



Exploring the photosynthetic response to light

An example using the LI-6800 portable photosynthesis system to quantitatively explore photosynthesis

Copyright © 2017 LI-COR, Inc. All rights reserved.
Contact LI-COR for permission to redistribute.

LI-COR®

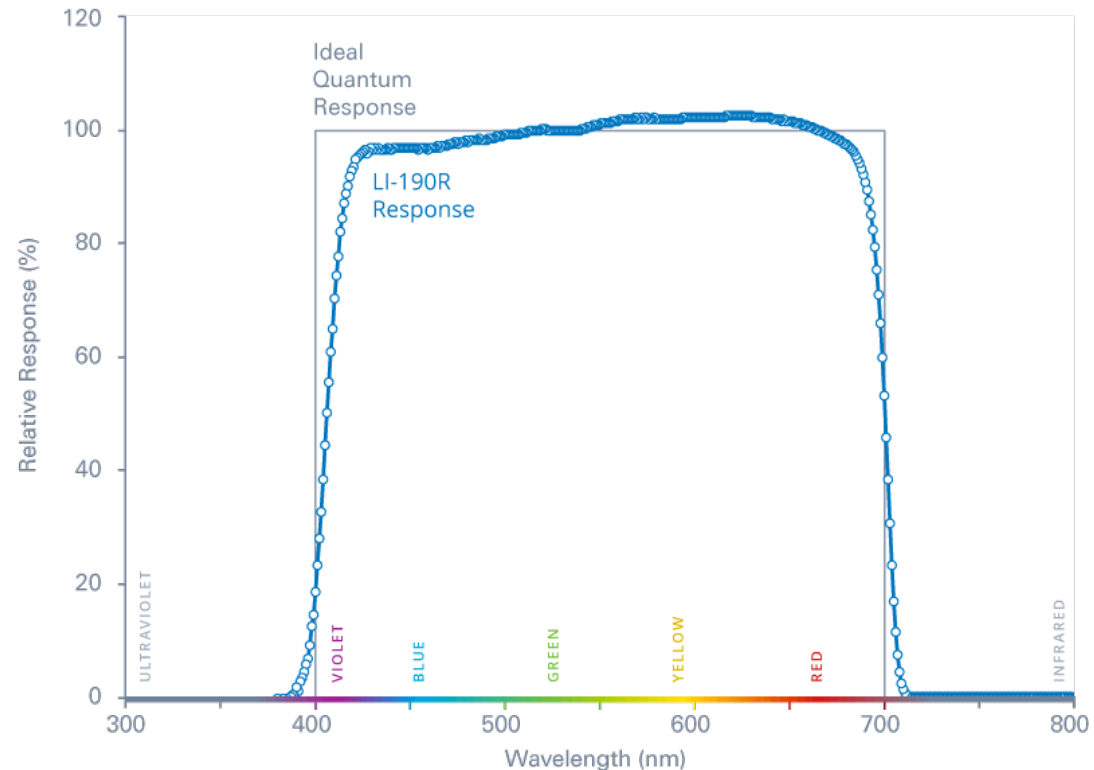
Agenda

- Review gas transport and photosynthetic pathways
- Review experimental protocol
- Measure photosynthetic response to light (AQ)
- Examine the data and fit light response parameters

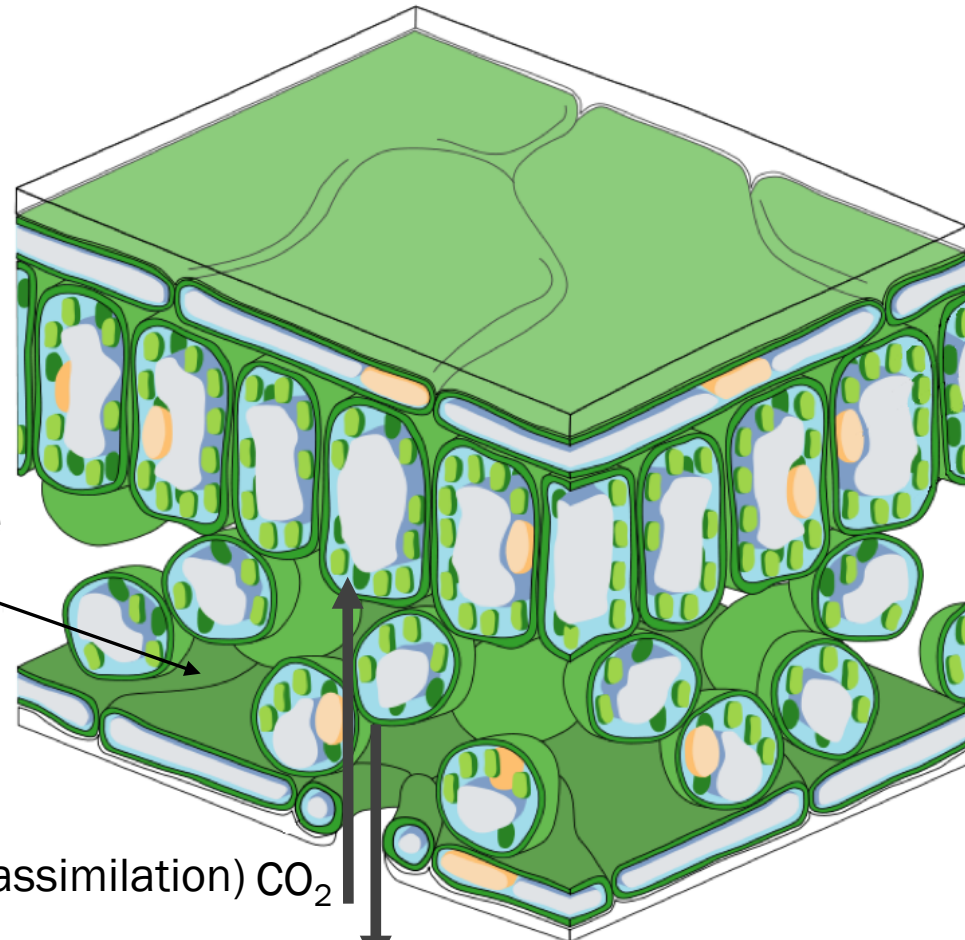
Don't be shy, this is meant to be interactive! Ask me questions as we go, and answer questions when I ask them.

Photosynthetically Active radiation (PAR)

- The light that is used to drive photochemistry
- Expressed as a flux of photons per unit area
 - $\mu\text{mol m}^{-2} \text{s}^{-1}$



Gas transport between the leaf and atmosphere

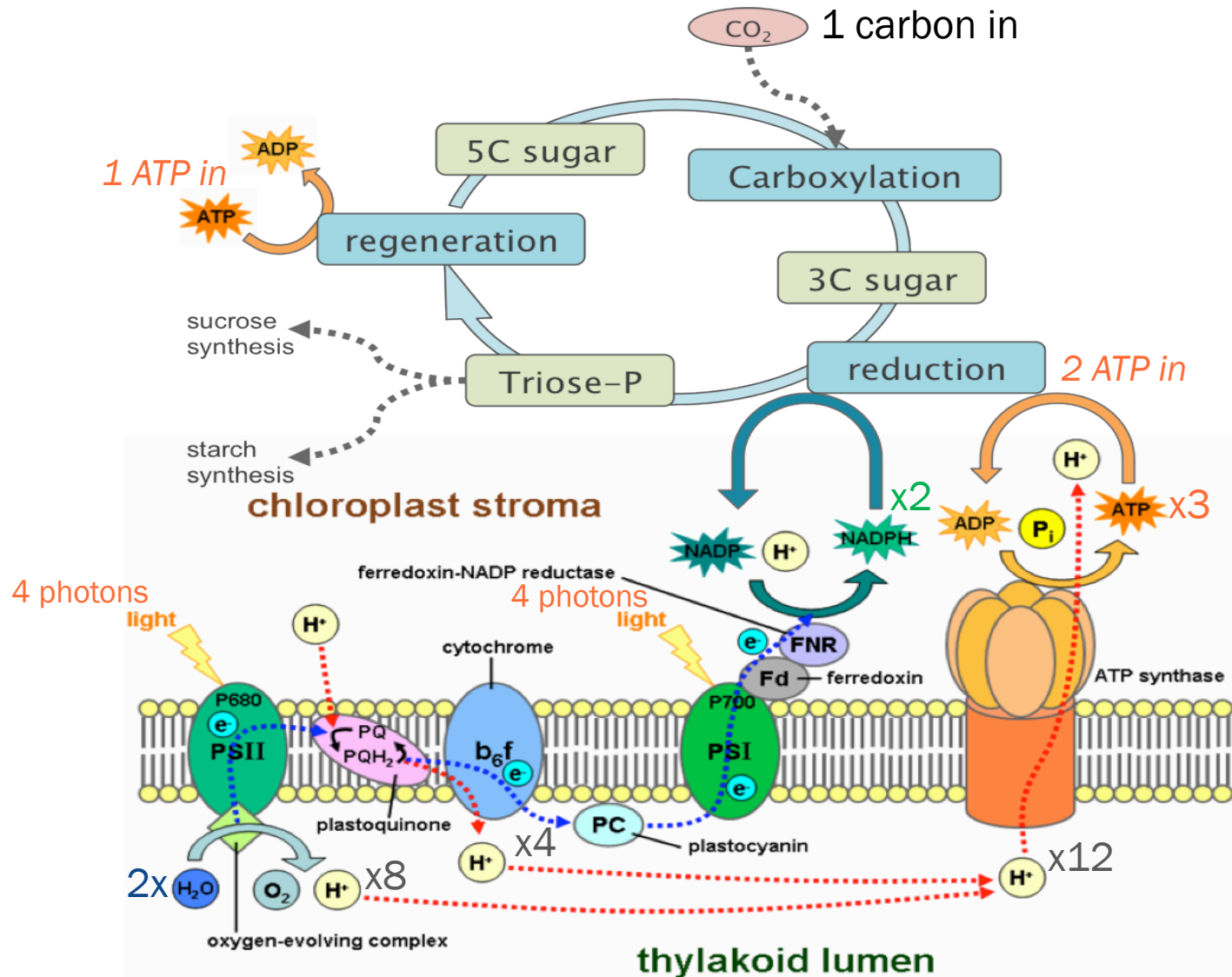


C_i : CO₂ concentration inside the leaf's inter cellular airspace

g_{sw} : Stomatal conductance to water vapor

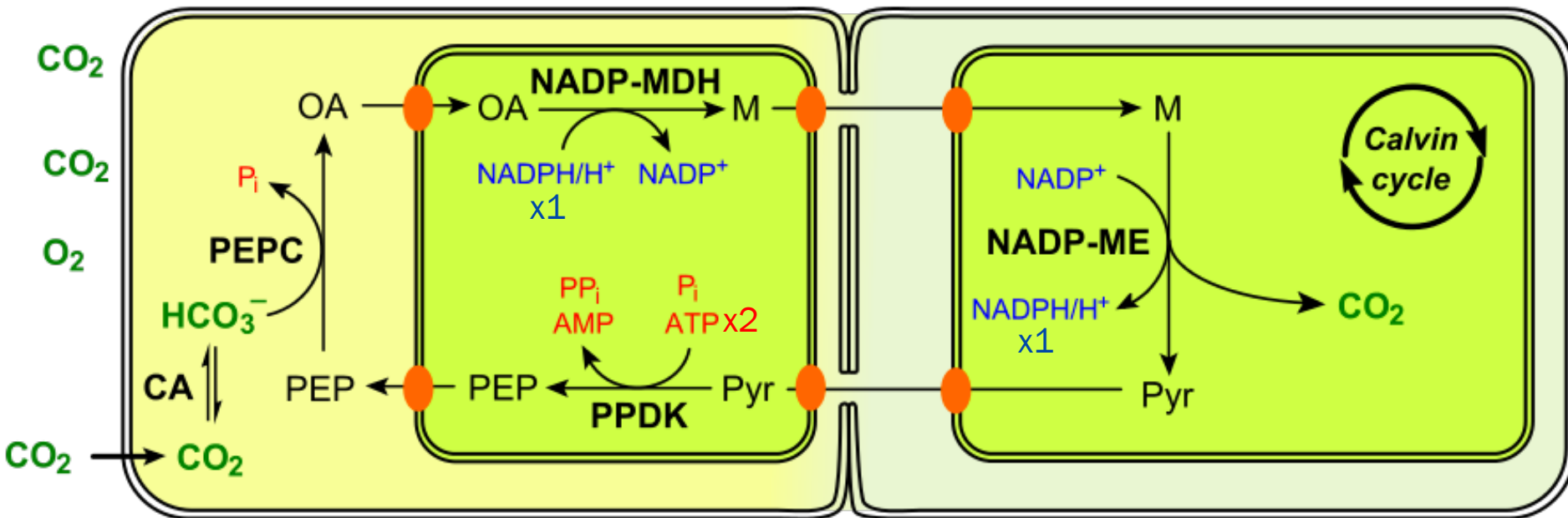
H₂O (E: transpiration)

The C3 carbon fixation pathway



The C4 carbon fixation pathway

- We add extra steps to carbon fixation in C4 plants
- These extra steps cost energy (2xATP) and concentrate CO₂ around the chloroplasts



NADP-ME type

The LI-6800 portable photosynthesis system



Review of lab procedure

- Your instructor has been pre-acclimating our plant material to full sun light
- You need to...
 - Verify that assimilation is at steady state
 - Open a log file
 - Configure the instrument to make the light response measurement sequence
 - Download and analyze the data

Measurement protocol

- Program:
 - Light_Response
- Qin value:
 - 2000, 1500, 1200, 1000, 750, 500, 250, 100, 75, 50, 25, 10, 0
- Minimum wait time:
 - 120 seconds
- Maximum wait time:
 - 300 seconds
- Allow early matching

Configuring the light response curve

Bluestem v.1.1.1 Wed Mar 29, 2017 04:00 PM

Start Up **7/7** Environment Constants **2/2** Stability **Log Files** Auto Programs Measurements Log(0) Yes(TCDH)

Match Options:
Actively logging... Matching settings when logging data: ver. 0.9

Logging Options:
 Never match
 Always match
 Only match if

Logging to:
[2017-03-29-1506_logdata](#)

Log Remark:

Export Logs:

Import Logs:

Analyze Logs:

Elapsed time > 10 minutes since last match

CO2_r changed > 100 ppm since last match

|CO2_r - CO2_s| < 10.0 ppm

H2O_r changed > 10 mmol/mol since last match

|H2O_r - H2O_s| < 1.0 mmol/mol

Bluestem v.1.1.1 Wed Mar 29, 2017 03:29 PM

Start Up **7/7** Environment Constants **3/3** Stability **Log Files** **Auto Programs** Measurements Log(0) No

Programs: Light_Response

Load Save New Delete

Last loaded: *

Settings
default
latest

Loop over a range of light values

Qin Values: 2000,1800,1500,1000,750,500,300,150,100,50,25,0 $\mu\text{mol m}^{-2} \text{s}^{-1}$

WaitForStability: Wait 60 to 300 secs, early match allowed

Min. wait: 60 sec

Max. wait: 300 sec

Allow early matching

Estimated max run time: 60 min 0 sec / Obs logged: 12

Logging to: [2017-03-29-1506_logdata](#)

Trigger Pause Resume Cancel Start

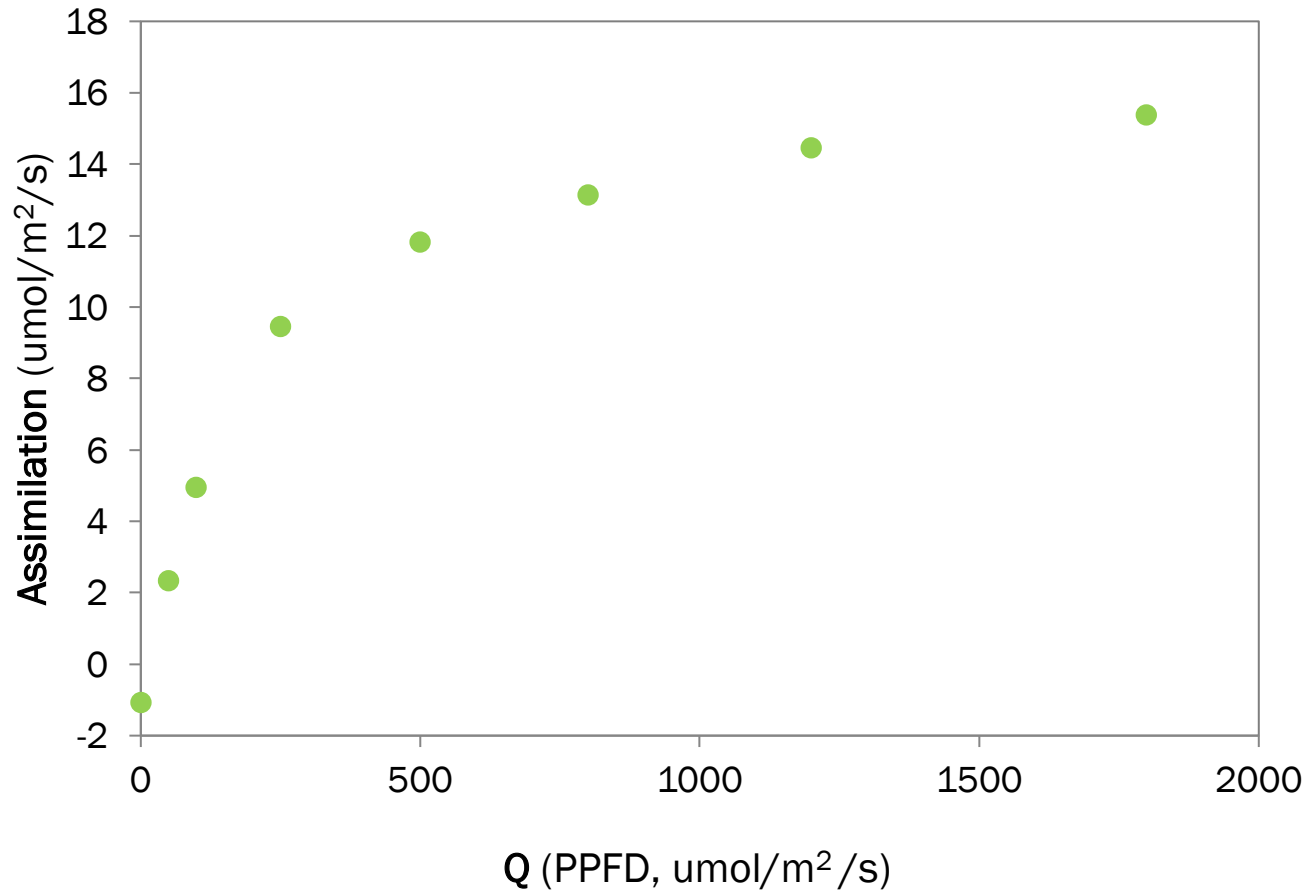
Some pre-measurement questions

- What might we expect the photosynthetic response to look like?
- Why do we start at high light intensity?

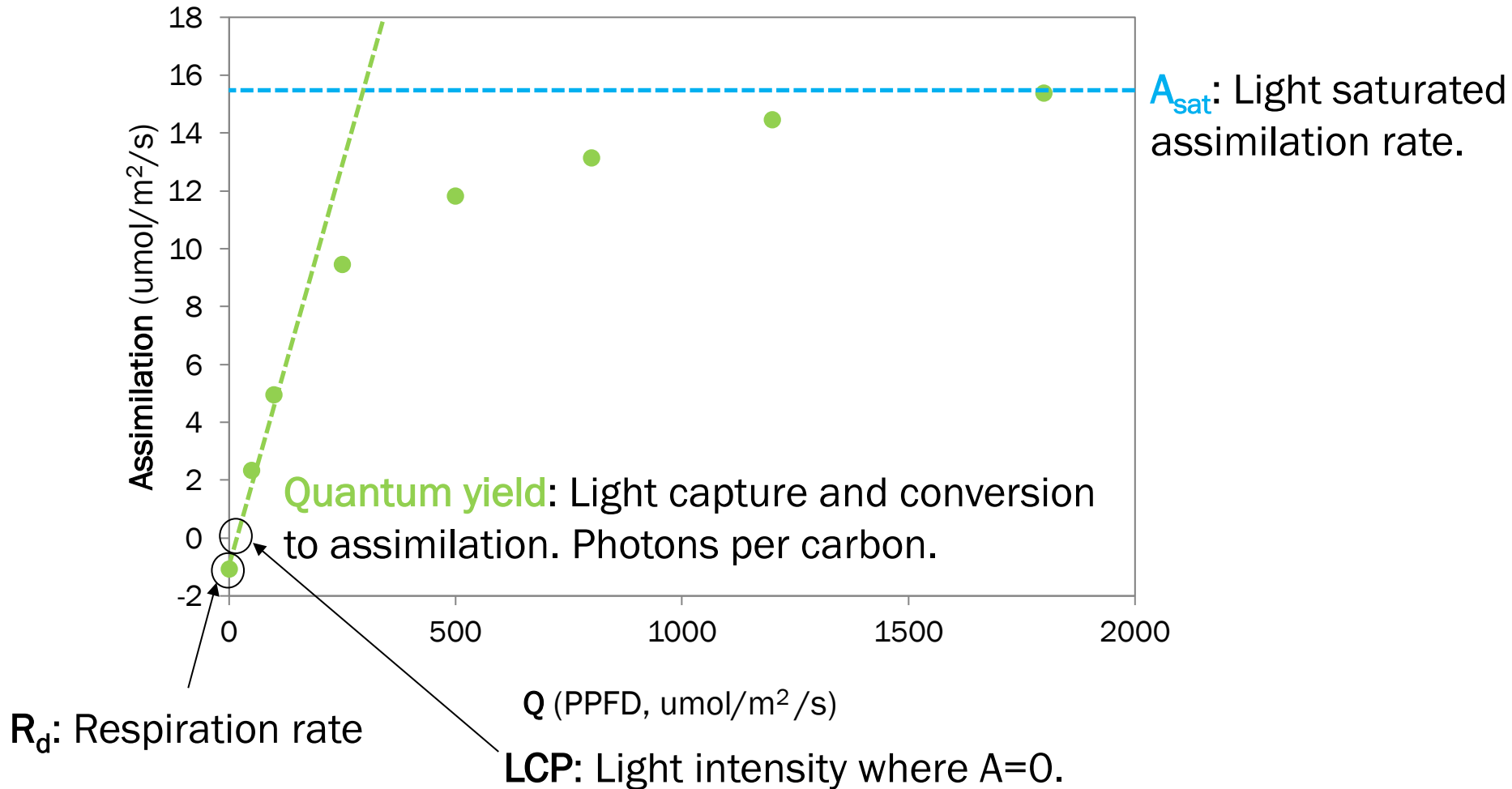
Let's do this!

- Volunteers?

AQ curve



Parameters from AQ response



Some questions to think about

- What was the quantum yield of carbon assimilation?
- What yield might we expect?
- Would we expect similar results in a C3 plant?
- What was the saturating light intensity and what was A_{sat} ? What does this tell us?