DOPE LABS

Nuclear Energy: The Past, Present, and Future – Lab 060

Titi Have you seen the gas prices in California?

Zakiya Have you seen the gas prices down the street? Girl.

Titi They high.

Zakiya If it's up, then it's up.

Titi If it's up, then it's stuck. It's been pretty wild. I guess I'm going to have to start biking everywhere?

Zakiya Oh, come on over to the biking community.

Titi I know that's your favorite thing to do. I don't want to get on that bike.

Zakiya You know, when gas prices started to go up, politicians and policy makers started talking about alternative forms of energy, which, low-key, they should have been talking about anyway, right?

Titi Because fossil fuels are a limited supply. We will eventually run out of fossil fuels, so we need some alternatives ASAP.

Zakiya And one of those alternatives that often comes up is nuclear energy.

Titi I love it.

Zakiya I know that's right in your wheelhouse.

Titi It absolutely is.

Zakiya But, I'm always like, I think I know. I'm not quite sure.

Titi You know a lot more than you think.

Zakiya Well, prove it to me.

Titi Oh, OK, that's my mission for today.

Titi I'm Titi.

Zakiya And I'm Zakiya

Titi And from Spotify, this is Dope Labs.

Zakiya Welcome to Dope Labs, a weekly podcast that mixes hardcore science pop culture in a healthy dose of friendship.

Titi This week, we're talking about nuclear energy, and there's a lot of things about nuclear energy that I think people don't know. We generally know that it's very powerful, but we wanted to know specifically why it's so important, how it's regulated and more of the applications.

Zakiya Let's get into the recitation. All right, listen. I'm a go head and tell you. Most of the things I know about nuclear energy--I know a little bit from history--but mostly from Call of Duty, ok?

Titi My friend is a gamer, OK?

Zakiya And then, second is from Marvel, and we've already talked about this on Wakanda Forever. Some of that stuff is not real. So, I'm going to really need you to separate fact from fiction for me. Tony Stark taught me a lot, but how much of it is really true?

Titi Yes. So because of that episode, we know a little bit of the basics about nuclear energy where it comes from. You know, it comes from the nucleus of an atom, but we really want to know a lot more, right? And I think that is a great Segway into what do we want to know?

Zakiya I know you're saying yes, it comes from the nucleus of an atom, but how do we get to it? Who's holding it? One atom, multiple atoms at the same time, sequentially, I have questions. And then, what about those halves, if you're splitting them?

Titi I think that's a very good question. I think I want to know more about the history of nuclear energy. I think I know a little bit of why we first started looking into it, but I really want to know why and what problem we were trying to solve and how we got to where we are today.

Zakiya And like so many things, what's the potential? What's next? How is this being regulated? How do we ensure that it's equitable access to something if it has all the potential folks are saying it has?

Titi OK, let's jump into the dissection.

Zakiya Our guest for today's lab is Dr. Mareena Robinson Snowden.

Dr. Mareena Robinson Snowden My name is Dr. Mareena Robinson Snowden. I'm a senior engineer at the Johns Hopkins Applied Physics Laboratory.

Titi Like we said, we talked about the basics of nuclear energy in our episode Wakanda Forever. But we asked Dr. Snowden to take us back to high school physics class and explain to us the anatomy of an atom.

Dr. Mareena Robinson Snowden So you have protons and neutrons that are in the nucleus, right? And then outside of that nucleus, you have electrons. And inside of that atom, it takes a lot of energy to keep all of those different pieces together.

Titi That's right. Atoms are the building blocks of all things. And just like Dr. Snowden said, you have your nucleus of your atom and that has neutrons and protons, and they're all packed together really tightly and then spinning around that nucleus is all of these electrons.

Zakiya If you think about how all of that energy is holding those things together, the vibes are definitely right. We want to start thinking about how to capture and use that energy. Dr. Snowden says there are a couple of different ways.

Dr. Mareena Robinson Snowden So, the first is something that I think we're all familiar with, which is kind of chemical reaction. So a chemical reaction is something where you are trying to remove an electron from an electron shell. Right. So you're trying to kick off an electron from that atom package, right? That's chemical.

Titi So think of fossil fuels. Burning fossil fuels is a chemical reaction. And so you take that fuel and igniting it kicks off the chemical reaction. That's what's happening in our cars that aren't electric. You know, they're using gas from the pump. Those are fossil fuels. And when you turn your key, there's an ignition and that sets that fuel on fire. And what it does is produce a lot of heat. And that heat is the energy that is released from this reaction.

Zakiya The byproduct of these reactions where we're burning that fuel are carbon monoxide, carbon dioxide, sulfur dioxide hydrocarbons, nitric oxide microparticles, a whole bunch of other environmentally unsafe compounds, just you name it. OK, the list goes on, and this is where we kind of get into greenhouse gas emissions and climate change.

Titi So in some scenarios, you can access chemical energy through combustion or burning things. And another way is by leveraging all that energy that's holding the nucleus together, a.k.a. nuclear energy.

Dr. Mareena Robinson Snowden So some really smart people decades and decades ago thought, how can we leverage the energy that's inside of the nucleus and also inside of the atom itself? When you're thinking about nuclear, we're not talking about electrons. Now we're down in the nucleus, right? Nuclear nucleus, that's what it means. So you're dealing with reactions that are happening inside of that central package in the atom. And the thing that's important to know is the energy levels when you compare chemical reactions to nuclear reactions are like a million times stronger. The amount of energy that it takes to keep those protons together is a million times stronger than it takes to keep the electron in the atom.

Zakiya And because chemical reactions are not as strong, we need a lot more fuel to burn.

Dr. Mareena Robinson Snowden So that's why nuclear energy is so promising, because if you can find a way to break those nuclei apart and harness that energy, you can do things like create electricity.

Titi And you can do it by using way less fuel. So that sounds really promising, right? But how is nuclear energy accessed? Dr. Snowden talked to us about the two ways this happens fission and fusion.

Dr. Mareena Robinson Snowden And fission is exactly as it sounds. You are trying to take a nucleus and break it apart. And when you rip it apart or break it apart, there's an energy release that's associated with that. That's what happens inside of nuclear reactors. So we're taking uranium or plutonium fuel, which are radioactive materials. We're doing a nuclear process on them to force those nuclei to break apart and give us that energy because we need that energy to create the heat, to create the electricity downstream.

Titi So what's happening in a nuclear reactor, this fission process is it's a pretty simple process, but it's complex because it takes a lot of energy. So a neutron hits a uranium atom in that neutron causes the nucleus of the uranium atom to split. So when that fission happens, that splitting of that nucleus, it releases a large amount of energy as heat and as it's splitting--remember, we said that there are neutrons in the nucleus-- as it splits more neutrons are also coming off and then going and hitting another uranium atom and causing fission with that atom. So, it's a chain reaction. All of these reactions produce energy, and that energy it produces is heat. Once the heat is generated, it turns the water that it's in the nuclear reactor system into steam, and then that steam starts spinning turbines and those turbines generate electricity. All carbon free.

Dr. Mareena Robinson Snowden The United States gets something like 20 percent of our electricity from reactors globally, it's something like 11 percent.

Zakiya That's a really big percentage, and it feels really important, and those are a lot of moving parts you just described. And that Snowden is driving home just how important those reactors are. And all this making me think is that OSHA or somebody should have come and stepped in in the town of Springfield because Homer Simpson was reckless at his reactor. This is all such an intricate process, and that's just fission, right when the nucleus is being pulled apart. What about fusion? What's happening there?

Dr. Mareena Robinson Snowden The second approach, though, is fusion, where instead of trying to break the nuclei apart, you're actually trying to smash them together. And in that same way, to take lighter nuclei and smash them together, there's an associated energy release in order to get them to actually bind. They have to give up energy so, that energy that's given up is the same thing that we're after. We're always after the energy release. Whether we're talking about burning fuel, fissioning fuel, or fuzing fuel.

Zakiya And I'd love to do a detailed example of how fusion works, but we haven't quite mastered that yet. Fusion is still an experimental technology. Scientists and researchers are still trying to figure it out, but it seems like fission and fusion are both viable from a climate change perspective because they eliminate a lot of those greenhouse gas emissions we see with chemical energy and combustion and burning.

Titi Yes, in the U.S., we have 93 nuclear reactors up and running right now, which is the most in the world. France is in second place with 56.

Zakiya They can't compete where they don't compare, or whatever that saying is. So, Dr. Snowden said that the United States gets about 20 percent of our energy from reactors. But what does that mean? How much energy is that? 20 percent of what, you know? How is it measured?

Titi Right. So that 20 percent of electricity generated that she told us about is about 790000 gigawatt hours? That doesn't really mean much.

Zakiya OK? When I'm typically looking at a light bill that's in like kilowatt hours. And I think we can start with the prefixes, right? Kilo just means a thousand. So a kilowatt is one thousand watts. And that's a measure of power. But a kilowatt hour is a measurement of energy. So that's how much energy something that takes 1000 was needs in order to run for an hour. So it's like a rate, almost.

Titi Absolutely, that's the difference between power and energy. Energy is power. And then a unit of time.

Zakiya So that's like miles versus miles per hour.

Titi Yes. So, you go from a distance to a distance per time and that gives you a speed.

Zakiya OK, so now understand the unit and the measure. Give me something to anchor it to.

Titi So, for example, a typical electric dishwasher uses about two kilowatt hours per load.

Zakiya OK. So I got that.

Titi A Nissan Leaf electric car uses 40 kilowatt hours when fully charged.

Zakiya But you told us that Dr. Snowden was telling us about 790000 gigawatt hours. So a kilowatt hour is a thousand watts of power. Over an hour. A gigawatt hour is one million kilowatt hours.

Titi So we go from kilowatts. So that's a thousand. There's megawatts, we're going to skip over that. That's in the millions. Now we're at gigawatts, that's in the billions of watts per hour.

Zakiya And so for those billion watts per hour, so that's gigawatt per hour. There are seven hundred ninety thousand of those

Titi Seven hundred and ninety thousand of those billions.

Zakiya Turn everything off right now.

Titi I'm turning off my computer right now. Goodbye. But that's still only makes up a fraction of U.S. consumption. Remember, that's only 20 percent. Oh, so I'm not going to do the multiplication. I'm let you all do the multiplication because now we're getting into numbers that I cannot say. A gigawatt hours is a unit of energy that is one billion kilowatts of power sustained for one hour. In 2020, the U.S. consumed trillions. That's TR trillions of gigawatt hours. We produce nuclear energy in the billions of kilowatt hours, but we consume electricity in the trillions of kilowatt hours.

Zakiya All this sounds great, right? It's a way to generate electricity that doesn't give us the negative effects of greenhouse gases. But Dr. Snowden said, "not so fast." There are some other things that we need to be worried about.

Zakiya But that doesn't mean that there's a free lunch, right? There are risks associated with nuclear technology, and one of the big risk is the waste that's produced at the end of the day. So when you split a nucleus apart, you create these things called fission products, daughter products. Those are some of the names of their use. That's like the waste. And these things are highly radioactive for a long time. So there's questions about what is the long term disposal strategy for this waste because there's a couple of different options. You can bury it deep inside of a hole. Right. Right now, we store it kind of in these spent fuel storage pools outside of reactors, but that's not a long term solution. But the politics of nuclear waste and spent fuel are non-trivial. We've been battling them for decades, and that's one of the key obstacles and the second risk with nuclear fuel that people really think about, kind of kitchen table issue is, you know, the risk of a catastrophic accident.

Titi And we've seen catastrophic accidents occur a few times. One in Fukushima in 2011 after an earthquake, Three Mile Island in 1979, which happened right here in the United States and Chernobyl in 1986 because of a flawed reactor and errors in the actions of the technicians and the event in Chernobyl was so long, it was releasing radioactive material into the atmosphere for 10 days, and it made it so that to this day, about 1600 square miles surrounding that nuclear reactor where the accident happened is still not allowed to be inhabited. 1600 square miles is about three times the size of Los Angeles.

Zakiya And that's what I remember from Call of Duty. They drop you into that zone.

Titi They put you in Chernobyl?

Zakiya Yeah, there is all these abandoned buildings and things and the grass is overgrown on this stuff because it hasn't been inhabited for so long.

Titi Y'all got to chill.

Zakiya Children should not be playing that.

Titi They should not!

Zakiya Not only the guns, but also the atmosphere.

Titi Geez, that's crazy.

Zakiya So even though there are a lot of these potential upsides with nuclear energy, like we mentioned, there are some risks involved too.

Dr. Mareena Robinson Snowden Risks, they say, is the probability of the event, the consequences of the event and the vulnerability of the asset. So even though the probability is very low, the consequences are so high: radioactive fallout contaminating large swaths of areas you have families displaced. There can be like generational impacts if there is a catastrophic accident. So those are some of the things that policymakers, communities that are thinking about hosting these facilities, right? Whether we're talking about the reactor itself or the repository for the spent fuel, these are the things that they have to think about in terms of kind of the near-term and long term benefits of the technology, balance that with the risks.

Zakiya We talk about nuclear energy and splitting an atom and uranium plutonium, I think about radiation in the way I learned about it in the lab. And I remember when I first was going through training to work with radiation, I was like, Oh, so worried, and so, you know? But I think it's important for people to understand that not all radiation is the same. There's a spectrum.

Titi Yeah, so, we're surrounded by radiation every day, you know, microwaves, radio waves, everything. But there are big differences between a microwave from your microwave and radiation that is potentially harmful to you.

Zakiya And I think once you have a grasp of that, then you can understand, OK, what does this mean for nuclear energy? What does this mean for the byproducts and offshoots of these processes and what's harmful and what's not? Could you tell us a little bit more about the harmful factors to consider?

Titi So the difference between a microwave and radiation, which is called ionizing radiation, so that's the type of radiation that is potentially dangerous is the wavelength. So when we're talking about microwaves, radio waves and things like that, these are literal waves that are so long. So that means that they're really tall and really deep. And the distance from one peak wave to the next peak wave is really long. So when you think about it, it's too big to be able to really interact with atoms or your cells.

Dr. Mareena Robinson Snowden Because the energy, the wavelength is so large relative to the size of your cells, you good, you gucci.

Titi But when we start talking about ionizing radiation, those waves are really tight and tiny. So they're so small, so tight and so tiny that they have the ability to really get up close and personal with the cells in your body. They just touching all over them. And they can do a lot of damage.

Zakiya And so exposure to that harmful ionizing radiation is what happened when we saw these accidents at nuclear reactors, so at three mile, at Chernobyl, at Fukushima. This is not the same as microwave waves. This is not the same.

Titi You can heat up your hot pocket, you'll be all right.

Zakiya But I think it's so important for people to understand like where we are on this scale, both in size of wave and in potential harm. And so I think that's a great way to think about risk, right? Not just oh, a thing could happen, but how likely is it to happen? And if it happens, how devastating are the events? But also, if we remove this from the equation overall, what does this mean for our electricity grid? What does that mean for day to day life in America?

Titi That's a really good point, because in 2020, 40 percent of the U.S. is electricity came from natural gas, 21 percent came from renewables. So that's when hydro, solar, biomass, geothermal and 20 percent came from nuclear and 19 percent came from coal.

Dr. Mareena Robinson Snowden You need kind of a constant energy source, something that can always run. There's these kind of classic lines about the wind doesn't always blow, the sun doesn't always shine. So those renewable sources? There is a temporal component to them. Whereas with a reactor, once you've built it and you've gotten the core up and running, it can go for a long time. And that can be kind of your assured energy source.

Zakiya And this is not something that we say all the time. Yeah, right? A lot of problems are not solved by one single solution, but there are multiple things working in lockstep to give you a reinforced solution. So even if one fails, you have some backups.

Dr. Mareena Robinson Snowden So I think the idea is to have a diversified portfolio with the lowest carbon footprint possible and being able to balance these near-term and long term risks and benefits with the, you know, global society in a way that mirrors our values today. Right. So you think about nuclear energy now versus then we have very vibrant conversations around equity and justice. So we're talking about where is this fuel being mined? Where is this spent fuel being deposited? We have to think about whose communities are these? What seat do they have at the table? So you're seeing administration starting to adopt a lot of this language and this perspective on the way that we need to make energy policy. And it's different than kind of the nature of the conversation in the 60s and the 70s and the 80s. So it's about a balanced approach, but you can see there's changes to the conversation.

Titi OK, so we've talked about nuclear energy and how it can be used to possibly replace some more harmful forms of fuel. But that's not why this form of energy harvesting was originally looked into.

Dr. Mareena Robinson Snowden The origin of our nuclear story really starts. And World War Two, when the international community was trying to grapple with a rising Nazi power, you had Adolf Hitler. You saw the expansion and the genocide that he was inflicting on Europe. At that time, you know, the 1930s was a really active time from a nuclear perspective. We were discovering stuff, y'all. We discovered fission, we discovered the chain reaction, which means like you could sustain fission, you could have sustained energy output. It wasn't just a one and done right. At the same time, there was a significant worry that the Nazis were trying to develop a weapon that leveraged the nuclear reactions that we talked about. We were really worried about the Nazis pursuing that technology, and it was actually Albert Einstein that wrote a letter to FDR at the time alerting him of this. Like, let me put you up on game from a scientific perspective, these things are happening. They could potentially use it for this. I think we need to figure out what we want to do. And the response of the U.S. government was to establish what was called the Manhattan Project. So we decided we got to beat them to this technology. If this bomb is a real thing, we got to be the first to have it.

Zakiya The Manhattan Project was started in 1942 by the U.S. government, and it was also supported by the UK and Canadian governments as well to develop nuclear weapons. You know, this started as a really small project, but it grew to cost $2 billion and employ over 130000 people. There are project sites all over the three countries, and these project sites had not only research, but testing as well.

Dr. Mareena Robinson Snowden And we can debate if that was the right policy decision because I think as an engineer that's been participating more and more in the policy discussions. It's really important to acknowledge where choice lies. None of these things are inevitable. We have choices in the policies that we make, right? So we made a choice to invest in beating the Nazis to a nuclear bomb. We established the Manhattan Project and really the first reactors that we saw on the scene were built in order to produce the plutonium fuel that was needed for the bombs. So it was only after the war ended. And again, there was a. Policy decision. We tested the first nuclear weapon on the Trinity site in Nevada in July of 1945. Not a month later did we drop it, dropped two bombs on the people of Japan, and there's an active historical debate about why we did that, why we did it in that way. Did it actually stop the war? There's a lot of narratives. But once we decided to do that and the war was over, you saw the international community shift from, OK, we have this technology now, right? We've discovered fission. We have these reactors. What if there's a role for them beyond nuclear weapons? It's just an energy source, it's just the way to make heat. But it makes heat a lot more efficiently than fossil fuels, right? Or the other energy sources we had at the time. Remember, we're talking like 1945, 50. So, you saw the international community shift to this conversation of using these atoms for peace. And there's a key speech that President Eisenhower gave in 1953 called the Atoms for Peace speech, where he said, How do we take these atoms from atoms of war to atoms for peace and use this energy source as a way to empower and enable society?

President Eisenhower The atomic age has moved forward at such a pace that every citizen of the world should have some comprehension of the extent of this development if the peoples of the world are to conduct an intelligent search for peace. They must be armed with the significant facts of today's existence.

Titi So, because they didn't want to create a world where nuclear bombs were all over the place and ready for use, governments decided to use this power for good, not evil. But let's take a quick break, and when we get back, we'll talk more about nuclear energy, policy and what we're going to do moving forward.

Zakiya We're back, and although we're talking about energy and nuclear energy specifically this week, next week we're digging deeper into the core of the Earth and talking about metals, precious metals, abundant metals, you name it. Our guest expert is chemist Dr. Kate Buettner, and we can't wait for you to hear this one.

Titi So we've talked about the bad and the ugly parts of the history of nuclear energy. But let's get into the good. Eisenhower gave his speech. But then what?

Dr. Mareena Robinson Snowden So from the very beginning, the conversation was about how do we promote the use of nuclear energy while also controlling the use? Because what we did not want to do was to give a country reactor technology to consult with them on expertise, only to see that country use that technology to fuel their own military nuclear program. That was not in the US interest, nor the global interest, at least at the time of the discussion. So, you saw the establishment of some key organizations. Chief among them was the International Atomic Energy Agency. What's known as the IAEA and the IAEA was established in 1957 to do exactly what Eisenhower said. How do we promote and control? There was a key treaty that we have to know about. It's called the Nuclear Nonproliferation Treaty, the Nuclear Nonproliferation Treaty for everyone who signs it. They agree not to proliferate nuclear technology. Meaning I'm not going to use my peaceful reactor to start my military nuclear weapons program.

Zakiya So when this treaty was signed, there were five countries that already had nuclear weapons the United States, Russia, France, the U.K. and China, and they all agreed to eventually disarm in good faith.

Dr. Mareena Robinson Snowden So at the time, we all agreed. We did not want a world with nuclear weapons, and we should work towards a world without it. So once you sign on to this agreement, there's a very heavy on- site inspection regime where the IAEA comes in and they do comprehensive inspections of all your different reactor facilities, all your nuclear facilities, reactors enrichment spent fuel pools, everything to make sure that you are not moving material from one place to another. Their main objective is to catch the diversion of nuclear material in time enough to respond.

Titi So now that the treaty is signed and countries are no longer developing nuclear weapons with their reactors, there became lots of different ways countries could start working together to share resources to produce nuclear energy, because, spoiler alert, nuclear reactors are expensive to build, and not everyone has the coins allocated for something like that.

Dr. Mareena Robinson Snowden So when you're talking about these developing nations, it may not be in their ability at the time to finance a capital project like that. So you can have a more privileged nation come in and build that system. The idea, though, is that they would allow inspection. They would allow those IAEA inspectors to come in and make sure it's being used for its intended purpose.

Zakiya And beyond just building another piece of the puzzle is having the fuel, the uranium, plutonium, et cetera that you outlined earlier. Not everyone has that, so they may need to run over to a neighbors for a cup of uranium.

Dr. Mareena Robinson Snowden It's not automatic that everybody needs to have every stage of that fuel cycle in their country, so you can have a country that had a reactor, but maybe they don't have the enrichment capability. Maybe they don't have the ability to take uranium ore out of the ground. Every country doesn't need to have that. Maybe we go into a trade agreement where I will provide that fuel to you and you just run it in a reactor. And then maybe I take the spent fuel from you on the back end. So, there's been different configurations within these trade agreements or within these kind of energy export agreements that will allow certain parts of the fuel cycle and others. Ionizing radiation means it is energetic enough to remove an electron from your atom. That's what it means to be ionizing. You can kick off an electron, if a gamma ray comes in, or a high energy neutron comes in, it has enough energy in it to actually start removing electrons from your cells.

Titi You know, we come in contact with ionizing radiation in very specific ways that is under the supervision of a medical professional like X-rays. A lot of people have gone in for X-rays, but if you have, you know that parts of your body are covered with lead to try and block the parts of your body that you don't want X-ray to keep them from being exposed and you're not exposed for very long. So even though we have been exposed to ionizing radiation, when we go in for an X-ray, the dose is so low that we don't feel any effects and our cells are able to live and thrive.

Zakiya And what you're covering when you do that are those tissues that have cells that are constantly regenerating themselves or that are replicating, which is your breast tissue, your stomach, which is your gut lining and GI tract and your ovaries, if you have them because those things are constantly regenerating themselves, you're not making new arms. You know what I mean, you're not making new arm meat. And so those things don't have to be protected in the same way.

Dr. Mareena Robinson Snowden An important piece that I wanted to highlight is the gendered component to the biological impact of radiation. For women, because we have more high turnover organs relative to our male counterparts, right? Like I said, we have breasts. We have ovaries. What are the type of cancers that that generate their right? Breast cancer, ovarian cancer. So, we have a disproportionate impact when we talk about the effects of radiation. If any of us were to be at a nuclear blast or working as a reactor operator and there was an accident and we got a full body dose. Those high turn over cellular systems would be exposed. And it's a vulnerability that we have that's unique to our male counterparts.

Titi I think that one of the things that I found surprising in making this lab was how many nuclear reactors there are. And Dr. Snowden was talking about weighing the risks with the benefits and things like that. And so then we have to start thinking if nuclear energy is something that we want to use moving forward as one of our possibly main sources for electricity, that might possibly mean more nuclear reactors. And so that risk will always be there. But I think as scientists are working in these reactors, the safety precautions that are in place, I think, are really great and the likelihood of an accident is super, super low. But I think it's exciting also because when we think about climate change and the train that's barreling down towards us, we have to start really locking into these alternative forms of energy to help save us all.

Zakiya OK. OK. OK, it's time for the one thing. What's your one thing this week?

Titi My one thing this week actually came from Dope Labs listener. Their name is Kristen Thomas, and they are actually a part of the U.S. rugby team. OK. What? Yes, the U.S. women's rugby team, and--.

Zakiya Are they trying torecruit you?

Titi Possibly. You know, I'm a little strong sometimes. But on their Instagram, they had made a post about having some shoes that they weren't using anymore. And so they cleaned them up. And instead of throwing them in the trash, they packaged them up and sent them to this really cool company called Soles4Souls. And they take your unwanted clothes and shoes, and they give them to folks in need. So I mean, you shouldn't send in shoes that you know, have holes in or anything like that, but really shoes that you know, might be a little bit worn but are still usable. So, I think that's a great way to reuse a pair of shoes rather than putting them in the trash. And then they end up in the landfill. And, you know, shoes have all of these plastic and rubber that then further contaminates our world given somebody who can use them. So that is my plan is that I'm going to be packaging up a few pairs of shoes that I don't wear anymore and sending them to Soles4Souls. So you can follow them on Instagram. It's @soles4souls.

Zakiya That sounds great. I have plenty of shoes that I could get right on out the door and give another home.

Titi What's your one thing?

Zakiya My one thing this week is really touching into your domain.

Titi OK, let's hear it.

Zakiya OK, so you know how I like to step it up in the kitchen? Mm hmm. I was reading this article about this group of scientists in Maryland who have produced basically a knife, but it's not a knife like a steel knife or a ceramic knife is made out of hardened wood. What? Yes. And they're saying that it's sharper than a steel knife.

Titi Is it going to splinters in my food?

Zakiya Oh, I don't know about that. But they're saying that this hardened wood, I don't know what they did to it. They say it is 23 times harder than like the natural wood. I don't know how they're developing it. I haven't read all into it. It was like a little skim bullet. But, you know, are we about to go back to the wooden tool?

Titi You know what? I kind of love that I do. I do.

Zakiya Yeah, I mean, I'd like to see it, you know, like that that meme of Monique? I'd like to see it, I like to see it. I'd like to see it. I'm like, What type of material science? And that's from the Department of Mechanical Engineering at the University of Maryland.

Titi That's very cool. I know what to get you for your birthday.

Zakiya All right. That's it for lab 060. Call us at 202-567-7028 and tell us what you thought. Also, you can call and give us an idea for a different lab you think we should do. Remember, we like hearing from you. You can call or text us at t2020-567-7028.

Titi And don't forget that there is so much more to dig into on our website. There will be a cheat sheet for today's lab, additional links and resources in the show notes. Plus, you can sign up for our newsletter. Check it out at dopelabspodcast.com. Special thanks to today's guest expert, Dr. Mareena Robinson Snowden.

Titi You can find her on Twitter @mrobinsnow, or check out her website at www.mareenarobinsonsnowden.com.

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Zakiya And Titi's on Twitter and Instagram @dr_tsho.

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Zakiya Our producers are Jenny Radelet Mast and Lydia Smith of Wave Runner Studios.

Titi Editing and Sound Design by Rob Marczak.

Zakiya Mixing by Hannis Brown.

Titi Original Music composed and produced by Taka Yasuzawa and AlexSugiura from Spotify. Creative producers Candice Manriquez Wrenn and Corinne Gilliard. Special thanks to Shirley Ramos, Yasmeen Afifi, Kimu Elolia, Teal Kratky and Brian Marquis.

Zakiya Executive producers for MegaOhm Media Group are us.

Titi Titi Shodiya.

Zakiya And Zakiya Watley.