

Speaker 1: Bulletproof Radio. A state of high performance.

Dave Asprey: Sleep. We all want a piece of it. Either you're getting some or you're not. I've shared with you all the ways that I hacked my own sleep and how it changed my life and how I'm up to the point where I can get about two hours of deep sleep and two hours of REM sleep in six hours, which has been really transformative for how I feel and even how I look.

Dave Asprey: On the show, I've brought in top sleep experts to share their research and offer up some really solid hacks you can use and, since sleep is one of the things I get asked about the most, I just created a multimedia sleep series as part of Better Sleep Month, so I've chosen the most compelling and useful interviews from Bulletproof Radio. It [inaudible 00:00:47] articles from the blog and a batch of different videos.

Dave Asprey: Each week, I'm going to bring you the best Bulletproof tips and tools for sleep that I know how to gather so you can start sleeping better. Get hooked up with sleep on the blog at [blog.bulletproof.com](http://blog.bulletproof.com) and check out [dave.asprey](https://www.instagram.com/dave.asprey) on Instagram, where I post all the good stuff.

Dave Asprey: For National Sleep Month, this is a reworked and upgraded, combined episode of Bulletproof Radio featuring Satchin Panda, who's one of the leading researchers on circadian rhythms at the Salk Institute. He explains why we're wired to fall in a natural pattern of light and dark and the ways that sleep has a profound effect on so many different things involving your health, things like weight, diabetes, depression, metabolic syndrome, even cancer. You're going to learn so much in this episode. I'm really excited to be able to put it together for you.

Dave Asprey: You're listening to Bulletproof Radio with Dave Asprey. I'm really happy to have a friend and former guest of Bulletproof Radio back on the show. I'm talking about none other than Satchin Panda, Ph.D., who's a leading expert in circadian rhythm and a professor at the Salk Institute in San Diego. He has written an app called myCircadianClock that helps you synchronize your circadian biology, and his lab has been transformative because he's shown the profound impact of ambient light and daily eating and fasting on preventing huge numbers of diseases like diabetes, depression, metabolic syndrome, heart disease, cancer and stuff like that.

Dave Asprey: He's also come up with this concept of time-restricted eating, and it's very related to intermittent fasting, but he says that people who eat everything within an eight-to-12-hour period can boost their circadian rhythm and maybe even reduce chronic diseases.

Dave Asprey: Dr. Panda, welcome to the show.

Satchin Panda: Thank you, Dave. That was a really nice introduction, and I'm really flattered that you are such a big fan of circadian rhythm, and everybody should be because, as you said, that's one of the foundations of better health.

Dave Asprey: Why are we finding all these changes just in the period of time of your work? What happens to make us become more aware and to crack the code, given that that's the title of your book?

Satchin Panda: Yeah. Circadian biology is a very interesting aspect of biology. If you think about every other field of biomedical research, there is a disease and then people work on the disease, circadian rhythm started as a very simple curiosity, why we go to sleep, why we sleep for seven hours or eight hours, and is there a clock inside?

Satchin Panda: What has happened is, in the last 20 years, the key discoveries can be summarized into three major things. One is people discovered that, just like our brain has a clock, almost every organ has its own clock, and that completely transformed how we think about circadian clocks.

Satchin Panda: The second one was we also figured out that blue light is a strong agent in sunlight that resets our clock or having exposure to blue light at night can distract the clock, and the third major discovery was how food timing affects our clock, so these three really transformed how we think about health because, if you think about now, what circadian rhythm field is doing, this is the only field that's actually studying what is health because all other fields of biomedical research study what is disease.

Satchin Panda: We can go over this three major discoveries or breakthroughs in circadian rhythm field. The first one is every organ has its clock, and that's a profound statement because, if we think about clock, we always think about sleep, so that means, just like our brain has a clock that tells our brain to sleep for seven to eight hours at night, it also tells our brain that the peak time to do complex math, have complex business negotiation or solve problem is somewhere, say, between 8:00 a.m. and 2:00 p.m., so that means, if other organs have a clock, they should have their optimum time to do their job and they also need downtime to rest, reset, and rejuvenate.

Satchin Panda: Slowly, over the last 20 years, people working in this field are finding out that, yes, that's true. Just like our brain has a clock, liver has a clock and it can digest food and can nurture our body for only seven to eight hours or a maximum of, say, 12 hours and that it needs downtime. Similarly, our gut has a clock. Even the microbiome that lives inside the gut, they have a circadian clock or a daily clock. Muscles have a clock, and so, now, if we think of every single... If we think of our health, our health is a product of our organs and hormones, and when our organs, hormones and brain chemicals rise and fall at the right time, then our body clock synchronize and we are at top performance, so that's a very profound concept that's evolving in the circadian rhythm field.

Dave Asprey: You mentioned the liver quite a lot in there, and, it's funny, people oftentimes don't associate circadian things and sleep with what the liver is doing. Tell me more about why you brought that up.

Satchin Panda: If you think about it, liver is the... one of the largest solid organ that is very important for metabolism. It produces fuel for almost every part of our body, including the brain. It also breaks down a lot of xenobiotics or unwanted molecules that we ingest. This is also a place where we produce many of the key molecules for fighting infection, so liver plays a huge role in our health.

Satchin Panda: In fact, interestingly, most of the circadian studies these days have moved away from looking at the brain and they're more and more looking at the liver since liver plays such a big role, so, for example, if we think about fasting, then liver is the major place where we should... Our liver produces some ketone bodies towards the end of our 14, 16 or 18 hours of fasting, and that ketone body is transported to our heart and brain for better function, so, in that way, liver plays a huge role in fueling our brain and keeping us smart.

Dave Asprey: It really matters so much. It seems like we're now using circadian biology to rediscover things that maybe we knew a thousand years ago. Do you agree with that?

Satchin Panda: The thing is, when it comes to health and wellness, anything that we can think of has already been tried in human history because humans have been trying by trial and error and many other methods to figure out what is the best way to live a healthy, long life, so that's what we always hear, that, yes, whatever you discover, our grandmother used to say.

Dave Asprey: Talk to me about what you've seen either in the lab or in other readings, other research around proper wake-up time, and is it the same for everyone?

Satchin Panda: Your day actually begins when you go to bed the previous night because that determines how long you'll sleep, how long you'll reset your brain and then how fresh you'll wake up in the morning, so if somebody's going to... so one rule of thumb is... Most sleep researchers agree that an adult should be in bed for eight hours. I'm saying should be in bed for eight hours, so, out of that, somebody may get six and a half to seven hours of sleep.

Satchin Panda: That means, if someone wants to wake up at 6:00 a.m., then this person should aim to go to bed at 10:00 p.m. at night, and then the question is, whether people who wake at 6:00 a.m. versus 8:00 a.m., 9:00 a.m. or 10:00 a.m., are there any difference in performance? I think that's where the wake-up time is not as important as how many hours you slept.

Satchin Panda: The person may be going to bed at 3:00 a.m. and waking up at 6:00 and maybe getting three hours of sleep, we know that that's not going to work very well for next day's performance, but when people wake up late, then the thing is they're

more likely to have a better night's sleep and... because what is happening is, in modern days, we have to stay awake later into the night for many different reasons. We have to have a social life or sometimes the kids come back and the parents help them with homework or something else, so, in that way, our sleep is getting delayed and, people who wake up later, maybe they are getting better sleep.

Satchin Panda: One nice study on that, not on older adults, but on high school students, just came out. It's a nice collaboration between Horacio de Iglesias from Seattle and our lab. What happened was, a few years ago, there was this hypothesis that teenagers are not getting enough sleep when they wake up in the morning and go to school very early, so maybe delaying their school start time will help them, so Seattle School District, which is the largest school district in the US, decided to delay their high school start time from 7:30 in the morning to 8:30 in the morning.

Satchin Panda: There was a big resistance from teachers because, teachers and parents, they are likely to wake up early and teenagers are likely to wake up late, and so that's why Seattle School District was very eager to see whether the school... delayed school start time has a better effect on students' performance.

Satchin Panda: Horatio and his team monitored 200 students from two different schools when the school start time was 7:30 a.m., and they monitored them with very high grade. There's FDA-approved medical grade sleep trackers and activity trackers for 75... up to 75 days, for up to almost two months before the school start time changed, and also tried their grades and tried their absenteeism or tardiness and then, after the school start time changed to 8:30, he again went back and collected the same set of data from 200 students, and then the results are pretty clean.

Satchin Panda: Over the last hundred years, US adults and teenagers have lost one hour of sleep, so that means, in every year, we are losing around 406 minutes of sleep, and what he found is, by delaying school start time by an hour, these students got 34 minutes of sleep, so that means we turn the clock back among Seattle school students so that now, in 2018, these students are sleeping as much as students in 1950 were getting, that much sleep.

Dave Asprey: I'm so happy that you're talking about this. I'm always talking about school start times on social media. You don't want to have your kids getting up at 6:30 in the morning when they're 14 years old. It's not natural. It's mean.

Satchin Panda: Not only that, we also saw that, when they slept more 34 minutes, it's not that they did not do their homework, actually they improved their grade by nearly 5%. Just imagine, if someone, if your kid is getting 86, 87 in all the subjects and is getting a B grade, just that extra sleep will bring their grade to A because now he or she is going to get all As and the average score will be around 90, 91.

Satchin Panda: We also saw a reduction in tardiness. Particularly, kids, when they're getting up too early and then they're sleepy and there's not enough time to reach school, a lot of them end up being late, so this is an exciting study that clearly shows that, in modern days, it's not ideal to wake up so early and, maybe for some people, at least for high school students who are the foundations of our future, we should let them sleep a little bit more, and it's going to improve their overall healthy, increase maybe longevity in the long-term, improve productivity and their score.

Dave Asprey: I am going to take the excerpt of this interview and I'm going to a play it for the school board here, and I would encourage you, if you're listening to this, to take... as we've got Dr. Satchin Panda, one of the world's preeminent experts from the Salk Institute on circadian biology telling you that sleep is a cognitive-enhancing substance you can use for your kids to get better grades, get them to show up at school more, so there's no excuse for starting school early, you'll hear these dumb excuses like, "Oh, it impacts traffic flow," so like, hey, this is the next generation here, so go around the school zone or something. It doesn't matter.

Dave Asprey: This is simply not okay, and I think it's one of those things that we're going to figure out multiple generations-wise. Let's see what happens when you have five generations of people who are sleep deprived as kids, what it does to the IQ of a country. Probably not good things. All right, I'll get off my soapbox there.

Satchin Panda: You pointed out one thing, traffic flow. Actually, there are studies showing that, when school start time is delayed, then the kids have less accidents.

Dave Asprey: Of course. I remember driving like a zombie to school when I was... What I can remember from my school, because I was so darn tired because they made me wake up in the middle of the night, but, all right, I have another question though. You mentioned most sleep experts agree on eight hours of sleep, but most exercise experts now will also tell you that they agree on 10,000 steps as the ultimate number of steps per day.

Dave Asprey: When I looked at the data on sleep and found that the people who live the longest from a 1.2-million-person study that went for three years that they only sleep six and half hours a night, I'm like I don't care if most sleep experts say that you should sleep eight hours a night because it's apparent that sleeping more than eight hours a night is actually dangerous compared to sleeping maybe seven and a half hours, so where does eight hours really come from, and do you believe that having seen rat melanopsin sensors in labs and Petri dishes and all that? How much BS are we dealing with?

Satchin Panda: The epidemiology is right. The self-reported six and a half hour of sleep correlates very well with longevity or [inaudible 00:16:02] life. When it comes to eight hours, it's not eight hours of sleep. It's eight hours in bed. I always tell people that.

Dave Asprey: Ah, so it's what else you're doing in bed that makes you live longer. Okay. That changed the whole equation.

Satchin Panda: Yeah. I always tell people aim for eight hours in bed. We know these days, when people go to bed, they're checking emails and doing other things, and then when they wake up, sometimes they wake up and then they're still tired. They check their email and other stuff before they get out of their bed, so that's what we said. Target eight hours in bed.

Dave Asprey: Okay, eight hours in bed no matter what you're doing. I might be able to get away with that. Do you have anything you've learned from all the work you've done specifically with lighting or food or anything else about reducing sleep latency so people can go to sleep faster when they want to in bed?

Satchin Panda: There are few things. I mean, so you already had how to do your neurofeedback. One thing is, what we are finding, people who do time-restricted eating, and particularly they stop eating two to three hours before bed time, that helps. Second, reducing exposure to blue light for two to three hours before going to bed, that also helps, and this is much more important because, now, actually, I have a app that we just built up from the lab called myLuxRecorder, one single word, and wherever I go-

Dave Asprey: Can I get now? Is it on the store?

Satchin Panda: Yeah, it's on iOS.

Dave Asprey: It tracks your light exposure all day? I've been wanting this for years.

Satchin Panda: No. No. No. You have to open the app and then record it, but then the point is, wherever I go, I just record it. What is interesting, two to three years ago, when LED lights were not that popular, many stores, department stores, grocery stores, drugstores, et cetera, they used to have 300 to 500 lux of light, and, now, after they switched to bright blue LEDs, these stores have easily a thousand lux or more of light, and that is very worrisome because most people go to do their grocery shopping or go to get a drug from the drugstore at night and, when they go, they spend at least half an hour in this bright blue light.

Dave Asprey: Yes.

Satchin Panda: One more thing I got to add is, if you're going to... If you're going out of your home and going to a drugstore or a grocery store or any store these days, then make sure that you are less exposed to blue light. Maybe this is where blue filtering glasses will come in handy because, in many cases, we cannot just stop going to the stores at night. That's the only time we may have to go shopping.

Dave Asprey: Okay, so [crosstalk 00:33:33].

Satchin Panda: No food for two to three hours, no bright light for two to three hours, and then, some people, their cold body temperature, their body temperature doesn't fall well at nighttime, and to have a good night's sleep, we need to have a good drop in cold body temperature. People can take a shower, and that actually helps to drop the body temperature they can go to sleep.

Dave Asprey: A cool shower.

Satchin Panda: Yeah. Some people like warm shower, some like a cold shower, but the bottom line is, whatever shower you take, your blood circulation will draw towards your skin, away from the core, and that helps to cool down your body.

Dave Asprey: Would drinking a glass of ice water be a good idea before bed?

Satchin Panda: Yeah, if you're not likely to get up and pee, then that is a good idea.

Dave Asprey: Okay, a fair point, that's bad for sleeping. It's bad for sleep. Got that one.

Satchin Panda: Then the last one is your right to darkness, because we have lost our right to darkness. There is so much light everywhere. Sometimes, it's mind-boggling how we have lost our right to darkness. Even in a modern house with the best architecture, without a good, I mean...

Dave Asprey: Blackout shades.

Satchin Panda: ... yeah, a good insulation or good dark-out curtains, it's almost impossible to get darkness. Plus, there are all these indicators and all these lights on your phones, on your appliances, TV, et cetera, so that can keep up very jazzed up. In fact, there is a study that just came out showing that even one lux of light, which is equivalent to even a bright moonlight on a full moon day... full moon night, having that one lux of light in some bedroom for some people can disrupt their sleep, and so that's why it's very important to have the right to darkness. If you cannot have darkness, then maybe a pair of eye shields or sleeping mask will help.

Satchin Panda: This is a very important issue because, right now, in many countries, the only bulb people can purchase is LED light, and if they're not aware about how much light they need or how dim they need, it's going to make the sleep deprivation more profound and widespread, so it will be epidemic of less sleep because of the LED lights.

Dave Asprey: What do you do at home for sleep with your lighting?

Satchin Panda: We don't have any light that's more than... that produces more than 40 watt of light, so these are all dim, and if we need lighting, then we have spot lighting or work lighting, for example, table lamps that illuminate the work area, but not your eyes, not your face, and then, all of my computers and smartphones, they

already have night shift or nightlight feature, so they switch to orange color or dim down around 8:30 or 9:00.

Satchin Panda: One has to be very knowledgeable and has to make that extra effort, but it just takes 10 to 15 minutes to change all your night shift and nightlight feature at least on your computer. It may not affect your sleep, but at least it nudges you because you're staring at the computer and your computer screen changes, then you know that it's time to go to bed. It acts as a going-to-sleep alarm clock. We have waking-up alarm clock, but these light changes actually prepares your body and then slowly you'll fall asleep.

Dave Asprey: That is fantastic. Yeah, having a go-to-sleep alarm clock is profound and using light as a way to do that is really cool, because most people listening are probably on some Internet ad or something. You've seen the alarm clocks that we wake you up with light. They slowly turn on and then the light comes up and up and up before there's a sound alarm, so that when the sounds happens, you're already mostly awake because the light signaled to your body, "Hey, it's about time to wake up." Why not do the reverse when you go to sleep, right? I really like that idea.

Satchin Panda: Yeah. I think, slowly, many of the building control systems will incorporate this idea, and just like your Nest thermostat cools down your home or warms it up before you get home, so, similarly, maybe all the lighting in the house will slowly dim down starting from the kitchen. The kitchen should close around 6:30 or 7:00, so the kitchen should become dark, and then slowly the living room, and then you'll be nudged to go towards your bedroom.

Dave Asprey: I love it, and junk light is bad as junk food. Would you eat a big bowl of French fries? I would hope not, and would you stare at bright light LEDs right before bed? I'd hope not because they're the equivalent in terms of doing bad things for you.

Satchin Panda: Yeah. It's almost like timing makes a healthy food junk. Similarly, timing can make healthy light junk. During day time, we need that blue light or bright light, but at night time, that's just junk light.

Dave Asprey: Yeah. When women are pregnant, they're much more likely to wake up between 3:00 and 5:00 in the morning, and a lot of people who aren't pregnant, and men and women have this problem, they wake up and they can't go back to sleep and their mind is racing and things like that. What is happening in many of these cases is their blood sugar crash. They didn't have enough blood sugar to basically run their glymphatic system into sleep, so the body said, "Oh, I know how to make sugar. Well, let's secrete some cortisol, maybe a little adrenaline because those will raise blood sugar. Therefore, now I have enough fuel for the brain."

Dave Asprey: Unfortunately, cortisol and adrenaline wake you up a 3:00 to 5:00, and you can't go back to sleep, so the hack for that was... I found two different groups. Maybe it's the gene. I don't have the genetic testing to tell what it is, but, one group of people, they did some collagen protein, high in glycine and low in the... stimulating amino acids that raise orexin the same way modafinil does, some of that out with some ketogenic things, dare I say brain octane, which raises ketones, they have enough energy that they sleep through the night, and then, the other half of people, they take a teaspoon or two of raw honey.

Dave Asprey: I found a study that showed it raised liver glycogen 22% more than cooked honey or other forms of sugar, and liver glycogen can fuel the brain effectively versus muscle glycogen, so try it out. If you're having this problem, a little bit of this before sleep can stop you from waking up because of the blood sugar-stabilizing effect of honey, not in hot tea because then it's cooked honey, but raw honey, because those are both eating before bed, they're small amounts, we're talking five, 10 grams.

Dave Asprey: Is there some lower limit of food like that that's not going to break my circadian rhythm, because I don't want to break my circadian rhythm, but I want to sleep all night? What do you do for that case?

Satchin Panda: We haven't done anything like that because it's a moving target. People will say how much is small enough? The reason why that raw honey or whatever you're eating is going to your liver and is getting stored is because the whole system wakes up. We haven't done any research in that area, but what we have seen is, people who do time-restricted eating, they do sleep very well. Maybe they normalize the way their body learns how much glycogen to store, and this relates to a very interesting circadian rhythm study done in plants, and you may laugh at it, but we learned a lot of insights into circadian rhythm from plants.

Satchin Panda: If you think about plants, plants have to make food only during daytime when there is sunlight and, at night, they don't have access to anything else. The only food source is their stored starch, and they have to break down that starch to go through the night, and they cannot have this exogenous food. They cannot just absorb glucose from the soil or anything else, so what happens is the circadian clock in plants, if you're growing plants, say, in 10 hours light, 14 hours darkness, then the plants will learn that they have to go through 14 hours of darkness so they will store just enough starch that will last exactly 14 hours when they wake up.

Dave Asprey: Wow.

Satchin Panda: Now, you take the same plant and make the night 10 hours night and 14 hours of light. Even though they're getting more light, they're not going to store too much starch. Again, they will dial down and they'll store exactly the same amount of starch they need to go over the 10 hours night. In fact, when this paper came out, it was from UK, and it was a few years ago when UK was having

some problem with their budget, so the headline was, "A tiny plant knows how to manage its economy, but a British finance minister doesn't know it."

Dave Asprey: That sounds uniquely British like their press.

Satchin Panda: Similarly, when one has a very strong circadian rhythm while we go through a very regular habit of when we stop eating, then our body will learn how much stored glycogen the body needs. Maybe that is what is happening because we see that, people who do time-restricted eating, they always report that they sleep better, particularly just waking up at 3:00.

Satchin Panda: I used to wake up at 3:00 for an hour or two, and then I thought that that was normal because they are so common, but then, quickly, I realized that what is common is not normal because you need that continuous restorative sleep. Now, it feels much better waking up after continuous sleep than waking up in the middle of the night and staying awake for one or two hours.

Dave Asprey: What is your take on longer fasts, maybe even going to up to three or four days, where you're just having water? I'll do water and black coffee because, I mean, come on, but during that time, what does that do to my circadian rhythm? Is it advisable? How does that line up with the circadian code?

Satchin Panda: The circadian rhythm still continues with longer fast, and it actually goes through a longer rejuvenation maybe. We haven't looked at longer fast in animals because animals don't like this very long fast, water-only fast for two to three days. In humans, we know there are a lot of studies from other groups showing that longer fasts are very good in reversing or managing many chronic disease, and we know that longer fast will activate autophagic pathway to much higher levels, so that will help. Longer fasts might also increase your ketone body production, and that also helps.

Satchin Panda: All the indications are, yes, longer fasts, if you can do, are beneficial for the body. It's not going to disturb the circadian clock because the circadian clock is an internal timekeeping mechanism that continues even without calorie, and that's how it will anticipate when you should go to bed, when you should wake up. In fact, people who do longer fast, they always report that it's not that they cannot go to be because they're hungry. They actually go to bed much better and they stay... They have their good night's sleep even during longer fast.

Dave Asprey: Yeah. I sleep well during longer fasts.

Satchin Panda: Yeah. When you finish a 48 or 72 or multi-day fast, breaking the fast is not easy because your body has forgotten food. You don't have that appetite for a big meal, so, usually, you break it with a small meal, so, in that way-

Dave Asprey: Like a one-pound rib eye steak the way I do it? Just kidding. [inaudible 00:31:06].

Satchin Panda: I don't know how you break it, but, for me, the first time I break, it's usually a small salad or a fruit, something like that, so I'm not actually... I'm not hungry, but I do-

Dave Asprey: Yeah, it's surprising. Yeah, you're not hungry at all.

Satchin Panda: When I do long fasts, it's usually four or five days minimum, so, by the end of four or five days, you have to force yourself to eat, and so I usually break the fast in the afternoon because that's when I have time to break the fast because, as you know, it takes... Even for that small salad, it'd take a relatively long time to even force that, so I think it will be very personal what time they are planning to break the fast and whether they are planning to break the fast alone or with somebody else and... Yeah, but then the idea is don't break the fast with a big meal.

Dave Asprey: I agree with that, by the way. I was joking about the rib eye.

Satchin Panda: I figured that out.

Dave Asprey: All right, cool. Is there anything else that you would like hundreds of thousands of listeners to know about their circadian biology, about your work? I mean, you've done so much, but, you've got a big microphone right now, help people with some stuff you know.

Satchin Panda: The thing is, the last couple of years, a few things that have come out that are very reassuring and essentially telling that timing makes healthy food junk, and the bottom line is this. Last year, there was a study that came out from Joe Takahashi's lab, who is considered a really... a leader in the circadian rhythm field because he discovered the gene clock.

Satchin Panda: What he found was we know that caloric restriction is beneficial, but most caloric restriction studies in mice and larger animals are done in a way that the mice are given their chunk of food, which is less than what they should be eating, and this chunk of food is given usually in the afternoon or evening, and mice eat that food within three to four hours every single day, so, essentially, all caloric restriction studies done in rodents are a mixture of caloric restriction and time restriction because they're going through almost 20 hours of fast.

Dave Asprey: Also, aren't those nocturnal animals, who should be eating at night and yet have weird indoor lighting, disturbing things as well?

Satchin Panda: That's why the second part of Joe's experiment is exciting.

Dave Asprey: Oh, okay.

Satchin Panda: He took two groups of mice and did caloric restriction on both of them. One group got food in the evening when they're supposed to get and then the other

group got food in the morning, and both groups got the exact same number of calories from caloric restriction, and if we go by CR, caloric restriction literature, both groups should see the same benefit irrespective of timing, but what was exciting was the morning-fed mice did not lose weight although they were less food.

Satchin Panda: That was really interesting, that even if you are doing caloric restriction, if you eat at the wrong time, then you may not see sufficient benefit of caloric restriction.

Dave Asprey: Here's the deal. If some joker tells you that calories in and calories out, losing weight is just a matter of counting calories, you can just quote that. You can cut out the snippet. You can send it to them. Here's the deal. That science is dead. There's a nail in it, and if that's not enough, let's just give a little bit of xenoestrogen to some of the mice in caloric restriction and see whether they lose weight. They won't, so screw calories. Yes, calories matter. You do not lose weight by cutting calories. You have to cut the right calories at the right time and do the other stuff. Right?

Satchin Panda: Yeah.

Dave Asprey: Thank you for pointing that one out.

Satchin Panda: Then you might ask, "Why do we have circadian rhythms?" One thing is have you ever tried doing two different tasks at the same time, for example, texting and driving or those kind of stuff, where two things actually don't match? You may be able to do it for a while, but that's not the best way to do, but at the same time there are different tasks that go together. For example, listening to Bulletproof Radio and sipping some Bulletproof coffee, they go together.

Dave Asprey: Okay, I'm not going to argue with that one.

Satchin Panda: Similarly, like eating dinner and talking to your friends and family, so those things go together, whereas many things that don't go together. Just like that in our body, when we go to sleep or when we wake up or when you go play sports, there are many things, many genes, many hormones, many brain chemicals that have to work together. For example, when you go to sleep at night, our sleep hormone melatonin should go up, our muscle tones should go down so that we can sleep nicely, we should not act out our dreams.

Satchin Panda: Conversely, during daytime, we need less melatonin so that we feel less sleepy, more cortisol, and then our muscle tones should go up. Our heart rates should go up, so these things go together. Circadian rhythms, essentially, make sure that compatible things go together and they're timed to the right time and in compatible processes, separated between day and night, and that's the basic principle or basic reason why we have circadian rhythms.

Dave Asprey: There are so many things that your work and that of others have teased out different environmental variables that affect our circadian rhythm, that part of my craft of biohacking is to recognize... I know I am going to fly. I'm not going to live a perfect circadian life, but if I can avoid harming my circadian rhythm more than necessary, I'll do that.

Dave Asprey: My house at home, all of the exterior lighting is a sea turtle friendly red lighting, so my friends think I live in a submarine or some sort of house of ill repute, but I can go outside, and red light doesn't affect circadian rhythm, so I can still see the stars, and the side effect is that I don't attract bugs with those, but I have three species of owl that nests within a hundred yards of the house because I'm not disrupting their circadian rhythm. It's like this external light pollution affects not just us, but every living thing on the planet, right?

Satchin Panda: Yeah. Exactly. This is what we discovered almost 15, 16 years ago. We know that there is a small, very small number of nerve cells in the base of our brain, and they act as master clock in our brain, and these 20,000 neurons are literally hardwired to our retina, to our eye, and there are only a very small subset, maybe 5,000 to 10,000 special cells in our retina that sense only blue light, mostly blue light, and they send that information back into the master clock neurons.

Satchin Panda: That's how we are designed. Not only us, as you pointed out, almost every animal is designed to synchronize their internal circadian clock with the sunlight or day and night cycle because sunlight or daylight is the richest source of blue light out there, so that's why we are designed to synchronize our clock with blue light.

Satchin Panda: That very simple understanding, that blue light synchronizes our clock, has a huge impact because, as you pointed out, in modern living condition, we spend a lot of time in the evening in front of bright screen or bright light, and most of those lights also have a significant amount of blue light, so that blue light suppresses melatonin. It confuses our circadian clock. Our clock doesn't know whether evening has already started or it's just twilight zone, so, I think like our body is in constant twilight zone, and so we get sleep disturbances.

Satchin Panda: Similarly, outside light pollution can disrupt rhythms in many birds, in many migratory species. They cannot migrate at the right time. They can be predated. They can completely be wiped out because they get confused which season it is, and so that simple idea is kind of interesting that, in 15 to 16 years, that simple discovery that we made in mouse and then, later on, other people verified it happens in humans, has led to your cellphones now tuning to orange color around 10:00 at night.

Satchin Panda: This also has a huge impact because we know that the amount of light that comes out of the iPad, iPhone or any kind of smart screen is enough to disrupt our circadian rhythm, but if we change that light color, that will have a huge impact, so it's gratifying to see a basic science discovery has made it to a billion

or more smartphones and people are actually starting to use that knowledge and, second, as you pointed out, the next revolution will be this lighting revolution where we can have tunable lighting so that we can change the color of the light depending on the time of the day.

Dave Asprey: Have you looked at LED, like white LED versus fluorescent versus halogen versus incandescent and what they do to circadian rhythm?

Satchin Panda: There are a lot of studies going on on those kinds of light sources. In fact three, four years ago, a bunch of us, including lighting engineers, architects, ophthalmologists and physician, primary care physicians and scientists, lighting manufacturers, we all got together in Tokyo and came up with a statement [inaudible 00:41:02] statement on LED lighting, and that was published last year.

Satchin Panda: It's very true that light has a huge impact, and people can do very simple things. Just like you, you had a lot of soundbites. One is dimmable switch. While you might have a lighting fixture that you don't want to get rid of, but at the same time you can just change the switch, put a dimmer. I think everybody should remove their light on/off switch, that is so last millennium, and then put dimmers.

Dave Asprey: Every switch in my house has them. That's exactly right.

Satchin Panda: My house has very old lighting, so most of our rooms have very dim lights to begin with, so we don't even got the dimmers, and then the few lights were... They came in built with dimmers. We have so dim light, so, people who come to the house, they think that we are in prehistoric age or something, but it's great because I feel sleepy...

Dave Asprey: Our house is the same. Yeah.

Satchin Panda: ... between nine and 10:00. I have a 15-year-old daughter, and she has perfect circadian rhythm. She goes to sleep early, gets up early, and then goes to high school, so everything is fine just by changing one simple thing. People should start thinking about buying those dimmers.

Dave Asprey: Do you think that there is any validity to that idea that some people have a later shift to circadian rhythm, some have an earlier shift to circadian rhythm? Could that be biologically based or do we just not know enough?

Satchin Panda: Oh, yeah.

Dave Asprey: Okay.

Satchin Panda: No, actually that's a very interesting topic that you brought up. Just like you said, you are naturally designed to or wired to go late. There are many people who are naturally wired to go late, and, in fact, most-

Dave Asprey: We call these the good people, right?

Satchin Panda: Yeah. Normal-

Dave Asprey: The very best people? No. I'm just kidding.

Satchin Panda: Now, almost 20 years ago, this was not even considered that we are designed to go early or late, so, in fact, there was this woman, I'm forgetting her real name, so she went to many sleep doctors and said, "Well, I have this problem that I cannot resist. I just go to bed very early."

Satchin Panda: She used to go to bed around 7:30 or 8:00, and she would wake up around 3:00 or 2:00, so she was a really early rise, and then the sleep doctor would say, "Well, you are already getting seven hours of sleep, so you're perfectly fine. There is nothing wrong with you. This is all in your head. This is some [inaudible 00:43:39]. Uh, don't worry about it. There is no cure. This is not a disease," and she went around many sleep doctors and, finally, she came to a sleep doctor in Utah, in University of Utah Medical Center, and this sleep doctor had a good friend who is a human geneticist, and he thought that maybe there is some truth to it, maybe there's a genetic mutation in this person.

Satchin Panda: He talked to a good friend of mine, Louis Ptacek, and Louis used to do and still does very good human genetic research, and this guy, Chris, and Louis, they were biking and they talked about the story and Louis got super excited. He went and talked to this wife, Ying-Hui Fu, who is also a human geneticist who was working on neuro disease, and they both were excited because they thought, "Well, this is something really cool because, if there is a sleep gene that times your sleep to different time, then it will be cool to discover."

Satchin Panda: For the next three to four years, they put all their time, resource and effort on figuring out what is wrong with this woman and, finally, they found a mutation in the circadian clock gene called Period 2. The bottom line is, when this gene is mutated, then, these people who had that mutation, they go to bed very early.

Satchin Panda: As they published this very groundbreaking paper almost 17, 18 years ago in 2000, a lot of people started calling them and saying, "Well, I have a natural tendency to go to bed super late or I can sleep with only four hours or five hours. I'm fully functional," so they got a lot of human mutants, and they have been publishing a lot of papers identifying new genes, so there is another gene. If it's muted, then those people can sleep only for four to five hours and they can... They're completely perfectly functional, so that's a gene that makes you need less sleep, so, similarly now, there are new mutations that people are finding that will keep you awake, so it's possible, Dave, that you are a mutant.

Dave Asprey: It's entirely likely given that half of my family comes from Roswell, New Mexico. The other half worked in the nuclear power industry their entire lives, so it has to be that. Given that so many people are now doing things like Bulletproof

Coffee or keto diets and things like that, do you think that there's a role in setting circadian rhythm by manipulating fat versus sugar versus protein?

Satchin Panda: It started with mice, so, as I told you, in mice, when we put these mice on eight hours or 10 hours eating window and they go through somewhere between 14 to 16 hours of fasting, then those mice run on treadmill twice longer than mice that have a limited access to even healthy diet, so that triggered us to think what is going on here, and that advantage goes away if the mice eat for 12 hours. Everything else remains the same. They have the same body weight. They have the same blood sugar, everything's the same. Only when they go to eight hours or 10 hours, then we see this advantage in endurance, and what we find is, when mice eat for eight to 10 hours, then towards the end of the fasting period, they naturally build up their ketone bodies.

Satchin Panda: That means the ketone-making enzymes, the pathway that breaks down fat into ketone, those are activated by circadian rhythm, but it also requires the combination of having a good rhythm and that long fasting of more than 12 hours, and what is interesting is, through our circadian, myCircadianClock app, a lot of athletes and a lot of health enthusiasts have been following time-restricted eating, and they experiment themselves between 12 hours, 10 hours and eight hours and, a lot of them, they report us back that when they do eight hours eating or 10 hours eating, then they can do that marathon less tired, or some people who are just going for spinning classes, after an hour, they're less tired.

Satchin Panda: That is telling us that the circadian program to make ketone bodies towards the end of our fasting cycle, and that ketone body has a huge impact not only on cardiovascular health, but also on brain health. In fact, in a follow-up to that basic science research that we did in mice, there was another study that came out from Europe that showed that, yes, when rats or mice are given access to food only for six hours, then they make ketone bodies, and that ketone body goes to the brain and acts on certain parts, only on certain part of the brain, clock neurons, to start what is called exploratory activity.

Satchin Panda: That means, when we're hungry, actually if you think about it, if you dial back, say, 100 years or 200 years back, if it was a winter night or even a long night, the person or the... Our ancestors, they had their meal maybe around just before evening, and then they fasted for the entire night, 12 hours, and then after twilight zone, maybe at 10:00 in the morning they would go hunt, and they have gone through almost 14 to 16 hours of fasting, but what is interesting is they have to, their brain has to act much better in that hungry state and the muscles have to act much quicker in that hungry state to go and catch that deer or some other animals.

Satchin Panda: That's why we are programmed to go through this daily cycle of ketosis so that, in the last two to four hours of our fasting period, we build up that ketone body to make our brain more active, our muscles more active, our heart more active so that we can go and hunt, and that exactly we see even in these mice and rats.

They become more active towards the end of the fasting cycle and they go look for food. Even an hour or two before they're supposed to get food, they will get up and then start looking around, so I think this is a very primordial signature, a primordial program in our circadian system that we naturally make. Yeah.

Dave Asprey: Beautiful. Is there anywhere else people can go to find out more about your research? Do you have a website or any page that they could go to if they want to read more about circadian geekiness?

Satchin Panda: Yeah. Actually, the same website, [mycircadianclock.org](http://mycircadianclock.org), has a blog post. We try to put blogs. Then I have my own Twitter handle, SatchinPanda, and I try to put everything new about circadian rhythm and also, once in a while, I put something, what I say milestones in circadian rhythm research or health research. It's not restricted to circadian rhythm because, as I said, I truly believe lifestyle is what, when, and how much we eat, sleep, and move, so they'll be about physical fitness, sleep, nutrition quality, quantity, et cetera. I have a few thousand followers, so I also take questions once in a while.

Dave Asprey: All right. You'll get a few thousand more here. There's a surprising number of researchers, medical professionals and pro athletes and people like that who listen to the show, so I hope that everyone listening to this, whether you're in one of those fields or not. This is really important stuff that's been missing from the world of chronic cardio and low-fat diets for long periods of time, all the stuff that made me weigh 300 pounds, so I am a huge fan of your research, and just my personal thanks for both doing the research, but then being willing to talk about it and say, "Well, what if you tried it because we think it might work." That just takes academic balls, so you've got those, Satchin.

Satchin Panda: Yeah. Thank you.

Dave Asprey: Thanks for being on Bulletproof Radio. I totally appreciate your work.

Satchin Panda: Thank you, Dave. I'm glad to be here.