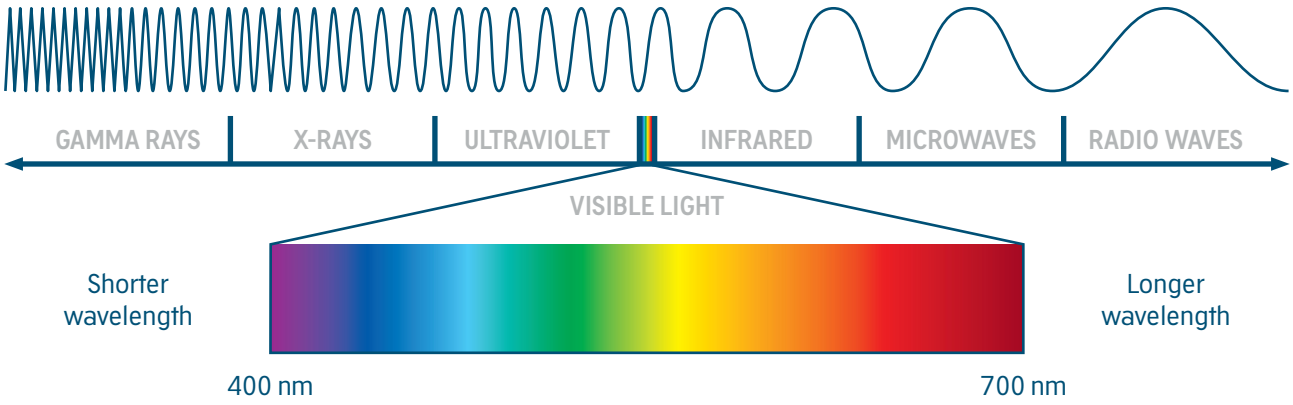
FB Academy
Kleresca

What is behind biophotonic technology?

What is light?

Light comes in a variety of sizes, frequencies and energies in a continuum called the electromagnetic (EM) spectrum. It moves in waves, and its size is measured as its wavelength, which is the distance between any two corresponding points on successive waves, usually peak to peak or trough to trough.

Usually when we talk about light, we refer to **visible light**. This is a very small part of the whole EM spectrum but it's the only part we can see as the human eye can only respond to wavelengths of light in this range. To measure it, we use nanometres (nm) [or billionths of a metre] because we are talking about very small distances. The visible light spectrum ranges from 400 to 700 nm and it is this range that allows us to see colours. Visible light is made up of seven colours (red, orange, yellow, green, blue, indigo and violet). Radio waves, infrared radiation, ultraviolet (UV) radiation, x-rays and microwaves are other forms of EM radiation that we cannot see.



Why is light important?

Light is an important part of our daily life and is present in many processes such as photosynthesis, vision and colours, and synthesis of vitamin D, etc. It is used for different medical treatments in dermatology, wound healing, pain treatment and even in regulating mood and sleep related conditions.

The skin is our largest organ, making up 16% of our body mass. Sunlight often feels good on our skin as ultraviolet (UV) radiation in sunlight (that we cannot see) helps to generate endorphins and vitamin D, but it can also cause inflammation, degenerative aging and cancer[1]. The red and blue light in visible light was shown by Niels Ryberg Finsen in the late 18th century to be effective in treating patients with *Lupus vulgaris*[2]. For patients with psoriasis, short periods of exposure to the sun can be effective in treating them if they use sunscreen to protect themselves from sunburn and cancer[3].

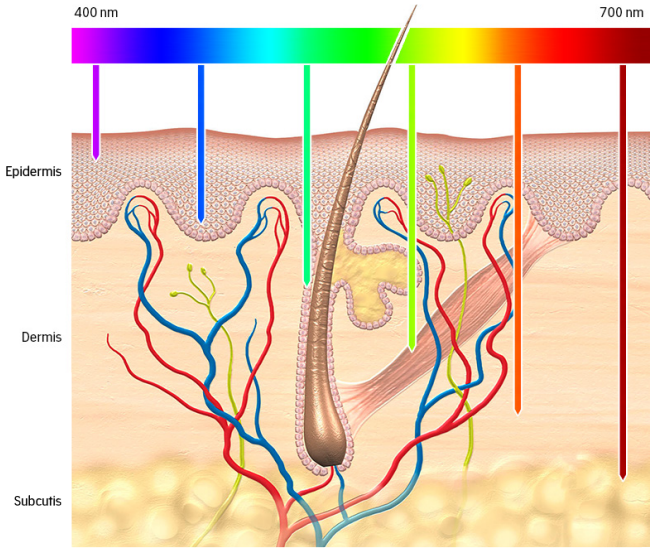
When talking about human skin, we can see that it has three differentiated layers:

- **Epidermis:** Outer layer of the skin, which is in permanent contact with the environment.
- **Dermis:** Lies below epidermis and consists primarily of fibroblasts and mast cells. It contains blood and lymphatic vessels, nerves, sweat glands and hair follicles.
- **Subcutis:** Lowermost layer of the skin that contains mainly adipose cells.

The skin can absorb visible light which can have a biological effect[4]. Visible light will penetrate the skin in different ways depending on its wavelength.

Shorter wavelengths (blue colour) will penetrate only the most superficial parts of the skin (epidermis) whereas longer wavelengths (green, orange red colour) will penetrate deeper into the tissue.

Depending on the depth reached in the skin, the different wavelengths of light can get access to a variable selection of biological structures and have different effects.



What is biophotonics?

Biophotonics is the interaction between light (photons) and biological systems (tissue or cells)[1]. The light must be absorbed by the tissue or cells for it to have a biological effect. If the light is transmitted or reflected, it will have no effect on the tissue or cells[1].

Biophotonics is a relatively new interdisciplinary field that includes all light-based technologies that have many different uses in medicine. They use light to view and analyse living tissues and cells to detect, diagnose and treat diseases such as cancer, heart disease and Alzheimer's. Some examples of biophotonic devices are the following:

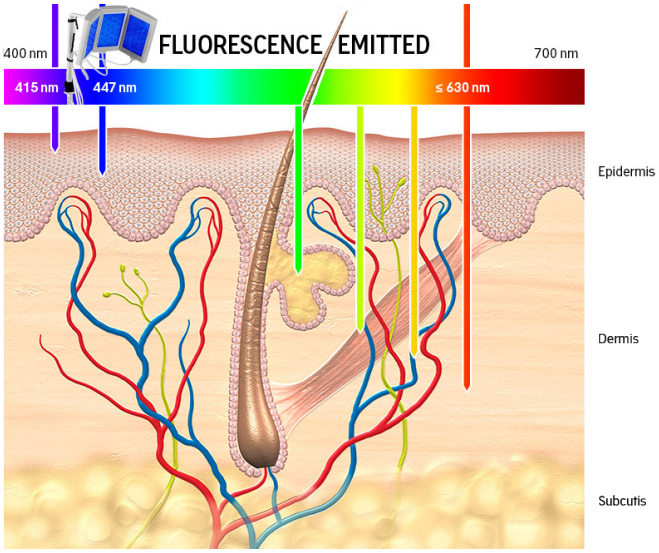
- **Optical coherence tomography** (OCT) imaging is a useful tool for distinguishing healthy and malignant (e.g. basal cell carcinoma) skin tissue and is used in surgery to distinguish the boundary of lesions[5].
- **Photodynamic therapy** (PDT) is the use of EM radiation (usually infrared light) to kill malignant skin, head and neck, lung and bladder cancer cells. It also treats age-related macular degeneration and psoriasis[6,7]. A photosensitizing chemical substance is excited with light of a specific wavelength. The sensitizer releases vibrational energy (as heat), which is what kills the targeted cells.
- **Biophotonic therapy** using blue light has been effective in regulating sleep cycles and mood in seasonal affective disorder (SAD)[8].

Biophotonics is non-invasive, fast and relatively inexpensive i.e. it does not require expensive and time-consuming laboratory analysis of cell and tissue samples.

What is photobiomodulation?

Photobiomodulation (PBM) is the use of photons (i.e. light) to change (or modulate) cell activity in the skin. PBM (also known as low-level laser light therapy [LLLT]) has proven to be effective in promoting wound healing, and reducing pain and inflammation in muscle injuries[9]. It uses visible and infrared light to produce photophysical and photochemical events in the skin. Mitochondria in the skin cells convert the light energy into energy that is used to turn on certain genes that regulate how quickly cells renew, repair and grow[10]. This results in skin that has faster renewal of skin cells. This light energy also speeds up enzyme activity and electron transport and increases production of adenosine tri-phosphate (ATP) in the cell[11]. ATP stores the energy to support metabolism in skin cells so its increased production leads to increased collagen production and reduced pore size.

PBM results in beneficial therapeutic outcomes that in many cases have shown visible, long-lasting effects. It has been shown to help in reducing pain, helping muscle recovery after injury, improving cognitive function and memory in cases of brain damage due to controlled cortical impact (CCI), accelerate bone healing and promote hair growth for conditions such as alopecia areata[9,12,13]. As these therapies are non-invasive, they are particularly suitable for patients who are needle phobic or who do not want to take drugs or have invasive chemical peels of their skin.



Kleresca® is pioneering the use of PBM to stimulate the skin cells' own natural repair mechanisms to treat acne and promote skin rejuvenation. The Kleresca® biophotonic system uses only visible light: blue light from the lamp (415 nm and 447 nm) and the generated fluorescent light energy from the chromophores in the gel (green 520 nm to orange–red 630 nm light). Both act to stimulate the skin cells' own natural repair mechanisms.

This non-invasive treatment has a range of beneficial effects such as reducing inflammation, increasing the build-up of collagen and normalising cellular activity.

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