

Energy Releasing Pathways: Accounting

Energy accounting describes the total amount of ATP produced from NADH, FADH₂, and substrate-level phosphorylation in anaerobic and aerobic respiration. From anaerobic respiration come 2 ATP and 2 NADH. Aerobic respiration yields 8 NADH, 2 FADH₂, and 2 ATP. Oxidative phosphorylation uses the total 10 NADH and 2 FADH₂ to produce 30 ATP and 4 ATP, respectively. Of note, 2 ATP are consumed when transporting the 2 NADH from anaerobic respiration into the mitochondrial matrix. Thus, the net total yield is 36 ATP (34 + 4 - 2) from the aerobic breakdown of one glucose.



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Characteristics

Anaerobic Respiration

Ant-robe

During anaerobic respiration, glycolysis is the process of breaking down glucose into a 3-carbon pyruvate to prepare it for aerobic respiration. In the conversion of glucose to pyruvate, 2 ATP are formed, along with 2 NADH molecules.

2 ATP

(2) Tutu ATP-battery

In glycolysis, glucose is broken down into pyruvate to yield 2 net ATP from substrate-level phosphorylation.

2 NADH

(2) Tutu Cigarette-H

In glycolysis, 2 NADH are produced in the breakdown of glucose into pyruvate. These NADH have to travel from the cytosol into the mitochondrial matrix, which will consume 1 ATP each, for a total of 2 ATP consumed.

Aerobic Respiration

Aerobics-guy

Aerobic respiration is the reduction of pyruvate to CO₂ in the mitochondrial matrix that generates NADH, FADH₂, and ATP. During aerobic respiration the pyruvate molecules (broken down from 1 glucose molecule) yield 8 NADH, 2 FADH₂ and 2 ATP in total.

8 NADH

(8) Ball Cigarette-H

8 NADH molecules are produced in aerobic respiration; 2 are formed from pyruvate decarboxylation, while the other 6 are created during the Krebs cycle.

2 FADH₂

(2) Tutu Flag-H₂

In aerobic respiration, during the Krebs cycle, two FADH₂ are produced.

2 ATP

(2) Tutu ATP-battery

2 ATP are produced in the Krebs cycle by the GDP-to-GTP and GTP-to-ADP pathway.

Oxidative Phosphorylation

Oxidative-ox with Pi-badge

In the oxidative phosphorylation stage, the cell cashes in on the energy carriers to form ATP. The total yield in this phase is 34 ATP.

34 ATP

(34) ATP-sign

34 ATP are produced from NADH and FADH₂ in oxidative phosphorylation. From 10 total NADH, 30 ATP are formed, because 1 NADH results in 3 ATP produced. From 2 total FADH₂ molecules produced in the Krebs cycle, 4 ATP are formed, because 1 FADH₂ results in 2 ATP produced.

2 ATP Lost

(2) Tutu ATP-battery Falling Out of Net

During oxidative phosphorylation 2 ATP are lost from the transfer of two glycolysis NADH molecules into the mitochondrial matrix. This happens because the active transport into the mitochondria and the matrix requires power in the form of ATP.

36 Net Total ATP

(36) Net ATP-sign

There are 36 net total ATP produced from glucose catabolism. 30 ATP come from NADH, 4 ATP from FADH₂, 4 ATP from substrate-level phosphorylation, and 2 ATP are removed because the NADH from glycolysis need to be transported into the mitochondrial matrix.