SI Biology - Full Discipline Demo

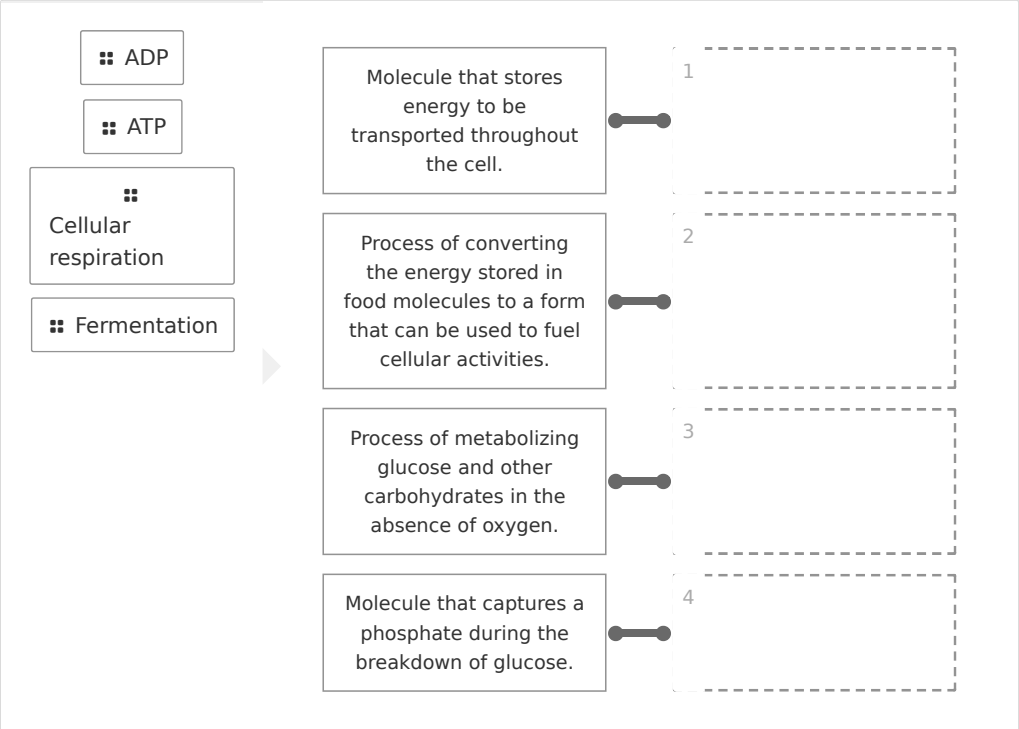
Cellular Respiration and Metabolism - Digital

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Biology - Full Discipline Demo
Course	SI Biology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

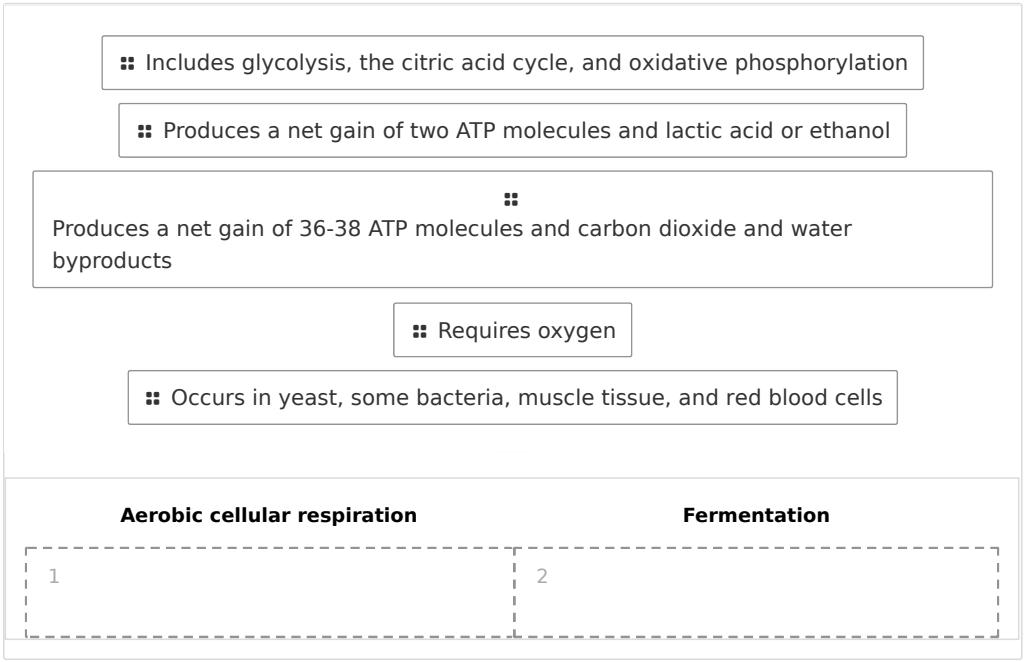
Match each term to the best description.



Correct answers:

1 ATP 2 Cellular respiration 3 Fermentation 4 ADP

Identify each characteristic as relating to aerobic cellular respiration or fermentation.



Correct answers:

1 Requires oxygen

Includes glycolysis, the citric acid cycle, and oxidative phosphorylation

Produces a net gain of 36-38 ATP molecules and carbon dioxide and water byproducts

2 Produces a net gain of two ATP molecules and lactic acid or ethanol

Occurs in yeast, some bacteria, muscle tissue, and red blood cells

Exploration

During cellular respiration, glucose reacts with _____ to produce carbon dioxide, water, and energy.

- phosphorus
- oxygen ✔
- nitrogen
- ATP

ATP is composed of the nucleotide adenine, a ribose sugar, and _____ phosphates.

- one
- two
- three ✔
- four

_____ is an eight-step process utilizing oxygen to complete the breakdown of glucose.

- The citric acid cycle ✔
- Glycolysis
- Oxidative phosphorylation
- Fermentation

Fermentation begins with _____, resulting in two molecules of ATP and two molecules of pyruvate.

- oxidative phosphorylation
- the citric acid cycle
- germination
- glycolysis ✔

Exercise 1

How much ATP was produced per molecule of glucose during aerobic respiration of the yeast in this exercise? Describe the steps of aerobic cellular respiration and the amount of energy produced by each step in your explanation.

At least 22 molecules of ATP were produced per molecule of glucose by the yeast in this exercise. Aerobic cellular respiration consists of **glycolysis**, which produces two net ATP molecules,

the **citric acid cycle**, which produces two molecules of ATP, and **oxidative phosphorylation**, which produces at least 18 molecules (normally 32-34) of ATP.

How long did the yeast metabolize glucose aerobically from the sugar water solution? Reference Photo 1 in your explanation.

The yeast metabolized glucose aerobically for 28 minutes. Photo 1 illustrates that oxygen levels dropped to 0 at 28 minutes preventing further aerobic respiration because oxygen is required for this metabolic process.

How much ATP was produced per molecule of glucose during fermentation by the yeast in this exercise? Describe the steps of carbohydrate fermentation in your explanation.

Two molecules of energy (ATP) were produced for each glucose molecule by the yeast during fermentation. Fermentation begins with glycolysis where two molecules of energy (ATP) and two molecules of pyruvate are produced from one molecule of glucose. The remaining steps of fermentation regenerate the electron carrier NAD^+ from the NADH produced in glycolysis, but do not produce additional ATP.

How did ethanol concentration indicate fermentation activity by the yeast in this exercise? Reference Data Table 1 in your explanation.

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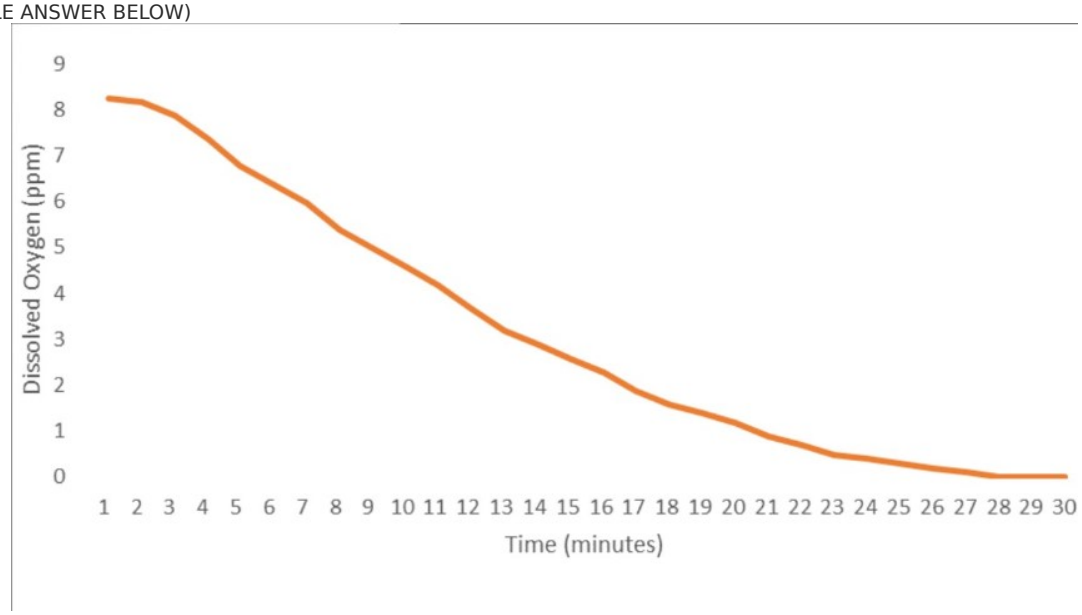
Data Table 1: Respiration and Observations

(SAMPLE ANSWER BELOW)

Day	Ethanol (%)
1	0.01
2	5
3	10
4	10

Photo 1: Oxygen Levels

(SAMPLE ANSWER BELOW)



Competency Review

_____ is represented by the equation:

$$C_6H_{12}O_6 + 6O_2 \rightarrow \ 6CO_2 + 6H_2O + \text{Energy}$$

- Fermentation
- Photosynthesis
- Cellular respiration ✔
- Glycolysis

ADP captures a _____ during the breakdown of glucose to reform ATP.

- phosphate ✔
- ribose
- carbon
- nucleotide

_____ involves the transfer of electrons to oxygen through a series of reactions involving intermediate carriers, producing 32-34 molecules of ATP.

- Glycolysis
- Fermentation
- The citric acid cycle
- Oxidative phosphorylation ✔

Fermentation is the process of metabolizing glucose and other carbohydrates to produce ATP in the absence of oxygen.

- True ✔
- False

In alcohol fermentation, two molecules of ethanol and two molecules of _____ result from the regeneration of NAD^+.

- [x] carbon dioxide
- [ ] oxygen
- [ ] sugar
- [ ] lactic acid

A(n) _____ can be used to measure aerobic respiration in a yeast culture bottle.

- [x] oxygen sensor
- [ ] airlock
- [ ] alcohol hydrometer
- [ ] pipet

An increase in the ethanol concentration of yeast culture over time indicates that the culture is fermenting carbohydrates.

- [x] True
- [ ] False

Extension Questions

Many microbe species, including the yeast from this experiment, are facultative anaerobes that can metabolize sugars by both aerobic respiration and by fermentation. Apply your knowledge of these processes and yeast metabolism to suggest the optimal growing conditions for facultative anaerobes to ensure maximum energy conversion during metabolism. (SAMPLE ANSWER BELOW)

The microbes should be grown in an oxygen rich environment to promote aerobic cellular respiration, which would produce up to 38 molecules of cellular energy (ATP) per molecule of glucose metabolized compared to fermentation which would only result in 2 molecules of ATP per molecule of glucose.