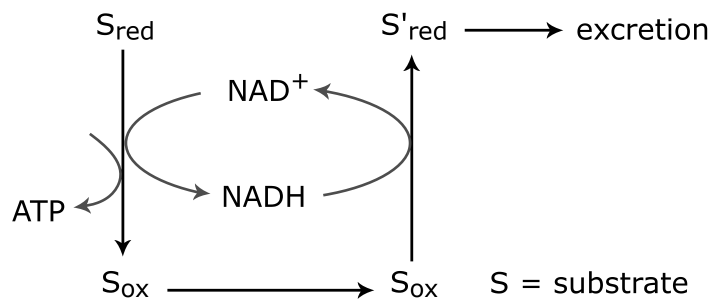
1.89, Environmental Microbiology
Prof. Martin Polz
Lecture 9

Biosynthesis is a huge cost for bacteria.

Pathogens are lucky because they use less energy, because their host makes stuff for them. They take up pre-synthesized precursors from host & intermediates.

1. Fermentation

No e- transport chain
→ Problem: how to reoxidize NADH?
↳ Do internal redox reactions.



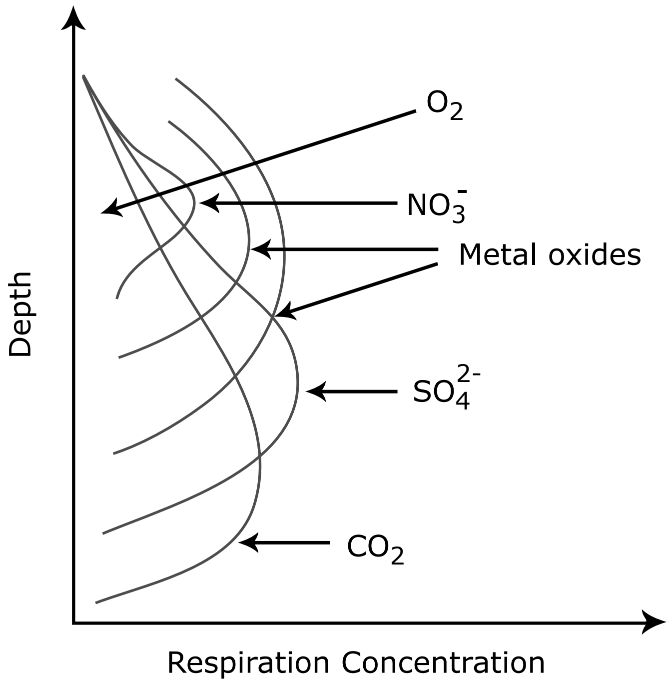
2-3 ATP/C

a) Lactic acid fermentation:

- ATP is generated by substrate level phosphorylation
- Strict redox balance: average oxidation state of products is same as substrates
  → only substrates with intermediate oxidation states can be fermented
- Most involve pyruvate as an intermediate
- Only under strict anaerobic conditions

2. Respiration

- NADH reoxidation via e^- transport chain
  ↳ ultimate reduction of external e^- acceptor
- Some of the major e^- acceptors ⇒



O_2/H_2O

NO_3^- / N_2
NO_2^-

1

$Mn (IV)/Mn (II)$

decreasing $E_o'(V)$

$Fe (III)/Fe (II)$

SO_4^{2-}/H_2S

CO_2/CH_4

a) Aerobic Respiration:

O_2: e- acceptor

Aldehyde of glucose $\longrightarrow [CH_2O] + O_2 \rightarrow CO_2 + H_2O$ ~ 5 ATP/C

- Can generally use a great variety of carbon substrates
- Different species are often specialized in terms of C-substrate key use

b) Anaerobic Respiration:

- e^- transport is analogous to aerobes, but use different e^- carriers with different redox potentials.
- Nitrate – most common form of nitrate respiration = dentrification

gaining e^-s

N(V) $NO_3^- \rightarrow$ nitrate reductase

N(III) $NO_2^- \rightarrow$ nitrate reductase

N(II) $NO \rightarrow$ nitric oxide reductase

N(I) $N_2O \rightarrow N_2$ gas

N(O)

What is meant?

"glucose"

$$5\left[CH_2O\right] + 4NO_3^- + 4H^+ \rightarrow 5CO_2 + N_2 + 7H_2O$$

Almost as energetically favorable as aerobic respiration (many aerobes can switch to using nitrate for respiration)

- As high as C-substrate diversity of aerobes
- Significance
  - N-removal from systems
  - Production of green house gases – N_2O, NO