See photosynthesis-related useful numbers on other side of page

BioNumbers (bioNumbers.org) is the database of useful biological numbers. It aims to enable you to find in one minute any common biological number important for your research, such as the rate of translation of the ribosome, concentrations of metabolites or the number of bacteria in your gut. You will find full references, comments and related numbers that are useful. Check it out at: www.bioNumbers.hms.harvard.edu.

Please let us know any suggestions and comments: ron_milo@hms.harvard.edu
Photosynthesis-related useful numbers

The numbers quoted here were extracted from the literature. They should only serve as an initial value. Consult the full references to learn about the specific system under study, growth conditions, measurement method etc. Full references at: www.bioNumbers.org

Solar flux:
Photon flux on earth’s surface when sun directly overhead (full spectrum): ~ $4 \times 10^{21}$ Photons/m$^2$/sec
Photosynthetic photon flux (400-700nm) when sun directly overhead: ~ 2000 micromol/m$^2$/sec
Mean photosynthetic flux (average during daytime over earth surface, clear sky): ~ 800 micromol/m$^2$/sec

Chlorophyll:
Effective cross section of chlorophyll for useful photons: ~ 0.09 Angstrom$^2$
Maximal absorption rate under full sun illumination of chlorophyll pigment: ~ 4 sec$^{-1}$

Photosystem:
Size of photosystem I (plants): 12-19 nm
Number of chlorophyll pigments per PSI (plants): ~ 168
Number of chlorophyll pigments per PSI (chlamy): ~ 240
P700 per cell (chlamy): 2-5 \times 10^6 /cell
Quinone A (QA) per cell (chlamy): ~ 4 \times 10^6 /cell
Chlorophyll pigments (Chla & b) per cell (chlamy): ~ 2 \times 10^9 /cell
Ratio of chlorophyll a/b (chlamy): ~ 2.7-3.2

Carboxysome (in Synechococcus 8102):
Diameter: 114-137 nm
Number of Rubisco per carboxysome: ~ 250 (207-269)
Volume of carboxysome occupied by Rubisco: ~ 27%

Carbon fixation, chloroplasts and leaves:
Processing time of an absorbed photon by the chemical reactions leading to CO$_2$ fixation: 2-20 msec
Incident radiation (photosynthetic) absorbed by a chloroplast: ~ 30%
Delta pH sufficient to drive net ATP synthesis in chloroplasts: ~ 2.5 pH units
Intensity at which a ΔpH sufficient to drive net ATP synthesis is formed: ~ 0.1% of full sunlight
Rubisco catalytic rate: 2.5-3.4 sec$^{-1}$ (C3 plants) 3.8-5.4 sec$^{-1}$ (C4) 11.6-13.4 sec$^{-1}$ (cyanobacteria)
Concentration of chlorophyll in a chloroplast: ~ 30 mM
Concentration of chlorophyll in a leaf: ~ 1 mM
Characteristic leaf area index of a plant: ~ 4

Biosphere:
Net primary productivity by land plants: ~ 45-60 Gt Carbon/year
Net primary productivity by ocean phytoplankton: ~ 45-60 Gt Carbon/year
Humanity carbon emission rate (2001): ~ 6.6 Gt Carbon/year
CO$_2$ equilibration time between atmosphere and near surface layer of the oceans: ~ 10-30 years
Time for CO$_2$ turnover in the atmosphere by photosynthesis: ~ 6-8 years
Time for O$_2$ replenishment in the atmosphere by photosynthesis: ~ 2000 years
Global photosynthetic efficiency (NPP, averaged over a year): ~ 0.3%
Percent of global photosynthetic carbon fixation performed by diatoms: ~ 20%
Worldwide primary energy consumption by humanity (average 2001): ~ 13.5 TW

Please send corrections and ideas for more bioNumbers to bioNumbers@gmail.com