Intro to the World of Non-Thermal Laser

Dr. Robert Silverman

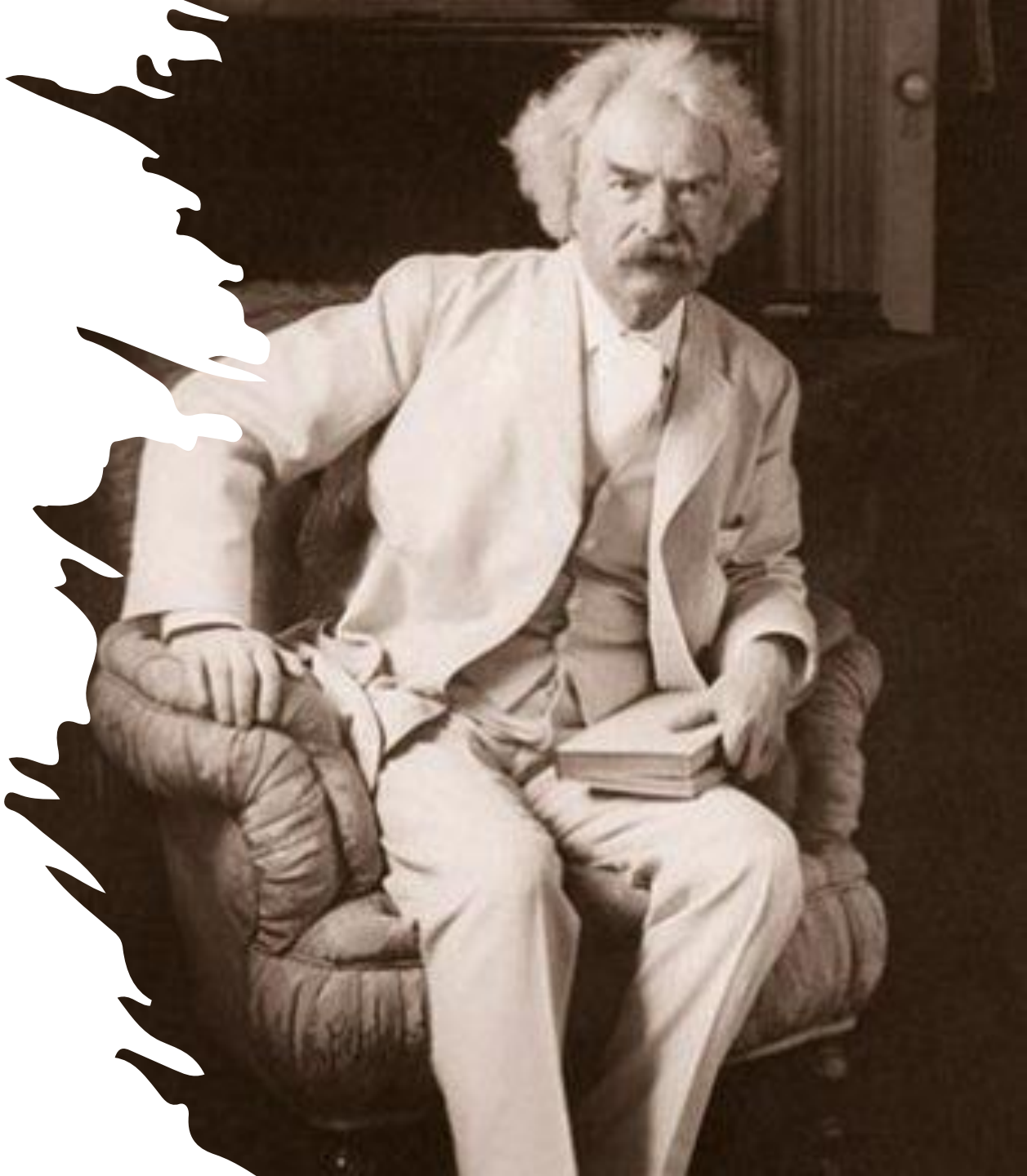
DC, DACBN, MS, CNS, CCN, CSCS, CIISN, CKTP, CES, DCBCN, HKC, FAKTR

www.DrRobertSilverman.com

@DrRobertSilverman @drrobsilverman @drrobertsilverman

The two important days in your life are the day you were born and the day you find out why.

Mark Twain



“Let there be light”

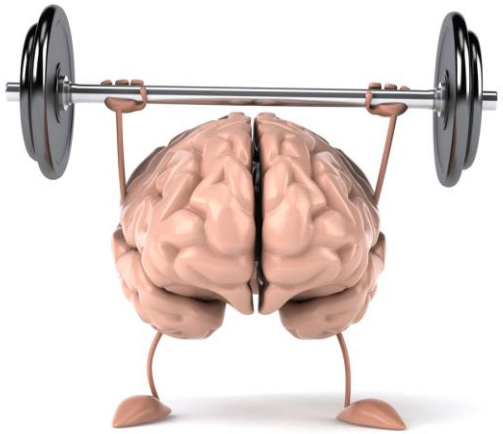
Laser history

1903 Dr. Niels Ryberg Finsen – awarded Nobel Prize in Medicine and Physiology for work in treating skin tuberculosis with ultraviolet or blue light and smallpox with red light

https://www.britannica.com/biography/Niels-Ryberg-Finsen

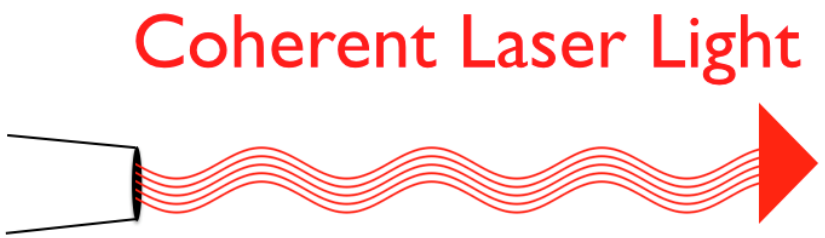
5 Reasons…

1) Effective – “The speed of light”
2) Research-driven; empirically studied. FDA-cleared
3) Practice building
4) Joint health
5) Brain health



Laser Focus

- Laser: Light Amplification by Stimulated Emission of Radiation
- A focused beam of light that emits photon energy
- All photons travelling same direction at same wavelength = coherent light



What is NTL?

- AKA photobiomodulation
- Low intensity light therapy
- Effect: photochemical, not thermal
- Light triggers biochemical changes within cells
- Can be compared to photosynthesis in plants
- Photons absorbed by cellular photoreceptors and triggers chemical changes

HB Cother, RT Chow, MR Hamblin, J Carroll. *MOJ Orthop Rheumatol.* 2015;2(5):00068. Published online 2015 Jun 9

Laser Therapy

5 components integral to beneficial outcome

LASER

1) Active ingredient

Specific wavelength (color) - component responsible for influencing biochemical cascades

2) Dosage

Intensity (power of light) determines response. Too little limits response. Too much produces adverse effect

3) Delivery Mechanism

Manner light is delivered determines proper tissue response and depth of penetration. Coherent, focused light insures deep tissue stimulation and absorption

4) Movement (advanced)

Turns muscle on and off.
Move handheld.
Built-in – FX635/405

5) Pulsing

Deliver shorter pulses of energy

Red lasers

Red 635 nm Laser:

- A modulator – increases energy flow and dissipates energy if too high
- Promotes increased energy through stimulation of mitochondria
- Anti-inflammatory effect
- Enhances ATP production and protein synthesis with pain reduction
- Creates improvement in collagen formation in wound healing
- Reduces pain and muscle spasm while increasing strength and ROM
- Balances sympathetic nervous system and enhances microcirculation of blood and lymph
- Balances cell-to-cell communication

Why violet light

- Violet – enhances physiological outcomes because it has more energy per photon (not power as in MW watts)
- Works in shorter period of time
- More anti-viral, bacterial, fungus
- Has greater response to immune function

Integrating Non-Thermal Laser into Practice

"The most versatile healthcare tool of the 21st century".

Dr. Rob

Therapeutic Laser Biological Effects

- **Rapid Cell Growth** — Laser light accelerates cellular reproduction and growth
- **Faster Wound Healing** — Laser light stimulates fibroblast development and accelerates collagen synthesis in damaged tissue
- **Increased Metabolic Activity** — Higher outputs of specific enzymes, greater oxygen and food particle loads for blood cells and thus greater production of the basic food source for cells, Adenosine Tri-Phosphate (ATP)
- **Reduced Fibrous Tissue Formation** — Laser light reduces formation of scar tissue following tissue damage from: cuts, scratches, burns or post surgery

Therapeutic Laser Biological Effects (cont'd)

- **Anti-Inflammatory Action** — Laser light reduces swelling caused by bruising or inflammation of joints to give enhanced joint mobility
- **Increased Vascular Activity** — Laser light induces temporary vasodilation increasing blood flow to damaged areas
- **Stimulated Nerve Function** — Slow recovery of nerve function in damaged tissue can result in "dead" limbs or numb areas. Laser light speeds process of nerve cell reconnection to bring numb areas back to life

Therapeutic laser biological effects (cont'd)

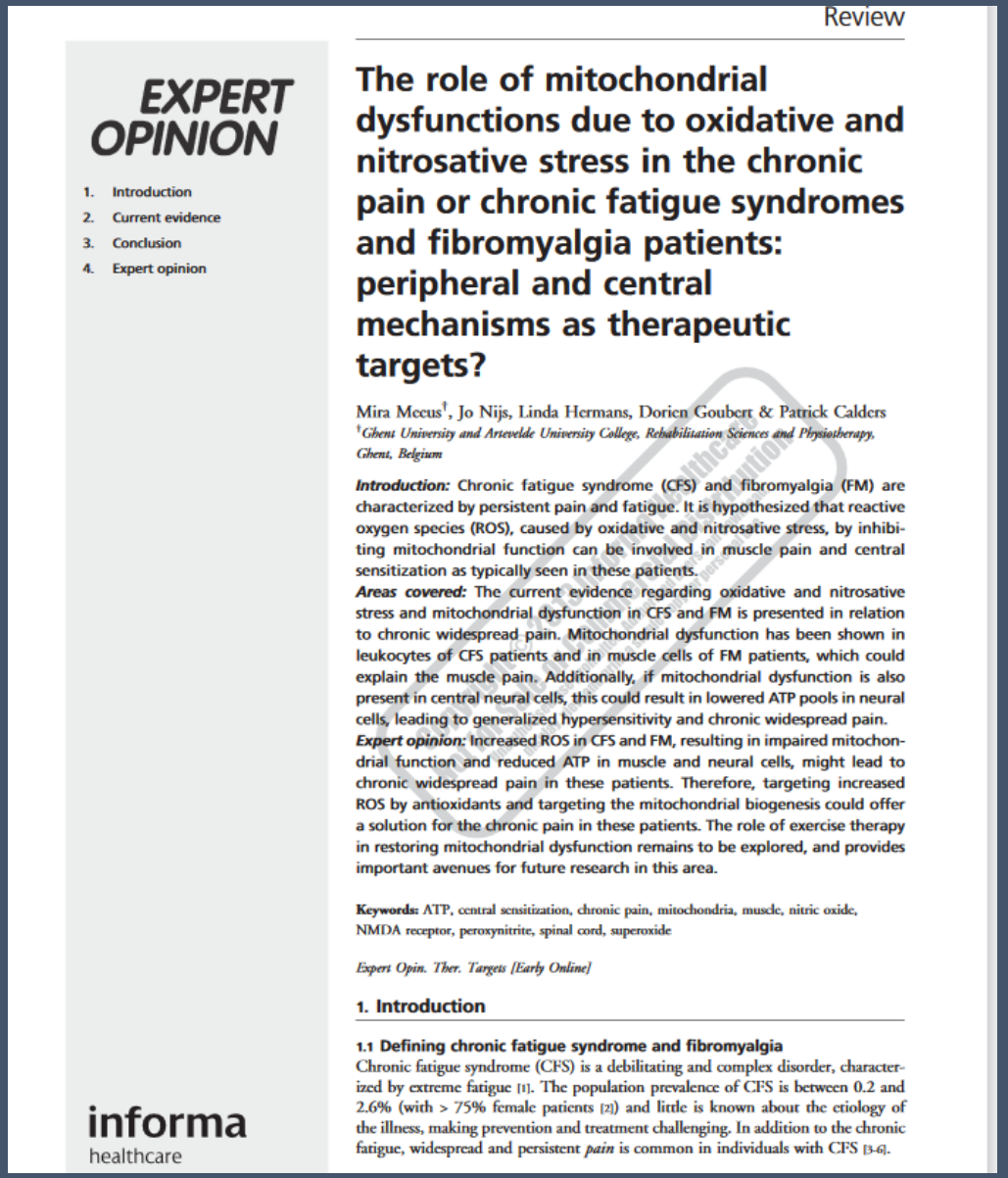
Stem cells to help in repair

- Stem cells – the body's raw materials from which all other cells with specialized functions are generated

Healthy immune response strengthens immune system and helps fight off infections

Emulsification of fat within cells without damaging the cell itself to assist in weight loss , and body contouring

Lowered ATP levels lead to hypersensitivity and chronic widespread pain



Review

EXPERT OPINION

1. Introduction
2. Current evidence
3. Conclusion
4. Expert opinion

The role of mitochondrial dysfunctions due to oxidative and nitrosative stress in the chronic pain or chronic fatigue syndromes and fibromyalgia patients: peripheral and central mechanisms as therapeutic targets?

Mira Meeus[†], Jo Nijs, Linda Hermans, Dorien Goubert & Patrick Calders
[†]*Ghent University and Artevelde University College, Rehabilitation Sciences and Physiotherapy, Ghent, Belgium*

Introduction: Chronic fatigue syndrome (CFS) and fibromyalgia (FM) are characterized by persistent pain and fatigue. It is hypothesized that reactive oxygen species (ROS), caused by oxidative and nitrosative stress, by inhibiting mitochondrial function can be involved in muscle pain and central sensitization as typically seen in these patients.
Areas covered: The current evidence regarding oxidative and nitrosative stress and mitochondrial dysfunction in CFS and FM is presented in relation to chronic widespread pain. Mitochondrial dysfunction has been shown in leukocytes of CFS patients and in muscle cells of FM patients, which could explain the muscle pain. Additionally, if mitochondrial dysfunction is also present in central neural cells, this could result in lowered ATP pools in neural cells, leading to generalized hypersensitivity and chronic widespread pain.
Expert opinion: Increased ROS in CFS and FM, resulting in impaired mitochondrial function and reduced ATP in muscle and neural cells, might lead to chronic widespread pain in these patients. Therefore, targeting increased ROS by antioxidants and targeting the mitochondrial biogenesis could offer a solution for the chronic pain in these patients. The role of exercise therapy in restoring mitochondrial dysfunction remains to be explored, and provides important avenues for future research in this area.

Keywords: ATP, central sensitization, chronic pain, mitochondria, muscle, nitric oxide, NMDA receptor, peroxynitrite, spinal cord, superoxide

Expert Opin. Ther. Targets [Early Online]

1. Introduction

1.1 Defining chronic fatigue syndrome and fibromyalgia

Chronic fatigue syndrome (CFS) is a debilitating and complex disorder, characterized by extreme fatigue [1]. The population prevalence of CFS is between 0.2 and 2.6% (with > 75% female patients [2]) and little is known about the etiology of the illness, making prevention and treatment challenging. In addition to the chronic fatigue, widespread and persistent *pain* is common in individuals with CFS [3-6].

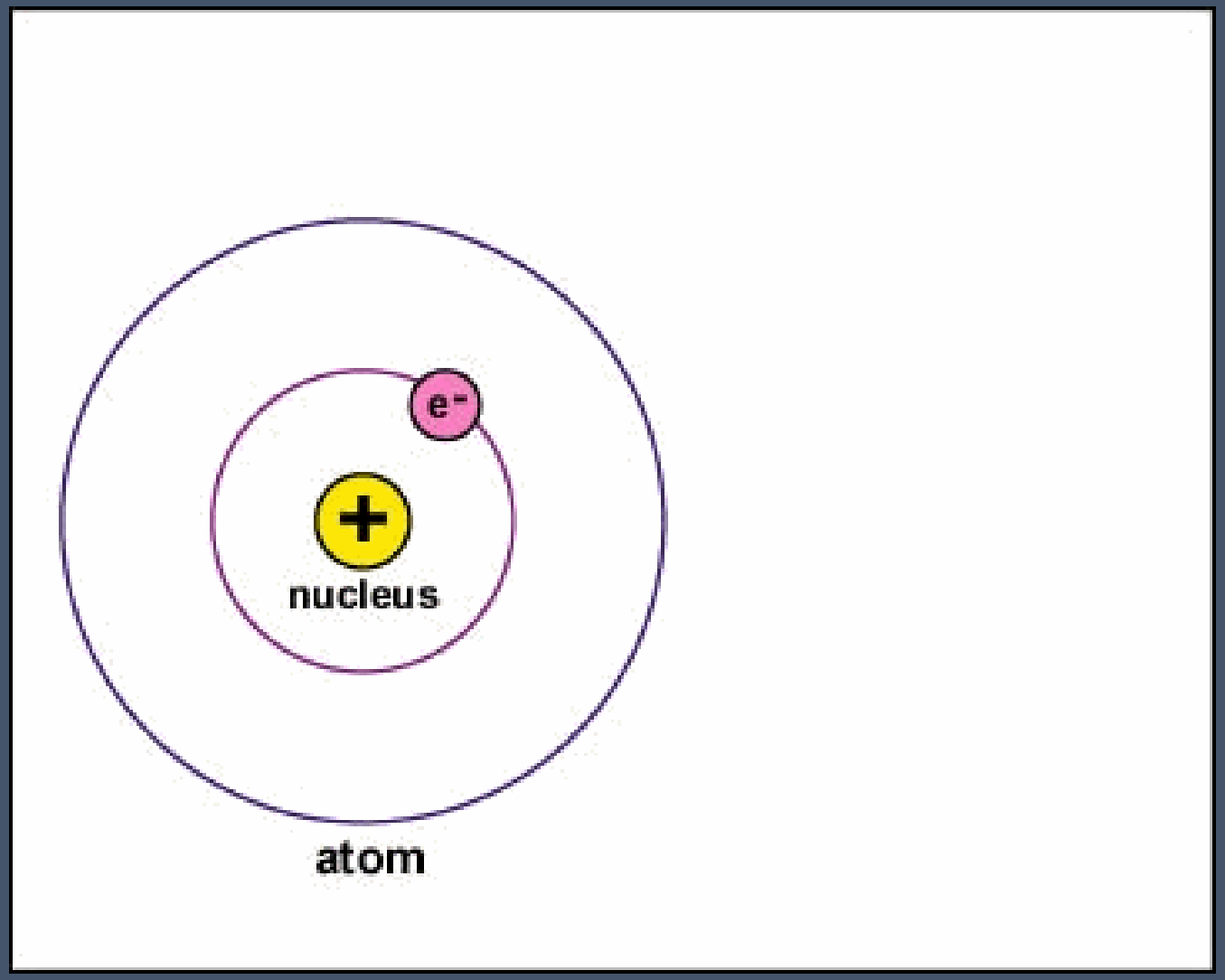
informa
healthcare

Laser energy fuels mitochondria

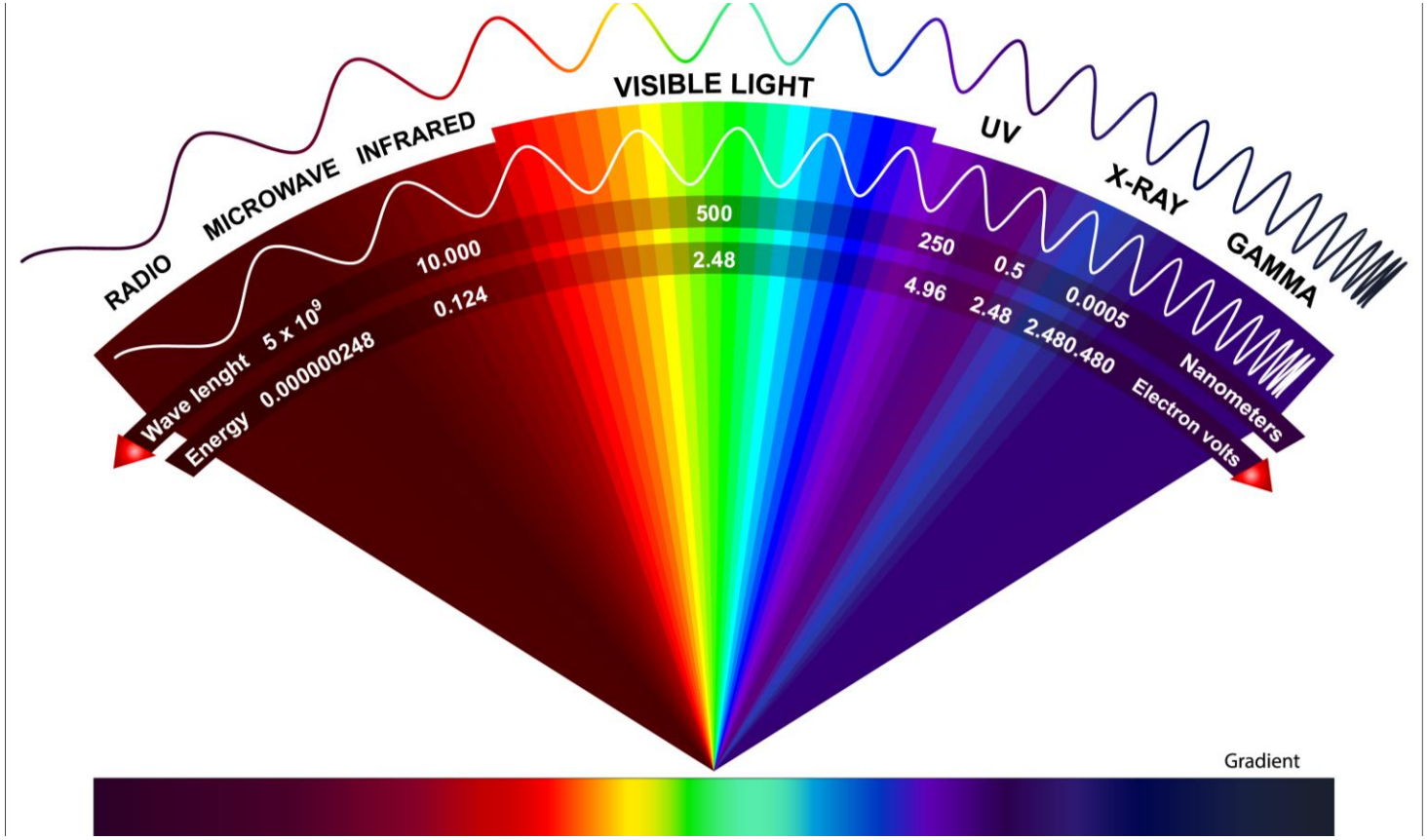
Electron Transport Chain

Electron transport chain uses high-energy electrons **to convert ADP into ATP**. High-energy electrons from NADH and $FADH_2$ are passed along electron transport chain from one carrier protein to the next.

When photons of visible light energy strike certain atoms, that energy may push an electron from that atom to a higher energy level where it can be picked up by an electron acceptor in an electron transport chain.



Non-thermal Laser fits in to the visible light part of the Electromagnetic Energy Spectrum



Electromagnetic Spectrum

Photon Energy is measured in Electron Volt (eV)

The shorter the wavelength, the higher the Electron Volt (eV)

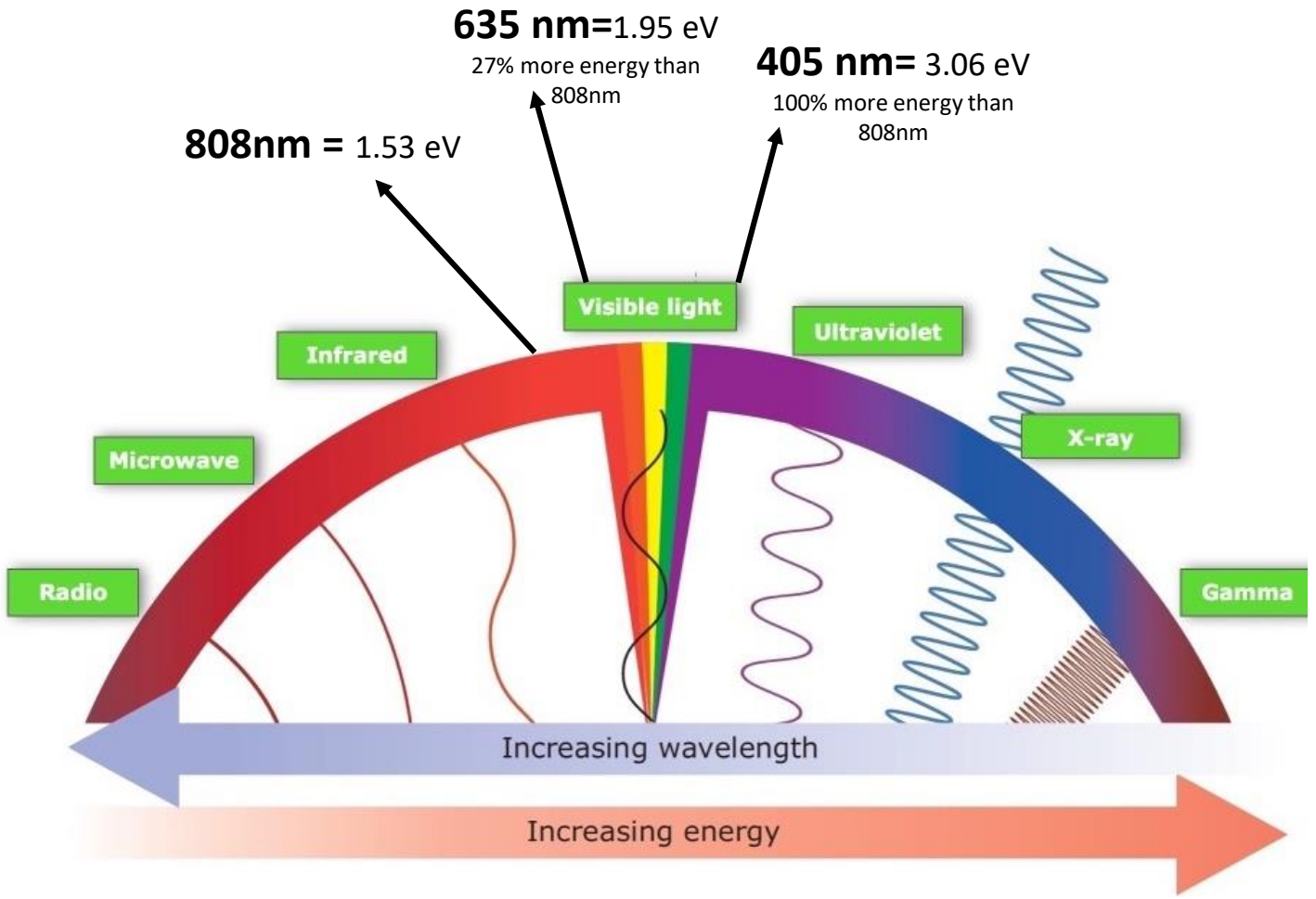
- 405nm = 3.06 eV
- 532nm = 2.33 eV
- 635nm = 1.95 eV
- 830nm = 1.49 eV

405nm has 70% more energy per photon than 830nm

WHICH FITS IN TO INFRARED LIGHT

Energy not power

Energy transfers.. Power heats
Increasing power does not change the Election Volt (eV).



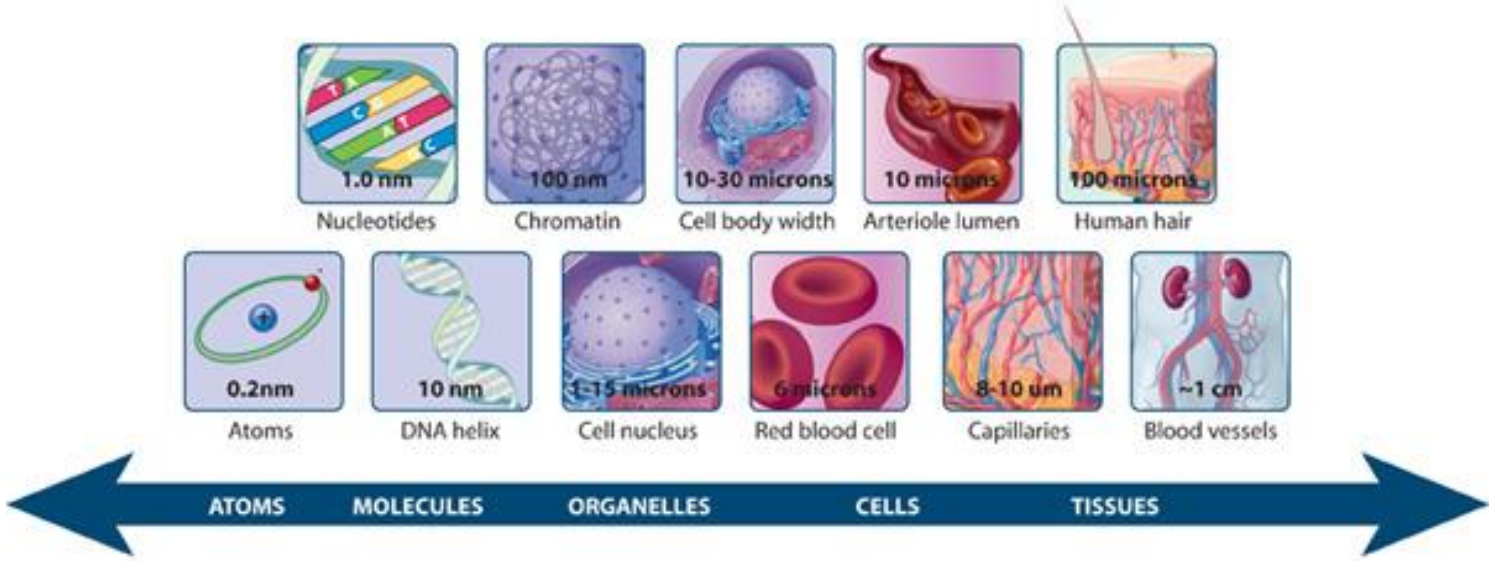
Note:
The minimum energy to induce direct photochemistry is 1.7 eV = 729nm

What is Photochemistry?

Boston University

When molecules absorb visible or UV light, they become electronically excited.

This electronic excitation result in breaking, reforming, and thus rearrangement of chemical bonds, as well as electron and energy transfer between various parts of a chemical system.



You cannot achieve this with infrared light OR THERMAL LASER

Non-thermal laser therapy in Russia: history, science, and practice

Key takeaway:

If you combine laser and LED together, you get diminished results

Moskvin SV. **Low-Level Laser Therapy in Russia: History, Science and Practice**. *J Lasers Med Sci*. 2017 Spring;8(2):56-65

Non-thermal laser prolongs longevity of degenerative knee joints

- 70 elderly patients
- Bilateral tricompartmental knee arthritis
- One knee per patient received laser plus therapy
- Other knee received PT and sham light
- Laser group 1 in 70 needed joint replacement
- Sham light 15 in 70 needed joint replacement

Clin Interv Aging, Aug 5, 2015. 10:1255-8

PBM in human muscle tissue: an advantage in sports performance

Results:

- Laser therapy applied before or after sports activity had profound impact on performance
- Results were as if athletes had taken performance enhancing drugs and they questioned if they should even be allowed in international competition as they seemed to provide an “unfair advantage”

Ferraresi C, Huang YY, Hamblin MR. **Photobiomodulation in human muscle tissue: an advantage in sports performance?.** *J Biophotonics*. 2016;9(11-12):1273-1299

Effect of NTL on serum vit. D and mg. levels in patients with diabetic peripheral neuropathy

Result:

Significant increase in vitamin D and magnesium levels after NTL

Anju M, Chacko L, Chettupalli Y, et al. **Effect of Low Level Laser Therapy on serum vitamin D and magnesium levels in patients with diabetic peripheral neuropathy - A pilot study**. *Diabetes Metab Syndr*. 2019 Mar-Apr;13(2):1087-1091

Efficacy of red NTL for postoperative pain management

Conclusion:

- Red NTL – FDA-cleared for treatment of postoperative pain relief, based on safety and effectiveness across various surgical types
- In addition to postoperative pain reduction, clinical research demonstrated – red NTL may promote healing and reduce consumption of analgesic drugs

Sammons T, Shanks S. **Efficacy of red low-level laser for postoperative pain management: A review of literature.** *J Perioper Pract*. 2022 Nov 17:17504589221124757

Laser pain relief

Conclusion:

- 632.5 nm laser may inhibit emergence of chemotactic factors in early stages of inflammation
- Also, inhibiting COX-2/COX-1
- Cox inhibitors and laser both inhibit expression of COX enzyme and PGE_2 release
- **Red light application decreased ROS level and $cPLA_2$**

WB Lim, SG Lee, I Kim, et al. **The anti-inflammatory mechanism of 635 nm light-emitting-diode irradiation compared with existing COX inhibitors.** Lasers Surg Med, Aug 2007;39(7):614-21

Laser wound healing

- Low doses of red light – affect the expression of 111 genes related to microcirculation, antioxidation and DNA repair, leading to acceleration of the proliferation of fibroblast and endothelial cells in wound healing

Sammons T, Shanks S. **Efficacy of red low-level laser for postoperative pain management: A review of literature.** *J Perioper Pract*. 2022 Nov 17:17504589221124757

Laser healing

- Red 635 nm laser exhibited ability to reduce oxidative stress that occurs during the inflammation phase in the muscle repair process by down regulating the expression of TGF-β1
- Fibrotic area of 635 nm LLLT group – significantly smaller that of control group 14, 21, and 28 days after injury

L Luo, ZW Sun, L Zhand, et al. **Effects of low-level laser therapy on ROS homeostasis and expression of IGF-1 and TGF-β1 in skeletal muscle during the repair process**. *Lasers Med Sci* (2013) 28:725–734

Laser healing

- Muscles treated with NTL show more regenerating myofibers and less fibrotic scar formation that that of untreated contusion group
- NTL found to modulate expression of IGF-1 and TGF-β1
- Drugs typically promoted IGF-1 signaling pathway or inhibited TGF-β1 signaling

L Luo, ZW Sun, L Zhand, et al. **Effects of low-level laser therapy on ROS homeostasis and expression of IGF-1 and TGF-β1 in skeletal muscle during the repair process**. *Lasers Med Sci* (2013) 28:725–734

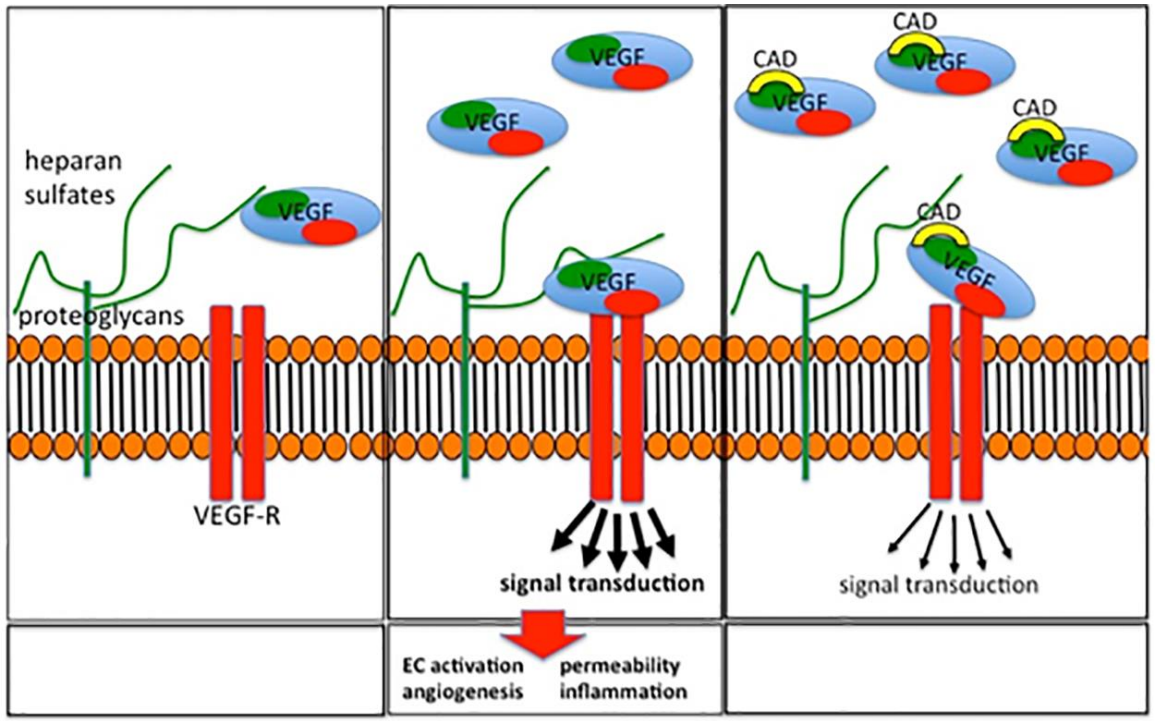
Laser healing

- Red laser – significantly raised IL-10 doses
- As IL-10 increases:
  - Inhibits release of IL-6, IL-8, IL-1β, TNF
  - Regulates switch of M1 to M2 phenotype in injured muscle

Sammons T, Shanks S. **Efficacy of red low-level laser for postoperative pain management: A review of literature.** *J Perioper Pract*. 2022 Nov 17:17504589221124757

Laser/blood vessels

- Red laser radiation at wavelength of 630 nm can cause statistically significant increase of about 30% in VEGF gene expression in vascular endothelial cells compared with that of control cells



doi: https://doi.org/10.1371/journal.pone.0218494.g010

Medical Research Journal, 9 Nov 2014;2(2):61–65

NTL regulates the remodeling of ECM

The remodeling of ECM	Factors associated with the process
Protein synthesis	TGF-β, MMP-2, MMP-3, and MMP-14
Protein degradation	TGF-β, MMP-2, MMP-3, MMP-9, MMP-13, and MMP-14

ECM, extracellular matrix; TGF-β, transforming growth factor-β; MMP-2, matrix metalloprotease 2; MMP-3, matrix metalloprotease 3; MMP-9, matrix metalloprotease 9; MMP-13, matrix metalloprotease 13; and MMP-14, matrix metalloprotease 14.

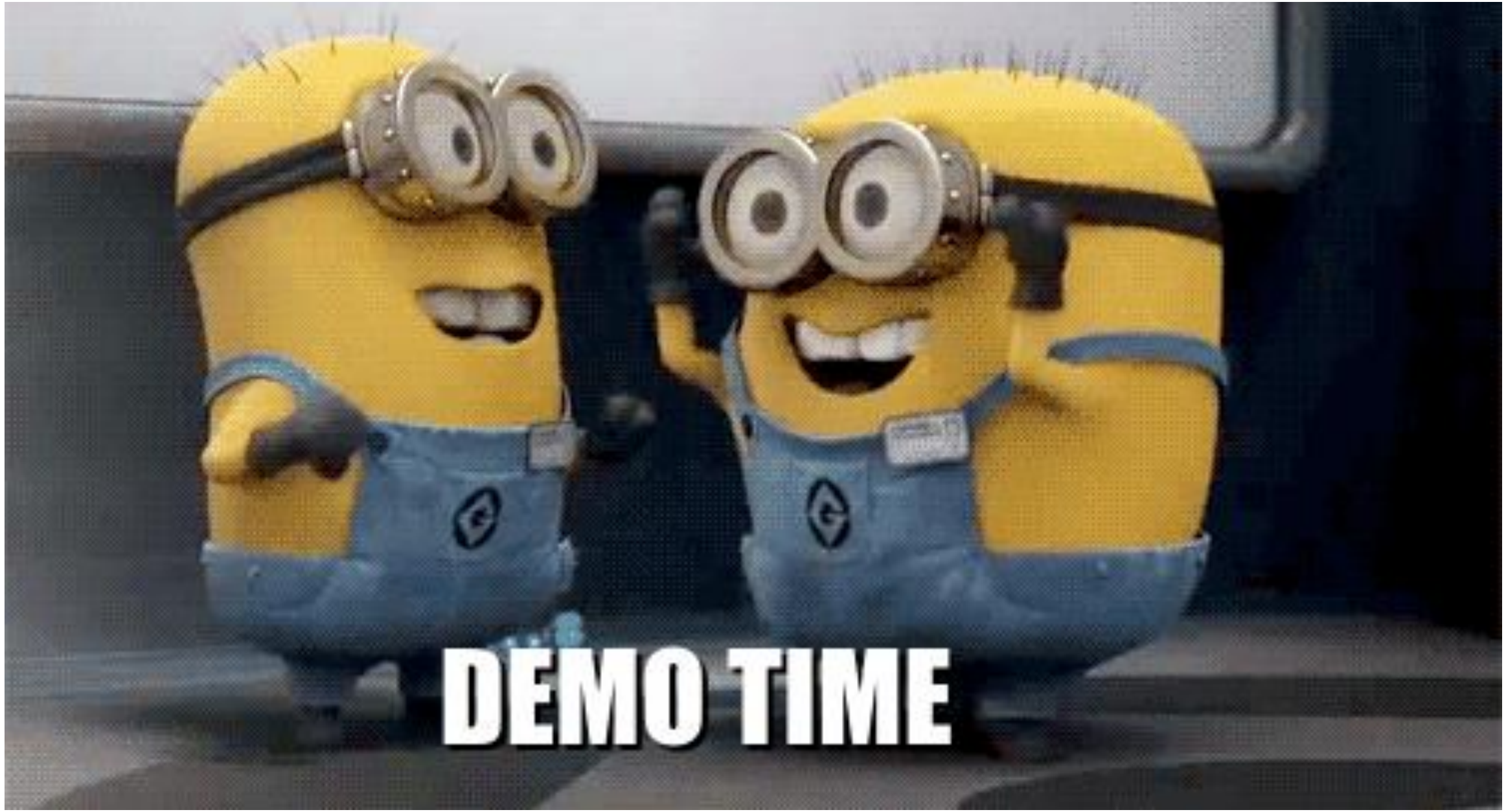
The Functions and Mechanisms of Low-Level Laser Therapy in Tendon Repair (Review). *Front Physiol*, 15 Feb 2022; 13

NTL downregulates diverse inflammatory cytokines

	Different cytokines associated with an inflammatory response
Damage stage	• M1 macrophages, neutrophils, TNF-α, IL-6, IL-1β, PGE2, Cox-2, and NF-kB pathway
Repair phase	• M2 macrophages, Cox-7, and IL-10

LLLT, low-level laser therapy; TNF-α, tumor necrosis factor-α; IL-6, interleukin-6; IL-1β, interleukin-1β; PGE2, prostaglandin E2; Cox-2, cyclooxygenase 2; NF-kB pathway, nuclear factor kappa-B; Cox-7, cyclooxygenase 7; and IL-10, interleukin-10.

The Functions and Mechanisms of Low-Level Laser Therapy in Tendon Repair (Review). *Front Physiol*, 15 Feb 2022; 13


DEMO TIME

DR. ROBERT G. SILVERMAN

IMMUNE REBOOT

Your Guide to

Maximizing Immunity, Restoring Gut Health, and Optimizing Vitality

Foreword by Jeffrey Bland, Ph.D.

Order now

on

ImmuneReboot.com

SCAN ME

www.DrRobertSilverman.com

@drrobsilverman

@DrRobertSilverman

@drrobertsilverman

facebook.com/groups/mastermindlasergroup