Ask a Biologist vol 031 Topic: Spiders & Arachnologists Guest: Norman Platnick

Spider Man Meets Spider- man -

World expert arachnologist Norman Platnick sits down with Dr. Biology to talk about his favorite eight legged animal. Sometimes scary to people, learn what the world might be like without spiders and if the current action hero Tobey Maguire is actually afraid of the animal who made him famous.

Transcript

Dr. Biology: This is "Ask-a-Biologist," a program about the living world, and I'm Dr. Biology.

If I was to ask you, “Who’s Spiderman," I bet most of you would answer, "Peter Parker." While the Marvel comic hero is likely more well known than our guest today, he's just fiction, and our guest scientist is real. OK, our guest is also not wearing a superhero costume, and he didn't swing into the studio on a strand of silk.

Instead, Dr. Norman Platnick is possibly one of the most well-known arachnologists in the world. You might be thinking "Arachno-what?" In case you're not up on your Latin, "arachno-" means spider and "-ologist," just like the ending of "biologist," means "the study of." So, Dr. Platnick studies spiders. And even though he does not have spidey senses, he does have "SPIDA-web", an artificial neural network used by scientists to identify spiders around the world at superhuman speeds.

We're able to talk with him while he's visiting ASU for the launch of the new International Institute for Species Exploration, which we'll talk about a bit later. Welcome to the show, Dr. Platnick.

Norman Platnick: Thanks, great to be here.

Dr. Biology: Now, your first name is Norm or Norman. Do you prefer I call...

Norm: I prefer Norm.

Dr. Biology: You prefer Norm? Great. Spiders, now how did you get started studying and collecting spiders?

Norm: [laughs] Well, I first got interested in spiders because of my wife. We were undergraduates together at a small school in West Virginia in the Appalachian Mountains, and she got very interested in millipedes, which are really beautiful in those areas. They're big, very colorful, every mountain has different species.

We'd go in the field and look for these things. When they're disturbed, millipedes emit defensive secretions that include cyanide gas, and they smell a little bit like maraschino cherries. If you've got a good nose, you can collect millipedes real well, but we'd get back

to the lab and there'd be nothing in my jar but spiders. So I started looking at them and just never stopped.

Dr. Biology: How many species of spiders are in the world?

Norm: Well, there are a little bit over 40,000 currently valid species that have already been described by scientists.

Dr. Biology: Forty thousand, all right. And how many do you suspect are still out there to be discovered?

Norm: Well, that's an open question and people have different opinions on it. I've spent a bit of time looking at the arguments. I think we're about halfway there. I think about another 40,000 remaining to be discovered.

Dr. Biology: About another 40,000. That's pretty impressive, because you gave a wonderful lecture last evening, and you had a list of people that are other spider experts. And if I recall--and it was getting late in the evening and it had been a long day--you're a little bit under 2,000 of those species you actually discovered or named or classified?

Norm: Well, those are species which I newly described. So, I was the first person to describe them. But that's actually just a small part of what I do, because most of my work is spent trying to find out what the previously described species are. So, we have a legacy that's gone on for about 250 years of scientific work on the group, and it's just as important to be able to figure out what species are already known as well as to describe the new ones.

Dr. Biology: Right. But if there are 40,000 species out there and you've done roughly 2,000, a little bit under that, that's about five percent, right?

Norm: I suppose so, yeah.

Dr. Biology: Well, that's pretty impressive. How many of those do you think are dangerous for humans?

Norm: Well, very few, actually. Almost all spiders have venom, but that's a long way away from being dangerous to a person. Most spiders are so small that they couldn't break your skin if they tried to bite you. So, you can get rid of about half of them that way.

Of the ones that are large enough and powerful enough to break your skin, if you got bitten, in most cases the venom would have absolutely no effect on you whatever. The venom has evolved over hundreds of millions of years to work on insects. If it has an effect on a human or another mammal or any vertebrate, that's actually an accident of biochemistry. It's just an accidental effect that the venom has an effect because, let's face it, we don't look like prey. We don't look like food to spiders.

So, the venom is generally completely harmless. There are a few exceptions, of course. First off, just like with a bee sting, some people can be allergic to an individual venom or

a component, some part of venom. And that happens rarely. And then there are very few species which have venom that actually is harmful.

Here in the U.S. there are really only a couple of species that are of any concern. Most people have heard of them. You have black widows. They are easily recognized, they have a round black abdomen and a red hourglass mark on the bottom of the abdomen. And you should treat them with respect. The venom is not generally fatal. In any case where venomous spiders bite humans, it's children and elderly and ill people who are at the greatest risk. Children, of course, because they get the same amount of venom, the body is smaller, so it has a larger effect.

With things like black widow bites you have to sometimes be careful because doctors can misdiagnose them. They may think you have appendicitis, treat you for that, and of course that's doing no good for the actual cause.

Dr. Biology: I didn't know that.

Norm: Yeah, it happens rarely. But there are few if any fatalities from that venom. The other kind of spiders which we have in the U.S. that are dangerous are the brown recluse spiders, and they have a very different kind of venom that actually destroys tissue. So, if you get bitten, you can lose quite a bit of tissue around the bite site, and that can be very unpleasant.

But again, neither of these spiders are aggressive. You're only likely to be bitten if they happen by accident to get in your clothes, or in your bedding and you roll over on them, and you're crushing them and they have no way to escape. And as a last resort they may bite. Much like as with snakes, humans are generally loud and noisy, and the spider hears you and it's long gone before you're in its path.

Dr. Biology: Right. It's interesting, you talk about it's by accident. The only time I've ever been bitten by a bee, for example, is when I rolled over on it. Well, what I'm getting at with the spiders--and it's kind of a roundabout way--is the fact that spiders are really not that dangerous to humans. In fact, they're really important to humans as well as all of life on Earth.

Norm: Oh, absolutely. Spiders are predators, they eat only live prey that they catch themselves, and they eat phenomenal amounts of insects. And they are in fact the dominant predators of insects, and without them we'd be in dire straits. In many cases most of our crops, for example, would be totally destroyed by the insects that already do take a large toll on our crop production, but the spiders help control them.

Dr. Biology: So, let's expand this a little bit further. What if there were no spiders on Earth, what would the world be like? Would many of the other living things still be here? Would we even be here?

Norm: I'd say it's questionable whether we would be here. Spiders can occur in amazing numbers and densities in some areas, so much so that people try to use them purposefully to control insect pests. They're not ideal for that purpose, because most spiders are

generalist feeders. They'll eat anything they can come across. They're not going to separate one particular species of insect and just eat that the way you might want to control that insect.

But because of the vast amounts of insects they consume, they are a crucial part of the ecosystem, and a lot of things would change if they weren't here.

Dr. Biology: I get a really hard time from my wife and children because when I find spiders--it doesn't matter what kind of spider--in the house, I get a cup and a piece of paper and I'm always capturing them and taking them outside. And they always laugh at me for doing this, but I am really rather passionate about these animals. They really aren't there to harm me, and I do know they're trying to get rid of a lot of the other insects that we wouldn't want in the house.

Norm: Yeah, but my first question would be, why are you taking them out of the house? Do you want more insects inside the house? The spiders are there eating mosquitoes, helping you out.

Dr. Biology: I had a feeling you were going to say that. Well, actually I take them outside because my wife and children would probably step on them.

Norm: I understand.

Dr. Biology: Right, so they're safer outside in this case than they are in my house. And hey, what the heck, they won't be in my bed and I won't accidentally get bitten.

Norm: True enough.

Dr. Biology: And they won't get crushed.

Norm: Right.

Dr. Biology: Why do you think people are afraid of spiders?

Norm: It's very difficult to say. I think a lot of it is cultural. I think it's something that kids pick up from their parents. I think most kids, until they've picked it up from their parents, are more curious than frightened. But spiders can move quickly. They can't move quickly for long distances, but they're good sprint runners, and they can be hairy.

And I think when you see a thing moving very quickly out of the corner of your eye, you have an instantaneous reaction, but it's not rational to be scared of a spider. It's thoroughly rational to be scared of snakes, especially in some parts of the world where a pretty high proportion of snakes can actually harm you. Most spiders can't harm you in any way, and so being afraid of them just doesn't make sense.

Dr. Biology: Right. And not that we're going to be able to change a lot of people's minds by just listening to the show, but I hope they'll at least think, "Well, maybe I'll capture that spider and take it outside."

Norm: Absolutely. And consider letting it stay inside and control the insects for you.

Dr. Biology: Well, let's move along to the best things about spiders, because that's really why we have you here. What I'd like to know is what are some of your favorite spiders?

Norm: Well, usually it happens to be just the group of spiders that I'm working on at the moment, because they're so diverse. There are so many different kinds. They are all so poorly known. I've been doing this for about 35 years now. One of the things that makes it exciting and fun is every day I get to come in and look at something that no one's ever seen before. Anf that's really cool.

Right now I'm working on a group of spiders that is very poorly known, probably the most poorly known group, and that's because they are very, very small. They are mostly under two milimeters., so that means you could put about 15 of them head to toe and still not fill up an inch. They're really small animals. But they are amazingly intricate. They do all kinds of things that other spiders don't do.

Dr. Biology: Such as?

Norm: Wow. Many of them have very peculiar modifications on the body. Generally, most spiders have a pretty soft abdomen. For example, lots of people like to keep tarantulas as pets, for example, and you have to be careful that they don't fall. Their abdomens are so soft that if they fall off the table they can actually rupture their abdomens and the animal will die.

These little small goblin spiders, they are called, are very tiny, often have extremely hard and highly ornamented abdomens. Every species is quite different.

Dr. Biology: What are some of the coolest characteristics of spiders?

Norm: Well, the thing that they are most known for, of course, is the silk. Everyone identifies spiders with silk, but it is important to remember that not all spiders spin webs to catch prey. In fact, only about half of them use a web to catch prey.

Of course they are some of the ones we notice most obviously, especially the ones that build very geometrically regular or webs that everyone is familiar with. But all spiders have silk glands and spinnerets. They all use the silk in at least some ways.

Spiders wrap their eggs in silk, for example. Most spiders lay a dragline behind them as they go. That's why if they fall off a branch, they can just climb back up the dragline of silk they left behind. So there are a variety of silks and an individual spider can have seven different kinds of silk glands in its body and produce seven different kinds of silk with different properties, that are used for different things.

Dr. Biology: That's fascinating! I didn't know that. I figured silk is silk.

Norm: No, there are lots of different kinds.

Dr. Biology: Well, that's great! How strong is silk?

Norm: Actually, silk has a tensile strength that's greater than steel. What that means is you can pull it out to a very fine fiber, as it is in any web. That fiber is actually stronger than steel of the same diameter, in the sense that it can be stretched more without breaking.

Dr. Biology: Hmm. Now is spider silk the same as silkworm silk?

Norm: No. They are similar, chemically, but there are differences and there are differences between spiders and differences in the silks produced by a single spider, chemical and physical differences, as well.

Dr. Biology: Hmm. OK well, earlier we talked about even though you don't have Spidey senses, you have SPIDA-Web, and it's an artificial neural network that you actually have been working with a team of scientists that have designed it, built it and you are using this computer system... So people don't think you are walking around with this neural network in your head.

You have your own, but this one is a computer one helping people identify spiders. And I'd like you to talk a little bit about SPIDA-web.

Norm: OK. One of the problems you have as you can imagine any group that is as diverse as spiders... if you've got 40,000 species, there aren't very many people who know how to distinguish those species.

Often ecologists, for example, people who are studying how spiders interact with other groups in a particular environment, need to be able to identify the animals. In fact, not just the spiders, but all the animals and the plants in the communities that they are studying.

But those people aren't trained, obviously, as spider specialists, and it's very difficult to identify a species of spider or almost any other living organism without having that kind of training.

So what we have tried to do with SPIDA-web is develop a system that trains computers to recognize individual species by showing them lots of photographs of a particular species and photographs of other species so that the computer learns to distinguish one species from the others.

Dr. Biology: So it's learning. That's pretty cool.

Norm: It's learning in an artificial sense. That's why they are called artificial neural networks, but it's very much analogous to the way that nerve cells work in your own brain. They receive and they transmit signals. That's the same thing the networks do.

So what we do is take a photograph and then use some techniques to get the information from the photograph into the computer as, obviously, a string of numbers, because that's what the computers understand, and then allow the computer to distinguish between the training sets, the pictures that belong to one species and pictures that don't.

Dr. Biology: Well, I'm not an arachnologist, so I couldn't identify very many species of spiders. I'd have to say I'm a novice.

Norm: OK.

Dr. Biology: Could I go on to SPIDA-web and identify a spider?

Norm: Absolutely. What we have up there is basically the first system, so it only covers spiders of one family, which are not found, actually, in the U.S. So it's not going to be particularly helpful to you right here.

But this is a prototype system and basically we have designed it so that it can be used for any group of organisms, not just other groups of spiders, but any group of organisms that you can identify visually, the computer can also be trained to identify from photographs.

So, yes, if you go to the website, you'll find instructions on what parts of the spiders you have to photograph. You submit those photographs across the Internet and within a few seconds you get an identification back.

Dr. Biology: That's just fabulous! Let's figure out what we could do here. All right. How about students and classrooms, once the prototype is perfected, so to speak, and you move on to other kinds of species, could they use it?

Norm: Oh, absolutely. You're obviously talking about something that requires a huge amount of resources to train if you want to cover all the species on the planet. We have no idea how many species of organisms there are on the planet.

We know that there are somewhere around two million already described and estimates of how many there are range from...anywhere from five to 10 or even 30 million. Obviously, it would take a lot of photographs to train networks to recognize all the species, even those that have already been described.

And it might not work for all groups. I mean, for example, if you get microorganisms, you're not going to be able to just go out in the field and take a picture of them with your digital camera and get an answer. But for lots of things it will.

Dr. Biology: This is a prototype. How did you get the money to do this?

Norm: We've actually got a grant for this from the National Science Foundation, which is the primary source of funding for what we call "pure research" in the U.S.

Dr. Biology: And how much money did it take to make the prototype?

Norm: That was about an $800,000 investment. The team had to involve computer scientists. In fact, the primary computer scientist on the project was one we had to hire away from IBM to do this project. That took money.

Dr. Biology: You know, it's interesting. We just had a show recently called "Math Biology" and I had two young mathematicians. They are actually an undergraduate and a

graduate student. They are blending math and biology and that was one of the questions: What can you do if you have a degree in math and biology? Lo and behold, here you are. We're talking about here's another place that they would fit perfectly.

Norm: Oh, absolutely.

Dr. Biology: And if I recall from the lecture last night, they get paid handsomely, too.

Norm: Computer scientists tend to be very well paid, much in the same way that geologists often tend to be paid more than comparable scientists, simply because there are commercial applications for their work.

In the geologist's case, the oil industry, and in the computer science case, obviously, the entire business world, which can use their skills and is willing to pay for it at levels that are higher than the normal college or university operation can afford.

Dr. Biology: If they are getting excited about spiders. I love seeing cool pictures. Can you recommend or talk about any other resources on the web that people might go to?

Norm: Wow. There are lots of sites dedicated to spider pictures. One of the easiest ways to find them would be to Google the International Society of Arachnology, which has a website and lots and lots of links. So lots of people's albums of spider photos.

Dr. Biology: Excellent. You also work in a natural history museum. It's the American Museum of Natural History in New York.

Norm: Right.

Dr. Biology: I don't know if a lot of people have visited natural history museums. I have to say that the one that you work in is probably one of the best in the world. It's just fabulous. And not everyone may think of museums and natural history as exciting. What's it like to work in a natural history museum?

Norm: Oh, it's fantastic. In particular, in my case, being at the American Museum is the best possible place, because we have the world's largest collection of spiders, well over a million specimens. And so it's an ideal place to do research on that group.

But natural history museums, most people know only the public side, the exhibition side. That's important and it's exciting. People come and they see our dinosaurs and they come and they see a live tarantula.

Those things are exciting, particularly in an urban environment like New York City where we are, that may be the only taste of nature that some kids living in New York City get.

The public side is extremely important. But most people don't realize that there is a research side to any major museum as well, and that there are faculty members just like at a university biology department.

Dr. Biology: Has anything recently happened or have you done anything at the Natural History Museum that's out of the norm?

Norm: When the third "Spider Man" movie debuted recently, they had a week of opening ceremonies in New York. So we set up a small exhibit for the public with a lot of tarantulas on view, which attracted a lot of attention.

Toby McGuire, the actor who plays Spiderman, came by the museum and we had question and answer session with a lot of kids. It was loud and chaotic, but it was a lot of fun. I got to put a tarantula on Toby's arm. He was able to show the kids that he wasn't afraid of spiders.

Dr. Biology: Cool! That's kind of like what, Spiderman meets Spider Man?

Norm: That's exactly it.

Dr. Biology: Obviously he didn't have arachnophobia.

Norm: Not at all.

Dr. Biology: What's an average day like for you, if there is such a thing as an average day.

Norm: Well, a good day is one where I get to come in and just go directly to my microscope and start looking at spiders. But in the real world, of course, good days are not necessarily the ones you experience every day.

We have teaching responsibilities. We have students. We have curatorial responsibilities, taking care of the collections, filling loan requests. We send thousands of specimens all over the world every year to other arachnologists in other countries and other institutions who need them to do their work.

Dr. Biology: And so, would you say that no two days are the same?

Norm: Oh, absolutely. Because every day that you can get to the microscope, you get to look at a different spider.

Dr. Biology: Right. And you said that it's kind of the thrill of the hunt. I have to say the same thing. I'm a microscopist, so I do mainly cell biology and cell structure, but I also have another little project called a "paper project."

We actually explore historic and contemporary handmade papers. And you'd be surprised at something the size of a period at the end of a sentence, the beauty that is in there. Seeing things that a lot of people have never seen.

Norm: Right.

Dr. Biology: And that's where you are actually more than a scientist. I think you are an explorer.

Norm: Oh, absolutely. The thrill of the hunt is actually mostly in the field when we do our collecting trips. So, most of my field work, for example, has been done in the south temperate parts of the world, the very far south in Chili and Argentina and South America, in New Zealand and New Caledonia and Australia in the Pacific parts of the world.

Those are the parts of the world which are most poorly known for spiders, so they are the most fun to go to.

Dr. Biology: And you mentioned yet another thing that is very important. I love to travel and it seems like a lot of our biologist guests love to travel. If you are the type of person that likes to travel, maybe science is the place for you.

Norm: Oh, absolutely. It's usually a joke that people who work on spiders and insects are always interested in the spiders and insects that occur at least 3,000 miles from wherever they happen to live.

Dr. Biology: [laughs] Well, tell me, do you have any interesting adventures or stories from your collecting trips?

Norm: Oh, well, I guess the most harrowing one was on the island of New Caledonia in the South Pacific, where I managed to get turned around on the top of mountain. Was walking 180 degrees in the wrong direction. I got quite lost and had an accident and hurt my leg, trying to cross a stream. Spent the night up there waiting for the folks to come find me.

Dr. Biology: OK, that does seem a little bit more exciting than I would have expected. And I hope at least you discovered a new species of spider after all that.

Norm: Oh, absolutely.

Dr. Biology: Well, speaking of travel, you're actually in town... you're here for the launch of a new institute at Arizona State University. It's called the International Institute for Species Exploration. In an earlier show, I actually got to talk about it, I caught up with Quinton Wheeler.

Norm: Terrific.

Dr. Biology: He's the founding director of the IISE. What do you hope this new institute will be able to do?

Norm: Oh, I think it has tremendous potential. Most people certainly, most of the people I encounter outside of science, don't understand how little we know about the organisms that share this planet with us.

Imagine, for example, that if we sent a space craft to Mars and found, for certain, living organisms there. You can imagine that almost immediately, lots more expeditions would be planned, enormous amount of resources would be placed into finding out about this life we have never seen before.

What most people don't realize is that you can go out in your own backyard and have exactly that kind of discovery. You can find things that are not known.

Dr. Biology: Actually we have a researcher here, Bob Johnson, and he did just that. He works with ants. And he discovered a new species of ant in his backyard.

Norm: Not at all surprising. Here in the U.S., for example, we suspect there are about 3,500 species of spiders, and about 300 of them are not yet described.

Dr. Biology: OK, you have heard it here. Now it's time to go hunting for those spiders and not to squish them. And in case you would like to learn more about IISE, it's easy to find on the web.

The address is species.asu.edu. It's got a wonderful site with lots of cool pictures and a gallery that's growing. It's brand new, so there's not a ton of things there, but as time goes on I think it's going to have a lot of really good content, including educational content.

Norm: Right. I think a very important function of the Institute's mission is to make people more aware of the need for learning more about our own planet.

Dr. Biology: All right, we are going to shift into the favorite part of the show for most of the listeners and for myself. I ask three questions. The first question is: When did you know you wanted to be a scientist or a biologist? And I usually think of that spark and it could have been a "eureka." In some people it was slow and gradual, but usually it's something that really triggers in someone's mind.

Norm: Hmm. I guess I first got interested in biology when I was in about the seventh grade. I had a biology teacher who was very interesting and her husband taught biology at a local college. So I got to know him and then sat in some of his classes.

That got me really interested. For a long time I thought I was going to go into genetics. Then, unfortunately, that never happened. I got interested in spiders and that just took off.

Dr. Biology: I think fortunately you got interested in spiders.

Norm: Actually, it is fortunate for me.

Dr. Biology: And it's also interesting. You went to college when you were in seventh grade?

Norm: I finished the seventh grade and then I went into college, yes.

Dr. Biology: Marvelous. Were you a regular student, or were you just having fun sitting in on the classes?

Norm: No. No. I became a freshman, just like any other student.

Dr. Biology: Wow. OK. Well, we have words about you.

Norm: [laughter] Precocious, I think, is the only relevant one.

Dr. Biology: Along that line, I'm going to take it all away from you.

Norm: OK.

Dr. Biology: You can't be a biologist. You're not going to be a scientist. You're going to shift. You're going to think, what would you like to be if you couldn't be...

Norm: Well, actually I already have another life; so, I don't have to actually shift. I got interested in spiders because of my wife, and for the same reason I got interested in antiques when she did. I've become quite interested in looking at early 20th century American illustrators. So that's my hobby and if I wasn't doing spiders, that's what I would be doing.

Dr. Biology: Early 20th century...

Norm: American illustrators.

Dr. Biology: American illustrators.

Norm: This was at a time before photography was common. So, every magazine that you would see on a newsstand would have reproductions of paintings on the front cover. That's how they sold their magazines. The people who did those illustrations also did postcards and calendars and posters and lots of other illustrations.

It's a fascinating area that was pretty much destroyed when color photography took over.

Dr. Biology: And one of the things during your lecture, and something that comes up over and over again, is the importance of an artist as part of the science process.

Norm: Oh, absolutely. For dealing with most groups of organisms, you can write long descriptions in words, but they don't actually tell another person what they need to know. You need good illustrations. So a skilled artist is essential to making good progress on the science of studying these animals.

Dr. Biology: Right. And even with the ability to do photographs, there's amazing detail and information from those beautiful pen and ink line drawings.

Norm: Oh, absolutely. For every species of spider that gets described today, we try to have lots of kinds of photographs, most importantly, for example, scanning electron microscope photographs. But we also have hand-done illustrations because they show details and they show them in a way that makes them more usable.

Dr. Biology: All right, I have one more question: What advice would you have for someone who wants to become a scientist or a biologist, or maybe we hooked someone and they want to get into the study of spiders?

Norm: Wow, that's a tough one. I think most important is to get out into the natural world yourself. To start looking at the animals that you find out there. Spend half an hour

watching a spider build its web. Watch a jumping spider catch its prey.

Look at all the different kinds of spiders you can find in one habitat. It's that direct experience with nature that's really going to make the difference.

Dr. Biology: Observations. Yes, I love it. Well, Norman Platnick, thank you for visiting with us today.

Norm: Thanks, it's been a pleasure.

Dr. Biology: You've been listening to "Ask-a-Biologist." and my guest has been Norman Platnick, who is currently the Peter J. Solomon Curator of Spiders at the American Museum of Natural History.

The "Ask-a-Biologist" podcast is produced on the campus of Arizona State University. We record our show in the Grassroots Studio housed in the School of Life Sciences, which is an academic unit of the College of Liberal Arts and Sciences.

Even though our program is not broadcast live, you can still send us your questions about biology, using our companion website. The address is askabiologist.asu.edu.

Or you can just Google the words, "Ask-a-Biologist." I'm Dr. Biology.