

Cellular Respiration and Metabolism Answer Guide

Exercise 1: Cellular Respiration

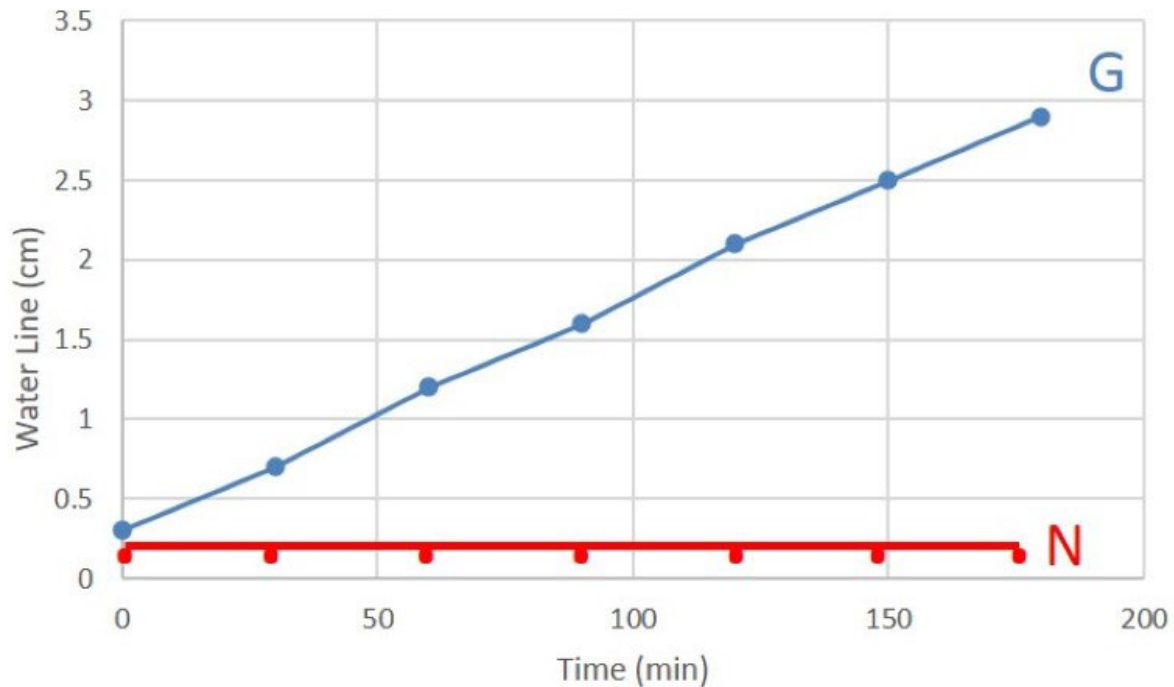
Data Table 1: Respiration and Observations

Time	Distance N (cm)	Distance G (cm)
0	0.1	0.3
30	0.1	0.7
60	0.1	1.2
90	0.1	1.6
120	0.1	2.1
150	0.1	2.5
180	0.1	2.9

Photo 1: Respiration Set-Up Results



Graph 1: Rates of Cellular Respiration



Question 1

Describe the steps of aerobic cellular respiration and the amount of energy produced by each step.

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 32-34 molecules of ATP.

Question 2

How do water level changes in the experimental setup demonstrate aerobic respiration in seeds?

Seeds undergoing aerobic cellular respiration absorb oxygen used in the citric acid cycle and oxidative phosphorylation processes and emit CO₂ as waste. The NaOH cotton absorbs and converts the CO₂ to a solid so that as oxygen is absorbed by the seeds, water is drawn into the tube.

Question 3

Which seeds were undergoing aerobic respiration? Explain your answer by referencing your results in Data Table 1, Photo 1, and Graph 1.

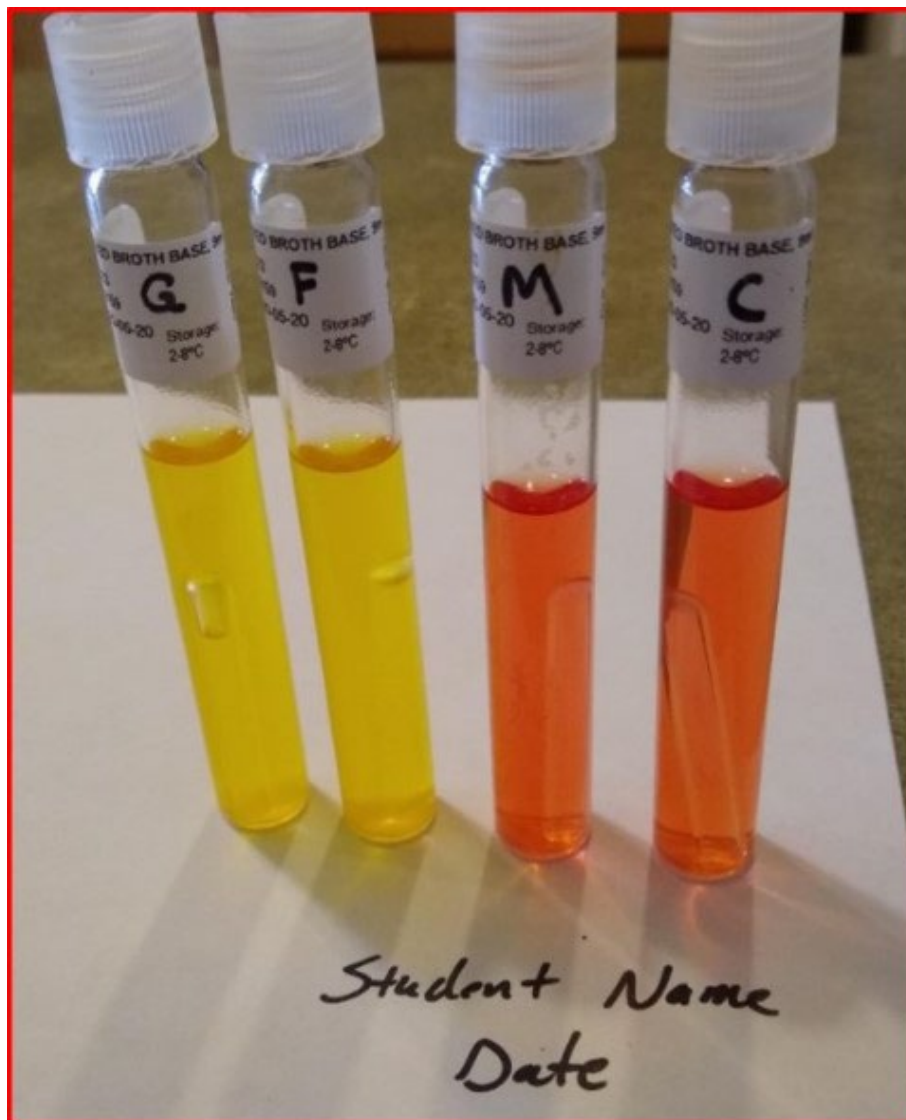
The germinated seeds were undergoing aerobic respiration, but the dormant seeds were not. Only the G test tube exhibited movement of the water line over the three hour period as recorded in Data Table 1, Photo 1, and Graph 1. The uptake of oxygen resulted in the water line moving up the test tube containing the germinated seeds. The water line remained stationary during the same period in the dormant seeds, suggesting no measurable oxygen was being consumed.

Exercise 2: Carbohydrate Fermentation

Data Table 2: Incubation Results

Vial	Color	Gas Production (Y/N)	Conclusion
Fructose	Yellow	Y	Fermentation with gas production
Glucose	Yellow	Y	Fermentation with gas production
Mannitol	Red	N	No fermentation
Control	Red	N	No fermentation

Photo 2: Fermentation Results



Question 1

Describe fermentation and the amount of energy it produces.

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

Question 2

How do color changes of broth and gas accumulation in Durham tubes demonstrate alcohol fermentation in yeasts?

The primary products of alcohol fermentation by yeast are ethanol and carbon dioxide. These products lower the pH of the media resulting in the phenol red (a pH indicator) changing color from red to yellow. The carbon dioxide gas produced from fermentation collects in the submerged Durham tubes.

Question 3

Were all three sugars fermented equally by the yeast? Explain your answer by referencing Data Table 2 and Photo 2.

Glucose was fermented most efficiently of the three carbohydrates as it resulted in both a broth color change and the accumulation of gas in the Durham tube as recorded in Data Table 2 and Photo 2. Fructose was also fermented, but not as efficiently as glucose, as indicated by the color change of the broth and small accumulation of gas in the Durham tube. Mannitol was not fermented and produced identical results to the control tube which lacked carbohydrates.