The global greenhouse effect - solar radiation enters the earth’s atmosphere, is absorbed by objects it strikes, and is converted to heat. A portion of what is now longwave radiation is trapped within the atmosphere.

Growers frequently monitor the weather during winter nights. Clear, cloudless nights are generally much colder than nights with overcast skies.

Ozone effect - decreases in the ozone layer allow more solar radiation to enter the earth’s atmosphere. Also, increased shortwave radiation (UV light) can penetrate.

The greenhouse effect - solar radiation enters the greenhouse, is absorbed by objects it strikes, and is converted to heat. A portion of what is now longwave radiation is trapped within the greenhouse.

Greenhouses heat up for 2 reasons:

- The greenhouse effect
- The greenhouse is an enclosed structure

The greenhouse covering functions the same way that clouds do to block the transfer of thermal radiant energy.

Greenhouse coverings have varying light transmission, but most are relatively opaque to longwave radiation. This reduces the outward flow of heat from the greenhouse.

**Light:**

Plants respond to light in 3 ways:
- Spectral quality
- Intensity (irradiance)
- Duration (photoperiod, daylength)
More on Light Quality:
There are 3 regions of the solar spectrum that are important to plant growth:

- ultra violet (.29 - .39 microns)
- visible (.39 - .70 microns)
- infrared (.70 - 4.0 microns)

*for nanometers (nm) move the decimal 3 places to the right…*

Photosynthesis proceeds only with visible light (red and blue are the most efficient)

The change from vegetative to reproductive stage of development is controlled by red (.66 microns) and far red (.73 microns).

Light Measurements:

- **Foot Candle** - the light produced on a vertical screen at a distance of 1 foot from a standard candle. This is equal to a lumen/sq. ft. (a lux is 1 lumen/sq. meter).

Foot candles quantify luminous energy, or the light visible to the human eye. This system emphasizes the green-yellow wavelengths (.53 - .58 microns) which the human eye sees best. However, photosynthesis uses a broader range of wavelengths with red and blue most predominant. FC can have as much as a 45% error compared with the actual photosynthetic energy in radiation.

- **Photosynthetically Active Radiation (PAR)** - measures the amount of energy equally in all wavelengths from .40 - .70 microns, without stressing the green-yellow portion.

- **Photosynthetic Photon Flux (PPF)** - The number of photons is measured in moles (mol) or einsteins (E) with:
  
  $1 \text{ mole} = 1 \text{ einstein} = 6.023 \times 10^{23}$

Thus the intensity of light would be measured in the number of photons being transmitted such as:

$u \text{ mol/second/meter sq.}$

Practical Implications:
Heat is the most limiting factor we have in the production of nursery/floral crops here in Texas.

Because we have both high day time and night time temperatures, respiration rates are generally high, making it is difficult to build a quality plant.

Also…our high summer temperatures influence the retail market as well.

Controlling heat (via the greenhouse effect) is difficult while providing adequate light levels for plant growth.

Some plants will not flower if temperatures are above a given level (i.e. tomatoes = 90 degrees).

There is a growing body of information showing that heat stress in a significant factor which predisposes plants to insect and disease infestations.

Growers have the greatest control over their crops while they are heating (it may be expensive…but control is easier).