

## Dr. Andy Galpin: Optimal Protocols to Build Strength & Grow Muscles | Huberman Lab Guest Series

In this episode 2 of a 6-part special series, Andy Galpin, PhD, professor of kinesiology at California State University, Fullerton and world expert on exercise science, explains optimal protocols for increasing strength and causing hypertrophy (muscle growth), as well as for increasing speed and power. He explains the training principles and underlying mechanisms for reaching these goals. Our conversation covers a breadth of training topics, including selecting the number of repetitions, sets, inter-set and inter-workout rest periods, warm-ups, exercise cadence, breathing, stretching, recovery, training frequency, overcoming plateaus, nutrition, and he gives specific examples of exercises for power, strength, and hypertrophy.

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## Articles

Sarcoplasmic Hypertrophy in Skeletal Muscle: A Scientific “Unicorn” or Resistance

Training Adaptation?: <https://bit.ly/3j4sXxq>

Towards an improved understanding of proximity-to-failure in resistance training and its influence on skeletal muscle hypertrophy, neuromuscular fatigue, muscle damage, and perceived discomfort: A scoping review: <https://bit.ly/3Dd9Mly>

## Other Resources

Andy Galpin: Science of Muscle Hypertrophy: <https://youtu.be/MyKrc-fheBw>

Prilepin’s Chart: <https://bit.ly/3XD9Nxx>

Cable Core Rotation: <https://bit.ly/3WDihnd>

Eric Cressey: <https://ericcressey.com>

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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 our professor of neurobiology and Ophthalmology at Stanford school of medicine today marks the second episode in the sixth episode series with Dr Andy Galpin, a professor of kinesiology at Cal, State, University, Fullerton and one of the foremost world's experts on the science And applications of methods to increase strength, hypertrophy and endurance. Todays episode is all about how to increase strength, speed and hypertrophy of muscles. Professor, Dr Andy, Galpin great to be back last episode. You told us about the nine specific adaptations that exercise can induce everything from strength and hypertrophy to endurance, muscular endurance, so on and so forth, and you gave us this incredible toolkit of fit tests for each of those adaptations so that people can assess them for themselves And then, of course, improve on each and every one of them if they choose by the way people can access that information. Simply by going to the first episode in this series with you and It's all there and time stamped, and I highly recommend people do that today, we're talking about strength and hypertrophy and so right out the gate. I just want to ask you: why should people think about and train for strengthen, hypertrophy, and that question is, of course directed towards those that are trying to get stronger and grow bigger muscles? But I know that many people out there perhaps have not thought about the benefits of strength and hypertrophy training and how beneficial it can be, not just for people that want to get bigger, biceps, Etc, but that have other goals, longevity goals and health goals unrelated to What most people associate with hypertrophy? So what are the benefits of training for strength and hypertrophy for the everyday person for the athlete for the recreational exerciser and so on? There is a wonderful saying, I think it was Bill Bowerman, the founder one of the founders of Nike, and he always said if you have a body or an athlete and - and I think That's very important for people to understand, because one of the major disservices we've done In this field is convince people that things like strength, training are for athletes or for growing bigger muscles and cardiovascular training are for things like fat loss and heart health, and that is a tremendous disservice, because it puts a lot of unnecessary barriers and leads to a Lot of false assumptions and then therefore poor actions classic examples of this are people who are resistant to strength training

because they don't want to put on too much muscle people who only perform one type of exercise because they want say fat, loss or they're in it. For longevity and health, and they don't work, they're, not worried about you, know being an athlete and so right out the gates. We can actually draw back a little bit to what we were. Our previous conversation, when I walked you through the history of exercise, science and the reason I did that is to help you understand. These are the railroads that you're running down and you don't even realize it in terms of everyone, thinks of strength, training and they immediately default to our principles, to optimize muscle growth and That's not the only adaptation. One should be, after with strength training when we think of endurance training. We immediately default to things like again: cardiovascular, health or fat loss, or things like that. What I really want to do across this entire series and conversations is to to just break that immediately talk about all the other things that you can do with your with your training and so that people can be comfortable and confident in doing an optimal training program. For whatever goal they have, whether that be specific, like growing muscle or non-specific, like just feeling better having more energy being more prepared for life and Longevity, and so to directly answer your question. I could really we could do a hundred episodes on the benefits of exercise and we could run all the way from mood and focus cognitive tasks to a better immune function. You will get less colds, you will, be you will fight them off more effectively to mortality right. So some of the strongest predictors of how long and how well you will live are exercise. However, there are independent benefits that come from just endurance, training and there are independent benefits that come from strength, training and so to just give you one categorically. The way that you want to think about this is resistance, exercise and strength. Training is the number one tool to combat neuromuscular aging. You cannot get that through any other form of exercise. Besides heavy overload, strength, training and we and we can walk through in detail what that is. But that is reason number one in general. Human movement is, is a function of number one, some sort of neuromuscular Activation, so nerves have to turn on. The second part is muscles have to contract, and the third part is those muscles have to move a bone all right. If you want to be alive and you want to live by yourself, you have to be able to engage in human movement. If you have any dysfunction in the neuromuscular system, there, then you're not going to be able to do that and again, as I mentioned, the only way to preserve that or fight that loss of Aging is to strength train, so people will tend to hear numbers like You lose about one percent of muscle size per year after age about 40., and That's true. However, what they

don't realize is you lose about two to four percent of your strength per year, so the loss of strength is almost double that the loss of muscle mass with aging muscle power is more like eight to ten percent per year, and so we can very clearly see the problem: you're going to have with aging is not going to be preservation of muscle, although that is incredibly important. It's going to be very specifically, preservation of muscle, power and strength, and why that really matters is your ability to again stand up and move your ability to catch yourself from a fall, your ability to feel confident doing a movement that is a function of muscle power. More than it is muscle size, and so functionality is really what we want to be right. You want to be able to do whatever you want to be do physically and feel confident in doing that, as you age, That's going to only be obtained through strength, training. So is it appropriate to say that training for strength and hypertrophy is also a way to keep your nervous system healthy and young? Absolutely it is the only exercise route we have for that. If you look at just basic numbers like motor units, you're going to see that older individuals have like a 30 to 40 reduction in total motor units, So when you say older approximately what ages are you referring to? Because I know many people out there, such as myself are 40 and older, but I know many of our listeners are in their 20s, maybe even in their teens, and I can imagine that people that start doing strength and hypertrophy training younger will afford themselves an advantage Over time, but that everybody should be doing strength and hypertrophy training for as much of their lifespan as possible. That's really the message that I'm getting so if somebody is, for instance, 45, would that fall into the bin of older you're, going to start seeing decrements passed again around that age of 40 or so now there is a lot of genetic variation there and a lot of Other things go into that equation like your sleep and your nutrition, but That's a fair number to sort of think about one actually responses. It's actually sort of counterintuitive the wonderful thing about strength training is you don't actually have to start at a young age uh? You can actually, in fact I was reading a paper this morning because of our previous conversation, it was an over age 90.. So these are folks, 90 plus, and they saw improvements like 30 to 170 percent in things like muscle, size and hypertrophy over a very short period of time. I think it was 12 weeks, so you don't actually have to start. There are some adaptations that you're going to need for health, that you, God, you really need to start in your 20s. The reason I like to mention that is because, if you are listening - and you are 50 and you're like oh [ , \_\_\_ ] - I haven't been strength - training you're, not toast, like you - should absolutely start now - um, but you're going to be able to get to A fantastic spot very quickly. Similarly, though, if

you are 20 or 25 and 30 and you aren't lifting there are still many reasons why you should do that now, and I'd like to point that out, because a lot of folks will be like. Oh my gosh. They said I have to do it when I'm 20 or 25, or you know I'll, be sort of screwed, and That's not the case at all. There is really no age limit on this. In fact, there is actually interesting data that just came out showing this reduction in muscle strength, and I perjury that I sort of talked about is basically ameliorated with a preservation of activity. In other words, you don't lose these functionalities because of Aging. You lose these because of a loss of training to state that again, you don't lose these because of some innate physiological thing that happens with genes become less sensitive or you lose functionality. You pretty much can describe the loss of function of strength and muscle and aging as exclusively because of a loss of training and nutrition and anabolic resistance and some other things. So you can do a lot more than you think when it comes to maintaining high quality muscle and That's really important to point out, I'm reminded of the words of the great sharrington he won the Nobel Prize he is a physiologist. I guess the neuroscientists try and claim him as a neuroscientist because he worked on the nervous system, the physiologists claim as a as a physiologist. He is 100 a physiologist. I would call him a neuroscientist, maybe we can argue about this later um. We will, but I think one of the key things that sharrington pointed out was that I believe the quote was that movement is the final common path and what he was referring to was the fact that a significant fraction of the brain itself is devoted to our Ability to move and our ability to engage in resistance type movements and that resistance, type movements and the continuation of movement throughout the lifespan is what keeps the brain, young and healthy and vital. And there are so much data now to support that. But I'm so grateful that you brought up early. This fact that there is a neuromuscular link, because I think a lot of people think about musculoskeletal. They forget that the nervous system is really in charge of the um strength of the muscle contractions and the types of muscle contractions that occur. I'M certain we're going to get into that in a lot of depth. Today, you're close there we're not totally right but we're close Okay. Well, I look forward to being corrected um and to achieving the Precision that you're known for uh around that discussion. So if we are to step back and say strength, training and hypertrophy training is critical for people of all ages, yeah for developing and maintaining the neuromuscular system and for our ability to function in the world. Yeah not just offset injury, but the ability to pick things up and move Etc.

## 00:10:52 Strength & Hypertrophy Training, Aesthetics

What are some of the other things that strengthen hypertrophy training can provide? I know a lot of people use strength and hypertrophy training for changing their Aesthetics. What is your sense about its potency for changing Aesthetics as compared to say, cardiovascular exercise, yeah, the the Mantra? I always like is the reason you want to exercise is threefold right. You want to look good, feel good play good, that That's really that comes from sport comes from football. Specifically, we always say that, and what that means really is you want to look good people want to look the way they want to look whatever that means to them, and there are any versions of what you feel to be aesthetically, pleasing and That's totally irrelevant, but People want to look the way they want to look number two. You want to be able to feel good. What's that mean you want to be injury? Free you want to have energy throughout the day. You want to be able to execute anything you want to so whether you want to go surf in the morning. You want to play racquetball, you want to hike, or you want to do all three of those. In one day, you should have the ability to do that, and then you want to play good, which means you should be able to execute any again activities that you want to execute whatever. That means all right so backing all up. What's that got to do with your question um one of the major benefits of strength training is the responses tend to happen extremely fast, so you can see noticeable changes in muscle size, certainly within a month absolutely within six weeks, and so we have this wonderful feedback. Loop, that sort of tells you am I doing the same correctly. Oh my gosh, yes, I am also It's very addicting the feedback, the response, the physical changes, whether this is actually point, two or three look good or feel good play good or It's even just part. One you're starting to see that when you compare that to things like fat loss, that Journey tends to be longer It's more difficult. It's more Reliant upon other factors like nutrition, Etc. Strength, training is really about like there is some very minimal nutrition requirements. Outside of that, it comes down to the training and the feedback is immediate. That's powerful, because if you look across the literature on exercise, adherence you will see that that is in fact the number one predictor of effectiveness of any training program. So what that means is, if you were to put any variable possible and figure out what is going to determine whether or not this program works. This is what we typically call the methods or many in the concepts are



few, so the methods of exercise, the methods of strength, training, the mess of the methods of hypertrophy training, which we'll talk about are infinite. However, there are only a handful of key Concepts that you have to achieve in order for that program to work, adherence is one of them and again is often the top one. So you need to do something you need to do something consistently when you are getting that feedback and you're seeing results in your appearance immediately, and you see that every single day, every time you take off your shirt or every time you look in the mirror, you see that result that tends to drive adherence um really powerfully. So It's important to give people wins, especially people who are not maybe like you and I who are like I'm going to lift weights and I'm going to exercise like no matter what the rest of my life, because I just love it not everyone's like that, and So giving them a little bit of carrot of success and if you can achieve that in you know, say three to four to five weeks already: It's very powerful tool.

00:14:02 Momentous, Eight Sleep, Levels

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 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 supplement 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 out so That's livemomentis.com huberman today's episode is also brought To Us by eight sleep eight sleep makes Smart mattress covers with cooling Heating and sleep tracking capacity I have been using an eight-sleep mattress cover for about the last eight months and it has completely transformed my sleep I'm sleeping about the same amount but I'm sleeping far deeper and I'm now getting the proper ratios of so-called rapid eye movement or REM sleep and slow wave sleep and waking up feeling far more recovered mentally and physically the underlying mechanism for all that is very straightforward I have talked many times before on this podcast and elsewhere about the critical relationship between sleep and body temperature that is in order to fall asleep at night your body needs to drop by about one to three degrees in terms of core body temperature and waking up involves a one to three degree increase in core body temperature with eight Sleep mattress covers you can adjust the temperature of your sleeping environment to be one temperature at the start of the night a different temperature the middle of the night and a different temperature as you approach morning Each of which can place you into the optimal stages of sleep and have you waking up feeling more refreshed than ever if you'd like to try Aid sleep you can go to adesleep.com huberman and check out their pod 3 cover and save 150 at checkout eight sleep currently ships in the USA Canada United Kingdom select countries in the EU and Australia again That's asleep.com huberman to save 150 at checkout 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 have 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 huberman That's levels.link huberman

## 00:17:48 Strength vs. Hypertrophy Training: Adaptations

Let's talk about strength and hypertrophy, if you would please remind us what strength and hypertrophy are in terms of the specific adaptation they represent, what I mean by that is when somebody is training for strength, what are they really training for?

Obviously, it means the ability to move more weight, but I know that it includes a number of other things as well and when one is training for hypertrophy for the growth of muscle fibers. What does that represent? Because I think, if people understand that they will far better understand the methods and protocols that are going to be best for strength and hypertrophy at its core, you've basically described it. When we talk about strength, we're talking about an actual function, so can you create more force across a muscle or muscle groups or our total movement, and when we talk about hypertrophy now we're specifically referring to just an increase in size, there is no actual mention of function. So a muscle can grow larger without actually technically being stronger. For a number of reasons, however, there is a strong relationship between strength and hypertrophy, so a lot of the times in the general public. In the lay conversations we sort of lump those two things in. It's the same thing, and so we have to recognize people who are new to training or people even are intermediately trained. There is a huge overlap between strength and our perjury. Once you get past that, though they become disentangled and a good example of it is this: if you look at the strongest people in the world, this would be people who compete in the sport of power lifting right, that's a true test of maximal strength, so it is a deadlift, a bench press and a back squat and you're going to do a one repetition max in all three of those, and so whoever wins is the person who lifted the most amount of weight? One time, that's it! It's not like World's Strongest Man, where it is how many reps can you do in a row or your time? Right is a true maximal, strength test and you compare those to say bodybuilders now. Both of those individuals are strong and both of those individuals have a lot of muscle. However, it is extremely clear: the power lifters will be significantly stronger than the bodybuilders on average right. There are individual exceptions, but we're just talking collective averages and the bodybuilders will have more muscle than the other ones. In addition, whether you look at Olympic weightlifting or power lifting or world's strongest man, for that matter, there are

weight classes and the reason is, as you go up in weight classes, you will always see the world records, go higher and higher and higher right. So you can clearly get stronger without adding any muscle. However, there is a point right where you simply have to add more mass to get a higher number and That's why we have weight classes in those Sports and in Combat Sports and lots of other things. So we have there is a lot of confusion right because people think man either. These are the same thing or if I want to get stronger, I have to get bigger, which is not the case at all another misnomer here is. I can't get stronger unless I add muscle, That's not true, either right, It's a similar idea. So what I'm saying is you have the ability to do whatever you'd like if you'd like, to get stronger and add muscle great, if you add muscle, you're, probably going to bring some strength along for the ride. However, if you want to get stronger and you don't want to add muscle for any reason - personal preference on Aesthetics, whether you're in a weight class - and you simply can't afford it - it is quite easy to get stronger and not add much muscle, mass either and so Differentiating these two things is, one of them is simply a measure of size and the other one is a measure of force, and when we talk about strength, what we're really talking about are two unique components. Component, one is what I call the physiology, so what it? What is the ability of the neuromuscular system? What is the ability of the muscle fibers to contract and produce Force? The other one is what we call mechanics and mechanics is simply things like It's minutia down to how long your femurs are relative to your tibia or or other things like this is biomechanics. This is also technique. This is skill. This is how smooth you feel. This is, are you firing the right muscle group in the right sequence and Order and all of these things play into strength, so somebody who maybe has more Force capability in their muscle, fibers, but their technique in the movement is worse, may lose in a competition or Somebody again who's um, like if you go into the world of speed and power, especially you will, hear a lot of people talk about like the Rhythm and there is just a certain Rhythm that has to happen. If you want to jump as high as possible or run as fast as fast as possible, but That's all mechanics at this fundamental level. So when we look at hypertrophy, It's just still simply about how big the muscle is.

00:22:42 Ligaments, Tendons & Resistance Training

So those are the really the the similarities and distinctions between strength and hypertrophy when strength improves and when hypertrophy increases. Is there also involvement in the ligaments and tendons? That is, of course, the ligaments and tendons are involved in the movements and yeah, but do ligaments and tendons themselves grow and or get stronger. This field is really difficult because connective tissue is not vascular, and so their plasticity is significantly lower than skeletal muscle. In fact, if you look across all the organs, a skeletal muscle is one of, if not the most plastic, meaning It's the most pliable, the most responsive, the one That's going to adjust It's. Basically, It's paying attention to everything. That's being said in the body, you cannot change blood pressure or pH or macronutrients floating around, without muscle knowing about it. It is, in fact this is why we call muscle an organ people. Don'T tend to think about this. If you were ever on like Jeopardy and they ask you that question like what's the biggest organ system in the body, people tend to say the skin muscle is actually the correct answer all right. Well, I'm going to cite you when I get it yeah Jeopardy. I don't have any immediate plans to go on Jeopardy, but who knows? Oh there you go Celebrity Jeopardy. Angie huberman wait. I don't know about the celebrity part, but uh Jeopardy would be fun. Yeah um, but I will say the muscle and I'll I'll. If you get a phone call in Jeopardy, I don't know I haven't seen that show in a very long time, yeah uh, maybe ever then I'll I'll call you, but that makes sense um, so that muscles would be the largest organ system in the body. The reason I was saying that is so muscle is both listening and talking. It is controlling uh the immune system, a lot. It's controlling blood glucose regulation. It is, it is the central Depot for uh amino acids, which are needed to do things like regulate the immune system, build any new red blood cells. A lot of this stuff is coming from skeletal muscle, so when we say organ by the way, That's actually like a physiological definition, so something That's communicating uh to either another organ itself or uh throughout the system. So It's listening and It's talking connective tissue is not the same way, and so we do see adaptations with strength, training in connective tissue. It's just much lower It's difficult to measure effectively. What we know now is you're going to have a combination of adaptations throughout the connective tissue. It is beneficial. This is probably one of the major reasons. That's that strength, training reduces injury risk, which is very, very important, because people who tend to want to pick up an exercise routine after say 10 years, the classic cliché is like. I played all these things in high school, then I went to college, got a job now, I'm 25 or 35 or whatever, and you sort of want to jump back into what you did when you were 20. well, there is no

tissue tolerance left and what we almost Always mean by that is connective tissue. The tolerance in there is not ready for the load you're about to handle, and so you go through some movement and then boom sprains tears um, you know even like the more significant ones are on Achilles tear which is going to really sideline you. So those are some of the problems and we know strength training as a large role in injury reduction for stress and strain and overuse injuries, and That's specifically coming from the connective tissue adaptations again. The difficult part here is It's very hard to assess. We actually um when I was a doctoral student we played around with patella tendon biopsies, so I actually had one. This is like a there is, a little piece of your patella tendon missing yeah, because your own yeah own lab. So now I have probably had I don't know how many hundreds of biopsies I have performed on people um, probably well over a thousand, certainly well over a thousand I have probably had 35 or 40 done in myself. There is no problem here I have no Scar Tissue. I have no loss of function and I have stuck needles in every leg, like all over myself, right, quads uh, my Soleus gastroc, like all up taking tissue out yeah. You want the needle looks like a pen basically and you, you know you're alive and you go in and grab a chunk and you pull it out and can I come to your lab and get biopsy absolutely yeah, you're, probably looking under the microscope. It'll, just look like the molecule caffeine, there is a there is, a mutual friend of ours who came down and did that he is a big big, big gentleman, big into lifting very into strength, training, uh and he he went through that experience and he was like. Oh my gosh. It was not what he was hoping to get. He actually had unbelievable muscle, morphology. His fibers were the diameter of muscle. Fibers is extremely large. It's one of the biggest cells by volume in all the biology, skeletal muscle and human and how large I can't help myself um millimeters. Well, you! So you have length right and then you have width right so lengthwise it can be extraordinarily long. You can be the classic example is like your Sartorius, which is like the front of your hip to the inside of your kneecap. Theoretically, those cells can run the entire length, which would be one muscle, fiber running that thing. If I were to do a biopsy on you and I and I pulled that tissue out, I could actually pull an individual fiber out with tweezers and hold it up, and you could see that whole muscle cell yeah I'm definitely not going to get biopsy. Um you'd. Be stunned how big they are anyways. His was the size of a rhino, so the diameter of his now he has a well-documented assistance in the area of muscle, growth, we'll say um, but yeah those can be large. So what were we even talking about there? Well, I was asking about tendons and ligaments um because I'd like to understand the

## 00:28:05 Bone Strength & Resistance Training, Age, Women

Various tissues and organ systems that adapt when one gets stronger when muscle tissue grows, and I do want to ask about bone yeah um, and here I'm not referring to Bone mineral density. What I was going to ask is whether or not bone itself can grow and get stronger and the reason I'm asking is there is a favorite result of mine. I have about 3 800 favorite results: 3 000 pet peeves and 3 800 plus favorite results um, but one of my favorite results is from Eric kindel's Lab at Columbia. Eric won the Nobel Prize for learning and memory and his laboratory got really into the effects of exercise on learning and memory yeah, and they had this incredible result, which is that load-bearing exercise yeah stimulates the bones to release something called osteocalcin. Excuse me and then osteocalcin acts as a more or less a hormone travels to the brain and enhances the memory systems in the brain by enhancing neuron Health. That's the basic Crux of of the studies. There were several of these and The Moment I Saw the first of those studies. I thought well, here is another reason to do resistance, type exercise and not just aerobic exercise, and then it brings to mind whether or not bones themselves get stronger when we do resistance training. I don't know the answer to that. Yeah. That's very clearly demonstrated and we've known that for for many decades um you have a a diminishing ability to do so with age. Particularly, you need to do this in your teens and 20s. This is where you're going to have the largest ability to enhance bone mineral density and It's particularly responsive to axial loading. Now I'm a muscle guy, I'm not a bone specialist, so we would have to consult somebody who can give you more position here. But That's you explain: axial loading, It's up and down It's vertical okay. So It's almost like a like a cylinder putting the weight of the on the small end of the cylinder on both small end of the cylinders yeah. If someone doesn't do this in their 20s or teens, however, can we assume that some degree of positive change will occur if they do resistance training, even if It's a small fraction? The answer is yes, it is small. We have worked with a number of women in our um, our rapid health program that come in and they are in their 20s and they're in their 30s, and they have significant bone marrow density problems. And eight months later, we can see noticeable changes that are outside of the measurement error of a positive change. Positive changes, correct and if you worked with the there are many Physicians that specialize in this area you you're

going to need a Nutri nutrition here. Strengthening alone is probably not going to get you there, particularly with women, because you have to figure out why and there is a lot going on with the physiology and biochemistry so, you probably like almost surely needed to have some blood chemistry done with that. You have to figure out, what's going on menstrual cycle, wise in fact like oftentimes, what we'll do for our women very specifically is we use a thing called The Rhythm plus a 30-day test, so you can actually do a salivary test across the entire menstrual cycle and You can take uh samples It's about every other day, so you get 15 or 16 samples and you get a really beautiful picture of what's Happening, hormonally across the entire menstrual cycle and That's really really important because, typically for women, if you get a single sample or Simple time Point whether It's salivary, urine or blood, you can have um well like a order of magnitude difference in any number of metrics because of what phase are in. This is one of the many reasons why It's been such a challenge to do a lot of physiology research with females, some metrics change throughout the menstrual cycle. Others don't like strength, is a very good example. I can strengthen and I can do a one rep max test on a woman. At any point, I don't have to do that at a certain phase of their menstrual cycle, because It's the evidence, I think, is pretty clear at this point. That number won't change. So I have no qualms, including female files in any of my studies, where strength is an absolute, is an important dependent variable, because I don't have to adjust around menstrual cycle. Other factors like anything in in blood anything hormone, related you're going to have to automatically account for it. So what I would say is those folks should absolutely work with a qualified physician and you you're going to have to get some nutrition supplementation potentially and then maybe even some other stuff going on to make that even more complicated if you're on any form of birth Control or not That's going to change the entire equation, especially if It's a hormone-based birth control, so it just gets really really complicated to answer it, though, you can see adaptations, they are significantly diminished relative to if you would have started in your teens and 20s, but There is hope you just need

#### 00:32:38 Strength Training & Major Adaptations

To work with somebody who specializes in that area so for both men and women, boys and girls, what are the major adaptations that occur to underlie improvements in strength



and if you would, if you could just provide a bullet point list of that, and then we can Dive into each of those in detail, for instance, are nerves getting more efficient at firing, our bones, enjoying adaptations in different yeah bone connective tissue relationships that that underlie strength. I have to imagine all these things are happening, but what are the the major changes that are occurring in those Origins and organ systems that reflect someone's ability to on one day, lift you know 100 pounds and then a week later, to lift uh 105 pounds now I'll try to keep this condensed again. This could be an entire University course. I will also try to give you a little bit of Bones here, so normally as a muscle guy, I only I take all the credit and muscle turns out. The nervous system gets a little bit of credit too here. Thank you. So as we walk through it just in as a big picture, if we think about again what causes human movement, basically, everything along that chain will improve the strength, training and I'm not really being using too much hyperbole there. It's quite impressive, so It's going from the nervous system side of the equation. What has to happen for human movement is a nerve has to send a signal through a motor unit. Now a motor unit is comes down and interface, multiple muscle fibers. So if you think about your actual muscle, It's not a thing. It is a component of many individual muscle fibers, so you've got millions, if not more think of it like a ponytail, so we collectively say ponytail and you think of it as like one thing, but really a ponytail is a combination of tons of individual hairs. Okay, muscles the same way, so this motor unit comes in and innervates a lot of different muscle fibers. Now every one of the fibers in a motor unit is generally of the same fiber type, so fast twitch or slow twitch, and they are not laid out next to each other in the muscle they are spread out across horizontally vertically, as well as closer to the Bone and further to the surface, so they're moved throughout the entire way, and this is what allows you to have smoother contractions and you don't have spasticity and things like that. So we see improvements from the neuromuscular side. Like firing rate, we see synchronization improvements, um that are coming in. You also see improvements in things like acetylcholine release from the presynaptic neuron, so you're getting it faster. We see, calcium recycling is improved back uh to there. So, in order for without walking into too much of the biochemistry, in order for a signal to go from nerve to muscle, there is a little bit of a gap, there is a physical space that happens and what happens? Is you release this molecule called acetylcholine? This goes into the postsynaptic left and then that actually binds to a receptor that receptor actually opens up a door that lets sodium in That's really what's happening. So It's not. The acetylcholine without acetylcholine then sits on that receptor

site. It's broken down, put back in and recycled back up in the presynaptic nerve site, the faster you can do that the faster you can recycle that signal, and so almost everything that I describe in that entire system improves and has been shown to increase with training. So that alone is given to give you benefits. We haven't even walked into to getting from an electrical signal now into an action potential which is going to cause a muscle contraction so getting from nerve into the muscle. We see everything from improvements when we call contractility, which means the muscle fiber themselves, can produce more force or more velocity, independent of muscle size changes. This is another component when we ask like well, how is it I got stronger without getting bigger well in the muscle fiber itself, its ability to contract Force increases, and this is because we have everything like the sarcoplasmic reticulum, which is the place that stores and releases The calcium, which is what's needed for this entire cross-bridge interaction from the myosin and actin to happen. I know a lot. I just lost a lot of people, but you can go look at some of these images. The sarcoplasmic reticulum gets gets activated more. It gets more sensitive. It is better at releasing calcium bringing it back in and doing it again. The bond between the crossbridge, the myosin actin, gets stronger. The calcium Affinity is the phrase that we use. There increases so we're literally walking through almost the entire process of skeletal muscle, contraction here and every step along the way. We we see improvements so that net result is, we see again more Force production, independent of any change in size, independent of any increase in contractile units. We didn't add anything to the equation. We didn't change size. We did nothing but improve efficiency effectively. Independent of that now we can actually start talking about changing muscle, fiber type, so we can change our fibers from a slow, twitch fiber to a fast twitch fiber. That alone is going to give you more force production, again independent of size, fast, twitch, fibers 10 to be larger than slow twitch fibers, but not always, especially in the presence of endurance training. So if you do a lot of consistent endurance training, It's very common for us to find slow twitch, fibers that are as similar size, if not larger, often very often larger than those fast twitch fibers. If you take slow, fibers, big, slow, very metabolically, effective fibrous, so extremely fatigue resistant. So It's not a bad thing to call them slow is like we tend to say fastest low and slow. Has this negative connotation, but It's like quite healthy, like fiber type, to have outside of that now we haven't even gotten into things like pennation angle, so this is an angle at which your muscle fibers interact with your bone. So we tend to think about this as like a muscle fiber is pulling on a muscle. Well, some some of these are oriented are almost a

90 degree, so a fiber runs perpendicular into the bone, and some of them are closer to like a 45 degree, and some of them are closer to almost parallel, and that confers a lot of unique mechanical benefits. So in one area It's actually going to increase Force production, you go the other direction, increases velocity, and so we have all kinds of changes in the angle at which the muscle inserts into the bone now we're already on the mechanic side of it right. So we've we've influenced how effectively it pulls and with any of these things, It's always a give and take so you're going to give up. In the case of a Nation angle, you're going to give up strength, but you're going to increase of a lot shortening velocity or if you want to increase the velocity you're going to give up sort of the strength right. We haven't gotten to any of the energetics. At all, so we haven't talked about increasing storage of phosphocreatine, which is the energy system needed to power that muscle contraction at the fastest possible rate. So we can continue to go as long as you want here, but hopefully you're getting the point of a little bit of the adaptations that occur. The reason I want to actually why I think that stuff is important to bring it back, maybe for some Muslims. I know I took you on a journey there and you're just like what the hell just happened that matters, because again, this is the specific explanation for how is it possible that I got stronger, but I didn't get bigger, and this is also why strength and hypertrophy Are intertwined and heavily overlapped but are not necessarily the same thing so, for example, we can increase muscle size and actually reduce strength because of what's called lattice spacing. So what happens? Is you have to kind of remember your muscle fibers? Are these long cylinders and the way that they contract requires an optimal space, and so what happens? Is you have this molecule called actin and you have this molecule called myosin myosin sits in the middle and there are six actin that surround each individual myosin. In a three-dimensional Circle here, so you got a myosin in the middle that has all these globular heads and they can reach up and grab man acting and again, there is six sort of around them right, um. Well, one of the things that can occur is if those those actin are too close together. So I imagine my hands um, I'm reaching out and doing a giant T right, so I'm horizontal out there. Well, if my fingertips are the tips of the myosin and I'm trying to reach up and grab an actin, and I want to pull those actins closer to my face. Well, those act and stack on top of each other, and That's what actually makes your muscles grow up like if I flex my bicep it actually, you know, grows up three or four inches because you're stacking these these sarcomeres or what they're called on top of each Other all right great well, if I'm reaching out to grab them and the muscle is stretched too far. I can't actually make that

strong of a connection. It would be like if I reached out and grabbed something, but I can only reach my longest fingertip on it. When I go to contract, I can't make that strong of a contraction, because my grip is weak. My grip's going to break before I reach my strength limit. If I'm too close there is nowhere to go, I'm already as close. So if you actually disrupt that lattice spacing too much, you can actually lose a little bit of strength. So It's not that getting bigger will ever make you weaker. It's simply that you're not optimizing for strength, You're, simply optimizing for size, and so that can that can

00:41:32 AG1 (Athletic Greens)

explain a little bit of the of the disconcurrency between growing and performance 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 have 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](http://athleticgreens.com) huberman to claim a special offer they'll give you five free travel packs and they'll give you a year's supply of vitamin d3k2 again if

00:42:25 Hypertrophy Training & Major Adaptations; Protein Synthesis

you'd like to try athletic greens go to [athleticgreens.com](http://athleticgreens.com) huberman to claim the special offer What are a few of the major changes that occur in muscle, nerve, Etc? When we experience hypertrophy I have heard of protein synthesis changes, I'm assuming That's true. Maybe you can tell us a bit more about that changes in blood flow yep. Perhaps changes in neural innervation. Who knows maybe even changes in fascia, I'm not aware of any specifically but um. I have to imagine that they're somehow involved sure so the when we talk about hypertrophy. A lot of the adaptations are going to be similar because the the mode of training is close enough, so your nerves probably aren't smart enough to differentiate between a set of five reps or a set of eight repetitions, they're smart enough

to differentiate anything like they know. Everything That's going on, but It's going to be a huge overlap. The primary difference with hypertrophy is a couple of things. So, if you think about the muscle microstructure um, I have a whole series of videos on YouTube. If you want to see the visuals behind this, in fact, in there I include the specific diameter size of muscle fibers that I have failed to give you a few minutes ago. We will provide an active link to this right so um. What happens is this when we talk about, and you hear that this classic Buzz phrase of muscle protein synthesis generally? What we're talking about there is is contractile units, and so when we say contractile units we're talking about the myosin and actin, and so what we're really trying to do is say: okay, there is some amount of protein turnover where we're coming in and we're trying to add More proteins to the equation, and so what has to happen there is a series of steps, so step number one is there has to be some sort of signal from the external World um. This could actually oftentimes It's things like stretching of the cell wall, which is what happens with exercise right, so you're Contracting a short, and you get this big stretch of the cell wall. It can come from a simple things like an amino acid infusion. This is just eating protein. This is why protein ingestion alone is anabolic right. It'll help you grow muscle, independent of even moving, so just eating protein will grow your muscles yeah, certainly and those that those data are very clear. Um, of course, like anything, there is a saturation point in terms of total amount you need to get to and, and things like that, but yeah. If you were to walk into a laboratory fasted overnight - and I gave you 30 grams of protein, we would see a very measurable increase in protein synthesis quite clearly for several hours, probably four to five plus hours um. We could maybe bring us to people. That would know those data better, but many hours with no waitron correct. I am betting that most people are not aware of that fact. You know what's actually interesting about. It is, if you do the exact same study again and you just did strength training. You would also see an improvement in protein synthesis right, but those factors are independent and the mechanisms are independent, such that, if you do them both together, they stack on top of each other, which is really wonderful and if you were to add carbohydrate into that mix. Now, you're, actually adding fuel for the entire muscle protein synthesis process and now you're going to see even additive benefits, and this is why, for so many years uh, this is what bore the whole like post exercise anabolic window thing, which is like you got to get Carbs and protein in post exercise to maximize um, mostly perjury. Now that turned out to be like not totally true in terms of the Windows window, to not be as strict as people initially uh asserted, as I recall, but but still I think,

That's super interesting. These are parallel Pathways for, for protein synthesis simply eating protein.

#### 00:45:56 Endurance vs. Strength Training & Cell Signaling, Protein Synthesis

um or training each independently increases protein synthesis Uh I can't help, but ask is the same true if one doesn't endurance type exercise, if I go out for a 45 minute jog where I can nasal breathe the whole time, but if I were to go any faster, I would have to kick over into mouth. Breathing as well so-called Zone 2 ish cardio will I see an increase in protein in synthesis as simply as a consequence of that jog. Now this is one of the unique factors of strength, training, you're, not going to say that in fact, you would It's difficult to measure protein breakdown. That's been as extraordinarily challenging to do in the laboratory, but you're not going to see those benefits. In fact, you're going to see quite the opposite: It's an entire molecular Cascade, so this is kind of how it works. So you have to have some sort of signal on the outside and this can be an energetic signal. So this could be glucose uptake. It could be protein intake, it could be a physical stretch. What happens is on the cell wall. There is some sort of it could be testosterone right, testosterone could bind to beta adrenergic receptors and this activates a whole series of Cascades of signaling proteins and these proteins. Basically play a game of telephone, so one tells the next one. This is the next one and I sort of walk this entire way. Well, that molecular Cascade is fundamentally the same thing with regardless of the insult but they're different Pathways, and so the pathway from strength, training or protein ingestion is going to go to the same nucleus. It's going to activate a whole set of Gene Cascades that are going to tell you to to go through this entire process of protein synthesis, which I'll walk through what that is in a second. If you do endurance training, It's a different pathway, and so instead of activating this entire thing of like mtor and akt - and this is anabolic, signaling Cascade, It's going to do a different one, which you can think of more of like as ampk an energy signaling thing. So there is a crossover Point here. In fact, one of the things you will notice is mtor and akt. Don'T really influence ampk. But there is some literature that years ago showed ampk will activate another protein called tsc2 and that will actually inhibit mtor, and that was the first molecular explanation for the quote-unquote interference effect of endurance training on hypertrophy. Could you just take a highlight for people what this is because, as you describe these signaling Pathways, I just want to um, maybe just put a top Contour

explanation. The mtor pathway is synonymous with cell growth yeah, both during development as organisms, humans included, mature and cells, get larger mtor's abundant in the system, to put it quite simply, and then the ampk pathway and some of the metabolic signaling that you're referring to is more synonymous With cardiovascular exercise in this, at least in the context of this discussion and fuel utilization yep, and what you described as a crossover point where certain forms of exercise can tap into both of these yep but at least for sake of this conversation, we're largely separating them. Yeah, because the the byproduct is the thing that uh that matters here so the result of uh mtor and akt getting into the nucleus is going to be increased in protein synthesis. The result of ampk running down to the mind is going to be result in increasing mitochondrial biogenesis, so the net outcome is different. Now I do want to flag it very quickly. This is an extraordinarily complicated thing and um. In fact, in our laboratory we were able to to be one of the first that figured out how to measure all the different subunits of ampk and individual muscles by fiber type so because you're ripping people's muscles out of their knees and their patellar tendons uh. So anxious teasing, they're, they're gently removing with under IRB protocol of course um. So even when we say something like ampk, It's not one thing Amy, we say things like mtor. It's not one thing either it is. You have the total amount that matters you have the activation, the activation sites or many of them. So It's not a simple um as what I'm laying it on. I just wan na a big concept of kind of what's Happening Here to actually kind of answer. Your question, which is okay, so how is the muscle actually growing? What you have to understand is is a little bit of how um protein synthesis occurs. So what I'm generally meaning is, you have a whole bunch of amino acids, and this actually goes back to maybe like middle school biology class right. So if you take a bunch of amino acids and you combine them together, we get these things called a peptide right and if anyone who's ever heard of like peptides, That's all it really means you put a bunch of those together. You have a poly peptide. You put a bunch of those together and we now have a protein, so any protein I want to make is going to go through the exact same system, the exact same steps. It doesn't matter. If that protein is going to be a red blood cell, it doesn't matter if That's going to be a hair, follicle doesn't matter if It's going to be skeletal muscle, That's basically protein synthesis. So when we tend to think of protein synthesis, we we just paint this picture of growing, more muscle and That's not the only thing, and so when we talk about the benefits of having high quality muscle as being this place, That's going to regulate most of your Protein synthesis: we tend to lose some people

because they're thinking, oh, I don't need to gain muscle and That's not what we're talking about we're talking about regulating the immune system or regular, we're talking about regulating any protein turnover. So any Protein That's degraded or needs to be broken down in your in your system at all autophagy. This is the end like this is such an important buzzword: um, That's just protein breakdown of an unneeded or damaged protein right. That whole thing is going to go through protein synthesis to be able to come back and replace the things. The only reason you go through autophagy, so you can clean that garbage out and then come back and build in a more properly functioning protein. So It's not just about growing, more muscle mass, It's why you want these systems to be operating well, so the protein ingestion is going to just activate that Cascade, because It's basically saying oh, hey, look. We have an abundance of Supply here. Why don't we make something out of it? Because we don't know the next time. This thing is going to be around carbohydrates and fat are very easy to store. Protein is very challenging It's more transient, and so you can store some of it and keep it around. But most of it you're going to lose, and so, when It's available, your body wants to act very quickly. It doesn't necessarily care if you have extra fat floating around in your system. It's all right. Let'S package it up and store it, we can easily bring this back out, but if you've got protein around you're going to want to use it, and so That's why it alone will activate and increase protein synthesis independent of exercise, so those effects are additive. Like I said, because that signaling process is independent and once you hit a rate limiting phase, then it you are you're there but at its onset those things will work independently

#### 00:52:26 Muscle Hypertrophy, Sarcoplasmic Hypertrophy

Okay, so that being said, what is skeletal muscle hypertrophy in general? We think about it as this increase in contractile proteins, so those myosin and actin effectively get thicker okay. Now what happens is since they are thicker and, as I talked about a second ago that influences and actually hurts the lattice spacing, and so what your body does, as a result is say: hey, let's increase the diameter of the entire cell, so that we can maintain Our spacing between these things right, It's effectively like if you know the two of us were sitting in this room and you doubled in size, and I was like well you're in my personal space like and I doubled in size now we're in each other's space. The at some point we just have to make the room larger and That's exactly what's happening in the



cell and so as you can continue to increased muscle size you're, going to get a muscle, myofibular accretion you're, going to continue to increase muscle fiber size for years. There was this other comment about non-functional hypertrophy and this is often called sarcoplasmic hypertrophy. Now this is not sarcoplasm particular. This is a fancy way of saying my muscle is larger, but it has no function and the question would be why the hell is that possible. If I have more contractile units - and I can make more of these cross Bridges perform more of these power strokes, this is what these contractions are called. How could I possibly be losing function? Well, that was challenged, for that was Bro Science for a very, very long time. In fact, what it really came down to was: are there different types of hypertrophy training, some that induce contractile protein hypertrophy and some that induce the sarcoplasmic hypertrophy, and that was the significantly challenged until recently Mike Roberts did at Auburn did a series of wonderful studies that Showed quite clearly that sarcoplasmic hypertrophy is probably happening and in fact, there is probably a pretty easy explanation in general. What happens is it is? It is a increase in fluid in the muscle fiber, and so this would allow for the diameter to be larger. But since there is no addition of contractile units, no more forced production happens, and so he actually has a wonderful review paper. I believe It's open access where you can go look and he created a wonderful graph um. I think That's in my hypertrophy videos on YouTube as well, and you can actually see that It's likely happening in phasic changes throughout your training experience. So, at the beginning of your training, but as as the years and year or weeks rather than months and then eventually years go by in your training, we have a change in the hypertrophy, That's coming from contractile units versus sarcoplasmic. So I think that is an important note, because again people are wondering like how the hell is it even possible for me to get larger muscle and somehow I'm not stronger. Well, if it came from Simply fluid retention, and this is not bloating. This is not there is. No negative really to this, it is simply holding a more hydration in the cell. Diameter gets larger and then everything works that way. What you just described calls to mind something similar in the nervous system, which is neuroplasticity, which of course, is the nervous system's ability to change in response to learning and experience and damage for that matter. Yep and we think about it as one term. But there are many different forms of neuroplasticity, a discussion that we don't need to get into now, but there is Spike timing, dependent, plasticity and ltp and long-term depression, which has nothing to do with psychological depression and on and a pair pulse facilitation and on and on. And on in short-term elasticity, and so what I'm starting to understand is that

there are many paths to what we call strength increase and there are many paths to what we think of as hypertrophy. Many of these are going to operate in parallel. It's going to be rare that any one of them is going to be active alone in order to create hypertrophy or strength changes and that certain forms of exercise and certain ways of doing exercises in terms of sets and repetition schemes and rest intervals between sets and Between training sessions are going to tap into different mechanisms, but also overlapping sets of mechanisms, which is why, if I understand correctly, you mentioned at the beginning that often not always but often strength increases are associated with some hypertrophy changes and hypertrophy increases are often not always Associated with strength increases, do I have that right?

#### 00:56:37 Muscle Physiology & Plasticity, Muscle "Memory"

Correct and the beauty of this whole thing is, while we don't yet know the mechanisms specifically and there is a lot of Confusion And there is a lot of changes that happen. There is uh. We actually just submitted a paper a few days ago, um my stuff uh Jimmy Bagley. At San Francisco and Kevin murick at uh, one has a wonderful muscle, physiology Lab at Arkansas, and we we actually. This is a very late article. Actually, It's incredibly easy to read. Um we describe the the role of myonucleation in uh muscle, my per tree and there is actually a lot of energy stuff we get into there, but um we're learning more and more about it. Uh as a quick example, so skeletal muscle is unique in the fact that it is so large in diameter. It's also unique in the fact It's multinucleated what that means is typically in biology. You see, like a cell, has one nucleus, That's the place that houses and holds the DNA, and It's the control center. That was a degro shrink, die repair that whole thing well, skeletal muscle and human is awesome, because it has thousands, if not more, there is nuclei, which gives it that plasticity, and so a normal cell has one place it has to go to for any time it wants To upregulate down regulate, do whatever the thing is your muscle fibers have these little control centers all throughout them, and for years we were like okay, great. The amount of hypertrophy that you can. Experience is probably limited by the amount of nuclei you have because you're not going to exceed a certain size of muscle fiber. If That's going to mean you lose control,

and so we're like okay, great, we found and identified a limiting factor to what will determine how much a muscle can actually grow. And then the next question was, and then, where are these things coming from, and this is where satellite cells come in, and so it was very clear. A satellite cell - That's lying dormant sort of on the outside. The periphery of the fiber will then go in um into the into the fibroid will turn into a myonuclei, and then it can. Actually, you know increase your diameter like that, and so then, actually it was like hey you're, actually limited by the amount of these satellite cells. You can get in and turn into nuclear, and then the evidence came out that showed hey what, if you D train. So what if I used to lift weights like a long time ago - and I got big, but now I have lost a lot of my muscle. If I train again, you actually get that muscle back faster than it took you the very first time to build it. Like That's what we call muscle memory like in our film now on your side, equation muscle memory is something different rights and nervous. When people talk about muscle memory, um like the ability to ride a bicycle after so many years of not having tried to ride one. That's actually largely independent of the muscle. It has something to do with exclusively Independence. It's basically a nervous system, phenomenon, 100, so muscle memory, uh has been co-opted by different communities to mean different things, yeah. So, on our side, muscle memory is going to mean that ability to remember that muscle size right that hypertrophy, because, as you explained, the motor control thing is that It's a totally a nerve thing. That's the one I'll give you this one right! You guys the nerve people can have this one well, it seems to me that there are a tremendous number of parallels between strength and hypertrophy changes and neuroplasticity. This is coming up again and again in this conversation um, because we know, for instance, that if you are exposed to a couple of different languages early on in life, you will learn any number of different languages, far more easily later in life. Of course, and That's because there is some crossover between different languages, especially Latin based languages, that allows for that there is a substrate for it, It's similar to the the ability to hop on a bicycle again phenomenon or play an instrument phenomenon, but It's broader than that and again I think this speaks to the huge number of different adaptive changes that are occurring in the cells and in the nerves that innervate these cells, when one experiences increases in strength and hypertrophy. So to round that out, um and to go back to what I was saying. There, what we're actually learning now is that nucleation thing, and by the way, this entire trajectory story is probably over the last like eight years like this, is how fast we've changed. Our understanding of how muscle grows. Uh, the sarcoplasmic reticulum thing five years ago

was was Bro Science. Now It's It's pretty well established. The mononucleation thing was eight to ten years ago. It's changing every week. This paper we just submitted this week showed actually why we had generally thought a few years ago, and in fact you can find me on podcasts and probably in some of my videos talking about this and I'm going to tell you right now. Those things are wrong. Like we've just had new things come out these last couple years, where that D training effect, we thought was a reason of well. What happens is if you had the muscle before and you've brought in these nuclei and they differentiated and turned into into nuclei, and then the muscle got small again, you would preserve those nuclei and That's why, when you go to train again, they were already around. So the muscle grows faster, the second time they did the first time. Well now it looks like That's actually not the case. In fact, It's actually probably hap what's happening. Is It's a It's a epigenetic change in the nuclei's ability to access the DNA needed to grow muscle? It's effectively the analogy we used It's. The nuclei are remembering how to ride a bike. So It's quite funny that you said that, because It's not really necessarily that they're being preserved over time, they have learned the sequence: it takes to grow the protein there and it goes. It happens faster. The second time and we've also learned that there are specific nuclei. We've known this for actually a while we found this in our lab and we didn't Discover it. We just we saw this in our sum of our Harbors, but there are different shapes the nuclei. Some are more oval, some are more elongated and the shape determines a lot of the functions. Some of them are hanging out more towards the periphery, and some of them are hanging out right around the nucleus. Well, it looks like there is actually probably different types of nuclei, a lot of them that are specific to the mitochondria. In fact, you can see like on some of the Imaging we have you're, just like they're, just packed around the the ma, the mitochondria, and there are some that are probably specific to injury repair, and so this is probably explaining a lot of the the individual variation. I mean, I know, you've you've said previously, like you're, just a very you're, very slow at recovery. There is a lot of things that go into that and I would I would love to walk through sort of all the buckets uh maybe later into recovery. But one of the inherent genetic variations, this could be simply that you maybe have more or less of the nuclei responsible for tissue repair. Um, That's something That's been happening in the last like handful of months, That's been coming out, we'll see if that holds up as true or not um, so as we're learning more and more almost every day about muscle physiology. What's super fun and interesting and I think the most exciting what to do in order in terms of like how to train and how to eat and how

to do everything else to get these adaptations has been pretty well established for a long long time, we're just Figuring out how like what's happening in the muscle now, but we know what to do so from a practical standpoint, putting together protocols for any outcome that you want or don't want for any modality. You don't have a gym. You have uh weights, you have dumbbells, only you only have kettlebells, you don't want to. You only use body weight. We can you only have three days a week. You have seven days a week you wan na maximize muscle growth. You want to get a Little Bit Stronger any of these variables you want to throw at me. We have a large evidence base for exactly how to get those adaptations and not others. So while we have a lot to learn about the mechanisms and the physiology we have

#### 01:04:00 Non-Negotiables & Modifiable Variables of Exercise Training

Pretty good legs to stand on in terms of what to do to get whatever adaptations you want. So what are the essential components of an effective strength and hypertrophy protocol? Okay, so what I would like to actually do is is walk you through both of those because, as we mentioned before, they overlap, but the training needs to be differentiated so that you can optimize either strength, hypertrophy or, if you actually want you can get a combination Of both this allows you to then get the adaptation you want avoid ones you don't want and then get it even a combination, if That's the preference, so a lot of people will talk about. I want to get a little stronger. I want to add some muscle. That's a different answer than someone who wants to truly maximize muscle, which is a different answer from somebody who maximizes wants to maximize strength, which is a different answer from somebody wants to Max my strength, but not actually gain muscle. So we have all these combinations. What's important to understand before we get into the details, there is a couple of things number one we've been teasing this concept so far of the concepts are few, but the methods are many, and so I want to hit those Concepts right now. These are as you, as you say, these are the non-negotiables that have to happen in any training program and I'm referring to these in the strength - and I particular conversation, but these are true of power, development, speed, development, muscular endurance, uh endurance, any other thing: these are Things that just have to happen for any training program to work. I mentioned one uh a little bit earlier, which was adherence and so that my frequent collaborator Dan Garner

will constantly say: consistency beats intensity. Um again. In fact, the literature will show you very clearly: adherence is the number one predictor of physical fitness outcomes. So we want to do something that you will engage in we'll uh you will, put effort into and you will be able to repeat consistently over time. So That's number one. The second one is, and this is a major reason that people don't hit their fitness goals. In fact, I would argue outside of not doing it. The number one mistake they make is Progressive overload. So I'm going to walk you through exactly how much you should be increasing um your sets and Reps and weight Etc per week per month later. But That's the biggest thing you have got to have some sort of overload. The body works as an adaptation mechanism right. So, in fact, we talked previously about the Harvard fatigue lab and one of the things actually people don't realize is the concept of homeostasis is actually comes from research of the Harvard fatigue lab. It was um work that they did on an endurance Runner. I forget his name and they sort of realized that, after a long period of time, working out this is an acute exercise spell the body actually comes back to some stable place. Despite the fact he was continuing to work and That's exactly what bore the phrase steady state and that actually, then, they launched off and said wow there is this state that the body wants to be in and we'll call this homeostasis. So those all Concepts came out of exercise physiology, which is really really cool right um. We don't get a lot of love a lot of times scientifically, but That's a good one that we took so why that all matters is, we have got to achieve some sort of overload without uh going excess, so we'll cover that later uh. Exactly what to do and we'll potentially get into over training and monitoring and mattering things like that, but you have to have some sort of consistent, predictable overload. That's what's going to cause adaptation to continue to cause stress, if you don't do that, you can still do things like burn calories. You can still get some of the other benefits of exercise like improved mood, cognitive function, etc, etc. Flexibility increases all those can happen without a progressive overload. But if you want to see these gains in strength and hypertrophy, you really need to progressively overload. So That's concept number two, the third one here is going to be individualization and this is where we can get into things. Like personal preference. You know: equipment, availability, you have kettlebells or dumbbells. You only have bands. We have none of that. These are all smaller details, but That's an important component to it. The last one I really want to get into is picking the appropriate Target and we went through this when we talked about the fitness protocol and and if you run through something like that - and you run some testing and figure out where your biggest

limitations are. That's going to help you identify where you need to go, so if you can do all those things you're going to be in a good spot to balance, specificity and variation all right. So if you want to make sure you grow your biceps, you better make sure your biceps are working. Having said that, if you over rely on specificity, you're, going to increase the likelihood of overuse injuries which is going to come back and actually hamper consistency over time all right, so this is when hedging towards specificity is important, but too much can cause a problem. If you go the other direction and you go with too much variation, so imagine you're just sort of doing all kinds of different exercises. Every time you you work out, That's actually not enough stimuli directly on the muscle or muscle groups or movement pattern. If you're wanting to learn a new movement um to get you very far, and so this is a classic problem of I'm doing a lot of work, but I don't have a very clear Direction. I lack specificity, so I'm working, but I'm not seeing a lot of improvements, and this is like in the business World Etc. This is like doing a whole bunch of different things means you get nothing really done. So That's the game. We're going to play here right. How do we overload this stuff? How do we make sure we're balancing specificity and variation? How do we make sure I want to do this and then how do I individualize it for my needs and circumstances and and movement restrictions and of time, availability and my calendar and desires and all these things? So those are the concepts we absolutely have to hit. The methods that we choose run across a handful of variables and we call these things modifiable variables because, as you modify them or you make different choices within these variables, you get different outcomes or adaptations. This is exactly what determines the nine adaptations that we've been talking about, so the way that I like to say this is exercises, do not determine adaptation, so you can't simply go. I want to get stronger, therefore, I'm going to choose these exercises. That's not how it works. What determines adaptation is the execution of the exercises, so a deadlift is my favorite example. A deadlift is a common example that people think of when they want to choose a lower body. Strength exercise, but a deadlift will not increase your strength unless you're executing it in the proper fashion. I'm not even talking about technique here. I'm talking about these modifiable variables. The same thing for power exercises we'll commonly see mistakes of doing uh activities like a box jump, which is great people, think, oh, I'm going to improve my power, which we know is extremely highly correlated to activities of daily living and particularly living unassisted as you age, Right is reduction in power, so they'll do an activity like a box jump. What they're failing to realize is, unless you do it powerfully, you won't actually

increase power. If you don't move fast, you won't get faster. So the the way that we manipulate these variables is everything to determining the adaptation you get or again don't get so with that Foundation. I think we can kind of run right into these things and we can start off with perhaps speed and power, and what I would like to do is walk you through all those modifiable variables, what to do with them and then hit you with as many different Methodologies, as we really have time for and then we'll move on to strength and hypertrophy and kind of round the entire thing out and then maybe at the end, we can talk some other variables like what happens. If I have a training protocol and I'm halfway through - and I can't finish my workout, what should I do - reduce my weight or reduce my duration or things like that, so there is lots of what-if scenarios that we can go through that potentially a lot of people

01:11:51 InsideTracker

listening have questions about so sound like a plan sounds like a plan 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 have 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 Etc 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

01:12:53 Tool: Speed & Power Training, "3 to 5" Approach, Periodization, Planning

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just interrupt briefly and make sure that I and everybody else have in mind the proper nine adaptations that we've been referring to and that were discussed in detail in episode one. I have listed number one skill and technique number two speed number three power, which is speed times Force number four strength: number five, hypertrophy number, six, muscular endurance, number, seven anaerobic capacity; number; eight maximal aerobic capacity and number nine long duration, steady state exercise; yep, you nailed it thank you for for that. It was probably important clarification for everybody um. So that being said, let's jump right into speed and power. Now I'll do these a little bit simultaneously. They are different if you're a high performance athlete. You really need to separate these two things for the most people that we can probably think about them is is the same thing. There is not a lot of pure speed, training that the general public is interested in um. If you want to actually further break down speed, there are multiple components: there is acceleration, there is top end velocity, there is change of direction or agility, and things like that. So we'll just kind of call All That speed and power. For now now, at the onset there is this three to five concept that we talked about many times where this is really fairly true for speed, power or strength. Now I I didn't develop the three to five. It's just an easy way to help. You remember one concept that will run true across all these things. So three to five, it refers to three to five days per week. Uh pick three to five exercises and you're going to do three to five repetitions per set. You will, do three to five sets and you will rest three to five minutes between each set. If you do that, and you execute any of the exercises that you choose at a high intent and that part is critical, you don't get faster by moving kind of fast. You can't improve Power by moving like and powerfully you have to be trying, regardless of whether actually moving faster or not anytime, you're talking about speed or power you're by definition using sub maximal weights, so you're going to be able to lift it. That's not the question. The question is: how fast can you lift that Implement, and so intention is incredibly important? So if you do that the same for strength by the way, so if you land on that that allows you to run the gamut from as little as three days a week, you're doing a three exercises. You're going to do three sets of three, which is a very, very low volume. It's a a very low amount of days, easy to handle all the way to five sets of five of five exercises five days a week, so it It's again. It's just one sample. That's something easy to remember and is quite effective for a very long time, and this has been tested quite extensively in in both the coaching Realms as well as the scientific Realms to be quite productive and easy to follow and grasp. If you do that, all you need to do is slightly

increase the load or the volume, but mostly the load over time, and the number we want to look for. There is something like a three to five percent increase per week, so an example would be, if you're going to do an exercise at 100 pounds. You can't necessarily just add five pounds every week. That's going to touch you pretty quickly, and so you may have to run some a smaller increment. If you're doing like a lower body exercise where you might have a couple of hundred pounds on the weight, you can probably get away with adding five pounds because it's still a low percentage of the total load. So that's roughly uh the guide that we want to get to for speed power and strength, so that sounds incredibly simple and effective. Yet I have a number of questions. First off. If somebody is using the three to five approach, does that mean they should not be doing any other weight training of any kind in those workouts or at all? No, you can certainly do that in combination with anything else you would like, especially if you think about speed and power. Those are very non-fatiguing, and so, if you can imagine, you're going to go to the beach and you're going to take a 10 pound to 20 pound medicine ball with you and you're going to do you know four different exercises or you're throwing the medicine ball as high, as you can in the air four times in a row taking a break and you two or three hits that you do maybe three or four different types of throws: That's very good for improving power, extremely good, but it's not very fatiguing. So you could certainly finish that workout in 20 minutes and then run on and then do any number of other things. So you could do some high intensity and aerobic capacity work. You could do steady state stuff, you could you could even do hypertrophy. On top of that, so there is a there is two major categories of what we call periodization. There is there is many many of them, but the two that have the most scientific literature are what's called: linear, periodization and another is called undulating or often daily, undulating periodization, and I'm flagging. These two again, despite the fact there are many many more because they represent two different concepts which you actually just touched upon. So linear periodization is a hallmark by basically saying we're going to train one adaptation at a time. So imagine going say six to eight weeks and you're only doing strength or you're only doing hypertrophy you're endurance for that matter. So in that particular case you would not do anything else in combination. If you contrast that to undulating periodization, you would actually be doing multiple different styles of training, even with either within the same day or just different days. So it could be Monday is power. Wednesday is strength, Friday's hypertrophy whatever, or it could be a little bit of strength every single day, a little bit. I perch for every day a little bit of power

every day and you would just change the amount of each that you do within the day to alter the emphasis all right. Now, if you look at the studies - and there have been many uh rcts on this, the result of both of these training programs is generally basically the same thing. They are equally effective. Here is the major difference, though one if your goal is very specific to one outcome. You want a hedge toward specificity, so if you're like hey I'm trying to maximize the amount of muscle I can build in the next eight weeks, then you don't really anything else. Besides, that is just distraction and potential interference. Does it really matter or not? It doesn't matter, but It's not helping anything else, so linear periodization is, is fundamental at providing focus and therefore the the adaptations tend to be oftentimes larger in that specific area. That downside is you now go six to eight to ten weeks of doing nothing else, and so you were losing those other adaptations that are great at a faster rate, and you can imagine doing something like speed work. Only again, speed work by definition is non-fatiguing. So when oftentimes, we think of speed work, It's like. Oh, I did ladder drills and I did all these things and, like I threw up at the end, That's not speed work. You just did a different type of endurance, training, okay, which is great and important. So true speed work is very high, rest very low fatigue and actually truly trying to reach a new level of speed or velocity. So non-fatiguing. If you did that exclusively for 10 weeks, you would be pretty unfit by the end of it, because you did. You would also lose a decent amount of muscle mass, not because there is an interference effect, but simply because the fact you have not stimulated muscle growth for eight to ten weeks, and so neither one of these is better than the other. We're going to see this classically across all program, design or periodization strategies is It's just a It's a give and take. There are tons of different systems, and - and perhaps at the end we can talk about some of the more advanced periodization Styles. These ones are. Are both effective? You could do these with beginners. You could do these with Advanced athletes. You can do them any Spectrum, but they're they're, some of the more well-documented ones. It's just a pro and con game right. It's. What are you willing to give up the way that you solve that problem is going back to that fitness assessment and your analysis and really truly understanding what your goal is. Is your goal to do a little bit of strength and a little bit? Okay, great, maybe undulated periodization is an approach. If your goal is really to maximize strength - and maybe you can wait on putting some muscle mass on - maybe a linear periodization is a better report or another style of periodization. That's optimal for strength gain. So It's just simply about addressing your things. One of the major problems folks have, in addition

to lacking Progressive overload, is they don't have any foresight past the next day of the training right, and so It's really important that you set off blocks that are anywhere between six to 12 weeks, long, where you're going To have the specific plan, ideally you have an idea for the whole year. I actually have like a structure. I could walk you through for that, but even if you don't have that really think about what you want the next 12 weeks and then maybe the next 12 weeks after that and That's going to give you a lot of guidance about what to do and what to focus on terrific what about warming up

### 01:22:02 Warming Up & Training, Dynamic Movements

I was taught that one should do higher repetition movements with lighter weights in order to warm up and then one of the things that did make a big positive difference. For me, in terms of strength and hypertrophy, training was to do a moderate repetition warm-up with a fairly lightweight, but then to actually keep the number of warm-up repetitions, fairly low and work progressively toward the first so-called work set. When you say three to five, That's three to five work sets correct yep. Are you also going to tell me three to five warm-ups? No, are you also going to tell me it has to be done between three and five pm so in terms of five friends in all seriousness, uh? What does a good warm-up look like yeah, and I realize this will vary depending on how cool your training environment is time of day Etc, but as a kind of umbrella for a good warm-up? Okay, what should people do the you've already sort of jumped the gun? With with my answer it, it is honestly very dependent upon the person, so some folks respond very well to a minimum work. Well, others. I have had lots of actually um professional fighters. I have worked with where they'll actually have a major league baseball player right now he is one of the best pitchers in the game, probably the best and the longer we warm up the better his numbers get. We actually did a vertical jump test with him. He is going to kill me because he got so mad uh. I wanted to see how long it sort of took him to reach a peak vertical jump and most times this takes people something like five to ten sort of reps and I said, take it up all the way to a maximum vertical jump and then what I Want you to do is continue to Jumping until you have three consecutive jumps or you're down lower than 90 percent, and so what we're trying to look at is sort of. When is he going to break because in baseball he is going to throw like 100 pitchers or so and we're trying to figure out, when is his Peak velocity on his fastball going to drop and sort of basis? Conditioning on that, so It's a different style of conditioning. It's power, endurance is

really what it is um. He called me in the middle of it. I'M, like oh you're, done whatever and he is just like no like how many of these am I supposed to do, and I was like what are you talking about he is like I'm on rep 130 or something, and I was like what and I'm like what rep did You peek on he peeked on rep 70., something like that 69. I think technically, because he is goofy um so he is a classic example. I have worked in for many many years. We have a ton of data on him, a ton of biological data, a ton of um neural muscular stuff like all kinds of stuff, and it just the more. He warms up an absurd amount of warm-up, the better he gets and the better he gets in power production and the better he gets in speed and velocity. So his warm-up prior to games is It's totally absurd and just the more volume we throw at him the better he does. I have other folks, you get past like two or three reps and fatigue starts to set in and now you're actually like reducing power production. So there is a ton of variation that goes in that I can give you some guidelines, though you need to differentiate if you're, training for speed power, strength or hypertrophy. Here is why. If we understand a little bit about what's causing the adaptation, That's going to tell you what you need to do or avoid, for example, volume is the primary driver in hypertrophy intensity? Is the primary driver in speed power and strength all right which what that means? Is you need to preserve intensity for the first three, you need to preserve volume in the second one at most. So if your warm-up is so extensive in the hypertrophy training that it compromises your training volume because of fatigue, even if it compromises the last set of the last exercise, then you're actually probably walking yourself backwards. By doing that, extensive, you would have been better off starting your first working set slightly sub-optimal right because It's not really you're just trying to accrue volume at that point. Strength Empower is the opposite until you're moving very, very fast or powerfully you're not really causing the adaptation. So there is no point of starting your working set until you're, really basically at a hundred percent, so the warm-up should be as long as it takes you to get to where your Mobility is in the right spot. Like your joints feel good, you feel fresh, you feel activated and you really feel Peak power anything before that is a warm-up set in the sport of Olympic weightlifting a lot of times. The coaches will measure barbell velocity Travis Mash has done a fantastic job with this he is got a lot of data on what's called velocity-based training, I'm Brian Mann at Missouri, and Miami tons of work here and generally those communities are not going to count any repetition. As a working set until you exceed 70 of your one rep max, where That's changed because of a lot of people doing, the velocity-based stuff is now they're, basing that simply on an achieved velocity and so

really the warm-up is irrelevant. They don't even It's sort of just like do whatever you want and we're going to measure the barbell until you actually hit an outcome and now you're at what a working set um so different ways to think about it. Um, depending on what you're training for that'll, give you a little bit of a guideline: if you're training for anything past hypertrophy, then really, and especially even hypertrophy, it just comes down to. Are you feeling um ready to work? Are you cold? Are you moving to the correct positions and if all those things are fine, I don't care if you start a little bit early and save some gas, then, especially if you're a person like you who may be a bit more inclined to fatigue quickly relative to Trevor Who'S just has no response to fatigue whatsoever. Is it useful to do more warm-up at the beginning of a workout say before the first exercise, and then once one has achieved both local and systemic warm-up in air quotes um then perhaps on the second or third exercise? Fourth, exercise Etc, one or maybe even zero, warm-ups yeah fair point. We generally think about warm-ups in a couple of ways. This is a really actually. This is a very clever question. You want to have some sort of General Global warm-up scheme. We tend to prefer Dynamic. Warm-Ups, so this is whole body movements rather than like sitting and stretching static, stretching things like that, so something that involves momentum, yeah momentum or movement right. So this is like uh think about this in, like old, gym class, It's like your high knees and your butt kickers and just different things like that, where you're moving in different planes, you're moving joints through tons of range of motion, you're getting a lot of movement, There so you're getting the local warm-up you're, also getting the the total systemic activation. Everything else is going on there. So that is what we consider to be a general warm-up. Five minutes is a very sufficient number, perhaps 10, if you're a slow, goer achy and some things like that, and you really got to get the ankle warmed up if you're doing lower body stuff really make sure that That's moving correctly, the hips and knees will follow. Um upper body stuff really get the shoulder blades and the neck like making sure you're going there and the elbows will follow after that um. So, five to seven minutes of a general warm-up a lot of times like classic exercise science, it will even just put you on a bike cycling for five minutes. I don't like that. Personally, Dynamic movement is more preferred if you really just move for five to seven minutes, you will be fine. There now specificity within each movement. It's very important that your first exercise of the day is generally the thing you've prioritize, That's oftentimes, the most important you're going to do it often times is also the most complex and the most moving parts, so it tends to be multi-joint. It tends. Therefore, you need to have movement, precision and skill diode

right, you don't typically start your workouts off with the forearm curl. All right like this, you don't need a tremendous amount of warm-up to get going on that you're, going to start off with medicine, ball throws or a snatch or some agility work you. You need to have the whole system going, because multiple joints are moving position. Matters technique, there is just a lot of skill requirement, Etc. So the individualized workout um or the specific workout for the specific movement for that very first one. My general rule of thumb is like whatever it takes to move perfect in that first exercise past that you don't necessarily need to do individualized warm-ups for your next movements, unless it is a movement you're trying to learn or just even get a little bit better at. Like drop the load, a little bit work on some accruing, some practice, reps fantastic or It's another dissimilar, complex movement. So let's say your first exercise was a front squat and you got loaded for that and now you're going to move into a pull-up. But your mechanics aren't the best there, and so you really need to change and do some, maybe more specific activation warm-ups for that or something else or It's running or something totally different. So yeah you don't need to re-warm up for every single exercise, as you go generally once you're good to go the same muscles that you're going to use in the next exercise.

#### 01:30:55 Strength vs. Hypertrophy Repetition Cadence, Triphasic Training

Are warm same joints then you're good to go? You talked about intent within the movement. What about specific cadences for repetitions yeah? I was taught that one should lower the weight, slowly, the so-called eccentric portion of the movement and then to try and explode the weight through the concentric phase and then also make sure that one is using full range of motion and perfect form. Yeah, as it were. Now, of course, that is one tiny slice of the possible rep cadences and ways to approach resistance training, although I think It's a pretty good one yeah, what are the general parameter? Sets that one needs to consider. You could imagine lifting you know four seconds concentric pause for one pause for two eccentric. I realize there is an infinite number of variations here yeah, but is there a way to use rep Cadence repetition Cadence? That is as a way to work through weak points um and to be strong in every position of the movement yeah, a lovely question, I think the the way I would like to answer this is maybe going back just a touch to get directly to that. So I think if we walk through Power, strength and hypertrophy, and I hit you with the concepts that are

specific to each one - That's going to lay out your answer because the most true answer there is it depends on the goal. The answer for what is optimal for strength is diametrically opposed for potentially what's optimized hypertrophy, the same exact thing can be said for momentum. So we've classically heard things like this. You know don't bounce at the bottom you're cheating right. So if you're doing a lap pull down or something you know you don't you don't bounce and rebound you, don't you stop at the bottom slow down? All these things are thought to be truisms of strength, conditioning, but guess what those are all truisms assuming or trying to grow muscle, and That's that actually goes back to our conversation and and episode. One about a lot of the things we think are just fundamental truths about strength. Training are just fundamental truths that came from the bodybuilding world and they're, not wrong they're, good ideas, but they're all their adaptations. One needs to get from strength, training that are not just maximizing muscle growth, so what I will lay out to you is a case for which you should bounce a case for when you should go fast, a case for when you should be under control. All these things are are different variables. We can modify and get different adaptations for it is there a way that you could lay out for us optimal repetition, cadences for strength specifically versus hypertrophy, specifically just to sort of bookend the conversation and then migrate toward the middle. In terms of rep cadences, that would satisfy the desire to have a bit of both. We can get pretty close yeah. So when you're talking about strength versus hypertrophy, remember strength is a movement. Hypertrophy is muscle size. That's That's the the key to your answer here. So, when you're trying to get stronger, what you're effectively trying to do is get better at producing a certain amount of Force - 3 movement. Okay, now Force is mass times acceleration. So, what's the mass in the bar multiplied by how well I can accelerate it intentionally going slower is only reducing acceleration right. So It's hard to argue that going slower is going to improve strength because you're simply reducing acceleration. So you need to practice lifting heavier at a faster rate. Now, does that mean if you're trying to get stronger there are no phases of your training in which you will slow down or plus? No, of course not, there are certain rules in different organizations where you have to pause the bottom, like there is all kinds of little things like there, but in general we want to think about what are we trying to do here? We're trying to get better at moving? A heavier Mass at a faster rate of acceleration that is more force. That is more strength. Hypertrophy is not that the goal here is not a functional outcome. It is what is needed to cause the most amount of hypertrophy and when you get to ipertory, then your optimal



Cadence is up to you. You can do any combination. In fact, you could do it. The same exact Cadence that you did your strength, training with and get the same adaptations as a poetry. If you modify the other variables appropriately or you could go slower or you could do pauses or you could do a thing that is called triphasic training, where you spend the first phase several weeks of your training, where you do eccentrics only so you're, just lowering the Bar and you're, basically stopping you can then do the next phase of your training, which is isometrics you're just holding at that bottom position and then the next phase, you're training, you're, focusing on the concentric portion of it right, triphasic, one two: three eccentric isometric concentric. So That's a fantastic way of developing actually strength a little bit of hypertrophy but you're manipulating the variables in terms of how you execute the repetition range. You can actually induce a lot of hypertrophy moving the weight fast, as you mentioned, even down slow under control. Now one thing one will never Advocate is moving any sort of weight or load uncontrolled. The Assumption here when I'm saying go fast, is you're always in control. I never want you bouncing and crushing your sternum with the barbell Off Your Dust, but you you can move at a lot of rates. You can um the isometric I mentioned, because this is when things like body weight training come into play. Absolutely you can gain strength and even a little bit of hypertrophy, especially in the upper body. Doing isometrics is much harder to do this, but the lower body um you just you just you outrun that coverage really quickly. You need load, but there is a lot of ways. This is also probably why people have done things like gone to yoga only or Pilates, or some of these things that are body weight based and there is no external load and they've actually increased muscle size. So I'm getting the picture. There are a ton of options in terms of rep cadences. However, can we say that one should pick a given rep Cadence within an exercise, rather than changing it from set to set within an exercise or that one should perhaps even pick a certain rep Cadence for an entire workout? I'M suspecting that your answer is going to be. It depends yeah, it is, but if you know I'm not going to use the if you had a gun to your head kind of situation, but if you had a gun to your head, what would be the rep Cadence that you would prescribe yeah for strictly strength Or as much strength with as little hypertrophy as possible and in picking that rep Cadence, then it therefore has to thread throughout the entire exercise bout, so you're actually right. You can because of that undulating periodization stuff I talked about. You can actually do this in a lot of ways, so you could do one exercise at the beginning, where you have a set. Cadence say a three one one. It is like a very one. So That's con, so That's Lifting for three pause for

one lower. For one uh be generally the opposite, okay, so the first number is always The Eccentric generally. Okay, so, depending on exercise, lowering the the weight for a count of three yeah pause for one yeah, it totally depends on the exercise like a deadlift, starts concentric and finishes eccentric, but a bench press starts yeah, okay, so It's start to finish. Start to finish. Is the better way to think about it, yeah so in I'll clarify? Actually, when we say 3-1-1 we're generally talking about almost always, The Eccentric is the slower portion, regardless, if It's the first or the last right, so whether you're doing a bench press or The Eccentric is lowering the bar to your chest. That's the first part of the movement, one two three pause, one, one up which means accelerate as hard as you can. The way up. That's what you describe right, as opposed to say, a row, a row which is actually going to be starting off concentric, so you're going to be pulling that thing to your chest as fast as you can under control, not slamming off your chest. Holding for one second and then taking three seconds to lower it back on the rack or on the ground or whatever. So the reason we do that is somewhat intuitive, but it is again to make sure you're not advancing a bar or an Implement onto your physical body at an extremely fast rate that That's very difficult to deal with. So a three one, one is a very standard. Um strength, protocol - that is something you can just run with. If That's all you ever wanted to do, it'd be absolutely fine, lower the bar for a count of three. It actually ends up being approximately three. Hardly anybody is counting off seconds precisely I mean It's. I suppose It's doable, but then pausing briefly yep and that brief is almost uh. That pause is almost um unmeasurable. It is simply, are you under control, before you transition from the center to concentricular concentration? It's just a safety thing, so once you feel down you've reached complete range of motion, you're ready to transition, then just go. You don't really need to go like 1000 Watts and then go up. It's just making sure again, we don't slam weights off of body parts and that final one in the three one one the execution of the usually concentric portion of of the exercise yep as fast as you possibly can, okay, so that would be for the majority of The outcome being strength, yep, okay and, of course we should acknowledge again. There are a ton of variations that one could Implement there, but that that would be a good starting place on the opposite side, for somebody who's mainly interested in hypertrophy yeah. What would be the rep Cadence that um, if you had a gun to your head, that you would prescribe? I would probably do the exact same thing, but I would like I would make the last number two. So three one two. You could also just keep three one on. It is still very fine. Even exploding on the contrast is still highly effective for training hypertrophy. So if you want to keep it

super simple and just make rep Cadence, not a variable that you play with, because you have other ones to move. That's great! If you want to add a little bit of time to the concentric phase. Fine, It's not going to do It's not going to make enough of a difference for most people for you to really worry about. I guess That's sort of the point I really want to make this is we're classically. This is a classic example of we're deep into a method right. If, as long as you get the concepts I talked about earlier, whether you want to do three one one, three, two, three, three, three three try phase. This is just a method: choice that doesn't mean they're irrelevant they are, there are subtle changes within them. It's just 80, 20 rule right, so 80 of the benefit is going to be from the concept. 20. Is this small thing if you're super into this field, or you actually want to work with a qualified, uh certified coach or something they there is lots of reasons to play with this? If you're, just on your own here and running this thing, 311 is fine. 312. Totally fine anything like that. You really just want to make sure that, in the strength side of the equation, you're under control - and you can add enough load to stimulate strength and not get hurt with an acute trauma right on the hypertrophy side. You're just wanting to load enough to where you can hit volume, because you got to put a lot on there. So if you want to go lighter, if you want to go slower, fine, you, if you go slower in your repetition, so maybe even like a five SEC. Second eccentric. A two second pause, a three second Rise, That's great! You can actually then stimulate the same amount of hypertrophy and either do it with less weight or do it with less repetitions. So It's a variable you can play with if you're like hey, I don't have enough weights at my house, or I only have a kettlebell or a dumbbell. How am I going to stimulate hypertrophy? Your only option is really doing more reps. Well, eventually, that that train runs pretty shallow, okay, here is the thing you can play with maybe just add time under tension. That's what we're calling right, just you know, do slower repetitions, go longer ones and hold it. So It's a variable that we use to individualize programs. Rather than something that you should really be focused on as like a core aspect, That's going to be driving whether or not your program works, It's just a tool we can play with in the what-if scenarios um. I will use this stuff a lot when I'm traveling, you can do a tremendous workout in your hotel room just doing like a 10 second eccentric. A 10 second hold a 10 Centric concentric yeah. I have had some decent hotel room, workouts they're, not my preference but um by simply doing things like um 10. Second, lowering uh handstand push up against the door totally um, obviously assisted for me. I don't. I can't do a free, handstand, push-up, yeah um. I just don't have the skill or the strength or both um, you can do some sort of configured dips

between the beds or chairs, and this kind of thing um squats, are great to do in hotels, put your back foot up on a on a bed and Get a an amazing split: squat workout done yeah a lot, glute Bridges, lots of stuff. You can do that yeah with a jump rope. If you've ever heard someone jumping in the in the morning, yeah um, it may or may not have been me. It could be any number of things but I am known to skip rope in uh in hotel rooms um

01:44:03 Tool, Breathing & Training Valsalva Technique not to get overly detailed, but I think there are going to be a number of people wondering about how to breathe during repetitions and how to breathe in between sets. So I'd like to just briefly touch on this, and this is something that I know we're going to return to again when we have our discussion about recovery. But is there a general rule of thumb for how to breathe during repetitions during work yep for strength? Maybe even strength versus hypertrophy in a way that maximizes oxygen input to the system, you know, keeps you uh, alert and conscious, but that also protects the body by creating some rigidity in the system right because, certainly being def with all your exhale. The body is a very different beast in terms of stability than with the body full of air versus you know, breathing during the repetition movement there is a maneuver that is long been uh labeled, the valsalva techniques. So what that really means is you're trying to use air to create intra-abdominal pressure and what you're really trying to do is create a cylinder around your spine. The real issue you have to to play here is regulation of blood pressure and spinal stability. Now you should be able to breathe and Brace what I mean by that is. You should be able to create total intra-abdominal pressure, regulate uh, spine control while breathing, It's just very hard for a lot of people to do It's a skill. You should absolutely work on. You can actually, you can do this and you can go around like I do this trick in class and students can come and they can push any part um of my entire abdomen. It's super tight and I can talk now. It's going to be a little bit. Labored, you can hear a little bit of a difference, but you should be able to do that if you have to like hunch down - and you can't even muster your breath and it takes that to create pressure you're. Not actually, you don't really understand the abdominal control necessary to create that stability so step number one is That's the goal now, with the blood pressure thing, we have to be careful because a standard blood pressure. Ideally, if we sat around right now, it was probably something like 120 over 80. systolic versus diastolic. That's a

normal number right. High blood pressure is something over that. Well with an acute bout of exercise, you can see that number reach as high as like 450. Over 350., which effectively means you have total blood occlusion right, your blood pressure is so high. Blood is not moving anywhere and It's in the middle of a very heavy set, especially complex movements, especially when they're loaded on your body. This could be an overhead press or squat variations. Anything like that blood pressure is going to be a problem and the reason why that matters is That's. What's going to make you pass out, It's not the fact that you ran out of oxygen in three seconds. It's the fact that blood pressure got so high, you blocked out, and so we want to have we're going to have to play this game of releasing a little bit of the pressure. So we can actually get blood to move a little bit, making sure that we don't lose spinal stability. So we can finish our workout. That's really the question you asked right. How do I play this game of? Oh? I have several hundred pounds on my back or my chest and I don't want to Exhale right, so I don't lose spinal stability but at the same time I don't want to pass out right, which is which is a problem. So a kind of a couple of rules of thumb if you're going to be doing something in which you can complete the entire exercise without a breath, and it is of a maximal or close to load. That's probably your best strategy. So in that particular case, you will see a lot of breathing techniques where you're going to take a very large inhale. Ideally, this is done through the abdomen, not the shoulders, so we shouldn't seeing clavicles Rising during this thing. You will see a common mistake of of the bars on their back, and you see people do this like big inhale thing and all they do is Elevate their collabos. That's not necessarily going to increase pressure through the abdomens, which is what you're looking for. So you want to be thinking about belly, moving out in all four areas in front of you to your left and right and to your back. That's that quadrant sort of idea of stabilizing your spine. You can do that independent of your clavicles moving like your shoulders. Don'T need to rise for that. You don't really need the oxygen for metabolic purposes, you're, just using the air for a brace, That's really all you're. After so you're trying to visualize your torso is more or less a cylinder, yep and you're trying to fill it with air. The logic being that, if I were to push down onto a say, a full unopened can of soda yep water for all your sugar phobes out there soda water, uh and then push as hard as I could. It's going to be hard for me to crush that. Can but if the can were empty or if it were a little bit kinked in the middle correct, then I could likely Crush that can yeah what you're really doing is you have your spinal Erectors in the back right and then a whole series of abdominal exercises And you actually have some neural control:

systematic control of Contracting those, but the you don't have muscles on the inside that you can do so. You're, basically bringing in air and saying I'll use air to push from the inside out and I'll use muscles to push from the outside in to create this brace, and I don't want over compression with the muscles. This is a like, if you, if you see people that have just enormous spinal Erectors, sometimes That's an indicator of actually a poor, breathing or bracing strategy, because they're using spinal rectors to create all their compression and not actually using the inside enough. That's not always the case, but sort of like a thing to think about so over compression through the spinal rectus is not necessarily ideal. If you wanted, the best scenario is a little bit of a brace of both, so we use some air to push this side. We use some musculature depressed that way and then that that spine is just nicely held in position again, not in a position where I have locked down my diaphragm and I can't get any air out. I should be able to get that brace pattern and then be able to speak. In fact, like I'm doing it right now and you will see like a little bit of if you're really paying attention to my voice, you can hear a little bit of a subtle difference, but I should be able to do this for quite a long time. Right like I, I could take a maximum rep right here in this position, whether I'm overhead pressing doing some sort of row like anything and feel very braced in in the entire quadrant. This is very helpful. I'm going to work on it, but can we say that a an effective way to start off in terms of breathing during repetitions would be to take a gulp of air during the lowering phase, The Eccentric phase and then to Exhale during the yeah concentric exertion Phase I asked that because That's what I have been doing for a while and it makes me feel safe, I don't know if I am and it allows me to Exhale as I exert the the hardest portion of the exercise. Yeah - and perhaps I also borrowed that from martial arts, where one tends most often is trained to Exhale on the on the strike yeah. If you're going to be doing again, the number of repetitions can be completed without a breath, a lot of times, you're better off saving that exhalation until you complete wow, but you don't have to, but for a reasonably heavy set of hack, squats or even leg. Extensions and given that I already can't leg extension, my body weight - maybe It's established - oh maybe this is why um the idea of holding my breath for an entire compound set. So again, I'm kind of listening to mine um, you know like where is my insurance card who's going to drive me to the hospital, this kind of thing um in all seriousness? What if I want to breathe during the set yeah, so I I'll clarify I'm generally meaning, if you're doing like a one, rep max or something like that? Okay? Well, they certainly could hold my breath for a one repetition maximum that you know maybe like a double or something like that, depending on what you're doing like maybe

a triple a bench press, you can probably do three and get away with it a squat. It gets harder deadlift, so it kind of depends on the exercise um. You want to take that breath, though, prior to The Eccentric portion, not during so lower, breathe in lock or set, and now start our movement pattern wherever It's going to be exhaling on the concentrate portion during it is fine. It's no problem um, especially if you're not extremely heavy, and what's your, what are your thoughts on grunting and screaming yeah? Fine, I don't care, I don't tend to do that, I'm occasionally known to squeal or whimper. I think of you and I think, squeal whimper. Absolutely thanks um. If you're going to be doing multiple repetitions, uh, what we actually do for the NFL combine is we teach them a very specific, Excel strategy, so there is one test that they do uh, which is they bench press 225 pounds for as many reps as possible? A lot of these people will get 25 to 40 repetitions, so we have a very specific breathing pattern. It would be something like if we think that they're going to do around 25 reps say That's like our goal. We might say: okay do the first 10 without a breath and then exhale reset and then do five breath. And then you might do five breath three breath two breath and then one breath per rep until we can't get any more um. So we'll have very specific strategies for them um. So what I would say is think about how many you're going to complete and then breathe according to that, and it tends to increase in frequency, as the number gets closer to failure, because you're going to want that. That error a little bit. But you just want to make sure that when you re when you're breathing back in you're in a safe spot, so you don't want to be catching that, like re-breath, when the weight's on you, you want to be in a locked out position or away from you When you're standing, so it tends to be like at the end of the exercise, not in the middle of it, which is, is going to

01:53:22 Tool, Training, Auto-Regulation, Specificity, vs. Variation, Prilepin's Chart

be a recipe for problems. If you take your breath, then one of the reasons I'm so happy to have you here and having this discussion is, we can really get into the weeds, but also hit a number of questions that I hear a lot. How does one contend with the first attempt at a lift, not working out? Is it too heavy? Something goes wrong, hopefully not injury promoting wrong, but something goes wrong. Do you count that do you reset the workout and then the counterpart to that question is what do you do if It's too easy? It went wrong because you didn't put enough weight on the bar. Do you pick up a heavy enough set of dumbbells? Do you abandon the set and and replace it with another, and I guess this is really a question of how much margin for error is there in volume yep when

doing this three by five program? Sure uh two things that I'd like to start with number one is: I talked about linear, periodization and unrelated periodization, there is actually a new model, newish model called Auto regulation, which basically says you're going to go in today and depending on any number of biomarkers performance, markers Or your performance, you will adjust your training based on how you're feeling that day and so 70 is not. Maybe, for example, not necessarily 70 of your one repetition Max highest ever is 70 of what you can actually do that day, and so it actually allows you to Auto, regulate your training based on actually what's happening, and so you don't have to have as much long-term Planning in your program, design, um because it'll sort of figure itself out as you're going, you can use velocity to determine the sort of Regulation you can use. Actually, It's like taking it up to close to a Max for the day and then basing all your percentages on that daily Max or a lot of different ways. So that is actually one of very effective strategy and there is a lot of research coming out on auto regulation. There is a lot of different ways to do it. So That's one thing to say: another thing to say: is this three to five? Okay, it depends on if we're going for speed, power or strength, because, while all those other variables are the same for three to five, the core difference between whether that is a power, workout or a strength. Workout is the load right. So if you are at a moderate load, say thirty percent of your one repetition Max up to about 70 percent, That's going to be a power based adaptation, assuming you're going with high intent. Can you sorry I I have to interrupt, maybe just clarify what intent is yeah you're attempting to move the implement or go through the movement pattern as fast as you can great? Thank you if you're trying to go for strength and you're below 70 percent you're not really going to be improving strength, because the total mass is not heavy enough and so really, when we say strength, we're assuming you're at at least generally 70 percent or higher. Now, if you're new to training totally different thing right, but if you're moderately trained to highly trained you're going to be whale north of 70, so anything below that we don't really count anyways um, That's those are warm-up, sets basically all right. So one thing to actually give you some very specific numbers here and I don't have all of these memorized, who can perhaps um, provide a chart later or send out something to them, but there is a chart that you can look up called a prilippin chart. How do you spell that uh, p r, i l - i p, i n and there is actually been a a few studies on it. It's It's a It's been old. It's been around for a very long time, It's sort of in the coaching realm and then a handful of studies out of New Zealand came out verifying and validating a lot of it. But what it effectively does is, if strength is the goal - and this comes



from the power lifting weightlifting sort of communities or optimizing for strength. Then how much time do I need to spend at each intensity range, so 70, 80, 90, Etc? Because specificity is going to say this: if you want to get better neuromuscular guy at shooting a basketball, the most important thing you could ever do is shoot a basketball under the exact circumstances that you're going to do it right. Specificity always wins. If you want to get better at strength, the most important thing you need to do is that exact movement at that load, and in this case, if you wanted to get better at your bench, press lifting at 100 of your max on a bench press is the Most specific thing you could ever do the more you can do that the faster you will increase your bench press Max. However, That's very hard to do without getting hurt. It's also not addressing what I call your Defender. So if the reason you can't bench press higher than whatever you're benching now it may not be your pure strength. It may be any number of things like you: don't have enough muscle or technique, or these things - okay, great so specificity over here, um variation on the other side, so we're playing this game. We've talked about of. How do I make sure that I can have enough specificity in my training without leading to uh overuse injury? All how do I maximize or how do I reduce my chance of injury while getting enough specificity, and so we have a classic Paradigm. However, here one actually training protocol you can look up is called a Bulgarian method and the bulgarians were an amazing at the sport of Olympic weightlifting. Probably in fact the um, the the patriarch of this entire thing recently passed away. Ivan IBA jayev uh niams glue pocket Hercules. One of the greatest weightlifters of all time came out of the system and they do a lot of things. But one example in the Bulgarian system is you're going to do a one repetition: maximum snatch, you're going to. Take a little bit of a break you will. Do a one repetition: maximum cleaner jerk take a little bit of a break. Do a one repetition maximum front! Squat take a little bit of a break and you're going to repeat that two to three times a day. Every day That's specificity right. Those people get extraordinarily strong. Now they don't do that all year round. They don't do that with all their lifters, but this is when we're trying to Peak for a major competition like the Olympics. We are going so far into specificity, and that was very counter to the Russian system at the time, which is much more of our classic periodization sort of approach. Okay, specificity is tremendous, but in doing that, the bulgarians just brutalized a lot of athletes right because It's very difficult to handle something like that, and you can't really do that that long without getting wrecked and they're the goal is to win medals. The goal is It's a totally different thing than longevity out of here right like we're, trying to push the boundaries of or aesthetic

changes. Unless someone has a naturally balanced Physique in general. If people do one sort of movement, I find that they tend to resemble the equipment that they did that movement with over time right. That was a joke against kettlebells. Of course. Of course, of course, I got it so we know specificity is technically optimal, but It's not realistic, not for that kind of a you know, extreme situation. So how do we balance these things? Well, it turns out this prilippin chart gives you guidelines for how much time, and by time I mean how many repetitions to stand um in each of these rep ranges so that you get kind of the best of this world you're going to find the same thing By the way, when we get into endurance training, there is only so much training, you can do at 95 of your heart rate before it starts becoming like quite detrimental. You need to actually spend a lot of time at those lower intensities, so the Philippine chart walks you through how many sets, and it gives you a range like like the. I think that the bottom of it is like um. How much time do you spend at? Like 60 to 70, every one or at Max - and it says, like you - know, minimum of this set to maximum of this set, but the ideal number of reps per set per week is like 18. and then I'll walk you through and so there is there is four criteria On it um, I think It's 55 to 65 again how many reps there is It's like three to six reps per set: um 18 to 30 reps total and I think the ideal rep range is like 24., something like that. So it takes you 55 to 65, 70 to 80, 80 to 90 and the 90 plus percent. What you will see is the 90 plus percent number is more like one to two reps per set for a total of about seven total repetitions. If you start cruising past that um other bad things start to creep up in there, so That's a really effective chart. What it really highlights, though, is even somebody who's trying to maximize strength, you're going to spend something like 30, five or so percent of your training time between this, like 55 to 65 range, so you're asking her like well. Do I even count that one? The answer is yeah. You know in that range if It's below 55 60 percent - you probably don't count it now again, some coaches don't count unless It's even above 70.. Fine, It's not a major distinction, but you're going to spend the bulk of your time. You know accumulating some some technique, basically and skill and tissue tolerance very important. The Next Step Up is like 28, I think is - is sort of the cutoff of how much time you spend between 70 and 80 percent of your 100 Max, and then it jumps down to like 23 and then all the way to 70. So you can walk yourself through that, and that gives you an extremely good guideline and you will notice. All of these are still in three to five range. It's just really you're, manipulating it by total sets or total exercises. So that can give you some instruction to play with

02:02:35 Training to Failure, Exercise Selection & Recovery, Standardization.

We will provide a link to the prilippin Chart yeah in the show note captions training to failure. When the goal is Strife, yeah should one do it should one avoid it or does it depend well yeah, it always depends um the way that I'll generally say it is because of what we just outlined it in the brilliant chart. You don't have to go to failure to see strength gains, especially early or even moderate, and I'm talking maybe five plus years in your lifting career. Would you um call beginner zero to five years of training, intermediate five to twenty years of training yeah, something like that and then Advance would be people that really put the time and energy into fine-tuning their program. The vast majority of people who think they're Advanced are really what we would call intermediate in all domains of life, Fair, even as a scientist um, It's quite rare to reach that number of advance so um. I actually don't have any problem going to failure. Quite often, I'm also fine with people who don't want to go all the way there you can get most of what you need getting, what we call technical failure. So this is like okay, that was really challenging. Uh boy, you started to have some breakdowns of technique. We're going to call that good. The Only Exception here I want to point out is people who are either novice or beginners. They really have no concept of what 100 means, and so I think It's actually very fruitful to take them to 100 just to give them a guideline of where It's at now, of course, do this on exercises that they are comfortable with or close, and then you, Maybe maybe this is on a machine. Maybe this is single joint movements or whatever it takes for them to have confidence, but I actually I don't think you should be scared of these they're, not really um, that much more dangerous than anything else. There is I mean think about it: if you're going to do a front squat or any exercise and your one rep max is 200 pounds, is it really that much more dangerous to do? One try at 205 pounds than it is to do five tries at 190. Pounds is it really that much more? No like It's not so you can do like we talked about in the the first episode. You can do a repetition, Max estimate where you get to like 85 to 95 of where you think you are and then instead of adding load, you just do as many reps as you can. Google, that number and it'll tell you the conversion estimate of what your own right Max is. That's fine, but also, I have absolutely no issue. In fact, I generally encourage it to take people up to that level. Um certainly not day one or anywhere close to that, but at some point let's see what you actually got, I'm just I'm just going to cut it off early. What I'm going to consider to be 100 Max anything more than a minor technical breakdown is, is for that crew we're going to

stop and call that good and ideally with a spotter, especially um. You know bench pressing, don't bench press alone in your basement kind of thing, a few people die each year from bench, pressing alone in their basement, yep or use dumbbells. If you're going to do that, yeah It's hard harder to die using dumbbells. I suppose you could um drop them on your head or something but not get stuck under them. Um exercise, selection and frequency of exercise implementation across the week. So I can imagine with this three by five routine done three to five times per week. You can imagine changing up the exercises every workout, although considering that most of these three by five routines, are going to be done with compound movements generally the sooner or later, one runs out of movements. If the goal is to hit major all the major muscle groups yeah, however, let me give an example and ask if It's okay to, for instance, do the three by five routine, where one of the exercises for back is say a bent over row uh, you do That Monday, Wednesday and Friday, okay, you know I can imagine one could do that and still recover and improve over time, but five days a week, bend over rows five days a week. Is that okay, I mean, can one still progress, um and there I could imagine It's a strong answer of Depends because some people recover more slowly and others, I'm very comfortable, doing hitting muscle groups once directly per week and once indirectly, That's worked for me far better Than two or three times per week, you know I get. You know looks of sympathy when, when I say this, but It's actually It's just how my physiology Works, um kind of yeah well and maybe I'm not optimizing a number of different features, but the point being that some people really do seem to be able to train A muscle every day and still make progress. Other people seem to have trouble when they train a muscle every day. So how does one establish exercise selection when the goal is to make progress um, and this brings up something very important and we're going to have a whole episode about this, but local versus systemic recovery? Yep, that you know, is the whole nervous system becoming fatigued, and is the muscle group and the related musculoskeletal systems becoming fatigued. We're going to go back to thinking about when you make these comments about it, takes you three to five days and you've got better results in there. The assumption that you're, probably running under is your training Style is more reflecting that recovery time than it is your physiology. It's not you It's how you're training. So if you look at again all the Olympic weight lifters that are competing, they're going to be squatting or some variation of squatting every day that That's going to happen like a lot of the times, they're training multiple times a day, and they will be doing some. Basically, barbell full squat multiple times a day every day, six

days a week. You know something like that: they're the best in the world at getting powerful, they're tremendously good at getting strong. You can do it right. It comes down to what does your volume look like? What type of movements are you doing what rep range, what overall volume are you hitting and how are you doing it? If you look at athletes, they train their legs every day, when they're running around they're, doing Speed and Agility training every single day, they don't need. You know three days to recover: can you imagine a basketball player trying to ask for like three days to recover between practice right well to be fair as you as you chuckle at me, I'm doing other things on the intervening days, yeah so I'll train a muscle Group like legs and then I'll give it four days before I do an indirect yeah, um uh, what I call an indirect exercise for legs which for me would be sprinting yep. Then I get two days and then I'm training them again, but nonetheless an athlete has to do that every day, right right, so the absolute the answer is, you absolutely can train any of these muscles every single day. It really comes down to volume right and it comes down to movement type um, and how are you getting it so with in the case of of weightlifters and athletes? What we tend to see happen is there is not a there is two things. There is a long period of conditioning, and I don't mean endurance. What I mean is: is tissue, tolerance and conditioning so they're not going to start off their career at that pace right. Their career might start off at five days a week, but maybe every other of those days is a PVC pipe only and you're just training, the movement patterns, you're, working on technique, Etc, and then, eventually, maybe after six months or a year, those PVC pipe days turn Into barbell only days so now you went from, you know a pound to 45 pounds and eventually, as your years, go on that that wrapses up so it depends on the style in general, speed and power. Stuff is so light. It almost requires because It's non-fatiguing it requires almost no amount of no recovery. So if you were truly doing say like um, you know when you say It's funny, because when you say I do legs on Mondays, you don't even realize it, but an athlete does legs. Every day, right but you're, saying legs, and what you're really saying is I do hypertrophy legs Mondays, pretty much that I don't want to get into what I do specifically because It's less important than what other people choose to implement. But the repetition ranges anywhere from 4 to 12. correct, so you're covering up pretty yeah you're smack dead in the peak soreness longest recovery rate volume is relatively low. Intensity is very, very high. Workouts are very, very true, so if you were to switch that and you were to stay under four repetitions, higher quality uh higher rest in between them, I would be willing to bet a large amount of money that you'd be fine the next day,

certainly 48 hours. And if you were to actually go way lower and keep you know three to five and keep it very, very light and train for Speed. You would have absolutely no issue the next day, so it really comes down to a function of training you're right in that hypertrophy Zone, which is something that you probably need 48 hours at minimum to recover from, because what you won't see are bodybuilders training, the same Muscle group, on multiple days like very often at most, it will be indirect, but generally they're not going to do that every single day for the same reason, so you're training in that style. That's what it's going to take to recover if you trained in a different style, then it wouldn't take that long to recover. So for the person starting out, would you recommend they pick three to five exercises and stick with those so that they can get their skill and movement and positioning and breathing all that really dialed in and then start to experiment by varying one or two of those Exercises over time, That's great if you look at the conjugate model, so these are the the strongest power lifters as a collective group that ever existed. What they're very good at is, they keep almost the exact same weekly structure, but they make a very small change in exercise variation. So, for example, say Wednesday is bench day right, they're going to always binge on Wednesdays, but maybe this week they're going to do close grip bench and then maybe next week it's going to be maybe a special type of barbell and then maybe the week after That it's um, you know, maybe they'll change the range of motion a little bit. So it's actually the exact same exercise where they're, making a very small variation and that change alone allows them to do enough specificity, but also gives them enough variation where it's not. The exact same stimuli in the exact same spot over and over and over, and That's what allows that group plus lots of other assistance. But it's what allows that group to train very, very, very heavy, very consistently and not have to worry about too much planning for periodization and other stuff like that they get their back off by making small variations in exercise. I will say a major mistake: folks do make. Is they change their exercises entirely way too often, if I were to have to pick one or the other, I would say: don't change anything on your exercises for six weeks, probably realistic, maybe even 10 to 12 weeks, and then you can make some changes. You should not be changing every single week, the general pump you're just you're not going to see progress. It's going to be very difficult to do that. So it's going to take you three weeks generally to figure out the groove of the exercise to figure out how well you can load it what's too much to where you woke up unbelievably sore. That was a train wreck. How much do I load it at what position? How long is this going to take It's going to take you three or so

weeks, and then you can really start pushing there. So changing it before that or in that time frame is, is you're not going to be able to progressively overload because you're just not going to know exactly where you're at on all the exercises. So it's very important to create standardization within them and then see some progress in a movement or a muscle.

#### 02:13:45 Tool: Power vs. Strength Training & Modifiable Variables; Supersets

Group, whatever you're going for and then make some changes so before we dive into our discussion about hypertrophy, can we just get a brief recap of the general parameters for an excellent power and strength training program? Okay, let me hit you with these rapid fire and you can maybe come ask questions along that. Remember those modifiable variables. Okay, so let's go through them in order and then what they mean specifically for power versus strength, so modifiable variable number one is called choice so, which exercises do I select for strength in general, for power or speed or strength? We want to select compound movements. You don't often see people doing maximum strength, work for like a tricep Kickback right, It's typically multiple joint movements and typically complex um movements. In selecting these compound movements, we generally want to actually think about exercise selection of movements rather than muscle groups. So this is an important distinction, because we'll see this is a different answer. When we get hypertrophy what I mean by that is when we think about again strength, training, we tend to think about bodybuilding Concepts. We go to the gym and we do things like. I got to make sure I get my chest today and I got to make sure I get my hamstrings and now you're selecting exercises based on a muscle. You want to work for strength, development and power. We want to think about movements rather than individual muscle groups. So there should be like things like: I need to train explosive, hip extension, which is like a a vertical jump, or something like that. I I want to train, pushing or pulling movements, or I want to attain road trip. I want to train rotation, which is a whole area we haven't gotten into, which is very important for overall health and wellness and Longevity. So we want to select big movements by the muscle, the movement patterns that we want to introduce, and we just want to select a reasonable balance between these. I don't care what the exact ratio is. You just don't want to go an entire six months without doing anything in this rotational area or an entire. You know

eight to ten weeks without doing something without the lower body hinge right. So any number of examples there so just think about the rough movement patterns, upper and lower, push and pull and then some sort of rotation that puts you in a pretty good spot if you're, using three by five method and you're going to pick as little as Three exercises just pick one from each one of those group pick a rotation pick a push and pick a pull. I can easily think of a pushing a pull so, for example, bench press or shoulder press sure, row or chin for pull and then squat or deadlift for hinge yep. What would be a good example of a quality rotational movement yep? So anytime um? You can use a cable machine like at the gym, and you can do It's kind of hard to describe this exercise, but basically you're going to stand facing the cable and you're going to pull it towards yourself and then rotate like you're pivoting. Like your either swing angle, golf club or hitting a baseball bat so you're facing One Direction, I'm facing you right now, I'm pulling the cable towards myself and then I'm going to spin do a 180 degree pivot and face exactly away from you. When I finish and then return it back to that same spot, so That's a rotation great. We will provide a link to an example of that that you consider a quality example. A medicine ball, throw any number of things like this. Are a great rotational exercise all right, so we select our exercises based on that. We generally then, okay, because that is the case. We don't worry about things like eccentric versus concentric, because you're deadly doing a whole body athletic movement right which The Eccentric concentric portion is going to be folded into that you really can't separate them out all right. So That's exercise Choice. Our first variable, the next one, is exercise order so because that everything driving power and strength is quality based. You want to do these at the beginning of your workout. You would not want to do anything fatiguing before this, so no cardiovascular, training, no other repetition to failure stuff. If you do those before and now you're slower, all you've done is practice getting slower and, and so these need to be done when you're fresh. You also need to do them when you're very fresh, because they are the most neurologically demanding they're complicated. They tend to have multiple steps and they're, often in multiple planes, and coordination is a difficult thing and if you're trying to do all that at maximum speed, your nervous system needs to be tremendously fresh and so any amount of fatigue here is only going to compromise. The results um to kind of recap that one of the major mistakes when training for strength and especially power, is people worry way too much about fatigue. Those things should not be part of the equation, in fact, if they are That's a very good sign, you're not doing this correctly right. These are non-fatiguing movements, especially



speed and Power, so Choice order is next, the next one after that is volume, and we sort of hit volume and intensity, which is the other one. We talked about that the volume is basically identical between power and strength. The the general number we're going to look at here is something like 3 to 20 sets total per workout per workout um, but that would be like 20 would be a little bit of a special case now three to five is what I told you earlier right. I'M just saying like sometimes you can actually go quite higher in this cases, but That's the general range and once somebody finishes the three by five workout for power or strength. If they decide they want to throw in some calf raises and curls and totally a forearm work or a little bit of jogging on the treadmill or something That's okay. Absolutely there is. You have very little risk of interference for things like speed and Power strength. You have a little bit of a risk only because now you're introducing fatigue, which, if you're, really pushing strength that might compromise your recovery. I could imagine doing the three to five routine for strength or for power, and then somebody finishing up with um, 10 or 15 minutes of hypertrophy arm work and then being very seriously compromised if they try and come in the next day or even the next day. Correct and do those big compound movements for Speed and power - That's right, not just because they're sore, but the muscles may actually still be damaged, and I know later we're going to talk about the um, somewhat tenuous, relationship between soreness and Recovery, yeah yep, so that That's A That's a really nice uh heuristic to pay attention to is you can, but just be careful. Energy starts to matter at that point. If you're really truly trying to maximize strength, you would do nothing at all outside of that training if you're, just like I kind of want to get stronger and some other things and you're willing to lose strength. You know five percent of your strength gains then you're totally fine um. The same can be said by the way for super setting. So supersetting is an idea that says like wait. A minute you're telling me dude. I got ta, take five minutes in between each set. Well, That's not so much a problem nowadays with phone with um smartphones, because people are filling their intercept intervals with social media and texting. Correct you, you don't really have to go that long. In fact, there was actually a study that came out in the last month. That showed, you know, like really. Two minutes is probably sufficient for most people. Having said that, if you really are trying to push maximal strength, adaptations like three to five is very, very reasonable. Um, your those training sessions are long because you have to take you're spending more time, not doing anything. Then you are doing something but you're trying to maximize quality. So That's just sort of like part and parcel. If you're not super worried about it, you can

actually do super setting, which is, let's imagine again, you're going to do some some lunges and while your legs are resting doing their three to five minutes, you can go over and do an upper body row or pull. And when your upper body is resting, you're going back the legs so that really cuts your time in half. Is it ideal? No, we actually ran a study uh, maybe 10 years ago, in our lab, and we looked at that specifically and we did see a reduction in strength performance in the supersetting group relative to the group who did not supersets the question then it becomes like. Is it enough for you to care? So if you were to, if I were to say hey, I can cut an hour off of your workout time, but you will lose five percent of your strength gain. Almost everyone would take that exchange with the exception of people who are getting close to competition or really trying to set a new lifetime PR or something, then you might say no, I don't want any interference there. That last little margin is what I care about. Give me the extra rest great, so it's not a does it work. Does it not work? It's always a. What are you willing to give up uh versus get the practicalities of supersetting are staggering. Push-Pull, push pull, in my mind are real because you have to take over large segments of the gym, which oftentimes leads to a situation where your rest times are too long or highly variable, because people are working in or you can't finish your set. Because now someone jumped into the machine right, it totally screws right. You lose three to five of your friends because it's obnoxious, when you're taking over all the equipment, but in all seriousness I think um, it's wonderful! If you have the space and the format to do it, but at least in my experience end observation, these people know who they are: it's not practical to do on a regular basis. If you train in an open commercial gym, yeah tough to pull up so um. We've covered choice, order, volume and intensity to a sufficient level. The last one is frequency, and we've already sort of indirectly talked about that where frequency can be as high as you'd like in this area. It really depends on your recovery if you're really truly pushing maximum strength. You probably do need a few days to recover, although that's dependent upon you but speed and power can be done multiple times a day almost every day. Basically, the one exception would be maximum sprinting speed. You need to be careful there for things like hamstring and injury, especially if you're pretty fast. So you want to be a little bit cautious of that. But if you're doing easier movements like medicine, ball throws or kettlebell swings or something you could do, those quite often as long as the volume is staying pretty low. Last little piece here is progression. How do I progress over time? So I mentioned this earlier, but just want to fill this gap right back in before we head over to hypertrophy, which is three to five percent increase

per week of intensity in general, and you can do upwards of about five percent increase in volume per week. Over time - and I generally recommend running that for at longest eight weeks, but probably most realistically - you want to go about five weeks or so and then have some sort of a deload or back off week. If you do that, you're generally going to be a pretty good spot, so those are like the Core Concepts now, there is a whole bunch of fun methods you can play with within all these categories, and I I would like to actually cover just a couple of them.

#### 02:24:22 Sets & Rest Periods Stretching

um if we've got a little more space. For that sure, I'd love to hear about those I'd like to also just cue up one which is well. I joked about people texting and doing social media between sets, and I That's not a joke. Well, I confess I stopped bringing my phone into the gym because of the urge to you know, take my mind off of the workout and I just started enjoying my workouts. A lot more yeah and the workouts go far better that way and they're just much more efficient it. For me, I realize that some people, their careers, take place in the gym and so for the. I don't um look down upon anyone using their phone at the gym, but that really tends to help me, but I do wonder whether or not there is an optimal Behavior or mindset in between sets. I have heard before that pacing around can actually help diffuse some of the lactate and other metabolic byproducts of of work and exertion yeah that can lead to better performance. I have also heard that um, you know shaking the muscles out. I mean there is all sorts of gym lore um about this, but maybe there is also some decent science. I'M just curious uh. If you have any specific recommendations that people could play with or try yep so for for Speed and Power, you want to walk this balance of stiff but fresh, and so, if you were to literally finish a repetition sit on a bench for five minutes, you would Stand up after that fairly stiff and you wouldn't feel sort of smooth. This is all so. This is an all-known science. This is all practical application right. Data anecdotal there you go strength is a little bit different, but It's the same concept. You're walking that line in general a lot of the times if you see Power, lifters and weightlifters in between sets they're going to sit down and not move for hypertrophy can be a little bit different because you're getting towards fatigue, and so the factors you mentioned, like Clearing lactate well, first of all, lactate is not actually causing fatigue. That's That's a giant myth that will, which is why I teed it up. No I'm just kidding um, but in the case of again speed power, you're not going to fatigue, so fatigue Management's, not really an issue. You want to make sure that you're getting complete

neurological recovery, which is a little bit slower than muscle, energetically you're, not out of any gas whatsoever right um, You are not a lack of fuel. You know doing three repetitions of a vertical jump: yep, no plenty of glycogen totally what about stretching between sets? Yeah, you probably don't want to do that either. There are very clear examples of pre-exercise stretching static, stretching being quite detrimental for maximum power production. The same thing for speed and strength and That's been shown actually a number of times in a number of Laboratories, which is like a a classic Hallmark. Any scientist looks for of like really jumping on board with an idea if It's shown not only multiple times but in multiple Laboratories for multiple scientists and they're all seeing the same thing, you start to get a lot of confidence that That's a real finding and That's Been shown, we've done that in our Center for sport performance, not myself, but one of my colleagues has done a lot of stretching research and he is seen that a lot on everything from vertical jump to ISO kinetic dynamometers and enforce velocity curves and there is we've seen this As printing we've seen this in speed, we've seen this in loaded stuff, so you don't want to spend a ton of time stretching statically stretching a muscle priority. If you do that - and you have to do that say, say, for example, you finish that you're just like feeling really tight yeah go ahead like you need to get in the right position, especially for most people. Where are you willing to sacrifice 10 of power to make sure you don't get hurt? Yes, that answer is almost always yes outside of some very specific athlete scenarios. So, if you're not in the right position, I actually remember having this conversation with Kelly. Uh Kelly started a long time ago. It was just like yeah, fine I'll, lose five percent. If that means I'm not going to get in a bad position and hurt my back, and I totally totally agree. So if you got to open up a hip or an ankle or something to get there, get in the right position, number one we'll live with the five percent reduction in power and if you do just reactivate so before you go, do your working set go? Do something fast again, a vertical jump, a short Sprint, acceleration and sort of get that system cleared back up um if you didn't stretch it for long enough and you didn't hold it for long enough, you should be able to be just fine. So when it comes to hypertrophy now you can really stretch all you want, because we're not It's not driven by intensity or outcome, It's being driven by an insult into the tissue, and so, if you're pre-fatigue for hypertrophy, it doesn't matter if you're pre-stretched, that doesn't matter We'Re not going for quality of outcome, we're going for quality of internal signal, which is not

## 02:28:48 Tools. Power, Training & Modifiable Variables Examples

going to be changed by your Force output, so it doesn't really matter. You mentioned a few other things that one might consider. In light of uh, the list that you provided of choice, order, volume, frequency and progression right, so starting off with power, I just wanted to hand the The Listener issue with a whole bunch of different methods to go play with right. So as long as you get those Concepts, the repetition range for power 30 to 70 percent of your one repetition Max, depending on the exercise and your training status, um you're going to get the power as long as you're attempting to go fast. It's going to be great a lot of things you can try. Applyometrics are a great example of things that are effective for um for power development we've mentioned medicine. Ball throws short Sprints, you can even do Sprints uh, unlike an air bike, which is a great super. Safe activity, you can do them from Like a Rolling start where you kind of like get going a little bit, and then you explode for five seconds and see how fast you can get or a dead start like both of those are very, very acceptable weight. Lifting movements so snatches and cleaning jerks are tremendously effective. In fact, they are pound for pound. By far the most effective exercise choice for power development like without question, so those are good ones - clapping, push-ups, speed, squats. These are all a whole host of different things that you can do for Speed and power development. I'M depending on your kettlebell, swings another great one. All these can be done depending on your preference exercise, availability. What's

## 02:30:16 Tools: Strength Training & Modifiable Variables, Cluster Sets, Dynamic Variable Sets

At your gym, or not gym any of those things if somebody is more focused on strength as opposed to power, what are the additional variables they should consider again within the context of this overarching theme of choice, order, volume, frequency and progression. Absolutely It's almost identical with a couple of small exceptions: number one. You probably can't do as many working sets per week for strength, because now you're introducing a heavier load and That's going to represent some sort of fatigue load on the tissue, all those things. So you could probably get away with doing 20 sets of two of a vertical jump. Four or five times a week. You probably couldn't do that at a 90 on squat right, so the total amount of sets and the total amount of weekly load you can get

to just needs to be lower and then the intensity right. So we talked about that needs to be generally higher than 70 yeah with you know, some portion of that being working sets at some point so that really truly being at 90 plus everything else is pretty identical. You still want to emphasize maximum speed. Despite the fact, you may actually not be moving faster because you've introduced load. You still need to be attempting that, but you're going to be picking complex exercises, you're generally going to be hedging more towards barbells and machines. So this is a case where bodyweight training can be effective again, particularly for the upper body, but at some point you're really going to have to move past that, because there is just a certain amount of load, you can't put on the lower body with just your body Weight you get limited by how much you weigh, or I mean there is a couple of things you can do, but you're going to run out past that pretty quickly and so in. When it comes to strength, they tend to be less athletic movements, because you know we have to have a barbell on us. We have to have a. We have to be on a machine or something like that, and so That's a subtle difference in exercise choice. We need to also be careful about The Eccentric portion and things like that. We don't have as much risk in like a speeder power, one so um some of the different things you can play with there. We've talked about doing things like pushes and pulls. I also love carries so a farmer's carry pushing a sled, dragging a sled, all kinds of things: a yoke walk, all kinds of carry modalities that are very, very effective for strength. Um there is eccentric overload, training which we really haven't gone into, but It's a really Advanced technique where you can actually load at greater than 100 percent of your one repetition Max, but you're only going to do The Eccentric portion of it so physiologically. You are much stronger. Eccentrically than you are concentrically for a variety of of muscle tissue reasons. Actually, and so imagine, if you can do a bench press at 200 pounds and what you might actually do is load it to 220 and you would have a spotter and maybe even use it in a rack and you would lower it Down Under Control all the Way to the bottom and then stop your friends would lift it back up the top, and you just practice that eccentric portion, you would actually be able to lower, say 220 pounds effectively, despite the fact that you wouldn't have been able to lift it back up. You don't need to start there, but that is a very effective method for increase, in fact arguing one of my um one of my doctoral students right now is doing a project on this at USC and he uh like he is focusing directly on this, and It's It's Quite clear, this oftentimes more effective at strength, development than anything else, because you can actually just like in the speed example where you want to actually practice moving faster. So, instead of

practicing 100 of you on our Max for strength, you actually practice that higher than that to get better at it. So That's That's another much more advanced tool. Please don't let me get sued by saying all that, like folks, be careful, make sure you're doing the proper exercise in your positioning and, like caveat caveat, caveat, okay, um, but outside of that it can be It's totally fine and safe yeah with it when people get Injured they can't train. You can't train you, don't progress, you lose progress, so uh, certainly That's worth highlighting so two more um, a little more advanced techniques that I want to throw out there and one of them is called cluster sets. So cluster sets are there is a bunch of ways to do it, but imagine taking a mini break in between every single repetition, so say: you're going to do five repetitions, yeah in a row. What you're actually going to do is do one repetition set it down, pause for five to ten seconds and then do the next one pause. Do the next one pause pause, pause, pause pause, so you can imagine doing like a squat and you're going to go down. Explode up and you're standing you're going to Rack it out you're going to kind of like shake back out catch. Your breath walk back in, do another one rock it out, and you can repeat that until you've executed your three or four or five repetitions, and then you take your three to five minute break before your next step. That is an incredibly effective way for both strength, power and actually even hypertrophy, because you can keep the quality, the force, output, the power output very, very, very high, because you're getting these little mini breaks and you're not getting fatigue setting in by the time you're say. Third or fourth or fifth repetition in that set after repetition one you start to see very small subtle reductions, power up, but because you start to see a little bit of fatigue, you you take those five to ten seconds off, even up to 20 seconds. You can actually do it, you don't see any drop and enforce output over the course of the five, and so what you really have done is you've gotten five in this example, first repetitions, which is the way we will kind of say it right. So all five of those have the same quality as rep number one, which is again as we're talking. That's the driver and strength, and so That's the one we want to preserve. So it takes a little bit longer for some exercises. It's not very good. It's great for like a deadlift, because you set it back down check it back out re-grip hard to do with the bench you got to re-rack it back in then re-rack it back out. That's like kind of a pain in the ass. So there is some exercises that doesn't work well with and some that it does, but cluster sets and a lot of research on those um very effective. Would you recommend, if somebody's doing cluster sets that they do them for every session within that week or just this? Is an occasional thing you could do it. This could be your training strategy yeah absolutely so you can really take it

that seriously um in fact like. If you look at again the weight lifters, they will do. Cluster sets by default, not even trying still say. They'll. Do like a clean and then they'll drop the weight back out, they're supposed to be doing say a set of three but almost always they're going to like shake it out, re-grip and then pull it again and sometimes they're set of three takes like a minute and Then, like you hear It's funny, because It's like, like a, I set a triple PR you're like no, you did three singles like. What's the difference between doing three singles and a set of three when you took a minute between each rep um, I love that community. So yeah I mean it could be your strategy like it could be like hey for this five-week block. This is all my training, especially for your compound movements. If you're going to go to start doing some of the smaller movements, Maybe you give up on that um. It could also just be something you do for your one primary exercise for the day. So do that thing, that is the most important first and just do it for that one and then the rest of them. You can kind of ditch it if you need to save a little bit of that time. It can also be something you do by feel. So you know you're two reps in and you go God like I'm not feeling like poppy here like re-rack it catch. My breath for a quick second, and do it so it doesn't have to be ultra planned. I guess what I'm doing is. Is I'm giving you an excuse to make sure you're super fresh for every rep? It matters the last one I want to talk about here is: what's called Dynamic, variable resistance, so Dynamic variable resistance is uh fixing the problem we have with What's called the human strength curve, so theory of constraints again you're only as strong as you are in your Weakest point of the movement so depending on the the movement you do, this happens at a different range of motion. Well, the deadlift has used this example. It's also because we've done like research in my lab using this stuff on the deadlift, so I can speak to it very directly when you go to pull it off the ground. Some people are going to fail right at the bottom, meaning they won't get the weight off the ground at all. Some people will feel just below the knees, That's likely kind of like the hardest transition period, and then some people will feel right at the top. Just before they can lock out okay great. So what that means is at some point of that lift you're, going to only be limited by your strength in the weakest area, all right! So if you have a constant load on the bar in those other two parts of the range of motion where you are not the weakest, they are never truly being tested for their maximum strength, because they're always being limited by the previous one. And this is the same argument that we would get into if people ask about, should I what do you think about using straps right strapping your hand to a bar for deadlift things like that, there is pros and cons here there are times when you want to use A strap - and



there are times when It's a bad idea, so what dynamic variable resistance is is either using things like a heavy band or or chains on the bar. If you've ever seen, people do that. So in my lab we actually have a force plate on the ground and then we have built-in basically hooks in the front and back so. We can actually set a barbell on top of the force plate where you stand on it and then run bands from the back to the front running over top of the weights. And so when you stand up as you're going up vertically, the bands are getting Tighter and Tighter and pulling the weight towards the ground, so the weight is getting heavier and heavier as you stand up. So, as you start to gain mechanical advantage in your positioning, you start to increase load because the bands are getting Tighter and Tighter and Tighter. So this allows you to train that full part of the strength curve and to challenge your stronger areas with heavier weight and your weaker areas with lower weight. You can do the same thing with a bench press. You can do it with a squat and any other exercise. Variation and dynamic. Variable resistance is incredibly effective for a number of things, you're going to give up a little bit because the total load you can put on the barbell is lower because you're going to be adding. You know in large cases several hundred pounds of band tension, and so it pros and cons. So It's always a game. It changes the curve, but It's It's a very good technique, um that that people is fairly easy to implement It's fun. In fact, if you try this on on a bench or a squat, you're going to be the first time you give it a go. You're like oh, my God, because the bands are pulling you all over the place um. So you have to get very stable, very quick um been shown a number of times a handful of studies out of many Laboratories to be a very effective training technique, a little bit more advanced, but I want to throw that in there for the folks that are Maybe just tired of sort of doing the same barbells and doubles and machines, and you want to

#### 02:40:44 Power & Strength Training Protocols

Try something different, a very effective technique sounds like fun, yeah, It's great. With your permission, I'm going to read back my summary list of training for power and training for strength. According to your description - and you can tell me where I'm right and where I'm wrong, I'm going to pick three to five exercises, and these should be compound exercises, so multi-joint movements I'm going to perform those exercises for three to five repetitions, each I'm going to do Three to five movements: total per workout

and I'm going to rest three to five minutes between sets. Okay, if I'm training for power the weight loads on the work set. So not the warm-up sets, but the work sets are going to fall somewhere in the range of 30 to 70 percent of my one repetition, maximum yep and the larger the movement the higher. That number goes so on a squat, you're, okay, getting 50 or 60 on a bench. You would not want to go that high. You would want to stay close enough 30 to 40 range. So the way you scale that up and down is dependent upon the difficulty of the movement great, if training for strength, I'm going to have my work sets be 70 or more of my one repetition, maximum yep and the only thing to add there is, in the Case of actually all of them, um It's okay to go less than three reps per set, so a single or a double one or two represent, is also fantastic, so uh we use three to five as the concept, but less is okay, going more than that is Generally, not a good idea, so less is okay, more is generally not okay, and then you listed off a number of really valuable. I don't even want to call them fine points, but important points to keep in mind within each and both of these programs. One that really stands out in my mind, is this idea of. If I perform this three by five program, but I'm also including some hypertrophy work for arms or calves or muscle groups, that might not be hit as directly as one might like during the three by five component. That's okay! But do that after the three by five Training and keep in mind that that additional work can potentially compromise recovery for the three by five power, promoting or strength promoting program, the example being, for instance, if one does arm work on the first workout of the week Or even the you know, the third workout of the week or the fifth workout of the week and that arm work is higher repetition. Hypertrophy directed work, It's reasonable to assume that it might impede some of the three by five power promoting or strength promoting training. In the subsequent workout, so just to be mindful of that and perhaps throttle back on the intensity or the volume or

#### 02:43:37 Intention, Focus & Exercise

If my goal is strictly power or strictly strength, probably best to leave out other forms of training, yep love it one last little thing I don't think we did. Justice is intention, and the reason I want to go back to this now is because we've talked a lot about specific loads. You have to hit - and That's generally the case, but if intention is there, you can fudge those numbers in terms of how much load goes on the bar. In fact, you can get as low as

no load on the bar. A great example here is like a plank exercise, so you can do a plank in which you get in a position and you simply contract the least amount necessary to hold the position. Also, you could contract as hard as possible, pulling your scapula down and back squeezing your core, squeezing your quads, squeezing your glutes that is actually going to still help strength production because you're attempting to contract very very hard, even though quote unquote, the load is the same. That thing extends to weight on the bar, so you could theoretically see large improvements in strength at 50 of your 100 max if you're Contracting as hard as possible, and so there is a lot lots and lots of different ways. You can train for strength that are outside of this weight, lifting weight, training, spectrum, and you know if people, if you hear things like this and you're like wow, I know I read this book or I saw this other coach who you know like I got so Much stronger that way. Well, if intention is there, those are absolutely possible. This could be anything from bodyweight style of training. It could be very low load Implement stuff, so a kettlebell, a light kettlebell or a ball. It could be single leg training, It's like all kinds of different methods. They will only work for strength, though, when you're past your first, you know handful of months of training. If intention is there, and if it is, then these specific numbers and protocols don't matter as much so don't get too caught up in them. If you're not worrying about exercise quality - and this is very very important because you mentioned earlier about how you stop taking your phone into the gym with you, one of our former students, Ramsay ninja - is uh the head strength, Edition coach at the University of Kansas and He made he made a great post a couple of days ago, where he gave sort of a tip of how do I improve training quality and one of his tips is set your playlist before you go to the gym and the reason is people spend so Much time in between sets just finding the next song that they like it makes their workout so long and so unproductive. So that is one strategy or do what you do, which is Ditch the music entirely. When you don't have music or a phone to look at, you only have one job. You only have one thing to pay attention to and what you will find is the quality of the training will go up exponentially. You will feel kind of quote unquote bored, but That's just means you will go back to training and you will get a lot more done because you have one thing to focus on, so you can get a lot more done when you avoid those distractions and when you're doing Strength and especially power work, since It's not fatiguing strength will be a little bit, but Power won't be p, get very bored, they're used to either feeling a pump or a burn or a sweat or, and That's their like perception of my quality of workout. These exercises will not hit that for you, so there has to be another metric, you're looking at,

which is I'm going to try to move as well as I can as hard as I can That's going to produce your results. If you can't do that, then you might as well just not do these workouts go. Do something else! You're just going to be wasting time, you're going to be burning, a very low amount of calories. You will have wasted an hour and you're going to go right back to the place. You were so be very intentional. There are actually some some studies showing that music can enhance performance. We've done some of these in our lab. So, what's that mean It's not about the music per se? It's about the focus and intent and do whatever it takes to be very focused and intent, and you can actually get in and out very quickly and get a lot of work done and

### 02:47:29 Hypertrophy Training Program, Muscle Growth & Signaling

See a lot of results, love it! Okay, let's talk about hypertrophy, a topic that occupies the minds of so many youth young men, but also a lot of women. I think one of the really interesting progressions That's taken place in the last decade or so is that far more men and women are using resistance training in order to evoke hypertrophy growth of muscles, for aesthetic reasons and for all sorts of reasons. What are the ways that people can induce hypertrophy so not to correct you or insult you, but probably a better way. To think about that question is really what stimuli do? I need to give the muscle to induce hypertrophy now there are hormonal factors that are important. There are nutritional factors, but just to stick with the context of training. This is really going to frame a lot of our answers and, as you will see It's one of the reasons why I call hypertrude training kind of idiot proof in terms of programming. Now the work is hard difficult and all that, but the Precision needed is a lot less than what we saw in power and strength. And so, if you note there, like It's very important that you do it in this style, with this intent and with with these Within These parameters and if you're outside the parameters, It's not going to be it hypertrophy has a very broad range in terms of your Actual applications - and this is why you have and will continue to see, countless styles of training that all work I mean. I know you were mentored earlier in life by one of my favorite people in this entire field, Mike menser, like just an absolute character, his style was completely different than what you would see in a classic textbook or any number of different influencers or coaches or individuals, And if you've ever thought thought to yourself like, why is it all these programs work and people love to jump to things like? Well, That's the steroids like just get that out of the equation for now independent of that

right. That's not even part of the equation! You're still going to see results, and the question is like why? Well That's because what's driving changes in strength and Power are the adaptations of specificity? What's driving changes in hypertrophy is much more well-rounded, and so you have options to get there. Remember: you're, training, a movement and now you're training, a response and a muscle that caused the growth, That's very, very different. So if we look at like the classic Dogma, we have to basically challenge the muscle to need to come back in this case specifically bigger, and the nutrients need to be there to support that growth. Okay, the nutrients aside - perhaps we can come and a few more minutes and talk about that, so all we really have to do is going back to our our dogma of activation of something on the cell wall. We've talked about this earlier. That's got to induce that signaling Cascade. That's got to be strong enough to cause the nucleus to react to it to go to the ribosomes, to initiate this entire Cascade of protein synthesis okay. So that signal has to be one of a couple of things: either has to be strong enough, one time it has to be frequent enough or it has to be a combination of these things, all right, so I can get there with a lot of frequency and A moderate signal I can get there with very low frequency and a large signal like more akin to what you did with Mike back in the day, I'm sure and still trained that way, still training. Each muscle group mainly once a week directly and once a week indirectly. So all you can, all you have to do there to not fail is to make sure the training is hard enough and It's going to work. If you choose the frequency path, then you actually have to make sure you're, not training too hard to where you can actually maintain the frequency. The only wrong combination here is infrequent and low intensity and low volume. That's it as long as one of those three variables is high you're going to get there, because the mechanisms that are needed to activate that signaling Cascade are wide ranging, and this is why, when we even see things like Blood Flow Restriction, Training right. This is when you put like a cuff on your arm or your leg, and you block blood flow and you use no load or as low as say 30 of your maximum, and you take it to fatigue. Failure that actually is an equally effective way of inducing hypertrophy, despite the fact that you know you're using three five ten, maybe most 20 to 30 percent of your owner at Max. Why? Because you went through the route of metabolic disturbance, okay other ways say a higher load, maybe as heavy as you can for say. Eight repetitions is going to get through, what's called mechanical tension, and so there is there is these different paths that we can get to the same spot now. Eventually, these things have a saturation point, so you don't need all three of these mechanisms. The third one, of course, being muscle

damage or breakdown, and I and I know we want to chat a little bit about that, but none of these three are absolutely required. You can have multiple of them in a session um. You don't have to have breakdown at all. That is a complete uh. Well, really, It's a flat out lie that you have to break a muscle down to cause it to grow. That's just not needed at all. You have to have one of these three things, though, and so again this allows you a lot of flexibility, which is why crafting your program, which is best for you, is actually fairly simple. When it comes to hypertrophy, you just have to make sure you do the work, and you want to make sure you have a few standards in place with the exercise, choice and some other things that will um we'll hit in just a second. But That's really the fundamental way of getting to it, making sure either. That signal is loud enough or frequent enough to give the nuclei a convincing enough reason to spend the resources, because you have to remember two things in order to grow new, skeletal muscle. You need amino acids which are your supply, and then you need primarily carbohydrates as the energy source to power that synthesis process. So you remember basic chemistry that says, if you're going to take two atoms and you're going to pull them apart or put them together right. That's going to take energy typically and in most of actually metabolism uh when you split a bond you're going to get It's called exergonic you're going to get energy from that, but when you put them together, That's going to take energy. This is why we call that protein synthesis right, so you have to convince your nucleus that one invest those resources in energy, primarily carbohydrate, but number two and more importantly, invest that Supply. There is a ton of possible ways to get energy, but there is a very low amount of amino acids available, and you need them for many more things than just taking your biceps from 17 inches to 18 inches right! It's not going to do that! If you're in a position where again, you can't sustain an immune function, if red blood cell turnover needs to be higher or any of the other main, like tons of things that you need proteins for, so you have to be able to say like. Are you sure you really want to spend these resources and build it in a muscle, because once we do that, It's very difficult to go backwards, break them back down and bring the amino acids back into the to that availability pool? So we can use them for either another function entirely or even another muscle group. That's called protein redistribution by the way, when you say, maybe you don't do um a lot of upper body work in your training and you're, not eating enough protein or a minimal amount and you're doing a lot of lifting in your legs. You will you will notice. Your legs will get larger, but That's actually a lot of times, you're pulling the protein from say your upper body in this case and redistributing it back down um to the

quads. So That's the way you That's what you have to get to and in terms of application, what numbers to hit we can go through each one of our modifiable variables, just like we did

## 02:55:12 Tools: Hypertrophy Training & Modifiable Variables; Examples

With speed and strength and power and walk through some of our best practices in each category. Yes, so I'd love to talk about those modifiable variables as they relate to choice of movements, order of movements, volume so sets and repetitions and frequency of training, and I'm particularly interested in frequency of training, because that relates to the so-called split, where typically one is not Training their whole body every workout, although there are I'm sure, hypertrophy workouts, that um our whole body workouts, but where people are dividing on their body parts on onto different days, so uh would love to go through this list, one by one, starting with exercise: Choice, cool Great so in the previous section we pretty much said exclusively choose your exercises by the movement patterns and you want to balance between pushing and pulling and rotation, and things like that. In this particular case, you have the option to do either. Here is my recommendation. Most people default almost exclusively to Choosing by body parts here right, I'm going to do calves and shoulders today and chest and back whatever combinations of things they want. That is clearly effective strategy. However, many Studies have actually been done where you choose by movement patterns and that is actually equally effective. Now one little caveat, I actually should have said a few minutes ago. When we talk about the research on muscle hypertrophy, it is important to distinguish the fact that the vast majority of This research is coming from a novice to moderately trained individuals. There is actually more and more research coming out on trained individuals, but That's still moderately trained right. Even those ones so what happens in those people that are actually way past that point we don't know scientifically It's very difficult to do, research there. So That's an important caveat. I will acknowledge when I say: hey, you don't need to do this or you have to do this. You're, assuming a training status of moderate to low may or may not be true past that we don't know scientifically. I have certain thoughts personally, but the science will only take us that far. So that being said, you can actually choose by muscle or by movement pattern. Here, whichever is is your personal preference, and this is actually where you can act, just become a good coach, whether you're coaching somebody else through this fitness

journey or It's yourself and give them a little bit of autonomy. So maybe you select the first three exercises and then let them select one every day, and so if they especially want to make sure that one muscle group grows, let them Target that muscle and maybe the rest of the day. You've actually split it up as Push Pull or something else like that. All those strategies are effective. Personal preference, as long as the total amount of volume on the working muscle is equated throughout the week, which we'll get to those numbers in a second, then you're, going to be in the exact same spot no problem. I would actually generally encourage people to choose exercises in a variety of Fashions. I actually think that It's important that you do some number of combination of what we call bilateral and unilateral exercises, so bilateral being think about it like a squat, where bi meaning two lateral. You have two feet on the ground. Moving in sequence, here, unilateral is one. So this could be something as simple as a rear foot, a limited split squat. It could be a single leg, leg, press or single leg curl. It could be a pistol squat, something where the the individual limb is moving one at a time. You need to have a combination of bilateral and unilateral trading. That's good to do for strength as well, probably not super important for power, but I'm also very important for making sure for hypertrophy's sake. You're not getting any imbalances, as you progress, especially through months and years of training, so make sure you're doing a little bit of a combination. Whether you want to pick specific implements, That's really a methods, question and a preference question. Then it is Concepts so dumbbell, great kettlebell, fine, barbell, awesome band doesn't matter body weight. None of these things are as important, because all you're trying to do is create a certain insult in the tissue, and the Implement is just whichever one you feel best doing it, and this is where actually machines come into play. A lot machines are greatly underappreciated. They are a fantastic resource, especially somebody who's, either early in their fitness journey or somebody who really is having a hard time targeting a muscle group with a bigger compound movement. So when you're choosing exercises for hypertrophy you're going to want to start with those bigger compound movements, That's going to be drive a lot of the adaptation you can get to these single joint movements like a little bit later. But having said that, because of of the way that people move differently their bomb or their anthropometrics and their biomechanics and even their technique, the same exact exercise will not necessarily work the same exact muscle groups for multiple people. So if you and I both went and did a back squat um, if you did a little bit more of what we call a high bar squat, so this is the bar is literally sitting up higher up on your neck you're,



keeping your back more vertical and Because, in order to do that, you shift your knees much further past your toes keeping, of course, your whole foot on the ground in good position. Okay, That's going to generally put more of an emphasis on the knee joint right, and so That's not a bad thing. You tend to see a little bit more work in the quads there, a little bit less work in the spinal rectus and back because you're actually not supporting the weight horizontally, which is a diff. It's a much more difficult position. It's vertically stacked! Okay, if I were doing the classic low bar squat, which is again lowering the bar down my further down my back towards uh one more. Like my shoulder blades, I probably take a little bit of a wider stance and when I squat, I drive my glutes back further away from the midline in as in fact, as a general rule. If you take the midline of your body, the thing that moves is the farthest away from that midline is likely to be the thing That's activating the most. So, in the case of the of the front, squat you're not generally going to be using your glutes as much if you're in that are not even front side just that high bar squat, where you're very, very vertical your knees are going to be moving very far Over your toes, which is fantastic, therefore, It's a little bit more knee dominant, as can we say it the other version here you can keep your shins really close to Vertical. You move your butt backwards, you're going to have to then lean forward with your torso, which means it'll be more low, back more glutes and a little bit less knee. Now, That's a general statement. It's not necessarily always true, but as a guideline there. That is one exact exercise where you may be going man, I'm trying to improve this clear weakness I have in my quads I can't even leg extension, my body weight. I have a significant problem there, so maybe in your particular case, if I'm hammering you or you're hammering yourself in a squat, exercise and you're wondering why your quads aren't getting any stronger or growing in any size, it may be because of the style of the movement. So I may need to go Andrew all right. Look squats in general, if you look at the research, are an excellent exercise for Quad development, but for you they're not because of the way you stand or just because of you know, neural activation, it doesn't matter. So I need to take you to a machine and isolate that muscle group, so we can make sure we see development in that. So if you're trying to grow a specific body, part area, individual muscle, It's very important that you're actually seeing progress there and don't worry about well in the textbook. The bench press is supposed to be good for your PEC, because, if you're not actually moving the right position or depends on the angle in which your sternum actually sits in your body, a bench press may actually be doing very little for your PEC and you may Need to adjust to say an incline bench or a decline

bench or a PEC fly, so machines can be fantastic at letting you isolate without having to worry about things like stability, your low back position getting hurt where is your neck at you can really concentrate on just The movement concentrate on the muscle and let everything else kind of go away and

### 03:03:02 Balanced Muscle Development & Hypertrophy

Ensure you're getting training in that specific area. Those are excellent recommendations. One thing I want to ask about is prioritizing specific body parts and therefore specific exercises, and here I'm not necessarily referring to trying to bring up a so-called weak body part. You know an area that tends to be either genetically deficient, because in some cases I learned, for instance, having seen a lot of competitive track and field championships. I love watching track and field as a spectator up to Hayward Field in Oregon. Whenever there is a meet, oh sure, I really love that the sprinters are amazing um. They have some of the highest calves in the world that I have ever seen. I mean like little like little micro Cavs but they're fast as hell they're right behind the knee, and they have a very long distance between that calf and their foot, which makes it propulsion excellent right. They wouldn't stand a chance as a competitive bodybuilder, but because something different is being selected for in bodybuilding, but obviously they're they're magnificent for sprinting. Most people, of course, reside somewhere between the extreme of you know. Very long muscle bellies from you know, origin to insertion or very very short muscles. Usually people have one or two body parts parts that they want to emphasize, for whatever reason you know these days, it seems to be. People are really. What are they saying now like glutes to the new biceps or biceps? Are the new glutes or I don't know anyway, you see this stuff. I love them by the way I am so Pro curls in the squat rack there. You go love it right there you go. So nobody kill me, so everyone has their thing, but the that they would like to emphasize. But I have a question because we're specifically talking about hypertrophy, which is, should people give themselves permission to not train a body part if their goal is balanced? Hypertrophy I'll give a couple of examples. One of the reasons why I, for instance, not done a lot of free weight. Squatting is because, despite my quadriceps being rather weak according to you um, they tend to grow rather easily relative to other muscle groups, and the goal for me has always been balanced. Development. Yeah, and so I emphasize hamstring work -

and I emphasize a you - know: calf work and hamstring work um. It's not that I don't train my quads at all, but I do far less for them and I avoid the big compound movements for them. I I occasionally do them and what again this is not about what I do or don't do, but I think that in the context of a conversation about hypertrophy, is it appropriate to give people permission to say, listen if you're, just genetically, you know strong large lats Doing a lot of chin-ups and rows might actually be the worst thing for you. If your goal is balanced development - and I um I ask because I don't often hear anyone any you know: credentialed people give people permission to completely avoid training a given body part if their goal is balanced development, and yet I think most people who are resistance. Training are seeking balance development. I don't know anybody that actively wants to have big upper body small legs. I think that comes from neglect and laziness in most cases, sometimes injury, related or other things, but um. I think this is an important point to raise that any good program for hypertrophy, I would think, would have to take into account people's genetic and natural variation. Um sport based variation in which muscle groups just tend to grow easily for them and which ones require a lot more focus and work yeah. Absolutely you, first of all, you have permission to do or not. Do anything you'd like to do in terms of of hybrid tree? I generally wouldn't not recommend disregarding a muscle group entirely. I know That's not what you actually suggested, but just to make sure that people didn't hear it that way, um. What I would do is in this example is: I would continue to do those big movements. I would just keep the volume low, so I might do two sets or something uh twice a week. There is a whole bunch of reasons. You want to make sure that those motor patterns are there. You want to make sure that the the especially the benefit of these compound movements is you get to work so many complementary muscle movements at the same time. So, in the case of like loaded squat you're, not only working stability in the hip, as well as the knee but you're, also working upper body uh, your your rhomboids are keeping you in position. Your neck has to stay in position. Your toes everything is working, and so It's really difficult to get those things. When you take that movement out and you replace it with say a a machine. Hamstring curl that whole element of balance and neurological control is very, very important to maintain over time and that just gets removed with. If you go to machines only so I would keep some of those things in, maybe even not all year round, but maybe one quarter of the year two quarters every other rotate it something like that as long as It's getting you're. Not if the reason you weren't doing say those squats was uh because you're like ah it hurts my backers. Okay,

great then leave it out. But if it's just simple, you don't want your quads to go too much. I would just keep that volume low and do something just to kind of touch it keep it activated and to maintain all those other things. Like flexibility range of motion, I would bet anything your adductors are probably underdeveloped right now you can get those by doing your squats, because you're not really doing I'm sure in much adduction training, and so this things like that that just get lost when you're. Only thinking all big muscle groups that that come inherent in doing the larger movements, and so you don't have to worry about them or train them separately. I appreciate that and in reality I do two to three really hard work sets of hack hack machine squats per week, which is plenty for me to maintain and even get a Little Bit Stronger, but per our earlier discussion about a year ago. I shifted to doing very low repetition ranges to main strength in that movement. There you go, but I am actively avoiding hypertrophy in that muscle. Group yeah or another solution would actually be do something like one set to failure a week, not even extremely long. Just you know do something in the 8 to 15 repetition range um at the end of all that strength set and just get a little bit of pump there and then, and then just so just so that those muscles can touch that level of fatigue. Touch that level of strain and

### 03:09:04 Tools: Hypertrophy Training & Modifiable Variables; Splits

Mechanical tension walk away great. Thank you for that. What about exercise order, amazing, so implicit in this exercise, Choice thing It's! What you're going to notice is these modifiable variables interact with each other right, and you can clearly see how, when we talked about volume and to clarify volume, is the repetitions multiplied by the sets? That's typically how we express the volume? Well, That's going to be directly influenced by intensity, the heavier load you put on the barbell, the less repetitions you can do and the inverse right rest intervals, the shorter you keep your rest intervals. Then either the lower the weight has to go the intensity or the lower. The rep range has to go. Order is the same thing. Choice is the same thing, so all of these things modify each other. They play a little bit of a hand and what everything else does so, with the exercise Choice thing rolling into exercise order. You get to play a couple of games here when we talked about strength and power. I basically said: stick to the big movements most complicated and compound movements. First, you don't have to do that with

hypertrophy. You can do this in a couple of ways. You can do the thing you're just simply most interested in first. You can do this thing called pre-fatigue, so say: you're you're, going to do a back day. You could go in and do nothing but isolated biceps as your very first exercise and then roll into your. Your pulling movements, because what you will see is during most pulling activities, the biceps are a secondary or tertiary muscle group, but you've pre-fatigued them you've guaranteed that muscle of most interest - God It's It's most training in and everything else is secondary. So you can start if you want with single joint movements, you can start with isolation stuff or you can start with compound stuff, either way it just really comes down to preference and what you're specifically trying to develop now. This also goes back to the exercise. Choice. Question right because It's sort of the same thing right like what, which one am I choosing and where I wanted it. The campus was the exercise splits and, and so we just sort of talked about, am I doing body part splits and I know a question. I get a lot here is well, which ones should I package together? I'M not really concerned with it. What you all you should worry about is how many times per week and in fact, total volume you achieve on a muscle group per week, and I don't doesn't really matter how those things are folded in It's really a personal preference issue. One mistake that we see here commonly is grossly under appreciating that the legs are not a muscle group right, so the legs have a whole bunch of muscle groups in them. So we see a classic split like I'll, Do shoulders and chest Monday and then I'll. Do you know biceps and forearms Tuesday and then legs Wednesday or whatever and then back to upper body? And then I was like you're like wait, a minute. You have four days dedicated to the upper body and one for quote-unquote legs. Well, like you. Hopefully, you can see the imbalance. What's That's going to happen there over time is you're going to do it do far more upper body than you are lower body and That's not appropriate. So you just want to think about your lower body, like you would do if you're going to do body. Part splits then include those things as well and they'll just chunk everything in as legs once a week. If you want to do that, That's actually, okay, but that day has to be very, very challenging, and you probably should do quite a bit of volume um there, because you're almost surely not going to hit the total weekly volume needed to optimize muscle growth. If you're literally only doing once a week of your quote-unquote legs so along those lines, Let's Talk Volume yep. How much volume does each muscle group need per week in order to generate and for that matter, maintain hypertrophy right? So the kind of a minimum number we're going to look for here is 10 working sets per week, correct per muscle group correct and just to make

sure that everyone's on the same page. If I do a chin up or a pull-up, I'm going to mainly be training. My back muscles, my lats, if I'm doing it correctly, lats and rhomboids and biceps right and a few so but they'll be indirect targeting of the biceps. So would you include indirect targeting so, for instance, if I you said 10 sets per week, let's just use biceps, because it seems that That's the go-to uh generic muscle for what. Why is that? By the way that when people ask somebody to you know Flex their muscle, they always Flex their bicep, they don't flex their calf or their quad or their glutes or something I guess, there is some um. You know public decency issues. I can tell you uh with my children: That's the very first muscle I taught them to flex their glutes, no they're, biceps and and good um, good uh, healthy parenting advice from Dr Andy Galpin. So if It's 10 sets per week for biceps in order to maintain or further grow the biceps, but does that mean if somebody does 10 sets of chin-ups or 10 sets of chin ups and rows that they are checking off any of the boxes for biceps? Assuming that they're doing the movement properly yeah and targeting the major muscle group that a given movement is supposed to Target which in my mind, when you're doing a chin up you're supposed to mainly be using your back muscles. And then there are secondary muscles or secondary activation of other muscles, but of course, some people, their arms grow like crazy when they do chin ups and their back doesn't grow at all. So this is where we're back to the kind of um genetic preloading of the system - yep um, if you will so how does one meet this 10 sets per week minimum when dividing different body parts and thinking about this direct and indirect Activation? So two things there is no specific exact rule here, and this is why these set ranges are ranges right, and this is why we don't say like 10 is so 10 would be sort of the minimum number you want to get to the more realistic number that most People, especially if you're Advanced or even intermediate, is more like 15 to 20 working sets per week. Okay, now, if you're very well trained, you probably want to even push more towards like 25 and in fact past that there is just not a lot of research, so the optimal number may be 30.. We don't. We don't really know It's just hard to get that much work in um. It may actually be detrimental, and here we're referring to Natural athletes. That is people who, for whatever reason, either because they're not taking any prescription drugs or maybe if they are, whose levels of steroid hormones, mainly the androgens, like testosterone, Etc, do not exceed the normal reference range values either because That's what they are naturally or That's. What they're replacing through pharmacology, whereas when we think of technically someone, could be taking exogenous hormones to replace a deficiency and then there is still a normal range?

Okay. But I just want to clarify, because you work with athletes, a number of different sports where drugs are and are not tolerated, Etc, and the general population that what we are talking about here is for the general population not for steroid, using athletes, correct, okay, yeah great. So um, so Ken was just sort of that, like absolute minimum number to maintain, which is actually pretty cool, if you think about it, this way, uh. If you went in - and you did three sets of ten, It's a very three sets of ten repetitions, correct you're. Already at three, you do that three days a week, you're at your nine, That's almost ten. If you also just went to the gym one day a week, you did three sets of ten, and you did three exercises you're at nine. Is that working sets you're basically done so achieving 10 sets per week per muscle group, and now we're not even talking about indirect activation of a secondary, so you're, going to hit 10 fairly easy um extension to that hitting 20 is actually still not that hard. Because of what's actually going to happen there, so in your example, if you're doing your chin UPS well, would the biceps count? There is no exact rule there, because uh there could be technique issues, it could be hand positions, so you mentioned chin up very specifically. A chin up is actually going to put your hands in in this position where your palms are facing up right. This is supination and pronation, so you're going to be there well, That's actually quite different than a pull-up or your hands are in the opposite direction. So a chin up actually is going to be pretty good activator in your biceps for most people um. So you would expect actually to probably count that, because It's going to be very difficult to not see some fatigue in your biceps depending on your mechanics depending on, and by that I mean just the the segment lengths of your bones right. That's where your muscles or originate and insert there is been something you can do about: It's not even a technique or a focus issue. It's just simple fact: the matter. That's how you pull best in that area. The position in which your hands are on the wider grip. More narrow grip, It's going to change muscle use, so we talked about earlier. I think in the previous episode that exercises do not determine adaptations. Applications do but exercises do determine things like the movement plane, The Joint you use and typically The Eccentric concentric sort of ratio. As well as oftentimes, the muscle groups involved, so there is just not a lot of things you can do depending on how you are built of you know some exercises activating a secondary group and you don't want it. So It's not always a technique, you, it may just be That's how you're built right and the same could be true for a squat, the high bar versus low bar sort of example. We talked about earlier, It's you know you. You could see plenty of evidence on muscle activation studies where people even doing the vertical back squat

style have tremendous glute activation and folks doing the the low bar have tremendous quad Activation. So a lot of it depends on personal mechanics. So what I counted is the question. Really you just have to ask yourself number one: do you really care that much? You know you have a range to get to if you're anywhere between 10 to 25 working sets. You know you're fine. So if you count it or don't count it, It's just going to change the difference between whether you did 17 working sets or 23 and either way you're fine. So I don't really care number two. Are you actually feeling anything there? So, if you're doing your chin? Ups and your biceps are blowing up. I'M counting that right, if you're doing it you're like no, I don't feel any fatigue there. It's all my then I'd probably say: okay, we're not going to count that as towards it so um you can just let that guide. You a little bit towards your account yeah. I have always noticed that there are certain muscle groups that are very easy to isolate yeah when under load and those are almost always the same muscle groups that are easy to contract very hard without any load whatsoever. Bingo. You know That's actually really insightful, so um. You can kind of use this heuristic of like if you can contract your lats just standing here, you're - probably going to contract them very well. When you lift, if you can't, you can probably assume about the same thing's going to happen so uh yeah you will, know um. This is actually the lats are actually really interesting because they tend to be one of the more difficult muscle groups to learn how to activate so, if you're in your journey you're just like, I have no idea and um, you can look up like a lat pose. So how do you like? How do you puff your last? How do you show it and if you do that and you're like wow there is no movement here just recognize That's extremely common, and that is probably going to take you many many many months of trying before you start to see some movements, and probably even a few Years before you really start to see Activation so you're, not some sort of like specific, like special genetic anomaly, It's very, very common. It's uncommon to not be able to activate your biceps right that everyone can do that, but if you're just like man, I can't get this here, I'm just going to stop doing it. Do not do that! Just keep at it and just keep concentrating and thinking about that muscle group. It will take some time It's very common, to have challenges. Activating Lots. Yeah I have noticed that many of the muscle groups that were responsible for a large fraction of the work in the various sports that I played as a young child are muscles that are very easy for me to selectively, isolate and induce hypertrophy in um. I suppose I'm one of those mutants where my lats happen to be one such of those muscle groups, but I think That's because I swam a lot when I was a kid literally going to ask me a swimmer yeah. That's



like a Telltale yeah every every kid. In my town swam and played soccer there you go and then later I you know I skateboarded and did something. You generally hear that answers you either were a swimmer or you're a wrestler. So It's like that pulling and pull toward you is thousands of repetitions allowed. You to get very good at Contracting, but because um I also played soccer and skateboarding, but I didn't do any baseball basketball or football muscle. Groups like deltoids are very challenging to activate nicely yeah. So I do think that early development is superimposed on a genetic template, that sort of predicts which muscle groups are going to be easier or harder to isolate and train. It's also a very good case for why It's important to do as many different athletic activities as you can in your youth yeah, and if you do skateboard definitely learn to ride switch, because every every skateboarder I know has one leg, That's larger than the other one. Calf, That's larger than the other, and actually for that matter, um people that do martial arts that don't learn to um if they're, not Southpaw, if they don't learn to switch up and do their uh their work. Southpaw, you see the same thing I mean you're. Building an asymmetry into the system and It's not just muscular It's neural, oh strongly, neural yeah, um, so yeah, kids, um parents get your kids doing a bunch of different things. I suppose gymnastics would probably be the best sport all around in terms of movement in multiple planes and activating all the different muscle groups - uh, yes, and no there is a lot of benefit, no question about it. There is a lot of other things, though, that it that has limited abilities so um, almost everything in not like gyms is great, but almost everything in that is pre-planned, which is a major downfall right. So the joy of skating is there is so much proprioceptive input that you have to make decisions very quickly, um in in small Windows. Now you have a little bit of that when you're flipping in the air you have to land, but you gymnastics, gymnasts tend to have a very specific routine that they're working on and they work on that routine for years. So um for me was Transportation. It was freedom and it didn't require any coaches or parental oversight. Yeah yeah Ball Sports have the beauty of reaction, and things like that. So all of them are

### 03:23:08 "Non-Responders" & Exercise Plateaus, Volume

Wonderful um yeah good to do a lot of them. You've established that 10 really to 20 sets per week. Yeah is the kind of bounds for um, maintaining and initiating hypertri yep. If I were to like flag one of them, I would say 15 to 20.. Is this That's right that you want to get um working now it gets complicated when you ask well how many reps per set do I

have to get to okay? Well, we also can complicate that by repetition, type and tempo just sort of let all that go for now and just think if you're getting close to that range you're in the spot - and all you have to do now - is balance two things: recovery and continued training. Okay, so if you're somewhere in this 10 to 20 working sets range and you're in a position where you can continue to do that, you're, not so sore and so damaged and beat up that, you can't maintain that volume. For you know eight weeks at a time, or at least six weeks at a time, then I'd probably say either the style of repetitions. The amount of repetitions per set you're doing are too much. The volume is getting to you. However, if you're not seeing adaptations, then I'd say maybe the repetitions aren't enough, and so That's like That's the kind of game you're running now. There could be plenty of other factors - intensity, of course, yeah intensity, um intent and then, of course, the other things, sleep, nutrition, Etc. All these other things that go into our visible stressor category that we always analyze. This sort of brings up this idea of responders and non-responders, so we get this one a ton. So why is it some people, my gym, buddy, my roommate? We go to sleep, the same time, we're on the same nutrition plan. We work out together. She triples in muscle size - and I don't have like no again whatsoever - well, there is a lot of work that we're trying to do to identify the molecular mechanisms behind responders and non-responders because they clearly exist. In fact, this is one of the reasons why every paper I basically will ever publish again, if I you know, if I do always reports individual person data so rather than group averages you get to see, you know if there is 10 subjects in it, you get to See how each of the ten responded, because the group average can get confusing? What you really want to see is how many actually people got better. How many got worse? How many maybe change you know so so we'll always report those individual data, because when you go to train you're, you you're, not the group average. That's very important to know all right. So if you do that, you can see a beautiful line of these hyper responders. The bell curve in the middle of the normal responders and those folks who, like through any training study, just won't, get any better. If you can tease out what you can't, but let's say in science you could tease out all the extra factors. Total stress load. Hydration, sleep, Etc. What you often see is non-responders a lot of the time. It's not that they have a physiological inability, It's just that they need a different protocol and a lot of times. It's they just need more volume, so if they can handle that and they're not successfully beat up just give them more volume and they tend to see a lot of breakthroughs. You see the same thing with plateaus. So typically, It's sort of just like okay, the routine you're on you've, been on it for too long.

We need to either go to the other end of the hypertrophy Spectrum for intensity, which means like, if you've been in the like 60 to 70 percent of your one repetition max range. Maybe we actually need to go heavier. Take our repetitions down - maybe even our total volume down and go heavier. Try that a great way to break through plateaus of grand. If all the other boxes are checked, um, the other one is due to the opposite, which is like okay, we're going to go higher. We're going to go sets of 20. set to 25 High, very high repetition range and really get after it not to do as much damage, because you don't tend to get as sore from those really high repetition ranges. You will get more sore from the lower repetition higher intensity range than you will typically the other ones and see if we can bust through some plateaus there, so it just generally means you need to do something a little bit different than your your training partner. So we've talked about exercise, choice and we've talked about the

### 03:27:06 Hypertrophy, Repetition & Rest Ranges, Muscle Failure, "Chaos Management"

Sets that one needs in order to induce hypertrophy per week. What about repetition ranges? You've mentioned some pretty broad repetition ranges how many repetitions per set is required in order to induce hypertrophy yep. So there are two caveats here before I give well, the number is somewhere between like four to 30, reps 30 repetitions. Absolutely in fact, I think you can go much higher. The first 20 have to be feel exceedingly light, correct and during those first 20 or so repetitions is the goal still to contract the muscle as hard as possible on each repetition. So this is the caveats here so caveat number one is: there is an assumption that by the end of this set you're getting somewhat close to failure, and so you don't have to go to Absolute failure to induce most like perjury, but you also have to get kind of close, so if you're going to do a set of 25 - and you finish it and you're, like oh yeah like that, was kind of starting to get hard at the end, That's not going to be enough! If you're going to do a set of five or six and the same sort of expression comes out of your mouth, It's not going to be up. So in that case it doesn't matter your rep range. If you're not getting somewhat close to failure again, it doesn't need to be complete failure. Um, a good number to think about is like minus two, which is what we call reps and Reserve, which is sort of like I got within two or so reps of failure, and then I stopped and can we Define failure, at least for sake of this portion Of the conversation as the point at which you can no longer move, the

resistance could be your body could be yeah a weight, machine, Etc that you can no longer move the resistance anymore in the concentric phase of the exercise. Movement in good form correct. That's a really nice momentary, muscular failure is how we typically Define it. There is a wonderful review. I think It's open access that just came out in the last handful of months, Eric helms's team out of New Zealand Eric's is a great scientist and a very experienced physique coach and a competitor himself. So he knows a lot about this area and that paper rent through all the exact definitions in detail, all the caveats that we're not going to have time to get into today. So I would recommend folks like check that out if they want more information but I'll try to get the highlights of it right here. So what they basically showed is going all the way to failure in the defining failure, like you just did right so momentary, muscular failure. You can't complete another repetition through complete range of motion through whatever range of motion you determine prior to, as well as with good technique, so other body parts aren't being compromised, sort of Etc and doesn't need to be total failure that minus two failure is still needed In caveat two, which is again very, very highly trained individuals, you won't see people who are like Eric or other folks who are six to eight to ten years in a very serious training um who don't have to go to failure, probably a little bit more than What I just said so, the the layout that they brought in their paper was very nice and they basically said. Okay, here is a couple of scenarios in which going to failure is maybe the best way to do it number one. You probably should do it on a little bit of the safer exercises, so maybe taking your back squat on a barbell to complete failure and doing that as like a standard protocol multiple times a week, It's maybe not the best choice. So maybe, if you're going to do barbell back squats, you take that to your you know your your one or two reps in reserve. Stop there It's a lot of work! It actually going back to our discussion on the prolapin chart. It's a similar idea right where you're going to spend most of your time in these working sets, 70 to 90 sort of percent and then you're going to take that failure to maybe the hack, squat machine or maybe even the leg extension machine. So a little bit of a safer exercise, they also can tend to be single joint exercises. Don'T have to be but they're just ones that are not as complicated and you're not likely to injure other body parts when you're doing it all right um. So That's one! One way to go about it another way to go about. It is simply doing it on like the last movement of the day, right and so again, you're not going to do it on your first three or four exercises, but whatever your last finisher is you will hit. Total failure on that one and that kind of keeps you in a range of yeah. You hit some failure. You got a lot of overall work done. So That's a lot of

stimulus. That's a lot of noise going to that nucleus. That says, grow grow grow, but you didn't totally obliterate yourself, especially if you don't have the assistance of anabolic steroids right. That's very, very important! If you have those you can push this a lot harder, because your recovery would be significantly enhanced. If not, you kind of want to walk away from that. I have to assume that you know 99 of people are saying this, do not and um and and yet among those who are not taking anything in terms of anabolics they're, I think, is a large range of recovery quotients out there. Some people just tend to recover better. Some people, I think, also are far more diligent about what I would call the um necessary, but not sufficient variables of yeah, adequate sleep, yep, uh, proper nutrition, limiting stress and and so on, yeah. I can't wait to break all that stuff down. I got a whole got a very long discussion for all those things we will get into it in all its practical realities and actionables before long. What about rest between sets great? This is the interplay now, so one actually thing we said for a long time is you want to stick between 30 to 90 seconds of rest between sets for hypertrophy, and That's because you're trying to um activate this metabolic disturbance or disruption. You'D need a little bit of a burn a little bit of a pump to go there more recent research. A lot of this out of Brad show on Phil's lab and others have shown that That's just doesn't seem to be the case again for moderate uh to newly trained individuals, whether That's the case for the highly trained folks, I don't necessarily know I don't think, there is Any difference here so you can take up to three to five minutes of rest in between sets and be fine. The caveat here, though, is this: if you're going to rest longer, that means the metabolic challenge is lower, so you need to then increase the challenge in either mechanical tension which think about as weight load or muscle breakdown. So you can't lower one of the variables. Keep everything else the same and expect the same result. So if you're going to have more rest, then you need to either preserve the load on your bar or the volume one of the two has to happen. So this gives people a lot of opportunity. I generally tell people if you're going to train for hypertrophy, It's probably best to stay in a two minute range at most you can go longer, but a lot of people have a hard time actually coming back and then executing that next set with enough intent to Get there and or It's going to make your workouts tremendously long, so you can stick to the shorter one. You don't have as much mechanical tension, but That's okay. You can still get there, but in reality of it is you can do whatever you would like. Tell me if this is a reasonable structure, given what you've told us three exercises per muscle group first exercise slightly heavier loads, so repetition range is somewhere between, let's say five and eight with perhaps hitting

failure close to it on the last set rest periods of somewhere Between two or let's, let's get wild and say five minutes; okay, so It's a little bit more of a strength, type workout at that point, but then moving to a second exercise of three or four sets where the repetition ranges and now 8 to 15.. Shortening the rest periods to 90 seconds or so, and then on the third exercise. Repetition ranges of 12 to 30.. This number 30 kind of it makes me wide-eyed. I know that can't remember the last time I did a set of 30 thinking. It was for hypertrophy, but what you're saying makes absolutely senses or is research back so very short, rest intervals, maybe 30 seconds between between sets. Would that allow somebody to Target all three forms of major adaptation. I mean my in my mind. It works. You know you're talking about mechanical loads, you're talking about stress and damage and you're talking about metabolic stress is that better than to, for instance, do all the high repetition work in one workout per week, um and then higher loads in the other workout. It doesn't matter. If you divide them up or combine them, it would not matter. I would say it matters in the sense of your personal, practical situation. Well long rest for me, I love training, heavier with longer rest right, but I'm hearing that there is real value to doing these higher repetition ranges yeah. So the formula you set up there in a second is great: if you want to do it the other way, That's fine! You really It's kind of idiot proof you can set this up, however. You'D like you, could actually do the inverse. Theoretically, you could do the sets of 30 first and then move to your sets of eight. It doesn't really matter because we're trying to just get to a certain total stimuli and you're going to hit it eventually. So you have a lot of room to play here. You also have a lot of room to adapt based on your circumstances, God, I'm short on time today. Typically, my workout takes me 60 Minutes for this plan. I have I have only got 35 today. What do I do? Well, if you're training for strength, That's a different answer than if you're training for hypertrophy, if you're training for a purge fee, you need to make sure you hit that total volume. So, in this particular case, lower the load lower the rest intervals and just get to the burn and get going as much as you can. If you're training for strength, I would rather you cut your volume in half, get those few repetitions done at that high load and just don't do very many sets today. That's a better result. So the goal that you're going after is going to determine what we call chaos management, which is that thing like that um running out of time today. My time is short, or I didn't even think my time was short - something got cut off, I'm not feeling it today, I'm in a hotel, etc, etc, etc, which is life right. That's going to be 10 to 50 of your workouts is going to be chaos, management. Well, how you make those decisions is going to go back to understanding number one.

What goal you're going after the number? Two? What are the physiological consequences? We call these physiological limiters for each one and That's going to tell

### 03:37:39 Frequency & Workout Duration, Splits

You what to select and prioritize the volume, the intensity or whatever else I'd like to ask about frequency. But I'd like to frame it a little bit differently than that. I'd like to ask about total workout duration, which dovetails with frequency, because if one is hitting the appropriate number of sets per week and one is combining different muscle groups on the same days. Well, then, workouts are going to be a very different duration than if one is doing a different body part each day, for instance, and so I feel like any discussion about frequency has to be within the context of workout duration and vice versa. Yeah, if you are a a lifting, junkie and you're very consistent in your schedule, I'm actually okay with body parts, but most people are not that and so the concern there is, if you say, are isolating and waiting to do your glutes on one day of the Week and something happens on that day, you might go another 13 days now before training it. You know between workouts and That's really difficult to maintain. The frequency won't be high enough unless the load and volume on that one day is astronomically high. It's just not going to happen so, while, if you look at the research frequency in terms of how many days per week doesn't matter that much as long as the total load and failure are equivalent practically It's a challenge. So It's hard because life gets in the way for most people, especially if you have kids and a job and all these things over there. So I actually prefer doing something more like three days a week of total body and if something happens, you've just missed that body part for 48 hours 72 hours. I, like that, a little better for most people, not because It's more effective, but just because It's a little bit more resilient to life and you can get there if you wanted to actually do a little bit of a combination. So if you wanted to do like two days a week of whole body and then two days a week of a little bit of a body, part split, then you're actually sort of hedging against all risks there. As long as you get to that total number there now, there is actually some evidence in a couple of ways that maybe a little bit more frequently is a little bit better, but the difficulties now we're going back to the practicality question of like how many people Really can train just their strength, training six days a week that doesn't count any of their long duration, stuff. It isn't other high heart rate, their flexibility, their okay. It's just

really really really hard to get all that stuff in so it is. It tends to be easier on folks in terms of execution and long-term adherence, in my opinion, to get that volume accomplished in a little bit more frequent patterns, but not once a week. So I like to kind of have it right there for most people not again, not because it is technically more effective because you're less likely to fail to progress because of skipping a workout, something popping up your power going out and your you know garage door being Locked on your whatever imagine that that happened to me this morning, folks couldn't get out of my driveway, because the gate with the electronic gate was uh down because the power was down anyway solve that problem yeah the way you describe it. My sense is that workouts will last somewhere between one and two hours of real work. Is that about right? It doesn't have to be nearly that long. I mean you could certainly get enough. The work done in 30 minutes if you're doing a whole body workout yeah yeah, absolutely so, if you're doing that three days a week. So remember the numbers we're trying to hit here. Let's say we're trying to hit 15 working sets per muscle group per week. That's five working sets per day for muscle groups. So if you did one exercise for that day, let's say you did squats, you did five sets. You did that three days a week, you're done there is your 15., but there are other muscle groups to hit on the same day, you're doing squats if you're doing a whole whole body yeah, so you've gotten them all ready and so, like all the leg muscles in That example are taken care of uh, so you would not do separate hamstring work. You wouldn't need to now. Hamstrings is actually a little bit of a caveat like That's a good example of an exercise or a muscle group. That's probably really good to make sure you isolate It's challenging to get with your standard, uh dead, lift and and the squat It's one of the probably ones That's most important to go Target outside of that, but in theory. Theoretically, though, outside of that, you would get most of your leg muscles done with even a single exercise, and even if you wanted to change it up, so you said all right Monday, I'm going to do a squat variation uh Wednesday. The next day I left, I'm going to do some sort of deadlift hinging variation and then maybe Friday. My third day, I'm going to do some sort of unilateral, maybe rear, foot, elevated, split, squat or something like that. All right, maybe even a lateral lunge, maybe a different plane: okay you're in a pretty good spot, you're going to hit most of those muscles um to your 15 working sets, especially if you take sort of that last set each day. So pretty close to failure. That's going to get some more serious work done, but you're not going to be so fatigued. You can't come back and train it. A couple of days later and you will be fine, so you could even split that up into two days a week and now all you really have to do is hit



something like seven working sets. So maybe That's two exercises per day. Maybe some sort of a leg press and a leg hinge. You know three to four sets each you can hit six to eight sets that day. You did that three days a week now, all of a sudden you're at that 20 24 sets but same thing with the upper body. I just gave lower body examples because you know I like the lower body more. So It's not that challenging to get to those numbers and split and those workouts can be extremely short. So if you're, if you're doing that three days a week um, you know you're getting you're doing that one exercise, everybody one exercise, lower body that certainly shouldn't take more than 40 minutes. I'M happy to hear that not because I don't like training yeah, please! Please excuse the double negative, but I found that resistance training, workouts that extend longer than one hour of work and certainly longer than 75 minutes of work. Leave me very fatigued, oh sure, and fatigue to the point where concentrating on cognitive work throughout the day can be challenging, need a longer nap in the afternoon. I'M a big proponent of naps in the afternoon in any case, but requiring longer naps in the afternoon, Etc. So, at least for me restricting the resistance training workouts to about 50 50 to 60 Minutes of real work yeah for me, three or four times per week has helped tremendously. So It's a case where doing higher intensity work in a shorter period of time and actually hitting muscle groups less frequently. For me, That's again once directly, once indirectly, yep has worked really well and, as you mentioned earlier, this could very well be explained by not my recovery quotient as some sort of genetic or physiological variable, but the way that I'm training - and indeed I like to do A few four straps and go to failure on too many sets, and you know I have weaned in the in that genre of training. It's also fun like to just train hard. It is It's really fun. It is. I think that um I have learned a lot by training to quote unquote to failure. Of course, I think there is a lot of learning in there provided It's done safely, but what you're describing actually inspires me to at least give a try to these other sorts of splits and and ways of training for hypertrophy and strengths, because this notion of not necessarily Having you go to failure and still being able to evoke strength and hypertrophy

### 03:44:52 Training Frequency, Infrequent Training, Intermediate Repetition Ranges

Adaptations is a really intriguing one uh, dare I even say a seductive one, and that leads me to a question that is based on findings that I have heard discussed on social media,

which means very little, if anything, unless it's in the context of people who really um know: exercise science and you're one such person and that's this idea that, because resistance training can evoke a protein synthesis adaptation response, but that adaptation response lasts about 48 hours before it starts to taper off that the ideal in quotes frequency for training. A given muscle group for hypertrophy is about every 48 hours. Is that true? Yes, and no so a couple of things there remember in order to grow a muscle, there is multiple steps here, so you have the signaling response, which actually happens within seconds of exercise and can last, depending on the marker. You know up to an hour or two hours step. Number two, then, is gene expression and we see that that's typically peaked around two to six hours post exercise, and then you have following that protein synthesis and that's that longer time frame somewhere between 12 hours there. It's certainly not peaked for 48 hours. It may be still there 48 hours from now, but it is, is absolutely coming down at that point, depending on sort of a number of factors, so that part of is sort of true. So this is a combination of like some half truths and some like maybe just pedantic things that aren't really that important to differentiate. The real question I think is, is like okay. Is it okay to train sooner slash? Is it better to train sooner or actually? Is it better to wait longer, there is no real reason to think that you need to train if the goal is hypertrophy any sooner than 48 hours afterwards. I can't think of an advantage that that would confer. I also can't think of any practical applications. Athletes, physique bodybuilders coaches - that ever found tremendous success, doing that, so I would be very skeptical that that is anyway, better now, could you do it in some instances of say you know, you've got travel coming up like that, so that you just yeah you want to preload the system by destroying the muscle, no problem and then waiting seven days or 14 days. I have known people have done that before I do vacations or layoffs every time like every single annihilate themselves and then take a two-week layoff yeah and it's like there is no benefit there other than psychological. Like I just love it like. It feels great to be super sore. I feel less crappy not training for those couple days, because I'm like I'm super sore anyway, you need the extended rest yeah, of course, and it's just like it's just a crappy justification in my brain that like excuse to do something really wild and that I totally don't need and get way sore that I should get Dr Andy Galvin's suggestions of what not to do, but that he does yeah 100. So do as I say, not as I do the famous words of every research Professor yeah, I think 48 hours is a reasonable time uh to wait, can't think of any advantage of going sooner than that. There is really not a tremendous amount of advantage of waiting. Much longer than that,

certainly 72 hours is fine. As long as you're hitting these Concepts we've talked about, you can let really life determine that. I mean there is situations too with like particularly our athletes, where we have to kind of break that because of schedule, obligations they're playing every fifth day every third day, or something like that. You're just going to have to lift some back-to-back days. You're, just going to have to get it done, um, but yeah. I can't think of why I'd go out of my way to do that. The second part of that question is, let's say somebody trains, a muscle. They train it properly. They hit it in the appropriate rep ranges and appropriate rest, Etc that the stimulus is there. The adaptation is set in motion they're, getting someone where, somewhere at 48 hours or so a protein synthesis Peak, That's going to taper off yeah, but they don't train it 48 hours later or 72 hours later. They train it five or six days later, not because they're lazy, not because they um they don't care, but because they have other priorities that are woven in with getting hypertrophy in this muscle right there are people who exist only to get hypertrophy in a given muscle Group, but let's be fair, most people would like to grow that muscle group, but then does it necessarily mean that the muscle starts to revert to its pre-hypertrophic state? That is, does it atrophy and get smaller again, because if it doesn't, I could see a lot of reasons for hitting a muscle group once every five days or seven days, provided you hold on to the hypertrophy that you initiated five or seven days ago, yeah. There is no reason to think you will lose anything in that sort of a Time domain, five to seven days. The only challenge with training that infrequently is, can you actually get enough total volume done so, if you're going to train them also, once a week, you either have to go to real failure, real damage and soreness, or you have to figure out a way to hit 20 cents that day in that muscle, not at all impossible, especially if you're thinking well actually all I have to do is 15.. I'M going to do five sets of three exercises. That's not outrageous, not at all so so like absolutely possible. If you're wanting to go more towards 20, we're getting closer to that 25 like now, it starts to get pretty challenging so scientifically, the research will suggest It's going to be equally effective, practically It's challenging for people to hit sufficient volume without just being so demoralized afterwards, Because they're in so much pain they can't get out of their car because their legs are so trash. They can't sit on the toilet and get back up without crying from pain. So That's not good. No, That's not good. I say that because those are actual examples that have happened in my life yeah - I I'm realizing as we're having this conversation about ways to stimulate hypertrophy that I have sort of defaulted to more intensity as opposed to volume because of the time factor. I have a lot of other

things going on in my life, and So within that hour I Can't Get Enough sets in across all the muscle groups. I need to hit, and I'm only going to do it about once a week, and so It's at least for me more advantageous to just train extremely hard. I actually use the pre-exhaustion technique that you mentioned before yep or pre-fatigue, as you refer to it of hitting something really strong with an isolation exercise. Then doing compound exercises, I'm starting to think based on what you've told me that pre-fatigue and then a compound exercise in some ways. It's not really two sets, because, if you're going to fail your four straps you're kind of pushing past failure, then you're doing a compound exercise and you're doing that two or three times well. That sounds like four to six sets, but the force repetitions are almost like an additional set right, yep, and so It's not 20 sets, but It's four to six really really hard sets that go beyond what we normally think of as a set totally okay. It's sort of the difference between running on concrete and running on Sand. When I go for a sand run, It's a very different experience, totally yeah, and this is why I should have mentioned this at the very very beginning of our our chat today. But all of these numbers that I'll give you for any exercise adaptation you, you cannot think of them as hard lines. They are gradients, and so, when we think about the number for hypertrophy in terms of repetitions, I said 4 to 30.. What do you think happens at three? Do you think hypertrophages stops? In fact the number you will see in literature is more like six to Thirty. I actually slide it down to four, though like personal preference, because of that, but it just Fades away. What do you think happens at rep, 31, 35, there is? No, it just Fades gradually over time. So you actually sort of brought this up. One of your other questions, and I'm not sure if you were even thinking about this - or maybe you were I just babbled on about something else. But if strength happens between this like one to five repetition, range and hypertrophy typically happens in this, like 8 to 30 range. What happens if I were to do the sets of six or God forbid, seven like seven and nine? Are these numbers you just absolutely don't do in strength, training right, It's just like! So That's a one. Two three four five six got eight ten twelve like do not program a set of 30.. Now, when I'm trained sets of seven to nine yeah, It's great uh, we'll use, sets of seven a lot with weightlifters, because you can actually count numbers more effectively. But what happens in seven to nine right. So this is actually a wonderful area of these, like five to eight repetitions, where you're going to get a nice combination of a lot of strength gains and a lot of hypertrophy. So someone who's coming in going man. I want to get stronger and I want to add muscle what do I do here? Well, That's actually, a really nice answer, train pretty hard in that, like four to eight repetition range and you're, going to get a lot

stronger and you will still induce a lot of hypertrophy. If you want to really maximize hypertrophy, I would probably spend most of your time in the 8 to 15 repetition per set range. You can go up to 30.. Admittedly, though, I don't think It's optimal to spend most of your time at more than 15 reps per set, It's very challenging to maintain the focus required at rep 27 to actually get sufficient failure by rep there. You just you, just give up way too early. It's hard to do the same thing at the bottom end of that Spectrum in terms of of really heavy to get there. So I really honestly think 8 to 15 is still It's cliché. It's that textbook number, but It's a reason That's a like. It is tried and true and very, very, very effective if, for instance, you want to get stronger, though, and not invoke a lot of hypertrophy. You have a couple of tricks. You can pull number one stay south of that five repetition range you do sets of. One sets of two go as heavy as you can, with all appropriate considerations and stick within maybe even up to three reps per set. You start getting to four to five to six now you're going to start itching towards that that hypertriort range so stay down. There do a lot more total sets, so do a classic example would be something like eight sets of three right you're going to get a lot of practice, you're going to get 24 very high quality reps with a lot of rest in between okay, you go from There you go to managing caloric intake, making sure your protein is still on point. You want to recover, but if your total calories aren't um, you know greater than 10 to 15. Above your maintenance needs, then you're not going to be able to put on a whole bunch of muscle mass, because you just don't have the fuel for it. You can also then space your workouts out so that stimulus isn't coming extremely often. So if you do that thing a couple of times a week, It's not enough frequency in that signal. So remember that signal has to be frequent or loud. You didn't make it super loud and now you're not making a super frequent. You can get very, very, very strong, like that and and put on

### 03:55:22 Hypertrophy, Muscle Damage & Recovery

Very low amounts of vibratory, if That's sort of the choice, so you told us a lot about volume and frequency and how that relates to protein synthesis and Recovery to evoke the hypertrophy adaptation response. How should people think about systemic damage and Recovery, because, obviously, the nervous system and the way it interacts with the neuromuscular system, is the site of all the action here, or at least a lot of the action and the nervous system can in fact become fatigued. You know that has a great capacity, but

the whole system that we're talking about can be worked to the extent that, even if a muscle group like the biceps or the back, is being allowed to rest, while you're training, legs and other muscle groups that your whole Neuromuscular system needs rest. How does one determine whether or not your entire body needs complete, rest or or low level active rest or exercise of a different kind? Yeah yeah sure. So I want to actually tackle this because we're on the topic of hypertrophy, I'm assuming that. That's the goal in mind here: yes, here, I'm asking specifically within the contexts of hypertrophy. I realize that for other training goals, the answer of this question could be quite different, yeah, okay, so we actually do this in a couple of different ways. Let's start local and work back to systemic right because number one. What you're really concerned about is at the local muscle level is. Am I going to create excessive damage and I don't necessarily mean muscle damage. I mean injury right so um. The kind of rule of thumb we use is like three out of ten in terms of soreness. If you're more than three out of ten in terms of soreness, we're going to start asking questions if you're higher than six out of ten we're, probably not training, this is subjective, total subjective measure, right and you will you will know very quickly right, I feel like, if you can barely graze your PEC with your fingertip and then you're like? Ah, I don't care what you score, that we're not training, there is just no damage if you're three out of ten, if you're, just like oh I'm kind of like a little bit stiff here, but once you get warmed up, you start feeling: okay, you're, probably okay, to Proceed there, so that is, is a very easy way to just think about soreness you're, going to be a little bit tight, depending on your training frequency now zooming out to systemic. We use a whole host of things, so we actually have a a whole host of biomarkers. We use you can get a lot of these from blood, so you can look at things like creatine kinase. That's the very common one marker of muscle, damage um, we'll! Actually, look at LDH, we'll look at myoglobin, That's just like. If you think about hemoglobin is the um is the molecule that carries oxygen throughout your blood. The myoglobin is the the part of that. That's actually in muscle. So when muscle gets broken down that gets leaked out and put in your blood, That's one of the markers. Actually, It's going to be associated with things like rhabdo, which is uh like you're, going to see your urine is purple and It's extremely dark, because you've got so much muscle breakdown that that happens and kidneys can have a problem, and you put a bunch of stuff In there, so we use those biomarkers we'll actually also look at probably a couple things you're familiar with alt and ASD. These are excellent biomarkers of muscle breakdown. So if we are actually suspecting that this is a chronic problem, we're going to actually go and pull

some blood if it's just like I'm super sore today we're going to use that subjective marker. But if we're seeing this as constant like man, are we really pushed pushing you way too much? Is there some sort of systemic problem we're going to blood and we're going to look at all those different things now AST to ALT is really specific, and I don't want to take us too far off track here, but the ratio to those things is actually very important as well, so if you look at the AST to ALT ratio, typically, the number we'll look at is like 1.67, as that ratio is like higher than that, you have a pretty high risk of muscle damage, but really between. You know me and you and a few of these listeners anytime, we start seeing AST out kick ALT we're immediately thinking it has a ratio being higher than one we're immediately. Thinking like there is something happening, muscle damage wise so um, That's actually a sneaky good indicator of just total muscle mass, because the vast majority of That's going to be in muscle. So those are actually some markers that we like a lot. If muscle damage is the thing we're concerned with, if we are more concerned with things like total training volume systemic overload, then we may turn to something more. Like sleep there is a lot of information, we can actually get a lot from changes in sleep, behavior and function. You could also look at things like HRV heart rate variability, which is a very classic marker and much more sensitive to changes with training than something like a resting heart rate, which is which is one thing you can actually do. That's totally cost free. Just look at your changes and any elevation resting heart rate over time, especially more than three to five consecutive days. It is an indicator, but HRV is much more sensitive to things like training induced overload. So That's a quick version of stuff that we're going to pay attention to the last one. I would add there is simply motivation. So if you're really training hard and you like training hard and you just like - cannot force yourself to go anymore. That in of itself, can be a good indication of it's, maybe not the day, maybe not the week. With all of these things, you want to be careful about overreacting to a single day measure. Again, we look. We need to look at at least a trend of more than three days honestly, I'm looking at more than five days, I'm going to pull back from that and think about what phase of training we're in what part of the Year we're in typically with our athletes. We're in season preseason, post-season off season, Etc, to make our decisions about what we're going to do about it. Are we capping the entire workout? Are we doing a modified, lower version, lower intensity, my default generally? If hypertrophy is the goal, remember volume is the driver there. So if I can like can we get in? Can we go real light? Let's go to 6 out of 10 rpe, so relative perceived exertion, maybe we'll reduce the range of motion. Maybe we'll make it a little bit easier,

maybe go to machines or instead of going a squat we'll just do you know uh leg extension, something like that, but I want to still get enough volume in there. That will keep you on target any again, even going at 50, not not to high repetition. You know 50 for a set of ten three sets just get a nice blood flow in there, get it in get it out, aid in recovery and then move on and come back the next day. That's probably

#### 04:01:15 Combining Cardiovascular & Hypertrophy Training, Interference Effect

What I would do, rather than canning the entire session, how do other forms of exercise combine with hypertrophy training, for instance, can I do cardiovascular training for two or three days per week, provided that cardiovascular training is of low enough intensity and not disrupt hypertrophy progression, and Can I do that cardiovascular exercise before or after the hypertrophy training, or does it need to be separated out? The answer to this is really what we call the crossover air interference effect. Okay, It's really an energy management issue. So the only time endurance exercise starts to interfere or block or hinder, attenuate hypertrophy is in one of two broad categories: number one total energy intake or your balance is off. So you can ameliorate this by just eating more. If you do that, then the interference effect generally goes away. The second one is, you want to make sure you avoid exercise, forms for your endurance, training that are the same working group and specifically The Eccentric portion. So, for example, we see much more interference with running. Unlike hypertrophy, then we move cycling, right, less eccentric, pounding and loading less damage. Less things to recover from the tissue seems to be totally fine. The only other thing you need to worry about here is total volume of your endurance work. So if you're doing a moderate intensity for a moderate duration, say 70 of your maximum heart rate for 25 minutes, It's unlikely to do much damage in terms of blocking hypertrophy you're. Totally fine. Can you do it before or after your workout? It's probably not going to matter that much all right, so pre-fatigue is okay for hypertrophy. So if your pre-fatigue is coming from endurance, then you're totally fine, not a big deal afterwards cool. You want to break it up into multiple sessions. That's probably better right! So if you do your endurance work on a separate day, That's probably best case scenario. If you can't do that, but you can break it up into two workouts say you lift in the morning and then you do your quote-unquote cardio at night. Maybe That's second best. Third, best is doing it at the end of your lift and finishing it.



That's fine just make sure that you're maximizing your recovery on all the other tricks. We'll talk about later make sure the calories are there, make sure you're not doing a lot of eccentric Landing in that endurance, stuff and you will be just fine and where does higher intensity cardio fit into a hypertrophy program, so higher intensity cardio, for instance. In my mind, is getting on the assault bike and doing um, you know eight intervals of 20, second Sprints and 10 second rest in between or perhaps go into a field and doing some bounds and Sprints and things of that sort not going all out. Not you know running for one's life, but getting up to about you know 85 90 percent of of running for one's life. So we have a lot less information on the potential interference or not of high intensities of it um the stuff we do have suggested it may actually Aid and hypertrophy, and That's because if you think about it, one the potential paths to activation and muscle growth. Is this metabolic disturbance you're going to get that a lot with the the high intensity interval thing? So It's not a terrible thing to do. I wouldn't do it to the level that it compromises your ability to come back and do your primary training. So if you're so fatigued, your legs are super heavy and they're depleted. You now have to ingest extra carbohydrates, to replenish muscle glycogen, to be able to handle both recovery and continued training, Etc. That could then lead to a problem, but in general we really don't see any reason why that is going to completely block or or make it such that your training was quote, unquote wasted or it didn't work in fact, actually um. A very recent study came out where they had individuals perform six weeks of purely aerobic endurance, steady state, long duration, endurance for six weeks. I think, prior to starting a hypertrophy phase compared that to individuals who did not do that and those folks that did these six weeks of just, I think it was cycling. Actually, just endurance work had more muscle growth at the end of their hypertrophy training than those folks that did not so this shows you very clearly. There are a lot of advantages that come with being physically fit to Growing muscle, so folks that also have actually hit plateaus a lot. One of the things you may actually see some benefit from is actually doing a little bit more endurance work, whether It's a steady state stuff, maybe a side, the higher intensity stuff. Certainly, if you're starting a training phase, It's a pretty good idea to do that and there is a number of physiological reasons of why That's potentially occurring but the the lowest hanging fruit here is weak sort of joke. You know like, if you're so unfit, that you're tying your shoes in your warm-up and you're already breaking a sweat. You probably don't have enough Fitness to do enough training to get enough hypertree. So that is in fact your limiting factor. You're not recovering you're super fatigued and damaged and

sore because you're so unfit so get fit first and then you can actually get more gains a week later, so you have to kind of Kick the Can down the road for a few weeks, but 10 weeks later, You will be in a better

#### 04:06:22 Hypertrophy Training Protocols

Spot than you were by investing a little bit in your conditioning, so, as you pointed out before - and I can only assume you're referring to me - hypertrophy training is idiot proof, meaning there is a lot of leeway in the variables, but not so much leeway that people can Do anything it It's bounded by these general principles? So, with your permission, I'm going to do a brief overview of my notes, based on your description of the modifiable variables that will direct somebody towards hypertrophy keeping in mind this backdrop of exercise, Choice, exercise, order, selecting appropriate volume that sets and Reps training frequency and needing Some Metric or way to have progression, either by adding more weight or by more tension or more metabolic stress and so on in terms of exercise Choice, it sounds like the choice of exercises is not super critical in terms of specificity yeah, but that the ideal circumstances That people are targeting all the major and frankly secondary and minor muscle groups, if you can even call them that yeah across their exercise, choices that they're picking exercises that they can perform safely and that they can generate enough intensity. So they're getting close to failure without placing themselves into danger right so um for some people. That might mean including large compound free weight exercises like squats and deadlifts and bent over barbell rows, as well as isolation exercises, and for some people there might be a biased toward more isolation, exercises and machines. But of course, machines don't necessarily mean that you can't use heavy loads. In fact, plate loaded machines like Hammer strange machines. It will allow for quite substantial loads, so picking two or three or more movements per muscle group can be valuable, but that overall, consistency is going to outshine variation in the sense that you don't need to hit muscles with a different exercise. Every workout, coming back to the same things, has a benefit, and we heard about this in our discussion around strength and power as well. Okay, in terms of order of exercises there too, it sounds like there is a lot of flexibility. One could do the large compound exercise for let's say quadriceps and hamstrings and glutes first like a squat or a front squat or could deadlift for that matter. But then, if one deadlifted and primarily

hit the glutes and hamstrings, then you might want to Target the quadriceps more directly with leg extensions or, if one squatted and was loading that squat bar carrying the squat bar in a way that was predominantly quadricep, yeah and less. So, glute and hamstring than leg curls would be a good choice, Etc. Okay and train your calves folks very important unless you're a genetic freak. Of course, It's actually a good opportunity to say unless you're, a genetic freak or you just have a genetic predisposition, yeah or you've done Sports and, and you have a genetic predisposition that gives you know very large caps that don't require any training at all. I know people like this they're, somewhat rare, but they're out there yeah and those folks sometimes want to stay away from or minimize their training. You told me that, even if you have a muscle group, That's a hyper responder in terms of hypertrophy, getting at least one or two good hard sets per week is good because you want to keep functionality in that neuromuscular system love it. Okay in terms of volume. Again, we have a large amount of variation. Is what I'm hearing that the total number of sets per week is a strong driving force of program, design and selection that ideally you're performing 10 to 20 and probably more like 15 to 20 sets per week, and that could be divided up across multiple workouts or done in one workout, but That's 10 to 20 sets per week per muscle group, not really taking into account indirect Activation, so that would be 10 to 20 sets for biceps. Your back work is going to hit your biceps a little bit, maybe a bit more depending on the exercise selection, but It's really 10 to 20 and given that hypertrophy can still occur, and maybe even occurs better with more volume. Yeah, then, don't include the indirect work unless something about the architecture of your body and the inability to engage certain muscle groups like makes the a pull-up really an arm exercise for you. Do I have that right? The way that I would maybe Define it is typically with movements we consider to be there to be primary movers secondary movers and then tertiary right if it is a primary or secondary, I'm probably counting it. If It's tertiary or less I'm, probably not counting, it got it so going back to our example of a pull-up, so an example of a pull-up, I probably wouldn't count the biceps in a pull-up, but I would probably count the biceps during a chin up. Would you count the rear deltoid in a pull-up, probably not maybe like uh, it just depends um, probably not, though okay train, the rear, delts. Also, That's only honestly. The reason I answered that is because most people don't do anything for the real adults anyways, but they should right. Absolutely That's why I didn't want to count it. I wanted you to go out of your way to make sure you did something specifically for the real rear delts for Aesthetics and for functionality, for health and balance across the shoulders

totally neck uh shoulder all of it. I'M so happy to hear you say this: I'm a huge fan of people doing rear deltoid work for all the reasons you described n network. For that matter. I think people forget that the neck is the upper part of your spine, yeah and for postural reasons, and for stabilization safety reasons. It's really critical, but I think most people aren't familiar with how best to train the rear, deltoids and neck, and I know a number of people are afraid of getting a big neck, which, for reasons that are still unclear to me, is

#### 04:12:06 Tool: Neck & Rear Deltoid Exercises, Stabilization & Hypertrophy

Referred to as no neck, but let's leave out that no neck comment for the moment. What are some good exercises for targeting the rear, deltoids and neck safely that people can perform for stabilization and for hypertrophy yeah? I would recommend people check out Eric Cressy. He is a wonderful strength, conditioning coach - he actually is, I think, the director of pitching for the New York Yankees now is that spelled c-r-e-s-s-i-e c-r-e-s-s-e-y. I believe, and he is got a facility in uh. I believe Boston as well as in Florida, so he is very, very involved in pitching as well as hockey and things like that so um. He has so many free videos and resources on a on so much of the shoulder girdle, mostly because he he is dealt with overhead and throwing athletes, and so the Precision required there is tremendous. So you want to be very careful when you start playing in this area, because the wrong positioning of your scapula can cause a whole bunch of problems in your neck and low back, and so he would be a great resource to go. Take a look at that. Um, depending on how your scapula's are gliding and sliding, and the way that you want your rotator cuffs firing your rhomboids there is It's like very complicated very quickly, so you want to learn more. Go there as a very, very quick couple of answers. Um one of my favorite exercises is, is lying on a bench or putting some bench and then just doing a reverse fly. Basically, the reason I like stabilizing the rest of the body, so you can make sure you can focus on just using those rear, dual ties and putting your scapula's in the right position. Now, there is a specific set of cueing that you want the scapula to move down and back for again check out Eric or any number of folks in that area. To do it, but That's a very simple way: uh the reverse fly to get there great and then, in terms of neck exercises I was told to avoid Bridges because they can cause damage to the discs. I will probably never do a bridge ever uh the rest of my life, so isometrics are a great exercise

for that, because if you think about what uh, what you're asking muscle groups to do in the neck, you mostly want it to be able to do a certain type of rotation a little bit of flexion extension and some other movements, but in general it should be being stable. So you want to walk through these joints by asking kind of what they do. Are they a moving joint? Are they a stability joint? In this case, you want to be there so isometrics are going to put you in a much better position. There are some actually pretty cool devices that you can wear and you can put them on your head and you can do all kinds of movement and get some great training there. Those are great starts, but if you don't have any of that, just basic isometrics are a great way to go about

04:14:42 Hypertrophy Reps Sets & Progression. "Hidden" Stressors Exercises to Avoid

it um neck Bridges would not be on that list. For me, no neck Bridges. Folks, in terms of sets and repetitions, we briefly touched on this, but anyway from I believe, six repetitions all the way up to 30 repetitions, but probably more in the 8 to 15 repetition range for hypertrophy, most of the time, yeah and I'll just throw in there Because I love this idea that if you want to get a relatively balanced adaptation related to strength and hypertrophy, that seven to nine range, the No Man's uh or Dan, no woman's uh land of training repetitions, I always joke in class, I'm like okay, we Go through the whole thing right, you're like one to five strength, eight to twelve. You know I perch reading like right and then I'm like okay, so six to nine means nothing will happen at all. The kids are just like writing it down like right, a good way to for everybody to remember that there are adaptations triggered in the six to nine rep range and It's a balance of strength and height you will, just get thrown out of any gym that I'm a Part of fantastic - if you do that uh so, but the important point is to get close to failure and occasionally hit failure, maybe occasionally throw in a forced repetition or a rest pause where you rest and then do a few more something like that, but those intensity Increasing Maneuvers will require a little bit more attention to recovery, either time or attention in some other way, and here is a little bit of care and I'll throw at people, because people generally don't like to be told to not go to failure that often right. So there is a handful of like half the folks are like sweet. I don't have to train that hard to get there and those folks It's like! Well, yes, but I also said you just can't: like do a half workout, you have to get pretty darn close to failure and most people don't really know what failure means. So for that group It's actually It's still probably harder than you think you want to train the other group, though, that like wants to completely blow themselves out every single time, dragging them back is more

the key now for those folks, here is what I can say if You make sure that your hidden, stressors, invisible stressors, are completely taken care of. You can go to failure a lot more often, and so you need to dial those things in and then now you can go hammer yourself because you will recover so much quicker, and we see this very commonly in all of our programs with our athletes and our non-athletes. That when we get the rest of the Hidden, invisible stressors taken care of their training, volume goes up so much because they'll just start coming back and they're like. Oh, my God, I'm not sore anymore. Oh my God, I'm not nearly a sore. I did this exact workout, you know countless times before and now I'm doing it and I'm not sore at all anymore. What the hell like, we didn't do anything different with the programming or really the nutrition, but we got the rest of that allostatic load under control and boom things take off It's a lot like drivers, so many people seem to be riding the brake, and so many People seem to be heavy on the accelerator yeah. That's actually one of the ways we describe it is like you want to go faster people's inclination step. One is to hit the gas our step number one is making sure your left foot's, not on the brake. You will go faster with less resistance, which means you will, actually wear down the system, a lot slower by just taking your foot off the brake first, if you're then not going fast enough now we can push the accelerator, but I'm not pushing that accelerator, while your foot's still On the brake you're going to go a little bit faster, but not as fast as you should be going with that much work and you're going to start wearing down brake pedals, and things like that. So I like the analogy so hitting that 10 to 20 sets per week. Repetition range is pretty broad, provided you get close to failure, hit failure every once in a while could be the final set of each exercise or maybe do one workout where you hit failure on everything, but then you don't do it for a few more again there. It sounds like there is a lot of play in the system here. Rest ranges anywhere from 30 seconds, all the way up to three or four minutes, depending on how heavy you're training and how close to failure or to failure, maybe even quote unquote Beyond failure. If there is such a thing, you're training, um, throwing in negatives and things like that. We didn't get into really high intensity techniques, but people again vary in the extent to which they're pushing the system. But there does seem to be some value to mixing up the rest between set ranges across exercises and across workouts, but you could combine them all in the same workout as what I heard yep and then in terms of progression. It sounds to me like the goal when hypertrophy training is not necessarily to add more weight to the bar, although That's one way one could do it, but that the progression actually can arrive through this really extensive kit of changing the speed of movement changing um.

The number of sets adding some volume, maybe changing the split so that you go from a three day a week, full body workout to more of a body parts, one or two body parts per day, every other day or two on one off at any number of Different variations that are out there sounds like all of these can and will work provided that people are obeying the general principles of this uh hypertrophy adaptation inducing protocol that you described and that they are meeting the necessary but not sufficient variables as well, such as sleep Nutrition and managing the stress in the rest of their life, do I have that correctly? Yeah, That's really good uh. One more thing. I'D like to add is this is a situation for hypertrophy, in which there are some exercises that I actually don't think are good ideas, so I want to make sure we included those in the conversation. That's not necessarily the case for strength. You can really do kind of whatever one you want, and that is specifically Plyometrics, although in fact, if you look at there is, a recent review paper came out showing that, like Plyometrics, are effective as well right, just like one can do almost anything as long as it Falls within this parameter set, the concepts are few, and the methods are many, and the methods for hypertrophy are many. Many in general, though Plyometrics are not my first second or even like 100th choice for hypertrophy. They, if they're a part of a total training program and you get some of our purchase as a result - cool you're lucky, not the first place, I'm going, the other major category are weightlifting variations, so that when I'm saying weightlifting I mean specifically Olympic weightlifting, as in Snatch clean and jerk and their variations. Those are just not a good exercise. Choice. It's not that they don't work, It's just the risk to benefit ratio starts to fall pretty fast and in the negative favor, and so It's just not worth doing sets of 10 of a snatch unless you're in a sport where That's like the competition or whatever. But if

04:21:09 Deliberate Cold Exposure & Hypertrophy vs. Strength,

the goal is simply hypertrophy choose different exercises than that great now I realize that we are going to do entire episodes related to nutrition, supplementation, recovery Etc. But I'd like to just touch on two or three specific topics and questions that come up a lot around the question of hypertrophy specifically, and that probably also relate to strength, training and training for Speed. So I'm going to ask these in um, not rapid fire, but I'll give you shorter answers, we'll put it that way. So I will ask these questions now, but with the caveat that we will get into these topics in much more depth, yeah very soon. The first question is about the use of cold showers and Ice baths and cold water exposure, which I know many people use for resilience, training to increase their

dopamine, which it does and for recovery. But there is also this issue of when one should use cold. That is deliberate, cold exposure relative to hypertrophy training specifically, and That's because I have heard that if deliberate cold exposure is done too soon after a hypertrophy adaptation inducing workout yeah right all the sorts of things we've been talking about that the hypertrophy response can be blunted reduced Or eliminated is that true? And if so, when could people do deliberate cold exposure, while still also including hypertrophy training in their program and still get hypertrophy great? So you know I'm a lover of the cold. I still have a deep freezer in my house. That is filled with water at all times that is plugged in and is a frozen chamber. I still do the old school style of it. Please unplug it before you get in it. Oh yes, absolutely and then don't do it by yourself so that the lid can close on top of you and then we don't see you sort of ever again. The Han Solo effect It's time for me to upgrade and get one of these new fancy ones. But I have been using this for so many years, so I love it. Obviously, I have been involved with xpt and Gabby and Laird and Brian McKenzie, and these folks, so I have been doing this stuff for a long time I have. But I don't even know how many hundreds of folks in the ice and a lot of reasons. So there are a lot of benefits and we could talk about those later. However, that that being said, it is very, very true. You do not want to get in the ice post, hypertrophy training - you wouldn't want to do that immediately after the workout. You probably don't want to do it before the workout, and you probably don't even want to do it that same day, It's just not worth it. It will blunt I apprecially in specifically, we've talked earlier about. What's driving muscle growth is that signaling Cascade through that gene expression through that muscle, protein synthesis cold exposure blocks that signal? Remember adaptation comes from stress, you've put in a stressor in now, you've blocked that stress, you've literally blocked this signal that tells your body come back and grow larger size. So not a good idea to do it if you're training for some other purposes, maybe strength. Maybe there is an argument there, although maybe not for Speed and power, maybe get away with the endurance, maybe a separate conversation if you're in season. I have no problem using it immediately after a game. The goal is entirely different, even if we did a hypertrophy type of training program, we're not doing it try to try to maximize growth. In that particular case, our priority for Recovery is higher than our priority for muscle growth. So we choose optimization in that category. You can only make those choices, though, when you truly understand what is the goal for the day the week, the month, the phase of training and really what part of the year you're in we have that all plotted out for all the people we



work with. So I know when we want to choose one over the other. It's not a this is the choice you always make such a nation. That's just not how we operate. We need more Precision than that. So that being said, we're generally not going to do it. If we want to do a lot of icing during a phase in which we're using a lot of hypertrophy, we're going to do a couple of things number one, we may just not use it, so there are phases in our training where I don't want to maximize Recovery, I'm not going to give you any tricks here, I'm not going to do ice or any of the other methods we're going to talk about. Why? Because the whole point is to cause overload: That's what's going to be the stimuli to cause adaptation, if all I'm doing is blocking that stuff attenuating it smashing it back down. I'm undercutting myself, I'm choosing to feel a little bit better to have a little bit better performance right now. Knowing That's going to compromise the results, I'm going to get 6 8 10 12 weeks from now all right, so I'm not going to choose it at all. In reality of it is, if I really am trying to maximize hypertrophy, I'm probably not doing any ice work through that whole phase. Maybe like my off day, I know That's similar to a setup. You have like one day a week when I'm not training, we'll jump in some ice, maybe even do some hot cold contrast. I love the xbc protocol. It's you know. You've probably talked about it before That's a great setup or just not do it at all right. It's just not something we need when we move into another phase of training where we're trying to maximize adaptation or maximize the result and get the benefit of that training. Now we're going to hedge more towards recovery and we're going to bring in some of these strategies and techniques and not worry about causing the most stimuli there, because we're trying to add attenuator because we're trying to actualize the work. We did. 6. 8. 10, 12 weeks before what about cold showers? Do those have the same hypertrophy blunting effect in general? No in general, you can do cold showers. That's not going to be a problem! You're not going to be in there very long and you're not going to get nearly as cold as you will submerge in 30 degree ice water for like that, the way that we do it nonetheless, so I have no problem standing in the shower for a

04:26:41 Nutrition Timing & Strength/Hypertrophy Creatine

couple of minutes using it for other reasons, if you want to That's no issue, I'd like to talk a little bit about nutrition and supplementation as it relates to hypertrophy, Dr Lane, Norton who's been a guest on the Hebrew and Lab podcast And we both know throughout a number range related to protein intake on the backdrop of how much protein synthesis can occur by meal across the day, Etc. A lot of a lot of research done

there and some important work by him in particular, and then the value that he threw out was 1.6 grams per kilogram of body weight. Being the lower end of the range up to, I believe is it was as high as 2.4, maybe even as high as 2.7 grams of protein per kilogram of body weight per day. That's a pretty broad range, but it's on the higher end of what I think. Most people think of in terms of protein intake and then again some people might already be right there, or maybe even above that value. Now, of course, this all depends on whether or not people are omnivore vegan, uh meat, based, Etc. We won't even go there, but assuming people are getting enough protein per day so somewhere in that range, and they are spreading out that protein intake to accommodate the fact that the body can only assimilate a certain amount of protein in any given sitting. What do you like to see people ingest at some point, post, hypertrophy inducing workout in order to get the protein synthesis Advantage if you will yeah that is stimulated by that workout? Earlier you mentioned the you know the post-training feeding window that you know in the 90s and probably earlier people were talking about. Oh you know within the first 90 minutes you have to get 30 amounts for a while yeah was it 30 minutes of? Excuse me a certain number of grams of carbohydrate and protein Etc. I think now the understanding is that that window is much broader um and how broad and Etc is still a matter of debate, but when somebody is training specifically for hypertrophy, assuming they are getting enough. Protein from quality sources in their other meals and assuming that their overall macronutrient intake and caloric intake is high enough, that is, they have enough of a caloric Surplus that they have the raw materials for hypertrophy. What do you like to see people ingest at some point post-workout in order to facilitate muscle protein synthesis and recovery, and this could include nutrition and supplementation, or if you want to divide those answers out, feel free to do so, of course, yeah. Okay, great! So a ton of work came out of Don Layman's lab. It was actually a Lane's Mentor as well as Stu Phillips at McMaster, so a ton of work there and we can answer a number of things here, so Lane's numbers that he recommended uh, also known as about a gram of protein per pound of body weight. It's a great start now, once you slide below per pound right one gram per pound right in earlier, which is also making sure because we're changing units here uh, it was 1.6 grams per kilogram of body weight all the way up to. I think it was 2.4, but maybe a size, 2.7 yeah grams of protein per kilogram of body weight so 2.2 in that unit would be the same thing. So 200 grams per kilogram is the same as one gram per pound right so depending on which, where you're listening at to this at one of those may be easier than

the other for you, if you start getting below that number now, you do start running into Questions of protein quality, protein type and protein timing - this is one of the reasons why I actually fully agree with Lane is just get that number higher than you think and then all those other variables don't matter. If that number is low, then you need to start paying attention to a bunch of other stuff. You've added now complexity to your program, things you got to pay attention to just stay high and it doesn't matter, and so you can just leave a lot of those things off the table. That seems to be fairly clear in the work of some of this gentlemen. I just mentioned that as long as you get to that total number, the question about timing and types and quality, it seems to matter a lot less. In fact, uh Stu's recent work in non-animal-based proteins. It really showed that to be fairly clear that those are quite effective, assuming total protein intake is high enough, the amount of leucine and other amino acids in those actual proteins matter less if the total threshold is just super high, so just do that and you're fine. Now the other caveat we have to say here is timing of macronutrients is seems to be somewhat Irrelevant for protein, but that is not the case for carbohydrates, so that timing does matter replenishment of muscle. Glycogen is very specific and you want to make sure that that is around a lot if you're doing either maintaining training, quality or you're sliding into endurance type of work, and so nutrient timing does matter with carbohydrates, maybe less so with protein, and certainly less so with Protein, if the total protein ingestion is high enough, so um it depends on what we're going after in terms of a training goal and where we want to get with all these things in general. The way that we like to think about this is, if you're doing a strength, type of work, where you're truly targeting that, then a one-to-one post exercise protein to carbohydrate ratio is generally what we're going to go after. So this would be something like 35 grams of protein and 35 grams of carbohydrate. It doesn't have to be post, it can be pre or my favorite is actually mid or post, but somewhere in that range, especially if you're training in the morning and you have not consumed anything prior to your workout and That's not necessarily eating in the middle of The workout That's drinking calories, yeah. It's going to be able to see someone eating a sandwich on uh in the gym, although I'm sure It's happened, yeah so one to one. Is that like sort of standard number here, um, if you're going to do sort of more of a really hard conditioning, workout that number slides up to something like three or even four to one which would be carbohydrate to protein ratio? So if we want to stay at 35 grams of protein, we're going to go maybe as high as like 100 or 140 grams of carbohydrate again, depending on what type of training we're sort of doing. If you're going to do a little

bit of a combination, then you like a little bit of strength, a little bit of conditioning and kind of a standard workout, which is probably something that a lot of people will do. Then you maybe want to go to something. Like two to one, so you know 35 grams of protein 60, 70 grams of carbohydrate and those are kind of just like rough numbers that you can go by and for Pure hypertrophy training. Would you like to see people ingest some carbohydrate post-training for Pure hypertrophy training? I want to see that as many of those nutrients around the training is generally possible. Now again, I might change my mind when our fasting study comes out, but as it stands now, there is no advantage to not fueling around the training and there are some known and some other potential advantages to fueling. So I just see no reason to not do it um. In fact, most people are generally going to do better now this is not science. This is just my coaching experience, and this is with our athletes and all of our non-athletes that we've worked with and do work with they're just going to be better spreading those meals out generally throughout the day and they're going to be better if they have those Nutrients, either pre-mid or post and so they're going to get even for my Purge fee, they're going to get something like that, one three to one ratio of carbs to protein personal preference. Some people don't like to eat before they train some people have to eat before they train some people, can't you know, put in food in their belly immediately after work around that you can. You can play based on personal preference, but we want that fueling in there, because we want to maximize the potential growth and we want to just get a jump start on recovery because we're going to be training again pretty soon. Supplementation is a huge topic and one that we will go into in great depth in a soon to occur episode. But if you had to pick one supplement that can benefit most everybody, if not everybody yeah, for their training, directed toward strength, power and hypertrophy. What would that supplement be, and how would you like to see people use it, meaning how much should they take and when should they take it sure, if you don't count protein and carbohydrates as supplements they technically are, but we'll just walk out of it right. Sorry, I should be more specific: I'm not referring to a non-food form um protein and carbohydrates, so powdered protein and part of powdered carbohydrate, Etc. Um technically are supplements they're highly processed, but they're um, but I'm not including that I'm referring to um non-macronutrient type supplements yeah does testosterone count um well in the context of this discussion, It's uh testosterone that people are manufacturing themselves. Ah, okay, the cheating kind, the endogenous kind, no um I mean creatine - is the answer here without question: it is the most well studied it is the most effective and

its uh benefits are robust, meaning they're going to confer positive adaptations across multiple physiological domains, and we can certainly have a very long chat about some of the interesting things that people, in fact we just had um during candel um on our Barbershop podcast, and he went into extensive detail about all the benefits of creatine that people have no idea about, including things like Bone mineral density you asked about that earlier, creatine is actually fairly effective for that, let alone the thing: the benefit in things like cognitive function, decision making memory um the work that That's being done there for neurological disorders, um, depression, a whole host of things that that Creatine is being studied, for some of those studies show a lot of benefits. Some of it show maybe a little bit some none, but there is just a lot of things. Creatine can do so when we could talk about Muscle, Recovery or muscle, hypertrophy um, That's where the bulk of the research is and it and It's very effective in terms of type creatine. Monohydrate is still the best one and That's just because it has the largest evidence base. You can maybe make some arguments for some other types, but you're really going to reach saturation pretty quickly within a matter of weeks, and there add a dosage of anywhere between like three to six grams per day. Now five grams is the very standard number we give reality. Is I change that number based on size? That's just the honest truth: um if you're 225 pounds you're not going to get the same dosage of creatine as 125 pound girl. That's just like this is not what we're going to do, so we may slide that number down a little bit closer to three for the the smaller girl boy. It doesn't matter It's just female physical size if you're, one of our 275 or 330 pound offensive right tackles in the NFL you're not going to get the same dosage as everybody else. So that number is going to go up to seven, eight, nine, maybe even 10 grams a day, I'm there. So That's just kind of the scale in general. If you wanted an easy answer, five grams is the standard taken after training. The timing doesn't matter totally irrelevant. Take it in the morning or breakfast: take it at night, take it anytime, you want take it pre, we tend to put it in a lot of people's workout um shakes just to make sure they get it in throughout the day, but the timing is irrelevant great. Well, thank you for that very informative answer and I look forward to much more discussion about nutrition and supplementation and recovery and all the rest in the episodes to come. This was incredibly informative. Thank you so very much. I appreciate the opportunity I had a great time doing that I love talking about these things. I also really like talking about what we're going to get into in

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