

Welcome to the Huberman Lab guest series, where I and an expert guest discuss science and science based tools for everyday life. I'm Andrew Huberman and I'm a professor of neurobiology and ophthalmology at Stanford School of Medicine. Today's episode marks the 6th and final of the six episode series on fitness, exercise and performance. And today's discussion is all about nutrition and supplementation to maximize your fitness, exercise eyes and performance goals. Dr. Andy Galpin I'm super excited to discuss today's topic, which is nutrition and supplementation for performance and recovery. And I'm particularly excited about this conversation because I've been interested in supplementation and nutrition for performance really since my teens, but also because in recent years we've witnessed a massive transformation in the general public in terms of their view of supplementation and nutrition. First of all, more people are thinking about nutrition, what is good nutrition, what is not a very barbed wire topic, as you know. But there are some truths in there that we'll discuss, but also supplementation. Whereas 1015 years ago, I think most people would either be really into supplements, that was a small percentage of people, but the majority of people were either told or were thinking, oh, vitamins, you mostly excrete them, they're just expensive urine. Nowadays it seems that many people, including many of my colleagues and physicians, all the way down to sports performance experts, are taking and making recommendations about certain supplements. And so the way that I like to think about supplements is that they aren't necessarily just supplements, which makes it sound like they are augmenting what should already be there, but you're not quite getting enough of. But indeed, a lot of these things we call supplements are very potent compounds that can transform our ability to perform in the short term, to recover from exercise, and that can really shape brain chemistry, hormone patterns acutely and when taken long term. So I'm very excited about today's topic and to be able to try and sort through this, let's call it a cloud, hopefully not a storm, but this cloud of supplements that are out there, because indeed, many of them are excellent and can provide us a lot. Some of them are terrible and then some just don't do anything and therefore are terrible because either they have side effects or because they're very expensive and they don't do anything. And then of course, within the realm of nutrition, there's an equal amount of confusion. But that's why I'm talking to you, because you're going to put clarity and structure and definition on these incredibly important topics. You absolutely nailed it there. One of the major reasons supplements can work is because you can consume nutrients in extremely high concentrations such that you would not get in nature through food. Having said that, you really do want to focus on the basics sleep, nutrition, hydration. And I'm going to get into very specific detail later with some of those things. That said, there are plenty of situations and circumstances when supplementation can do exactly what you said. Also, though, because you are taking them in such high concentrations, they can also be unproductive, they can be destructive, or they can be counterproductive. So in case if you're taking a couple of supplements over here, it may actually be counteracting the benefits of some of the other supplements over there. So in the ideal situation, we would be able to work like snipers here, so we would be able to run full biological testing. So extensive blood work and saliva and urine and stool and have an in depth analysis. Of your gut microbiome and your stress patterns and your time of day and your cortisol curve and all the things that we do in our high performance folks. With that, then we can get extremely high precision supplementation. Quite honestly, our philosophy is we only give individuals exactly what they need. So even some of the standard, generally safe and effective supplements, we don't really necessarily use them if there's no specific need. We've talked about the consequences of this with things like antioxidants, but even simple stuff like stimulants and other tools that are effective for recovery, we don't use them unless we have a reason. That said, that's not the reality for a lot of people. They're not going to be able to do something like that or work with somebody who can help them in that. So there are a handful of supplements that I would consider to be in my 80 20 rule, which is sort of like the 20% of supplements that are going to give you 80% of the benefit for the lowest cost. And so what I can actually do is just sort of start there. Even though this burns my skin and my soul a little bit. I absolutely hate this. I am the context guy. It depends, it's high precision guy. But let's be real, there are a number of supplements that are fairly effective and fairly

cheap for a wide range of outcomes. So this is for general public, this is for people who want to do the three buckets, right? You want to look a certain way. So supplements that could enhance muscle growth and fat loss, non hormonal based supplements, of course, supplements that can improve energy or physical performance. Again, from everything from squatting more to feeling better in your yoga class, to having more energy throughout the day, to our third major bucket that we've been talking about throughout this entire series, which are longevity. So we can cover those first, if you'd like to start there. Yes, absolutely, let's start there. Oftentimes when we think of supplements, we immediately jump to high sport performance type of things, or vigorous workouts or muscle building, though that doesn't necessarily have to be the case. Take for example, Creatine, and I've spoken about this at length, and it's with Darren Candow, who's done a tremendous amount of research. I was just up at his lab recently in Canada and he has covered extensively. In fact, I think I put up a post, perhaps I could draw this up where he laid out all the myriad of benefits of Creatine. This is taken in the typically three to 5 grams per day of dose of Creatine monohydrate, which has the most research behind it, seems to be extremely low side effects in almost anyone. And the benefits include in course, things like muscle performance and strength and things like that. And if you go back to our discussion in our episode on metabolism and endurance, we talked about the phosphocreatine system so you can figure out kind of what this is going to do in terms of effect. That said, there's excellent information and data coming out on the benefits of bone mineral density in Creatine. There's a ton of work looking at a host of cognitive factors from memory, executive function, to effects potentially on even things like depression, mood, to Alzheimer's, Parkinson's, all forms of neurodegenerative disease. In fact, it's pretty obvious the brain loves Creatine as a fuel. And so not only we sort of discussed it in the episode as being the fuel for skeletal muscle contraction, but the brain needs to do that as well. The astrocytes around the brain need to be able to provide energy, et cetera. So it's very clear that metabolism in the brain is reduced with things like TBI and potentially concussions. Now to be extremely clear, Creatine does not prevent any of those diseases, it does not treat any of them. And the data are mixed, but more and more are coming. Some show a little bit of benefit, some show maybe none, but I'm not aware of any research in those areas that show it has any downside. For the most part, side effects are extremely minimal, if not null and then potentially some benefit depending on the specific study. So we could put up, if you'd like, a couple of links directly to those metaanalyses and folks can go through those things one by one. So I only say that to again, maybe expand our understanding and thinking about what these types of supplements can do. It's not just about growing muscle or high performance, it's everything. To again, there's an association with recovery. So Creatine is fantastic for recovery from muscle, for muscle damage helps and can potentially aid in fat loss and a whole host of things. So you can actually also even look at websites like Examine. I have no affiliation with them whatsoever, but if you want to just type in something like Creatine monohydrate, you can see a whole list and you're going to see thousands of studies of the potential benefits of Creatine. So that is always number one on my list. I'm relieved to hear that Creatine sits at the top of your supplementation list because well, first of all, I started taking it when I was in college. At that time, I was taking it in this kind of loading mode where you take it in anywhere from 15 to 25 grams per day, often causing some gastric distress, often combining it with fruit juice to try and shuttle it into the muscles. Sure. And then so called maintenance phase of reducing to ten or 15 grams per day. Nowadays I just take about 5 grams or so, although later I know you're going to tell me why I should probably be taking more than 5 grams per day given my body weight. So I know we'll get into some of those specifics a little bit later. But in addition to experiencing direct effects on muscle size and strength, which I did, I don't know how it contributed to my cognitive function or if it does now, because there's really no way to tease that out with standard at home tests like a scale. But it is very clear to me, based on the literature that you described and some of which we've covered on other episodes of the podcast, that the phosphocreatine system is vitally important for forebrain function. The forebrain, of course, being the portion of brain, broadly speaking, the portion of brain just behind your forehead that

is responsible for planning, action, setting rules and context. So even as simple as if you're going downfield in a game of soccer or basketball and you're on offense and then you make an attempt on goal or basket and then it switches and you go back, now you're on defense. Being on defense is very different than being on offense. And that rule switching is a prefrontal cortical function, as is every context dependent way of thinking or acting. And so anything that can favor function of the forebrain, I think is good for humans in general. It suppresses anxiety, allows us to interpret what's going on for us. And so I'm very relieved and gratified to hear that Creatine sits at the top of the list. Also, as I'm sure you'll point out again later, creatine is for the most part, a relatively affordable supplement for most people. So here we're not talking about something that's really esoteric or that you have to fly to some remote location to get an infusion of. Right? Although I apologize to all you because I know the price has skyrocketed recently. Really? Yeah. Why is that? Well, nobody knows, but it's quote unquote, a supply and demand issue, if you will. So those prices have gone up. There's also, of course, been shipping problems in the world and things. So every time I talk about Creatine right now, people just flame me for like, oh my God, it's so expensive now. I'm like, I know, I'm sorry, but honestly, it's only so expensive because you're used to being so cheap. So when you counter the fact that you're like, right. Yeah, relative to the other stuff you're probably taking relative to any other number of purchases, it still lands very high in my ROI list, my 80 20. Because of that, it can be taken any time of the day. It doesn't have to be in magical combination. You talked about co ingesting it with carbohydrates. That can enhance how quickly you can get into the system. In fact, it's going to work on the exact same mechanisms. We'll probably potentially talk about hydration, but these things are shuttled. So anytime you bring in carbohydrate that's going to be chipped into tissue as quickly as it can, creatine then goes along for the ride, and then it brings water fluoride. That's how you enhance hydration. That's why it's important to have carbohydrates when you're trying to hydrate. So you're just going to take it in there. And that's also why you get, quote unquote, cell swelling, which is a good thing. It's just enhancing hydration. We actually use it a ton in our post weigh in protocols. So individuals that have to cut water weight, creatine is a great thing to throw back in there. It's going to help you rehydrate it's. Also why when you take 30 grams of it, it can pull a bunch of fluid in the intestines and there you go with your little bit of GI distress. So, yeah, there's a lot of fun things you can talk about there. I just had to flag that because every time I've been talking about it recently and I say it's cheap, people are are killing me for it. So I apologize. I don't know how to make it any cheaper, but it's still fairly affordable. Yeah, I would say relatively inexpensive compared to a lot of supplements out there. And when thinking about the return on investment, it's quite good, actually. Sorry to cut you off, but I was just also thinking, there's been a number of studies on sleep deprivation as well with creatine that can help. So obviously, sleep deprivation will generally reduce cognitive function and creatine can ameliorate some of that drop. So if you think about it in that context, I had a crummy night of sleep. Well, and if that enables you to perform a little bit better in your job, then you would make up the dollar or so, whatever you paid for that day's supply of creatine. So it is something kind of on that note. It's not going to work as an acute response. So it's not something you're like, I feel terrible, let me throw some creatine down the hatch, I'll feel better. That's not going to work. It's going to take several weeks to have a noticeable effect. It needs to be stored in tissue. It needs to be built up before you can actually do much of anything. So it is unlike some of the other things like stimulants or caffeine, that have an acute response right now. And so if you're going to take it, you probably need to consume it consistently. If you can't do that, then really there's no point in doing it. And the loading phase you mentioned distanceware here is something you can do again if you need to enhance the storage of it really quickly. So say for example, we've done this in some military cases where it's like you get back to base and you've only got a week and then you got to go back out. We may actually have to do a little bit of a loading phase then. But if that's not the case, the loading phase is unnecessary. It's not really harmful other than maybe GI stress and maybe waste. But you're going to have three or four weeks, it's going to reach full saturation, plenty of time to be

there if you're in that three to 7 grams per day range. I'm glad you mentioned the slow accumulating positive effects of creatine as compared to so called acute effects. Because the way that I think of health promoting and performance enhancing protocols like viewing morning sunlight or endurance exercise for that matter, or creatine or sleep, for instance, is that while they can have effects in the immediate term, you might feel a little bit or in the case of a good night's sleep, a lot better. It's really the cumulative effect of raising your baseline level of functioning. Another way to think about it is these supplements or behaviors and quality nutrition when done consistently over time and that doesn't mean 100% of the time, but probably 80% of the time sure lead to a sort of buoyancy in your system that allows you to be more resilient under conditions where conditions aren't perfect, right? And if conditions are made perfect or close to perfect and you already have that buoyancy, that's when you really start to see the ultra high performance effects that are so much fun. But they have to be established through consistent supplementation, consistent nutritional intake. So today I know we're going to distinguish between normally they're called chronic and acute effects, but that makes it sound like chronic illness. The moment people hear chronic well, they might think of other things, but in the context of health they typically think of chronic illness. And we're not talking about that. What we're talking about is slow modulatory effects in the body. A lot of things in the body take time to build up but once they've built up, they clearly can benefit us. And then other things. As you mentioned, a stimulant for instance, has a very acute effect that is going to occur, peak within 30 minutes and wear off within 4 hours or so can also have some chronic effects but typically it's a short lived effect. So we just want to frame up the language that we'll be using and I'm really excited to dive into this topic and I think Creatine is a beautiful example of a supplement that has positive chronic mental and physical benefits. Down the road I can come back and talk a little bit more about Creatine and we can cover some other information regarding best practices for getting the most out of it, as well as we'll certainly dive into some of the common side effects, or at least a thought of side effects. While we're here, though, I also could throw in a few other of these high impact, low cost, generally safe things that are my 80/20 rule, if you will. So the way I actually kind of think about it is you want one from each of three categories, and these categories are fuel, stimulant and fatigue blockers. So creatine is actually in the fuel. It's not a stimulant as we talked about, it's a chronic effect there, so we've already knocked that one off. Another one from the fatigue blocker is going to be anything like beta alanine or sodium bicarbonate. And then from the stimulant use, of course, we have anything like a beetroot juice to a caffeine or something of the equivalent, so we can come back again and talk about all those in more detail a little bit later. Before we begin, I'd like to emphasize that this podcast is separate from my teaching and research roles at Stanford. It is also separate from Dr. Andy Galpin's teaching and research roles at Cal State Fullerton. It is, however, part of our desire and effort to bring zero cost to consumer information about science and science related tools to the general public. In keeping with that theme, we'd like to thank the sponsors of today's podcast. Our first sponsor is Momentous. Momentous makes supplements of the absolute highest quality. The Huberman Lab Podcast is proud to be partnering with Momentous for several important reasons. First of all, as I mentioned, their supplements are of extremely high quality. Second of all, their supplements are generally in single ingredient formulations. If you're going to develop a supplementation protocol, you're going to want to focus mainly on using single ingredient formulations. With single ingredient formulations, you can devise the most logical and effective and cost effective supplementation regimen for your goals. In addition, Momentous supplements ship internationally, and this is of course important because we realize that many of the Huberman Lab Podcast listeners reside outside the United States. If you'd like to try the various supplements mentioned on the Huberman Lab Podcast, in particular, supplements for hormone health, for sleep optimization, for focus, as well as a number of other things including exercise recovery, you can go to Live Momentous, spelled O-U-S so that's [Livemomentous.com](https://livemomentous.com) Huberman today's episode is also brought

to us by Levels. Levels is a program that lets you see how different foods and activities affect your health by giving you real time feedback on your blood

glucose using a continuous glucose monitor. Many people are aware that their blood sugar, that is, their blood glucose level, is critical for everything from fat loss to muscle gain to healthy cognition and indeed, aging of the brain and body. Most people do not know, however, how different foods and different activities, including exercise or different temperature environments impact their blood glucose levels. And yet blood glucose is exquisitely sensitive to all of those things. I first started using Levels about a year ago as a way to understand how different foods, exercise, and timing of food relative to exercise and quality of sleep at night impact my blood glucose levels. And I've learned a tremendous amount from using Levels. It's taught me when best to eat, what best to eat, when best to exercise, how best to exercise, and how to modulate my entire schedule from work to exercise and even my sleep. So if you're interested in learning more about levels and trying a continuous glucose monitor yourself, go to [levels link slash huberman](#). That's [levels link slash huberman](#). Today's episode is also brought to us by Element. Element is an electrolyte drink that contains the exact ratios of the electrolyte, sodium, magnesium, and potassium to optimize cellular functioning for mental and physical performance. Most people realize that hydration is key. We need to ingest enough fluids in order to feel our best and perform our best. But what most people do not realize is that the proper functioning of our cells and nerve cells, neurons in particular, requires that sodium, magnesium, and potassium be present in the correct ratios. Now, of course, people with pre hypertension and hypertension need to be careful about their sodium intake. But what a lot of people don't realize is that if you drink caffeine, if you exercise, and in particular if you're following a very clean diet that is not a lot of processed foods, which of course is a good thing, chances are you're not getting enough sodium, potassium, and magnesium to optimize mental and physical performance. Element contains a sciencebacked ratio of 1000 milligrams. That's 1 gram of sodium, 200 milligrams of potassium, and 60 milligrams of magnesium and no sugar. If you'd like to try Element, you can go to [drinkelement that's lmmnt.com](#) Huberman to get a free Element sample pack with your purchase. Again, that's [drinkelementlmmnt.com](#) Huberman to claim a free sample pack. To start off, I want to ask you about something that as soon as I say it, some people might roll their eyes or wonder, why are we even talking about that now? But that, I have to believe, is among the more fundamental, if not foundational, aspects of nutrition and supplementation for performance. And that's hydration, right? I mean, I think we hear hydration. It's like, okay, we have to drink six to eight glasses of water every day. Our urine should be relatively clear. If it's too dark yellow, we're not doing a good job of hydrating enough. How much of that is true is alkaline water worthwhile for changing the alkalinity of my body? I learned when I was in college and graduate school that the alkalinity of the different tissues in your body is very well controlled in order to keep you alive, and that you don't want it to shift too much or you can enter pretty horrible states of seizure, vomiting and even death. So tell me about hydration and woven into that, if you would educate me on electrolytes and hydration because I think most often when people ingest electrolytes, sure, they could be ingesting salt tablets, probably getting some electrolytes, by the way. Electrolytes, sodium, magnesium, potassium through their food. I think most people think about drinking electrolytes. So water and electrolytes I think, is a vitally important topic to kick this off with. Sure, we can jump right into your alkaline water. While there is perhaps much to say about this, we can maybe revisit this in another seven part series all on its own. I would just say it this way. There's probably a few things you should do before worrying about the alkalinity of your water. And I'll just leave it at that. Meaning the alkalinity of the water is sort of irrelevant. Not that you won't go that far. It's just it's probably remember we sort of started off talking about 80 20. Well, this would be in my like 99 one in terms of like if we're really at the level of worrying about the PH of your drinking fluid, we have optimized so many other things that then we can talk about it. But until we have nailed months and years of work on other things, this is just not going to make much of an impact. Great. Then perhaps you could tell us about what volume of water we should be drinking when we should be drinking that water relative to training and just generally and anything else related to water and electrolytes that can improve mental performance, physical performance and offset any ill effects. I like the

fact that you mentioned physical and mental performance because it's clear in both cases we hear that we need to drink more water. And I can give you some numbers and I will in a second. What we also need to recognize is this is hormesis. We talked about hormesis a few episodes ago and this is the case, right? Whether we talked about food or hydration or I think I gave you the example of cyanide naturally occurring in your food. Hot water is the same way. So if you are under hydrated or dehydrated, then there is a clear negative effect on your body. And as I increase the level or improve the level of hydration, things get better, whether this are physical performance or whether this is mental performance. In fact, we know that a body weight reduction of as low as 2% via dehydration. So imagine you're doing a bout of exercise and you're sweating and you lose 2% of your body weight. That alone is enough to reduce accuracy and performance. So the classic study we talk about here was in basketball players. So shooting accuracy. So free throw shooting I think is specifically what they looked at. Significant reduction in performance with as little as 2% dehydration at that level, you also see a significant increase in perception of difficulty of exercise. And so only right at 2%, again, when I say 2%, I mean percent body weight lost, right? That's what that means. You start getting the three, four, 5% dehydration, you start having a significant reduction in blood volume, and that's incredibly important for endurance. Your blood becomes viscous, it gets hard to pump through, and you're going to start having all kinds of issues. So being dehydrated is, again, not only going to reduce performance, but because of the mental aspect which we just walked through and neuromuscular issue, you're going to lose accuracy, you're going to lose total endurance performance, and you're going to lose speed and power. So we have the triad there. No matter what you're interested in, it's going to be harmed by being dehydrated. That also is happening then if you're starting your program dehydrated. So if you're already 1% or so dehydrated, maybe you're like a little under hydrated, and then you lose a little bit of sweat. You've already hit that 2%. And so we're starting to see reductions in performance there. The same happens on the other side of that hormetic curve. So if you are optimally hydrated in some large window, but you start going past that, we can start running into equal problems. Remember, there is a need for an optimal concentration of sodium and potassium and chloride between your cell, inside your cell, and outside of your cell. These are electrolytes. This is what we call osmolality. And osmolarity is really what it is. Think of it like concentration and osmosis, if you remember those terms. So if we are trying to create a muscle contraction, that requires an electrical gradient. And so sodium and potassium, specifically in magnesium, calcium are positively charged, and chloride is negatively charged. And we need to have a certain amount inside the cell and outside the cell so that the positives and the negatives are balanced appropriately, so that when we move one, we change the voltage. And we have in the case of a muscle contraction, I just skimmed through a whole lot of physiology there to say if you then go mess with fluid only, and you say, if I were to give you a bolus of three liters of pure water right now, you're going to dilute your blood. And so there's not going to be as many chemical there won't be as many electrical signals in there because you've taken the same amount of sodium, potassium, et cetera, and put it in a larger volume of pure water. So that gradient has now changed. That becomes a significant problem for contraction. I mean, quite literally, it can kill you. This is what we call hyponatremia. So neutremia spelled NA, hypo being low hyponatremia. If you actually go to the periodic chart, NA is what we use for sodium. It's because the word is neutremia, actually. So what that literally means is low sodium. And. You didn't get that from sweating out all your sodium. You actually get hyponatremia from drinking in too much water. So it's not that the total amount of sodium gets low, it's the fact that the concentration gets low from excessive fluid intake. So in the extremes in fact, if you look at the literature, you'll see anywhere between like two to 15% of people who finish endurance races are into hyponatremia. Now, that varies wildly. If you're doing Iron Man and Kona versus like the marathon in Denver in October, it's going to be totally different depending on weather conditions. But these are all important. So while death happens, that is sort of extreme. If

you back up just a little bit, you start seeing the same types of performance decrements. In fact, the symptoms can be identical. Brain fog, confusion,

performance irritation, a GI distress, and you think, man, these are symptoms of dehydration. So then you drink more water and you're just exacerbating the problem. And I can actually give you one little example of this. We had an executive, actually a female CEO. I'll say she probably was in her early forties. And so she came to us and she thought, man, for sure she had some sort of gut problem going on because we hear a lot about kind of like gut health and how it affects everything. And so she's just like, I have brain fog and I've done all these things and I got blood work done and everything's fine. Like nothing's going on. I think I must have some sort of gut thinger going on or whatever. Okay. And we just started going through her stuff and she was, I think, about 170 pounds plus or minus, and she was consuming like 250 to 600oz of water a day. That's a ton of water. And we were like, holy shit, what are you doing this for? And she says, that's sort of like my thing. But she didn't realize it was more of like a nervous tick than it was anything else, right? She just like, sip, sip, sip, sip, sip water. I'm like, man, how often do you go pee? And she's like, yeah, like every 30 minutes or something. I'm like, fantastic. Sleep problems. Focus. And so she's smashing caffeine. She was at like eight cups of coffee a day, which is also going to add to excretion of sodium. Totally, right? So it's like, okay, we don't really need to come in and run a sleep study on you. We're just going to lower your water. And she was like, what? We dropped her down to like 180. So basically an ounce per pound of body weight, which is still high because she did train 180oz. Correct. She does work out. So she needed to replenish some stuff. And we'll cover these numbers in a second instantaneously. I mean, like two days in she's like, oh my God, I haven't slept six straight hours in years. And then after that, it was like basically tears coming back to us, right? My focus, my brain fog is gone because she's in a very high pressure job. It's like everything's coming back now. She was down to three or so cups of coffee a day, blah, blah, blah. Like the whole thing digestion improved, all of it. Her only problem after all the analyses was she was just drinking way too much water. And adding more salt to her would not have solved the problem because she would have just had simply way too much fluid in her system. She was having all kinds of ADH problems and Aldosterone like the whole thing, and then that rolls into cortisol. The whole system goes into chaos. So it is important that you pay attention hydration, even though, as you sort of mentioned, people tend to just kind of like roll their eyes around it, because if you're in the middle, it's fine. But if you're anywhere past not even the extreme extremes, but just that first standard deviation away, you're going to have problems and you might be thinking adrenal fatigue. You might be thinking your testosterone. You're going to think all these things, and you simply just haven't actually dialed in your hydration. Yeah, I think people sometimes roll their eyes at the discussion of hydration because it just doesn't sound very sexy. It doesn't sound like a neurotransmitter or a hormone. It doesn't sound like testosterone or estrogen or DHEA or dopamine. But it actually is all of those things. It sits at a level beneath all of those, but not beneath on a hierarchy, beneath in terms of a foundation, it's actually the without proper electrolyte balance and hydration, none of the cells of the body can function. And then I think people also hear that, oh, we are 70% water, and somehow that statistic alone, or that fact alone, doesn't seem to stimulate any kind of actionable takeaway, right? It's like great gravity also keeps us from jumping as high as we like. What do I do? And so I think it's important that people understand that every cellular process in the body critically relies on having enough sodium, magnesium, potassium around. And the way that it's concentrated in fluid water is really the way that you allow every cell in your body to function as well as it possibly could and respond to all the sorts of kind of quote unquote high performance tools that we're talking about. The other thing I've observed many times over is that if people are ingesting too much water and also drinking a lot of caffeine and their electrolytes are low, they get shaky and they actually can have anxiety like symptoms. When people come into my lab to do studies on anxiety and fear, we ask a few questions, and those questions include how much water they've had that day. Also a sort of bizarre fact, but one that I think is worth mentioning is that when the bladder is full, it stimulates a sort of anxiety. If you ever had to urinate very badly and you're in the car, or you can't urinate and then you get to the door, talk about anxiety. And that's because there's a direct neural pathway from the bladder

that registers the mechanosensors, how much stretch there is on the bladder that sends a signal to the brain stem alertness areas, broadly speaking, locus, ceruleus, and others that wake us up. These are the when we're awake, it makes us more awake. And when we're asleep, this is what wakes us up to urinate in the middle of the night. Yeah, that's actually why you can use night urination as a pretty good diagnostic of sleep disorders. Because of vasopressin. Right? Exactly what you're talking about. If you're having sleep disorder issues and you're staying awake and a vasopressin gets taken off, right, an APN goes straight to the kidneys. Your kidneys are supposed to be dormant, basically, at night. You're not supposed to be filtering a lot of and producing a lot of urine at night. If that's happening, and say you have any number of apneas kicking on or anything going on, vasopressin keeps going, keeps sending a signal, kidneys start filtering. So if you're waking up and peeing multiple times a night, that's called nocturia. That is a very, very good sign that either one of two things happen. One, you have some sort of sleep disorder, or two, you're drinking outrageous amounts of water. And so that's actually a bit of a backward cycle now, right? Because you're drinking way too much water, you're waking up and peeing all night. That's actually ruining your sleep. And so we have seen this a number of times with our sleep company as we go in, and it's just like, you don't need any of this crap. You just need to be properly hydrated. Alternatively, if your hydration is sound and you're still waking up more than one time a night to pee, on average, then you almost well, I shouldn't say like that, but there's a potential that you actually have some sort of sleep disorder or sleep condition going in. So the rule of thumb on that, just so we're here once or night, once a night or so of urination is fine. If it is routinely or consistently more than two, you need to make some adjustments. Start with hydration. It's the simplest way, right, getting a full sleep study done. Just figure out hydration. We've had this happen a number of times where people want to get more health conscious, and they hear things like this, and they're like, I got to get in my water, and then they just start train wrecking their sleep and they're waking it up. So if you're waking up multiple times and you're urinating, and it is a large amount of urine for you, and it is clear that's probably not sleep apnea induced. Nocturia, that's probably excessive hydration. If you're waking up a bunch of times and it's fairly small amounts of urine, then it's probably not the fluid issue. It's probably the fact that the vasopressin is kicking your kidneys into gear. So that's not a perfect criteria, but it's just like a quick little tool you can sort of use. That's actually one of the reasons why we measure almost always your body weight at night as well as in the morning. So that's like the combat sport in the UFC fighters, boxers, we call that your float. So how much you floated overnight? I like to know that number because I want to know as well. Your first morning void. So when you wake up and you went to bed at 200 pounds, you woke up the next morning at 195. Oh, you floated five pounds. Did you pee last night? Yeah, three times. Interesting. In other case, you woke up, you went to bed at 200 pounds, you wake up at 199.5. Okay. You're dehydrated because you should have a certain amount of fluid that you're just respirating out as you're breathing throughout your nose, throughout night. Ideally, guaranteed, you're going to wake up. What was your urine like? Oh, yeah, a little bit pretty dark, like shocker. You're dehydrated. So you can kind of look at numbers like that. A general float is something like a pound to two pounds for the 170 plus pound person. As you scale up, that number can go up a little bit, but you can kind of use these to triage a little bit about what's going on. With this kind of combination, everything is everything, right? So it's like it's not just about one system. So you're going to pay attention. You can also look, if you want to jump into it, we can, but there's a whole bunch of ways I can teach you to diagnose hydration, and then maybe we can start there, and then we could talk about hydration numbers. Yes, I'd love to talk about diagnostics for hydration overhydration dehydration. To start off, would you be willing to give us some numbers? How much water should we be drinking? The classic rule here, and you're making me do what I hate, right? I want to give all the caveats first, but I'll go straight to your number. Half an ounce per pound of body weight is a rough rule. So

if you weigh, again, 200 pounds, that would mean you drink 100oz of water a day. Most water bottles are like twelve to 20oz, something like that. So you end up drinking six of those or so a day. Kind of like plus or minus, which is not

that unreasonable. This does depend on a number of factors, which I could go over, but that is a rough starting place. The only other thing to add to that is that does not account for exercise induced water loss or sauna or anything like that. So that's assuming, just like basal daily needs, if you are exercising or sweating at all for any reasons or work related. So folks that work outside or in the heat or a humid environment, these numbers all change. And you can slide this scale up, but you generally want to drink about 125% of the fluids you've lost during that physical activity back. And how much do you lose per hour of exercise? That number ranges between one to five pounds, depending on the person. It can even be higher with some of our athletes. Like, I can think of a number of NFL players right now. It's not uncommon for those guys to do eight or nine pounds even. Not even, like, crazy circumstances. If it's August and we're in Jacksonville, it's not wild for us, those guys, to go 910 pounds. But what about the typical person who goes to an air conditioned gym or goes out for a run on a day that is somewhere between, let's say, 55 degrees Fahrenheit and 85 degrees Fahrenheit, you're probably looking at like a pound. Got it. It's not extremely high if you are totally soaked. Might be like a pound and a half to two pounds. If you come back and your pits are a little sweaty and there's a little bit of water kind of on your neckline, it's probably more like a pound or so. So in that case, you might drink back a pound and a half of water. Okay, so just to review these numbers to make sure that I'm on the correct page here, a half an ounce of fluid per pound of body weight is sort of a foundation for hydration. And then you want to replace 125% of the fluid lost during exercise. And exercise varies where exercise is done, varies whether or not people are wearing uniforms or helmets is going to impact how much fluid they lose, et cetera. In a very hot environment, the amount of fluid lost can be anywhere from one to five, maybe even ten pounds easy per hour of hard exertion. For most exercise done in conditions of 55 degrees Fahrenheit to 85 degrees Fahrenheit done with some degree of effort, one might lose a pound or two pounds of water. Super easy way to find out. All you have to do is weigh yourself naked, go do your workout, come back in, dry off, weigh yourself naked. That'll tell you exactly what you lost. So if you went in, you were 160 pounds, you come back out, you weigh you 158, you lost two pounds. Drink back two and a half pounds of water, you're good. Honestly, it's like fairly gold standard for identifying. You can actually buy a whole bunch of technology for this, and they are using the exact same equation, which is your body weight when you were there. Now, if you do that, though, you do need to account for any fluid you drank during the workout. Sure, because that then offsets it. Simple. But I think important question we're talking about a half an ounce of fluid per pound of body weight. Does that include things like coffee, tea, soda, pre workout drinks? Mid workout drinks, mate, matcha, whatever. There's a yerba, mate. There are a million things out there. Or just water. Any fluid, for the most part is going to count. And is it true that fluids that contain caffeine generally cause us to secrete sodium? Yeah. Okay, so do you recommend including electrolyte powder or a small pinch of sodium or any number of other supplement type electrolytes that can replace that sodium, magnesium and potassium? A couple of things we have to pay attention to to accurately answer that question. What you also sort of asked about, you may have not realized is, does caffeine actually enhance dehydration, which is not really what you asked, but it's probably a lot of people thought that as well. So caffeine can, but coffee doesn't necessarily do that because, remember, you're co ingesting that with fluid. And so we used to say that all the time. Coffee dehydrates you. It doesn't it might make your urine yellow and certainly gives off an odor in your urine, but in general, coffee will not do that because you're ingesting. If you were to now be taking caffeine pills alone, now, there is a bit of a diuretic effect there, and so you're going to urinate how much? Maybe not enough for you to be really concerned with, especially when you balance that against the ergogenic effects and benefits of caffeine. It's not something we are concerned about. Second part of your question, do you need to then offset the loss of sodium? I'm not super concerned about the amount of sodium lost to caffeine. I am more concerned about simply the amount of sodium being correct because of the bigger circumstances, like how much is actually in your system and how much you lost in the training session. So it's not the caffeine that I care about that much relative to if you lost 3 grams of sodium because of the training and you added another few milligrams

because of the caffeine, I don't really care or didn't. I'm glad you brought up the difference between a substance like caffeine and the vehicle it's contained in, like coffee. This is all really important. And it also raises a question about individual differences in sweating ability. And I call it sweating ability because I have a good friend I've known for ages, really actually work with him in my laboratory as well. And he's one of these people that the moment he starts any physical activity, it's like a flood warning, right? He just soaks through clothing. The sweating adaptation is exceedingly robust in him. Other people less so. So is it true that sweating and our ability to dump heat through it by loss of water is something that we tend to vary on and that also that we can build up that capacity? I know a number of people are probably thinking, EW, gross, why would I want to sweat more? But there's actually a huge advantage to be able to dump body heat during exertion because body heat in some ways sets the cap for performance in many, many ways, including mental performance. Our ability to stay alert often is enhanced by it being cold. And of course, we all want to warm up properly. But in terms of loss of fluid through sweating, is there a way to easily bin ourselves into kind of a low sweater, medium sweater, heavy sweater? That sounds like an article of clothing. But in any case man, another a lot to say here. Wish we had a whole series on this. Listen, if we have to go 17 hours, we can do it. Just everybody hydrate. Well, I think we've shown the listeners that is a real threat. That's a very real threat. Podcasting to failure. You don't have to do every set in the gym to failure, but here we are attempting a podcast to failure. In all seriousness, what is the role of sweating ability? And is this something that any of us should care about or train for or pay attention to or is this just kind of getting into the arcane? Number one, you can train your ability to sweat. This is important for heat acclimation and why that matters. When you sweat, that actually is not what regulates your temperature. What you want to have happen is the fluid to hit your skin and that to be evaporated. That's the actual mechanism. So in fact, if you stop sweating, you can guarantee within a short amount of time you're going to be done moving. Oh, very interesting. I hope people heard that and really are highlighting that in their mind that sweating is a process of bringing fluid from your body onto the surface of your skin. And then the heat dumping aspect of sweating is the evaporation of that off your body, which brings to mind all sorts of ideas about how to dress during exercise, et cetera. But what you said is that if you are not sweating enough, you are limiting your output capacity. So it's not just about having enough fluid to sweat. It's also about being able to sweat and being dressed appropriately to allow that sweat to move to evaporate off your body. Yes, and heat acclimation training is as simple as it sounds. So just practice it more. So if you're going into a process where you either need to be in a hot environment or you need to improve your sweat rate, you just need to practice sweating and your body will get better. Practice a sauna, practice a jacuzzi, just get in those things and you will improve your ability to do that. Now, there is a huge genetic component. I have one individual, actually a UFC fighter I've been working with, and I don't mind mentioning his name, he'll give me full permission. Scott Holtzman. Many, many years. He's actually fighting right now. Actually, today he'll be is, like you described, like buckets and buckets and buckets of fluids come off. This guy, when he's tying issues, he just goes, right. And we've improved that. I actually sweat too much. We worked on that a lot early in his career, and we got some improvements down to get him to hold on to fluids better. That being said, I've worked at the other individual in his weight category, and it's the opposite, right? So we can have them literally do the exact same training session together. And Scout will dump six pounds, and other folks at his size will dump two, two and a half. So there's a genetic component that is just there, and you don't need to worry about it there. So can you identify if you are a heavy salt sweater or not? Well, you have a whole bunch of routes for this. Number one is you can use the old free, cost free test of just looking at your clothing, and if you're seeing that white residue all over it. So you all have the friend who probably wears that same

baseball hat that they've had for eight years. If it is covered in the white junk all over the place, that's a sign of a higher salt sweater. If the opposite happens, and it's like you can pull their clothing back and there's just nothing there, they are maybe a little bit of a lower salt sweater. You can also use any

number of hydration tests. I know that there is some coming out in the market very soon that can give you theoretically, real time measurements, just like a CGM would be. Although I haven't seen any data on if those are accurate or not. I haven't used one yet. But there are a number that are out super cheap, 10, 15, 20 blocks, all the way up to a couple of \$100, where you can buy these patches, put them on you, and get a reasonably close estimate it. And again, if those things are five or ten or 20% off, I don't know. We have to see independent data come out first. But even if they are, you're not worried about the specific milligrams, right? Whether you sweat out 1250 milligrams, it'll work out, or if it's 1340, it doesn't really matter. You're trying to look for big numbers, right? Are you losing 500 milligrams using three and a half grams where you're at? So those things will get you in a ballpark to do exactly what you just said. Am I high, medium, or low? And there's a lot of them that I've used in the past, so that's another way to go about it. Then what you want to do is probably match your electrolyte intake to something close to what you sweat. That's the ideal scenario. You can get a lot of information about hydration from blood. You can look at, like, acute markers of dehydration, like hemoglobin. Hematocrite, if your hemoglobin is like 15 plus. It's funny, we've talked about this in a few episodes before, but I see that and I'm like, man, that dude's super fit. Like a 15 for hemoglobin would be pretty high. 14 or so would be pretty good for a female. That's also the exact same thing as a sign of acute dehydration. So hematocrite, same thing. If you're north of 50%, you're probably dehydrated, so you can get a lot. There are also, though, a lot of biomarkers that can tell you more about chronic dehydration so you can run through those things as well. So a good blood chemistry test can tell you a lot and you can actually get some insights in your sodium and potassium albumin is another fantastic way to measure longer term hydration status. Another one of these amazing globulins that we've sort of talked a lot about. So you can do all those things. You can also simply measure the body weight pre and post and use a sweat patch or not, and use the freer version of your clothing test and get a rough idea of where you're getting it from. So those are good places to start. I want to go back though and make sure I wasn't over terrifying the audience too much on a silver piece. If you're performing a type of training or exercise or sport in which you're not losing more than 2% of your body weight, you don't need to be overly concerned about hydrating in the sport. And so we can actually get into some equations for how much water to drink during training right now. But if you're again losing less than that, it's not critical. You can have some fluids if it makes you feel better, but you're not going to be experiencing tremendous amounts of performance sacraments. If you're again out playing a baseball game and it's 50 degrees out, you're fine. You can drink some water, but that's not going to be compromising performance or recovery. So we can actually then, if you'd like, I can go through the three step system for optimizing hydration, but I want to make sure I planted that flag so people aren't just terrified that they got to be guzzling down water if they're going to their physical therapist for some stretching. That's probably not super important. I'd like to take a brief break and acknowledge our sponsor, Athletic Greens. Athletic Greens is a vitamin, mineral, probiotic, and adaptogen drink designed to help you meet all of your foundational nutritional needs. I've been taking Athletic Greens daily since 2012, so I'm delighted that they're a sponsor of this podcast. The reason I started taking Athletic Greens and the reason I still take Athletic Greens once or twice a day, is that it helps me meet all of my foundational nutritional needs. That is, it covers my vitamins, my minerals, and the probiotics are especially important to me. Athletic Greens also contains adaptogens, which are critical for recovering from stress, from exercise, from work, or just general life. If you'd like to try Athletic Greens, you can go to [Athleticgreens.com](https://athleticgreens.com) Huberman to claim a special offer. They'll give you five free travel packs, and they'll give you a year supply of vitamin D, three K, two. Again, if you'd like to try Athletic greens, go to [Athleticgreens.com](https://athleticgreens.com) Huberman to claim the special offer. I would love for you to tell us what I refer to as the Galpin Equation. Understanding, of course, that you did not name it the Galpin Equation. Listen, folks, scientists can have things named after them, but in general, it's not reflective of healthy psychology if they name things after themselves, correct? Sometimes, yes. Neuroanatomists used to do that. But in any case, Dr. Andy Galpin did not name the Galpin equation after himself. I named it after him. And

the Galpin equation for how much fluid to ingest during exercise is you want to take your body weight in pounds and divide that by 30, and you want to consume that number, which would be in ounces about every 15 to 20 minutes. So in the example of you being 200 pounds, you would take 200 divided by 30, which is let's just call that number seven to be close, which means you would consume about 7oz of water every 15 or 20 minutes or so. Now, as a little bit of a point, while I also did not name it, I also didn't do the research. It's important to point out that other scientists figured these things out. I just read their papers and made that derivation of their equation to make it a little bit easier for us folks who do not work on the metric system. Okay, a couple of things. First of all, I'm not 200 pounds, but it doesn't matter how much I weigh, because the point is that the listener correct. Should take their body weight in pounds divided by 30 and just that number of ounces in fluid every 15 minutes. And then for those out there outside the US. That are accustomed to thinking in milliliters and liters, not ounces and kilograms, not pounds, what is the Galpin Equation? In the metric system, this would be 2 ML/kg, which, again, if you were, let's say, 200 pounds, that's going to be something roughly like we'll call it 90 kilos. And so if you did 2, you'd be something like 180 fluid again every 15 or 20 minutes. Great. And how should people ingest that fluid? And of course, I would imagine it's through their mouth. I hope there are other orifices that might suffice, but let's not go there. They're drinking that water consistently, or is it every 15 minutes? They slug it back. Does it matter? Okay, yeah, that's very good. A handful of things. In general, when you talk hydration, the slower and steady you can go, the better. In fact, the reason this 2 ML/kg number came out. Is because a number of trials were run when they looked at that every 15 minutes, just one bolus of it in different variations. And it is pretty clear that the slower pace one could do it, the better. So whether you're doing it every ten minutes or 15 or 20 minutes, the reason we actually give that gap is because you have to be also offset a little bit of GI distress. In fact, like kind of the four golden rules of recovery, if you will. We use sort of three R's. You need to rebuild, rehydrate, and replenish. What that really means is you need to have a continuous glucose stream, you need to have a continuous amino acid stream, you need to hydrate, and you need to do all one, two, and three without disturbing your gut too much. And so in this particular case, it was sort of found that we can hit that level in general and be just fine for most people. So, I mean, a little bit of context. The example we gave there, in both cases, it's something like six to 7oz for 15 or 20 minutes. If you think about that, there's 16oz in a pound. And most water bottles, like, if you go buy a water bottle at a store here, they generally come in like 16 ounce bottles ish. So six or 7oz is really like a third of a water bottle, maybe every 15 or 20 or so minutes. So it's not some egregious amount of water that you have to slam down. Now that is influenced heavily by how hydrated you started the session with. So how hydrated you came in external factors like heat, humidity, temperature, things like that. But that gives you a rough idea again. And these are numbers that you would need to consume to optimize performance. At the end of that then, is when you would look to see how much I lost, like we talked about earlier, and then add back that 125%, taking into account how much fluid you ingested. So if you're 200 pounds and you drank a total of, say, a pound of water during the training, and you started off at 200 and you finished at 198, you actually lost three pounds. Not two pounds, because you lost three. You drank one during it. So your final net number is two. So now you really need to drink back 125% of that remaining two pounds, two and a half pounds, something like that. These numbers, especially that 125, are they're just rough guidelines? Some actually papers suggest it's all the way up to 150%. So it's just like an idea. Don't measure out whether you need 5.5oz or 6.2oz. It just sort of gives you an idea of where to start. All right, a few sips every 15 or 20 minutes is close enough. I've actually started using the Galpin equation to determine how much fluid I need for mental work. Given the now robust data

that are out there on the relationship between hydration and mental work. It's been very effective for me. And again, there are peer reviewed studies that support the idea that hydration is important for proper mental clarity and energy and focus, and that even being slightly dehydrated can disrupt that. But if one is drinking so much water that they're frequently going to the restroom

and can't comfortably focus on the work they're doing, that's also an issue. So that's very helpful. What are the three most critical features of hydration? And then I'd like to move on to some of the more particulars about supplementation and nutrition. Three parts, start hydrated, maintain hydration throughout. Part three is hydrate post. To fix it, okay, we gave you the half ounce per pound of body weight equation. So you start the training hydrated. We gave you the 2 weight divided by 30 to stay hydrated, and we gave you the 125 percent. But I can actually just give you sort of I'm giving you another list here. I'm sorry, but it is my five step cheater guide for optimizing hydration for performance. All right, step number one, drink a lot of water first thing in the morning. This gets everything. Kickstarter gets you going. It also saves you from having to drink a bunch of water at night, which is then going to compromise your sleep. What's? A lot, depending on how big you are. The general thing I'll tell people is one of the very first things you should do throughout your day. You wake up, go to the bathroom as you're consuming your sunlight, consume water. This is maybe chugging a full glass. It's honestly what I do. It's not the best route, but I'll just get back 16oz. 16oz or so is great. It's fine if you're larger. I'm 165 to 70 pounds, depending on what's going on. Maybe a little higher sometimes. If you're 225 pounds, maybe that number is 30oz. So you just sort of scale up and down. And the only reason I say a lot is it just depends on what you're doing. And I also should clarify, I don't really literally mean chug, just like sips, because the faster you drink water, the faster it's going to expand blood volume. The faster it expands blood volume, the faster you get rid of it. I don't think a lot of people know that. Yeah, maybe this is clarifying. We sort of talked about earlier. If you drink too much water, you'll dilute the system. Well, if you have a diluted system, your body's first reaction is to rid of water to bring total blood volume down. Right? Remember if you were to go to a doctor and they looked at your total blood volume, and they're like, man, you're at five and a half liters. You're going to be like, holy crap. You're going to be put on a diuretic because you don't want to have a heart attack and have blood pressure. I wonder if people are drinking a 16 ounce glass of water or other fluid all at once before going to sleep, and that's why they're waking up in the middle of the night. Totally. Given what you just said, probably a better protocol would be to sip on a glass of water in the final hour or 2 hours before sleep. Generally the number we say is 3 hours in the 3 hours preceding sleep. You want to basically limit fluid intake to sipping as needed. I'm going to start that tonight because I wake up generally once per night to use the bathroom, and I do drink some fluids before I go to sleep, mostly because I'm pretty thirsty at that time. But I'm going to start sipping that water in the 3 hours heading into sleep. Yeah. So you can actually pay attention to is to go back. I love doing this stuff, but if you're waking up at night and you have a very dry mouth not for me, all right, because it can be one of two things. You might actually be dehydrated. And so then the mistake people make is they're like, man, my mouth is so dry, I keep getting up to drink water at night. That makes you then pee too much. What that also indicates is probably your mouth breathing. So a lot of ways to fix people waking up and urinating too much at night is to tape your mouth and or use a dilator over your nose. And then what happens is you don't feel like you have a dry mouth, so you don't get up to consume any extra water throughout the night. So that actually reduces your fluid intake. So you don't have the problem of actually now having too much fluid to do it. And so it's another reasons why mouth taping can really help. If you are having those issues and or snoring, those are not benign, you really should get some work on those. Something you're not sleeping very well is the way I'll say it. It doesn't necessarily mean something life threatening, but it's not a good thing. So you're going to run kind of your triaging things back and forth. So if you're like, I'm waking up to pee a lot, but my mouth isn't thirsty. Okay, great. Then you may actually have just a water consumption issue. If it is my mouth is dry, but I'm actually waking up and having these large urinations, then you're not actually dehydrated. You're just breathing through your mouth. If you're waking up and your mouth is dry and there's not a lot of pee there, then you actually might actually legitimately be under hydrated. So a little bit of a game you can play there. Well, that's super informative. I think that the point alone that gulping a bunch of water all at once is going to cause you to need to excrete that water soon after is a really important point. Also

for people that are going to give a talk, or you don't want to have to get up to use the restroom. You have to sit through a long meeting. Clearly, I'm violating all these rules. Up until right now. I'd sort of follow the seagull approach to consuming fluids just in enormous volumes. I'm going to start sipping fluids instead. What are some of the other rules of hydration? So you're going to wake up, you're going to start your day and start hydrated. So you're consuming a larger percentage of your water earlier in the day. Then you get all the performance enhancing effects of water, and you don't have to worry about it compromising your sleep. So that's step number one. Also, now you're going to start your session closer to hydration. All right, great. Number two, eat mostly real, whole foods. Why? Interesting, what you may or not have thought about is a huge determinant of your hydration status is your food choices. If you look at different foods, for example, most fruit watermelon, watermelon is like 95 plus percent water. Fantastic source. Also, by the way, since we're here, it is not extremely high in carbohydrate. It's not extremely high in sugar. It is by percentage. But since it is almost exclusively water you're eating, it is not something that is extremely dangerous. In terms of sugar. There alone, probably of all the things we've talked about in the six episodes, that comment right there will probably blow the Internet to pieces, and I'll probably get hate mail for life for it, but from people throwing sugar water. Throwing watermelons, yeah. Oh my gosh. Well, I don't think the point is that sugar is necessarily bad. I think the point is that for most people, they're ingesting too much sugar. Most people. And it's interesting, oftentimes the people who are justifying the ingestion of sugar are exactly the kind of people that should not ingest so much sugar. So there's a little bit of a well user bias. The point here is if you're eating whole, real food, this is like now we're kind of splitting hairs about those things. So morning hydration consume real food. Yeah. Now, important point here, if you compare it to other foods, like actually meat is a very high percentage of fluid. Depending on how well or long you've cooked it, you will reduce it. Remember you said earlier over 70% water, right. So if you're eating meat, you're getting actually a big chunk of water as you cook it. Of course, you lose some of that. But meat can be like I wouldn't call it a hydrating food item, but it is not as low as something like a biscuit, which can be actually like 10% water. That's why it's like dry and dense, which doesn't mean it's bad for you. But there if you're eating highly processed foods, almost by association, that means they've been dehydrated or partially. Right. So you're just getting less total fluid intake. In addition, they have also been highly salted in general, right? So now we're in this position where we're under hydrated and highly salted. Bad spot. If you now switch over to mostly, again, just mostly whole real food ish whatever that means to you, then your hydration is going to skyrocket. You're going to have a lot. So you're eating a ton of food. In fact, it should be a large percentage of the fluid intake you have actually should be coming from your food. And you shouldn't have to be smashing water bottles after water bottle all day. In that case, though, you do need to add salt back. So we do see this a lot with people who try to make a transition from maybe a suboptimal nutritional lifestyle, and they give up a little bit of the processed food and they come over and they start having problems because they're not actually consuming enough salt. So add that back. Easy way to do that. You can use electrolytes, and we could talk about those numbers if you want. If you just salt your food that you're making to taste, that's going to get most people in a pretty good spot. So start hydrated, consume hydrating foods. Step number two. Step number three, you want to prehydrate. If you know you're going to do a workout session and it's going to be hot and long or one of those things, you want to look for that half a pound per body weight of ounces. So that's the number we're looking for to start our hydration session. We do that, we're pretty much taken care of. And then, like I said, adjust. Depending on lifestyle, humidity, and other factors like that, you can use what is called the

what system. Wut I think Bob Kennefick, who's done a ton of research in this area, if you want to read more, look up his research. It is simply weight, urine, and thirst. So in other words, check your body weight, look at your urine color, and gauge your thirst. And actually you can use those three things, and those can significantly predict actual hydration status independent of actually measuring osmology or anything like that. So those three metrics alone are a

pretty good indicator of where you're at. So you're going to have that normal amount of water plus or minus. If you miss that number, for whatever reason, you get distracted. The number we typically tell people is like something like 400 to 500 water in the hour preceding the training. All right, so that's like 13 to 20oz. So like, you know you're going to go work out at 03:00. It's 02:00 and you realize, oh man, I have not drank as much water today. You don't need to go smash tons and tons and tons. Just look for something like that. Call it a bottle of water, if you will. If that's not enough, if you're in a really tough spot, you can do more like five to 8oz, 15, or 20 minutes before exercise. You want to be really careful about drinking a bunch of water like in the seconds before exercise, because you're just going to feel a whole bunch of water bouncing up and down in your stomach. And nobody likes that. So one to 300 or so 20 minutes before that assumes you're in this like 185 pound range ish, again, if you're talking people of much larger size, you may need to increase those values accordingly. If you do all that, then you use the gallup and equation for your intra workout hydration and you're in a pretty good spot. What you want to consume in that is what I call sweat. What I mean by that is you don't actually want to necessarily consume water only during a workout. You want to consume something that is ISO osmotic to your blood. So something that is the same concentration that you lost in your sweat. So if you've done a sweat test, you would then drink a fluid that is of the same osmology. The short version of that, something in the neighborhood of 200 to 400 milligrams of sodium. Most electrolytes products are going to be something like that. Now I know element is 1000 milligrams and it's a lot higher. But most products now that you're going to find are 250 to 400 milligrams and they're typically in the like two to maybe up to three to one sodium to potassium range. Right. Coconut water is actually cool. It's like basically the opposite. Like a cup of coconut water I think has something like 200 milligrams of sodium but like 600 milligrams of potassium. So like total spoiler alert, but will we use coconut water? A lot of hydration. Just add little pinch of salt because that'll bring the sodium way back up. Yeah. One note about sodium. Obviously people who have pre hypertension or hypertension want to be careful with their sodium intake. Anytime. I've suggested that people might consider ingesting more sodium, it's like putting a target on your back. And yet the data are pretty good showing that if people are not getting enough sodium, their mental clarity, their focus, their mental stamina, their physical stamina really suffers. And then people argue, well, most of us are getting too much salt. That often is true for people that are eating a lot of processed foods and not training. And not training. But for many people who are already sort of health conscious who are training, they're largely consuming, or I should say they're consuming largely non processed or minimally processed foods. And especially for folks who are not ingesting many carbohydrates and are consuming caffeine. Totally. A lot of people don't know that carbohydrates hold water. And that makes it sound bad. It's not necessarily that you're going to get subcutaneous swelling of your body. It's recovery. It's bringing water into your system and it holds water. So when you drop carbohydrate, starches in particular, you urinate a lot more. And when you drink caffeine, you also urinate a lot more, as you pointed out earlier. So you start combining a few things like slightly lower carbohydrate or low carbohydrate eating, really quote unquote, clean. You're not getting a lot of salt in your food and drinking caffeine and then exercising. And then pretty soon those numbers that come along with a gram of sodium in your electrolyte drink are not all that outrageous. And what you find is people feel much, much better when they're getting enough sodium. And of course, I should say that there's no reason why someone has to ingest a supplement like element or something. There are plenty of other ways to bring sodium into your system. You use a pinch of pink salt or Himalayan salt or sea salt, or even just table salt in water, or just making sure that you're salting your food enough. And I think that there too, salt appetite and salt taste is a pretty good guide. If you taste something and it tastes really salty to you, that's an indication that either it's really salty or your salt stores are kind of tapped off you're. Okay. Whereas if you're craving salt and you're thinking, gosh, I really want to put salt on this already salty thing, not necessarily, but oftentimes that means that you are salt deficient. So salt appetite is a pretty hardwired set of neural circuits and hormones. And I think we would all be wise to learn to tap into our kind of

intuition about salt intake. But of course, also to measure your blood pressure, et cetera. Yeah, of course, if you think you have some sort of contraindication there that work with a medical specialist, without question, those situations you laid out, though, were very real. A lot of people are living like that. And so it's important for those folks to understand if you are going through symptoms, fatigue, lack of focus, cognitive function, performance isn't there, then hey, you may be under salted. And again, actually a good amount of blood chemistry work can unravel that a lot, and it can sort of tell you if you're running out of whack. There are a number of folks who are extremely sensitive to sodium in terms of health risk, and that is a real thing. Again, work with your individual folks on that. I don't work with anyone for disease treatment or management at all. I've said that probably four times. I'll say it six more times. I only take people who are healthy and try to make them perform at their best possible level. So it's actually funny you mentioned that because I was going to give people my recommendation for sodium intake in general throughout the day. And then I decided I'm not going to say that because all it's going to do is make all the rest of the people who aren't coming to come after me for the watermelon comment come after me for that. By the end of today's episode. The goal is that everyone's coming after you, but also that everyone has learned something of value. You've already given us tremendous insights and actionable information on creatine and hydration. And along those lines, I'd love for you to tell us about some of the things that we can do with supplementation in order to enhance training by taking certain things before we train. And I also have the question of how long before training should we start thinking about supplying nutrients and supplements for the training session? I'm not sure I actually finished my fiber. Maybe I wasn't clear enough about the last one. So I just want to tie that bow and then we'll go to your next one. Yeah, no, it was probably my fault. So in addition to the Galpin equation in terms of amount I ran, I recommended roughly three to one sodium to potassium recommendation, and I gave you some rough numbers for things to look at. I actually, in all honesty, use probably six to ten different electrolyte companies, depending on the situation. Some of them are really good in the case, again, like Element that's nice about that is there's no carbohydrate. However, the downside is there's no carbohydrate. So sometimes I want carbohydrates in the training because, as you mentioned, there's significant evidence going back actually several decades on the benefit of carbohydrate during exercise. So if you're in a situation where you're trying to again maximize actual exercise performance, especially if it is either a long duration so more than 2 hours, or extremely high intensity. And this has to be well north of 100% of your go to max in that situation, as we talked about in the Endurance episode, you can actually start having a decrement in performance because of a drop of muscle. Glycogen glycol glycogen can start coming down. If that's the case, augmenting with the carbohydrates during the training, then is going to enhance performance. It's going to do what we call spare the liver, and it's going to keep my second rule of my four, which is maintain glucose ingestion. It's going to keep that going. In general, what you're going to find is the number is like a five to 9% glucose concentration in your fluid, which turns out to be like exactly the number that most sports drinks have, as well as I think that's pretty much exactly what coconut water is. The downside of sports drinks, since we're here, is they actually tend to be under salted and so that they don't provide enough of them. If you look at the numbers, they're going to say something like 60 to 100 grams of carbohydrate per hour is the target. And now if you're using the sort of Galpin equation and you're splitting that up into 15 minutes intervals, it's something, again, like 20 or so grams of carbs per 15 to 20 minutes if you're doing, again, an hour long plus training valve. So admittedly, 100 grams is a bit much for some folks, depending on your size. So I would recommend starting in that 60 grams or so range again per hour. Total is

what you want to get to, and only in a situation in which muscle glycogen depletion is becoming a limiting factor to performance. So the other benefit of that is, as you mentioned, that actually drives water into the cell. And so you're going to be in that nice sweet spot of you're actually keeping glucose going, which is going to enhance performance, and you're helping hydration at the same time. So the other little part that's important to pay attention to here is the type of carbohydrate matters. So you can use actually a whole

combination of things called resistant starches, which I will use for a long bouts of exercise. But in the middle of the workout, you're going to want to focus on glucose and fructose, mostly glucose, typically at least a two or three to one ratio of glucose to fructose. And the reason is those actually get into tissue through separate transporters. And so what happens is once the glucose transporters get full, you can't bring anything else in. However, since fructose comes in a separate route, you can maximize total carbohydrate intake by using two different unique forms. There's a lot of ways you can do this, but this is where the momentous fuel product specifically has that exactly in it. So it's fantastic. You can use food, no problem. You can use a combination of things like honey and different, easily absorbable and usable and things that you can actually maybe put in a drink to get away with. So there's lots of routes for it, but you want to look in that sort of combination of five to 9%, roughly glucose for there. So you do need to train your gut. So do not do anything, and this is generally a good rule, do not do anything in your competition that you've never done in practice. So try these food items, try these amounts, the carbohydrate numbers, try the sodium numbers, try the total amount of water. Start low, you can always increase. What you don't want to do is have to run out during the middle of your spin class and sprint to the bathroom and hope nobody's in your way, which in the lab we've seen, we'll just say accidents like that occur more than once. So just be careful of your stomach. I'd like to take a brief break to acknowledge our sponsor Inside Tracker. Inside Tracker is a personalized nutrition platform that analyzes data from your blood and DNA to help you better understand your body and help you reach your health goals. I've long been a believer in getting regular blood work done for the simple reason that many of the factors that impact your immediate and long term health and well being can only be analyzed from a quality blood test. One issue with a lot of blood tests and DNA tests out there, however, is that you get information back about various levels of lipids and hormones and metabolic factors, et cetera, but you don't know what to do with that information. Inside Tracker makes knowing what to do with all that information exceedingly easy. They have a personalized platform that lets you see what your specific numbers are, of course, but then also what sorts of behavioral do's and don'ts, what sorts of nutritional changes, what sorts of supplementation would allow you to bring those levels into the ranges that are optimal for you. If you'd like to try Inside Tracker, you can visit [Insidetracker.com](https://insidetracker.com) Huberman to get 20% off any of Inside Tracker's plans. Again, that's [Insidetracker.com](https://insidetracker.com) Huberman to get 20% off. I realize I jumped the gun a little bit asking you about supplementation for before, during, and after a workout, because what I neglected to ask about was training in the fasted state. This is something that we talked about in an earlier episode, but I think it's worth highlighting now. Sometimes the best way to supplement, if you will, a workout or pre workout, is ingesting nothing. I'm one of these people. I actually prefer to do my weight training somewhere between seven and 08:00 A.m. Each morning, sometimes a little earlier, sometimes a little bit later. I drink fluids, water, and I do ingest caffeine prior to those training days. On days when I don't train, I do as I often recommend people do, delay my caffeine intake 90 to 120 minutes after waking, but in any event it's water and caffeine yerbromate or coffee or some sort of stimulant for weight training workouts and generally not for cardiovascular training workouts, although sometimes yes. So I'm training fasted. That said, I'm ingesting carbohydrate the night before to make sure that I have glycogen stores that are topped off. So it's fasted. But with that caveat, what are your thoughts on training fasted? And what I just described is fasted overnight, but some people are training in the afternoon and they may opt to not eat anything in the two to 4 hours prior to training, or maybe even longer. I personally find that caffeine hits my system a lot better when I'm fasted. Better meaning it just seems to have more of a potent effect. There are some reasons for that. And of course we dissuade people from ingesting caffeine too late in the day because it'll disrupt sleep. So I'm not saying fast for 3 hours, then drink caffeine, but who knows, maybe that's in your protocol. The simple version of this question is what are your thoughts on training fasted? And if people are going to train fasted, how should they modulate their fluid intake, if at all? What happens with exercise in the endurance and metabolism episode we walk through, and the fact that no matter what you're using for fuel carbohydrates or fat or even

other potential sources, the end product of all of those is ATP. CO₂ and water. Right? So you're trying to make ATP, that is the fuel for exercise. Now ATP is adenosine triphosphate. So one, two, three phosphates on top of an adenosine. Well, what you may have not put together is if you hydrolyze ATP and you break off one of those phosphates, you now have ADP. If you do it again, you have adenosine monophosphate. If you do it one more time now you just have adenosine. And if you have, then therefore run through a lot of exercise, burned a lot of energy, you have increased the amount of adenosine that's floating around. Now, if you have a high concentration of adenosine, what's that going to make you want to do? That's going to bind to certain receptors. And when we know when those receptors get bound to, you fall asleep. Bingo. Caffeine will competitively bind to those receptors. Therefore, that's why caffeine stops you from feeling like you want to go to sleep. Right, so we have a very clear relationship between exercise fuel. In fact, if you look at the literature, there's a pretty clear relationship between the more caloric expenditure in different sports and the higher amount of hours needed for sleep. So there is a nice tie between how hard you're exercising, how much energy you're burning, how much you need to sleep stimulants. Which brings us all the way back to your question of fueling. So do I need to fuel prior to my exercise bout? If you're going to be limited in your exercise bout by fuel, then fueling is necessary one way or the other. If it is a type of training that is not, then it's not going to matter. And so the examples we gave, if you're going to go do a 32nd bout of maximal exertion and you're going to do it one time, you don't need to worry about fueling at all. We're eating within your workout because it's only 30 seconds. Yeah, you get 30 seconds. You don't need to worry about hydration post exercise. You don't need to worry about recovery. Total energy expenditure was nothing. If you're going to go practice, you're going to go to the driving range and practice your golf swing, you don't need to worry about it. The total amount of energy expenditure is just not high. In fact, in that case, you might want to keep it somewhat low because you want to keep blood glucose fairly even and you don't want to bring it in the system. You certainly wouldn't want to use stimulants because you may get over exerted in all of these things. We probably should have started off our conversation with this. In terms of macronutrients, the total amount throughout the day is more important generally than the timing of them, which is why you can do things like have a bunch of carbohydrate at night, not eat the next morning and lift and be just fine. It doesn't matter that you didn't have them in a few hours before your muscle glycogen is topped off, your liver's glycogen is topped off, you're absolutely fine. You have plenty of fuel even if you were to wait a few more hours. In fact, even if you were to do conditioning, you're probably fine. I have plenty of athletes that prefer to do many of their training sessions faster in the morning for personal reasons, not because it enhances performance, but if it doesn't enhance or harm it and it's a personal preference thing, fine. If you're going to go do a session though, where you're going to be really concerned with muscle glycogen depletion, and again, you can go back that episode to learn of different types. When those thresholds hit and what you worry about it, then fueling would be important. You would either need to have something before the session or consume it during the session. So one of the other things we'd like to say here is recovery starts during the previous workout, right? So if you're working out right now and you optimize nutrition right now, even if you don't necessarily need it for the current workout, if you can get ahead on recovery, then you're going to be fine the next day. And the differentiation here between carbohydrate and protein is important. So the total amount of protein you ingest throughout the day is probably a bigger determinant for things like muscle growth than the timing. So the post exercise anabolic window, it doesn't necessarily matter. Carbohydrate is different. The timing of that does matter. It needs to be around and available so you can maximize both hydration and muscle glycogen resynthesis, which is restoring the muscle glycogen you burn during exercise. I also work with athletes that train multiple times a day. So in those particular cases, recovery window is half what you normally have. So if you're in a situation where you have two or three days before you work out again, you don't need to worry about getting carbohydrate in before, during, or after. Because by the time you go to train again, you will have restored your muscle glycogen levels easily. However, if you're training every day or twice in

a day, then the timing of carbohydrate really starts to matter. And in that case, I see no reason to not ingest those nutrients either before, during, or after. You don't need to necessarily do it, but you can. The general rule of thumb I give is something like this. If you're doing something where you're trying to really work hard, whether this is hypertrophy training or a lot of endurance, energy expenditure is going to be high. Potential muscle damage is high, and or energy utilization is high. What you want to look for is a number, something in the area of like half a gram of carbohydrate per pound of body weight. So you weigh 200 pounds. You want to make sure that either pre, mid, or post or total, you bring in 100 grams of carbohydrate. It's just a very rough number to start. Protein is about half of that. So it's about a quarter of your body weight. Right. So those numbers would be if you're 200 pounds, make sure you have 100 grams of carbs and 50 grams of protein. And again, it doesn't necessarily have to be before or during or after and you'll be in a good spot. All you need to do then is alter what I do, I should say, is alter the amount of carbohydrate based on energy expenditure. So a lower energy and easier workout. Instead of having 100 grams of carbs, I might tack that down to 75 or even 50 and be at a one to one carb protein ratio. If it was even harder, more sun, hotter outside, more fluid loss, I might go from 100 grams of carbs up to 150 or 200 and get closer to like a three to one or four to one carbohydrate to protein ratio. So those are the numbers that I generally go by. Well, as I take a sip of my double espresso Americano here, I'd love for you to tell us about Stimulants. Sure. There's no shortage of these in most of our lives and of course you can cover the health benefits of it later. Maybe you have an episode. Yes, we have an episode on caffeine and it does have certain health benefits, although one has to use caffeine correctly in order to drive those. So caffeine is the easy one to struggle with. And we won't belabor the point here. The evidence is strong, it has an ergogenic effect, you can take it at whatever dosage is reasonable for you. And of course there is a bit of a learning curve there such that obviously the more you take it, the more you need to take, even though there's actually some recent evidence showing even folks who are acclimated to it will still see an ergogenic benefit, even though if they don't feel a big boost of it. So typically that takes 30 to 45 minutes or so, but it's highly dependent upon the person. So some people can smell coffee and immediately feel better and that's probably working actually through a different mechanism of anticipation. But you can take it there. The half life of it is four to 6 hours or something like that. It can totally depends on the person, so don't let it ruin your sleep. But if you take it prior to performance, it has a noticeable effect on particularly endurance. Maximum strength may be less well, quite clearly less so. In fact, the data are mixed there on whether it actually does anything for peak strength. Although I think most people would suggest that you're going to take it prior to trying to truly lift as high as trying to lift a one repetition max or similar. But most of the documented effects are on the endurance based activities. Yes, so my read of the literature in terms of performance enhancing effects of caffeine are that one to three milligrams. I want to make sure that people hear the units correctly before people blitz themselves out with that caffeine. One to three milligrams per kilogram of body weight about 30 minutes prior to exercise has a definite performance enhancing effect. It also has a definite mental performance enhancing effect, especially when people who are regular caffeine users have abstained from caffeine for anywhere from two to 15 days. And that's an extremely rare circumstance. But even if they have not, it appears that one to three milligrams per kilogram of body weight of caffeine taken about, again, it's not super precise. As far as I can see, about 30 minutes before the event starts can really enhance reaction time and power output as well as, as you mentioned, endurance. When I was researching the caffeine episode, one interesting caveat that I discovered was that if people are not caffeine adapted, they are not regular users of caffeine. The sudden introduction of caffeine can really degrade performance, mostly because people don't know how to operate at that high level of autonomic arousal. Have you ever observed that? Yeah, 100%. In fact, there's actually data going up as high as ten milligrams per kilogram of body weight wow. Which is in fact, once you cross the five milligram per kilogram threshold, you will start seeing performance decrements. So there is absolutely such a thing of ruining your performance with too much caffeine. So most people listening to this, if

you're thinking, wow, they said caffeine, I'm all in, and then you just stop listening. And now you go for your quad espresso shot before every time you go to workout, you probably are passing that threshold. If you think about those numbers, one to three milligrams per kilogram body weight. If you weigh 100 kg, that's 220 pounds. That'd be something like two to 500 milligrams of caffeine, which is like a pretty high amount. But a coffee is going to get you close. An espresso is going to get you somewhat in that ballpark depending on source and stuff. So you don't really need to go and blister your brain with caffeine. And in fact, if you do, it's quite common and in fact likely that you'll actually make performance worse. Right? Yeah. The amount of caffeine in different coffees and sodas, et cetera, of course varies. One thing that people ought to know is that the smallest of commercially available coffees at the most popular commercial vendors generally contain anywhere from 250 to 350 milligrams of caffeine. What that means is that the so called medium and the large contain as much as 500 milligrams or 1 gram of caffeine. So for you, morning large coffee at commercial vendor drinkers. If you're wondering why you get a headache if you're 30 minutes late on that caffeine, or if you can't access that caffeine at all, or even if you're drinking coffee, excuse me from another source you're finding like oh, it's really not doing it for me. It's because the amount of caffeine in the now commercially sold coffees is exceedingly high. It's about two or three times higher than the standard lookup tables that you'll see on the internet. So I'm not saying that to demonize caffeine. We can pretty quickly adapt to and form a tolerance to caffeine. Some people never really can get over the jitters. Other people are just fine with even 1000 milligrams of caffeine but only because they've been drinking a lot of caffeine consistently anyway. It's also wildly inconsistent from location to location, the brew type, the functionality. So yeah, that stuff can be very hard. To figure out what's happening. There's only one way really to objectively measure caffeine and that's use caffeine tablets. And they work pretty well actually. Someone I know who's prominent in the podcast space uses 100 to 200 milligrams of caffeine in tablet form combined with tea. So they've now conditioned themselves to think that herbal tea actually has this caffeinating effect. But tablet form caffeine, while I'm not recommending it to outright it is going to give you the best sense of how much caffeine you can tolerate and how much is performance enhancing or is performance degrading. There's actually another line of supplementation that we can go down here which is not technically a stimulant but it's something I use to help performance when you don't want caffeine. And so this think specifically if you're one of those folks who have to exercise at night and you want a little bit of boost for your training but you don't want to have caffeine because it messes up your sleep. And this is when you can turn to the whole like citrulline, arginine, nitric oxide sort of route and we'll skip the explanation there. But effectively what happens is nitric oxide is this wonderful compound that causes vasodilation and of course that's going to aid then in transporting nutrients in and out of the cell so it has an ergogenic effect. You have a number of ways you can go about this. Some of them have more pros and cons than others and there are more and more data coming out specifically on Citrulline more recently. If you look though, in my opinion the most consistent evidence for the most consistent effect is in the supplement of beetroot or beetroot juice or extract or something like that. So you can find those supplements and they tend to again, they're pretty effective at enhancing performance, specifically anything moderate to longer duration endurance performance and they are not a stimulant so they won't ruin your sleep that much. One note of caution for those of you that are interested in citrulline or beetroot because they are in the Arginine pathway, if you're somebody who has a predisposition to cold sores oral cold sores, that is or other forms of cold sores, that because activation of the Arginine pathway can exacerbate some of the neural related aspects of cold sores. And that's because the viruses that cause those cold sores actually live on neurons. Then you want to be very cautious. With citrulline, especially high dose citrulline, I can really amplify the cold sore response. What about non stimulant yet focus enhancing supplements, things like Alpha GPC for example. I routinely use 300 to 600 milligrams of Alpha GPC prior to hard physical training, typically weight training, but occasionally I'll take 300 milligrams of Alpha GPC prior to a mental work bout. Less often these days because I kind of reserve it for

physical training and I don't tend to use it every day, maybe once every third or fourth workout combined with caffeine. So that combination is pretty potent, I find. And so technically, because it's a cholinergic agonist, it's not a stimulant in the traditional sense, but it has a focusing and an alertness promoting aspect to it. What are your thoughts on those sorts of compounds? There is not much human exercise performance data on those. There are certainly cognitive functioning tests on those. So you're not going to find a lot of information. No, there isn't none. We actually will use many of these substances. You could globally call them nootropics, which is any substance that specifically will enhance brain function is a rough way to think about it. We'll use them prior to more challenging bouts of training. This is something that we'll pull out, say on sparring day only, or the most important training session or a session when you're trying to work on pitch command, or when you're trying to enhance work on your shot as a basketball player, or you're really trying to improve a certain swing as a golfer or something like that. But we do not use them every day. We do not use them with every person. So yeah, we will use those. They are not stimulants, but they can be performance enhancing. And another kind of way to think about this is if you're in the case of caloric restriction. So whether you're trying to lose weight or we're actually trying to control weight for weight purposes, in terms of a sports where you have to be in a certain weight class or something like that, well, we may not be able to give you food. In fact, we may not be able to give you stimulants because of the sleep thing or because we're already like maxed out on stimulants now we can go this route. And so at least like mentally you're a little bit there and you're more likely to be alert and focused and you can train harder despite the fact that we didn't actually change fuel. Now, that's a little bit of a short game in terms of that's not your permanent solution. You eventually need to bring calories up or whatever other trains you're training or whatever you're going to do, but it can work in a nice short pinch. I'm very interested to learn from you about fatigue reducers and I'm hoping that Rodeola Rosea will come up in the conversation. Yeah, great. Let's just start right there then. There's actually a lot of research on this despite most people not having heard of it. I think I mentioned in a previous episode, I've used it a lot over many, many years. You have to be a little bit careful of it. Well, first of all, we should have said this at the onset. No supplement is a panacea, right? Nothing's going to work for everything in Rodeola is no different. It can have a number of effects. And if you look across the literature you're going to find generally somewhere between a small benefit to little benefit, but not often is it detrimental. With a few exceptions. I know of a handful of papers that would be two specifically where it may actually reduce muscular endurance. Okay, fine. If you think about what's happening is one of the benefits that has been seen so far with rodiala is it is helpful at managing Cortisol. But Cortisol suppression is not a necessarily a good thing. We talked about how if you do an acute bout of stress, cortisol will go way up and that is a sign of acute stress. However, a sign of long term excessive stress is Cortisol suppression. And so this is a thing to be really careful of is if you're feeling down or lethargic or tired and you think your adrenals are messed up and then you start taking cortisol modulators, you could be making the problem worse because now your cortisol is actually suppressed. And now you're taking these things to blunt it or keep it low and you continue to feel lethargic and lack of desire and libido and focus and sort of all these things. So Cortisol is not a bad thing. We want this to be going up and down in the amounts that we want. So if we're thinking about like for example, waking up, you would want generally something like a 50% reduction in the first hour in terms of Cortisol concentrations. However, if you're extremely suppressed already, going down is only going to be a problem. So rodiala has a good evidence base to support it. For that you'll see actually a number of studies that have looked at it in a whole host of areas for benefits. So something good to do. The difficult part with rodiala, to be quite honest, is getting it from a high quality brand and source. It's difficult to get as a single source, which is a very, very important thing to do with supplements is try to get them sourced alone. rodiala typically comes in combination with any other herbals or other stuff, adrenal support, et cetera, et cetera. Also then getting them then third party certified, which for most folks is not necessary. But for any athletes that need to go through drug testing systems, you should

not take any supplement at all. That does not have some sort of third party certification. So those are the challenges. That being said, if you've ever ran into somebody who's taken Rodeola and they're like, it didn't do anything for me, it's possible nothing works for everyone. It also could be just very poor quality sourcing. So if you look at there have been a number of papers on its perception of fatigue, and you've sort of mentioned that you felt pretty immediate effects of taking it a few times. Yeah, I'm fairly sensitive to supplements, but I've started taking rodiola before workouts and found that I could push much harder, much longer through the workout, normally or typically before taking it. That is, in sessions where I did not take it, I would be able to work out very hard for 20 minutes or so. The next ten minutes I could get some work output and then the remaining period of time, it was kind of a tapering off. Now, granted, these are very intense training sessions. These are not the endurance training sessions. These are the weight training sessions. That one time per week per body part type sessions. What I've noticed is I can complete the entire 60 minutes with minimal fatigue. Now, I mean, obviously I hit fatigue within sets, and of course, you remain human despite taking it, but I found to be very useful and I've been using it whenever I use Alpha GPC prior to workouts, and I've been impressed by it overall. I do want to highlight something that you said because I think it's so vitally important, which is that using single ingredient formulations for most things is critical to figuring out what works for you, what doesn't, what dosages you need. Being able to take things two on, one off, two days on, one day off. For instance, being able to increase dosage in the morning and then maybe reduce the dosage and combine with something else in the afternoon. Single ingredient formulations are pretty much the only way to do that. There's perhaps only one supplement that I take at all, and that's Athletic Greens as they've been a regular podcast sponsor for a long time. That is a cocktail of many, many things, and those are all adaptogens, as well as some probiotics and vitamins and things like that. So I'm not opposed to blends where the blends include a lot of nutrients that are synergistic, but for all pill, capsule based supplements where I'm looking for a very targeted effect. And it's not just about foundational nutrition. I really believe strongly that single ingredient formulations are the way that you can build a rational approach to supplementation and also make adjustments if something isn't making you feel better, and also make adjustments if something's really working for you. So, for instance, some people might take Alpha GPC 300 milligrams and not feel anything, go up to 600 milligrams, not feel anything, maybe just feel kind of they don't like it. Other people like myself took 300 milligrams of Alpha GPC the first time. It's like, wow, this really puts me in the zone, but I want to be really careful how often I use it. I did mention I go up to 600 milligrams occasionally, but that really puts me on the outer threshold of kind of overall levels of focus and amped up such that if I drink too much caffeine, it can tilt me over the edge. So I encourage people to become scientists of themselves, and the only way to do that is to try and limit the number of variables. And the final point is that I think that single ingredient formulations are by far the best in terms of changing things over time. This could be women during their menstrual cycle might find that during certain phases of the cycle they're more sensitive to certain things than not others. And for men and women, it may be that certain times of year even, and certain supplements might go better, closer to sleep some earlier in the day, and on and on and on. There's just no real way, in my opinion, to have a supplementation protocol that involves lots and lots of blends. One or two blends, okay, but lots of blends. I actually think that's potentially dangerous territory. Yeah, I mean, just take rodiola as a good example. I know a new meta analyses came out just in the last few months looking at it, and they found in general, you see again a slight to moderate improvement in everything from power output to fatigue resistant antioxidant effects to endurance performance. So it's like, okay, great, maybe there's a little bit here. Now, let's say you went to do it and the only way you could access Rodeola is in combination with that and some lion's mane and some other of these adaptogens, and it's like, well, wait a minute, I just wanted to take this to get a better workout. But now it also came with this stimulant or this cortisol suppressor or cortisol activator. Well, now all of a sudden you can't take it at night or you can't take it in the morning because you already had coffee. Your options are just way limited. So I think

the biggest part of all that is if something doesn't feel good, you have absolutely no idea. You don't know if it was roliola, you don't know if it was the bus well unit that's in there. You don't know if it was any of the other things that were smashed in there, or it could be something as simple as the citric acid they use, like some other combination of thing. And now here you are thinking that some supplement that actually works for you doesn't, and you throw that out of your repertoire for the rest of your life, which is not the biggest crime, but it's not needed and you're not really going to know. So, yeah, I fully stamped. You can look back at my course lectures for the last decade and you will see like stamped number one on the supplementless sections is make sure you're taking single ingredient supplements at all costs. The last part about that too is you're more likely to ensure the amount that is on the label is correct. So if you're taking rodeola and it says it's 100 milligrams in there, and if that's only thing that's in there, you're more likely than not to actually get something close. Now, they're never perfect, but it will be close if it's in a combination of 20 other things. You actually don't have any idea if that's in there. In fact, there have been many papers on melatonin and vitamin D and a number of other supplements in which when you actually just pull them off the shelf, these are standard studies where they will go in and buy like 20 to 25 different supplements in the case of melatonin. And we'll actually measure the amount of melatonin actually in them. And despite the fact that the label says five milligrams, they can be up to a 500 to 1000 fold actual concentration in that supplement. And then you wonder why some people react great to melatonin, some people that absolutely destroys you. And this is also why we'll see this constantly, where people will have like, 500 times the upper limit of melatonin the morning after, when the half life is supposed to be more like 90 minutes. It should be totally gone, but we're seeing extremely high. I'm not even talking, like, double. I'm talking 1020 30 x the upper limit range for melatonin the next morning. And then it's like, well, what are you taking? And he's like, oh, I got this melatonin at X store or X website and you're like, holy cow. So I'm not opposed to melatonin theoretically, but you have to be careful with that one in particular. So any supplement has that to be true. So you want to buy them from as many places as you can that are high quality and if they are third party tested even if you're not a performance athlete I want to stress this. Even if you're not a performance athlete, third party certified and tested supplements, you're less likely to just get wildly high concentrations or low concentrations of active ingredients relative to other ones who you might get for cheaper. But you could be totally wrecking yourself by getting 50 milligrams of melatonin every night and not realizing it. So then of course, the next morning you drown yourself in caffeine and then you can see what death cycle you're in now. Yeah, people can look for third party certification on the packaging and some websites will allow you to zoom in on the bottle beforehand. It's largely listed on certain vendor websites. A brief point about supplement cost and blends, and I promise this will be a brief point. Different ingredients, meaning different types of supplements, have widely varying costs. In order to create to get them to manufacture them. So oftentimes what you'll find is that blends will include the least amount of the most expensive ingredient. Right? Not always the case. There are certain exceptions to this and I mentioned some blends that I like a few minutes ago that are for foundational nutrition, adaptogens and probiotics athletic greens. Of course, just being one of several examples out there. But when it comes to say, a sleep blend or a pre workout blend there are some decent products out there but a lot of them tend to put in more of the least expensive ingredients and less of the ones that you're actively seeking. And so those tend to be caffeine tends to be a kind of a buffer against the other things. Meaning if you have pre workout putting caffeine in there isn't necessarily a bad thing. But if it has five other things in there oftentimes what manufacturers will cheat on is the actual amount of the things that are costly. So again single ingredient formulations for 80% of your supplements I think is really the way to go. And the other thing that I know is going to come up as we're talking about all these supplements is this issue of dependency. I often get this question and when I solicit for questions on social media in anticipation of this episode, a number of people said, okay, so if you take a sleep formulation do I need to take it every night? If I don't take it will I have an incredibly hard time sleeping? If I take a pre workout every time

I train will I need it? It's a great question. Some people will take supplement holidays as they may be called for a couple of days each week back to back. Some people take them straight through. I myself take a sleep cocktail. We've described this. It's magnesium theanine and things. This is not one ingredient. These are multiple ingredients in fact, precisely because some people who have sleep walking and vivid dream issues can't take theanine before bed. In any case, I've had times when I either forgot my supplements that's rare or I just didn't have what I needed or just simply took a break for a night and it was not a problem. But in terms of pre workout I do think that people become dependent on being in that really ramped up state. But I don't think we view all this as true dependency. Kind of like addiction totally. Right? I mean I define addiction as a progressive narrowing of the things that bring you pleasure. So I suppose people could get addicted to pre workout but it seems a little unlikely. More likely there would be a dependency such that if you didn't have your pre workout you might feel like you're not motivated to train. So what are your thoughts on taking little holidays from supplements and varying the frequency of supplement intake in particular as it relates to stimulants and fatigue reducers. The end goal anytime I coach somebody, is to get them into a physiological state in which they require no or close to no supplementation. That's the target. We should really be in a position to where our lifestyle, our sunlight exposure, our stress management, our physical activity, our sleep and our hydration and our whole food nutrition provide us almost everything we need. Now look again. There are some foundational items that we can give people. We put together a little bundle actually, for this of basic things that you can go look at. But that's the goal, right? So the target is to let your physiology run the guy. Your physiology is way smarter than we are. Even if I take a bunch of biomarkers from you, your physiology still knows better than those few markers can tell me. So that's always where we're ending up. I actually personally don't like people being in a position that they have to take a supplement for anything. So I don't like it if you have to take a supplement to have a good night of sleep. I don't like it if you have to have a supplement to train. We will use any of these stimulants very, very carefully with any of the athletes we work with. And certainly for the non athletes, because at least the athletes, we have an end date, we have a fight schedule, we have a season, we have a game, you're going to pitch, whatever. When you don't have that, it's sort of like you're in this endless cycle of, oh, you're just going to do that all day, every day. We don't really need to be in that spot. So the way that I describe my philosophy is I will use those short term tactics to symptom manage if I have to. So if somebody comes to me and they're like, you're feeling awful and we've got to get through the hump, okay, great. Maybe we'll give you something for sleep immediately to get you sleeping, that allows us to then come back and work on the causal problem. Right? So this is why are you having a hard time sleeping anyways? If you have to take a nine cocktail supplement to sleep, then all we're doing is blinding. The reason. Why are you in that position to begin with? Right. So we see this all the time, whether it is sleep problems, whether it is cortisol or testosterone. The question is, well, why is that low? Now, we may give you something again to manage it immediately, but the mystery I'm going to try to unveil is why? Why is it there to begin with? This could be something like this is natural for you and your lack of energy is something else. Or it could be actually it is not a natural level for you, but something is suppressing it. Any number of you've got some infection going on. There's some allergic reaction to something in your environment. There's mold mercury. Like that one comes up a lot.

You'll see mercury in folks and that's causing a lot of problems or any number of heavy metals or toxins, any host of things. Psychological distress, bad daily habit. You don't ever see the sun, you don't ever sweat, you don't ever drink. We've talked about so many things, so I'm always going to hunt for that. And I hate using this phrase. It's highly maligned for a good reason, but root cause. All right, so we're trying to find that it's like, are we making sure that we're not causing this problem? And I'm not going to want to give you a supplement to cover up something if we're not even trying to solve the problem of what's being there. That being said, am I that concerned about people taking a multivitamin just all throughout? No, not really. Am I concerned about people taking creatine? No. Like go ahead. Those ones are generally pretty fine to just take,

but anything else, I want a reason. I really don't like giving people anything in a super physiological concentration or a superfood concentration. Right. So again, an amount you wouldn't find in a normal food dosage unless we have really a specific reason. Some of these things are more problematic, others are less problematic. So to answer the question of dependency, you have a combination of actual physiological dependency, caffeine, that actually creates a physiological dependency versus an emotional or psychological dependency, or just a, I like drinking this, that's my habit, that's my routine. There's a fancy scientific phrase for that, but it doesn't matter. So yeah, we want to get off that. And again, my personal philosophy is I don't want you dependent upon anything. I want to create extremely resilient people, and I want to create physiological resilience. We actually have a fancy little algorithm we use to measure that in people, and so we can actually calculate that number. And the goal of us is to push that number higher so that we don't have to have anything. So many situations pop up in your real life that you're not going to have your supplements or you're not going to have your routine, or you're not going to have your journal or whatever. But also for the long term, I don't want to create a situation in which this is a short term success that you have to now do that the rest of your life. No, let's just get out of the way. Let's fix the problem. If there is something symptom management that's real while we're actually searching for better foundational habits. The last thing I want to say about this is if you're only covering symptom, you're really missing signal, which is if you're constantly tired throughout the day and all you're doing is giving yourself a number of alpha, GPCs and caffeine, et cetera, even though there's good literature. Okay, are you really just using that to allow your poor sleep hygiene to happen? If they took those away, I bet you, you would actually start addressing your sleep if that's the cause, right? Or your stress or your poor hydration. Like you would go hunting for the problem. And so you want to walk a fine line here of going like, hey, look, is an athletic greens supplement that big a deal? No, probably not. But wait a minute. Am I actually now covering up the pain point that is maybe needed? It's a signal to actually get my ass in gear to go make one of these changes, whatever it needs to be. So I know I got like a little bit meta on you and a little bit philosophical, but that's honestly how I approach it. Yeah, I think it's really important. A friend of mine who's a physician has a great saying which is, better living through chemistry still requires better living. That's golden. That's so good. And it pertains also to things like antidepressants and ADHD drugs and things of that sort. Most all of those things were developed as tools to allow people to move from a maladaptive state. Maladaptive is hard to define, but think about in any domain of life. You can either be back on your heels, flat footed or forward center of mass. And there are times when people are so compromised neurochemically that they need to use pharmacology in order to get into a flat footed position. They're really back on their heels, flat footed or forward center of mass. But the idea was always that those things were developed as things to allow people to engage in the sorts of behaviors that can produce the same sorts of neurochemical shifts. And if people are thinking, well, what sorts of behaviors can induce these neurochemical shifts? I'll just zoom out myself for a moment here and say I am a big proponent. I believe you are as well, if I may, in doing behavioral tools first, whenever possible, really establishing good habits, the do's and don'ts, which we've talked a lot about in this series and in this episode. Then excellent nutrition, which involves do's and don'ts, volume, food choice, timing, all the factors and then also supplementation. And also there is sometimes a case for prescription drugs, certainly, and often brain machine interface or body machine interface, measuring stuff, using devices. But the foundation of behaviors and good nutrition are really, truly foundational. And it's hard in anything to skip steps. But supplements and prescription drugs are one place where people often skip steps and then they don't actually learn how to cultivate the best behavioral practices, including the don'ts, as you mentioned. And then just one more point along these lines you talked about taking anything for energy is really disruptive to the system. And it is because especially caffeine, while it has its uses and even health benefits, it's really borrowing against the adenosine system with interest. And so because caffeine acts as an adenosine antagonist effectively. While caffeine is present in those receptors, you don't feel as sleepy, you have more energy,

your reaction time goes down, memories enhance focus, performance of all kinds, yes, but then when that caffeine is dislodged from the receptor, then the adenosine can act even more potently at those receptors. So it's sort of like being able to borrow against the normal variations in wakefulness and sleep. And this is why we encourage people, if they're not training first thing in the morning, to push their caffeine intake out about 90 to 120 minutes after waking, so they can clear some of that adenosine in the morning, which tends to happen even after we wake up. People can listen to episodes on Master Your Sleep or Perfect Sleep or the Caffeine episode to understand more about that. But the final thing I just want to say here, and then it prompts a question, is in thinking about supplement protocols, I think a lot of people assume that once they start taking something, they're going to have to take it all the time. And one idea perhaps is that people have some alpha GPC around that they could take. And granted, it'd be great if people could try things without having to buy a whole product. I think companies hopefully are listening to this and will give people a sample to see if something works for them and then give them an opportunity to try it, to have things around, but not necessarily assume you're going to take it every time. Right. Some things you take every day, foundational nutrition supplements, for instance. But then also to take a look at how well you're eating or not eating. Right. At times when I'm eating much better, I consuming low sugar fermented foods, which are great for the gut microbiome, I consume less probiotics. If ever I've been really compromised, for whatever reason, then I will take pill form probiotics, but I don't take those all the time because I get them from food and from certain greens drinks, like athletic greens and so forth. So I think that nutrition and supplementation are tethered in this way in my mind. And I don't think that most people think of supplementation as something that where you can induce a lot of variability in when and how you take them. But as far as I'm concerned, as long as they're single ingredient formulations, you can use supplements once a week. If you want. You can use them seven days a week. You could use them twice a day, four times a day, every day, or you could use them not at all. Agreed? Yeah. Some of them will have an effect randomly like that, others will not. And we talked about Creatine being one of them. If you're going to take it once or so a week, then there's no benefit. That's a very good point. Creatine beta Alanine is another fantastic example of something you need to take consistently. If you want some sort of benefit. It needs to be built up in muscle. We need to use that to create carnitine, which is what's actually going to help us with our fatigue management. That's why we call it like an acid buffer. So in our previous metabolism episode, we talked about that being a major cause of fatigue. The wonderful part, one of the reasons why Beta Alanine works so effectively is it blocks that build up. So that is an example of another one that you would want to take other things like fish oil. You could certainly skip a day here and there. It wouldn't be that big a deal. I also do support your comment of you can take absolutely none of these things and be just fine in terms of and we'll come back maybe to Beta Alanine in a second. In terms of some other fun stuff. My colleague Greg Gasicki ran a really cool number of studies looking at how exercise actually alters the gut microbiome. This is actually an area that I probably have 300 stool samples sitting in my freezer in my lab. Oh, goodness. Another reason to pause before entering your lab. Yeah, another reason to not apply, to come be one of my graduate students. Unless you want to deal with that. We actually have a number. We've applied for a couple of grants to look more into this, specifically with females. So hopefully we can get that funded. But nonetheless, you can actually see pretty traumatic, and I say that word on purpose. Changes in the gut microbiome. This one in particular study I was thinking of, that Greg did, is he looked at the changes pre post an ultramarathon, and even within a single bout of exercise, I can't remember some of the markers, but I know one of the markers was specifically increased by like 14,000% after a single bout of exercise. Now, this is an ultramarathon, this is totally absurd amount of exercise relative to what normal people would be. But that number I remember, it was like 14,229% or like something some random number like that of something meaningful. Yeah, something meaningful. I can't remember which marker that was that had changed. I know streptococcus was in there, streptococcus went up. Maybe something more like 30 or 40 or 50%. The point is we haven't even had the proper time and we don't to even launch into the gut

microbiome supplementation, there needs to be ultra specific. You wouldn't be best served to just jump in and take random things there. It's a whole area of emerging science. We know very little about it, but there is a number of actionable things one could do there. So probably something to not mess with would certainly work with a qualified physician. If you think you have something going on clinical or some actual problem there, don't work with someone who's not a specialist, a medical doctor there, but just randomly assigning a bunch of probiotics or prebiotics without intention is maybe the next forefront of human performance research. But we'll have to maybe come back in a few years and dive into that in detail. Or perhaps you could bring somebody on as an expert in that to discuss that. Yeah. Gut microbiome is fascinating. I think of sleep as the most powerful performance enhancing activity. Of course, you still have to do the activity. I consider it foundational. It basically raises the tide on mental health, physical health, performance of all kinds. There's recent data that during sleep your body goes through all its various forms of metabolism possible, which is amazing. So it's measured from breath in human subjects, breath metabolites in human subjects. So obviously, if one is thinking about supplementation and wondering, okay, what's the best supplement to enhance performance? You gave some great rationale for why Creatine would be an excellent choice, provided you're eating well and hydrating well. And then to my mind, the next thing on the list would be anything that allows you to improve the quality and maybe even the duration of your sleep. Although if you wake up and you feel rested throughout the day and only need a short nap in the afternoon, not everyone needs one, but then generally that means you're feeling okay. People sometimes get flipped onto this idea that they have insomnia. Insomnia is excessive daytime sleepiness where you're falling asleep during the day. That's insomnia could also be narcolepsy, but that's insomnia. But supplementation to improve the quality or duration of sleep, or both, seems to me like the most direct route, even though actually technically it's an indirect route to performance enhancement and then thinking about things that increase alertness and stimulants and fatigue reducers. Do you think that's a good logic? Yeah, we go to absurd lengths to dial sleep in as much as we can. I mean, the honest answer is like, truly absurd. This is a conflict of interest that my company, I'm a part of this absolute Rest is the name of that company. We actually go out to your house and run a full clinical grade sleep study in your bedroom on you and run that over multiple nights. So instead of having to go to a sleep clinic and have it done in this weird hospital room or sort of setting with these people looking at you through a mirror, it's like totally creepy. That is important because that's the only way to truly determine how you are sleeping now. That said, the technology of wearable trackers is getting better. In fact, I would actually predict those things will reach a level of accuracy equivalent to the PSG in the next couple of years and probably will get FDA approval to be able to diagnose officially sleep disorders. That's my prediction from some inside information. I don't know that to be true, but it is getting a lot better. Right now, those wearables are not accurate enough to meet that threshold. So what we do is we bring out basically all the equipment to do that. So we'll come in and do that. Now, once we understand exactly how you're sleeping, the next question is to answer, why are you sleeping that way? And so this is a full fourfold system. Number one is we're going to look at biology, which means you're going to take saliva and blood, and we're looking at everything from neurotransmitters concentrations to vitamins B, six B, twelve, et cetera, that are important for sleep performance. So we're going to see, is it a physiological problem? Is there something happened there? Is Cortisol DHEA ratio that we've previously talked about, or is something like that off? If it's not physiology, then we're going on the next one, which is environmental. We run a full environmental scan of your bedroom during those nights of sleep that were there. And that's really important because we can look at everything from dander and pollen and allergens that are in the air. A quick tip here is wash your sheets at least once a week. One of the common, most common places that people get allergens in the air is actually from accumulation on your sheets. So if you clean those more often, you'll be in a better spot. The next one there also is like, keep your I'm sorry, this hurts my heart. In truthfulness, I violate this. But keep your pets out of your bedroom and certainly keep them off your bed. Our ghostface killer is my dog, and nelki is my other one. They don't go on my bed,

but they're right next to my bed. So we violate that one. But full environmental scan includes all those things. Of course, we measure light and temperature and humidity and everything else that's going on in the room. Volatile, organics that are coming out of the mattress, formaldehyde lead out of the wall, like all these things that could potentially disrupt your sleep. And we want to make sure that none of those things are kicking on. We see this constantly. People will have things like trying to be cool and they want to be cold at night because that's important. And so they'll turn an air conditioner on or a fan. But the air conditioner kicking on and off at night actually can shoot you out of various sleep stations. So you want to be really careful that it's going. The last metric on that is actually CO₂. And so what you remember from our metabolism discussion is when you exhale, you're breathing out CO₂. Well, if your room is closed and the ventilation isn't great, the amount of CO₂ in your room starts to build up. And we actually very specifically know the threshold based on information collected from the International Space Station. Actually, we know the threshold at which CO₂ crosses and starts disrupting sleep. So we want to make sure that you're not sitting in this CO₂ bath in front of your face and then breathing it back in and disrupting your sleep. So environment is the second one. The third one is actually now psychology. So one of the members on our team is a Harvard MD in psychiatry and put together an entire sleep scanning survey. So we run through all that to see if there's anxiety, depression, anything like that psychologically going on. And then the fourth one there is if you have some sort of actual sleep pathology. And so this again will include some eye tracking stuff that we can use. So we take all those data, they go back to our team. We work in combination with Steve Lockee from Harvard, who's done a ton of stuff. He actually set up a lot of the circadian rhythm stuff in the International Space Station as well himself, Jeffrey Drummer and MDPH, et cetera, and all these folks in a room. Go over your data, identify what's going on, then build action plans off of that. Occasionally those action plans will include supplementation, but only if necessary. We're really going to try to come back and work through a system to improve. The sleep however is needed. So I realize that is not totally accessible for a lot of people, but if you really need to go to the end of the Earth to figure it out, sleep, that service is available. Absolute Rest sounds like an amazing tool, given that most people won't be able to use it or access it. Although we will provide a link in case people are interested in it and do want to try it. You mentioned a few things that I think everyone should assay their sleeping environment for and determine whether or not they are hindering their sleep without realizing it. For instance, the air conditioning going on and off. Or this could be heater going on and off, or central heating or cooling unit. This could be keeping the room dark. This could be cleaning your sheets. Certainly that doesn't require that one sign up for Absolute Rest. So cleaning one sheets routinely, keeping pets out of the bedroom, as you admitted you don't entirely differing opinions about that. But if you're having sleep issues, the dander from Animals may be part of those issues. And then one that I'll just add, which I think is pretty interesting, is there's some beautiful data out of Michael Terman's lab at Columbia Medical School in New York on negative ionization. And this sounds pretty wacky, kind of new AG. I'm sure some people are like negative ionization. But listen, the Termin lab is a serious laboratory focus on circadian biology. For many decades now, negative ion concentrations are higher near coastal locations. So if you've ever gone to the sea or gone on vacation and you sleep better near a body of water, that's actually a real thing. And there are negative ionization machines. But there are also some things that one can do in order to increase the negative ion concentration in their sleeping environment that are nearly zero cost, if not zero cost. You can look those up online and we probably will do an entire episode about this in the future. But I think what you describe for absolute rest really highlights a more general set of themes that I think are really important, which is your sleep environment is an environment. It's got a lot going on in it, and it's worth running through the checklist that you described and asking, where are things maybe not optimized, but where am I really getting in my own way in terms of sleep? All of this again, being related to the fact that getting excellent sleep consistently will completely transform everything that you do. And not getting excellent sleep consistently, which is a challenge for so many people, will also

transform everything that you do and think and feel, but in the negative direction. Yeah. I can also offer a few tips on sleep based on things we find most consistently for those that can't go through the whole protocol. One quick little actually, app called Timeshifter is really cool for anyone that's dealing with consistent travel and jet lag. So you can go and enter your location, your time, where you're going with the location, and then it'll actually back calculate and it'll give you full light stimulant food, hydration and stuff. Protocol and you just follow along with that. And we've used that for many years actually, especially when traveling to like Abu Dhabi for Vice and Mongolia and Brazil for the Olympics and sort of all over the so that's I think that app is still available. I hope so. It's great. A nice tool. A couple of things we found major if you're dealing with acid reflux. So if you're someone who has problems like that, you can just elevate the head of your bed by like six inches. So if you put little piece of wood or something underneath it, you can also buy very inexpensive pillows that can elevate that. Now, that's not solving the problem but at least can help you sleep, whether it's just that night or if it's a consistent problem you can do there. If you're snoring, like I said, that's not really benign. You should probably take a look at that. Your first step there is mouth tape. If that doesn't work, you can go through what's called myofunctional therapy, which I don't know if you've covered that before, but it's basically tongue exercises and that can be quite effective specifically for people who have problems with REM sleep. So myofunctional therapy, it's kind of like you do, like depending on the protocol, some tongue exercises kind of in the morning, afternoon or night. And that takes a while, to be honest. You're probably going to need at least six weeks before you start seeing anything. But that actually is pretty well demonstrated to help with sleep. So you can probably Google we could find a link for exact protocols. I don't. Want to describe all them but yeah, you're going to strengthen your tongue so that it stops falling in the back of your neck and waking you up at night. So that's a really free, easy free protocol to use if you're struggling with it could be insomnia, but it could be just things like when you get into bed you're super tired and you can't fall asleep or things like that. Kind of a basic rule of thumb we use is only two things happen in your bed and if you can make sure those are the only two things you do in your bed, the problems of falling asleep or insomnia tend to go down. Those two things are you have sex and you sleep and nothing else goes down in your bed. And so you can make that environment very special and that can help quite effectively improve your ability to fall asleep and then not wake up early. So keeping that environment specific to what it's for can be effective. The only other thing I would think of is, and I hate to say this because it's not super practical, but it's just quite clear at this point, sleeping with a partner in your bed, it's just not very good for sleep. Good luck with that one. I know you can do a couple of things if it helps, you can get two smaller beds and put them right next to each other. If you can actually have separate sheets, that alone can be helpful. So if you're on a king size bed or something and again, I know some people are just like there's no chance, but if you want to know the cost for your relationship, use your loved one ideally. Please don't. Please don't. Oh my goodness. The only last thing I want to mention here is something that's popped up just a few times recently, but you're going to see more of which is called orthosomnia. So that is a term that people are growing concerned over, which is wearables and sleep trackers causing sleep issues. So people basically become too obsessed with optimizing maximizing scores and that alone will actually so you learn when to wake up and so you have actually an anticipatory response when many hours prior to waking up. So if you actually learn to have a little bit of a what's that little molecule of excitement and reward. Oh dopamine that's the one. If you start getting that because you wake up and you get super excited to check your score or your phone, it's the same thing if you check your phone or Twitter or whatever and immediately morning that'll actually start carving back your wake up time because you start launching it so it can ruin sleep becoming too obsessed. So what I'll say is if you're going to use a sleep tracker and you just don't care, you want to check it and you have fun with it, great. But if you are really interested in it and you pay a lot of attention to it. Don't check your sleep score for at least the first 60 minutes after waking up and then that should help you. That's a great tool and piece of advice, I think

generally, because I think a lot of people are waking up in the middle of the night checking their phone two or three times per night. I'm kind of wondering why they're doing that. And I'm guessing it's this anticipatory wake up circuit. Yeah, you absolutely should use either your night mode or Do Not Disturb or airplane mode or something overnight or leave it out of the room. Yeah, I mean, if you have to wake up and some people have a family member who's maybe not in great health, and so they have to keep their phone around in case they call or things like that. So I get it, you're like, I can't leave it out. Leave it in there, leave it in do Not Disturb and enter in their phone number or whoever's phone number so only they can get through. But keep it black and white. So if you do have to look at your phone at night, you see black and white and you do not have notifications. So make sure that there's no notification for no email and a new DM, like, get all that stuff off your screen. And so you look at the did anybody call, did anybody text of importance, what time is it? No emergency going on. Black and white. Okay. Right back to sleep. So that can help a little bit. One of the supplements that I found is extremely useful for being able to fall back asleep if I've woken up in the middle of the night and for some reason can't. And is also very effective for enhancing sleep when one is ingesting fewer carbohydrates, an issue that a lot of people run into. Or for people that are fasting for many hours before sleep, people are trying to not eat anything within two to 4 hours. But is inostatol 900 milligrams of myoinostatol I find again, this is anecdotal to be clear that if I wake up in the middle of the night and I've taken 900 milligrams of inostatol before initially falling asleep, that I fall back asleep much more easily. So that's why I've added 900 milligrams of inostatol to my so called sleep stack. I've also tried just taking it alone, and it works well alone, but it works better, of course, with the mag three and eight apigen and theanine sleep stack. Also, in terms of tools for sleep, the app reverie that was developed by my colleague, Dr. David Spiegel, who is a medical doctor at Stanford Psychiatry, Stanford School of Medicine, Psychiatry. There is a free trial. There's a nominal cost if you use it month to month, but the data are really strong that people that use that I think it's eight to eleven minute sleep hypnosis once a week, and it doesn't have to be in the middle of the night when you wake up. Really helps improve people's ability to fall asleep quickly, stay asleep, fall back asleep if they wake up in the middle of the night. In some cases, curing insomnia, in other cases, really just helping people with their general sleep issues. And I mentioned this because obviously it's a technology, it's not a supplement, but I know that some people are supplement averse. Also, if you look at the cost comparison between taking the sleep stack totally and the Reverie app, it's pennies on the dollar, really. So again, I'm a proponent of both for myself, but I realize that people have varying budgets and again, I should say, as always, behavioral tools first. And I think of the Reverie app as more or less a behavioral tool. Yeah, it's really just a tool. Any of these breath work protocols, hypnosis protocols, they're just a tool for you to touch back in with your own physiology rather than a substance that's coming in. So I fully support those. We have used a number of those in protocols. There's some other tricks that we can pull in those areas. I probably shouldn't say this, but the reality of it is, depending on what's keeping you up, sometimes we recommend just getting up and getting it done. If it's a project or a thing or whatever, sometimes rather than laying there all night not sleeping, you can get up, get it done, and then if you stay awake, fine, at least the anxiety is gone. Or sometimes you can actually go back to sleep because you're like especially if the task only literally would take like ten or 15 minutes. It may ruin your sleep, but you're going to have ruined sleep anyways, so you can try that tool. You don't want to pull that card very often, and you have to be very careful with what you consider to be something worthy of doing that. But that is like, between me and you and nobody else here. That's a tool I have used personally more than a few times, where it's just like, I get an idea and I don't lose it, or the solution for something you've been noodling on for a long time pops in your head and you're not wanting to forget it. Just get up and get it done and get on with your day. In several previous episodes, you emphasized how exercise induces various adaptations depending on the type, specificity, volume, intensity, et cetera, of the exercise, and that during exercise, the degree of adaptation that one triggers is often associated with things that normally we don't associate

with exercise related health. Things like huge increases in blood pressure during exercise, huge increases in inflammatory markers, muscle damage, things all sound terrible, but as you beautifully explained, all of that triggers adaptations that then bring those markers below the baseline with which they were previous to the exercise. So that's the adaptation and the recovery. Within the realm of supplementation and nutrition, I'm aware of a number of things, some herbal, some lipid based, other compounds that are used for various things, but that are known to have a potent antiinflammatory effect. Things like omega three fatty acids, ashwagandha for its effect on cortisol, although that's a bit indirect to the inflammatory pathway, curcumin and things of that sort. Given that we want inflammation in order to trigger the adaptation response to exercise, and given that we want to reduce inflammation in the recovery period, can we put together a logical framework as to when is best to take? Anything anti inflammatory, whether it's supplement based or prescription or over the counter drug, and when to strictly avoid taking any anti inflammatory supplement or behavioral tool. You mentioned ice can reduce inflammation. That's why you don't want to do it too close to exercise. Anyway, I think you get the gist of the question. What about specific supplements related to inflammation and anti inflammatory responses? What are the best ones? When should we take them? When should we avoid taking them? The way that I think about it is understanding what we call the fitness fatigue model. So what I mean by that is whenever you do some sort of insult, the whole idea is for you to come back and get an adaptation. Now, recovery is not adaptation. Recovery is recovery. Adaptation is what happens after you're recovered. So there's a very important distinction there. Fitness fatigue model says basically you've done something and you've got an adaptation and you've enhanced fitness. And by fitness in this case, I mean it as a nonspecific term. So you got stronger, you've improved your endurance, like whatever thing you're trying to train for. At the same time, though, your fatigue elevated. So what happens is if fitness increases at the same or similar rate as fatigue, your performance actually isn't any better. And so you may think, oh, my program isn't working. I need to then train harder, or I need to take more antiinflammatory, or whatever the things are. When reality, all you really need to do is reduce fatigue. And if you do that, your performance will increase and all the training adaptations will be actualized. So the way that we do that is a couple of things. First and foremost is actually a taper. So the first step I think of, if someone is training very, very hard and you're not seeing any results and we want to think about supplementation before I get there, I want to think about taper and deload if you're actually training hard and sleep and everything else is taken care of. So just without going too far into taper, some general parameters there, you want to think about about a 50% reduction in training volume over the course of about a week for every eight weeks of training. Super, super rough, right? So if you've been training hard for three months for something you might want to taper for two weeks, something like that, right? It's sort of a rough estimate, that taper. You actually don't need to reduce intensity because intensity is not the driver of fatigue. It tends to be volume. So as long as your volume is reduced by 50%, you can maintain intensity. You can maintain in fact, I generally would recommend maintaining frequency. So if you're used to working out four days a week, keep it four days a week, you can go down a little bit in frequency. But if you go down too much in frequency, you actually tend to feel super lethargic. So I wouldn't do that. If you do those things correctly, you can typically see somewhere between like a three to 8% improvement in performance within a matter of days. So it's important to do that. We actually ran a study on cross country runners years ago, testing on a metabolic, heart muscle, biopsies, blood, a whole bunch of things. And we did it pre and post three weeks of taper. And this is cool because we did this in competitive season. So these were collegiate cross country runners. And we got them to come to our lab three weeks before their conference championship, ran them all through a bunch of testing, biopsied them. They went through their three week taper, and then we biopsied them again. And then they went and ran their conference championships and stuff. Well, what happened was they end up hitting about a 50% reduction because what they did is they took out what we call the junk volume. So they kept their race, tempos, high intensity stuff in there, they kept their recovery stuff, and then that medium pace they just basically reduced. Now, they were terrified, as any

endurance runner or endurance athlete or participant would understand, when you take volume away, they tend to get very nervous. And so they didn't like that. But as a result of that, what we saw is their Vo two max. Despite the fact that they covered half the mileage, their Vo two max did not go down in three weeks of reduced taper. Your fitness is extremely stable. And in fact, once we actually looked at their data, the enzymes in their muscle were responsible for oxidative metabolism, were maintained, and so you don't have to worry about losing again fitness, or they're talking about overall performance or even oxygen capacity, mitochondrial function, et cetera. That was all preserved. Obviously, we saw performance go up. What was actually really interesting is we saw, I think it was around a 10% increase in type two, which are fast twitch muscle fiber size. So we saw a 10% increase in fast twitch fiber size at the end of three weeks of tapering. Now, what you may think is like, wow, I guess tapering is anabolic, but that's probably not what happened. What realistically probably happened was their volume of training was actually causing their fibers to be reduced in size. And then once we removed that fatigue, they just recovered back to normal. So that's a good example of what I'm talking about. Once you remove the fatigue, you can actually see enhancements in performance, not because you're necessarily getting better, but because you're removing the stimuli light suppressing you. So that being said, the way that you want to think about recovery like this is although recovery, especially like injury recovery, seems chaotic, biology is very organized and there's a very specific three step process that you're going to go through for recovery. And then there are different supplements that can help you in each of those three areas. So area one is basically inflammation. So this is when the cytokine storm comes rolling out. It starts signaling the injuries there. In this case, even if it's muscle damage, it activates the immune system to kick on and that whole repair process happens there. What you're trying to do effectively, in fact, this is why you probably ever wondered, why is inflammation a thing? What you're trying to do is bring in fluid, enhance the size and increase blood flow in so that you can get nutrients for repair and immune cells and everything like that in the system and get the waste out. So short term inflammation, even in the case of muscle soreness, is the example we talked about in the previous episode. But any inflammation, it is part of the necessary process. That's why you would not want to take an anti inflammatory in that state. And so why you also would not want to do things like an ice bath. So in that immediate inflammatory response time window, this is seconds to hours after training, you would want to stay away from things like that a good option. Here are things like omega three s. Good evidence somewhere in the neighborhood of like two to 5 grams total. Typically like a one to one EPA to DHA ratio is fine. Similarly, this is another example of when good doesn't mean more is better. Because, for example, there is actually evidence showing up to 15 grams will harm the immune response. And so you don't just want to be like, man, I'm super sore, I'm training harder, I'm just going to go to 10 grams a day or more and more. You're actually causing yourself more of a problem. So antioxidants, anti inflammatories are fine. Again, omega three s in that dosage are a decent thing. You can also do something like 500 milligrams of Curcumin three times a day. That's going to be enough to keep you in a decent spot. There are some other things that you could look up, maybe some potential benefit for ginger and baswellia and some things like that for inflammation. But unless we're in very specific circumstances where we have an injury, we're probably not going to those areas. I just wanted to highlight one thing that came up in a previous episode. Some, not all people, but some, including myself, are very sensitive to curcumin. It has a very potent effect in reducing DHT dehydrotestosterone and leads to all sorts of clamping of testosterone associated positive things. So I have experienced that myself. I've had people write to me and say, I don't understand. I started taking a supplement. Curcumin is supposed to be a great anti inflammatory. It flatlined my libido, it took away my drive and kind of wondering what's going on there? Those people are very likely to be very DHT sensitive. Curcumin, while it's a potent anti inflammatory, can also potentially reduce DHT. But some people tolerate it quite well and are hearing this and probably think that's ridiculous. Well, it's certainly substantiated by the biochemical pathways that curcumin taps into in the known roles of DHT on libido, aggression, power output, et cetera, and mood. So just be wary that a

there's no way to predict this. One simply has to figure it out empirically, meaning you have to try and see if you like it or don't. The good news is those negative effects on DHT seem to reverse pretty quickly after ceasing to take curcumin. So just a mention of something that came up in a previous episode, but in case people didn't hear that segment, just wanted to highlight those facts. Further evidence I strongly discourage strongly discourage taking anything in the anti inflammatory antioxidant realm unless you actually have a reason to do so. If you're waking up and you're like, maybe I'm inflamed, that's probably not a good approach. Let's have a reason to do so. Step two is actually what we call proliferation. And that's kind of like the cleanup crew. That's when you're going to be going in there and cleaning out dead cells and debris and misfolded proteins and things like that. At this stage, a fantastic evidence based supplement is glutamine. Glutamine, 20 grams a day. We typically honestly split it up into two dosage, 10 grams morning, 10 grams night. It's a conditional amino acid, which means you can make it, your body can make enough of it at times, and other times you may want to support it. Generally those conditional times are things like burn victims, high stress situations, or injury, things like that. So there isn't also like a ton of downside to glutamine because it can go through transamination, which means your body can take it and say, like, we don't need anything here for our muscle recovery. Let's make it into something else and use it for whatever else is needed. So it's kind of another one of these low risk products. It's honestly why you see it in a lot of recovery products. If you're ever wondering like, what the heck is that in there? I don't need amino acids. And you're thinking it's like for protein synthesis, it's really not. It's because of this it is beneficial to this proliferation process. I've been taking glutamine for years. I tend to take it in higher dosages several times throughout the day. If I'm ever feeling particularly run down. I know there are decent data, not great, but decent data on the role of glutamine for leaky gut, totally for offsetting leaky gut. That's getting a little bit into the realm of not super well substantiated, but in the peer reviewed literature, but a lot of anecdotal and certainly some peer reviewed work, but not a ton. And then there is also growing interest in the idea that glutamine, because it can trigger activation of the neurons in the gut that signal to the dopamine pathway in the brain that it can be used to offset sugar cravings. This is kind of an interesting new and emerging theme which makes sense given the biology of the neurons in the gut that respond to specific amino acids, including glutamine, essential fatty acids and sugar. And because they respond to any and all three of those, any one or combination of those, I should say, to trigger this dopamine response. Some people have taken to a teaspoon or so of glutamine in some water or other drink a couple of times throughout the day as a way to reduce their sugar cravings because what's essentially doing is it's tricking the pathway into activation of those neurons through an alternate ligand receptor interaction. Right. Also, another interesting point. There are very I'm trying to think right now off the top of my head, I can't think of a time and I've used glutamine a lot. I can't think of a time where I've ever heard anybody come back with any side effect reports. I think if you take enough of it, you can get some gastric distress, but of course, you take enough of any powdered substance mixed in water, you're going to get a gastric distress response. And what I've noticed about gastric distress with things like creatine glutamine and even protein powders for that matter, I use a high quality whey protein powder routinely is that if you build up to it over the course of a few days, then you can get away with using much higher dosages without any issue. Yeah, beta Alanine is the same thing, by the way. We sort of talked about that earlier. If you've ever tried that and you're like, oh my gosh, I feel like I've just rolled around in grass and my skin is itching everywhere that ants under the skin sensation. Yeah, all that stuff. You can just take a little bit of a lower dosage and be fine for the most part, and then you will build up a tolerance to that pretty quickly so you can up that dosage along the way. So what we will oftentimes do there is start at a dosage that's pretty minimal, like 2 grams, and then every week or so you can go up another gram until you get to whatever final point you want to be. Five, 6 grams a day, whatever. So that's another way you can sort of mitigate that problem. So the third step in this recovery process, after inflammation proliferation, we're now into remodeling. And this is when you're actually, quote unquote, growing back

bigger and stronger. This is where the majority of the repair is actually taking place. And at this point, we're basically playing a micronutrient and macronutrient game. By that I mean we've talked about basic macronutrients. One thing to pay attention to oftentimes if people are hurt, whether they had an injury or they've had just, they're super sore and they are concerned about eating excess calories, they tend to want to eat less food during this process because they're like, I'm not working out so much, so I'm going to eat less calories. Well, one of the things that you have to pay attention to is injury can increase basal metabolic rate by up to 10%. Wow. So what you want to do in general is just take your calories up about 10%. At least that's what I recommend. If that is an extended period of time, then yes, you may put on a slight amount of body fat or something, but if that also means you come back some percentage faster, then it's worth the exchange. So we recommend that in terms of your carbohydrate or fat split, I'm not super worried about it. My general recommendation is just don't make any major changes relative to what you were doing. Right. Keep yourself pretty much in the same spot. In terms of protein. This is the big one. You want to make sure you are absolutely at 1 gram per pound of body weight because we need those amino acids to come in and start helping with recovery. 1 gram of protein per pound of body weight or more. Or 1 gram or more. Yeah. There's going to be very little downside to having more. Remember, protein and carbohydrates both stimulate insulin. And remember, insulin is anabolic. And so we're trying to drive this process of recovery. That's why you want both. So you wouldn't want to skimp on carbohydrates in this phase, nor would you want to skimp on protein because you need the activation, the drive into the tissue as well as the structure. Going back to one of our earlier conversations, and at this point in the week, I honestly can't remember at all what episode we covered this in. But I gave an analogy about making a campfire and using fat and carbohydrates as the wood and the log and the protein were the metal structure. So you need that supply if you're trying to bank, if you've cleared out in the previous step, damaged proteins and you need to make new ones to recover that process, you have to have the raw supply and material. So you wouldn't want to avoid either one of those things. There's actually some indirect inflammation management that comes from fatty acids, which you actually sort of alluded to earlier. I don't think you need to necessarily go crazy. You don't need to change your fat intake that much. Just don't drop it depending on where you're at. So if you're a little bit of a higher carb, lower fat person, great. If you're moderate, great. If you're the indirect, if you're a higher fat, lower carb person, awesome. Just don't make an extreme change and try to not be on the extremes of either one of those ratios. But the only specific number to pay attention to, again, is that protein number. And if you go a little bit high or even a lot high, it's totally fine. Just don't go low. So that's the macronutrient portion of remodeling in terms of micronutrients, to be honest, you just get your bases covered. This is when a basic multivitamin is effective. What you're really trying to look at here are vitamin A and zinc. They actually have independent mechanisms that are helpful here, but those are typically covered in most multivitamins. So we generally just give people a multivitamin. Magnesium actually has some benefits here. Something like six milligrams per kilogram of body weight is the dosage you're looking for there magnesium. Citrate probably

has the most evidence in terms of this respect, but it doesn't mean I actually have no reason to think you couldn't use glycinate. Or if you're using another form for sleep, that's probably fine. I don't know that for sure, but I can't think of a reason why the other forms of magnesium would all of a sudden not work. So you could probably choose whichever form you like, albeit Citrate has probably the most research in this aspect. The only other things you would probably consider here three things. Calcium might be on your list, particularly if you're concerned with some sort of bone injury. And we've sort of gone past recovery and we're actually into injury. So you'll see that in recovery products occasionally, and that's why. And then the last two ones, of course, are vitamin D, and that's pretty well researched. And then the last one is actually something that can help you if you're at this stage and you still are dealing with a lot of soreness or not, and that is tart cherry juice. And that's actually effective for both DOMS muscle injury, muscle soreness, and actually has another benefit of potentially aiding with sleep. So not a bad one to turn

to as well. And there's a number of companies that make these things. And then there's actually more ongoing research that I know of on those areas. But promising literature, we'll say, not often, but every once in a while on this podcast, I will solicit social media for questions from the audience, or I should say the audience to be, and then ask some of those questions on the fly. During the podcast, I did this with Dr. Lex Friedman. I'm going to do it with you. Your goal is to answer each of these questions, certainly not all of. Them, thousands of them within the last couple of hours to answer each of these questions in three or four sentences. I certainly won't be counting the number of sentences that you speak. So just know that if you want to go over a little bit, that's fine, but feel free to refer to your Instagram site at a future time where you might go more in depth or to refer to a study. Or if you like, you can also say pass if you don't think that you can answer the question succinctly enough for this format. And here the goal is not to put you on the spot. The goal is simply to allow the audience to ask some questions directly. And I confess I'm looking at these for the first time, so I'll try and be quick with my reading. Some of these we may have touched on in previous episodes, or in this episode even, in which case you can just kind of queue us to the reminder. This is not directly related to supplementation, but it is related to nutrition. And I don't think we touched on this directly. Can we do intermittent fasting, aka time restricted feeding with Keto and still gain muscle mass TBD? I am quite clear such study does not exist. So I don't know, I think I've alluded to before that we did run an intermittent fasting 16 eight hypertrophy study. There was no Keto Arms. The results of that study, by the time this comes out, will probably be ready, though I'm not sure, so I can't comment on it. I haven't looked at the data, but regarding whether or not if you did that with Keto or not, I can't comment scientifically. Do you ever prescribe the use of GABA supplements? Well, I can't prescribe anything to make sure we're clear, but you're a professor, you can profess. I can profess. We generally don't spend too much time on GABA. Rarely is it okay to weight train fasted than not break the fast and eat for three or 4 hours after training. So, in other words, train fasted. I do this but then also not eat immediately following training and wait another three to 4 hours after training. Once we have our results from our intermittent fasting study back, we will have a better answer here. My general recommendation as it stands now though, is as long as your total protein intake is sufficient, you should be in a decent spot. Great. A lot of questions about fasting and training. Just to note that. Can you train high performance fasted and how long before you need to refuel the body? Yeah, you can certainly do that. I know of actually many athletes, some athletes that will do that, though the vast majority will not. As it gets higher and higher in intensity and or duration, it gets more challenging. But it really does come down to what you did the day before as well. So if you ate sufficient calories the day before, didn't train, and your Glycogen stores are topped off, you have a fighting chance. Now, the duration part of that equation is really kind of dependent upon you. So are you really talking 30, 45 minutes, 60 minutes? You're probably fine. Whether you're out past that in several hours, you may not be. And then the only other comment I would make is there is, keep in mind, whenever you think about fasting and any other, let's say against the textbook, quote unquote style, you really, really need to be careful in thinking the difference between can I do it? And is it optimal? So I have absolutely no reason to think fasting. Like that would improve performance. I only work for the most part, with people who are trying to perform at the highest level possible. So I can't think of a scenario in which I would go to fasting to try to enhance performance. So whether or not you can maintain some level of performance, probably will it provide any benefit? I struggle to find scenarios in which that would actually make you perform better. How do different forms of carbohydrates impact performance? And then right below it another question about carbohydrates, which is, does carbohydrate cycling work? So these are two questions from people that I think don't know one another, but a lot of questions about carbohydrates and performance, which we've touched on. Anything else that you want to add to that conversation? I don't think I really maybe you might want to think about carb loading. Carb cycling. So carbohydrate loading does help, however, a misconception. There is it's just a big bowl of pasta the night before that can help top off storages. But really optimal carbohydrate loading prior to a long duration endurance performance is

probably best over the course of three or four days. So you want to gradually increase carbohydrate intake for multiple days rather than just have one big bowl of pasta. Branch chain, amino acids and essential amino acid supplementation. Yay nay, or as I would say, meh. Meh. Usually if your total protein intake is fine, then you don't really have a need for them. If you're for whatever, any number of valid reasons, total protein is not, then going to an essential amino acid would be my first step, rather than a BCAA. Now, admittedly, we actually do use essential amino acids somewhat regularly because it's also sort of like there's no real harm other than if you're price conscious and you're sort of like, I'm wasting money, that's fine. The people I work with generally, again, that's not a few dollars to maximize recovery is not that big. So we will sometimes use that premit or post training in some circumstances. Total protein would be a high quality whey, something like that. If you can't use whey for whatever reason, there are plenty of high quality vegan proteins you could use. If you want to top all that off, though, and add some essential amino acids, it wouldn't hurt anything and may potentially help slightly. So you choose based on that algorithm. I was hoping somebody would ask this. We've touched on it a little bit. It's a little bit of a loaded question, the way they've phrased it. So, at risk of leading the witness, does the mythical anabolic window really exist? And I'm just laughing because the way they posed the question, they're already telling us what their stance is, making it more effective to create hypertrophy to eat within a certain time frame. After working out, I'm going to assume that this person genuinely wants to know whether or not the anabolic window really exists or not. Because they refer to it as mythical, I'm going to assume that they're suspicious. But what's the deal? Is the anabolic window a real thing? The postexercise anabolic window is extremely real. So what this is you can see more detail in a number of videos on my YouTube page. I believe it is the idea that you need to must consume some sort of nutrients, specifically, usually protein in some time domain, 30 or 60 minutes post exercise in order to maximize growth. So is that window real? Yes. Are you hypersensitized to nutrients in that time frame? Yes. Is it very important that you rehydrate replenish muscle glycogen and rebuild tissue quickly after exercise to maximize recovery? Absolutely. It's not real, though, in the sense that you have to have it within 30 minutes. In the case of protein, as we talked about a second ago, your total protein intake throughout the day is more important. Timing, though, for things like carbohydrate, especially if you're training multiple times a day, it is very real. So it is a very real thing. It's just you may or may not actually care about it. It may not be important for your context. Garlic seems like an appropriate question. What, if any, functional roles does garlic have in performance? Garlic is actually really cool. There's a number of things you can dive into that are outside of my three to four sentences, considering I'm at like two and a half probably already, you're not going to find strong human data on garlic extract. However, there is a little bit suggesting it can actually enhance recovery from injury or potentially tissue damage. So you got to kind of be careful, though, because in order to understand what's happening, you have to differentiate between innate and adaptive recovery processes. And when we say things like immunity, realize, Spence, that's not one thing. That's just like a very colloquial

term for a number of things. Again, it's a verb. It's a noun, right? The immune system. But immunity is a bunch of processes or processes. If you're about to correct my speech, I'll correct yours right back. Not yours, Andy. Listeners, processes. Tomato, tomato. It's a verb. Immunity is a verb. This is my problem with immune boosters. Same issue, right? You're like, Whoa, what are you boosting specifically? Because in fact, if you're boosting the wrong part of immunity during the wrong phase of recovery with garlic, you may be actually hurting the process because you theoretically could be trying to down regulate that portion so that you can up regulate an X portion. That's the faster way to say it, if you will. So you may see more data come out that says the garlic extract is overrated. I actually don't even know yet. We just don't have enough human data on it. But yeah, there's some stuff there if you want to look hard enough. I'm going to ask this question for myself because I'm curious to know the answer selfish. Tart cherry extract pretty effective actually for two things, potentially aiding in sleep, getting to sleep, as well as muscle soreness. That's the bulk of the research is in muscle soreness and seems to be

a moderate effect there, I think for people that might be interested in dosages of things like tart, cherry extract, garlic, et cetera. Obviously Dr. Andy Galpin's Instagram and Twitter are great places to ask questions like that and to find answers to questions like that as well as Examine is a terrific website. They actually recently overhauled their entire website. So they have this human effect matrix that shows the effects and the strength of different effects in human studies of many, many different compounds relating to everything, to hormone health in men and women, sports performance, cognitive performance. It doesn't cover everything, but it certainly covers a lot with links to studies. There's a lot that's available at completely zero cost. By joining Examine, you can access some additional features and this is, by the way, not a paid endorsement from Examine. I'm simply a longtime user of Examine.com myself and so I just want cue people to it. And again, many of the resources there are available completely free of cost. It's a wonderful site. So for dosages of garlic, tart, cherry extract and things of that sort, whether or not you're getting it from food or you're getting it from extract powders rather, all of that information is pretty nicely laid out there. So unless you have something to add to that, I was just going to cue people to that resource. No, I've been using that since the first day that website was launched. I was made aware that it was coming. Been fortunate to know those guys for a while. So yeah, I've used it. I've used it in all my classes. I use it, I don't even know, probably weekly at this point. Another nice feature that's actually on there is they have a series of like they'll do some topical reviews basically. So they'll write a big paper out on muscle damage or blood pressure or testosterone, testosterone enhancement or hormone menstrual cycle. Yeah, PCOS, I think they do one on and all kinds of stuff. So you can search by topic like energy or recovery or whatever. Or you can search by Black human seed extract or like, whatever number of things you want to do. And they'll also tell you if there's any interactions to pay attention to. So it's really, really nice. So be careful if you're taking A and B or whatever. So, yeah, it's wonderful. Wonderful. Yeah, they've done a marvelous job. So thank you. Examine. Keep up the amazing work. Well, we've come close to the end of this episode, and that means that we are close to the end of this series, where you have so graciously joined us for six full episodes of the Huberman Lab podcast to educate us on all things fitness. Episode one, you reviewed and educated us on assessing our level of fitness. In fact, I learned so many ways of assessing fitness that I had not thought about and also assessing my recovery capacity. For instance, one thing that I'm definitely going to implement from that episode is a routine broad jump test, an in home high jump, jump and touch test. If people don't know what I'm referring to, that's all contained in that episode. It's timestamped. These are very straightforward, zero cost ways to assess one's level of fitness. There are a few others that require a bare minimum of technology, like taking your pulse rate in very specific ways at specific times. Also some timing of mile runs and some other things related to strength and hypertrophy and on and on. Really, it's a buffet of options that we can select from. And I already know the four or five that I started implementing this week. I've recognized how I'm pretty good in a couple of areas. I'm doing maybe better than pretty well in one area, but that I'm doing abysmally poorly in a few areas that I just wasn't aware of. And so I've already started taking on ways to adjust that over time and I'll keep people posted. So that first episode was absolutely incredible and just provides so much actionable knowledge and the rationale behind it. The second episode, you educated us about strength, speed and hypertrophy training. And there too an immense amount of incredible knowledge. We got way down into the details you explained sets reps, the rationale for sets reps, rest, cadence, number of workouts per week. I'm definitely going to take away my need to do some speed based training and some power based training. Normally, I think in terms of strength or hypertrophy. And I'm relieved to learn that a lot of the speed and power based training, low intensity enough that it can be done fairly often and incorporated into my program, which already touches on strength and hypertrophy and indeed some endurance work as well. So, amazing tips that you provided there. I'm certainly going to implement the three to five program that you described. Three to five exercises done for three to five repetitions, three to five minutes between sets. You're doing this three to five times per week and so on and so forth. All the details, again, timestamped in the strength and

hypertrophy episode show note. So just incredible. We even used that to set up PR with you this week. That's right, I did PR this week thanks to your input and following that program, and I'm really grateful for that. It does feel good to break through a barrier. And I intend to break through more barriers, but not just with strength and hypertrophy. Because episode three you taught us all about endurance, the four different forms of endurance, how to train for each of those different forms, the value of doing even very brief 22nd sprints or bouts of jumping jacks throughout the day, which to some people might just sound like a little hack or a gimmick. But no, these are actually tapping into fuel systems and modes of neural muscular interactions that greatly aid other forms of endurance, like long duration endurance. I would love to return to my high school mile time. I won't reveal what that is because this is not really about me, but I plan to start doing, if not mile repeats, then doing some mile runs and testing there once a week. You laid out a beautiful program for how to do that. And then in the next episode, you wowed us again with a description of the science and the tools and this, right down to the details, but all laid out very cleanly and clearly as to how to design an optimal fitness program. What are the things that really represent an optimal program? What questions does one have to answer before designing a program? What are some of the barriers in the way this concept of defenders as things that prevent you from reaching your goals? And one of the key things I have it right here in front of me that I took away from that episode was this quadrant approach of really thinking about and figuring out how much one intends to devote to work, career calling. Let's make that one bin, relationships, another bin, fitness in the other bin, and recovery in the other bin. And here we'll tip our hat to our good friend Kenny Kane for mentioning that overall scheme for doing things. It's been immensely useful and I've actually charted it out and thought about and drawn out which different things fall into each of these categories. You might think it's obvious, okay, relationships, but that includes a lot of different things. And there's crossover between these bins in terms of how you can combine enhancing relationships with fitness, work, recovery and so on. So that episode is just, again, a treasure trove of knowledge. And then in the next episode, you educated us on recovery in all its forms in the very short term, within the workout, immediately after the workout, and from workout to workout, ways to really accelerate recovery, assess recovery. And as you pointed out, for people like me who always assume that we don't recover very well. And that's some sort of character trait or nervous system thing or genetic to really think about how my training is impacting my level of recovery. And in doing so has revealed to me that I have far more capacity than I thought I had. And already this week I've managed to train more often, doing more work, and I feel better than ever. And that's also despite the fact that we've spent a fair amount of time in these chairs across from one another. It's a kind way to say it, it's been a pleasure. And then in today's episode, you explained nutrition and supplementation as it relates to performance. And of course, that touches into recovery, but also optimal mental states for training, how to approach one's training, and how to extract the most from training through quality nutrition. So what to eat and when, which carbohydrates, protein amounts, windows of opportunity, windows you absolutely don't want to miss, and then some that are a bit more flexible. And then we went deep into the weeds of magnesium, garlic, tart, cherry extract, alpha, GPC. We touched on neurotransmitter related systems, hormone related systems. We went deep into a discussion about sleep, because, of course, sleep is the foundation for recovery and performance of all kinds, emotional, mental and physical recovery and performance. And in taking us through this enormous arc of a journey through fitness, I think it's fair to say that you've given us your knowledge contained in your head. I was telling someone just the other day that one of the things that I always lamented in science is that I would encounter these incredible professors and scientists in other domains of life too. And you just wish there was some way to download their brain because they had so much knowledge inside them. And I'm looking for a USB or USBC port on you, and I don't see one yet. But what you've effectively done for us across these six episodes is to download the actionable knowledge. And it's wonderful. The information you've provided is clear, it's super interesting, it's highly, highly actionable, and in many cases it's counterintuitive and surprising. But once one understands the logic behind it,

as you've provided for us also, then it all makes sense in a way that's extremely satisfying and extremely motivating. So it's certainly motivating me to change the way that I train in a number of ways, and I promise that I'll report back to our audience and to you as to what my results are. But really, as we both agree, this is not about me, this is not about you. This is really about the people listening. And so for those of you listening, I hope you can appreciate what an incredible gift it is to have somebody of Dr. Andy Galpin's experience and drive and scholarly background who also works with athletes and everyday people just to splay out all this knowledge for us systematically over six episodes. Dr. Andy Galpin, thank you ever so much. I appreciate that. Far too kind of words to me. If you've been following along through this entire journey, as you called it, you know, I like first principles thinking, and I like lists. So I'm going to get you with one more list, and I got five things on this final list. Get your pen and pad out, please. Number one, I want to really emphasize science itself is a verb, which means it's ongoing and changing. I did my best over the course of these many, many hours to provide my interpretation of the science, to provide my practical knowledge and things that I use. But that's fallible. Science changes. There are many, many things in my career that I was very sure that the evidence was clear on, and then it changed. So as you move forward, do not think of any of the recommendations I gave you, whether they were about supplement dosages and timing, rep ranges or breathing tactics, anything in between, just use them as guidelines. So, number one, science is a verb. Number two, I really want to thank the audience. This has been an extremely long haul. Some of you have somehow, I'm sure, which I'm not sure how, but some of you have probably made it through this entire journey and listened to all six episodes. And you should probably get some sort of free Huberman Lab shirt or something, or a plaque or I don't know, how about a galpin plaque? Ah, galpin plaque. How about an Internet high five? And even if you just dropped in for a few of the know, I appreciate you taking the time. There's a lot of things you could be doing with your time, and to spend those resources on my words is touching. Number three, I want to actually thank you, of course, Andrew and the whole team and the crew up here for three things. Number one, I think it's incredibly important that you have gone out of your way to give other people credit for their work. You go out of your way on your large platforms of social media to tag people, to give scientists credit for their work. Most people do not do that, and that's something you don't have to do. And I think that is a culture. I know why you do it. You come from science. That's just what you do. You give people credit for their work, but you go out of your way to do that. And so I want to thank you for that. The next one is many people who have outlets and platforms will try to fill those with people who are going to grow their platforms. It doesn't mean these people are wrong or bad. But I think what's extremely special about what you've created here is, again, you have gone out of your way to bring on the direct source of information. I can't even imagine how many of your podcast guests have never been on a podcast before or have been on a very short number of them. And you've made an extremely large platform doing nothing but talking about super deep, dork science directly from the scientists themselves and to create a community like that. I'm so happy that science has made it here and you've shown the world people aren't stupid. People want detail and people want science, and you've given it to them. And the last one, of course, let's see if I can get through this is thank you for what you've done for me in my career. I understand there could have been any number of people in this chair. To put me on your platform once was incredibly gracious. But to do it for 600 hours or whatever we did in this series is I can't thank you enough for that opportunity. So I hope I lived up to it and I had a tremendous time. And then thank you for being such a gracious host. Well, you more than exceeded expectations. You are absolutely the person to be in this chair talking about these topics with me and for the world. And once again, I just want to say thank you as a colleague, as a public educator, as an exercise scientist, and as a friend. If you're learning from and or enjoying this podcast, please subscribe to our YouTube channel. That's a terrific zero cost way to support us. 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