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# Photobiostimulation in C. elegans as a Model for Low Level Light Therapy

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## Abstract

Low-Level Laser Therapy (LLLT) is a developing therapeutic technique that has been gaining recognition in the scientific community in recent years. Previous experiments performed in LLLT research projects have been primarily mammalian and cell culture based. These experiments have produced results showing accelerated tissue repair. In this experiment, we introduce a new model, *Caenorhabitidis elegans,* a free-living soil nematode, to be used in LLLT research by testing the effects of exposure of the organism to various wavelengths and intensities of light commonly used in LLLT. *C. elegans* was shown to respond to photobiostimulation when exposed to specific wavelengths of Infrared light, 920nm-980nm, at an intensity of 5J/cm$^2$. These responses include an 18-20% increase in growth rate and overall length and width of each organism. The cellular mechanism behind this acceleration of growth is unclear and as an excellent model for examining the interactions of cells and tissues on a molecular level; the introduction of *C. elegans* into the field of LLLT research will provide valuable insight into the cellular processes that produce this significant change in biochemistry resulting in accelerated tissue repair and growth induced by LLLT.



## Document Type

Undergraduate Project

## First Supervisor

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## Second Supervisor

Dr. Max Rempel

## Keywords

Photobiomodulation, C. elegans, Photobiostimulation, Cellular Proliferation

## Subject Categories

Alternative and Complementary Medicine | Biochemical Phenomena, Metabolism, and Nutrition | Biology | Cell Biology | Developmental Biology | Medical Cell Biology

# Photobiostimulation in *C. elegans*

## Implementation of LLLT In a New Model

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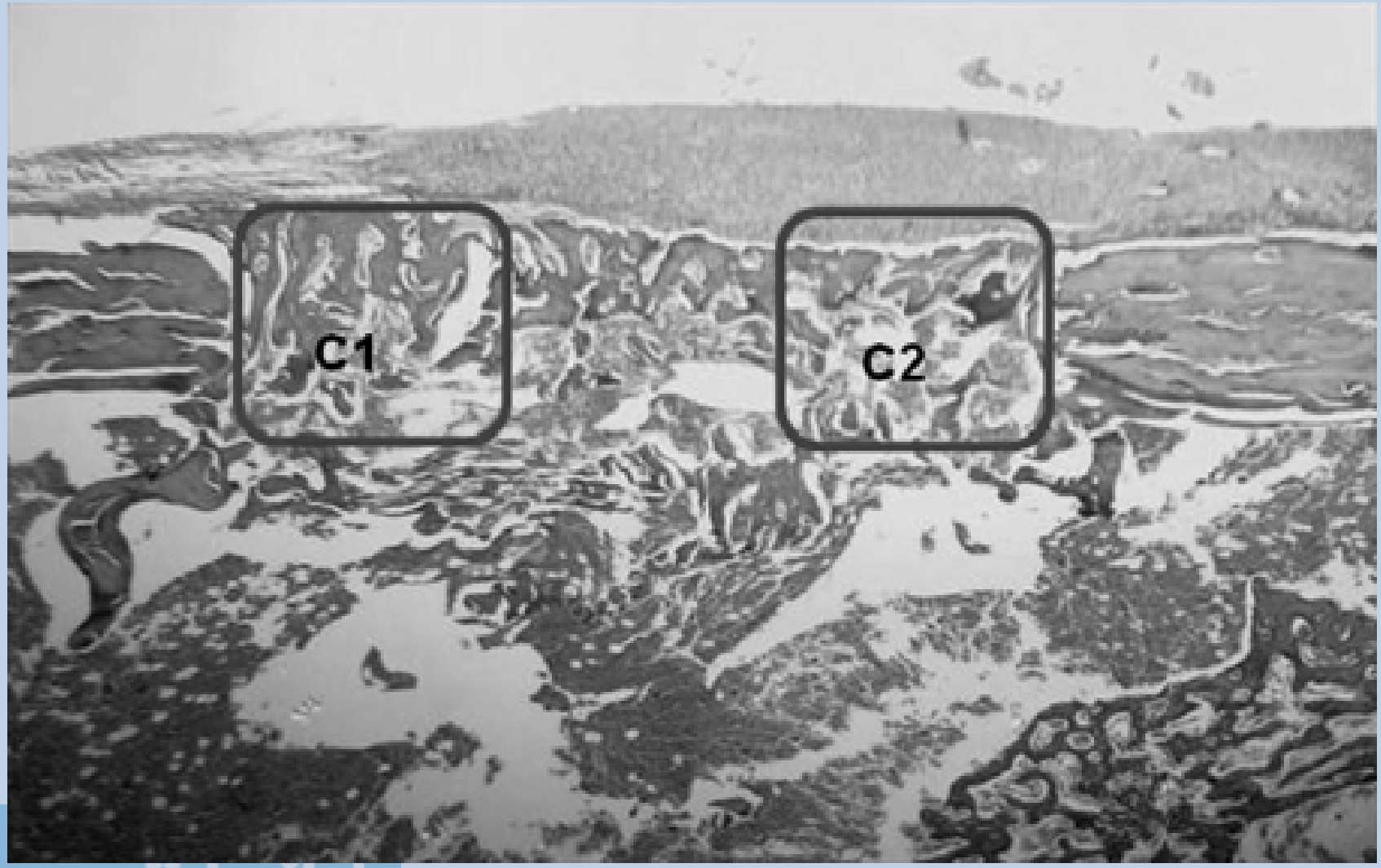
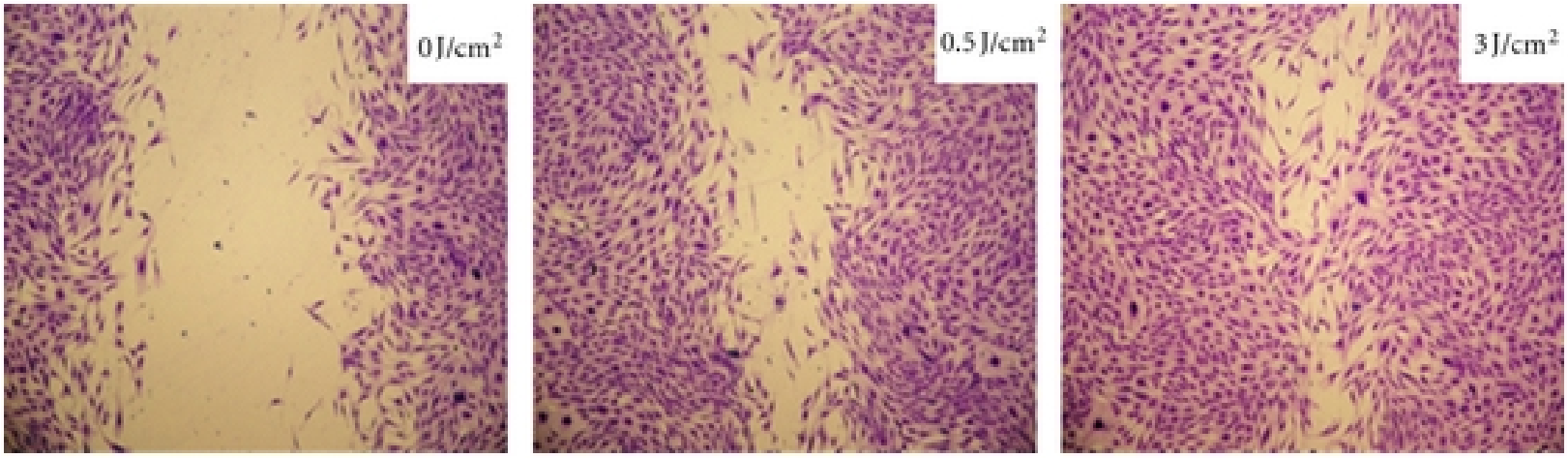
# Low Level Laser Therapy

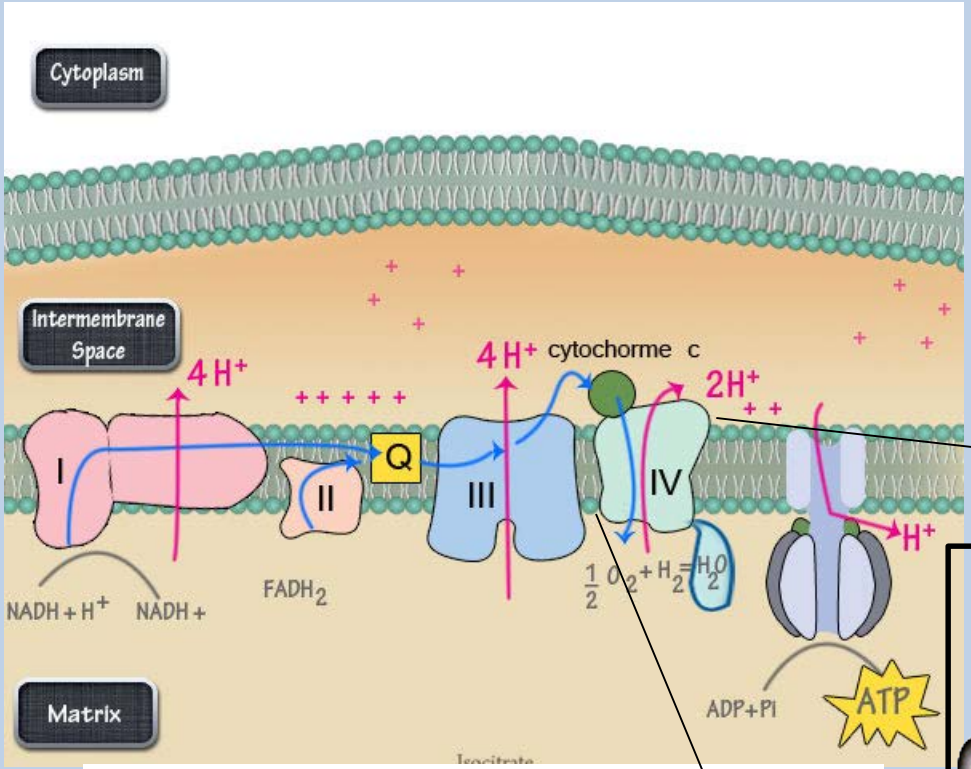



Poliani et.al. Brazilian Journal of Physical Therapy (2010)

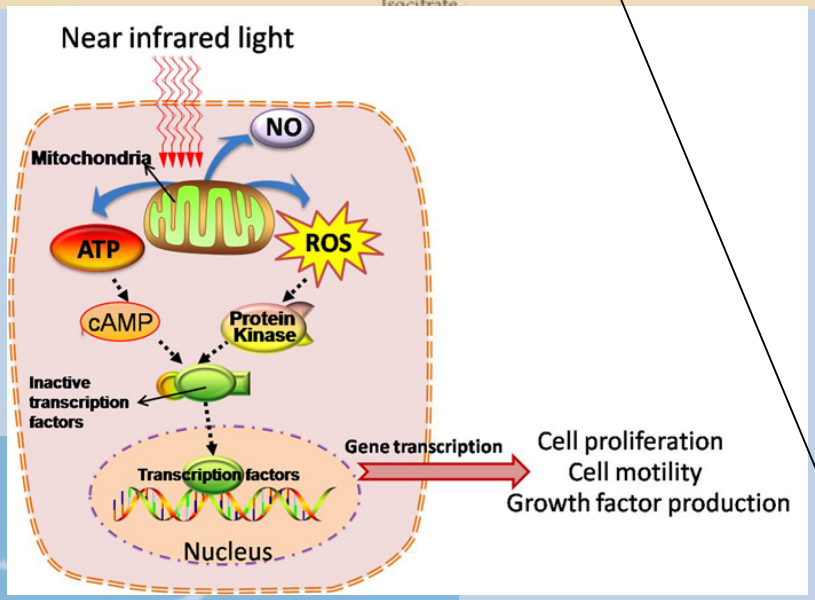
# Experimental Precedent

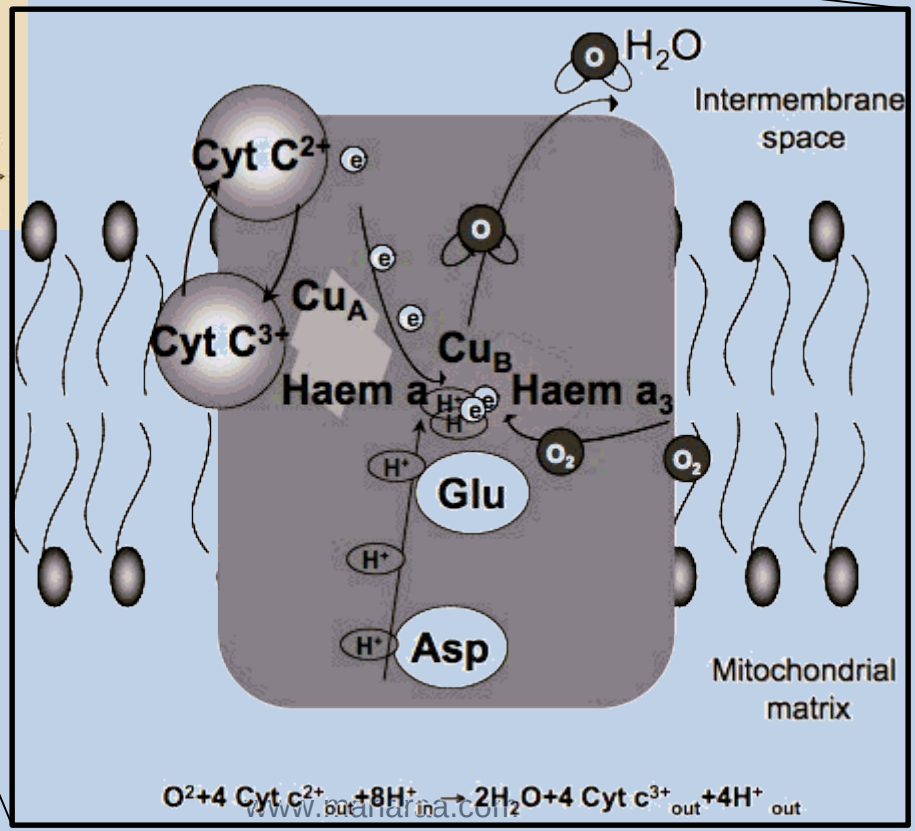



Eesmaeenerjad et. al. Lasers in Medical Science (2012)



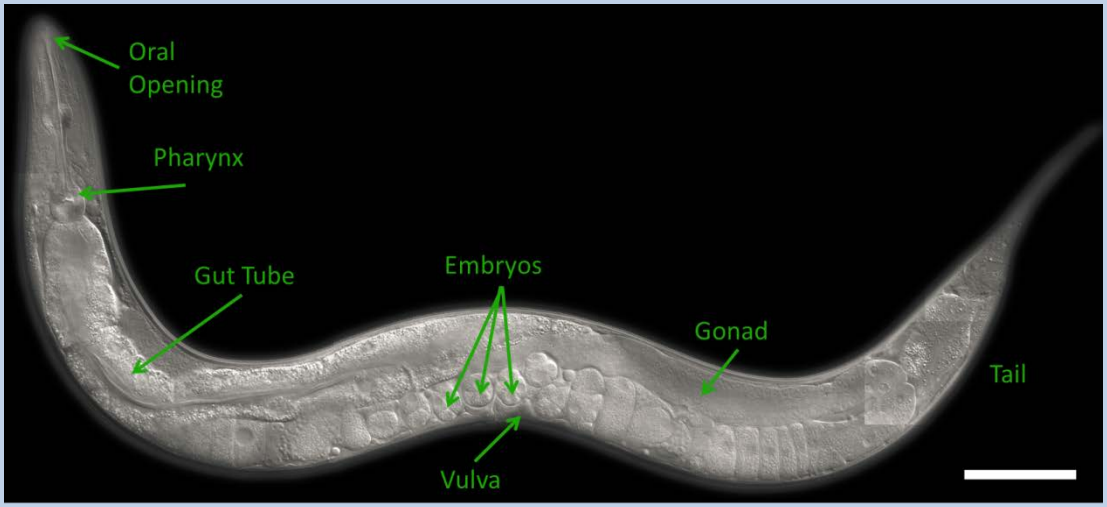

Red and Infrared Light Energetically Excite Iron (Fe) in heme group of Cyt $C^{2+}$ in favor of Cyt $C^{3+}$ , a more energetically capable electron transfer state.



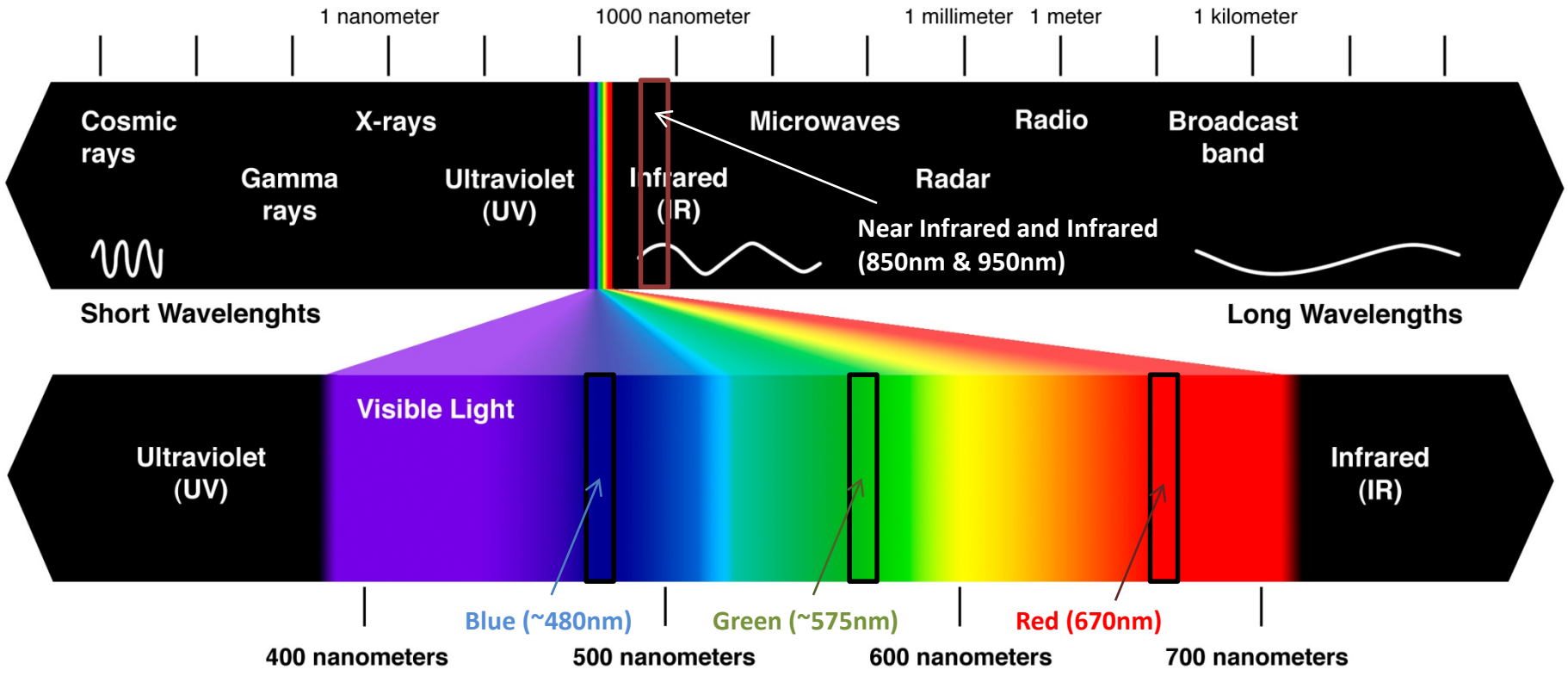
# *C. elegans* as a Model Organism

- 60% homology with human genome, 80-85% with proteome




- Well mapped genetic code, neural network and proteome.
- Easily maintained and manipulated.
- Ideal for studying biomolecular pathways.

# Experimental Light Sources



# Assay For Photobiostimulatory Effect-Procedure

**Setup**

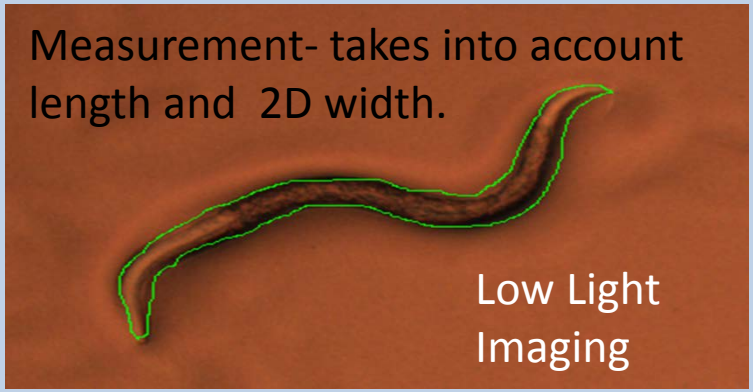
- N2 Phenotype Nematodes Farmed
- Bleach Synchronization (only embryos remain)

**Exposure**

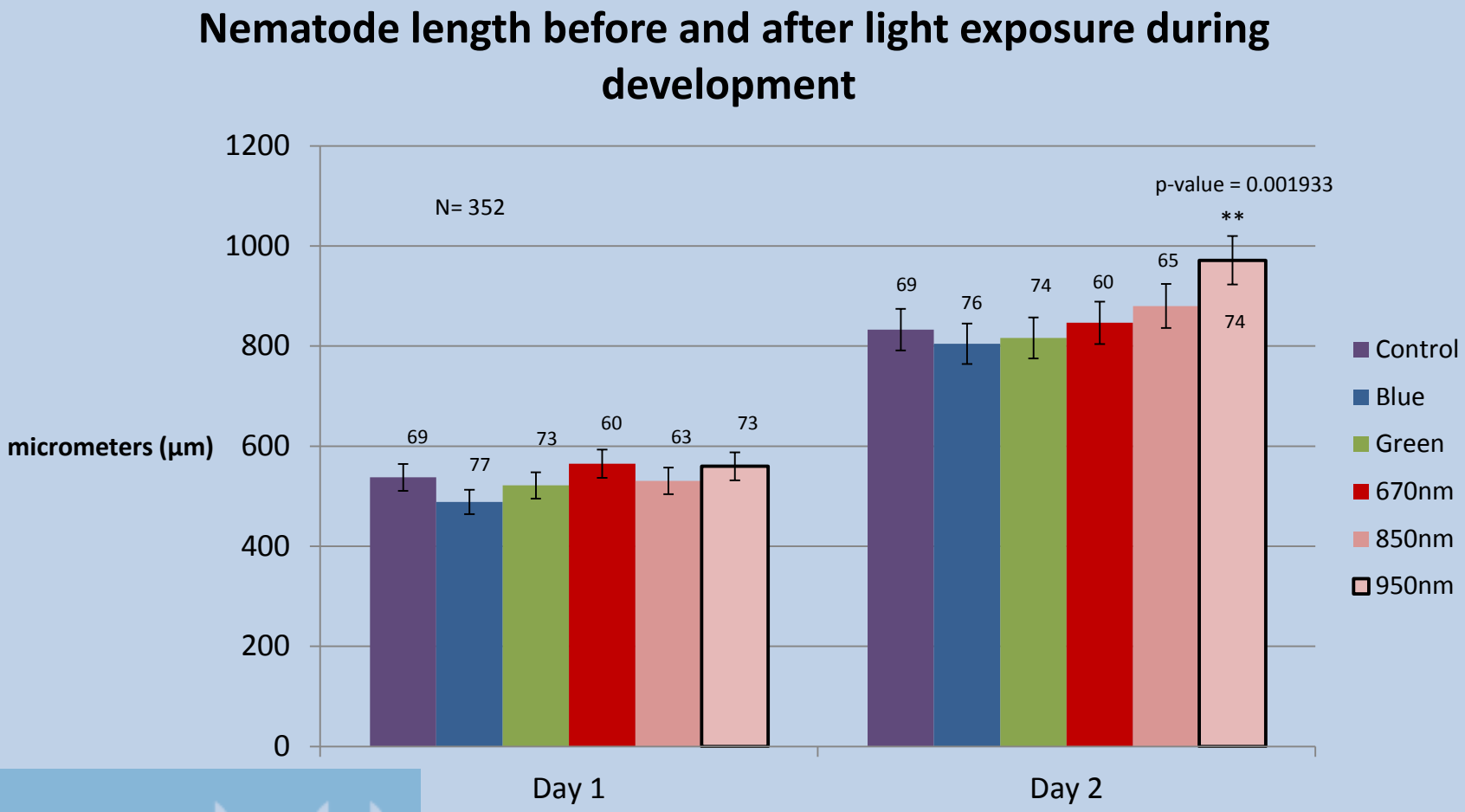
- Embryonic Development @23°C (1 day to maturity) or 16°C (72-84 hours to maturity)
- Exposure to Light (5J/cm$^2$) per Plate
- Blue, Green, 670nm, 850nm, 950nm, Control (no exposure) (Ultrasound added later)

**Measurement**

- Image Each Individual in low light @ 24 hrs. in increments Before Exposing
- Measure Length and Total Body Area in pixels and convert to microns.

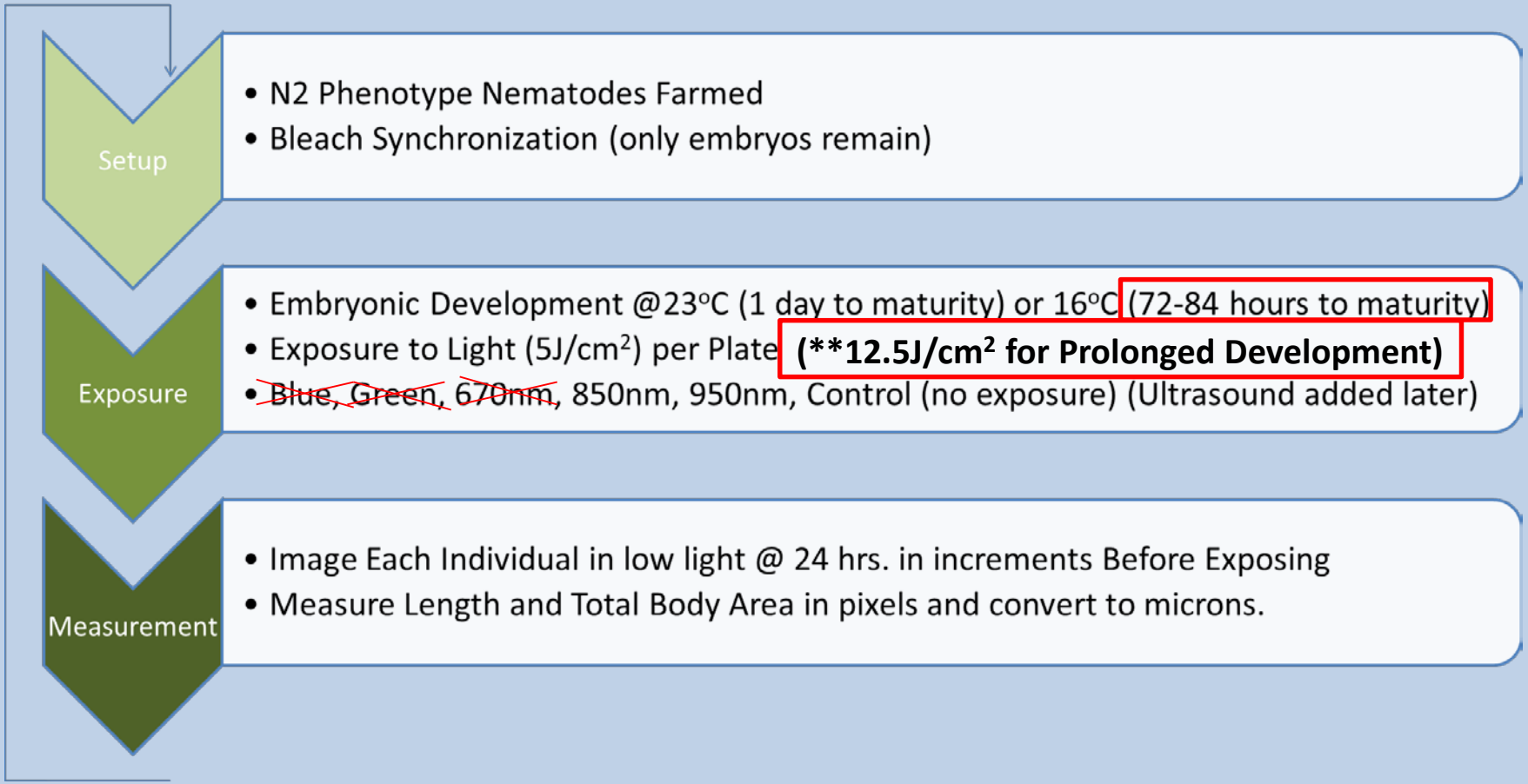


# Assay for Photobiostimulatory Effect

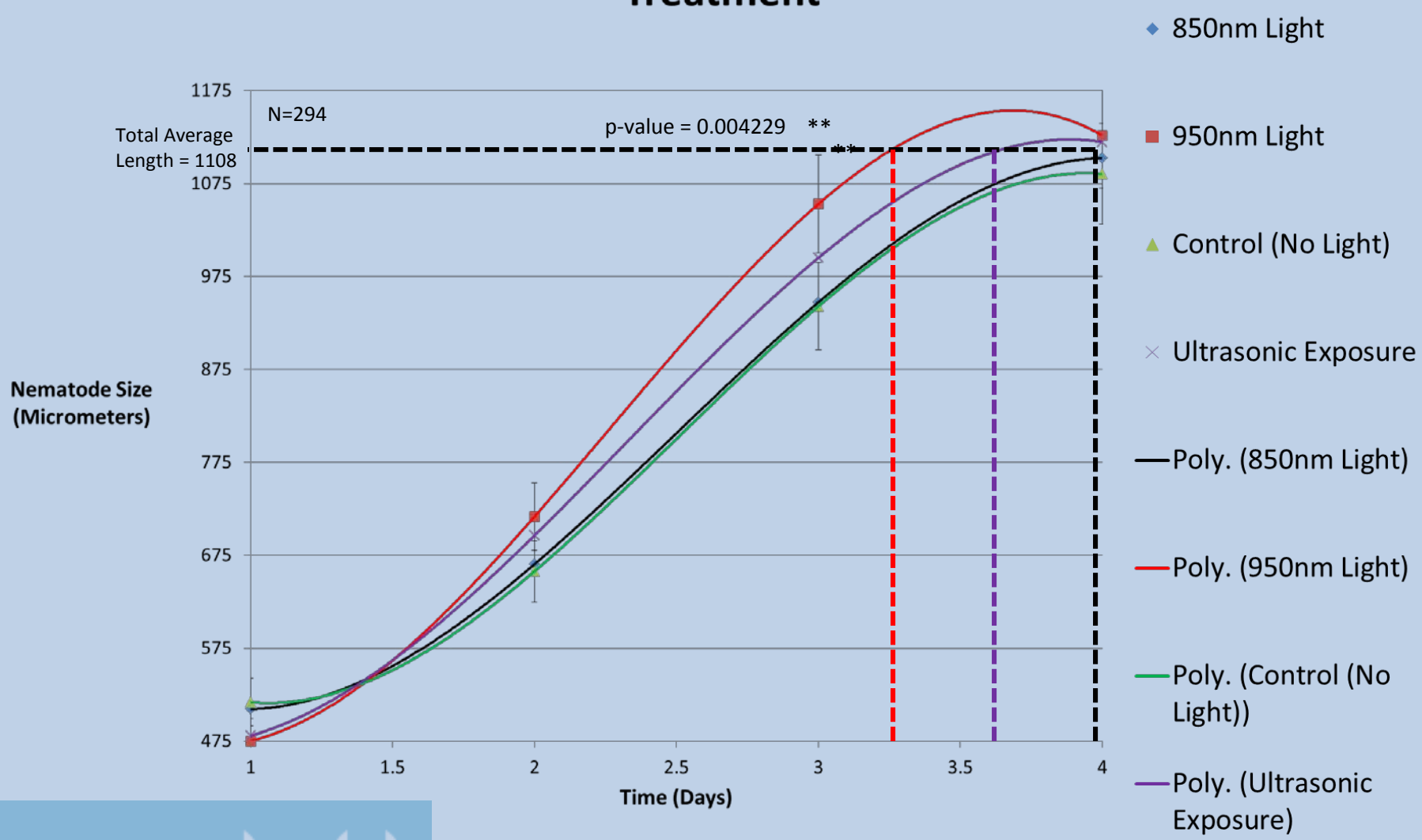


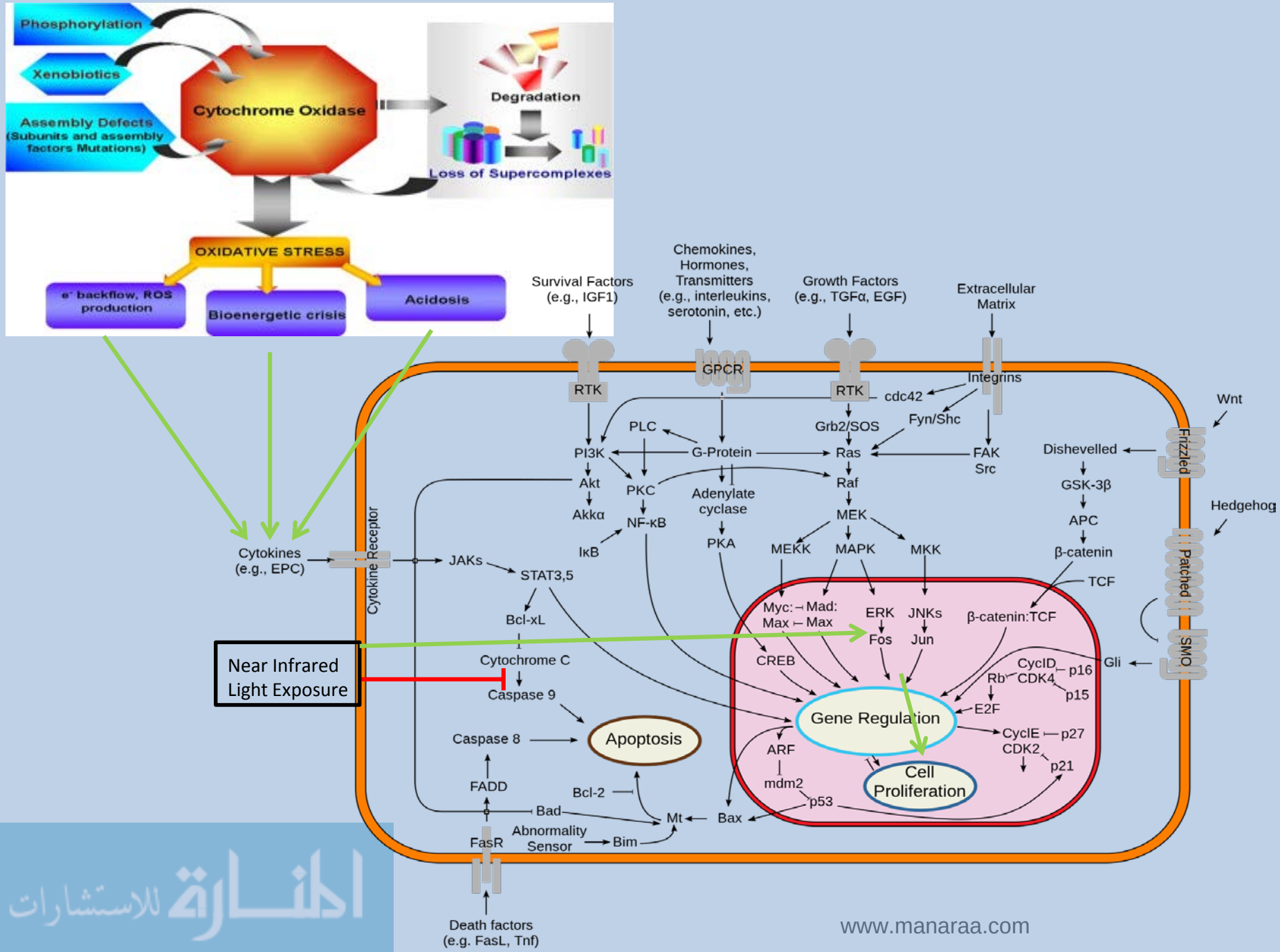
# Multiple Systems Measurement

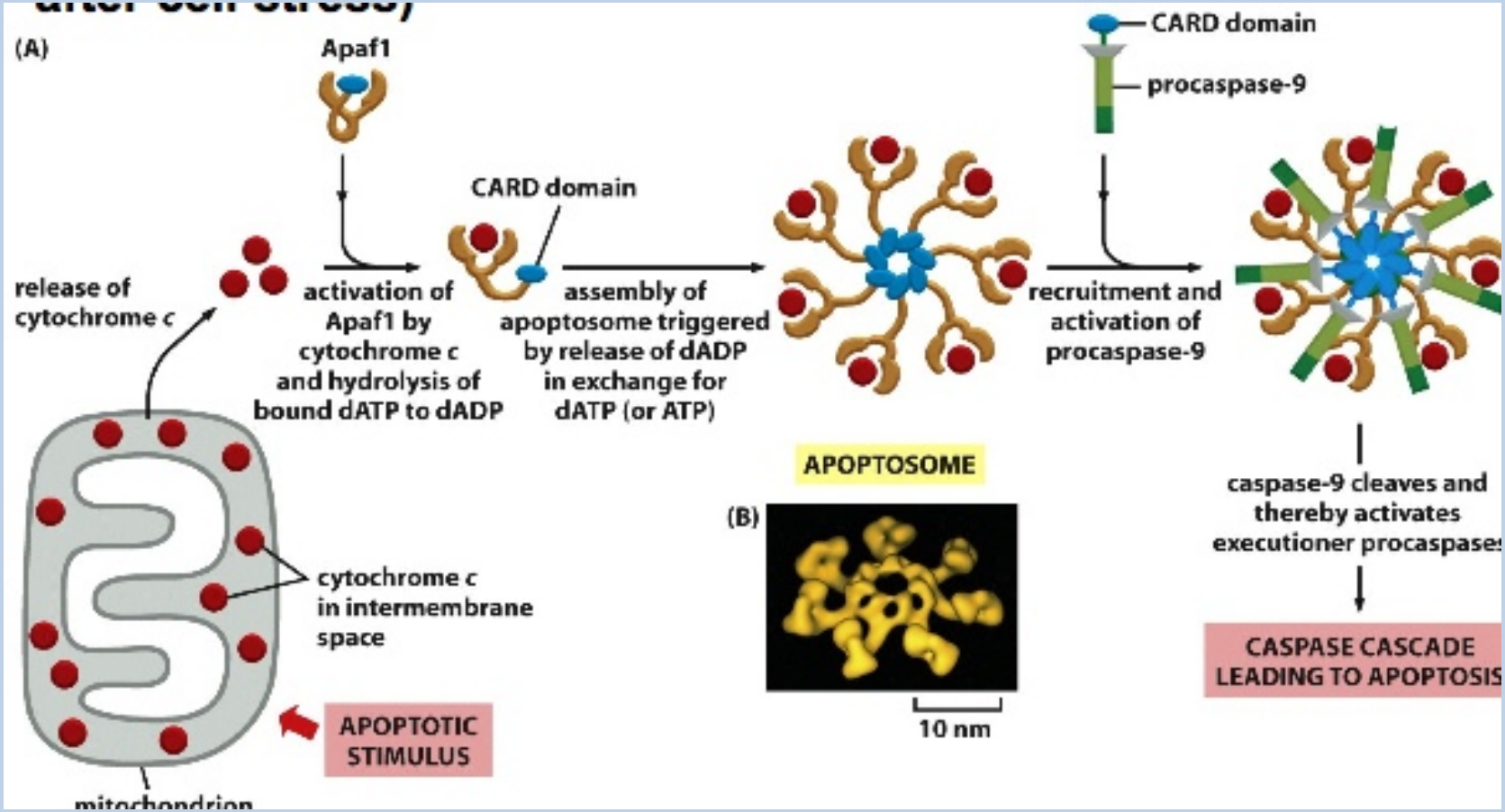
## Procedure



# Average Size of Nematodes over Four Days based on Treatment

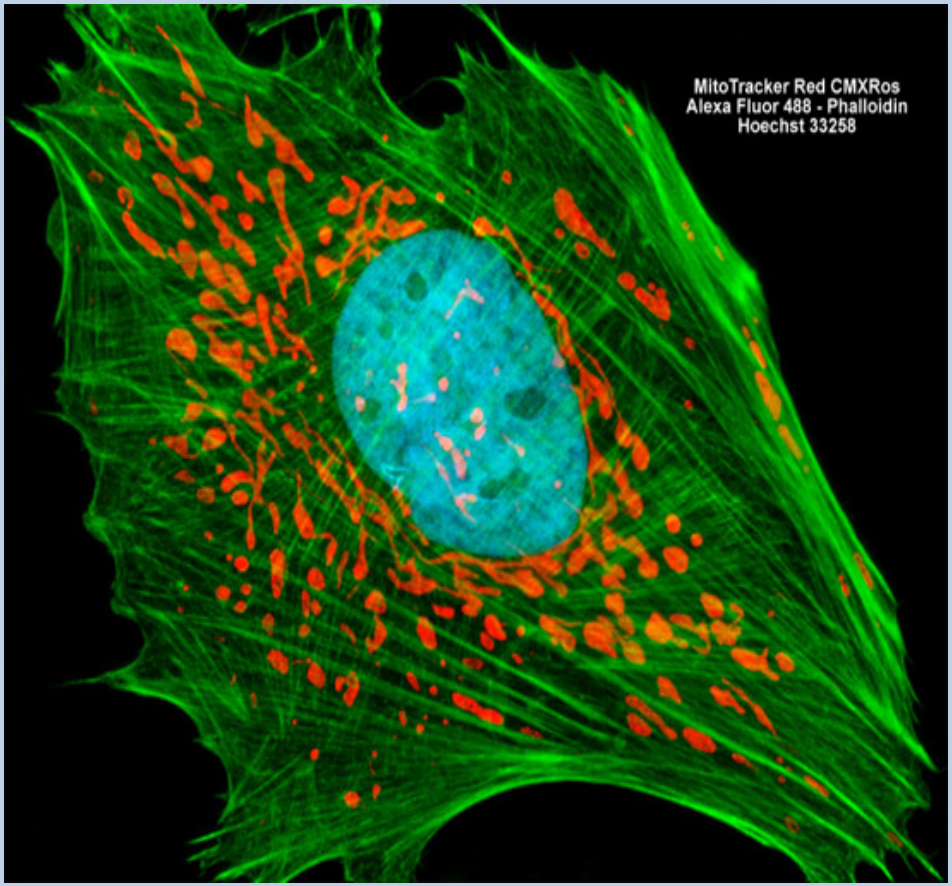






# Future Directions

- **Visualizing mitochondrial morphology**
  - Visualizing modified Oxidative Phosphorylation *in vivo*.
- **Suppression of mitochondrial mutants**
  - Hone the range of study to enhance understanding of biochemical pathway
  - Identifying the protein or proteins responsible



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