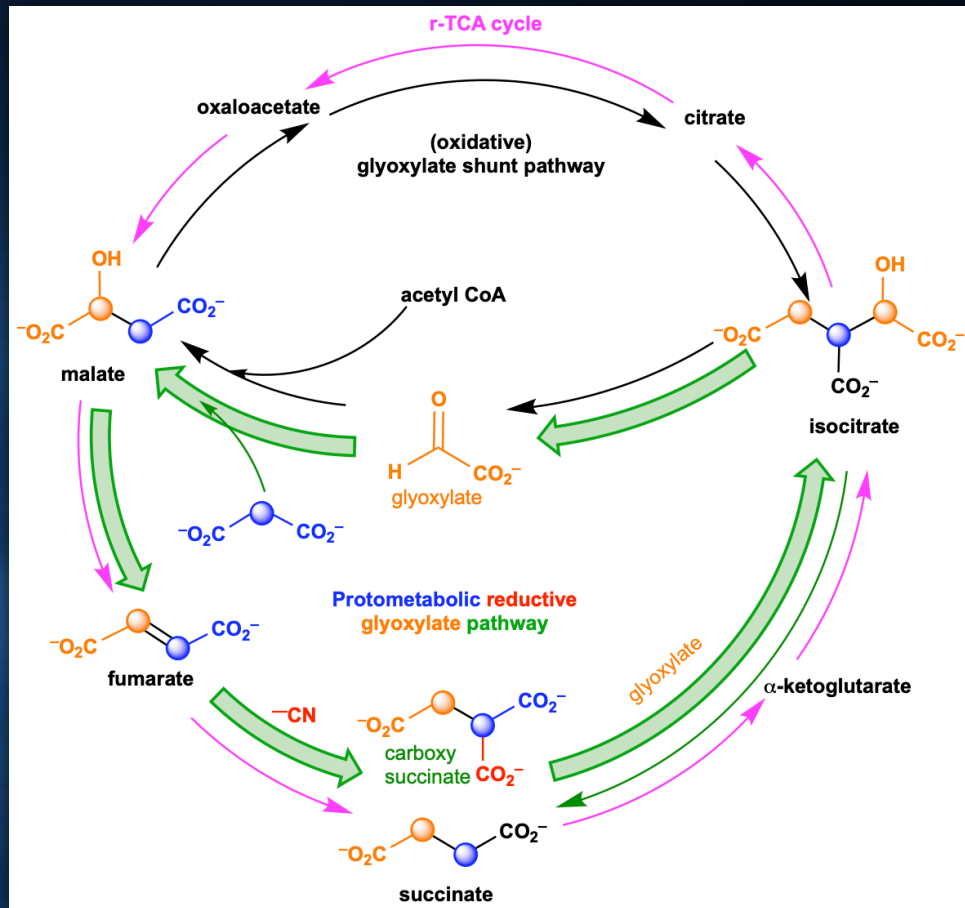


# Did cyanide play a role in metabolic reactions on early Earth?

Cyanide enables a network of reactions that can function as a proto-metabolic pathway to convert  $\text{CO}_2$  and  $\text{H}_2\text{O}$  into chemical compounds necessary for life.

- Previous attempts to reproduce the reductive citric acid (r-TCA) cycle pathways under prebiotic conditions with metals like those found in modern, complex metalloproteins had resulted in complicated mixtures and unsustainable pathways.
- This study used cyanide as a reducing agent instead of the metals and demonstrated efficient and selective chemical transformations of the compounds in the r-TCA cycle allowing it to proceed.
- Cyanide facilitated reactions of malonate with glyoxylate (middle pathway, image at left) naturally ushered a reductive glyoxylate pathway – one that bypasses the challenging steps involving oxaloacetate and  $\alpha$ -ketoglutarate.
- The results show that simpler networks of protometabolic reactions can function – implying that extant metabolic processes like those found in the r-TCA cycle are an evolutionary invention with multiple steps having been replaced from earlier pathways.



*Cyanide acts a mild and efficient reducing agent mediating selective transformations of rTCA intermediates*