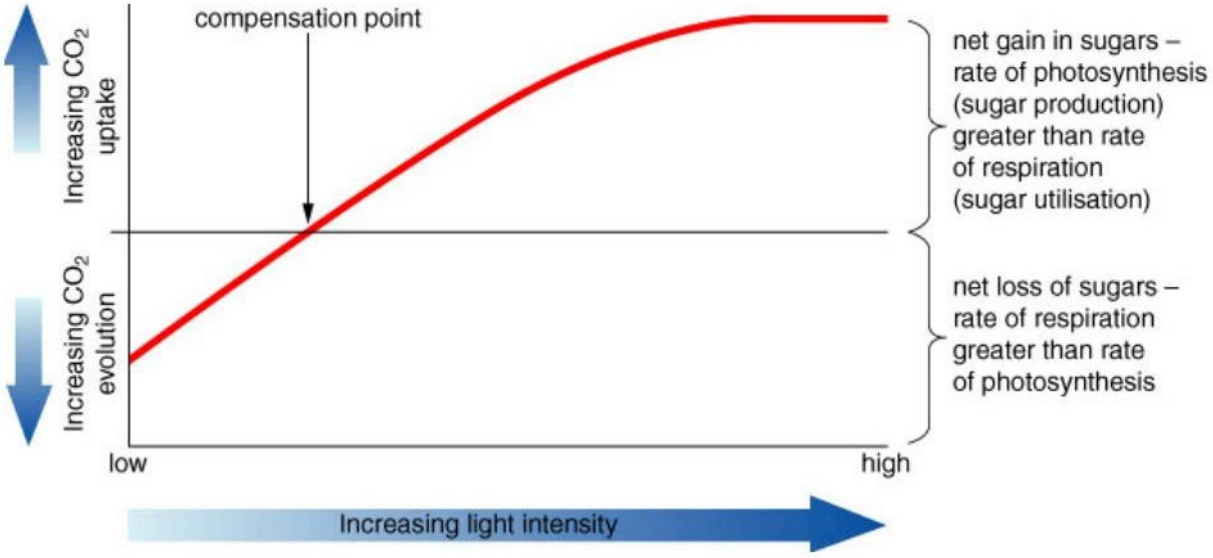
Fun Facts about Light

by Sue Bottom, sbottom15@hotmail.com

Photosynthesis is the process that drives the growth of plants. Carbon dioxide is absorbed from the air and chloroplasts absorb sunlight. The energy from light is changed into chemical energy by converting carbon dioxide into sugars, releasing oxygen back into the air. These sugars can then be used in the respiration process in which sugars react with oxygen to fuel plant growth and maintenance processes. When sugars are produced by photosynthesis in excess of what is needed for growth and respiration, they can be stored as starch for future use.



(Chart source artofbonsai.com, accessed 6/21/23, link: https://www.artofbonsai.org/the-importance-of-light-intensity-in-photosynthesis/)

The compensation point is the amount of light required for a plant to produce enough energy through photosynthesis to cover the amount of energy required to grow and maintain cellular function through respiration. If there is not enough light, the plant will be stunted and not grow well. This sometimes happens to indoor plants that are grown under low light levels.

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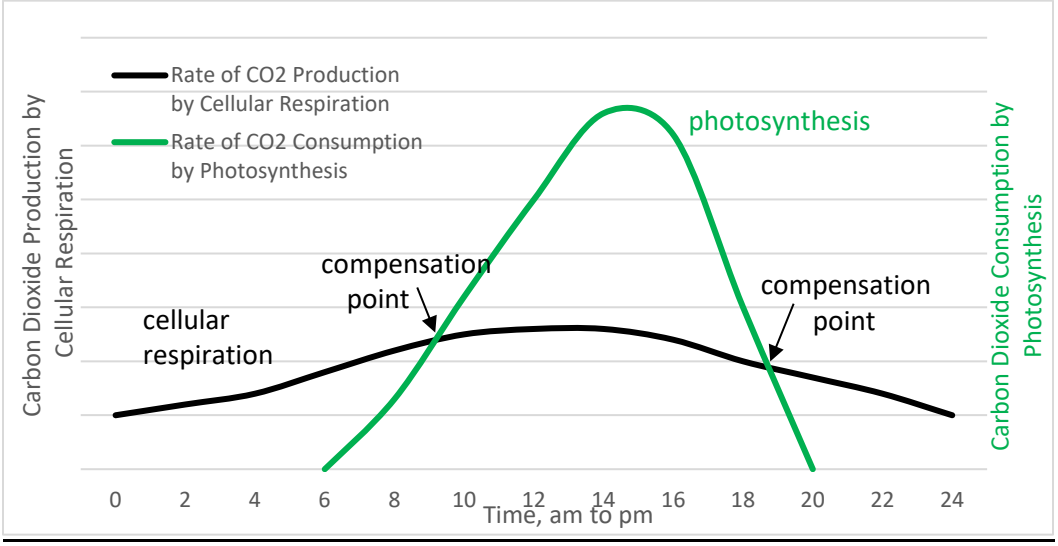
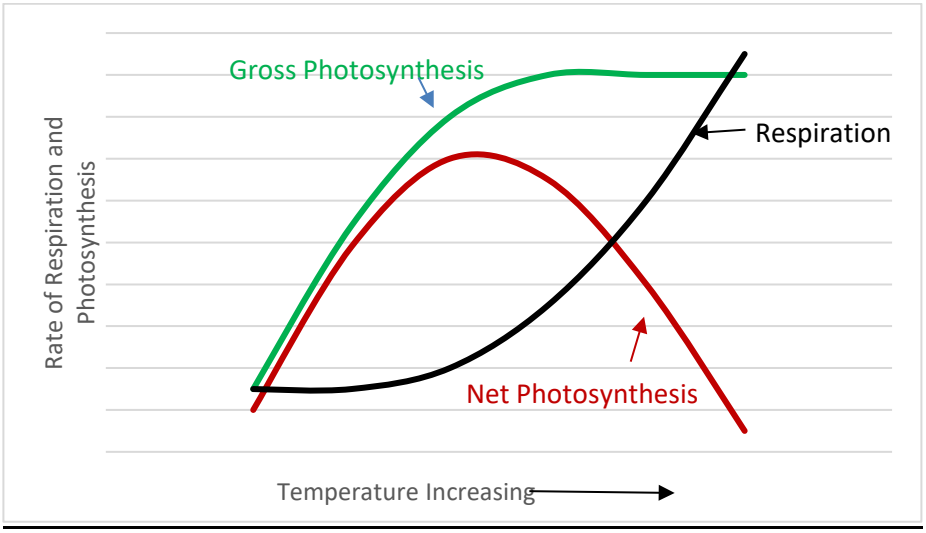


Photosynthesis occurs during daylight hours, while respiration occurs around the clock, during periods of light and periods of darkness. For plants to store up enough energy to bloom, the total amount of energy produced by photosynthesis has to be greater than the total amount of energy consumed by respiration.



Photosynthesis and respiration are both temperature dependent, and both processes initially increase in rate as the temperature increases. At a certain temperature, the photosynthesis rate becomes capacity limited and will increase no further while the respiration rate has no similar temperature limitation. This is one of the difficulties in growing plants in the heat of the summer. Additional shading added in the summer keeps the plants

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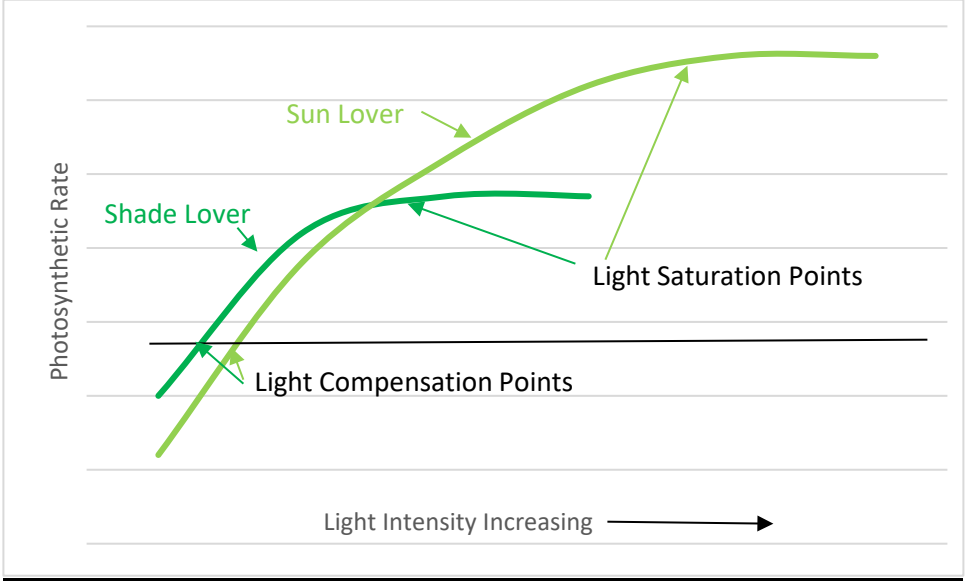
cooler, so they don't burn all the sugar that is produced, leaving some in reserve for flower production. This chart also illustrates why plants enjoy a drop in nighttime temperature. The lower nighttime temperature reduces the respiration rate so energy stores are not exhausted.



Each plant has a maximum light saturation point, the maximum amount of light that it can absorb and convert into chemical energy. If it is exposed to higher levels of light, it will absorb the energy of the light without being able to process it, so the internal leaf temperature will increase to potentially unsafe levels, possibly becoming sunburned.

Many orchid books give recommendations for maximum light levels in foot-candles, a measure of light visible to the human eye. A more meaningful measurement to plants is the light intensity of photosynthetically active radiation (PAR). The Photosynthetic Photon Flux Density (PPFD) value is measured in the barely comprehensible units of micromoles per square meter per second (μmol/m^2/sec). For sunlight, you can estimate the PAR by dividing the amount of light measured in foot-candles by 5. If the orchid books recommend 3,000 foot-candles for your cattleyas, it is comparable to PPFD value of 600 μmol/m^2/sec. Artificial lighting has different conversion factors depending on its light spectrum. More and more you see lighting recommendations based on the PAR value. We might as well get used to it!