

DOPE LABS

Transcript of Lab 027: Here Comes the Boom

Titi: OK, so we've got to talk about the elephant in the room. As soon as we thought that the list like you couldn't pile anymore on top of us in 2020, we've had enough. Then you all started shooting off fireworks every day.

Zakiya: But what are we celebrating?

Titi: I don't know. And that's it. Things like all the rules have been broken like people are...I heard fireworks two nights ago in my neighborhood,

Zakiya: I heard fireworks during the day. We can't even see those bruh!

Titi: You can't even see those...

Zakiya: What's happening?

Titi: I'm Titi.

Zakiya: And I'm Zakiya.

Titi: And from Spotify. This is Dope Labs.

Titi: Ok Z, listen to this...

Zakiya: What is that?

Titi: I know you know the sound because it has been keeping us all up at night. It should have sent shivers down your spine. It is the fireworks. And this sounds specifically are fireworks in my neighborhood that I was hearing at night not too long ago.

Zakiya: I don't know of what's going on. Did everybody get together?

Titi: I missed the meeting because I didn't get any fireworks. I don't know who was handing them out or what. But it's mind boggling and it's driving a lot of people nuts. I've seen a lot of people ranting on Twitter and on Instagram about fireworks and being kept up late because of fireworks and how was driving them crazy.

Zakiya: I was initially thinking, OK, this is just limited to the Internet. These are jokes. But then The New York Times ran a piece talking about the conspiracy theories and that told me that we needed to investigate.

Titi: So today's lab is all about fireworks.

Zakiya: We're going to tell you exactly how they work and what you should probably consider before you jump in on this.

Titi: Let's get into the recitation.

Titi: So what do we know?

Zakiya: I know people keep setting the fireworks off. I know that they're supposed to be illegal here.

Titi: I mean, we know that, you know, fireworks can be cultural and that folks love them. They range in what they look like, what they sound like and their size.

Zakiya: But beyond that, I don't know too much. I know I enjoy them, which is crazy to me because the things I enjoy, I really like to really dig deep.

Titi: So what do we want to know?

Zakiya: We want to know what are the basics behind fireworks? I don't really know how they work.

Titi: And I want to know why are there so many fireworks going off in neighborhoods?

Zakiya: And I don't know if everybody else got their pyrotechnic license, but I feel like there's some basic safety we need to cover.

Titi: I want to know how the field like how the fireworks field has changed over the years and what can we expect in the future.

Zakiya: I saw on Twitter a couple of weeks ago some drones doing a firework display. Is that the new firework drones?

Titi: Soon you're gonna be able to shoot a firework from your iPhone?

Zakiya: Yep.

Titi: Its going to be an app?

Zakiya: You know how you send the message now. You can send it with confetti. It is going to be a real firework in the sky.

Titi: Yes.

Zakiya: We are closer to Hunger Games than we thought. Let's jump into the dissection.

Titi: In this lab we brought in pyrotechnics expert Fran Scott.

Fran Scott: I'm Fran Scott and I'm a pyrotechnician, and engineering presenter and a general maker.

Zakiya: Pyrotechnics is the science and art of self-contained and sustained reactions. And those reactions make heat, light, gas, smoke, sound, you name it. Fireworks are just one type of pyrotechnic.

Titi: OK, so first we had to figure out, like, where do we even start with fireworks?

Zakiya: Yeah.

Titi: And it seemed like a good place to start would be with fire.

Zakiya: I've always been fascinated with fire. Like, I light candles. Like it's nobody's business. And yes, I like the aroma. But I think half of that, maybe 75 percent, is just striking a match. You know, I can remember as a kid and I don't ever think I told my parents this, my grandma used to keep matches in the bathroom and you light a match if it was really stinky in there. Man. I was a match lighting fool. OK, I'll go in there. People will be outside and I would go right in the bathroom and get that pack of matches. Now just let it sizzle. Sometimes I will stick it in water to see what was going to happen. I mean, I don't know where that fascination comes from. Are you are you fascinated with fire, Titi?

Titi: No, I'm not a pyromaniac. So I don't have these I don't have these problems. But now I'm worried Z, I am. Because you do have a lot of candles in your house. I was just reflecting. I was like, OK, so now I know what my friend has been doing during the quarantine.

Zakiya: Relaxing,.

Titi: Keeping herself busy, lighting fires.

Titi: So with fire, fire is something that I feel like most people interact with, but none of us know really what it is.

Zakiya: Yeah.

Fran Scott: Fire is a plasma, so it's a charged gas. With fire We'll all gladly sit round it and look at it. But if you were to ask someone, what is it? Is it a liquid? Is it a gas? If it's a gas, why can

we see it? Why does it change color? Why is it orange? Why is it red? Why does it flow in that certain way? All of these questions that most people, including myself, would be like. Hang on, just let me Google a little bit because it's so intriguing. And yet we we actually, as a as a population, know so little about it.

Titi: So a fire starts when a material is rapidly oxidized. So that means that it's losing electrons at a really, really rapid rate. And energy is also released in the form of heat, light and other things. And then a flame is produced. And when you think about how quickly we see a flame when it comes to fire, that's how quickly those reactions that I was talking about happen. It's happened so quickly that there's really we don't visually see any time between when we light a match and when we see the flame. Right?

Zakiya: I never thought about it that way. Usually we don't. But I have these matches and they're really cheap and there is a delay. No, I'm serious. I got them from HomeGoods. They're really cute. They say stuff like, "you go girl!" and, you know, stuff like that. "Stay calm." "Be focused." That's exactly what's happening. There's that first strike. Those materials on the tip of that match are being oxidized and then the flame comes up.

Titi: Yeah,.

Zakiya: That's exactly. I never thought about it.

Titi: So, yeah, once that flame is produced and all these reactions are continuing to occur over and over and over again, that's the reason why that flame stays alive and it's releasing gas. That reaction is the foundation of what Fran does as a pyrotechnician.

Fran Scott: The whole basis of explosions and pyrotechnics is the faster something burns the faster it produces hot gases, which means that when it actually expands and expands so quickly that you hear a bang.

Zakiya: So what's in a firework? What are the main ingredients?

Fran Scott: The main ingredient for most of the firework is basically gunpowder and gunpowder if you don't know, it's like it's what we call black powder that basically the same stuff. And they are a mix of charcoal, sulfur, and potassium nitrate.

Titi: So from the charcoal, you get carbon and carbon acts as your fuel. And from the potassium nitrate, you get oxygen. When you mix carbon and oxygen together, they're going to burn, but they burn pretty slowly. Adding the sulfur is what makes all the difference. Sulfur is the intensifier. It melts at 120 degrees Celsius.

Zakiya: For those who don't live in Celsius, that's around 250 degrees Fahrenheit, lower than you'd even set your oven.

Titi: And so when it starts to melt, then it starts to accept some of the oxygen that's already in this reaction. And that turns the sulfur into sulfur dioxide. Sulfur dioxide releases energy in the

form of heat and that heat will interact with the carbon and the oxygen that's already there. So that keeps that initial burning reaction going and it speeds it up. And so that's how you get the bang, because all of these reactions are happening so quickly.

Fran Scott: So if you cram that black powder into a tube and you have it open at one end, if you like, that tube, that that hot gas needs to go somewhere. So it comes out the bottom of the tube and shoots up into the air.

Zakiya: But once it's in the air, I'm still waiting for the beautiful display. What gives? Fireworks, their colors.

Titi: I think before we get too deep into the firework color, that there's some basic things that we need to establish first.

Zakiya: All right, let's hear it.

Titi: So each element in the periodic table is made up of atoms and the amount of atoms is different for each element. So, for example, hydrogen has one atom and sodium, which on the periodic table is denoted as Na has eleven and atoms are made up of protons, neutrons and electrons. The protons and neutrons are at the core and the electrons are all just spinning around that core.

Zakiya: So those are elements. And when you combine more than one element, that's a compound.

Titi: And some compounds give off energy in the form of light when you apply heat. We talked a lot about these things in the Wakanda Forever episode. So you should definitely go back and listen to that. It was so much fun. But with fireworks, there's a different metal compound in each firework that when you add heat, gives off light with a specific color. And that's what's happening when the fireworks burst in the sky.

Fran Scott: Now, once they're up there, there's actually another part. And that part is basically where all the effects are. And in there, there's more black powder. But it's also things called "Stars".

Titi: And stars are like little containers for the metal compounds.

Zakiya: So are there some preferred elements that people use in fireworks?

Fran Scott: So if you use barium, then it will become green. If you use strontium, it will become red.

Zakiya: So that's the basics of a firework. So the charcoal, sulfur and potassium nitrate doesn't get you up in the air. And then these other metal compounds that burn and give you different colors from that reaction.

Titi: Yeah. And it's just the buildup of that gas inside of this contained space that causes that huge boom. That sound that's keeping us all up.

Fran Scott: But the basics of a firework haven't actually changed since they were invented about a thousand years ago.

Zakiya: Let's go back to 600 to 900 A.D. We're in China. I'm your favorite cook and I'm just whipping it up in the kitchen. You know, I'm seasoning up these chicken legs. I have some little beef tenderloins. I'm getting it right. OK,.

Titi: I hope I'm invited.

Zakiya: It depends on how you act. And, you know, I'm mixing things together. I'm reaching for my saltpetre, that's potassium nitrate, which was common then.

Titi: Is that in Season All? I use Season All on everything.

Zakiya: Season All over Goya. So.

Titi: Absolutely.

Zakiya: You know where we stand with that.

Titi: Yeah.

Zakiya: So you have your saltpetre, your charcoal, sulfur and all these other ingredients, and you're just like, 'this is going to be good let me Sprinkle a little bit of this on here. Oh, I'm going to give them a little extra spice' unwittingly. You're making gunpowder. OK. You're seasoning your chicken and then boom. Can you imagine? Nobody's gonna believe you, first of all. But guess... They must've had a recipe because they are able to recreate it.

Titi: Mm hmm.

Zakiya: Once they figure this out, they take this mixture and put it in bamboo shoots. And You already know. You take a bamboo shoot with basically gunpowder in it. And you throw it over a fire. That's the birth of the fireworks, My friends.

Titi: We asked Fran, what's her theory on all these fireworks going off all the time?

Fran Scott: It's funny cause fireworks sort of can go into two compartments in society. I would say they can be the celebration part and they can be the anarchy part. And at the moment, I would say in society, we're sort of in both of those phases.

Titi: That is very true. There's a lot going on right now. A lot of folks were not celebrating the Fourth of July because not all people were free on Independence Day. And also people were celebrating the Fourth of July.

Zakiya: So sometimes the fireworks are a celebration or a way of saying, 'hey, we're still here. We're glad to be alive.' This is a little bit of boom, a little bit of celebration for that. And it's sometimes it's a little bit of anarchy. Like 'we're still alive but What the heck is going on? '

Titi: You're right. And trying to draw attention and make sure people are still paying attention. You know what I mean? It's a great metaphor for what's going on, actually, and what we've been talking about so far in the show. With the firework. It takes, you know, a light to ignite it. And then these electrons get excited. And then you get this big boom. And that's the same thing. That's what's happening with people, with us, with what is going on right now. There is an event that ignites all of these emotions and feelings,.

Zakiya: Everyone's shifts to a different state. The response. Everyone responds to that event. Right?

Titi: Exactly. And then, boom.

Zakiya: When we get back, we're gonna get more into the field of pyrotechnics at large and it will blow your mind.

Titi: OK. So we're back. And now we're going to talk about the field of pyrotechnics more broadly.

Zakiya: One of my favorite things I learned when we were talking to Fran was about the small pyrotechnics that exist in our day to day that we don't even think about.

Titi: And so we talked to Fran about the materials she uses in her demonstrations. And one of her favorite materials is Flash cotton.

Fran Scott: Flash Cotton is I I'm a little bit obsessed with it because it's basically nitrocellulose.

Zakiya: Nitrocellulose is this compound that is formed by adding nitrogen groups to cellulose.

Fran Scott: And what that means is it's just packed with oxygen, which means it burns to completion.

Zakiya: Now, you I was crazy about this one. I used nitrocellulose in the lab.

Titi: What do you use it for?

Zakiya: When I ran Western Blotz, nitrocellulose was the membrane I used to kind of capture the proteins. So I was separate the proteins in the sample. And then we. You want to imagine them you've got to hold them in to something. You trapped them on a nitrocellulose membrane.

Titi: Why didn't they catch on fire?

Zakiya: They're flammable at 200 degrees Celsius. And I didn't have a spark or anything like that.

Titi: Well, that's good.

Zakiya: And I had great lab safety skills. Hello. That's why I did catch on fire.

Titi: That's good. That's good.

Zakiya: But I never thought of. I never thought of them. I didn't know they were flash cotton that it was the same material. It definitely didn't know that.

Titi: What other materials are used in pyrotechnics?

Fran Scott: So hydrogen is an absolute. It's a dream for developing demonstrations because it just it sets on fire so easily.

Zakiya: Where else are pyrotechnics used?

Fran Scott: They are all around us. So like airbags, for instance.

Titi: I bet you didn't think that you had pyrotechnics in your car.

Fran Scott: So in an airbag, you have a small electronic match. And once you light that match, that produces the hot gas, which then actually inflates the airbag. Yeah. When you are impacted, that that will actually set off a switch, which then sets off the match.

Zakiya: The future pyrotechnics is really wide open once you understand the basics. So Fran told us this really interesting story of lighting a hydrogen rocket with her finger. She said she was inspired by some YouTube videos of people lighting Bunsen burners with their fingers. But I feel like a Bunsen burner and a hydrogen rocket is pretty different. Now, this isn't my ministry, so I'm going to have Titi explain how I works.

Titi: The way this she was able to do this was that she used a Van de Graaf generator. We've all seen it. It's a spherical silver ball that usually people put a piece of glass around and then you'll see all these little things that look like lightning bolts jumping out and touching the glass around it.

Zakiya: And when I used to think of what a scientist was, it was Albert Einstein touching a Van de Graaf generator.

Titi: Yes. And it makes it makes your hair stand in.

Zakiya: It makes your hair stand up. Yeah.

Titi: What it is, is an electrostatic generator. And so from this electrostatic that's generated, if you touch it and then you touch something else, you know, you could shock it, which I think we've all kind of done something like that, whether it's using a Vandergriff generator or rubbing our feet on the carpet and then touching our friend.

Zakiya: Oh, that's a pasttime.

Titi: That static. She can use that to make a spark. So she was able to use a Van de Graff generator and through many, many iterations. So she did a lot of research in the lab. She was able to generate a significant enough spark to light this hydrogen rocket.

Zakiya: And I want to point out something. Fran is an expert. OK, so I don't want you all at home rubbing your feet on the carpet, trying to light your gas stove.

Titi: Right. Please don't do nothing stupid. We're just here to give you the information so you could talk about it with your friends. Don't try this stuff at home.

Zakiya: This is one of the major things that stood out to me when everybody when I was hearing fireworks everywhere, I was like, what are the safety protocols for this? These fireworks sound close. They sound close to my home and all these apartments around here. Something's gotta catch on fire.

Titi: So we asked Fran, what are the big safety precautions that folks should be taking when they are shooting off fireworks?

Fran Scott: Distance is the biggest thing you can do to make it safe.

Zakiya: One aspect of distance is distance from flammables.

Fran Scott: People think, oh, a flammable that's a kind of butane light to fuel or whatever. No, it's your lawn. It's your pile of leaves that you've just swept up in your wooden shed that you haven't looked after for like three years. It's that type of stuff. That's the things that can catch fire.

Zakiya: So if you think about your grass, it's been a really dry summer. If you have had rain recently, maybe wet the lawn.

Titi: The second aspect of distance is distance from you.

Zakiya: And then aside from distance, Fran says we should consider the weather.

Fran Scott: And it's quite scary as well, because especially in the northern hemisphere right now, you know, we're going into summer. Things are getting dry. All it takes is a little ember that's it. That's an entire fire started.

Titi: Fran told us that in the UK that the time of year that they're most likely to be shooting off fireworks is in November? And part part of that is because it's a lot cooler and a lot wetter during

that time of year. In the U.S., we are shooting fireworks off during the hottest, driest time of the year, which sounds like a recipe for disaster.

Zakiya: Yes.

Titi: So if you already have fireworks in your possession, how should you be storing them?

Fran Scott: So I would say keep it in a lockable, unflammable cabinet, because the most dangerous thing I would say that could happen in households is people getting hold of them that shouldn't. So your kids, your neighbor's kids. And so by putting it in a place that's got a key, then you know that sound to you that can access them.

Zakiya: So a minute ago, we just said distance is one of the most important things for kind of keeping you safe. If you're going to light fireworks. But luckily, there have been some advances in technology that can also get you a little bit of space away from that lit fuse.

Fran Scott: Fireworks nowadays instead of, you know, guess someone going around and just lighting them with a stick. They're all done electronically. So you can get these electronic matches, which, again, I quite like the science behind them. These electronic matches are, well, that just matches, but they've got a little bit of nichrome wiring. And when you've run electricity through the nichrome wire, it heats up, it melts, and it burns a little bit of pyrotechnic material, which when you let them off just themselves, they're basically just like a Christmas cracker type spark. But when you put that in a firework, then it burns the bigger bit.

Zakiya: But those things can also go wrong. I don't know if anybody else remembers. There was a fireworks display in San Diego and instead of a 30 minute show, all those fireworks were on an automatic fuse and they all went off at the same time. Please Google it. It was just one big loud bang. And there's someone took a. Someone was taking the video and you can see people like grabbing their partner, trying to run away because they knew something was definitely wrong.

Titi: Right. It was a pretty big fail.

Fran Scott: Recently, I was out in Singapore and I actually saw a firework display in inverted commas done by drones. And it was totally different to a firework display because it's like a firework display on mute.

Zakiya: I think that could be really cool, but I would miss the sound. I like the boom.

Titi: Yeah, I feel like part of fireworks is the sound that goes along with it. But also I think it might be pretty cool because once you start thinking about drones and what drones can do and how they move, I mean, the possibilities are endless. You could draw on all types of stuff with those fireworks.

Fran Scott: I think there will always be room in our lives for things that go bang because there is something so innate that basically a bang scares us. And by scaring us, it entertains us in a really weird way.

Zakiya: I think that's true. That's why I continue to watch horror movies.

Titi: You know, we love all things scary.

Zakiya: Yeah. I don't know any more political thrillers that's happening in real time.

Titi: Just turn on your news.

Zakiya: I'm excited about the potential of drones, but I'm all about the boom. I like the display.

Titi: I'm sorry we couldn't give people like advice on how to stop the noise.

Zakiya: Yeah.

Titi: If you want to buy some soundproofing stuff for your for your apartment or for your house. We will put some links in the show notes.

Zakiya: Maybe we'll have to tell them how to create basically a podcast studio at home because that's what you're doing.

Titi: Mm hmm. The longer we're inside, I feel like the more that they're going to be going off. Even while we've been recording this, we've heard fireworks going off in Chicago and in Maryland. So I don't know if there's an end in sight. I'm sorry, but at least you know a little bit more about how they work.

Zakiya: Are you setting off fireworks? I want to know who's doing it.

Titi: Show yourself.

Zakiya: I'm not gonna report you. I just want to know. I want to see. Is anybody on the sound of my voice?

Titi: That's it for Lab 027. But we have so much more for you to dig into on our Web site. So make sure you head over to dopelabspodcast.com.

Zakiya: On our Web site You can find a cheat sheet for today's lab along with a ton of other links and resources in the show notes.

Titi: And if you want to stay in the know with dope labs, don't forget to sign up for our newsletter on our site, too.

Zakiya: Special thanks to our guests expert Fran Scott. You can find out more info about her on her Web site. FranScott.co.uk.

Titi: Or you can follow her on Twitter at [@Frans_Facts](https://twitter.com/Frans_Facts).

Zakiya: Yes. Also, we love hearing from you. What did you think about today's lab? Do you have ideas for Future Labs? Call us at 2025677028 And let us know.

Titi: You can find us on Twitter and Instagram @DopeLabspodcast.

Zakiya: Titi is on Twitter at @dr_tsho.

Titi: And you can find Zakiya @zsaidso.

Zakiya: Follow us on Spotify or wherever else you listen to podcasts.

Titi: Dope Labs is produced by Jenny Radelet Mast of Wave Runner studios.

Zakiya: Mixing a sound design are by Hannis Brown.

Titi: Our theme music is by Taka YAsuzawa And Alex Segiura with additional music by Elijah 'LX' Harvey.

Zakiya: Dope Labs is a production of Spotify and Mega Ohm Media Group and it's executive produced by US.

Titi: Titi Shodiya

Zakiya: And Zakiya Whatley.

Zakiya: When I think about everything that's going on right now, the last thing I have time to do is to go to another state to buy fireworks. But they tracked they traced most of the fireworks in New York. Back to Pennsylvania.

Titi: You know, Pennsylvania has been causing a lot of trouble over the last few years.

Zakiya: They've been dropping the ball.

Titi: They've got to get it together.