Announcer:

Bulletproof Radio, a State of High Performance.

Dave Asprey:

You're listening to Bulletproof Radio with Dave Asprey. Today's guest is a really impressive guy you've probably not heard of, but he's the subject matter expert for NASA's circadian lighting system onboard the International Space Station. And this is actually circadian biology in deployment. And it's really cool to be able to interview Satchin Panda at the Salk Institute talking about circadian biology in a Petri dish. It's different when you're talking about a team of people who are in space, who see a sunrise every 90 minutes. And it's also very power constraint, how do you not have to use incandescent bulbs? How do you keep people from going nuts when they spend a year in space? So, he designed the first LEDs used on the International Space Station, and he has since co-founded a NASA spin off company that brings that technology to the general public, and the company is called BIOS for Biological Innovation and Optimization Systems.

Dave:

And BIOS and my company TrueLight have partnered to launch the first consumer bulb, and we're going to go deep on biology of lighting, why LED lighting has been your number one enemy indoors for years, if you've been following my work. And I think Robert has cracked the code because his LEDs, which are custom built from the ground up, do something different than any LEDs I've seen. So, power consumption and sleep and a brain that works, how do we do it? Robert's the man. Robert Soler, welcome to the show.

Robert Soler:

Thank you very much. Thank you for having me. I'm excited to be here.

Dave:

78 patents on lighting under your name, what made you such a lightning fetishist?

Robert:

So, that's a great question. I think it started when I was little, I am allergic to the sun. It started when I was little, I am allergic to the sun. And so, when I was 10, doctors couldn't figure it out but I had these rashes all over my arms only where it was exposed to the sun and they couldn't figure it out. And it was probably a couple years of testing and testing blood work, tried to figure it out and we realized that it was the sun the whole time that I had an allergic reaction to. So, I think from a young age, I had an appreciation for what light could do to us or for us, and the power that light had. So, then I kind of got excited about it, pursued electrical engineering, Cal Poly. And then, there are very few programs that focus on lighting, so Rensselaer Polytechnic was one of them. And so, I pursued a master's degree there to really kind of dive into light as an element.

Robert:

And because that's a prominent education place, NASA seemed to want to pull from that school, so that's how I ended up at NASA doing some really cool stuff. But yeah, I'm passionate about what LED provides, it's led to a lot of patents. Really what's most interesting about LEDs and what makes it uniquely different is that it could produce a very specific spectrum of light. So, given the material

composition, you could produce a very specific spectrum of light. And you could do all sorts of things to elicit different biological effects, knowing that we have all these photoreceptors that are looking for light to do different things.

Dave:

Did you figure out which part of sunlight you were allergic to?

Robert:

We haven't really delved into it too much. Luckily, I've grown out of it, by and large, so it's not that big of a deal. But I'm guessing it's UV spectrum.

Dave:

And so, you would just get rashes? Or, what is allergic to the sunlight... I've heard of people, I never talked to someone who actually has that.

Robert:

It would be hives, and it'd be all over my arms and I get nauseous. And it was just a bad day when that happened. But being a little kid, I'd go outdoors every day and I spent all my time outside and so, it was just a constant. It never came and went, it was just always there.

Dave:

So, do you have PTSD, post traumatic sun disorder, where you got in the sun and you feel vaguely uncomfortable because you used to get a rash, or you're just over that?

Robert:

Oh, no. So now, I try to get out as much as I possibly can. I mean, it's what's giving us the vitamin D, so it's giving us sky blue signals to get us up and alert. That's probably the most important thing that we have.

Dave:

Okay, so you guys be like hyper aware of light, and you started sort of surgically pulling it apart and looking at what's going on. That's actually really cool, I didn't know that about you. I mean, obviously, we've been working together for a while on launching the TrueLight bulb that you guys are powering with your tech. And it's just going on the market and I replaced all of the bulbs in my house with it and I'm just so happy, I'm sure my power bill will be lower but my eyes are happier. But I want to go deeper around LED light itself. I was so excited, I remember WIRED magazine 20 years ago, they had this article about a Japanese inventor who made the first blue LED, and it was called True Bru, B-R-U, because he was Japanese, they were kind of making fun of this. Do you remember that article? You might, because-

Robert:

I think I do. I certainly, remember when the blue LED was invented, and I mean, it changed everything.

Dave:

It really did. And this article was all about it, and it was sort of saying, this is going to lead us to have white LEDS. And I was all excited, I'm a geek [inaudible 00:05:57]. But then I started really feeling crappy

under compact fluorescent lights. I would get dizzy, I'd get nauseous, I would just feel like I took a Valium. And it led me down this path like you, I wasn't allergic to the sun but I would try to sit in a boardroom with the first generation LED bulbs, the ones that cost $500 and you bought them just to show you're cool, and the lighting was such low quality, I couldn't function in an executive staff meeting, because I would sit there and I was like [inaudible 00:06:22] drooling on myself and really bad.

Dave:

And so, I said, I got to start filtering and I found out about Irlen Lenses and Helen Irlen [inaudible 00:06:32], and I ended up launching the line of glasses to filter out all this crappy light that comes from those blue LEDs. And you started from, I think the other end, said, "Well, I'm not going to have astronauts wearing glasses, I'm going to have to do something to the light so that it works." What did you do to fix the junk light problem in LEDs?

Robert:

Yeah. So, there's kind of this blue light paradox that there's some blue that's bad for us, the shorter wavelength blue, and there's the longer wavelength blue, the sky blue, that's actually good for us. Yeah. So, what we did was we basically shifted it, we took out the bad blue and re-appropriated into the good blue region, giving those sky blue signals that we need and getting rid of the bad blue in the shorter wavelengths. And it's just really kind of pinpointing that and what we've done is, we give this amplification of blue light, but it's really quite interesting because there's this key photoreceptor that drives our circadian rhythms-

Dave:

Inside the eye, the melanopsin sensor, that you're talking about.

Robert:

Yes, yes, yes, yes. I'm not sure how much the audience know-

Dave:

It's tough. If you're listening, and you've read my books, you've probably heard about these special light receptors, but let's assume that some of the audience hasn't purchased the book yet, Head Strong has a lot of the details here. But okay, so talk about that receptor and then what blue light does to it.

Robert:

Yeah. So, in 2001, newly discovered photoreceptor, we thought we knew everything about the eye, hundreds of years of research. And then 2001, we figure out that there's something else in the eye that goes to a different place of the brain, just goes to the... Well actually, we're starting to understand it goes to all sorts of different regions of the brain, but it doesn't go to the visual cortex. So, it drives our circadian rhythms. There's different ipRGC subtypes. RGC is retinal ganglion cell, the ip means that it's intrinsically photo sensitive. And how that's different than regular retinal ganglion cells is those ones go on the optic nerve to the visual cortex. So, the standard rods and cones that we have are looking for blue, green and red, and this melanopsin photoreceptor is looking for something that's right in the middle, kind of this sky blue, kind of cyan color, actually kind of the color of our [crosstalk 00:08:58].

Dave:

Kind of French bluish sort of thing.

Robert:

That's right. So, it's a very specific 490 nanometers that it's looking for, and with that signal, it's sending a lot of this daytime signal. So, that's a very prominent sky blue signal that is evident when you're outside, that sky is pumping in that signal. And electric lighting is not giving you hardly any of it. And it's really all because of how it's trying to be energy efficient. It doesn't really contribute to vision as much as driving these biological processes. So, early day LEDs really had poor amounts of this sky blue signal going into it. So, we basically looked at this and said, "Guys, this is going to be a really big problem." So, we created a technology that we call our sky blue technology, that infuses it into just standard LED light bulbs.

Dave:

So, the one that we're launching, which is [inaudible 00:09:52] the only one you can buy for consumers, most of your work is with large corporate headquarters and hotels and places like that, so you get a BIOS Lighting system and then it just feels good everywhere in a building. But for screw in light bulbs, the one where we're launching with you, the daytime bulb looks like a normal LED screw in bulb. But I look at it and it doesn't make me want to punch people. [inaudible 00:10:19] When Helen Irlen tested me, she said I was one of the five most sensitive people she'd ever met. She's like, "No wonder you don't like LEDs and [inaudible 00:10:26] I can see you wilt under them." And I don't wilt, I actually don't have any issues with this. Is it just because you took out the low blue and you left the sky blue?

Robert:

Yeah, I mean, I can't tell you why you're feeling what you're feeling but, I mean, from a physiological standpoint, that's exactly what we did. We took out that shortwave like blue, put in the good blue that you need, and I guess the result for you is less face punching.

Dave:

I've actually measured it; I punch 74% less people [inaudible 00:10:59] I don't really want to punch most people. Every now and then the urge comes up and I let it wash over me like a wave of peace. Now, the theory that I have, and I want to test this with you, and I know you're more of a lighting engineer than a biologist, but we know that it takes way more energy for the light receptors in the eyes to see the blue color, they have to resonate a lot more, they have to move more frequent, it takes more energy to... I'm going to say, digest blue light than it does say, the opposite of blue, which is red, just because it's very slow wavelength.

Dave:

And so, I have this hypothesis that, the more energy it takes to absorb the light, the harder it is for the eyes. And there's actually some good data about that out there [inaudible 00:11:46]. So, maybe by taking out the light that's metabolically expensive to digest, it's creating less of a load on the eyes or less of a load on the brain, which would be Helen's thing, but whatever the difference is, during the day, you use this bulb, the TrueLight bulb, and you feel like you've been outside. And [crosstalk 00:12:09] Is that the same thing you did on the space station, you basically took out the bad blue and left the good blue?

Robert:

Yeah. Well, on space station, we had kind of a couple different modes, kind of an alert mode that is basically this heightened amount of this sky blue signal-

Dave:

The good blue, that suppresses melatonin but wakes you up and is good for you.

Robert:

That's right. And then at night, there's kind of a nighttime mode that pulls out kind of all the blue, and then there's kind of something in the middle that's neither one nor the other. But it's a basic premise that if we're going to do this, the best time to get that bright blue light is first thing in the morning. Ideally, we want it all day long, and then you want to pull it out at the end of the night. And it's a very simple premise of... We evolved around the sun coming up at the same time each day, you want to basically replicate that inside.

Dave:

It's really funny because, I mean, you know the TrueDark glasses story because we're partnered, but I can't do this when I'm traveling and all, so during the day, how do I cut out the annoying blue but leave enough blue? Which is why I've always been against blue blockers, in general, because if you block blue all day long, you don't get to wake up, right?

Robert:

Right.

Dave:

And so, you get these people selling blue blockers, and you're like, "No, that's not how circadian stuff works." So, it was sort of like, you want to have a snack but not eat the whole cake. All right, so you wanted enough blue, and what you've done is you've basically taken most of the sugar out of the cake, so you got the good stuff, but not the bad stuff. And then, when you dim the bulb... This is for me, the reason I was literally halfway down the path of creating a bulb that would do what I wanted, and I met you guys, I'm like, "This is so good." Because you have way more experience in bulbs and you actually had to go in and get a new driver for the LEDs, you've tons of patents and all. So, I said, "All right, we're going to create this partnership."

Dave:

But then, when you dim the bulb, it changes its color. So, the dimmer it gets, the less and less blue there is in it. Why are those tied together, so that the strength of the bulb is tied to the color? This is the only thing like that out there.

Robert:

Right. So, we just thought that, that was kind of an intuitive way to think about it, is that as you kind of dim it down, it pulls out that sky blue first or those blue signals first, and not only it's biologically pulling out that blue, but emotionally, you see it all change, you see the color get yellower and redder, and it really feels like more of a nighttime environment. I think that we could have done it in a way where it was the exact same color, but I think that the psychological component of kind of seeing it change and seeing it go into these ultra-protective almost red lights, really is beneficial to set the mood to kind of

get you to wind down. But it also kind of communicates to you that, hey, behaviorally, I should be getting ready for bed. And if you automate it, it's a very profound effect.

Dave:

It works really well. In fact, there's a patent on the sunset glasses, the TrueDark lens, specifically around creating the biological effects of the sun going down. It's not down yet, but those are the glasses that you can wear out to a bar and you look like a rock star, but people can see your eyes, and then the ones for really late at night, you wear those and you look like Cyclops, no one's ever going to see your eyes but you're not going to get jet lag, right?

Robert:

Right.

Dave:

So, what you did is, you sort of package that up in a bulb where the sunset part of it, is you turn it down. And what I particularly like... I mean, you can get Philips Hue and all sorts of color changing bulbs, but then they're toxic blue during the day and it's kind of a washed out white. But then at night, they're full of EMF, so you get all sorts of either Bluetooth or Wi-Fi, they're expensive. And frankly, I don't really want to screw around to just dim the bulb. So, the new TrueLight bulb you just use a dimmer switch, and automatically as the brightness goes down, the color changes. And so, no weird stuff. But what is the effect of brightness versus color on sleep?

Robert:

I mean, we really want to tie those two together, so the whole premise is brighter days, darker nights. I know you guys advocate for red light, but if you had red light and you made it really, really bright, it still sends some signals that is daytime. Because you have these ipRGCs that contain melanopsin, but then they're also still connected to the rods and cones. So, there's still something going through, so it's not immune. So, you really do kind of want to bring that light level down with the spectrum together. So, brighter days, darker nights, and we kind of basically decided to tie those two things together to pull it all out holistically.

Dave:

I think it's brilliant, which is why we're the only people with your bulb out there-

Robert:

That's right.

Dave:

And why we're collaborating because... The other two things. This is a very recent study from Satchin Panda's lab, who's one of my favorite circadian biologists. He talked about, there's three things, and we didn't know this back when you guys founded BIOS, back when I started TrueDark, but we did know that at least the color of the light mattered. And since then, they've found three different kinds of melanopsin receptors. There's some that look at color, which are the predominantly important ones, and blocking just blue isn't enough so your bulb dims the right colors. The next thing though, was

brightness, right? Where like you said, even red light, which is generally a good thing, it will wake you up if it's a spotlight in your eyes. And we make some little dim red reading lights instead of a red spotlight.

Dave:

And then, the third one was the angle of the light, right? So, if you can get all those things down, and you have dimming light bulbs that change their colors and get dimmer at the same time, I think it's awesome, because if you have a home automation in your end, all that stuff, whatever dimming system you have, well, these bulbs work with it like any other one. But the bulbs themselves don't need all the Wi-Fi and all that crap on them, so it works very naturally.

Robert:

Right. And that's a really important part, I don't think that... EMF is an important thing to just try to get rid of in your house, but I just think from a control system it's too complicated. I'm an engineer, so I think about those things as, you're putting radios around metal and it's hard to get those signals out. I know that's a different message but it's an engineer's perspective, is that, does it really need to be that complicated-

Dave:

No.

Robert:

.... in order to really just create this day night simulation?

Dave:

It's kind of funny, I wouldn't be that opposed to bulbs that had a little Wi-Fi receiver in them, but the way people do these wireless control systems now is they're sending data all the time for no apparent reason, which both uses power and there's some data that says you probably don't want to bathe in EMF. There's also data that says some EMF is just worth it. I like my cell phone a lot, and so it's a harm minimization thing.

Robert:

Right.

Dave:

And some people say, no EMF is ever going to be acceptable, I don't think that's the case because we have a sun. And there are others who are saying, if as long as you're not inside your microwave, you're not fine. I think the truth is in the middle somewhere, so-

Robert:

Sure.

Dave:

But why gum up the works? It's horrible. Think about it, there's 500 wireless radios, if you have 500 little devices around your house, someone has to make all those, chips have to be manufactured, we have to

use huge amounts of water to make those chips. So, you can dim your lights instead of flicking a switch? How stupid are you? I'm sorry, [inaudible 00:20:21] but-

Robert:

You're preaching the choir on this one. Yeah, I completely agree.

Dave:

Do you have an internet connected toaster?

Robert:

I do not, no.

Dave:

What? Robert. But it's the same kind of thing-

Robert:

I am not stuck into the new age, no. Yeah.

Dave:

I am admitting that I'm old fashioned, but I like a good old fashioned binary light switch or a wonderful little dimmer at the bottom, which is what my entire house has now, thanks to our partnership. Because there were a few light switches that I didn't use that often that didn't have dimmers, so now [inaudible 00:20:52] dimmers everywhere because now literally, instead of having to go through and turn on red lamps, which is what I was doing before, I'm just like, "Yeah, let's just dim..." And I would dim the lights and then after the sun went down I turn on red, now I just dim everything and it's like this gentle almost like candles have lit everything. And I didn't have to change anything which, I don't know, it was liberating, maybe I'm just a dork. What do you hear from people when they go into a well-lit circadian compliant environment you've designed? Do people walk in and go, "Whoa." Or they're just entirely oblivious, they just feel better? Or maybe nothing?

Robert:

The best compliment from a lighting perspective is that they say nothing. Because as you know, it's only a problem when you hate it. So, as long as it's not harsh or glary I mean, It feels like what it should feel like when you're outside and one's going, "Wow, it just feels right." And when it feels right, that's the way it should be. It's only when it feels wrong that you kind of go, "There's something not right with the lighting that's going on here."

Dave:

In big-box stores, they put in incredibly intense over illuminated, very high in the low frequency blue lighting. And you go in there and you feel stunned and you just put shit in your shopping cart, stuff you don't even need. I honestly think that your decision-making is depleted when you're in environments like that. And they've done studies, you actually buy more, that's the reason those stores are lit that way, and you go in there at seven o'clock at night and it's like you're in Tron land, it's to make you buy.

Robert:

Interesting.

Dave:

If you were going to design a lighting system to just trash people the most, the lighting system for people you didn't like, what would you do to it?

Robert:

Well, there's a lot of interesting things of what lighting does to trick people. There's a really cool study, I think it was in London, where they made the lights pink because they were upset with teenagers loitering in the space, and the pink made their acne glow and so they looked really unattractive in that light. So, they wouldn't hang out there.

Dave:

Especially in Instagram land, that's funny. Okay.

Robert:

Yeah, I think that there is some really cool studies of people putting blue light in public bathrooms, so people couldn't go in there and see their veins, so they couldn't do drugs in those bathrooms. So, there are things that I've seen from a lighting standpoint that... I don't know that it's tricking people, but it's kind of playing the game so that you're avoiding the wrong kind of public.

Dave:

The first time I saw a light like that, was when I got my marriage license in Stockholm with my wife... Well, not wife, she wasn't my wife then. And I went into the bathroom at city hall or wherever and it had this bizarre greenish bluish light, and I am pretty sure I peed on the toilet because it was so intense. I didn't want to open my eyes. It was the most horrible color ever. And I came out, I'm like, "Something's wrong in there." And Lana laughed and she said, "That's so people won't use needles in there." And Stockholm is very progressive on stuff like that. And I had never considered that, going to use a needle at city hall, in fact that seems like a dumb place to do it but... Okay, so we have the pink light for acne, we have the blue green light for not seeing your veins. I've read something about pink, because pink light if you use it for long periods of time apparently makes people go nuts, is that anything you've heard about?

Robert:

BIOS who is biologically optimized also does agricultural or horticultural lighting. And so, early day horticulture lighting was pink, it was... Plants are green, which means they reflect green, which means that they absorb the red and the blue. So, you could put them in purple lights and they look black, you have no idea how they are. But you're bathed in this pink light. I'll tell you, it's weird being in that environment, and the weirdest part, I would say, is that you are in there and then your eyes are trying to make sense of what's going on. And then you leave that space and then everything is green, because your eyes have tried to white balance that pink light. And then, you leave that environment and everything all of a sudden is green, it's like Emerald City. So, I wouldn't be surprised if pink light would make you mad.

Dave:

Okay, I believe that. And I'm trying to find the study and I'm not finding it right now. It's an old one, probably from Russia or somewhere, but they would use only pink light in cells or something and it would cause bad things to happen. What about flicker? This is something that... I could see flicker that other people apparently couldn't see and it would just drive me crazy.

Robert:

Oh, yeah.

Dave:

Okay. Do you know why some people can see flicker and some people can't?

Robert:

There are certainly people... And I know one that I could think of who is just a... She's better than a meter at detecting flicker. There are some people who are insanely sensitive to it, and a lot of these light bulbs, especially if you go to Home Depot, the cheap ones out there, I mean, it's 100% flicker, it's going at 120 hertz and it's just going all the time. So, the low end of flicker is a stroboscopic effect, you're doing laundry or something and you feel like your hands are missing half the time because it's just kind of going black. And that's when you pick it up. And those other times it's like, oh, you see everything flickering. All I know is that, it's mostly in the periphery, is that, you look at the light and it's not flickering, but you look away and then you see it flicker, because it's kind of the stuff that's in the... The periphery is really good at picking it up.

Robert:

But we see that flicker is associated with migraine, headaches, fatigue, it's just really not a good thing to have a flickering light source. So, I know the lighting industry is very keen on trying to get regulations put on flicker to kind of get rid of the junk light, not just in spectrum, but in a flicker standpoint as well. It's a really good point.

Dave:

Now, if you have an incandescent bulb or a halogen bulb, you don't see a lot of flicker because the bulb glows, so if the light is literally turning on and off in North America 60 times a second, which is the way the power system cycles are, 50 times a second in Europe. It goes on off, on off, but all you see is a little tiny kind of wave like variants because even when the light's off, is kind of glow for more than one 60th of a second. So, it looks like... On a graph, it's mostly a straight line. But then with an LED, but if the light turns off 60 times a second, how does the LED handle that? I mean, the original ones would turn on and off 60 times a second, right?

Robert:

Yeah, absolutely. So, incandescent with an analog system, which means that... I mean, it's just a heater. So, it would weigh a little bit when it went to zero, on the 60 times a second, it would just get a little bit dimmer because it got a little bit cooler on the... LED is their digital devices, so they turn all the way off and what that means, that's really important from a detection standpoint, because everything goes black for a fraction of a second, 60 times a second or 50 times a second. So, it's very noticeable to our eyes that something has changed. What happened with incandescent it was very, very minimal and it wasn't to complete darkness. So, these digital systems have the ability to go do something that we've never seen before.

Dave:

Okay. I'm concerned about that 60 hertz flicker rate because that stuff just really, I don't think it's good for anyone. And the fact that your brain knows or your body knows that it's going light dark, light dark, light dark, light dark, and your brain is telling you, oh, no, don't worry, don't worry, don't worry, it's kind of using energy to smooth that out. But you mentioned 120 hertz, so how is it that an LED can blink 120 times a second, which is going to be much less stressful in the brain? What are you doing electronically in order to allow a 60 hertz to turn into 120 hertz?

Robert:

Oh, so, all it is, is the AC wave, it goes up and then down. So, that's 60 hertz. So, in LED, we rectified the signal so it goes up, and then that downward gets flipped over so you get up, up, so the off goes twice. So, basically, when you rectify it, you're getting... 120 hertz is the time that it goes off, off, off, off.

Dave:

So, if you're able to basically double it, but the 120 hertz you said is not really good either, you said like the big-box store lighting is like that. So, there are 240 hertz lights, so these are turning on and off 240 times a second, and the briefer the period of darkness, the less biologically disruptive it is, how do you get to 240?

Robert:

Well, so, most of them actually, if you have enough capacitance and you have a true driver that's going to go on [inaudible 00:30:35], a lot of that gets smoothed out. And so, usually, the better quality stuff will kind of be switching at 1000 hertz or even faster than that. So, it's really not perceivable by our biology. And it's really just conditioning that AC power that's coming in and turning into something that is going to go a lot faster, that's going to smooth out that signal and do something with it to get to 1000 hertz and above. So, 50 hertz, almost everyone could see it, as you get to 120 hertz, then there's the select people who could see it, like you. Once you get to, above 500 hertz, then it gets into the realm that nobody could see that. So, that's where it gets to the threshold of, we feel pretty confident that there's not a whole lot going on biologically.

Dave:

I like to think there's super tasters who are able to taste things other people can't taste. And then, we also know there's people who can see more colors than other people, that normal 16.7 million colors people can see. It turns out, there's people who can do more. And I feel like that flicker rate, there's probably people who are super tasters for light, who are just more able to perceive things. And I don't know if those are actual superpowers or not. They're outliers of human capabilities but whether... Well, if it's irritating, maybe it's a weakness, but the ability to perceive more of the world to me is a strength. So, I don't know what's going on there, but you're saying above 500, I would say most people can't see it. But I do know people who work specifically with flicker rates for lasers and things like that, who can very reliably tell the difference between a 500 hertz laser flicker and 1000 hertz laser flicker just by putting over their hand. But this is 10 years of working with that kind of stuff.

Dave:

So, there's some kind of weird cellular even light reception in the hands, but I'm going to consider those people just weird as a compliment. But for everyone listening even for those set of four people I can think of, they're going to walk into a place with 500 hertz or a 1000 hertz lighting and be like, "I'm okay

with this as long as it's not that weird blue color." So, the new TrueLight bulbs that we've put together, what's the flicker rate on those?

Robert:

A 1000 hertz.

Dave:

1000 hertz. Okay. So, compared to the first generation LEDs, I don't feel stressed when I look at them, and I have for every other bulb including the so called natural spectrum bulbs, they don't look natural spectrum and you look at the graph of the light and like, how can you call it natural spectrum? But I'm truly impressed with what we've got. Okay, so flicker mattered, and we talked about that, so people understand is what's going on. What happens to people who are under the bad color of blue and flicker by the end of the day? What do their brains do? What do their bodies do biologically?

Robert:

Yeah, I can't tell you exactly, biologically, I don't think that too many people have studied the effects of this. But I could tell you, those who've experienced it, that it feels like excess fatigue from being in that environment for too long, they come home and they're just wrecked for the day. They don't feel right. What it is, I couldn't tell you, I don't have enough letters on the back of my name to tell you what that is. But I could tell you that for those who feel it and those who know that it's there, it is real and it's very strong. And if they could do anything about it, they would absolutely do this, make a change.

Dave:

It was kind of desperation that led me to really jump in on this, I mentioned the boardroom stuff. One of the weirdest times in my life was, I had finally gotten to work at a venture capital firm. This is something I wanted to do since I was 12. I don't know what kind of 12 [inaudible 00:34:43] read it in a magazine, Entrepreneur Inc or something, I don't know why I read those when I was 12, I was just like, "Entrepreneurship sounds like fun. I want to go make stuff. And I want to help entrepreneurs, I'll be a VC." And I didn't understand that, that's not really what VCs do. Their job is to mechanistically, take what they can. But I'm sitting, because I'm an entrepreneur in residence, on Sand Hill Road, the most famous [inaudible 00:35:07] I'm a big deal. And I got a Mac for the first time. And Macs have bright white background, super glowy, 10 times more than everyone else.

Dave:

And I'm sitting in an indoor room with no light because I'm bottom of the rung and there's this horrible compact fluorescent LEDs, whatever. And by the time just lunch rolled around, I couldn't function. I would just got aside and my eyes were twitching, and I would just kind of sit there and stare [inaudible 00:35:31] sunlight, and I'd go back in, and it was like this oppressive thing. And then, I'd start my bright white Mac, and I would just get so tweaked, which had... I don't know what the flicker rate was in the first generation Mac with super bright screens, but it wasn't great. And I felt disabled by the end of the day. I mean, it was horrifying.

Robert:

As you say that, I think that what we're starting to understand specifically about this melanopsin receptor, these ipRGCs, is that those are receptors that are looking for things, as you mentioned before, angle, intensity, color or spectrum. But that's what we know what's going on in the super cosmic

nucleus. But these receptors or these ipRGCs, they project all sorts of different places in the brain, and they drive things like mood, so the happy feelings that you get. We're working with the National Institute of Health on trying to figure out what the right quantity of these sky blue signals are to give you that proper spectrum for just overall mental health on a day-to-day basis. It's really important for not just sleep and waking energy, but everything that we do, we're supposed to be outside, we're supposed to be getting that sky blue signal all day long. And then, when it's not there, that's time to sleep.

Robert:

So, when you're modulating that throughout the day, it's not the best way to live your life. And I think that we see higher... You see that downturn and you replace it with things like food, and you replace it with things that try to make you happy to replace that. So, it's really quite interesting how important light is into not just our sleep and wake, but how we just feel on a day-to-day basis.

Robert:

So, it's really quite interesting how important light is into not just our sleep and wake, but how we just feel on a day-to-day basis.

Dave:

It reminds me of a guy who reached out on social and he said, "Dave, I'm a biohacker like you, I've got my continuous glucose monitor on the back of my arm. And every day I eat the same thing." You can tell these are my people, software developer, engineering types. You're in my kind of person, honestly. I mean, you're in engineering, which is, we look at life effectively. And he was single. And he'd say, "So, on weekends, I have perfectly good blood sugar regulation and I eat exactly the same. And every day at work, by the end of the day, I'm getting hypoglycemia and my blood sugar is getting unstable. And then, I come home and I'm having a very different response." And he said, "So, it's been a mystery, what's different? Is it just stress of work?"

Dave:

And then, he tried the day timer glasses, the ones that filter out the nasty blue but not all blue, the ones from TrueDark. And he said, "Dave, my blood sugar got fixed, now I feel the same on weekends-"

Robert:

Wow.

Dave:

"When I go home, I have so much more energy, my metabolic regulation feels like it's changed. And I've noticed something, my blood sugar is less stable under blue light." And the circadian... You get a bad night's sleep, your blood sugar regulation is off by 40%. So, I think there's a lot more metabolically going on. This is more like Satchin Panda's side of things about what's going on. But it matters, and I'm worried right now because so many people including you and me are pretty much stuck at home for a while, and there's a lot of people... Maybe you have a window, but it may not be open or sun facing or whatever else, and I feel like our junk light is now a much bigger [inaudible 00:39:14] anti nutrient than it was before.

Dave:

If you're at home and you had junk light, and you didn't have access to the new TrueLight bulb that we've made through our partnership, what would you do to stay healthy from a lighting perspective? You're not allowed to buy anything, you got to make do with whatever crap your landlord put in your lights and your windows. Tell me your strategy.

Robert:

Oh, well, yeah. So, you would definitely want to face all chairs towards those windows that you have, try to get as much of that sky blue signal that you can. I mean, what I've been doing, is I've been holding all my meetings outside. I hang out either on my balcony, outside of my back porch, front porch, wherever I could go, to get as much of that signal that I can, just because it's what we're supposed to be getting. So, if you could spend as much time outdoors as you possibly can... I know there's some parts of the country that can't do that because it's colder or rainy out. But that would be the best strategy that you can during the daytime and at night.

Robert:

Try to use as little light as you possibly can. The TV signals is not too bad, but that would be what I would do. I think incandescent light bulbs are a great way to do it, if that's what you had, couldn't buy anything. Obviously you can't really buy incandescents right now, but-

Dave:

You can still buy halogens, which work. So, I guess if you did buy something really cheap, you could buy one halogen light and a dimmer lamp or something, but if you're going to do that, you could just go to TrueLight and buy one of our new bulbs which would be amazing, and use that one by your bed, if I could say it so.

Robert:

Yeah. Actually, it's funny. So, I just had a baby, he's sleeping right next to our bed and my wife's like, "All right Robert, you got to set me up with some sort of lighting scheme for the baby so that I could keep an eye on him, but I want to keep an eye on him, I don't want him to wake up, I don't want to wake myself up." And so, we used the TrueLight bulb, dimmed it all the way down, pulled out all the sky blue so it was enough to see. And I took some pictures, I'll have to share with you, of the light bulb. Actually, bear light bulb on a cord kind of under where he was sleeping. So, it just had enough of this kind of orange amber light kind of parading around so you could see some reflected light. It wasn't too bright for him. It was enough light that my wife could see him, make sure he's okay, feed him in the middle of the night, didn't disturb our sleep.

Robert:

And that's actually a really... It's a really cool solution to be able to have that control. Because most solutions out there they're just on and off. And so, to have that control, have the ability to pull out the blue spectrum, that was a solid win. And it's not just for babies, everyone else needs to sleep too.

Dave:

It works, and you would still turn off the lights when you're not in the room, though, right? You wouldn't want even a dim light on for the baby.

Robert:

Correct.

Dave:

That's what we did. Our babies have always been in a completely black room when they're sleeping so that they sleep better, and mom sleeps better too. And we make a little TrueLight, a little handheld flashlight thing that has only the right red spectrum and it's like a real dim kind of night lighty thing, that is motion activated. So, you can have that on and then, only if you move around you get this little bit... Enough to nurse, but not enough to wake anyone up. And this is how dorky I am. So, I'm like looking, okay, what's the cheapest thing you could do if you... Okay, I'm on a budget, I'm one of the 26 million people who just [inaudible 00:43:12] doesn't have a job. So, on my phone light... I'm going to hold my phone up, I don't know if my camera will pick that up, it's red.

Dave:

And so, what I did is, we make these little dots to cover LEDs, that's one of the TrueDark things, I don't know if we still have them on the site, but it's these little colored red dots. So, I put a little red sticker. So, if you take a picture with the flash [inaudible 00:43:32] Who uses flash anyway? You always look bad on a flash. So, I did that. And I kind of sneak around at night.

Dave:

So, I guess, in hotel rooms, I will put a towel around an LED light, as long it's not one that gets hot, because you don't want to start a fire, that's really a bad thing. But I sneak around, so what you would do is you're saying, in the morning, during the day, as much windows as you can, at night you turn everything off. What about TV brightness? How important is it to turn that down?

Robert:

Yeah, actually, the evidence shows that TVs aren't that bad, because they're usually so far away. In fact, the tablets and cell phones because there's so much closer to your face, are a lot worse than a television. So, between the two, TV is a much better win than tablet or a cell phone, or a laptop, to watch your TV, or watch whatever you're going to watch at the end of the day, just because those things are so close and it's so much dedicated directly on your face where the TV is going to put less. So, I [inaudible 00:44:38].

Dave:

Okay, so basically, putting your TV away... I still think it does matter, at least some it, the new TV... It's like, I'm sitting in front of a TV, that's my backdrop. I don't know if... If you're on the Dave Asprey YouTube page, you'll see this cool background. It's all digital and neat. But what I found is at night, if I had that thing on it lights up the whole room, but may because it's a LED backlight, or whatever. So, I do tend to dim those. The other thing, and you probably know about this, but this is more for listeners, I'm going to show my phone right now. And what I'm doing now is I'm... Just on normal brightness, it's on full brightness, and if I triple click the power button, little thing comes up it says, color filters, and I check the color filters box and now my phone is bright red as the background.

Dave:

And then, I click it again, and I click the reduce white point, and now the phone has a dim backlight and it's red. And I can look at that in bed at midnight without messing my circadian rhythm. And if I look at it under normal light, I can't see enough to undo it, which is a problem. But I might be extreme but I'm

with you in that I feel the difference from my phone. So, as a lighting engineer, you would tell people in the space station, dim your phones.

Robert:

Yes, I would tell the people in the space station, I'd tell everyone to dim their phones, use the filters, Apple has night shift, it's not the best. There's f.lux or f.lux-

Dave:

F.L-U-X, right?

Robert:

Yeah, well, Michael [Heffer 00:46:16] is a good friend of mine, so he tells me that it's f.lux, not f.lux.

Dave:

Okay, I'm going to believe you. I always say, f.lux so I can tell people what to do. So, he says it's f.lux, all right. So, I've never talked to him but for 15 years, I've used that free software to make my phone... I even donated once to say thanks. [inaudible 00:46:34] my phone but to make my computer dim. In fact, I'm using it right now in my computer.

Robert:

Yeah, when I give a presentation on circadian rhythms, which I do a lot of, it's always the best when I do it around dinnertime, and the sun goes down and my whole presentation changes to a warmer color, and people go, "Whoa, what's happening?" Oh, yeah, it's-

Dave:

Free software called f.lux, justgetflux.com, no financial affiliation, just cool stuff that's been out there for a long time.

Robert:

Yeah. And they're free. They accept donations. But it's cool software and it's free, and it works like a champ. And it automatically goes... So, you said in some points about where your bedtime is, wake time is, and when it gets closer, it actually [inaudible 00:47:18] redder to pull out more of that blue out of there. So, it does some things that sunset... But then it pulls out even more blue as it gets closer to your bedtime. So, it's really actively trying to pull out that blue light.

Dave:

So, if you wanted to spend no money, you get the f.lux, you turn off all the lights in your house at night-

Robert:

There you go.

Dave:

And just run your TV with your computer powering it with f.lux, and you'd get kind of sort of close, but probably still too much blue. And if you did the TrueLight bulb, you would be even better off, but that's

spending money. So, I want to really just encourage people, look, you want to be highly resilient right now, your circadian rhythm is the thing, which is going to affect survival, to be perfectly honest, of any sort of assaults or insults that the body can go under? If, oh, I got a good night's sleep, I can handle more. I got a bad night sleep; I can't handle more.

Robert:

That's right.

Dave:

What are the other things you worry about for astronauts specifically, when you're designing lighting? I'm still just like, this is the worst environment ever for circadian. So, you're the Navy Seal of lighting engineers.

Robert:

Well, this isn't biologically important, but one other thing... I mean, we did stuff for rapid decompression, so, if basically, there's a whole sprung on space station and all the pressure drops, the last thing you want is your lighting to fail on you, right? So, we had to make sure that it was all designed so that if anything like that, a rapid change in pressure happened, the lighting wouldn't be affected.

Dave:

But what's the best color frequency for rapid decompression hypoxia?

Robert:

Actually, hypoxia is a very interesting thing because your whole color vision changes, that's one of the things. We tested some of our [inaudible 00:49:14].

Dave:

Holy crap, we have to talk about that, I'm so excited. Okay, let's just talk about that, all right?

Robert:

Well, the only other thing that you had to design for was the fact that these astronauts are basically pushing themselves off of everything, and up is down and all that stuff, so it has to be... Was able to stand an astronaut basically, pushing off your light and basically propelling themselves off that light.

Dave:

Oh, so that would be really rugged and pressure capable. So, the physical demands of the lighting case and the chips themselves. Okay, that's kind of cool, I never even would have considered those.

Robert:

It's like a tank.

Dave:

And the ones we're doing are just normal bulbs, so people shouldn't be jumping up and down on them, I don't think.

Robert:

Don't do that.

Dave:

All right, we won't. All right. Hypoxic or hypoxia, hypoxic brains and color perception, what do you know about that? Because I want to share some stuff I've never written about. In fact, I'm writing about it right now, but it's not on the blog yet. So, what do you know?

Robert:

The only thing that I know is what I experienced, which is, we tested some hardware with NASA in what's called the Vomit Comet, which is the parabolic flight. So, you get 20 seconds of zero-G, 20 seconds of 2-G, and you get stuffed in the middle. And so, they train you before you do this to understand what hypoxia feels like, what the experience is. And so, they give you a color wheel to look at, and then they kind of reduce the partial pressure of oxygen. And what happens is, your receptors, your cones are getting depleted of oxygen, and so they're changing their sensitivity. And so, the colors just kind of shift. I didn't pay much attention to it, but if you're in a hypoxic state, colors just go weird and blue is not exactly blue anymore but it gets shifted to a slightly more greenish color.

Dave:

Okay, I didn't know about that specific shift. Here's some interesting stuff, if you don't mind me sort of rambling for a minute here. I just want to get your take on it, [inaudible 00:51:30] I didn't hear that but that's fine because I think it's viable for listeners. But tell me what you know, I think something good will come from this thing. Okay. I've had toxic mold exposure and poisoning from aflatoxin, which by the way, is a major issue on the space station and especially if we're going to other planets, we have to kind of control biofilms. That's a different... One of my companies is working on that. But it's a major thing. And one of the ways... When I had this mold poisoning, [inaudible 00:51:58] 300 pounds, it damages your mitochondria.

Dave:

And one of the interesting ways of diagnosing whether someone has toxic mold exposure or sometimes Lyme disease, which is usually toxic mold, they just think it's Lyme. But you look at their visual contrast sensitivity, and you're unable to see subtle differences in shades of gray. And I used to have this problem where, when my vision was the most sensitive, I would fail a test. You would be able to say, oh, that gray is [inaudible 00:52:25] and I look [inaudible 00:52:26] they're the same damn gray, or I just don't see any gray at all there.

Robert:

Interesting.

Dave:

And so, one of the things that happens then is pseudohypoxia. And this is what happens when your mitochondria basically get poisoned, and they act like they're hypoxic because they can't use... Just like you can get sugar backed up in your blood, high blood sugar, because you can't use the sugar going in. Well, if a different pathway is blocked by a toxin, you can't use the oxygen going in, right? So, you can have high blood sugar and... I won't say high blood oxygen, but basically your cells act a little bit hypoxic,

especially in the brain. And that's why you get the painful... I used to have this horrible back pain all the time and joints and all this stuff, this pressure points... Anyone with chronic fatigue syndrome knows about these diagnoseable areas of tenderness that are pseudo hypoxic points.

Dave:

So, why am I talking about hypoxia so much? Because COVID damages hemoglobin, which causes system wide hypoxia. And I will bet you, and I have not written about this yet, but I will bet you 100% not only are people having a problem with losing their sense of smell and taste, they're also having visual disturbances that they just don't notice because no one's paying attention to it yet. And I will bet you can tell someone who is getting hypoxic and should go to the hospital.

Dave:

I just did a video on my YouTube channel around just a $30 pulse oximeter will tell you, oh, you're at 92. If you're below 90, you're... Actually, really need to go to the hospital probably, because you can't carry oxygen, even if you don't feel like you're out of breath. But I think just, "Oh, look, my vision just changed." That's going to tell you about the same time that a change in smell or taste is. Okay. That's enough of my scientific A leads to B leads to C, what could we do with light and visual contrast and all this other hypoxic stuff? What does your engineering brain tell me?

Robert:

Oh my gosh. So, what I think is most interesting is... Though, I don't know what you did on that pulse oximeter, but it is actually like a far-red that it's measuring, and what's interesting is, our lighting that we've created actually, meets the cyanosis observation index, which means that you get a higher contrast of that bluish if you're... Or cyanosed, basically your extremities will be bluish colored, and it's a lack of oxygen that causes that. Well, it's not actually blue, it's a lack of red that causes that. So, one of the things that we don't talk about, we talk about the sky blue, that's important, but this far-red actually could change the contrast of those reds so that you could see visibly that your lips might look a little bluer, your ear lobes or your fingertips might look a little bluer.

Robert:

So, there's something that's really interesting based on what you said, that could be interesting for detection. Maybe you wouldn't detect it in yourself, but maybe your wife would go, "Hey, something's not right with you." And this lighting is very good at kind of illuminating those issues.

Dave:

So, there's the color rendering of the new TrueLight BIOS bulb, is it as good as sunlight? Or is it what you'd find in a museum? Actually, I should have known this already because we're launching it, but I never asked about that for color rendering.

Robert:

Yeah, I mean, it's something that we threw in there because we thought the far-red is... The reason why it works is because it penetrates the skin deeper, and it actually... There's another photoreceptor in the mitochondria called cytochrome c oxidase, that when it gets illuminated, it produces more ATP density.

Dave:

That's the same far-red that we put in the therapeutic side of the TrueLight, the energy squares, those things, because of its effect on that. And as a matter of fact, COVID is messing with cytochrome c oxidase, we think according to some of the things, probably through its effect on hemoglobin. So, stimulating or repairing that seems to be important. And so, they're actually getting a... Not really a therapeutic dose, but they're at least getting the right frequency that would be a natural sun, that far-red, not far-infrared, but far-red. It is in sunlight, so that's there but it's not in normal LED bulbs at all, right?

Robert:

Correct. That's absolutely correct. Yeah. It's something that we... Oh, it takes a very sophisticated audience to start getting into mitochondrial. The circadian story is important but we actually think that the ATP has an intracellular signaling that basically is almost like a double tap of the fact that it's daytime, because as you mentioned, you're getting in sunlight to try to amplify that in the built environment.

Dave:

That is esoteric knowledge. I mean, I really have a lot of respect for the engineering abilities and just the level of rigor for what you're doing. There are actually studies now, well, scientific papers proposing that ATP is a signaling molecule, extracellular ATP outside the cells. And anyone who's listened to a few of the shows knows that I'm a big mitochondria geek, my big science book was on that, and my secret recipe for being more Bulletproof is just have more ATP, have it outside the cells, have it inside the cells, be better at making it. And if you do that, you'll have enough energy and willpower to do whatever you want to do, and probably fight off viruses and stuff.

Dave: Quote for Martin

But the fact that you're recognizing, okay, the light on your skin from your LED lights may create more ATP through cytochrome c oxidase and honestly, it probably does, sunlight does, right? And we don't know what percentage of red from sun, but we know that other bulbs are completely deficient in this stuff and the TrueLight BIOS bulb is more natural spectrum than you're going to get anywhere else like that. And then, if it is a signal molecule, we don't know how much of it would be necessary to cause an upregulation elsewhere. But people feel really good when they use red light therapy, I have for almost 20 years now. So, I actually didn't realize that you guys had put it in for that reason, which is killer.

Dave: Quote for Martin

I mean, you guys have to understand, I've been dreaming about building a proper LED bulb and it's a massive engineering effort. And so, I've been thinking about this for TrueLight, I think, "Man, I'm going to have to go raise funding and do something really magic and find a lighting engineer who really understands all this stuff." And I was getting ready to launch kind of our first... This is 20% of what I want to do, but it was just not there. And then, in walks Robert and the team from BIOS, I'm like, "Wait a minute, they've already done it." So, we formed our partnership and now, the first ever bulb you can buy that actually meets my standards for indoor lighting without having to wear the protective TrueDark glasses, it's here. I think we're doing on truelight.com... TrueLight is the company who makes it or who's selling it, and you guys are the ones who have the tech. And-

Robert:

That's right.

Dave:

Do you see in one year or three years or five years, how long is it going to be until no one wants to go to work at a company that doesn't have a BIOS Lighting system?

Robert:

Yeah, I think that... Well, they say that people should change out their lighting around every seven years from a commercial standpoint. From a residential standpoint, a consumer standpoint, you could do it today. So, I'd like to think that in three years from now just as people have switched from incandescent to LED pretty quickly within... When did they become reasonable in price? Maybe-

Dave:

About four years ago.

Robert:

... three or five years ago. I think that they did it for the energy efficiency, now as people start understanding the messaging for biology and how it's important for your health and well-being, we'd like to think that in the next three to four years, it'll be a next transition to kind of what's next. I think that it's the next evolution.

Dave:

All right, what did I not ask you? You're a lighting engineer, I'm a pretty geeky guy, our audience... We can handle it. What's the most annoying lighting thing or the best lighting thing, or I don't know, what did I not know?

Robert:

We're looking at some interesting things about what's called color constancy, which is why you might buy a daylight bulb from Home Depot, with all that junk blue light, and it feels so wrong. And it might be just the junk blue but it also might be about the way that we perceive a homogenous space of all that one color. When you go outside, you have all those different gradients of light. And so, we've actually been experimenting with the blue sky component as a background to your lighting, to make it feel more natural, to try to create these kind of layers of light. So, I think that the perception of light is kind of the next frontier of things that we could start playing with that. I think it's probably the coolest thing.

Dave:

I've been dreaming about doing exactly that in the Bulletproof Coffee Shop and upgrade [inaudible 01:01:50] for a long time. And so, we've got a roadmap together of some other stuff we're going to come out with for all the consumer level stuff, or you want to do this in your apartment, in your home, you can do it. And it's going to be, I think, a big part of how TrueLight helps to solve the junk light problem. And you guys are the engineering company, and you're going to solve this problem for probably 20 times more people, because you're going to do it, I believe, in every office building, globally. And I mean, you've done the work, you have the patents and all that stuff.

Dave:

And this is not a five year vision, this is a 20 year vision, but I truly see that people could say, "Oh, I could buy the junk LEDs but I don't like it." And I have to work here and I'm the guy who makes the decision.

And it would be kind of douchey to be like, "I put BIOS Lighting in my office and then, I bought the 20 cents cheaper, or whatever it is, lighting for everyone else." I don't think that, that's going to pencil, because they'll realize, I didn't make as much money when I did that. So, we're going to see quality light in all, but the very, very worst workplaces. So, a sign of quality in future is not, "Oh, Google made me lunch." It's that, "Google lit my office properly and bought me lunch." So, that this is the new park.

Robert:

That's the world I want to live in.

Dave:

Me too. I'd like to walk around without wearing my TrueDark glasses when I'm indoors most of the time, because I don't need to, wouldn't that be amazing? All right, I'm feeling hopeful. And if you're sitting at home and you're not feeling hopeful, because, oh my god, there's a pandemic and all that sort of stuff, hey, maybe getting a little bit more sunlight through your windows is a good idea. Maybe getting some more darkness before sleep is a good idea. And strangely enough that can make you feel more hopeful. Thanks Robert. Thanks for your work. Thanks for lighting up our astronauts and just caring deeply about the anatomy of light, because it's a beautiful thing.

Robert:

Absolutely. Thank you for having me. It was a pleasure.

Dave:

If you'd like to learn more, you can head on over to shoptruelight.com and bulbs will be prominent there on the front of the page when this comes out. And if you want to know more about BIOS Lighting, the engineering firm, you want to put it in your building or hotel, whatever, even your house, go to... Robert, what's the URL of BIOS?

Robert:

bioslighting.com.

Dave:

bioslighting.com. Man, I'm so stoked on this bulb, it's one of the things that's as big as [inaudible 01:04:12]. It matters at that level to me personally. So, I'm really hopeful that this changes a lot of people's sleep and days. We shall have you back on the show probably another six months. We'll let people digest the new lighting, see how it changes. And I know we've got some new stuff coming out after that. So, thank you.

Robert:

Awesome. Great. Thanks, Dave.