

TODAY's TOPIC: Metabolism Continued...

Announcements:

Be sure you know where to go for Exam 1 and show up on time because the exam will start promptly (1pm or 3:30pm, depending on your session) and will end after 1.5 hours. *Section 1-5 : 119 Kentchoff (here!)*

*6-10 : 22 Gates*

DKN

Metabolic diversity and cellular strategies (~15 min)

*iClicker Quiz 1*

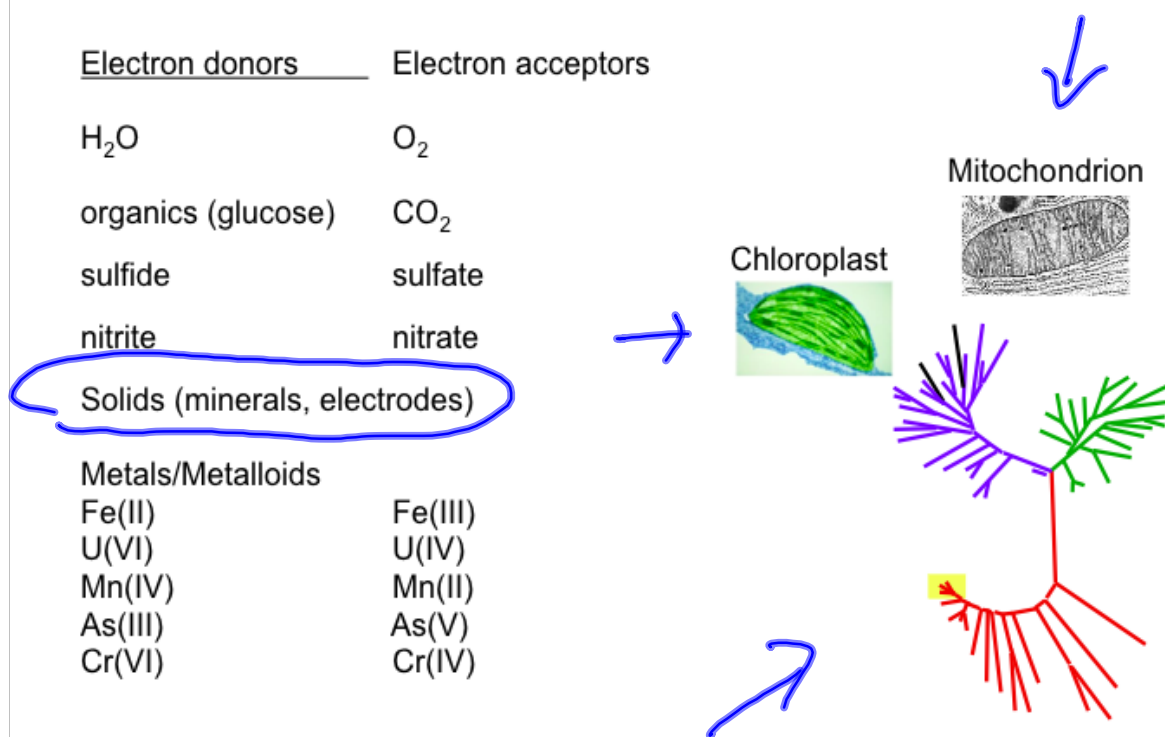
*Short break*

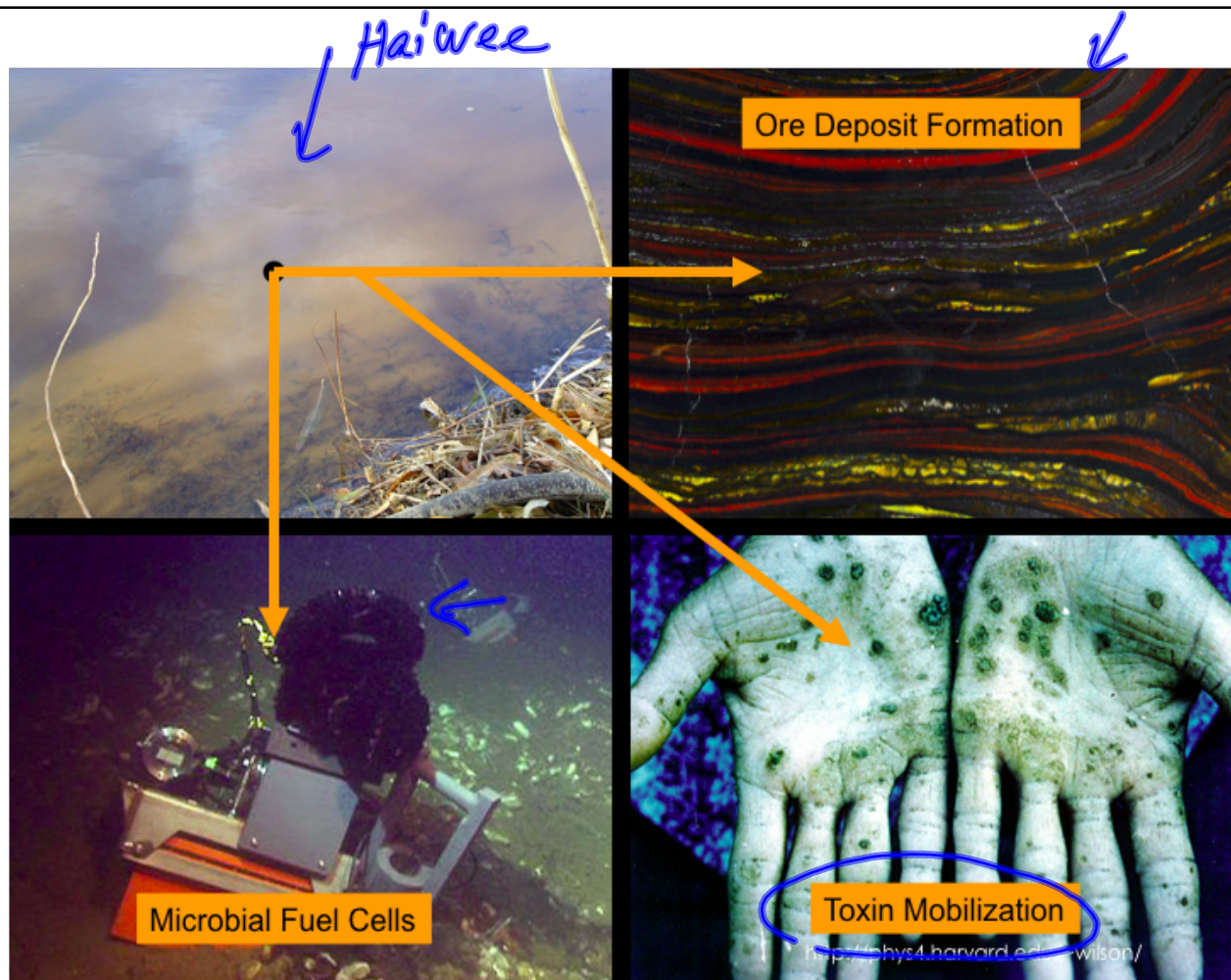
Dr. Nicky Caiazza (Synthetic Biology, San Diego)

Biotech perspective

*iClicker Quiz 2*

When it comes to metabolism, bacteria are the best!





Let's use these relationships to calculate important things:

How large must  $\Delta p$  be to synthesize ATP?

Given:  $\Delta G$  to make ATP = - 50 kJ (for an actively growing cell)

$y = 3$  (recall:  $3H^+$ /ATP in ATP synthase)

$F = 96,000$  C (charge for a mol of a monovalent ion:  $e^-$  or  $H^+$ )

$$\Delta G = yF\Delta p$$

$$\Delta p = \frac{\Delta G}{yF} = -174 \text{ mV}$$

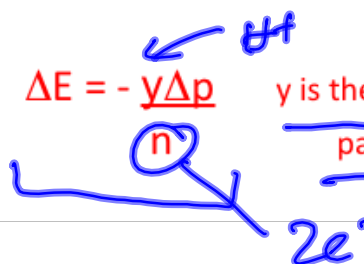
NOTE: most bacteria have  $\Delta p$  between -140 to -200 mV. *Why variation?*  
depends on assumption for  $y$ ,  $\Delta G$

What is the minimum potential difference ( $\Delta E$ ) to sustain this assuming  $2e^-$  are transferred?

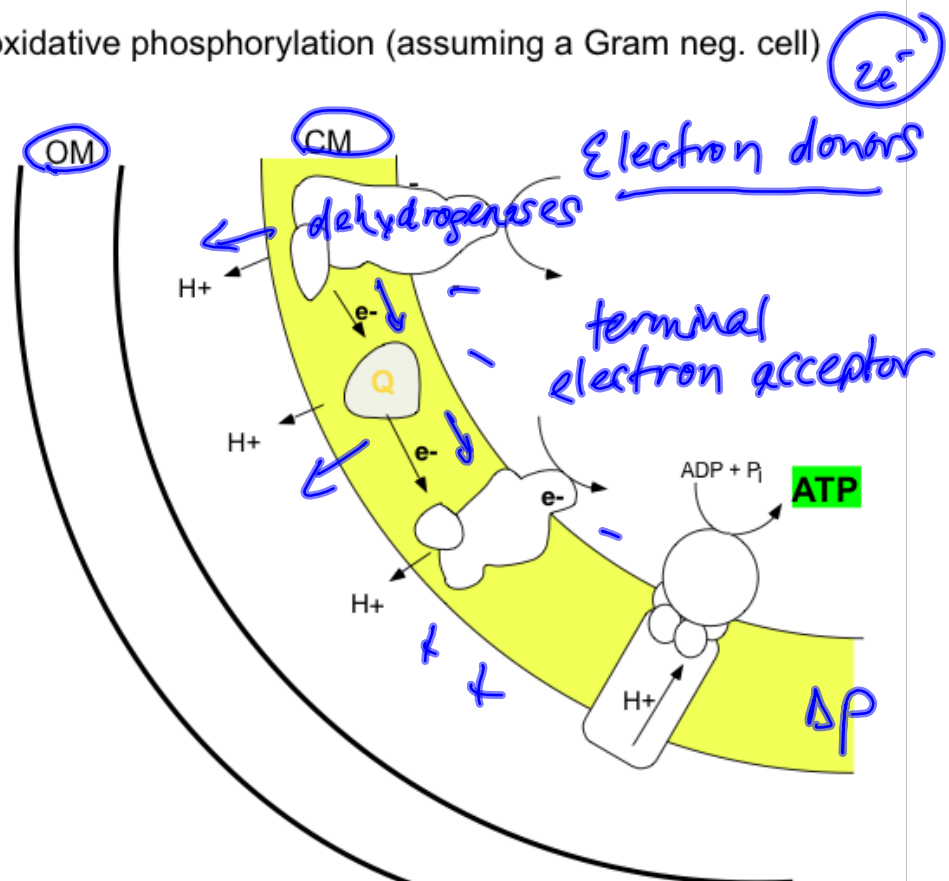
$$-nF\Delta E = yF\Delta p$$

$$\Delta E = -\frac{y\Delta p}{n}$$

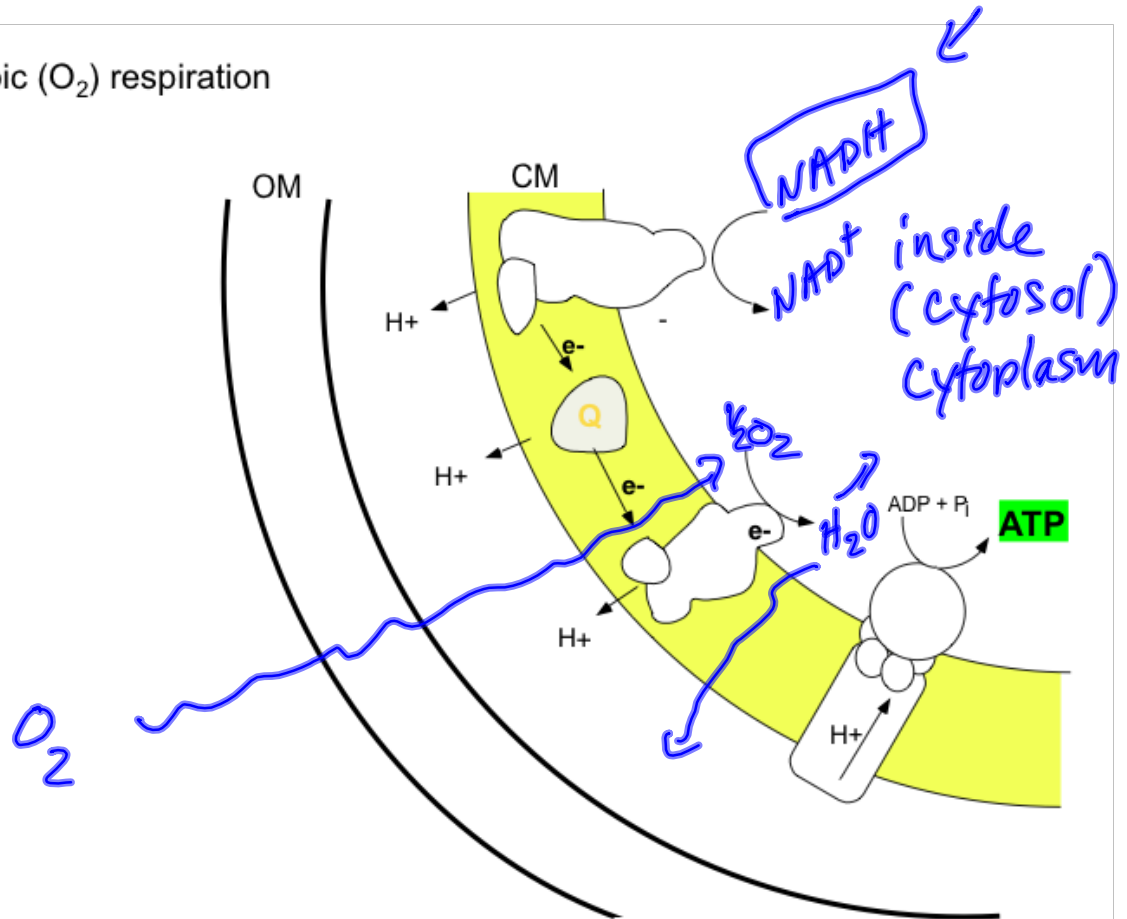
$y$  is the critical tunable parameter!



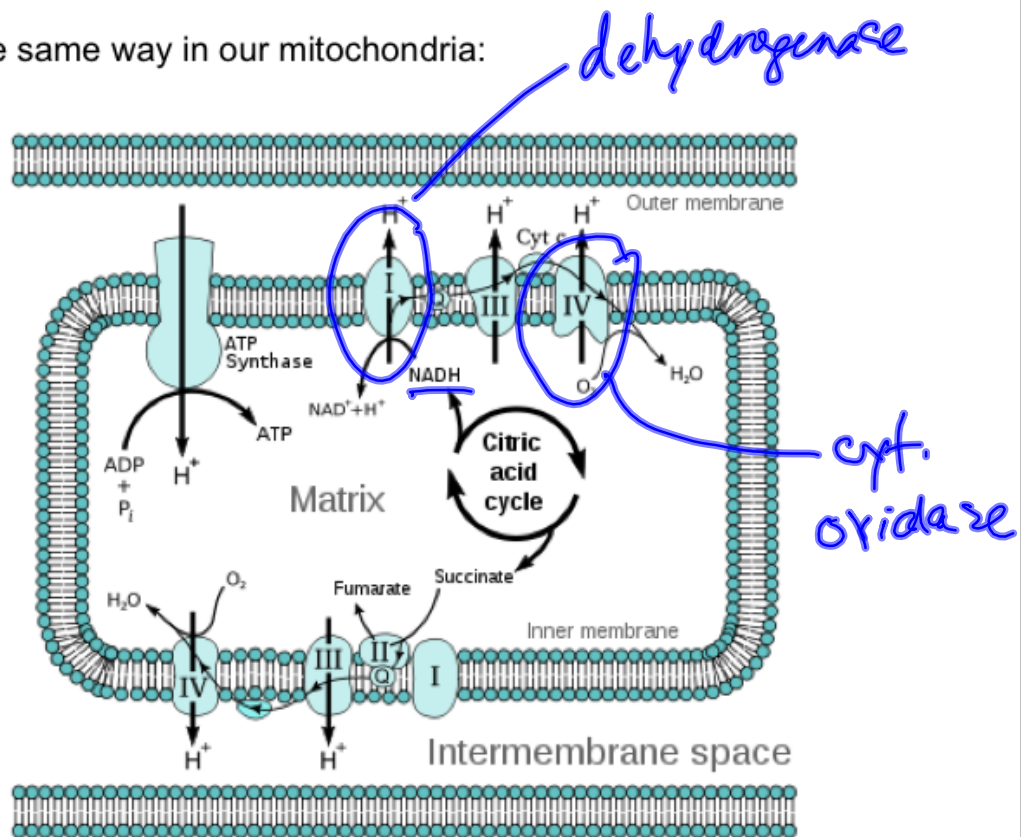
Modular nature of oxidative phosphorylation (assuming a Gram neg. cell)



# Aerobic ( $O_2$ ) respiration

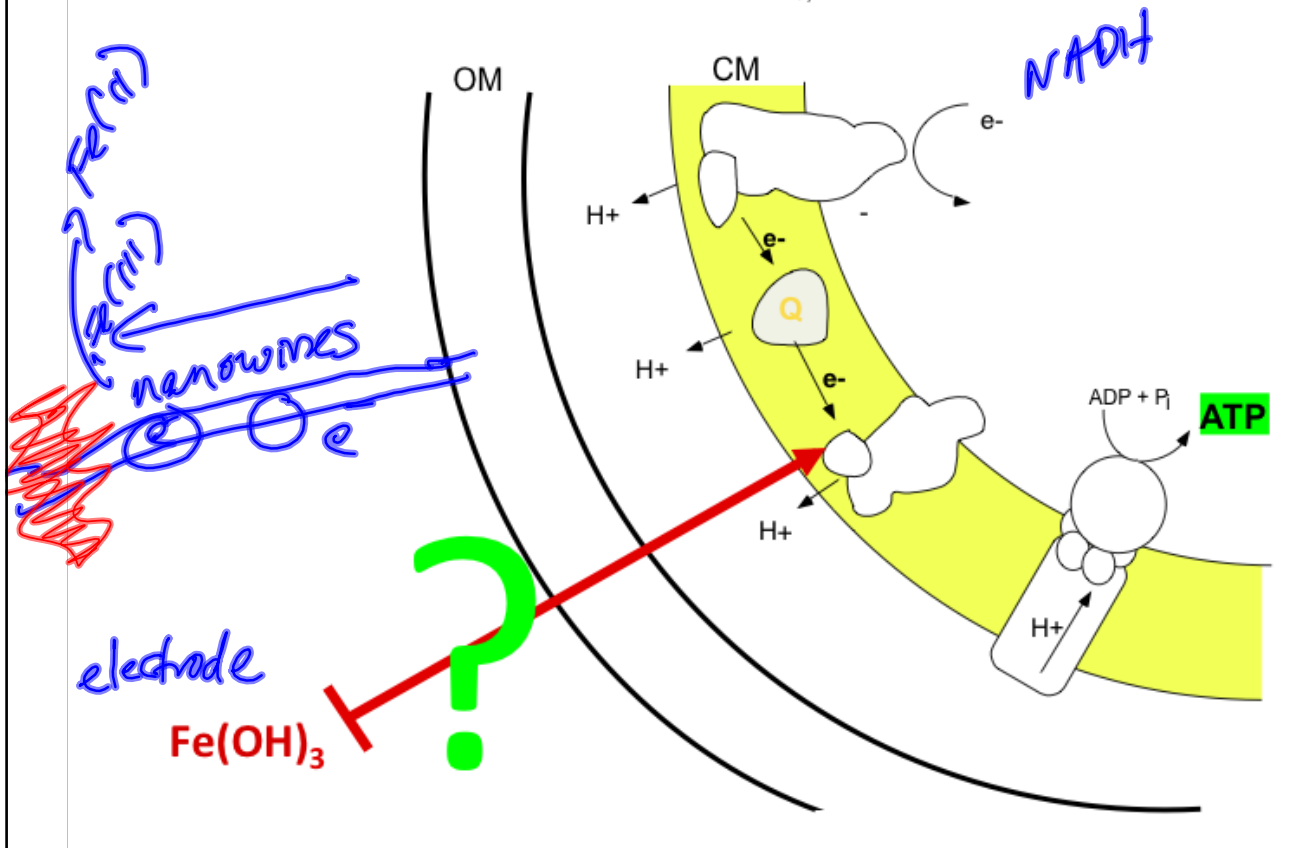


It works the same way in our mitochondria:



Wikipedia graphic

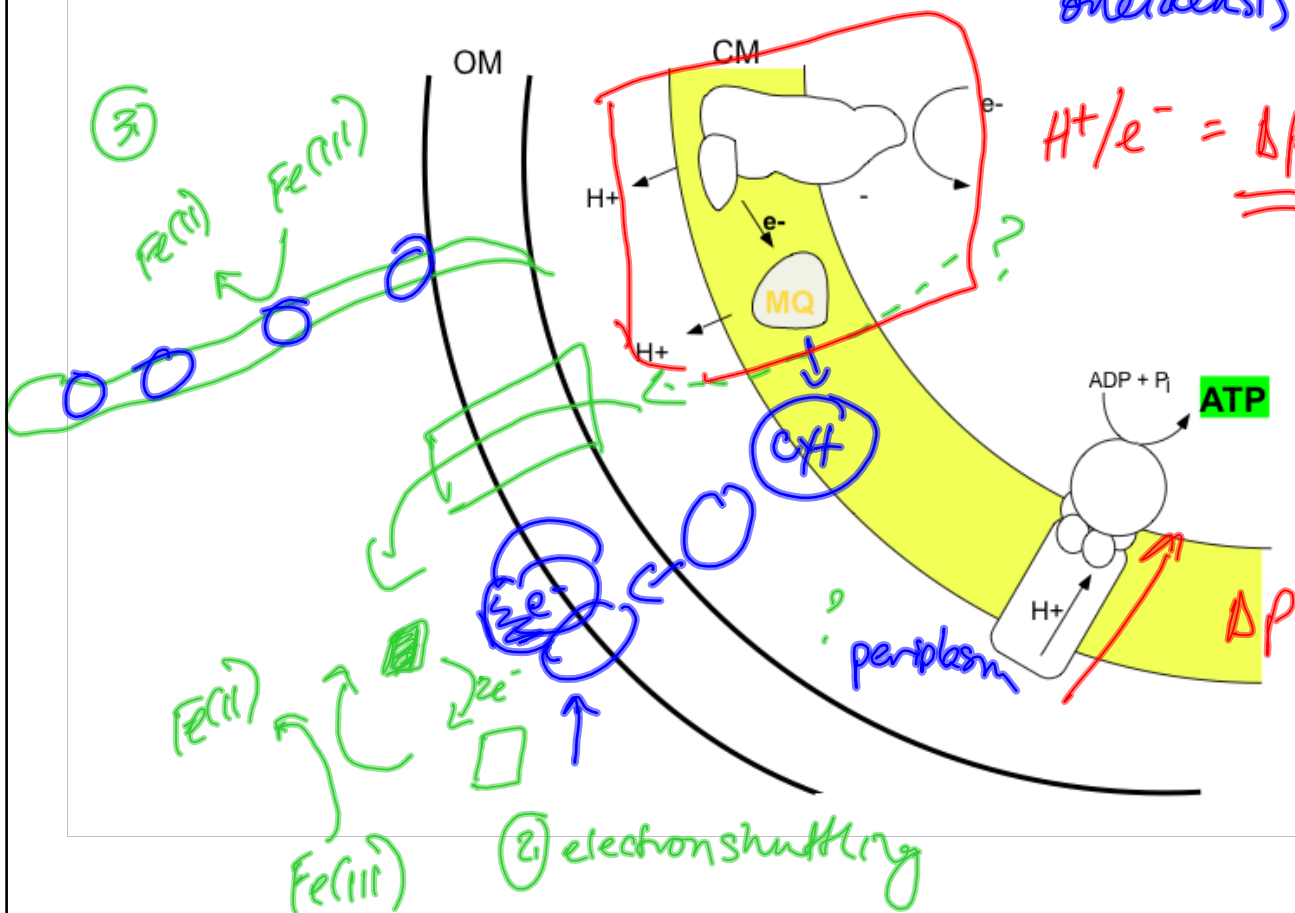
How does a cell respire a solid [e.g.  $\text{Fe}(\text{OH})_3$  electrode] ?



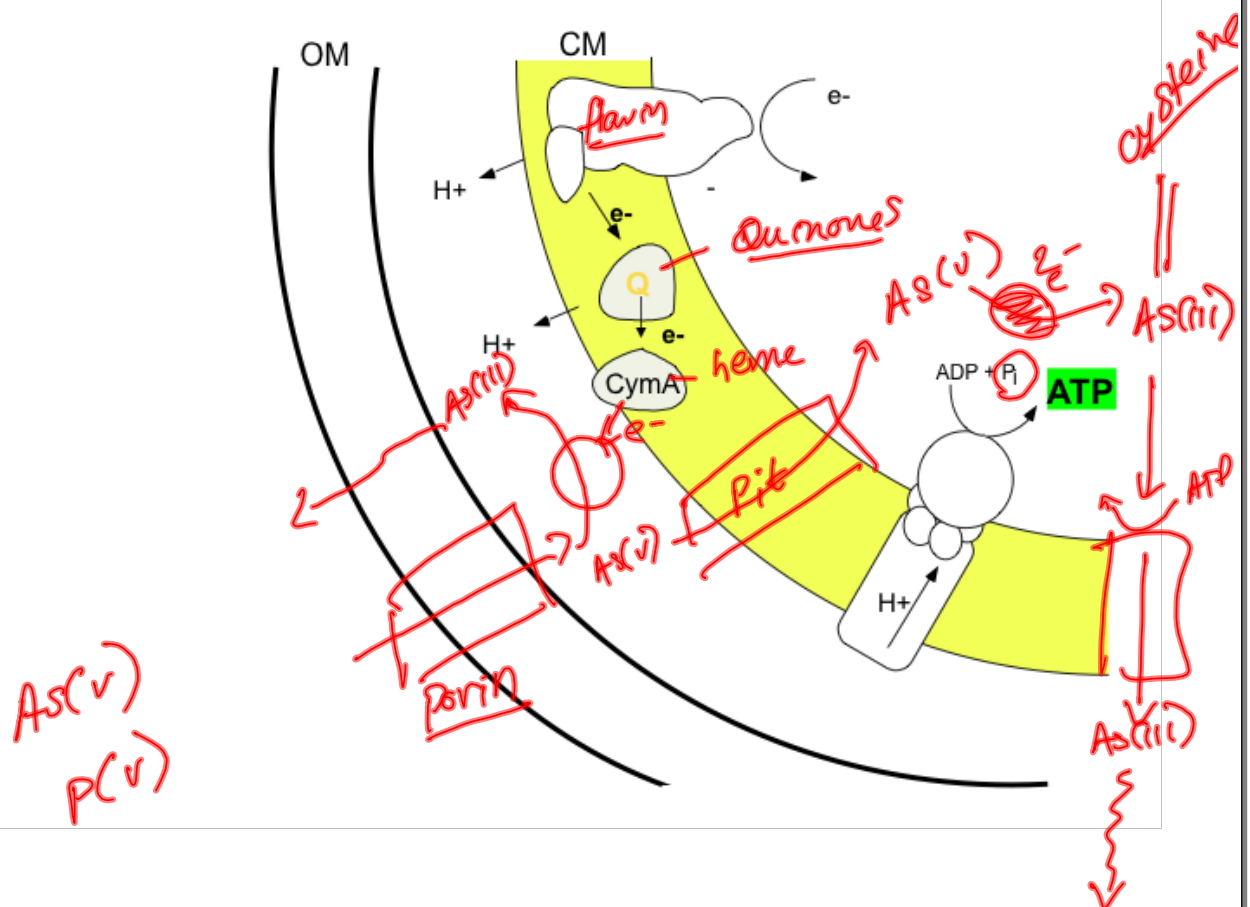
How does a cell respire a solid [e.g.  $\text{Fe}(\text{OH})_3$  electrode] ?

*Shewanella  
oneidensis*

$$H^+/e^- = \Delta P$$



How about a toxic substrate (whose product is even worse)?



BOTTOM LINE: MICROBIAL METABOLISM IS FANTASTIC

1.) What is needed for making new cells?

nutrients  $\rightarrow$  biomass } anabolism  
energy  $\uparrow$  } catabolism

2.) What is needed for survival?

nutrients/energy  $\rightarrow$  maintenance/repair  
transport of waste

3.) What constrains metabolism?

thermo, kinetics, reactivity

4.) How do cells access diverse substrates?

through modular ET chains