Metabolism Worksheet

1. What is the total number and the net number of ATP produced during glycolysis.
2. What are the reactants and products of glycolysis?
3. Which molecule/s is most likely to be used in a reaction coupled with the reaction shown below?

glucose 🡪 glucose-6-phosphate

1. Why is glycolysis considered a catabolic pathway?
2. Conversion of dihydroxyacetone phosphate to D-glyceraldehyde 3-phosphate is a(n)
3. Both NAD+ and FAD are used for oxidation. Why do we have two oxidizers? What is each used for?
4. In steps 5-8 of the citric acid cycle, the high-energy molecules \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_are produced, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is regenerated to begin another turn of the cycle.
5. Which step(s) of the Kreb’s cycle is/are catalyzed by an oxidoreductase?
6. List the 3 irreversible steps in glycolysis?
7. Kinase, isomerase, Dehydrogenase and Mutase are some of the enzymes found in Glycolysis? What are the functions of these enzymes? Does it result in a change in carbon #?
8. Explain how it is possible that the initial reactant in glycolysis (glucose) has six carbons, but the product (acetyl-CoA) has three carbons.
9. In the citric acid cycle, is the alcohol group in isocitrate oxidized, or reduced?
10. What does coupling reactions mean?
11. Consider the two reactions below.
12. 9.2 kJ + Glycerol + HPO42-🡪(Glycerol-3-Phosphate)2-+ H2O
13. 2. ATP4- + H2O 🡪 ADP3- + HPO42- + H+ + 30.5 kJ
14. Which one is exothermic?
15. What is the net result of these two reactions being coupled?
16. Would the overall coupled reaction be endothermic or exothermic? Explain.
17. For each enzyme listed below, where is it located in the body? What might happen if that enzyme was not there or did not work properly? (From lab and lecture)

Salivary Amylase:

Pepsin (protease):

1. What is anabolism?
2. Prior to the Krebs cycle, the 2 pyruvate molecules from glycolysis are converted to 2 molecules of acetyl CoA. In the space below, SUMMARIZE the 3 steps of this reaction:
3. In the Krebs cycle, what molecule is given off as “exhaust?”



**Glycolysis**



Metabolism Worksheet KEY

1. What is the total number and the net number of ATP produced during glycolysis.

 A total of 4 ATP are produced by phosphorylation during glycolysis, but since 2 ATP were used in steps 1 and 3, the net total is 2 ATP.

1. What are the reactants and products of Glycolysis?

The reactants of glycolysis are glucose, 2 NAD+, 2 ADP, and 2 inorganic phosphates (also written as 2Pi in textbooks).

The products of glycolysis are 2 pyruvate, 2 NADH, 2 H+, and 2 net ATP. 2H2O also produced.

1. Which molecule/s is most likely to be used in a reaction coupled with the reaction shown below?

 glucose 🡪 glucose-6-phosphate

ATP (this is a phosphorylation reaction)

1. Why is Glycolysis considered a catabolic pathway?

Because it is a set of reactions that breaks food down into biochemical energy

1. Conversion of dihydroxyacetone phosphate to D-glyceraldehyde 3-phosphate is a(n)

Isomerization reaction

1. Both NAD+ and FAD are used for oxidation. Why do we have two oxidizers? What is each used for?

They oxidize different things. NAD+ is used for oxygen-containing groups while FAD is used for C-C bonds.

1. In steps 5-8 of the citric acid cycle, the high-energy molecules \_\_\_GTP, NADH\_\_\_\_\_, and \_\_FADH2\_\_\_\_\_\_ are produced, and \_\_\_oxaloacetate\_\_\_ is regenerated to begin another turn of the cycle.
2. Which step(s) of the Kreb’s cycle is/are catalyzed by an oxidoreductase?

STEP 2, 4, 5,6,7,8

1. List the 3 irreversible steps in glycolysis?

1. Hexokinase, Glucokinase

2. Phosphofructokinase-1

3. Pyruvate kinase

1. Kinase, isomerase, Dehydrogenase and Mutase are some of the enzymes found in Glycolysis? What are the functions of these enzymes? Does it result in a change in carbon #?

• Kinase- Addition or removal of a phosphate group, no change in carbon #

• Isomerase- Generates isomers by switcing the positions of chemical groups, change in oxidation state, no change in carbon #

• Dehydrogenase- an oxidoreductase enzyme that catalyzes the removal of hydrogen (can be reversible)

• Mutase- A mutase is an enzyme of the isomerase class that catalyzes the shifting of a functional group from one position to another within the same molecule.

1. Explain how it is possible that the initial reactant in glycolysis (glucose) has six carbons, but the product (acetyl-CoA) has three carbons.

Because glucose is split into two 3-carbon compound in steps 4 and 5 of glycolysis. Ultimately, two pyruvate ions are formed.

1. In the citric acid cycle, is the alcohol group in isocitrate oxidized, or reduced?

The alcohol is oxidized; it loses hydrogens.

1. What does coupling reactions mean?

The process of coupling reactions that are unfavorable with reactions that are favorable in order to make them “go.”

1. Consider the two reactions below.
2. 9.2 kJ + Glycerol + HPO42-🡪(Glycerol-3-Phosphate)2-+ H2O
3. 2. ATP4- + H2O 🡪 ADP3- + HPO42- + H+ + 30.5 kJ
4. Which one is exothermic? Second reaction since it energy is a product
5. What is the net result of these two reactions being coupled?

Glycerol + ATP4- 🡪 (Glycerol-3-Phosphate)2- +ADP3- + H+

1. Would the overall coupled reaction be endothermic or exothermic? Explain.

Exothermic: it release 21.3 kJ of energy

The energy released in step 2 is greater than the energy absorbed in step 1

1. For each enzyme listed below, where is it located in the body? What might happen if that enzyme was not there or did not work properly? (from lab and lecture)

Salivary Amylase:

* Enzyme that catalyzes the hydrolysis of starch into simpler compounds
* Helps begin the process of digestion in the mouth
* Present in human saliva (in the mouth)
* If it were not present, you would not be able to break down complex sugars into simpler sugars in your mouth, which would make digestion of sugars difficult.

Pepsin (protease):

* In stomach juice
* Helps breakdown proteins like those in dairy, meat, nuts, and eggs
* Small amounts are also found in the intestine and the blood stream.
* Without pepsin, the body would be unable to breakdown proteins into their peptide and amino acid parts.
1. What is anabolism?

Build large molecules from simple molecules (requires energy input, endothermic)

1. Prior to the Krebs cycle, the 2 pyruvate molecules from glycolysis are converted to 2 molecules of acetyl CoA. In the space below, SUMMARIZE the 3 steps of this reaction:
2. Carboxyl group removed & given off as CO2
3. Remaining 2-Carbon sugar fragment is oxidized to form acetate (extracted electrons are transferred to NAD+ to become NADH
4. Coenzyme-A is attached to the acetate to become Acetyl Co-A
5. In the Krebs cycle, what molecule is given off as “exhaust?” CO2