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SUMMARY
METABOLISM

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Bioenergitics

ΔG: free energy difference at any conditions

- $\Delta G > 0$ ⇝ non spontaneous (unfavorable, anabolic)
- $\Delta G < 0$ ⇝ Spontaneous (favorable, catabolic)
- $\Delta G = 0$ ⇝ Equilibrium ⇝ No net production of reactants or products

ΔG°: free energy difference at standard conditions

$$\Delta G = \Delta G^\circ + RT \ln \frac{[Product]}{[Reactant]}$$

☆ ↑ Reactants ⇒ ΔG more ⊖

☆ ↑ Products ⇒ ΔG more ⊕

$$\Delta G^\circ = -RT \ln K_{eq}$$ ⇝ At equilibrium

K_{eq} → $\frac{Product}{Reactant}$

☆ Metabolism: all chemical reactions in the biological system

- Catabolism: Degradation (break down) ⇝ Release energy (favorable, exergonic)
- Anabolism: Synthesis (building) ⇝ input of energy (unfavorable, endergonic)

☆ ATP: high-energy intermediate, used for energy coupling

(→ X long-term storage)

- intermediate amount of energy ($\Delta G = -7.3$)
- ATP hydrolysis ($ATP \rightarrow AMP + PP_i$)
  - PP_i: broken into $2P_i$

energy coupling: utilizing the energy released from exergonic to drive an endergonic by ATP, UTP, GTP, CTP

- UTP → sugar
- GTP → Protein
- CTP → lipid

☆ In the muscles:

↑ ATP/ADP ration ⇝ more production of creatinine phosphate

↓ ATP/ADP ratio ⇝ more conversion of creatinine phosphate into ATP

Thermogenesis: using energy for ATP production or producing heat

- → **Non-shivering thermogenesis:** ↑ efficiency for ATP synthesis
- → **Shivering thermogenesis:** ATP utilization for heat production during sudden cold with asynchronous muscle contractions

☆ **Redox potential ($\Delta E°$):** energy released by the transfer of electrons

- → $\Delta E° = \ominus$ ⇝ loss of electrons ⇝ oxidation ⇝ strong reducing agent
- → $\Delta E° = \oplus$ ⇝ accept electrons ⇝ reduction ⇝ strong oxidizing agent

$\Delta G° = nF(\Delta E°)$ ⟵ مهم

☆ **Oxidation half reaction:** $A \rightarrow B + e^-$

☆ **Reduction half reaction:** $A + e^- \rightarrow B$

Electron transfer Co-enzymes

☆ NAD^+, NADH ⇝ e^- in the form of H^-

- → Source of e^-: Alcohols

☆ FAD, $FADH_2$ ⇝ e^- in the form of H

- → Source of e^-: Variable
- → Succinate DH, Dihydrolipoyl DH

Q: Does this reaction occur spontaneously under standard conditions (F = 2306 cal / Volt)

$OAA + 2H^+ + 2e^- \rightarrow Malate$ $(\Delta E° = -0.17)$

$NAD^+ + 2H^+ + 2e^- \rightarrow NADH + H^+$ $(\Delta E° = -0.32)$

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