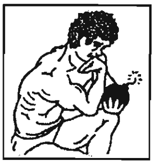
Think It Over



This section of *Resonance* presents thought-provoking questions, and discusses answers a few months later. Readers are invited to send new questions, solutions to old ones and comments, to 'Think It Over' *Resonance*, Indian Academy of Sciences, Bangalore 560 080 Items illustrating ideas and concepts will generally be chosen.

B N Anand
Chemistry Department
Panjab University
Chandigarh 160 014, India

Chemists Don't Digest

There is one point which has always bothered me most on the topic of photosynthesis. The process is represented by the chemical reaction:

$$6CO_2 + 6H_2O + \text{light} \xrightarrow[\text{plants}]{\text{Green}} 6O_2 + C_6H_{12}O_6 + E$$

in almost all of the texts.

This chemical equation representing photosynthesis implies that H_2O is being oxidised to O_2 by CO_2 and that carbon dioxide is being reduced to $C_6H_{12}O_6$ by H_2O, though neither CO_2 nor H_2O are the redox reagents. In fact as nicely explained by V Krishnan in his article[1] these redox reactions occur at two different sites of chlorophyll (green plants). These two sites are photosystem I (PS-I) and photosystem II (PS-II). The reduction of CO_2 to $C_6H_{12}O_6$ occurs at PS-I, while the oxidation of H_2O to O_2 occurs at PS-II. Therefore photosynthetic process may be best represented in the following way.

[1] 'Electron Transfer in Chemistry and Biology – the Primary Events in Photosynthesis', *Resonance*, Vol.2, No.12, 77, 1997.

H_2O and CO_2 undergo redox reactions at two sites of chlorophyll in presence of sunlight. The two sites are PS-II and PS-I respectively. PS-II and PS-I are coupled through electron transport chain consisting of electron transfer reagents (like cytochromes, plastoquinone, iron-sulfur proteins (ferredoxins), Plastocyanin, NADP reductase etc.). Thus in

At PS-II (in chlorophyll)

$$H_2O \xrightarrow[\text{Oxidation (Photoxidation)}]{\text{Sunlight}} O_2 + 4e^- \quad \text{(A)}$$

At PS-I (in chlorophyll)

$$CO_2 \xrightarrow[\text{Reduction}]{\text{Sunlight}} C_6H_{12}O_6 \quad \text{(B)}$$

fact, at least four metals are involved in the photosynthetic process (Mg, Fe, Cu and Mn).

The above representation would help the young students at +2 level as much as graduate and postgraduate students to have a correct grasp of this process at their initial stages of learning.

Locate the Electrons

Question by:
Anirban Sadhu
Department of Microbiology
Y M College
Pune 411 038, India

By Bohr's laws, an electron around a nucleus is restricted from occupying any arbitrary state of energy (energy level) and hence only predetermined discrete energy levels are allowed. This implies that the electron can exist only in certain fixed regions of space around the nucleus and nowhere else. It is these regions of space that we loosely call orbits or energy levels.

Suppose an electron has been excited from $n=1$ to $n=2$. After staying in the excited state for some time and losing the excess energy, it will jump back to $n=1$. My question is, where exactly is the electron located in this process of jumping when it has left the state $n=2$ and has not yet reached $n=1$. Because the process of transfer proceeds with a finite speed, the electrons have to be situated somewhere between the two orbits (i.e. between energy levels 1 and 2) at some point of time. But again, by Bohr's laws, they are forbidden from occupying any intermediate positions. Wherein does the anomaly lie?