KREBS CYCLE WITH MOLCULAR MODELS

David B. Fankhauser, Professor of Biology and Chemistry
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http://biology.clc.uc.edu/fankhauser/Labs/Cell_Biology/glycolysis/Glycolysis.htm

Assign each molecule in the following Krebs cycle to a student or student team to construct. They should memorize the name and structure of the molecule(s), and illustrate it on the board in proper sequence of the metabolic pathway, then copy the eight stages, four on each facing pages into their notebook. Be sure to include the coenzymes and side products for each reaction.

TCA cycle: (p. 408)

step	**molecule**	**notable chemical features of the reaction**
00	pyruvate	Pyruvate is the end product of glycolysis. An α ketoacid, it is easily decarboxylated, requiring thiamine. CoASH required, NADH is generated.
0	Acetyl coenzymeA, CO_2 & NADH	**Formation of acetyl coenzymeA**: decarboxylation of pyruvate with concomitant condensation with CoASH forms an energetic thioester.
1	citrate	**acetylation:** Acetyl CoA transfers acetyl group *via* CH_3 *end* to the keto carbonyl of oxaloacetate (C-4). The keto carbonyl becomes an alcohol.
2	isocitrate	**dehydration, rehydration:** citrate (a tertiary OH, not oxidizable) is **isomerized** to isocitrate, with an oxidizable secondary OH
3	α-ketoglutarate	**oxidation, decarboxylation:** 2° hydroxyl on isocitrate is **oxidized**, making **NADH**, creates unstable molecule causing **decarboxylation** (drives rxn) yielding α-ketoglutarate. (Requires thiamine as in step 00)
4	succinyl CoA	**oxidation, decarboxylation, form thioester:** α-ketoglutarate is an α-keto acid, similar to pyruvate: analogous to formation of acetyl CoA, oxidation (makes **NADH**), decarboxylation (makes CO_2) and formation of a high energy thioester bond (succinyl CoA).
5	succinate	**hydrolysis of thioester, phosphorylation of GDP:** Thioester bond energy is used to **PO_4ylate GDP**, release succinate and CoASH. GTP PO_4ylates ADP (only direct ATP in cycle)
6	fumarate	**oxidation: Succinate** α,β carbons dehydrogenated**,** forming **$FADH_2$** and fumarate. Occurs tied to electron transport complex II.
7	malate	**hydration: fumarate double bond is hydrated** to form malate
8	oxaloacetate	**oxidation: malate is oxidized** to form oxaloacetate, producing **NADH**.

For the construction, refer to protocol for molecules of glycolysis.

Arrange students with their molecules in sequence in a circle and have each student in succession give the following information:

1) The name of the molecule
2) Its characteristic features
3) How it differs from the previous molecule
4) How it will be changed into the next molecule and why
5) Identify key structural characteristics of their molecule which drive its chemical activity.

Have students leave the room for a drink, randomize the molecules around the room and number them 1 through 10. On a fresh page in their notebook, have students write a column of numbers, 1 through 10, and go around the models naming the numbered molecules without looking at their notes. Collect and redistribute notebooks to be graded by fellow students.

Note that the video this in the library: VIDT QH 633 .C45 1992 pt.4 *The Krebs Cycle* citrate

isocitrate

α-ketoglutarate

succinyl CoA

succinate

fumarate

malate

oxaloacetate

1	5	9
2	6	10
3	7	11
4	8	12