Glucose as a catalyst for “proto-respiration”

One thing glucose is really good at is reacting with hydroxyl radicals. These form from hydroxide ions stored in protoplasm gel, hydrated potassium hydroxide. Glucose may be a catalyst for proto-respiration, tipping water-oxygen redox balance in favour of degradation of water.

The anode reaction,

$$2\ (CH2O)n + 4\ OH^- + O2 \rightarrow 4\ H2O + 2\ CO2 + 4\ e^-$$

Glucose, (CH2O)6, catalyses the release of 12 electrons.

Steps in anode reaction,

$$2\ (CH2O)n + 2\ OH^- \rightarrow 2\ HCO + 2\ H2O + 2\ e^-$$

$$2\ HCO + 2\ O2 \rightarrow 2\ CO + 2\ HO2$$

$$2\ CO + 2\ OH^- \rightarrow 2\ CO2 + 2\ H^* + 2\ e^-$$

$$2\ HO2 + 2\ H^* \rightarrow 2\ H2O2 \rightarrow 2\ H2O + O2$$

The missing O2 in the reaction comes in at the cathode,

$$4\ e^- + O2 + 4\ H^+ \rightarrow 2\ H2O$$

Overall reaction:

$$(CH2O)n + O2 \rightarrow H2O + CO2$$

Steps in overall reaction:

Anode: $2\ (CH2O)n + 4\ OH^- + O2 \rightarrow 4\ H2O + 2\ CO2$

Cathode: $O2 + 4\ H^+ \rightarrow 2\ H2O$

“Proto-respiration” as a catalyst for photosynthesis

In photosynthesis the process is reversed.

Anode in photosynthesis:

$$4\ OH^- \longrightarrow 2\ H_2O + O_2 + 4\ e^-$$

Cathode:

$$CO_2 + 2\ H_2 \longrightarrow (CH_2O)_n + H_2O$$

Steps in cathode reaction:

$$CO_2 + 2\ H^+ + 2\ e^- \longrightarrow CO + H_2O$$

$$CO + 2\ H^+ + 2\ e^- \longrightarrow (CH_2O)_n$$

Overall reaction:

$$CO_2 + H_2O \longrightarrow (CH_2O)_n + O_2$$

Steps in overall reaction:

$$4\ OH^- \longrightarrow 2\ H_2O + O_2 + 4\ e^-$$

$$CO_2 + 4\ H^+ + 4\ e^- \longrightarrow (CH_2O)_n + H_2O$$