Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_ Hour\_\_\_\_

Student Bead Activity for the Krebs Cycle

Developed by R. I. Halleran, NBCT

**Materials:**

8 white beads

6 green beads

12 yellow beads

2 purple beads

**Procedure:**

Assemble 2, 4-carbon strings of white beads

Assemble 2, 3-carbon molecules with green beads

1. Using the circle (mitochondrion) on your table, place the 2, 4-carbon strings of white beads inside the mitochondrion (at the 11 0’clock position in the mitochondrion) within the circle.
2. Place the 2, 3 carbon bead strings (pyruvates) at **12 o’clock** outside the mitochondrion.
3. Place the 12 yellow beads (Oxygen atoms) randomly inside the mitochondrion in any position.
4. Slide one pyruvate into the mitochondrion. Then separate one carbon atom from the pyruvate molecule. Connect two Oxygen atoms (yellow beads) to this carbon atom and make CO2. Move this molecule out of the cell. **Using your wax pencil, write 1 NADH at the 12 o’clock position inside the mitochondrion.** Repeat this procedure with the second pyruvate molecule.
5. Now, you should have 2, 2-carbon molecules (known as Acetyl) at the 12 o’clock position ready to enter the Krebs Cycle.

# THE KREBS CYCLE

1. Take one purple bead and attach it to one of the 2-carbon molecules inside the mitochondrion. **The purple bead represents Co- Enzyme A.** Together now, **this is known as Acetyl-CoA**.
2. Move your Acetyl-CoA molecule over to the 1 o’clock position in the mitochondrion. Then remove the purple bead and return it back to near the 12 o’clock position of the mitochondrion. The job of the Co- Enzyme A is to shuttle (carry) the Acetyl molecule over to the Krebs Cycle.
3. Now slide one of the 4-carbon molecules from the 11 o’clock position over to the 1 o’clock position and attach the 2-carbon Acetyl molecule to it to make a 6-carbon compound.
4. Slide this 6-carbon compound over to the 3 o’clock position in the mitochondrion and remove one bead (a carbon atom) and attach this bead to 2 yellow beads to make a \_\_\_\_\_\_\_ molecule and then slide this molecule out of the mitochondrion and out of the cell. Write on your table at the 3 o’clock position 1 NADH.
5. Slide the 5-carbon compound down to the 5 o’clock position. Again remove one bead (a carbon atom) and attach to it 2 yellow beads to make \_\_\_\_\_\_\_\_\_. Slide this molecule out of the mitochondrion and the cell. Write at the 5 o’clock position, 1 NADH and 1 ATP.
6. Slide the 4-carbon compound over to the 7 o’clock position and write 1 FADH2. Then slide this 4-carbon compound around to the 9 0’clock position and write 1 NADH. Then slide the 4-carbon compound back up to the 11 o’clock position. **Remember, each time you use one 3-carbon pyruvate to go through this cycle**, this is called **1 turn of the Krebs Cycle**. **Stop ! …………**

**Now go back and take the second Acetyl compound through the Krebs Cycle.**

REMEMBER, EVERY GLUCOSE MOLECULE WILL TAKE 2 TURNS OF THE KREBS CYCLE TO BE COMPLETELY BROKEN DOWN!!!!!

Total up all the energy molecules we have created so far from glycolysis and the Krebs cycle.

ATP \_\_\_\_\_\_\_\_ NADH \_\_\_\_\_\_\_ FADH2 \_\_\_\_\_\_

Summary Questions:

1. In this activity I learned that there must be \_\_\_\_\_ 4-carbon molecule(s) in the mitochondrion for every pyruvate molecule in order for the Krebs Cycle to operate.
2. I also learned that there must be \_\_\_\_\_\_\_ oxygen(s) present to add 1 carbon atom to in order to make \_\_\_\_\_\_\_\_\_\_.
3. In order to capture the high-energy electrons that are released when a carbon atom is stripped off our carbon compounds, \_\_\_\_\_\_\_ and \_\_\_\_\_ needs to be present.
4. What new electron carrier shows up in the Krebs Cycle? \_\_\_\_\_\_\_\_\_.
5. Is the 4-carbon compound that is left, after the 2 carbons we added were stripped off, ready for the next Acetyl group? \_\_\_\_\_\_\_.
6. Explain your answer to question 5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. It takes \_\_\_\_\_\_ turns of the Krebs Cycle to totally strip all the energy from 1 glucose molecule.
8. What substance is absolutely necessary for this process to take place in the mitochondrion? \_\_\_\_\_\_\_\_\_\_
9. Where is the next step in Cellular Respiration going to take place that will really crank out the ATP’s?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. What molecules that we have produced thus far will be involved?

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