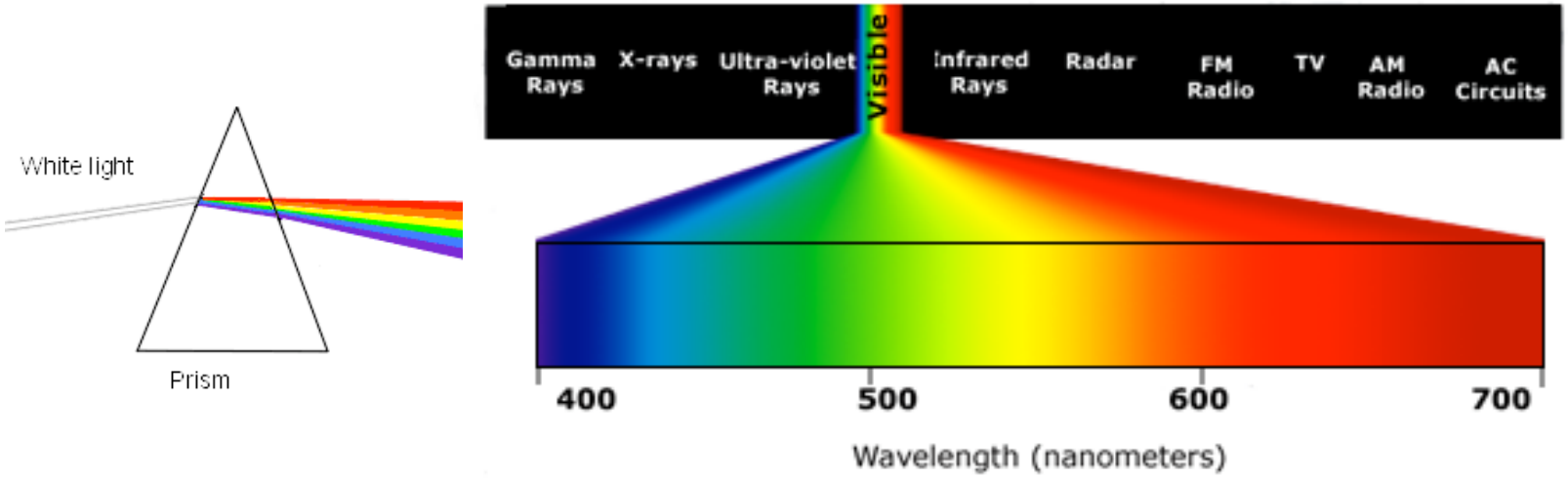
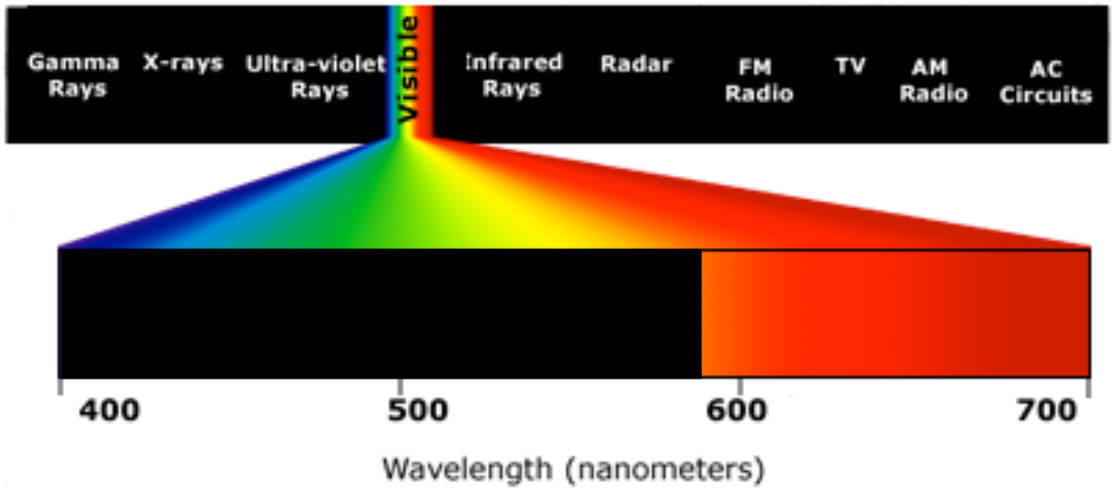
LLLT- what is it?

LLLT is the shining of red, near infra-red and infrared light (600-1100nM wavelength) at tissue to induce beneficial physiological changes within intracellular biochemistry



What does the light do?

Materials absorb light of different wavelengths. We see that in the world around us. When white light hits a material that absorbs light between 380 and 580nm and reflects all other light it will appear red. The absorbed light will impart energy to that material (mostly it becomes warmer).

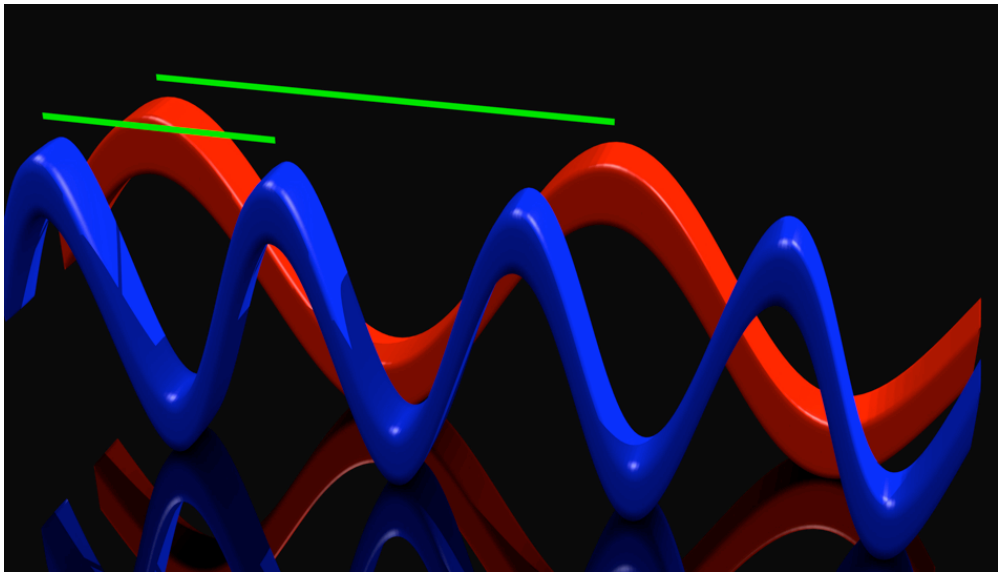


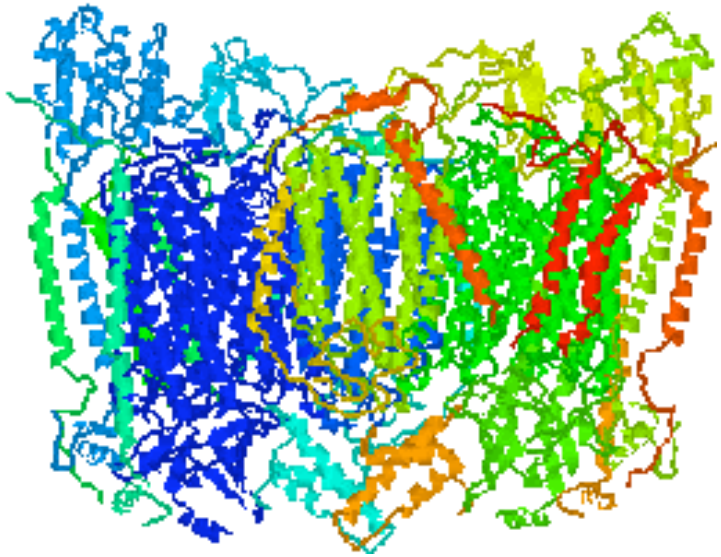
Biochemicals response to light

-Photosynthesis- blue-green light hits a photosynthetic pigment (chlorophyll a) to produce a proton from H_2O that can then be used to manufacture H_2O and CO_2 into CHOs and O_2

-Anti-biotic effect of UV light (eg sunburn). UV is short wavelength (and therefore highly energetic) and when it hits materials it tends to break chemical bonds and thereby producing free radicals. UV damage goes beyond the repairable chemical wreckage as the wreckage goes on to wreck other biochemicals around it causing a chain reaction.

Cytochromes, Haems and other proteins





Cytochrome C Oxidase

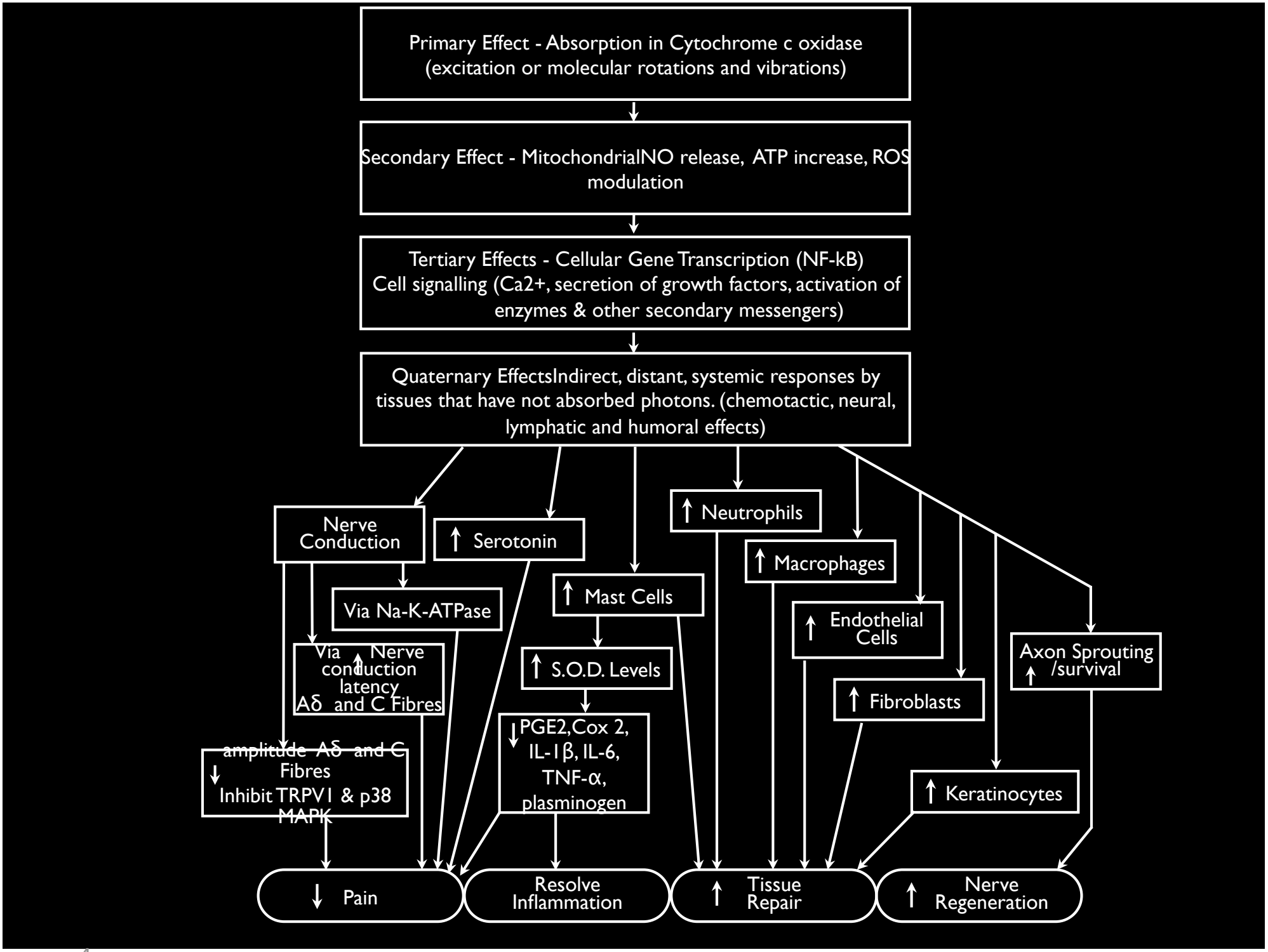
Some important proteins (particularly those with iron or zinc based functional groups) in the human cell absorb near infra-red light and being proteins can translate the energy received into changing shape (temporarily). The best understood one of these is Cytochrome C Oxidase (COx).

Cytochrome C Oxidase in mitochondria

COx is an oxygen receptor in the electron transport chain in mitochondria. It is the penultimate link in the main energy (ATP) production of the cell.

Stressed and inflammed tissue is perfused with Nitric Oxide (NO). NO will outcompete O_2 at the COx receptor and block energy production. Without ATP the cell cannot function. Inability to function can and will trigger cellular apoptosis.

If a way can be found to liberate COx from being bound to NO, cells that normally do not contribute to healing or even perish will be able to do their job. End result: increased healing rate.


Primary Effect - Absorption in Cytochrome c oxidase (excitation or molecular rotations and vibrations)
Secondary Effect - MitochondrialNO release, ATP increase, ROS modulation
Tertiary Effects - Cellular Gene Transcription (NF-kB) Cell signalling (Ca2+, secretion of growth factors, activation of enzymes & other secondary messengers)
Quaternary EffectsIndirect, distant, systemic responses by tissues that have not absorbed photons. (chemotactic, neural, lymphatic and humoral effects)
Nerve Conduction
Serotonin
Neutrophils
Macrophages
Via Na-K-ATPase
Mast Cells
Endothelial Cells
Axon Sprouting /survival
Via Nerve conduction latency Aδ and C Fibres
S.O.D. Levels
Fibroblasts
amplitude Aδ and C Fibres
Inhibit TRPV1 & p38 MAPK
PGE2, Cox 2, IL-1β, IL-6, TNF-α, plasminogen
Keratinocytes
Pain
Resolve Inflammation
Tissue Repair
Nerve Regeneration