Metabolism and thermodynamics of hot spring living (Fri morning)

terminology

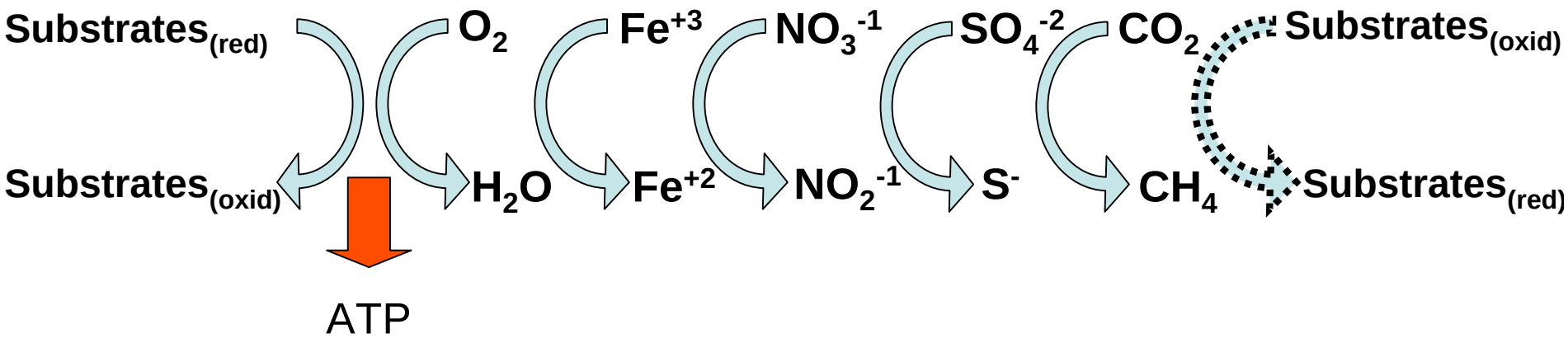
- **Anaerobe, aerobe, microaerophile**
- **Chemolithoautotrophs**
- **Photoautotroph**
  - **Anoxygenic phototroph**
  - **Oxygenic phototroph (lots of examples here at Norris- *Cyanidium* and *Zygogonium*, acidophilic Eukarya)**
- **Syntrophy**

Temperature Ranges and Environments for Microbial Life

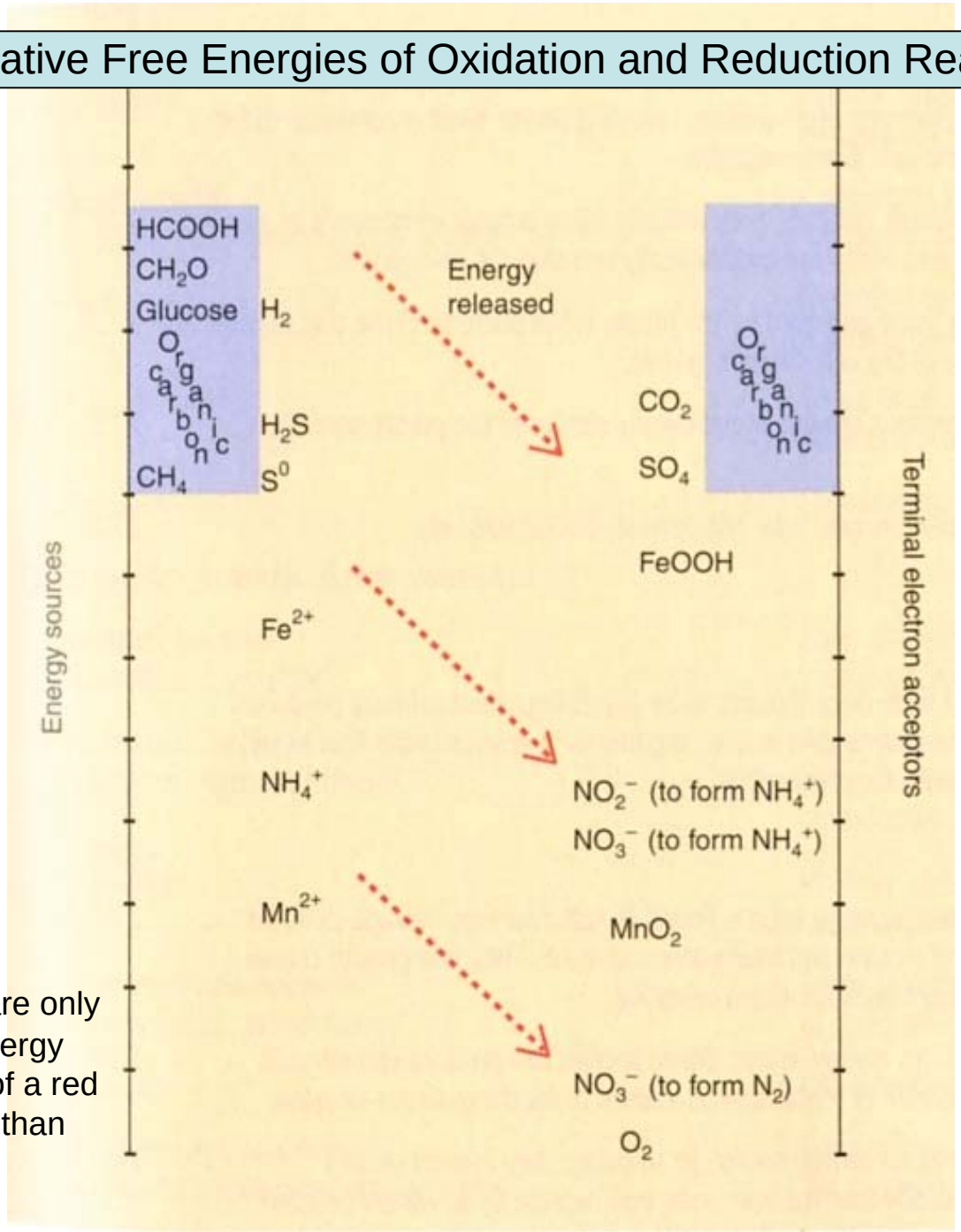
- **Hyperthermophile** 70-113 C
  - opt >80 C
  - hot springs, volcanic areas, deep-sea hydrothermal vents
- **Thermophile** 45-70 C
  - hot springs, volcanic areas, compost heaps, hot water heaters, deep gold mines, deep subsurface
- **Mesophile** 20-44 C
  - soil, water, pathogens
- **Psychrophile** 0-20 C
  - Permafrost

Oxidation-Reduction Processes

- **Extraction of electrons.**
- **Consequences;**
  - **destablization of C-C and C-H bonds.**
  - **energy gain.**
  - **final electron acceptor to create energy gradient.**



Relative Free Energies of Oxidation and Reduction Reactions*

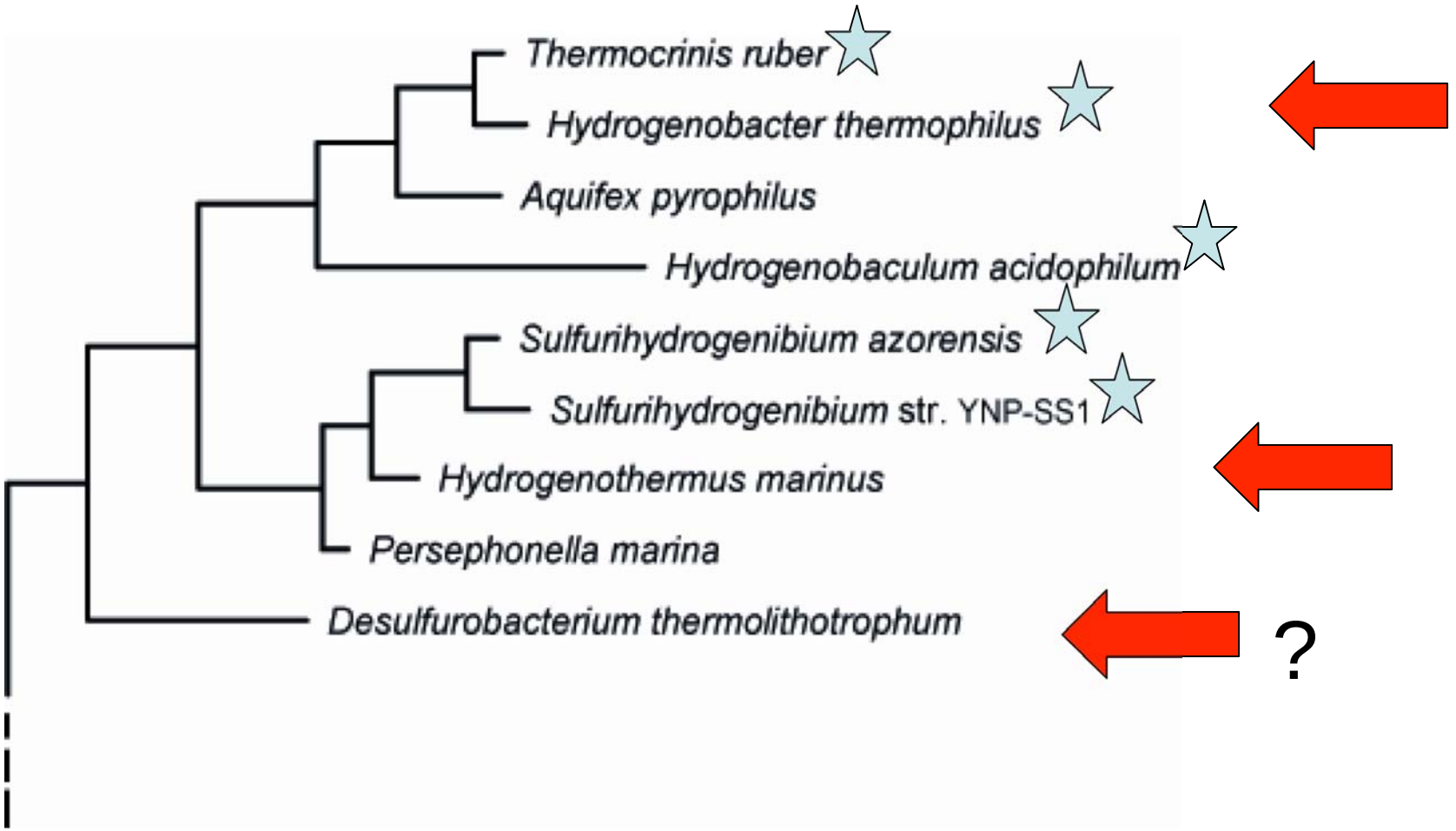


*Electron transfers are only possible down an energy gradient; i.e., slope of a red arrow must be great than zero.

Geochemical control of community composition

- A case study: the Aquificales in Yellowstone
  - *Thermocrinis, Hydrogenobaculum, Sulfurihydrogenibium, Hydrogenobacter*
  - Dominant visible members in many flowing hot streams
  - Utilize chemical gradients

The terrestrial Aquificales



Distribution of the Aquificales in Yellowstone

- *Thermocrinis* ---
  - higher temps, low sulfide
- *Hydrogenobacter*---
  - 65-75, sulfide, iron, sulfates
- *Sulfurihydrogenibium*---
  - similar niche as *Hydrogenobacter*
  - Metabolically plastic, taking advantage of chemical and temperature gradients
- *Hydrogenobaculum*
  - Acid pH 3-4