

Electron, Faraday et radicaux libres

Christian Amatore

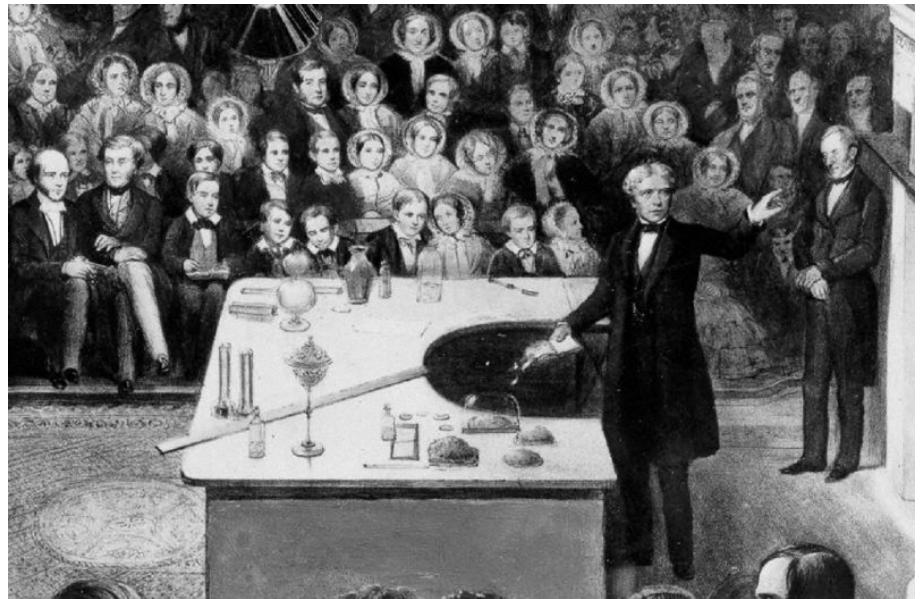
*Ecole Normale Supérieure, Département de Chimie
UMR CNRS-ENS-UPMC 8640 "PASTEUR"
Paris - France*



□ Michael Faraday et l'électron



Michael Faraday par Cochran, 1820

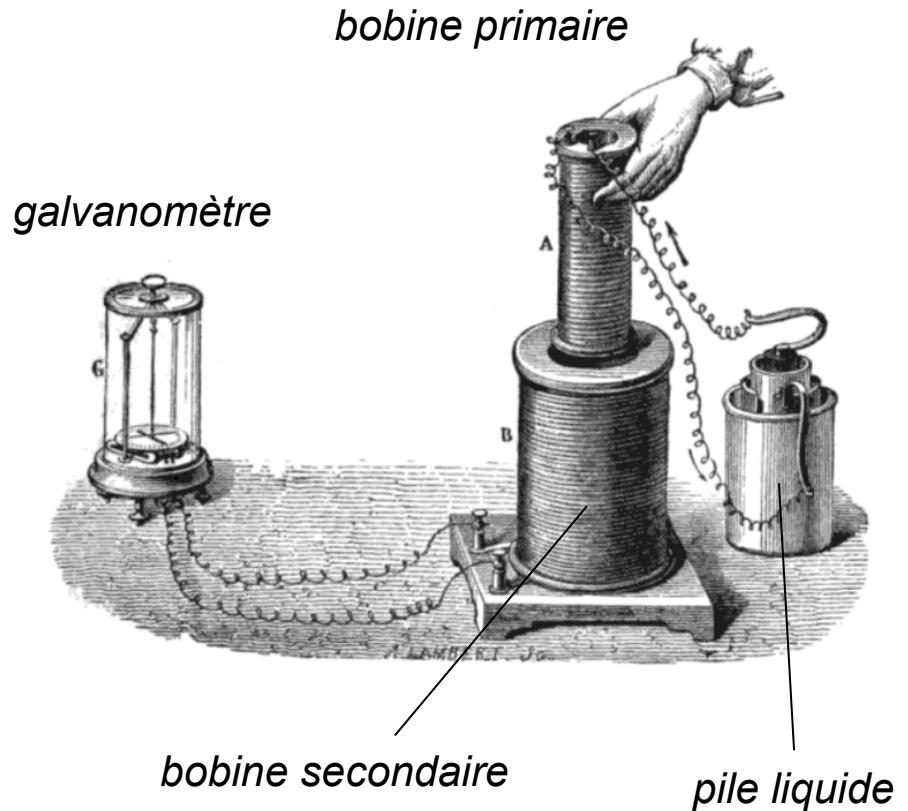


*The Royal Institution
Lecture par Michael Faraday*

□ Michael Faraday et l'électron ‘‘physique’’



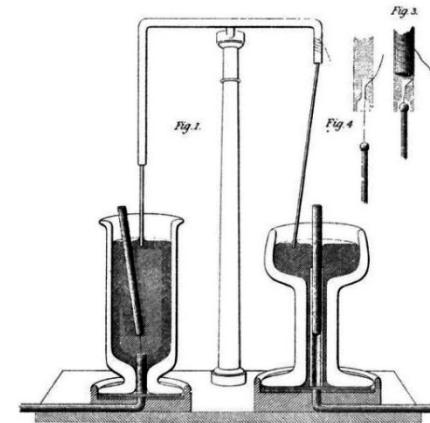
Michael Faraday par Cochran, 1820



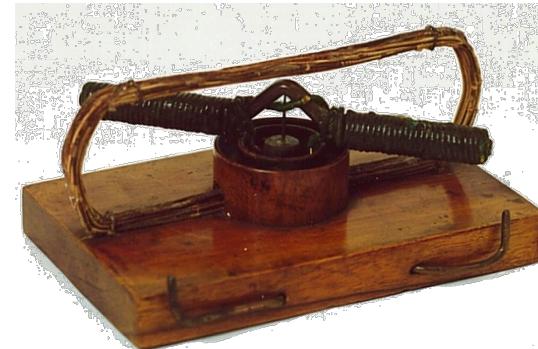
□ Michael Faraday et l'électron ‘‘physique’’



Michael Faraday par Cochran, 1820



1821 L'expérience de Faraday expliquant l'observation décrite par Oersted en 1820

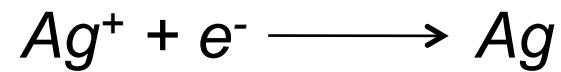
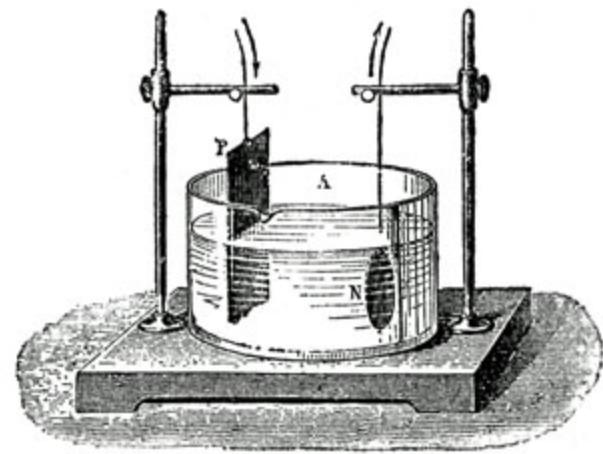


1827 Le premier moteur électromagnétique de Jedlik (Musée des Arts Appliqués de Budapest)

☐ Michael Faraday et l'électron (Chimie)



Michael Faraday par Cochran, 1820



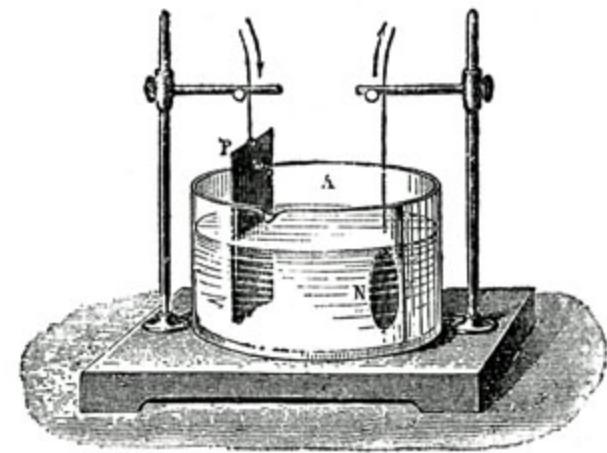
$$\begin{array}{ll} 1 \text{ Faraday} = & 1 \text{ mole} = \\ 96500 \text{ Cb} & 108 \text{ g} \end{array}$$



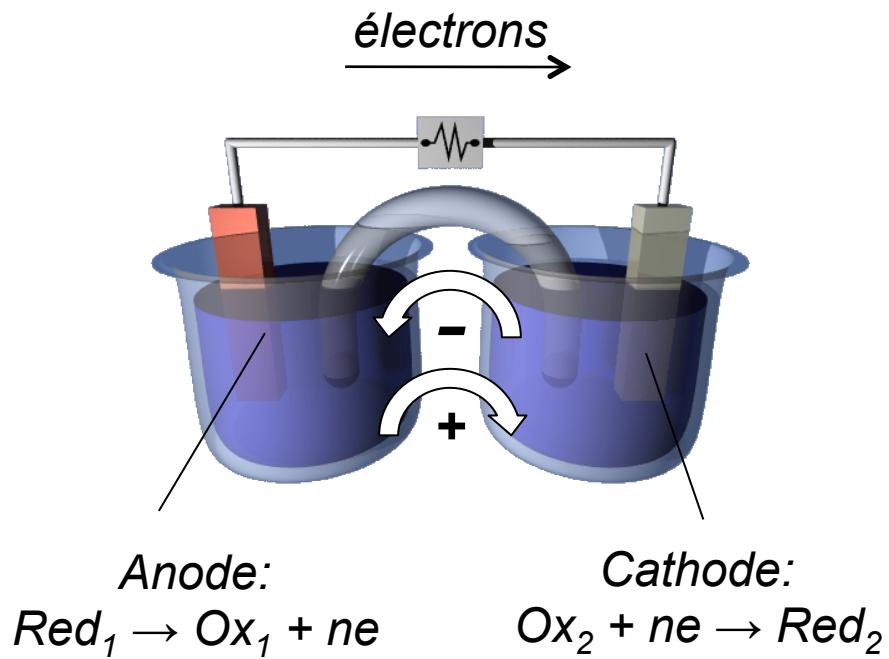
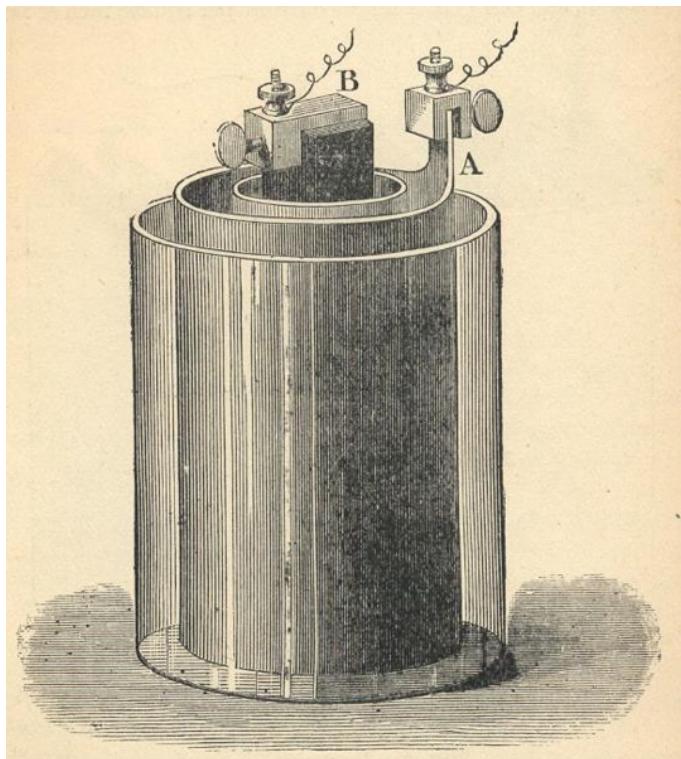
□ Michael Faraday et l'électron ‘‘chimique’’



Michael Faraday par Cochran, 1820

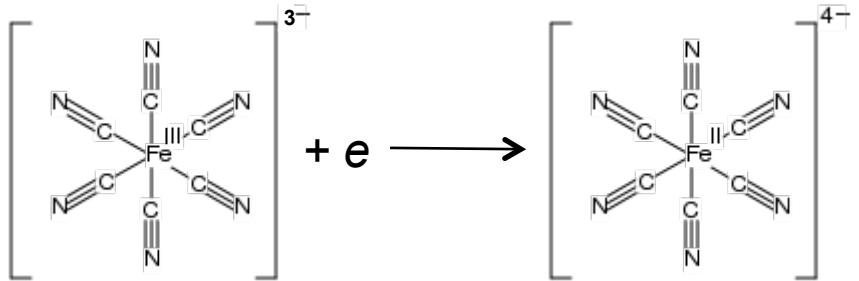


□ Michael Faraday et l'électron ‘‘chimique’’



Electrolyseur de Bunsen

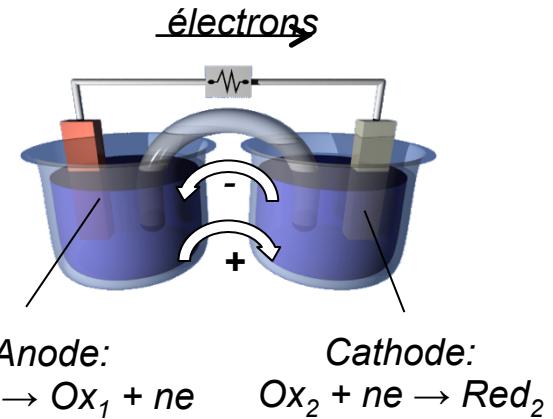
□ L'électron ‘‘chimique’’



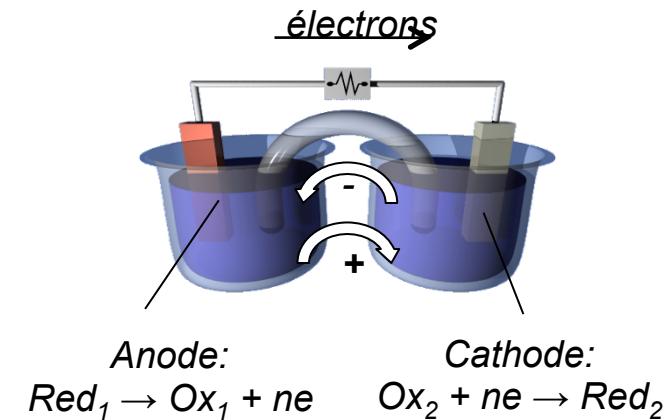
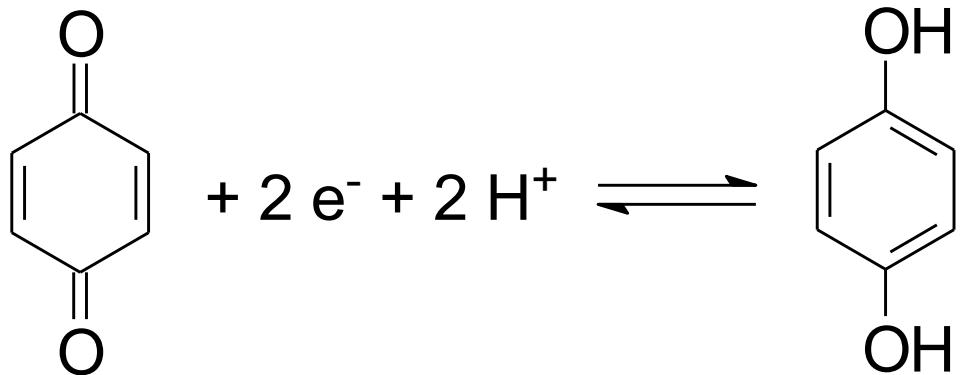
Rouge de Prusse



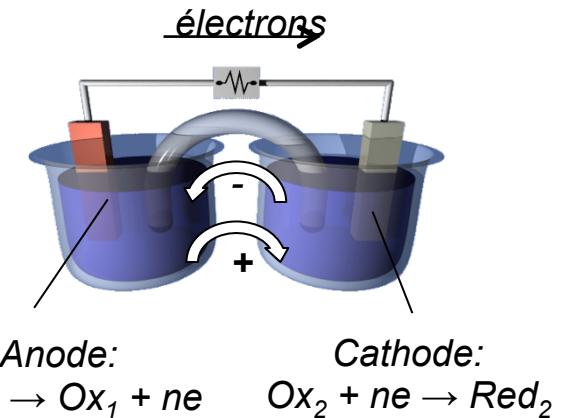
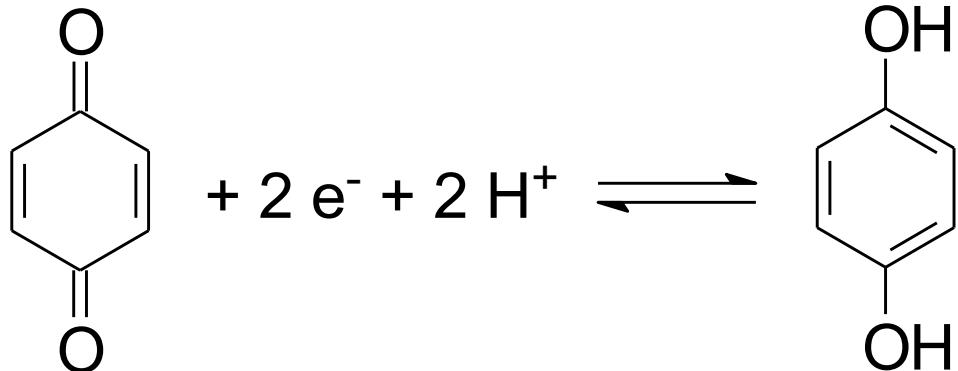
Bleu de Prusse



□ L'électron "chimique":
"transmutation" des propriétés chimiques

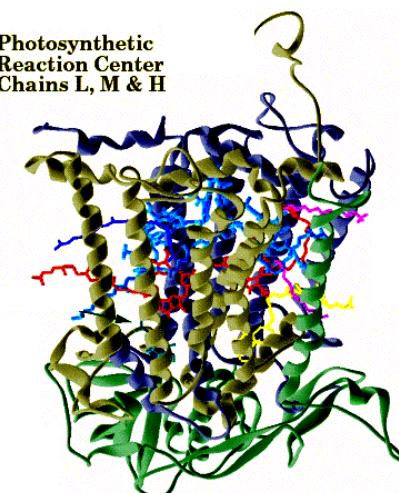
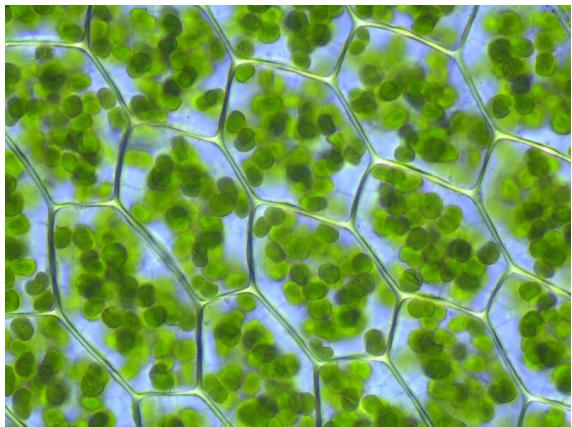
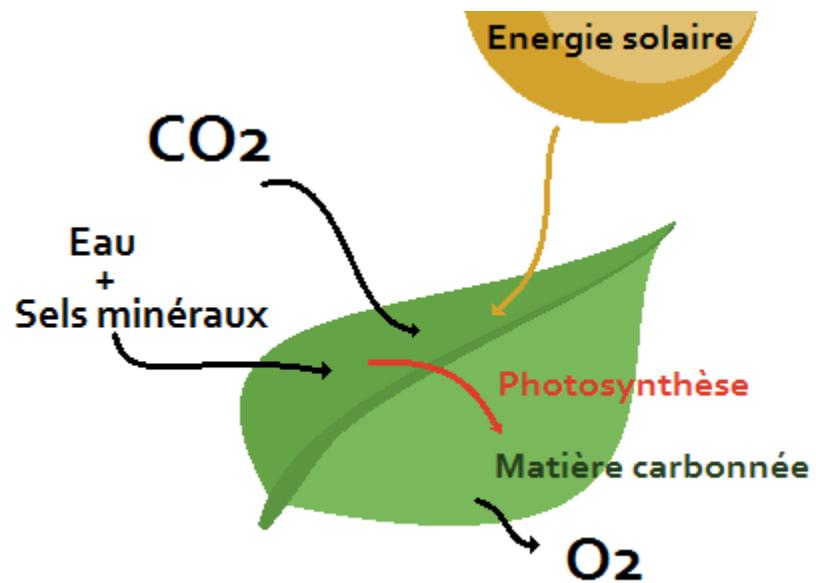


□ L'électron ‘‘chimique’’: ‘‘transmutation’’ des propriétés chimiques

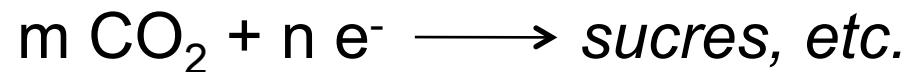
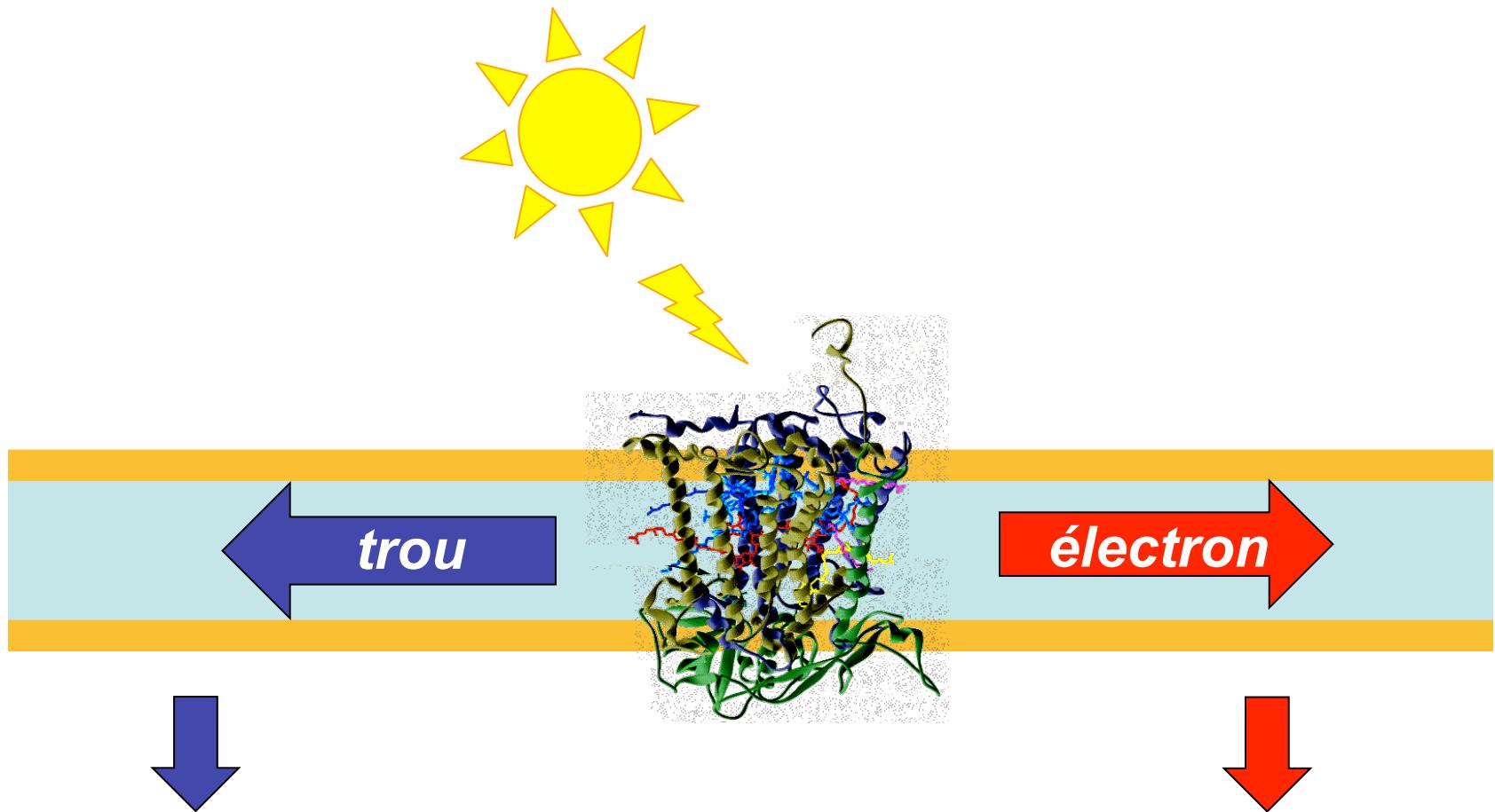


Point de vue du Gras (1826)
Première photographie par Nicéphore Niépce

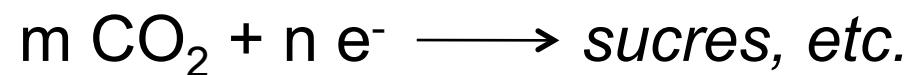
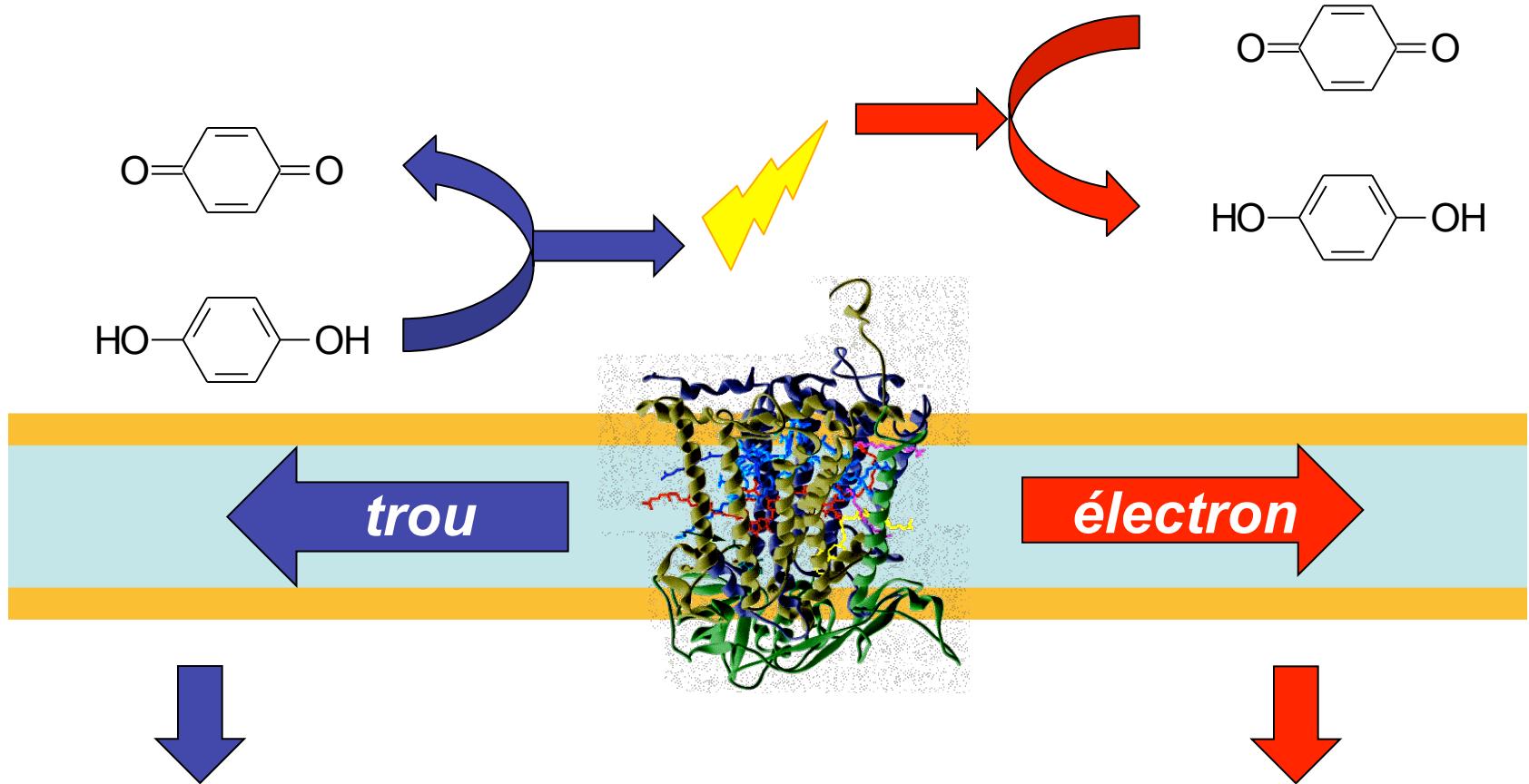
□ L'électron et la vie: la photosynthèse



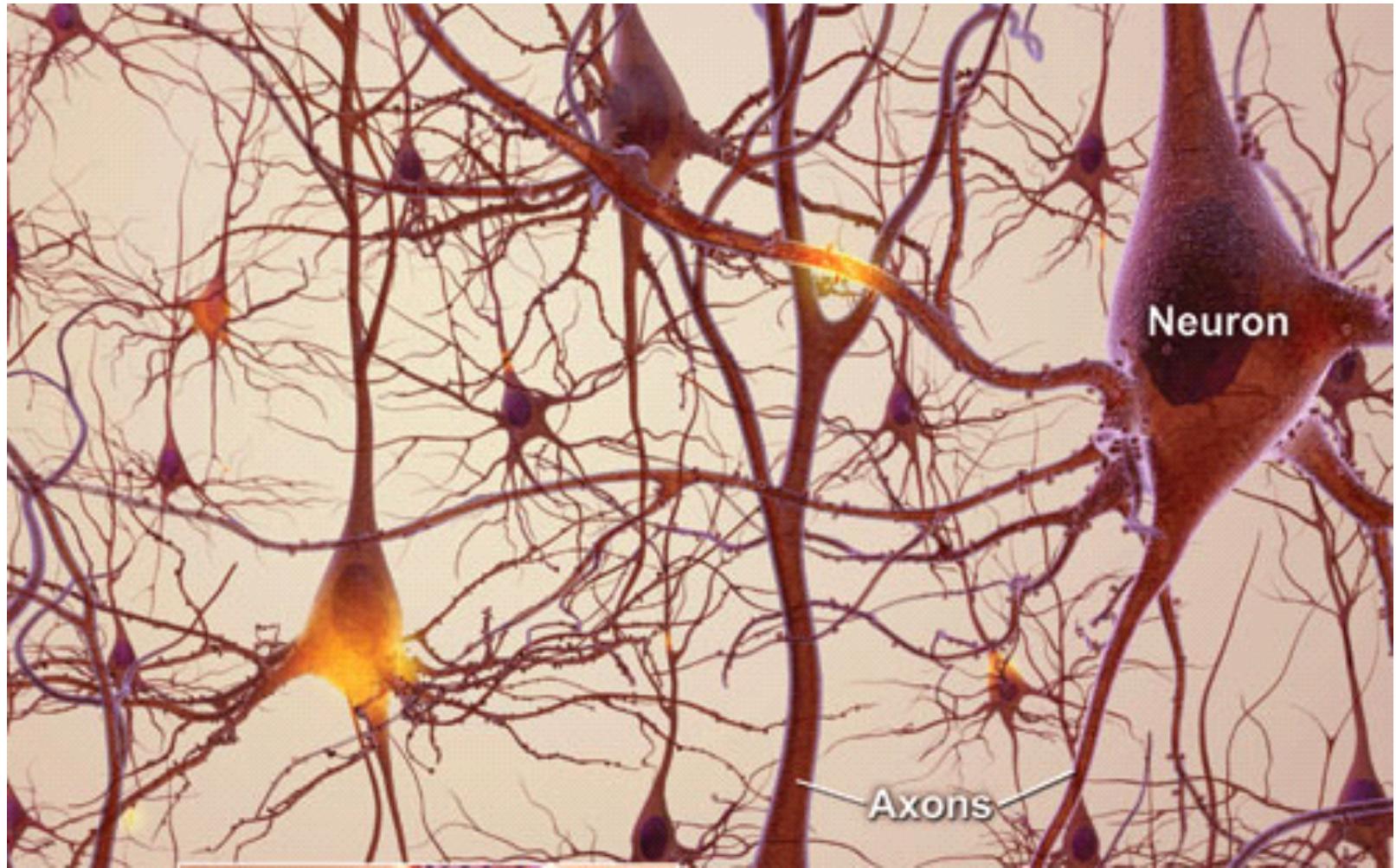
□ L'électron et la vie: la photosynthèse



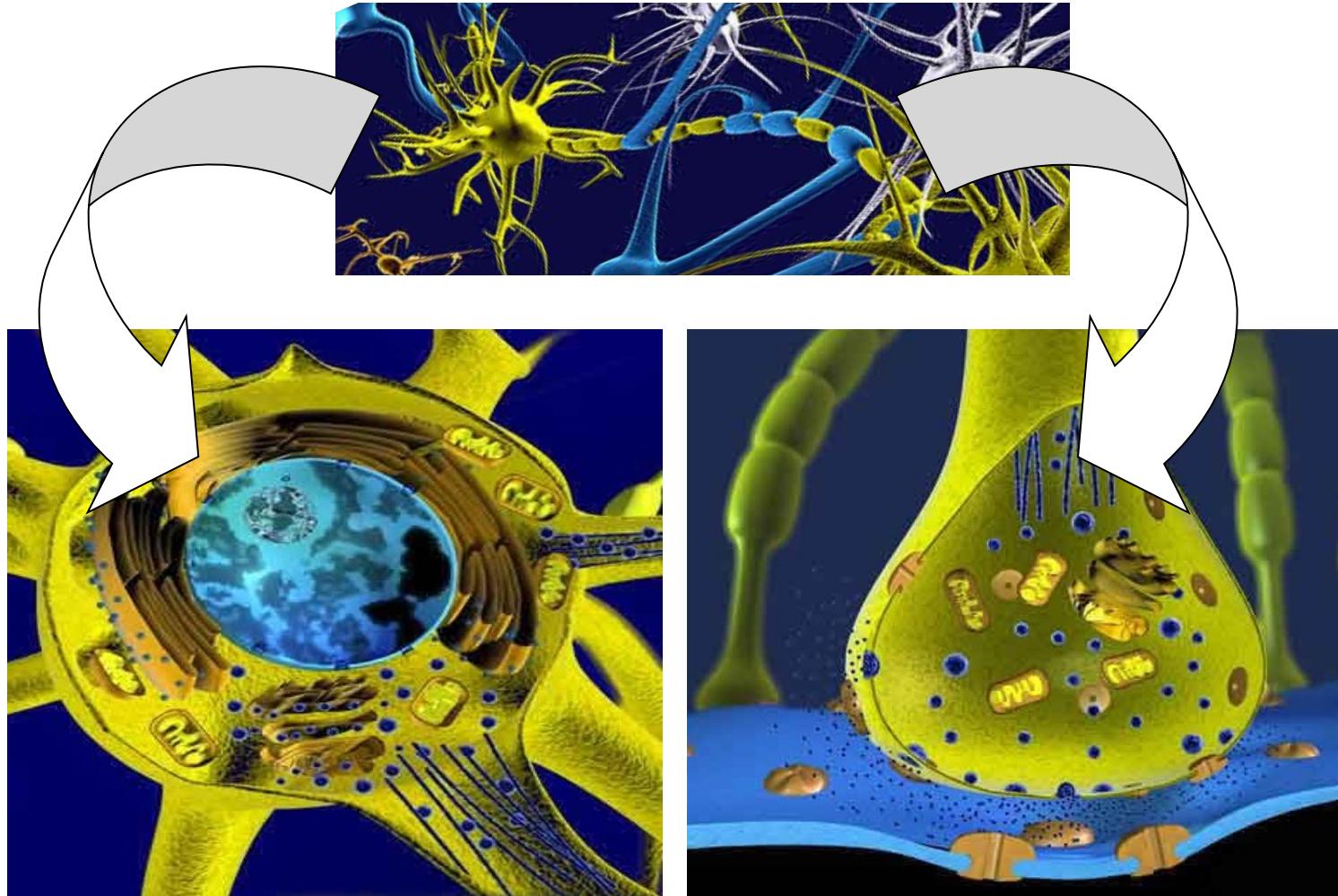
□ L'électron et la vie: la photosynthèse



□ L'electron et la vie: mesure des flux de neurotransmetteurs

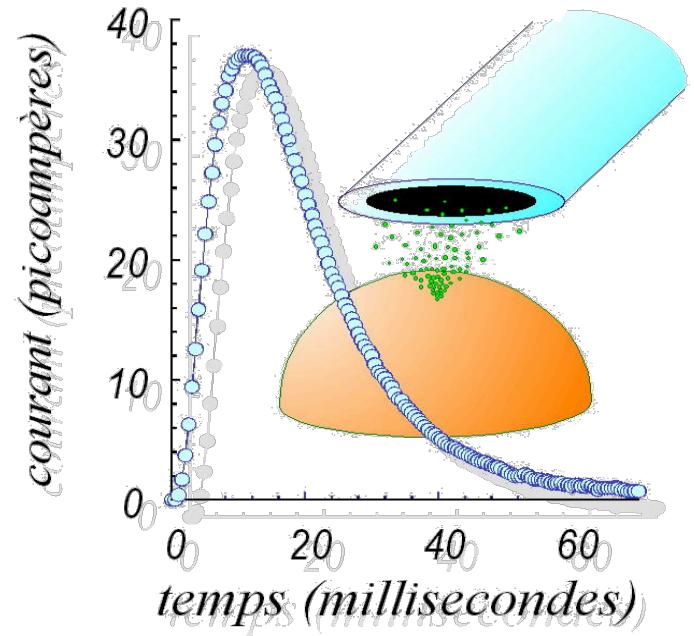
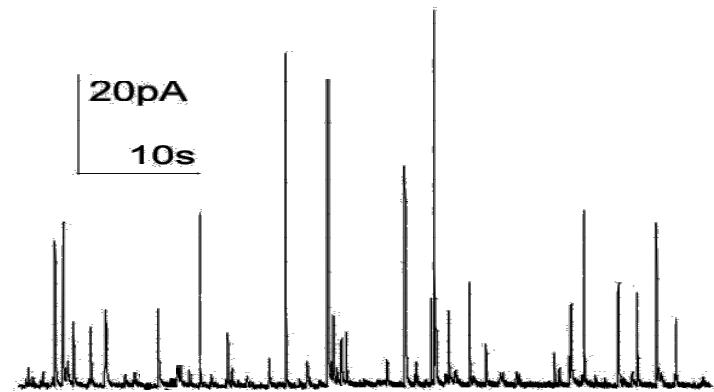
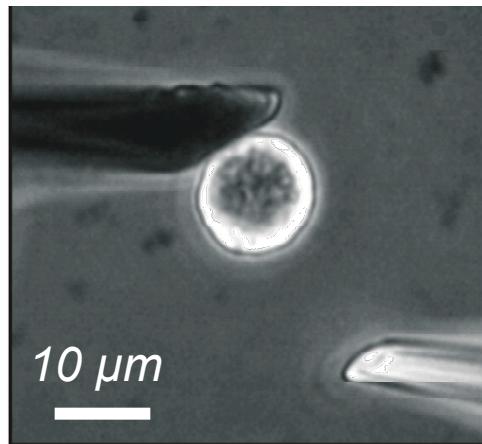
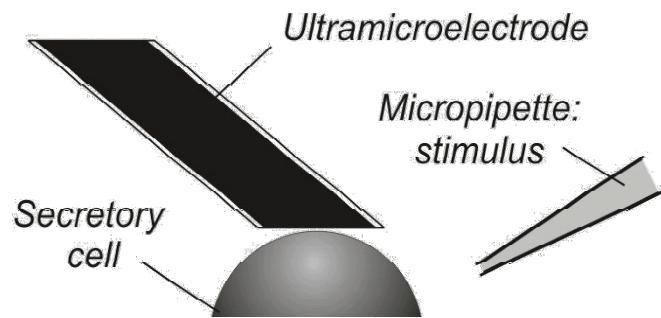
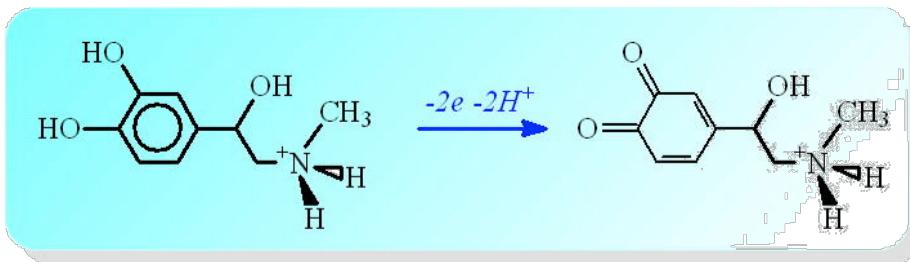


□ L'électron et la vie: mesure des flux de neurotransmetteurs

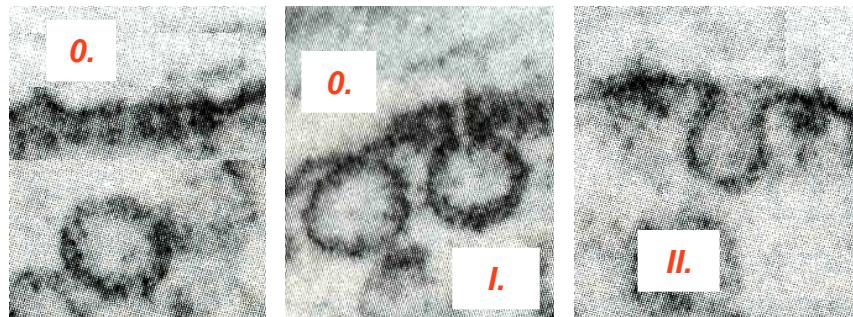
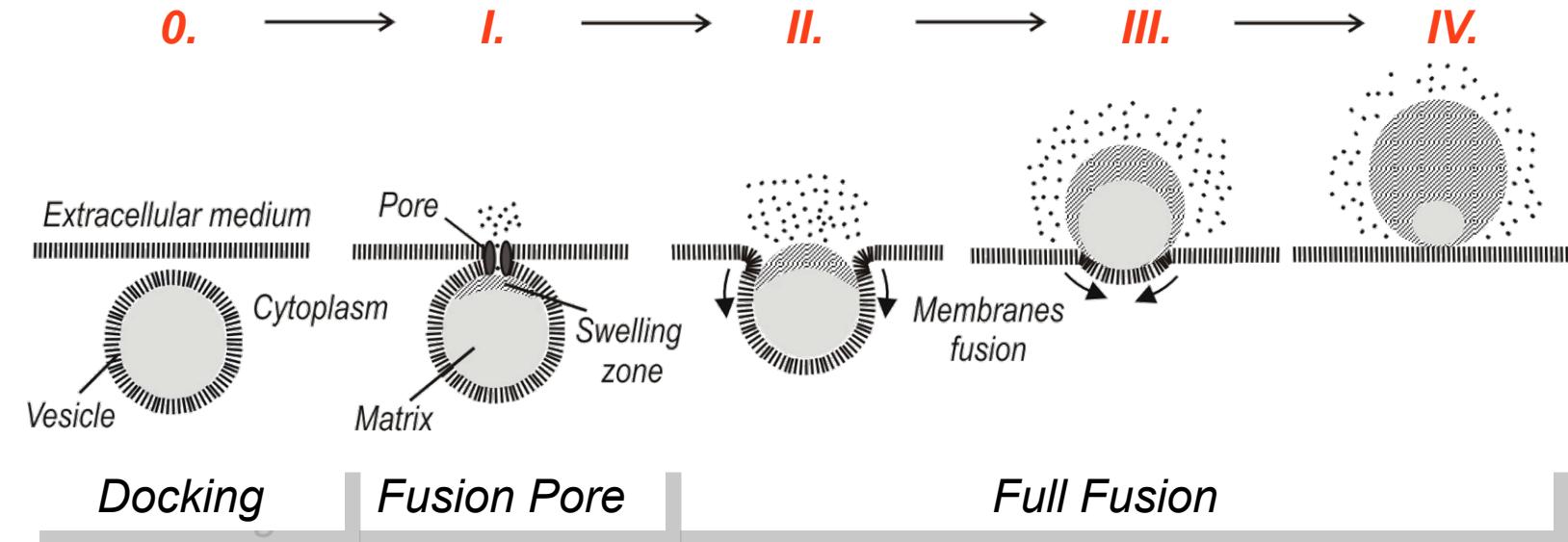


Adapted from: <http://www.abcam/neuroscience/>

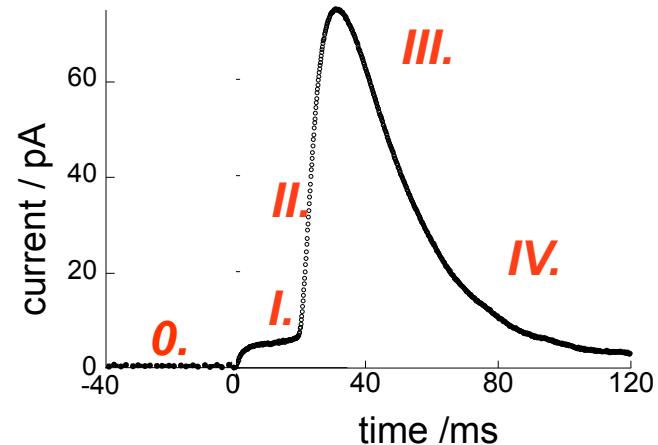
□ L'électron et la vie: mesure des flux de neurotransmetteurs



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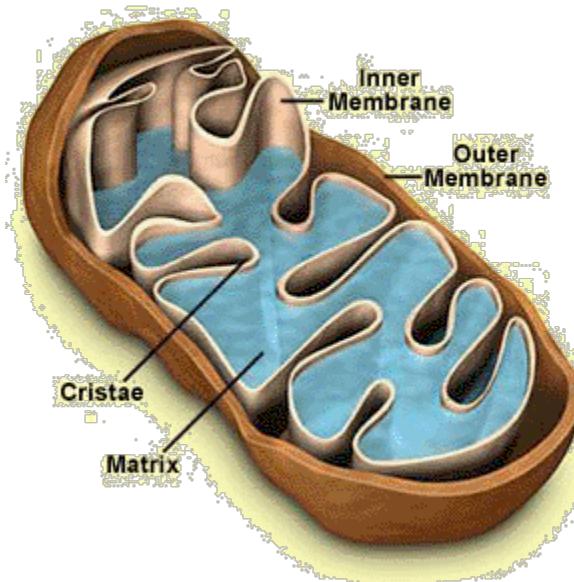
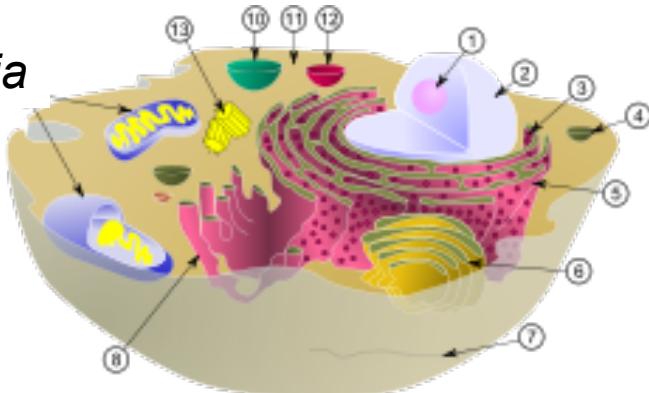


Photographs adapted from:
R. Fesce et al., Trends Cell Biol., 4, 1994, 1-4



□ L'electron et la vie: Radicaux libres

Mitochondria

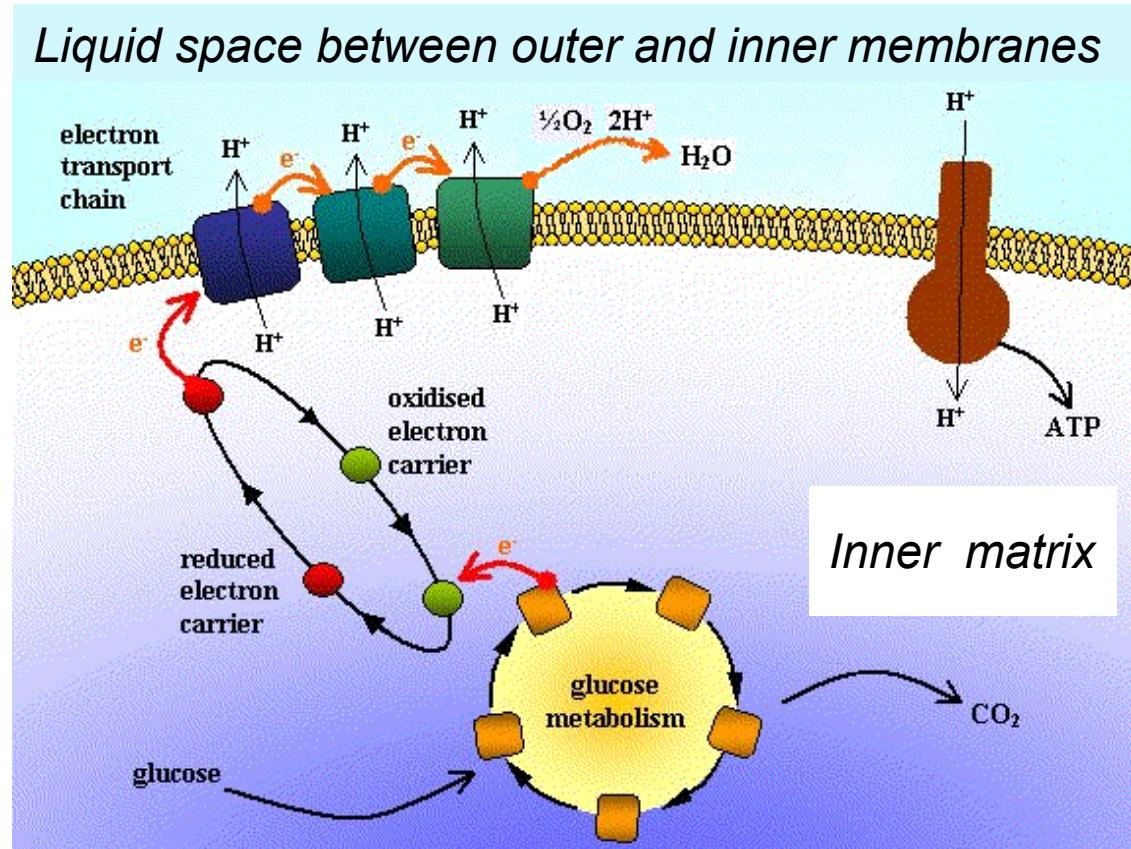
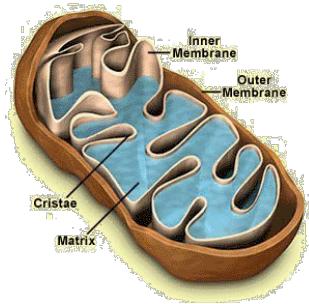


Mitochondria produce energy (stored as ATP from ADP). In animal cells:

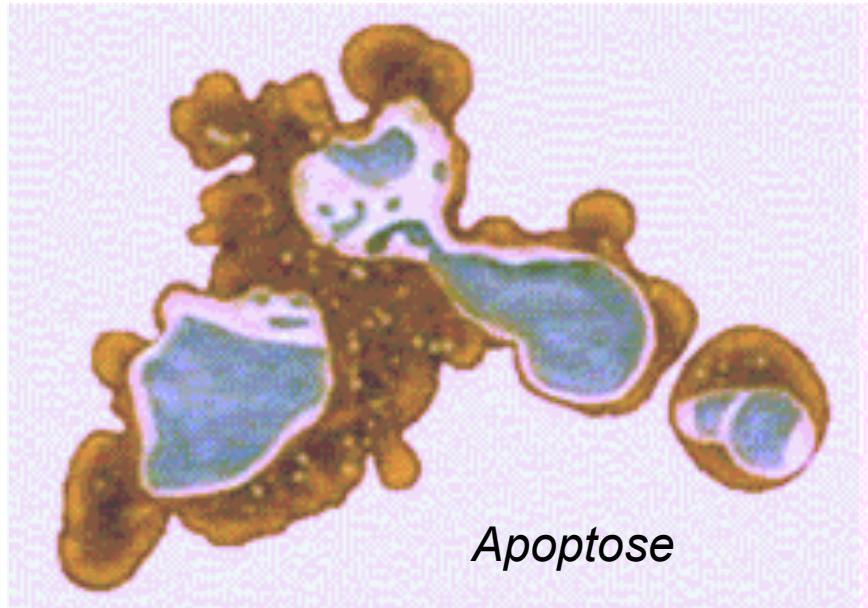
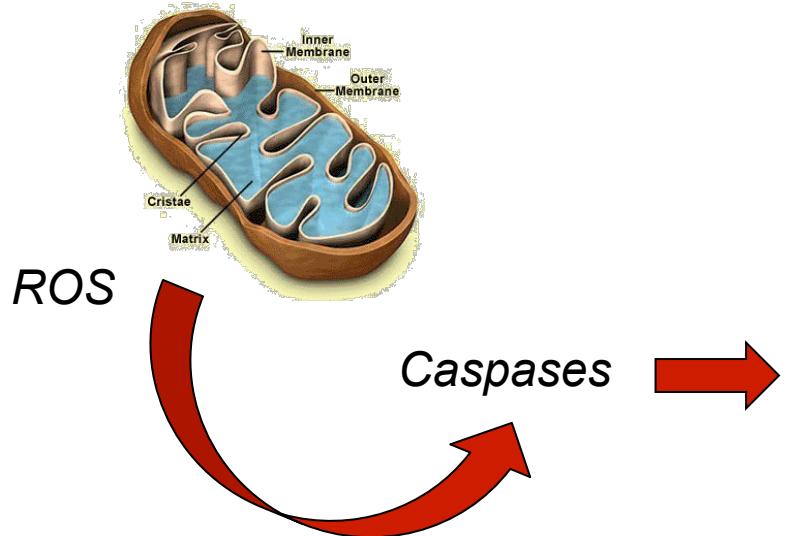


(where n varies up to 36 according to the mitochondria status)

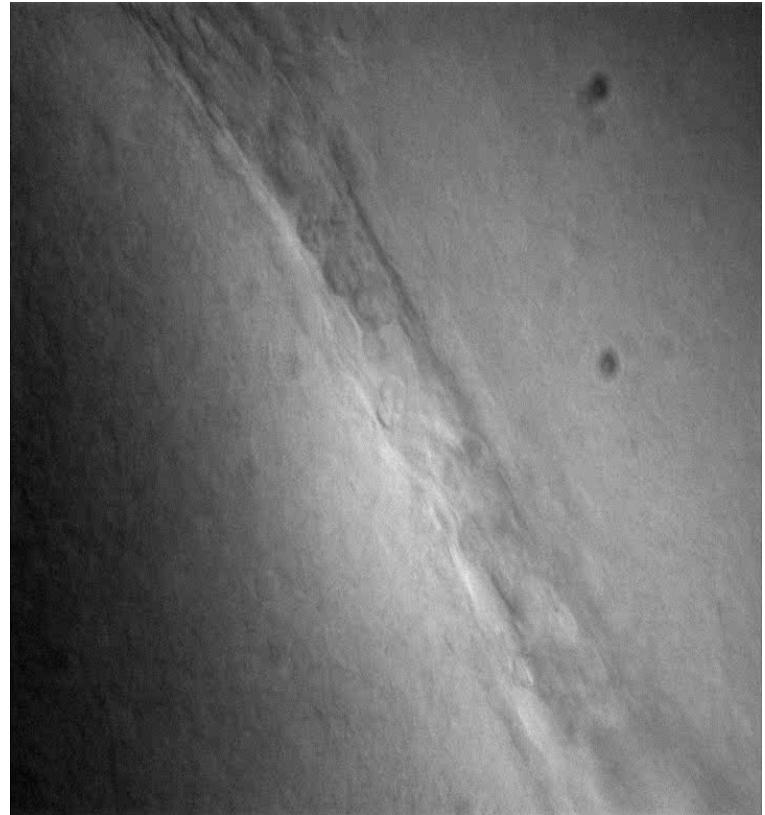
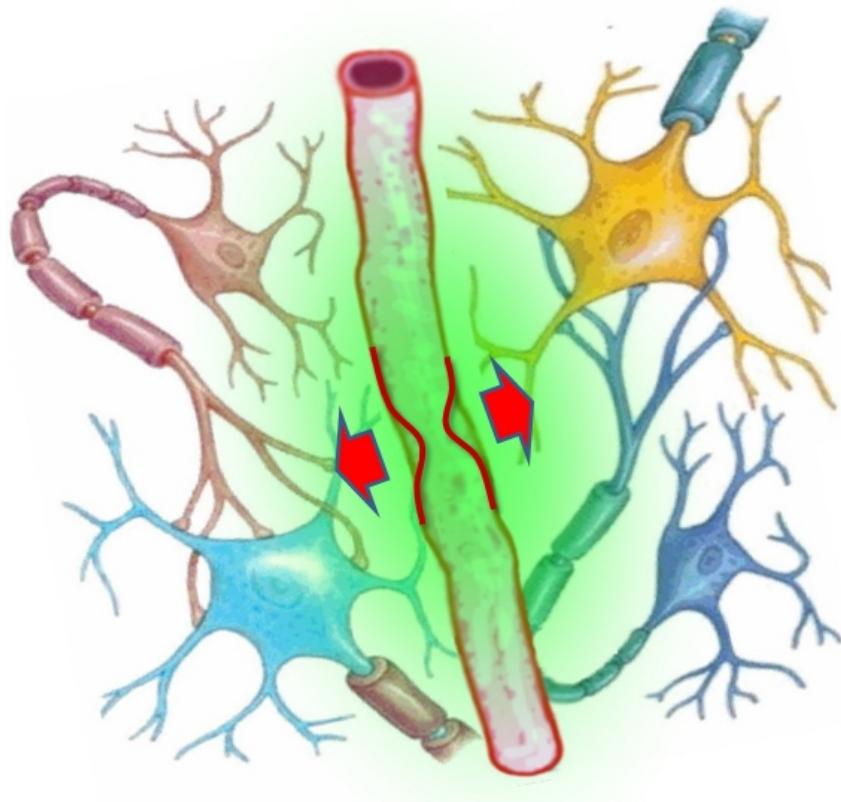
□ L'electron et la vie: Radicaux libres



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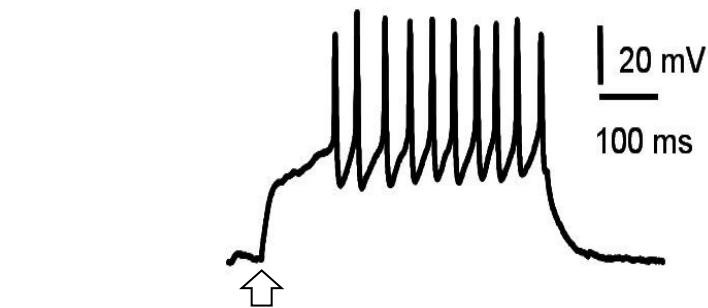
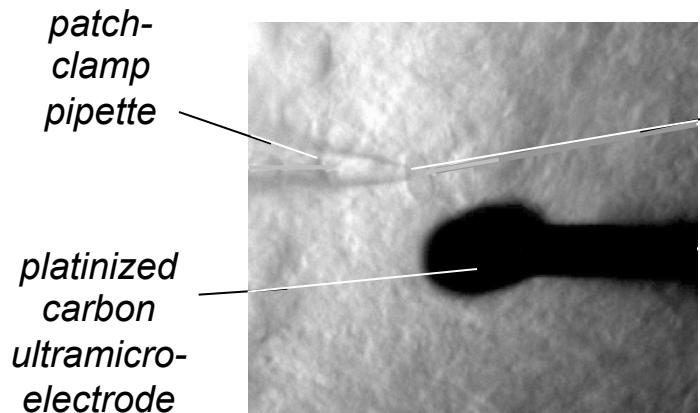
Rat Brain Slice 300 μ m.

C. Amatore, S. Arbault, Y. Bouret, B. Cauli, M. Guille, A. Rancillac, J. Rossier. *ChemPhysChem*, 7, 2006, 181-187.
A. Rancillac, M. Guille, X.-K. Tong, H. Geoffroy, E. Hamel, C. Amatore, S. Arbault, J. Rossier, B. Cauli. *J. Neuroscience*, 26, 2006, 6997-7006.

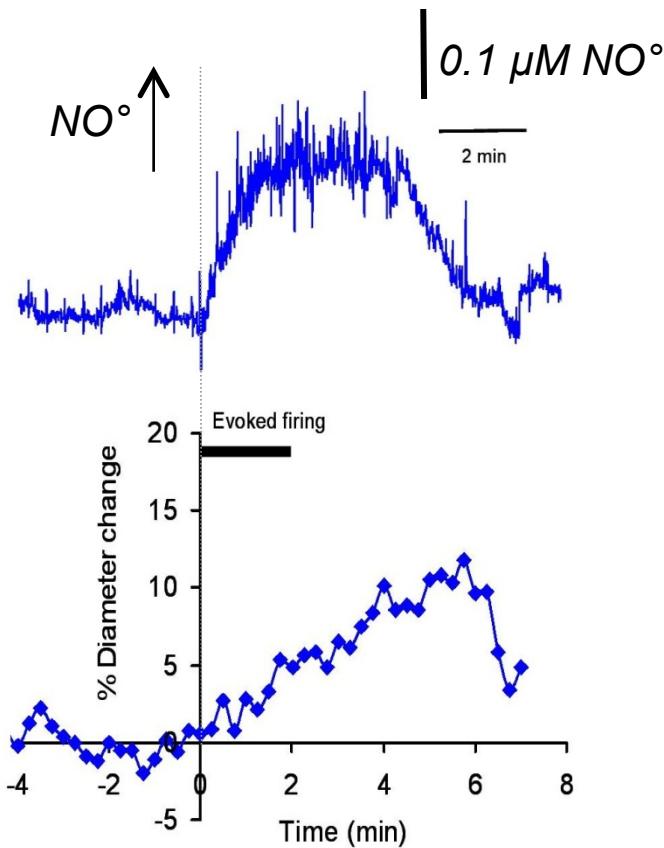
□ L'electron et la vie: Radicaux libres



Action Potential Firing



NO° Release and Vessel Dilatation



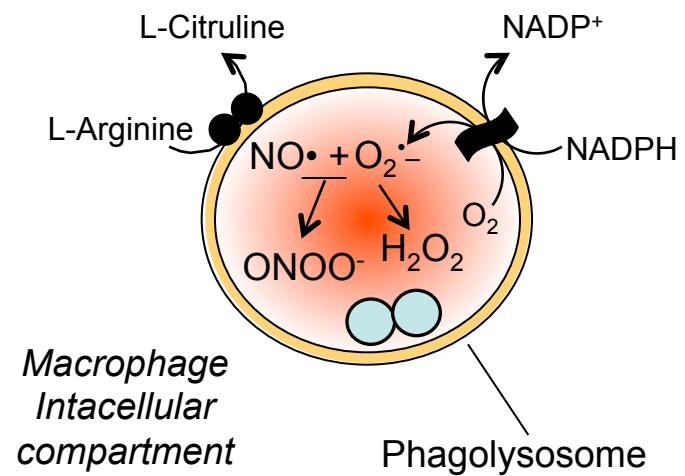
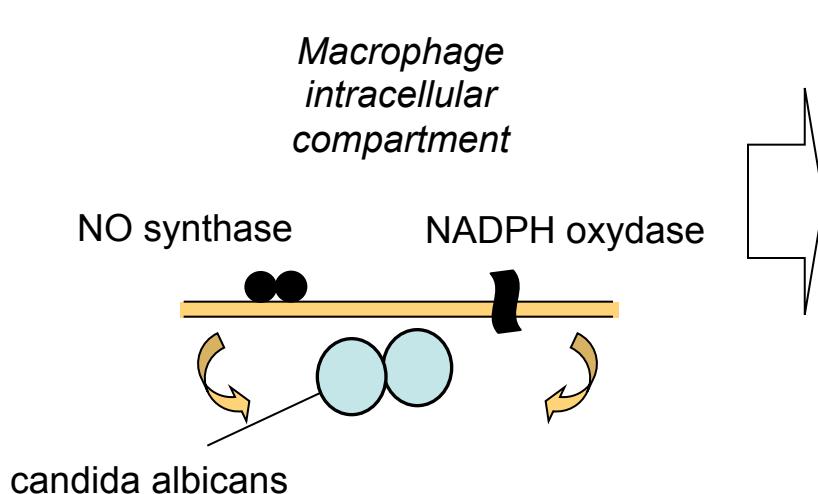
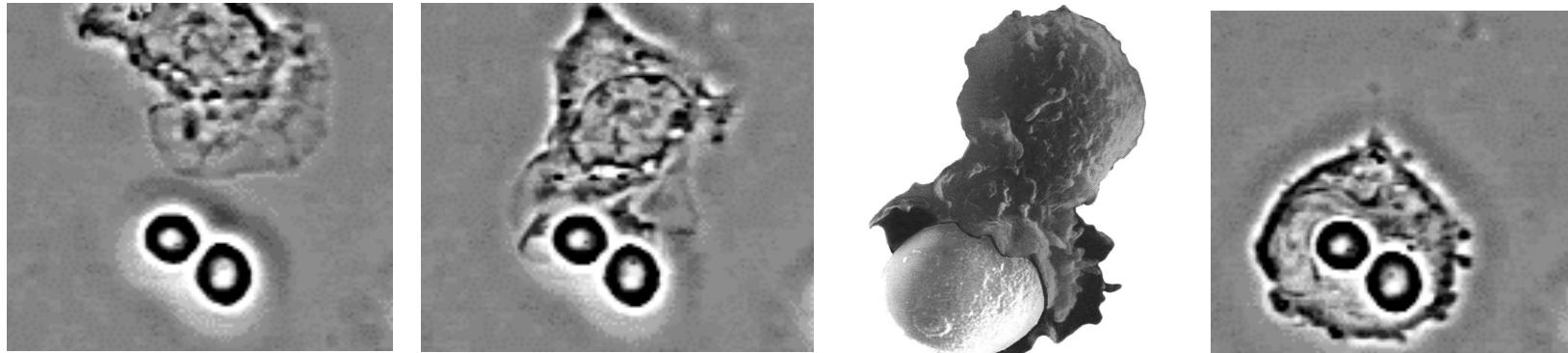
Electrophysiological Stimulation with Patch-Clamping of Single Neuron

Rat Brain Slice 300μm; detection of NO[°] at 0.65 V vs SSCE.

C. Amatore, S. Arbault, Y. Bouret, B. Cauli, M. Guille, A. Rancillac, J. Rossier. *ChemPhysChem*, 7, 2006, 181-187.

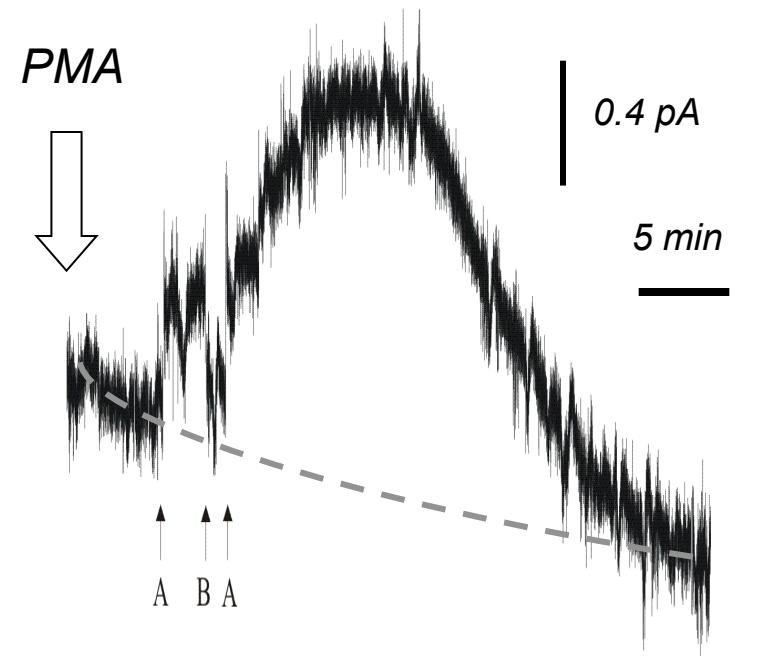
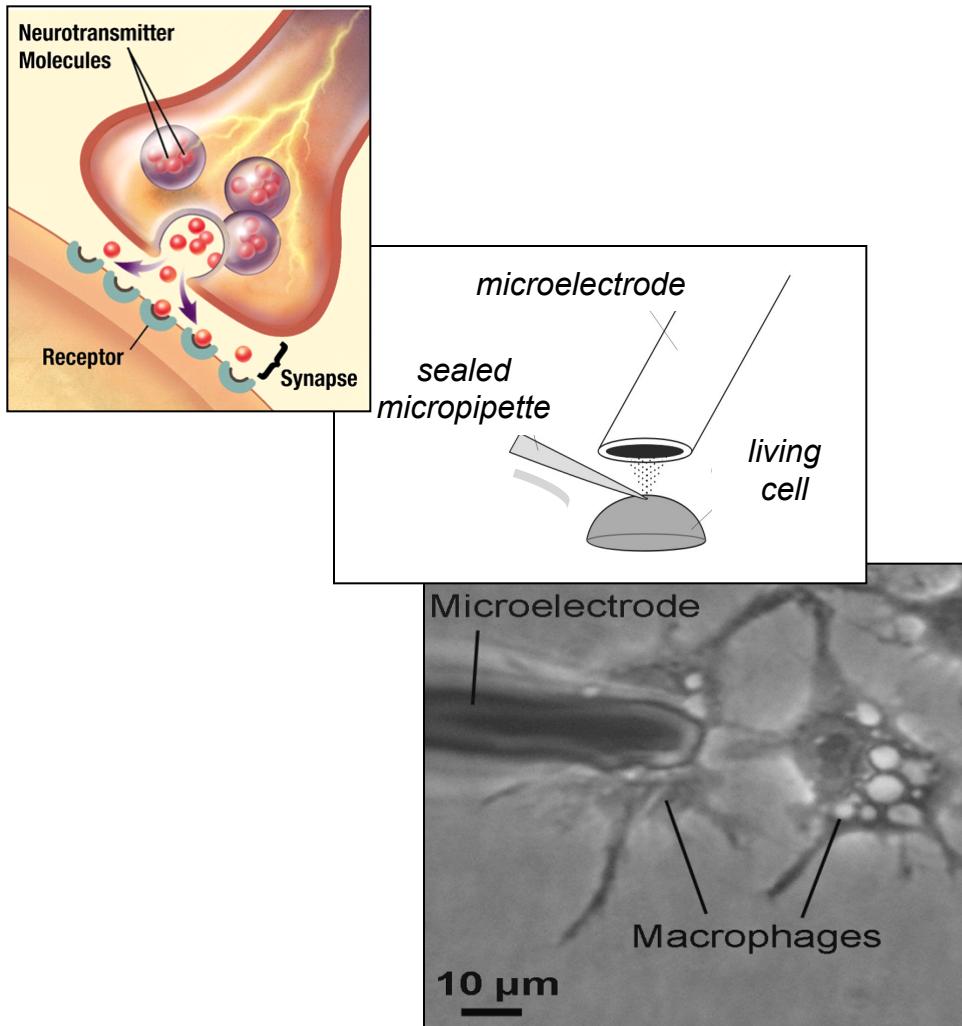
A. Rancillac, M. Guille, X.-K. Tong, H. Geoffroy, E. Hamel, C. Amatore, S. Arbault, J. Rossier, B. Cauli. *J. Neuroscience*, 26, 2006, 6997-7006.

□ L'électron et la vie: Radicaux libres



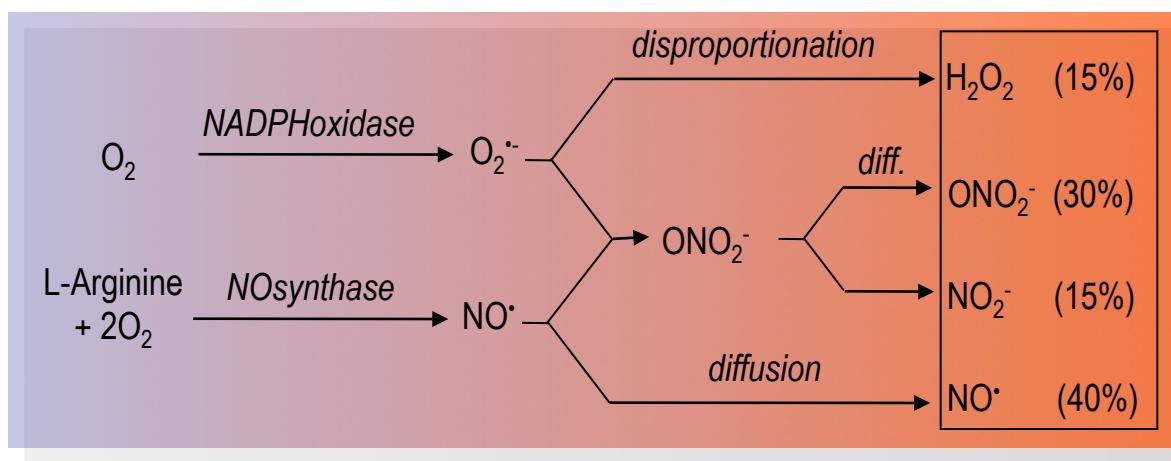
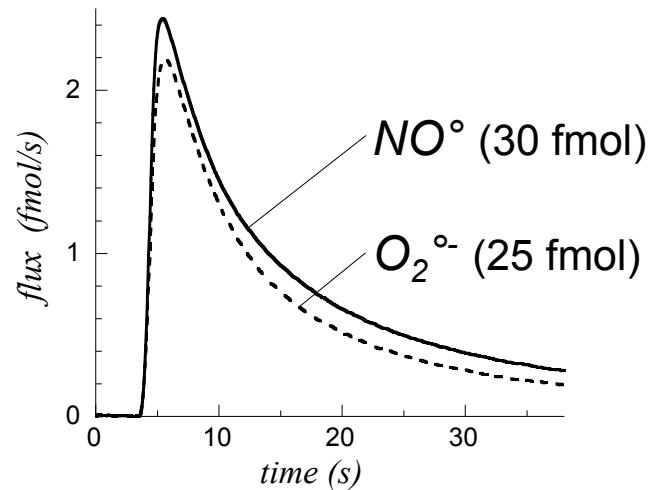
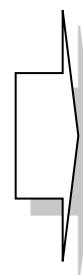
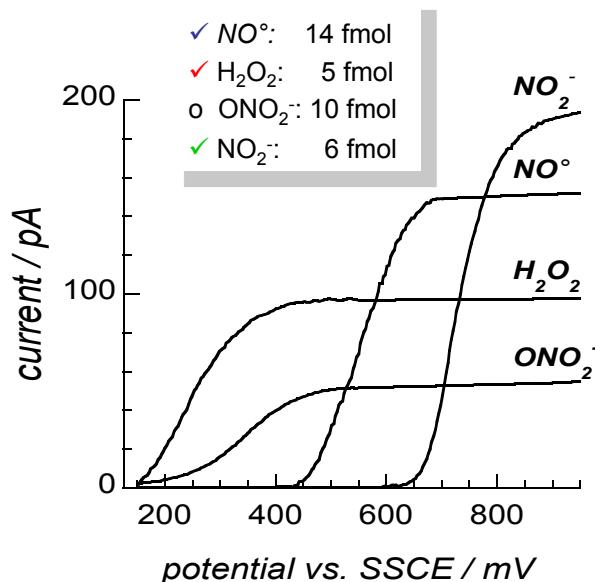
Photographs adapted from www.cellsalive.com. © James A. Sullivan

□ L'electron et la vie: Radicaux libres

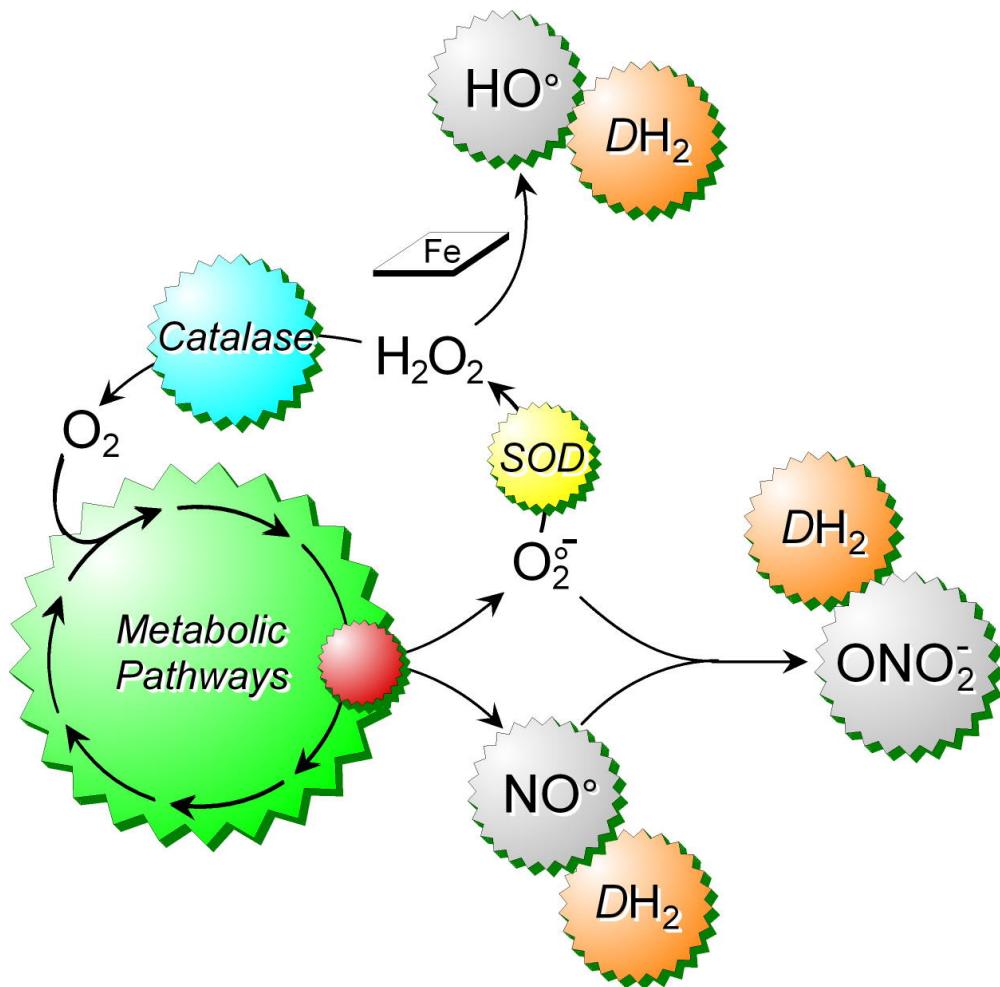


PMA: phorbol 12-myristate 13-acetate
(3 μ M in PBS)

□ L'electron et la vie: Radicaux libres



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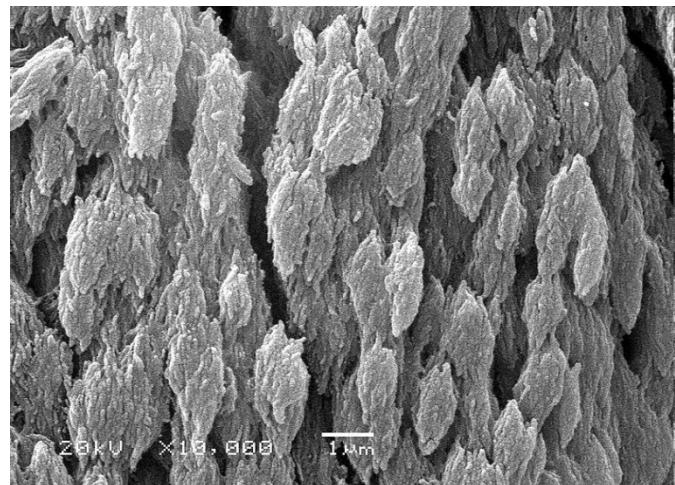
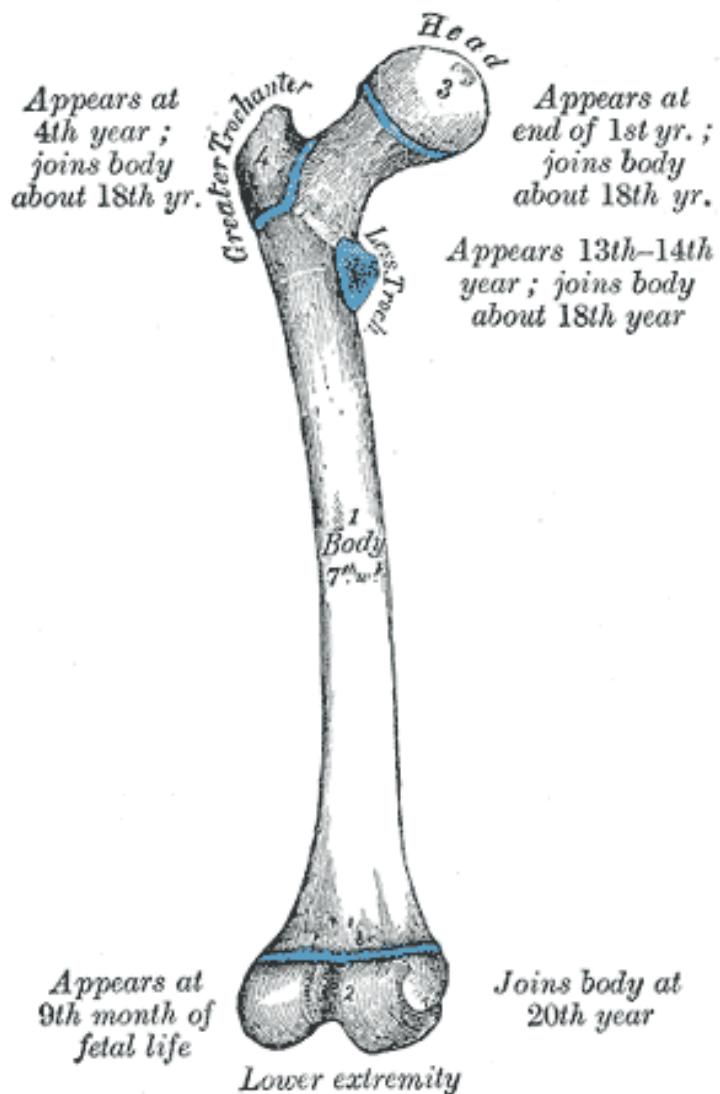


Homéostase

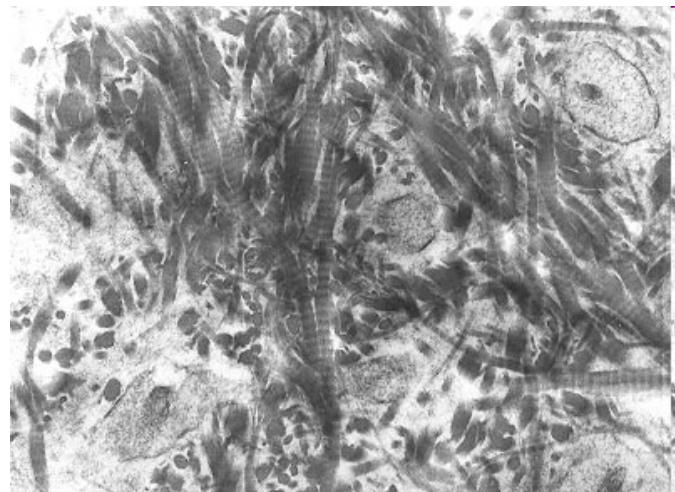
SOD: SuperOxide Dismutase

DH₂: Anti-oxidants, e.g., glutathion, tocophérol, phénols, tanins, vitamin C, etc.

□ L'electron et la vie: Radicaux libres et os

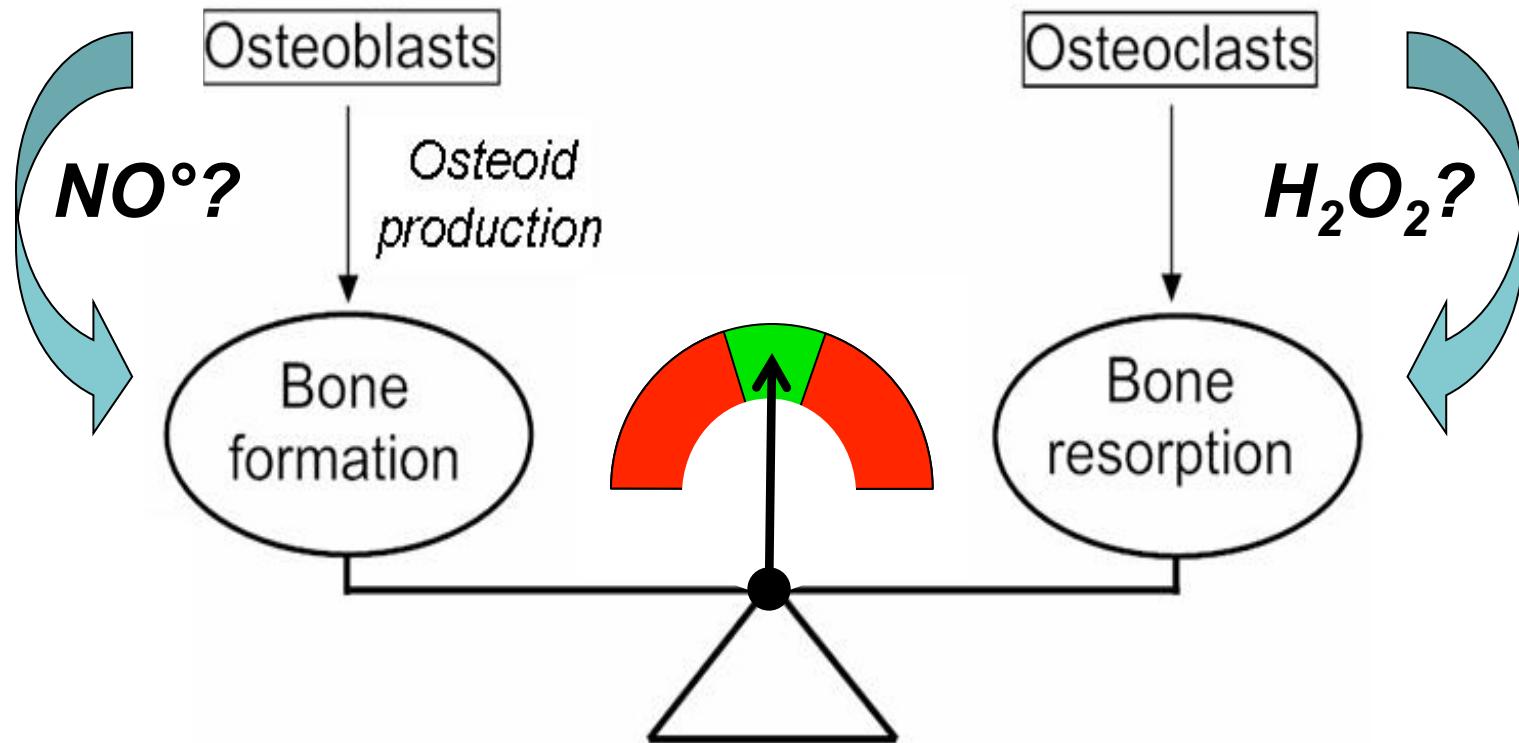


SEM of Bone mineral matrix

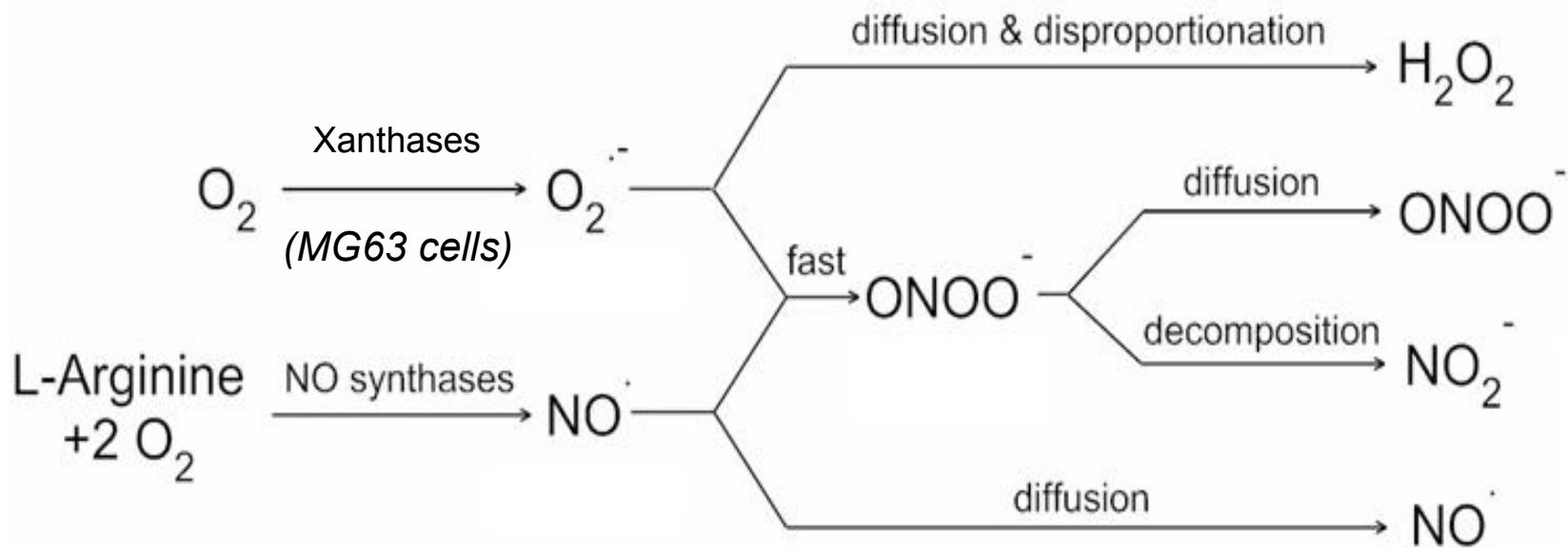
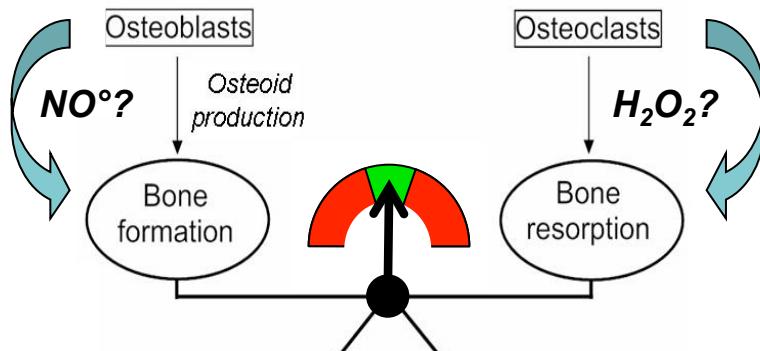


*Collagen fibers, cells and mineral matrix
« woven » in bone*

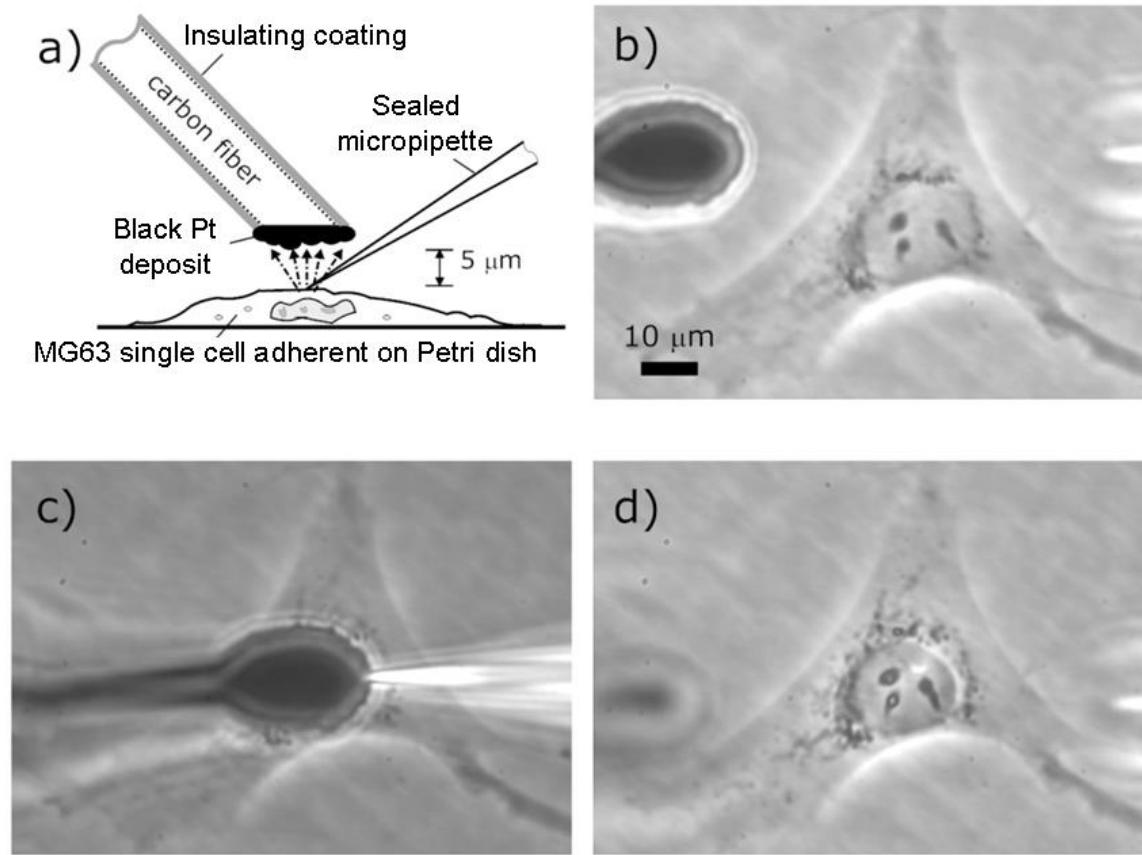
□ L'electron et la vie: Radicaux libres et os



□ L'électron et la vie: Radicaux libres et os

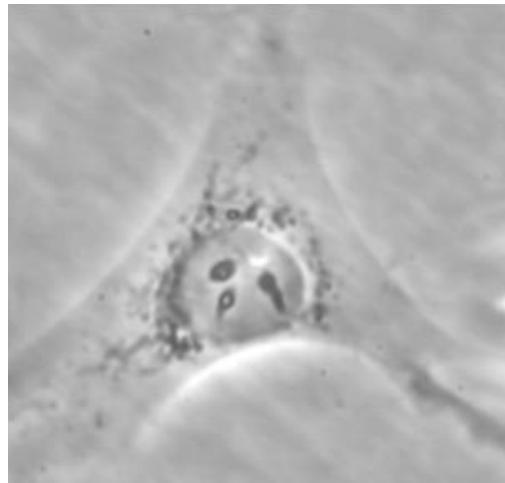
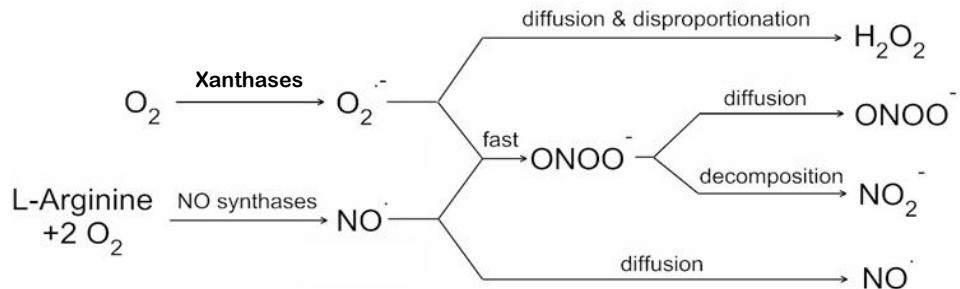
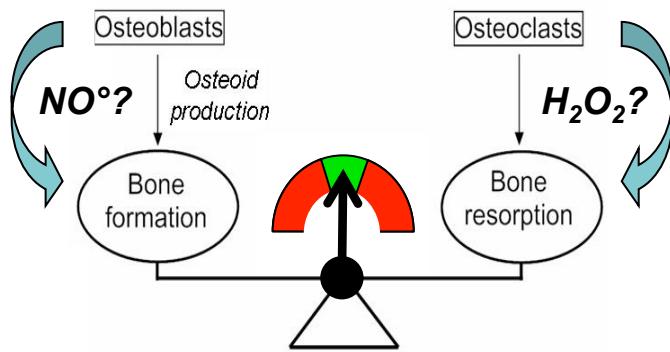


□ L'electron et la vie: Radicaux libres et os



(a) Schematic view of the “artificial synapse” configuration and of the micropipette sealed tip used to induce a brief mechanical stress onto an adherent single MG63 osteosarcoma cell. (b-d) Optical microphotographs illustrating different phases of the experimental protocol

□ L'electron et la vie: Radicaux libres et os



MG63 osteosarcoma cell

o *Composition of Average Efflux:*

2 fmol of H_2O_2

6 fmol of $\text{ONOO}^{\cdot-}$

17 fmol of NO^{\cdot}

5 fmol of NO_2^-

o *Initial Productions by Enzymatic Pools:*

NO^{\cdot} (28 fmol) > $\text{O}_2^{\cdot-}$ (13 fmol)

Remerciements

□ ENS:

- ❖ ***Dr Stéphane ARBAULT***
- ❖ Dr Yuehong TONG
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- ❖ Dr Manon GUILLE
- ❖ Dr Frédéric LEMAÎTRE
- ❖ Dr Issa TAPSOBA

□ Collaborations:

- ESPCI (CNRS, Paris):
 - ❖ ***Prof Jean ROSSIER***
 - ❖ Dr. Anabelle RANCILLAC
 - ❖ Dr. Bernard CAULI

□ Collaborations (cont^d):

- Kharkov (KNURE) :
 - ❖ ***Prof Irina B SVIR***
 - ❖ Dr. Alexander OLEINIK
 - ❖ Dr. Oleksiy KLYMENKO
- University of Xiamen:
 - ❖ Prof Zhong-Qun TIAN
 - ❖ ***Prof Chang Jian LIN***
 - ❖ ***Dr Ren HU***
- ENS (UMR Pasteur) :
 - ❖ ***Prof Yong CHEN***
 - ❖ Dr. Cécile CROZATIER

