

NPR: Talk of the Nation/Science Friday

Analysis: Animal diseases and their effects on human health

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IRA FLATOW, host: You're listening to TALK OF THE NATION/SCIENCE FRIDAY. I'm Ira Flatow.

This week's monkeypox outbreak in the Midwest has been traced to prairie dogs who caught the disease from rodents imported from West Africa, where the disease is endemic. And the origin of SARS outbreak in China is suspected to be the civet, which is a small mongooselike animal that is a delicacy there. Food handlers were the first to become ill earlier this year.

So what's going on? Are animals catching more diseases and passing them on to us, or are we humans coming into contact with more animals, increasing our chances of catching what's already out there? Well, in a recent study, researchers catalogued infectious microbes that make people sick, and more than half of the 1,400 pathogens are zoonotic--that is, they can be transmitted between animals and humans, usually from animals to humans. And when the researchers looked at new or emerging diseases, three-quarters of them came from animals.

So up against these statistics, how can we protect ourselves against the next SARS or monkeypox? This hour we'll talk about the threat that animal diseases pose to human health, and what we can--to minimize the chances that wildlife diseases will spread out of the wild. And if you'd like to join our discussion, our number: 1 (800) 989-8255; 1 (800) 989-TALK. And, as always, you can surf over to our Web site at sciencefriday.com for more information.

Let me introduce my guests. Peter **Daszak** is the executive director of the Consortium for Conservation Medicine at the Wildlife Trust in Palisades, New York, and he joins us today here in our SCIENCE FRIDAY studios.

Welcome back to the program.

Dr. PETER **DASZAK** (Executive Director, Consortium for Conservation Medicine): Oh, good afternoon, Ira.

FLATOW: Jonathan Patz is the director of the Program on Health Effects of Global Environmental Change and assistant professor of environmental health sciences at Johns Hopkins' Bloomberg School of Public Health in Baltimore, Maryland. He joins us today by phone from Oakland, California.

Welcome back to the program.

Dr. JONATHAN PATZ (Director, Program on Health Effects of Global Environmental Change): Thank you, Ira.

FLATOW: You're welcome.

Dr. **Daszak**, Dr. Patz, let me--I mentioned monkeypox and SARS in the introduction. Can we expect more emerging or re-emerging wildlife diseases or rare animals in contact with people more frequently? Are we going to be seeing more of this? Let me ask you, Dr. **Daszak**, first.

Dr. **DASZAK**: Well, that's certainly true. I mean, one of the key characters that defines emerging diseases is that things we do to the environment drive their emergence. So as we move around the planet and take these strange new wild animals into different areas and keep them as pets, as we

move domestic animals from one place to another, we also move their pathogens and we spread diseases and cause emerging diseases. So we can predict that this is going to continue and probably increase.

FLATOW: Jonathan?

Dr. PATZ: Yeah. That's a great point about the international trade and travel, but this issue about disturbing natural ecology, I think, is one that is really becoming more and more recognized. Deforestation may be a cause for increase in malaria; certainly bush-meat hunting, where I think we'll talk more about this, where you have more contact with monkeys that are very similar to us as far as genetic information--whatever they carry, we have a risk of catching. And other issues like biodiversity loss, a new issue that may be related to diseases, even as close to home as Lyme disease. So some of these disturbances that we are doing at a global scale may be one reason, and another one is related to some of the practices that we're engaged in, not only the travel issue, but intensive factory farming is one problem that may be leading to antibiotic-resistant strains, certainly mad cow, and I'm sure we'll talk about SARS and some of the issues of exotic agriculture.

FLATOW: You mentioned one at the beginning, which was eating of monkey meat, and isn't that how we suspect that AIDS was moved from the monkey population to the human population?

Dr. PATZ: Yes. I mean, historically, it's felt that AIDS may have jumped into the human species as early as the 1930s. It has been found that, you know, the virus was found in chimpanzees, so it looks like a disease that was in monkeys. And certainly AIDS is not a disease to be taken lightly when more than 20 million people have died from that disease. And this is the classic example of a zoonotic animal disease that, based on close contact--certainly, bush-meat hunters go out there, and slaughtering monkeys, it's likely that you're going to have exchange of blood. HIV is the classic zoonotic disease. But there are many more historically; even TB and smallpox, which originally resided in ancient populations of wild cattle, spread into humans when we domesticated them.

FLATOW: Peter, this week's big news, of course, is monkeypox, and the animal transmitting the disease to people seems to be prairie dogs, but they didn't start with prairie dogs. It came before something else infecting the prairie dog.

Dr. **DASZAK**: Yeah, the giant Gambian pouched rat, which was brought in a shipment of 50 of these animals into Texas. Then a shipment was moved up to Illinois, and these rats carried the virus, the monkeypox virus. They spread it to prairie dogs, which people are now keeping as pets, and people in contact with infected prairie dogs started to show the symptoms of monkeypox, even in the States.

FLATOW: But then couldn't you just stop this by, you know, stopping the importation of these Gambian pouch rats and sale of prairie dogs and...

Dr. **DASZAK**: Well, yeah. In fact, today, CDC and FDA eventually blocked the importation of rodents from Africa. They've blocked the sale and distribution of prairie dogs and six other African rodents in the USA.

FLATOW: And then we had the case of SARS jumping from animals to humans. It came from a civet, is that correct?

Dr. **DASZAK**: Well, the evidence seems to point towards that. I mean, it's fairly convincing. Certainly, there was a high seroprevalence, so that's high evidence of antibodies, in people working in markets in Guangdong province in China who sold these civet cats, handled them as food sources. And sure enough, when the researchers went to the civet cats and took tissue samples, they actually cultured virus out of those animals. So it looks like they may be the reservoir for SARS.

FLATOW: And let's go down the list. You have all kinds of--historically, there have been many diseases from animals to humans, and we talked about some--even TB and the measles. You have Lyme disease, we have West Nile virus...

Dr. **DASZAK**: The Hantavirus.

FLATOW: ...the Hantavirus. Keep going. The Hong Kong flu, even.

Dr. **DASZAK**: Ebola virus.

FLATOW: Ebola.

Dr. **DASZAK**: Yeah.

FLATOW: And even a lot of, as I say, the flu that we get travels from birds, is that correct?

Dr. **DASZAK**: Yeah. It's a very bizarre thing, actually. I mean, flu is a fascinating disease. The virus can actually move segments of its genome from one individual to another, individual virus. And what happens is, in China, where pigs are farmed very closely with ducks, the avian form of influenza is able to infect pigs, and then recombine with the pig form and then become available to humans. And this is how new strains of influenza emerge each year and then move across the globe.

FLATOW: Jonathan Patz?

Dr. **PATZ**: Yeah. I mean, we've learned a lot from influenza, which used to live in swine and, of course, in birds as well. And, as Peter is mentioning, this mixing, combining farming pigs and ducks that happens a lot in China, allows not only for these viruses to be in one animal--for example, duck virus influenza virus may come into the pig--it allows for recombination. But this is what we think may be what's going on with SARS. For example, these viruses are single-stranded RNA viruses, so they don't have repair enzymes. So they have a very high mutation rate. And when you have this mixing of different viruses across animals, you get the possibility of recombination. And it's thought that SARS--this is what may have happened with those animals all in close proximity, where you had genetic exchange that led to a new variant of this coronavirus that is actually common in animals and also even a human cold virus.

So I think the issue about, you know, these viruses and other pathogens cross species barriers. And when you have agricultural practices--and we are concentrating these different species together--it's not--it wasn't necessarily unpredictable that something like SARS would emerge, considering the nature of that RNA virus.

FLATOW: So you just have to wait for the timing. The timing is what counts here. It would happen inevitably because of the mixing of the DNA/RNA parts, things like that, to create the one that escapes.

Dr. **PATZ**: Right

Mr. **DASZAK**: In fact, we're not really waiting. I mean, people are out there trying to predict the next strain of influenza to emerge each year and developing vaccines to prevent that, so that's why you need a vaccine for influenza virus each year because it's a different strain that emerges.

FLATOW: Is it the habits of how the Chinese raise their animals, Jonathan, that is the problem here?

Dr. **PATZ**: Well, I think it's simply a matter of probability, if you've got microbial diversity across different animals. And they may be--the rate of contact and intimacy is increased by overcrowding conditions. I think that is something that can affect the probability. And as I said before, some of the other issues that we're doing--disturbing natural ecosystems, as well as this type of intensive farming and agriculture--these increase the probability of new pathogens arising.

And there is an issue of crossing species. You know, we think that we're not gonna catch diseases from animals, but as you've pointed out, and historically, many of our diseases come from animals. There's something that--it's called the taxonomic transmission rule where the closer a species is to

humans the more likely that pathogen that it carries may jump into humans. And this is why something like bush meat hunting is of a special concern because, you know, genetic information between non-human primates--monkeys--and us is so close.

FLATOW: Is the fact that it crosses species--does that have anything to do with why it's so difficult to fight it, like AIDS, something like that?

Dr. PATZ: Well, I think the main issue there is that we're talking about ecological processes, so we're talking species, biodiversity and disrupting natural biodiversity, but we're also talking about coming into contact with these species. When we are deforesting and building logging roads in the African jungles or the Amazon, people are coming into contact with these organisms that they wouldn't normally come into contact with. So that...

Mr. **DASZAK**: Yeah, and there are, in fact, some really bizarre examples of this--humans contacting wildlife pathogens. For instance, there was an outbreak of a new virus in Malaysia in 1999 called Nipah virus that emerged from fruit bats. And what was happening in Malaysia is that people farming these huge, intensive farms with pigs really close to fruit bat habitat--and planting orchards of fruit trees around the pig farms, and fruit bats would come and feed at these. And somehow the virus that fruit bats live naturally with, this Nipah virus, moved into pigs, caused a large epidemic, and then infected people associated with the pig trade. Over a hundred people died, and it's a very lethal disease with about 40 percent of people that get infected actually die. So...

Dr. PATZ: You know, speaking of Nipah virus, that brings up an other issue that we really haven't talked about, and that is climate extremes. And one theory--and, Peter, jump in anytime here--is that the reason that Nipah virus occurred when it did was related to the severe El Nino of 1997-'98, when the entire Indonesian forests were on fire because of the extensive drought, and the fruit bats were forced to migrate to places up in Malaysia, where Peter has been studying this. So here's an issue where an extreme climate phenomenon may have led to species like the fruit bat migrating that may have led to this emergence of Nipah virus.

And we have other examples, like pulmonary Hantavirus. Pulmonary syndrome in the desert Southwest seems to be another one related to extreme climate driven by El Nino.

FLATOW: We're talking about diseases this hour on TALK OF THE NATION/SCIENCE FRIDAY from NPR News.

Peter, did you want to say something?

Mr. **DASZAK**: Yeah. I just think it's interesting that we always look to tropical countries and imagine these very scary diseases emerging out of tropical countries. But let's not forget that we do some very strange things with agriculture in Europe and in North America. For instance, mad cow disease, BSE, emerged because we're feeding meat rendered from infected cattle carcasses back to cattle. So that's a disease that emerged in our own agricultural system because of the increased intensity in the strange factors that we were involved with.

FLATOW: It's not a natural thing for cows to eat meat, is it?

Mr. **DASZAK**: Not really. Certainly not in Europe.

FLATOW: Not contented cows. Anything else? Anything you can point to? Any sort of examples of that where when we're forcing nature we're creating unpredictable results here?

Mr. **DASZAK**: Well, another example is there's been a series of food-borne outbreaks of salmonella and E. coli in the States. And one of the real causes of this is increased intensification of agriculture by trying to make it more economic to process meat for hamburgers and things. We actually centralize these processing factories, and we bring more and more animals together. All it takes is one infected animal in a batch of carcasses that are then spread out to a number of hamburgers and sent out all across the States, and you get these sort of nationwide outbreaks.

FLATOW: That's why we feed more antibiotics to the cattle, and that creates a whole different set of...

Dr. PATZ: Yeah. Let me just mention that's...

FLATOW: Yeah. Go ahead, John.

Dr. PATZ: ...yeah--that if you look at the number of poultry and number of cattle that we are raising, the numbers are going up and up and up, and yet the facilities are decreasing. In other words, we are getting larger and larger concentrated animal-feeding operations. And by the very nature of preventing disease from that overcrowding situation, we are using a lot of antibiotics in agriculture. In fact, much more so in agriculture than in human medicine. And it's felt that a lot of the antibiotic-resistant strains are a direct result of our overuse of antibiotics in agriculture. And it's expanding into aquaculture as well as a problem in the marine environment.

FLATOW: Yeah. We were talking last week about farm-raising fish, salmon, fish like that, where they're putting out a tremendous amount of waste in some of these fish farms. And then being fed antibiotics to prevent these things?

Mr. **DASZAK**: Yes. So the antibiotics get spread straight out in the ocean, and who knows what effects that's going to have on an ecosystem.

FLATOW: But this is a trend. How do you cont--reverse a trend like this?

Mr. **DASZAK**: Well, it's very difficult because what we're talking about here are things that are very good for the human economy. We're talking about international trade; we're talking about agriculture. And obviously, we like cheap meat products. We like cheap animal products. And it's difficult to deal with diseases without affecting those trends. But I think what we've got to do is we've got to look at what's happening out there and try and understand the process of disease emergence. And we know now, pretty clearly, that what drives disease emergence are these different changes to the environment, these increases in trades and human population movement. We know where the pathogens are. We know that they've got a large biodiversity out there. Let's try and move towards predicting the next SARS or the next monkeypox outbreak, and I think then we can deal with it in a much more cost-effective way, rather than blocking a trade after the event.

FLATOW: All right. We're going to take a short break and come back and take more of your questions. We're talking with Jonathan Patz and Peter **Daszak** about merging/re-emerging disease. Stay with us. We'll be right back.

FLATOW: I'm Ira Flatow, and this is TALK OF THE NATION/SCIENCE FRIDAY from **NPR** News.

(Announcements)

FLATOW: You're listening to TALK OF THE NATION/SCIENCE FRIDAY. I am Ira Flatow.

We're talking this hour about animal diseases and human health with my guests, Jonathan Patz, director of the Program on Health Effects of Global Environmental Change and assistant professor of environmental health sciences at Johns Hopkins Bloomberg School of Public Health in Baltimore. Peter **Daszak** is executive director of the Consortium for Conservation Medicine of the Wildlife Trust in Palisades, New York, just up the road a bit from New York City. Our number: 1 (800) 989-8255.

We're in sort of the West Nile virus season, aren't we, Peter--I mean, with mosquitoes and things? Are we going to be seeing that re-emerging and moving and...

Mr. **DASZAK**: Oh, for sure, and we've just seen the first few cases of dead birds reported that are coming through now. And last year was an incredible year for West Nile virus. And let's not forget the West Nile virus is an example of one of those diseases that was introduced into the States from

a foreign country. It was brought in, probably, with infected birds or maybe an infected mosquito, so it's part of this problem of globalized trades and wildlife and their products.

FLATOW: Well, could it have been predicted it was going to be coming here sooner or later?

Mr. **DASZAK**: Well, it's a tough one, isn't it? I mean, it's very difficult to guess which is the next disease that's going to be introduced, and very few people would have said monkeypox, I think. But what we can say now with West Nile virus is we know it's moving very rapidly out to the West. It's already reached Washington state last year. It was in California last year.

One of the things that we're actually working on with the US Fish and Wildlife Service in Hawaii is predicting sort of risk of the virus getting into Hawaii, because one thing that West Nile virus does is it kills crows. It kills crows and related birds very efficiently, and on Hawaii there's an endangered crow, the Hawaiian crow, which there are only two left in the wild and about 30 or so in captivity. And this disease, if it moves on to Hawaii, will be a really serious threat to cause an extinction of that species and maybe some other endemic Hawaiian birds. So US Fish and Wildlife out there are working on an action plan to prevent West Nile virus getting in and to deal with it if it does get in. One of the things that they've found out is that it's actually completely legal to post live birds from the mainland over to Hawaii, so they're looking into dealing with that as a potential way of the virus getting in.

FLATOW: Jonathan Patz, tell us about yellow fever.

Dr. **PATZ**: Well, yellow fever is a disease. It's a viral disease that's carried by mosquitoes, and it happens in the wild naturally. It's up in the canopy of rain forests, and it's cycling between mosquitoes and monkeys up in the canopy. And one problem with yellow fever, a potential of concern in large urban areas down in the tropics, is that loggers going into the rain forest cutting down the trees can bring down the canopy and bring down the mosquitoes with them and actually get infected by this mosquito and get yellow fever.

The scenario that I know that CDC is quite concerned about is then these infected loggers going back into a large urban area where the mosquito called *Aedes aegypti* that's very efficient in carrying dengue fever, which is a rampant disease, can also carry yellow fever. And so, you know, the idea that these people cutting the trees and then bringing the disease into the city is of concern. We do have a vaccine for yellow fever, but we don't have it in large enough supplies, and the concern is that once an epidemic would start it could be very difficult to control.

FLATOW: Do you have to give the vaccine before exposure, or can you give it after exposure?

Dr. **PATZ**: It's best to get it before exposure, and it's actually one of the most effective vaccines we have for travel, and it lasts for 10 years.

But, you know, there are other concerns with deforestation in that part of the world. I know that there's an example--that's a very large risk--but one disease that has been seen to re-emerge from deforestation in the Amazon is rabies. And, in fact, there have been instances where you have gold miners going into the Amazon, mining for gold, and there's a lot of machinery, and there's also a lot of logging that goes on at the same time, where natural hosts of rabies disappear and so the bats are looking for something to eat. And so there's one direct implication of deforestation in that region. A big fear, though, is yellow fever, and we're conducting studies linking a rise of malaria to deforestation because of--the species of mosquito that carries malaria likes open, sunlit pools. So here there are all sorts of diseases that are related to deforestation that are on the rise.

FLATOW: 1 (800) 989-8255. Let's see if we can get a phone call or two. Let's go to Tom in Davis County, Utah. Hi, Tom.

TOM (Caller): Howdy.

FLATOW: Howdy.

TOM: Let me kill this other phone. Curious thing that I never hear when we're talking about vilinosis(ph)--that's this issue, right?

FLATOW: Right.

TOM: I'm a former rancher/dairyman. Also worked in pathology and, of course, with my ranching and animal experience, worked in veterinary pathology. And everybody is wont or afraid to speak about the transmission of the diseases from the animals to man; not only that, but the interanimal transmission. You know, you talk about a bird carrying a virus. Birds fly. They don't care about boundaries. They don't even care about oceans. They'll cross at the Aleutian Islands. They'll cross, you know, the Northern Atlantic and bring their viruses from other continents and then mingle with other animals. And, of course, birds are generally obligate carnivores, and then other birds are obligate carnivores, so if you have a bird that picks up an infection and dies, it becomes the lunch of another.

And when these birds are flying they mingle with the livestock, the flocks. And, of course, the chicken is an obligate carnivore. It doesn't care. I raise chickens. They eat rodents. They eat other dead birds. They have no problem eating another piece of animal tissue. Pigs are obligate carnivores, or are made to be. And, of course, like you say, the cow is now being fed rendered meat, which includes pig and other animals. So there is no stopping of these viruses going from one species to another, and then ultimately man wraps his lips around it.

And, of course, working in pathology, when we go into the lab we don't use another human being to culture the infection we've picked up from man or cultured from man; we use a mouse or a monkey or some other animal, or even cow's blood or tissue to culture it. So when you're talking about these barriers, there really is no barrier. And even though a virus may not do well in one species, it has no problem being transmitted, even in a dormant or a homeostatic state, to another animal that is capable of supporting it.

FLATOW: You're describing the multipaths that these things can take. Let me get reaction from my guests.

Jonathan, any reaction to that?

Dr. PATZ: Why--one thing that I wanted to raise that this caller brings up is the issue that we're talking about transfer from animals to humans, and he's asking about animal-to-animal transfer. I'd also like to extend that and talk about there's been documentation of transfer from humans back to animals and endangered species. Their ecotourism, for example, in Africa has led to cryptosporidiosis in mountain gorillas, so it goes both ways.

Mr. **DASZAK**: And, in fact, Jane Goodall talked about polio in the Gombe chimps.

FLATOW: She did? Wow. Peter, where are the hot spots? Where are the hot spots now that we should be watching out...

Mr. **DASZAK**: Well, it's interesting. I mean, the last caller raises a very important point: Diseases don't respect national boundaries; they don't know any political or country-type boundaries. So animal disease move with animals, and where animals come into contact with others there's a chance for disease spread. What's happening in the world now is that we're getting humans encroaching into wildlife space and animals being transported from one place to another, so we're getting an increase in the contact between different species of animals and their viruses and other pathogens.

So it's interesting trying to predict where the hot spots for emergence are. Certainly, if you look at the tropics there are more vertebrate species there, so there are likely to be more, potentially, zoonotic viruses that these vertebrates carry. But it isn't always the tropics where we're having these big changes going on, and it's the changes that drive emergence that count. So it's a tradeoff

between where you've got lots of intense agriculture and land-use changes vs. areas where you've got very high diversity of new pathogens waiting to emerge.

FLATOW: Talking about diseases moving around the world this hour on TALK OF THE NATION/SCIENCE FRIDAY from **NPR** News.

So should...

Dr. PATZ: Well, I...

FLATOW: Yeah, go ahead.

Dr. PATZ: No, I'd just like to follow up where, you know, you ask about where the hot spots are.

FLATOW: Yeah.

Dr. PATZ: I think one issue is, you know, it's hard to tell right now where the hot spots are, and right now we're in this sort of brush-fire, wait-and-see response mode where something happens and then we respond. And I think as Peter points out, some of these underlying changes--the changes in landscape and disturbance of natural systems--you know, there are some case studies we've brought up, but there's so much that we don't know. And I just want to mention that this new Consortium for Conservation Medicine that Peter directs, and Johns Hopkins is a member partner of this consortium, was established to precisely look at these questions about the issues we're talking about. And what it does is it brings together conservation biology, wildlife veterinary medicine and public health so that we can begin to better predict and figure out where the hot spots are so we're not in the wait-and-see, brush-fire mentality of treating these after the horse is out of the barn.

FLATOW: Is China still a hot spot?

Mr. **DASZAK**: Well, I'm not sure it is. I mean, certainly for influenza virus it's clear that China is a place where these viruses emerge. SARS emerged from China; we can't argue with that. But, you know, Nipah virus emerged from Malaysia. A related virus called Hendra virus emerged in Australia. And what we're actually doing right now at the consortium is trying to map out a hot-spot approach to emerging diseases to see actually where these viruses and other pathogens come from, and I think that there are going to be some surprising results. West Nile virus came from the Mideast. It moved in through New York. Is New York a hot spot for emerging diseases? Certainly areas where there are big ports and lots of strange animals being moved in, lots of contact with different populations of animals and humans--they're areas where you're going to get disease emergence, too.

FLATOW: Is terrorism...

Mr. **DASZAK**: Oh, certainly.

FLATOW: ...a tool for worrying about, or a reason to worry about?

Mr. **DASZAK**: Certainly. And there is, not only from the government, a huge interest in trying to predict what's going to be the next bioterrorist agent. But also scientific researchers too are very concerned about this issue. Some of these pathogens are very lethal, and some of them are very easily transmitted. And it's not beyond the realm--I mean, certainly after 9/11--for terrorists to quite easily get hold of some of these pathogens and use them against his fellow humans.

FLATOW: And to disguise it, I mean, is something that you would, you know--was naturally occurring or something, and I...

Mr. **DASZAK**: Absolutely. And it's interesting that quite often people suspect when there's a new outbreak like West Nile virus and SARS, 'Is this a bioterrorist event?' Maybe one day we'll see that, but so far, frankly, not yet.

FLATOW: You're making it sound scary to travel anywhere.

Dr. PATZ: You know, one thing, though, about bioterrorism is that we are not great at detecting it because we don't have very good disease surveillance right now. And so in order to detect an unusual increase in a disease that may be seasonal--like influenza, for example, comes up and down--there are other disease where because we don't know the baseline prevalence and incidence of that disease because of our lack of public-health infrastructure and surveillance, we will have trouble detecting these. So the bioterrorism issue, again, is a call for increasing our surveillance and public-health infrastructure just so we can know when it's happening.

FLATOW: All right, gentlemen. We've run out of time. Thank you both for joining me this hour.

Peter **Daszak** is executive director of the Consortium for Conservation Medicine at the Wildlife Trust in Palisades, New York. Jonathan Patz, director of the Program on Health Effects of Global Environmental Change, and assistant professor of environmental health sciences at the Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland .

Thank you both, gentlemen, for joining us this hour.

Mr. **DASZAK**: Thanks very much, Ira.

Dr. PATZ: Thank you, Ira. It's a pleasure.

FLATOW: You're welcome.

(Credits)

FLATOW: If you have questions, you want to write to us, TALK OF THE NATION/SCIENCE FRIDAY, 1221 Sixth Avenue, 37th Floor, New York, New York 10020. And surf over to our Web site at sciencefriday.com. We have curricula made just for you and your students.

Have a great weekend. We'll see you next week. I'm Ira Flatow in New York.