Competition for Substrate

K_m = substrate concentration at which uptake (or rate of reaction) is 1/2 of the maximum rate

Low K_m indicates high affinity for the substrate

High K_m indicates lower affinity for the substrate

High K_m, high V_{max} have high uptake of substrate at high substrate concentrations

Low K_m, lower V_{max} have higher affinity, more competitive at low substrate concentrations

Maintenance energy - that energy needed to maintain basic biological functions (active uptake of substrates, transport of ions, maintenance of ionic equilibria across membranes) - occurs even in absence of biosynthesis

Under slow growth conditions, mainenance energy is greater proportion of total energy requirement

Bacteria with higher maintenance energy requirements do competitively poorer under low substrate conditions, bacteria with lower maintenance energy requirements do better competitively under low substrate conditions

Y_{ATP} grams (dry weight) of cell mass produced/mole ATP produced from catabolic processes

(for relatively rapidly growing cells, Y_{ATP} about 10 g/mol)

As maintenance energy proportion becomes higher, Y_{ATP} will decrease

Y_{ATP} will also be related to the energy requirement for synthesizing new biomass (which depends on carbon source(s) available), also will be related to number/types of biomolecules available in the medium (addition of amino acids will decrease energy demand for synthesis of proteins)

Under very high substrate concentrations, rate of substrate uptake may counteract efficiency of mainenance process, Y_{ATP}, and amount of ATP produced by catabolic pathways

Anaerobic respiration

- involves use of external electron acceptor (usually inorganic but not always)
- may involve some substrate level phosphorylation for ATP production, but will also involve some oxidative phosphorylation (requires presence of intact membranes, generation of some sort of gradient across the membrane)

Typically, energy yield from respiration is higher than for strictly fermentative processes

Phototrophs also use membrane gradients to generate ATP and to produce the reducing power needed to reduce CO_2 to organic carbon

Fumarate Respiration

to be respiration, has to involve membrane, generation of potential across membrane, and at least some ATP generated by substrate level phosphorylation

Chemiosmotic gradient

electron transport chain - alternates carriers which carry
both H^+ and e^- with those that carry only e^-
net result is to pump protons (H^+) to the outside
pH is locally lower outside, more + charge outside
pH is more alkaline inside, more - charge inside

proton/charge gradient represents potential energy
relief of this gradient by allowing proton flow through
ATPase allows trapping of some of the energy released as ATP

The greater the differences in the redox potential of the initial electron donor (for instance NADH) and the final electron acceptor (for instance O_2) the greater the amount of energy possible