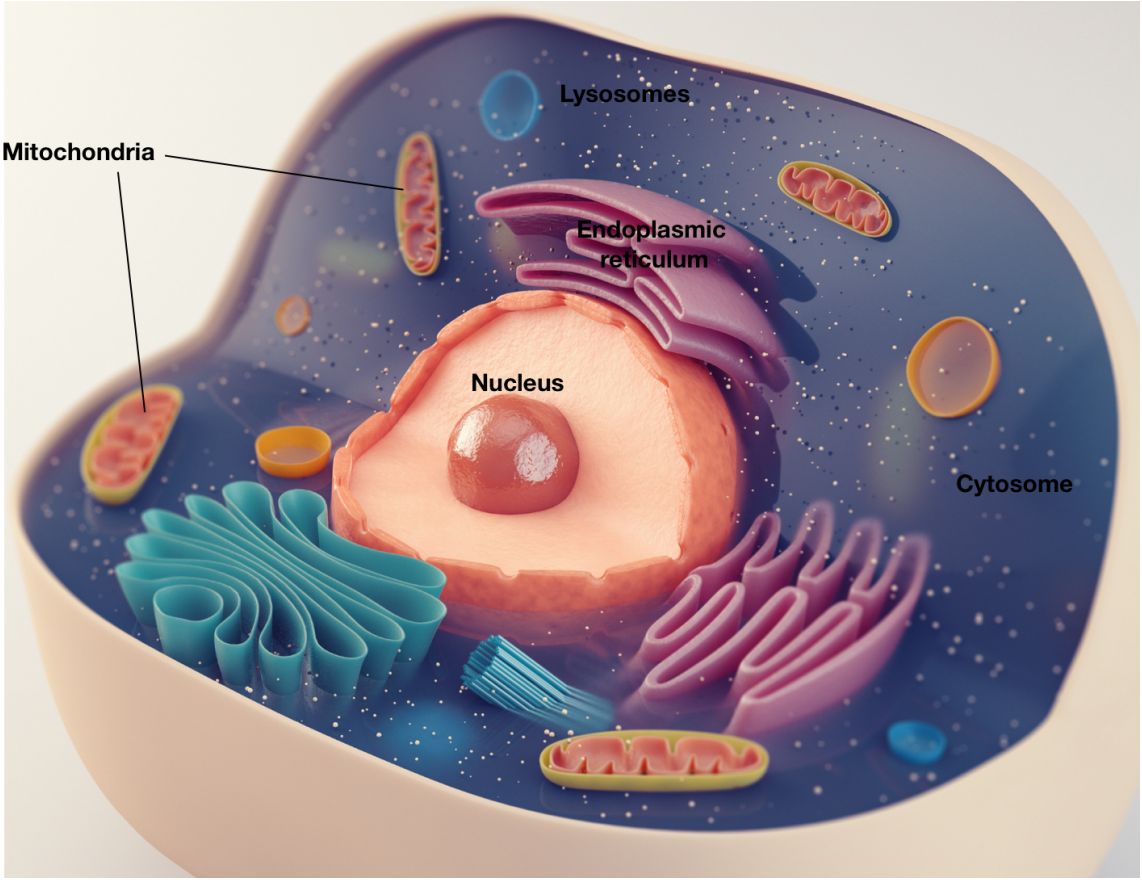
Mighty Mitochondria

for Fertility

Learn How to Amplify Your Egg Quality With Mitochondrial Biohacking

Cell Biology Review:



The above picture is a simple representation of a cell. These are the building blocks of life.

Cells are the smallest units in an organism that can be considered alive - humans are multi-cellular, meaning we have lots of different cells that make up who we are.

There are 3 basic truths about cells:

1. All living things are made of cells
2. Cells are the basic unit of structure and function
3. All new cells are made from other cells

Humans are made up of approximately 100 trillion cells

Parts of the cell:

- The nucleus is responsible for storing the cell's DNA
  - It's job is to coordinate all of the important cellular activities like protein synthesis, cell division, growth, and many other functions
  - The nucleus knows what needs to get done and directs the entire cell's activities in order to achieve the cell's objective
- Mitochondria are individual organ-like structures inside the cell but outside the nucleus, and these guys are the star of our show.

Mitochondria

MITOCHONDRIA ARE THE "POWERHOUSE" OF OUR CELLS. THEY ARE AT THE VERY FOUNDATION OF OUR HEALTH AND FERTILITY

Mitochondria are the unsung heroes of our fertility! Not only are they critically important in all aspects of our bodies, they are imperative to us getting and staying pregnant. They're frequently referred to as the "powerhouses" of the cell, and in fact these small parts of our cells are the energy factories that drive all cellular activity.

Mitochondria act like a cellular digestive system - they take in nutrients like food, water, and oxygen, break them down, and then create an energy unit called ATP, which is then used by the cell for every job the cells needs to perform. There are mitochondria in every single cell in our body. Some have hundreds, some have thousands!

More mitochondria are found in cells that have a lot of energy required to do hard work. For example, cells found in the heart, muscles, brain, and organs have a lot of mitochondria to keep up with the cell's work demands. Our heart needs that energy to keep pumping!

There are many processes mitochondria go through in order to make energy, and of course these need raw materials and nutrients! Without the raw materials for the mitochondria to produce energy, our cells suffer and so does our health.

Mitochondria have an extremely unique job: they combine oxygen with food molecules to create energy for cells. This is the *only* place in the entire body that energy can be made. These energy producers are so important to the health and function of our body that if our mitochondria were to stop, we would die.

In fact, cyanide poisoning kills exactly by this mechanism: it stops mitochondria from being able to produce energy. It could be said that our entire daily existence is to be in service of keeping our mitochondria healthy and working so that we can continue living.

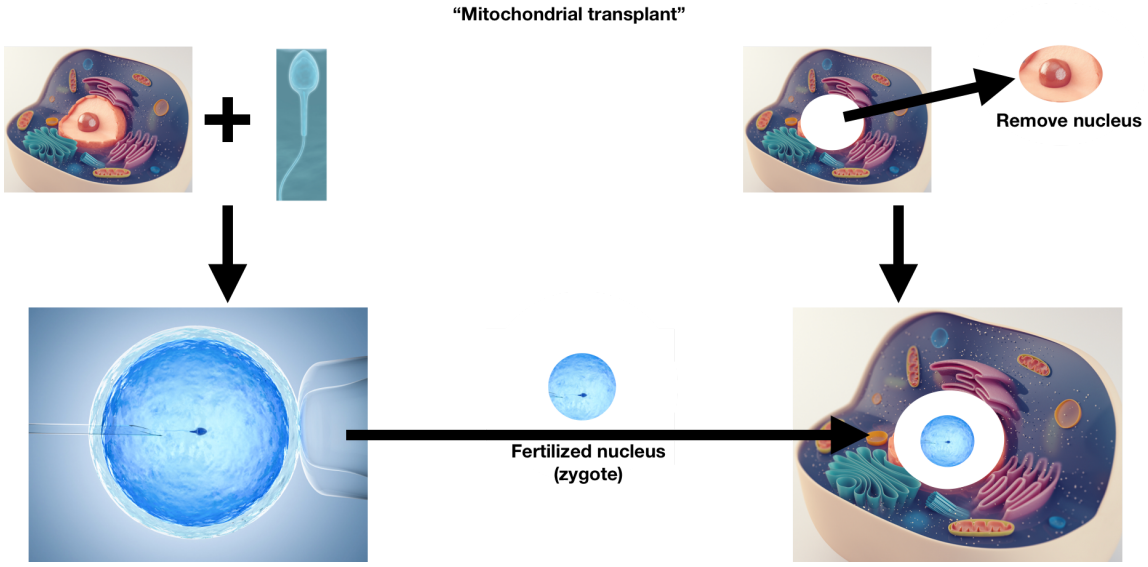
As we went over before, each cell has a few hundred to several thousand mitochondria, but the cell that has the *most* is our egg cell! Our eggs contain 100,000 mitochondria in each one, which is quite amazing because this cell is inactive for the majority of its life. Usually cells have the amount of mitochondria that's necessary for that cell's job. The greater the need for energy, the more mitochondria those cells typically have. Even though eggs are essentially asleep and don't need to produce a lot of energy for years on end, an egg cell has this huge amount of mitochondria so it can support all the energy requirements of growing a baby.

Those mitochondria inside egg cells need to become the entire mitochondrial foundation for the baby! So this 100,000 mitochondria need to divide and divide until each cell of the baby has the proper amount. If the mitochondria are dysfunctional then they're not able to produce enough energy. The cells will struggle or die off and this leads to birth defects or miscarriage.

In contrast to an egg's very large mitochondrial number, sperm only have a few hundred. Their main function is to promote good motility so it can get to the egg, but once inside the egg those sperm mitochondria degrade. It's actually the maternal mitochondria, not the paternal mitochondria, that go on to make the energy for the cells of a child. When we understand this it becomes clearer why an egg needs so many mitochondria.

There is, of course, a natural age-related decrease in the quality of our mitochondria. Between the ages of 20-40 our mitochondrial capacity is decreased by half. Then it's decreased by another 50% between the ages of 40-70. In fact, decreased amount of mitochondria, mitochondrial dysfunction and decreased energy making capacity is now being considered as one of the biggest contributing factors to egg quality and pregnancy achievement, especially in women over 35.

NUCLEAR GENOME TRANSFER



A procedure called nuclear genome transfer has highlighted the critical importance of healthy mitochondria in order for pregnancy to occur. This procedure includes using a healthy egg cell from a fertile woman and removing its nucleus - the portion of the cell that has all of the DNA. The rest of the cell including the mitochondria are left intact. Then the *fertilized nucleus* of an infertile woman is placed inside the healthy donor egg. This is essentially a mitochondrial transplant - the healthy donor egg's mitochondria are what provides the energy for the transplanted nucleus to develop into a baby. This technique has worked in producing live children and has undoubtedly confirmed the role of age-related mitochondrial dysfunction.

Though this procedure is banned throughout most of the world because of the ethical concerns of technically having 3 parents, it's still an exciting revelation for us. We now have a confirmed specific target that can drastically change our fertility and pregnancy outcome: mitochondria.

The Mitochondrial Twist:

When we talk about mitochondria in the world of fertility we only talk about them in terms of making enough energy for pregnancy or egg quality. It might be surprising but mitochondria don't *only* make energy.

Before we can go ahead and start biohacking our mitochondria to work better and grow, we need to know that mitochondria have another really important job other than energy production

Mitochondria have 2 main jobs. Not only are they responsible for making all the energy that cells need, they're also responsible for cell defense

The mitochondria are actually the cell's primary environmental sensor, and when they detect danger like an infection, toxin, or even psychological stress, it will shift into defense mode and this is what's called the cell danger response.

The cell danger response decreases the energy production and energy requirements of the cell to keep it safe, and puts the cell into a hibernation-like state. It essentially locks the cell doors when there's danger lurking outside. If there is a burglar or someone outside your home it's not likely that you would unlock the door and give them access to you or your things. It's more likely that if someone was lurking outside your house that you would lock and close everything and wait for them to go away or wait for someone to come and take them away. This is akin to the case of an infection, the cell is waiting for the immune system to come and intervene, but otherwise it's going to lock down the cell so nothing can come inside it.

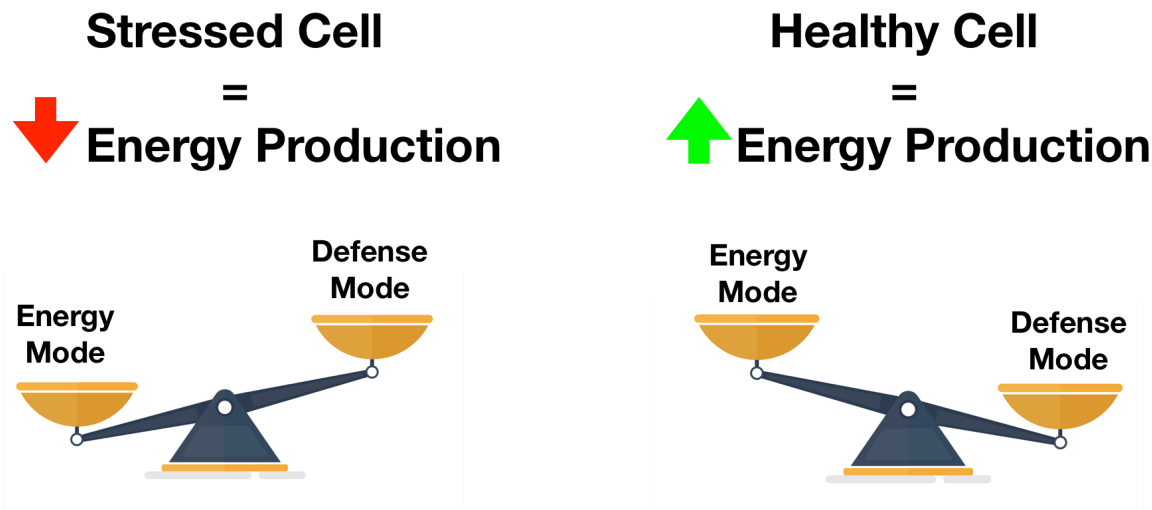
Here's the trick about mitochondria - they're really bad at multi tasking. They can't do energy production AND cell defense at the same time. Cell defense by definition means the cells needs to shut down to preserve its resources and to survive. If we think back to previous modules, the body is all about survival. Everything it does is so that it can protect itself and continue to survive and this is also true of our cellular system. The cells themselves need to have a system in place to survive when it sense a less than optimal environment and that system is the mitochondria's cell defense response.

Since the mitochondria can only do one thing at a time, it can either be in energy mode or defense mode. When it's constantly in defense mode then this is when we have dysfunctional cells and disease show up.

Dr Robert Naviaux is the founder of the Mitochondrial and Metabolic Disease Center, and he's been doing research for many years trying to understand the underlying common unifying trait between all disease. His research has been asking the question: what is one thing that's true for all cells and all disease or dysfunction? His research has uncovered a groundbreaking finding that mitochondria are that unifier and specifically now its turned our eyes towards understanding the significance of mitochondria being in energy mode versus cell defense mode.

He says "Mitochondria lie at the hub of the wheel of metabolism. Because mitochondria are also the concertmasters of innate immunity and inflammation, it makes them uniquely positioned to help the cell decide whether to devote energy and resources to 'peacetime' metabolism, or cellular defense."

Mitochondria decide whether the cell is in energy mode or defense mode - it's one or the other, it's not both.

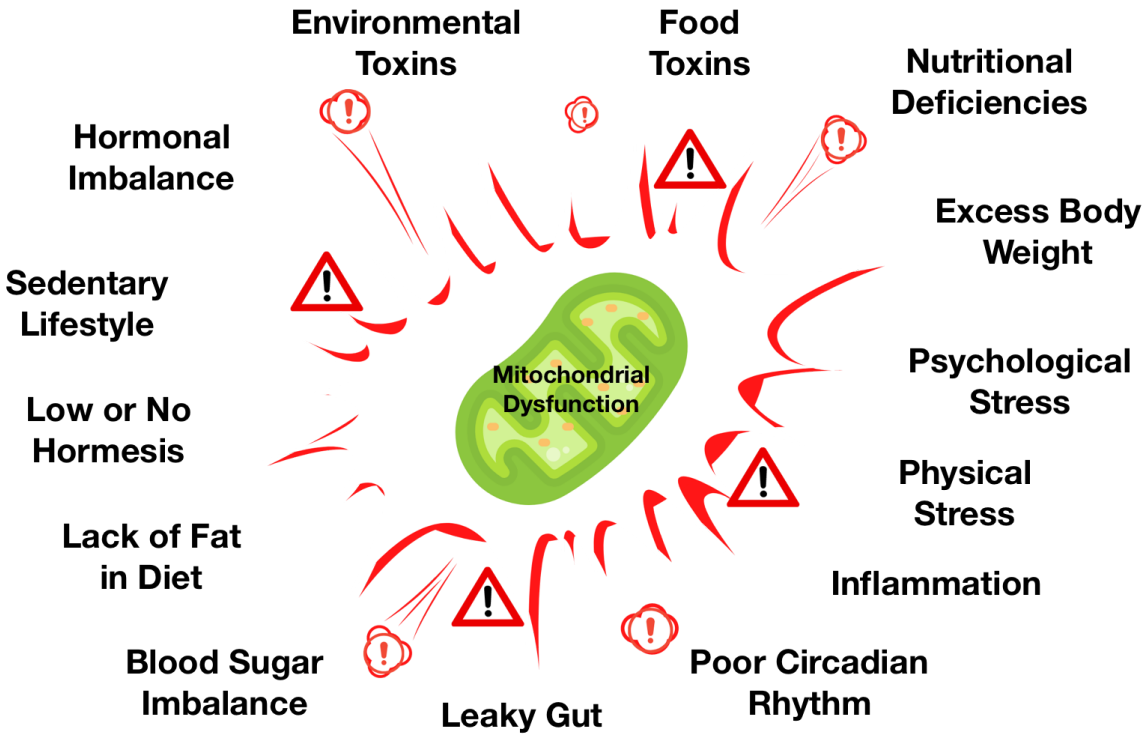


When we have a cell that has sensed a dangerous lurker outside its doors, it shuts down energy production and goes into defense mode. On the other hand, when we have a healthy cell then we have increased energy production.

Let's consider defense mode as a sort of hibernation state, but also understand that this is an actual survival mechanism. A lot of bacteria will actually steal our cell's own mitochondria to replicate. The cell danger response is designed to know when this is happening and to shut down or even destroy itself to prevent that hijacking bacteria from taking charge. If our cells didn't have this response then we wouldn't survive very long.

A really important consideration for us is making sure that our cells are in energy mode and not defense mode. Another consideration is that when they are in defense mode, that they're working as efficiently as possible.

In order to change how our mitochondria are functioning, we need to know how to bring our cells out of defense mode first.



The above cell is a dysfunctional mitochondria in defense mode and the causes are mostly familiar because we've been working on them a lot already. Your mitochondria today are already in better shape than they were many weeks ago when you first started this program. That's something to celebrate! The one thing that sounds new to us is this idea of hormesis, which we will come to talk about in just a little bit.

The health consequences of having our cells and mitochondria in cell defense mode are vast. Anything from neurodegenerative diseases like alzheimer's to autoimmunity like Hashimoto's or MS to infertility - all of these things plus 300 other ailments are now being considered as mitochondrial disorders. This is because our energy making powerhouses are critical to our foundation of our health!

Building new and stronger mitochondria is possible! And it's something we're going to work on in this Amplify phase through something called Hormesis. Hormesis is the process by which a low level, acute stressor stimulates adaption, which then leads to enhanced healing, increased energy production and resilience, and better health

Hormesis is the key to unlocking vastly improved health and cellular energy production, and you can use hormesis even to reverse mitochondrial loss that has already happened.

Hormesis includes placing very low dose stress on the body that helps the cells relearn how to manage stressors so they adapt and become stronger. When we use these hermetic techniques regularly it really works to not only teach the cells how to heal themselves again but they then have an incredibly improved ability to handle more and more stress as it comes.

Dr Hans Selye was one of the first to actually study stress in a lab and he describes a stressor as anything that challenges an organism to adapt — we can either adapt to the stressor or the stressor can overtake us. When we use hormesis, which is a very low dose stressor, it actually enhances the body's ability to adapt and makes it stronger.

An example you're probably familiar with is exercise — exercise is an acute stressor for us, but it stimulates the body to adapt to that stressor and become stronger over time. Exercise in the technical sense is stress. However, when we use it properly at the right dose and the right frequency it *improves* our strength and increases our body's ability to make energy eventually allowing us to increase the amount of exercise we can handle.

For instance, one week you'll be sore from a certain set of exercises, and the next week those same exercises don't make you sore anymore that's because your body adapting to the stress of those exercises.

This whole idea of hormesis was discovered by a German scientist back in the 1880's who found that using low doses of a disinfectant on yeast particles actually enhanced their metabolism, whereas a high dose of that same disinfectant killed them off.

There are many different types of hormesis:

- Intermittent Hypoxia Training (IHT)
- Exercise
- Intermittent fasting
- Nutrient cycling
- Cold
- Heat

Intermittent Hypoxia Training (IHT):

Hypoxia is a deficiency of oxygen, and you may recognize "hypoxia" as being something bad that we want to avoid, and yes, a large amount of hypoxia is not something we want because a significant amount of hypoxia will kill us. However, a low intermittent dose of hypoxia has been shown to be therapeutic.

One way you might recognize this as being something that makes the body stronger is when we think about high altitude versus sea level. There is less oxygen in the air at higher altitudes and there are a lot of athletes who purposely go to these higher altitudes to train in a lower oxygen environment. Training in this environment measurably enhances their ability to perform when they return to sea level — that is a form of intermittent hypoxia therapy.

How is this relevant for us in trying to get pregnant? This specific type of hormesis has been shown in a lot of studies to help grow mitochondria all throughout the body, including in our egg cells.

According to Rosalba Courtney, one of the leading experts on hypoxia training, “IHT increases the efficiency with which the body takes up,transports and utilizes oxygen. The heart and lungs are stimulated to increase their functions and even over the long term to increase in size.” IHT is a type of breathing training that actually trains the body to get better at absorbing oxygen in the lungs, and it increases the ability of mitochondria to then use that oxygen more efficiently.

Many studies have been done over the last 30 years that have included over 300,000 trial participants showing the benefits and efficacy of IHT. For many years, it was difficult to find funding for these studies until one study involving women and fertility issues was done. This study included 49 women who were unable to get or stay pregnant. They were given IHT exercises to perform and during the course of this study 48 out of the 49 women got pregnant and had healthy children. The children and mothers were followed for 2 years and found to be totally healthy with no issues.

This is quite exciting for us because we have now 2 separate ways of confirming the importance of mitochondrial health in fertility and pregnancy: the nuclear genome transfer (mitochondrial transplant) and IHT training both were able to help women get pregnant, and deliver healthy babies.

IHT has been shown to increase vagal tone and regulate our stress response, improve exercise tolerance, build immune function, increase energy levels, improve sleep, improve cardiovascular and respiratory function, and improve hormonal balance, as well as many other benefits.

The implications for this therapy, and hormesis in general, is that we're able to turn back our mitochondrial physiological clock and improve not only our health, but specifically our egg quality. We're not beholden to age-related decrease in mitochondria or mitochondrial dysfunction because we can use hormesis to improve both quantity *and* quality.

For us, our intermittent hypoxia training can be easily done at home. We will be using 3 different breathing exercises, but the trick is that we need to see *progression*. We need to be doing these exercises in a way where we're getting better at it each day and each week - there needs to be progressive ability to handle more and more of the stressor so that your mitochondria are getting the benefit.

Progressive breathing exercises - achieve low level hypoxia to induce this mitochondrial growth

1. Wim Hof Breathing Technique
2. Breath of Fire
3. Walking Breath Holds

The links above will take you to videos that will take you through each breathing exercise.

Disclaimer Please go slowly and listen to your body. Some light-headedness or tingling sensations are normal but always listen to your body and stop when you need to. Always come to a full recovery before starting another set

The walking breath holds are really great to do whenever you're walking anywhere. Walking from your car to the grocery store? Build some mitochondria while you're at it! This involves taking a deep breath in, exhaling it out, and walking as many steps as possible before needing to breath in again. Always recover between. Progression with this exercise means being able to walk more steps as the days and weeks go on.

Do these breathing IHT exercises 1-3 times per day, 3-5 times per week.

Exercise

This is another hormesis technique that helps build mitochondria. For us, we want to be exercising 3-5 times per week for approximately 10-30 minutes. We will be following our Cycle Balance exercise phases, and organize our exercise routine according to where we are in our cycle.

A really good type of exercise to do are HIIT (high intensity intermittent training) workouts. You can do anywhere from 10-15 minutes of a HIIT workout to get great benefit. This type of workout is usually best for the follicular phase of your cycle.

Intermittent Fasting

This one is a hot topic with fertility but, as we've talked about before, it's not something we want to do often or for very long. We've previously said to keep a regular fasting window of around 12-14 hours per day and this is predominantly to help our sleep-wake cycle.

When using intermittent fasting for hormesis purposes, you *can* use it once per week for an 18 hour fast, or once every other week for a 24 hour fast. This type of fasting helps clear out old, dead, or dysfunctional cells, and keeps the body making new ones.

Nutrient Cycling

This was found by Dr. Robert Naviaux as something that can benefit mitochondrial health as well. Nutrient cycling means rotating macronutrient contents regularly so your body doesn't get used to one specific thing. If you typically eat low carb, then having a day or two that are higher carb can benefit the body. Since we don't have a stringent "diet" persay, this nutrient cycling is already built in to our 80/20 rule.

One thing that they found is that cycling according to the seasons can be good for mitochondria. This means higher carb from seasonal fruits during the summer, and higher fat during the fall and winter time.

Cold Therapy

The best way to achieve hormesis using cold is a cold shower at approximately 68 for 2-3 minutes. You can start slow and turn the temperature a little cooler at the end of your shower for 10-20 seconds. Progression with this technique means staying in the cooler water for longer, and/or making the water colder as well.

Heat Therapy

If you're able to get to a sauna, this type of hormesis is extraordinarily beneficial. Sauna has been shown in studies to decrease mortality rates for those with cardiovascular disease. You can use sauna therapy for 5-60 minutes as tolerated.

How many of these things should I use and how often?

You're going to aim to do Intermittent Hypoxia Therapy (IHT) 1-3 times per day, 3-5 times per week.

Your overall goal is to be engaging in some sort of hormetic activity every day. You can mix and match as you like. Remember: one of the reasons our cells switch into defense mode is not having enough hormesis.

Hormesis should be done every day in one form or another.