Ask A Biologist Vol 083 (Guest Kelly Miller)

Cybertaxonomy

The race is on. It is one where biologists and citizen scientists are working as quickly as possible to find and identify all the species on Earth before some go extinct. It might not seem like an important race, but we learn from entomologist Kelly Miller that not knowing what species we are losing might be more important than we think. Today scientists combine traditional and newer computer tools to speed up the search. These combined tools are part of the world of cybertaxonomy.

Transcript

[beeps – electronic lock and vault door opening]

Dr. Biology: This episode of "Ask A Biologist," is being pulled from our special collections, that have been stored in our secret vault.

This is Ask A Biologist, a program about the living world and I'm Dr. Biology. There is a race on today. You may not know it and it's one that's critical, not only for humans but also for all living things on this planet. Like many races, it's a race against time and the growing list of living things becoming extinct.

Leading the race is a group of scientists and citizens scientists who are searching our planet to find undiscovered species to organize them and name them. This is all part of the world of taxonomy.

Now people have been discovering, classifying, and naming species for thousands for years. More recently with the invention of computers and the development of the Web taxonomy is moving into the cyber world.

My guest scientist is Kelly Miller, professor in the Department of Biology at the University of New Mexico. He's here to talk about the world of taxonomy and the new frontier, cyber taxonomy. What is it, and how will it change the way we see and learn about species that live on this planet?

Welcome to the show, Kelly, and thank you very much for visiting with me.

Kelly Miller: Good to be here. Thank you very much for having me.

Dr. Biology: All right. Before we jump into the world of cyber taxonomy let's first talk about taxonomy. I mentioned it briefly at the beginning of the show, but let's do it justice and talk more about it. Why is it important?

Kelly: Well, it's important because the study of taxonomy is the study of the diversity of living things. With thousands and thousands, in fact probably millions, of species of living things, that's

one of the most amazing scientific endeavors that human have ever undertaken, is to better understand the diversity of living things, the things that live around us every day.

Dr. Biology: Let's put some numbers on this. How many species do we know? We've given them names, and we've started ordering them.

Kelly: Right now it looks like we have about 1.7 million species.

Dr. Biology: OK, we'll round that up to two million species. How many do we think we are missing?

Kelly: We think we're probably missing on the order of 15 million species.

Dr. Biology: Whoa. Lots of work to do.

Kelly: That's a lot of work to do.

Dr. Biology: When I talk about the race against time, every day we're losing species.

Kelly: That's right. Because of things like deforestation, habitat change, climate change, and things like that, our earth is changing. As a result of that many species are going extinct, many of which we don't even know yet. Species that we don't even know about are going extinct every day.

Dr. Biology: This has been going on before humans were even thinking about taxonomy. Why is important to find them? I mean they go extinct. They're missing. What we don't know, we didn't have. Who cares, right?

Kelly: Well, some might argue that. I would argue the exact opposite. Those things that we don't know about, that's the thing that enriches us and helps us to better understand the world around us.

When they're gone, they're gone forever. That means that knowledge is gone forever. That means that the possible uses of new species to humanity is gone forever. That knowledge will be gone forever if we don't go and try to understand it now.

Dr. Biology: Right. Some of this mining if species and in particular, some of the drug companies been doing this for quite some time, right?

Kelly: That's absolutely right. Many of the drugs that we get are found in plants. What's interesting about that, now I study insects and insects are chemical factories.

There's so many chemicals involved in insects that we don't know anything about. And we haven't exploited those for pharmaceuticals and other sorts of medicines yet. We've only done it with plants. We haven't even started looking at insects yet.

Dr. Biology: To be fair, I'm on your side. I'm very interested in knowing about what's out there before we lose it. I mentioned that there is a group of scientists, taxonomists, but they're also citizen scientist, right?

Kelly: You bet.

Dr. Biology: As a citizen scientist what can I do to help in this endeavor?

Kelly: One of the things that can be done is simply collecting the specimens that are there. It's something that I started when I was just a kid, I started collecting insect specimens. That's how I got interested them.

Those insect specimens, if you combine the specimen with information about where you collected it and when you collected it, that becomes a valuable data point for scientists to use down the road.

Dr. Biology: If you're taxonomist or a citizen scientist, what are the things you need to write down and catalog?

Kelly: Well, the most important thing is the place where you collected it. We know that insects, for example, occur all over the world, but certain species only occur in certain places and you need that information to better understand the distribution of those species.

You also need to know the date that you collected it, as many people know, some insects come out certain times of the year and you have to have that information. That's true of plants, that's true of fungi and that's true of all living things. So it's primarily the place that you collected it and the date that was collected.

Dr. Biology: Now, when you collect, do you always have to have the thing or can you get by with a photograph?

Kelly: Well, in my opinion you have to have the thing. A photograph is nice for hanging on the wall and for recording your adventure, but the thing is what goes into museum collections and that's what's there for all time. We have specimens and collections that were collected by Darwin.

Now, if he had only taken photographs of those specimens, we wouldn't have the actual specimens. We wouldn't know exactly what he was looking at because now we can go to the actual specimen and identify it.

Dr. Biology: Right. And you don't know what view you might need to look at and so if they only took a view of, in the case where you work with beetles, the top of the beetle...

Kelly: That's a good point.

Dr. Biology: ...and not the bottom then there'd be all sorts of problems. All right. So, we go out there. We collect the specimen. What do we do next?

Kelly: There are certain techniques you need to use depending on what kind of thing you're collecting. With insects, certain insects need to be collected into alcohol to preserve for all time. Other insects need to be collected, so they can be pinned. If you're collecting plants, they need to be pressed, so that they can be put on herbarium sheets and preserved in museums.

So, there's a variety of different techniques. If you want to learn more about how to collect a particular species of living things, there are a lot of resources available on the Internet, for example.

Dr. Biology: We actually have a really nice section on, Ask A Biologist, that actually shows people how to make their own herbarium and it's a great way to start a collection.

Kelly: Now, that's great.

Dr. Biology: We've collected these specimens in various ways. Whenever I look in a book they always have a name. Who names them?

Kelly: Well, that's the job of the taxonomist.

Dr. Biology: OK. And what's the big deal about naming specimens?

Kelly: Well, what's so big a deal about naming people? Could you imagine if your family didn't have names? What's the first thing when you bring a dog home, a puppy home, you need to give it a name. You need something to call it. You need a handle so that you can communicate about it.

Dr. Biology: But there is more to the name other than just communicating. When we give it a name or when taxonomists are doing it, were actually naming them in order to organize them?

Kelly: That's exactly right. We have an organization system for the names that we use. That organization system ensures a number of different things. For example, we want only one name for every species of living things on the planet. That's critical, otherwise we wouldn't be able to communicate effectively.

Dr. Biology: So one scientific name, very precise. OK. It's an interesting thing because we have a really fun little video that was produced out of the International Institute for Species Exploration and it's called Planet Bob. And the reason I like it is, it's not just so much the fact about giving a name. In this case, everything is named Bob.

That's the same problem if it didn't have any name. In this case, everybody and everything is named Bob and it is pretty comical. So, let's talk about cyber taxonomy.

Kelly: OK.

Dr. Biology: How computers and computer networks, i.e. the Internet are changing taxonomy? What's going on? What's the Brave New World?

Kelly: Well, one of the most exciting things about cyber taxonomy is, no longer does taxonomy have to be restricted to just scientists. Now, anyone who can access the Internet has the possibility of going online and finding out what the different species are.

Back in the old days, it used to be just scientific journals and stodgy old museum guys who were able to do this kind of work and understand the diversity of life. Now anyone can go online and access information about the diversity of life, about taxonomy from anywhere.

Dr. Biology: So, more people can get involved and one of the things you mentioned was, making sure you write down the location of where you collected the specimen and that used to be, maybe just a map and a reference of a town or something. But that can be a problem because town's names change and there are other issues because you might need to be more precise.

The new smartphones and mobile devices now have GPS, Global Positioning Systems in there. So I have heard and you can tell me more about this, that you can use those now to tag where you collect the specimen?

Kelly: Well, that's absolutely right. In fact, that's exactly what we do. All of the specimens that we collect now have latitude and longitude that we get from a Global Positioning System and that's included with the information associated with that specimen. That allows us to do very sophisticated things like digital mapping of the distribution of species.

So you can see every place on the world where the species occurs by mapping it, using latitude and longitude information from that label data that's included on the specimen.

Dr. Biology: Does this require a special software or we hop on the Web and go to Google Earth.

Kelly: You can absolutely go to Google Earth. That's the easiest way to get that information out there. We have a number of projects where we are labeling all of our specimens with latitude, longitude, getting them into a database that Google Earth can access and you can see the distribution of species, just with a simple click of your mouse.

Dr. Biology: Are there other tools out there that we're going to be able to use or are using right now, that are making a big difference on taxonomy and world cyber taxonomy?

Kelly: Well, one thing that I hope is in our future is the ability to download an application onto your phone that will allow you to identify specimens while you're in the field.

Wouldn't that be fantastic if you could download some sort of an identification tool for the butterfly that you're looking at right now while you're in the field? That's something that I do think is in the future.

Dr. Biology: Wow! That would be cool.

Kelly: Yeah.

Dr. Biology: So, I went out and did some research on you. I went to your website and one of the things I loved about it, you had the classic areas, publications and the lab and the things you're dealing with, research was a topic.

We had one section there called expeditions and I like just the word alone. And I saw that you've been, jeez! You've traveled to so many countries, Central and South America, Africa, Australia. It sounds like a really pretty cool life?

Kelly: Well, you know it's cool. It's fun to see these exotic locations, but it can also be very difficult. A lot of these places we go don't have the kind of roads we have. They don't have the kind of food that we have and it can be a real challenge getting into these areas. Especially when our goal is to collect insects in some of the most remote areas on the planet, which is where many of the unknown species occur.

Dr. Biology: So this isn't for the simple tourist?

Kelly: No, not for the faint of heart.

Dr. Biology: [laughs] All right. But do you really have to go to the far ends of the earth to discover new species? Could I go out to my backyard and find something?

Kelly: You absolutely could. We know so little about things like insects, that there is new species being discovered literally in our backyard every day. In fact, just to give you an example. You guys have all heard of field crickets, the little black crickets that live outside your house. Well, it turns out that the species that lives right in Phoenix has never been described.

Dr. Biology: You're kidding.

Kelly: No, I'm not kidding.

Dr. Biology: Wow!

Kelly: Never been described. In fact, from all of the Western United States, only six species have been described. Now we have as many as 50 new species from the Western United States.

Dr. Biology: That's pretty cool. Sounds like a neat project to me. How about, if we are talking about your expeditions, do you have a favorite one?

Kelly: A favorite expedition. Boy, they're all so great. But there is one that, I think, really blew my mind and that was a trip I took to Africa, the country of Namibia. And what was so great about that expedition was, not only were we collecting a lot of fantastic new insects, but we also got to see all of the big African animals. We saw elephants and rhinos and lions and every kind of big animal that you could think of over there.

Just to give you an example of one story. We were camping actually in the bush one night and we woke up in the morning. We were sleeping in tents and I heard off in the distance, a lion roaring. And then, pretty soon I heard a roaring a little closer. And then after a little while it roared a little closer.

Dr. Biology: [laughs]

Kelly: And he kept getting closer and closer. And finally we'd had enough and we decided to get into the pickup trucks that we were driving. We sat in there and the lions roared within 40 yards of us on the other side of some bushes.

Dr. Biology: OK. I'm in the trucks with you.

[laughter]

Dr. Biology: Let's talk a little bit about when you're on these expeditions what are you actually looking for? Because obviously you don't hunt for every species out there. You have some favorite ones. So what's your favorite one?

Kelly: That's right. The groups that I work on are mostly water beetles. We study beetles primarily that live in the water. And the group that I work on right now has about 6,000 species described. But we find new species on every expedition that we go on.

Dr. Biology: What's the name for these water beetles that you like?

Kelly: The main ones are diving beetles and whirligig beetles.

Dr. Biology: Whirligig beetles. I love that name alone, whirligig. Those are the ones that, if I'm not mistaken, if you look at a pond or a little pool of water, it looks like there are these little almost ripples going around and if you actually look, instead of being something dropped on, there's a little beetle in there...

Kelly: That's right.

Dr. Biology: ...in that little ripple. They also are pretty unusual. They're not your normal-looking insect. If you could say that insects are normal-looking?

Kelly: That's right. They're pretty unusual and they're very uniquely adapted for living right on the water's surface. That's pretty atypical. What you find though is that if you look really close at the beetle, you'll see that one of the adaptations they have is, their eyes are divided.

Now, most insects have one pair of eyes like we do, but whirligig beetles actually have two pairs of eyes. One pair looks up into the air, the other pair looks down into the water, and that's pretty unique to beetles.

Dr. Biology: Now, that's almost like having eyes in the back of your head.

Kelly: [laughs] Yeah. That's exactly right. It's exactly like it is.

Dr. Biology: That makes me wonder, how do you think they see it? I mean do they have a split screen? I mean, how you're going to process both of those? Do they turn one on and one off and why do they have two pairs of eyes?

Kelly: That's a really good question. I think the best answer to that is, they probably see everywhere all of the time and so they're processing all that information, all at once. I don't think they turn anything off. But they look up and they look down, because as with most insects, they need to worry about getting eaten by birds and other predators. So they're looking up for birds, but they're also looking down for fish.

Dr. Biology: Fish. So how big are these whirligigs?

Kelly: Most of them are pretty small. They might only be about a quarter of an inch long, but then there are some that are over an inch long.

Dr. Biology: But that means pretty small fish?

Kelly: Well, pretty small fish, yeah. Sure.

Dr. Biology: When something is that small, how do you get a good look at it. I mean you can obviously grab a microscope, I suppose. But how do you look at it in real detail?

Kelly: Well, I'm afraid that the best way to do it is through a microscope. Sometimes, we use different kinds of microscopes, including electron microscopes to look very close at the small details. Because it's in those details where species are different from one another.

Dr. Biology: Recently, I had some students, some co-hosts. Ask A Biologist has student co-hosts. They spend a lot of time in the W. M. Keck bio-imaging lab, which is really just down the hall from us and they were exploring the microscopic world, or as I like to say traveling into inner space as Micronauts. [laughs]

Everybody is excited about astronauts, but inner space has got some amazing things and worlds to explore. You also spend a lot of time imaging your insects using a very cool instrument built by Visionary Digital?

Kelly: That's right.

Dr. Biology: We think you can collect a series of images, it's like get a stack of cards, each card and each one of those is nice and sharp, because of anybody's ever looked through a microscope, some things are in focus and some things aren't. If you readjust, you can get the stuff that was blurry in focus.

This lets you get all the things sharp and then you take it to the computer and it puts it back together in unbelievable detail. How important is this new tool to cyber taxonomy and to your work?

Kelly: It's absolutely incredible. Even though we talked about at the beginning that a picture isn't substituted for a specimen, pictures are critical for communicating information about those specimens. The opportunity to take high-quality digital images and make those available on the Internet has revolutionized taxonomy and identification work.

Dr. Biology: You also showed me illustrations today that are based on the photographs. The big question for me is if we get all this detail and we can do this wonderful imaging with this instrument, why are we still drawing them?

Kelly: Well, have you ever used field guides to identify birds?

Dr. Biology: Some people have and I have, yes.

Kelly: Sure. There's some field guides use drawings of birds and other field guides use pictures of birds and sometimes one of the field guides is a little better for a particular bird than the other type of field guide. And that's true when it comes to identifying parts of insects as well.

Sometimes, a particular thing is communicated better using a drawing. Other times, it's communicated better using a photograph.

Dr. Biology: In this case, maybe simplifying what you're looking at with the drawing, makes it easier to understand the overall structure, and the way that insect looks, whereas the photograph has just got so much detail, you might not catch all that information?

Kelly: That's exactly how it works here.

Dr. Biology: All right. So part of discovering new species is giving them names and you actually have quite a history with this. Yes, he is rolling his eye.

Kelly: [laughs]

Dr. Biology: I'm saying this because you've come up with some rather exotic and actually well-known names. Can you give me a couple?

Kelly: I have. I need to say that, I've done this in large part, in collaboration with Dr. Quentin Wheeler and I blame him for much of it. But we've named some species after some famous people. One of the great things about discovering new species is that, when you find a new one, you get to name it. You get to give it a name and that name stays for all time.

It's a great opportunity for us. We have given a number of species some prominent names. We named a species after Steve Colbert. We also named a species after Roy Orbison, the great singer and probably the most famous one is, we named a species after George Bush.

Dr. Biology: Oh, really.

Kelly: We did, we named the species after President Bush, while he was President and believe it or not, he actually gave us a call to thank us for naming that species.

Dr. Biology: Now, which George Bush are we talking about?

Kelly: George W. Bush.

Dr. Biology: So give me that name of that species.

Kelly: The name of that species was *Agathidium bushi*.

Dr. Biology: OK. And what was the actual insect?

Kelly: It's a type of beetle that lives on a group of organisms called slime-mold.

Dr. Biology: OK [laughs] . Well, I was going to ask and I suppose, I'll go ahead. Do you make sure you match the species characteristics for the person it's named after?

Kelly: [laughs] . No, I'm afraid that's not quite what we go for.

Dr. Biology: [laughs] OK.

Kelly: I need to say that any time we name the species after a person, it's considered an honor. In fact, it's considered poor form to name a species to dishonor somebody. And in fact, there are species that I've named for my wife, for my daughter, and for my son. Also, for certain friends. But we also name species for a variety of other reasons.

Sometimes, we'll name a species after the place where it was collected. Sometimes, we'll name a species after a particular feature that's really different on the species.

Dr. Biology: Getting back to cyber taxonomy. Most collections are housed in natural history museums and similar museums. It may be housed at universities around the world. In that case, you've got to be able to get the physical collection to see the specimen in most cases. How is cyber taxonomy changing the natural history museum?

Kelly: It is revolutionizing, how we use natural history museums. Back in the old days, you had to borrow specimens or go visit the museum just in order to see the specimens in that museum. Nowadays, with the digital imagery, we can put images of all the specimens in the collection online. So you don't necessarily have to go to the museum or borrow specimens.

The other possibility that, I think, is really exciting, is the idea of having a virtual microscope. Perhaps, you could look from your desktop computer, through a microscope that exists at a museum somewhere and look at specimens in that museum through their microscope. That's one of the most exciting things, I think, about cyber taxonomy.

Dr. Biology: Right. So you wouldn't have to rely on how someone took a picture, you'd actually be able to get the specimen, maybe even move it around.

Kelly: Maybe even move around, maybe even do a dissection of that specimen.

Dr. Biology: That'd be pretty cool. We're getting into the next question and the next question is, all right. I'm going to let you build the Natural History Museum of the future, using cyber taxonomy. What would be your dream museum?

Kelly: Well, of course, the specimens are still really important, so we would have the specimens still residing in the museum. But all of those specimens would have the label information digitized so that you could access it from anywhere in the world and would also have images of all of the specimens available from multiple different angles.

In that way you could access that collection from anywhere in the world, anytime you needed to and get all the information that was available there.

Dr. Biology: Now, assuming you going to throw that microscope in there or a tool that could go out grab a specimen, and bring it over, put it under the microscope, let's you look at it...

Kelly: Now, that's a great idea.

Dr. Biology: So, now we have these robots at this giant room. I can see robots going and grabbing specimens, depending on who needs what. What about some hunting for a specimen, if you're not an expert? You know your water beetles like the back of your hand, which you probably had them on and so for you it's not that difficult, and you also speak the language because there are terms and words we use that the average citizen scientist may not have.

What are we going to do about that? Is it already out there? Can you go some place, if I know nothing about water beetles and I find one and I want to know what it is, that I could track down, what it is?

Kelly: Well, there's a few resources like that, but that's just getting started. That's something that we need to develop as a community, as taxonomists is, those resources online for people to access.

You've all used Wikipedia. I can imagine a taxonomic Wikipedia, where all of that information was available.

Dr. Biology: We had Norman Platnick on the show and he had spider web, which was a really cool tool and that's one when where you could actually go take a picture of a spider, upload it and the computer would actually go out and try to find a match. That is intriguing to me. Do you think that's going to be in somewhere in the future of cyber taxonomy?

Kelly: I absolutely do think it will. You guys have all heard of face-recognition technology, where you take a picture and you match it up against faces in a database. The same exact sort of thing could be used for taxonomy or for identification. Take a picture of a specimen, match it against a database and hopefully come up with an identification.

Dr. Biology: So in this case, everybody could be a taxonomist?

Kelly: Well, everyone may be able to identify specimens, but keep in mind, it takes a lot of knowledge to identify new species and what are the new species and to categorize them and catalog them.

Dr. Biology: OK. So then everyone can be helpful for a taxonomist?

Kelly: Absolutely, anyone can be helpful.

Dr. Biology: Because you could go out there, plug in a new water beetle that you found. It goes through this fancy database. It doesn't find anything and says, "Uh, this might be and I can say might be a new species." At that point give you instructions and how to mail it too, maybe off to your laboratory.

Kelly: I think that would be fantastic if we had something like that available.

Dr. Biology: OK. So, we can get people involved, because if I remember at the beginning we're short species by at least 15 million?

Kelly: That's right.

Dr. Biology: And if we don't get involved, all of us, we're going to have some problems?

Kelly: That's right. All of that information will be something we'll never know about.

Dr. Biology: And it can be in your backyard. You don't have to travel off to exotic places. Although, if you have the money, the time and the desire, maybe you could do that too.

Kelly: And you're not afraid of lions.

Dr. Biology: [laughs] And you're not afraid of lions. One of the things we do on this show, none of scientist gets out of here without answering three questions. All right, the first one is an easy one. When did you first know you wanted to be a scientist or a biologist? Was there that spark?

Kelly: Well, I would have to say was, when I was so young, I can't even remember exactly when it was. As far as I know, as long as I've ever been alive. I wanted to be a scientist.

Dr. Biology: Now, did you always know you're going to be a taxonomist and that you're going to be working with water beetles?

Kelly: No, I didn't know that. That came quite a bit later. But once I found out that there were people in the world that got paid to identify new species, describe them and name them, I knew that's exactly what I wanted to be.

Dr. Biology: Right. So did you think of yourself and do you think of yourself as an explorer?

Kelly: Absolutely. My whole life, I wanted to be an explorer. Once I found out that most of the places on the earth had already been explored, but then I found taxonomy and I found new species. That's the cutting edge of exploration. And that sense of discovery is very fulfilling.

Dr. Biology: Right. I always say, especially the taxonomist that go out and do these wonderful expeditions, I really do see the Fedora, the Indiana Jones hat or the Indiana Jane hat, depending on if you're a male or female. It is really, I think a cool job. If you want to do it, that's probably one of the best you could do.

Kelly: Absolutely.

Dr. Biology: OK. Now a little more challenging. If you were not a scientist or a biologist, what would you be? And because my scientists have a tendency to say, Well, I'd love to be teaching, because we also teach. I take that away now. I love both of them.

Kelly: OK. That was going to be my answer.

Dr. Biology: Yeah. [laughs]

Kelly: If I wasn't a scientist, I don't know what I would be. Well, I'll be honest with you, I think one of my great loves in life is woodworking and I think I could be a carpenter or a cabinet maker or a woodworker. I think that's the type of thing that I would probably be.

Dr. Biology: It doesn't surprise me. I mean, again it's working with this form and shape and there's some really beautiful pieces of furniture, and objects that are made.

Kelly: Well, it's similar to taxonomy too. You take something that's unordered and disorganized and you organize it into something that's beautiful.

Dr. Biology: All right. And the last one, all right. What advice would you have for a young scientist, maybe someone that just got turned on to taxonomy? What's your advice for them?

Kelly: My advice is go for it and contact the experts. Most of us are really excited to help you out, to encourage you, to give you resources if you want to try to identify things. And you should contact us. Don't be afraid just because we're scientists somewhere. We're just people just like you and contact us and let us know what your interests are and how we can help?

Dr. Biology: Well. And if you're trying to say ID, a water beetle, Ask A Biologist, of course, has the ask section and now that we have Professor Miller here. He is on the hook. He has now become

an honorary member of the team and so maybe we'll get him the images and move him along there. Or if you live in Albuquerque, right.

Kelly: Yep.

Dr. Biology: You could do that or if you just want to give him a call you can actually find him on the Web.

Kelly: Absolutely.

Dr. Biology: Professor Miller, I want to thank you very much for visiting with me today.

Kelly: It's been my pleasure. Thank you very much for having me.

Dr. Biology: You've been listening to Ask A Biologist, and my guest has been Professor Kelly Miller, visiting ASU from the Department of Biology at the University of New Mexico.

The Ask A Biologist's podcast is produced on the campus of Arizona State University, and is recorded in the Grassroots Studio housed in the School of Life Sciences, which is a division of the College of Liberal Arts and Sciences.

And always remember, 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.

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