

## Lab 2: Osmosis and Hemolysis

Cells are surrounded by a plasma membrane that separates the contents of the cells from the solution bathing them. The cell membrane is a **selective barrier** allowing some molecules to pass through it easily, some not so easily, and some not at all. We will use the red blood cell (RBC) to study the movement of water and other molecules across the cell membrane. RBCs have **aquaporins** (water channels) in their plasma membranes that permit water to diffuse across the membrane, a process known as **osmosis**.

### Osmotic Flow

A difference in water concentration ( $[H_2O]$ ) on two sides of a membrane provides a driving force for water diffuse from the region of high  $[H_2O]$  to the region of low  $[H_2O]$ . For example, the  $[H_2O]$  is higher in a solution of 0.1 M NaCl than it is in a solution of 10 M NaCl.

Rather than speaking in terms of  $[H_2O]$  one usually speaks of osmolarity, which is a reflection of total solute particle concentration. The presence of solute in a solution reduces the water concentration of that solution. Body fluids (both intracellular and extracellular) generally have an osmolarity of about 300 mOsmolar (which is the same as 0.3 Osmolar).

### Volume Changes in the RBC Caused by Osmotic Forces - Hemolysis

Consider a red blood cell placed in a bathing solution of a non-penetrating solute (i.e. a solute that can't cross the membrane) that has a lower osmolarity than the cell contents. The difference in water concentration causes water to move down its concentration gradient into the cell, and consequently the cell swells. An associated effect is the diluting of the cell contents by the entering water. Water will continue to diffuse into the cell until the osmolarity is the same inside and out, at which point there is no longer a driving force for water to diffuse. In this instance, we are considering a solution with only non-penetrating solute, so diffusion of water into the cell is the only way that the osmolarity of the intra- and extra-cellular solutions can be equalized. The extent of swelling depends on the osmolarity of the non-penetrating solute in the bathing solution. If the bath osmolarity is very low, the cell membrane will be stretched until the cells burst (i.e., hemolysis). By finding the lowest osmolarity at which the cells can swell but not burst, one can estimate the amount of swelling the cell can withstand, i.e. the limit of cell fragility. This test is performed clinically, and changes in cell fragility are observed in several pathological situations (e.g. increased fragility in hereditary spherocytosis).

Intact RBCs scatter light in all directions, making it difficult to see through the solution (cloudy). The bursting of RBCs results in the release of hemoglobin and other cell contents into the medium containing them. These molecules in solution, being much smaller, allow the light to pass undeflected. Therefore, when hemolysis occurs, a suspension of RBCs turns from cloudy to clear.

### Observations with NON-PENETRATING Solutes

Red blood cells will be added to solutions of NaCl ranging from 40mM to 160mM. The NaCl molecule dissociates into separate  $Na^+$  and  $Cl^-$  ions in solution. The membrane is effectively impermeable to  $Na^+$  and  $Cl^-$  ions. **What is the osmolarity of each solution? In which solutions do you see hemolysis? Which way does water move across the cell membrane? Record your observations in the following table.**

	Distilled Water	NaCl 60mM	NaCl 70mM	NaCl 80mM	NaCl 100mM	NaCl 120mM	NaCl 140mM	NaCl 160mM
Osmolarity (mOsm)	0	120	140	160	200	240	280	320
Hemolysis?	Y	Y	Y	Y/N	N	N	N	N
Movement of Molecules?	$H_2O$ in	$H_2O$ in	$H_2O$ in	$H_2O$ in	$H_2O$ in	$H_2O$ in	$H_2O$ in	$H_2O$ out
Shape Changes?	Swell - burst	Swell - burst	Swell - burst	Swell - burst	Swell	Swell	Swell	Shrink

From the lowest NaCl concentration at which no hemolysis occurs, calculate the relative change in volume these red blood cells can tolerate before they lyse (burst).

# Student Manual Lab Answers

**Saura, Jose Ramon**



## **Student Manual Lab Answers:**

*Resources in Education*, 1997-07      Study Guide & Laboratory Manual for Physical Examination & Health Assessment E-Book Carolyn Jarvis, Ann L. Eckhardt, 2023-01-02 Both a comprehensive lab manual and a practical workbook the Study Guide Laboratory Manual for Physical Examination Health Assessment 9th Edition gives you the tools you need to master physical examination and health assessment skills in the lab and in clinical practice Corresponding to the bestselling Jarvis textbook this guide features terminology reviews application activities clinical judgment questions regional write up sheets and narrative summary forms with answers to study questions at the back of the book to facilitate both learning and review The 9th edition has been thoroughly updated with a fresh focus on the Next Generation NCLEX NGN with case studies featuring new NGN question formats to prepare you not only for the skills laboratory but for success on the NCLEX and in interprofessional collaborative practice Authoritative review and guidance for laboratory experiences personally written by the textbook authors provide a seamlessly integrated study and clinical experience Consistent format includes Terminology Review Study Guide and Clinical Judgment Questions in each chapter Physical examination forms familiarize you with what you will encounter in clinical practice and offer practice in documenting the patient history and examination findings The only full color illustrated lab manual available for a nursing health assessment textbook with anatomy exercises that align with the main text NEW Clinical judgment exercises equip you for success on the Next Generation NCLEX NGN including questions with an increased focus on clinical judgment robust single episode case studies that employ the latest NGN question types and unfolding case studies which reflect the language of the NCSBN Clinical Judgment Measurement Model NEW Chapter 33 includes unfolding case studies for the NGN that present opportunities for you to practice prioritizing decision making and using clinical judgment skills NEW Increased emphasis on activities focused on higher cognitive levels Applying and above UPDATED Critical Thinking Exercises offer suggested readings based on your participation in the skills lab and discussions with your instructor UPDATED Content corresponds to the 9th edition of the Jarvis textbook and incorporates the latest research and evidence based practice      Student Handbook and Solutions Manual Harry Nickla, Klug, 2002-08 Harry Nickla Creighton University This valuable handbook provides detailed step by step solutions or extensive explanations for every problem in the text Additional study aids include extra study problems chapter outlines vocabulary exercises and an overview of how to study genetics      **Laboratory Manual for Exercise Physiology, 2E** Haff, G. Gregory, Dumke, Charles, 2019 Laboratory Manual for Exercise Physiology Second Edition provides guided opportunities for students to translate their scientific understanding of exercise physiology into practical applications      *America's Lab Report* National Research Council, Division of Behavioral and Social Sciences and Education, Center for Education, Board on Science Education, Committee on High School Laboratories: Role and Vision, 2006-01-20 Laboratory experiences as a part of most U S high school science curricula have been taken for granted for decades but they have rarely been carefully examined

What do they contribute to science learning What can they contribute to science learning What is the current status of labs in our nation s high schools as a context for learning science This book looks at a range of questions about how laboratory experiences fit into U S high schools What is effective laboratory teaching What does research tell us about learning in high school science labs How should student learning in laboratory experiences be assessed Do all student have access to laboratory experiences What changes need to be made to improve laboratory experiences for high school students How can school organization contribute to effective laboratory teaching With increased attention to the U S education system and student outcomes no part of the high school curriculum should escape scrutiny This timely book investigates factors that influence a high school laboratory experience looking closely at what currently takes place and what the goals of those experiences are and should be Science educators school administrators policy makers and parents will all benefit from a better understanding of the need for laboratory experiences to be an integral part of the science curriculum and how that can be accomplished

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*Lab Experiments Microbiology Brf* Gerard J. Tortora,Christine L. Case,Ted R. Johnson,1986

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educational methodologies Teaching innovation is a pioneer in the understanding and comprehension of the different teaching methodologies and models developed in the academic area Teaching innovation is a process that seeks validation in the academic and teaching communities at universities in order to promote the improvement and its practices and uses in the future characterized by digital development and data based methods Teaching Innovation in University Education Case Studies and Main Practices features the major practices and case studies of teaching innovation developed in recent years at universities It is a source on study cases focused on teaching innovation methodologies as well as on the identification of new technologies that will help the development of initiatives and practices focused on teaching innovation at higher education institutions Covering topics such as didactic strategics service learning and technology based gamification this premier reference source is an indispensable resource for pre service teachers lecturers students faculty administrators libraries entrepreneurs researchers and academicians

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**Distributive Education from AIM, 1967-1971** United States. Office of Education,1972 **Resources in Education** ,1997

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