

Permeability of the Red Blood Cell

**By Name
Student ID**

BIO1140 Section B3

**Demonstrators:
Maddison Reed and
Dane Goh**

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**Department of Biology
University of Ottawa**

Table 1. Time of Hemolysis in Red Blood Cells in Five Different Solutions Tested in Lab

Solution	Time (s) ^a			Avg ^b (s)	Sd ^c (s)	Se ^d (s)
	Sample 1	Sample 2	Sample 3			
Distilled water	<2.00 ^e	<2.00	<2.00	2.00	0	0
Triton X-100 2% (v/v)	<2.00	<2.00	<2.00	2.00	0	0
Ethanol (0.3M)	<2.00	<2.00	<2.00	2.00	0	0
Thiourea (0.3M)	53.3	57.2	57.4	56.0	2.31	1.33
Dextrose (0.3M)	>1200.00 ^f	>1200.00	>1200.00	1200	0	0

a Time of hemolysis is measured in seconds

b Arithmetic mean in seconds

c Standard deviation in seconds

d Standard error in seconds

e hemolysis occurs in less than 2 seconds

f hemolysis occurs in more than 1200 seconds

What are the factors that affect the diffusion of the solutes tested in the permeability experiment?

Although there are many factors that affect the diffusion of solutes across the selectively permeable plasma membrane of red blood cells, the factors tested in this permeability experiment are the polarity, the size, and the concentration of different solutes.

How do these factors affect the diffusion of solutes?

The plasma membrane is a bilayer composed of amphipathic phospholipids. The outer surfaces, in contact with the extracellular matrix and the cytoplasm respectively, consist of hydrophilic phosphate group heads and the inner core consists of hydrophobic fatty acid tails. As a general trend, small, non-polar solutes can easily pass through the plasma membrane.

The polarity of a molecule affects diffusion across the plasma membrane due to their lack of interference in the hydrophilic- hydrophobic interactions of phospholipids. Dextrose is highly polar as a result of its five hydroxyl groups and thiourea is polar due to the nitrogen and sulphur present in the molecule. This explains the greater time required for hemolysis in solutions of Dextrose (D-Glucose) 0.3 M and Thiourea 0.3 M.

The size of a molecule (solute) is another factor that affects diffusion. Larger molecules such as sugars (seen in Dextrose) diffuse at slower rates than smaller molecules such as oxygen or carbon dioxide. A larger amount of phospholipid interactions need to be disrupted in order to allow larger molecules to pass. Although Triton X-100 2% (v/v) is a larger molecule relative to the others tested in this experiment, it displayed a time of hemolysis of fewer than 2 seconds. Triton X-100 is a detergent that can separate lipid molecules in the plasma membrane using amphipathic properties and can cause the cell to lyse¹. Thus, the polarity of a molecule can have a more pronounced effect on the rate of diffusion than size.

Although distilled water is a polar molecule, it is observed to have caused hemolysis in fewer than 2 seconds. This is due to the large concentration gradient between the red blood cells (RBCs) and the pure water solution. When animal cells (like RBCs) are placed in a hypotonic solution such as pure water, water will rush into the cells via osmosis and cause the cell to lyse. Ethanol is also polar due to its hydroxyl group, however it is able to form hydrogen bonds with lipids in the bilayer and increase the membranes solubility to water. This similarly causes the cell to lyse.

¹ Preté, P., Malheiros, S., Meirelles, N., de Paula, E., & Preté, P. (2002). Quantitative assessment of human erythrocyte membrane solubilization by Triton X-100. In *Biophysical chemistry* (Vol. 97, pp. 1–5). Retrieved from <http://search.proquest.com/docview/71796090/>