



Enlightened Growing: Using Biomimicry to Emulate Sungrown Food and Cannabis Crops in Controlled Environments




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<https://www.youtube.com/watch?v=Jjva9ZhxmEA>

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HEALTHY  PLANTS  PROFITS  PEOPLE™

BRINGING TRUE SUNLIGHT INSIDE

To advance

the cleanest, highest quality, full nutrient, locally grown food and healing plants in the world using regenerative and sustainable methods.

To produce

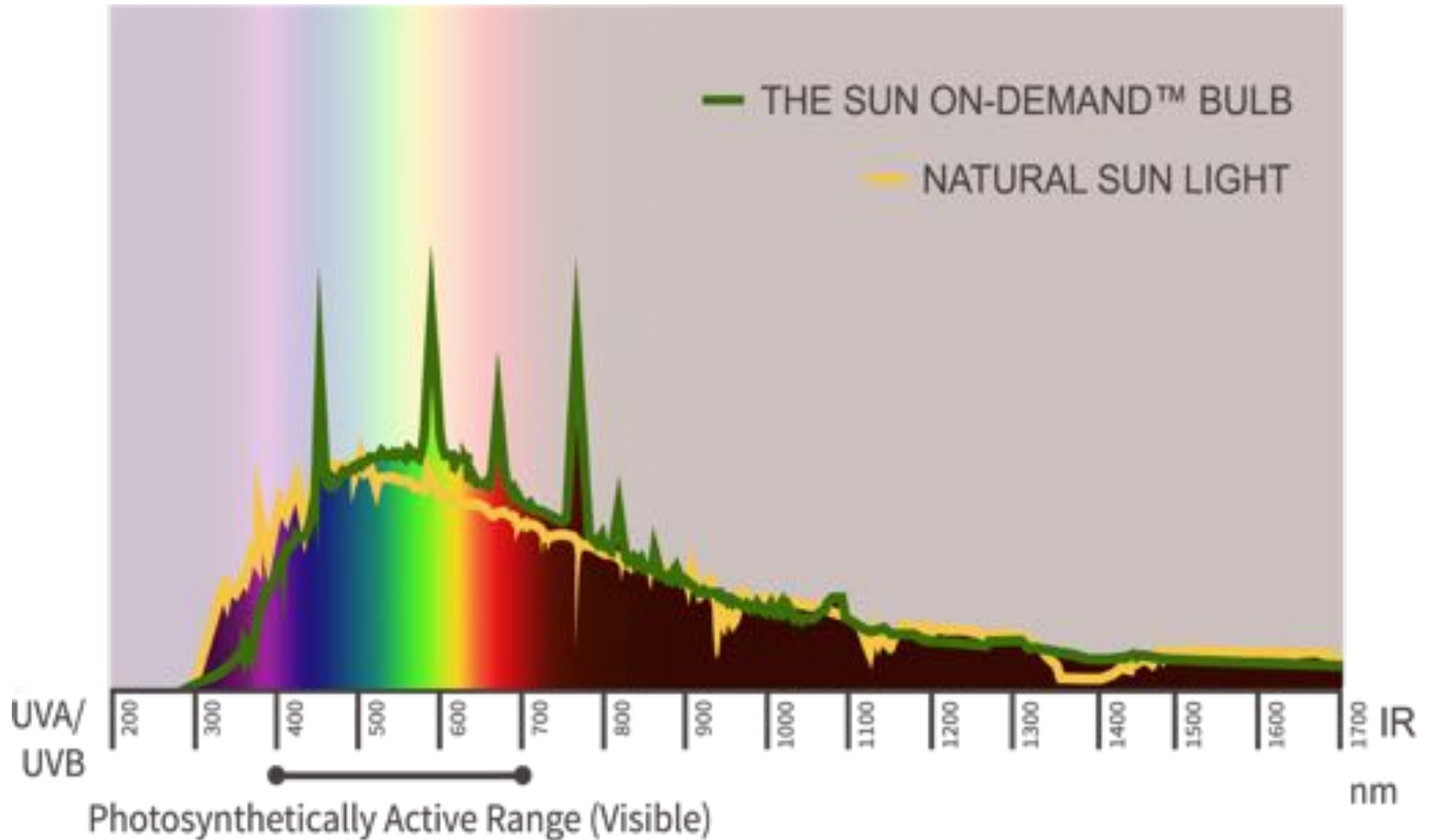
- Healthy profits
- Holistic wellness + sustainability
- Organic growing
- Biomimicry solutions
- Collective action
- People benefits

"The day science begins to study non-physical phenomena, it will make more progress in one decade than in all the previous centuries of its existence."

-Nikola Tesla.

THIS IS THE SUN INDOORS

Full Electromagnetic Sun Spectrum Light



THE SUN ON-DEMAND™

Technical Details

System power:

1100W | 230 V

Amperage: 5.3A

Power factor: > 0.95

Power conversion:

75% of each Watt
converted to light

Fixture footprint:

6' x 6' (36 sq ft) up to
12' x 12' (144 sq ft),
depending on crop
requirements

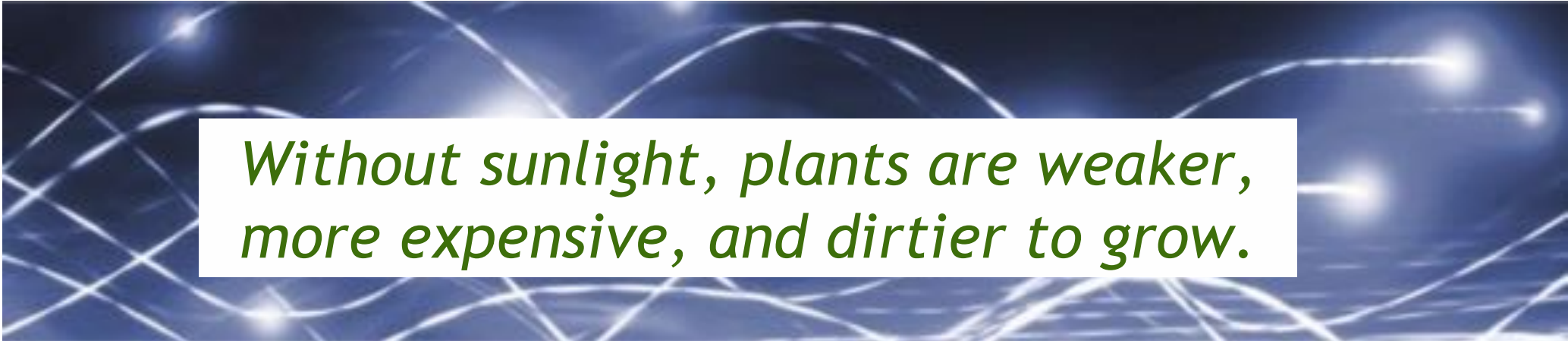
Color temperature:

5,650 Kelvin (exact
daylight)

BASIC TRUTH:

Plants thrive in sunlight

- The Sun is the life force for all life on Earth
- The Sun's spectrum provides complete electromagnetic energy for plants
- Photons contain particles of light and frequencies/wavelengths



Without sunlight, plants are weaker, more expensive, and dirtier to grow.

Photo source: <https://blog.anton-paar.com/what-is-light-a-particle-or-a-wave/>

SOLUTION: MIMIC NATURE

1. Create maximum bioavailability with optimum **abiotic** conditions

Such as: spectrum, temp, humidity, CO₂, water, etc.

2. Enable adaptive stress reactions for maximum expression of genetic potential by cultivating **biotic** conditions

Such as: plant genetics, beneficial microbial, bacterial, & fungal networks, plant communities, herbivorous insects, fungal pathogens, etc.

3. Achieve maximum desired plant responses

That is: Organic, full nutrient density, higher yielding outputs

BIOAVAILABILITY OF SUNLIGHT

Spectrum and Frequencies

- Photoreceptors absorb beyond PAR
- Stronger immune systems
 - Phenolics,
 - Terpenoids,
 - Antioxidants
- Faster growth and development

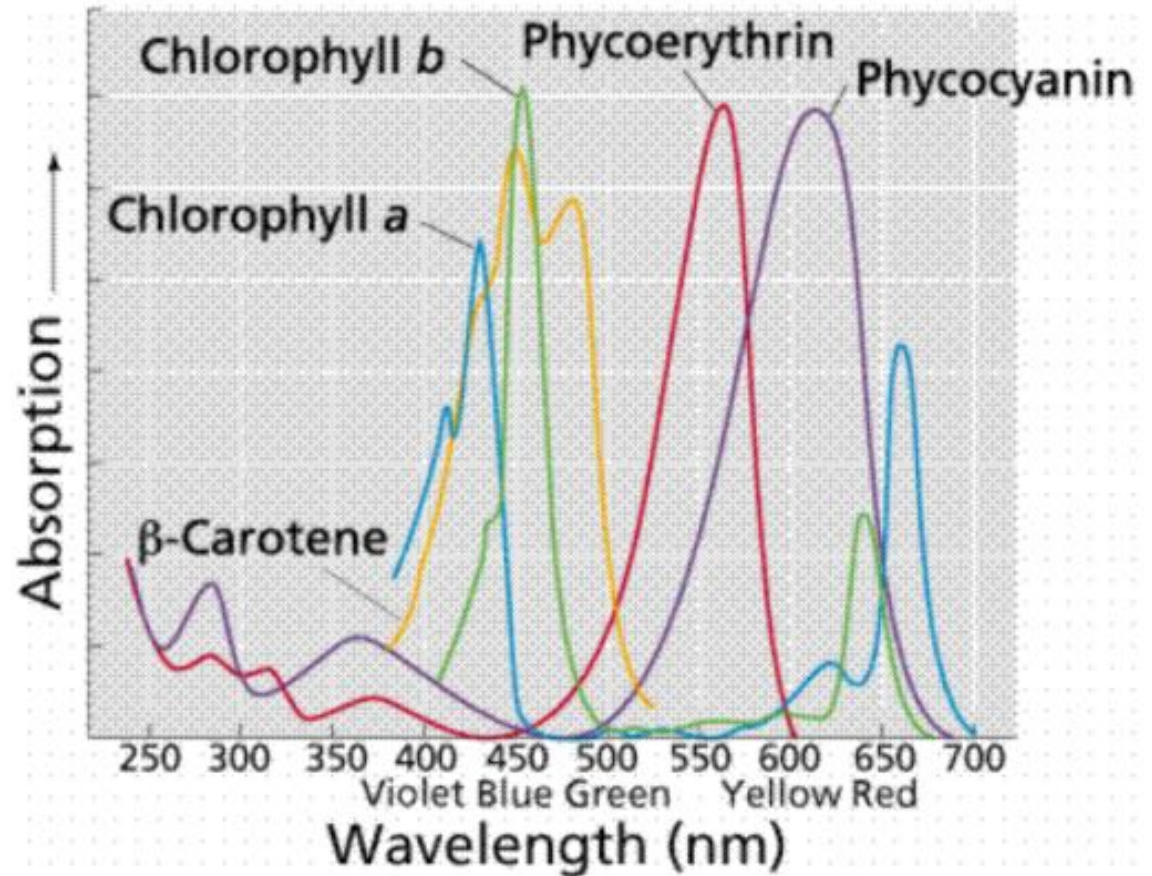


Photo credit:

<https://13tellge.files.wordpress.com/2012/01/pigment.gif>
http://aventalearning.com/content168staging/credit_recovery/2008CRBiologyA/unit2/section2_03.html

BIOAVAILABILITY OF SUNLIGHT

Photoreactivation

- Combination of UVA + blue light allows plants to heal from and adapt to damage from UVB (Brit, 2004)
- Adaptations include increases in antioxidants, terpenoids, phenolics, and resistance to herbivorous insects (Goto, et. al., 2016).



UVB in isolation



UVB with UVA + Blue

Sources:

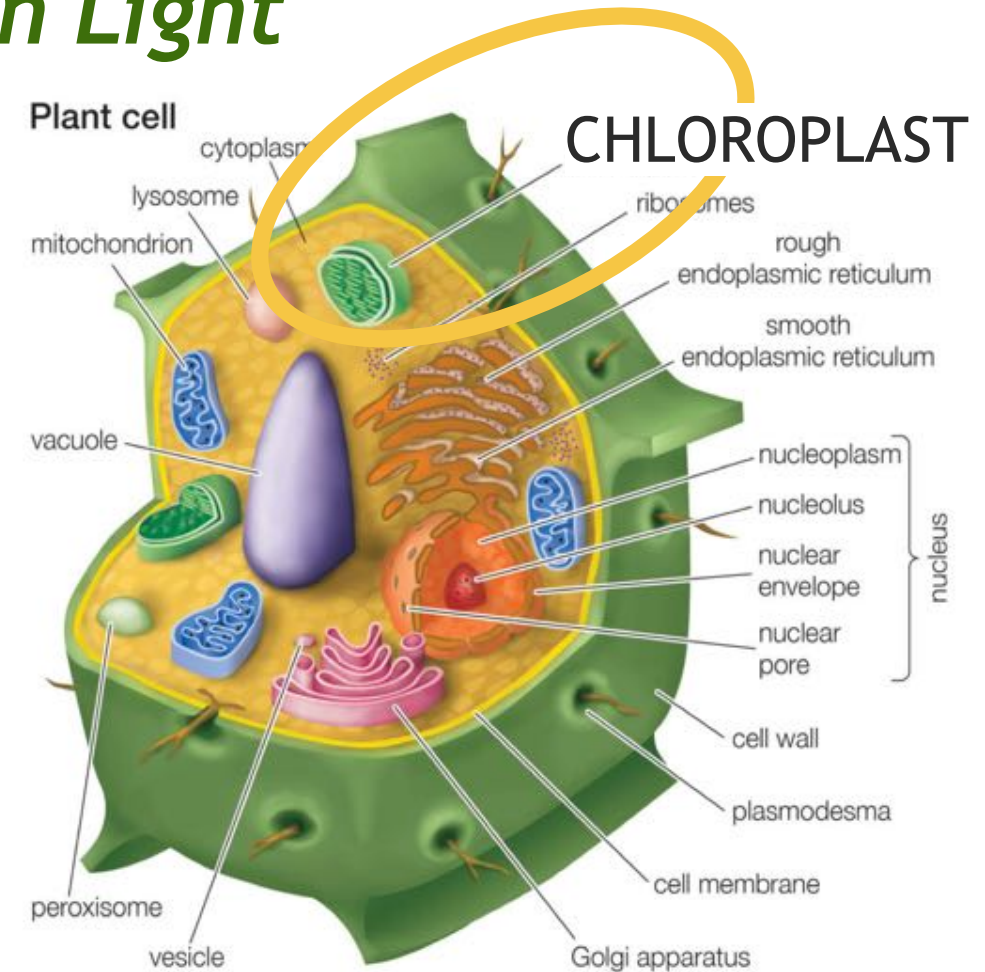
Britt, A. B. (2004). Repair of DNA damage induced by solar UV. *Photosynth. Res.* 81, 105-112

Goto, E., Hayashi, K., Furuyama, S., Hikosaka, S. and Ishigami, Y. (2016). Effect of UV light on phytochemical accumulation and expression of anthocyanin biosynthesis genes in red leaf lettuce, *Acta Hortic.* 1134, 179-186

BIOAVAILABILITY OF SUNLIGHT

Green Light

- Penetrates to deeper layers of chloroplasts to activate photosynthesis deeper in the leaves
- Improves absorption of photons



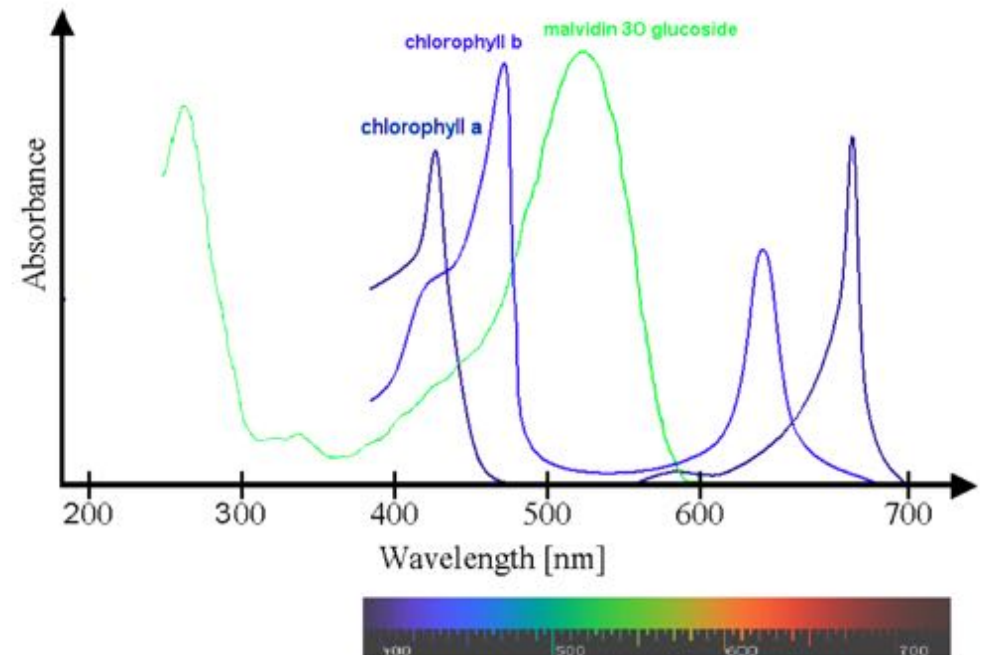
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BIOAVAILABILITY OF SUNLIGHT

Green Light

- Penetrates to deeper layers of chloroplasts to activate photosynthesis deeper in the leaves
- Improves absorption of photons
- Stimulates unique photoreceptors



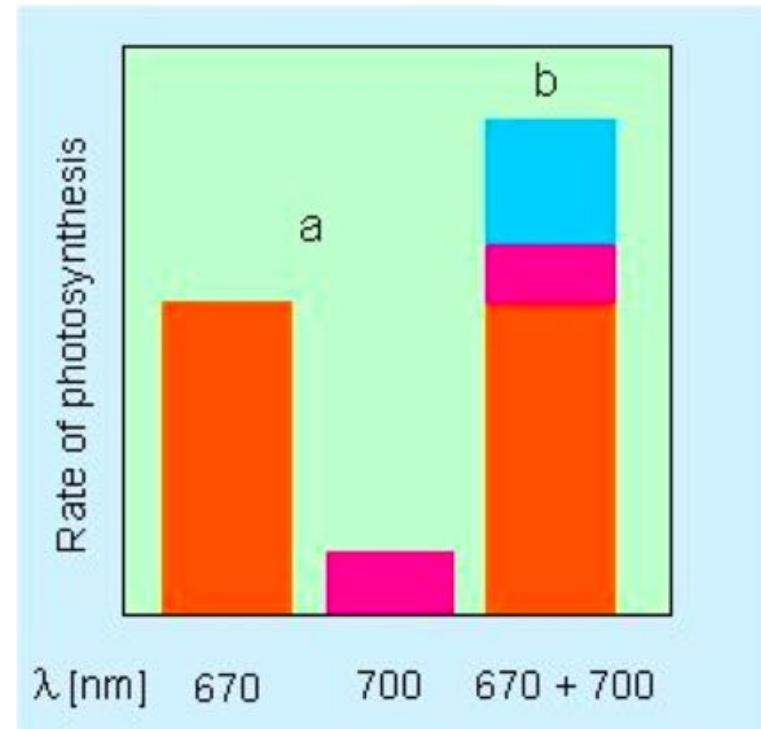
Source:

By NotWith - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=19204428>

BIOAVAILABILITY OF SUNLIGHT

The Emerson Effect

- Two complementary photosystems for optimized photosynthetic efficiency in Red (670 nm) and Far red (700 nm) wavelengths
- Helps plants maximize photosynthetic efficiency in variable light conditions



Plant photosynthesis rate when exposed to:

Red (670 nm), Far red (700 nm), and both frequencies

Graph source: © Peter v. Sengbusch - b-online@botanik.uni-hamburg.de

Source: Emerson, Robert. (1957).
Dependence of yield of photosynthesis in long wave red on wavelength and intensity of supplementary light. *Science*.

A PROBLEM WORTH SOLVING

Without sunlight, plants are weaker, more expensive, and dirtier to grow.



- Existing indoor lights force plants to adapt to limited, artificial light.



- Current Grows: High CapEx/OpEx, & energy intensity from indoor lighting.
- Cannabis alone already accounts for >1% of all electricity consumed in the US.¹



- Cultivators need
 - Energy efficient, cost effective solutions
 - To improve the health, quality, consistency, & output of their plants.

*GHG=Greenhouse Gas Emissions

¹Mills, Evan. "The Carbon Footprint of Indoor Cannabis Production." Energy Policy, 17 April, 2012.

THE SOLUTION: FOR ALL INDOOR GROWING

The world's first truly organic grow light



- Full electromagnetic sun spectrum
- For commercial-scale indoor, greenhouse, and container cultivation

The Sun On-Demand™ is the only light on the market designed to support indoor organic growing in living soil.

THE SOLUTION: FOR ALL INDOOR GROWING

The world's first truly organic grow light



- Today: Indoor ag, commercial cannabis, and cinematography
- Soon: Commercial buildings, outdoor lighting



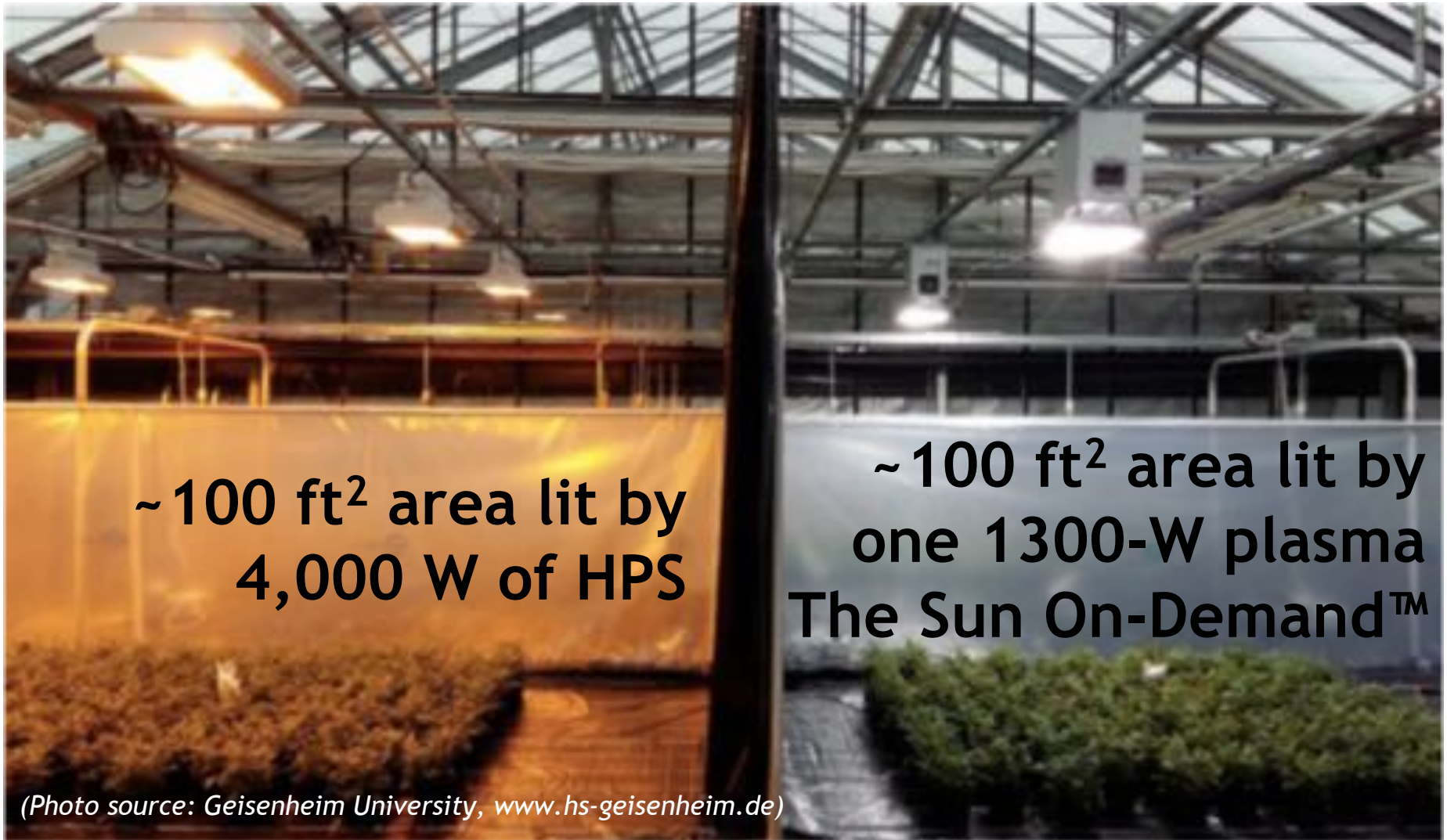
- Superior cost-effectiveness
 - Up to 50% less energy than LEDs
 - One fixture replaces 2 to 6 HIDs or LEDs (depending on crop and grow setup)

ENERGY EFFICIENCY COMPARISON

Indoor Ag, 10,000 ft² Facility

	The Sun On-Demand™ (10' x 10' footprint)	LED (6.5' x 6.5' footprint)	The Sun On-Demand™ Difference
# of lights	100	236	57% fewer (136 lights)
Electricity	110 kW	139 kW	26% fewer (39 kW)
Amps	530A	519A	2% more (11 Amps)
BTUs/hr	375 KBTUs/hr	507 KBTUs/hr	26% fewer (132 KBTUs/hr)
Useful Life	> 100k hrs	40k to 60k hrs	Plasma - no spectral degradation; LEDs - replaced up to 3 times over 10 years

Up to 75% REDUCTION IN LIGHTING *Compared to HPS*



INDOOR AG UNIVERSITY TRIAL

- Shorter grow cycles, with added annual harvests for many crops
- Avg 25% increase in yield (crop-dependent)
- Improved morphology increases nutrient density and “retail readiness”



Photo source: Riik Zwaan, Eijnaart, Netherlands

Above, cucumber starts placed under The Sun On-Demand™.

Below, the same plants after 11 days.

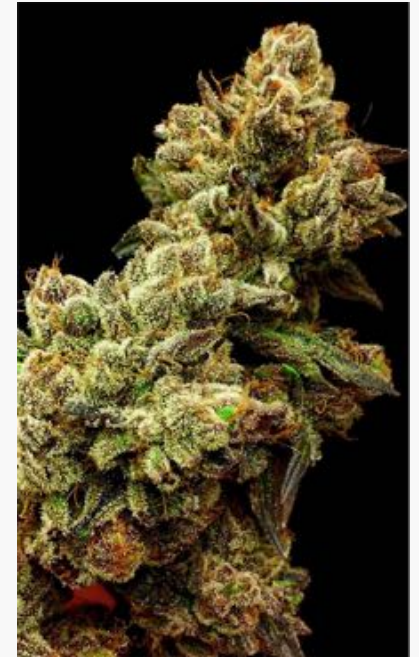
COMMERCIAL CANNABIS TRIALS

Plant Productivity and Yield

- Increase dry weight 25% avg
- Increase cannabinoids & terpenes 3% to 5% for a higher price per lb
- Shorten finishing time up to one week

Efficiency

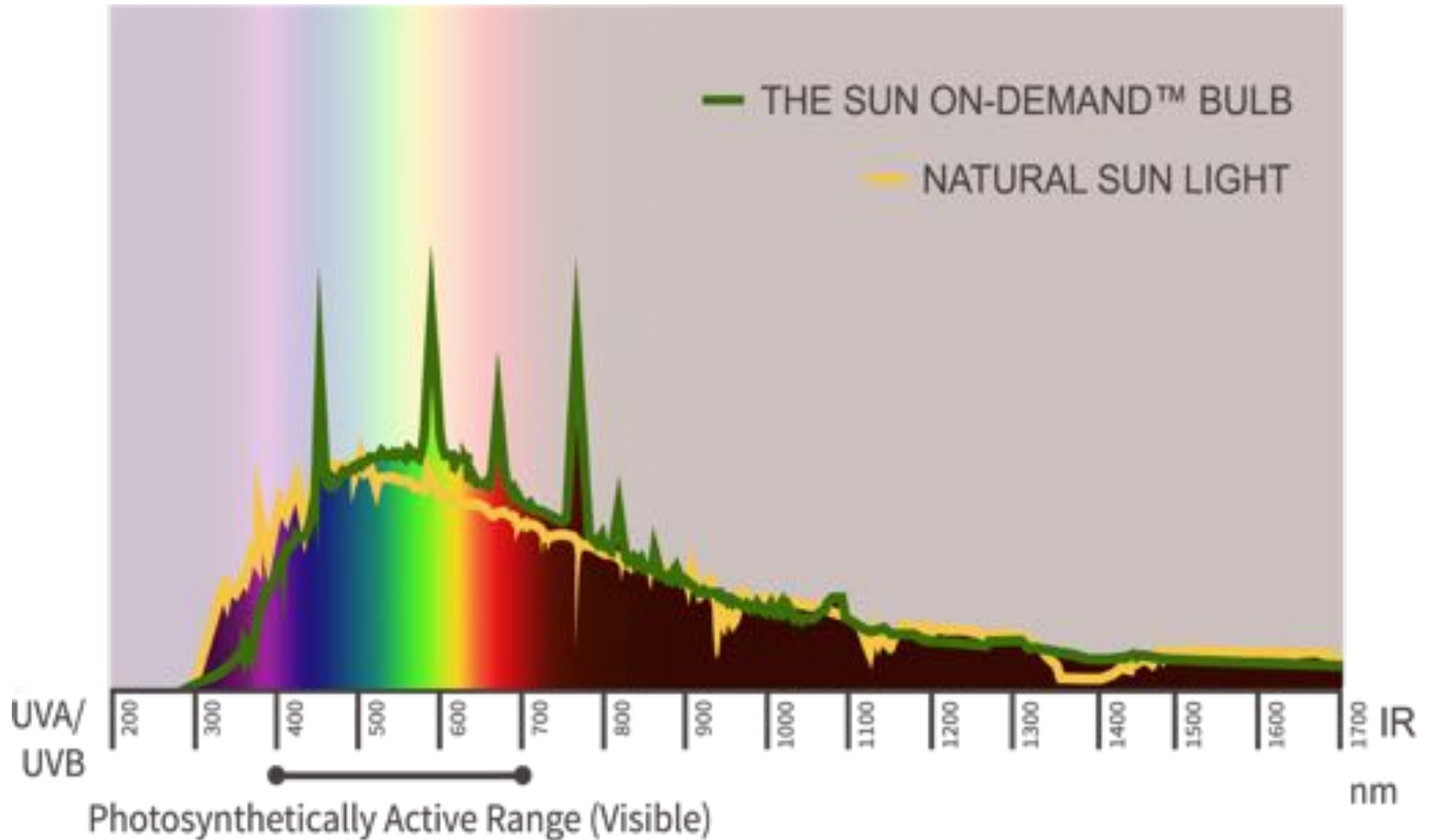
- Up to 50% less energy use than LEDs (system level)
- Superior ROI to any other light (<1 year payback)



At left, one branch (not the cola) of plasma grown Molokai Frost, a rare, hard to grow Hawaiian landrace strain. At right, close-up of plasma-grown Headband flower, a notoriously difficult to grow strain, usually exhibiting “popcorn” flowers.

THIS IS THE SUN INDOORS

Full Electromagnetic Sun Spectrum Light



THIS IS THE SUN INDOORS

Full Electromagnetic Sun Spectrum Lighting

- Opportunity to cut the environmental impact of controlled environment farming
- Reduced lighting-related electricity and climate control compared to other indoor lights
- Improved yield and quality of crops

NEED TO UNDERSTAND MORE

- Plant growth & intelligence
- “Brain-gut-heart” connection
- Role of “light” beyond PAR: electromagnetic energy

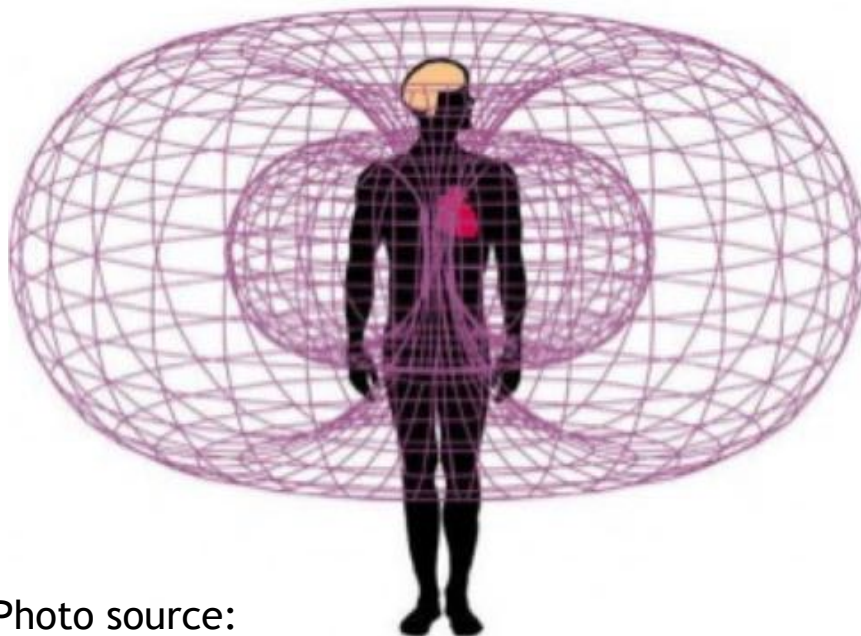
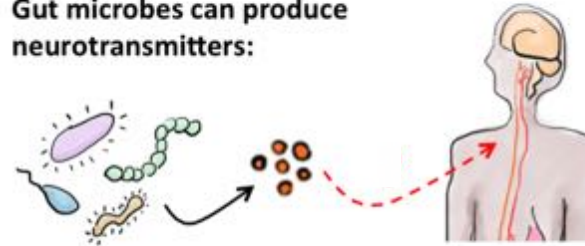


Photo source:
Copyright Institute of HeartMath Research Center

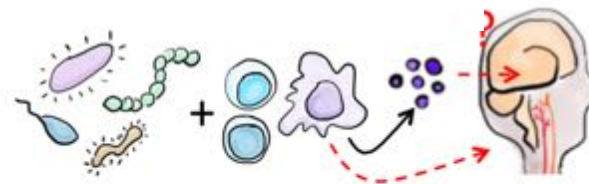
Hypotheses about the gut-brain axis

Gut microbes can produce neurotransmitters:



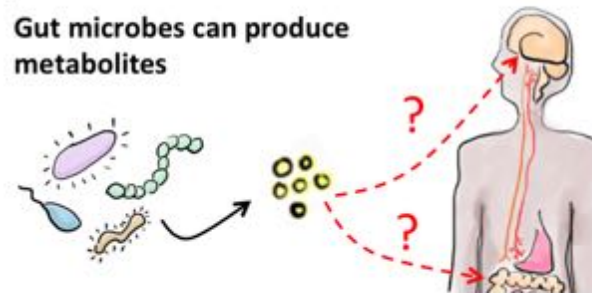
Signal brain
via vagus
nerve

Gut microbes can stimulate immune cells to produce cytokines



Signal brain
via blood
vessels

Gut microbes can produce metabolites

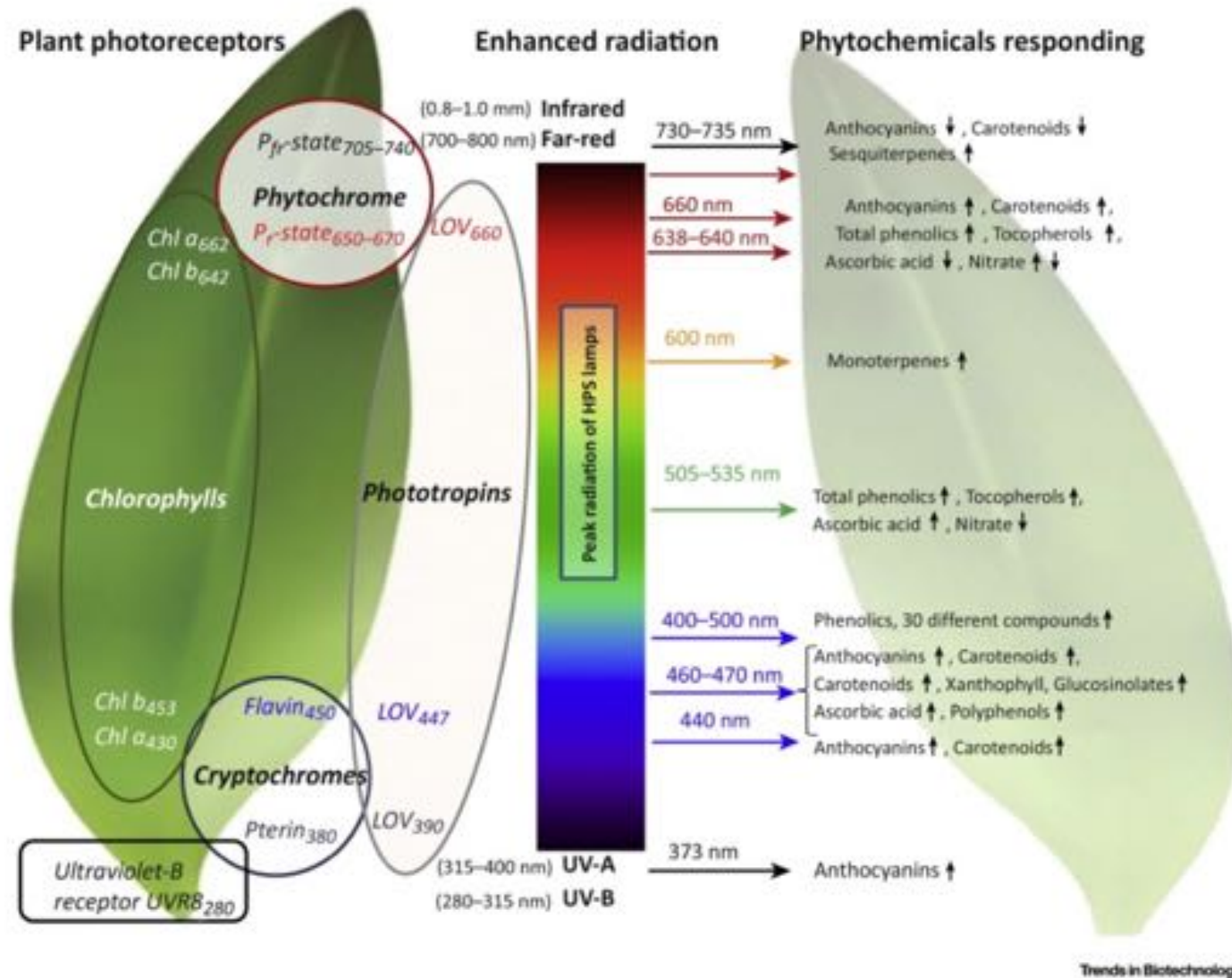


Signal brain
via vagus
nerve or
blood
vessels (?)

Photo source:

<http://www.wildculture.com/article/gut-feelings-parkinson%E2%80%99s-and-depression/1651>

NEED TO UNDERSTAND MORE



Copyright Fondriest Environmental, Inc. (2014) “Solar Radiation and Photosynthetically Active Radiation.” Fundamentals of Environmental Measurements.



THANK YOU

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