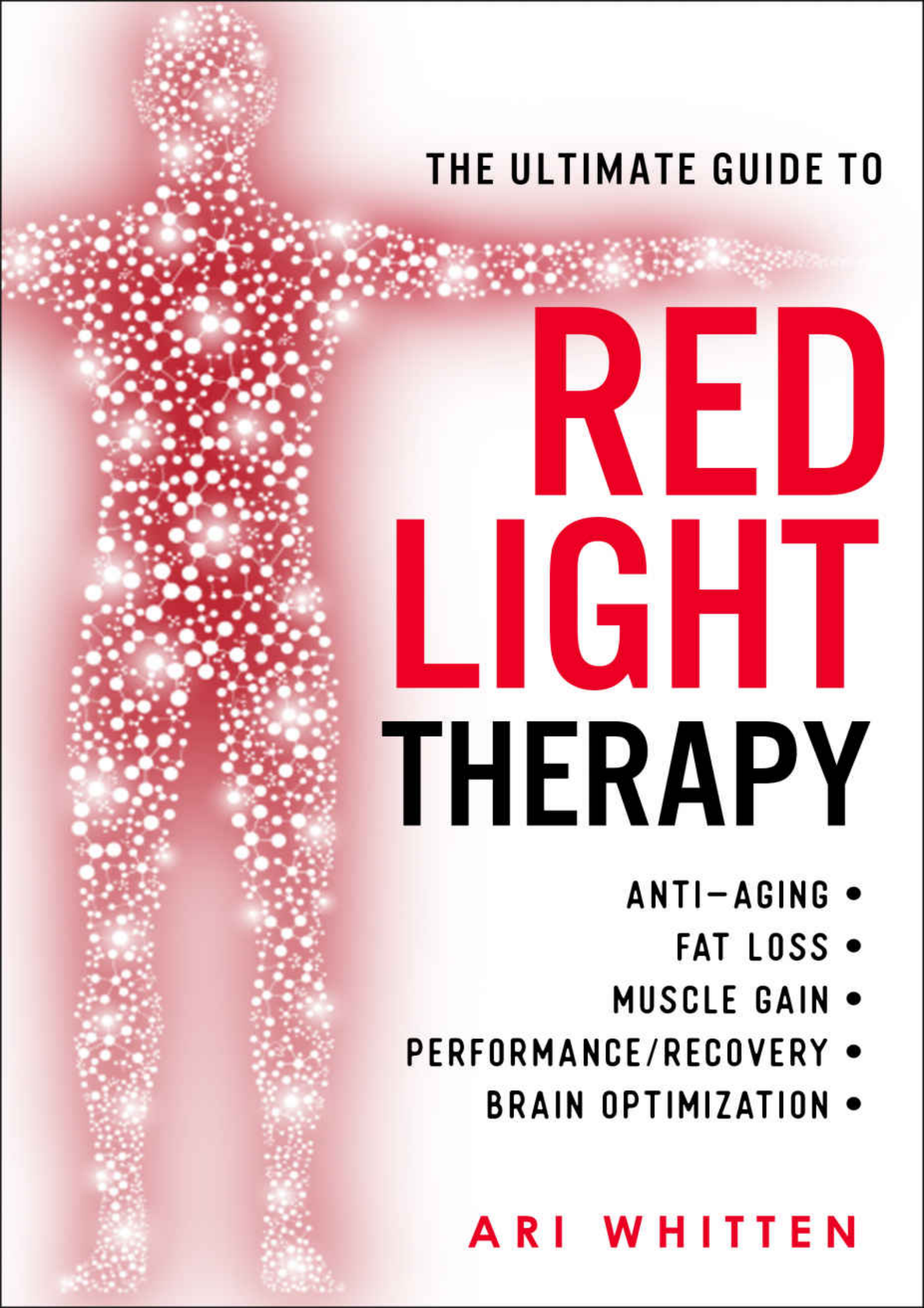

THE ULTIMATE GUIDE TO

RED LIGHT THERAPY

ANTI-AGING •
FAT LOSS •
MUSCLE GAIN •
PERFORMANCE/RECOVERY •
BRAIN OPTIMIZATION •

ARI WHITTEN

The Ultimate Guide to Red Light Therapy

Ari Whitten

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The intention of this book is to provide information about the scientific research as it relates to red and near-infrared light therapy. We also have attempted to provide guidelines for using red and near-infrared light therapy devices safely. None of the information in this book, and none of the guidelines for safe usage of devices should ever be interpreted as claims of diagnosis, treatment, or cure of any medical condition.

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Introduction

If there were a pill that was proven to have powerful anti-aging effects on our skin, combat neurological disease, fight depression and anxiety, increase fat loss, speed recovery from exercise, increase strength and endurance, combat certain autoimmune conditions, fight hair loss, and speed healing from injury—all with little to no side effects—it would be a billion-dollar blockbuster drug. Hundreds of millions of people would be told to start taking it by their doctors every day. And doctors all over the world would call it a "miracle drug."

Here's the crazy part: That drug exists.

But it's not a pill. It's red and near-infrared light.

Red and near-infrared light therapy are one of the biggest breakthrough discoveries in health in the last half century. Scientists have quietly accumulated thousands of studies on the power of red and near-infrared light to enhance human health for the last several decades. And yet, most people have never even heard of it.

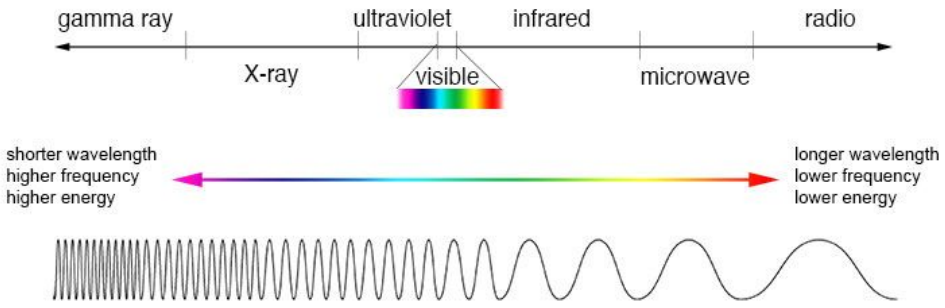
Most people think of light simply as the opposite of darkness. Darkness is the absence of light, and light is what illuminates and allows us to see things. That's the typical way most of us think about light. Thus, the idea

that light is getting into our cells and affecting human cell function is often met with blank stares or even people laughing at such a “crazy” thought. Indeed, most of us are completely unaware that light (very specific types of light) have a profound impact on our health, and are actually necessary nutrients, similar to nutrients from food. Unbeknownst to most people, there are literally over ten thousand studies that have been done on the relationship of different kinds of light to human health. Of these, it is red and near-infrared light that are perhaps the most interesting and powerful in their effects on human health.

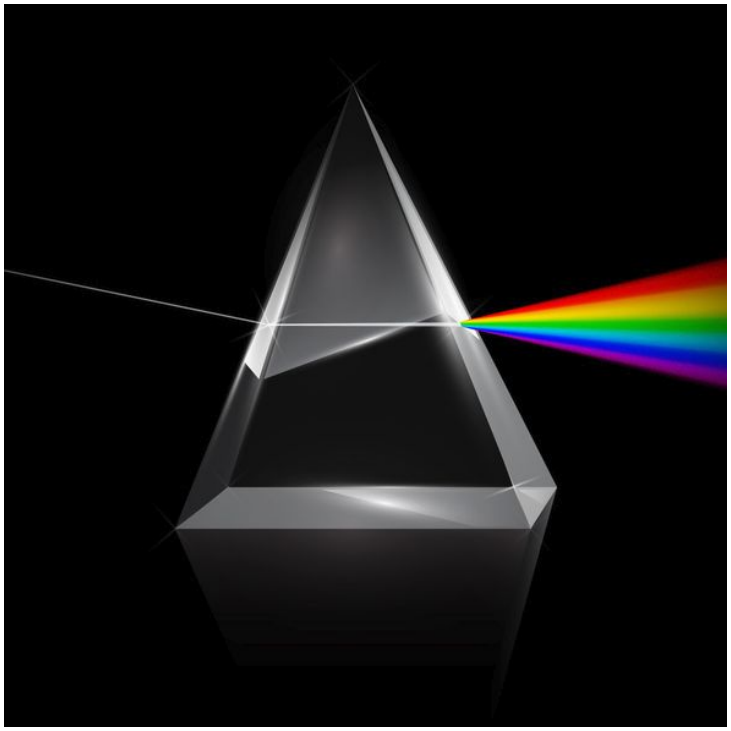
But let’s back up for a moment: What exactly *are* red and near-infrared light?

Red and near-infrared light are part of the electromagnetic spectrum, and more specifically, part of the spectrum of light emitted by the sun (and fire light). These wavelengths of light are “bioactive” in humans. That means that these types of light literally affect the function of our cells.

So what’s all this talk of “electromagnetic spectrum” and “spectrum of light”? Let’s take a look at the electromagnetic spectrum so I can show you more clearly what I’m talking about…

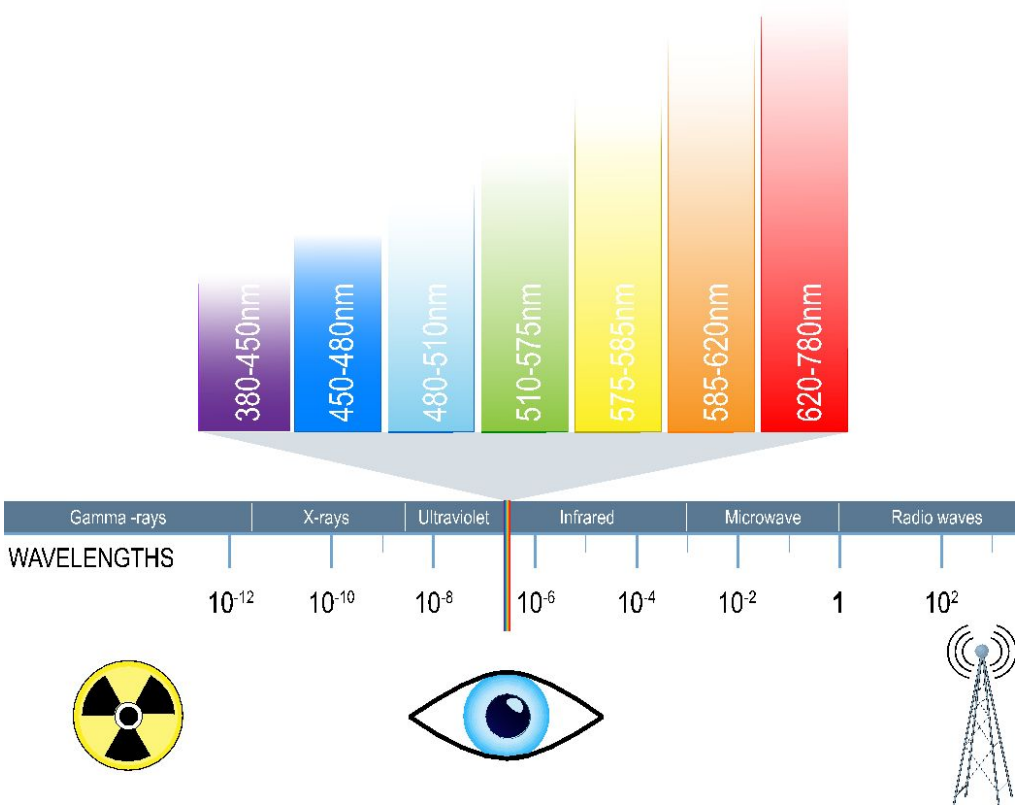


Electromagnetic waves range from 0.0001 nanometer (gamma rays and x-rays are very small waves) all the way to over centimeters and meters (radar and radio waves).



If you pass white light (like sunlight) through a prism, it will separate out the different colors based on their wavelengths. This is how we get rainbows as well, and you might remember this from school with the acronym ROY. G. BIV, which stands for red, orange, yellow, green, blue, indigo, violet.

VISIBLE SPECTRUM



Only a tiny part of this spectrum—from roughly 400nm to 700nm—is visible to the human eye.

At the highest end of the visible light spectrum is red light, which goes from a little over 600nm to approximately 700nm. Above the visible light spectrum is near-infrared, from about 700nm to a little over 1,100nm.

It is the red and near-infrared wavelengths specifically that have these amazing effects on our bodies. (Interestingly, even within that range, not all the red and near-infrared wavelengths seem to be created equal. Specifically, most research showing benefits of red and near-infrared light have used wavelengths in the narrow ranges of 630-680nm and 800-880nm. More on this later.)

As you're about to discover in this book, light in these red and near-infrared wavelengths have absolutely incredible effects on human health.

In this book, you'll discover the incredible power of red and near-infrared light therapy and how it can help:

- Increase your energy
- Combat aging and make your skin healthier, reduce wrinkles, and help get rid of cellulite
- Speed up fat loss
- Improve muscle recovery and athletic performance
- Improve mood and cognitive function
- Speed healing from injury
- Improve metabolism and hormonal health

Sound too good to be true? Think again!

Red and near-infrared light have already been proven in over 3,000 scientific studies to do all that and more!

The Discovery of How Red and Near-Infrared Light Affect Human Cells

Within documented human history, it is now known that humans have been aware of the power of light to heal for literally thousands of years. Many ancient tribes worshipped the sun or given massive importance to it as a giver of life, for likely tens of thousands of years. But as far as the use of light for therapeutic purposes ("photomedicine" or "photobiomodulation"), one could say that it goes back over three thousand years to India. It has even been documented in the Hindu text Atharva Veda, written in 1400 BCE.

In the 18th century, reports started to appear in medical literature about the power of sunlight to treat an array of different diseases. In the 2018 textbook "Low-Level Light Therapy: Photobiomodulation," Hamblin et al. gives a detailed account of the history of how it came to be recognized that light influences human health. If you're interested in all the nuances of the history of the use of light therapy, I highly recommend getting Hamblin's

textbook, but let me give some highlights from their book of this amazingly detailed accounting of the history of photomedicine:

> "In 1735, Fiennius described a case in which he cured a cancerous growth on the lip using a sunbath. In 1774, Faure reported that he successfully treated skin ulcers with sunlight, and in 1776, LePeyre and LeConte found that sunlight concentrated through a lens accelerated wound healing and destroyed tumors. There were also reports that sunlight had beneficial effects on internal maladies. In 1782, Harris used sunlight-exposed mollusk shells to improve a case of rickets (fragile bones due to vitamin D deficiency), In 1845, Bonnet first reported that sunlight could be used to treat tuberculous arthritis (a bacterial infection of the joints).
>
> In the second half of the 19th century, the therapeutic application of sunlight, known as heliotherapy, gradually became popular. In 1855, Rikli from Switzerland opened a clinic in Veldes (now called Bled), Slovenia for the provision of heliotherapy. ...
>
> Theobald Adrian Palm (1848–1928) discovered the role of sunlight in the prevention of rickets. ... Many years later, the role of sunlight exposure to the skin, in mediating the biosynthesis of vitamin D, eventually explained these observations.
>
> Nils Ryberg Finsen (1860–1904)... suffered from an illness that would later be known as Niemann—Pick's disease, which is characterized by progressive thickening of the connective tissue of the liver, heart, and spleen. His discovery that sun exposure improved his own symptoms encouraged him to treat his patients with light. He had particular success in 1893 when treating smallpox with red light and in 1895 when treating lupus vulgaris (also known as scrofula or cutaneous tuberculosis) with what he thought was ultraviolet light from an arc lamp (but was in fact probably blue light). ...

> Two pioneering Swiss physicians, Oskar Bernhard (1861–1939) at St. Moritz and Auguste Rollier (1874–1954) at Leysin, were responsible for extending the use of heliotherapy. Solar therapy as practiced by these practitioners included increasing graduated exposures of parts of the body to sunlight, and the beneficial effects were considered to be enhanced by the fresh and cold mountain air in the Alps.
>
> Bernhard obtained an impressive initial success treating a large nonhealing abdominal wound (from a knife attack) that had resisted all other accepted healing approaches and which he decided to expose to the sun as a last desperate measure. Thereafter, he treated all nonhealing and infected wounds with sunlight. … In 1905, Bernhard had established his own small private clinic for sunlight therapy at St. Moritz that could accommodate some 33 patients and had south-facing balconies on two of the upper floors for convenient sun exposure.
>
> Rollier … became disillusioned with the poor results obtained by surgery for the treatment of skeletal tuberculosis and went into a rural general practice … where he began to treat non-pulmonary tuberculosis with sunshine and fresh air. Over the next forty years, the technique Rollier devised for exposing the body to sunlight (Rollier's Sunlight Therapy or Heliotherapy) came to be broadly accepted in Europe. His clinic, called "Les Frênes," was the first large, purpose-built sunlight-therapy facility to be constructed in the world."[1]

Thus, the general concept that sunlight was a powerful form of medicine (and even necessary for human health and the prevention of diseases like rickets) became general knowledge.

Then in the 1900s, the discovery of quantum physics and the shifting focus of many physicists during the World Wars led to the development of laser technology. In the 1960s, the theme of photomedicine (which prior to that, was purely focused on using natural sunlight as therapy)

began to merge with laser technology, which ultimately led to people experimenting with laser technology on the human body.

So where do red and near-infrared light come into all this? The story of the discovery of the effect of red and near-infrared (NIR) light on human health is a fascinating one.

In the 1960s, a Hungarian researcher named Endre Mester was using red light lasers to cure tumors that were implanted into hamsters. (Note: This is often how researchers study models of cancer in animals—they implant a tumor and then attempt to treat it). He was trying to repeat the earlier research of Paul McGuff in Boston, who had successfully been using the laser light to kill tumor cells. Interestingly, Mester's laser only had a small fraction of the power output of McGuff's light, and thus was insufficient to kill the tumor cells.

But Mester did observe a fascinating phenomenon: He noticed that the skin wounds made during the implantation of the tumors healed dramatically faster in the animals being treated with the red light compared to the animals not being treated with light. The light actually caused damaged cells to heal faster!

Indeed, this discovery of the power of red light to speed up healing and regeneration of human cells has now been confirmed by hundreds of studies. In the 1990s, even NASA starting using it. They were initially using red light LED technology for the purposes of growing plants during shuttle missions. But once it was discovered that these lights also affected human cells, NASA started testing and refining the technology with the idea to use it to help astronauts maintain muscle and bone mass, as well as to treat chronic wounds.[2]

It turns out these effects are just scratching the surface of the power of red light and near-infrared light to improve human health.

Since these early days, photobiomodulation (PBM) and low-level laser/light therapy (LLLT) have grown into entire fields of research, the body of scientific evidence

has grown to several *thousand* studies over the last few decades, and these light treatment technologies have begun to work their way into the offices of doctors and health practitioners, and into the homes of thousands of people.

There have now been literally *thousands* of studies conducted upon both animals and humans. Overall, red light has been repeatedly shown to have positive effects on cell function in animal and human studies and aid in improving a wide range of conditions, improving health in numerous ways. Red and near-infrared (NIR) light therapy devices have been FDA-approved for several purposes so far, including anti-aging, hair-loss reversal, acne treatment, pain relief, slow to heal wounds, fat loss, among other purposes. (This is worth noting as it proves the abundance of research showing benefits—the therapy has to be proven safe and effective in numerous trials to gain FDA approval.)

That said, there have been a few of big barriers to the widespread adoption (or even just the awareness) of red and near-infrared light technologies among some physicians:

1. Some of the cellular mechanisms of how red/NIR light therapy works in human cells are still being elucidated, and some physicians have difficulty adopting something without fully understanding the cellular mechanisms by which it works.
2. There is a wide variety of light dosing parameters and devices used in the many thousands of studies done, so some physicians and medical practitioners feel confused about what the correct dosing actually is.
3. Insurance reimbursements are higher with many other types of therapy, so many practitioners choose other forms of treatment that give them higher payouts.

Two big barriers specifically have hindered the widespread adoption of this technology by the general

public:

1. Until recently, it was thought that you needed an expensive laser device to obtain these benefits. This technology has been in use in doctor's offices for many years now and goes by the name of either "low-level laser therapy" (LLLT) or "cold laser." These red/NIR light laser devices often cost $5,000-$30,000. This is precisely why this technology hasn't gone mainstream and why most people still haven't heard of it—because most people are under the impression that you can only get red and near-infrared light therapy from these incredibly expensive laser devices.
2. Red and near-infrared LED panels are also being used in anti-aging clinics, where people are being charged $75-$300 per single session to use these lights. This is one of the other barriers—most people believe not only that these lights cost many thousands of dollars, but also that they can only use them by paying hundreds of dollars for a single treatment in a fancy clinic.

Shockingly, new research has shown that it is not necessary to use these expensive laser devices, and most experts now agree that it's possible to get the same benefits from red and near-infrared light therapy LED panels at a fraction of the cost.

Here's what Harvard researcher Michael Hamblin, PhD (widely regarded as the world's top authority on red and near-infrared light therapy) has to say on this subject:

> *"Most of the early work in this field was carried out with various kinds of lasers, and it was thought that laser light had some special characteristics not possessed by light from other light sources such as sunlight, fluorescent or incandescent lamps and now LEDs.* ***However all the studies that have been done comparing lasers to equivalent light sources with similar wavelength and power density of their emission, have found essentially no difference between them.****"*[3]

So you don't need a $5,000-$30,000 medical laser device to get these amazing health benefits. You can get these effects with a device that costs just a few hundred dollars.

You don't have to go to a clinic and pay $75-$300 *per treatment*. Once you buy one of these devices, you can do unlimited treatments at home for free (or for just the cost of a few minutes of electricity)! **You can do light sessions at home with your own light and get all the same benefits, while saving yourself the thousands of dollars you would spend at an anti-aging or medical clinic.**

I'll give you my recommendations for the best devices at the end of this book but for now, please be aware that there are a lot of cheap, underpowered and ineffective devices on the market that are being sold for hundreds or even thousands of dollars. It's very important that you get a superior quality, high-powered device. Don't worry, I'll show you how to evaluate which devices work and which don't, so you don't get hoodwinked.

Right now, this technology is on the cusp of exploding in popularity.

As people come to realize that you can get all the amazing benefits of red and near-infrared light therapy without spending $5,000-$30,000 on a laser device or $75-$300 for a single treatment session in an anti-aging clinic, I believe this therapy will go mainstream and nearly *everyone* will have a red/NIR light therapy device in their home.

After all, who wouldn't want to have a simple-to-use device in their home that can dramatically speed healing, improve hormonal health, improve cognitive and physical performance, accelerate fat loss, increase energy, and combat skin aging?

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1 Hamblin, M, et al. (2018). Low-level light therapy: Photobiomodulation. Society of Photo-Optical Instrumentation Engineers (SPIE).

2 Whelan, et al. (2002). The Use of NASA Light-Emitting Diode Near-Infrared Technology for Biostimulation.

3 Freitas de Freitas et al. (2016). Proposed Mechanisms of Photobiomodulation or Low-Level Light Therapy.

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The Five "Bioactive" Types of Light: Why Humans Need Sunlight to Be Healthy

"LLLT/PBM (photobiomodulation) is more than an alternative kind of medical treatment; it is a whole new method to control cellular processes and modulate living organisms by precise alterations in the chemistry of biomolecules. PBM enables the contemporary clinician or therapist who holds a modern and multidisciplinary outlook to fight against diseases and other disorders in both humans and other animals. Moreover, it is a possible way to stimulate or inhibit many different biological processes that occur in most (if not all) different living creatures. It could even be suggested that the photobiomodulation phenomenon is as old as life itself!"[4]

—Michael Hamblin

Just as human cells need nutrients from food, light is also a necessary nutrient for our cells to function well. Certain wavelengths of light can help power up our cells, affect hormones and neurotransmitters, balance our mood, enhance physical performance, hasten recovery from stress, increase alertness, improve sleep, and positively affect the expression of our genes.

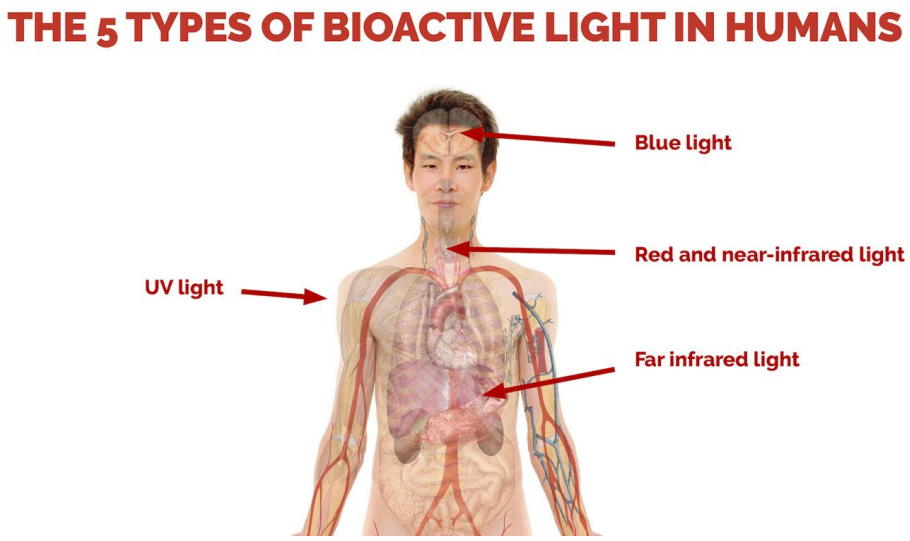
Most importantly, you need to grasp that **the human body *needs* light to be healthy**.

This may seem like a strange idea at first, as we're generally not used to thinking of light as playing an important role in our health. We're used to thinking of light as what we turn on in our house so we can see, or the headlights of our car that allow us to drive at night.

Most of us are deeply unaware of the fact that many different types of light are "bioactive" in humans (which means they affect the functioning of human cells), and that our health is largely influenced by the dosage of these different types of light that we get each day.

These are the five types of bioactive light in humans:

1. **Blue light**—sets the circadian rhythm in our brain, which in turn regulates numerous different neurotransmitters and hormones
2. **UV light**—allows us to synthesize vitamin D from the sun
3. **Far-infrared**—acts to heat up our cells (this is the part of the sun's spectrum that you feel as heat) which stimulates changes in cell function, as well as circulation changes
4. **Red light**—acts on the mitochondria in our cells to stimulate increased cellular energy (ATP) production (among other mechanisms discussed in this book)
5. **Near-infrared (NIR)**—acts on the same pathways as red light—particularly in the mitochondria in our cells to stimulate increased cellular energy (ATP) production (among other mechanisms discussed in this book)



It turns out that *light* is in fact an essential nutrient for humans and our health depends on getting the right dose of these five types of light.

Our ancestors didn't have to worry about all this living outdoors in the sun, they were able to get exactly what the body needed at the right dose.

But in the last few generations, modern humans have made the switch to living indoor lives with electricity, man-made artificial lighting systems and limited sun exposure. Therefore, we have developed light deficiencies and toxicities that are having a massive impact on our health and well-being.

Some people have made calculations on the difference between living outside vs inside houses, and have suggested that the difference in light exposure is roughly a 1000-fold difference, and in many cases even more! And that is just one point about light intensity—it says nothing of the huge deficiencies in exposure to specific wavelengths of light, like red/NIR, far-infrared, and UV light.

The point is that modern humans are deficient in the benefits of all of these five wavelengths of light, and there are health consequences when we don't get enough.

What kind of health consequences?

The most common light-related health problems that most people are already familiar with are vitamin D deficiency (from too little UV light) and circadian rhythm disruption (from too little blue light in the morning, and too much artificial light at night). Just these two light-related health issues alone are responsible for a massive burden of disease in the modern world. These two issues caused by inadequate and improper light exposure are linked with dozens of types of cancer, as well as heart disease, obesity, diabetes, neurodegenerative disease, and multiple other conditions.

Just as the modern world of processed food leads to chronic malnutrition, our modern light environment (of too much of the wrong kinds of light and too little of the right kinds, and with poor timing) is called mal-illumination. The vast majority of people living in the modern world are suffering from chronic mal-illumination and don't even realize it. And it has widespread effects on our brain and organ function, immune system, energy levels, mood, neurotransmitter balance, and hormone levels.

Sunlight deficiency has been linked with numerous diseases, such as:

- Neurodegenerative diseases like Alzheimer's, dementia, Multiple Sclerosis, and Parkinson's[5,6,7,8]
- Dozens of types of cancer[9,10,11,12]
- Obesity[13,14]
- Diabetes[15]
- Metabolic syndrome[16]
- Heart disease[17]

There is even research that suggests that low levels of sun exposure are a risk factor for human health equivalent to that of being a cigarette smoker![18] A Swedish study looked at nearly 30,000 women for 20 years (note: studies with this many people that are this long-term are exceedingly rare) and found that **women with the lowest sun exposure had a twofold higher rate of death compared to the women with the most sun exposure!**[19]

As another example of mal-illumination, artificial light exposure at night (from electronic devices like phones, TVs, computers, indoor lighting, etc.) have been linked with numerous diseases, like:

- Numerous types of cancer[20,21]
- Depression[22]
- Fat gain, obesity, diabetes and metabolic syndrome[23,24,25]
- Insomnia and poor sleep[26]
- Mood disorders[27]

And this is just a few of the dozens of health problems linked to mal-illumination.

But what if I told you that there is another kind of light deficiency that most people are totally unaware of, and that is likely even more problematic?

Red and near-infrared (NIR) light deficiency.

With respect to human health, I believe the most interesting and powerful of all the different wavelengths of light are the red and near-infrared parts of the spectrum. When you learn what these forms of light can do inside our bodies—and specifically how our cells use them to produce more energy—you'll be blown away, as it revolutionizes the way we think about how our cells produce energy, and has the potential to massively improve our health.

We need the sun to be healthy. And red and near-infrared light are a big part of the reason why. Just as our body requires the intake of certain vitamins and minerals (e.g. vitamin C, magnesium, zinc, etc.) from the diet to function normally, our cells also require certain "light nutrients" (adequate amounts of certain wavelengths of light) to be healthy. In short, **the human body needs red and near-infrared light to function optimally.**

Just as we can have malnutrition from a poor diet, we can have mal-illumination from poor light exposure.

Put bluntly, most peoples' light exposure habits are the equivalent of eating an all-McDonald's diet all day, every day. Like I said, mal-illumination.

We used to be exposed to far more light and of the right wavelengths because our ancestors spent hours each day working under the sun and spent evenings around the fire, both of which emit ample red and near-infrared light. Thus, humans never had to think about this subject for hundreds of thousands of years—our outdoor lives in the sun took care of our daily red and near-infrared light needs.

In fact, this book really wouldn't even be necessary if we still spent hours in the sun each day. There would be no need to have a book on red and near-infrared light therapy or to create red and near-infrared light therapy devices, because if we all spent several hours a day with

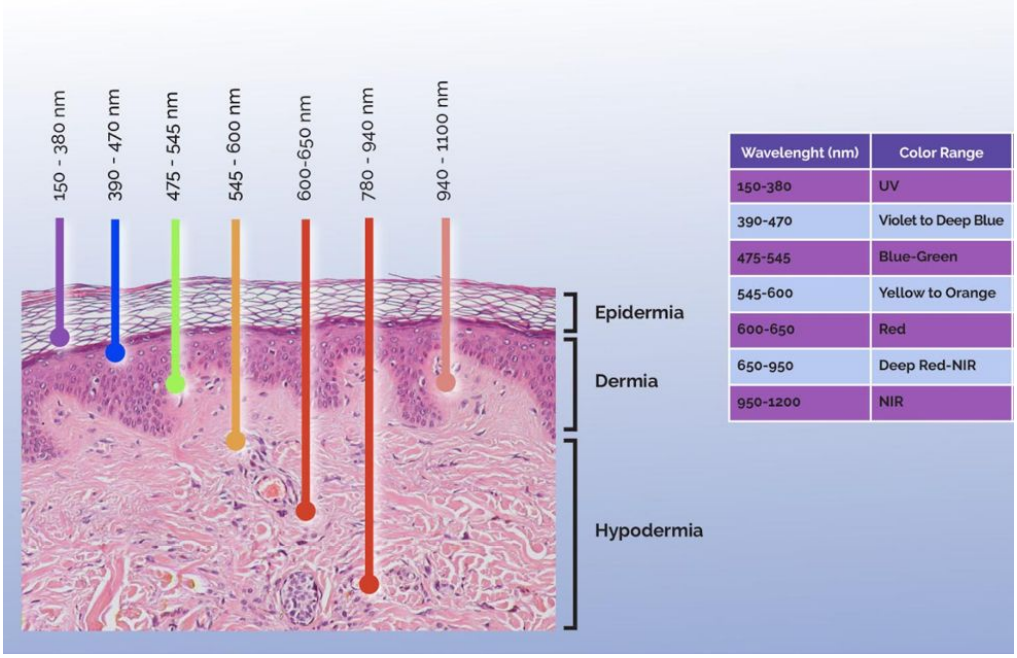
sunlight on our bodies, we'd be getting all the red and near-infrared light that our bodies need to thrive.

Red and near-infrared light have profound effects on our cellular and hormonal health. And we're designed to *need* ample amounts of those types of light to have optimal health.

Given that virtually all modern humans now spend almost all their time indoors, we are massively deficient in sun exposure. Thus, we are massively deficient in red and near-infrared light exposure. And, as you're about to read in this book, this causes big problems for our health. I personally believe that much of the positive literature around the benefits of red and near-infrared light devices is largely due to how it *corrects the deficiency in red and near-infrared light*. In other words, if you took a group of hunter gatherers (who spend hours in the sun each day) and another group of Westerners spending most of the day indoors and gave them both a red/near-infrared light treatment, you'd probably find that it's much more beneficial to the Westerners. Why? Because they are deficient in red/near-infrared exposure from the sun. (Of course, this hasn't actually been tested and is just my speculation of what I think they'd find if it *were* tested.)

The fundamental reason that red and near-infrared light have so many incredible benefits on our health is because they are correcting a deficiency. We should be getting plenty of red and near-infrared light from the sun, but since we're not, we can apply a device in a targeted way to give us that light "nutrient," and get profound benefits from it. (We'll go over what those benefits are in detail later.)

While most other wavelengths of light (such as UV, blue, green, and yellow light, etc.) are mostly unable to penetrate into the body and stay in the layers of the skin, near-infrared light and red light are able to reach deep into the human body (several centimeters, and close to 2 inches, in some cases) and are able to directly penetrate into the cells, tissues, blood, nerves, rods and cones of the eyes, the brain, and into the bones.



Once in those deeper tissues, red light and near-infrared (NIR) light have incredible healing effects on the cells where they can increase energy production, modulate inflammation, relieve pain, help cells regenerate faster, and much more.

The key point is this: Red/NIR light are not some weird technology that benefits us for some random reason. These wavelengths of light come from the sun, and it turns out that our body has evolved over millions of years to be capable of utilizing red and near-infrared light from the sun to help power up our cells—literally enhancing the function of our mitochondria, our cellular energy generators—among many other beneficial effects.

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4 Hamblin, M, et al. (2018). Low-level light therapy: Photobiomodulation. Society of Photo-Optical Instrumentation Engineers (SPIE).

5 https://www.ncbi.nlm.nih.gov/pubmed/29565713

6 http://sunlightinstitute.org/new-research-sheds-more-light-on-parkinsons-disease/

7 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4808871/

8 http://n.neurology.org/content/early/2018/03/07/WNL.0000000000005257

9 https://academic.oup.com/jnci/article/97/3/161/2544132

10 https://www.ncbi.nlm.nih.gov/pubmed/23094923

11 https://www.sciencedirect.com/science/article/pii/S2214623714000386
12 https://www.ejcancer.com/article/S0959-8049(06)00482-5/abstract
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25 https://academic.oup.com/edrv/article/35/4/648/2354673
26 https://www.sciencedaily.com/releases/2017/07/170728121414.htm
27 https://hub.jhu.edu/2012/11/14/light-exposure-depression/

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How Does Red and Near-Infrared (NIR) Light Therapy Work?

The next important question to answer is "how the heck does red and near-infrared light actually cause these effects?"

We know how UV light affects us, for example—it works primarily by interacting with our skin and stimulating the production of vitamin D. We also know how blue light enters our eyes and feeds back into the circadian clock in our brain (in the suprachiasmatic nucleus) to regulate our 24-hour biological rhythm, including the complex array of hormones and neurotransmitters that are regulated by this circadian clock in our brain.

These mechanisms are well understood by science. But what about red/NIR light?

There are numerous different physiological and biochemical mechanisms that researchers have identified as being affected by red and near-infrared light, but for our purposes here (since this is not a book meant for academics, but for regular people wanting to benefit from red and near-infrared light), I don't want to get too bogged down in the details of dozens of different molecular signaling pathways at the cellular level. Instead, I want to keep things as simple and easily understandable as possible.

First, it's important to understand that there isn't just one mechanism. For example, this isn't a drug that acts on one particular enzyme, compound or receptor (e.g. serotonin, cholesterol, etc.). There are literally **dozens of mechanisms** at the biochemical and cellular level.

It also can affect different cells differently—for example, affecting damaged and dysfunctional cells differently than healthy cells. It even has the capacity to irradiate the blood (and affect things like inflammatory mediators and immune cells), thus affecting the entire body through the changes in blood cells/compounds, not just

the area the light was shined on. Here's Hamblin et al. summarizing this in their 2018 textbook:

> "Light irradiation using a low power density has been reported as a noninvasive, noncarcinogenic, nontraumatic procedure that can provide a therapeutic benefit to many diseases and medical conditions, and that has been reported to have few (if any) side effects. In addition, PBM (photobiomodulation—the changing of biology with light) is used to improve human wellness with aesthetic and cosmetic applications, improvements in sports performance, and has diverse veterinary applications. The biomodulation achieved by PBM allows it to be applied in situations that can be apparently paradoxical because it can sometimes be used to stimulate cells and tissues, and in other situations it can inhibit the same biological effect. For this reason, PBM is referred to by many researchers as a regulator or modulator because it restores the organism to homeostasis. Moreover, there is considerable evidence of the systemic effects of PBM, which means that application to one site of the body can produce an improvement of a condition in another distant body part that did not receive light. Systemic effects can be explained by local effects of light that can be transferred to other sites through the circulating blood, via the lymphatic system, or via the nervous system."[28]

To go into the details and nuances of all the mechanisms and pathways known to be affected by red and near-infrared light could easily fill a textbook. Again, that's not the goal of this book. I'd like to simplify the mechanisms here as much as possible and not turn this into a biochemistry textbook, so let me first give a very brief overview of many of the molecular, cellular, and tissue mechanisms of action of how red/NIR light works, according to what is currently confirmed by research.

Please note that even here, I am only going to list them out and give brief descriptions of the more notable factors. If you'd like to see a complete medical textbook-

level in-depth discussion of *all* of the factors, I suggest getting Hamblin et al.'s new 2018 textbook *Low-Level Light Therapy: Photobiomodulation*. If you're wondering why I am simplifying here, I'll give you a brief example of the type of writing you'll find in that textbook, and after reading it, hopefully you'll have a greater appreciation for my attempts to make things easily understandable for even those without any science background:

> *"**ERK/FOXM1:** Fork-head box protein M1 (FOXM1) is a protein involved in the regulation of the transition from the G1 to the S phase of the cell cycle and the progression to mitotic division. Ling et al. investigated the protective effect of LLLT using red light at 632.8 nm against senescence caused by UV light, and reported an activation of the ERK/FOXM1 pathway that caused a reduction in the expression of the p21 protein and G1 phase arrest. Senescence was attenuated by over-expression of FOXM1c with or without LLLT, and if FOXM1 was inhibited by shRNA, the effect of LLLT in reducing cell senescence was abrogated. LLLT promoted the nuclear translocation of extracellular signal-regulated kinase (ERK), increasing FOXM1 accumulation in the nucleus, and the transactivation of c-Myc and p21 expression."*[29]

Now, how many people without a strong background in physiology and biochemistry do you think can understand just that single paragraph, let alone hundreds of pages of that kind of writing?

Hopefully you now have more of a sense of appreciation for how much I've simplified things. If you thought my explanation is unnecessarily complex, perhaps now you have a new reference for comparison! So hopefully you love me a little bit more now for making things relatively easy to understand.

Again, my goal here is not to make this into a textbook for researchers, but to make it accessible for regular people. That said, here is a summarized, simplified, and greatly shortened version of the mechanisms known to

science about how red/NIR light works (broken down by molecular, cellular, and tissue-level mechanisms), as discussed in the latest 2018 textbook[30] from several of the world's top authorities on this topic. (Note: If you don't care about all the details of the mechanisms and specific molecules at the cellular level, you can skip the next couple pages of bullet-point lists to the part right after "Two Key Mechanisms of Red/NIR Light Therapy." In that next section, I explain the details of the two most important mechanisms of how red/NIR light works in our body.)

Red/NIR light has been shown in research to affect all of the following compounds and pathways:

Molecular Mechanisms:

- **Cytochrome c oxidase:** This is a photoreceptor located on mitochondria in our cells that "accepts" light photons and then triggers events in the mitochondria. (More detail on this below.)
- **Retrograde mitochondrial signaling**: This is a key factor where mitochondria in the cells communicate with the nucleus of the cell about what is going on, thus affecting what genes get expressed in the DNA-containing nucleus of our cells.
- **Light-sensitive ion channels:** There are channels in our cells which control the flow of various ions (e.g. calcium, potassium, sodium, etc.). Some of these are affected by light, and then are involved with triggering further events in the cell or between cells.
- **Adenosine triphosphate (ATP):** This is cellular energy produced by mitochondria. One of the more notable findings from many studies is that exposure to red/NIR light increases levels of ATP production.
- **Cyclic AMP:** This is involved with opposing inflammatory pathways, among other functions in

the cell.

- **Reactive oxygen species (ROS):** These are also commonly called “free radicals.” While commonly associated with bad things (e.g. cell damage, oxidation, etc.), they also play vital roles in our bodies as signaling molecules. For example, ROS are produced from physical exercise and signal many of the positive adaptations that our body makes to exercise.
- **Calcium:** Red/NIR light can affect calcium levels in the cell, which in turn act as a signal for numerous cellular processes.
- **Nitric oxide (NO):** It is known that NO levels rise after red/NIR light exposure. NO is well known by most people for its role in blood vessel dilation, but it also acts in many other signaling pathways. (More on this below.)
- **Nuclear factor kappa B:** This is a signaling compound that regulates many genes involved in inflammation and cell survival to stressors.
- **RANKL:** A protein involved in bone regeneration/remodeling.
- **Hypoxia-inducible factor:** A protein involved in cellular adaptation to low oxygen levels.
- **Akt/GSK3b/b-catenin pathway:** This pathway relates to cell survival and apoptosis (programmed cell death).
- **Akt/mTOR/CyclinD1 pathway:** Involved in cell growth signaling.
- **ERK/FOXM1:** Involved in regulating cell division.
- **PPARy:** Involved in the inflammatory response.
- **RUNX2:** Involved in bone cell differentiation.
- **Transforming growth factor:** Stimulator of collagen production (e.g. in the skin).

- **Pro- and anti-inflammatory cytokines:** Many pro- and anti-inflammatory cytokines and mediators have been shown to have their levels altered by red and near-infrared light exposure.
- **Vascular endothelial growth factor:** Involved in angiogenesis—the formation of new blood vessels.
- **Hepatocyte growth factor:** Involved in liver cell health.
- **Basic fibroblast growth factor and keratinocyte growth factor:** Involved in the wound healing process.
- **Heat-shock proteins:** Involved in inflammation, wound healing, and cellular survival against many types of stressors (e.g. exercise, sauna/heat stress, etc.).
- **Melatonin:** Interestingly, red/NIR light therapy has been shown to increase "extra-pineal" production of melatonin outside of the pineal gland. Melatonin is much more than just a sleep inducing hormone as most people know it—melatonin has critical roles in protecting the mitochondria from damage and supporting glutathione levels, which is one of our body's most powerful and important antioxidants and detoxifying compounds. Some researchers have suggested that this increased melatonin may be a significant factor in the effects of red/NIR light.[31]
- **Brain-derived neurotrophic factor:** Involved in neuron/brain cell growth and regeneration.

Cellular Mechanisms:

- **Inflammation:** One of the most important cellular mechanisms that red/NIR light have is their effect on inflammation pathways. It appears to do this through inhibition of inflammatory prostaglandin PGE2 production and expression of

COX-1 and COX-2, as well as inhibition of the NF-kB pathway. The net effect: Reduced inflammation.

- **Cytoprotection:** Various studies have shown that red/NIR light can help protect cells from dying after being exposed to various toxins (e.g. methanol, cyanide, etc.). It appears to have cell-protective effect in some instances.
- **Proliferation:** Some types of cells (e.g. skin cells, bone cells, cells that line blood vessels, etc.) have been shown to grow and replicate faster with exposure to red/NIR light.
- **Migration:** Some types of cells (e.g. tenocytes in tendons or melanocytes in skin) need to actually move to get to the location they're needed. Some research has shown that red/NIR light can stimulate this.
- **Protein Synthesis:** Red/NIR light can also stimulate cells (e.g. skin cells, bone cells, etc.) to produce more proteins (e.g. collagen).
- **Stem Cells:** Stem cells are apparently even more sensitive to red/NIR light. Red/NIR light has been shown to positively affect growth, movement, and viability of stem cells. This may be relevant to both stem cells already present in our body, as well as in the context of stem cell therapy.

Tissue Mechanisms:

- **Muscles:** Numerous studies have shown that red/NIR light affect muscle performance, recovery from exercise, and adaptations (i.e. enhanced strength, endurance, muscle growth, fat loss) to exercise. (These studies are discussed in this book in later sections.)
- **Brain:** Red/NIR light has been shown to benefit brain function as well. Studies have shown improvements in cognitive performance and memory, improved functioning after traumatic brain injury, improved mood, as well as

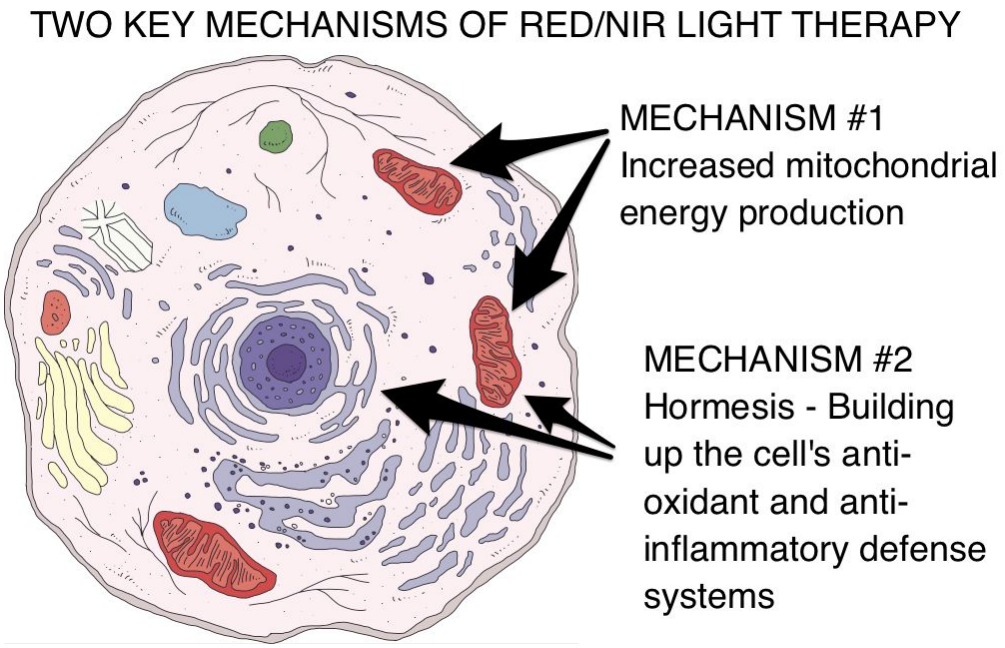
improvements in certain neurological diseases (e.g. Alzheimer's disease). The improvements in mitochondrial function, reduction in inflammation, and increased Brain-Derived Neurotropic Factor (BDNF) likely all play a role in enhancing neuron health.

- **Nerve (Pain):** Some studies have shown that red/NIR light can dull pain due to blocking conduction at nerve fibers. Anti-inflammatory actions, as well as blocking of substance P, likely play a role in this effect.
- **Healing (Bones, Tendons, and Wounds):** Numerous studies have shown that red/NIR light can stimulate and accelerate healing of numerous types of injuries—from tendon/muscle/ligament tears to bone fractures, and skin wounds. This is likely by affecting local growth factors involved in cellular repair, as well as effects on the inflammatory processes.
- **Hair:** Red/NIR light is also used in the context of hair re-growth, and numerous studies have shown it to be effective for this purpose. This is likely due to local blood vessel dilation and anti-inflammatory effects.
- **Skin:** Numerous beneficial effects on skin wrinkling and laxity, cellulite, collagen production and other aspects of skin health have been found. Anti-aging of the skin is one of the most common uses for red/NIR light.
- **Fat:** The exact mechanisms of how this happens are still debated among researchers, but numerous studies have shown that red/NIR light can stimulate the release of fatty contents from fat cells, and ultimately, lead to body fat loss.

Two Key Mechanisms of Red/NIR Light Therapy

Having gone through this more complete list of factors and mechanisms, now I want to simplify and condense the science. I generally think of red/NIR light as having two central mechanisms in how it benefits cellular function and overall health:

1. Stimulating ATP production in the mitochondria through interacting with a photoreceptor called cytochrome c oxidase.
2. Creating a temporary, low-dose metabolic stress (known as hormesis, which is also a primary mechanism of why exercise works) that ultimately builds up the anti-inflammatory, anti-oxidant and cell defense systems of the cell.



Let's talk about each of these mechanisms in more detail:

Mechanism #1: Stimulating Mitochondrial Energy Production

Researchers have found that one specific mechanism of red and near-infrared light therapy is that these wavelengths of light are able to penetrate into cells and activate the mitochondria, directly leading to increased cellular energy production. Many lines of research indicate that the mitochondria are the key player when it comes to the mechanism of how red and near-infrared

light affect our cells. According to Hamblin, M. and Carroll, J. et al.,

> *"Several pieces of evidence suggest that mitochondria are responsible for the cellular response to red visible and near-infrared light. The effects of (red and near-infrared light) on mitochondria isolated from rat liver, have included increased proton electrochemical potential, more ATP synthesis, increased RNA and protein synthesis and increases in oxygen consumption, membrane potential, and enhanced synthesis of NADH and ATP."*[32]

This point deserves special attention, because a huge amount of research in the last decade points to the mitochondria as being critical to health, disease prevention, energy levels, and longevity. So let's go into some detail about why mitochondria are so important.

The mitochondria are the life-yielding, energy yielding engines within the cells of all living things. Our mitochondria produce cellular energy in the form of ATP (adenosine tri-phosphate). Our bodies are constantly producing and using massive amounts of ATP in every cell in order to fuel every function in the body, from breathing to thinking to lifting a dumbbell. Every time you breathe, digest food, your heart beats, or you perform a bicep curl, your cells are using ATP energy.

Our heart and liver are packed with mitochondria, because they work constantly to pump blood, give life, filter toxins, and protect us from toxic damage. The brain is also packed with mitochondria. So are all our organs, tissues, skin, and especially muscles, which power us through movement.

The mitochondria are the batteries that fuel all the processes of our organs; thus, **things which enhance the mitochondria translate into more cellular energy inside the cell, which allows the cell or organ (e.g. brain, heart, liver, skin, muscles, etc.) to work optimally**.

However, since we don't get enough red light anymore, we are paying the price in the very core of our cells themselves—our mitochondria, the energy generators in our cells—and this has dire consequences for our health because we need red and near-infrared light therapy to generate energy efficiently in our cells.

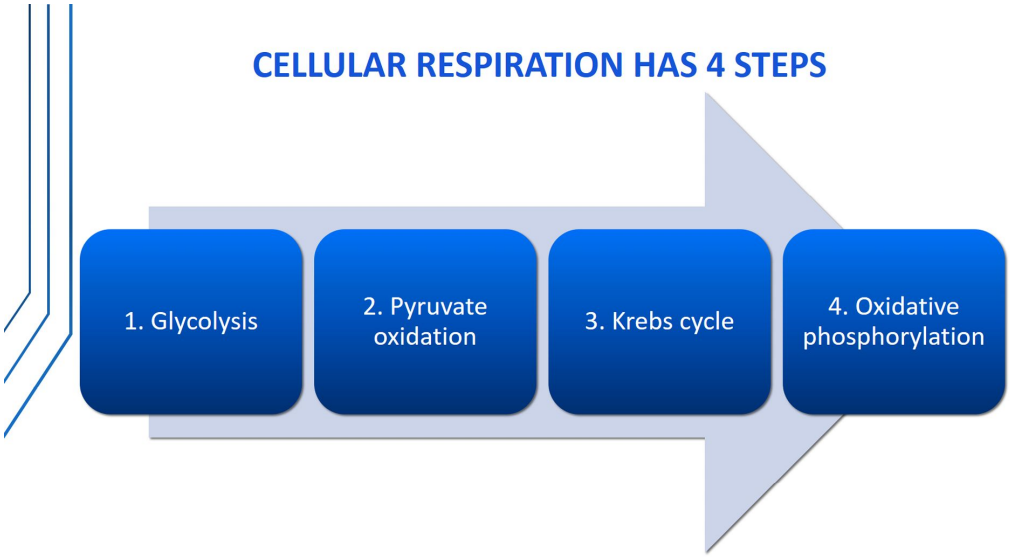
Thus, this lack of red and near-infrared light today impacts every organ and tissue in our bodies—because every cell in our organs, tissues, skin, heart, liver, lungs—all contain mitochondria. This gives our heart energy to beat, our skin the energy to synthesize collagen more efficiently, our liver energy to detoxify, and so forth.

To understand the detailed mechanisms of how red and near-infrared light actually enhance mitochondria, you need a basic understanding of how our cells produce energy.

We produce ATP by going through a cycle of something called "cellular respiration"—which is what gives us energy to do anything. It gives our body energy to chew, breathe, sweat, produce hormones—everything.

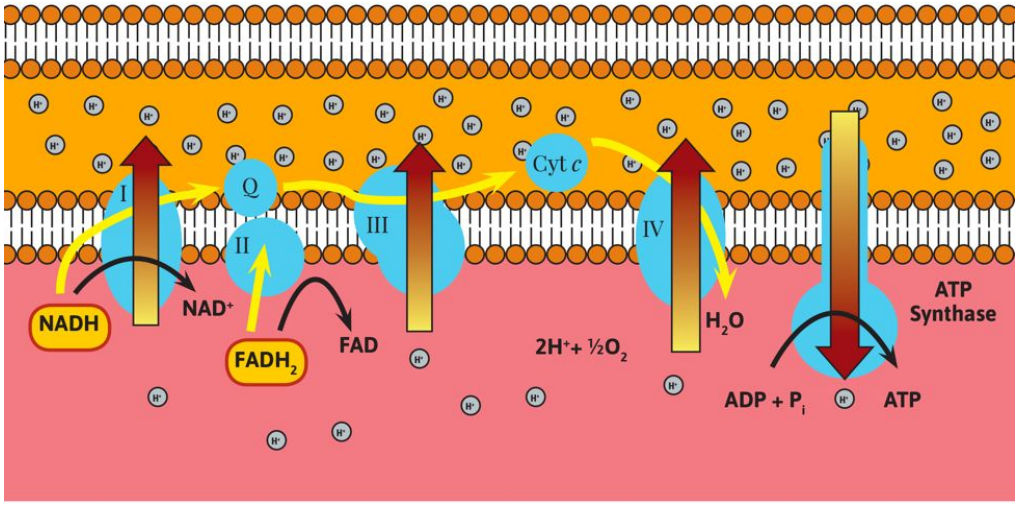
Cellular respiration has 4 steps:

1. **Glycolysis** (this the first step in cell respiration, which is the conversion of glucose/sugar to pyruvate)
2. **Pyruvate Oxidation** (the next step in converting glucose to ATP, which entails converting pyruvate to acetyl-CoA, to enable ATP to be manufactured)
3. **Krebs Cycle** (this uses acetyl-CoA to generate a pool of chemical energy substances, ATP, NADH, FADH2)
4. **Oxidative Phosphorylation** (the last step in ATP production, where the mitochondria use the chemicals produced in the Krebs cycle to pump out ATP)



This last stage, oxidative phosphorylation, is the when red light (red and near-infrared light) does most of its magic.

There is a crucial step in the production of ATP, when electrons pass through the electron transport chain (ETC) in the mitochondria.



As these electrons travel down this chain, protons are pumped across the inner mitochondrial membrane into the space between the inner and outer mitochondrial membrane. This forms a gradient across the membrane, which in chemistry and physics has what's called "potential energy" since substances at a high concentration will be driven to move towards lower concentration.

And sure enough, the mitochondria harness this potential energy—as the proton moves back across the membrane to lower concentration, it passes through a little rotating motor called “ATP synthase” which uses the energy of the proton moving across the membrane to power the process of producing ATP (cellular energy).

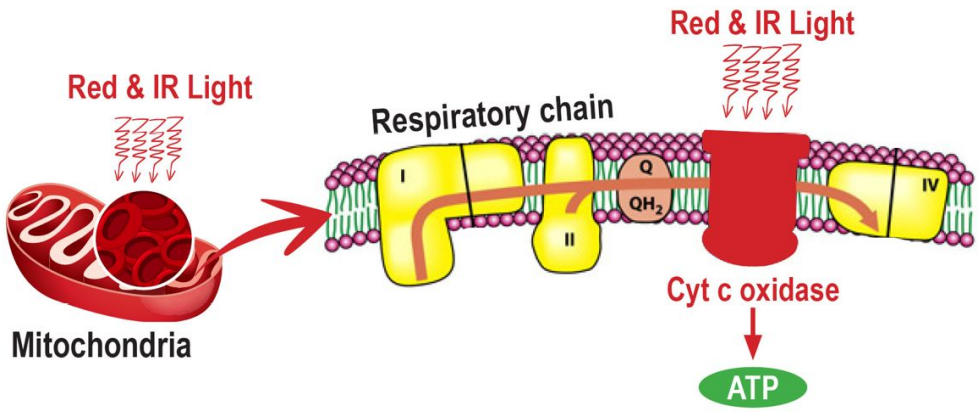
One of the key parts of this energy production in our mitochondria is a photoreceptor—cytochrome c oxidase—that helps oxygen be used efficiently by the mitochondria to power the ATP synthase pump.

A “photoreceptor” is something that absorbs light photons.

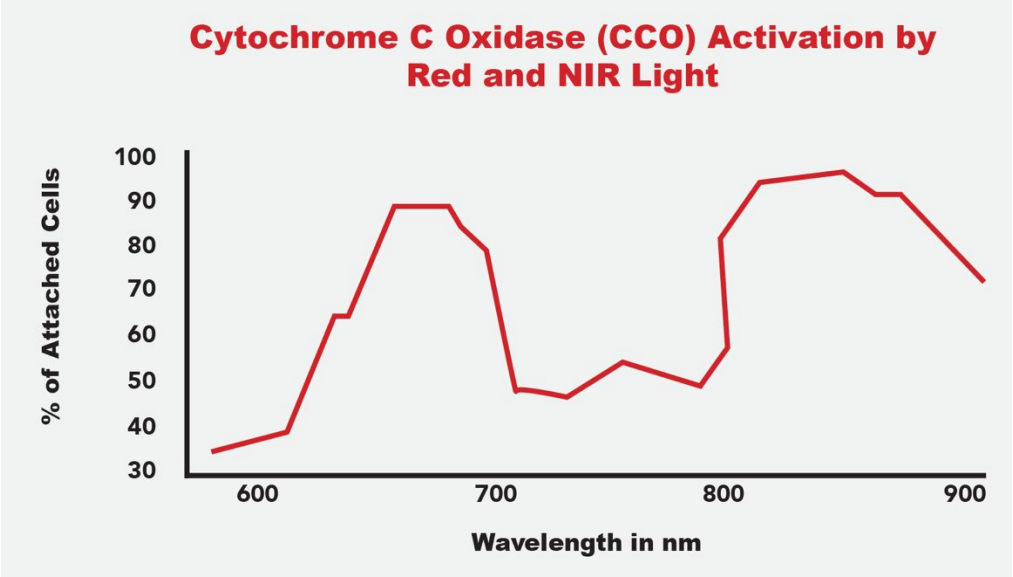
The first law of photobiology states that for light to have any effect on a living cell or body, the photons of light must be absorbed by something in that organism/cell. It turns out that there are indeed such things in many different organisms from plants to humans. It is well known by virtually everyone that plants have such a light photon absorber—chlorophyll, which is a “chromophore” light photon acceptor that turns photons into energy that the plant can utilize. What is not well known by most people is that *humans* also have light absorbing compounds (chromophores or photoacceptors) in our cells and our blood—hemoglobin (in your blood cells), cytochrome c oxidase, myoglobin, flavins, flavoproteins, porphyrins, and melanin in your skin (that’s what gives your skin a tan). (Side note: It turns out that even plain old water—including the water that fills our cells—is also a photoacceptor that absorbs certain wavelengths of light.)

And it turns out that many of these light absorbing compounds in our bodies have been verified by research to absorb certain wavelengths of light, and translate that light into various biological effects.

When it comes to red/NIR, the photoacceptor cytochrome c oxidase in our mitochondria is of particular importance.



Cytochrome c oxidase is part of the respiratory chain in our mitochondria that plays a key role in producing ATP (cellular energy). When red and near-infrared light photons hit the photoacceptor cytochrome c oxidase, it helps the mitochondria use oxygen more efficiently to produce ATP.



If all of this seems complex, let me simplify: Mitochondria need this little enzyme called cytochrome c oxidase to bind efficiently with oxygen to produce cellular energy (ATP) efficiently, and red and near-infrared light help make that happen.

Cytochrome c oxidase and oxygen working together well means good things are happening—energy production and cellular respiration—which yields energy for the body and all its functions.

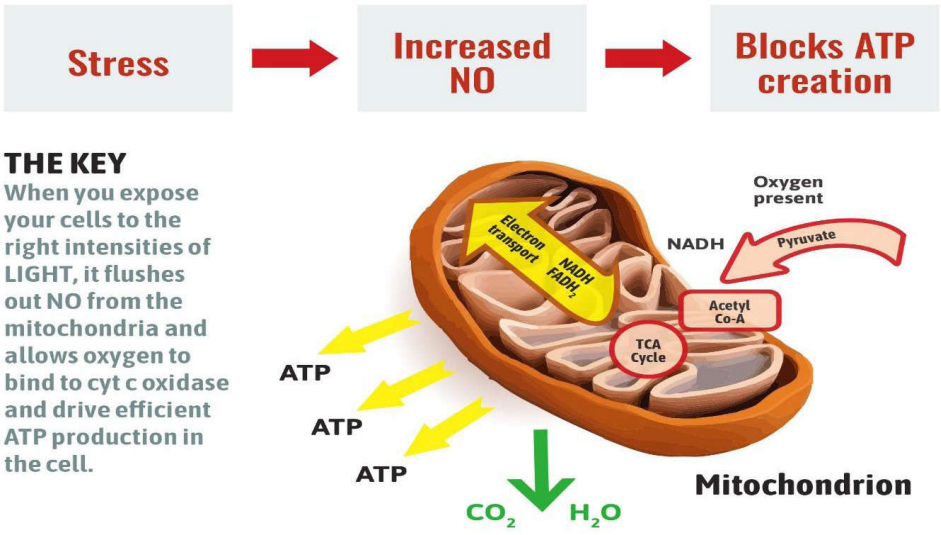
When cells are functioning poorly—**which most human's cells are today** because we live a life full of stressors, like job stress, toxins like BPA and pesticides and heavy metals in our food, too much artificial light at night, and air pollution (among others)—these toxic impacts hinder our cells' ability to produce energy.

While the exact mechanisms are still debated, many researchers (including Dr. Michael Hamblin) believe that nitric oxide (NO) plays a central role.[33,34]

NO of course plays many vital roles in the body, but when we have too much of it, too much in the wrong place, or when our cells don't have the antioxidant capacity to quell the buildup of NO, it can hinder ATP from being manufactured in the mitochondria.[35]

How?

Well, nitric oxide begins to compete with oxygen in the mitochondria.



In fact, NO binds with cytochrome c—preventing it from binding with oxygen. It basically blocks the oxygen from being used by the mitochondria. Because of this, the NO inhibits efficient ATP production.

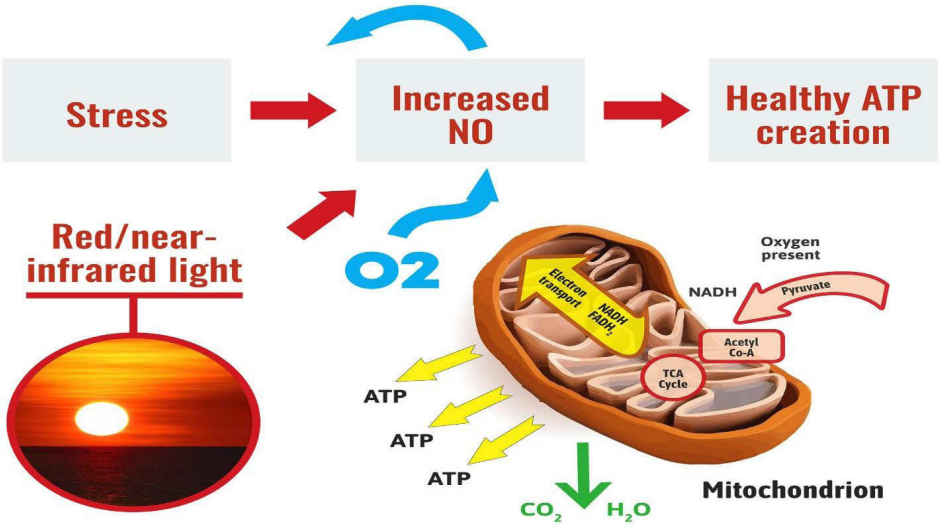
Mitochondria cannot generate ATP efficiently without oxygen. So anything that slows oxygen from being

utilized by the mitochondria will slow energy production dramatically.

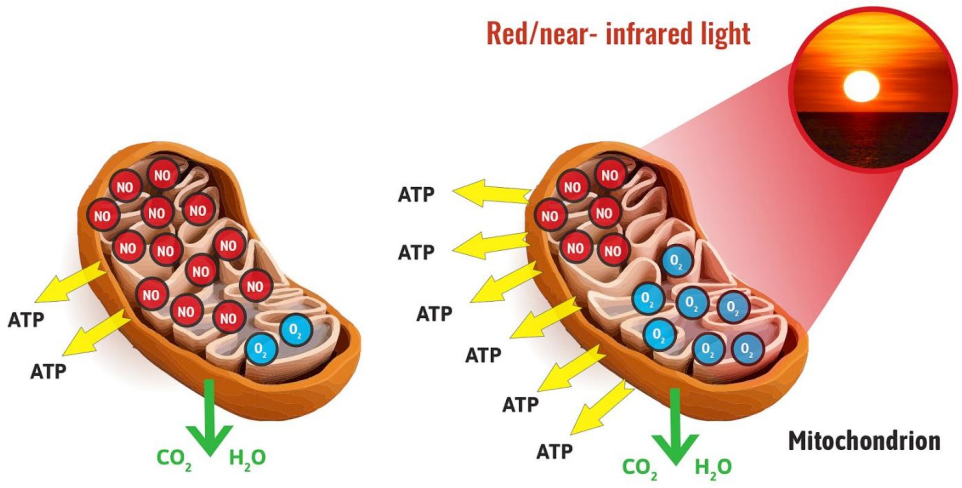
Therefore, in unhealthy cells, nitric oxide prevents cytochrome c from getting enough oxygen molecules. This hinders ATP production, which is a recipe for poor mitochondrial function, and thus, poor cellular function.

As shown by several research groups around the world, red and near-infrared light essentially prevents this pairing of NO with cytochrome c oxidase. It knocks the NO out and lets the oxygen in!

This allows cytochrome c to have its oxygen molecules and thus, allows for efficient mitochondrial function.



This image gives the basic idea of a mitochondria with too much NO that is not producing ATP efficiently, and how red/NIR light al-lows more oxygen in, to allow the mitochondria to produce more ATP:



To have great mitochondrial function, we want to kick out the NO from the mitochondria and get the oxygen in.

This means oxygen can once again be utilized efficiently by the mitochondria, which then allows mitochondria to produce energy efficiently.

This is explained in more detail on the mechanisms by Farivar et al.:

> "The activity of cytochrome c oxidase is inhibited by nitric oxide (NO). This inhibition can be explained by a direct competition between NO and O2 for the reduced binuclear center CuB/a3 of cytochrome c oxidase, and is reversible. It was proposed that laser irradiation could reverse this inhibition by photodissociating NO from its binding sites. Because this coordinate binding is much weaker than a covalent bond, this dissociation is possible by LLL (low-level light). The dissociation of NO from Cox increases the respiration rate. Light can indeed reverse the inhibition caused by NO binding to cytochrome oxidase, both in isolated mitochondria and in whole cells. LLL can also protect cells against NO-induced cell death."[36]

In essence, red and near-infrared light therapy allow oxygen into the mitochondria (and prevent NO from halting energy production), which boosts mitochondrial function and improves the health of every organ and system in our body.

I should add here that, to some extent, the nuances of all of the exact mechanisms of how red/NIR light affect mitochondria are still debated amongst researchers, but **everyone is in agreement that red/NIR light does indeed increase mitochondrial energy production**.[37]

Also note that this cytochrome c pathway may not be the only way that red/NIR light increases cellular energy production. There are several more potential mechanisms by which red/NIR light can increase mitochondrial energy production that are described below—including increasing the size and number of mitochondria through hormesis, and more speculative theoretical mechanisms of how this type of light may interact with water in our cells and chlorophyll metabolites. See the section below on "potential mechanisms" for more on the evidence on ways that red/NIR light may potentially affect our cells.

This appears to be the major mechanism that drives many of the beneficial effects associated with red/NIR light on skin, muscles, bone, glands, and brain cells. In short, when mitochondria are stimulated, the cell produces more energy, and when the cell has more energy available, it essentially does everything better—heals faster, is more resistant to stress, produces more proteins (e.g. collagen) and performs better (e.g. muscular performance). Mitochondrial energy production is the heart of all optimal cell function.

Mechanism #2: Hormesis

Another key mechanism for how red and near-infrared light therapy work is through hormesis. Hormesis is the process by which a transient metabolic stressor stimulates adaptations that actually improve health. This may sound like an odd concept at first, but you're more familiar with it than you realize—exercise is a type of hormesis. Exercise works by transiently creating metabolic stress—stressing out the body (workouts are hard work!) and temporarily increasing reactive oxygen species, a.k.a. free radicals—and then in response to that stress, the body adapts to it with things like improved

cardiovascular efficiency, improved blood delivery to the muscles, and by strengthening and growing the mitochondria. It also involves downregulating the genes involved in chronic inflammation and oxidative stress (two keys drivers of aging and disease), and upregulating the genes involved in energy production and the internal cellular antioxidant defense system.

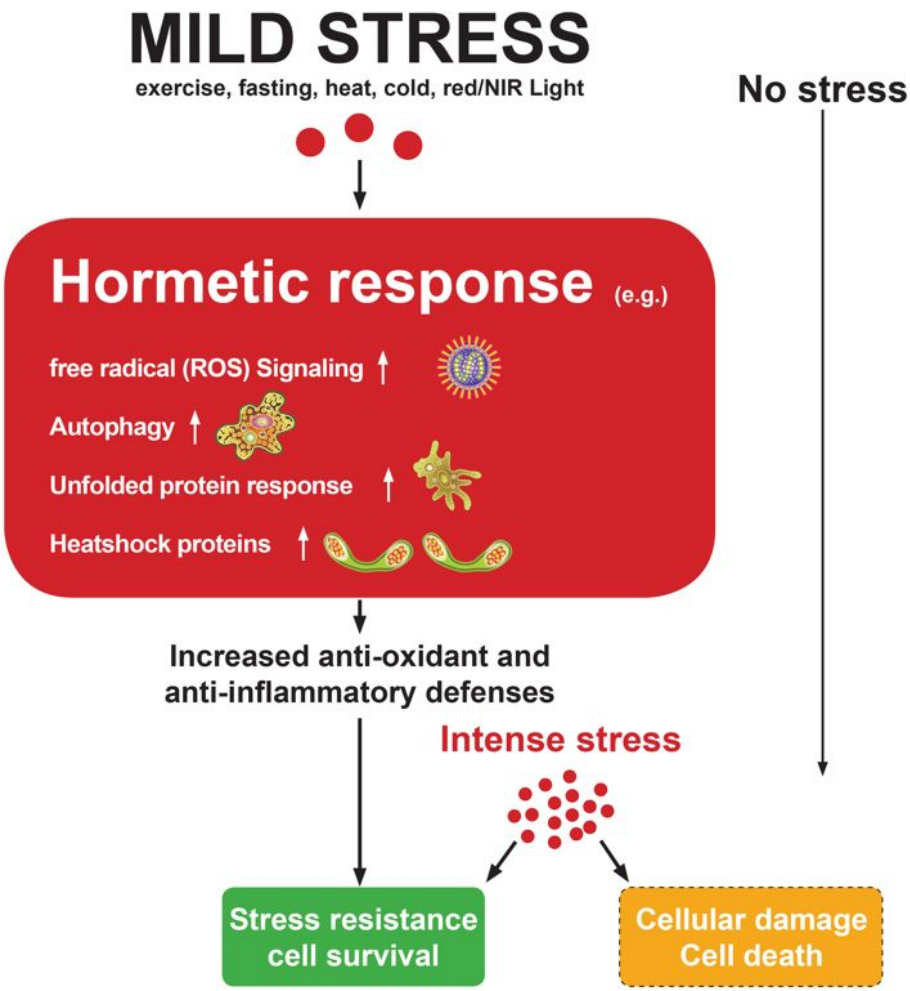
The mitochondria get temporarily stressed in a way that causes them to send signals back to the nucleus of the cell (which contains your DNA), and these signals are literally used by the nucleus to determine what genes should be expressed. This is called "retrograde signaling." It's a remarkable phenomenon, because most people think that our genes do all the dictating of what happens in our cells. In fact, mitochondria generate signals (based on the environment) that signal back to the nucleus which genes to switch on and off!

In particular, the transient increases in ROS (free radicals) from red/NIR light activates many of the same cell defense systems that exercise does. The transcription factor NF-kB is activated through exposure to free radicals generated by red and near-infrared light, which promotes a very low level inflammatory response. This then engages a mechanism called the NRF2 pathway and the Antioxidant Response Element (A.R.E.)—our internal cellular antioxidant defense system—which helps put out the fire by eliminating the inflammation and free radicals. In short, in much the same way that exercise builds your muscles stronger by temporarily stressing them, light does the same thing to our internal anti-oxidant and anti-inflammatory defense system. It helps make your cells more tolerant to stress, combats inflammation, helps prevent the buildup of free radicals, and ultimately makes your cells healthier, more energetic, and more resilient.

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

Light serves a transient low-level stress to your cells. The end result of these cellular adaptations to the temporary

stress is *healthier* cells that produce more energy, have a stronger anti-oxidant and anti-inflammatory defense system, and are more resilient to overall stress.



This is the same way that exercise makes us healthier. Red and near-infrared light therapy also work by temporarily creating an increase in metabolic stress and increasing reactive oxygen species (free radicals), just like exercise.[38] In that sense, some researchers have called it an "exercise mimetic" because it mimics some of the same effects of exercise. (As you'll see in a later section, research shows that it also combines well with exercise and amplifies the benefits on fat loss and muscle gain). So red and near-infrared light therapy also are a form of 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 stimulates your body making *lasting* adaptations at the cellular level that lead to more resilience against stressors and a greater capacity to produce energy.

Potential Mechanisms

In addition to these—what I consider to be the two most important general mechanisms—there are a couple of other fascinating potential mechanisms for how red/NIR light works inside our bodies. Some of these potential mechanisms may even revolutionize our understanding of human biology and how our cells produce energy. (I list these as "potential mechanisms" because we have some evidence for them, but not enough yet for there to be a consensus within the scientific community that they are "proven." Further studies are still needed for widespread acceptance of these physiological mechanisms, but they are incredibly exciting nonetheless!)

Potential Mechanism #1: Interacts with water in our cells to produce more energy.

Water itself is a photoacceptor. That means that water can actually absorb the energy from some wavelengths of light—including wavelengths in the red and near-infrared spectrum.

This may not be such a trivial fact.

Why?

Water fills our cells. While many people think of our cells as just bags of inert water—just a place for chemical reactions of other compounds to take place—this may in fact not be accurate. The water in our cells itself may be impacted by the light exposure in a way that affects cell function. That is, the water itself may have much more biological activity than we have previously thought.

Researchers have found that when water that is next to surfaces that are biochemically similar to structures in our cells, is exposed to red/NIR light, it literally changes the viscosity of water. The water literally changes in "thickness" and "wetness."

Think of it like this. Imagine swimming through a pool of water vs. swimming through a pool of Jell-O.

It's a heck of a lot easier to swim through regular water than through Jell-O, right?

The point is that things that are surrounded by liquid which need to move, will likely function a whole lot better if the liquid that surrounds them is not giving a lot of resistance. That's the basic idea here.

A 2015 study published in *Scientific Reports* titled "*Light Effect on Water Viscosity: Implication for ATP Biosynthesis"* suggests this may be exactly what is going on inside our mitochondria.

The researchers suggested that if this change in water viscosity occurs inside our cells, which is probable according to many experts—may allow the physical rotation of the ATP synthase pump on the mitochondria (the little motor on the mitochondria that actually pumps out cellular energy) to operate more efficiently.[39] (Side note: This is likely related to Gerald Pollack, PhD's work on the "fourth phase" of water, which he has written a book on and done several interviews and TED talks that can be found on YouTube).

To some extent, much of this has in fact already been demonstrated—that light does in fact affect water viscosity when next to surfaces that are ostensibly similar to cellular membrane surfaces, and that light increases ATP production. But as explained earlier, the conventional explanation for this is solely that red/NIR light impact the mitochondrial respiratory chain components (e.g. cytochrome c oxidase). Based on their findings, the researchers of this 2015 study suggest that it may be due (partly or mostly) to how light affects the water viscosity in the mitochondria and allows for easier rotation of the ATP synthase pump.

The researchers of this 2015 study summarized their findings by saying:

> "Thus, we feel justified to assume that the [red/NIR] irradiation upregulates ATP turnover by reducing the viscosity of the nanoscopic interfacial water layers which seem to control the efficiency of the mitochondrial nanomotor. The insight deduced from our laboratory experiments is expected to allow the improvement of the present theories and hypotheses of light-induced ATP synthesis, and promises to enhance the predictive capability of existing models. Explicitly, realistic models designed to explore the functioning of ATP synthase may have to consider interfacial viscosity gradients, within and around the nanoturbine [the ATP synthase pump]. This aspect is of considerable biological interest and may lead to a shift in the paradigm of ATP synthesis."[40]

In short, the idea here is that red/NIR light penetrates cells and makes the water thinner and more slippery, so the little ATP motor in the mitochondria rotates with less friction and ultimately pumps out more energy. Again, this is a potential mechanism still, and we need more research to know for sure if this is in fact a major mechanism of action. But it's pretty exciting to think of these possibilities!

Potential Mechanism #2: Interacts with chlorophyll in our cells to help our mitochondria produce more energy.

For most of the history of biology, plants and animals have been thought of as autotrophs and heterotrophs, respectively.

"Autotrophs" are those organisms which provide their own food sources. Plants do this by capturing sunlight and doing a process called photosynthesis. (Carbon dioxide + Water → Carbohydrates + Oxygen)

"Heterotrophs" are organisms which consume other organisms for food. Thus, whether animals are herbivores, omnivores or carnivores, they are eating other organisms to acquire their energy.

For most of biology, we have generally classified organisms into these categories. But with some exceptions we have called "photoheterotrophs" or "mixotrophs." Most corals, for example, can both synthesize energy from sunlight as well as consume organisms like plankton. Another example is the Venus flytrap and other insect-eating plants that can derive energy both from sunlight and from the organisms they consume. More examples include some types of non-sulfur bacteria, heliobacteria, many types of plankton, and even many types of insects.

But of course, humans have always been conceptualized as purely "heterotrophs." We need to eat plants and animals of various kinds to get our energy.

Yet, I have already explained that hundreds of studies have now found that human cells—the mitochondria in our cells—*do actually produce more ATP when exposed to red/NIR light!*

And it even goes further than that…

A recent study has actually found that other organisms—including mammals that are biologically very similar to humans (like rodents and pigs)—have now been shown to be capable of taking up chlorophyll metabolites into their mitochondria, and using those metabolites to capture sunlight energy and amplify cellular energy production! The research suggests that some animals can use these chlorophyll metabolites to speed up the rate of energy production and increase the overall volume of ATP produced by fairly large amounts in many cases.

This revolutionary discovery was published in 2014 in the Journal of Cell Science in a study titled "**Light-harvesting chlorophyll pigments enable mammalian mitochondria to capture photonic energy and produce ATP**."

Here is a chunk of the abstract from this fascinating study, where researchers succinctly summarized their findings:

> "Sunlight is the most abundant energy source on this planet. However, the ability to convert sunlight into biological energy in the form of adenosine-59-triphosphate (ATP) is thought to be limited to chlorophyll-containing chloroplasts in photosynthetic organisms. **Here we show that mammalian mitochondria can also capture light and synthesize ATP when mixed with a light-capturing metabolite of chlorophyll**."[41]

So how do light and chlorophyll interact in our cells to help our mitochondria produce more energy?

Specifically, it appears that chlorophyll metabolites and light may have some synergy that affects one of the key players in mitochondrial energy production—CoQ10.

A 2013 study titled "Dietary chlorophyll metabolites catalyze the photoreduction of plasma ubiquinone" found something remarkable.

First, you need to understand a bit about how CoQ10 works in our cells. CoQ10 is often thought of as simply an "antioxidant," but it is much more than that—it does many things that go far beyond just neutralizing free radicals. In particular, it acts to facilitate electron transfer in mitochondria to allow energy production. Now, in order for CoQ10 to do its work of facilitating mitochondrial energy production, it has to be constantly "regenerated" from its oxidized form (ubiquinone) to its active form (ubiquinol). When much of the CoQ10 is being oxidized, but it's not being efficiently converted back into ubiquinol, we get problems. We accumulate ubiquinone and our ubiquinol stores are low. (In fact, CoQ10 deficiencies are very common. And that's why there is so much positive research around CoQ10 supplementation.)

But what if the reason our CoQ10 stores (especially ubiquinol) are decreased in the first place is actually a deficiency in sunlight exposure and chlorophyll consumption?

These researchers took dietary chlorophyll metabolites (compounds that our bodies actually make when we

consume dietary chlorophyll) and mixed it with some CoQ10 in ubiquinone form.

Then they exposed the chlorophyll metabolite and CoQ10 solution to red light…

Guess what happened?

The ubiquinone form of Coq10 was regenerated into ubiquinol CoQ10!

But without the chlorophyll metabolites or the red light, no ubiquinone gets converted to ubiquinol!

Pretty damn amazing, right?!

It turns out that light can actually interact with chlorophyll metabolites in a way that leads to the regeneration of CoQ10!

What kind of light has this effect?

Well, as luck (or biological design) would have it, it's the kind of light that penetrates deep into our body—red/NIR light. (Remember, most light only gets absorbed at the skin, but red/NIR light can penetrate beyond the skin, deep into our body.) In short, this research suggests that we are in fact designed by nature in such a way that the wavelengths of light that happen to penetrate deeply into human tissues are biologically active in human cells, and do a lot of amazing things—including, interacting with chlorophyll metabolites and helping to regenerate the active form of CoQ10.

The researchers of this study suggest that red/NIR light and chlorophyll may in fact be the key players in helping our cells maintain the proper ratio of ubiquinone to ubiquinol.

But you might be wondering "Can't this only affect the cells that light can penetrate into? And since red/NIR light can only penetrate a couple inches into the body, this wouldn't affect all the cells of our body deeper than that, right?"

Interestingly, it turns out that ubiquinol can be carried in our bloodstream. So theoretically, the ubiquinol that cells produce could be carried to cells throughout the

entire body via the bloodstream. Hence the light may have effects on all the cells of the body, not just the cells that light can penetrate directly.

In the words of the researchers of this remarkable study:

> "The mechanisms responsible for maintenance of plasma ubiquinol are poorly understood. Here, we show that metabolites of chlorophyll can be found in blood plasma of animals that are given a chlorophyll-rich diet. We also show that these metabolites catalyze the reduction of plasma ubiquinone to ubiquinol in the presence of ambient light, in vitro. We propose that dietary chlorophyll or its metabolites, together with light exposure, regulate plasma redox status [the balance of oxidants to antioxidants] through maintaining the ubiquinol pool."[42]

And here is the astounding conclusion from these researchers of the previously mentioned chlorophyll study:

> "Both increased sun exposure and the consumption of green vegetables are correlated with better overall health outcomes in a variety of diseases of aging. These benefits are commonly attributed to an increase in vitamin D from sunlight exposure and consumption of antioxidants from green vegetables. Our work suggests these explanations might be incomplete. Sunlight is the most abundant energy source on this planet. Throughout mammalian evolution, the internal organs of most animals, including humans, have been bathed in photonic energy from the sun. Do animals have metabolic pathways that enable them to take greater advantage of this abundant energy source? The demonstration that: (1) light-sensitive chlorophyll-type molecules are sequestered into animal tissues; (2) in the presence of the chlorophyll metabolite P-a, there is an increase in ATP in isolated animal mitochondria, tissue homogenates and in C. elegans [roundworms], upon exposure to light of wavelengths absorbed by P-a; and (3) in the

> presence of P-a, light alters fundamental biology resulting in up to a 17% extension of life span in C. elegans suggests that, **similarly to plants and photosynthetic organisms, animals also possess metabolic pathways to derive energy directly from sunlight.**"[43]

I must say that I personally found these studies to be some of the most exciting and potentially revolutionary studies I have read in years! Who would've thought that human cells have the ability to use chlorophyll to capture energy from sunlight?

A quick funny story: When I was in high school 20 some years ago, I had a biology teacher who everyone thought was totally nuts, because she would drink vegetable juices and then go lay in the sun. She was convinced that there was some synergy between consuming the chlorophyll and exposing her body to the sunlight.

We used to joke around that our crazy biology teacher thought she was a plant and that she could photosynthesize! We thought the whole idea was total nonsense and that she was crazy.

But hey, 20 years later, it turns out that maybe she was onto something after all! Human mitochondria may in fact have the ability to use dietary chlorophyll metabolites and red/NIR light to more efficiently produce energy!

Mechanisms Summary

In short, it is clear that humans can indeed harness sunlight energy and translate it into energy production by our mitochondria—either through the conventional cytochrome c pathway (the widely accepted pathway), or through how light affects water viscosity and the ability of mitochondria to pump out ATP, or by using chlorophyll metabolites to more efficiently produce energy, or through increased production of CoQ10 in the mitochondria, or perhaps through some combination of all of these mechanisms. More research is certainly needed to confirm these speculative pathways, but they

are certainly fascinating to think about, and if proven, they have the potential to revolutionize our understanding of human biology.

Now let's move away from the more speculative mechanisms and cutting-edge research, and get back to the scientific consensus...

The bottom line here is that we have scientific evidence for several mechanisms of how red and near-infrared light therapy enhance mitochondrial energy production and overall cell function.

In essence, what this all boils down to is that red and near-infrared light therapy help mitochondria produce more energy, decrease inflammation, and help build the cell defense systems to increase resiliency.

But as mentioned above in the list of factors known to be affected by red/NIR light, there are also many other mechanisms of action of red and near-infrared light therapy which researchers are still elucidating. It is likely that other effects on specific compounds (e.g. BDNF, cAMP, nitric oxide, etc.), on stem cells,[44] on hormones,[45,46] DNA repair,[47] or some other specific effects on gene expression[48,49,50] also play a role in mediating many of the positive effects of red/NIR light therapy.

The truth is that it's possible to get endlessly complex and nuanced about all the different molecular and biochemical pathways involved. An entire textbook could be written on the various pathways. (And that's acknowledging that many of the mechanisms are still being elucidated, and some may even yet to be discovered.) One study gave a nice brief encapsulation of the mechanisms by saying:

> "During near-infrared phototherapy, absorption of red or near-infrared photons by COX (cytochrome c oxidase) in the mitochondrial respiratory chain causes secondary molecular and cellular events, including activation of second messenger pathways, changes in NO levels, and growth factor production.

> NILT (near-infrared light therapy) leads to the reduction of excitotoxicity, the production of neurotrophic factors, the modulation of ROS, the transcription of new gene products with protective or pro-proliferative properties, and the release of numerous growth factors for neurons and other cells. near-infrared appears to initiate a cascade of subcellular events which can yield immediate, delayed, and persistent beneficial changes in the injured neuron or other cell."[51]

So the reality is that there are dozens of signaling pathways in the cell and between cells that are affected by red/NIR light. But again, to simplify all this, most experts agree that the primary mechanism of action is how it works to increase mitochondrial energy production.

In essence, red and near-infrared light "fires up" this engine of the cell, driving ATP production by the mitochondria. And since everything cells do depend on energy supplied by the mitochondria, red light and near-infrared light therapy have been linked with a wide range of amazing benefits:

- Anti-aging effects in the skin (enhancing collagen synthesis, production, and elastin production for youthful skin and dramatically reducing cellulite) [52]
- Lowering inflammation
- Enhancing fat loss[53]
- Enhancing physical performance and muscle recovery afterward[54]
- Boosting testosterone[55]
- Speeding wound healing[56]
- Spurring neurogenesis in the human brain, strengthening synapses, spurring brain cell growth[57]
- Helping prevent cognitive decline[58]

- Reducing waist circumference and liberating fat from cells so it can be burned again[59]
- Enhancing physical performance and muscle recovery afterward[60]
- Enhancing fertility[61]
- Combatting gingivitis and promoting healthy gums[62]
- Enhancing stem cell implantation and proliferation[63]
- Enhancing gland health from the thyroid to the lymphatic system
- Clearing skin for sufferers of acne, rosacea, eczema, psoriasis[64]
- Improving eye health[65]
- Fighting chronic fatigue and fibromyalgia[66,67,68]
- Potentially helping the body to fight cancer (in tandem with chemotherapy)[69]
- Removing wrinkles, lines, and veins on the surface of the skin[70]
- Increasing energy
- Improving the appearance of scars[71]
- Killing pain[72]
- Protecting cells against damage from stress[73]

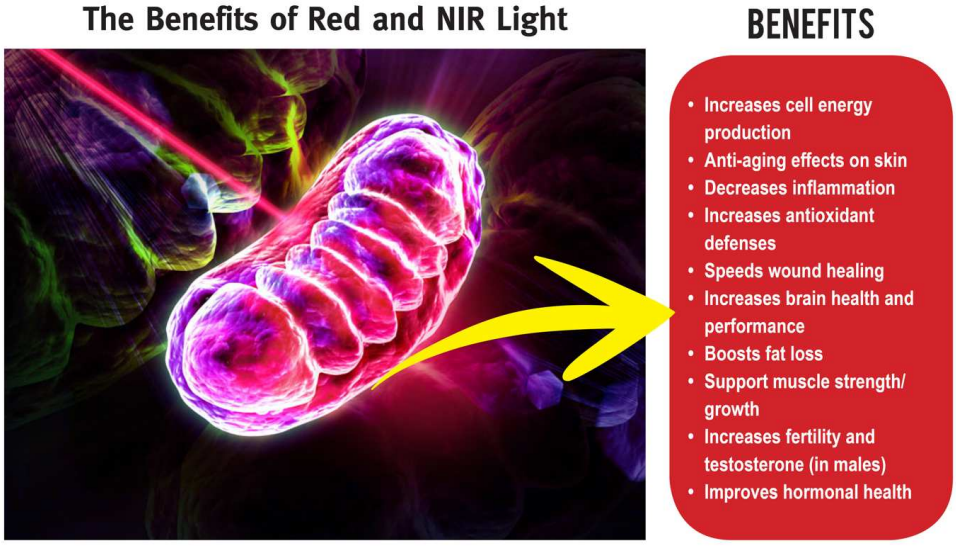
This list might seem too good to be true. How could one technology benefit so many totally different types of conditions?

It almost seems to claim that it's a panacea. So it's only natural to express skepticism.

Yet, the reason it can benefit all these radically different conditions is actually quite simple: **The health of every organ and every cell in the body depends on the energy being produced by the mitochondria in those cells. Thus, because red/NIR light therapy work to enhance**

mitochondrial energy production in essentially *every* type of cell in the body, it can enhance the cellular processes and cellular health of potentially almost every type of cell in the body.

In essence, the basic principle is this: Whatever cells you shine it on—whether muscle, skin, gland, or brain—those cells will work *better* when the mitochondria in those cells are producing more energy.



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Benefits of Red and Near-Infrared Light Therapy

Today, research into the power of red light to improve health and treat disease is really gaining momentum. We are learning that red and near-infrared light therapy can benefit virtually every system of the body and can even improve the way you look—it can help you to shed inches of fat, reduce the signs of aging, regrow hair, increase the results you get from your workouts, reduce pain, speed healing, boost hormonal health, and lower inflammation.

So now, let's talk about the specific benefits of red and near-infrared light that have been shown in studies. Here are the major benefits that have been proven by scientific research for red and near-infrared light therapy:

Reverse Skin Aging and Get Youthful Skin with Red Light Therapy and Near-Infrared Light Therapy

Red and near infrared light are working wonders in the anti-aging communities, and dermatologists and plastic surgeons, even dentists who do Botox and other treatments are capitalizing on the incredible powers of red light for anti-aging.

Because red light stimulates both collagen and elastin production, eradicates lines and wrinkles, as well as the appearance of scars, surface varicose veins, acne, and cellulite, red light therapy is fast becoming recognized as a safe and welcome alternative to injections and surgeries for anti-aging and skin rejuvenation.

Collagen is important—not just for giving us youthful skin and helping us avoid that saggy "schnauzer" look around the neck and jowls—collagen is needed to keep the *entire* body youthful, resilient, strong, and vital. In fact, collagen is the most abundant protein in the entire body. Even more important than what we can see on the

surface, collagen is also what gives our muscles, skin, blood vessels, bones, and digestive system the healthy tissues that they need to keep us strong and free from disease. In some schools of medicine popular in Europe, physicians put a lot of emphasis on keeping the "extracellular matrix" (the fibrous skeleton that surrounds and supports our cells) healthy, and dysfunction in the extracellular matrix is seen as a major source of disease. Why is this important? Because collagen is an integral part of the extracellular matrix, and red and near-infrared light are integral in supporting the collagen networks of our body.[74] Supporting the health of your extracellular matrix may very well turn out to be far more vital for overall health than we currently understand.

Red and near-infrared light therapy has been widely researched and is a proven anti-aging, skin improvement tool that brings numerous positive effects to facial skin and skin all over the body. Repairing damage from UV rays requires that skin be able to repair cellular and DNA damage, much as it does when healing from wounds. Red light does this extremely well through stimulating collagen synthesis and fibroblast formation, anti-inflammatory action, stimulation of energy production in mitochondria, and even stimulating DNA repair.[75]

A wealth of human studies is proving red and near-infrared light therapy can reverse the signs of aging, repair damage from UV rays, and reduce the appearance of lines, wrinkles, and even hard to remove scars.

A 2013 issue of *Seminars in Cutaneous Medicine and Surgery* featured a review of the research that highlighted dozens of studies proving red and near-infrared light therapy can reduce the signs of aging.[76]

Another review of the research by Harvard professor Michael Hamblin, PhD has found that red and near-infrared light therapy can:

- reduce the signs of damage, DNA damage, [77] and aging from UV rays[78]
- reduce wrinkles[79]

- reduce color patches, hyperpigmentation, and skin discoloration[80]
- enhance collagen synthesis and collagen density (research has shown it can enhance production of collagen by 31%)[81,82]
- accelerate repair in the epithelial layer of skin[83]
- combat other skin conditions like acne, keloids, vitiligo, burns, herpes virus sores, and psoriasis[84]
- speed wound healing by enhancing skin tissue repair and growth of skin cells[85]

In short, red and near-infrared light therapy is offering a new, completely safe and non-invasive alternative to various anti-aging skin surgeries, Botox injections, and more abrasive chemical peels. For combating skin aging, red and near-infrared light is an extraordinarily powerful tool.

Slow Hair Loss and Re-Grow Hair with Red and Near-Infrared Light Therapy

Red light has also been shown to help with certain types of hair loss. Red light has proven to help both women and men with various conditions to regrow hair and even thicken the diameter of individual hair strands. Red and near-infrared light therapy has proven to help women

with alopecia to significantly regrow and thicken hair.[86] Red and near-infrared light therapy has also proven to regrow hair in men with hair loss in several studies.[87,88,89,90,91]

To get a little more detailed on the mechanisms, basically hair growth takes place in several phases:

- Anagen—growth phase
- Catagen—the hair transitions upwards towards the skin pore
- Telogen—the dermal papillae (are of blood supply) fully separate from the hair follicle. (After 5-6 weeks, the dermal papillae move upward to meet the hair follicles again and the hair matrix starts forming more hair—i.e. to go back to the anagen phase.)

Red and near-infrared light has been shown to help transition hair from the telogen phase back to the anagen phase and prolong the anagen/growth phase. It can also increase the rate of growth in the anagen phase while preventing premature catagen phases.

These effects may be mediated by increases in certain growth factors, of effects on inflammation, improved mitochondrial functioning in the cells in that area, or on nitric oxide levels and blood circulation to the area, or some combination of all these factors.

In short, it helps hair stay in the growth phase, grow more, and re-enter the growth phase (instead of dying off). The end result is less hair loss and more hair growth.

Reduce Cellulite with Red and Near-Infrared Light Therapy

Red light therapy has a profound effect on reducing fat layers and eliminating cellulite.

Cellulite is a problem caused by a combination of unhealthy collagen and elastin in the skin layers,

combined with excess fat accumulation in the fat cells in that area. (The health of the extracellular matrix likely also plays a role.)

Red and near-infrared light therapy actually combat cellulite in three ways:

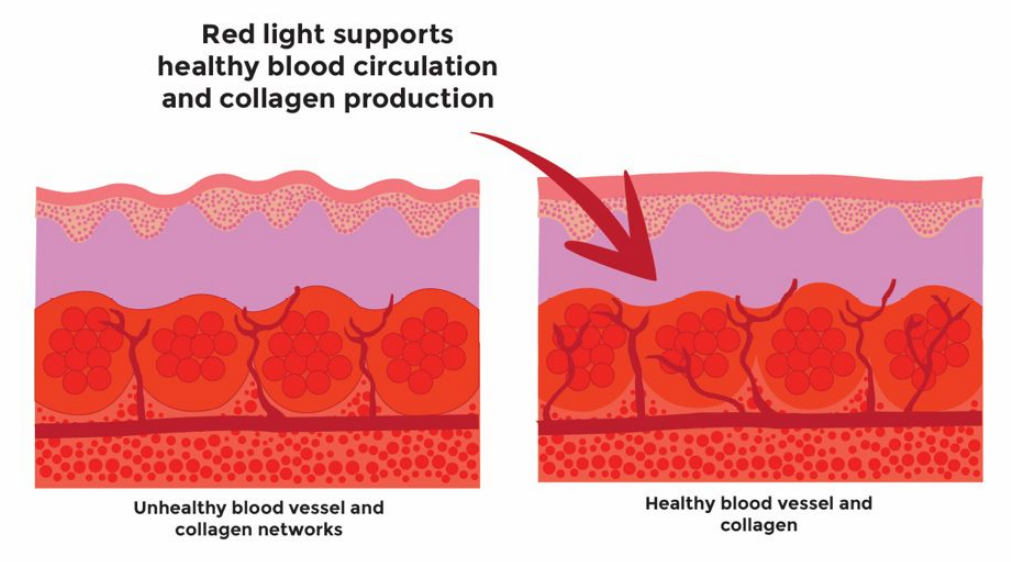
1. By bolstering production of collagen and elastin (and supporting the health of the extracellular matrix—the fibrous support structure around cells).
2. By supporting blood circulation and blood vessel health in the area.
3. By causing fat cells to release their fat contents into the blood where they may be burned off.

One study found that when red and near-infrared light therapy is combined with massage, **it led to an astounding 71% reduction in cellulite**![92]

Another study that assessed the use of red and near-infrared light therapy on skin health found that "***91% of subjects reported improved skin tone, and 82% reported enhanced smoothness of skin in the treatment area.***"[93]

In fact, this is one of the *only* scientifically proven ways to reduce cellulite, and likely, the single most powerful.

(Note: Most creams and products sold to reduce cellulite have little to no scientific evidence of effectiveness.)



Red/NIR light support collagen and elastin production, increased blood vessel health and circulation, and potentially, also fat loss in the area—all leading to enhanced skin smoothness and decreased cellulite.

Speed Up Wound Healing with Red and Near-Infrared Light Therapy

Red and near-infrared light therapy are fantastic for wound healing. This was one of the original findings of the NASA research that really put red light therapy on the map. In fact, red and near-infrared light therapy has been found to help close wounds—even those resistant to healing—20% faster and with less scarring. Red and near-infrared light therapy has also proven to reduce the appearance of facial scars.[94]

It also increases circulation and the formation of new capillaries. Increased circulation and the formation of new capillaries means the wounded area receives more of the oxygen and nutrients it needs to initiate and maintain the marvelous healing process. Red/infrared light accomplishes this in several ways:

- cleaning up dead and damaged skin cells (phagocytosis)
- increasing ATP in skin cells, giving cells more energy to heal themselves
- increasing the production of fibroblasts[95,96]
- increasing blood flow, supplying the wound more oxygen and nutrients needed for repair
- stimulating the production of collagen and the health of the extracellular matrix[97]
- stimulating lymph activity
- stimulating the formation of new connective tissue and blood capillaries on the surface of the wound.[98,99,100,101,102,103,104]

Combat Fibromyalgia and Chronic Fatigue, and Increase Energy Levels with Red and Near-Infrared Light Therapy

Studies show that red light therapy is also effective at restoring energy and vitality in persons suffering with fibromyalgia. Because red light is so effective at reducing inflammation, it is proving effective at treating fibromyalgia, which is partly caused by inflammation in the brain stem/hypothalamus region.[105,106] This same effect would likely also benefit chronic fatigue syndrome (which shares many of the same symptoms as fibromyalgia), though it has not yet been studied.

Red and near-infrared light therapy is very effective for the treatment of fibromyalgia, for virtually all of the most problematic symptoms that accompany fibromyalgia.

Multiple studies have found that red and near-infrared light therapy offers:

- Enhanced quality of life for fibromyalgia patients
- Decreased pain

- Decreased muscle spasm
- Decreased morning stiffness
- Decreased total tender point number in fibromyalgia cases

Research—including a very recent 2017 study—suggests that this therapy method is a safe and effective treatment for fibromyalgia.[107,108,109]

Once you understand the pathways through which red/NIR light works its magic on the human body, it actually makes good sense that red/NIR light would benefit chronic fatigue conditions and increase energy levels. Much research over the last 5 years suggests that **mitochondrial dysfunction, brain function, and inflammation are at the core of chronic fatigue**.[110,111,112,113,114,115] As explained throughout this book, there are hundreds of studies now showing that **red/NIR light therapy has huge benefits to mitochondrial and brain function, and that it powerfully decreases inflammation**. So even though there are only a few studies that have tested this directly thus far, based on a simple understanding of the mechanisms at play and the science that is already known, it is perfectly reasonable to think that red/NIR light has massive potential for helping people struggling with chronic fatigue.

But it's not just "potential!" I've already been using red/NIR light therapy with members of The Energy Blueprint program (which is the system I've developed to help people overcome fatigue) for over 3 years now, and I've had hundreds of people tell me that red/NIR light therapy has been one of the absolute biggest factors in their recovery from chronic fatigue. In short, this stuff really works!

Fight Hashimoto's Hypothyroidism with Red and Near-Infrared Light Therapy

Several studies have shown profound benefits of red and near-infrared light therapy for autoimmune hypothyroidism. This is one of the only treatments that has been shown to potentially reverse (or at least greatly slow the progression of) autoimmune hypothyroidism.

- A recent 2013 randomized, placebo-controlled study in hypothyroid patients demonstrated that in people who got near-infrared light therapy, thyroid function dramatically improved, and remarkably, that thyroid antibody (TPOAb) levels were massively reduced. **Amazingly, 47% of patients were able to stop medication completely!** Moreover, the researchers also followed up 9 months after treatment and found that the effects were still evident![116] They even published a 6-year follow-up, which basically said that even at 6 years, some of the benefits still remained, but periodic sessions were recommended to maintain all benefits.[117] (To be honest, I don't suggest red/NIR light as a one-time treatment that is expected to last long-term. For optimal benefits, most research indicates that sessions be done with red/NIR therapy at least once a week consistently.)
- A 2010 study found that red light therapy helped 38% of study participants reduce their hypothyroid medication dose, with **a whopping 17% being able to stop taking the medication altogether!**[118]
- A 1997 study done in Russia included some data on people with autoimmune hypothyroidism who underwent a thyroid surgery. They found that red/NIR light therapy improved thyroid hormone levels enough that they required, on average, roughly half as much thyroid hormone medication.[119]
- A 2003 study done in the Ukraine showed that red light therapy can decrease thyroid medication needs by 50-75% in people with postsurgical hypothyroidism.[120]

- A 2010 Russian dissertation study gave red light therapy on the thyroid gland to a group of people with hypothyroidism and found that 17% of people could completely get off thyroid medication and 38% could decrease the dose by 25-50µg.[121]
- A 2014 study used the light therapy for 10 sessions with 347 women with subclinical hypothyroidism. At baseline, the average TSH (thyroid stimulating hormone) was 9.1 mIU/L. (Note: Higher TSH is a sign of hypothyroidism). After ten sessions of light therapy, the TSH was normalized in 337 (97%) of these women. Their TSH averaged at 2.2 mIU/L after just 10 light treatments.[122]

While more research is still needed, the existing research is very consistent that red/NIR light therapy has profound beneficial effects on thyroid function. It appears to improve thyroid hormone output, increase blood vessel formation (and thus blood flow) in the thyroid gland, and decrease the progression of the condition through beneficial changes in thyroid gland health and immune system modulation.

I don't want to sound hyperbolic, but these effects are astounding! You'd be hard-pressed to find any other type of therapy in existence that shows anywhere close to this level of improvement in hypothyroidism.

Potentially Combat Cancer Growth with Red and Near-

Infrared Light Therapy—with Caveats

Since red light tends to enhance energy production in whatever cells it's shined on, it was speculated many years ago that it might actually enhance cancer growth.

For this reason, it's probably **not** a good idea to use red light therapy directly on cancerous tumors. (Though there is some research using it in extremely large doses to actually damage tumor cells,[122][123] it is not worth risking the possibility that exposure directly on the tumor could stimulate growth.)

But, according to Michael Hamblin, PhD, using the light on other areas of the body (not directly on the cancerous growth) will likely improve overall outcomes in people with cancer.[124]

For example, a 2004 phase 1 trial in patients with advanced neoplasia demonstrated that red and near-infrared light therapy was safe for clinical use and improved performance status and quality of life. Antitumor activity was observed in 88.23% of patients and remained so in a 10-year follow-up.[125]

These early results from this 2004 trial, combined with a growing body of research, demonstrate that red and near-infrared light therapy can exert strong antitumor effects[126,127,128] and are consistent with experimental and clinical reports from multiple studies that red and near-infrared light therapy exerts anti-cancer and anti-tumor effects.[129,130,131,132] It may also help decrease side-effects of chemotherapy and radiation.

Further studies are needed to confirm that red and near-infrared light therapy is safe and effective for use in treating cancer patients.[133]

WARNING: I do NOT recommend trying this sort of cancer treatment with red/NIR lights at home—it should only be done under the guidance of a physician who knows the proper dosing and administration of the therapy. Again, let me emphasize that none of this is to

be construed as medical advice or as claims to treat or cure any medical condition. As stated above, more research is still needed on this topic. Do not attempt to self-diagnose or treat yourself for any medical condition. The above paragraphs are meant only to educate about experimental research that's been done, not as advice for anyone to treat any condition. If you have any medical condition, follow your doctor's advice.

Increase Bone Healing with Red and Near-Infrared Light Therapy

Studies on animals and humans have found that red and near-infrared light therapy greatly aids in healing breaks, fractures, and bone defects.[134] ATP production is interrupted in broken bones, and cells begin to die from lack of energy. Red and near-infrared light have been shown to:

- Stimulate energy production in the bone cells[135]
- Increase bone growth factors[136]
- Enhance blood vessel formation and blood flow to the affected area[137]
- Modulate inflammation[138]
- Enhance the attachment and production of collagen and procollagen and stimulates growth of bone cells—all of which accelerate the bone repair process[139,140]

Overall, bone irradiated with near-infrared wavelengths shows increased bone formation and collagen deposition.[141] Red and near-infrared light therapy is becoming very popular in all sports where breaks, sprains, and fractures are frequent—from horse racing to football.

Combat Inflammation (and Potentially Inflammation-Related

Diseases) with Red and Near-Infrared Light Therapy

Red and near-infrared light therapy is highly effective in treating chronic inflammation. It suppresses inflammation and production of inflammatory cytokines, and dramatically reduces inflammation throughout the body.

Since chronic inflammation is now being recognized as a major contributor to **most chronic diseases** from heart disease, depression, and cancer, to Alzheimer's and chronic fatigue syndrome, this effect of red light therapy on inflammation is a very big deal.

Many aging scientists now speak of "inflamm-aging"[142]— the concept that the genes and pathways that control inflammation may very well be the key drivers of aging and disease.

Red light has shown to decrease inflammation wherever mitochondria are present—from the tissues to the joints and other specific organs of the body. Recent studies are exploring the possibilities of using red light therapy to treat autoimmune diseases which originate in inflammation, such as lupus and multiple sclerosis.[143] Red and near-infrared light therapy has been used with positive effects in autoimmune diseases such as rheumatoid arthritis[144] and Sjogren's syndrome.[145]

Studies have even shown that red/NIR light therapy can have anti-inflammatory effects on par with non-steroidal anti-inflammatory drugs (NSAIDs),[146] which are the anti-inflammatory drugs routinely prescribed and typically, the over-the-counter drugs people buy when in pain. (It's important to mention that chronic use of these drugs comes with a big risk of side effects).

In general, red and near-infrared light therapy powerfully downregulate the body's inflammatory pathways. This has profound implications for its potential role in disease prevention and longevity.

Improve Eye Health with Red and Near-Infrared Light Therapy

Research into the benefits of red and near-infrared light therapy for eye health is very promising. Studies on animals show that red light therapy can heal damage to eyes from excessive bright light in the retina. This kind of damage is similar to the damage that occurs in age related macular degeneration (AMD).[147]

One human study in patients with AMD showed that red light therapy improved vision, and that improvements were maintained for 3-36 months after treatment. It also appeared to improve edema, bleeding, metamorphosia, scotoma and dyschromatopsia in some patients.[148]

Note: The eyes are sensitive tissues, and as such, for any self-use of light therapy, I suggest shorter sessions at an increased distance away from the light. And as always, for any medical conditions, consult your physician rather than attempting to self-treat.

Combat Depression and Anxiety with Red and Near-Infrared Light Therapy

We know that bright light therapy and light boxes have shown great promise in treating seasonal affective disorder and depression. What about red light and near-infrared light therapy?

Although large randomized studies on using humans are still needed (two major studies are currently in progress), early research regarding the use of red and near-infrared light therapy for treating depression and anxiety disorders is very promising.

In a recent review of all existing studies on red and near-infrared light therapy and depression/anxiety disorders, researchers found that these light therapies offer a "promising treatment" for major depressive disorder, suicidal ideation, anxiety, and traumatic brain injury.[149]

Several studies have indicated that people with depression have abnormal blood flow in the frontal cortex of the brain. Since red/NIR light improve blood flow and circulation to the brain, it is reasonable to believe that could be part of the mechanism at play.[150,151]

Note: For treating the brain, it is likely that near-infrared will be superior to red light, as it penetrates more deeply. Specifically, research has shown that it penetrates the skull better than red light.[152] We'll talk more in detail later for which scenarios it's better to use red or near-infrared, depending on what you are trying to do. But in this case, for any brain-related issues, near-infrared is generally superior.

A 2009 study **took 10 patients with a history of major depression and anxiety** (including PTSD and drug abuse) and gave them four weeks of treatments to the forehead with red/NIR light. Remarkably, by the end of the four-week study, 6 out of 10 patients experienced a remission of their depression, and 7 out of 10 patients experienced a remission of their anxiety."[153]

Though further research is needed, there have been 10 studies so far on the use of red and near-infrared light therapy to treat depression and anxiety related disorders with 9 of 10 studies yielding very positive results.[154,155,156,157,158,159,160,161]

Researcher Julio Rojas, MD, PhD has stated "The data supports that LLLT to the head constitutes a promising neurotherapeutic tool to modulate behavior in a non-invasive manner."[162]

Improve Cognitive Performance with Red and Near-Infrared Light Therapy

One aspect of human health that red and near-infrared light therapy almost always improves, is cognitive performance. It not only improves the metabolic pathways but also enhances the health of mitochondria

in the brain. Since the brain is incredibly rich in mitochondria, this is where people often notice effects the most.

In studies, researchers have found that transcranial red and near-infrared light therapy profoundly benefits the brain and cognitive performance.[163] Research has also shown that transcranial near-infrared stimulation has been found to increase neurocognitive function in young healthy adults,[164] finding that it improved sustained attention and short-term memory retrieval in young adults, and improved memory in older adults with significant memory impairment at risk for cognitive decline.[165]

Another study found red and near-infrared light therapy also increased executive cognitive function in young healthy adults, providing hope that further studies find that red and near-infrared light therapy may provide a hopeful treatment in the fight against Alzheimer's disease, as well as prevention.[166]

Help Tendonitis with Red and Near-Infrared Light Therapy

One of the most common uses for red and near-infrared therapy in clinics is for injuries and tendonitis. Because red light stimulates collagen production, speeds wound healing, and is highly anti-inflammatory, it has been shown to bring great relief to people suffering from tendinopathy and tendonitis. [167,168]

A systematic review of the research concludes that red and near-infrared light therapy has proven highly effective in treating tendon disorders in all 12 studies conducted.[169]

Red light therapy exerts positive effects on tendon disorders by modulating inflammation, improving energy production and increasing growth of tendon cells, while stimulating collagen production—all of which act to improve tendon healing processes.[170]

Increase Fertility with Red and Near-Infrared Light Therapy

Some research suggests that red light therapy may be useful for fertility, which is making quite an impact upon couples trying to conceive.

A growing number of studies have shown that red and near-infrared light therapy may significantly boost pregnancy rates, even in women who have been unsuccessful with other assisted reproduction treatments, such as in vitro fertilization (IVF).

Red and near-infrared light therapy improves fertility, even in older women, by boosting ATP production in eggs, profoundly improving their viability.

It also improves follicular health, which are highly vulnerable to oxidative stress. Two recent studies, one in Japan and one in Denmark, found that red and near-infrared light therapy improved pregnancy rates where IVF had previously failed, in Denmark, by 68%.[171]

In Japan, red and **near-infrared light therapy resulted in pregnancy for 22.3% of severely infertile women with 50.1% successful live births**.[172]

The testicles also have photoreceptors that respond to red light, and research shows that red and near-infrared light therapy can greatly enhance sperm motility and therefore, fertility.[173,174]

In studies on human sperm, near-infrared light therapy at 830 nm produced significant improvements in sperm motility.[175]

Why does red and near-infrared light therapy enhance sperm motility outside of the body? The tails of spermatozoa are comprised of a string of mitochondria, therefore improving their mitochondria increases their ability to “swim” upstream and enhances their viability.

Given that red light boosts mitochondrial function, it should be of little surprise that it boosts ATP production

of the mitochondria in the sperm and testosterone producing cells of the testes as well, thus leading to improved sexual function, and sperm viability.

So red/NIR light therapy can be a powerful tool for both men and women trying to conceive.

One caveat for men: Never use any type of red light therapy that gets hot, like red heat lamps, near your testicles, as that could damage fragile Leydig cells. In fact, let me make three things very clear about applying light to the testicles:

- Avoid heating the testicles, heat damages sperm cells and negatively impacts the Leydig cells.
- Avoid blue light on the testes (blue light inhibits the production of ATP—thus decreasing, not promoting, mitochondrial health).
- Avoid any infrared heat lamps and infrared bulbs on the testes—these emit far too much heat to be used.
- I recommend low dose red light therapy in general, as the testes may be especially sensitive to overdoing sessions. Don't overdo it—small doses only.

Note: Some people in the red light business and biohacking communities have made claims around the capacity of red light therapy to increase testosterone levels. While I was initially excited about this, upon exploring the research that was cited, I have concluded that the evidence is simply not strong enough to support these claims. The claims are based mostly on one study in rats, which wasn't an impressive study—it only showed elevations in testosterone briefly on one day, before returning to normal.[176] It also didn't show testosterone elevation for the group using near-infrared (only in the group using red light). The study did use very high doses (far too high, in my opinion) and it's possible that a more reasonable dose could lead to benefits for testosterone levels. However, other studies have failed to show similar benefits.[177,178] I remain open

to the possibility that red/NIR light may increase testosterone levels when used on the testes, but the evidence for it as of this writing (2018) is insufficient. That said, there is some intriguing research on the ability of sun exposure and vitamin D to boost testosterone levels, and that seems a safer bet for now.[179,180]

While the research on boosting testosterone is not strong, there is an abundance of solid evidence for the ability of red/NIR light therapy to improve fertility.

Improve Joint Health and Combat Arthritis with Red and Near-Infrared Light Therapy

Studies have also shown that red and near-infrared light therapy can help people with osteoarthritis (often called just "arthritis").[181,182,183] It does this through four primary mechanisms:

- Decreasing pain[184]
- Modulating inflammation (decreasing pro-inflammatory cytokines) and increasing anti-inflammatory cytokines)[185]
- Increasing circulation to the area[186]
- Stimulating wound healing and cellular repair mechanisms in the damaged joint itself[187]

It's worth noting that there have been some mixed reports in the data about the effectiveness of red/NIR light therapy for osteoarthritis. Here's what Michael Hamblin, PhD wrote in his 2013 review of the scientific literature on this subject:

> "LLLT has been used clinically in osteoarthritis for many years but is still considered controversial. Although a Cochrane review reported mixed and conflicting results, a subsequent analysis conducted by Bjordal and colleagues concluded that the Cochrane review conclusion was neither robust nor

> valid. Further sensitivity analyses with inclusion of valid non-included trials, performance of missing follow-up, and subgroup analyses **revealed consistent and highly significant results in favor of active LLLT for osteoarthritis**." [188]

In short, while some published studies apparently failed to find positive results, a more detailed review of the research showed that red/NIR light does in fact have powerful benefits for osteoarthritis. Given its capacity to decrease inflammation, kill pain, and increase connective tissue growth, this finding is exactly what we would expect.

Decrease Diabetes Symptoms with Red and Near-Infrared Light Therapy

For diabetics, the most positive results gleaned from studies on the effects of red and near-infrared light therapy for healing is healing foot ulcers. Historically, these are harder to heal due to poor circulation and high glucose levels, especially in the lower limbs. Studies in animals and humans reveal that red light therapy restores diabetic patients' normal healing ability by exerting a stimulatory effect on the mitochondria with a resulting increase in adenosine triphosphate (ATP).[189,190,191,192]

Red light therapy also has had profound success in helping patients with painful diabetic neuropathy. Studies have found that red and near-infrared light therapy also helps to relieve pain and improve nerve function and foot skin microcirculation in diabetic patients.[193,194,195,196]

Improve Oral health with Red and Near-Infrared Light Therapy

Red and near-infrared light therapy have proven to have numerous benefits for oral health and research in this area is booming right now. So far, studies indicate

promising results for red and near-infrared light therapy, which has been shown to:

- Combat viral and bacterial infections of the mouth (tonsillitis, herpes, cold sores)[197,198,199]
- Reduce mouth pain[200]
- Facilitate tooth growth/tooth movement and reduce pain for individuals with corrective braces[201,202,203]
- Help diabetics with gum problems and periodontal disease[204,205,206]
- Reduce thrush (yeast in the mouth/candidiasis)[207,208]
- Improve tooth sensitivity[209,210]
- Fight gum disease and gingivitis[211,212,213]

Hamblin et al. note that red/NIR light therapy can be used with a huge variety of dental procedures to improve outcomes and speed healing.[214]

Improve Respiratory Health with Red and Near-Infrared Light Therapy

In studies, red and near-infrared light therapy has been shown to improve the health of those who suffer from chronic respiratory diseases such as asthma, COPD, bronchiectasis, and ILD,[215,216,217,218] as well as patients suffering from chronic obstructive bronchitis.[219]

Red light therapy has also proven to decrease lung inflammation in rodents after exposure to toxins and common indoor air pollutants, such as formaldehyde.[220]

Improve Heart Health with Red and Near-Infrared Light Therapy

So far there have only been animal studies on red light therapy's benefits for heart health and heart repair after

cardiac events and surgery. In a recent systematic review (2017) of the scientific literature, scientists found that animal studies reveal consistently positive effects of red light therapy by reducing infarct size (the size of the damaged area in heart attacks) up to 76%, decreasing inflammation and scarring, and accelerating tissue repair.

In heart tissue studies, red and near-infrared light therapy works through multiple molecular pathways, including modulation of inflammatory cytokines, signaling molecules, transcription factors, enzymes and antioxidants.[221] Other studies have noted many other benefits to heart function.[222,223,224,225,226,227]

Improve Liver Function with Red and Near-Infrared Light Therapy

The study of red light therapy to enhance the health of the liver is still in its infancy. So far, only animal studies have been done. However, in these studies, red and near-infrared light therapy yields very positive results for healing cirrhotic livers in rodents[228] as well as in surgical applications, such as to enhance regeneration of the liver during liver transplants.[229]

Increase Pancreas Health with Red and Near-Infrared Light Therapy

So far, there have been very few studies done on this organ with red and near-infrared light therapy. However, in human and animal studies conducted so far, red and near-infrared light therapy has proven to enhance islet cell function before transplantation,[230] and stimulate regeneration of islets and ducts in experimental models of diabetes.[231]

Decrease Pain with Red and Near-Infrared Light Therapy

Red and near-infrared light therapy has been remarkably effective at reducing joint pain in virtually all areas of the body.

There are a number of proposed mechanisms (that have some evidence to support them) for exactly how red/NIR light works to combat pain: changes in tissue opioid receptors, changes in substance P, and interference with nerve transmission and pain sensation.[232,233]

It's worth noting that there are different types of pain that are caused by different things. Red/NIR light therapy almost certainly does not work equally well for all types of pain, regardless of location and cause of the pain. For that reason, not all studies on various types of pain have shown benefit. The most recent 2014 review of the scientific literature noted:

> "Studies have demonstrated that LLLT may have positive effects on symptomology associated with chronic pain; however this finding is not universal. A meta-analysis utilizing 52 effect sizes from 22 articles on LLLT and pain from Fulop et al. (2010) demonstrated an overall effect size of 0.84. This would be classified as a large effect size and suggests a strong inclination for the use of LLLT to reduce chronic pain."[234]

Here are several conditions where red/NIR light has proven effective:

- Chronic neck pain[235,236]
- Knee pain[237]
- Fibromyalgia
- Low back pain[238]
- Chronic pain in the elbow, wrist and fingers[239]
- Chronic joint disorders[240]
- Sacroiliac joint pain[241]
- Chronic tooth pain[242,243]
- Osteoarthritic pain[244]

- Tendinitis and myofascial pain[245]

So while not every study has shown benefit for every type of pain condition, the overwhelming bulk of evidence suggests that red/NIR light can at least be moderately helpful for most types of pain.

In a recent systematic review, researchers concluded that red light therapy has proven "beneficial for many individuals suffering from pain, regardless of the condition that is causing it."[246]

Improve Immunity with Red and Near-Infrared Light Therapy

In numerous studies, red/NIR light therapy has proven to benefit the immune system.

In animal studies, red and near-infrared light therapy has a boosting effect on the immune system of immune-deficient cancer-inoculated animals, resulting in an increased lifespan.[247]

In human studies, red and near-infrared light therapy also boosted the immune systems and T cells of preoperative cancer patients without increasing tumor size. [248] (Researchers have expressed hope that these exciting results may mean a form of safe treatment for immunodeficiency diseases in humans.)

In the context of wound healing, it has also been shown to have beneficial effects, in part by modulating immune function.[249]

One review of the scientific literature noted:

> "Immune cells, in particular, appear to be strongly affected by LLLT. Mast cells, which play a crucial role in the movement of leukocytes, are of considerable importance in inflammation. Specific wavelengths of light are able to trigger mast cell degranulation, which results in the release of the pro-inflammatory cytokine TNF-a from the cells. … Lymphocytes become activated and proliferate more rapidly, and epithelial cells become more motile,

> allowing wound sites to close more quickly. The ability of macrophages to act as phagocytes is also enhanced under the application of LLLT."

Another study found that red/NIR light therapy to the bone marrow could increase the platelet count and help resolve low blood platelets caused by chemotherapy or by an autoimmune disease.[250,251]

It also appears to selectively modulate cell function in some types of infected cells while not affecting healthy uninfected cells in the same way.[252]

In vitro studies on human leukocytes have shown that near-infrared light can increase activity of these immune cells. Given that we know red/NIR light penetrates our blood vessels and irradiates our bloodstream, it is reasonable to think may also happen internally.[253,254]

A fascinating study in mice looked at shining red light on the thymus gland (an important gland in the immune system) and on an area of a back leg. They found that the mice who received the treatment on the thymus gland area (in the center of the chest) had more profound changes in immune cell function.[255] (They also noted that overdoing the dose could have immunosuppressive effects, which is consistent with what is known in every other context—you can overdo the dose. We'll talk more about this in a later section on the "biphasic dose response.") Another remarkable and more recent study from December 2017 looked at the potential for red/NIR light to reverse "thymic involution." What the heck is "thymic involution," you ask? As we get older, our thymus glands "involute"—they basically shrivel up and become much less functional, which has a negative impact on our immune function. This study suggests that red/NIR light may be able to slow or even reverse this "thymic involution"—thus keeping our thymus gland function and immune function in tact as we age.[256] The researchers concluded "This perspective puts forward a hypothesis that PBM [photobiomodulation] can alter thymic involution, improve immune functioning in aged people and even extend lifespan."[257]

Another fascinating study looked at the influence of red light therapy on people with treatment-resistant schizophrenia and found symptomatic improvement in a large portion of people. They also found pronounced improvement in immunological markers.[258]

As discussed in the section on thyroid health, in people with Hashimoto's—a common autoimmune condition responsible for most hypothyroidism—red/NIR light has proven to have remarkably beneficial effects on immune function.[259] Another animal model of multiple sclerosis (another autoimmune condition that degenerates the fatty sheath around nerves that helps nerve conduction) showed that just two treatments done over a span of 14 days led to significant improvement with less brain cell death and slowed the progression of the disease.[260] Other animal studies have found similar effects:

> "Finally, histological analysis showed that LLLT blocked neuroinflammation through a reduction of inflammatory cells in the CNS, especially lymphocytes, as well as preventing demyelination in the spinal cord after EAE induction. Together, our results suggest the use of LLLT as a therapeutic application during autoimmune neuroinflammatory responses, such as MS."[261]

As you can see, it doesn't just appear to increase immune activity—but to also beneficially modulate immune activity, regardless of whether one currently has underactive or overactive (or otherwise imbalanced) immune activity.

Overall, the body of research looking at immune function in different conditions paints a more complex picture than simply that red/NIR light either stimulates or inhibits immune function. While I'm sure we'll find exceptions to this rule as more studies are done, red/NIR light seems to be an "immune nutrient" that supports *optimal* immune function in a wide variety of different scenarios and health conditions. It seems to be able to positively affect immune function in the right direction, potentially, regardless of whether someone has low immune function during an infection or has an overly

active and imbalanced immune system due to autoimmune disease.

Help Heal Traumatic Brain Injury (TBI) and Spinal Cord Injury with Red and Near-Infrared Light Therapy

Red light therapy is bringing recovery and enhanced cognition to those suffering from traumatic brain injury. Patients who have suffered TBI report improved cognition, better sleep, and enhanced recovery from the traumatic experience of their accident.[262,263]

In animal research, red and near-infrared light therapy has impressive outcomes in recovery of animals after stroke. Scientists believe the therapeutic effects stem largely from increased mitochondrial function (i.e. increased ATP production) in brain cells irradiated with red and near-infrared light therapy.[264,265,266]

Spinal cord injuries cause severe damage to the central nervous system with no effective known restorative therapies. However, red and near-infrared light therapy has been found to accelerate regeneration of the injured peripheral nerve and increase the axonal number and distance of nerve axon regrowth, while significantly improving aspects of function toward normal levels. Numerous studies indicate that red and near-infrared light therapy is a promising treatment for spinal cord injury that warrants full investigation.[267,268,269,270]

Improve Stem Cell Therapy with Red and Near-Infrared Light Therapy

There have been wonderful results in both human and animal studies where infrared light has been used in conjunction with stem cell implantation, and potentially in activating the body's own stem cells. Bone marrow stem cell transplantation depends upon the survival and

colonization of the new stem cells that have been transplanted. So far, research has found that "Red or near-infrared light from 600–1,000nm (red and near-infrared) promotes cellular migration and prevents apoptosis"—meaning, it helps promote cell growth and prevent cell death in the newly transplanted cells.[271] Red light therapy also increases stem cell growth and promotes cell proliferation without the creation of excessive ROS (free radicals).[272,273]

Researchers have also found that red and near-infrared light therapy can help repair heart tissue after a heart attack.[274] In a recent study, Professors Oron et. al. shined red laser lights onto the bone marrow cells of heart attack patients and found that "After a low-level laser was 'shined' into a person's bone marrow — an area rich in stem cells — the stem cells took to the blood stream, moving through the body and responding to the heart's signals of distress and harm… Once in the heart, the stem cells used their healing qualities to reduce scarring and stimulate the growth of new arteries, leading to a healthier blood flow."[275] Studies like Oron's are giving scientists hope that red and near-infrared light therapy can be used to make stem cell therapy easier and more effective in a wide range of surgeries, and even aid in the repair of other organs, such as the liver and kidneys. Overall, red and near-infrared light therapy has proven to speed internal wound healing, cell regeneration, cell proliferation, promote cellular migration and prevent development of ROS and apoptosis (cell death).[276,277,278,279,280,281,282,283,284,285,286,287,288] It is very possible—likely in fact—that part of the healing mechanisms at play is the activation of stem cells.

Hopes are high for transplant patient, bone marrow recipients, and patients recovering from organ failure and degeneration of all kinds.

Heidi Abrahamse assessed the potential of red light therapy combined with stem cell therapy, noting that

> *"… by combining regenerative medicine, stem cell therapy and (red light therapy), the numbers and patients [receiving transplants and regenerative*

> *therapy] will increase, the applications will expand, and, therefore, the quality of life of millions of people may be improved. Regenerative medicine has the ability to transform the treatment of human disease by introducing combined, innovative new therapies such as stem cell and (red light therapy) that offer faster, complete recovery and reduce the risks of donor organ transplantation rejection through autologous grafts seem harder to believe than what it is possible."*[289]

Abrahamse adds that these new discoveries of red and near-infrared light therapy's powers to enhance transplant and regenerative surgery to the point that "Revitalizing or replacing worn-out or diseased body tissue and organs in a 'made to order' fashion may well be in our near future." [290]

Fall Asleep Faster and Improve Sleep Quality

There is some research suggesting that red/NIR light can impact melatonin. Melatonin is a hormone produced primarily by the pineal gland in the brain, and even most non-scientists are somewhat familiar with melatonin for its role in promoting sleep. Interestingly, based on a few studies done in China, red/NIR light seems to increase melatonin produced by the body! Even more interestingly, it seems that this increased melatonin production comes from other parts of the body other than the pineal gland! **The studies found increased melatonin in blood circulation following red/NIR light exposure, and studies have also found dramatic benefit to sleep in people with insomnia.**[291,292,293] (Note: The studies used intranasal light specifically, but there is no logical reason to believe that light in the nose is necessary for this effect—it is likely from irradiating the bloodstream or the skin, or both.)

Here is a quick summary of the relevant research from Lew Lim, the founder of VieLight:

- The first documented use of a similar intranasal light therapy device to directly observe melatonin level was conducted by Xu C et al in 2001. They treated 38 subjects that had insomnia with intranasal low-level laser therapy once a day over 10 days. They found that serum melatonin had increased.
- The same group of researchers further treated another group of 128 patients with insomnia and found that the polysomnogram (sleep study that includes data on brain waves as electrical activity) data had improved.
- In 2006, Wang F et al reported that they had treated 50 patients with insomnia with intranasal low-level laser therapy that is of similar specifications to Vielight's laser device for 60 minutes per session. Each session was conducted once a day over between 10 to 14 days. They found that the condition had **improved significantly in 41 (82%) of the cases, mild for 4 (8%) of the cases, and none for 5 (10%) of the cases**.
- Traditional Chinese Medicine practitioners often prescribe herbs as remedy for insomnia. This seems to help somewhat. Chen YM et al tested 90 patients and found that that the condition improved significantly for 40% of the cases, mild for 37.5% and none for 22.5% of the cases. In the group that added the extra element of the intranasal low-level laser therapy, the improvement in the number of positive results were significantly more impressive. **78% of the patients experienced significant improvement, 20% mild and 2% none**.[294,295,296,297]

More research is still needed on this topic. But I also want to mention that I have experimented with this heavily with my Energy Blueprint program members and the reports I get from people who try it line up perfectly with the research—it just flat-out works, in a very noticeable and powerful way for many people.

There is one more thing I want to add about melatonin…

Most people know melatonin as a sleep-inducing hormone. And it is certainly that.

But most people have no idea that melatonin is imperative for mitochondrial function, protects mitochondria from damage, and is vital for mitochondrial regeneration while we sleep.

Evolutionary side note: It is interesting to think that maybe our bodies are wired to benefit from sitting next to a fire for several hours each night, as many of our ancestors did. Perhaps the red and near-infrared light emitted from the fire actually benefits us at the cellular level, partly because of the impact it can have on melatonin production and sleep enhancement. Some researchers have suggested that many of the health benefits of red/NIR light therapy may have to do with the effect on melatonin levels.[298])

There are a number of impressive—and little known—studies showing how vital it is for mitochondrial health that you produce adequate melatonin each night. Melatonin benefits our mitochondria in numerous ways, including:

- Preventing free radical damage directly in the actual mitochondria[299,300] (which is quite unique to melatonin since virtually all other "antioxidants" cannot do this).
- Regulation of mitochondrial bioenergetic function and maintaining respiratory complex activities, electron transport chain, and ATP production in mitochondria.[301]
- Acting as a neuroprotectant in the brain, preventing the kind of oxidative stress/nitrosative stress-induced mitochondrial dysfunction seen in experimental models of Parkinson's, Alzheimer's, and Huntington's disease.[302]
- Potentially slowing aging.[303]

And remember, mitochondrial health is critical to not only our energy levels, but poor mitochondrial health is also implicated in numerous diseases and even aging itself.[304] So the fact that red/NIR light supports melatonin production may have far-reaching benefits to us for increasing energy levels (and preventing fatigue), slowing aging, and preventing disease.

Improve Brain Health, and Slow Progression of Alzheimer's and Parkinson's Disease with Red and Near-Infrared Light Therapy

Red and near-infrared light therapy is having a *profound impact* in diseases and conditions of the nervous system of all kinds from traumatic brain injury, to spinal cord injury, peripheral nerve injury, painful diabetic neuropathy, and has potential to help reverse Alzheimer's and Parkinson's disease, and may potentially contribute to delaying and/or halting them if caught early enough.[305]

Red and near-infrared light have been shown to:[306,307,308,309,310]

- Benefit cognitive performance and memory
- Improved mitochondrial function of brain cells
- Have a protective effect on neurons
- Improve cellular repair of neurons
- Increase brain-derived neurotrophic factor (BDNF) and nerve growth factor (NGF)
- Decrease brain inflammation (decreased pro-inflammatory cytokines and increased anti-inflammatory cytokines)

Recent studies have now found that red and near-infrared light therapy may significantly slow the progression of Alzheimer's and Parkinson's disease.[311,312]

Although still in its infancy, scientists are hopeful that red and near-infrared light therapy may offer a new way to halt or reverse Parkinson's and Alzheimer's or halt progression of these conditions if caught early enough. Alzheimer's is, at least in part, caused by mitochondrial damage or dysfunction, which reduces ATP production and contributes to neuronal death. This process leads to an increase in toxic reactive oxygen species, generating oxidative stress and subsequent neuronal death, as observed in Alzheimer's disease.[313,314,315,316]

Although researchers are still unclear as to the exact way that near-infrared-induces its neuroprotective effects, they believe it operates by:

1. Activating healing intracellular cascades that result in the survival of target and surrounding cells.
2. Spurring neurogenesis (growth and birth of neurons in the brain) through increases in BDNF, for example.
3. Triggering systemic protective mechanisms.

As researchers note,

> "…with the bulk of results still at the pre-clinical 'proof of concept' stage, near-infrared therapy has the potential to develop into a safe and effective neuroprotective treatment for patients with Alzheimer's and Parkinson's disease (and presumably other neurodegenerative diseases such as multiple sclerosis and amyotrophic lateral sclerosis). If near-infrared was applied at early stages of the disease process, for example at first diagnosis, it could potentially slow further progression by protecting neurons from death. Consequently, over time, the greater neuronal survival would lessen the clinical signs and symptoms. Further, near-infrared therapy—because of its lack of side-effects and neuroprotective potential—is amenable to use in conjunction with other treatments."[317]

In short, near-infrared light (because it penetrates the skull better than red light), appears to be a promising therapy for neurological conditions and improving brain health.

Enhance Muscle Gain, Strength, Endurance, and Recovery with Red and Near-Infrared Light Therapy

> *"Sports medicine will benefit from PBM [photobiomodulation] because both professional and amateur athletes can better recover from intense exercise, and the process also aids training regimens. In the near future, sport agencies must deal with 'laser doping' by at least openly discussing it because the aforementioned beneficial effects and the pre-conditioning achieved by laser and LED irradiation will highly improve athletic performance."*[318]
>
> —Michael Hamblin, PhD

Red/NIR light with exercise makes a potent combination. Not only does red/NIR light help you recover faster, it seems to amplify everything that happens with exercise—increased muscle gain, fat loss, performance, strength, and endurance.

Studies show that both red and near-infrared light therapy can powerfully repair muscle tissue and help people perform better. It also helps the body get more

benefits from exercise—both in terms of muscle gain and fat loss.[319,320, 321]

There is also research (albeit from animal studies) showing that red and near-infrared light may help prevent muscle loss that occurs with aging.[322,323]

Muscle tissue has more mitochondria than almost any other tissue or organ in the human body. So muscle tissue is particularly responsive to red and near-infrared light therapy. **The muscles are packed with mitochondria, because ATP is needed for every muscle twitch and movement, no matter how insignificant.**

Through their effect on ATP production and cellular healing mechanisms, red/NIR light help individuals to recover more quickly from strenuous and resistance exercise, and even helps to prevent muscle fatigue *during exercise*.[324]

Studies provide evidence that red and near-infrared light therapy powerfully help prevent muscle fatigue, enhance muscle strength and endurance, increase fat loss responses from exercise, increase muscle growth responses from exercise, and promote faster recovery.[325,326,327,328,329,330,331,332,333] Not too shabby for one simple treatment that takes only a few minutes, right?

How does red and near-infrared light affect muscles—what is it actually doing to cause these benefits? It works through several important mechanisms in the body:

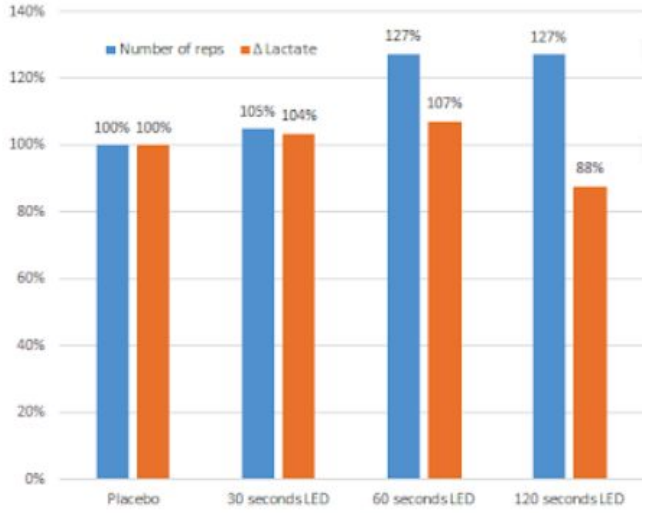
- Red and near-infrared light help promote the production of internal antioxidants by your cells, which prevents oxidative stress and damage to the muscle tissue (when light is applied before exercise).[334,335]
- Red and near-infrared light help reduce inflammation that will lead to cellular damage (and fatigue) in the muscle tissue as well. [336,337]
- Protect damaged muscles from secondary damage from further exercise.

- Pre-conditioning: By using the light prior to exercise, it creates a “pre-conditioning” effect where the muscle cells suffer less damage from the exercise, as well as display higher strength/stamina in subsequent exercise following the initial bout of exercise.
- Red and near-infrared light decrease lactic acid production by muscles.
- Red and near-infrared light improve mitochondrial function during exercise.
- Increases acetylcholine receptors on muscles (this is the neurotransmitter released from nerve cells that stimulates muscle contraction).
- Red and near-infrared light increase the production of specific types of heat shock proteins that protect cells from oxidative damage, stress, and apoptosis (early cell death).[338]
- Red and near-infrared light also enhance muscle growth, as well as increasing strength significantly.[339]
- Red and near-infrared light therapy promotes the development of muscle stem cells, myosatellite cells, which develop into specific varying types of muscles.
- Red and near-infrared light also have the profound benefit of increasing mitochondrial adaptations and mitochondrial biogenesis (the creation of new mitochondria) following exercise.[340]

To get into some of the research on this topic:

- One study looked at the number of reps that 34 athletes were able to perform on a leg extension weighted exercise as well as the amount of lactic acid their muscles produced, in placebo treatment (sham red/NIR light therapy) vs. 30, 60, or 90 seconds of real red/NIR light therapy. After receiving 60 or 120 seconds of light therapy, **the number of reps the athletes were able to**

perform went up by 27%. And in the group that received 120 seconds of light therapy, **their lactic acid levels were also significantly lower**—indicating less muscle strain while actually performing better.[341]



This graph shows the improvement in number of reps performed (blue) with 60 seconds of light therapy, and the improvement in both reps performed and lactic acid levels (red) with 120 seconds of light therapy prior to exercise.

- Another study by Vieira et al. examined levels of fatigue in leg muscles after endurance exercise and found that using light therapy immediately following **significantly reduced fatigue scores** relative to the control group. The researchers concluded "The results suggest that an **endurance training program combined with LLLT leads to a greater reduction in fatigue than an endurance training program without LLLT**. This is relevant to everyone involved in sport and rehabilitation."[342]
- Leal-Junior et al. performed a review of the relevant research in 2015 to examine the effects of phototherapy on exercise performance and recovery. They compiled data from thirteen randomized control trials and examined the number of repetitions and time until exhaustion

for muscle performance, as well as markers of exercise-induced muscle damage. **The researchers concluded that pre-conditioning the muscles with red/NIR light (i.e. using the light prior to exercise) improves muscular performance and accelerates recovery**.[343]

- Another study looked at use of LED red/NIR therapy lights in male athletes who performed 3 intense bouts of exercise on a stationary bike. The **athletes who were given the LED light therapy prior to the exercise had significantly lower levels of creatine kinase (a marker for muscle damage)** compared to the sham light therapy (placebo) group.[344]
- A recent 2016 review of 16 studies by Nampo et al.[345] looked at research using both laser and LED therapy on exercise capacity and muscle performance of people undergoing exercise compared to placebo/sham treatments. They found an **average improvement of 3.51 reps, a 4 second delay in time to exhaustion (i.e. people were able to exercise longer before exhaustion), increased peak strength, and a significant reduction in lactic acid production**.
- A review of research by Borsa et al. found that studies consistently show that **red/NIR light done prior to weight training improved performance and decreased muscle damage**.[346]
- Another double-blind study (that means that neither the researchers nor subjects know who is getting the real treatment and who is getting the placebo) with 22 non-exercising people were subjected to exercise on a treadmill until exhaustion. **The group that received the light therapy for 30 seconds before exercise had significantly lower levels of creatine kinase and lactate dehydrogenase (LDH)—both**

markers of muscle damage—suggesting that the light therapy decreased the level of muscle damage.[347]

- Another study compared red/NIR light therapy with LEDs to cold water immersion (e.g. ice baths) as a recovery method after exercise and found that **red/NIR light improved recovery more than ice baths**. The researchers concluded: "We concluded that treating the leg muscles with LEDT 5 min after the Wingate cycle test seemed to inhibit the expected post-exercise increase in blood lactate levels and CK activity. This suggests that LEDT has better potential than 5 min of CWIT [cold water immersion therapy] for improving short-term post-exercise recovery."[348] This is notable for another reason: Ice baths have been found to accelerate recovery, but at the same time, they have been shown to hinder some adaptations to exercise such as muscle growth, whereas red/NIR light therapy accelerates recovery while also *amplifying* (rather than hindering) adaptations to exercise. So all in all, red/NIR light therapy would appear to be a superior recovery method compared to the typical ice baths that many athletes engage in.
- A 2015 study by Baroni et al.[349] looked at 30 healthy males who were randomized into 3 groups:

1. Control group—remained sedentary
2. Training group (TG)—did an 8-week exercise program
3. Training + light therapy (TLG)—did the same 8-week exercise program plus also did a light treatment (total dose of 240J) using a near-infrared light (810nm wavelength) before each training session.

   What happened?

   - The training group improved strength by about an average of 14% while the group that

included light therapy improved by nearly 25%.[350]

- The training group improved muscle size of the quadriceps muscles by about 10% while the group that included light therapy nearly *doubled* that improvement! [351]

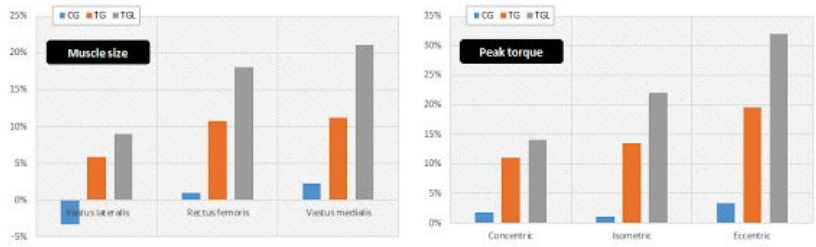
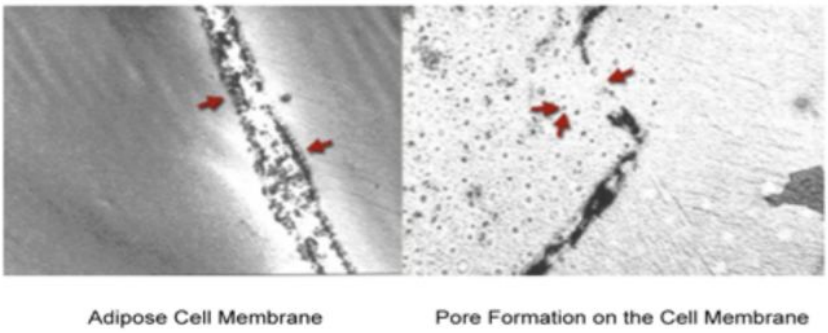


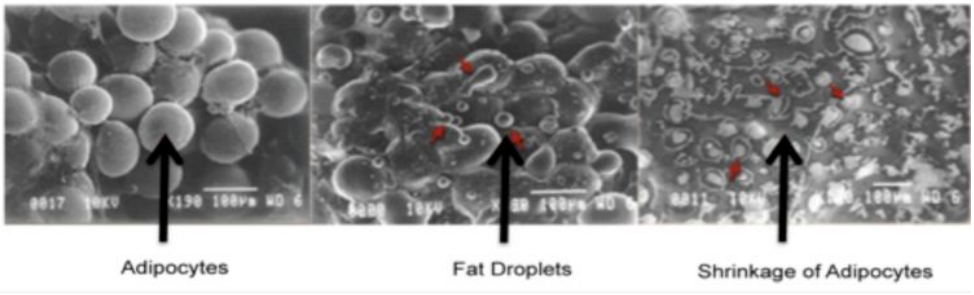
Figure 2: Muscle size and peak torque changes over the course of the 8-week study (Baroni. 2014).

As you can see, red and near-infrared light also have the ability to increase your strength and endurance adaptations to exercise, decrease muscle damage from your workouts, help you recover faster, and even increase muscle gains.

Increase Fat Loss (And Burn Off Stubborn Fat) with Red and Near-Infrared Light Therapy

How does red light therapy enhance weight loss, fat burning, and shrink waist circumference? While there is still some debate among researchers over the exact mechanisms involved, the research clearly shows that it does work.[352] The most popular theory among researchers is by causing fat cells to release stored fat into the blood stream, where it can then be burned off during energy expenditure or via exercise.





Source: Pinar, A. et al. *Low-Level Laser Therapy for Fat Layer Reduction: A Comprehensive Review.*

Research has shown that red and near-infrared light therapy has a profound impact on reducing fat mass and fat tissue, and at eliminating cellulite.

In studies, red and near-infrared light therapy have **helped shave an entire 3.5 to 5.17 inches off waist and hip circumference by reducing the fat mass layer in just four weeks of use**.[353,354]

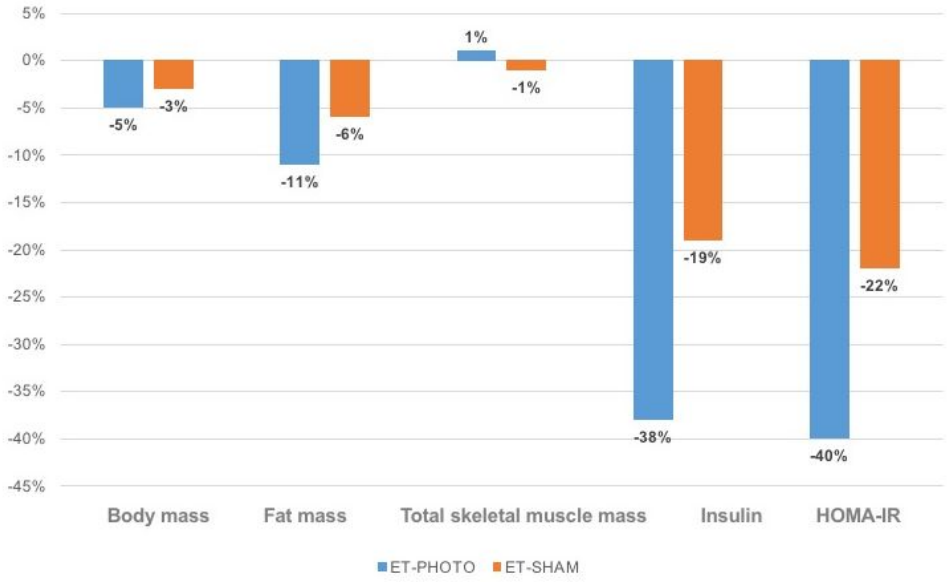
Red and near-infrared light therapy works to not only release the fat into the blood, but does so *without* negatively affecting blood serum lipid profiles.[355]

In another study of 86 individuals using red light therapy at 635 nm for **20 minutes every other day for two weeks, study participants lost 2.99 inches across all body parts—yes, 3 inches—in just 14 days** of red light therapy.[356]

That said, I am not a strong advocate of trying to use red/NIR light therapy *alone* to cause fat loss. Where I believe red/NIR light therapy really shine (forgive the pun) is when combined with exercise.

<u>Some research shows that near-infrared light therapy can dramatically enhance—nearly *double*—fat loss from exercise, as compared to people doing just the exercise routine without the NIR light therapy.</u>[357]

In addition, **the group using the NIR light therapy in tandem with exercise saw nearly *double* the improvements in insulin resistance!**[358]



The above graph shows the differences in reductions in body weight, body fat, insulin levels, and insulin resistance (IR) from either NIR light therapy (ET-PHOTO) vs. sham/placebo light therapy (ET-SHAM). As you can see, exercising with NIR light ***<u>nearly doubled the loss of body fat</u>*** *and nearly doubled the improvement in insulin resistance.*

There is also some fascinating potential for use on "stubborn fat" areas and even the mythical "spot reduction."

For those not familiar with these terms "stubborn fat" and "spot reduction," I'll summarize below…

What is stubborn fat? And what is spot reduction?

- Stubborn fat = Areas where we store body fat that's hard to get rid of, no matter what we do.

- Spot reduction = The idea that you can burn off fat in a specific area by doing exercise that targets that area.

So really everyone knows what spot reduction is. How could we not know about the idea of stubborn fat and spot reduction?

For the last several decades, infomercials on TV have been selling us various exercise gadgets that are meant to cause fat loss in the specific area. “Use this ab cruncher and you’ll shed inches of fat off your waist and stomach!” “This thigh blaster will take inches off your thighs!”

It is absurd how many billions of dollars have been spent by consumers in the pursuit of spot reduction—mostly through various exercise devices (like thigh masters, ab crunchers and butt blasters), wraps that cause temporary water loss, and electrical stimulation devices that shock muscles in a targeted area.

Walk into any gym around the world and you’re likely to find lots of men trying to burn off unwanted abdominal fat with 30-minute long ab workouts, and women doing all sorts inner and outer thigh exercises and “butt-toning” aerobic classes. Most of us have some area of our body that has a little excess flab, and most people think the solution to this problem is to do exercises for that area.

We all tend to store fat in certain areas—men more in the belly/lower back/love handles, and women more in the thighs and hips (generally speaking)—so given that our body deposits fat in specific areas, it seems to make sense to also pursue fat loss from those specific areas.

Indeed, we’ve been pursuing the goal of spot reduction for well over a century. There were the vibrating belt machines of the early 1900s, countless other machines that looked like they could double as torture devices, and of course, corsets, which have been around forever (and seem to be making a comeback). These devices that we’ve seen come out over the last few decades are really nothing new. They’re just the latest gadgets to be created in the century-long pursuit of spot reduction.

So what is the bottom line on spot reduction? Do any of these devices really work?

The simple answer: No. Most of these are based on general public's lack of understanding that muscle and fat are two separate and distinct tissues, and they confuse the "burning" one feels when working a muscle with the "burning" of body fat from the layer of fat on top of that muscle. Unfortunately, these are two distinct entities, and working a muscle in a specific area does not have a significant relationship to how much fat is burned off from the adjacent layer of fat. Yet, since most people don't understand that, they are gullible for products selling them on the idea that working a muscle in a specific area will cause fat loss in that area. Or to use the words of the people who manufacture these spot reduction products, these devices will "tone," "shape," "trim," and "sculpt" that area of your body.

Interestingly, there have been some studies testing whether spot reduction really exists:

- A 1971 study conducted on tennis players also found evidence to confirm this. Tennis players constitute a population whose right and left arms have been consistently subjected to very different amounts of exercise over several years. Consequently, if spot reduction were a valid concept, one would expect the players' dominant arms to have thinner layers of subcutaneous fat compared to their non-dominant arms. When the researchers measured the thickness of subcutaneous fat at specific points along the players' arms, however, they found no statistically significant difference between right and left arms.[359]
- A classic study that was performed back in 1984, looked at fat biopsies taken from the abdominal area before and after a 27-day period that had subjects progressively increase the number of sit-ups they were doing. Subjects started with 140 sit-ups a day and by the end of the study they were doing 336 sit-ups a day. The group averaged 185

sit-ups a day while a control group did not exercise. Following the study, the fat cells in the abdominal area were not reduced. There were no significant changes in either fat-folds, girth, or total fat content assessed by underwater weighing. **Over 5000 sit-ups and zero fat loss off the stomach to show for it. That's pretty damning evidence to show that spot reduction is not possible.**[360]

- More recently, in a 2007 study led by the University of Connecticut, 104 participants completed a twelve-week supervised resistance-training program in which their non-dominant arm was selectively exercised. MRI assessments of subcutaneous fat before and after the program revealed that fat loss was generalized across the entire body, rather than only occurring in the exercised arm.[361]
- Even more recently in 2013, another even more impressive study was published. Three times per week, for 12 weeks, the participants were required to do about 1,000 repetitions of low resistance activity on a leg press machine. Here's the cool part: They only did the exercise on *one* leg and left the other one unexercised. What was the result? **The participants lose 5.1% of their body fat on average, but virtually *none* of that loss came from fat tissue in the legs—there were no differences in fat mass on the legs at the end of the 12 weeks of training compared to when they started. Most importantly, there was no difference between the leg that did all that exercise and the leg that wasn't exercised at all!** Where did the fat loss come from? It came from the upper extremities and torso. In short, if you can do 1,000 repetitions of an exercise on one leg, three times per week, for 12 weeks, and that doesn't lead to any detectable difference in fat on that leg relative to the leg that wasn't exercised at all, then that's pretty clear evidence that chasing spot reduction through "ab

crunchers" and "thigh blasters" is a big waste of time and money.

So the science is clear: Exercising a muscle does not cause fat loss in the adjacent fat tissue. You don't lose fat off your stomach by doing crunches, or lose fat off your thighs by using the thigh machines at the gym. And for several decades, this is exactly what all respectable fitness professionals have been preaching: Spot reduction is a myth!

Simply put, the scientific consensus about spot reduction through muscle contractions is that <u>it does not work.</u>

There are a couple of reasons why this is the case:

1. There's no direct link between the underlying muscle and the overlying fat. So in order for working a muscle to cause fat next to it to be burned off, that fat would have to connected to the muscle via blood vessels. Yet, there is no such direct connection between muscles and their adjacent fat area. This means that working a muscle in a particular area, basically has no effect on the rate of fat burning in the fatty tissue adjacent to it. Performing those exercises may strengthen the muscle responsible for those movements, but they have negligible impact on reducing the amount of fat stored there.
2. Fat contained in fat cells exists in the form of triglycerides, and muscle cells cannot directly use triglycerides for energy. The fat must be broken down in glycerol and free fatty acids first, then enter the bloodstream where they can be carried to the muscle cells for burning. So there really is no reason for the muscle to preferentially use fats from the fat cells adjacent to it—it is using up the fatty acids in the bloodstream and doesn't care whether those fatty acids were released from the fatty area right next to it or from the other side of the body.

The bottom line: Spot reduction via exercising a specific body area doesn't work. Working a particular muscle does not impact the amount of fat in the fatty area adjacent to the muscle being worked. Whether you lose fat or not comes down to overall energy balance. But you have no control over *where* your body takes that fat from. Your body will lose fat from some areas quicker than others, and there is nothing you can do about it. This has pretty much been the consensus among highly-educated health professionals for the last several decades and is what I personally taught for a decade.

But it may not actually be correct…

It's generally true that just working a particular muscle doesn't burn off the fat in the fat tissue adjacent to that muscle (i.e. thigh exercises don't selectively burn off thigh fat), but with an understanding of *why* stubborn fat is actually stubborn, perhaps we can impact things after all.

Even though most fat loss experts shun the idea of targeting fat loss in specific areas of the body, there are actually a few experts who have suggested that it is possible through a slightly different approach that revolves more around burning lots of calories (not just exercising the muscle in a specific area, like the abs or thighs) combined with selectively enhancing blood flow to certain fatty areas of the body.

For example, Dr. Lonnie Lowery (a bodybuilder) and Christian Thibaudeau (a strength coach) have both developed spot reduction protocols published on a website called T-Nation. And exercise physiologist Lyle McDonald has written a book called *The Stubborn Fat Solution*. That book presented a ton of new science-backed information that shows the physiological reasons why some fatty areas are harder to burn off than others—the areas that don't seem to come off no matter how much dieting and exercise you do, thus, "stubborn fat." Some areas of the body store fat easily and release it poorly. Other areas don't get fat very easily and those areas are the quickest to lean out. That is, in the context of someone doing things right with their lifestyle such

that they are losing body fat, the body burns off body fat from some areas more so than other areas. So what is going on physiologically to make this the case—why are some areas so easy to put on fat and so difficult to get lean?

Those reasons are outlined by McDonald in the book, but here's a summary:

1. **Poor blood flow to certain fat tissues.** Certain fatty areas of the body (mainly the stomach and low back areas of men, and the thighs and hips on women) receive poorer blood flow than visceral fat (fat in the center of the body around the organs). If there is little blood flow to those fat cells, they are not able to dump their fats into the blood to be burned for energy. How can you possibly lose fat if your body's fat cells aren't able to dump their fatty acid contents into the blood where they have the potential to be burned? They can't. When there is low blood circulation to the fat cells, the potential for fat to be burned from those cells is also low. Even when you're in a state where you're burning lots of body fat (i.e. on a weight loss diet), very little of the fat you're burning will be coming from these areas that have poor blood circulation.
2. **Muscle cells become de-sensitized to insulin and fat stores become hyper-insulin sensitive.** This is the body's way of shuttling the calories you eat away from muscle cells (where they are burned off) and towards fat cells (where they are stored as fat). The above-mentioned gender-specific fatty areas also tend to be more insulin sensitive and generally speaking, soak up nutrients from the blood most efficiently.
3. **Fat cells themselves become resistant to releasing fat due to their receptors.** There are two types of adrenoceptors (receptors that respond to adrenaline) that control the flow of fatty acids in and out of fat cells and the blood flow to the fat cells—beta and alpha receptors. Beta receptors are the good guys who increase fat burning and fat

> tissue blood flow. Alpha-2-receptors do just the opposite—they inhibit fat burning and they inhibit fat tissue blood flow. Stubborn fat areas have a high density of alpha-2 receptors and low density of beta receptors. So not only is there poor blood flow to these fatty areas (making it difficult for the cells to release any fats into the blood to be burned), but also, the fat cells themselves are incredibly resistant to releasing any fats into the little blood flow that is present.

McDonald's program to burn off this stubborn body fat is essentially that you do a morning protocol before breakfast whereby you do some things to boost adrenaline levels (high-intensity interval training, and taking tyrosine), take some yohimbine to inhibit the alpha receptors on your fat cells, and then do some light exercise. The idea is that this would boost adrenaline and then also allow stubborn fat cells to release more of their fats into the bloodstream, and then you would burn off some of these stubborn fat areas. Many people have reported success using this method, so it does appear to work. (Side note: I once tried it and the yohimbine made me feel so anxious and jittery that I never wanted to do it again. It was like 8 cups of coffee and what I can only imagine crack must feel like.)

Now, it's important to realize, as McDonald himself points out, that this is *not* true spot reduction. This is simply for people who are already doing a calorie restricted diet and *actively losing fat*, but still have one area with some fat that won't come off. It is not spot reducing that specific area—you are burning overall fat, but the only place left to burn it from is that specific area. While oversimplifying the nuances, basically, the idea of this protocol is just to get more blood circulation to those stubborn fat areas and pair that with exercise (burning off fat) with the hope that a large portion of the energy you burn would come from fat in the stubborn fat areas. With greater blood circulation in those stubborn fat areas, your body will have the opportunity to release and burn more of the fatty acids stored in those tissues.

Even though this is not really spot reduction per se, McDonald's examination of all the scientific literature on why certain fat tissues are so hard to burn off was instrumental as a step towards figuring out how to get rid of stubborn fat. The most important factors in this regard are how the cellular receptor profile influences how easily the cell will give up its fats into the bloodstream, and even more importantly, the blood flow to that fatty area. Poor blood flow to an area combined with cells that are resistant to giving up their fats makes fat loss from that area essentially impossible.

Science has now shown that blood flow to a particular area might be the biggest factor of all that hinders fat loss from that area. Blood flow is critical for fat extraction. Poor blood flow equals poor fat loss. Here's a fun test that you can do to put this in practical terms. Buy a forehead thermometer and take the skin temperature of different parts of your body. In particular, test the temperature of your hard to burn off fatty areas. What do you notice? They are a *lot* colder than other areas of your body. I myself have tested this extensively and found that generally, the lower abs/love handles/lower back areas (typical areas where men tend to store stubborn fat) have temperatures that are 1-2 *full degrees* Fahrenheit lower than other areas of my body. Just prior to writing this, I told my wife about it and she didn't believe me. So she immediately grabbed our thermometer to test it. Sure enough, if she measures in most places on her body, she gets between 97-99 degrees F, but on her butt and thighs, it is between 94.7-95.7 F. Again, that's 2-3 full degrees F° lower than anywhere else on her body. This is not a coincidence. Areas that are hard to burn fat are primarily that way due to lack of blood flow to that region, therefore they are significantly colder. Blood flow to the tissues is a huge factor.

As physiology expert Dr. Keith Frayne notes in Proceedings of the Nutrition Society: "There is evidence that adipose tissue blood flow does not increase sufficiently to allow delivery of all the fatty acids released into the systemic circulation."[362] In other words, fatty acids may indeed be getting released from the cells in our

hard to burn off fatty areas, but due to poor circulation to those areas, most of those released fats don't even make it into the bloodstream where they have the potential to be burned. So they end up just getting deposited right back into the fat cells they originated from, essentially being locked off in that area.

If we can somehow cause a specific fatty area on our body to have all its blood vessels dilated and be filled up with blood, and if we can preferentially stimulate the fat cells in that specific area to release their glycerol and free fatty acids into the bloodstream, then we have the key to targeting fat loss to specific fat areas on our body.

Now here's the key thing to understand: Most people who have tried to lose fat in a "stubborn fat" area have been trying to pursue the goal of either enhancing localized fat burning or increased blood flow to a particular region through muscle contractions in the muscle next to the fat we want to burn off. As research (that I showed you above) has already proven, relying on muscle contractions in a specific area to burn fat from the layer of fat next to that muscle is basically a worthless approach.

But what if there were a truly effective way to get the fat cells in a particular area to be perfused with blood and release their fats into the blood? Something that no one talking about spot reduction has yet thought of.

It turns out that red/near-infrared light affects both blood circulation to the area it's shined on, as well as stimulating the release of fatty acids from fat tissue!

And there are numerous studies showing it contributes to fat loss:

Here's a quote from one review of the scientific literature on the ability of red/NIR light to help with fat loss:

> "Within the past decade, LLLT has also emerged as a new modality for noninvasive body contouring. Research has shown that LLLT is effective in reducing overall body circumference measurements of specifically treated regions, including the hips,

> waist, thighs, and upper arms, with recent studies demonstrating the long-term effectiveness of results. The treatment is painless, and there appears to be no adverse events associated with LLLT. The mechanism of action of LLLT in body contouring is believed to stem from photoactivation of cytochrome c oxidase within hypertrophic adipocytes, which, in turn, affects intracellular secondary cascades, resulting in the formation of transitory pores within the adipocytes' membrane. The secondary cascades involved may include, but are not limited to, activation of cytosolic lipase and nitric oxide. Newly formed pores release intracellular lipids, which are further metabolized."[363]

To give you an idea of some of the research:

- A group of 20 women riding stationary bicycles 3 times per week for 4 weeks while being exposed to NIR lost (on their waist, hips, and thighs) an average of 8 centimeters or 444% more fat (specifically on the waist, hips, and thighs) as compared to 20 women doing the same exercise without NIR.[364]
- Studies on "laser liposuction" have also shown that red/NIR light therapy alone can even have significant fat loss benefits. "LLLT achieved safe and significant girth loss sustained with cumulative treatments of 8 treatments over a 4-week period. The girth loss from the waist gave clinically and statistically significant cosmetic improvement." [365,366]

Given that red/NIR light stimulates both blood circulation and the release of fatty acids from fat cells, it is reasonable to believe that it may very well be the most effective tool out there for getting rid of stubborn fat. While more research is needed to confirm this, I actually developed a "stubborn fat protocol" around this several years ago, and based on my experimentation over the last few years with clients, I

can say with a high degree of confidence that it works amazingly well.

Here's how to do my Stubborn Fat Protocol:

1. **Start when you wake up in the morning in a fasted state.**
2. **Get your body (and especially the stubborn fat area) warm.** A hot shower or sauna is great. Then put on clothes to stay warm, and maybe even use extra clothing on the stubborn fat areas.
3. **Do some light warm up exercise (walking, resistance bands, yoga, calisthenics, etc.).**
4. **Remove clothing from the stubborn fat area and do 3-7 minutes of red/NIR light exposure on the stubborn fat area at 6" away from the light.**
5. **Do 5-10 minutes of high-intensity interval training (HIIT).** There are many variations of how to do this. But to keep it simple, do fast-paced bodyweight exercises like squats, pushups, burpees, jumps, jumping rope, running, or cycling. There various time intervals for workout and rest periods, but a simple and effective way to get started is to do 20-45 second bursts of high-intensity effort with 10-30 seconds of rest between each interval.
6. **Go for a long walk for 30-60 minutes.** (During this period, keep your body warm, especially the stubborn fat area to keep optimal blood circulation in that area. You can even add a neoprene wrap to the area to create extra heat and blood circulation.)
7. **Ideally, wait at least 1 hour before eating.**

Do this protocol in the mornings during a fat loss phase (i.e. a period when you are actively on a weight loss regimen and losing fat) and you'll notice that you are slimming down in those stubborn fat areas more than you ever have before!

Now, this isn't the only potential way that you can use red/NIR light therapy to support fat loss. Some studies have shown that using the light in tandem with exercise (before or after) on the muscles used during the workout (as opposed to on fat areas) leads to increased overall fat loss.

Again, please note that red/NIR light therapy doesn't actually burn off the fat by itself. The mechanism appears to be that it causes the fat cells to release their stored fat into the bloodstream where it can (potentially) be burned for energy. One still must be in a calorie deficit to have actual fat loss. Your overall diet and lifestyle must be conducive to overall net fat loss, otherwise you will just put back the fat right back into the fat cells it was released from. If you're not actively doing nutrition and lifestyle interventions to lose fat, please don't think that the light therapy alone will cause fat loss. Think of it more as a tool to *amplify* the fat loss effects from diet and exercise, rather than a tool that generates fat loss by itself. Nevertheless, this technology can be used to greatly accelerate loss of overall body fat, and even "stubborn fat" from fat areas that normally are resistant to being burned off—for men, this is the lower abdomen and love handles, and for women, the hips and thighs most typically, or belly fat.

Overall, the research is clear that red/NIR light can be a powerful tool to support your fat loss efforts.

So, with a red/NIR light therapy device of your own, you can potentially achieve significant weight loss and fat reduction (and dramatic improvements in insulin sensitivity) in the comfort of your own home.

Summarizing the Benefits of Red and Near-Infrared Light Therapy

In summary, red and near-infrared light therapy are incredibly powerful tools you can use to dramatically enhance your health. As I said at the beginning of this book, if there were a drug that had scientific research showing all these benefits, it would be an absolute

blockbuster drug for pharmaceutical companies—it would be hailed as a "miracle drug" and prescribed to basically *everyone*.

Here's the best part: That "drug" exists. It's just not in the form of a pill. It's in the form of red and near-infrared light therapy!

From Adel Moussa, the author of SuppVersity, a popular fitness blog that reviews scientific research:

> "When I started this blog a few years ago, I was guilty of believing that supplements would be the most relevant ergogenics [performance enhancers] for anyone who trains, myself. Today, 2,300 articles later, this has changed: don't get me wrong - supplements can be useful, but diet, training and - at least in a few cases - even things like using light emitting diode therapy (LEDT) or low-level laser therapy (LLLT), as it is also called, are much higher on the 'things that really work'-list."[367]

This is a remarkable quote. Basically, after reviewing thousands of studies examining supplements, he concludes that, in general, red/NIR light generally provides bigger effects than the vast majority of supplements. This is also notable because there is so much focus and attention on supplements, and so few people have heard of red/NIR light therapy.

Now that you can see how red and near-infrared light have the potential to help combat skin aging, improve brain health, decrease pain and speed healing, improve mental and physical performance, increase muscle growth and/or fat loss, and many other benefits, you're probably wondering how you can get your hands on one of these devices.

You might also be thinking: "There are lots of red LED lights for sale on Amazon and eBay that claim to have health benefits…so how do I know which devices work best and which device I should get?"

There are indeed hundreds of different red and near-infrared light devices for sale online—devices for the face, hair, tendons, and more.

Here's the crucial piece of information you need to know: **Virtually ALL of these devices—even the ones that cost hundreds of dollars—are grossly underpowered, too small, and ultimately, ineffective or very time-consuming to use, or both.**

To understand why, let's talk about red light therapy dosing…

Don't worry, there are several companies that offer high quality devices and products, and I am going to break down my recommendations for you in a later section.

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Guide to Red Light Therapy Dosing

Before we discuss all the factors that go into device selection and how to get the ideal dose of light, let me preface this next section by saying that **if you don't care to understand all the technical aspects of this, that is perfectly fine. You don't *need* to understand all of the factors that go into light selection, power density, joules, the nuances of the mathematical calculations and so on. If you just want the practical how-to guidance, you can skip to the summary "Key Points for Dosing."**

I will just add that you do need to pay attention to my warnings not to overdo treatments. While red/NIR light therapy is very safe, thinking that "more is better" and then overdoing treatments will actually *decrease* the effectiveness. So make sure you understand and adhere to the general guidelines for dosing.

Also, please note that dosing in red/NIR light therapy is a tricky and complex issue because of the wide variety of different types of devices (laser units vs. LED panels vs. other devices), a wide range of different doses used in various studies, the overall body surface area treated, the types of treatment (e.g. general light on an area vs. light on acupuncture points), the goals (e.g. performance enhancement vs. fat loss vs. skin anti-aging), and the specific body tissues you're trying to affect (e.g. the skin requirement is very different than that of deep tissue, and something like the brain, which sits behind the skull, may require much larger doses to deliver a significant amount of light).

Due to these complexities, different people sometimes have different views on the subject of ideal dosing. For example, I have talked to some people who recommend only very low doses, with lasers. Others who advise against lasers. Others who advise much larger doses than what I recommend here, and who think that it's basically impossible to overdose on red/NIR light therapy. So

there are a number of people in this field who don't agree with each other on finer details. With all of that in mind, I am going to do my best here is to accurately represent the overall body of research and what I perceive to be general consensus of the world's most respected experts on red/NIR light therapy.

The dosing guidelines here are generally intended for use with LED panel-style light devices. (I'm assuming most people don't want to spend $2,500-$30,000 on a laser device, and want to be able to do red/NIR light therapy for less than $1,000 or $500, so I'm focusing on how to do treatments with LED panel light devices rather than lasers.)

Now, let's get into a detailed discussion of applying what we've learned.

If you want an effective light therapy session, you must have an effective dose. That requires:

- A light that is relatively powerful (i.e. has an ideal "power density")
- Ideally, a light that can treat a large area of the body at once
- An understanding of the optimal duration of time using the light to get the right total dose

Too little of a dose and you get minimal to no effects. Too strong of a dose and you get minimal to no effects.

Let's talk about power density of the light first.

As mentioned previously, most studies showing benefits of red/NIR light therapy used light outputs of 20-200mW/cm^2.

This is basically a measurement of power density—how much power the light is emitting (in watts) over how big of an area.

To put that in different terms, if you shine the light on your torso (let's say, for the sake of ease of calculation, that it's an area of 50cm x 40cm, which equals 2,000cm^2) and the light you're using is 200 watts (which

is 200,000mW), then you have 200,000mW/2,000cm² = 100mW/cm²

That's a great power density.

But, beyond this simple calculation, there are a few nuances here that make this considerably more complex:

1. **Distance from the light.** It's also important to be aware that **this measure of power density decreases dramatically by moving further from the light source**. So you'll get the highest doses by being within a few inches of the light. Moving further away than about 3 feet from the light (as a general rule) and you'll get little to no effect on anything below the surface of the skin. (And that's using a powerful light. Many lights won't provide effective doses beyond just 12" away.) Essentially, moving closer to the light increases the potency of the light dose, and moving further away dramatically decreases the dose. However, closer is not universally better—I generally advise staying at least 6 inches away to minimize exposure to EMFs (electromagnetic fields), just to err on the side of caution. This applies to all electronic devices, from TVs to dish washers to blenders. So the sweet spot is generally between 6 - 36 inches, and we'll talk more later about when to go closer and when to move further away depending on your goals. But again, the point here is to understand that distance from the light dramatically affects the dose your cells receive.
2. **Wavelengths of the light.** Certain devices emit all the light output/wattage in the effective therapeutic wavelengths, and others emit only part of their total wattage in therapeutic wavelengths.

Therefore, they may have 20-60% of their total wattage at non-therapeutic or non-optimal wavelengths. This also factors into the dose. When this is the case, it makes calculations quite complex.

3. **Claimed wattage vs. actual wattage.** The claimed wattage of a light differs from the *actual* power output of the light. This is a critical difference One thing is the claimed wattage that the light device is rated for, and another thing is the actual intensity of the light emitted. **Generally, lights emit a power density about 25-50% lower than the claimed wattage would suggest.** So the truth is that even with the calculation above, it's really just a *theory*. You don't know the *true* light intensity output of the light you get until you actually measure it. You have to rely on actual measurements using a PAR meter, rather than calculated measurements based on theoretical wattages. Don't worry—I've already done all this for you, so you don't have to worry about it. **But again, be aware that the *actual* light output of many devices may be a whopping 50% lower than what the companies are claiming! (If you're interested in learning more about this point, Platinum Grow Lights has videos on their website where they compare actual light emission from various lights that are all rated at the same wattage. They even show in the video how massively the actual light output can differ from the claimed power.)**
4. **Size of the device/treatment area.** One other nuance that's important to note here is that even if a device is technically powerful enough to create beneficial effects, it may still be too small. In other words, one can have a device that has a power density of let's say 100mW/cm^2, but it may be a device with only a few inches circumference and thus, only emits light over a small area of your

body. If you're trying to treat large areas of your body, this makes things extremely inefficient and time-consuming.

Overall, the device needs to emit light above a certain power density (light intensity), needs to be at the right wavelengths, be at the proper distance away from your body, and ideally, needs to be physically large enough to emit light over a large portion of your body.

But for simplicity, let's leave all these nuances of the calculations out of it.

The next part of the equation is how long should you apply the light. The dose (duration of exposure) is calculated by:

Dose = Power Density x Time

So all we are doing is taking that number we already have (mW/cm^2) and then the "dose" can be calculated once you know how long you should apply that light for. (If this sounds complex, don't worry, because it's actually VERY simple if you get the lights I recommend). Here's the equation you need to calculate the dose:

mW/cm^2 x time (in seconds) x 0.001 = J/cm^2

Here's the critical piece of information you need to know: **The dose you want to shoot for is between 3J/cm2—50J/cm2.**

(Note: Depending on whether you're treating superficial areas like the skin or surface wounds or deeper tissues like muscles/organs, etc., you want different doses. We'll talk more about the specifics of those treatment goals in a later section of this book.)

Here are some sample calculations to show you how this works:

- 25mW/cm^2 applied for 40 seconds gives 1J/cm^2
- 50mW/cm^2 applied for 20 seconds gives 1J/cm^2
- 75mW/cm^2 applied for 15 seconds gives 1J/cm^2
- 100mW/cm^2 applied for 10 seconds gives 1J/cm^2

What that means is that if you have a device with a power output of 100mW/cm² (at the distance you are using it), then you want your treatment time to be between 30 seconds-7 minutes on a given area of your body (that will equate to roughly 3-50J/cm²).

If you have a device that has 50mW/cm² (at the distance you are using it), your treatment time would be 1-14 minutes on each area.

That's a pretty wide range of times, so let me simplify this.

If you get either of the two top lights I recommend, they emit roughly 90mW/cm² at a distance of 6" away from the light, about 55-65mW/cm² at a distance of about 12 inches away from the light, 35-45mW/cm² at 18 inches away, and 25-30mW/cm² at 24" away.

If you're a more visual person, this will help get what I'm saying here:

Irradiance at 6"	Irradiance at 12"	Irradiance at 18"	Irradiance at 24"
85-95mW/cm2	55-65mW/cm2	35-45mW/cm2	25-30mW/cm2

Now you might be wondering, "Okay, so how do I know whether to use it for 1 minute or 10 minutes? And how do I know whether to use it from 6" away or 24" away?"

Good questions!

For skin issues (e.g. anti-aging benefits) and other more superficial (near to the surface) body issues, there are a few things to note. **We want a relatively low overall dose on each area of skin, of roughly 3-15J.** Also, there is some indication that lower power densities (below 50mW/cm²) may actually be more optimal for treating the skin than very higher power densities. This may cause you to think that low power lights are okay, but high-power lights *still* have a huge advantage because they allow you to move the light further away (note: light spreads out and covers a larger area the

further you are away from it) and thus treat a much larger area of your body at once with the optimal light intensity and dose. Smaller lights are much more inefficient and time-consuming, and limited in what they can be used for. (More on this later!)

In contrast, for treating deep tissues, you want bigger doses and higher power density (light intensity) for optimal effects. You want doses of 10-60J. So in general, you'd want to have the light much closer to your body with a much higher light intensity. That's what's needed to deliver optimal doses of light deep into your tissues.

To sum up: With skin/surface treatments, you want to be further away from the light (which lowers the light intensity and covers a broader area of your body) for an overall lower dose. With deeper tissues, you want to be closer to the light (which increases the light intensity) for an overall higher dose.

To make this very specific and practical, here are some simple guidelines:

- **FOR SKIN ISSUES:** Assuming you have one of the lights I recommend, for skin issues (e.g. anti-aging benefits) and other more superficial (near to the surface) body issues, here are my basic usage suggestions:
    - Somewhere between 1-4 minutes from 12" away. (Note: For skin issues, I recommend going 12" or more away from the device, whereas with deeper tissues, you want to be closer and have higher power density to reach deeper into the tissues.)
    - Or 1.5-5 minutes from 18" away.
    - Or 2-8 minutes from 24" away.
- **FOR DEEP TISSUES:** For deeper issues in muscles, tendons, ligaments, bones, glands, the brain, organs, etc., you want much higher doses more in the neighborhood of 10-60J. In general, this means that you want higher power devices and you want to be 6-12" from the device (as opposed

to further away as with treating the skin) to get optimal doses of light to those deep tissues. The deeper the tissue you're trying to treat, the closer to your body you want the light to be (i.e. 6" is ideal) and the higher the overall dose you want to do, so that you deliver adequate therapeutic doses to the deeper tissues. Also, for use on the brain, this may require higher doses (or doses on the higher end of the spectrum shared here) because it takes a relatively higher dose for enough light to penetrate through the skull and be delivered to the brain. Here are my general suggestions for treating deep tissues below the skin:

- Using the light from 6" away for between 2-7 minutes per area is the ideal dose range.
- Or 5-10 minutes per area from 12" away. (For treating deep tissues, I don't recommend going further away than 12" away from your body.)

If you get the lights I recommend, that's really all you need to know.

If you choose a different device than one I recommend, you'll have to do the calculations yourself using the above equations. And now that you know how to do all this math, you can certainly do these calculations for yourself. The only tricky part is that actual wattage is often much lower than claimed wattage for many lights, so if your calculations are based on the claimed wattage instead of actual measurements using a PAR meter, your calculations will likely be off by a fairly wide margin.

Reminder: More is not necessarily better! As you'll see below, there is something called a "biphasic dose response" whereby doing too much can actually result in a *lesser* benefit rather than more. So don't assume that "if a little is good, a lot must be better." **All you're doing is decreasing the benefit by doing more than the recommended doses**. Let me repeat that for emphasis: Doing larger doses than what I recommend will render *less* of an effect, not more.

For those of you with health struggles, if you are very ill or your health is severely compromised, be aware that you in such state you're more fragile and will not be able to tolerate as much of the light. A healthy young person may overdo the light and not really notice anything, but an ill person will notice that they feel fatigued if they overdo it. And as an ill person is much less tolerant, their body may have a lower threshold for overdoing it compared to the younger, healthier person. So for anyone who is in very poor health (especially those who are easily overwhelmed by any type of stress or physical activity), it is very important to start with very low doses (i.e. at the bottom of my recommendations, or even lower), to make sure that your body can tolerate it. Then *slowly* increase the dose over the subsequent days and weeks to find the appropriate dose for you within the range outlined above.

Can You Overdose on Red/NIR Light Therapy? (The Biphasic Dose Response)

As I mentioned, there is something called the biphasic dose response. But what does that mean?

That means that too little red/NIR light therapy won't provide much, if any, benefit, and too much will also negate the benefit.

In other words, it's important to get the dose right and to be in the range I'm recommending. You aren't doing yourself any favors by dosing higher than my guidelines suggest.

The principle of the biphasic dose response is often explained as the Arndt-Schulz law, which dates back to the end of the nineteenth century, when H. Schulz analyzed the activity of various kinds of poisons like bromine, iodine, mercury, arsenic, etc. on yeast, where he showed that in very low doses, all of these poisons actually had a slightly stimulatory effect on the yeast metabolism. With the help of psychiatrist R. Arndt, they developed the concept (that later became the Arndt-

Schulz law) which states that weak stimuli slightly increase metabolic activity, stronger stimuli increase it even more until a peak is reached, and from there, increasing the dose further suppresses the effect until a negative/harmful effect is eventually reached. Later, this concept became known as "hormesis" (which I discussed earlier.) The term "biphasic dose response" is also used.

In the context of light therapy, Hamblin et al. describe it this way:

> "Simply put, it suggests that if insufficient energy is applied, there will be no response (because the minimum threshold has not been met), and if more energy is applied, then a threshold is crossed and biostimulation is achieved. However, when too much energy is applied, then the stimulation disappears and is replaced by bioinhibition."[368]

In fact, Hamblin believes that in instances where studies don't find significantly positive effects, it's almost always because they did *too large of a dose*.

One other important aspect here is that it's much easier to do too large of doses on surface issues (like the skin) than it is for deeper tissues. The optimal doses for the skin can be reached within seconds or a few minutes with many devices, and it is very easy for people to use devices for two or three times longer than is ideal—often times, with people thinking that doing more will lead to better results—and they actually negate the benefits in the process.

Although this idea might sound odd at first, there are many common examples where we know this occurs. One example is physical exercise. In small or moderate doses, it is clearly linked with countless health benefits. But we also know that people who over-exercise can actually cause themselves a great deal of harm. It's not uncommon to hear of ultramarathon runners dropping dead from heart attacks, or developing calcification of arteries in the heart, or of female athletes over-exercising themselves into losing their menstrual cycle and fertility (hypothalamic amenorrhea). And of course, anyone who has overdone it with exercise knows that fatigue is a

common side effect. In athletes, there is “overtraining syndrome” which is associated with stalled progress, fatigue, depression, headaches, insomnia, weakened immune function, and many other symptoms.

In short, exercise is an incredible and powerful medicine for us. But only when done in the right amounts. Too much, and you may negate the benefits. And if you really overdo it in an extreme way, it actually damages your cells.

Many other things are like this too—sun exposure is associated with numerous health benefits, but if you do too much, you can get severe sunburns, accelerated aging, skin damage, and potentially skin cancer.

Red and near-infrared light are the same way. You must use them in the right dose to get the benefits. Too much and you negate the benefit.

Fortunately, red and near-infrared light are safer and have less potential for harm (when you overdo it) than either sunlight or physical exercise. Therefore, it’s extremely safe! I even know some people who have used red light therapy for decades and believe that it’s very hard to realistically overdo it in a way that negates the benefits. Generally, if you overdo it slightly, you won’t likely notice any negative effects whatsoever. And many people won’t even notice negative effects if they overdo it by a lot. But if you massively overdo the dose, it’s common to feel some fatigue or get a slight headache. That’s typically as bad as gets for most people. Someone with severe health issues who is more fragile may notice very significant fatigue for a day or two following overdosing it with the red/NIR light (much as they would if they overdid exercise). Basically, there is very limited potential for side effects with overdosing, particularly when compared with exercise or sun exposure.

So if you feel a little fatigued after using it, that’s usually just a sign that you overdid the dose a little. Lower the dose, and the problem is solved. Just think about this: If you got really sore and fatigued after doing an intense workout, would you conclude “exercise is terrible for you

—it just makes you inflamed and fatigued… I quit!"? Or would you think along these lines: "I know that there are thousands of studies showing that exercise is highly beneficial to health, but I'm really tired and inflamed from this last workout, so I better back off the intensity/duration of the workouts and do a dose that is more appropriate for my body and my fitness level."

Hopefully the latter.

Key point: Red/NIR light is exactly the same principle.

Since this phenomenon is well-known, and we know that it applies to red and near-infrared light therapy, what causes it?

It's not completely understood, but there are several theories:

- **Excessive Reactive Oxygen Species (ROS).** All hormetic stressors produce some ROS or "free radical species." These ROS are vital for building up the internal anti-oxidant defense system (the A.R.E. or Antioxidant Response Element) and are vital for your body to gain the benefits of things like exercise or light therapy. But, they still produce free radicals that oxidize, and if they are produced in too large amounts that overwhelm the body's capacity to quench those free radicals, cell damage can occur. Also, some people may have a very weak internal antioxidant defense system that is easily overwhelmed by even small amounts of hormetic stressors like light therapy or physical exercise. In this case, the exercise or light therapy doesn't create a small stimulus that the body adapts to successfully—the body is overwhelmed by it and cannot deal with the stressor, and thus, cell damage occurs.
- **Excessive Nitric Oxide (NO).** Another potential mechanism is excessive NO release. NO serves many vital roles in the body, and can either be protective or harmful, depending on the amount and the place it's located in the body. It's a double-edged sword. One function for example, is dilation

of blood vessels. Another function is its role in the immune response to kill certain kinds of microbes that can cause infections. The right balance in the right locations is key with NO. Since it is known that red and near-infrared light affect NO release, it is possible that overdosing on red/NIR light may imbalance NO or release too much. Very high amounts of NO can lead to the formation of a highly toxic free radical called peroxynitrite, which can cause cell damage.

- **Activation of a cytotoxic pathway.** The third theory is that while low doses stimulate cells with a low dose stressor that the cells can adapt to, very high doses may activate an additional pathway that triggers apoptosis (programmed cell death). This is not unreasonable, because over-exercising can also cause severe cell damage and trigger apoptosis.[369] Hamblin et al. describe this possibility in their textbook: "high-dose LLLT was found to induce apoptosis via a mitochondrial caspase-3 pathway, and cytochrome c release was attributed to the opening of the mitochondrial permeability transition pore caused by high-level intracellular ROS generation."[370]

It is also possible (perhaps even highly likely) that these three pathways are intertwined and it's all three, rather than just one of them. But the basic idea is that much like overdoing physical activity, you can get symptoms like fatigue and headaches if you overdo red/NIR light therapy.

Hamblin et al. summarize the biphasic dose response by saying:

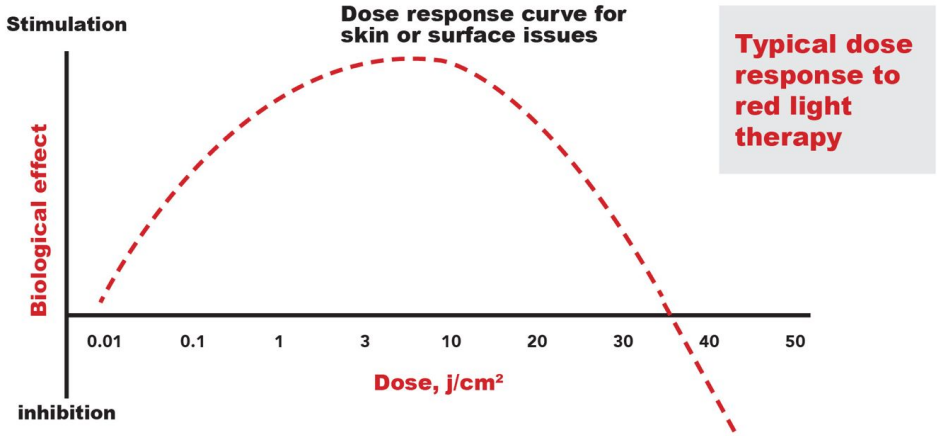
> "LLLT delivered at low doses tends to work better than the same wavelength delivered at high levels, which illustrates the basic concept of biphasic dose response or hormesis. In general, fluences of red or near-infrared as low as 3 or 5 J/cm^2 will be beneficial in vivo, but a large dose, e.g., 50 or 100 J/cm^2 will lose the beneficial effect and may even become detrimental… These advances [in our understanding

> of the biphasic dose response] will lead to greater acceptance of LLLT in mainstream medicine and may lead to LLLT being used for serious diseases such as stroke, heart attack, and degenerative brain diseases. Nevertheless, the concept of biphasic dose response or LLLT hormesis (low levels of light are good for you, whereas high levels are bad for you) will remain."[371]

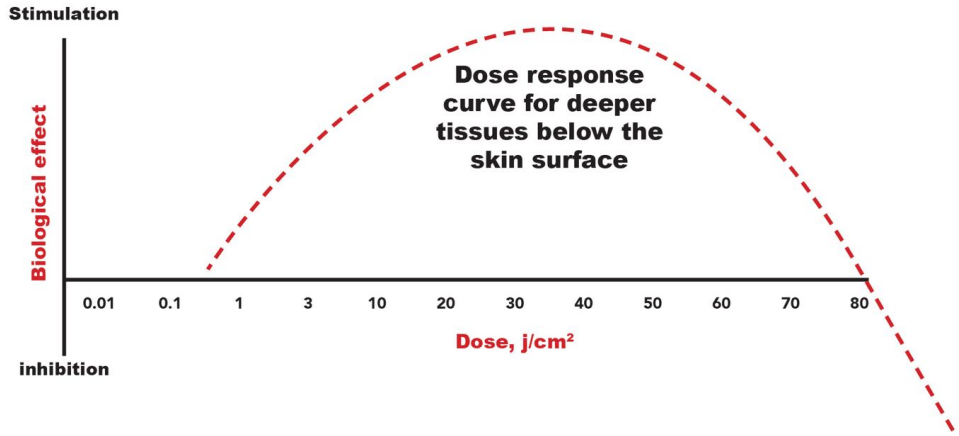
There are a number of studies that have shown that by overdoing the dose, you negate the benefits. If anything, the research indicates that smaller, more conservative doses are *superior* to very large doses.

Below are two illustrations meant to give you an idea of the optimal dosing parameters for surface tissues and deep tissues. (Note: These images are not exact, because actual responses differ somewhat depending on the exact tissues treated and the type of device and other parameters used—these images are intended to illustrate the general concept of the biphasic dose response and give an idea of the general range of optimal doses.)

Here is an illustration of the general optimal dose range for skin treatments (or tissues near to the surface of the body):



Here is an illustration of the general optimal dose range for deeper tissues beneath the skin:



Please know that it's perfectly fine, and may even be *better,* to stick with the lower end of my recommended ranges of doses than to try to push into the upper limits of dose ranges.

I know there is a tendency in human psychology to want to do more and think that higher amounts of something will be better—i.e. "if a little is good, a lot must be better."

So let me repeat one more time for emphasis: **With red/NIR light treatment, more DOES NOT equal better.**

Stick with the recommended dose range, start with the lowest end of the range, and don't be in a rush to do a lot more. The benefits may be most optimal in the lower to mid-range of the recommended dosage.

How Often You Should Do Red and Near-Infrared Light Therapy Treatments

The last question to answer is "How often should you do the treatment?" The studies all use different dosing schedules, but in general, the range is from two times per week to two times per day.

As a general approach, I suggest starting slow to assess your body's response at first (with low doses done infrequently for the first few sessions) and then building up to 3-7 sessions per week.

As with the biphasic dose response (and with many other types of hormesis, like physical exercise, for example), note that it may turn out that too high of a frequency is detrimental. Although there is no consensus in the research yet, my hunch is that optimal treatment times are probably once every other day to once per day at the most. I personally do it every other day, because that's what I believe will turn out to be most optimal.

How Deep Does Red/NIR Light Penetrate Into Our Body?

The answer to this question is actually much more complex than you might imagine...

The penetration depth differs depending on many factors:

- **The type of tissues (e.g. skin vs. bone vs. fat vs. muscle).** First, it depends on exactly what part of your body you shine it on. It will penetrate much more deeply into your belly than your skull.
- **The power output of the device.** More powerful lights can deliver more light to deeper tissues of the body.
- **The distance of the device from your body.** As explained previously, the closer the light is to your body, the higher the light intensity will be and the deeper it will penetrate.
- **The wavelengths of light.** Blue light and UV light, for example, get almost completely blocked by the skin and do not penetrate much more deeply than the very surface layers of skin. Whereas red and near-infrared penetrate much more deeply. And within that category, near-infrared has significantly greater penetration depth than red light, and there are even some small differences between specific wavelengths of red and near-infrared light in terms of penetration depth.

Penetration depth is also made even more confusing due to varying claims of red/NIR light penetrating only *millimeters* into the body and other claims of it penetrating *inches* into the body.

How can we make sense of this?

Well, first of all, it is actually very easy for even a child to verify that red light penetrates much further into the human body than just a few millimeters. Take a flashlight and go into a dark room. Then shine the light through your fingers. You can see the light—specifically the red wavelengths of light—penetrates all the way through your fingers. If you have a strong enough light, some light can even penetrate all the way through the palm of your hand! So this 5-second test that you can do yourself at home can tell you that it penetrates at least an inch or more.

So why the varying claims of millimeters vs. inches?

It turns out that "penetration depth" is actually a technical scientific term within the study of light, and it has a specific definition. Most people misunderstand the meaning of this term "penetration depth."

Penetration depth "is defined as the depth at which the intensity of the radiation inside the material falls to 1/e (about 37%) of its original value at (or more properly, just beneath) the surface."

In other words, the penetration depth is technically defined as the depth that a light penetrates a specific type of substance where it loses 63% of its overall light intensity/irradiance.

In most human tissue (and this depends on the specific type of tissue, whether fat vs. bone, for example), red/NIR light may have a technically defined "penetration depth" of 3-6mm. Then over the next 3-6mm, it may lose another 63% of that remaining light, and then over the next 3-6mm, another 63% is lost, and so on. In other words, the deeper you go, the more of the overall light doesn't reach as it is absorbed in the tissues closer to the surface.

So a light may have a technically-defined "penetration depth" of 5mm, but you can take that light and shine it through your hand that is more than an inch (25mm) thick and see light coming out the other side. How does that make sense? Well, the light that penetrates all the way through your hand is not at the same light intensity as it went into your hand. That's because 63% of the light was absorbed in the first 5mm of tissue, then another 63% was lost in the next 5mm, and another, and so on, such that maybe only 5-15% of the light photons that are emitted actually penetrate all the way through your hand and out the other side. In fact, we even know that near-infrared light can penetrate through bone (like the human skull) into the brain. According to Hamblin et al.,

> "One of the best studies on penetration was provided by Tedford et al. in 2015. They performed a light-penetration study on human unfixed cadaver brain tissue … They compared 660-nm, 808-nm, and 940-nm laser penetration. 808 nm achieved the best penetration, and they concluded that 808-nmwavelength light penetrates the scalp, skull, meninges, and brain to a depth of approximately 40 mm." [372]

Penetration depth is also a confusing topic when it comes to red/NIR light because many light device manufacturers make claims about how their lights penetrate deeper than other light devices. Some also make claims about the particular pulsation of the light ("super pulses") and claim that affects penetration. (Note: Based on the evidence, pulsation of the light does not appear to affect penetration depth.) These claims make it hard to know what's really going on. But it is true that higher power devices will deliver more light to deeper tissue depths.

To sum up all the confusing concepts around penetration depth, here's what you really need to know: **Red and near-infrared light can penetrate several *centimeters* (close to 2 inches) into your body, and a high-power light with the right wavelengths (especially near-infrared) can even**

penetrate through the thick and dense human skull to deliver light directly into the brain. Hamblin has given the general rule of red/NIR light penetration of "up to 5cm," which is almost exactly 2 inches. So that gives you a sense of how deep this light is actually getting into your body.

As you can see, "penetration depth" is not actually as simple a concept as one would think. But the general point here is that with high-power light sources, red/NIR light can deliver significant amounts of therapeutic light *inches* into human tissue.

The Problem with Most Devices on the Market

Now that you understand the importance of the power density of the light, here's the big problem with most lights on the market.

Most devices being sold (that you might pay $100-$900 for) are:

1. Grossly underpowered and simply too low wattage to reach therapeutic power densities of above 50mW/cm² with large coverage of body areas. This is especially problematic for treating deep tissues. So you'd end up having to use the light for extended periods (sometimes upwards of 20-40 minutes) to generate an effect. Moreover, the weaker lights won't penetrate deeply into the body and to even treat any deeper issues, even with extended exposure times.
2. Very small, and thus, only treat a small area of your body. Even if a small light has optimal power density, a small light that radiates light on only 5-10 square inches will require multiple treatments to cover a significant portion of your body. (Note: This is a major limitation with small LED devices.)

If I can give one piece of advice on which light to get, it's this: **Get a high-power light that reaches therapeutic power outputs *and* is big enough to cover a significant portion of your body**.

Take it from someone who has wasted over $10,000 on underpowered red light devices (that now are just junk in my garage). I bought them before I understood everything I just explained to you about power density, dose, and how much of the body is being illuminated, thinking that just because the light was "red" that it would provide all the benefits. Nope.

I will tell you right now that 99% of the red light therapy products being sold in major outlets online are a waste of money. So please be aware of the power output and size of the light you're interested in. Not understanding those two factors caused me to waste a huge amount of money on ineffective and time-consuming lights.

I've given you all the information you need to know if a light will work or not. So if you have any interest in lights others than the devices I recommend, I suggest making sure to closely examine the wattage, wavelength, and size and do the calculations to see for yourself whether a light is quality or not. I urge you: Don't waste your money like I did!

Why You Should Get a High-Power Device

One might ask the question: "Do I really need a high-power device? Couldn't I just get a cheap low-power device and then increase the length of time I use it to get up to the recommended doses?" An alternative but similar question is: "Do I really need a large device? Couldn't I just get a small device and then just treat each area of my body separately for a few minutes—e.g. 5 minutes on my left knee, then 5 minutes on my right knee, then 5 minutes on the left cheek, and 5 minutes on the right cheek, etc.?"

This are good questions, and it's important to understand the answers to them.

Here's why low-power devices and small devices are a problem (even if you were to increase the length of time you use it):

1. **Penetration Depth:** Let's take two lights of equal size, but one light is 50W and the other is 100W. Theoretically, you could use the 50W light for twice as long (let's say 10 minutes instead of 5 minutes) and reach the same dose. And on paper, based on the simple math, this is indeed the case. **But here's the problem: More powerful lights *penetrate* more deeply into the body. They deliver more overall light deeper into the body.** So if you're trying to reach deep tissues, you may use the weaker light device for 5 or 10 times longer (than the more powerful device) but still not deliver enough light to the target tissues to reach therapeutic levels. According to Hamblin et al.: "For example, the application of a 100-mW laser will deliver higher irradiance at a given depth than a 1-mW laser (assuming all other parameters are equal). The former might generate enough light (threshold) to produce a meaningful therapeutic effect at the required depth in the target tissue, whereas the latter will not, regardless of the length of the illumination time. Therefore, technically speaking, a claim such as 'this system penetrates deeper than others by virtue of extra-high power' may be true."[373] Simply put: If you want to treat deeper tissues below the skin, I strongly suggest getting a high-power device rather than a low power device.
2. **Convenience:** Don't underestimate the simple power of being able to do an entire treatment in 1-5 minutes vs. having to do it for 10-40 minutes. A smaller and weaker light will require much longer sessions to treat a significant area (or areas) of your body. A light that can treat the entire front of your body at once and allow you to treat virtually all areas of your body in less than 5-10 minutes, whereas a smaller or weaker light may require 5-10 times longer to accomplish the same thing. (And due to differences in penetration depth, they may still be less effective.) So convenience is a huge benefit of larger and more powerful lights. For

many people who are busy, this is the difference between actually *making time to do it* vs. just having another thing sitting in your garage unused because you don't have the time.

3. **Body area treated at once:** This is a huge factor as well. The bigger more powerful devices allow you to do something very cool. They allow you to stand further back from the light (2 or 3 feet away) and still have enough power output to reach therapeutic levels. This allows the light to spread out and hit a *much larger area of your body at once*. In this way, a light that is 20 or 30 inches long can effectively treat the *entire front or back of your body at once, from head to toe.* Basically, a light that size can effectively *act* the same as a light twice the size. In contrast, if you take a small light and stand 2 or 3 feet away, it's still only going to hit a relatively smaller portion of your body, but more importantly, if the light is low wattage, you have to be within 6" of it to even get therapeutic effects—so standing back 2 or 3 feet will decrease the power density so much that you're no longer getting an effective dose (even if the light is technically hitting a large portion of your body). So ideally, you want a light that is both high wattage *and* relatively large, so you can treat large areas of your body at once with effective doses.

Without getting too complicated, I should also mention that the power of the light and the distance from it also impacts the effectiveness of the dose. Even when the calculated total doses are equal between devices, results may not be the same. So if you use a powerful light for 2 minutes, the end result may be different from a much weaker device used for 20 minutes—even if the total dose of both is 10 Joules. So total dose is not the only thing that matters—the power of the light and distance from the body also influence the end result.

I believe that for both skin issues *and* deeper tissues, a high-power light is superior. This may seem counter-intuitive at first, because how could a high-power light be

best for both contexts where you want to treat surface issues with low doses (and lower light intensity) *and* for deep tissues where you want higher doses (and higher light intensity)? Here's why:

- For skin issues, a high-power device gives you the ability to place it much further away from your body while still having optimal light intensities. In fact, with a high-power device, you *want* it to be further away to give a little lower power density of below 50mW/cm^2. Most importantly, the fact that light spreads as you move further from the source creates a huge advantage. By having the light source further away, it allows the light to spread and hit a *far larger area of your body at once*! So basically, it makes the treatment much more time-efficient compared to a lower power device that is closer to your body.
- For deeper tissues, it's straightforward—you want and need high-power lights to give the intensity needed to deliver optimal doses to the deep tissues. So even if you were to use them for long periods of time, the lower power devices simply can't do the job.

Remember, one of the big benefits of getting a high-power light is that—since light spreads out as you move further away—it allows you to treat much larger areas of your body while still getting an effective dose on all the parts of the body it is shining on. Remember, the power density (dose) of the light decreases as you move further away. In contrast, lower power lights need to be right next to your body for an effective dose, therefore, can only treat a much smaller area. **So with a high-power light that's less than 24" long, you can move it a little further away and treat the skin on almost the entire front or back of your body at once!** Whereas, with a lower power light of the same dimensions, it has to be much closer to your body to get an effective dose, and thus, you will only be able to treat a much smaller area. This is just one of the amazing benefits of high power lights—they allow a relatively

small light less—than half the length of your body—to *function* like a light that is full body size.

In short, whether your primary objective is anti-aging skin treatments, fat loss, muscle gain, or to treat organs and glands, including the brain, high-power lights are the way to go. They allow you to do so much more and get numerous benefits, are more effective, and they can treat larger areas of the body at once, so they're far more time-efficient.

Comparing Power Densities of Light Devices from Popular Brands

Below are some photos I took of actual measurements of the power densities at different distances of several lights from the companies that I consider to be the top red/NIR light device companies on the market—the Red Rush360 by Red Therapy Co., the Bio-300 from Platinum Therapy Lights, and the Joovv Mini.

Remember what I explained previously about how actual power measurements differ from claimed measurements (which are usually based on the theoretical numbers that the lights are supposed to achieve). I wanted to provide this section for you to see the actual light intensity of these three options at various distances. Again, knowing the light irradiance (power density) of a light at a specific distance is critical to getting the dose correct. If you get any of the three lights below, you'll have the actual (rather than claimed) light output measurements at various distances, so you can dose accurately. (Note: I've already done this for you, so all you have to do is follow my dosing guidelines—you don't need to do any calculations or measure light output or anything complicated.) But if you decide to get a different light other than what I recommend, you will want to buy a PAR meter and test your device to get measurements of the actual output and dose accurately.

Before we get into the photos and measurements, I want to mention a few specifics:

For all three lights, I tested a 50-50 mix of red and near-infrared LEDs. Also note that if you get a pure near-infrared device, it will emit slightly higher outputs due to the LED bulbs themselves emitting more light output.

- If you were to measure a pure red light vs. a pure near-infrared light produced by the same company, the near-infrared device would have roughly 20-30% higher light output.
- Compared to a 50-50 mix of red and near-infrared LEDs, the pure near-infrared device would have roughly 10-20% higher light output.
- If you get a pure red light device, your light output numbers will be slightly lower, and if you get a pure near-infrared device, your light output numbers will be slightly higher.

For the sake of equal comparisons, I am using a 50-50 mix of red (660nm) and near-infrared (850nm) LEDs for each of the three brands.

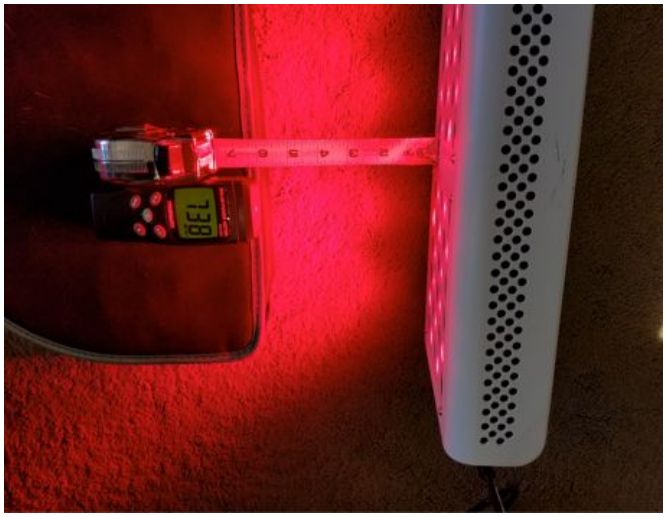
(Also, please note that one might get slightly different measurements depending on the specific light output meter one uses. So you may see other people's measurements in articles online as being 5-20mW/cm^2 different than my measurements. Rather than getting caught up on the specific number, what I'm trying to demonstrate here is the differences in light output between devices, which stay the same regardless of the specific device one uses to measure light output.)

That said, below are the photos of actual light output measurements of each device at 6", 12", and 18":

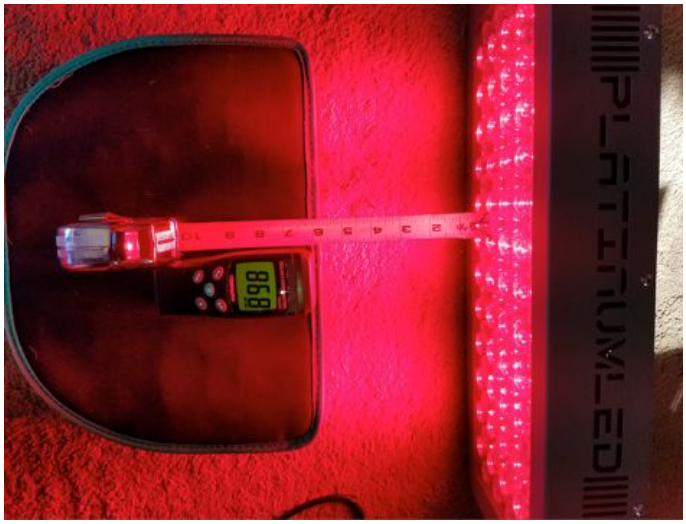
The Joovv Mini (left) Platinum BIO-300 (center) and Red Rush360 (right)

Here is a photo of all three lights side-by-side so you can get a sense of size. Note the overall number of individual LEDs—the Joovv has 60 LEDs, the Platinum BIO-300 has 100 LEDs, and the Red Rush360 has 120 LEDs. So even though they are somewhat similar dimensions in terms of casing, there is a large variance in the number of LED lamps packed within that space. Also, the Platinum light has a slight edge in terms of length, while the Red Rush360 has a significantly more expansive coverage area with its width. Also note that there are significant differences in overall wattage—the Joovv is 120W, the Platinum is 300W, and the Red Rush360 is 360W. These differences in size of the light, number of LEDs and wattage all affect how powerful the light is (especially at further distances) and how broad of an area of your body it can effectively treat at once.

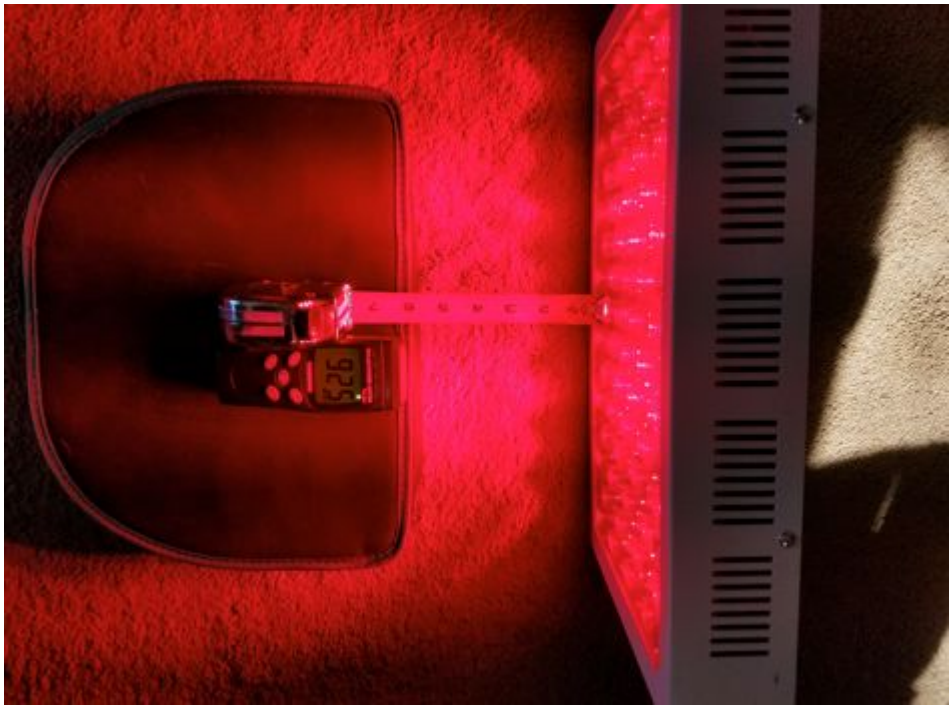
Here are the light output measurements for the three lights from 6” away:



Joovv Mini (50-50 mix of red and near-infrared)
from 6”—74mW/cm2



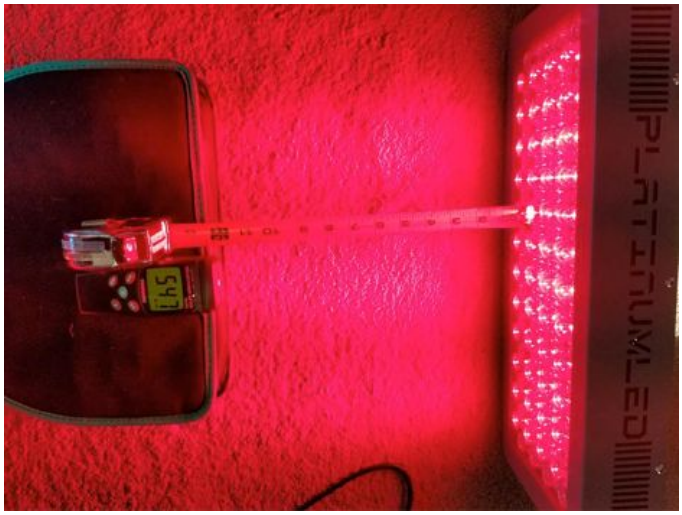
BIO 300 (50-50 mix of red and near-infrared)
from 6”—87mW/cm2



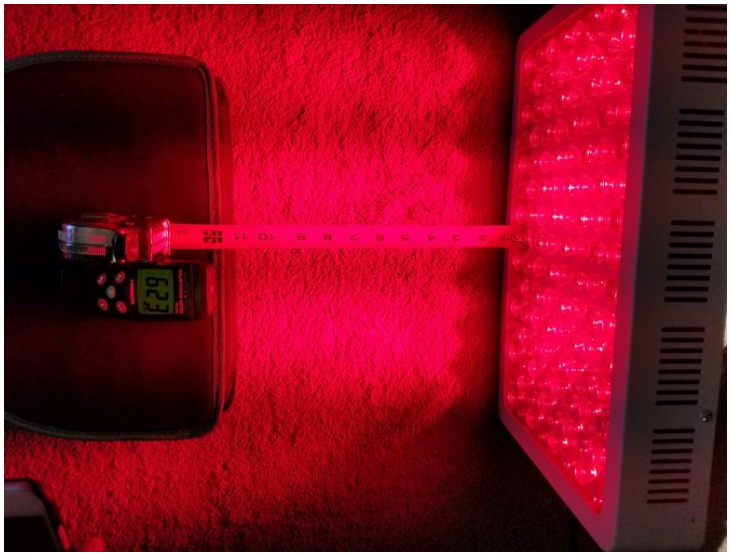
Red Rush360 50-50 mix of red and near-infrared) from 6”—92.5mW/cm2

Here are the three lights from 12” away:

Joovv Mini (50-50 mix of red and near-infrared) from 12”—38mW/cm2



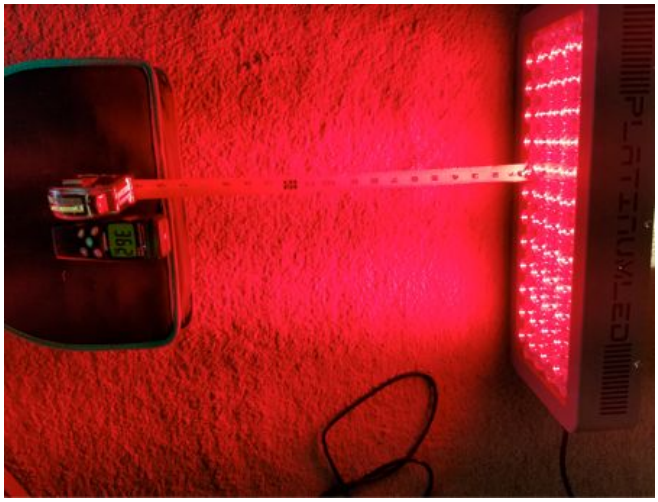
BIO 300 (50-50 mix of red and near-infrared) from 12”—55mW/cm2



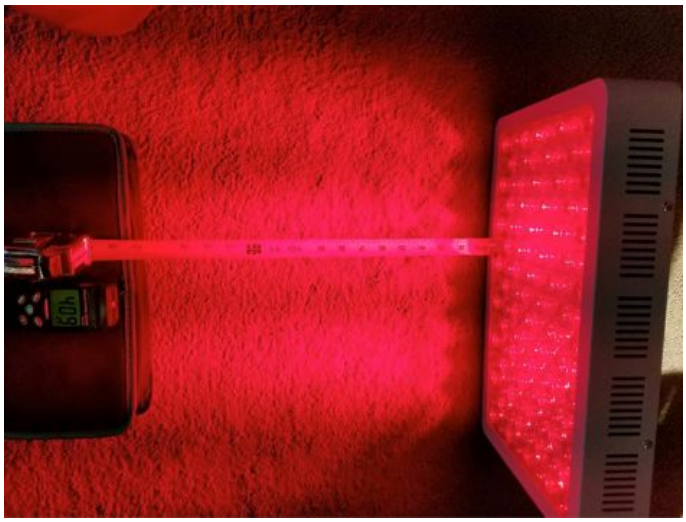
Red Rush360 (50-50 mix of red and near-infrared) from 12”—62mW/cm2

Here are the three lights from 18” away:

Joovv Mini (50-50 mix of red and near-infrared)
from 18”—22mW/cm2



BIO 300 (50-50 mix of red and near-infrared)
from 18”—36mW/cm2



Red Rush360 (50-50 mix of red and near-infrared) from 18”—41mW/cm2

As you can see, there are significant differences in light output between the different devices, even though they are similar in size and cost.

The Red Rush360 and Platinum BIO-300 have consistently higher light output than the Joovv. They can also treat larger areas of the body at once. All three of these lights emit enough power to be highly effective, but do be aware of these differences in light output so that you can adjust the dose accordingly. Longer sessions are ideal with the Joovv while shorter sessions are needed with the Platinum BIO-300 and Red Rush360. Remember that my default recommended treatment times listed in this book are for the Red Rush360 and Platinum BIO-300, but I have also put notes for how to adjust the doses for anyone who wishes to purchase the Joovv Mini.

Also, notice that the further you move away, the bigger the difference between light output of each device. At 18” away, the Platinum has about 65% higher power density than the Joovv, and the Red Rush360 has about 90% higher power density than the Joovv. (Note: I didn’t show photos here of 24” and 36” away, but the differences in light intensity are even larger at those distances.) These differences do have a large impact on how long you need to use them to get the right dose, so depending on the distance you’re using it, the Joovv will increase session time by 20-100% to get the same dose.

The Joovv can certainly also work, but you’d want to increase the treatment times compared to the Platinum BIO-300 and Red Rush360. Also, using it from greater distances than 24” away from your body may not work well as the power density drops significantly. To adjust the dose with the Joovv, you’ll want to add 20-30% more time from a close range of about 6”, and if you’re using the light from further away like 18” or 24”, you’ll want to add 60-100% more time to your session compared to the other two lights.

All three of these lights are quality devices that are certainly capable of providing effective treatments. But do note the difference in size, wattage, and light output at different distances, which impact how much of your body you can treat at once and how long you need to do each treatment.

Key Points for Dosing—Summary:

IMPORTANT: The following recommendations are based on the lights I recommend. All these calculations change when you use lights that are less powerful than the ones I recommend. If you purchase a different light, you will need to measure the power density of that light at different distances and calculate doses for that specific light according to the guidelines in this book.

- For general use, the light should be about 6-36 inches away from your body.
    - Closer distances (6”-12” away from your body) are ideal for deep tissue treatments as you’ll get a higher dose and much greater depth of penetration.
    - Further distances (12”-36” away from your body) are ideal for treating surface skin issues and anti-aging purposes.
- **Get a high-power light that can still deliver an effective dose from further distances.** This allows you to treat much larger areas of your body at once compared to lower power lights. This is especially important for people wanting to treat their skin for anti-aging purposes. By getting one of the high-power lights I recommend, even though they are smaller (i.e. not the size of a full human body), you can use them from a further distance away and basically treat the *entire* front or back of your body at once. Because light spreads out the further you go from the source, a light that is only 15” or 20” inches long may be able to treat 40” or 50” inches of your body at once when used at a further distance. (Again, be aware that this ONLY

works with high-powered lights. If you have a low power light and you move it further away from your body, it will quickly be out of the effective range as far as the power density of the light.) This is why getting a high-powered light can be so cost-effective—even a smaller light that is high power can essentially function like a much larger light that is lower power. So take advantage of this!

- **Ideal frequency of use is likely between 3-7x/week (or up to once per day).** There are studies which have used more and less than this, however, based on my experience working with hundreds of people, I believe between 3 to 7 times per week is optimal.
- **Start SLOW.** This is especially true if you are in poor health. Do not immediately assume that "more is better" by using the high end of the range of doses. It's not. It's especially not true when first starting out with red and near-infrared light therapy, or if you are in poor health. If you are in poor health, start with the lowest possible doses and SLOWLY increase the dose from there in subsequent sessions. (If you are extremely ill or severely fatigued, you can even start with lower doses than the lowest end of my recommended ranges.) Also, giving a day or two between sessions is a good idea at first.
- **Be conservative with dosing for any sensitive areas.** If you're going to use red or near-infrared light therapy on your eyes, genitals, or a raw wound on your skin (or any other particularly sensitive area), I suggest going only low doses of 2-10J (and lower may be better here).
- **For skin issues, we want between 3J to roughly 15J per area. So optimal treatment times with the lights I recommend are:**
    - 30 seconds-2.5 minutes per area (if the light is 6" inches away). (But remember, further away is likely more optimal for skin anti-

aging purposes, if you get the lights I suggest. See details below.)

- 1-3.5 minutes per area (if the light is 12" away)
- 1.5-5 minutes per area (if the light is 18" away)
- 2-7 minutes per area (if the light is 24" away). Remember that having it further away from the body allows you to treat much larger areas of your body at once, since light spreads out the further you move away from the light source.
- 3-14 minutes per area (if the light is 36" away).
    - If you get the lights I recommend, for skin and anti-aging purposes, I suggest using it a little further away—from between 12" to 24" (or even 36") away from your body. Remember that moving it further away may get the light intensity in a more optimal dose for the skin, but most importantly, it has the advantage of treating larger areas of skin at once.
    - If you get the Joovv light, these tend to have lower power density than the Red Rush360 and Platinum lights. So for the Joovv lights, you'll want to add roughly 30-90% more time to the above dose ranges (especially when using the light from greater distances from your body, because the differences in power output between lights are largest from further away.) Therefore, if you would use the Red Rush360 for 5-6 minutes from 36" away, you may need to use the Joovv Mini for 8-12 minutes.

- **For deeper issues (e.g. muscle, bone, brain, organs, glands, fat, etc.), we want around 10-40J per area, so optimal treatment times and distances with the lights I recommend are:**
    - 2-7 minutes per area (if the light is 6” inches away)
    - 5-10 minutes per area (if the light is 12” away)
        - I do not recommend going further away than 12” if you’re treating deeper tissues. Roughly 6” inches away is ideal for delivering the most light to the deeper tissues.
        - If you get the Joovv light, these tend to have lower power density than the Red Rush360 and Platinum lights. So for the Joovv lights, you’ll want to add roughly 20-40% more time to the above dose ranges (when using them from 6-12” away from your body) E.g. If you would use the Red Rush360 for 10 minutes (from 12” away), you may need to use the Joovv Mini for 13-15 minutes to get the same dose.
        - For use on the brain, some people recommend much relatively higher doses (the high end of my recommended dose ranges), due to the fact that it’s harder to deliver a significant amount of light to the brain tissues since the light has to penetrate through the skull before it can reach the brain. Thus, less overall light actually makes it to brain tissue (relative to say, treating fat or muscle tissue). As a general rule, the deeper the tissue and the more it is covered by bone, the longer doses will be needed

to deliver a significant amount of light to that targeted tissue.

- **Total Treatment Dose/Time:**
    - I suggest that you limit total treatment dose for *all* areas of the body to no more than roughly 120J. So assuming the light is 6" or 12" away from your body, that means **no more than 15-20 minutes of time total with light shining on your body**.
    - There isn't adequate research on this yet, so I suggest being conservative. Here's Hamblin on this subject: "What we don't really know is can you overdose the body on total joules or is it only when it's concentrated? That's what we don't know … Ten minutes or half an hour does no harm at all … Mostly, I tell people they can use these things for 10 or 20 minutes a day and it'll have major benefits and extremely unlikely to have any ill effects."
    - If you use the lights I recommend for supporting muscle recovery or fat loss for example, a reasonable session might be to treat your chest and abdomen for 3 minutes from 6" away, then the front of your legs for 4 minutes from 6" away, and then your back for 4 minutes from 6" away.
        - This would give a total treatment time of 12 minutes, 24J per body area, and a **total body dose of 72J**.
    - Another example for anti-aging, would be to treat your face from 18" away for 3 minutes, the front of the legs and thighs for 3 minutes from 18" away, and the back of your legs and thighs for 3 minutes from 18" away.
        - This would be a total treatment time of 6 minutes, roughly 6J per body area, and would give a **total body dose of about 18J**.

If all of this is overwhelming, here's the quick and simple summary of the most important points for how to do red/NIR light therapy:

How to Use Your Red/Near-Infrared Light Device

With all these details and discussion of science, it's easy to get overwhelmed and think that using one of these lights must be terribly complex.

It isn't.

It's actually very simple and straightforward: The basic idea is to just switch the light on and put your body in front of it.

Okay, it's a little more complicated than that, but really not much. The details to be aware of are:

1. Optimizing power density/irradiance for the tissue you are treating by adjusting your distance from the light
2. Getting the dose right
3. Your body position
4. Practical tips/strategies for specific goals

Let's cover each of these in more depth now.

Optimal Power Density

First, you must know the general optimal power density/irradiance for the tissue you're trying to treat. I'm not going to go into detail on this one again, because I already covered in-depth in the earlier section on getting the dose right. The basic idea is that for treating the skin (e.g. anti-aging), you want to use the light from further away from your body (ideally 18"-36" with the powerful lights I recommend) to get lower power density and higher body coverage. For deep tissues, you want to use the light much closer (6"-12") to get a higher power density and to deliver more light to the deeper tissues.

Dose

I covered dosing guidelines in the previous section on dosing as well, so please reference that for specific guidelines on how long to use the different light devices from the different distances away from your body. Also remember that skin and surface treatments need much lower doses than deep tissues, and that total body dose (adding up all the light delivered across all areas of the body you treat) also matters. Again, please see the section on dosing for all the details.

Body Position

What position should you be in?

You can sit, stand or lay down. Whatever is the most comfortable position for you to treat the desired area of

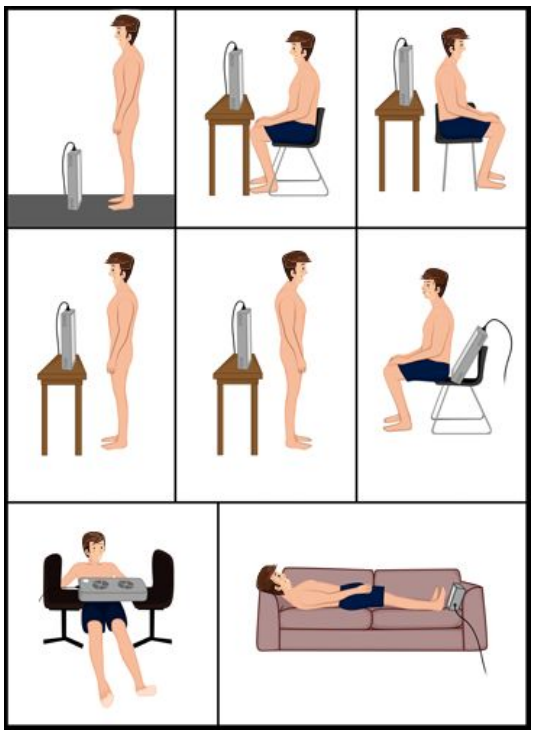
your body.

Depending on what part of your body you're treating, you may find different positions more comfortable than others.

Many light devices come with a door hanging kit. If you choose to use that, then you'll be standing (or sitting in a chair) next to the device. Many people do it this way.

I personally almost always use mine while laying down. I position the lights on the ground and lay next to them either on my side, back or front to treat the targeted area. I just find it more relaxing (than standing) to lay down while doing it.

Here is a little illustration showing various positions that you can use your light:



Practical Tips and Strategies for Specific Goals

Depending on your goals, there are more ideal and less ideal ways of using the light.

This is the most significant factor to be aware of, because for some purposes it is best to use the light in a specific way. But for other purposes, there really isn't any specific protocol or timing you need to be aware of, so in most

cases, you honestly don't have to worry about timing or whether you're not using it incorrectly.

In most cases—like using it for oral health on your gums, decreasing inflammation, wound healing, or for skin anti-aging, etc.—you really don't need to worry about this. Just use the light on that area at whatever time is convenient, while of course, following the dosing guidelines.

But, I do want to mention a few specifics of when to use the light to accomplish certain goals and how red/NIR light therapy best pairs with other things. Please note that in most cases, more research is needed to confirm my findings, but from my own experience and experimentation with hundreds of people, here are some tips:

- **Fat loss**—Follow my protocol I outlined in the fat loss section. If you can't do that specific fasted morning protocol, I suggest using it right before your workouts. You can shine it on both the fat areas you want to lose as well as the muscles that you are going to exercise in that workout. Use the light from 6" away for 2-5 minutes on each area.
- **Cellulite reduction—**Ideally, follow the stubborn fat protocol outlined previously while specifically targeting the light on the areas of your body with cellulite. Alternatively, if that protocol doesn't work for you because of the timing, then use the light on the cellulite area just prior to exercise at whatever time of day you do your workout.
- **Immune health—**Doing one treatment every few days on the thymus gland area in the center of the chest is likely supportive of good immune health. During an acute infection, you can try one treatment per day. I suggest a treatment time of 3-5 minutes from 6'-12" away on the thymus gland area in the center of the chest.
- **Skin anti-aging**—Either in the morning or at the end of the day. Use the light (assuming you have

either the Red Rush360 or Platinum device) from about 24”-36” away for 5-10 minutes. (E.g. 5-10 minutes on the whole front of your body and then 5-10 minutes on the whole back of your body.) If you get the Joovv, a more ideal range would be from 24” away for about the same amount of time (but with less broad body coverage area), or from 36” away for several minutes longer (roughly double the time) than you’d use the other lights.

- **Muscle and/or strength gain**—The ideal time for this is either right after exercise or 3-6 hours later. Some research has even shown muscle gain benefits while using the light before the workout. Do 3-7 minutes from 6” away on each of the muscle areas you exercised in that session.
- **Exercise performance**—You can use it to allow your muscles to perform better (endurance, strength, and power) during your workouts/training. For this purpose, I suggest using the light right before exercise (between 0-30 minutes prior) from 6” away for 2-4 minutes on each muscle area.
- **Brain performance, mood enhancement (e.g. combatting depression and anxiety), or brain healing**—Use the light (ideally a pure near-infrared light or 50-50 mix of NIR and red, since near-infrared penetrates the skull much more effectively than red light) from 6”-12” away. Since hair blocks the light, you want to use it on an area of your head without hair. For people with hair (no shaved or bald head), this generally means to use it on the forehead, or on the sides of the head through ear area, or at the base of the neck. The base of the neck may allow you to target the cerebrospinal fluid (the fluid that surrounds the brain), and this may provide beneficial effects on the cells in that fluid which impact brain health. The forehead is definitely the most effective area, and has actually been used in several of the studies on depression and brain enhancement. In addition

to using the standard LED panels in this way, you also have the option to get the VieLight Neuro device, which allows you to work the lights into the base of your hair follicles and deliver light through the skull at multiple points on the head, even if you have hair. For people who wish to target the brain as their primary focus, I think it's definitely worth it to get that VieLight Neuro device. (Note: I don't recommend their intranasal lights—only the whole head "Neuro" device.)

- **Photopuncture**—For this, you'll need the photopuncture kit from the Photonic Therapy Institute. They provide detailed instructions with the kit on how to use their special "torch" lights on the acupuncture points. This has primarily been studied in the context of tendinitis, muscular trigger point pain, and headache treatment—with very positive results. My friend Kay Aubrey-Chimene (the owner of Photonic Therapy Institute) also uses it on animals (mainly horses) for a wide variety of ailments and reports a lot of success.
- **Sleep enhancement/melatonin production**—As mentioned previously, there is some research suggesting that red/NIR light can impact melatonin (interestingly, melatonin produced by the body outside of the pineal gland!)[374,375,376] While further research is needed to explore the potential for red/NIR light to be used for increasing melatonin/sleep enhancement, I have experimented with this heavily with my Energy Blueprint program members and it clearly seems to work to enhance sleep. For many people, it has an extremely powerful and *very* noticeable sleep-enhancing effect from the very first time they do it. Here's how I recommend using it:
    - Timing is key for this purpose. Do the treatment 1.5-2 hours before bed. I do not suggest doing this closer than 60 minutes to bedtime.

    - Use the light on your spine and the back of your neck area from about 12-18” away for 3-7 minutes
    - Even though blue light is primarily what effects circadian rhythm and suppresses melatonin (red light generally doesn’t suppress melatonin), research has actually shown that very bright red light (like red light therapy LED panels) *can* suppress melatonin. For that reason, I have a few more detailed recommendations:
        - I don’t recommend doing this within an hour of bedtime
        - I recommend avoiding *looking* into the light (i.e. doing it with eyes closed or a towel over your eyes and avoiding actually looking into the light is ideal).
        - Also, in my experience, pure near-infrared lights are more optimal for sleep enhancement because they don’t have the bright red light that makes you squint your eyes. (Remember, near-infrared is mostly invisible to the human eye). So a quick NIR treatment on the spine for a few minutes 1-2 hours before bed can really make a difference in your sleep.
- **Circadian rhythm/SAD**—As discussed previously, red/NIR lights are not optimal for use as SAD lights for treating/preventing seasonal affective disorder or for optimizing circadian rhythm with bright light in the mornings. However, the bright light devices used for circadian rhythm optimization/SAD prevention typically have a huge amount of blue light and little to no red/near-infrared light. Blue in isolation can be harmful to both the eyes and skin, so I always advise using the red/NIR light alongside the bright white/blue light to counteract the blue and give some healing to your cells at the same time. For

this use, I suggest using the light from about 3 feet away. You can position it behind or next to the bright white/blue light.

- **UV light treatments for vitamin D**—To be clear, I don't mean that red/NIR lights work for stimulating vitamin D synthesis. For that, you need UVB rays. To understand this requires a bit of background. In some cases, when people live in latitudes/climates where there is little sun or little UVB available for months during the winter, I advise using a "vitamin D lamp," which is basically a fluorescent bulb setup specifically designed to emit UVB light to stimulate vitamin D synthesis in the skin. (I recommend the Sperti UVB Light Box.) In these cases, I also advise using the red/NIR light alongside the UV light, for the same reason as explained above in the circadian rhythm/SAD section—UV light in isolation can also damage cells, and the red/NIR helps mitigate damage and support cellular healing/protection processes. For using it in this context, you can put the red/NIR light next to or behind the UV lamp, and I suggest using the red/NIR light from 24" away during the 3-6 minutes that you use the UV lamp.
- **Injuries** (e.g. sprains, strains, cuts, burns, fractures, whiplash, etc.)—In these cases, the most important tip is to get the red/NIR light on the area as quickly as possible after the initial injury. The sooner the better. I know some practitioners who swear that they've seen injuries that normally take weeks to heal, take only a day or two when they can get red/NIR light on the area very quickly after the injury. The other thing to be aware of is if the injury is a surface/skin issue (e.g. cut or burn) or deeper tissue issue (e.g. bone bruise/fracture, muscle strain, ligament sprain, etc.), then follow the dosing guidelines for either the surface issues or deep tissues—i.e. closer distances and higher doses for deep tissues, and further distances and smaller doses for surface tissues.

- **Fatigue treatment/energy enhancement—** For this purpose, we want to boost overall mitochondrial health, decrease inflammation in the blood, enhance immune function, optimize hormones, and decrease brain inflammation.
    - First, take of all your clothes and shine it diffusely on your entire body for 30-60 seconds (from 24”-36” away), back and front from head to toe, to wake up every cell in your body.
    - 1-2 minutes shining it on the neck and thyroid gland area and thymus area in the center of the chest, from roughly 6-12” away. There are studies already showing this can impact thyroid function (the studies were done in people with Hashimoto’s hypothyroidism), which is critical to metabolic health in the entire body. The light on the thymus can potentially enhance immune function.
    - 1-2 minutes on your sex organs (from 6-12” away) if possible, as this will increase the health of those tissues and promote optimal hormonal function.
    - 1-2 minutes on your belly (from 6-12” away) to get systemic effects through getting the red/NIR light in the entire blood of your body. (Remember, some research has shown systemic effects, likely from irradiating the blood and affecting blood cells, inflammatory cytokines, and immune cells.)
    - 1-3 minutes on your forehead/brain (from 6-12” away) and another 1-3 minutes on the base of the neck and spine area to decrease brain inflammation and support mitochondrial health in the brain.
    - Total treatment time should be no more than 10-12 minutes. Also, be aware that if you have severe fatigue (e.g. Chronic Fatigue

Syndrome) or are very ill with a particular condition, you may need to cut these doses in half or even do only 1/4th or 1/5th of these recommendations to start. Remember that the more unwell you are, the smaller doses you should use, especially starting out.

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The Ultimate Guide to Choosing a Red/NIR Light Therapy Device

When choosing the right red and near-infrared light therapy light device, you want to select a device that's long-lasting, has a great warranty, is well-manufactured, and most importantly, one that offers the correct wavelengths at the right power density over a large area.

Let's cover each of these more in depth. The most important things to look for specifically include the red and near-infrared light therapy devices:

1. **Wavelength:** What wavelengths does the device offer? Do these have health benefits? Are they in the proven ranges of 600-700nm and 780-1070nm, or better, the most researched ranges of 630-680nm and 800-880nm?
2. **Power Density:** How much irradiance/power does the device deliver—what is the power density in mW/cm^2? (To calculate this, you need to know the total wattage and the treatment area of the light.)
3. **Size of the light and treatment area:** This is critically important—how big of an area will it treat? Is it a small light of less than 12" or a big light that can treat half of your body or your whole body all at once? Think about it: Do you want to hold one of these small devices by hand for 30-60 minutes to do a treatment? Probably not. You'll get tired of using it pretty quickly. So it has to be convenient, and ideally, has to be something that is not only fast, but something that you do while doing other things (if you wish), so you're not sitting there holding a device in different positions for 30-60 minutes.
4. **Warranty:** How long does the warranty last? Will you have time to find out if it works? (Hint: look for at least one year or longer.)

5. **What do you want it for?** Depending on your specific purpose, there are a few different devices you may want to consider. (If you have specialty needs like brain health, or skin health, it will affect the wavelengths you want, the power of the device, and even the type of device.)

I cannot emphasize enough: When choosing a red light or near-infrared light device, you want to be extremely careful to choose wisely, based on the wavelength and power density levels of the device.

Wavelength and intensity makes all the difference between incredible benefits and *no* benefits.

You Want Therapeutic Wavelengths that Achieve Real Results

Again, not all wavelengths are equal—nor all devices. Look for wavelengths in the *proven* therapeutic ranges.

Based on the bulk of the research, you want:

- 630-680nm (the optimal healing spectrum of red light)

- 800 to 880nm (the optimal healing spectrum of near-infrared)
- or a combination of both

Earlier, it was mentioned that wavelengths of 600 to 700nm and 780 to1070nm have been proven to have the most significant impact upon cytochrome c in the mitochondria, and thus, these are the wavelengths that will provide the most stunning results for anti-aging, arthritis, fat loss, reduced waist circumference, re-growing hair for individuals with hair loss, joint repair, bone repair, cancer recovery and prevention, cognitive enhancement and brain health.

The therapeutic range is only within those specific wavelengths.

I do not recommend devices that specify other wavelengths than the ones I mentioned above (or don't specify any wavelengths at all). If you see a device offering wavelengths in the 700-770nm range, be aware that far fewer studies support health benefits at these wavelengths.

Again, if the company doesn't give you information about the wavelengths in their light devices (or you have to go searching for it), or they are not using optimal wavelengths, I don't recommend it.

Also, when it comes to red vs. near-infrared, be aware that it doesn't have to be one or the other! Some quality devices offer red light wavelengths (630–680nm) specifically. Other devices offer the near-infrared ranges of 800–900 specifically. And a number of devices now offer a combination of red light and near-infrared LEDs in the same device. I generally recommend getting a mix of red light and near-infrared for most people and purposes. Unless you know that you *only* want to treat deeper issues (like the brain, for example) and nothing else in your body—in which case, a near-infrared light is best—then a combination of red and near-infrared is ideal most of the time. But again, since they work through the same mechanisms, a pure red or pure near-infrared device can also work great.

Why Power Density of The Light Matters

Power density is also important because your cells need to receive a certain intensity of red light to benefit.

Remember, to know power density, you simply need to know the wattage of the light and the treatment area (as described in the guide to dosing section).

We want a sizable light that has a power density of **at least 30mW/cm^2**, and around 100mW/cm^2 from close range (e.g. 6" away). That's what will allow us to get up to the therapeutic levels that are used in the studies—especially for the deeper tissues. Importantly, it also allows you to use the light from further away and treat a much larger area of your body—since light spreads out with more distance—while still getting an effective dose. In contrast, lower wattage lights will need to be right next to your body to get an effective dose, and thus can only treat much smaller areas at once.

A reputable company will give this power density information to you. If the company doesn't give this information, it's likely because they don't want to, because their device is sub-par.

The intensity of light used also impacts how *long you need to use the device on the body*. A **device with only 1/5th the irradiance of another device will take 5 times longer to yield any positive effects**. And it *still* won't be nearly as effective—especially for treating deeper issues like muscles, bones, the brain, glands, organs, tendons, fat cells, etc.—because the lower power light won't penetrate nearly as deep into your tissues as the more powerful light.

Again, you want to get an LED device with the power capacity of at least 30mW/cm^2 and ideally close to 100mW/cm^2 (from close distance, like 6" away).

In addition to whether the light has a high enough power density, it's also physically large enough to treat a large

enough area of your body all at once. That leads us to the next critical point…

How Big is the Light and How Much of Your Body Can It Treat at Once

Most red and near-infrared light therapy devices have a very small treatment area capability.

Most handheld devices and red lights sold online as skin improving/anti-aging devices offer about 10mW/cm² (and many of them offer far less than even that!) and only treat about a 5-10 square inch area, meaning you'd have to use the device, held right over your right cheek, for example, for around 15-30 minutes, to achieve any benefits for anti-aging. Then you could treat the other cheek for another 15-30 minutes. Then the forehead. Yawn.

And to treat the full body? Impossible! Imagine the length of time it would take to treat the belly, thighs, and derriere. No one has time for multi-hour treatments each day.

But if you get a device with a high-power output that also treats a large area at once, that's where the magic is.

Higher powered devices, like the lights I recommend, deliver close to 100mW/cm² at about 6» from the device and still have effective doses (roughly 20-30mW/cm²) even a full 24" away! This is a huge benefit, because now even a smaller light (say 15-20" long) can basically *function* as though it is a full human body-sized light! In other words, a powerful light that's 15" long can be positioned 24" or even 36" away from your body, and since light spreads out the more you move away from the source, that light can now give an effective dose to nearly your *entire front or back of your body* at once! (Note: This way of using it is not ideal for deep tissues—it is ideal specifically for anti-aging and skin health purposes.)

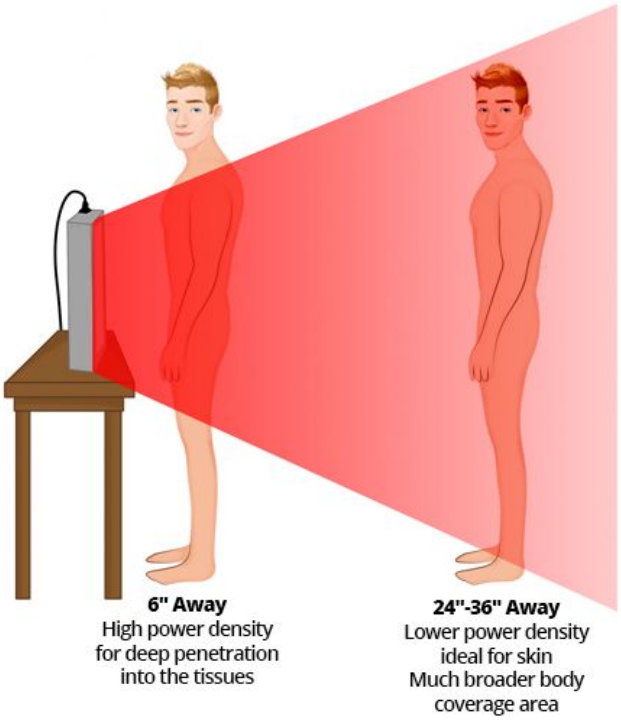
So again, it can basically function the same as a light that is 3 times the physical size (i.e. a light that is the size of your entire body).

Having a high-power light that is also large enough in size allows you to treat large areas of your body at once in just a few minutes. You can **treat an area like the face, the whole torso or legs, or even do multiple parts of the body and effectively, the entire body, in just a few minutes!**

I suggest thinking about long-term goals here and making a wise purchase. Get a device that is powerful, cost-effective, and efficient so you can conveniently do treatments for a large area of your body in just a few minutes.

High-power lights are going to give you far more benefits in far less time, are more effective (especially for deep tissues), and have more flexibility in how you can use them.

I also *strongly* recommend getting a large panel light over a hand-held device. Most people who purchase the small devices end up never using them because it's just too time consuming.



What is the Warranty and How Long Will the Device Last?

This one is very straightforward—buy from a company with a strong warranty who stand by their lights. Otherwise, you'll likely be throwing money away and having to buy a replacement in 6 months to a year.

With a high-quality red/NIR light therapy device from a reputable company, you will have it for many years without any problems whatsoever. And if there is a problem, they'll replace it.

If you're going to spend hundreds of dollars on something, quality is key.

What is Your Purpose Using Red Light Therapy? (And the Difference Between Red and Near-Infrared Light)

As I mentioned earlier, **red and near-infrared light work through the same physiological mechanisms at the cellular level.**

So then you might wonder, why distinguish between them at all? What differences—if any—exist between red and near-infrared light?

Let's briefly delve into the most significant differences to be aware of, and then at the end of this section, I'll provide a practical summary to help make your decision easier.

There are basically four differences to be aware of:

1. **Red light is visible to the human eye, while near-infrared is almost entirely invisible.**
    - This isn't significant, other than the fact that you can see that it's working. Some people will get a near-infrared light and think "Is this thing even on? Is it even doing

anything?" because it doesn't emit light that is visible to the human eye. So it can be a bit of a shock for some people to turn an LED light "on" and not see any light.

- Then we have the placebo effect. As with any therapy, part of the effect always comes from the placebo effect. And certainly, one's ability to see and feel something working figures into the placebo effect. So while there is no actual research testing this theory, based on my experience working with people, I believe that it is likely that red light has a superior placebo effect compared with near-infrared light. Again, just because the human eye cannot see the near-infrared light, it immediately causes some people to wonder "Does this thing even do anything—I can't see or feel anything. What the heck did I just buy—a light that doesn't even emit any light?" In other words, some people will have thoughts that create an ANTI-PLACEBO EFFECT, which works against them (and causes them to send me angry emails because they're confused and think that they just bought a non-functional light). To be blunt, part of the reason I suggest a 50-50 mix of red and near-infrared over a pure infrared device (most of the time) is simply to avoid people getting confused and thinking that their light doesn't work.

2. **Near-infrared (800-880nm) has significantly more power output per LED bulb.** Some estimates are about 30% more power output. So the dose will be higher with near-infrared lamps compared to red lamps of the same wattage, so you get a more potent dose.
3. **Near-infrared can be more expensive, depending on who you purchase it from.** Certain companies like Joovv charge significantly more money for near-infrared compared to red.

4. **Near-infrared penetrates a little deeper into the tissues compared to red light (especially through the skull).**
    - This is the much more important difference between red and near-infrared light.
    - Red light from 630-680nm will not penetrate as deeply into the human body, and therefore, is likely superior for treating skin and other superficial issues like combatting hair loss, since more of the light energy stays on the surface tissues.
    - The 800-880nm range (near-infrared) is better suited for penetrating deeper to affect muscles, bones, tendons, ligaments, organs, the brain, and hormone-producing glands Particularly if you want to treat the brain, research indicates the really only near-infrared will penetrate the skull to deliver light to the brain. So if that is one of objectives, I recommend getting a pure near-infrared light or mixed red and near-infrared light.
    - If you primarily want the light for anti-aging purposes (e.g. wrinkle reduction and combatting cellulite), red light may be a better choice. (Arguably, that is nitpicking because near-infrared probably has most if not all the same benefits.) Whereas if you want to treat deeper tissues like muscle, bone, tendons, glands, or the brain, near-infrared is a better choice. (Keep in mind you can also get lights that have both wavelengths, which is probably ideal for most people and purposes.)

The most significant difference here worth noting is the penetration depth. It's worth figuring out exactly what you intend to use the light for—either more surface treatments or treating deeper tissues.

That said, please keep in mind that both red and near-infrared light have the same effects on cells, and both essentially work for all purposes. Near-infrared will still work great for anti-aging benefits on the skin, and red light will still work for things like fat loss or muscle gain. But if you have specific things that you want to treat, you can choose the light wavelengths that will be best for your individual needs.

In most cases, we're talking about a *slight* edge for one over the other for specific uses. But in some cases (e.g. penetrating the skull), certain wavelengths do have a clear advantage over other wavelengths.

Other than that, the only other distinction is that red light is visible to the human eye while near-infrared is invisible to the human eye.

In fact, for most uses, research has shown that *both* red and near-infrared light can be effective in providing benefits. For example, here is a list of wavelengths proven effective for various conditions, so you can see for yourself that both red and near-infrared are effective:

Condition	Wavelengths shown to benefit condition (in nanometers)
Alzheimer's	627, 670, 800, 810, 1070
Cognitive performance	660, 810, 1064
Depression	630, 650, 810
High blood pressure	660, 780
Eye health	630, 650, 660, 670, 680, 780, 810
Hair growth	630, 650, 830
Exercise performance	630, 640, 660, 670, 810, 850
Arthritis	630, 660, 785, 810, 830, 910
Oral health	630, 640, 650, 660, 670, 685, 780, 790, 810, 830, 850, 900, 940, 980, 1060
Pain	650, 660, 780, 810, 820, 830, 900, 980
Fertility	630, 650, 830
Skin rejuvenation	630, 650, 660, 830, 890
Thyroid health	630, 780, 830

The point of all that is only to illustrate that for pretty much all conditions, both red and near-infrared light have proven to work. So you really don't need to worry too much about the differences between the wavelengths or start thinking "oh no, I don't have the right wavelength for fat loss... skin health" etc. Again, for most things, either red or near-infrared will do the trick!

My general recommendation is that if you want to treat deeper tissues, prioritize near-infrared over red light. The more you want to treat skin issues, prioritize red light. That's a general principle you can use to tailor your choice of a light to your unique needs keeping in mind that both types of light will work for most purposes.

For most purposes, a large mixed LED panel with a mix of 660nm and 850nm is the best choice.

But for specific issues, you may want to consider other options:

- For skin issues and hair loss, it is possible that red light at 660nm may be the most optimal. (Though near-infrared at 850nm will still have most of the same benefits. It's just a question of what is most optimal.
- If you only want to treat deeper organ, gland, joint, or muscle/tendon issues (and NOT skin issues), then you may want to go with a pure 850nm light device.
- If you only want to treat your brain (e.g. for depression, anxiety, cognitive performance, or neurological disease), then near-infrared is best. (The VieLight Neuro is likely the best option for this specific purpose. See the information on this device in the "Recommended Devices" section later in this book.)
- Again, let me emphasize that for most purposes and for most people, the best choice is a combination of the 660nm and 850nm LEDs in a large LED panel that will treat a large area of the body at once. This option is best because it works for basically any and all purposes you could possibly want it for. A combined red and near-infrared light therapy device offering both 660nm and 850nm will allow you to do anything you want on any given day—whether anti-aging treatments on your skin, or healing an injury or lower back pain, or muscle recovery and fat reduction.

Do Heat Lamps Work for Red/NIR Light Therapy?

There are some companies who sell red heat lamp incandescent bulb setups as either red/NIR therapy devices or as saunas, or a combination of both—sometimes advertised as a "near-infrared sauna." So I

often get the question if these are ideal for red/NIR light therapy.

There are various takes in articles online on this subject, with some LED companies basically saying that they are not effective for red/NIR light therapy, and some companies that make these heat lamp saunas saying that they are effective.

Here's my take on all this…

These red heat lamp bulbs can work to deliver the benefits of red/NIR light therapy, but there are some challenges with trying to use these devices for red/NIR light therapy:

1. They are not pure red or pure near-infrared light sources as some companies sometimes try to imply (some companies try to imply that these bulbs emit pure red or pure near-infrared light, which is not true) and much of the light emitted is not in the red/NIR spectrum. They actually emit light across a broad spectrum of the spectrum, from red light all the way up through far-infrared. I.e. Instead of an LED panel, where, for example, 200W of light are being emitted right at the specific therapeutic wavelength of 660nm (or 850nm), you have 200W of light that is spread across a big spectrum from roughly 600nm-3500nm+).
    A. Roughly 14% of the overall irradiance is emitted in the therapeutic band of 600nm-1000nm. And based on that, roughly 1/3rd of that is in the part of the spectrum where most red/NIR light research has been done—from 630nm-680nm and 800nm-880nm. Stated differently: About 85% of the light emitted from these bulbs is not in the red/NIR spectrum. So if you have a bulb that is 250W, less than 40W is actually in the red/NIR therapeutic window, and an even smaller amount is in the specific bands of light commonly used for red/NIR light

therapy and that are known to most strongly stimulate mitochondria.

B. The company that makes these heat lamp saunas with a canvas tent around it (SaunaSpace) suggests that, because the sauna uses 4 heat lamps (not just 1), these numbers go up significantly and do reach therapeutic levels. This is true, and it is likely the case that these lights can give some benefits of red/NIR light therapy. But this 4-bulb setup is roughly $1,000 (roughly twice as much as the LED devices that I recommend), or $3,000 for the sauna version which comes with a canvas tent enclosure to create a heated room.

2. Dosing is a little complicated, because much of the light emitted is outside of the most therapeutic bands (630-680nm and 800-880nm). To demonstrate why, think of this scenario: Let's say you're using an 850nm LED device that has an irradiance of 75mW/cm2, and let's say you're using an incandescent bulb that has the same irradiance of 75mW/cm2, but that light output is spread across 600-1000nm instead of being concentrated at a known therapeutic wavelength (like 850nm). Is the dosing the same? I don't know if anyone has a definitive answer to that. The power density is the same, but the spread of the light output over different wavelengths is very different. The answer is probably that time should be increased somewhat, but it's hard to know exactly by how much. Also, the fact that there is virtually no scientific research on red/NIR light therapy that uses these types of devices also makes it difficult to draw conclusions about dosing guidelines.

3. The fact that it creates lots of heat makes it difficult to use it in a targeted way on specific deep tissues from close distance (like you can with LED panels) without overheating the tissues and potentially causing burns. Ideally, you don't want a red/NIR

light source that emits lots of heat, as it greatly limits how close you can get to it, and therefore makes doing treatments on various areas much more complicated and limited in what you can use it for. For skin treatments, this is not an issue since you're generally using it from further away, but for doing targeted treatments on deep tissues in specific areas, this is a significant factor.

    A. Side note: For the sake of clarity (since some manufacturers of the bulbs sometimes imply that their bulbs are pure red or pure NIR light), I want to note that the heat is created from the far-infrared rays, not from near-infrared rays. The heat one feels from these devices (i.e. the fact that they get hot and heat up your body and create a sauna environment if you do it in a closed space) is not a result of red and near-infrared light—it's from all the far-infrared rays being emitted. Those create heat, not the same therapeutic benefits of 630-680nm and 800-880nm red/NIR light.

4. Finally, one further potentially complicating factor is that if you're using it as a sauna, the optimal treatment time for sitting in the sauna (and getting hot, sweating, etc.) is generally not the same as the optimal treatment times for red/NIR light therapy. In some cases, depending on how you use it, there can be some overlap. But in general, if you're using it as a sauna to get hot and sweaty, then you're probably not using it in the very precise doses that are optimal for red/NIR light therapy. E.g. Optimal doses for red/NIR light therapy tend to be in the range of 2-10 minutes per area (maybe a little longer if you're relatively far away from the light source), and optimal sauna use times are generally considerably longer than this. But you could potentially get around this issue by rotating your body to a new position (where the light is on a different part of your body) every 5-10 minutes while in the sauna.

Overall, these heat lamp saunas can be used for red/NIR light therapy (especially if you get SaunaSpace's 4-bulb setups), but they do come with a few issues that make red/NIR light therapy a little more complicated.

Other Types of Light Devices and Treatment Options

In addition, there are other types of light devices one can get.

- **Laser devices.** These can range in price from $2,500-$30,000. And as I quoted Hamblin previously, there is no strong evidence that LED devices are inferior to laser devices. The research comparing the two has shown similar outcomes. But there are still some practitioners who believe that lasers are superior in their effectiveness. Laser devices are generally purchased by health practitioners for use in their clinics, and not by regular people. Since this book is intended as a guide for regular people, and because I assume most people don't want to spend thousands of dollars on their red/NIR light device, I am not discussing all the different laser devices available for purchase. If you wish to purchase a laser device, you can find a guide here: https://www.top5reviewed.com/cold-therapy-lasers/
- **Hair-loss specific devices.** There are several devices that are marketed specifically for hair loss —e.g. combs and helmets, etc. These devices are generally underpowered and overpriced. For hair issues, I believe the LED devices I recommend are going to be superior.
- **Facial anti-aging devices.** There are also several devices that are intended for facial beauty/anti-aging effects on skin. Some of these devices appear decent, but most are also greatly underpowered and overpriced, and inferior to the LED devices I recommend. There is simply no need

for face-specific products. You can just as easily use the LED panels I recommend. Plus, they have the added versatility to be used on many other areas of the body.

- **Joint-specific devices.** There are several devices that are marketed specifically as joint pain alleviators. I've even seen some commercials on TV for one device. These devices are generally also underpowered, and there is so much pseudoscience in the claims some companies make about their product. As with the other body areas above, for joint issues, I also believe the LED devices I recommend are going to be superior.
- **Brain-specific devices.** There is one brain-specific device from a company called VieLight that I do recommend, and is likely the best option for treating the brain. The LED devices I recommend can be used to treat the brain on the forehead, or other areas of your head where you don't have thick hair, but they are limited by the presence of hair in what parts of the head/brain they can deliver light to. There is research showing, however, that treating the brain through the forehead alone can be effective. Having said that, I still think the VieLight Neuro is the best option for the brain specifically. I discuss this device in more detail below.
- **Laser acupuncture and Photopuncture.** Some people—like my friend Kay Aubrey-Chimene of the Photonic Therapy Institute—do something called "photopuncture." This is using targeted high-power red light "torches" specifically on acupuncture points, with the idea that the light travels along the bodies energy "meridians." (This is a concept from Chinese Medicine.) Some people have suggested that light can essentially work to rebalance the body's energy/meridian system with light just as well as needles. And the Photonic Therapy Institute has reported great success using these methods. There are several studies that have

actually used red/NIR light on meridian/acupuncture points and shown very exciting and positive results.[377] There have been at least 18 studies done on this over the last 20 years on conditions such as headaches and myofascial pain, and most have shown positive effects. The only issue here is that there is a paucity of data comparing treatments on the acupuncture points vs. light treatments not on acupuncture points. That makes it hard to know exactly how much the acupuncture point-targeted aspect of the light treatment is actually a major factor in the effectiveness. Without controlled studies, it's not possible to determine if shining the light on non-acupuncture points would have the same effect. But again, there are positive studies that have used these methods, so I'm interested to see studies that explicitly test what role the focus on acupuncture points is playing in the results. The Photonic Therapy Institute offers a 1-torch and 2-torch light kit (along with instructional materials) for Photopuncture. Based on the positive studies, this may very well be worth experimenting with. I recently purchased it to experiment myself and see what kind of effects I notice. I discuss this kit again below in the recommended devices section.

Please note that my general dosing recommendations are for the LED panel devices I recommend, not for specific devices like the Photopuncture device or the VieLight Neuro. For those two devices, I suggest following the dosing guidelines from those two companies.

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377 Baxter, D. et al. (2008). Clinical Effectiveness of Laser Acupuncture: A Systematic Review. Journal of Acupuncture and Meridian Studies. Volume 1, Issue 2, December 2008, Pages 65-82.

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My Recommended Lights for Red/NIR Light Therapy

I know all this information can feel overwhelming and confusing. So let me break it down for you very simply, by giving you my top choices for devices in each category from small to large.

You want to get a light device that gives spa-worthy treatment in your own home. While treatments from health professionals and doctors using red/NIR light therapy can cost hundreds of dollars, a wise one-time investment in a high-quality light will allow you to do treatments at home that would cost tens of thousands of dollars if you were to go to an anti-aging clinic or doctor's office for treatment.

By the way, I happen to know of some anti-aging clinics that use the *exact* lights I'm recommending, but charge people $75-$150 for a *single session* with the light. Now you know how to accomplish this in the privacy of your own home, at your own convenience, while—after the initial purchase of the light—only costing *cents* to use each day.

Here are my top choices for the light devices I recommend:

Best Small Red/NIR Light Device

I do not recommend the small devices, as they are extremely underpowered and only irradiate a small portion of your body. In general, I think it is much wiser to spend a little more and get a much bigger and higher power device.

But if you must get a small device (or you only want to treat a very small part of your body), the only small light that I recommend is this one from Red Light Man. It's 100 watts with LEDs split between 610nm, 630nm, 660nm, and 680nm. Or you can get it as solely a 670nm light. I recommend doing the latter, because 670nm will active cytochrome c oxidase in the mitochondria more

effectively than lower wavelengths like 610nm. This light will have a good power density at about 4-5" away from the light, but remember, it's a small light, so light will only hit a small part of your body.

To treat larger areas of your body at once—which I strongly recommend doing for time-efficiency and to get greater benefits, especially for general skin anti-aging uses—you'll definitely want to get a larger light.

In general, it's best to spend your money (even if you have to save up) on a larger more powerful light rather than rushing to get a small one.

Best Medium Sized Red/NIR Light Devices

These lights get into the optimal range for power output and size, so they can treat a large portion of your body at once with a sufficient dose.

These devices generally cost upwards of $450 and deliver upwards of 120-300 watts of power to large portion of your body (like large muscle groups and a large portion of the torso at once). This is a huge time-saver when compared with treating the same areas with a small device and will lead to better results. Also, since some of the effects of the light are from irradiating the blood and lowering inflammation, the larger lights will treat more of the blood at once and will have better body-wide effects.

My top choices in medium size devices are as follows:

1. "Red Rush360" by RedTherapy.co.

- It's 360 watts (significantly higher power output than the other lights in this category) and gives a solid power density of about 100mW/cm2 at 6" from the light. (That's the actual light output, not the claimed power output.)
- It's 16.3" tall by about 10.6" wide (slightly larger than the other lights in this category).

- It has 120 LEDs (twice as many as the Joovv).
- It comes with a 50-50 split of 660nm and 850nm.
- They've also developed new technology to nearly completely eliminate EMF (electromagnetic fields) emission from their light device, making it extremely safe to use even from very close distances. (They are the only manufacturer to do this, to my knowledge.)
- The price is excellent at $449. (This is my overall top choice for a light under $500.)
- Given that it has the highest power output, the broadest coverage area, the most LEDs, a very competitive price, and the lowest EMFs, it is my top choice in this category.

2. The "BIO-300" by Platinum Therapy Lights

- It's 300 watts (more than double the comparably sized Joovv, and almost as much as the Red Rush), and gives a great power intensity of about 100mW/cm2 at 6" from the light (almost as high as the Red Rush360).

- It's 19" tall by about 9" wide (slightly larger than the Joovv, and roughly the same size as the Red Rush, slightly longer just not as wide).
- It has 100 LEDs.
- It's available in the same options as the Joovv light —660nm, all in 850nm, or a 50-50 split of 660nm and 850nm.
- The prices are excellent:
    - All 660nm = $449
    - 50-50 split of 660 and 850nm = $449
    - All 850nm = $449

3. The Joovv Light "Mini" by Joovv (Joovv is the brand that has been around the longest and has a good reputation overall.)

- It's 120 watts, which is considerably less than the two lights mentioned above. (Note: Their claimed power intensity is 110mW/cm2 at 6" from the light but this is based on the calculated theoretical numbers on paper, not the actual measured light output. I've measured it right next to the Platinum BIO-300 and Red Rush360 and measurements show that it has significantly lower light output than the other devices. At far distances like 24" or 36" away, it has close to 50% less light output than the Red Rush360. Note that is for the 50-50 mix of red and near-infrared. A pure red device would be slightly lower than that, and a pure near-infrared

device would be slightly higher. Also be aware that the differences in light intensity between these devices are even larger the further you move away from the light device, as you can see in the photos in the previous section of this book titled "Comparing Power Densities of Light Devices from Popular Brands.")

- It's 15" tall by about 8" wide (slightly smaller than the other 2 lights).
- It has 60 LEDs, so considerably less coverage area than the other two lights in this category.
- It's available with all in 660nm, all in 850nm, or a 50-50 split of 660nm and 850nm. The 850nm options are more expensive:
    - All 660nm = $495
    - 50-50 split of 660 and 850nm = $595
    - All 850nm = $645

Remember a high-powered light allows you to treat from further away and thus treat a much larger area of your body at one time, while still maintaining an effective dose. Whereas with the lower power lights, you'll have to be much closer to the device and thus can only treat much smaller areas at one time.

These are all great options. (Of course, I suggest the lights that offer higher power and are simultaneously lower cost, so options #1 and #2 are the clear winners here.)

Now, if you want a large light to treat the whole front or whole back of your body at once with high power density, I would strongly recommend considering the larger and more powerful half-body units.

Best Half Body Red/NIR Light Devices

These units generally cost upwards of $700 to $2,500, with a couple great options of large, high power effective lights for under $1,000.

There are much more expensive options available and full body devices like tanning beds that can treat basically every inch of your body at once, but these are far more expensive and unnecessary for most people. There are a lot more expensive “luxury” red light options for those that want them, but in my opinion, there is really no need to go beyond the lights in this category. This is the category that provides all you need to get great results at a very reasonable price. In my opinion, these half body devices are a fraction of the price, and essentially offer the same benefits.

Several of the devices in this category are much higher power (relative to the medium-sized lights), from about 300 watts on the low end to 600 watts.

This is a great thing, especially when combined with being able to shine light on a much larger area of your body at once, because this will dramatically increase the overall number of photons hitting your body and the dose you receive. Thus, the effects are stronger, and the benefits are greater—especially if you want to treat deeper tissues in larger areas of your body, for organ health, muscle gain, and fat loss, etc. And you can do less treatment time per session.

Plus, if you want to treat deep tissues in large areas of your body at once, it's very time-efficient with sessions of just a few minutes, whereas with smaller devices, it can be more time consuming by having to treat multiple areas.

So if you're looking for a large high-power device to do full body treatments, this is ideal.

Here are the large high-power devices I recommend:

1. The BIO-600 by Platinum Therapy Lights:

- It's 600 watts (about double the power output of the comparably sized lights from the other manufacturers mentioned below) and gives a solid power intensity of over 100mW/cm2 at 6" from the light. (This is the same power density as the medium-sized lights from Red Therapy Co. and Platinum Therapy Lights, but here you get it with a larger light that covers more of your body at once. So you can do full-body treatments from closer distances.)
- It's 36" tall by about 8" wide (essentially the same dimensions as the Joovv "Original" mentioned below).
- You can also get this in all the same options as the Joovv Original Light—either in 660nm, all in 850nm, or a 50-50 split of 660nm and 850nm.
- The prices are wonderful:
    - All 660nm = $749
    - 50-50 split of 660 and 850nm = $749
    - All 850nm = $749

2. The "Joovv Original Light" by Joovv:

- It's 300 watts (about half the power output of the option mentioned above) and gives a power intensity of over 70mW/cm2 at 6" from the light. (Note: Again, the actual measured power density is significantly lower than what is claimed.)

- It's roughly the same dimensions as the Platinum BIO-600.
- You can also get this in all the same options as the Platinum light—either in 660nm, all in 850nm, or a 50-50 split of 660nm and 850nm.
- The prices are considerably higher (about $50-$340 more, depending on the specific light wavelengths you want):
    - All 660nm = $795
    - 50-50 split of 660 and 850nm = $995
    - All 850nm = $1,095

3. The "Combo Bodylight 2.0" by Red Light Man:

- It's 300 watts (half the power output of the comparably sized Platinum light and about the same as the Joovv light).
- It's 4 feet long, so about a foot longer than the other lights.
- It uses red and near-infrared light at the wavelengths of 620nm, 670nm, 760nm and 830nm.
- You can also get this in all the same options as the Platinum light—either in 660nm, all in 850nm, or a 50-50 split of 660nm and 850nm.
- The price is $750
- Is a nice light, but from my perspective, has two drawbacks:
    - It's not as high power as other options in this category (in particular the Platinum light).
    - Part of the light spectrum is at 760nm, which is not an ideal choice in my opinion, as research generally indicates that the wavelengths from 700nm-780nm are less effective. (That's why very few studies ever use these wavelengths.)

    - Overall, it can still be effective.

Note: With a larger light (around 36-48” long) that is this powerful, you can effectively treat the entire front or back of your body—even the deeper tissues—at once. So if that is something you’d like to do, this is a great investment in your health.

Full Body Red/NIR Light Therapy Options

There is also the option of doing a light setup that will shine on the full front or back of your body from head to toe.

- Joovv has a very large device (the Joovv “Max”) that’s 960 watts and 4.5 feet tall by 16” wide. It comes with the same options of either pure 660nm, pure 850nm, or a 50-50 mix of the two. This is an excellent and very powerful light, but it’s far more expensive than the lights mentioned above—you’ll have to pay between $2,400-$3,000 to get it.
- My personal favorite setup is simply two of the Red Rush360s or Platinum BIO-300s (or one BIO-600 combined with a BIO-300 or RedRush360). I lay them on their side on the ground and then I lay down next to them and treat one full side of my body all at once in a laying position instead of a standing position (which I prefer anyway, because I find it more relaxing to use it in laying down compared to standing up). In contrast to the $2,400-$3,000 light setup mentioned above, this light setup can cost less than $1,000. So it’s a way to get a full body treatment at a relatively low cost.

Deluxe Red/NIR Light Therapy Options

There are also a couple options for super high-end tanning bed-style red light therapy units.

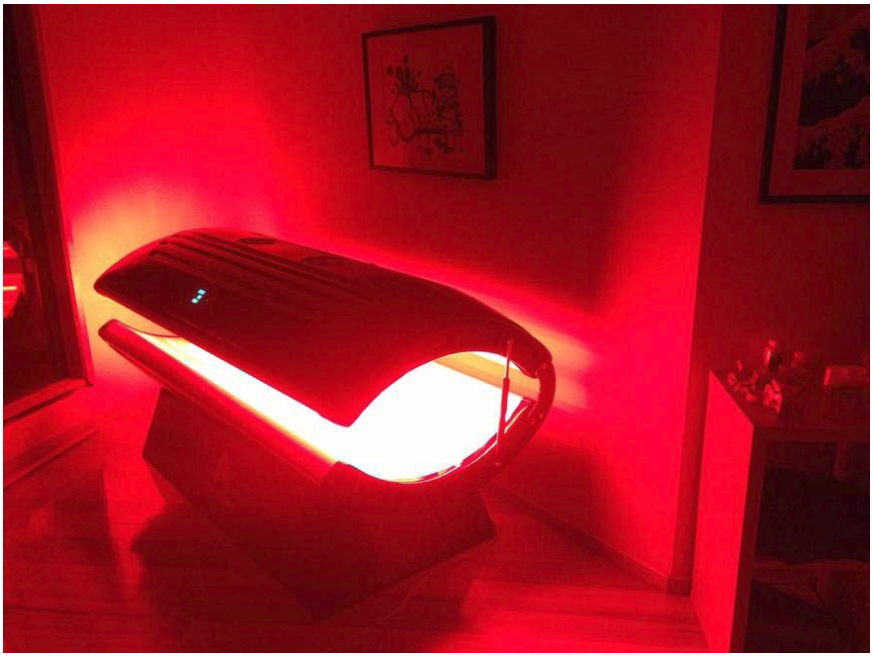
These are generally priced in excess of $15,000 with one well-known brand selling their unit for upwards of $100,000!

I put these here in case you're interested in very high-end devices (and you're doing well enough financially to entertain such purchases), but to be honest, I really do not think such devices are necessary. I do not believe that the benefits of these devices will be vastly superior to the other far cheaper lights I recommend.

The main benefit here is being able to treat your entire body (front and back, from head to toe) all at once while in a laying position. And perhaps also that you have a pretty cool looking device in your home to impress friends (which may be a real consideration for some people.)

Below I have listed possible full body options:

- Mitogen Red Light Bed. This consists of 10,000 LEDs that are a mix of 660nm and 850nm light (the same wavelengths as the RedRush, Platinum light and Joovv. The power output is 15mW/cm^2. Treatment times will generally be about 10-25 minutes.



A Full Body Red Light LED Tanning Bed
by Mitogen Energy Medicine

- NovoThor (a well-known manufacturer of laser devices) also offers a full-body tanning bed-style LED device. This one is a mix of 630nm, 660nm, and 850nm. It has a power density of 17mW/cm2. And it costs over $100K. This is most likely an option either for extremely wealthy people or a professional gym/spa/medical setting.

Note: These devices have relatively low power densities (below 20mW/cm2)—probably because if they had high

power densities and treated your entire body at once, it would quickly lead to too large of doses. Treatment times might have to be cut off at 30 or 60 seconds if that were the case. Also, research suggests that lower power densities are better for skin anti-aging effects, and I suspect they were likely wanting to optimize skin benefits and overall systemic effects through irradiating the bloodstream. In my opinion, these power densities are more ideal for skin anti-aging, but not necessarily for treating deep tissues.

To be clear, I am in NO WAY implying or suggesting that you need to purchase these ultra-expensive devices.

Nor am I even suggesting that they are the most optimal way of doing red/NIR light therapy. While I have heard positive things about these light beds, I believe you can get all the benefits of red and near-infrared light therapy with the previously recommended LED lights, which are a tiny fraction of the price of these tanning bed-style units.

I mention these purely for the sake of presenting all the options on the market, but again, this is not to be interpreted as me implying that you should purchase these luxury red/NIR devices. I believe that you can get all the benefits of red/NIR light therapy with the far less expensive LED panels recommended above.

Sauna + Red/NIR Light Therapy Options

There are a few sauna brands make far-infrared saunas that also add near-infrared light into their sauna. This allows you to get all the benefits of near-infrared light discussed in this book while also getting the benefits of the sauna heat (sweating, detoxification, mitochondrial benefits, etc.).

These are a great option, provided you have the money for it, as they are considerably more expensive than the pure red/NIR devices.

Sunlighten saunas, ClearLight saunas and SunStream saunas all offer excellent lines of top-notch wooden saunas with both far-infrared and near-infrared that are extremely high quality. With this type of premium sauna, you can enjoy all the benefits of both near-infrared therapy and a traditional far-infrared sauna at the same time.

SaunaSpace manufactures the previously mentioned heat lamp saunas that use 4 incandescent heat lamp bulbs. These will have far-infrared, red, and near-infrared light. They come with a canvas tent (as opposed to a wooden room), and thus are considerably less expensive than the wooden saunas made by Sunlighten, SunStream and Clearlight.

All of these brands make very high quality full-spectrum saunas that provide tremendous therapeutic value.

For those who can afford it, this is an excellent option. It's also convenient as it allows you to get your near-infrared treatment while doing a sauna session.

Photopuncture

Some people have suggested that "photopuncture" (light on acupuncture points) can essentially work to rebalance the body's energy/meridian system (a concept from Traditional Chinese Medicine) with light just as needles are purported to work in acupuncture. There are several studies that have actually used red/NIR light on meridian/acupuncture points and have shown very exciting and positive results—mainly on conditions such as headaches and myofascial pain.[37][8] As I mentioned previously, the only issue here is the lack of data comparing treatments on the acupuncture points vs. light treatments not on acupuncture points, which makes it hard to know exactly how much the acupuncture point-targeted aspect is affecting the result. But again, there are positive studies and Kay Aubrey-Chimene (the owner of The Photonic Therapy Institute) has reported a lot of amazing success in her treatment of horses using this system. The Photonic Therapy Institute offers a 1-torch and 2-torch light kit (along with instructional materials)

for Photopuncture. It is possible that this form of light therapy could be superior to standard treatments, but as of now, without controlled studies directly testing the extent to which light on the acupuncture points specifically is a key factor in the treatment success, it's hard for me to draw conclusions.

I got the 2-torch kit to experiment with, and while I'm not yet sold on the concept of "photopuncture"—I want to see more controlled research first—I have to say that I enjoy using it for targeted treatments on specific small areas (e.g. tendons and muscles). You can dig the tip of the light right into the precise target tissue and get deep penetration in the targeted area. For that purpose, it works extremely well.

If you're interested in experimenting with "photopuncture," (or using the torches in the way I described how I use them), you can get her 1-torch or 2-torch Photopuncture Kit here: https://www.photonictherapyinstitute.com/light-store/

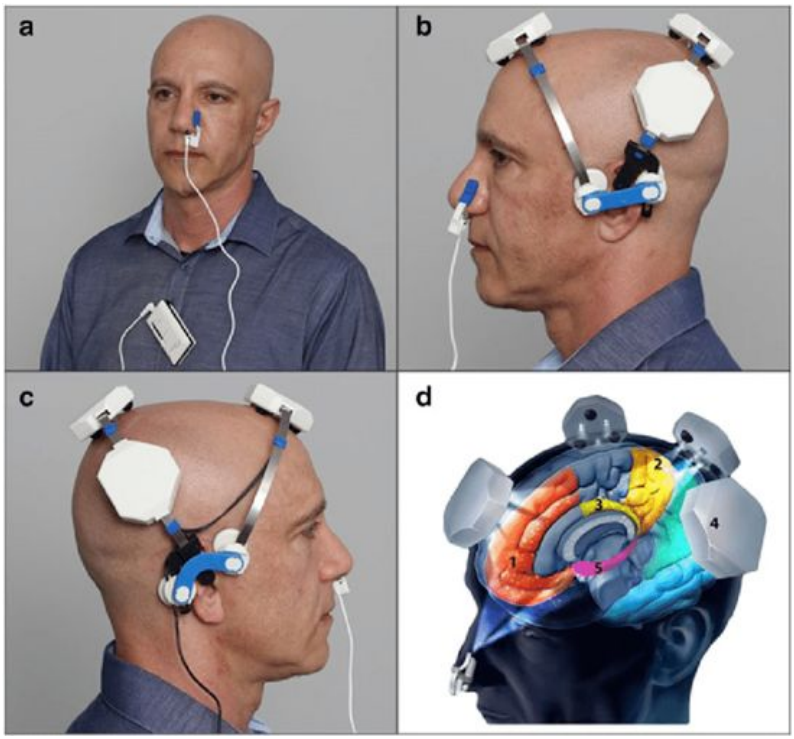
Top Light for Use on the Brain

If you're using light on the brain specifically—for either a brain health issue or to improve mood or cognitive function—it's important to get a light with near-infrared, not just red light. Research has shown that near-infrared is more effective in penetrating the skull than red light (which has minimal to no penetration of the skull), so this is ideal for the brain.

The LED panel lights I recommend like the Red Rush360 and Platinum Lights have near-infrared (either pure near-infrared or mixed near-infrared with red) and are powerful enough to be used on the forehead and will likely be effective in penetrating the skull with some light.

Nevertheless, if your main goal is to treat the brain, the best option is the VieLight Neuro, which has multiple contact points on the head (that can be worked into contact the scalp to allow light to penetrate through the hair) and will likely have the best results for brain-

specific issues. (Note: This device is designed specifically to be worn on the head and thus, won't work well at all to treat other areas of the body.)



Please note that they also sell intranasal devices that claim to target the brain, but Michael Hamblin, PhD does not believe these devices actually do reach the brain directly[379], therefore, I do not advocate those devices. Yet they do have some positive research. Hamblin believes that they don't work by directly irradiating the brain, but that they work through irradiating the blood through the capillaries, which indirectly affects the brain (and other systems of the body). Assuming he is correct, it really does not make sense to use these low-power intranasal devices to treat the blood—it would be much better to use a high power (and much larger) LED device for that purpose.

Having said that, the VieLight Neuro has the head unit which likely *does* effectively target the brain. And the VieLight Neuro may very well be the best product for treating the brain specifically. We don't know for sure, as there are no studies comparing it directly to LED lights, but there is research supporting the use of this product in treating dementia.[380]

Other options:

- Photopuncture Kit from The Photonic Therapy Institute. https://www.photonictherapyinstitute.com/light-store/
- REDjuvenator—https://catalyticcolor.com/redjuvenator-light-therapy/ (Unclear information on wattage and power density of lights.)
- GembaRed—https://gembared.com/ (A small, low-power 45W panel.)

Animal treatment devices:

- Photopuncture Kit. https://www.photonictherapyinstitute.com/light-store/
- RevitaVet Wraps. LED wraps to lay on your animal. https://photonictherapyinstitute.com/product-category/revitavet-wraps/
- LED wraps to lay on your animal, and many light therapy accessories for dogs and horses. http://equinelighttherapy.com/welcome-equine-canine-light-therapy

Comparing the Top Red/NIR Devices

If all these stats are overwhelming for you, let me map it all out very simply. Below you can see all the lights I just mentioned **in descending order of their power output**, along with their size, price, and warranty:

Device	Power Output	Size	Price	Warranty
Red Light Man "Red Light Device"	100 watts	7" x 7"	$219	1 year
Joovv Mini	120 watts	15" x 9"	$495-$645	2 year
Joovv Original	300 watts	37.5" x 8.25"	$795-$1,095	2 year
Red Light Man Body Light 2.0	300 watts	45" x 7"	$750	1 year
Platinum BIO300	300 watts	19" x 9"	$489	5 year
RedTherapyCo Red Rush360	360 watts	16.3" x 10.6"	$449	2 year
Platinum BIO600	600 watts	36" x 8"	$789	5 year
Joovv Max	960 watts	53" x 16"	$2,395-$2,995	2 year
My personal setup: BIO600 + RedRush 360	960 watts	50.3" long width from 8-10.6"	$1,198	2 year on the Red Rush360

Note: I was able to arrange discount codes with some of the manufacturers. Pricing above is before discount. Info on these discounts are in the next section.

I also want to give specific recommendations for what I think are the top 5 best choices of light devices.

My Top 5 Overall Lights

Here are my personal recommendations for the lights that are the most powerful, cost-effective, and provide amazing bang for the buck:

Note that two of the brands listed have agreed to offer my readers a discount.

1. Red Rush360 by Red Therapy Co. - $449

You can get this light at:
https://redtherapy.co/products/redrush-360-light

For a light this large and powerful (360 watts) to be under $500 is just phenomenal. It's nearly 3 times the wattage of the comparably sized Joovv, has much higher light output (especially at further distances away), and at the same time, it costs less. It has 120 LEDs (the most of

any light around this size). Overall, this light is probably ideal for most people's needs. Also, because of its extra high-power density, you can use this light from 18", 24", or even 36" away and still have high enough light output to do effective treatments—thus allowing you to treat a large area of your body all at once. Basically, this allows it to function like a much larger light. Overall, a wonderful option for almost all purposes.

In addition, they just developed EMF-blocking technology for their lights that makes their devices ultra-low EMF. They are the only company on the market to do this. This makes them the clear top choice in my opinion as they have the highest power, lowest cost, and lowest EMFs of any device in this size range.

Discount Code: They will give a $25 discount to readers of this book bringing total cost down to $424. Just enter the discount code "energy blueprint" when checking out.

2. Platinum Therapy Lights BIO-600 - $789 (Top Choice)

You can get this light at:
https://platinumtherapylights.com/products/bio-rlt

If you are in the market for an extra-large light to essentially treat the entire front or back of your body at once, this is the light for you. If you're looking to go all out on a larger light without spending a ton of money, this is the way to go.

Discount Code: They will give a $40 discount to readers of this book bringing total cost down to $749. Just enter the discount code "energy blueprint" when checking out.

3. Platinum Therapy Lights BIO-300 - $489 (Top Choice)

You can get this light at:
https://platinumtherapylights.com/products/bio-rlt

This light has similar dimensions to the Red Rush360 and is almost as powerful. It's slightly smaller, but still a wonderful choice relative to all the other competitors.

Discount Code: They will give a $40 discount to readers of this book bringing total cost down to $449. Just enter the discount code “energy blueprint” when checking out.

4. Joovv Original - $795-$1,095

You can get this light at: https://joovv.com/products/joovv-light?variant=39356431694

This light has similar power output to the Red Rush360 and Platinum BIO-300 while being larger in size (close to the same dimensions as the BIO-600). It is also considerably more expensive, but overall, it’s a great light that will allow you to treat a large area of your body at once.

Discount Code: They will give a $25 discount to readers of this book. Use the discount code “ENERGY BLUEPRINT” when checking out (note: this one is case sensitive, so you need to use all caps).

5. Joovv Mini - $495-$645

You can get this light at: https://joovv.com/products/joovv-light?variant=39356431502

This light has similar dimensions to the Red Rush360 and BIO-300, but has significantly lower light output (especially at further distances away). Overall, it’s not as cost-effective as the above options, but it’s still a very high quality light that can certainly provide therapeutic benefits.

Discount Code: They will give a $25 discount to readers of this book. Use the discount code “ENERGY BLUEPRINT” when checking out (note: this one is case sensitive, so you need to use all caps).

(Disclosure: As you can see, I have arranged discounts for you with many of these manufacturers offering high quality devices. I was not able to arrange discounts with all of the manufacturers listed here, but I tried to do it with every manufacturer that was open to offering a discount to readers of this book. Please be aware that I do get a small commission on any of these lights or

saunas that you purchase if you use my discount code. If you appreciate the work I've done in writing this book, I would appreciate you using my discount code and supporting my work. Please know that this is at no expense to you. In fact, I have negotiated directly with these manufacturers to get you discounts off the normal prices. In short, everyone wins. But if you have any objection to this, please feel free to order the lights without using the discount code. Please know that my rankings of these devices are in no way influenced by this. I have no ownership in any of these companies or vested financial interest in promoting any one of them over another. My recommendations for which light devices you should get are exactly the same whether you choose to use the discount codes or not. Moreover, there are in fact many other devices I could promote that offer much more generous commissions, which I am actually not promoting because they don't offer high quality devices. I give you my word that all my rankings here are best on a purely objective analysis of the power output, quality, and bang-for-the-buck of all these devices. My #1 priority is making sure that you get the best device for your needs. In addition to that, I have done my best to negotiate the biggest discounts for you as possible with all of the manufacturers who were open to giving discounts.)

Best Sauna + Near-Infrared Option:

Sunlighten "mPulse" saunas, ClearLight "Sanctuary" sauna line, or Sun Stream Saunas (with the NIR LED panel in the sauna) all offer sauna options with both far-infrared and near-infrared. For someone looking to get a sauna as well (which also provides a wide variety of amazing health benefits) and a red/NIR light therapy unit, these are wonderful options.

These sauna options tend to be less flexible in the ways that you can do the NIR light therapy (compared with the red/NIR LED devices), but they compensate for that drawback by also giving you the benefits of far-infrared sauna therapy (which you don't get with red/NIR LED devices).

These “full spectrum infrared” saunas are great options for some people, but the price can be an obstacle for many. If you can afford them, they’re great.

Discount Code: I have also arranged discount codes for you to use with Sunlighten, SaunaSpace and ClearLight—you can call any of these companies directly and use the discount code “energyblueprint.” I was not able to arrange a discount code with Sun Stream, but they also make excellent far-infrared + near-infrared saunas. (Note: Sun Stream is located in Canada, which makes them a great option to avoid huge shipping/customs charges for those of you living in Canada.)

Contact info for these companies are:

- Sunlighten: www.sunlighten.com and (877) 292-0020
- ClearLight: www.infraredsauna.com and (877) 790-9368
- SaunaSpace: www.saunaspace.com and (844) 999-5858
- Sun Stream: http://www.infraredsaunacanada.ca/ and (250) 477-2277

To be clear, it is not necessary to get an expensive multi-thousand dollar sauna in order to get the benefits of red/NIR light therapy. The red/NIR LED devices I mentioned previously (that are much lower cost than saunas) are more than adequate for red/NIR light therapy. Again, these full-spectrum infrared saunas are for those people who want both a far-infrared sauna and red/NIR light therapy all in one package.

Best Brain Device:

VieLight Neuro Alpha or Neuro Gamma - $1,749 You can purchase through their website here: https://vielight.com/neuro-alpha-gamma/

Discount code is “energy blueprint” which gets you 10% off, which equates to $175 off the regular price. Note: I recommend the Neuro Alpha over the Gamma.

The clear winners are the Red Rush360 and Platinum Therapy Lights LED panels, which simply offer far more power relative to other similar-sized lights, and therefore, have the added benefit of actually being lower cost than the comparable lights in those categories.

The full-spectrum saunas are also excellent, and the VieLight Neuro Alpha is wonderful for anyone looking for brain-specific treatment.

Overall, for an all-purpose red/NIR light, it's hard to beat the Red Rush360 and Platinum lights in terms of the combination of overall power and the pricing. Either one of those lights is a great choice by itself—and will be perfectly adequate for most people—but if you want to go all out and get a larger light setup that will cover your full body, I suggest getting two of the smaller lights (i.e. two Red Rush360s or two BIO-300s), or one BIO-600. Or you can combine a BIO-600 with either a BIO-300 or Red Rush360. (This is what I personally use myself at my home.)

With these setups, you can get all the benefits of red and near-infrared light therapy (that a clinic might charge over $100 per *session* for!) in the comfort of your own home with **unlimited sessions** for less than $1,000 or even less than $500.

Wrapping Up

If all of the complexity and science talk has you feeling overwhelmed, I want to end with some simplicity. I've tried to cover the nuances of the science on this topic in this book, but I don't want you to get so caught up in all the details that you feel overwhelmed and confused on how to get started and actually *do* a red/NIR light therapy session. So let me summarize the practical aspects of all this in a very simple way:

1. Go get yourself one of the recommended light devices.
2. Switch the light on.

3. Put your chosen body area in front of it for a few minutes (following the dosing guidelines for different body areas and treatment goals).

That's it. It's really that simple.

Once you are comfortable with those basic three steps, then go through the details of my recommended dosing guidelines to make sure you're doing optimal treatments for the specific body area (e.g. skin issues vs. deep tissues). Then make sure to go through the specific strategies, tips, and protocols I offer in the section titled "Practical Tips and Strategies for Specific Goals" to get more specific detailed guidance on using the light for specific goals you may have like brain enhancement, muscle/strength gain, overcoming fatigue, improving mood, fat loss, sleep, or anti-aging.

It's that simple.

After you get one of these lights, you can immediately start using it to:

- Increase your energy
- Make your skin healthier and get rid of cellulite
- Speed up fat loss
- Improve muscle recovery and athletic performance
- Improve mood and cognitive function
- Increase muscle size and strength
- Speed healing from injury
- Improve metabolic and hormonal health

You now know everything you need to know to start using this powerful technology. Now go start using it and taking your health, body and energy to new heights!

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378 Baxter, D. et al. (2008). Clinical Effectiveness of Laser Acupuncture: A Systematic Review. Journal of Acupuncture and Meridian Studies. Volume 1, Issue 2, December 2008, Pages 65-82.

379 https://www.selfhacked.com/blog/interview-with-dr-michael-hamblin-harvard-professor-and-infrared-therapy-expert/

380 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5568598/

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Frequently Asked Questions

Q: My practitioner (chiropractor, naturopath, etc.) said that only his/her laser will work and not the LED lights. Who is right?

It is a myth that only lasers have these effects. It was thought by many people for many years that only lasers had these effects (because they were first discovered with laser devices), but more recently, it has been proven that non-laser light (like from LED devices of the appropriate wavelengths) essentially have the same effects.

There are over 250 studies using LED red and near-infrared light therapy that have been done in just the last few years. The studies that compare them have found basically the same benefits. And there is virtually nothing to indicate that one needs lasers to generate these effects. Even some companies (like Thor Laser) that have been producing laser technologies for years are now producing LED products.

According to Harvard researcher Michael Hamblin, PhD (widely regarded as the world's top authority on red and near-infrared light therapy):

> *"Most of the early work in this field was carried out with various kinds of lasers, and it was thought that laser light had some special characteristics not possessed by light from other light sources such as sunlight, fluorescent or incandescent lamps and now LEDs.* ***<u>However all the studies that have been done comparing lasers to equivalent light sources with similar wavelength and power density of their emission, have found essentially no difference between them</u>****."*[381]

Q: You said that both red light and near-infrared light work through the same physiological mechanisms at the cellular level, so I'm confused on what exactly the difference is. Can you explain?

See the section earlier in the book titled “What Purpose Do You Want to Use Red Light Therapy For?” for a detailed explanation of differences.

Q: Are there any concerns of EMFs (electromagnetic fields) if the device is very close to the body?

All electronic devices emit EMFs (electromagnetic fields) and the health effects of EMFs are still debated. By the strictest safety standards from Europe, you don’t want to regularly be exposed to more than 3mG (milligauss).

Just for comparable reference, please note that **your cell phone emits much more than this every few seconds**, and if it’s in use, emits far more than 3mG (upwards of 50mG and even close to 100mG). A household blender emits upwards of 100mG.

I’ve measured EMF output of the Joovv, Red Rush360, and Platinum LED lights and EMF output is moderate (on par with a typical computer or laptop, and less than a cell phone) within 0-3 inches. As you move away by 5 inches or so, there are virtually no detectable EMFs. (Note: EMFs drop off dramatically as you move away from the source). So by using it at least 6” away from your body, you can get a strong dose of light without any concern at all over EMFs. Anywhere over roughly 3” away is going to be very safe, but if you want to be extremely cautious and have **no EMF exposure at all**, going over 6” is ideal. This will completely eliminate your exposure to EMFs. (Note: I have already figured this fact into my recommended treatment distances outlined in this book, so basically, there are no detectable EMFs at the treatment distances I recommend so EMF’s are a non-issue here.)

Note also that Red Therapy Co. (the Red Rush 360 light) has just come out with a line of ultra-low EMF lights, so they are taking extra steps to ensure the safety of their products, which I think is wonderful.

One more important point: One must also consider not just the strength of the EMF emitted, but much more importantly, the frequency of the dose. What I mean is

that sitting with your hands on your laptop or having a cellphone on your body for several ***hours*** each day (common practices for most people in the Western world) is infinitely more of a concern for your health than a 3- or 15-minute exposure to the red/NIR light done once a day or every other day. So if you're going to worry over EMFs, then I suggest directing your attention to things like the cell phone you have on your body or in your hand for maybe hours each day, your use of laptops and iPads, etc. Those are much more real concerns.

Q: How far away should the light be for maximum effect?

The closer the light is, the stronger the dose. So "maximum effect" would be with the LED light basically on your body, as close as possible. However, because these electronic devices emit EMFs (electromagnetic fields) and the health effects of EMFs are still debated, I recommend minimizing EMF exposure by being at least 3" away from the device. As explained above, going at least 6" away is ideal.

All my treatment distances recommended in this book are 6", 12", 18" or 24".

As explained in the dosing section, for deeper tissues, treating from 6" or 12" is ideal. For skin and anti-aging effects, there is a benefit of moving the light further away to 12", 18", 24" or even 36", which is that since light spreads as you move away from the source, going further away allows you to treat much larger body areas all at once.

See the dosing section of this book for more specific instructions on the best distances and doses for different purposes.

Q: How long and how often should I do the red/NIR light sessions?

As far as how long to do the treatment, please see the section on dosing.

As for frequency of use, there is no universal agreement on the dosing frequency in the research, so I can only

make a recommendation based on what is most common in the research and based on my experiences with thousands of people I've worked with. In general, I've found that more than once per day is too much. For most people, the optimal frequency is between 3-6x per week. (Daily or every other day.)

For an acute problem, like healing an injury, it may be ideal to do one treatment per day. (E.g. You just sprained your ankle and you want it to heal as fast as possible.)

I don't recommend doing more than one treatment per day. Remember the biphasic dose response explained earlier in this book. Doing too much will give less beneficial results than doing the right amount.

Q: How deeply do these lights penetrate into the tissues of the body?

See the section in the book "How Deep Does Red/NIR Light Penetrate Into Our Body?"

Q: Is there a best time of day to do it? Or are there certain recommended practices you have for using the light for specific issues?

There are few points worth making here:

- If you are using the light for cognitive enhancement, using it on your head prior to the period you need to focus or perform is likely the best approach. (E.g. In the morning before starting your work day).
- If you are using the light to enhance performance during physical activity, use the LED on the muscles that are going to be most active 5-60 minutes before the activity.
- If you are using the light to enhance fat loss or muscle gain in response to exercise, using it before or after exercise is ideal (whatever time of day that is). (Note: Some studies use it before and others after. I personally favor using it after, but there are some studies that have shown good results with applying it before exercise as well.)

- If you are using it to speed recovery after exercise, using it right after exercise or several hours later is ideal (whatever time of day that is).
- For most purposes—e.g. anti-aging effects, boosting immunity, decreasing inflammation—the time of day likely does not matter at all. (It is theoretically possible that certain times might be slightly better than others, but there is no research to indicate this.)
- If you are using it for cellulite reduction, it may be beneficial to use the light on the affected area right before doing exercise (whatever time of day that is).
- Even though red light doesn't affect the circadian rhythm nearly as much as other wavelengths (like blue or green light, or typical indoor white house lighting, etc.), very bright red light like these high-power LED lights will suppress melatonin release and disrupt sleep if you use it too close to bedtime. So I would suggest not using it within an hour of sleep. (NIR is likely much less of a problem than visible red light in this regard.)

Q: Can you split into several small sessions for the same effect?

You can potentially do that, but I generally recommend that people stick with no more than one session per day. I suggest doing one longer treatment rather than multiple shorter treatments.

Q: I have the light and have done some treatments, but how do I know that it's actually working? How quickly will I see or feel the effects?

Much like supplements or prescription drugs, you can't always know just based on your subjective feelings if something is working or not. For example, consider a statin drug that lowers cholesterol. Can you feel that it is working to lower your cholesterol? No, of course not. But

if you get your blood drawn and measure your blood lipids, you will see that it is lowering your cholesterol.

As another example, if using it for muscle gain or fat loss, the research says that, in general, red and near-infrared light therapy increase fat loss or muscle gain by 30% beyond just doing the exercise alone. (That's actually a very large effect by the way). However, what that means in practical terms is the difference between you losing 4 inches off your waist (without the light) vs. 5.2 inches (with the light). Unless you were measuring it and comparing your results to your identical twin doing the same exercise and diet plan as you, you have no way of knowing that the light caused you to lose an extra 1.2 inches of fat beyond what you would've lost without the light. You are totally unaware of the amplification effect of the light on your results. All you know is that you got results, but you don't know how much the light contributed to them, because it's not as though you apply the light and watch the fat melt off right before your eyes —it's an effect that is happening slowly over time, and is not something we can readily see or feel happening instantly after the light treatments.

So in many cases, there's no way of knowing with certainty whether it is working or not based on casual observations (i.e. without tightly controlling things and measuring things with vs. without the light).

But here's the good news: You don't really have to wonder if it is working, because the actual science has tested these things and already proved that *it does work!* In essence, trust the science! These scientists did far more rigorous and tightly controlled experiments than you could ever do in your own personal experience, so trust their work. What that means is this: Simply DO IT, and then trust that you're getting beneficial effects.

Now, there are of course, many instances where one will notice an effect.

For example:

- If you are using it for pain relief, you will notice that there is an immediate pain killing effect within

20 minutes.

- If you regularly get cut or injured in some way, and you observe how long it typically takes you to heal, and then you do it with the light, you will notice it heals much faster.
- If you are using it for hair loss and you take photos, you will likely notice that over weeks or months, your pictures show improvement.
- If you are using it for arthritis, you may notice after a few weeks or months of treatment that your joints hurt a lot less and move better, or you don't get pain the day after exercise, etc.
- If you are using it for cellulite reduction, take photos and observe changes over a few months, and you'll likely see significant reduction.
- If you are using it for wrinkle reduction and anti-aging purposes, you will likely notice effects within a few weeks (and may even have people complimenting you on how good you look).

Again, the key point is that you don't have to second guess this or wonder if it is doing anything, because the actual controlled research has already shown that it *does work*. So just do it and know that you are doing something which the science has already shown works. Trust the science, and just do it!

Q: How can we be sure we are replicating the conditions in the studies and what the key points we need to be mindful of during our sessions?

My recommended dosing ranges in this book are based on the research. These general dosing guidelines are based on the bulk of the data. So by following these dosing guidelines for your specific issues, you'll be in line with the research.

In essence, that's really all you need to know, so don't overthink it too much.

Q: What are the relative benefits of 660nm (red light) and 850nm (NIR) and the pros and cons of combining these in one unit?

As explained previously, red and near-infrared act through the same mechanism. The major difference is the penetration depth. But see the previous section on red vs. near-infrared for a more detailed discussion of the differences.

Since both red and near-infrared work through the same mechanisms, there really are no universal pros and cons—it's dependent on how you want to use it. If you want to use it to treat deeper tissues like glands, muscles, or the brain, go for pure near-infrared or a 50-50 mix. If you want to do anti-aging or heal things more in the surface tissues, red light may have an advantage. But please keep in mind that BOTH red light and near-infrared will work for both purposes. When we talk about these differences, it's just a matter of degrees of effectiveness, not that one works for a specific purpose and the other doesn't work at all. They both work for pretty much all of these purposes, so don't overthink it, or convince yourself that the red light won't work for treating muscles, glands, etc. The one exception might be the brain, where it has been shown that near-infrared penetrates much better through the skull than visible red light does. So if you want to use it to enhance brain health, near-infrared is a better choice.

Q: What is the risk to eyes? Any danger after cataract surgery? How best to protect the eyes as a precaution? Any differences between red vs. near-infrared here?

In general, the research indicates that red and near-infrared light are extremely beneficial for eye health. While there is no official consensus among researchers about this, I think it is likely that you do not need any special protective eyewear as you would with many other types of light, like UV light. Having said that, there is some research indicating that long-duration exposure in the eyes may not be a good idea, and you may want to

keep the dose very low for the eyes (i.e. the eyes may not tolerate larger doses as well as other body parts.) One researcher commented:

> "Eye safety: In a study by Merry et al (2016), 50-80 mW/cm² of visible red light appeared to improve vision, though in that study, subjects kept their eyes closed while looking at the Warp10 treatment device (670nm). Another scientific article on eye safety stated that 10 mW/cm² would be a safe upper limit for a near-infrared exposure of long duration."

If you have any specific condition or eye health issue (e.g. post cataract surgery), please talk to your doctor and make sure it's okay for you.

I will also mention, importantly, that lasers are very different from LEDs. **You should NEVER shine lasers into your eyes!**

But LEDs are much safer for light exposure in the eyes. Whether they are 100% perfectly safe for large doses is not yet clear. If you have any eye health problems and you want to err on the side of caution, you may want to:

1. Make sure that you only expose your eyes to low doses (less than 5 Joules is probably a good estimate). Much less than you would dose all the other areas of your body.
2. Close your eyes or wear fabric (e.g. towel, shirt, blindfold, etc.) around your eyes while using the light.

Until we have more conclusive data, it doesn't hurt to err on the side of caution.

(Remember to consult your doctor if you have any specific issues—these statements are not intended as medical advice or claims to treat or cure any specific eye condition).

The one other difference here is simply eye sensitivity. Some people find the brightness of a powerful red LED light to be hard on the eyes (in the sense that any bright light will be). So if you are sensitive to the light, feel free

to close your eyes or use some sort of fabric or blindfold to cover your eyes. Note that the near-infrared light is not visible to the human eye, so you won't have any bright light that your eyes are sensitive to with near-infrared.

Q: What if you have certain problematic tissues like tumors or cysts? Are there any risk factors when shining it over an area where one has polycystic ovaries or perhaps a benign cyst on a breast etc.? Should these areas be covered when treating?

(Standard Disclaimer: As always, for any specific medical condition, please consult your doctor before using red or near-infrared light. Nothing I say here should be construed as medical advice or as a claim to treat or cure any condition.

In general, red and near-infrared light will be stimulating to tissues that you shine it on, so it is reasonable to speculate (even though we don't have much data to go on) that shining it on cancerous tumors would probably not be a good idea. Though Michael Hamblin said that overall, the research shows improved outcomes in cancer when red/NIR light is used on OTHER PARTS of the body (i.e. not the tumor itself).

Regarding benign cysts or polycystic ovaries, there is really no research on this. But as a precautionary principle, I would suggest not shining it on any tissues that you don't want to potentially stimulate.

I believe that I am being excessively cautious in my recommendations here, but I think it's smart to do so until we have more research to base recommendations on.

Q: Will it help decrease fat and cellulite and in what way does it help do so? Is it only by the way of losing fat or purely by shining on area of skin?

As far as cellulite is concerned, it reduces cellulite primarily by enhancing the structural integrity of the

collagen networks. (It also may work by helping to stimulate fat loss.)

For fat loss, red/NIR light *by itself* (i.e. in the absence of nutrition and lifestyle interventions) likely won't do much to help you lose fat. Where it's really going to shine is if you are actually engaged in a nutrition and lifestyle routine that is driving overall fat loss. In that scenario, it will amplify the effects and allow you to lose a lot more fat. But again, by itself, just doing the red/NIR light without nutrition and lifestyle changes, you will not notice much benefit on fat loss. It's not a magic pill, but rather a key lifestyle strategy that amplifies the benefits of other lifestyle strategies.

Q: What makes the red light therapeutic—is it the amount of nm? I found a different light that is 660nm and it's only $50 or $100 or $150. Do I really need to get the ones that are $400 and up?

It's not just the wavelength that matters. For example, I can give you a little LED device with 10 bulbs of 3 watts each that is a 660nm device and it might only cost $14, but it's basically worthless because it's way too underpowered, and it's not going to illuminate a significant portion of your body.

The dose (power of the light combined with the distance away from your body), along with being a sizable light, along with being at the right wavelength are all key factors.

Any light that you've found that is cheap is almost certainly missing one or more of those three factors.

If you don't have a light that can give an effective dose to your body (and the right amount of your body), you have a device that is mostly worthless.

Take my word for it, it is a HUGE mistake not to listen to my advice in this book about getting a device with adequate power. You can buy some of the devices on the market that are 30 watts or 60 watts for $100 or $300 or $400, but you will have just wasted your money, because those devices can't give you an effective dose. So do NOT

buy the cheaper devices, and save your money to get one of the devices from the brands I am recommending here. It's the difference between getting results and not getting results.

And remember that the devices I recommend that are $449-$1,000 dollars are actually incredibly cheap compared to getting a laser ($5,000-$30,000) or going to a clinic to get treatments ($75+ per treatment).

Q: I am confused by all these different terms like photobiomodulation (PBM) and Low-Level Laser Therapy (LLLT). What are these and how do they differ from red/NIR light therapy?

In short, these are all basically interchangeable terms. So don't get confused by quotes or various people who use terms like "photobiomodulation" or LLLT? Even "LLLT" itself doesn't always mean the same thing—some people write it as "low-level laser therapy" and others as "low-level light therapy."

Historically speaking, it was thought that lasers (coherent light beams) had unique effects that were totally different from regular sources of light like lamps or LEDs. Thus, the bulk of the research has been done with lasers and uses the term "low-level laser therapy" or LLLT for short.

To make things even more complicated, many other terms have been put into use by some people like "cold laser," "therapeutic laser," "photobiotherapy," etc.

(Side note: There is also the broad term "light therapy" which people use to mean many different things unrelated to red/NIR light therapy, like therapy for the eyes, or sleep issues, or using a SAD light for seasonal affective disorder, and other uses.)

But back to red and near-infrared light therapy…

In recent years, it has become accepted that lasers don't have the unique effects once thought, and that it's just light at these wavelengths in the right intensity (not specifically laser beams) that produce these effects.

So now there have been hundreds of studies on red/NIR light therapy that use regular LED panels (not lasers). This is sometimes referred to specifically as LEDT (LED therapy) or more broadly as still LLLT, but now defined as "low-level *light* therapy" (rather than *laser* therapy).

Since it has been found that it's not only lasers that produce these effects, most researchers now use the broad and all-encompassing terms "low-level *light* therapy" (still with LLLT) or the better term, "photobiomodulation" (which means literally the changing of biology with light).

But again, don't get confused by these different terms. For our purposes here, all of these terms are interchangeable with "**red and near-infrared light therapy**."

Q: Do red light devices emit UV light?

No, they do not. UV light is another part of the light spectrum entirely separate from red and near-infrared. The light devices I recommend do not emit any UV light.

Q: Can I use any red light to get the benefits?

No. As I explained in the section on choosing a device, you need a device that has enough power (wattage), is of good size for what you want to use it for, and has the proper wavelengths of light.

Q: Does red light therapy tan you or burn the skin?

No. Tanning and sun burns come from UV rays. These devices do not emit UV light.

Q: Do you get Vitamin D from red light?

No. Our body synthesizes vitamin D from exposure to UVB light. These devices do not emit UV light.

If you are looking to synthesize vitamin D, you need exposure to either sunlight or a specialty UV lamp. (I suggest the Sperti UVB lamp for this purpose.)

Q: Can I get the benefits of red/NIR light therapy by standing in the sun?

Yes and no. It's a bit of a nuanced answer…

First, the truth is that if you were spending hours every day outdoors with the sun on your skin (like our ancestors did), then you probably don't need a red/NIR light device.

But since most of us do not spend hours a day with the sun on our body, we end up deficient in the *nutrient* of red/NIR light. So getting a red/NIR light device is a very smart move.

I should mention that the sun has benefits that red/NIR light devices do not have. The sun emits UV light, which we use for several purposes, like synthesizing vitamin D. It's also going to be better for setting circadian rhythm in the morning.

But red/NIR lights also have some advantages over the sun…

One is convenience and access. Not everyone lives in a place that is sunny all year-round. And not everyone has the ability to get outdoors in the sun every day during the time of day where it's warm and sunny (and you'd want to have your skin exposed).

In addition, for very targeted treatments of specific issues, the sun is not going to give you the precision targeting of a light device that you can shine specifically on the thyroid gland or on a specific wound site with the precise light intensity and dose that will lead to the best effects.

Also, the spectrum differs in important ways that affect some goals. In particular, for skin anti-aging (on the face for example), many people would want to *avoid* getting lots of UV on their face from the sun (which may accelerate skin damage and skin aging), but get the benefits of red/NIR. The sun doesn't give you the ability to do this—with the sun, you get the whole spectrum of red, near-infrared, far-infrared, blue, and UV. But with a red/NIR light device, you can get the therapeutic benefits on your skin while avoiding the potentially counterproductive wavelengths entirely.

To be clear, red/NIR light devices are not a replacement for sunlight. We still need plenty of sun exposure to be healthy. But red/NIR light devices can make up for our lack of sun exposure and give us several targeted benefits in a way that we can't get from the sun.

Q: Does red/NIR light work as a light for treating Seasonal Affective Disorder (i.e. a "SAD light")?

No. SAD lights are used by people who live in places that have poor sunlight in the winter months to avoid/treat Seasonal Affective Disorder. They are meant to keep circadian rhythm strong during the periods where there is little sun. Red and near-infrared lights do not work for this purpose because it is specifically blue light (light in the blue wavelengths) that affects the circadian "clock" in our brain. Thus, you need specifically blue light of ample intensity to affect SAD.

Note that many of the SAD lights actually use "white light" which is a mixture of blue and many other colors (such that it appears "white").

One other thing to note here is that blue light in isolation may be harmful to the eyes—even while it benefits SAD or circadian rhythm. Some researchers believe that the red/NIR parts of the spectrum emitted by the sun help to counterbalance some of the potential harms of blue light. Yet with SAD lights, we get high power blue light separate from the red/NIR light that we'd normally get from the sun. So I personally think it's wise to also include some red/NIR light—using the red/NIR lights I recommend at a distance of 3-5ft away—while using the SAD light. This is what I advise to members of my Energy Blueprint program (who use SAD lights) to help protect their eyes.

Q: I see some people using blue lights in their devices, what are the differences between blue and red lights?

Companies that do this are misguided, in my opinion. Blue light does not have the same physiological effects as red/NIR light, and in fact, has some effects which *oppose* red/NIR light.

To be clear, blue light is necessary and vital to our health because blue light entering our eyes feeds into our circadian rhythm/clock in the brain, which regulates numerous hormones and neurotransmitters, and many vital functions. So I am *not* saying that blue light is bad—to the contrary, we need blue light to be healthy (especially blue light entering our eyes). There are also some other potential uses of blue light like whitening teeth or treating acne.

But blue light directly on the skin, or on wound/injury sites, muscle tissue (or anything where one might use red/NIR light) is a bad idea. The blue light isn't doing anything beneficial in that case, and may even be detracting from the benefits of red/NIR light. In the case of anti-aging treatments on the skin specifically, it is almost guaranteed to be counter-productive, as blue light can actually damage skin cells.

Moreover, we all spend huge amounts of time indoors under fluorescent or LED indoor lamps that have tons of blue light. Our personal devices like phones, computers, iPads, etc. also emit a lot of blue light.

So most of us are being bathed in blue light all the time, while being massively deficient in red/NIR. Again, blue light does *not* stimulate the same physiological benefits as red/NIR light.

Q: Does red/NIR light therapy work through clothes?

The short answer is no. But if the clothing is very thin and light can penetrate it well, then maybe to some extent. How do you know if red light can penetrate it? Simply hold the fabric up next to the light while it's on and see how much light gets through. You can literally observe it with your naked eye.

Now, with most clothes, they will block at least 50% and more like 80%+ of the light, so if that is the case, just realize that it is massively lowering the dose of the light.

In summary, I wouldn't recommend trying to do any light treatments through clothing. For best results, do it

on bare skin.

Q: What about red/NIR light therapy with animals?

There are many companies who manufacture red/NIR light therapy devices specifically for animals. It is a common practice in some veterinary clinics, and among race horses in particular.

Q: Does red/NIR light therapy work through clear plastic or glass?

In general, I would say yes. While plastic or glass does block some parts of the light spectrum (like parts of the UV spectrum), it should not interfere too much with red or near-infrared. But it is possible that certain types of plastic or glass could block some wavelengths. To know for certain, you'd have to test it with and without a PAR meter (using the specific piece of plastic or glass you're referring to) to see if it blocks any of the light output.

Q: What is the difference between these red/NIR light devices and plant grow lights that some plant growers use, or lights on coral reef aquariums?

Plant and coral growing lights use lights with many different parts of the spectrum—blue, UV, green, red, orange, etc. (There are a few lights for plant growing that are purely red, but are generally extremely underpowered, and don't have optimal beam angles.) Red and near-infrared lights use LEDs that specifically emit only red and/or near-infrared light at the specific therapeutic wavelengths, and at the right power output for therapeutic effects.

So the short answer is no, you can't use plant growing lights or aquarium lights as red/NIR light therapy devices. They are totally different. If you want to do red/NIR light therapy, get the right kind of light device specifically designed for that purpose.

Q: Can it be used while pregnant?

There is no data on this, so we cannot say for sure. I will say that humans get red/NIR light exposure from the sun—so this occurs all the time whenever a pregnant woman is sunbathing. But it is feasible that red/NIR devices could differ in some way that has unexpected effects. Thus, since we do not have the data on this, I will stick with my precautionary recommendations and advise you to err on the side of caution and don't do anything which we don't know the effects of.

This article has more nuanced recommendations and speaks of some relevant research that suggests that using it on other parts of the body (away from the belly) is likely perfectly safe: https://www.chiroeco.com/lllt-not-recommended-during-pregnancy/

But again, consult your doctor first and always err on the side of caution.

Q: Can you clarify dosage on a particular area of the body compared to total session dosage? In other words, if max dosage is 20 mins can I do 20 mins on each area or 20 minutes max for all areas combined (i.e. if 2 areas 10 mins each)?

Max dosage is the maximum total treatment time for all areas treated. That means that you can either do 20 minutes (potentially) on one area of the body, or divide that 20 minutes over multiple areas. It does NOT mean 20 minutes on each area.

Note: 20 minutes is the maximum dosage (with the lights I recommend). Remember that doing the maximum isn't necessarily the best. Most people will notice better effects with lower doses than the maximum doses in the recommended dosing range. And especially people who are in very poor health will NEED to start with much smaller doses at the very bottom (or below) the recommended dosing range.

If you do a longer treatment time like 15-20 minutes, I strongly suggest doing it on more than one area of the body (e.g. 2-4 areas), rather than the whole 20 minutes just on one area. 20 minutes on one area will almost certainly be too strong of a dose on that area of the body.

- **Total Treatment Dose/Time:** To calculate the total dose more precisely, please see the earlier sections that went over on power density numbers (e.g. 100mW/cm²) and how that relates to the amount of Joules. I suggest that total treatment dose for *all* areas of the body should be no more than roughly 120J. So assuming the light is 6" or 12" away from your body, that means **no more than roughly 15-20 total minutes of time with the light shining on your body**.

Q: Here is a study saying that near-infrared light could potentially be harmful to the eyes. What do you think?

https://www.researchgate.net/profile/Nikolaos_Kourkoumelis/publication/50291066_Eye_Safety_Related_to_Near_Infrared_Radiation_Exposure_to_Biometric_Devices/links/0fcfd50fefcdad89c3000000/Eye-Safety-Related-to-Near-Infrared-Radiation-Exposure-to-Biometric-Devices.pdf

They are mainly saying:

1. LASER light (coherent light) can damage eye health. I agree with that completely. You MUST always protect your eyes from laser light! So if you are using a laser device, then yes, it can damage your eyes.
2. They are speculating that it might be possible that VERY bright LEDs could potentially be hazardous to eye health, but more research is needed.

Keep in mind that there is actually research showing that it can BENEFIT eye health. See the many studies on this in the section of this book on eye health.

But if you have any eye health problems and you want to err on the side of caution, you may want to:

1. Make sure that you only expose your eyes to low doses (less than 5 Joules is probably a good

estimate). Much lower doses than you would do for any other area of your body.

2. Close your eyes or wear fabric (e.g. towel, shirt, blindfold, etc.) around your eyes while using the light.

Until we have more conclusive data, it doesn't hurt to err on the side of caution.

Q: Is there a reliable way of calculating the appropriate duration for effective treatment with a LED device, if you know the power/wattage of the specific device, the size of the area being treated, and the distance between the light and the surface of the area being treated?

Yes, please see the section of the book titled "Guide to Red Light Therapy Dosing." But also note, that the calculations on paper (about the theoretical power output of a device based on their specifications) often do not match up with actual power output. Many devices emit 30-50% LESS light than they claim. So the only real way to know for sure is to actually get the light and measure the light output with a PAR meter.

Q: If you have weird and intense vision effects after your eyes are exposed to either the red or near-infrared LED lights, how can you determine if it is still safe to expose your eyes?

As a general rule, if you notice any negative effect, lower the dose. As far as this visual effect specifically, first, it's fairly normal to see spots after being exposed to any bright light. If you feel your vision is altered in some profound way or you don't like any visual effects that it causes, feel free to cover your eyes (or simple close them) while using the light.

Q: You gave significant ranges for treatment times, so how do I know whether I should do for example, 1 minute vs. 10 minutes?

There is no universal way of dosing here, because it differs between individuals. If you are in poor health or are severely fatigued, I always recommend starting with smaller doses, and some people in very poor health can feel fatigued from doing too much (in much the same way that they might from over exercising). So in the first few treatments, use times at the lower end of my recommended doses. If you ever feel fatigued after using it, that means you overdid the dose. Therefore, lower the dose on your next session.

To make it simple: I suggest starting with smaller doses, and then working up to the higher ends of my recommended treatment times over the course of a couple weeks. Then, if you feel fatigued, back off the dose a bit and you've found your ideal dose. Or feel free to continue using the doses at the higher end of my recommended doses if you have no adverse reaction to it and you feel good from it (as most healthy people will).

Q: How does this red light "heal" the body so well? My son had tried everything to get rid of plantar warts and within 2 weeks of consistent daily usage of the red light LED, they completely disappeared! Totally amazing and remarkable results!

It's hard to say why it helps get rid of plantar warts. Red/NIR light does seem to have differential effects in certain types of cells. And it may have an effect on cells infected with viruses (like wart tissues) that help to kill off the virus or kill the tissues, or activate the immune system cells in the area to help combat the virus. There is research to suggest red/NIR can help in combating other viral issues that affect the skin like herpes simplex virus[382], so it's not unreasonable that it would also benefit a condition like plantar warts.

Q: Can you explain the difference between the LED lights available to the general public and the more expensive laser devices only available to medical professionals? Is there solid research to demonstrate that they have comparable effects?

How do you determine the parameters of treatment using an LED device that would be comparable to the parameters of treatment used in a study using a laser device?

Yes, there is plenty of research to show that they have comparable effects. Please see the quote from the world's foremost expert on this subject, Michael Hamblin, PhD, earlier in this book where he explicitly says that they have basically the same effects. It is also worth noting that he himself uses an LED device, not a laser device. (He uses it on his forehead in the mornings to enhance brain/cognitive function.)

As far as the parameters of treatment using a laser vs. an LED device, you do this by calculating the total dose they used and using the same dose with the LED. (Remember, it's just a function of total energy delivered, so it can be calculated with a laser or LED device just fine.) To simplify this, just follow my dosing guidelines.

Q: When using it for the brain, are there big differences between red vs. near-infrared light? And does the light penetrate through hair and skull?

NIR will get through the skull more effectively, so for the brain specifically, near-infrared is going to be superior.

Neither near-infrared nor red light will penetrate effectively through hair, so you don't want to shine it on the hairy parts of your head, but the forehead, back of the neck, and ear areas are all good.

Also, it's worth noting that certain devices are meant to target the brain specifically. VieLight is one company that makes these brain-specific devices. They sell intranasal devices that are claimed to target the brain, but Michael Hamblin, PhD does not believe these devices actually do reach the brain directly, but rather they work through irradiating the blood in the capillaries, which indirectly affects the brain (and other systems of the body). Assuming he is correct, it really does not make sense to use these low-power intranasal devices to treat

the blood—it would be much better to use a high power (and much larger) LED device for that purpose.

Having said that, VieLight also makes a product called VieLight Neuro which is a much higher power device with multiple light points around the skull. (It can be placed to emit light through the hair follicles directly on the skin, so the hair doesn't block the light). The VieLight Neuro may very well be the best product for treating the brain specifically. We don't know for sure, as there are no studies comparing it to LED lights, but it looks to be a great product.

Q: Are there any recommendations on how to use the light differently during the different seasons?

This is an interesting question. We don't have any data on this, so my answer will be speculative. With UV lights, we know that this is pretty straightforward: Obviously you use UV light on your skin to help synthesize more vitamin D during the time of the year where you get less sun—the winter. In the case of red/NIR light, we are not concerned with vitamin D specifically, but I would say follow the same principle of doing much more in the winter (as with using a UV light) to make up for lack of sun exposure in winter. This is especially true for anyone who lives in a place where they don't get much sun exposure during the winter months.

Q: Are there any side effects of using a red/NIR light device? Can you do too much?

Remember that red/NIR light has a "biphasic dose response" (I wrote about this earlier in the book). That means that at very low doses, you will get little to no effect. At the right dose, you'll get good effects. And if you do much more than that, you will go back to having little to no effect.

So please do follow the recommended dosing guidelines and be aware that doing more than that can lead to counterproductive results.

As far as specific side effects, in most cases for most people, there is little to no risk of side effects. The main concern is simply doing too big of a dose, in which case, you would likely experience less benefits rather than terrible side effects.

In contrast to say, use of UV light (e.g. tanning beds)—where there is a huge risk of cell damage by overdoing it—red/NIR light is extraordinarily safe and has little risk of negative side effects.

Having said that, a small percentage of people will experience side effects from doing too much. The main side effects are headaches and fatigue/exhaustion (it can require a significant amount of energy to deal with the healing and mitochondria-stimulating properties of red/NIR light).

Also, potential source of side effects is from the EMFs from the device. Some people are extremely sensitive to EMFs (you know if you are, because your cell phone and laptop/tablet cause major symptoms for you). In the same way, the EMFs from a light can be problematic if you decide to put the light device right on your body and don't leave several inches of space between your body and the light. (See my recommendations on keeping the light at least 3" away, and I'd suggest at least 6" for anyone who is EMF sensitive. At 6" there will be little to no detectable EMFs.)

Another potential side effect is poor sleep in those who use the light right before bedtime. This is because even though red colored light doesn't generally suppress melatonin production (melatonin is necessary for good sleep), if the light is high enough intensity/power, it will still suppress melatonin—much like light from your TV or cell phone will. This is why it's best not to use the light within an hour of bedtime.

One more thing worth mentioning here is that certain people seem to be far more sensitive than others to the effects of red/NIR light. The dose that is optimal for one person may be far lower than that of another. In general, I've found that people with severe health problems are sometimes very sensitive to the effects of the light and

need MUCH lower doses. Some people in this situation may experience fatigue/exhaustion or headaches even from relatively low doses. This is likely due to the differences in overall redox balance in cells. Specifically, people in poor health or those with various chronic diseases may have extremely elevated levels of oxidative stress (excess free radicals) in their body, and the hormetic effects of things like exercise or red light therapy may be tough for their cells to handle. So just as over-exercising can cause exhaustion/fatigue in these people, so too can overdoing the red/NIR light treatment.

The solution to this is relatively simple: If you are in poor health or are severely fatigued, I always recommend starting with smaller doses. In the beginning, use times at the very low end of (or below) my recommended doses. Then slowly increase the dose on subsequent treatment sessions (within my recommended dose range) to find your maximal dose below the threshold of any side effects. If you feel fatigued after using it, that means you overdid the dose. Therefore, lower the dose on your next session.

Q: I did my first treatment and felt very fatigued for hours after or even the next day. Why did this happen and what should I do?

If you ever feel fatigued after using it, that just means you overdid the dose. Similar to exercise or doing other healthy things like using a sauna, if you overdo it, you will feel fatigued. That doesn't mean exercise is bad, or that using a sauna is bad—in fact, research shows they are amazing for health—it means that you overdid it and you need to decrease the dose.

Simply lower the dose on your next session to the very low end (or below) my recommended dose range, and then—assuming you don't have a negative reaction anymore, which you shouldn't—then slowly work up to within the recommended dose range and find the dose at the upper limit of what you can tolerate before you experience negative effects. Then simply lower the dose

by 30 seconds or a couple minutes or so below that upper limit, and that's the right dose for you.

Be aware that people in poor health or with chronic fatigue can be very sensitive to the light (just the same as they will be sensitive to overdoing exercise and feel bad effects from that). So please be conservative with the dosing and always err on the side of doing too little rather than too much. Start with low doses and build from there rather than trying to rush in to doing larger doses.

Q: I've heard of far-infrared saunas, so what's the difference between near-infrared and far-infrared?

Far-infrared are the higher wavelengths in the infrared region. There is a very big difference here, because far-infrared is felt by us as HEAT. It heats up our body. That's why it is used in saunas. The thing heating the sauna is the far-infrared energy. Near-infrared emits no heat and does not heat our body.

It is also unclear if far-infrared has any of the same effects at the cellular and mitochondrial level as red and near-infrared light. In general, think of far-infrared as HEAT, which can increase circulation and promote sweating (like in a sauna).

Basically, you can think of this as two categories:

1. Red/NIR light—emits no heat, and acts on the mitochondria
2. Far-infrared—heats up our body

These are not the same, and a far-infrared sauna (or far-infrared heater/mat of any type) does not give the same benefits as red/NIR light therapy.

Q: I've heard of NEAR-infrared saunas. What do you think of these?

This is a misnomer. There are some companies using this sort of misleading statement ("near-infrared sauna"). There is really no such thing as a purely near-infrared

sauna—i.e. a sauna that only emits near-infrared and no far-infrared. If a sauna did that, it would not be a sauna at all, because it wouldn't be hot (it would be room temperature). All it would be is you sitting inside a box with an invisible light source (remember, near-infrared is not visible to the human eye) at room temperature. No sweating, no heat, and just an invisible light. In other words, a truly "near-infrared sauna" would not be a sauna at all.

What these companies who are selling "near-infrared saunas" are actually selling is far-infrared (i.e. heat) that also includes a source of near-infrared light (for example, the heat bulbs I discussed earlier in this book). There are also some wooden saunas that advertise themselves as "near-infrared saunas" that are also a mix of far-infrared and near-infrared.

There are sauna options which do include near-infrared and truly do act as sauna and get hot. Of these options, the top choices are Sunlighten's mPulse saunas, Clearlight's full spectrum saunas and the SaunaSpace Pocket Sauna. So if you have the money, this is a wonderful option, as you can get the benefits of far-infrared (sweating and benefits of heat hormesis) while also getting the benefits of near-infrared talked about in this book. In this case, you wouldn't need to buy a red/NIR light device separately, as you would be getting your near-infrared therapy in your sauna. Remember, it's quite a bit more expensive to get one of these saunas (roughly 10x more money) compared to just a red/NIR light device, so I generally don't push for people to go purchase a home sauna, let alone a higher priced home sauna (that generally costs $4,000-$10,000).

Q: What device do I personally use?

I have both a Red Rush360 and a Platinum BIO600. Both are excellent lights that I highly recommend.

I've also had many other light devices that I purchased and didn't realize that they were underpowered or not ideal wavelengths, so they sit unused in my garage.

Using these two powerful lights simultaneously, I can basically treat my entire body (or any area I want to treat) in less than 5 minutes.

Typically, I use these two lights while lying on the ground and have one on either side of me at 6”-24” away. I either lay on my back or my side, and this way, I can treat both sides of my body at once or the front and back of my body at once. I typically use it for anti-aging purposes on the skin, enhancing the effects of exercise (muscle gain, performance, and recovery), fat loss, preventing hair loss, as well as treating any injuries that I get from living a very active outdoor lifestyle.

Both are excellent, high-quality lights that I’ve had for a long time now and they still work perfectly well, while providing amazing therapeutic benefits.

Any of the lights I recommended are going to be excellent. But these are the two I personally think are best, which is why I bought them. And having bought close to a dozen different devices, these are by far the best I have seen and used (perhaps with the exception of Thor’s $100K light bed, which I have no plans of purchasing any time soon).

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381 Freitas de Freitas et al. (2016). Proposed Mechanisms of Photobiomodulation or Low Level Light Therapy.

382 Hamblin, M et al. (2013). Low-level laser (light) therapy (LLLT) in skin: stimulating, healing, restoring.

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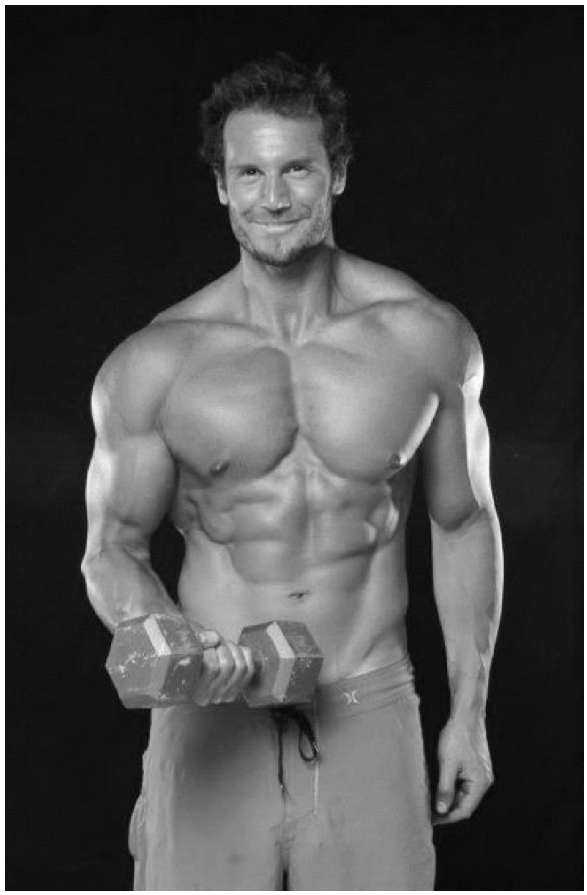
About the Author



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He also hosts *The Energy Blueprint Podcast*, where he interviews many world-renowned physicians, scientists and health practitioners to uncover secrets to overcoming fatigue, optimizing health, and increasing energy levels. His podcast is quickly becoming one of the most popular health podcasts on iTunes.

If you're interested in overcoming chronic fatigue or just taking your energy levels to new heights, you can learn more about his work at www.theenergyblueprint.com. He offers a 60-day Energy Blueprint program designed specifically for people struggling with chronic fatigue and low energy to help them get their energy (and their life) back.

You can view testimonials from people on his Energy Blueprint program here: https://www.theenergyblueprint.com/reviews/

You can listen to or watch his weekly podcast here: https://www.theenergyblueprint.com/category/podcast/

(Make sure to enter your name and email when on the site so that you can receive notifications of new podcast releases each week.)

Finally, you can get access to his free "Double Your Energy Masterclass" training (value - $199) at www.theenergyblueprint.com/virtual-training

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