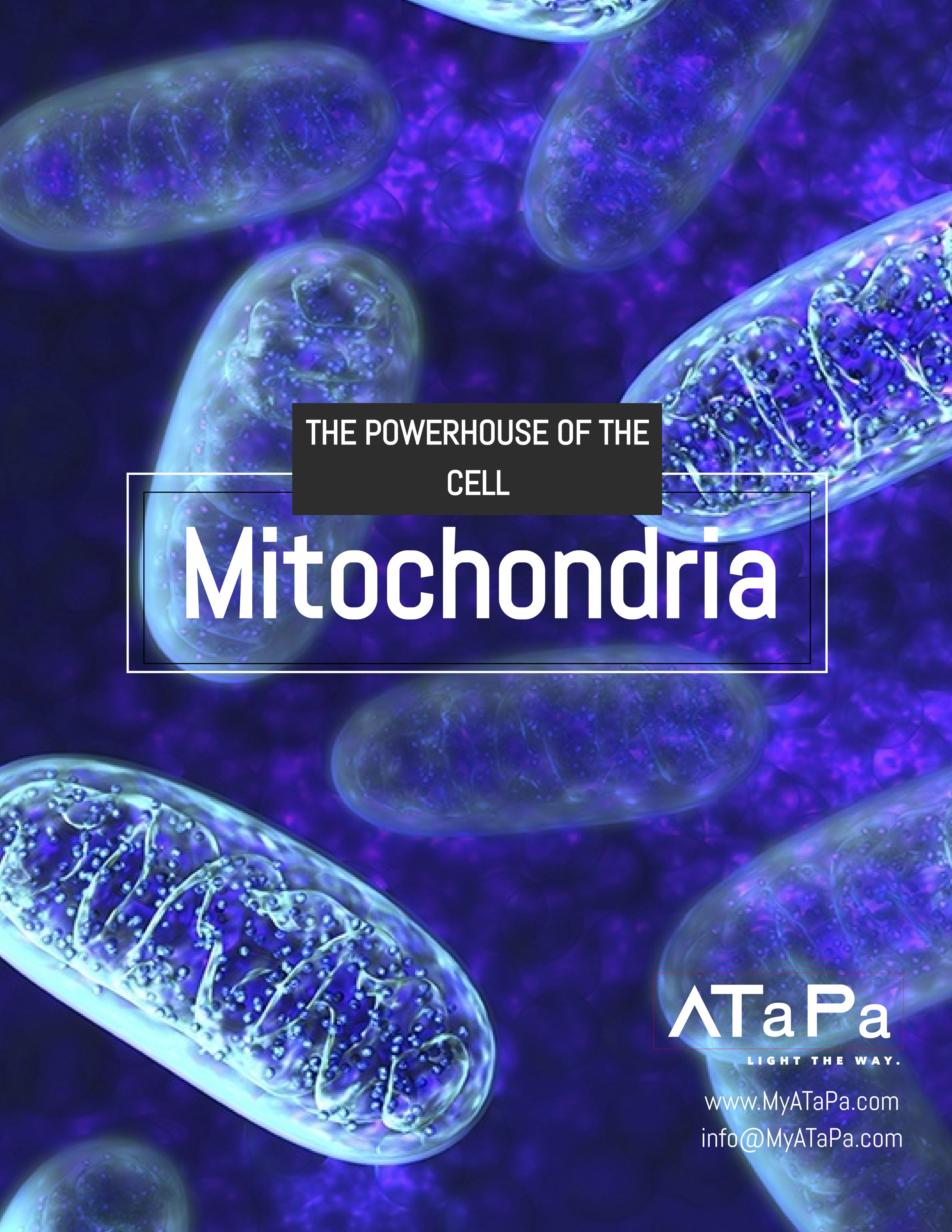


THE POWERHOUSE OF THE CELL

Mitochondria

ATaPa

LIGHT THE WAY.

www.MyATaPa.com

info@MyATaPa.com

Imagine.

There is a radical shift happening in the way we view health, disease, and human performance, and the shift is this...

The tuning of the engine is more important than the fuel.

What does that mean? It means that the health and tuning of an engine is more important than the fuel that goes inside it.

If you were to take a fine tuned engine and fill it with low-grade fuel, it will still go 200mph. However, If you take a poorly tuned engine and put great fuel in it, it won't go 200mph.

So the shift is that If we want to be healthy and perform at a high level, we have to maintain the fine tuning of our cellular engines that provide the energy for every single one of our metabolic functions, just as much as we care about the fuel (food) that goes inside.

Those engines are called mitochondria. They have been referred to as the "powerhouse of the cell" and that's because they make energy from the light we're exposed to, the food we eat, and the air we breath.

If you want to learn the "4 essential practices for mitochondrial health", feel free to skip ahead to page 10.

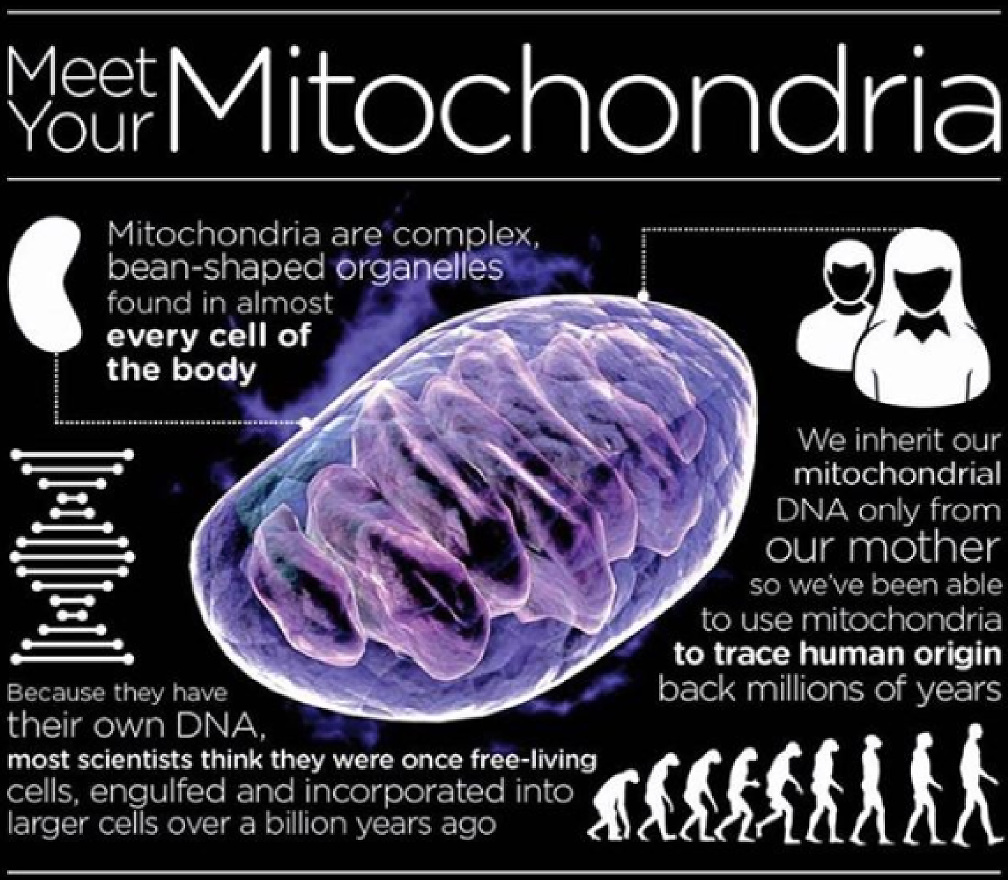
But if you want learn something that will radically change the way you view health, pay close attention to the content in these pages.

Let's continue.

Why is mitochondrial health important?

Look inside any cell today, and you'll see remnants of ancient bacteria by the thousands. These mitochondria—tiny organelles in the cell that each possess their own DNA—have come under a growing scientific spotlight; scientists increasingly believe they play a central role in many, if not most, human illnesses. Extremely sensitive to environmental threats, mitochondria convert dietary sugars into a high-energy molecule—adenosine triphosphate (ATP)—that cells use as fuel.

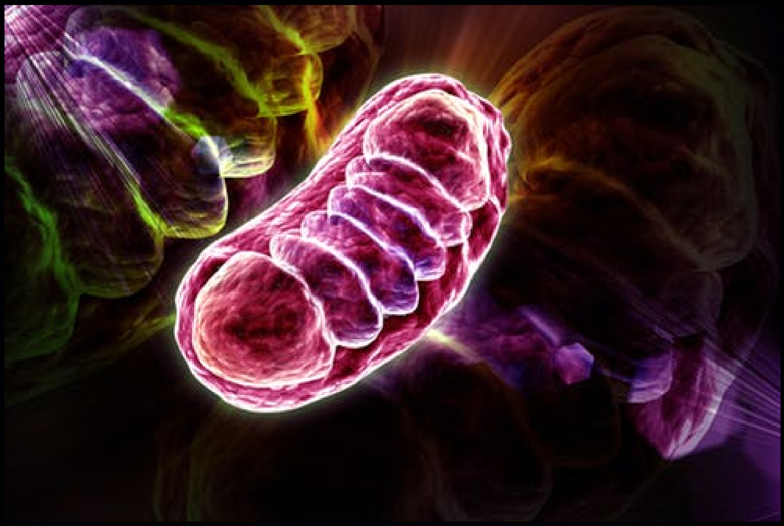
Now scientists are linking environmental interactions with the mitochondria to an array of metabolic and age-related maladies, including cancer, autism, type 2 diabetes, Alzheimer disease, Parkinson disease, and cardiovascular illness.



Mitochondrial Origins

- A fateful and historic event

Perhaps the most peculiar thing about mitochondria is that we actually stole them in a fateful turn of events that was absolutely crucial for the evolution of our species.



The origin of mitochondria began about **1.45 billion years ago** and is one of the seminal events in the evolutionary history of life. However, little is known about the circumstances surrounding its origin, and that question is considered an enigma in modern biology.

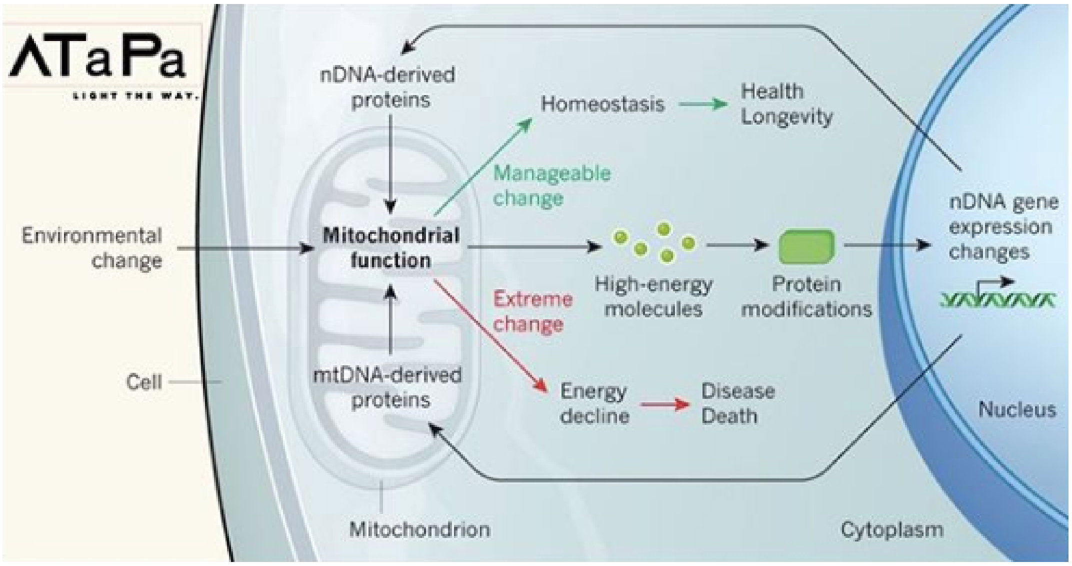
Our primordial ancestor was a simple single-celled creature, living in a long-term rut of evolutionary stagnation. Then something dramatic happened – One of the cells engulfed another and enslaved it as a continuous source of energy for its host.

The increase in available energy to the cell powered the formation of more complex organisms with multiple cells, eyes, and brains. Slowly, the two species became intertwined – sharing some of their DNA and delegating specific cellular tasks – until eventually they became firmly hardwired to each other to form the most intimate of biological relationships. Two separate species became one.

These energy slaves are the mitochondria, and there are hundreds or even thousands of them inside every one of your cells. They still resemble their bacterial origin in appearance, but we can no longer exist without them, nor they without us.

The evolutionary explosion powered by mitochondria is evident by the fact they are found in almost every complex multicellular organism. Without mitochondria we may have never evolved into the complex forms of life we are today.

Mito Quick-Fact: When the cell needs more energy, the mitochondria can reproduce by growing larger and then dividing. If the cell needs less energy, some mitochondria will die or become inactive.



Your Central Environmental Sensor

Mitochondria are the link between homeostasis and disease. The regulators of cell death and longevity. This is because energy production is what is responsible for the genetic expression of our cellular DNA. What controls energy production? Our mitochondria.

But what dictates healthy energy levels? How do we ensure our mitochondria stay healthy and produce an adequate ammount of energy to keep us happy and healthy?

"When mitochondria falter, cells lose power, just as a flashlight dims when its batteries weaken. Now scientists are linking environmental interactions with the mitochondria to an array of metabolic and age-related maladies, including cancer, autism, type 2 diabetes, Alzheimer disease, Parkinson disease, and cardiovascular illness." [1]

As mentioned in the title above, our mitochondria are our central environmental sensor. They the take cues from the environment and adjust energy demands accordingly.

So the mitochondria plays a central role in mediating between environmental change and genetic responses.

"If energetic homeostasis can be re-established, health and longevity are preserved. However, if genetic or environmental changes are too extreme, energy production declines, leading to disease and even death." [2]

Our mitochondrial ability to handle stress has been abolsutely crucial in the evolution of our species. This is because our mitochondria adapt to stress in a few different ways, these include but are not limited to:

1. Increasing energy demands when needed
2. Growing in size and number for more energy
3. Producing heat
4. Apoptosis: a cellular program which purges underperforming and weak cells
5. Mitophagy: Recycling cellular parts for more nutrients

Needless to say, minor stresses our mitochondria only make us stronger.

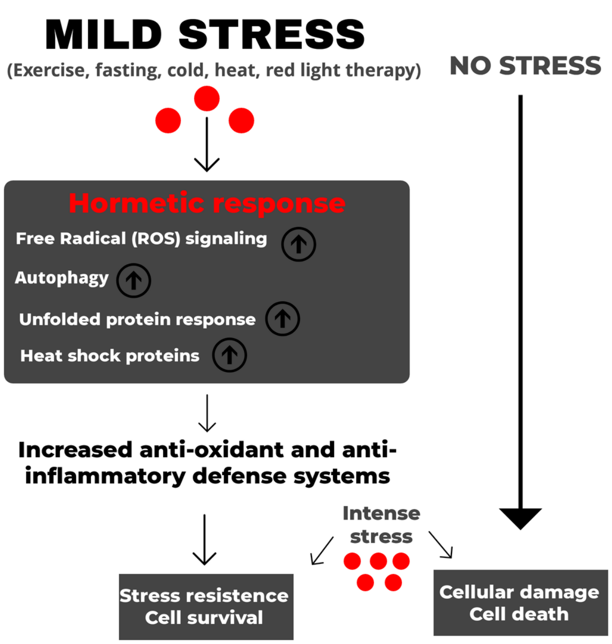
How much stress is too much?

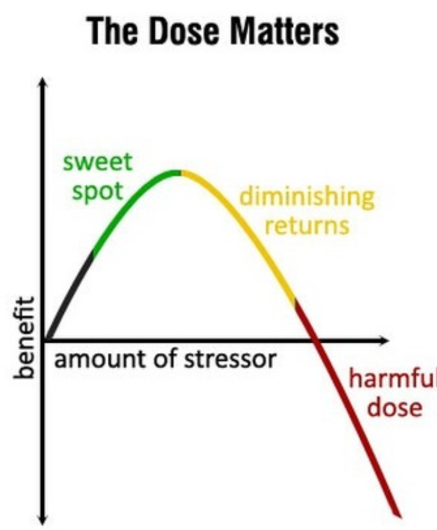
The bi-phasic dose response

The bi-phasic dose response is the scientific explanation of how "what doesn't kill you makes you stronger." Where do we draw the line between stress which is harmful, and stress which is beneficial? The bi-phasic dose response shows us that "the dose makes the toxin". How much of a toxin or stress we receive is whether or not it actually becomes harmful.

There are a few key types of stress which are shown to have extremely powerful benefits. These include but are not limited to:

- Cold exposure
- Heat exposure
- Exercise
- fasting
- light therapy





We are all familiar with the unending benefits of exercise, but at a certain extreme those benefits begin to diminish and ultimately produce a harmful effect. An example of this would be the increasingly large ammount of ultra-marathon runners who experience Rabdomyolysis: the death of muscle fibers and release of their contents into the bloodstream. This can lead to serious complications such as renal (kidney) failure.

This is what happens when you take a positive stress, increase the "dose", and experience a harmful effect. Our mitochondria play a major role in this bi-phasice dose response, and when given the right amount of stimulus, will actually increase the anti-oxidant, and anti-inflammatory defense systems of the cell.

In essence, mild stress stimulates powerful benefits promoting cell survival.

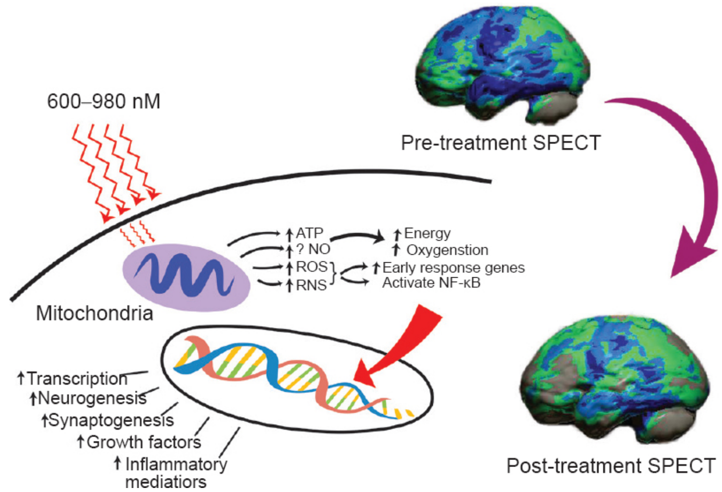
Light-Induced Stress Benefits

The ROS advantage (reactive oxygen species)

One way light therapy works by creating metabolic stress – stressing out and temporarily increasing reactive oxygen species (ROS), a.k.a. free radicals. These ROS can be considered the by-product of energy creation and in high-doses can be harmful. Interestingly, they can also be very beneficial to organisms as cell regulators and play an important role in immune health.

In particular, the transient increases in ROS (free radicals) from red/NIR light activates many of the same cell defense systems that exercise does[5]. This low-level inflammatory response caused by ROS stimulates many anti-inflammatory and anti-oxidant responses within the cell.

In short, in much the same way that exercise builds your muscles stronger by temporarily stressing them, light does the same thing to the internal anti-oxidant and anti-inflammatory defense system. It helps make your cells more tolerant to stress, combats inflammation, helps combat the buildup of free radicals, and ultimately makes your cells healthier, more energetic, and more resilient.



Brain Before and after (more green more blood flow)

It turns out that humans actually need some of these low-level stressors in their lives. The absence of these stressors actually sabotages our health.

So red and near-infrared light therapy are a form of what is called "hormesis", and benefit the mitochondria by creating a low dose stressor that the body then adapts to by becoming even stronger – the body increases production of internal antioxidant and anti-inflammatory systems, and builds up the size and strength of mitochondria.

In this way, red/NIR light become a powerful tool that doesn't just temporarily alleviate symptoms (like say, an anti- inflammatory or painkiller drug), but it is actually stimulating your body to make lasting adaptations at the cellular level that lead to more resilience against stressors and greater capacity to produce energy.

Mito Quick-Fact: Not only do mitochondria have their own DNA, but mitochondrial DNA also varies by region! These are called haplogroups, and are formed as a result of the accumulation of mutations through maternal lineages.

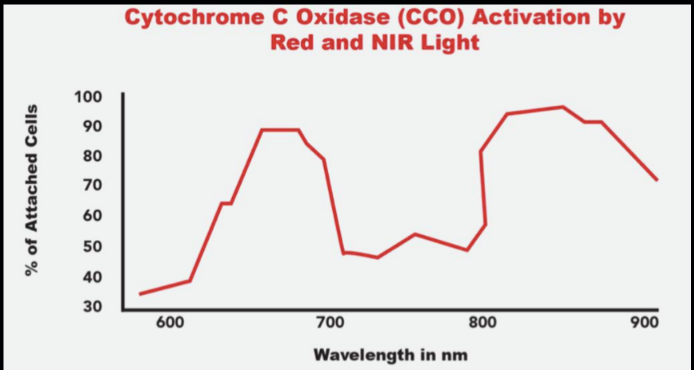
Mitochondria, Light, and Energy Production

How do mitochondria respond to light?

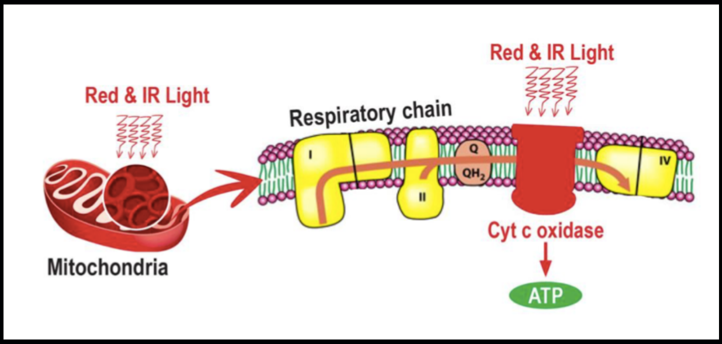
Without going too far into mitochondrial anatomy, it's important to know that mitochondria don't just respond to light, but they are designed for it! Within the mitochondria exists something called the respiratorychain, and along this chain exist little respiratory complexes numbered 1-5. The 4th complex, named Cytochrome C Oxidase (CCO), is whats called a photoacceptor; which means it is designed to take in light!

But not just any light, red and near-infrared light! Particularly between 600nm-700nm, and 800nm-900nm. These wavelengths of light are shown to have unique effects on CCO. How does this work?

You see, when our cells are under stress they release excess nitric oxide. This excess nitric oxide has a tendency to bind with CCO halting the normal production of energy. This is where red light therapy comes into play...



(Optimal CCO activation window) [4]

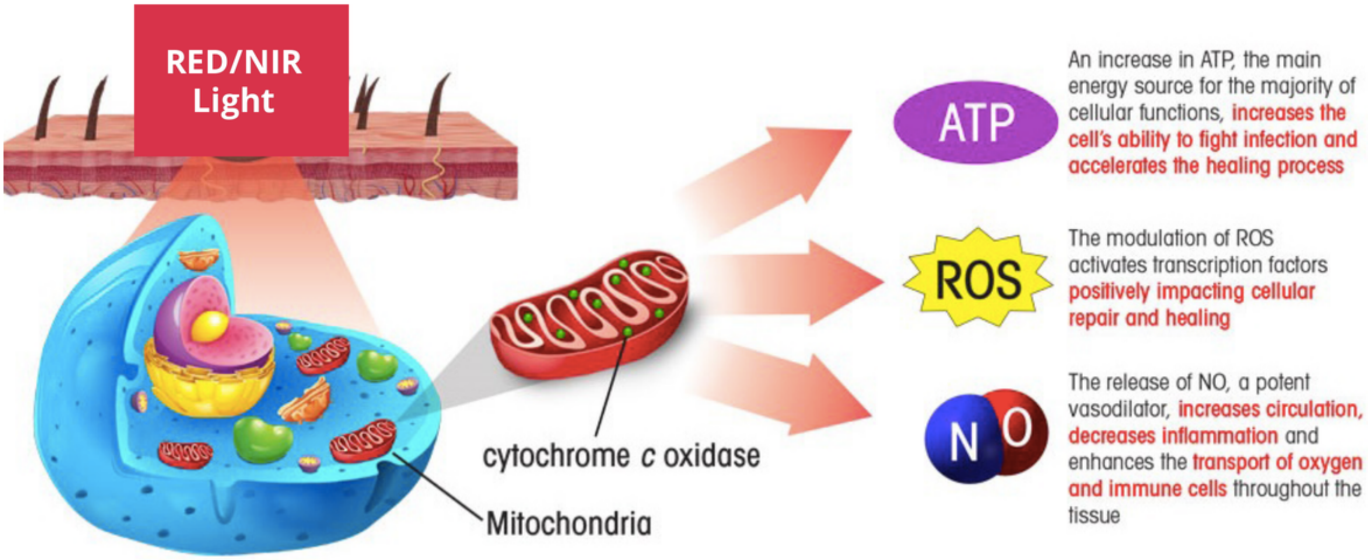


(Red/NIR light stimulating CCO within the mitochondria) [3]

Red and near-infrared light have the unique ability to break this bond between nitric oxide and CCO, allowing normal ATP (energy) production to occur by shuttling more oxygen into the cell. This is only one way in which red and near-infrared light produce positive effects on mitochondrial health and energy production.

Cytochrome c oxidase and oxygen working well together is crucial for cellular performance. When cells are functioning poorly – which most human's cells are today because we live a life full of stressors- ie. job stress, toxins such as BPA and pesticides, heavy metals in our food, too much artificial light at night, and air pollution (among others) – these kinds of toxic impacts on our cells hinder our cells' ability to produce energy.

Red and near-infrared light have the power to fix this energy problem we are faced with today. and it all takes place within the mitochondria.



Light & Mitochondria: Summary

It's not just that getting more sunlight and supplementing with red and near-infrared light is good for us, we actually need it. Our modern day lifestyle of spending 90% of our time indoors is having detrimental effects on our mitochondrial health. We need healthy light just as much as we need healthy food.

In fact, researchers are beginning to conclude that all disease and age related health challanges begin with a decrease in the quality of our mitochondria.

The world's leading mitochondrial DNA researcher, Doug Wallace, PhD, published a review in 2010 of over 250 studies on the impacts of mitochondrial mutation and disease and concluded that, "mitochondrial genetics are driving the modern epidemics of obesity, diabetes, neurodegenerative disease, cardiovascular disease, and cancer." [6]

"We need healthy light just as much as we need healthy food."

Our mitochondria need light to create more energy and improve our immune health. When our mitochondrial health declines, so does overall cellular performance. This is exactly why red light therapy has so many benefits, because it treats the root cause of most symptoms and disease: Poor cellular health.

The advancements in LED technology make red light therapy extremely accessible for users to experience any of the 29 proven benefits of red light therapy. Red light therapy isn't new, it has been researched for decades but most devices were laser technology and cost upwards of $20,000. Not exactly within budget for most individuals.

The Dark Side of Light

With the more scientists becoming interested in mitochondrial research, we are gaining a better understanding of just how vital these little engines are for our well-being. One thing is sure, mitochondria are extremely light-sensitive.

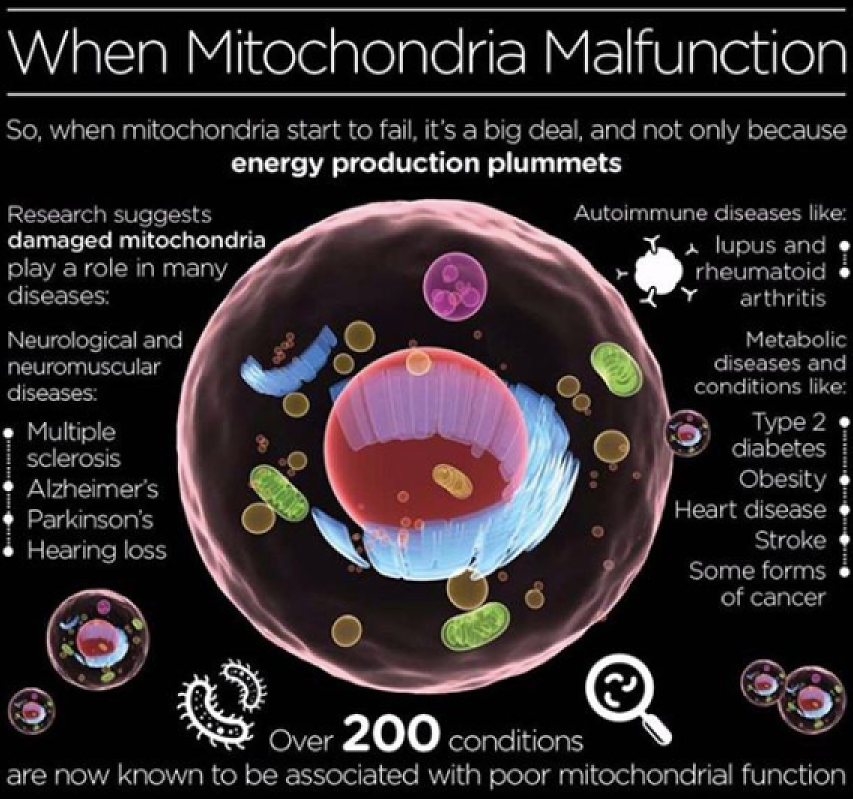
Not all light is created equal, there is light which heals us and light that harms us. Light within the blue spectrum is proving to have rather negative effects on mitochondrial DNA. It's not that blue light is inherently bad, but we receive an abundance of it from artifical light and our smart devices such as a phone, computer, or TV. In regards to our blue light exposure, humans are experiencing the negative effects of a bi-phasic dose.

We are receiving so much blue light that we are now paying for it with our health, and our mitochindria are taking the brunt of the damage.

Commercially available, "energy efficient" white lights have an intense emission in the range of blue light, which has raised a range of public concerns about their potential risk.s

A 2019 study concludes that "Excessive blue light exposure breaks the delicate balance between the oxidant and antioxidant systems within mitochondria via photochemical effects, leading to ROS accumulation and oxidative stress. Blue light-induced damage can morphologically and functionally affect retinal mitochondria and trigger mitochondria-involved death signaling pathways, which ultimately result in irreversible cell death. " [7]

This is only one more reason to supplement with red light therapy, which has the power to negate the effects of hazardous blue-light exposure.



4 Essential Practices for Mitochondrial Health

Block blue light

Knowing that our mitochondria are a primary target for the hazardous effects from artificial blue light, it is absolutely essential to invest in some form of blue light blocking technology. There are many great ways to block blue light such as blue blocking glasses, apps for your mobile phone and computer, and red light fixtures. This will protect your eyes from the copious amounts of blue light which surrounds us, and from the ill-effects of artifical light at night.

Red light therapy

If you didn't already know by now, red light therapy is without a doubt the most effective an easy way to give your mitochondria a big boost. This is because we are red and infrared light improve the efficiency rate at which our mitochondria can produce energy.

Cold water

Cold exposure, cold water immersion, cold plunging, cold showers, cold anything... signals many beneficial programs that are controlled by our mitochondria. These include mitochondrial biogenesis, the growth in number and size of new mitochondria, and autophagy, where we recycle intracellular components for fuel. Autophagy means "self eating", is our cellular recycle program which helps improve cellular function in times of stress.

H.I.I.T

High intensity interval training is another activity which signals mitochondrial biogenesis. HIIT workouts stimulate your body's release of nitric oxide (NO), improving your mitochondrial health, slowing down age-related muscle decline and boosting heart health.

HIIT is so important is because it makes your mitochondria work harder. As such, they create more free radicals, which signal your body to create more mitochondria (mitochondrial biogenesis) to keep up with the heightened energy requirement. This is important, since mitochondrial damage can trigger genetic mutations. If you couldn't already tell, all of these processes which improve mitochondrial health actually happen in response to some form of stress, following in line with our 'hormetic response."

If you engage in these activities you will supercharge your health and drastically improve your sense of well-being. So where do we go from here?

One last thing...

If you've made it this far we want to say thank you, it is very clear to us that you take your health seriously and that you're willing to take the time to learn more about how important light is for cellular performance.

Now that you know just how imperative it is that we get red and infrared light in our life, how many benefits it has, and that without it our energy and immune health declines... We're not going to tell you that you need a 30k red and infrared laser to stay healthy.

Thankfully, we can get all those same clinically proven benefits in the same ammount of time with a device that offers much more coverage than a laser for a fraction of the cost.

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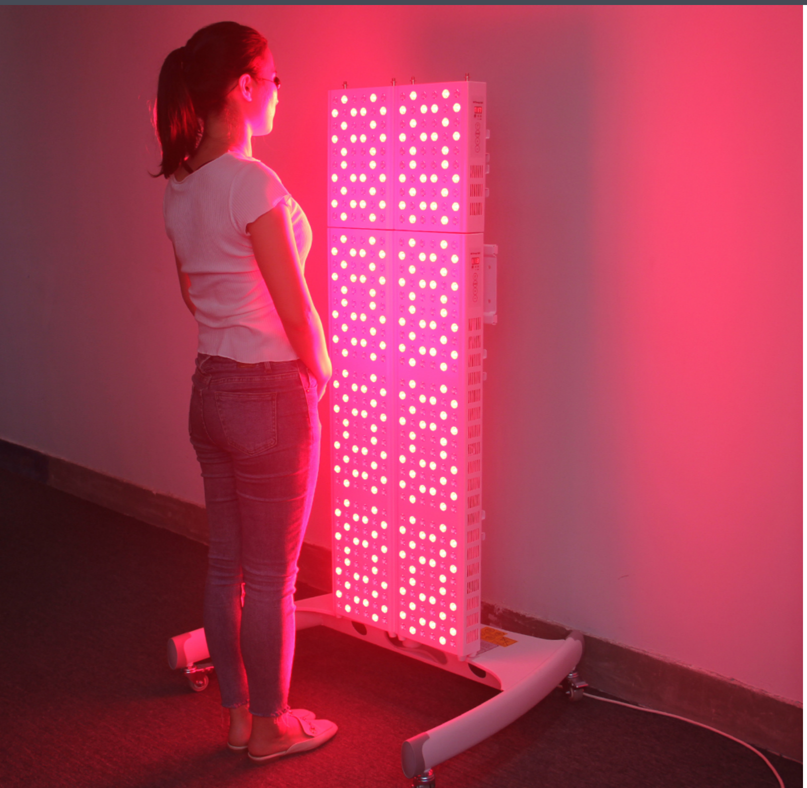

Resources:

[1]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2920932/
[2]https://www.nature.com/articles/nature18902/figures/1fbclid=IwAR0ZiLPvbUeEPemVTPrBfxtv6Ri8ueu_X4wWk_s2uYZEcWMLogTp6nSunxQ
[3] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2790317/
[4] http://photobiology.info/Hamblin.html
[5] Hamblin, M. (2017). Mechanisms and Mitochondrial Redox Signaling in Photobiomodulation.
[6] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2821041/
[7] https://www.hindawi.com/journals/omcl/2019/6435364/