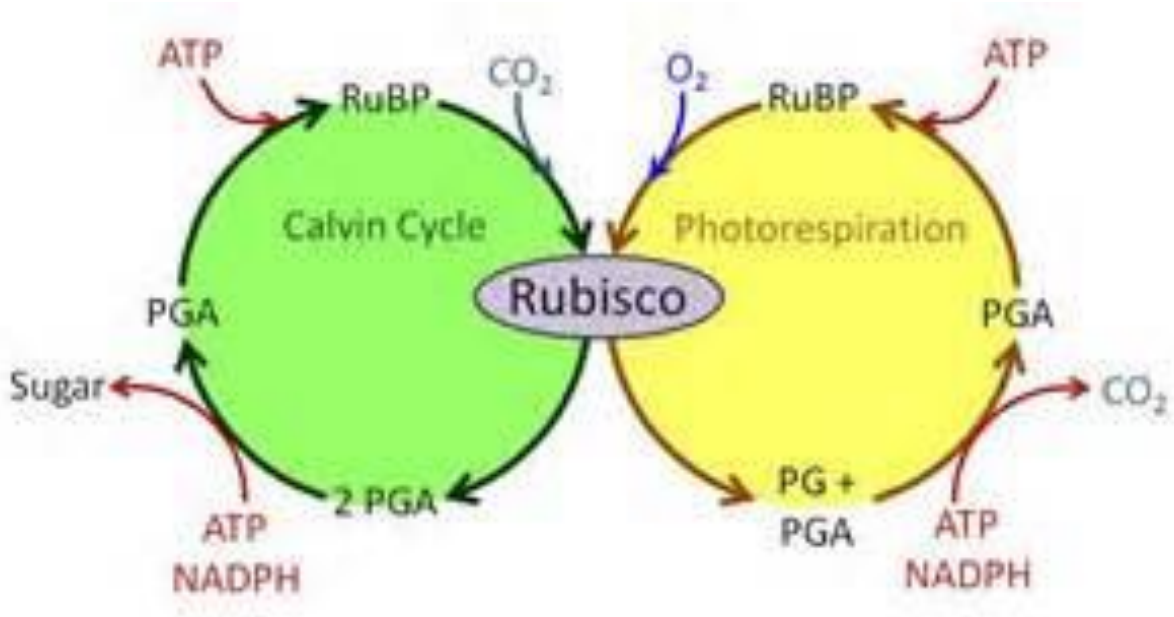
Photosynthesis & the Environment

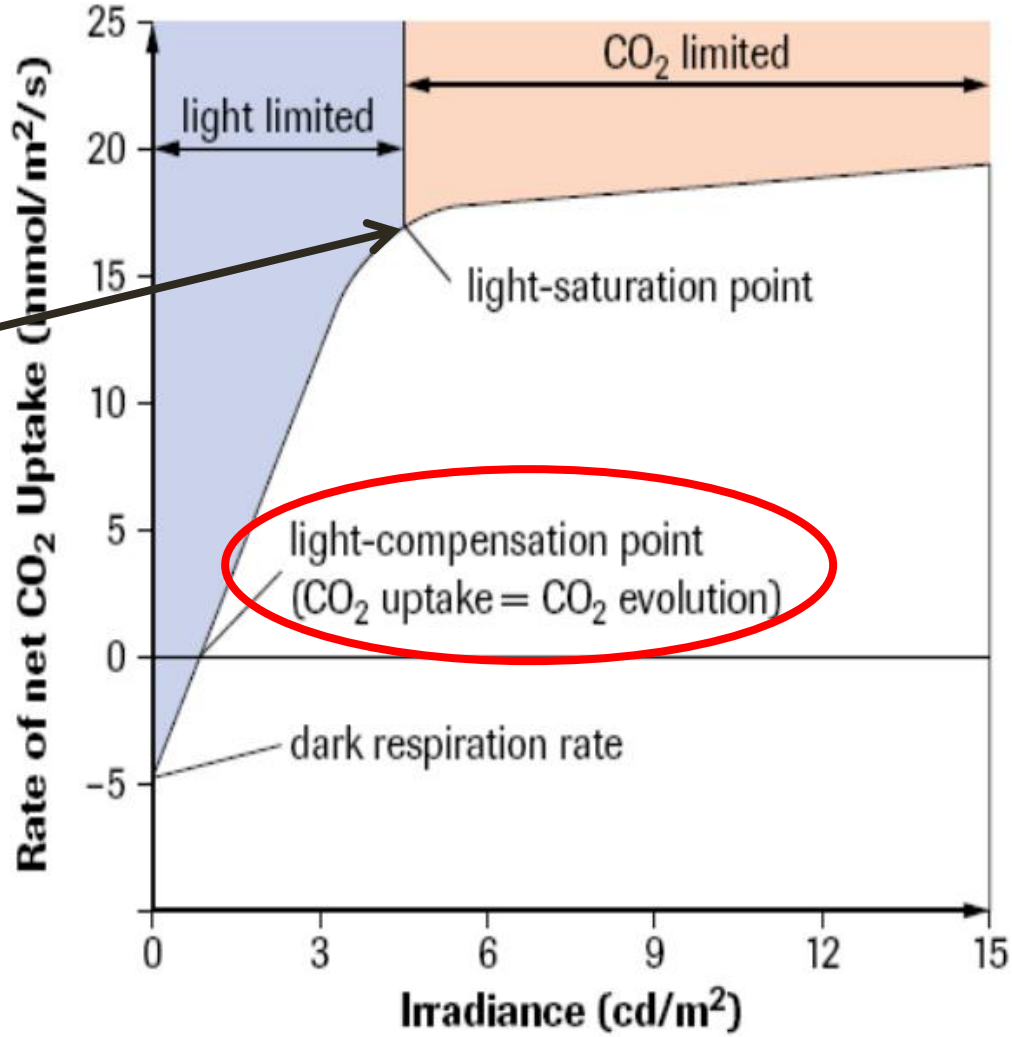
Terms to Remember:

- **Irradiance** = light intensity per unit area of a leaf
  - zero = darkness
- **Photorespiration** – when Rubisco binds oxygen instead of CO_2
- Net
- Net



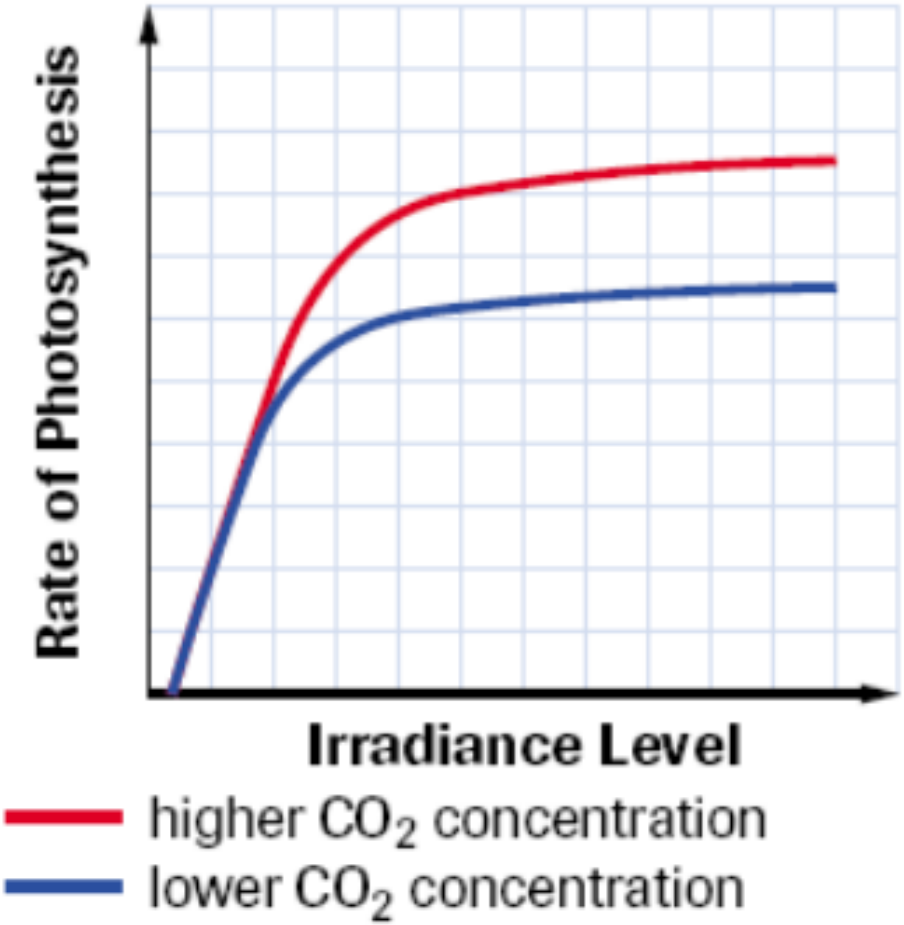
C3 Light Response Curve

- Rate of photosynthesis ↑α with ↑irradiance
- Carbon fixation reaches maximal rate
- CO_2 availability limits overall rate of photosynthesis



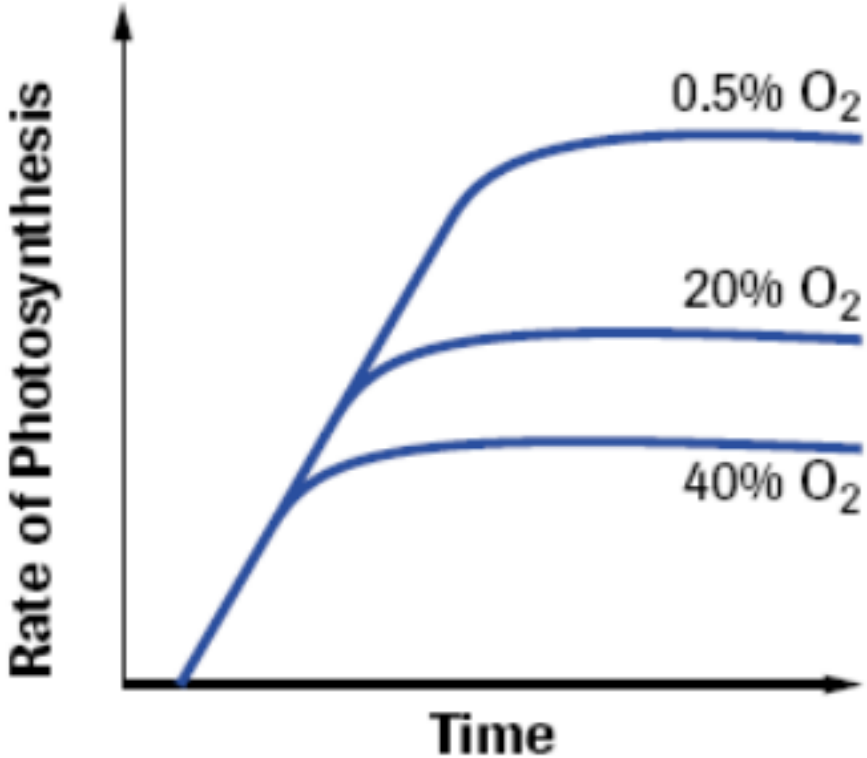
Photosynthesis Light Response Curve at Two Different CO_2 Concentrations

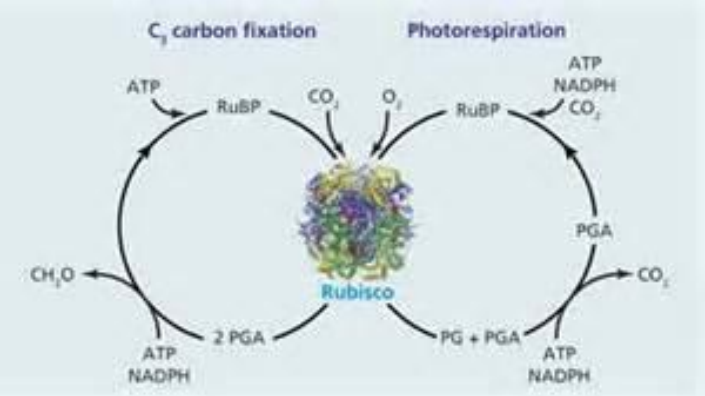
- More CO_2 binds to Rubisco
- Eventually all active sites are occupied – enzyme is saturated



Oxygen Consumption & Rate of Photosynthesis

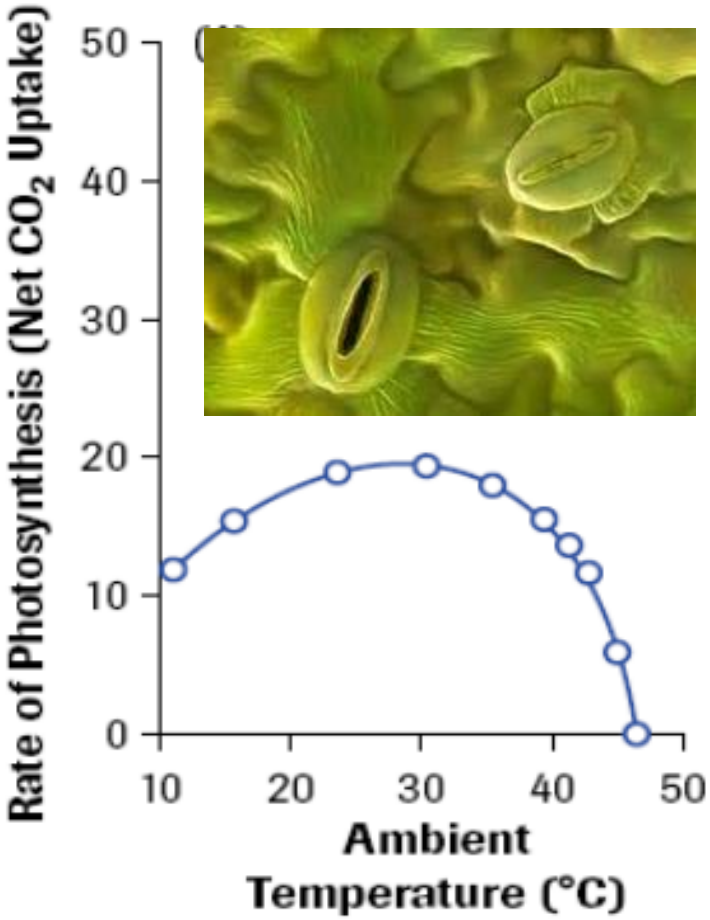
- High levels of O_2 inhibit photosynthesis
- Oxygen competes with CO_2 for active site on Rubisco
  - Photorespiration
- ≥ 20% of fixed carbon lost to photorespiration
  - PGA + Phospholycolate produced instead of 2 PGA





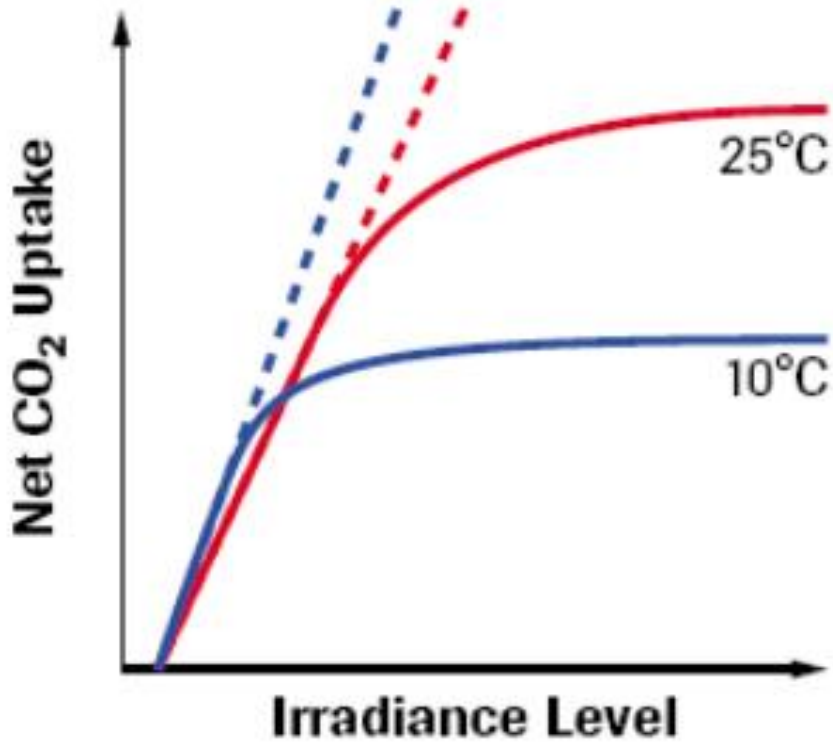
Temperature & Rate of Photosynthesis

- Rate of light reactions not significantly influenced by temperature
- Calvin cycle influenced by temperature – enzyme catalyzed reactions
- $[CO_2] \downarrow$ because stomata close in higher temperatures to reduce water loss



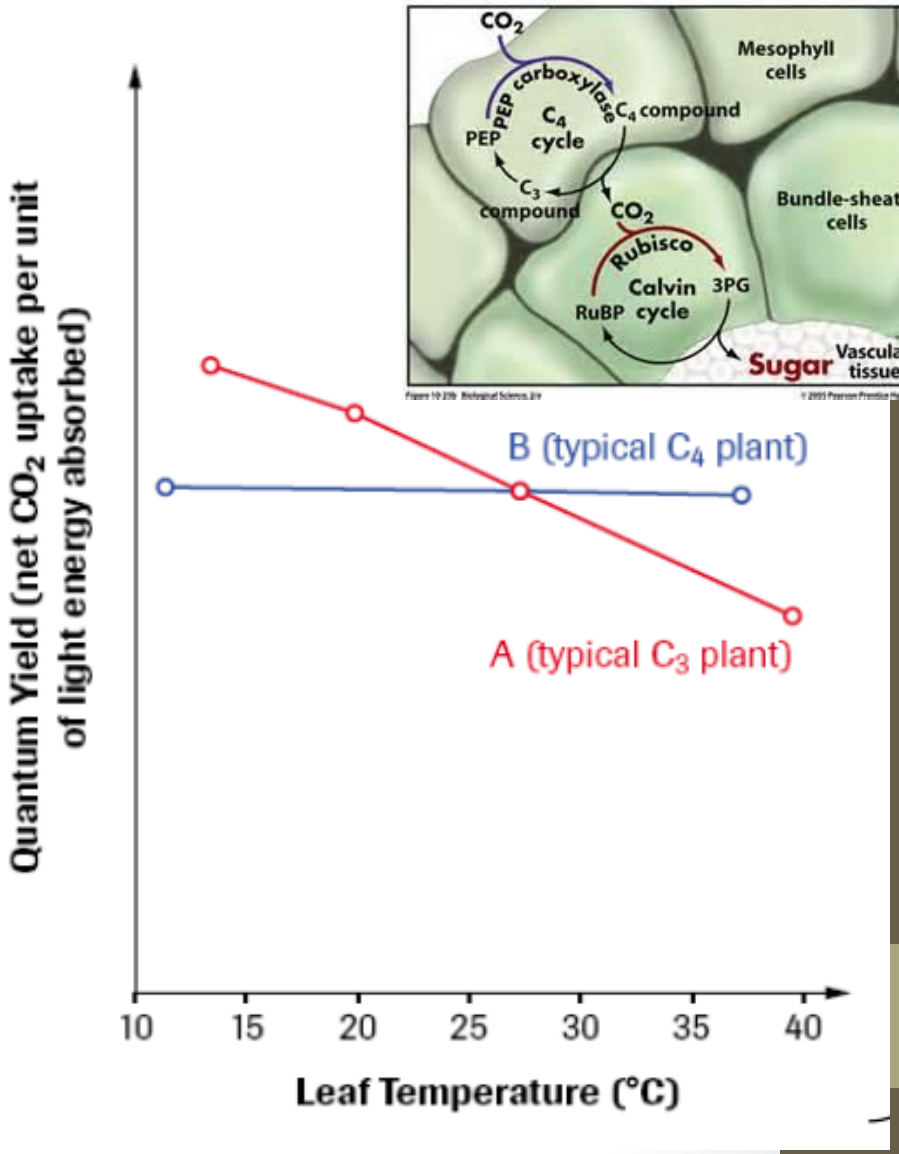
Photosynthetic Efficiency

- Slope = CO_2 uptake /unit of light energy
- Most C_3 plants net CO_2 uptake ↓ as temperature ↑ because stomata close to conserve water
- Light reactions more efficient at cooler temperatures



C3 vs. C4 Plants & Temperature

- C_3 plants more efficient at lower temperatures – due to ↑ $[CO_2]$
- C_4 more effective at higher temperatures because of ability to actively pump CO_2 into bundle sheath to out compete O_2 levels
- C_4 plants have consistent CO_2 uptake due to $[CO_2]$ regulation mechanisms



Sun Plants vs. Shade Plants

- Shade plant leaves:
  - thinner
  - broader
  - ↑ chlorophyll (greener)

- Increases efficiency at low light intensities