Must-Knows: Unit 4 (Cellular Respiration) KEY

Mrs. Wilkening, AP Biology

Directions: *To prepare for your upcoming test, please answer the following questions thoroughly and accurately on your answer sheet in the column titled "Your Answer Before Checking the Answer Key."*

Objective #2: You will be able to describe the role of glycolysis, the formation of Acetyl CoA, and the Krebs Cycle in cellular respiration.

1. What evidence do scientists have to indicate that glycolysis is an ancient process?
   The large number of steps that it takes. The fact that every living thing uses the process of glycolysis.

2. What are the reactants (starting molecules) and products (ending molecules) of glycolysis?
   Glucose, NAD→ 2 pyruvate, NADH, 2ATP

3. Describe the amount and type of ATP production during glycolysis. (Note: The type of ATP production refers to substrate-level phosphorylation vs. oxidative phosphorylation.)
   4 ATP are produced, but 2 are needed for substrate level phosphorylation

4. What are the reactants (starting molecules) and products (ending molecules) of the intermediate step between glycolysis and the Krebs / citric acid cycle in which pyruvate is converted to Acetyl CoA?
   Pyvurate, NAD (in the presence of O2) → Acetyl CoA, CO2, and NADH As it travels from the cytosol to the inner matrix of the mitochondria

5. What are the reactants (starting molecules) and products (ending molecules) of the Krebs / citric acid cycle?
   Acetyl CoA, NAD, FAD→ 2CO2, 3 NADH, 1 FADH2, 1ATP

6. After the Krebs cycle, how is most of the energy from the original glucose molecule stored?
   In electron carriers (NADH and FADH2)

Objective #3: You will be able to describe the role of the electron transport chain and chemiosmosis in the formation of ATP and list the steps involved in these processes.

7. How are high-energy electrons from NADH and FADH2 used during the electron transport chain?
   They are pulled through the ETC and separate the proton and electron, Proton to the outer membrane space and the electron travels through the ETC

8. How is oxygen gas (O_2) used during the electron transport chain?
   Oxygen is the final electron acceptor. It uses the protons that have diffused through the ATP synthase and produces H2O

9. Why are their folds (aka cristae) in the inner mitochondrial membrane?
   To increase the surface are so more reactions can take place.

10. Define "proton motive force." How is this used during the electron transport chain?
    The protons move through ATP synthase like a water through a water wheel that can convert energy into the formation of ATP.

11. How is oxidative phosphorylation / chemiosmosis (the type of ATP production that occurs in the electron transport chain) different from substrate-level phosphorylation? Is there more or less ATP made during oxidative phosphorylation than substrate-level phosphorylation?

There is no substrate in this process the electron carriers are recycled back to the Kreb cycle and glycolysis. This process make good use of the electronegativity of oxygen to work.

Objective #4: You will be able to describe the use of anaerobic respiration in living organisms.

12. How is aerobic respiration different from anaerobic respiration (aka fermentation)? Which steps of aerobic respiration (i.e. glycolysis, the conversion of pyruvate to acetyl CoA, the Krebs cycle, or the electron transport chain) occur during anaerobic respiration?
    The amount of ATP that is produced and the complete oxidation of the sugar. After the formation of acetyl CoA, the rest is aerobic.

13. Why does NAD+ need to be regenerated from NADH for glycolysis to continue? How is this accomplished in lactic acid fermentation vs. alcoholic fermentation?
    The process of glycolysis will stop if there is no NAD to reduce. This must be recycled from another cellular process like fermentation or oxidative phosphorylation.

14. In what types of organisms / cells does each type of fermentation occur?
    Ethyl Alcohol: Bacteria
    Lactic Acid: Animals and bacteria

Science Skills: *You will be able to design an effective experiment and analyze data.*

An experiment to measure the rate of respiration in crickets and mice at 10°C and 25°C was performed using a respirometer, an apparatus that measures changes in gas volume. Respiration was measured in mL of O2 consumed per gram of organism over several five-minute trials and the following data were obtained.

Organism	Temperature (°C)	Average respiration (mL O_2/g/min)
Mouse	10	0.0518
Mouse	25	0.0321
Cricket	10	0.0013
Cricket	25	0.0038

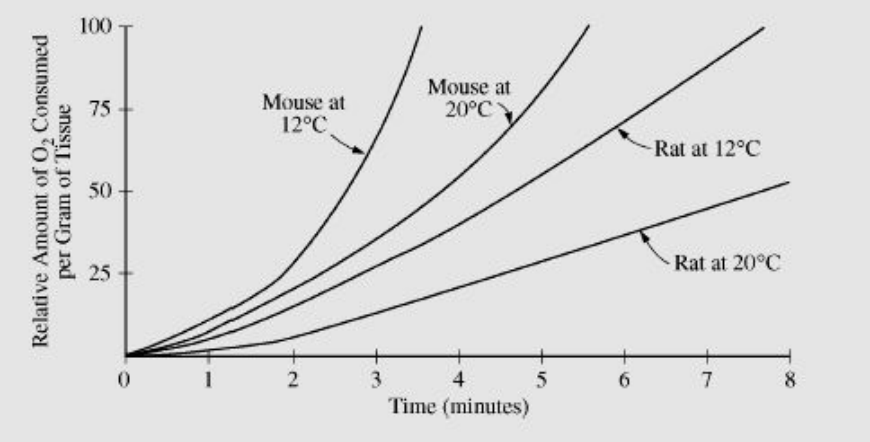
15. How will carbon dioxide produced by the crickets and mice affect the measurements of average respiration (mL O_2 / g / min)? How did we address this issue in our respirometer lab?
    You have to account for the CO2, this can be done by adding KOH and will precipitate the CO2, so the amount of gas remaining is due to O2 consumption.
    Carbon dioxide is formed as oxygen is used. The pressure due to C02 might cancel out any change due to the consumption of oxygen. To get rid of this problem, a chemical will be added that will selectively take out C02. Potassium hydroxide will chemically react with carbon dioxide by the following equation:
    $C0_2 + 2\ KOH \rightarrow K_2CO_3 + H_20$

16. Why do you think the rate of respiration is higher at lower temperatures for both crickets and mice?
    This is a bad question sorry, the cricket is lower at the colder temp. They are ectothermic and will not need to maintain their body temp.

17. If mice are endotherms (regulate their temperature by using the energy from ATP to generate body heat) and crickets are ectotherms (regulate their temperature using behaviors like basking in the sun), how do you explain the difference in rate of respiration for mice vs. crickets at both 10 degrees Celsius and 25 degrees Celsius?

At colder temp. Mice need to invest more energy into maintaining their temperature, while crickets do not. This will increase the mouse respiration rate at colder temperatures.

A respirometer is a container used to measure the amount of oxygen consumed by an organism. A respirometer was used to determine how environmental temperature affects the uptake of oxygen in one 300-gram rat and one 50-gram mouse. The results of this experiment are shown on the graph below.



18. From the data given above, what can you conclude about the effect of temperature and body mass on the rate of cellular respiration?

At colder temperatures, both mice and rats have greater rates of respiration than when they are at warmer temp. Also mice are smaller, so their rates will be higher for both temperatures that the rats.