Oklahoma Innovations Radio Show

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Guests: **Jimmy Weaver**, Oklahoma State University Department of Chemistry

>> From the OCAST Radio Network, this is *Oklahoma Innovations*, a weekly science and technology radio magazine, brought to you as a service of OCAST, the Oklahoma Center for the Advancement of Science and Technology. OCAST is the state's only agency whose sole focus is science and technology. The OCAST mission is to identify and fund promising research and technologies that allow Oklahoma to compete in a global market economy from our own backyard. This program features some of Oklahoma's most gifted scientists, inventors, entrepreneurs, manufacturers, educators and business leaders who all have one common goal: developing technology based economic growth for all Oklahomans. Now, here are your hosts Gary Owen and Tessa North.

[Music]

>> **Gary Owen:** Welcome to this edition of *Oklahoma Innovations*. Tessa and I are thrilled about this subject this week, aren't we?

>> **Tessa North:** We are. I must say that I struggled. This was one of my more difficult subjects in high school and college, so I will be interested to hear about what awesome things you can do with it. Because I was kind of scared growing up.

>> **Gary Owen:** Chemistry is going to be our subject. And I'll tell you a little bit more about this later on. But if you can recall your days of high school or college when you were involved in chemistry, well, what can I say? You either loved it or you hated it. So our guest this week is going to be Dr. Jimmy Weaver. He's associate professor of chemistry as OSU. And he's one of those guys that I think it went way back when he was probably a kid. We'll have to ask about that. But he's just passionate about chemistry, and we're going to learn what he's doing at OSU and some pretty cool stuff. So what's going on at OCAST this week?

>> **Tessa North:** Well, we've got a couple of newsworthy events upcoming. Our intern funding cycle has just opened up.

>> **Gary Owen:** Now, what does that mean to the layperson?

>> **Tessa North:** So anybody who has an idea for an internship that could benefit undergraduate students in any way is welcome to apply for funding. Now, the program -- the project that students are working on has to be sort of a technical project. It can't just be, you know, answering phones or getting coffee or something like that. It has to be a real meaningful experience that these undergraduate students might have in a university lab or in a company. So if anybody has an idea for an internship that they would like to get matching funds for, they can apply to our program. You can find out more information about the intern program at www.OCAST.OK.gov. And so that funding cycle is open now, and applications will be due in September. So we've got several weeks to work on those.

>> **Gary Owen:** Explain to our audience who may not understand what the benefits are about this program for interns.

>> **Tessa North:** So the goal of this program is to give an opportunity for companies or university researchers who have an experience that they want an undergraduate student to go

through, to get matching funds. So that means that we would pay $1 for every $1 that the company or the researcher puts in to fund these students. So like I said, students have to be working on an actual project, not just, you know, doing clerical type of stuff.

>> **Gary Owen:** Not just gofer stuff?

>> **Tessa North:** Correct, correct. But it gives an opportunity basically for, like, a half-price internship sort of since we will foot half of the bill up to $30,000.

>> **Gary Owen:** Wow, very impressive.

>> **Tessa North:** Yep, pretty cool opportunity.

>> **Gary Owen:** Great experience for interns. And who knows? Some of these interns may be looking at future employment with some of these organizations. So there's a lot of perks, lot of benefits there. Okay. What else you got there?

>> **Tessa North:** We have recently awarded a lot of applications from our applied research program. And today I wanted to talk a little bit about some of cool stuff that's going on actually in the Tulsa area with one of those companies. We have a company in Tulsa that's helping patients to recover safely and cost effectively at home after surgeries. Many people may be familiar with deep vein thrombosis, which is a potentially life-threatening condition that occurs when a blood clot forms in one or more of a person's deep veins, which usually are in the legs.

>> **Gary Owen:** And that's not uncommon, by the way.

>> **Tessa North:** Correct, correct. And this is especially dangerous following an extended period of immobility, such as after -- such as when you're recovering from an accident or a surgery and you're just lying in bed for a while. So this company in Tulsa that we funded is called Compression Solutions. And they've developed a line of products and programs that increase patient safety, improve outcomes, and reduce costs, all while preventing the risk of developing DVT at home, which is when people are most likely to develop deep vein thrombosis. So the company's line of products helps to facilitate the vital continuum of care from hospital to home while providing pain and swelling relief through cold and compression. And we've had the opportunity to see some of their devices in action, and they're pretty cool. You know, so this is a company that's doing real business across the nation. And we are proud that we've been able to fund them recently.

>> **Gary Owen:** You see, Oklahoma? Now you know why OCAST is here, to give companies opportunity. And wow. And, you know, you think about all the companies that have evolved in Oklahoma that are science- and technology-related, it's -- it's slowly making Oklahoma really a spotlight center for technology-based companies.

>> **Tessa North:** Absolutely. And so even with a company like Compression Solutions here, you know, I mentioned that they have these great products and everything that's out on the market, but these are all backed by science and research. They're doing actual science here. So we have so much of that going on in Oklahoma, and it's really cool to see what everybody's working on.

>> **Gary Owen:** It's very cool. And boy, what it's doing to provide high-paying jobs in Oklahoma. And investors are looking for a good return, there's opportunities like that. It's great.

>> **Tessa North:** Absolutely.

>> **Gary Owen:** Our innovation in history this week, well, it was July 9th, 1968 when a US patent was issued for the portable beam generator, also known as a handheld laser ray gun. The patent was granted to inventor Frederick R. Schollhammer. The name laser -- didn't know this -- is an acronym for light amplification by the stimulated emission of radiation. Did you know that?

>> **Tessa North:** I had no idea that laser was even an acronym.

>> **Gary Owen:** Well, there you go. There you go. So you learn something new every time you listen to this show. Moving right along, we are going to introduce our guest this week, Dr. Jimmy Weaver, associate professor of chemistry at Oklahoma State University. An Oklahoma Sooner, born and raised in the state. Chemistry, for those of you as I mentioned earlier in the program who can recall their high school, college days -- even back to junior high, I guess, middle school -- you either loved it or you hated it. You were required to take it in some situations. And you are an individual, Dr. Weaver, who obviously was passionate about chemistry. I got to ask you this question. So was this a childhood dream? I mean, did you get one of those chemistry kits as a kid for Christmas and you went, "Oh, wow. This is cool"?

>> **Jimmy Weaver:** No, I actually wasn't.

>> **Gary Owen:** Interesting.

>> **Jimmy Weaver:** So, you know, I don't think I was that different than most other adolescent children in the sense that I enjoyed all the normal things -- seeing things burn and, you know, maybe pop and blow up. But no chemistry set. Unfortunately, those are kind of almost a bygone. You know, there's too many liabilities with giving kids chemicals these days. So you can't find them.

>> **Gary Owen:** So where did all this start? Like I mentioned, you're originally from Oklahoma, and I know you did have some experiences out of state? But tell us about your history.

>> **Jimmy Weaver:** So I grew up in Duncan, Oklahoma, and my father worked for Haliburton and was actually a chemist there. In fact, he actually got his PhD in the program that I now am a faculty member at, at Oklahoma State. So small world moment. But, you know, I toyed around with it, and I did all the compulsory courses in it. I took it in high school. And I thought it was interesting and could do it, I think. So I kept my options open, went to -- when I went to college, I took general chemistry and I did all right in the course. I don't know that I would actually say I fell in love with it really until maybe a little bit later. And actually, I would say it's been a very rewarding relationship; the further along I've gone in it, the more I've enjoyed it. And I actually think that's probably that polarizing effect that you talk about as most people are so turned off by the way you come into it and you have to, you know, learn a whole lot real quick. And really, those are fairly mundane things that you have to do. And it's not fun until after you've kind accomplished those things. And so, yeah, we're trying to work on that.

>> **Gary Owen:** That's amazing how -- I would have thought this was, you know, like a high school thing and he just got hooked on it. But it didn't pan out that way.

>> **Tessa North:** Apparently not. Now, you're not just a chemist, you're a synthetic chemist; is that correct?

>> **Jimmy Weaver:** That's -- yes, what I would call myself.

>> **Tessa North:** I have never heard of synthetic chemistry; can you tell us a little bit about what that means?

>> **Jimmy Weaver:** So a synthetic chemist is just kind of as a, I guess, maybe a classification that we kind of used to tell whether we try to just understand systems or whether we actually want to be able to make systems. So a synthetic chemist is someone that can synthesize molecules or other things, you know, macromolecules. There's some more gray lines in there for the person in the know as to how -- what exactly -- where you put yourself, what box to put yourself in. But it kind of comes from our historical way that we viewed chemistry as four major divisions, you know, which were physical, organic, inorganic, and analytical. But now these are in many ways the lines between these different categorizations have really blurred. And so maybe the easier way is are you a person that just tries to study a system and understand it, analyze it; or are you a person that can -- actually goes out and synthesizes molecules, puts them together from smaller components? And so I'm the latter type.

>> **Tessa North:** So I'm guessing that you have -- the things that you are making have a lot of -- or you hope will have a lot of applicability perhaps in -- I don't know, are you looking for applicability in drugs or what is it that you're synthesizing these things for?

>> **Jimmy Weaver:** Right, great question. And that's what is a very important question. So, you know, in essence we try to look at what is maybe missing -- that's one thing, which is actually sometimes hard to convince my community -- when we look at drug molecules, you know, we need to be able to build molecules that aren't available. And so sometimes that's hard to convince people that if there's not an example out there, that you should make that molecule. And so we develop not necessarily any one specific molecule, but what my lab focuses on is actually developing the reactions, the chemical reactions and the ways of making and putting those molecules together. So we develop strategies. And so oftentimes that really lends itself to drug discovery or agrichemical discovery. So you're looking for a drug that can help you treat high blood pressure or something like that. And there's a protein that you know is responsible for up regulating some pathway. But if you could inhibit that protein with a small molecule, then you could maybe help actually deliver some kind of therapeutic value. And so that's where small molecules come in. And almost something like 90 percent of all the drugs that are available are small molecules. There's a few macromolecules -- antibiotics -- not antibiotics, sorry, protein-based ones. But most of them are small molecules. And so we look at those and we try to figure out how we can help. So what we specifically do and why I say we're good for drug discovery is that the methods that we develop are very, you know, aimed at trying to be able to generate many, many analogs very, very quickly. You know, so for every one drug that the FDA approves throughout the year, supposedly there have been 10,000 that have been tested to try to get to that drug molecule. So -- and it's been told -- I heard the number a med chemist can make 100 compounds and get them isolated in a year. So you can start to do the math and realize that's a whole lot of man hours to try to get to that one FDA-approved drug. And that's aside from all the other testing and all the other effort. And so what we really hope to do is take -- and that doesn't count how many synthetic steps it takes to build that one molecule out of 10,000. So if it takes four or five steps, you're talking about 50,000 different compounds. And so you're talking about years and years of work. What we hope to do oftentimes is either cut down the number of steps to get to that molecule from let's say four or five to maybe one step to do that same thing.

>> **Gary Owen:** Wow. Dr. Jimmy Weaver is our guest. He's with OSU's department of chemistry. And he specializes in what is called synthetic chemistry. Fascinating stuff here. We have -- we're starting to get into the molecular level of how drugs are made and listen to all the, I

guess, speed bumps that scientists run into. He's got a good picture for us. More to come on *Oklahoma Innovations* .

[Music]

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>> **Gary Owen:** Dr. Jimmy Weaver is our guest, and I want to apologize, I said he was associate professor, he's actually assistant professor. I want to clarify that. Assistant professor. And he also provides a great service as a graduate admissions coordinator in the department of chemistry at Oklahoma State University.

>> **Tessa North:** So before the break we were talking a little bit about some of your -- all of your research. And you're actually funded under an OCAST project right now, under our health research program. And that -- oh, I can't even pronounce most of the words in this. That project is called photoredox catalysis for the rapid synthesis of diverse medicinally-relevant motifs. Close?

>> **Jimmy Weaver:** Very good.

>> **Gary Owen:** Wow, you get an A today.

>> **Tessa North:** Yay. So obviously you've been funded under OCAST. OCAST has, you know, OCAST reviewers have thought, "Man, this guy's really sharp and he's got some good work going on." But you've also been funded -- especially recently -- under some pretty big other grants from federal agencies. Can you talk a little bit about your funding that you've gotten?

>> **Jimmy Weaver:** Right. So two major federal grants. One was an NSF career award, which came through this past year. I'm really excited about that. So it provides funding for the next five years for one project that's going on in my lab. And then the second major federal funding is an NIH R01 grant, which also provides funding for the next five years. And so that is in the final steps of being finalized at this point.

>> **Tessa North:** Awesome. And so this -- correct me if I am wrong, but the NIH R01 grant, that's a big first-time grant for somebody to receive, correct?

>> **Jimmy Weaver:** It is.

>> **Tessa North:** So that's a pretty big accomplishment?

>> **Jimmy Weaver:** Yes.

>> **Tessa North:** Congratulations. And just so that everybody knows, that's about $1.8 million, which is pretty awesome. Congratulations on that.

>> **Jimmy Weaver:** Thank you.

>> **Tessa North:** Sorry.

>> **Gary Owen:** Oh, she's got a frog in her throat. I hope he'll hop right out of there. Okay. Well, let's talk a little bit about -- for those who may have just joined us, now, you're a synthetic chemist. And there's a difference between organic and synthetic, and I want you to -- is that right or wrong? What is the difference?

>> **Jimmy Weaver:** Well, it can be true. But synthetic encompasses more than just organic. There's people that build molecules that are not organic in nature. So just the definition there is fairly cut and dry, which is organic chemistry involves carbon as the primary thing. We also have other atoms involved, but it's carbon-based, which is what all of life is, is based on carbon. But there are other -- you know, lots of inorganic materials as well. And those people can be synthetic as well.

>> **Gary Owen:** So in the synthetic lab, as you mentioned earlier, you're interested in developing new strategies for building molecules of interest for people who are in pharmaceutical development, those kinds of things, right? And what other areas can that go off into?

>> **Jimmy Weaver:** Right. So the pharmaceutical is the big one where they have to do -- and agrichemicals. Both of these industries, as well as others, really develop -- rely on -- making molecules and testing them. And so when that's necessary, then the ability to make them fast is important for the development of, you know, further technology. And so those are two major areas that utilize the skillset that we have and the products that we produce, which is the knowledge of how to put these molecules together.

>> **Gary Owen:** Do you have any collaborations with other research labs of your nature?

>> **Jimmy Weaver:** Yes. Although now my collaborations more tend to be with labs that are -- they're developing -- but have complementary skillsets I would say. So we were working with a guy at the University of Michigan medical school to, you know, test compounds for -- well, I probably can't talk about that.

>> **Gary Owen:** That's okay. Well, if things are proprietary, we understand that.

>> **Jimmy Weaver:** Yeah, that's all right. I would hate to violate --

[Multiple Speakers]

>> **Jimmy Weaver:** But there's other collaborations that we have, but they don't tend to be with other synthetic groups. They tend to be with biologists or with physicians, things of that nature where we're trying to take what we have and put it out into people that can actually develop it and, you know, take it to the next stage.

>> **Gary Owen:** Okay. So for our audience to comprehend what we're talking about -- and I know this is difficult on the radio because when we talk chemistry, it can go so many ways -- but if you could give us a story. Give us a storyline. Give us a particular project from A to Z that

could start on the research level, and where would that go from there? Let's just take a -- maybe something you've already had success with. Give us an example.

>> **Jimmy Weaver:** Sure, sure. I'll start with maybe the story of how the NIH grant came to be. So it's -- you know, we like to look at the fundamentals of chemistry and the nature. And so one of the questions that we really had was: Can we reduce a carbon-fluorine bond? Which is to me kind of interesting because a carbon-fluorine bond is a particularly strong bond; in fact, it's the strongest carbon single bond in any element. And so -- or it makes that, I should say. And so this was fundamentally kind of interesting if we could actually pull this off. And we wanted to use our photocatalytic system. So it started there. Turns out that we could do that. And we were kind of the first ones to show that you could use photocatalysis to do this. We went from there. And so that, you know, went from being just kind of a fundamentally interesting transformation, we showed it was applicable to a number of substrates and we were able to publish that in a peer-review journal -- it's a very nice journal. And then we, you know, went on, we continued to develop some more work. But as the time went by we started to realize -- or we started to ask the question: So how can this be useful in the real-world setting? Well, it turns out that carbon-fluorine bonds are really important in the pharmaceutical as well as the agrichemical industry. So 30 percent or a third -- so nine out of 27 the FDA-approved drugs in 2013 contained a carbon-fluorine bond. And more specifically, this is a subclass of those carbon-fluorine bonds -- aromatic carbon-fluorine bonds, half of those compounds contained those CF bonds if you will. And so the point is to say that it's actually a really important motif. It has a whole lot -- and the reasons why -- that's the normal question: Why is carbon-fluorine bond so important? It's a very unnatural compound; in fact, there's only like a dozen natural compounds that contain carbon-fluorine bonds. And yet, almost a third of all and -- 40 percent of new agrichemicals and a third of drug entities or drug-like molecules contain these carbon-fluorine bonds these days. And that's because it just gives many molecules very good biological properties. It significantly enhances that. And so that's why they're in there. But it turns out that it's one of the most difficult molecules to make.

>> **Gary Owen:** Okay. Let's stop right there because we got a break coming up here. I know this is a lot to digest. It's like, "Where is this guy going?" But we'll try to be a little more elementary when we come back on *Oklahoma Innovations* .

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>> **Gary Owen:** We appreciate you listen to go this week's edition of *Oklahoma Innovations* . Our guest this week is Dr. Jimmy Weaver, assistant professor at the department of chemistry at OSU. Now, the last break I know he kind of got a little scientific there because that's what he does. But I think I could simplify your job in three words: You build molecules. Does that pretty well lay it out for us?

>> **Jimmy Weaver:** Yeah, I think that's fair. We build molecules and come up with new strategies for building them.

>> **Gary Owen:** And the types of molecules that you work on cover a variety of fields. Now, let's use the word "synthetic." During the break we were collaborating with our producer, Debbie Cox, and she pretty well gave a great abbreviation of this. Everything in our world, when you think about it, today be it from food to soaps, to everything we use in our -- I mean, even things like fuel products or byproducts -- everything seems to be synthetic in some form or another. Am I right or wrong about that today?

>> **Jimmy Weaver:** Oh, sure. There's no field or no area of our lives that chemistry hasn't touched. And if you don't appreciate that, that's because you aren't aware of it.

>> **Gary Owen:** Well, and what we take for granted. I mean, because we just go buy the products; we don't realize the research that went behind the development of those products.

>> **Jimmy Weaver:** Absolutely.

>> **Gary Owen:** Now, and I'm just going to give you just an example of just go to your nearby drugstore and look at the products in that store. Pick up a label -- doesn't matter whether it's vitamins, doesn't matter whether it's soaps, perfumes, conditioners, all kinds of health aids, something as simple as toothpaste, for example, deodorant. I mean, everything we use for

personal use is drug -- or, I mean, chemistry compounds. Somebody had to create all of these, and guys like you in the lab are going, "Hmm, let's see what we can do with this chemical reaction. Let's see what it does for us." So talk about your job from that perspective because it's extremely challenging. And you get lots of either interest, demands, or requests, "Hey, try this." Do you get that? Or do you just take it upon, "Let's try this, let's go for this particular project." How does that work in your lab?

>> **Jimmy Weaver:** Yeah, we usually initiate the projects in that regard, and then we try to find use for what we've figured out.

>> **Gary Owen:** So what stimulates the project?

>> **Jimmy Weaver:** Basically it grows out of fundamental interest in the nature of chemistry. I mean, we're -- truly at the very heart of our research we are interested in pushing the frontiers of what chemistry -- what's known in the field of chemistry.

>> **Gary Owen:** So you're really -- and I guess in a nutshell you're stepping out of the box?

>> **Jimmy Weaver:** That's right. I mean, I like to think about it as truly the analogy would be, you know, the Lewis and Clark.

>> **Gary Owen:** The new frontier.

>> **Jimmy Weaver:** Right, trying to discover what's there. I mean, now at the same time, while we are pushing westward, we also look back and try to figure out how to further develop this, turn it into something that might be useful. Follow up our really remarkable findings.

>> **Gary Owen:** Or make improvements.

>> **Jimmy Weaver:** That's right. And so we kind of have to have our head on a swivel in that regard, looking both directions. But we -- you know, as an academic I very much want to be on the frontier. But at the same time I don't think there's room in the funding anymore for purely, you know, frontiersman. You know, you have to be willing to go both directions.

>> **Gary Owen:** You have for -- and you also have to have a mission. You have to have a specific mission. I would assume to get your financing, to get the grants that you get, you have to have a target, I guess, or a goal.

>> **Jimmy Weaver:** Yeah, absolutely. You have to be able to convince a large panel -- you know, a dozen or more of your peers who are highly educated and highly respected in the field to, you know, buy into your proposal that you're going to be doing something that's cutting edge and that not only that it's cutting edge because it's really hard to sell knowledge for the sake of knowledge these days but that it could really help solve some real problems or some real gaps in the fields.

>> **Tessa North:** So one thing that we have noticed here at OCAST and, certainly, we've been hearing about it for years at the national level is that the amount of funding available for research has really come down. And unfortunately, you know, we're starting to see that a little bit here at OCAST, although we're still able to give out awards. So what that seems to mean is that, you know, the competition is a lot fiercer now for the funding that is available. So I would assume that that means that the projects that are being funded both at OCAST and at the national level are really the cream of the crop. They are some of the strongest research that's going on out there. But I imagine that also means that lots of other worthy projects with really strong research

are being left on the table without any funding. Can you talk a little bit about what your -- you know, obviously I'm going to guess that your stance on the decrease in funding is that we need more funding. But talk a little bit about how it might have affected you or some of your colleagues.

>> **Jimmy Weaver:** Right. That's a great question, Tessa. So you're absolutely right on the funding situation. You know, there are -- pretty much every grant that's funded is an excellent grant. What's not funded, though, are oftentimes excellent grant proposals. And that's really sad and demoralizing, really, to the same field because you have really good scientists fighting over relatively few dollars that, you know, just a decade ago was probably twice. That may not be correct, but it seems like the pay lines are there. You know, somewhere in the range of probably a fourth to a fifth of all grants really should be funded. But now that number is far, far smaller. What was the second question there? Sorry, I kind of spaced.

>> **Tessa North:** I was just wondering, you know -- just wanted to elaborate more on the projects that are left on the table. And is this hurting -- I mean, you have received these prestigious grants recently, but surely you know that this puts a strain on departments everywhere, not to mention the private sector who may depend on these grants for survival.

>> **Jimmy Weaver:** Sure. No, you're right. What you might imagine of only half the people or fewer than that being paid does put a lot of stress. But I think maybe the more, you know, important thing for the rest of our society is that there's a lot of good science that isn't being developed, but there's also this idea that it's not a good return on investment. But I think that's maybe short-sighted. And I think anybody that looks at it that way would be hard-pressed to not see that. I mean, fundamental research really needs to have a long-term perspective when we go to think about how quick that should be. You know, we should see returns on investment there.

>> **Tessa North:** Absolutely.

>> **Gary Owen:** Well, when you look at research being done on cures or therapies for common diseases for years when you think about it, whether it's cancer, whether it's heart-related diseases, or whether it's muscular, I mean, research has been going on for years and years and years. Yes, we found some promising therapies; we found some therapies that are on the cusp of showing promise. People wonder why it's so expensive to get therapies. Why does it take so long to get therapies or a cure? You're a perfect example of where it starts and why it takes so long. Talk about that.

>> **Jimmy Weaver:** Right. So, you know, I mean, I think we should acknowledge first off cures have been developed, and several cancers that were incurable just a decade ago, now there is a 95 percent survival rate for several of them, although that is not my area of expertise.

>> **Gary Owen:** But I am saying look how long it took to get there.

>> **Jimmy Weaver:** That is right, it does take a long time. And it is an investment worth making. But it starts at the fundamental level; we discover new stuff. But then some of the difficulty I was describing earlier with the number of effort that goes into that final drug molecule that they are coming up with, that is a huge amount of resources. And the companies often take over some of the later stage development; in fact, they almost always do. But they are a for-profit business and they want to get a return, you know, be profitable.

>> **Gary Owen:** But a research lab like yours is the type that goes through the trial and errors, the weekly, monthly, yearly, frustrations of just finding that combination that you know is

actually there, that chemical reaction that is going to work versus those -- I mean, you think about the failures you have had. We do not want to go there; we want to talk about the success stories that you have had because we know the failures are enormous. But those success stories is really what has made you motivated and your department motivated. The students who are involved in your labs -- we have not even touched the surface there about the creativity among students, which is another whole different story we are going to get into before we end the program. But what is it that keeps a guy like you moving forward?

>> **Jimmy Weaver:** Right. So how do you stay motivated if 95 percent of what you do is a rejection [inaudible]? No, I mean, you -- maybe there is something wrong with us. But no, I think it does take a certain type of personality. No, what I would say is that although it is not just a yes or no where the no answer is a dead end; rather, you want to learn from the no's as well. And so that is the type of question that you try to ask. So there is some -- we learn when we get our things that do not, you know, go the way we planned for them.

>> **Gary Owen:** Sure.

>> **Jimmy Weaver:** And so that is to some regard better. But sometimes we really just have an idea and it does not pan out the way we want. And that can be frustrating. And sometimes you have to learn to say -- throw in the flag, I guess.

>> **Gary Owen:** I think your success is those outcomes that show promise is what leads you down that path and keeps you motivated. I mean, the success stories, you know, that is what it is all about. We have got to take a little break here, Jimmy. We appreciate your candidness there. But I think we kind of get that picture. We will be back with Dr. Jimmy Weaver from OSU's chemistry department when we return on *Oklahoma Innovations* .

[Music]

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[Music]

>> He calls himself a synthetic chemist. And we're talking about Dr. Jimmy Weaver, assistant professor and graduate of admissions coordinator in the department of chemistry at OSU. And as you have learned through the program he is certainly a motivated young fellow, and he likes the speed at which they learn how new chemical systems work. And that seems to be the interest in

the Weaver lab, certainly. They build molecules. You are surrounded by a team of students. I want to you talk about them because these are the future chemists of the world that are going to help create new ideas and new technologies for us in the chemistry side of things. Talk about that.

>> **Jimmy Weaver:** Yeah -- no. So I am wonderfully blessed to get to work with a handful of really bright students who I am responsible for trying to teach them the -- you know, the skills of organic chemistry. And so we do that by cutting our teeth on challenging problems that we do not know the answers to. And so I think that is a big part of what keeps me motivated. I love being around them. And where they -- you know, they are the first to know things in the world about how chemistry actually works. And when I get bored and tired of doing the more administrative parts of my job, I wander through the lab and get to talk to them about the latest experiment and what happened and then sit there and speculate with them on what that means about how the reaction actually takes place, and how it works, and how, you know, the electrons want to flow. And so we try to figure out how the world wants to work and then -- to understand that. You know?

>> **Gary Owen:** I just wonder if in your experience since you have been at OSU, if you have ever had somebody come screaming down the hallway, "Dr. Weaver, Dr. Weaver, you're not going to believe this. Look what I found."

>> **Jimmy Weaver:** Not yet. I think maybe --

[Multiple Speakers]

>> **Jimmy Weaver:** I think maybe they have - I have taught them to be cautious. And we are often fooled initially until we gather -- you know. So I certainly have been that person. You know? And maybe it is lessons learned from my own experience that it is not nice to the advisor to tell them one thing and then jerk the carpet out from underneath them afterwards.

>> **Tessa North:** I could see that.

>> **Jimmy Weaver:** So they are pretty good about not doing that until they are really sure.

>> **Tessa North:** Now, Dr. Weaver, I wanted -- our guests -- our listeners probably are not aware of this, but you are pretty young, pretty new to OSU. Certainly you have been there for about three years now. So you are just starting out your lab. I am assuming this is your first lab that you' have managed [inaudible].

>> **Jimmy Weaver:** That is right.

>> **Tessa North:** So I really wanted to underscore what good work it is that you are doing but that other people outside of OSU certainly are recognizing this and acknowledging it. I understand that you have recently been awarded the Thieme Chemistry Journal's awardee for 2015, which is a pretty cool accolade. You know, obviously you have gotten these huge grants, which are extremely awesome, and that is what we love to hear. So I just wanted our audience to understand that this is a really accomplished young guy here, and he is only going more places after this -- hopefully here at OSU, staying in Oklahoma, of course.

>> **Jimmy Weaver:** Of course.

>> **Tessa North:** But there is some pretty cool stuff going on up there at Stillwater, and I think that we should be pretty honored to have you here today. One of the things that I also wanted to

talk about was when we were off air, you gave a really good analogy as to what synthetic chemistry is like and learning a foreign language. Because this is what I -- you know, to me it is a totally foreign language. So give us that analogy so that our listeners understand what it is that it is like.

>> **Jimmy Weaver:** Right -- no, I think the best analogy is you are dropped -- and when I try to teach people organic chemistry, it is a lot like a foreign language. You know? You go in knowing none of it, you feel like maybe you have been dropped off in the middle of a foreign country and you have to try to learn to survive there. And everyone does. And after about two years you get pretty fluent at it. And so most people -- strangers come into my office and look at my board and I look over there, and their eyes go wide and then I realize, "Oh, you don't know the language."

>> **Tessa North:** You do not speak the language. Right, right. So I think that one of the underlying themes that I have seen here, at least from a personality standpoint, is that you have to be pretty darn inquisitive and tenacious to be a chemist or probably any scientist certainly of any type. But, you know, Gary mentioned that you see lots of things that do not perhaps pan out -- I do not call them failures; things that do not work the way you thought they would -- and you just kind of divert. You go a different direction. So I think that is pretty cool. And you definitely see that with your students in your lab, I am guessing?

>> **Jimmy Weaver:** Sure, sure. Yeah. If you are easily frustrated, chemistry may not be the best place for you. And that is okay. But there are plenty of us who are stubborn and not willing to do -- you know, take no for a good answer. So if that is the case, then chemistry might be a good area for you.

>> **Tessa North:** Awesome. Now, are you completely full in your lab right now? Are you guys -- do you have any possible openings for anybody or undergraduates or whatever?

>> **Jimmy Weaver:** Yeah -- no, I am looking to hire from the postdoc down to graduate students and even undergraduates. I have projects for, you know, anybody that is interested. Right now we are very short of manpower.

>> **Tessa North:** Okay.

>> **Gary Owen:** Yeah, that is kind of like engineering. Because you think about chemists, you are engineers in your own world, recreating, trying to restructure molecules basically for different types of products. And I think that is the way we have to think about that. What we take for granted in our everyday lives of everything that we use in the world, we forget where it started. And it started in many cases in a lab like yours. And there are trials and errors. And there are those success stories, and there are also stories that did not turn out quite as well. But I think the motivator for guys like you is that you are doing good in the world. You are changing our world for now as well as in the future. All of the graduate students that are working under you, their desire is to help make this a better place to live. And I think curiosity seems to be your motivator, wouldn't you?

>> **Jimmy Weaver:** Sure. Yeah -- no, I think that is what fundamentally I derive a lot of pleasure from my job, is that I -- like you picked up on -- is I get to be -- you know, answer my own curiosity. You know, I do think that -- I at least -- take it as a real role, though, that I do try to use the skills that we have in this opportunity to try to provide the world with something

better. You know? And so we're constantly looking for how to apply our skills to try to solve problems -- real-world problems.

>> **Gary Owen:** In the chemistry arena, just when you collaborate with other colleagues, what do you think the biggest challenge is in the chemistry world today as far as the demands of the future? Where are we going in the future in terms of chemistry? What are the things that chemistry's going to be applied to that we have not heard of you yet? But you have kind of -- you kind of see that pin light at the end of the tunnel -- where is chemistry going? What is the new evolution?

>> **Jimmy Weaver:** A great question. So -- so chemical biology would be one area where I think chemistry will be particularly important. That is -- you know, to put it in basic terms -- is taking small molecule chemistry, like what we are good at doing, and using it to help biologists to solve problems like protein structures or, you know, cloning -- or not cloning, sorry.

>> **Gary Owen:** That's okay.

>> **Jimmy Weaver:** You know, putting antigens onto proteins that would not normally have been there. So there are some ways where chemistry can make some real contributions in that area. That is a particularly new area, but there is a lot of classic areas that it is going to continue to be the way of the future. I think the agrichemical -- there is kind of pendulum swing towards more of a biological end with, like, Roundup Ready stuff in the mid '90s. In fact, a lot of the agrichemicals kind of dropped their chemistry discovery programs.

>> **Gary Owen:** Really?

>> **Jimmy Weaver:** Yeah, at that time. But now we are finding that Roundup Ready may not be the way of the future, the silver bullet that one kind of thought it was. And so there's some major moves in that industry to go back to trying to use chemistry to solve the problems. And the great news is, you know, with tighter regulations they want greater potency, and selectivity, and things like that. But that is something that we can deal with and help with.

>> **Tessa North:** So we talked -- something that I read in your bio just mentioned a little bit about a project that you had worked on in the past related to bio fuels. So obviously you guys are working on small molecules with pharmaceutical applications. There is a potential for synthetic chemistry to be used in bio fuels. You can really -- this area can really touch pretty much anything, right? Is there -- are there other -- are you guys focused in your lab specifically on pharmaceuticals? Do you see that you will branch out and investigate anything else in the future?

>> **Jimmy Weaver:** Oh, yeah. Absolutely. There is -- yeah, we are not wed to the pharmaceutical or the agrichemical. That is just easy targets or places where I say, "Hey, this is directly applicable." But no, we have other things in mind where we are trying to develop some things that would be more applied projects in the oil and gas, you know, converting feedstocks, converting lignin-type cellulosic material into usable fuels - that is an area where chemists can make a real difference. It is not one that my lab's working on specifically at the moment, but certainly we could.

>> **Tessa North:** It is out there, yeah.

>> **Gary Owen:** It is great stuff.

>> **Jimmy Weaver:** And people could like me.

>> **Gary Owen:** We have certainly had a real eye-opener here, haven't we this week? I tell you. So when you talk about chemistry, I mean, you -- it just goes all over the map so, and it affects everything in our everyday lives. Hey, we appreciate you listening to this program. And we thank Dr. Weaver for coming and kind of give us a little chemistry education here today and how it affects Oklahomans as well. Thank you. Tessa, we will see you next week.

>> **Tessa North:** Absolutely, next week.

>> **Gary Owen:** Okay. On *Oklahoma Innovations* . Have a good week.

[Music]

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