***Sorry guys, I forgot to take a picture of this part of the board today, so I typed up the calculations for you* ☺**

**ATP from Substrate Level Phosphorylation**

Glycolysis 2 ATP

Citric Acid Cycle 2 ATP

4 total ATP from S.L.P

**ATP from Oxidative Phosphorylation**

When electrons are passed down the ETC, protons (H+) are pumped into the intermembrane space. This creates a gradient. When the protons flow through the ATP synthase, the energy released is used to make ATP. NADH drops off electrons “earlier” in the ETC than FADH2 does, so it is responsible for creating more of a gradient and therefore more ATP.

For every NADH ~3 ATP result

For every FADH2 ~2 ATP result

Glycolysis 2 NADH x 3 ATP 6 ATP

Transition Reaction 2 NADH x 3 ATP 6 ATP

Citric Acid Cycle 6 NADH x 3 ATP 18 ATP (or 16 depending on shuttle\*\*)

2 FADH2 x 2 ATP 4 ATP

32-34 total ATP from O.P.

\*\*When Pyruvate (which is a charged molecule) is shuttled into the mitochondrion it requires either NADH or FADH2. Using FADH2 is more efficient. If NADH is used instead we would make ~2 less ATP during oxidative phosphorylation.

**Total amount of ATP = 36-38 ATP (depending on shuttle)**

* ATP has 7.3 kcal/mol
* Glucose has 686 kcal/mol

*How efficient is Aerobic Cellular Respiration?*

38 mol ATP x 7.3 kcal/mol = 277.4 kcal

277.4 kcal/686 kcal = ~40% - the rest of the energy is “lost” as heat (actually endothermic animals utilize this heat to maintain body temperature!)

For comparison, the most efficient engine is able harness 25% of the energy from fuel, so 40% is actually quite efficient!

*How efficient is Anaerobic Respiration?*

2 mol ATP x 7.3 kcal/mol = 14.6 kcal

14.6 kcal/686 kcal = ~2%