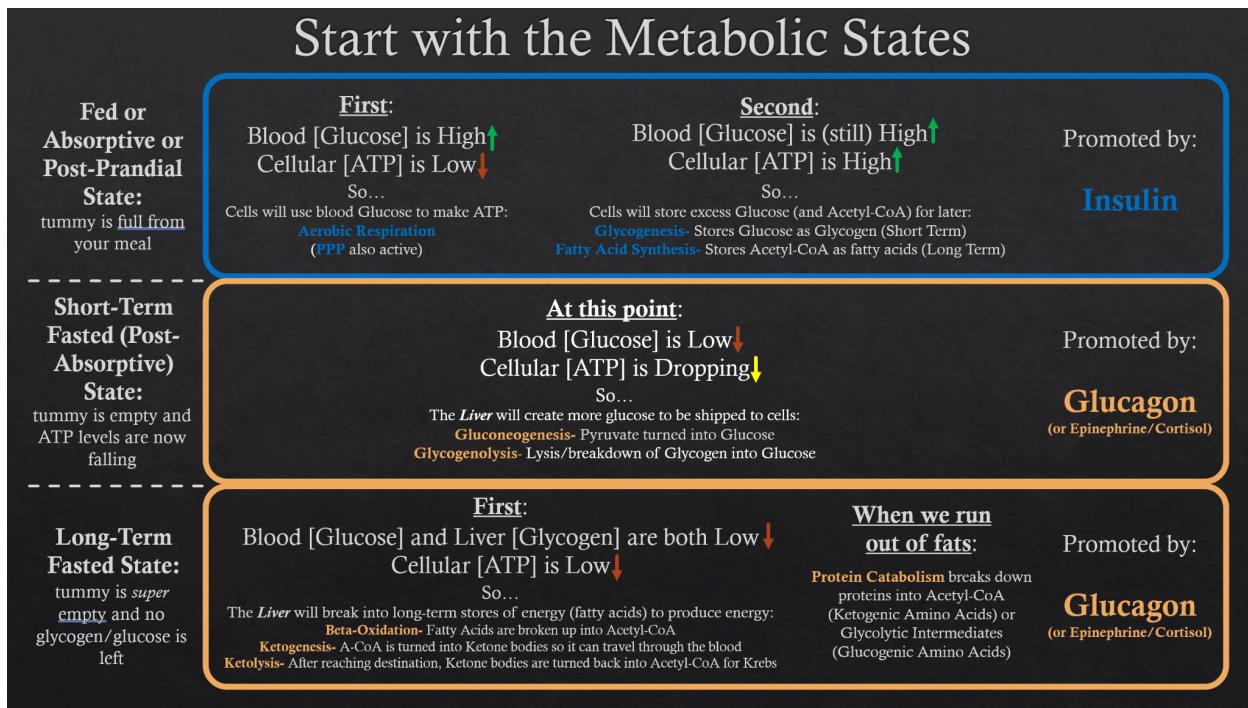


Make Metabolism Easier- MCATalyst Video Support Notes

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Metabolic States Overview of Metabolism



- Fed State: Use glucose in any way, either turning it into ATP via aerobic respiration or into glycogen via glycogenesis. Insulin is the signal to do so.
- Short-Term Fasted State: Since we haven't eaten in a while, we'll need to produce glucose for the tissues around the body, so the liver does GNG and glycogenesis to liberate to the body. Glucagon is the signal to do so.
- Long-Term Fasted State: We've now starved for so long that we've run out of pyruvate and glycogen to turn into glucose, so we have to resort to Fatty-Acids to produce acetyl-CoA which is sent around the body via ketone bodies. If we run out of fats, proteins are broken down. Glucagon (and epinephrine and cortisol) all can stimulate any of these processes.

Simple Explanation of The Metabolic States

Simply put...

Fed State

Lots of glucose in blood from meal, and cells need ATP.

Insulin is released to help us turn Glucose into ATP (Aerobic Respiration) *or* store it as Glycogen (Glycogenesis), and Acetyl-CoA as Fatty Acids (FA Synthesis)

Short-Term Fasting

Glucose levels are falling/low, but cells are starting to need more ATP.

Glucagon is released telling the Liver to produce Glucose via Gluconeogenesis and Glycogenolysis

Long-Term Fasting

Haven't eaten in a long time, no glucose, no glycogen, only have Fatty Acids left.

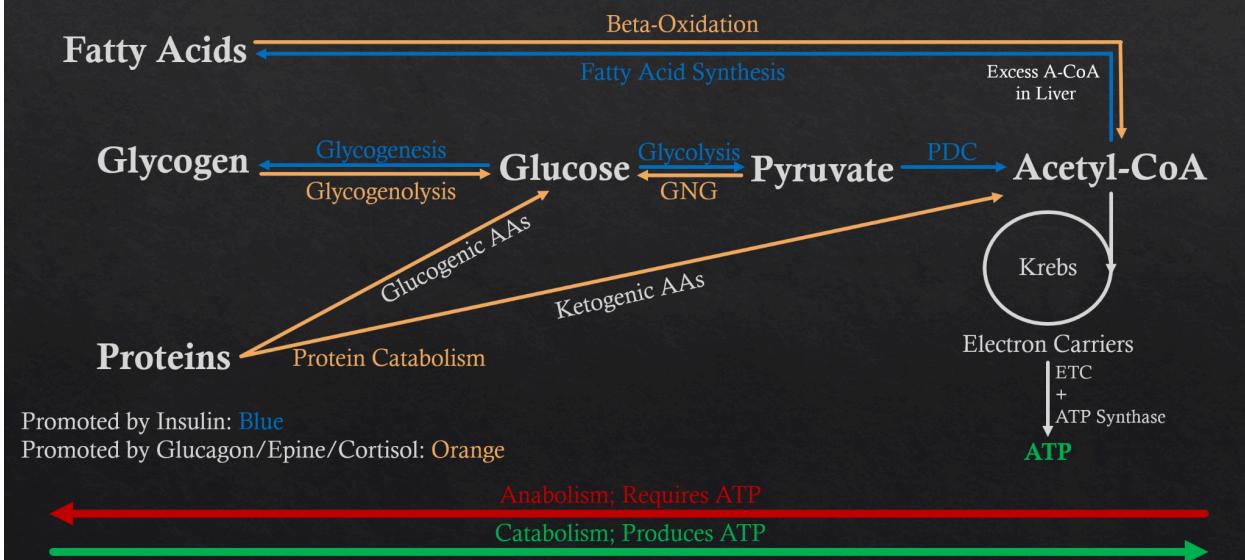
Glucagon (and Epine/Cortisol) tell the Liver to break up Fatty Acids, liberating Acetyl-CoA to the body (via Ketone Bodies)

No more fats? Protein Catabolism.

Hormonal Control of Metabolism

Now let's look at the hormones...

Notice: Arrows away from glucose = **insulin** stimulation; Arrows towards glucose = **glucagon** stimulation

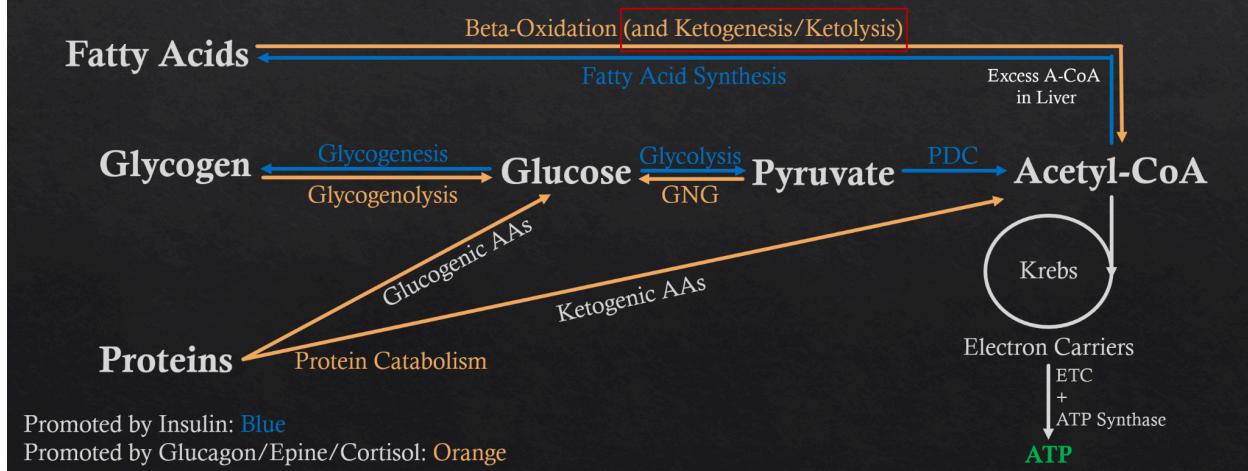
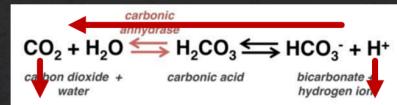


Diabetes

Let's test our knowledge:

Diabetics: Insulin isn't working for some reason, so remove all blue arrows!

- Notice: only (non-protein) way to make ATP is through Beta-Oxidation!
- But... **there's a problem with this:**
 - Ketoacidosis: acidification of the blood
 - Response to Ketoacidosis: breathe off more CO_2 (hyperventilation) to increase blood pH back to normal!



- Diabetics don't have functioning insulin, so all blue arrows disappear.
 - Main way to produce ATP is via Beta Oxidation and Acetyl CoA
- Beta Oxidation → Produces acetyl CoA → must be turned into ketone bodies to travel through the blood → decreases pH of the blood since they are acidic → ketoacidosis
- Ketoacidosis → acidification of the blood, results in hyperventilation which causes the breathing off/removal of more CO_2 from the blood, which will cause the bicarbonate buffer system to shift left, decreasing how much hydrogen ion is in the blood and raising blood pH back to normal
 - A symptom of diabetics is hyperventilation, which all results due to their inability to utilize insulin!

Insulin and Glucagon Summaries

In Summary:

Insulin

- Released by **beta**-islet cells of the pancreas
- Responsible for processes in the Fed State (high blood [Glucose])
- Only goal is to decrease blood [Glucose], either by turning it into ATP (Aerobic Respiration) or storing it (Glycogenesis)

Glucagon

- Released by **alpha**-islet cells of the pancreas
- Responsible for processes in the Fasted States (low blood [Glucose])
- Only goal is to raise blood [Glucose] (or acetyl-CoA), first via GNG and glycogenolysis, then Beta-Oxidation, then Protein Catabolism