

Ask-a-Biologist Vol 014 (Guest Quentin Wheeler)

**A Walk On the Wild Side: in search of species -**

Dr. Biology travels to the Tres Rios wetlands, a place where all types of living things can be found. He talks with local biologists about many of the species and also gets a chance to sit down and talk with Quentin Wheeler who is starting a new Institute that will be exploring and looking for species all around the world.

**Transcript**

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**Dr. Biology:** This is Ask-a-Biologist, a program about the living world, and I am Dr. Biology.

Today we're going to be doing something really different. We're going to be getting out of the studio, and we're going to go exploring the Tres Rios Wetlands in Phoenix, Arizona. These wetlands are formed where the Salt River, Gila River, and the Agua Fria River join together, and they make a home for native plant and animal species.

We'll be joining a group of biologists from the School of Life Sciences at Arizona State University. Along with visitors from the local community, they will be heading out on several different hikes to explore and learn about the wetlands, along with many of the plants and animals that live there. Now this should be a fun trip. And who knows, we might just find a new plant or animal species while we're out exploring.

First we have to drive about 30 miles west of ASU to get to the site, and talk with some of the people that will be exploring the wetlands.

Oh, as a special guest, later in the show we will be talking with Quentin Wheeler, vice-president and dean of the College of Liberal Arts and Sciences, and also the director of a new center at Arizona State University called "The International Institute for Species Exploration." Dr. Wheeler is an internationally-known expert on beetles, and we'll have a chance to learn more about the Institute and to answer this question: what does a beetle have in common with Darth Vader?

So now, let's get going and let's start exploring.

[sound of car driving on gravel road]

Well we turned off the main road, and we're approaching the parking lot for the wetlands. It looks like there's a parking spot right here, so we should be able to get started in just one moment.

[sound of footsteps]

I'm walking up to the wetlands, and I have to stop for a moment because I'm looking at these giant trees that are at least, oh, I don't know, 40, 50 feet in height, and they are looking like old cottonwoods, or cottonwoods that have been damaged by fire. But instead of being useless, they are now home to what look like herons, either grey or blue herons. These are really big birds--they have wing spans up to five feet--and these nests--there are oh, a half-dozen nests--the young herons are being raised there. You can see the chicks' heads bobbing up and down periodically when Mom or Dad are feeding them. I'd let you hear them but I think they're too far in the distance to pick up the recording. Right now I think I'll head on towards the wetlands.

[more sounds of footsteps]

A little more walking and I've ended up at the wetlands themselves. You've got these tall reeds, they must be maybe ten feet tall. They look like they might be cattails, we'll find out later, and we've got lots of birds flying around and singing in the background and calling.

And as I walk a little further, I keep seeing this, it looks like dander or little feathers of the birds, and there is just so much of it; and it dawns on me, as I look up, there is a giant grove of cottonwood trees, and I'm going to bet that those are the seeds that come from the cottonwood trees, and those are the ones that can float around, and that's how they travel from place to place to be able to get planted in soil that's away from the other trees, which is really important.

Oh, it looks like maybe we have, possibly, Pierre Deviche here. He's running away from me. I can see him running. [laughs] Hello, Pierre!

**Pierre Deviche:** How are you doing?

**Dr. Biology:** I'm doing very well. I was just talking about you.

**Pierre:** Yeah? Oh, that can't be good.

**Dr. Biology:** It has to be good! We were looking at the large black birds.

**Pierre:** Yes, these are Red-winged Blackbirds.

**Dr. Biology:** Beautiful birds.

**Pierre:** It's a very common species in this kind of habitat. They really like to breed in reeds or reed beds, sometimes that, and you'll see them also, like, in big fields, alfalfa and this kind of thing. So they're really gearing up to breed, so they are very active, singing, and very vocal right now. Very conspicuous, too.

**Dr. Biology:** Very much so, very much so.

**Pierre:** They've got two red patches on the shoulders, and if you look at them when they are displaying, they'll sort of sit on, like, a tall branch or something like that, and they sort

of open their wings like that, and they do this vocal behavior, and these little patches become very, very conspicuous. They sort of open them up, they sort of puff up kind of thing.

**Man 1:** They're probably using that to establish territory.

**Pierre:** Yeah, yeah, it's like a social signal, and the females just find that irresistible.

**Dr. Biology:** I'm going to let Pierre Deviche continue on with his bird watching. We actually had Pierre on in an earlier broadcast of Ask-a-Biologist, and if you'd like to listen to more about birds and bird songs, just go to the "Podcast" page on Ask-a-Biologist.

All right, now I see Jim Elser in the distance. He's brought an important tool for looking at different species. I want to talk to him about that.

[more footsteps]

I'm here with Jim Elser. Remember that tool I said he'd brought? He's brought some microscopes, so we can see what's inside the water in the wetlands, which you're going to find has more living things in it than we could ever see without this tool.

Let me tell you just a little bit about Jim Elser. He's a biologist that studies bodies of water that are inland--you know, like lakes and streams--and those kinds of biologists are called limnologists, correct?

**Jim Elser:** Well that's right. So most people know what oceanographers are, and we have an oceanographer here, Dr. Susanne Neuer. Everyone knows what an oceanographer is, but hardly anyone knows what a limnologist is, and a limnologist is essentially a freshwater oceanographer. So if there is water inland, on the continents, then limnologists want to study it, whether it is moving, in a stream or a river, or whether it's standing, in a pond or a lake; and that's what limnologists study.

**Dr. Biology:** One of the things I want to talk about before we get into some of the details: species in general. We're going to have a new center coming along. Do you think we could discover a new species here?

**Jim:** Oh, undoubtedly. Microorganisms are the best place to look for new species. They are just being discovered constantly as people have developed the proper techniques for telling one kind of microorganism from another; because very often they look very similar, because they're so small and their cells kind of look the same, especially bacteria. But now that we can look at the DNA and figure out who's really related to who and how different things are, now they are finding so many different species of bacteria, it is really quite amazing. We haven't even begun the process of describing all of the bacterial species on Earth.

**Dr. Biology:** So, in a drop of water, in something like the wetlands here, about how many living things do we have in there?

**Jim:** Oh, that's a phenomenally large number. A drop of water is about a milliliter, about a thousandth of a liter, and in a drop of water that size, you would have a thousand algae of the kind we're looking at--easily a thousand, maybe five thousand. And even more amazing, you might have a million bacteria.

**Dr. Biology:** A million? A million bacteria? Wow. The population in the Phoenix is what, maybe about two million?

**Jim:** That's right. So in two drops of water we have more bacteria than all the people in Phoenix, that's right.

**Dr. Biology:** That's very impressive. Also very scary, almost.

**Jim:** Well then, let me tell you another number. If we were to count the viruses in drops of water, also, the viral particles in them--and most of them are harmless, maybe not the ones here at the water treatment plant, but mostly--in any natural body of water, the ocean or lakes, there are also viruses, and there are a billion viral particles in every drop of water.

**Dr. Biology:** So let's talk a little about bacteria. Because we talked about a drop of water, and we had this really nice analogy of how much you can find in it; but a lot of people think of bacteria and viruses and everything as being really bad. There's good bacteria, right?

**Jim:** Absolutely. Most bacteria are harmless to people, and many have very important and helpful functions, especially here at the waste-water treatment plant. The people who work here have engineered it in such a way that the bacteria are here to clean the water. We usually think about bacteria making water dirty, but here the bacteria actually clean the water by processes that remove chemicals that are harmful to the environment and release them back to the atmosphere, like nitrogen especially.

**Dr. Biology:** Now let's get back to that drop of water. What are we going to be seeing inside of this water?

**Jim:** Well that's the amazing thing about a drop of water. You can spend your entire life trying to understand what happens in a drop of water. What we'll see in there, again, are these photosynthetic algae that are fixing carbon dioxide from the air and making sugars they use for their growth. They also will take up all the other nutrients that they need from the water, and grow and reproduce. In that drop of water will be bacteria, and those bacteria that are in there, they're using sugars that are made by the algae for their own growth, and they also are breaking down compounds, organic compounds, that are in the water, releasing nutrients. Then the algae then take those up and use them for growth.

So in a drop of water you have a complete cycle of nutrients, from algae to bacteria to the water, back to the algae. It's really quite amazing.

There's also a little food web in there. If you can see in there, swimming around there will be single-celled protists, that eat the bacteria and eat small algae themselves, so there is a

little food web in there. You can almost think of these single-celled protists being sort of like antelope running around in Africa, eating the grass, and there will be things in there that will eat those protists.

That whole thing, that oceanographers will now just call that thing--the process by which bacteria and small algae are eaten by protists, which are eaten by larger protozoans, which are eaten by larger animals. They call that "the microbial loop."

**Dr. Biology:** Well as you can imagine, we could spend our entire visit here, just looking at a drop of water. But I see someone else here that could probably answer that question I had earlier about the floating material--you know, the stuff that looked like bird feathers? I think she'll probably have the answer, so let's head on over that way.

[more footsteps]

So I've been able to catch up with Liz Makings, who is a researcher at Arizona State University, and she is actually in the herbarium, which is a really cool collection of plant species. It's been going on for quite a while, so I'm going to ask Liz about the herbarium at ASU.

**Liz Makings:** Well, the herbarium is a collection of dried and mounted specimens, with label information on when it was collected and where. We have about 260,000 specimens right now, and they are mainly from southwest and northern Mexico. We have a really good collection of cacti, and representative plants in arid regions.

**Dr. Biology:** 260,000 specimens, that's just unbelievable. Now, we're out here at the wetlands, and there are just some amazing plants. For example, in the actual water here, there are these giant reeds. What are these?

**Liz:** Yeah, there is what appears to be just a big old homogeneous set of plants, but actually, if you look closer, there are a lot of different things in there--you've got some cattails, you've got some bullrush, you've got some chairmaker's rush, and a lot of other wetland plants that are a lot smaller. But the cattail definitely dominates. It is really big. Apparently this place was burned about a year ago, and they have already grown back well over my head.

**Dr. Biology:** I'd have to say they're at least ten feet tall. When you talked about homogeneous, just to make it clear, that means "same species." In other words, it looks like it's just a bunch of cattails, but in reality there are a lot of different plants that are in there.

**Liz:** That's right. Diversity is really important in a place like this, because the more diverse a place is, the better habitat it tends to be for animals and the little, tiny little microscopic plants and animals that depend on the bigger things.

**Dr. Biology:** Earlier I noticed all this, it looked like downy feathers, right around the shoreline. Then all of a sudden I realized, "Man, that would be an awful lot of birds

there." Then I looked up at these giant trees, and I bet you can tell us a little bit about that downy material.

**Liz:** Well, the downy material this time of year is coming from the cottonwoods, which are the main tree that you see around here. Cottonwoods, the female trees produce a little seed, and then they have this little silky, feathery thing that helps the seed float around in the air and find a new place to land. So what you're seeing is basically the cottonwood seeds flying all over the place.

**Dr. Biology:** The other thing I wanted to mention, if someone would like to make their own herbarium they can just go to Ask-a-Biologist. We have a really neat article on Les Landrum, who is the herbarium curator--it's called "Smashing Success." Or you can just go to Google and enter the words "Ask-a-biologist" and put in the word "herbarium," and that will take you directly to this fully illustrated guide to how to make your own herbarium. And this is actually something you can do with very little money. You can give us some little details, right Liz?

**Liz:** Yeah, it's really easy. You just need some plywood, and you need some newspaper. You should probably have a little journal to take some notes about what you're collecting, and you want to make them as flat as you can, because that makes it a lot easier to store. The mounting process is not really that difficult, either. Basically you just need some Elmer's glue, some archival paper, and you've got an herbarium specimen.

**Dr. Biology:** Well, Liz, I want to thank you for spending a little time with us.

**Liz:** You're welcome.

[sound of more walking]

**Dr. Biology:** After a little more walking I've caught up with one of the groups that is hiking, and it looks like they might have Susanne Neuer and Ron Rutowski, two professors in the School of Life Sciences, and they're talking to the group. Let's listen in.

**Female 1:** No, we haven't. We're, none of us are scum people. You want to talk about the scum?

**Susanne Neuer:** Oh good, yeah. Yeah, so what looks like this yucky scum, most of these are filamentous algae that are actually very tiny, tiny cells, but because many of them are stuck together in filaments, and then the filaments are together in tufts, you can actually see these microscopic organisms. They are like plants on land. They are algae that make photosynthesis, and there is a whole food web in there. So, little crustaceans, little ciliates, unicellular, multicellular animals that feed on these algae.

And these algae are extremely important because they take up a lot of the nitrates which are in the water and convert it into their own biomass, and then there is lots of bacteria in there that also convert the nitrogen. And, actually, some degrade the nitrogen into molecular nitrogen that goes back into the air. So there is an extremely important microbial ecosystem in here; and we talked about numbers before. So in each drop of

water there is maybe 1,000 algae, a million bacteria--so an enormous amount of organisms in a very small volume of water--but extremely important for the ecosystem here.

**Ron Rutowski:** So it serves as a tremendous base for these wonderful insect populations that we have here.

**Suzanne:** [laughter]

**Ron:** Because the bacteria, the microorganisms, get eaten by the larvae of mosquitoes and gnats and other small flies such as these dragonflies that you see. And so this dragonfly is the adult stage that is aerial, flying around. The larval stages actually live in the water and feed on other small insects and organisms as predators. They have these huge jaws, huge eyes, so if we could get down in here with the net and scoop around, we'd no doubt come up with some of them. But they come up to the, they crawl up the reeds, and then they do their last molt, and out comes a dragonfly--they expand and harden the wings.

So this is the adult stage, which is the one that is responsible for the reproductive activities--mating, laying eggs. And this probably, this blue one, which you can see here--is he still there?--he is probably defending a territory. He is probably sitting here waiting, keeping other males away in the hopes that a female will come by and he will have exclusive access to her.

**Man 1:** Do you know that this is a male?

**Ron:** Pardon?

**Man 1:** Do you know that this is a male?

**Ron:** Yeah, because of the coloration. Females are not so brightly colored in this species. So the male has his, you see he's got his ab... --is he still there?

**Several people:** Yeah.

**Ron:** OK, good. He's got...

**Woman 1:** This is a beautiful one, and he's so cooperative.

**Ron:** Yeah.

**Dr. Biology:** Well, I've been able to catch up with Quentin Wheeler, and I promised that we'd have him later on in the show. He's our special guest scientist. Quentin is actually a professor in the School of Life Sciences, and also, he is an entomologist, which if you don't know what that is, that's a person who likes to study insects, and his favorite insects are beetles. We're going to get to learn a little more about that.

Quentin, I want to thank you for joining us here at the Tres Rios Wetlands to talk to us about your interest in beetles.

**Quentin Wheeler:** Oh, my pleasure.

**Dr. Biology:** Now, one of the things I have to mention: we're sitting here at the Wetlands and it's a beautiful place. Quentin is sitting here with his cowboy boots and a lot of people might think that, well, you're in the Arizona desert, everybody walks around in cowboy boots. But that's not really true. That's not the normal apparel that someone wears on their feet. But in this case, Quentin is an explorer, and he is someone that actually fits very well with the realm of cowboy boots, because he has got that pioneering spirit, and we'll get to learn about an institute he is starting.

But before we do that, what got you interested in studying beetles?

**Quentin:** Well, it was when I went to college. I took an entomology class, fell in love with insects, and just naturally gravitated toward beetles. They are so diverse in their habits and their appearance, they are absolutely fascinating to study.

**Dr. Biology:** They are just really cool-looking creatures. Are there some you like more than others?

**Quentin:** Well of course. There are about half-a-million described beetles, so there are plenty to choose from, and while it's difficult to choose, I'd have to say my favorite is a genus called beetle *Eliodes*. If you go out into the Sonoran Desert around Phoenix, it is actually one of the most common insects you'll encounter. They're large-sized, they're black, they're flightless, and if you approach them, their only defense is to secrete some noxious chemicals. So they actually do a headstand--put their head down, their rear end straight up in the air--and then exude, or sometimes even squirt, defensive chemicals out.

**Dr. Biology:** Well that must be quite a sight. So this is your favorite beetle? I wanted to know, early on we mentioned in the program that you might answer a question: what does a beetle have in common with Darth Vader? You have the answer.

**Quentin:** Well, yes I do. One of my former students, Dr. Kelly Miller, now at the University of New Mexico, and I were naming a number of new species of slime-mold beetles, and one that caught our attention in particular was a flightless species, nearly blind--its eyes are reduced to just a few facets on the front of the head, so if you look down on the top of the head it looks very shiny like a helmet, no visible eyes, just this little slit across the front--and it reminded us very much of the Darth Vader helmet.

**Dr. Biology:** What is the actual name?

**Quentin:** The scientific name is *Agathidium vaderi*.

**Dr. Biology:** *Agathidium vaderi*. This is cool. So let me get this straight: you discover a new species and you get to name it? That's so cool.

**Quentin:** It is cool. It's one of the many privileges of exploring for species. There are international rules you have to adhere to, but within broad parameters you get to choose any name you like for the new ones.



**Dr. Biology:** You must have some other interesting names you've picked.

**Quentin:** Well, that study I referred to of the slime mold beetles, we actually described 65 new species and named them, and among some of the names we came up with were what are called "patronyms"--names in honor of humans. We chose President Bush and Vice-President Cheney, and Secretary of Defense Rumsfeld, so there are now *Agathidium bushi*, *cheneyi*, and *rumsfeldi*.

**Dr. Biology:** This is so great!

**Quentin:** Let me add an interesting side note. A few months after word of *Agathidium bushi* hitting the popular press, it was getting a lot of conversation among reporters and so forth, and one day I received a phone call from the White House. And I was thinking it would be their news office, asking, "What's a slime mold beetle, and what's all this press coverage?" But instead, a lovely female voice said, "Professor Wheeler?" And I said, "Yes." And she said, "Please hold for the President."

And sitting there for a few moments, wondering what friend was playing a prank, the next voice I heard was President Bush, and we had a lovely conversation for about five minutes. He thanked me for the honor of having an insect named after him. I daresay it's one of the few times that beetles have surfaced as an issue in the Oval Office.

**Dr. Biology:** That's really pretty cool. You've started a new institute. It's called The International Institute for Species Exploration, which is a mouthful, but an easy way to remember it is, you're going to be able to go to [species.asu.edu](http://species.asu.edu) to get to the web site. Can you tell me just a little bit about the Institute?

**Quentin:** Yes. We're going to try to do a couple of things. First, we're going to build partnerships with museums, with experts on various groups of plants and animals around the world, with other universities, with botanical gardens, and try to accelerate the process of species exploration, of discovering, describing, and classifying the world's species. And to facilitate this work, we are also cooperating with computer scientists and engineers, with philosophers, with historians, to try to better understand the process of species exploration, and invent a whole new generation of tools that will enable people to work much faster.

**Dr. Biology:** Today at the Wetlands we have also had a chance to talk to people about species, and we've been on our own little quest to find our own species, and we have asked them if they thought they would find a new species, or if there are new species here to be found. What would your answer be to them?

**Quentin Wheeler:** I would say unquestionably so. Species, probably quite a few of them representing quite different groups. I might categorize new species in two ways. First, species totally new to science, no humans have ever known or seen before. I dare say there are lots of them here, whether they be microbes or small insects. I'm quite confident if we looked hard enough find some new ones. But in addition, because of human activities around the world, there are introductions of species into places where they did

not naturally occur. If you did extensive collecting you will undoubtedly uncover some of those species as well.

**Dr. Biology:** How many species are there, and how many do you think there are still left to be discovered?

**Quentin Wheeler:** Those are difficult questions. In fact we are in the process of compiling a catalog of all the species that have been discovered and described in the past.

We have been keeping track of these things since 1758 and our best guess is that there are about 1.7 million named species to date, of all plants and animals. Estimates of how many remain to be described vary from 10 million to 100 million or more. It shows you how little we actually know about earth's species, that we can't tell you which of those numbers is closer to the truth.

**Dr. Biology:** The new institute, what is it going to be doing and what kind of impact will it have on biology in general?

**Quentin Wheeler:** What we would like to see is a few years from now a much better sense of what species do exist on earth. If you think about it, all the complex ecosystems that provide necessary services to us are comprised of unique kinds of living things of species.

In order to understand the evolution of life on our planet, over several billion years, also the key are the species that are the individual elements whose relationships you are trying to reconstruct. So, if we can get enough understanding of the species on earth, then we start to be able to look at these emerging complexities in evolution and in the environment in a much more precise way than we can today.

**Dr. Biology:** Ok, so for the scientists I can see lots of really cool things going on, but what about the public? I know there are plans for some really fun things you could do at the institute. It's a virtual institute that actually brings all these centers together from all around the world.

**Quentin:** Right. What we are hoping, in a few years, to have a new generation of electronic tools that link the world's museums and botanical gardens so that one can actually go on a tour of the full diversity of life on the planet pulling up specimens, examining them. Ultimately we'd like to see web sites where anyone could go visit any species they find to an interesting and useful level.

**Dr. Biology:** So I could go to this site and I would be able to go in there and if I am interested in beetles and I wanted to learn more about them I could go to learn about beetles in Australia or I could be in the desert of Arizona and I could actually compare them and I could see really wonderful pictures?

**Quentin:** That's the vision, obviously in partnership with many scientists, and curators of museum and lots of specialists around the world in cooperation. The institute alone is a catalyst, to create some of these tools to make them openly available to the community,

but largely the work through the partnership using the expertise that exists around the world to improve our knowledge.

**Dr. Biology:** I can't wait. I can't wait. I always ask the scientists that come on the Ask-a-biologist program, I have three questions. One you have kind of answered but it is more of when you were interested in beetles and insects in general. What I want to know is when did you first know you wanted to be a scientist?

**Quentin:** As far back as I can remember. Some of my earliest memories in childhood are playing with little toy model dinosaurs and imagining going to expeditions digging for fossils. From that progressed through much of my youth actually studying protozoas, single cell animals, in fresh water. Even then, I didn't realize it but I was being a taxonomist, I was exploring, I was looking for species that I had not seen before. So it is really that same excitement that I carry for beetles today. That urge to go out and find that next one that no one has ever seen.

**Dr. Biology:** You use the word taxonomist and that brings up the word taxonomy which is an important term. We have to not to only find the species but we have to different them. We have to find out if one is different than the other. This has been going on for quite a while and actually there is a real important birthday coming up soon right?

**Quentin:** That's right. It was a Swedish naturalist, Carl Linnaeus, who invented what we consider the modern techniques of classification and the system we use to give names to plants and animals. He worked in the middle of the eighteenth century and this is the 300th anniversary of his birth this year.

**Dr. Biology:** Three hundred years, wow. The other question that I always like to know, and this sometimes tells me more about you then anything else...what would you be if you couldn't be a biologist or scientist?

**Quentin:** Well I would give up this career fighting, it wouldn't be easy. I suppose, if I had to be something else, a couple things come to mind.

One might be a historian. I'm just fascinated by understanding the present by coming to piece together evidence from the past. That's actually what I do with the beetles, I'm trying to construct their history, but it would be equally intriguing to reconstruct human history or other kinds of history.

The other alternative would be furniture making. A hobby of mine for several years has been building reproductions of 18th century American furniture. There's kind of sense of connection with the past there as well. In terms of the beautiful designs of that period of time and then just the satisfaction of working with your hands and creating something.

**Dr. Biology:** I have to agree. That is something I would actually get interested in. All right, I have one last question. What advice do you have for anyone that would like to get into a career in science, and in particular biology?

**Quentin:** I would say follow your instincts. Find out what is fun, what gives you passion in terms of asking questions about the world, and then follow that. In my experience I've trained a generation of young entomologists who were given advice that it would almost be impossible to find a job in this narrow field, but each of them brought so much passion and commitment that every single one has ended up with a job. So my advice has always been go with your instincts and if you follow that you will succeed.

**Dr. Biology:** Well I want to thank you for joining us, Quentin Wheeler, this has been wonderful. I know the students will enjoy not only listening to this, but coming to your new institute on the web at [species.asu.edu](http://species.asu.edu).

**Quentin:** And I'll look forward to meeting them there.

**Dr. Biology:** Oh I have one more question. I'm hoping that once the institute is open and has been running for a little while that you will come back on the program and tell us how it is going.

**Quentin:** I would love to do that. Thanks.

**Dr. Biology:** You've been listening to a special episode of "Ask-a-biologist." We've been exploring the Tres Rios wetlands and have been learning about plant and animal species. We've had a chance to talk to several of the biologists from the School of Life Sciences, and our special guest scientist Quentin Wheeler, who is starting a brand new institute. It is called "The International Institute for Species Exploration."

You will be able to find it on the web at [species.asu.edu](http://species.asu.edu) and, even though our broadcast is not live, you can still send us your questions by using our companion web site - [askabiologist.asu.edu](http://askabiologist.asu.edu), or you can just Google the words "ask a biologist." I'm Dr. Biology.