of other groups also published on this finding, and they're not as convinced that you can trace blue eyes back to this particular period of time, so the jury is still out on that part.

Interviewer - Robert Frederick
Well, could there be other ways that blue eyes are made?

Interviewee - David Grimm
Well, it's a good question, Rob. Researchers already know that there's about ten ways to make red hair. So, just because this is one way to make blue eyes doesn't mean there aren't other ways to make blue eyes.

Interviewer - Robert Frederick
Why does this mutation for blue eyes persist?

Interviewee - David Grimm
Well, that's another good question, Rob. And most mutations that we acquire stay in our gene pool because they confer some sort of adaptive advantage, like mutations that would give us a bigger brain size. But researchers don't really think there was any selective advantage for blue eyes. One possibility, however, is that women just find blue eyes

more attractive. So, females were more likely to mate with males who had blue eyes, blue eyes would stick around in the gene pool.

Interviewer - Robert Frederick
And the same thing could work for women?

Interviewee - David Grimm
Exactly.

Interviewer - Robert Frederick
How might people apply this knowledge?

Interviewee - David Grimm
Well, one interesting application is in the field of forensics. You could imagine that if you had someone's DNA, say from a blood sample, you might be able to tell what eye color the suspect was or the victim.

Interviewer - Robert Frederick
All right. Well, thanks, Dave.

Interviewee - David Grimm
Thanks, Rob.

Interviewer - Robert Frederick
So what other stories are you looking at for *Science*NOW?

Interviewee - David Grimm
Well, Rob, we're looking into a story about how alligators digest big, bony meals, how a laser can be used to change the color of aluminum – green, red, and yellow - and finally why married cousins have more kids.

Host -- Robert Frederick
David Grimm is the editor of *Science*NOW, the free online daily news service of *Science*. You can check out the latest science stories at sciencenow.sciencemag.org.

Music

Interviewer — Robert Frederick
And that wraps up the February 8th, 2008, *Science* Podcast. If you have any comments or suggestions for the show, please write us at sciencepodcast@aaas.org. The show is a production of *Science* Magazine and of AAAS, the Science Society. The content is provided by the news and editorial staff of *Science*, and Jeffrey Cook composed the music. I'm Robert Frederick. On behalf of *Science* Magazine and its publisher, the American Association for the Advancement of Science, thanks for joining us.