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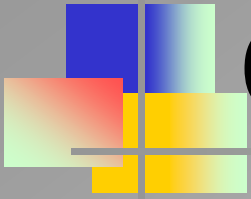
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Inflatable Greenhouses

# Current Greenhouses

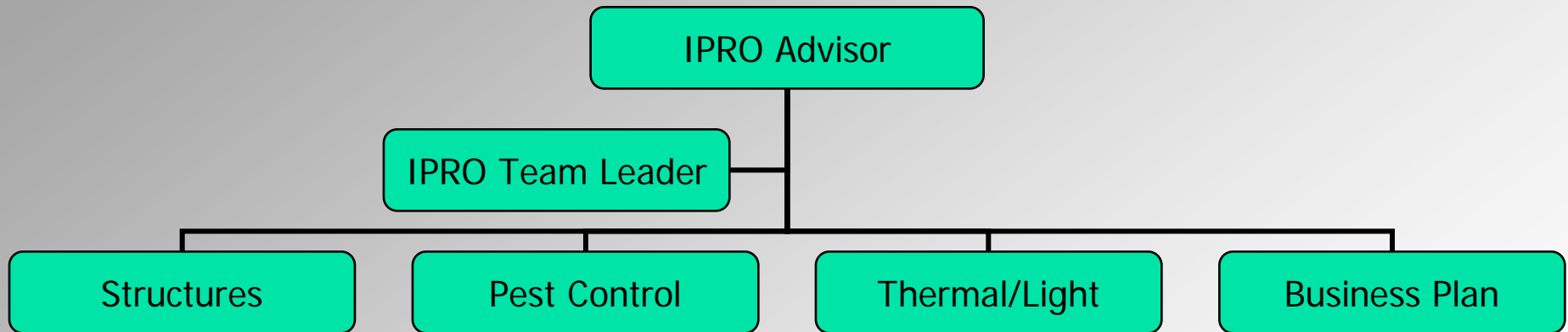


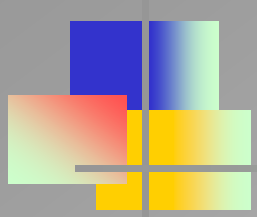
- Use lots of energy
- Young plants need a narrow range of temperature to thrive in
- Excessive volume
- Structure
- Pest Control



# Group Structure

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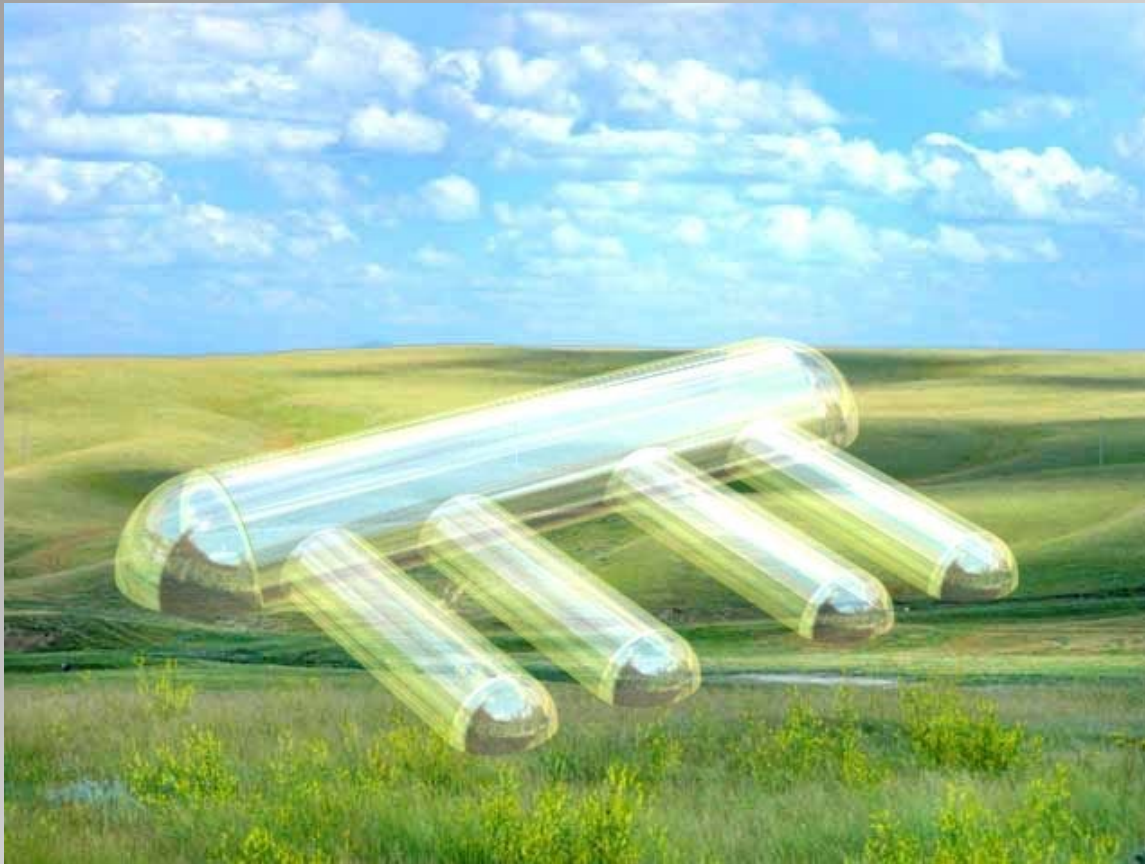


# Structures



# Structures

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- 1. Why plastic?**
- 2. Structural Concept**
- 3. Fabrication**

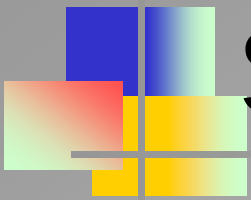


# Structures

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## **Why PLASTIC? (PolyEthylene)**

- Plastic is much cheaper construction than stand and glass structures that are currently used.**
- The amount of UV transmitted is nearly the same as glass.**
- The greenhouse when constructed can be deflated and moved to suit different locations.**
- Plastic is light weight, making it easy to inflate; this way the air become the major structural element**
- Creating connections with plastic is easily accomplished through ironing or light welding.**



# Structures

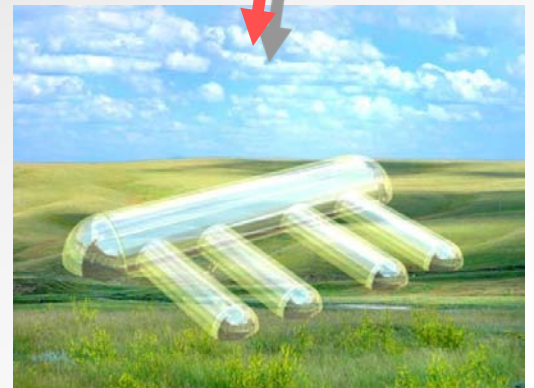
## STRUTURAL CONCEPT



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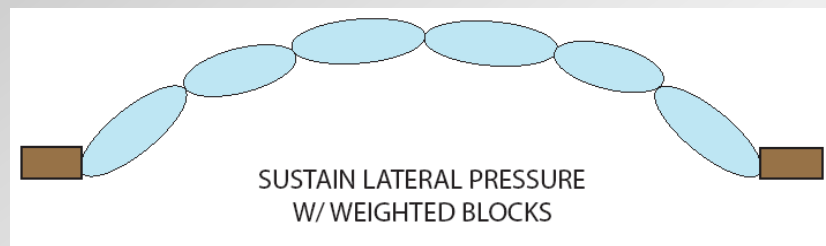
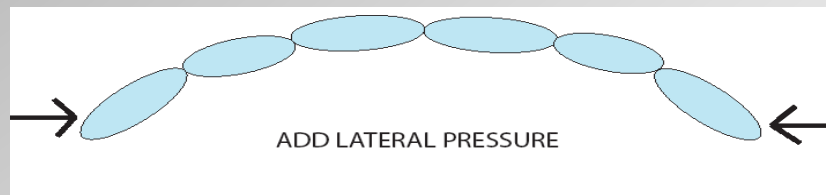
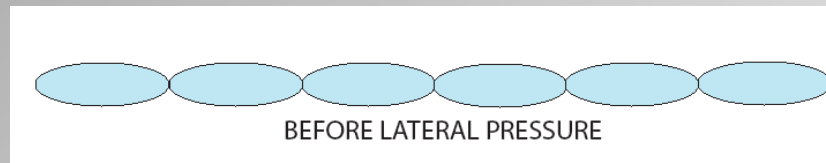




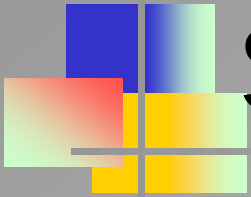
# Structures

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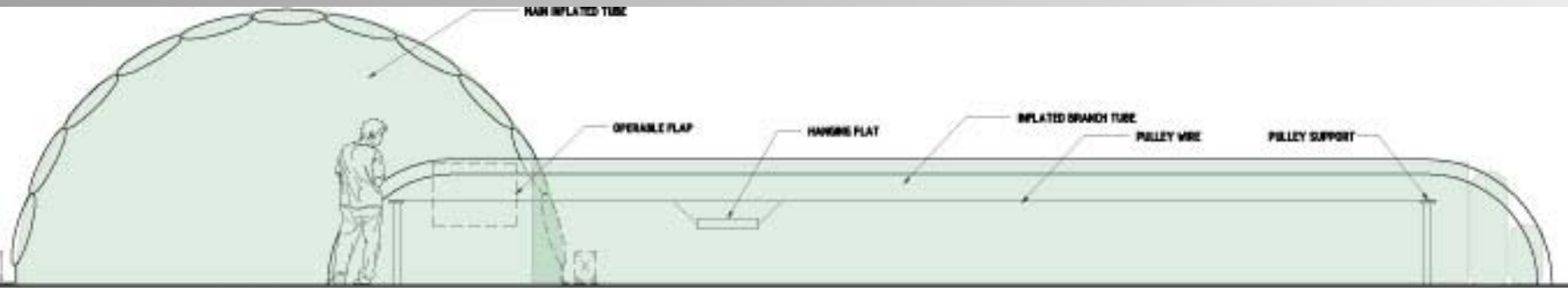
## STRUTURAL CONCEPT (SECTIONAL VIEW)

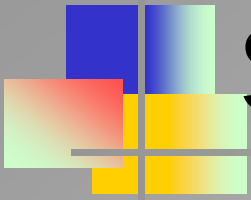






# Structures





# Structures

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## FABRICATION





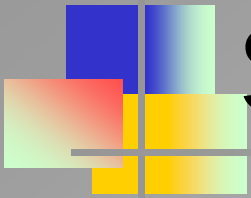
# Structures

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## FABRICATION



**THE PROBLEM WITH LATERAL TUBES IS THAT “PINCHING” OCCURS.**

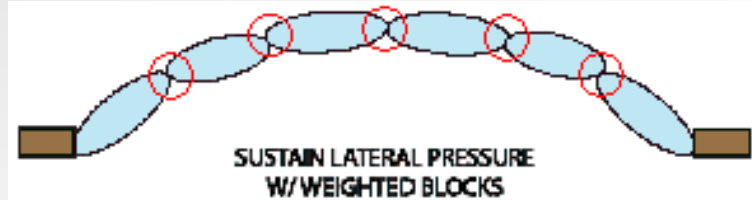


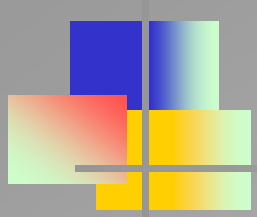
# Structures

## FABRICATION



**TO ALLEVIATE THAT  
VERTEX POINT,  
LONGITUDINAL TUBING  
GIVES MANY MORE  
PLACES TO “PINCH”  
MAKING IT MORE  
FLEXIBLE**



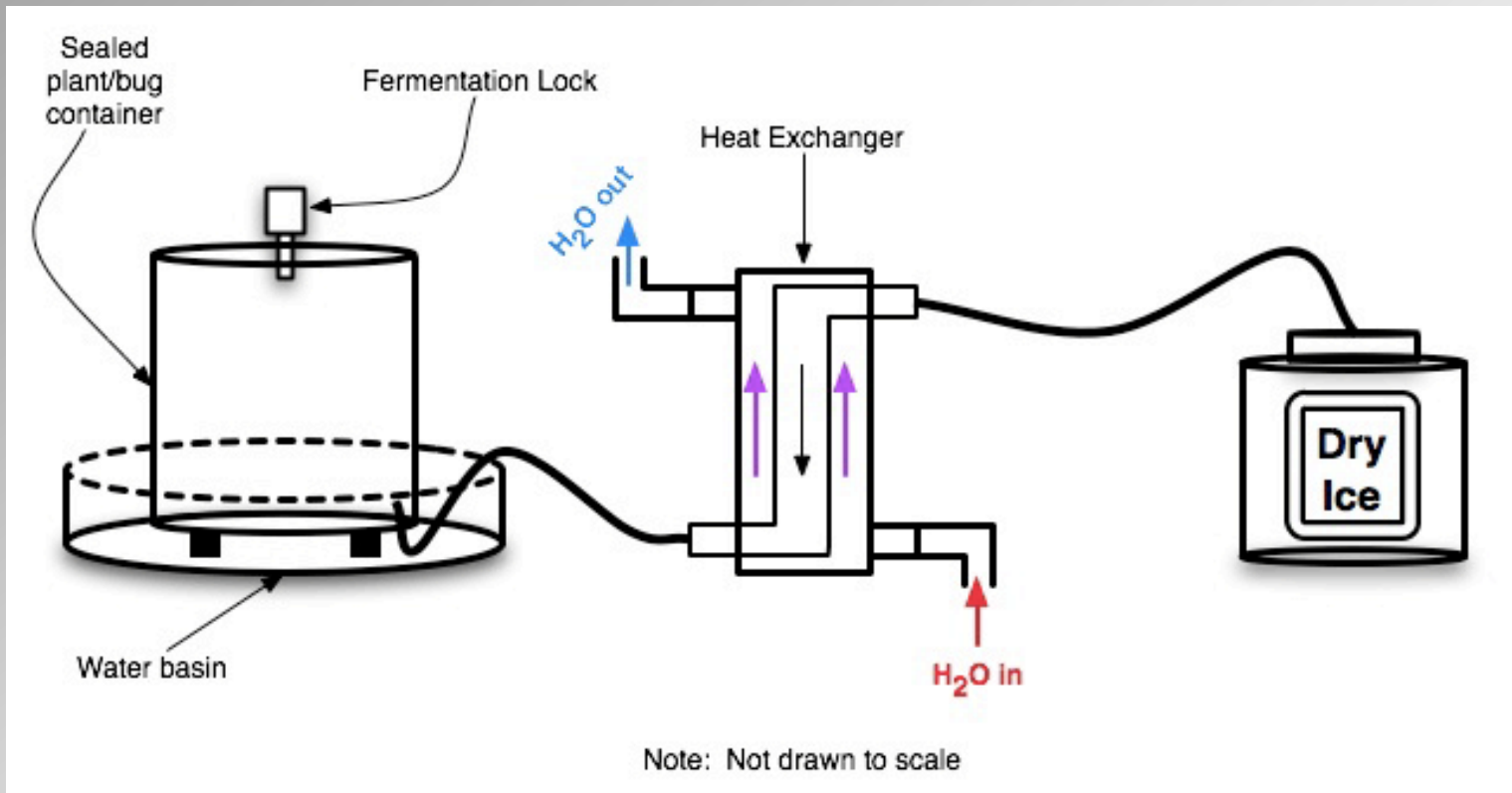


# Pest Control

# Experimental Setup



# Experimental Design





# Results

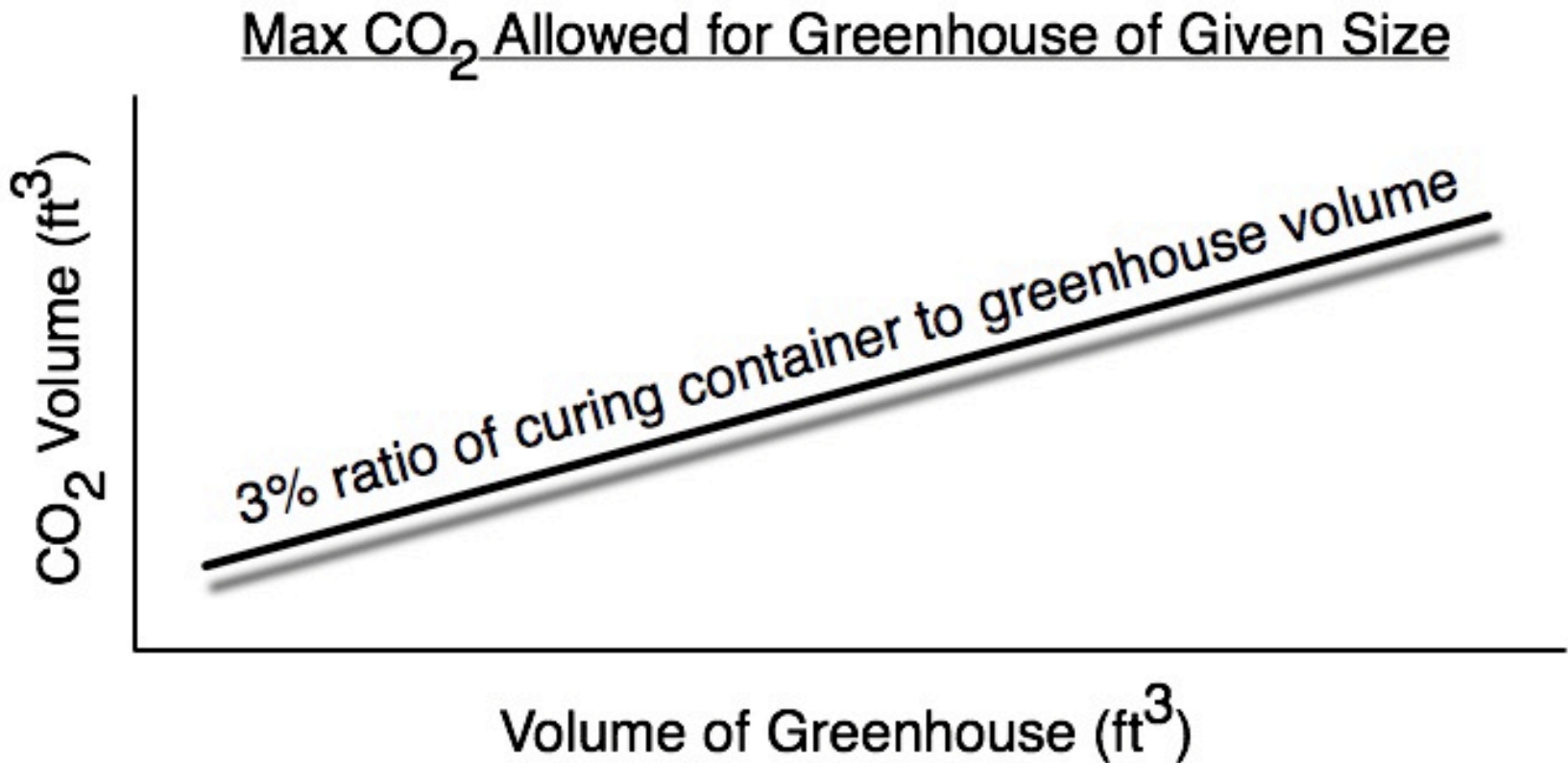
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- Insect incapacitation within 30 seconds
- Death within 3 hours





# Application in Greenhouses

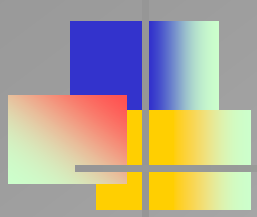




# Temperature Control

- Several Options Available
  - Misters
  - Foggers
  - Fans
  - Plastic Coatings





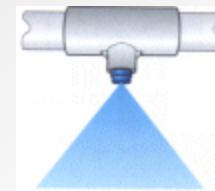
# Thermal Analysis

# Mister



- Mistifiers attach to hose via attachment
  - Cheap
  - No pumps required; use water pressure to generate mist

- Mistifiers with pumps
  - User defined temperature settings
  - More expensive



# Foggers

- Cools greenhouse by generating a cooling fog
- More complex and expensive than misters
  - Price: \$25-\$250/unit
  - Modular units require no tubing
  - Pool of water required





# Fans

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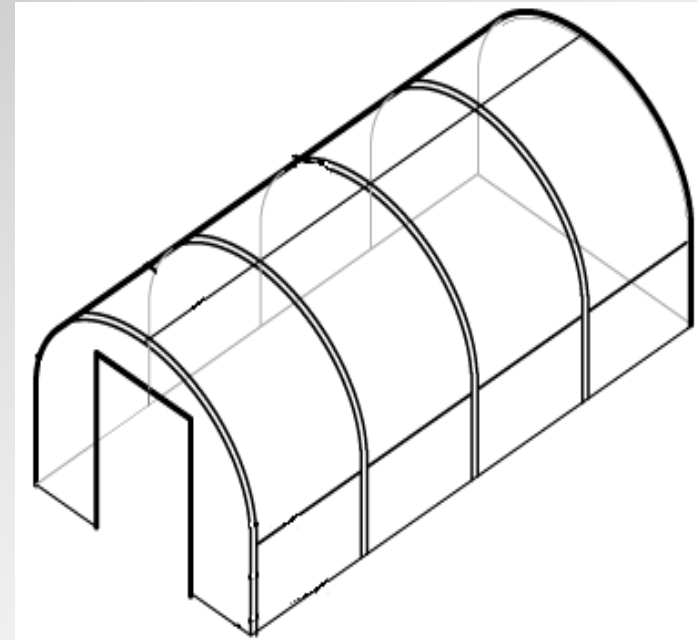
- All cooling options require a fan
- Serves a double purpose
  - Circulates air within greenhouse
  - Keeps greenhouse inflated
- Size of fan dependent upon size of greenhouse
- Typical circulation in a greenhouse is 1 total air exchange per minute



# Plastic Coatings

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- Solarflair™ 870 is a pigment that offers a way to absorb the “Photosynthetic Active Light” (PAR) which has a wavelength of around 400-800nm. Designed by EMD Biosciences.
- Offers a way to reflect some of the UV and IR wavelengths that supply unnecessary heat for the greenhouse.



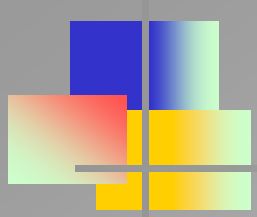


# LIGHT RED/DARK RED RATIO

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- For optimum plant growth more red and blue is desired.
- The positive light red/dark red ratio of 1.4 : 1 was intended to affect the length growth of plants in a way that the internodal distance (the distance between the base of leaves) is decreased and thus the plant has more energy available for photosynthesis.





# Business Plan

# Economic Advantage

## of Inflatable Greenhouse

- Reducing Initial Capital
- Energy efficient
- Suitable for Organic

# Reducing Initial Capital

Initial cost of ~~Conventional Greenhouse~~ **Inflatable Cal Greenhouse**

- Structure = \$ 3,425.44
  - Film = \$ 520
  - **Cooling and Heating System = \$ 8,689**  $\downarrow \frac{1}{2}$
  - Growing Media = 1,794.50
  - **Equipment = \$1,965**  $\downarrow \frac{1}{2}$
  - Installation Cost = \$ 1,348.75
- Total Cost = \$ ~~17,394.69~~ **15,394.69**  $\downarrow$

**TOTAL SAVINGS IN INITIAL CAPITAL = \$ 7,604**

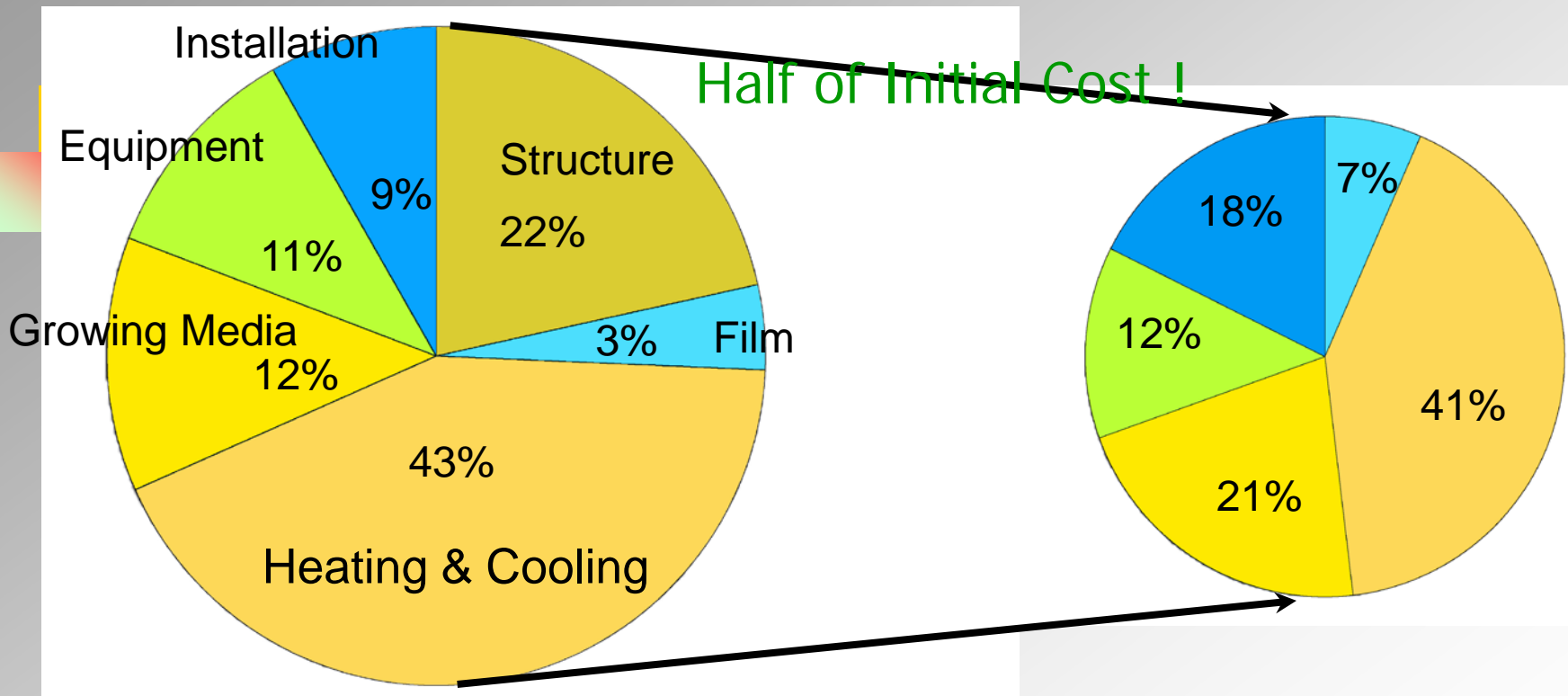
\* Assumption

Size : 6ft x 41.5ft = 250 ft<sup>2</sup> , 250ft<sup>2</sup> X 8 = 2000 ft<sup>2</sup>

Location : Illinois, Moderate Climate

# Reducing Initial Capital

## Structure of Initial Cost



# Energy Efficient

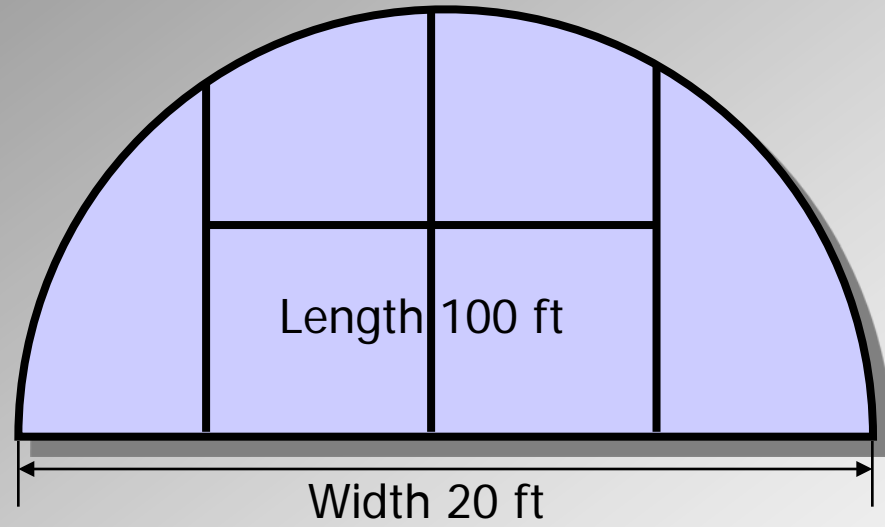
## Operation cost of Conventional Greenhouse

- Labor Cost
- Seed and Fertilizer
- Fuel Cost : Electricity, Natural gas
- Pesticide



**Savings opportunities**

# Energy Efficient



Surface Area

1526.04 ft<sup>2</sup>

3,516.8 ft<sup>2</sup>

Required Heating

177,631,056 Btu/yr

409,355,520 Btu/yr

Required Cooling

45,094,482 Btu/yr

103,921,440 Btu/yr

Assumption: 90% energy efficiency

Electricity = 3412.8 Btu = 1 kWh

Gas price = 23\$/MBtu

0.1\$ / kWh

**TOTAL SAVINGS IN ENERGY COST = \$ 6,945.35**

Cost of Heating

\$ 4,539.46/yr

\$ 10,461.09/yr

Cost of Cooling

\$ 1321.33/yr

\$ 3045.05/yr

# Suitable for Organic

Not using pesticide

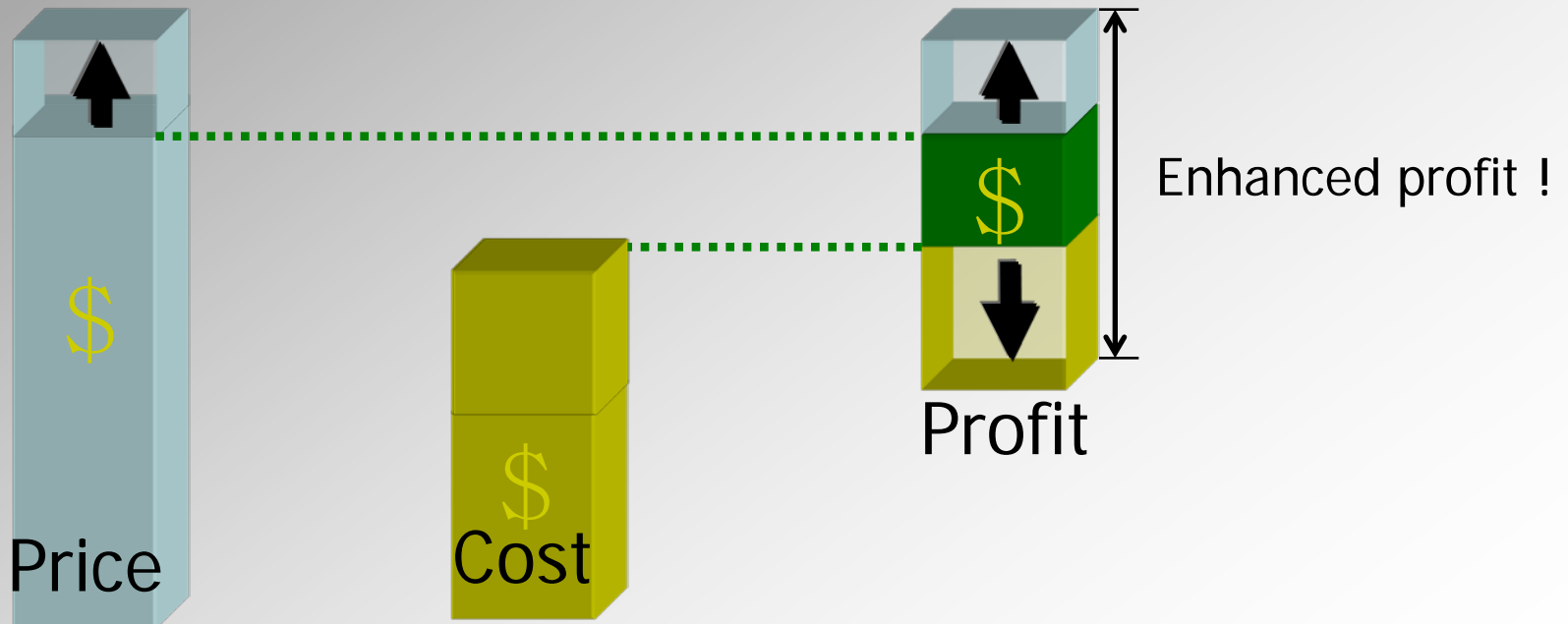
- Reducing operations cost

\$ 169 / 6 month  $\implies$  \$ 340 / yr

Assumption : Tomato Farm

Using alternative Material for organic

- Producing high quality goods



## Total Savings

Savings in Initial Cost

\$ 7,943.44

Savings in Energy Cost

\$ 6,945.35 / yr

Savings in Pesticide

\$ 340 / yr

## Savings by years

Initial year

\$ 15,228.79

3 year

\$ 29,799.49

5 year

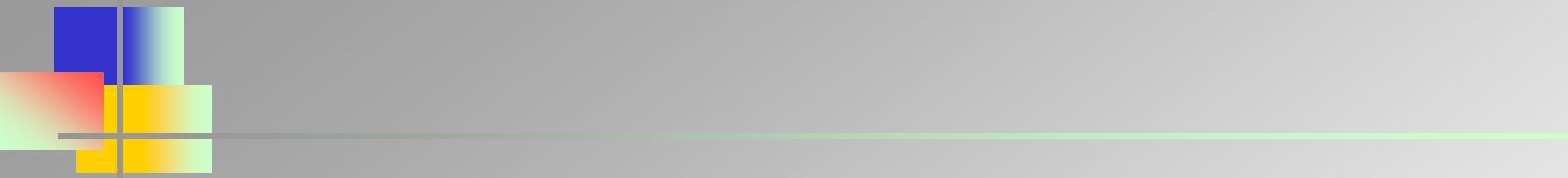
\$ 44,370.19

10 year

\$ 80,796.94



# Green Greenhouses

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- Saves Energy
  - Structure
  - Selective Cooling
  - Pest Control



# Conclusion

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- Questions