Transcript

Speaker 1: You're tuned in to 90.7 FM, k a l x, Berkeley. My name is Tesla Munson and this is the graduates, the interview talk show where we speak with UC Berkeley students about their research here on campus and around the world. My name is Tesla Munson and today I'm joined by molecular and cell biologist, Amy Strom from the Department of Molecular and cell biology. Welcome. Thank you. Okay. I'm a biologist. You're a biologist. I'm an integrative biology. You're in molecular and cell biology. What? What do you think that difference is? Mostly we're [00:00:30] focused in molecular and cell biology on the very small, the microscopic and the molecules and how those influence cellular and physiological processes. So instead of focusing on the environment or populations were really thinking about what's happening inside one cell at a time. Okay. So we're talking about things that are so small that you can not see them with your naked eye.

Speaker 1: Right, right. [inaudible] okay. This is like high school biology. Look under a microscope, see what's wiggling around or, yeah. Yeah. So our [00:01:00] central dogma is the DNA makes RNA, makes protein. That's the three things that we focus on the most. So you have those three macro molecules is what we call them. And that's uh, the main center of everything that we're studying in molecular biology. Okay. And so a cell is actually kind of large than compared to those things, right? Cause they, they fit inside of a cell, right? So each of those things is a small piece and you have many of them that work together to make a cell function. Okay. [00:01:30] And for a reminder, for many of us, what is DNA? DNA is your genetic material and it hosts all of the coding genes. So anything that performs a function in your cell is blueprinted in your DNA.

Speaker 1: And one of the fun facts that I like to say is that you have, if you support to stretch out the DNA from one cell in your body, as long as it goes, it would be about six feet tall. So every cell on your body [00:02:00] has that amount of DNA scrunched up really tiny. And, uh, that's part of what I'm studying personally is the packaging of that DNA. Yeah. It must, how does it do that? Is it all twisted up or, yeah. What is the special configuration? Yeah, there are kind of more dense areas and less dense areas and that helps some of the regions of DNA be expressed or be used and the parts that are more compressed will be silenced. So for example, like your skin cell is different from your liver [00:02:30] cell because it's expressing different parts of the DNA. And so those open parts of the DNA are the things that are being actively used.

Speaker 1: And there'll be different inside a skin cell then inside a liver cell. But ultimately you have basically the same DNA in each cell. Right? It's just these different on or off parts. Yes. So it's the same coding sequence in all of your cells and it's just the arrangement that helps express only certain parts and not other ones. So just the configuration [00:03:00] is different in every cell type. Excellent. Okay. So DNA, lots of it. Uh, I work with mammals, you know, but animals in general, they all have DNA, right? Yeah. Every living organism that we know of on earth has DNA except for, there are a couple viral exceptions that have an RNA genome. But every other thing that we know of has DNA at its core. That's a blueprint of its body plan and function. But you don't work on viruses or anything? No, [00:03:30] I work with fruit flies.

Speaker 1: OK. Fruit flies. Okay. So then because all these animals and all these living things have DNA, you know, you can use the fruit fly kind of as an analogy for humans. Is that the case? Yeah, there's a lot of very similar genes that we call them homologues and they will be conserved and have the same function in a fruit fly and a mouse and a human. So we can study a lot of basic biological functions [00:04:00] in fruit flies and then later apply that knowledge to humans. And it's easy to work with fruit flies. They, you can keep a lot of them at once. You can control their meeting habits. They have a very short life span so you can have lots of them and go through many experiments in a short time. Whereas if we were to do similar experiments on mice than it would take much longer and be much more expensive.

Speaker 1: And you didn't even mention humans. So we not do experiments on humans generally not know, especially. So there are like genome wide association studies are [00:04:30] common in humans, which is not that I'm manipulating a human, but that I'm interested in some phenotype. Like what genes influence diabetes, what genes influence the chance that someone will become an alcoholic. And you can study by sequencing the DNA of people and then just associating what traits the people who have this certain DNA mutation tend to have. So that's kind of a reactive science instead of a proactive. So in [00:05:00] fly we could say, hey, we found this gene and we think that it does this, therefore I'm going to go in and actually change that DNA sequence and then see what happens to the flies. But we don't actually change the DNA of humans. So it's more like if I'm, I am not very up to date on my genome sciences, but um, there's that breast cancer, gene BRAC, one of the BRAC genes, right?

Speaker 1: And so in humans, what you're saying is that maybe they looked at a lot of people that had breast cancer [00:05:30] and then they found that they all happen to have this one version of that gene and so that led them to think that maybe it might be associated with breast cancer in humans. Exactly. Yeah. So you can study, uh, what genes are associated with certain phenotypes or traits and then figure out its likely caused, this trait is likely caused by that gene, but it must get complicated than fruit flies. Because if we're talking about breast cancer for example, can fruit flies even? Do they even have that gene? Is it there? There must be certain genes that work better than [00:06:00] others, for example. Yeah. There are certain genes that are more conserved than others, so fruit flies don't have the equivalent tissue of breast tissue l that's a mammalian specific trait.

Speaker 1: So we could study things like breast cancer in mice, but not in flies. But we can study other things like I'm studying aging in flies and they have some similar aging mechanisms that are very basic that don't involve humans, specific tissues that you can study in then draw conclusions or at least associations from fruit flies [00:06:30] to humans. So when you say aging, you mean like how the body deteriorates over time? Yeah, so one of the main hallmarks of aging is accumulation of cellular and molecular damage over time. And that then causes these physiological phenomenon that we see like neuro-degeneration muscle degeneration, um, in older humans and also older mice and also older flies. So that's a very basic process that we can study on the fly and then hopefully later eventually [00:07:00] look forward to changing something about humans and helping them be healthy for longer.

Speaker 1: So flies actually get old then. Yeah, they do. Their average life span is about 60 days, which is older than a lot of people would guess. And my main project is studying how that packaging of the DNA that we were talking about earlier changes with age and how that influences the tissues function over time. So if that organization of the genome is important for the tissues function [00:07:30] or for the cells function, and then that changes over time because of damage that happens with UV radiation or chemical changes, then you can end up with dysfunctioning tissues as you age. Okay. So before we get more into that, let's go back towards the beginning and I mean, have you always been interested in flies? That's not how you got into this business or not? My, uh, straight path to fruit flies. My parents are scientists and chemists and a biochemist and [00:08:00] I grew up thinking a lot about how and why things happen.

Speaker 1: They would encourage me to do science fair projects myself, or you know, let's go watch an eclipse or do these scientific things, even if it wasn't exactly experimentation. And so they, they encouraged my curiosity and I think that led me to a scientific career. And you did your undergraduate work at Michigan, correct? Yeah, University of Michigan. And I saw it was a bachelor's of science, but with a minor in music. And that's right. So [00:08:30] how did that, how did that play into your undergraduate experience? Yeah, that was a lot of fun actually to have that combination, that of two very different studies. So I, I played the flute and I was very into it in high school and I was in lots of orchestras and bands and was considering majoring in music or doing a double major, but that ended up being maybe too much.

Speaker 1: So I did a minor in music and that was a lot of fun. I got to do classes [00:09:00] that took my mind off of the molecular things and let me get some perspective. Think about humans and culture and broader aspects in addition to my more detailed studies. Yeah. So do you think that minor in music has contributed to your work as a scientist? I think it often gives me nice perspective. It's good to kind of get out of the detail oriented things and think about the broad picture every [00:09:30] once in a while. And maybe music isn't what molecular biology is aiming towards, but it helps me stay balanced and be happy. Excellent. If you're just tuning in, you're listening to the graduates here on KLX Berkeley 90.7 FM. My name is Tusla Monson. Today I'm speaking with Amy Strom from the Department of Molecular and cell biology here on campus, telling us about her past life as a musician and a entire life as a scientist though it seems like. [00:10:00] And so now you're here, uh, you're in your fifth year at Berkeley and you said you're working on aging in fruit flies. So how, what does that look like in terms of like a day to day basis? Do you just have a lab filled with fruit flies? Kind of. Yeah.

Speaker 1: So we keep the fruit flies in these little round plastic tubes with uh, food in the bottom and a little cotton topper on the top to keeping them in there. And we just have trays and trays of these little fruit flies that live in the vials. Um, [00:10:30] so that's one of the special things about our lab is that we are fruit fly lab. So we have this room that we keep it 25 degrees Celsius, which is ball me almost 80. And that's what the fruit flies like. So we hang out in that room with all the flies and we use carbon dioxide to put them to sleep. And then you can sort through, pick out the ones that have the genetic mutations that you're interested in and do all your, all your mating pair matching and things like that with the Feis that way. So when you decided you were interested in [00:11:00] aging, where they're already a bunch of genes that you knew you could focus on or did you have to figure out which aspect of DNA you wanted to focus on?

Speaker 1: How did that work? I kind of came into it from the perspective of my lab, the carbon lab studies, chromatin packaging. And as a second year in MCB you are supposed to choose a project and propose this project to a group of professors in the MCB department. And part of what they're looking for is that it will be [00:11:30] useful to the general public. Interesting and will be possible to do in your graduate career here. So I was looking for a project related to DNA packaging that also would be interesting and useful to a wider audience than just people who are interested in DNA packaging. So that's where I came upon other studies that had looked at DNA packaging during aging and I thought I could use my expertise in flies and connect all those three things [00:12:00] and be able to hopefully make some headway in understanding how and why the genome packaging changes over time.

Speaker 1: So what is it about DNA packaging that really gets your goat, so to speak? I guess in general what I'm really excited about is being the first one to know something. So imagine like reading a mystery novel or watching a TV show that's revealing small pieces of a puzzle and then you make an idea in your head like, oh, I think it's because this, and [00:12:30] then you find out later that you were right. Having that Eureka moment is what keeps me in science and specifically DNA packaging is because it's the blueprint of most life. And I think it's, it's the basic building blocks. So understanding how those can change and how those can influence everything else downstream is what I'm really interested in. Okay. So you've got all these fruit flies in jars. You're hanging out in a balmy [00:13:00] room, full the flies, hopefully not all the time.

Speaker 1: Um, but how do you actually tweak their DNA so to speak? Yeah, we have a lot of interesting genetic tools because fruit flies have been used as a model organism for about a hundred years now. So we have ways that you can cross a male and a female fly that each have specific cassettes that are inserted into their DNA and that will influence the offspring's DNA. So for example, we have [00:13:30] taken some pieces of DNA from yeast that is a protein and it binds to a DNA and causes transcription of a gene. So it causes activation of a gene and you just need these two parts. And so if you separate this two parts and put them in the mother and the father, then it'll only become activated once the offspring, uh, once the offspring has both of those pieces in the same cell. Okay. So a couple of things.

Speaker 1: You said, one you said model organism, we, [00:14:00] can you tell us what that is? Right? What does it mean that fruit flies are model organisms? So, so we're hoping to study human diseases in organisms that we can manipulate in the lab. So these model organisms, like fruit flies and mice are ones that we know enough about and can manipulate to understand each of those, the flies in the mice, but also hopefully make conjectures about the human. And so they've just been widely used as well. So there's a lot more literature on it. They're easy to work with. And as you said, you mentioned genetic tools, there's probably more that [00:14:30] are designed specifically for flies, right? Sample, yeah. Okay. And then you said you had the mother and the father who you cross, which means that they like do the Hanky panky. Right. Okay. In their little vile, they're sweaty.

Speaker 1: Vials falling. Yeah. And then they have offspring or children. And so you insert DNA of another organism. The yeast, which people may or may not know. That's a living thing that we drink and beer and other and other things, right? Uh, and then the male or the mother [00:15:00] and the father, Hanky panky happens and their DNA crosses. Cause that's what happens during reproduction. Yes. You get one set of chromosomes from your mother and one set of chromosomes from your father. And so having those two pieces then comes together in the offspring. So like a put like a puzzle. Basically it comes together and all of a sudden you have this new picture and the child. So each part individually wasn't able to do its function. But now that you bring them together, they're able to do their function. Okay. And so, and then you can see how the piece [00:15:30] of DNA that you put in the mother and father changes the child and that gives you a sense of what it does.

Speaker 1: Yeah. Awesome. Okay. And so you said there was some literature out there on aging, so you already had some candidates as we call them? Yeah. Yeah. There was a paper already from a lab at U C S D in San Diego and they were showing that one of the proteins that's involved in keeping those packaged parts of the genome that are normally silenced, not expressed, uh, that protein. If you [00:16:00] overexpress it in the fruit fly for the fruit flies entire lifespan, then it can cause the fruit fly to live longer. So I was interested in knowing what the connection is from the molecular to the cellular to the physiological. So how does that actual a bump in protein level lead to longer life span. And I can see why that would be something people are interested in longer life span, longer lifespans. Okay. So do you have any news flashes in terms of what you found so far?

Speaker 1: [00:16:30] Yeah, so part of what I've been doing is screening for which tissues are the most important for this. So I use that technique where I have the mother and father's genes come together in the child and then that child will only express this gene in the tissue that I specify. So I can say I only want to express this gene extra in the neurons or only in the muscle or only in the gut. And I found that if you express this protein only in the gut, then it can still extend lifespan. [00:17:00] So there's something special about what's happening in the intestine, in the gut. And then also if you express it in neuronal Glioma, which are the support cells for your neurons. Yeah, only expressing it in the neural neuronal Glio was able to extend life span as well. And is that because the gut is actually what kills us eventually?

Speaker 1: Or what, what's the connection? I mean, when we start to degrade, it's not our gut that goes first, is it? No. Uh, in humans, the gut is not as common to cause death, but it is something [00:17:30] that happens. Um, there's something called the gut barrier dysfunction, which happens if you take a lot of antibiotics or if you have surgery. And it does actually happen with age. But the idea is that inside of your intestine there are microbes that are good for you. They help you digest things, but part of your intestines function is to prevent those microbes from getting into the rest of your tissues and causing infections. So the, that's what we call the gut barrier. And then the gut barrier dysfunction [00:18:00] is as you age, you can get fissures or cracks in your intestine lining and then those microbes are able to then infect your other tissues that are supposed to not have microbes in them.

Speaker 1: So now that you found that the gut and the brain are really important for aging and flies, at least with this one protein, what, what's your next step? My next step is hopefully to understand that molecular to cellular connections. So now I know which tissues are important and I want to know what specifically about the DNA packaging in those [00:18:30] tissues is happening to make the tissues dysfunction go wrong and cause the aging phenotype. Okay. Again, if you're just tuning in, this is KLX Berkeley 90.7 FM. My name is Tesla. I'm here with Amy from MCB molecular and cell biology, talking about her work on aging in fruit flies. But as you said, as we both said, you know, this obviously is very interesting for humans cause everybody, you know, does, wants to find the holy grail and live forever. Right. Or at least live longer. Uh, how do you think [00:19:00] that your work can directly apply to humans?

Speaker 1: Yeah, direct application is a multiple step process I think. So my work is not going to be immediately turned into a pill that you can take and then be healthier for longer. But it is something that it is possible to screen these candidates quickly in fruit flies and understand their function quickly in fruit flies and then later go through the process of applying them to a higher organisms. We call [00:19:30] them or mammal mammals, mice and then human cells. And eventually it will go through the pipeline of becoming something that would be applicable to humans. Okay. And because humans, you know, we tend to care about ourselves the most. Right. Do you have anything else about your work or your field that you feel like is really important for people to know? Why it's important? Like, not just for humans, but maybe for other animals or anything at all.

Speaker 1: Like what you know, what should the public really be thinking about when they hear the words molecular [00:20:00] and cell biology? Something that I am really passionate about and that Berkeley is leading the world in is something called basic science. So things that are not directly applicable to humans today, but that we think are important tools that will let us understand and discover things that will be directly applicable to humans in two, five, 10 years from now. So one of the big examples that's happening right now is the CRISPR cas nine technology from Jennifer Doudna, his lab, which was [00:20:30] developed from a bacterial immunity system that didn't seem to have any direct application to human technologies or human disease. But then now they found this really great technology that's able to do gene editing and it's become applicable to every system, including humans very quickly. So I like to push the idea that studying the basic science right now is what gets us innovations in the future.

Speaker 1: And you can think about it almost like a pyramid, [00:21:00] right? Without those building blocks, without the cornerstones, you know, you're never going to be able to build anything up on top of it. Exactly. Awesome. And I know you're passionate about other things as well. I saw that you do a lot of outreach. You're involved in be a scientist for example. You want to tell us a little bit about what outreaches and why it's important to you. Yeah. Outreach is bringing the science and the scientists who spend most of their time in the lab out to the public and creating communication and understanding [00:21:30] between the groups that seem so maybe distant from each other, especially with scientific jargon. So this show is actually really great. I'm glad to be here, uh, to do this outreach. And something that I am excited about is teaching inquisition based science as well.

Speaker 1: So keeping people curious instead of just spewing facts in, in science classrooms to get people to try and actually be doing experiments one at a time and learning things hands on [00:22:00] as they go along. And that makes sense with your curiosity driven past. Right. And that's how you got here. So, uh, which program are you involved with now or what? What's your main outreach form? I know it's the beginning of a new year, but yeah, I am doing a couple of things this year. The be a scientist, which is where we go to middle school classrooms for about six weeks in a row and we do hands on scientific projects that they come up with themselves, which is a lot of fun. I'm also starting to get involved with the bay area scientists in schools, which goes to elementary [00:22:30] school classrooms and does more showy science or does little examples of scientific projects for the elementary schoolers.

Speaker 1: And I'm doing some mentorship programs between the older students in my program and the younger students. It's nice to also have some intra scientists' communication as well course. So it sounds like you have like this idea of get them young. Right. You know, start start when they're pretty young. Do you have advice for younger generations of students who are [00:23:00] thinking about going into science, whether it's a career or even as sort of a passion on the side? Yeah, I guess my advice would be to stay excited and keep doing things yourself. Do things with your hands, do the experiments yourself. If you are interested in something, look it up and yeah, always be learning. Yeah, definitely. And um, since you're involved in these school programs, you know of any resources that might be [00:23:30] good online or otherwise, even library I, anything that a student might be able to interact with if they don't have access to one of these scientists programs for example?

Speaker 1: Yeah, there's a lot of great youtube channels for people who are just getting into science or who maybe in elementary, middle, high school you can look up things like crash course in science. Um, but then also MIT has biology and other science courses at the university level [00:24:00] and they take all of their classes and put them online. So you can watch videos of lectures on this. There are also videos of specific researcher talks as they go around the u s and are presenting their own research. A lot of schools will videotape these and then put them online. So if you have the jargon and you can follow along, that's a really fun way to see what's happening currently in the science world. No, definitely. I haven't really thought about the video aspect of it, but it makes sense with today's Internet. [00:24:30] I mean, and, and you mentioned that MIT talks and I assume those are free for anyone.

Speaker 1: Yeah, those are free. Awesome. So you know, I could use a little, a little update too. So we're actually coming to the end of the show here. So now's when I ask a if you have anything that we did not cover that you definitely want to say, like any last words, any Shibam conclusions from your dissertation, anything at all really. Let's keep funding basic science. You know, that's a really great point. It seems like it's easier and easier to get caught up in the applicability of something and even some of my questions about [00:25:00] that. Right. But as we mentioned, without the fundamentals, what, what else can we do? Yeah, we need to keep looking at the basic science and build up from there. Keep our foundation strong. Excellent. Well. Uh, thank you so much Amy. Thank you for having me. Yeah, and for the listeners out there, you have been tuned in to the graduates here on Calex graduates as the interview talk show where I speak with UC Berkeley students about their work here on campus and around the world [00:25:30] today.

Speaker 1: We've been hearing from molecular and cell biologist, Amy Strong from the Department of Molecular and cell biology or MCB as we call it. She's been telling us about her path, wants a scientist, always a scientist, but with a little bit of music thrown in there and how she got interested in packaging of DNA as the basic building blocks of life and a fruit flies because you've got to have that model organism right and, and longevity and aging and, and what we can understand about how an organism changes over time and [00:26:00] how the DNA plays a role in that. And um, it's also been great to hear about your outreach with be a scientist and basis are bay area scientists in schools. Yeah, that's it. And uh, thank you for your words of advice for all for students. We really appreciate it. Great. Thank you. Again. My name is Tesla Monson. The graduates will be back in two weeks with another episode. Until then, stay tuned. You're listening to 90.7 FM, k a l ex.