Eric Hall: Welcome to the Destination Biotech podcast. This is episode one. We're here to share all of the exciting research that's happening at the Iowa State University campus with you in a way that's informative and engaging and will support what's happening in your classrooms. I'm Eric Hall, your host, along with the co-host:

Matt Shafer: I'm Matt Shafer, the Biotech Outreach Student Intern.

EH: And on each of our episodes, we'll share things that are happening in biotechnology research along with related subjects. We're joined today by our first guest of our first episode, Doctor Clark Wolf.

Clark Wolf: I'm very happy to be here.

EH: And we're happy to have you. Doctor Wolf is the Director of Bioethics here at Iowa State University and chair of the Sustainable Agriculture graduate program. And he's also a professor of philosophy and political

science. And that keeps you very busy.

CW: It does, yes.

EH: Excellent. Well, so talk to us a little bit about what bioethics is. So we know from our school days that that “bio” means life and “ethics” has something to do with what's right and what's wrong. But tell us a little bit more.

CW: Well, in medical practice and in biotech research or in life science research, there are all sorts of issues that come up that are not really technical issues. So bioethicists have as our job- as, as, as we're allowed to do this as our job, it's a wonderful thing to be able to do- we examine those issues and try to come to reasoned, appropriate and informed understanding of them. Let me give you a brief example. Right, so I mean so if you are ever having, planning to have children, the choices that are available to you are very different from the choices that were available to me 25 years ago when I had my children. New technology would permit you to intervene in your child's development, to change your child in the womb, even to adjust the DNA of your child to change what she or he would look like. So the question: How? You know, how do we do this? That's a technical, scientific question. But the question of should we do this? Should parents have those abilities? That's an ethical question, and it's the job of bioethicists to address questions like those.

EH: And it takes me back to the Jurassic Park days where he, where he suggests that we know how to do it, but the question is, should we do it?

CW: So, yes, exactly. Well, you know, bioethicists refer to that passage in Jurassic Park now in the things that seem important.

EH: That's right. That's right.

MS: So, so you're a bioethicist researcher. So what does it look like to do research on a topic like bioethics?

CW: Well, one of the projects that I've been working on involves the regulation and public attitudes toward gene edited foods and crops. And what that means is that I look at the policies we use to regulate these products, I look at public attitudes, and I try to find out what the reasons are for- for the attitudes that people have and find out whether or not the regulations we've got appropriately respond to people's concerns and to the risks that any new technology might arise.

EH: So there seems like there are a lot of people who would be interested in that information. So who is the audience? I mean, you do your research, you learn about the different ways to think about a topic, but who is the audience for your work?

CW: There are many different audiences for bioethics. I mean in one sense, one audience is the general public and bioethicists are occasionally in the news talking about important issues of the day. Other bioethicists work in hospitals, they're available for consultation by physicians who have difficult decisions to make. Others work in policy organizations trying to inform the development of rationally supported public policy, and then others like myself spend our time teaching and doing research in universities. So those are different activities that have somewhat different audiences.

EH: So how does so how does that research, you know that might be of interest to a person here on campus dealing with a different topic, how does your research get to them? How do they find out what you're learning around bioethics as it relates to their research topic?

CW: Well, in some contexts, bioethicists are available to be consulted by researchers or medical practitioners. That's not usually the way it works on college campuses. I like to be incorporated early in a development process when people are writing a grant or beginning a new project that way the ethical issues can emerge as the project develops, and you know, a bioethicist can be valuable in overseeing the development of a new technology and understanding the issues as they arise.

EH: Mm-hmm. And so you know one of the one of the issues I think that that we're all familiar with in some context is this idea of like you mentioned gene edited organisms or genetically modified organisms. So talk to us a little bit more about what that means, maybe a little bit technically, but then more what it means as it relates to your work and your research.

CW: Scientists have been genetically modifying organisms now for many decades and the early stages of that process were kind of crude. I mean, it involved shooting genes into cells and hoping that they would find their way to the right place. Over the last three decades or so, that

process has become much more, much more precise. The early- the earlier process involved developing transgenic or genetically modified organisms, as they're sometimes called, which usually involved importing DNA from one organism into the structure of the DNA of another organism and the hope that it would express characteristics that it didn't otherwise express. So all over Iowa, we have corn that resists the European corn borer. We have soybeans that can survive being sprayed with Roundup. Those are genetically modified organisms that have DNA from one organism spliced into the genome. More recently, with the development of what's called CRISPR, scientists can actually go into the structure of the DNA of an organism and change the spelling of the gene, and that's called genetic gene editing. It doesn't involve insertion of new genes from another source. It simply involves changing the lineup of genes in the genetic structure of the DNA, so gene edited organisms don't have new DNA inserted from elsewhere, they simply have, well, the genes are edited.

EH: Hmm. OK. So we've talked a little bit about some of the topics that you've dealt with in research and that researchers on a campus like Iowa State deal with. So how does knowing about bioethics help us address those kind of issues? How do we start to put these two things together so that we're, we're supportive of the research through that lens of what the bioethicist does?

CW: Well, let me give you an example. When genetically modified organisms came on to the American agricultural system, people were deeply worried about them. Many people are still worried about them, and it's easy to understand why. This is a big change. It's strange, it's an unusual thing. At least it was in the 90s and 80s when it was just emerging as a as a technology. What a bioethicist needs to do is to look at people's reasons for holding the views that they hold or having the concerns that they have. Some of the time our concerns are based on good reasons, sometimes they're not based on good reasons. The job of a bioethicist is to look at those reasons and those arguments, to understand them better so that our actions and policies can be well informed.

MS: So you said the word argument there. Usually when we think about arguments, we think about fighting with someone, yelling at them. You know, we're raising our voices. So tell me a little bit more, what is an argument in bioethics and how do you make a good one?

CW: Yes, that is the standard view of arguments there. They're raised voices, and…

EH: We should, we should give them an example.

MS: The podcast mics would pick that up really well.

CW: Exactly. Well, in philosophical context, an argument is a set of propositions, some of which are supposed to provide evidence over another. So, whenever you give reasons for something, you're making an argument for that thing. Now the difference between argument and opinion, right, opinions just come out of nowhere. If you have a belief about something or have an attitude towards something, that means you have an opinion. Opinions can be well justified or not well justified. If your

opinion is not based on any reasons that you can identify- well, it's

still your opinion, and as I tell my students, sometimes as your friend I care what you believe, but as your philosophy professor, I care what you can support with good reason. And the goal of bioethics is to understand the opinions we have and to evaluate whether they're supported with good reasons or not. One of the things that we do is to collect arguments on both sides. We collect the different opinions that people have and try to come to an articulate understanding of the reasons that support various opinions, either for or against some new technology or some new process. So analyzing those reasons turns out to be very productive. Sometimes we discover that the reasons we have for believing or wanting to do something turn out not to be very good reasons at all. And other times we may discover reasons that weren't easily available to us before we did an analysis.

EH: Yeah, I mean, I think that's really important, is knowing what the person who is opposing you is thinking is just as important as the argument that you're putting forward. And I think that's what you're saying, yeah. So… And it's an important skill. I think there's a there's definitely a skill in putting an argument together from your perspective, but there's also a skill in understanding that counter argument to the point where you can incorporate that into what you're thinking, too.

CW: Often in my classes, I try to make sure that my students are able to give an argument for positions that they don't accept. So if people are skeptical about gene edited foods and crops, for example- and many people are skeptical- if they're skeptical, I think it's very important that they be able to argue to make the argument for the position that they reject. And if they’re supporters- some of my students are working in

biotechnology, developing new crops or new foods- it's very important for those students to be able to understand and articulate the arguments of those who are skeptical about the research they're pursuing.

EH: So I think, so I think it's interesting, you know, one of those issues like you're mentioning here, there's been a lot of buzz around some genetically modified organisms that are very, very small but have a pretty big impact on their environment and us! Talk to us about this issue and how you would look at it through a bioethicist lens.

CW: Well, there is an organism that most of us encounter about this time of year that flies around: Mosquitoes.

EH: We let- we let about 300 mosquitoes loose in the studio just before this podcast.

CW: We have all encountered mosquitoes. They are prevalent in Iowa, but they're prevalent in other places as well. Sometimes they're called the most dangerous to humans, the most dangerous organism on Earth because they carry diseases like Zika and chikungunya and malaria, other diseases that cause hundreds, millions of deaths every year. So there's a British company named Oxitec where researchers have developed a genetically modified mosquito that would reduce the population of mosquitoes by inhibiting reproduction. And there's a question of whether or not they can release these in Florida and California and other places in the world where mosquitoes are a problem.

EH: So, so are these- do you know if these are gene edited or genetically modified?

CW: I believe these are genetically modified mosquitoes.

EH: OK, so the modification reduces the mosquitoes opportunity for reproduction or chance for reproduction or ability to reproduce?

CW: There are two genes that they've inserted. One is a self-limiting gene that prevents female mosquito offspring from surviving to adulthood. So these mosquitoes, they mate with one of the genetically modified mosquitoes and the resultant larvae do not develop into adult mosquitoes, and another is a fluorescent marker gene that allows researchers to identify the modified mosquitoes and their offspring in the larger population.

EH: Which would be useful, I suppose, so they could then analyze how well the modification is working.

CW: I think there are two ways to analyze how well the modification is working. One is to take a survey of the population of mosquitoes and find out if it was in fact diminishing. The other would be to take a sample and find out how many of them have the marker and have the marker.

EH: Yeah.

CW: But interestingly this is a genetic modification that's designed to disappear and eliminate itself in a couple of generations. So the goal of the researchers would be that after a couple generations, none of the genetically modified mosquitoes would remain in the population.

EH: Would the other mosquitoes still be there?

CW: Other mosquitoes would still be there. This isn't designed to exterminate the mosquitoes, but in principle you could design a genetic modification that would exterminate mosquitoes. That would be kind of an awesome- and I don't mean that in a positive way, but an awe-inspiring thing to do. We don't like mosquitoes, but mosquitoes are an important environmental feature. They are a food source for bats and birds and other creatures that we do like. Eliminating an entire species from an ecosystem would be a remarkable- and scary, I hope- thing to do, and I hope we would find that to be kind of scary, but again, the reasons why we are concerned about eliminating a species are interesting, right? They're interesting and they're definitely the province of bioethics as a field. Why should we be concerned about the introduction of these mosquitoes? If we should, is it right? Is it a policy we should promote or is it something we should not promote? One of the things that's relevant in this particular example is that the species of mosquito that's targeted is itself an alien invasive *Aedes aegypti*. They're not native to the United States, so some people have argued that since these are non-native mosquitoes in the first place, reducing their population, or even eliminating them, shouldn't be as concerning to us as it might be if they were a native species. On the other hand, and remember, bioethicists need to think about on one hand and on the other hand, on the other hand, some of these species may have naturalized. The non-native *Aedes aegypti* mosquitoes. They may serve an ecological function that we should investigate before we eliminate or reduce their populations.

EH: Yeah, well, and it's an interesting intersection then between the work of a bioethicist and the work of a of a researcher who focuses on

that particular organism, the mosquito in this case, the intersection of where those two schools of thought need to start to work together or continue to work together and think about all of the issues surrounding that work, not just on a technical side, not just on a bioethical side, but together.

CW: Absolutely. Now you raised Jurassic Park.

EH: Right.

CW: Which, of course, it's a fun movie, but in another sense, I think it's interesting to think about that film. I mean, it's like a Frankenstein film, right? I don't think it should be taken too seriously, but it is worthwhile to separate the question, “Can we do this?” from other questions, like, “Are there reasons why we should be concerned about doing this?” or, “Is it a good thing to do?”. Are there rights or other considerations that need to be taken into account as we're moving forward with some technological advance?

EH: Right.

CW: And scientists who are well-versed in the technology and the development of the new technology or development of new knowledge may not be in a position to address those ethical issues.

EH: And that is exactly why we had you on our first episode of our podcast.

CW: Well, thank you for having me. And I guess the last thought I'd have is when our discussions are based on the best reasons and the evidence, and I do mean the best scientific evidence as well, it's more likely that our decisions and our actions will be better than they would otherwise be.

EH: Very good. Excellent place to end. We appreciate you joining us today, Doctor Wolf.

CW: Thank you for having me.

EH: And thank you to our co-host, Matt.

MS: Thanks for having me.

EH: You're going to be here every time. [LAUGHTER]

EH: All right. We want to thank you for joining us as well. Remember that there are classroom resources that go along with each of these podcasts, and we'll release a new one at the beginning of each month. Next month's guest will be Dr. Michelle Soupir from Ag and Biosystems Engineering, and she'll talk to us a little bit about her work around woodchip bioreactors. So for all three of us here at Destination Biotech, thanks for joining us.