Ask-a-Biologist Vol 045 (Guest: James Elser)

The Other Marine Biologist

When many people hear the words "marine biology" they think of oceans and the things that live in oceans and seas. What most people do not know is there is an area of biology that studies marine life found in lakes, rivers, and streams. Co-host Michael Saxon and Dr. Biology catch up with limnologist James Elser to learn more about these other marine biologists. Along the way they learn about, fantastic places, evolution and a new computer game called evoSpore.

Transcript

Dr. Biology: This is Ask a Biologist, a program about the living world and I am Dr. Biology here with my co-host Michael Saxon from Mesa Academy. Welcome to Ask a Biologist Michael. Can you tell us a little bit about yourself?

Michael Saxon: Well I go to Mesa Academy for advance studies in Mesa, Arizona and I am in 7th grade and my teacher is Mrs. Klingaman.

Dr. Biology: And, is she a great teacher?

Michael: Yeah.

Dr. Biology: OK, well she is sitting right back here.

Michael: Yeah, so we have to say that.

Dr. Biology: But it's true, right?

Michael: We have no choice, it's true though.

Dr. Biology: Yeah, well that makes it even easier for us. Well, Michael when people talk about Marine Biology, what images come into your mind?

Michael: I think about oceans and I think about ocean animals because biology is about animals and marine is water.

Dr. Biology: Yes, that's what comes to my mind. But, today we are going to learn that there is more to Marine Biology than oceans and the things that live in the oceans. Our guest scientist is James Elser, a professor in ASU School of Life Sciences and he is a Limnologist, which is someone who studies life in and around inland waters like lakes and rivers; makes sense?

Michael: hum.

Dr. Biology: OK. So, he is a Marine Biologist, just not the way you might think of a Marine Biologist. He is also interested in evolutionary ecology and has researched projects literally all around the world including inner Mongolia, China, and I think we have learned today, he has been down to the Antarctic and to the Arctic poles, and to Norway. I have also heard that he is involved with a new multi-player video game called Evospore. If you are a gamer, are you a gamer Michael?

Michael: Somewhat.

Dr. Biology: Somewhat? OK. If you are a gamer or someone who is interested in evolution, you probably want to stay tuned to this show because we are going to be talking about this really cool game that, we are hoping that everybody will get to play sometime in the future. Welcome to the show Professor Elser.

Prof. James Elser: Thanks Dr. Biologist, great to be back.

Dr. Biology: So Michael, let's start off with some questions.

Michael: How does the climate affects the way that animal adapt and evolve?

Prof. Elser: Well that's a really good question. I think we hear a lot about the climate these days in the context of something called global climate change which is the idea that Earth's climate is warming perhaps, and changing in other ways due to the effects of human beings. But, climate change has always been a part of earth's history. So, there are warm periods on Earth's history and cold period on Earth's history. And the climate of course, refers to the average temperature, and rainfall you would expect in any given area and those very important parameters for all living things. And so, some animals for example, do very well at low temperatures. We can think about arctic animals. For example like, Polar Bears, which do very well when weather is cold and has special adaptations for surviving a cold winter. And other species of course do much, much better in warm climates like the ones we have here in Arizona.

We have snakes, and lizards, and birds, all which have interesting adaptations for coping with high temperatures and lack of water. And so when the climate changes, it places special stresses on organisms which are adapted to particular climate. And so there is a lot of interest now among scientists about whether the climate changes that are now occurring due to human activity are going to change the ecology of animals and plants. And whether or not animals and plants would be able to cope with those changes and adapt to them quickly enough, or whether or not the climate changes will come too rapidly for animals and plants to respond and many species may actually go extinct. And so there is a lot of concern about this.

Michael: How fast are you talking about having the temperatures change like what's the range of...

Prof. Elser: Well, the most of the climate models that people are looking at now for climate change, or things that will happen over the next 100 years or 200 years, which seems like a long time. And it certainly is compared to a person's lifetime. But, for the time scale of evolution, for example, it's very, very short for long lived organisms or larger animals like mammals and reptiles which have generation time of one year, five years, ten or even twenty years. Even 200 years is only a few generations. It's very hard for major evolutionary change to take place. So, the concern is that, many species, if they are not able to change their distribution in response to climate change, the changes are too fast for evolution to take place quickly enough to save them. So, there is some serious concern about species extinction in response to climate change.

Michael: How does evolution occur in the first place?

Prof. Elser: Well, that's a great question and the answer is interesting because it's so simple. So, evolution occurs essentially because it has to. So, we know from Charles Darwin that evolution by natural selection occurs whenever three conditions are met. And those conditions are that there is a variation among individuals in a population of a given species. That there is the ability of traits to be passed from parents to offspring, that's the second condition, genetics. The third one is, what we call limits on reproductive success, that is not every individual in a population is able to reproduce as much as everyone else. And so what Darwin realized and which we now understand as the main driver of evolutionary change, is inevitably the case that there will be some individual in a population who just happens to be born with genetic based differences that give them a little bit of an advantage in an environment, allows them to survive a little bit more, have a few more babies than everyone else.

And therefore in the next generation there are more individuals like that one around. And so the average characteristic or the frequency of that characteristic is different in the next generation than it was in the current generation. So, then we will just call that evolution, because evolution is just change over generations in a biological population.

Dr. Biology: So, if it was an advantage for say, an animal to be really fast. Maybe it's able to escape its predator right; the ones that are really fast are the ones that will be able to reproduce.

Prof. Elser: That's right. If they are fast based on a genetic mutation or genetic combination they got from their parents that made them a little faster than the other individuals in the population. Therefore, in the next generation, they've left more babies than the slower ones. And therefore the species has gotten a little faster.

Michael: So, the animal has offspring, whom are more suited to their environment. And those ones are more likely to survive and reproduce. And so eventually the population will gain that way?

Prof. Elser: That's right. The population comes over time to be well matched to its environment. One of the best ways to think about this is in terms of something like camouflage. Right, so idea that sometimes a prey item will look just like its environment. So, if a species lives in a forest it will be sort of green and look like a leaf. And if you can imagine back in time, in history that species may have been not green at all; maybe a variety of different colors. Maybe an individual happen to be born and it was just a little bit greenish because it got a mutation from its parents. Because it's slightly greenish, it blends a little bit better into the background and therefore some birds or something that are preying on it are less likely to find it. And therefore it leaves more off-spring than the ones that weren't so greenish.

But remember, the greenishness it has is based on the basis of genetic change. So, it's stable. It can give that greenish trait to its off-springs and so all its babies are kind of green and now they have an advantage compared to the ones that aren't green. So, the whole thing started to spread through the population and they get a little bit better matched to their environment.

So, the evolution of camouflage is a really way to think about evolution by natural selection.

Dr. Biology: So back to our climate change, if where they live all of a sudden they didn't have a whole lot of green things, and they're sticking out as green when it's say now turned into brown foliage. There's a problem, right?

Prof. Elser: Well, that's right. So, climate change means that the vegetation changes, they might all of a sudden lose their camouflage, for example. But, camouflage is just one example of adaptation. Organisms adapt in all kinds of ways, including with their physiology. And so desert dwelling organisms have very good adaptations for conserving water and operating their metabolism at relatively high temperatures, for example. But, on the other hand, cold adapted species do best under cold temperatures. So, they run their enzymes and their physiology systems very, very nicely at the low temperature. And so when the climate warms up a little bit they aren't quite so well suited to that new warmer world. And so there's some concern that a lot of these species won't do so well in a future climate.

Michael: Well, I know that I've heard that birds are the descendants of dinosaurs. Do you believe in that theory?

Prof. Elser: Well, I'm sort of as interested in dinosaurs as anyone who's seen Jurassic Park. I'm not a dinosaur paleontologist though, so I'm not a very good expert to ask those questions. We probably have better people we can talk to in a future episode of Dr. Biology's ask a biologist program. But, what I do know about it is that the paleontologist, who are the scientists who study fossils, have looked at fossil dinosaur remains and compared them to the anatomy and bone structure of modern birds, and there really is a remarkable resemblance in a very, very detailed level between the bone structure and the details of bone structure in certain dinosaur groups.

The theropod dinosaurs and modern birds, and so that has led them to conclude that modern birds are in fact descendants of theropod dinosaurs. And so dinosaurs did not actually go instinct in this view, there are still dinosaurs among us, they're just called birds. And I think it makes sense. I think I buy it. I'm not a specialist in that area, but the consensus among most paleontologists who study the evolution of birds and reptiles have come around to this view based on the evidence.

And there's some really cool fossils, like the most famous fossil of all time probably, is this fossil called Archaeopteryx, which is a feathered toothed dinosaur from about 140 million years ago. And this is one of the first indications of the idea that birds evolved from dinosaurs. More recently I think they have some other fossils from a more recent time, 125 million years ago, they found in China of feathered dinosaur like things.

But, now they're not toothed anymore. They lack teeth, and so they're much more bird-like in that sense. So, I think the consensus is converging around the idea that birds are descendants of dinosaurs. But, the really cool thing is that in science, nothing is ever sort of settled forever. There's always the possibility of changing your mind based on the evidence.

And so what scientists do is they make up their minds in proportion to how much data is available. And so right now most of the data indicates that birds are descended from dinosaurs.

Dr. Biology: Alright, since you're not a paleontologist, but you are limnologist, what is your main focus?

Prof. Elser: My main focus is to try to understand how lake food webs function in terms of energy flow and nutrient cycling.

Dr. Biology: So, a food web, we learned about that in school is what eats what.

Prof. Elser: Yeah, a food web is a map of feeding relationships. It sort of just tells you who is eating who. What we try to do is to understand how energy moves through such a feeding map. So, we know the energy that fuels 99.9 percent of the ecosystems on Earth comes from the Sun, and it's captured by plants. In lakes these are microscopic plants, doing photosynthesis. Michael looked at some of them in my laboratory today, and fixing, using that energy to fix carbon into sugar, and that essentially fuels the entire system, because the algae are in turn eaten by small animals called "Zooplankton." Michael looked at an example of that in my lab.

Dr. Biology: What was that you were looking at?

Michael: Daphnia.

Dr. Biology: Daphnia, yeah.

Prof. Elser: Yeah, daphnia is a filter-feeding crustacean about a milometer or two in length, and really interesting organism.

Dr. Biology: If you had to describe it, what would you say it looks like Michael?

Michael: Well, under a microscope it really looks like a tiny little circle, with two little arms going out of the front, and something that looks like an eye on the front. It seems to have a bunch of little legs or limbs inside of its stomach that it seems to kick to circulate water.

Dr. Biology: Right, right, and it's also I noticed transparent.

Prof. Elser: Yeah, daphnia are transparent, and it's sort of a form of camouflage. Many things that live in the water are clear, which I like to think of is if you need to look like your environment, what does water look like? It's clear, so it's good to be clear. So, being clear in the water is sort of like being camouflaged. That's because there's lot of predators in lakes, especially ones that use vision to find their prey. These are plankton feeding fish like minnows and small fish like that. Then they're eaten by other fish, bigger fish, like bass or pike or these kinds of things that people like to catch with their fishing poles. So, sort of in that sense, the end of the food chain is in your 'frying pan.'

Dr. Biology: Oh, OK. So, what else did we look at in the lab, do you remember?

Michael: Well we also looked at algae, which you were growing to feed the daphnia, right?

Dr. Biology: That's right. What was the coolest part?

Michael: I liked looking at it in the incubator where you were growing it; it smelled just like the ocean.

Dr. Biology: I also liked the fact it's all bubbling. So, why is it bubbling?

Prof. Elser: Oh, well because we're just trying to keep the algae mixed in the flasks where we're growing them, and that bubbling keeps them mixed. Also the air is carrying carbon dioxide in, and maintaining the carbon dioxide levels in the water, so that the algae have carbon dioxide for use in carbon fixation for photosynthesis.

Dr. Biology: So if we were to take a drop of pond water, and we were able to count all the living things in it, how many living things do you think would be in that drop of pond water?

Michael: Hundreds, maybe?

Dr. Biology: Hundreds?

Michael: Yeah, I think that's a pretty fair estimate.

Dr. Biology: Yeah, and I bet for most of us, that we would think hundreds, maybe even thousands.

Michael: Maybe.

Dr. Biology: Right, OK. Well, Dr. Elser, what are we going to find in that drop of water?

Prof. Elser: Well, it will depend on where you got your drop of water from. If you go to a very, very clear lake, it will have fewer things in it, and if you go to a very, very green lake, it will have more things in it. If we took an average, a drop of pond water might have tens of thousands or hundreds of thousands of cells of the phytoplankton, such as we saw under the microscope today. So, tens of thousands and hundreds of thousands of them, but even more than that every drop of pond water has probably a million or more of bacterial cells in it. The city of Phoenix proper has about a million people in it, so it's a lot of stuff. Then if we were to define viruses as a living thing, we might actually find that there are a billion virus particles in a drop of water.

Michael: That's amazing!

Dr. Biology: You took the words right out of my mouth. We talked a little bit about evolution, but I mentioned that you're interested in Evolutionary Ecology. What's that all about?

Prof. Elser: Well, there are two aspects of Evolutionary Ecology that people think about as a discipline. One of which is captured in the description of the mechanism of evolution that I described. Do you remember that the third part of my argument was that there are limits on reproductive success. And essentially what that means is that in the environment, not all organisms have the ability to survive and reproduce. So, in evolutionary ecology, you're studying those ecological forces that at any given time prevent all individuals in the population from reproducing maximally. So, the key there is that part of evolutionary ecology is essentially studying natural selection in operation in the here and now.

Dr. Biology: Now, let me get that straight. Does that mean that you're seeing it happen in a shorter time frame? Does that make it easier for you to see it happen?

Prof. Elser: Sure. So, in a lot of evolutionary ecology work people are trying to understand how different genetic variations in individuals in a population who differ from each other based on genetic traits that they got from their parents may have more or less success in a given ecological system in any given moment in time. That's essentially natural selection, so we can study natural selection in the here and now, and that's one thing evolutionary ecologists do.

Michael: So, can I ask you about some of the studies or other research that you've been conducting?

Prof. Elser: It'd be my pleasure.

Michael: Well, I know that I've seen a lot of things about biological stoichiometry, is that how it's pronounced?

Prof. Elser: Great, yes, that's how it's pronounced.

Michael: What is that?

Prof. Elser: [laughs] Good question. Some of my colleagues are still trying to understand it. Stoichiometry is a word from chemistry class. It just refers to the study of the chemical composition in terms of elements that are comprising something you're interested in. Usually it's used in chemistry class to describe the element make up of individual molecules. And therefore the elements that you need to build them in a chemical reaction. So glucose, for example, has six carbon atoms in it, and six oxygen atoms in it. And so you can't make glucose unless you have six carbon atoms and six oxygen atoms and twelve hydrogen atoms. That's just the recipe for making a glucose molecule. And what we're trying to do in biological stoichiometry is to understand the rules for the element recipes for living things.

Michael: So, that's kind of like, you have a recipe to make a cake and you have to have all the right ingredients or else it won't come out right?

Prof. Elser: That is a beautiful analogy, that's exactly right. What we try to do is understand the nature or in lakes, or in something like that. Sometimes nature doesn't provide all of the ingredients in the right proportions to grow an adult cell or to grow a daphnia, or do one thing or another. And so we try to understand those rules and their consequences for how ecological systems work and how they evolve.

Dr. Biology: So, with your research in the study of fresh water lake streams, where have you gone? I mean, do you just stay right here in Arizona? Or it sounds like you get around.

Prof. Elser: Well, I do get around. Arizona is one of the few places where I haven't worked actually very much. In my career I've worked in Siberia back when the Soviet Union was still around in a famous lake called Lake Baikal, the oldest and deepest lake in the world, and that was in 1990. I've studied lakes in the north slope of Alaska north of the Brooks range, above the Arctic circle we've sampled ponds and daphnia in Spitsberg or Spabard in Norwegian Archipelago in 79 degrees north. In summer of 2007 we spend the summer in southern Norway sampling a variety of lakes. In summer of 2006, 2008, we sampled a lot of high elevation lakes in Colorodo's Rocky Mountains. I've worked in lakes in California. I've worked in Lake Biwa in Japan, which is an ancient lake in central Japan.

I have had a long standing project in central Mexico in the Chihuahuan desert in a place called Quatra Sienegis. And actually there's a science studio podcast that's available that discusses that work.

Dr. Biology: That's our other podcast that comes out of the schools other live sciences.

Prof. Elser: Yeah. So, my work has taken me to every continent on Earth except for Africa.

Dr. Biology: Oh, so you have a place yet to go?

Prof. Elser: That's right.

Dr. Biology: OK, of those places Michael, where do you want to travel?

Michael: I'd have to say Antarctica, that is just so amazing. Getting to go to such a remote place and study things there that most people don't even know exist. And I just think that that's...

Prof. Elser: Yeah, Antarctica is the closest I think you can get to leaving our planet without being an astronaut.

Dr. Biology: Oh, yeah, I hadn't even thought of it that way.

Prof. Elser: No, it is very much like being on another place entirely than Earth. Right now there's a really exciting project going on in Antarctica, that I'm not involved in, but some colleagues are called Lake Vostok, which they've recently discovered a very large water body, possibly rivaling the size of Lake Superior, under 1,000 meters of glacial ice. And they're trying to figure out a way to sample it without contaminating it. A lot of the technologies that they're developing for that project are relevant to space exploration because they might need the same technologies, if they can ever send a probe to Europa, which is an icy moon of Jupiter.

Dr. Biology: So, you're saying that you can't just drill a great big long hole and just stick something in there and draw some water out because you might cause some problems?

Prof. Elser: Oh yes. There's been more than a decade of controversy about this possibility. While they're trying to decide whether they should do it in the first place, and if they're going to do it, how they should sample it without contaminating this water body. And what they really want to find out is if there's anything living in it. And, in order to find out if there's anything living in it, they have to make sure that they don't contaminate their samples with micro-organisms that may have come from the drill itself or from the sampling devices.

Michael: 1,000 meters, I think that's incredible, of ice. That's what, three-thousand feet?

Prof. Elser: That's right but most of Antarctica's covered with ice sheets of that depth. It's really a remarkable thing.

Michael: Wow. I never thought that the ice in Antarctica was so deep.

Prof. Elser: There is a remarkable place in the dry valleys of Antarctica, which is a pond called Don Juan Pond. And it never freezes, even in the Antarctic winter, when the air temperatures are minus one-hundred or so, or even worse. And it never freezes because it's essentially a calcium-chloride brine. It's so salty with calcium-chloride that the freezing point is lower than even is reached in the Antarctic winter. It's really a very, very strange place.

Dr. Biology: And are there living things there?

Prof. Elser: I think there are. I don't know too much about it, but it is a shocking thing to think that something could live in such an environment.

Michael: That salt content, that's incredible. Because I've been thinking about how the Dead Sea is so salty that nothing can live in it.

Prof. Elser: But things do live in the Dead Sea. They're called halophiles, halophilic, salt-loving micro-organisms that live in the Dead Sea. So, there are things living in the Dead Sea, it's not dead at all, actually. It's just different, so it really should be called the "different sea."

Dr. Biology: [laughter]

Prof. Elser: It doesn't have the normal lake organisms that we see, but it has special types of micro-organisms that can tolerate that salty temperature.

Michael: So, that lake in Antarctica is similar to the Dead Sea in that aspect?

Dr. Biology: I would say so, it's very, very different, that's for sure.

Michael: At the beginning of the show we were talking about this game that you're working on, called Evo-Spore. And I was really wondering more about it, because I'm really interested.

Prof. Elser: Lots of folks probably know about this game, "Spore, " which is now out there. And is very, very popular. It's a game where you start as a micro-organism and you work your way up to becoming sort of like an animal. And eventually you get to civilization and you take over space, or something like that. So, it's a game that's kind of about evolution, about how things change over time. And it's a really, really interesting game. But, when some colleagues and I took a look at it, we realized that it wasn't really about evolution. All the changes that take place in the game are more or less due to the accomplishments of the player, who sort of drives the organism around and makes things happen. But, that's really not how evolution happens. Evolution sort of happens on its own. So, what we want to do is use the whole spore framework. All the cool creatures that they have and the environments that they have and use it to really show how evolution works and make it kind of a fun game.

And so we're working now to develop a game that will hopefully that will become a competition to students out there where students and teams of students will be able to come together, develop a creature using the creature creator which is part of spore, but that creature has its own genes and its own behavior and its own characteristics.

And essentially what the team will do is make a creature like that, then throw a bunch of them into an environment and the other teams will throw their creations in the environment. And then essentially what will happen is all those creatures will then be on their own. They will have to find things to eat, avoid getting eaten, find a place to live, find mating partners, and all the genetics and normal sort of developments will take place. And all the conditions for evolution by natural selection will be met.

There will be variation among the individuals in each species. They'll have genetic basis for those variations, and there'll be limits on reproductive success in the game environment. And so over time what will happen is these computer entities that were generated at the beginning will change. They'll evolve in the game environment on their own.

Dr. Biology: I see.

Prof. Elser: And so what we're going to do is then you'll be able to watch how your species is doing over time, and how it's doing with everyone else's and see how it changes.

Dr. Biology: Cool. So, can you speed it up, too?

Prof. Elser: We think that we'll be able to speed it up using the supercomputer or something like that, so we might have 1,000 generations overnight, and you come back the next morning and see how your species did while you were gone.

Michael: I'm hooked. Now, when is this game going to be out?

Prof. Elser: That's a good question. We're hoping that we'll have it available this spring for at least ASU students to practice with and have a competition and maybe by next year, maybe we'll be able to make it more widely available.

Dr. Biology: And whenever it does become available we'll put a link on this podcast so you'll be able to get to it very easily.

There are three questions we like to ask every scientist that comes on this show. So, Michael, will you start us off?

Michael: When did you first know that you wanted to be a limnologist?

Prof. Elser: Oh, when did I first want to be a limnologist? That's a great question. When I was in the fifth grade, I believe it was the fifth grade, I had a copy of Jacques Cousteau's book The Shark, and it has all these incredibly cool pictures of sharks, but what I really found exciting was that Jacques Cousteau and all his sons and their partners with their cool red caps that they used to wear would go out in the zodiac raft and zoom around and collect fish and take pictures of sharks. I thought that was thing. So, I wanted to be a marine biologist when I was in fifth grade. And I don't think it was until I was in high school, when really I was well into college did I realize that there was something called limnology. And that there was a whole science devoted to studying lakes and ponds and streams.

And I think if I was a kid I would've been so happy to know that, because most of my time when I was very young I spent in the woods behind my house catching turtles and salamanders and frogs and keeping them and such. And that's kind of what I still do, I go out into lakes and ponds and streams and catch organisms and species. And now what I do is I study them from a scientific perspective. But, it's still very similar to what I did as a kid, so now I really didn't ever grow up.

Michael: That is so cool. So, if you weren't a limnologist what would you be?

Prof. Elser: Well, I know that Dr. Biology asks this question, so I thought about it a little bit ahead of time. I think I'd like to be an architect. I like art. I used to do a lot of painting and drawing. My wife and I built a house together in the last five years using the help of an architect who designed it with us. I like architecture because it sort of combines scientific understanding - you know, you have to know how things work so that your building doesn't fall down - with artistic expression. I think there are a lot of creative aspects to architecture, and I also think that architecture is very important, that is, it really shapes the way that we interact as human beings.

Dr. Biology: Michael, I have actually been to Dr. Elser's house, and it's really pretty cool, out in the desert. And it's got some amazing shapes. All right, well, what about for Michael or someone Michael's age? What advice would you have for him if he decided that he wanted to be a biologist or, heaven forbid, a limnologist?

Prof. Elser: Maybe, I'll take this chance to pass on some advice that was given by a famous limnologist, another famous limnologist. So, there's this famous limnologist named Tommy Edmundson who was an undergraduate at Yale University. When he was an undergraduate there he went to visit a very famous limnologist called G. Evelyn Hutchinson who's probably the best known limnologist of all time and also a very famous evolutionary ecologist. He asked Hutchinson, "How many math courses should I take in order to be successful in ecology?" G. Evelyn Hutchinson said, "You should keep taking math classes until you find one that you can't pass". [laughter]

Prof. Elser: What he was trying to tell Tommy Edmundson, the young scientist, was that mathematics is very important to being successful in science. That's really, really true so if you're excited about birds, if you're excited about bugs, if you're excited about plants or whatever as a biologist, you have to remember that the mathematics is going to be very important to your success in analyzing your data and understanding theory and all kinds of other ways. Keep your math together if you want to be successful in science is the advice I would give to a future scientist.

Dr. Biology: Good advice. Professor Elser, thank you for visiting with us today. It's been great to have you on the show.

Prof. Elser: Dr. Biology and Michael, it's a pleasure being here again, and I encourage Michael to have a great future ahead of him.

Dr. Biology: And, Michael, I hope you enjoyed being a co-host on the show.

Michael: Oh, yeah. It was lots of fun.

Dr. Biology: OK. And the tours today. Was there anything really the best part for you?

Michael: The eye scanner.

Dr. Biology: The eye scanner?

Michael: Everyone loves the eye scanner.

Dr. Biology: The eye scanner, OK. We're talking about the eye scanner over at the Biodesign Institute.

Michael: Please move a little closer. Please move a little further back.

Dr. Biology: [laughs] All right. You've been listening to Ask-a-Biologist and my guest, Professor Jim Elser from the ASU School of Life Sciences, and my co-host has been Michael Saxon from the Mesa Academy in Mesa, Arizona. The Ask-a-Biologist 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 both the School of Life Sciences and the College of Liberal Arts and Sciences provided funding for our co-host contest.

So, how cool was that?

Michael: That was fun.

Dr. Biology: OK. Now, remember even though our program is not 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...

Michael: ... and I'm Michael Saxon.

Dr. Biology: Hey, teachers, podcasting is also a great project to do in your classroom or in your school. We have all the information about podcasting and the contest and how you can create a contest in your own school. We have details about the equipment and the software that we use to create these cool shows and much more on the website. By the way, the software and the hardware doesn’t cost very much and many cases is free.