

Field Notes Ep. 7
Research For Undergrads
School of Civil and Environmental Engineering
Georgia Institute of Technology

<THEME MUSIC>

ANDREY GUNAWAN: I'm not going to let you go until you do this, 'cause you have to know how fun the research could be and you will not know without doing this.

JOSHUA STEWART: Sometimes you go looking for the research opportunity — and sometimes the research opportunity comes looking for you. For this Field Notes, how a research project blossomed for one environmental engineering senior.

<THEME MUSIC SWELLS AND FADES>

STEWART: Welcome to Field Notes our occasional deep-dive into life in the School of Civil and Environmental Engineering at Georgia Tech. I'm Joshua Stewart. You may think of research as basically the purview of grad students. But more and more undergraduates are jumping into some kind of research project before they finish their bachelor's. It may open their eyes to grad school or offer another dimension of preparation for their careers. Yet, despite the opportunities that abound on campus, there are no doubt others who'd like to work on research — but don't.

That was certainly the case for Megan Haynes. She had often thought about finding a research project while she was working on her bachelor's degree in environmental engineering. But for any number of reasons, it never worked out. And, before she knew it, she was a senior and seeing the end of her college days on the horizon. Then, one day after her Thermodynamics class, the opportunity she'd been waiting for came knocking.

GUNAWAN: We have 30 students in the class right. And then I think like I'm looking for top five, top 10 students. And basically I approach every single one of them. Hey, you like to, you know, like doing research? It's like, 'Oh yeah, I heard about it. Oh, you know what I already work with another professor.' But

Megan said, 'Um, I don't know. I don't think so.' So I saw, like, oh OK. Well, she's very energetic but then I can see the potential there. But she said no, and it seems like she just like don't want to do it. But that's what draws me in.

STEWART: Sort of hard to get...

GUNAWAN: That kind of thing, right! And then like because...

STEWART: Now we need her even more in the lab.

GUNAWAN: Yeah right. Because I can see the potential.

STEWART: And that, as they say, was the beginning of a beautiful relationship. At the invitation of Andrey Gunawan, her Thermodynamics instructor and a research engineer in the Woodruff School of Mechanical Engineering, Megan jumped into work with a bunch of mechanical engineers in Assistant Professor Shannon Yee's Scalable Thermal Energy Engineering Lab.

HAYNES: I had a really full schedule and he knew that, and so what he wanted me to do was write an abstract to get into this student competition for research. So I wrote an abstract with his help and somehow I got past that, they accepted it. And he was like, well now you have to, you know, do this research and write this paper. I was like, oh dear God, I don't what I got myself into.

STEWART: That was his plan all along.

GUNAWAN: See, like, when I found, like, you know, a student like Megan, who you know intrigued me, and I can see the potential in her, right? I can see the potential in her. But then, like, there's like a resistance. No, I don't want to do it. But I see the potential. Then what I simply do is just push him or her off the cliff right. Little does she know that, you know that, hey, I have this conference and I was like you know what? You just need to write a 250-word abstract. She's like, 'Oh that's it?' Yeah, that's it. And then she did. And that's when I realized — the 250 words, usually when I was when I told an undergrad or my student to do so, it will take two to three days. She's like, I told her, like that night, she gave me 250 word.

STEWART: Did you already have a project in mind?

HAYNES: No, actually. He kind of gave me some ideas for some stuff. And I just looked some stuff up online, and I was like, this seems like it might be interesting. I don't know, I don't like to procrastinate very much.

GUNAWAN: And that's like one of the quality that that I saw in her. You know what. I'm not going to let you go until to do this, because you have to know how fund the research could be, and you will have no without like doing this. And then especially for like Megan's case, like again, you need to push her off the cliff. You just need to do it, because like once that, right, she got her abstract accepted, then what's next? She need to write a draft.

STEWART: You're not going to back out now.

GUNAWAN: Oh yeah. I told her, 'Well you've put your name in there. You put my name in there, and Professor Shannon Yee is there. So you better not be disappointing us, the school, and Georgia Tech.

HAYNES: I'm also very competitive too. This is a competition, so I'm like let's go.

GUNAWAN: See? Those potential coming out.

STEWART: All these things sort of stacking up against you, but in your favor

HAYNES: Definitely a snowball effect.

GUNAWAN: Exactly. So you know it's like you're pushing Wonder Woman off the cliff, and it's all of a sudden, boom.

STEWART: She's gonna fly.

GUNAWAN: Yes, that's for sure.

STEWART: So you ended up working on desalination. How did you pick that? What was it about that project?

HAYNES: I think we were kind of... So we basically started the conversation about it in a way that would combine I guess our two disciplines.

GUNAWAN: Yes, yes.

HAYNES: So I think the main thing was, it was a thermodynamics class, so a big thing about it was combining a power cycle and using that waste heat to desalinate water. So you're co-producing electricity and freshwater. And so a big thing with environmental engineering is, you know, fresh water scarcity and sustainable engineering and everything like that. And something like that would definitely fit those things. And it also happened to fit really well into my thermodynamics course, because we're learning about Rankine cycles and Brayton cycles, so I actually was able to use a lot of the knowledge that I was learning in his class for this paper. And while I was reading these 50 research papers to write the research that I was, it helped me understand them so I wasn't so lost.

GUNAWAN: So testing her if she paid attention to my class.

HAYNES: Yes he was definitely testing me.

STEWART: So she comes to you and says, OK this is the project we're going to do.

GUNAWAN: Yeah.

STEWART: Not in your wheelhouse . Not in Shannon Yee's wheelhouse.

GUNAWAN: No, but something that we are interested in.

STEWART: OK. And fits into the overall sort of scope of the work that you guys are doing?

GUNAWAN: Absolutely. Like she mentioned earlier, with again...

STEWART: I like this by the way. He's pushed you off the cliff, and now you're saying, OK, great. You're coming with me.

HAYNES: Exactly. I was like, if I have to do this, then...

STEWART: If that's the case, we're all going to go.

GUNAWAN: Yeah yeah. It's something that, I think, more like my personal interest that I've been working. I really wanted to start this new topic about how to desalinate, get a freshwater, but by using solar energy, something that we know — I think Megan knows more than me now that, you know, mostly...

HAYNES: Sure.

GUNAWAN: ... people desalinate water from using electrical energy, right? Through the RO, what they call pushing through the membrane.

STEWART: Takes a ton of energy.

GUNAWAN: Correct. Yes.. So we want to like, kind of like — my field is more like a solar energy. So I want to see like, what is the potential? Is it feasible? And so like that's what the paper all about. Right. Like it's kind of like the feasibility study of how we desalinate water using solar energy.

STEWART: Yeah. So is that ultimately what came out of this, was a study looking at how how do we actually do this? Is this something that's possible, and if we were going to do it what would that look like?

HAYNES: It was actually a cost analysis of different combinations of the systems that would be able to co-generate fresh water and electricity.

STEWART: And it's possible, doable?

HAYNES: Basically the whole conclusion of the paper was that there's a lot of things that need to be considered before we get a really accurate cost estimate of what the system would be capable of. But generally what the conclusion was is it, I guess, outlined which combinations of the systems would be most cost effective relative to each other. And then also adding on a desalination plant to a concentrated solar power plant would not increase the cost so much that you wouldn't be able to do it. So it could be economically feasible; there's a lot of things, a lot of things that need to be ironed out, but it definitely should be

looked into. And especially with the search for more sustainable systems and reallocating waste in different ways that you don't necessarily think about, it's really important that you're combining different disciplines, I guess, and especially things like this, and combining different systems so they work to the best of their ability.

STEWART: So we mentioned a competition a couple of times, and I want to get to that in a second, but you brought up something that I think is really key about this whole relationship and it's this idea of sort of crossing disciplinary boundaries, right. You were an environmental engineering student, you graduated with your degree in environmental engineering, and Andrey, you and Shannon work in mechanical engineering.

GUNAWAN: Yeah, yeah.

And so I wondered if... Megan, we've talked a little bit about this, but this idea of the interdisciplinary collaboration and relationship — that, I got the impression, really struck you through this process.

HAYNES: Yeah I've always been very interested in lots of different things, and not necessarily things that really typically went together. When I was in high school, I was debating becoming an athlete or going to art school or becoming an engineer. I started out as an athlete and then switched over to engineering. But then, even once I switched to engineering, I still really wasn't sure what I wanted to do because I really enjoy lots of different things. So I took a bunch of chemistry classes, biology, things not necessarily required for my environmental engineering major. I don't know, it's just, I think it's really important to understand different disciplines or at least form relationships with people who understand things, because once you start talking to somebody, you're going to think of things that no one has really ever considered before.

STEWART: The whole point here was you were writing an abstract for a competition. This was an American Society of Mechanical Engineers...

GUNAWAN: Yes

STEWART: competition. A Power and Energy Conference, I think, right?

GUNAWAN: Power and energy, yes.

STEWART: You had to be the only environmental engineering student there.

GUNAWAN: I think.

HAYNES: I definitely was...yeah

GUNAWAN: Yeah, pretty much. I mean, at least in the competition itself. I mean, 10 to 12 students, and this is, we're talking about undergraduate, master's students, and the Ph.D. students.

HAYNES: He also failed to mention when I started this that...

STEWART: You were competing against...

HAYNES: I was competing against people who had gotten..

GUNAWAN: Oops. Yeah.

HAYNES: And when I got there I found out that a lot of them had graduated in May, so a lot of them already had their Ph.D.s by the time the competition came around.

STEWART: Wow.

HAYNES: So that was not intimidating at all.

GUNAWAN: Well that's one thing that I want to point it out. Like, all the judges actually came to me and then...

HAYNES: Oh dear, I did not know that.

GUNAWAN: And they're kind of like, well, we actually thought that Megan will take the first place. But again, like, you know, she compete against the Ph.D. students. And then like the first place, of course, like, you know, won by the

Ph.D. students, and then so, practically, she won the first prize for the undergraduate student.

STEWART: And they were they were sort of considering, is this first place overall?

GUNAWAN: They said, like it's so hard for us to...

HAYNES: I didn't know they were considering me. No. I wasn't even close to him

GUNAWAN: Yes, they did.

HAYNES: Well this guy, he was, he had already graduated with his Ph.D. And he'd already accepted an assistant professor job, didn't he?

GUNAWAN: Correct.

HAYNES: Yeah. So he was...

GUNAWAN: But still the judges said that it's very close.

HAYNES: I did not know they thought that.

STEWART: Would you recommend an undergrad research experience?

HAYNES: Absolutely, yes. But I would also say, do not take it lightly. You shouldn't do it just because you think it might be impressive later. You should do it because it means something to you.

GUNAWAN: You know she started from like zero. She wanted to do research, but she doesn't know what the resource that Georgia Tech provide for the undergraduate students, which is immense. There is like PURA.

HAYNES: Yeah, I mean, I got two different scholarships. I presented at the Tech symposium, and there's just good, I guess, support for the research students at Tech.

STEWART: That's another, I think, an interesting point to make about this is, it's never too late, right.? As long as you're still here....

GUNAWAN: Absolutely.

STEWART: ...you could still jump in on something, and you could still get the President's Undergraduate Research Award. You could still get funding, you could still find a lab to plug into.

HAYNES: I mean, you know, I'm out now, but August of last year, I had that plan. I was like, I'm going to graduate in a year and a half. I am, I'm not going to get to do research, which is sad, but I am going to accept that, and I'm just going to move on with my life. I'm going to focus on my school. And this happened, and all of my plans changed, and I graduated earlier, and it's like, it's just, you never know. It's not too late to do research at any point. And it's definitely been an amazing experience.

STEWART: Here's my last question: You've graduated, but it sounds like you're still in touch somewhat, and this relationship continues.

GUNAWAN: Hopefully.

HAYNES: We're supposed to be writing a paper right now. I feel like he doesn't want me to just run off.

STEWART: Disappear.

HAYNES: Exactly.

GUNAWAN: But I mean, like, you know, above that and after that, I mean I see Megan as a colleague now. Right? You know, someone that I can learn from, especially from the field. Again, like there's tons of field out there that I want, I'm interested to work with; the desalination is just one of them. That's like, I think, what makes my day. To have this energetic young student that's just like, 'I want to do research.'

STEWART: Point me in the right direction.

GUNAWAN: Point me in the right direction.

HAYNES: Push me off that cliff.

STEWART: That's right.

GUNAWAN: Yes. I'll be more than happy to do that.

STEWART: Megan Haynes just finished her environmental engineering bachelor's degree, earlier than she expected, we might say. And Andre Gunawan is a research engineer in the Woodruff School of Mechanical Engineering. Great to talk to you both.

GUNAWAN: Oh, thank you.

HAYNES: Thank you again.

GUNAWAN: Thank you for having us.

STEWART: Students who'd like to dive into a research project of their own can find all kinds of resources from our undergraduate advisers. Or just ask one of your professors. Maybe you'll find that incredible opportunity right in front of you, like Megan Haynes did. You can also check out Georgia Tech's Undergraduate Research Opportunities Program at <https://undergradresearch.gatech.edu>.

And with that, we wrap up this Field Notes. As always, it's a great pleasure to have you along for the conversation. Remember that our story — and the conversation — continues. Find us on Twitter, Facebook, Instagram and LinkedIn at CEEatGT — CEE-at-GT. If you have thoughts about the podcast, get in touch. Email us at communications@ce.gatech.edu. I'm Joshua Stewart. Thanks for listening. We'll see you next time.

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