LIFE AND PHYSICAL SCIENCES
Student Learning Outcome Alignment Form

Course Prefix/Number: BIOL 1306

Course Title: Biology for Science Majors I

Core Objective	Course SLO	General Learning Activities	Assessment
Critical Thinking Skills	(SLO #10) Apply scientific reasoning to investigate questions and utilize scientific tools such as microscopes and laboratory equipment to collect and analyze data.	Enzyme lab where rates of catalase activity are investigated. Temperature, ph, concentration of substrate are examined. See attached activity.	Grade, included rubric. See attached rubric.
Communication Skills	(SLO# 4). Compare and contrast the structures, reproduction, and characteristics of viruses, prokaryotic cells, and eukaryotic cells	As essay question on the test, the student draws or describes the process of meiosis for a diploid organism for even numbers 2-10 (including interphase). See attached activity.	Test essay question, included rubric. See attached rubric
Empirical & Quantitative Skills	(SLO #7)Identify the principles of inheritance and solve classical genetic problems.	Student works Mendelian genetics problems. See attached activity.	Test questions, included rubric. See attached rubric
Teamwork	(SLO #17) Describe the structure of cell membranes and the movement of molecules across a membrane.	Students work in groups of four, using electrical conductivity probes to track ions across membranes into sucrose or water solutions. The students determine rates of diffusion with different concentration gradients, compare with sucrose and water solutions. See attached activity.	Grade and included rubric. See attached rubric

CRITICAL THINKING VALUE RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric

Definition

Critical thinking is a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Explanation of Issues	Did not state issue.	Issue is stated without clarification or description.	Issue is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined and/or backgrounds unknown.	Issue is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.
Evidence	Does not identify the basic components of an issue	Information is taken from sources without any interpretation. Viewpoints of experts are taken as fact, without question	Information is taken from sources with some interpretation but not enough to develop a coherent analysis or synthesis.	Information is taken from sources with enough interpretation to develop a coherent analysis or synthesis.	Information is taken from sources with enough interpretation to develop a comprehensive analysis or synthesis.
Influence of Context and Assumptions	Did not show awareness of the issue.	Show an emerging awareness of present assumptions.	Questions some assumptions. Identifies relevant information when presenting a position.	Identifies own and others' assumptions and several relevant contexts when presenting a position.	Thoroughly analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.
Student's Position	Takes no position on issue	Specific position is stated but is simplistic and obvious.	Specific position acknowledges different sides of an issue.	Specific position takes into account the complexities of an issue. Others' points of view are acknowledged within position.	Specific position is imaginative. Limits of position acknowledged. Other points of view are synthesized.

Conclusions and Related Outcomes	Does not use previously learned information in new situations.	Conclusion is inconsistently tied to some of the information discussed; related outcomes are oversimplified.	Conclusion is logically tied to information; some related outcomes are identified.	Conclusion is logically tied to a rage of information, including opposing viewpoints; related outcomes are identified clearly	Conclusions and related outcomes are logical and reflect student's informed evaluation and ability to place evidence and perspectives discussed in priority order

Communication RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric and Making Learning Real

Definition

Written communication is the development and expression of ideas in writing.
Oral Communication is a prepared, purposeful presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors.
Visual Communication is the use of images to persuade, entertain, inform, and enlighten an observing audience of products, ideas, and messages.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Quality of Information and Organization	Presentation lacks main points and related details. Information lacks connection to the presentation topic. Information is not organized.	Main points are not clear and lack significant detail. Some information is linked to the presentation topic. Information is loosely organized.	Main points are somewhat clear but could use more detail. Most information is linked to the presentation topic. Information is organized.	Main points are clear and detailed. Information is linked to presentation topic. Information is well organized.	Main points are very clear and very detailed. Information is directly linked to presentation topic. Information is very organized.
Nonverbal Communication	Speaker appears very uneasy and insecure. Speaker faces away from the audience or makes no eye contact. Speaker appears disengaged from the audience. Speaker uses few body motions or gestures or has gestures or movements that distract the audience.	Speaker appears uneasy and somewhat insecure. Speaker rarely faces the audience or makes eye contact. Speaker rarely appears to be engaging with the audience. Speaker uses few body motions or has gestures or movements that distract the audience..	Speaker appears generally at ease and confident. Speaker sometimes faces the audience and maintains eye contact. Speaker sometimes appears to be engaging with the audience. Speaker's body motions and gestures neither support nor detract from presentation.	Speaker appears fairly comfortable and confident. Speaker generally faces the audience and maintains good eye contact. Speaker generally appears to be engaging with the audience. Speaker uses body motions and gestures well.	Speaker appears very comfortable and confident. Speaker consistently faces the audience and maintains good eye contact. Speaker consistently appears to be engaging with the audience. Speaker uses body motions and gestures very effectively.
Quality of Verbal Communication	Speaker's voice is consistently too weak or too strong. Speaker fails to use inflections to emphasize key points and create interest or often uses inflections	Speaker's voice is frequently too weak or too strong. Speaker rarely uses inflections to emphasize key points and create interest or speaker sometimes uses	Speaker's voice is generally steady strong and clear. Speaker sometimes uses inflections to emphasize key points and create interest.	Speaker's voice is steady, strong, and clear. Speaker often uses inflections to emphasize key points and create interest. Speaker's	Speaker's voice is very confident, steady, strong, and clear. Speaker consistently uses inflections to emphasize key points or to create interest. Speaker's

	inappropriately. Speaker's talking paces is consistently too slow or too fast.	inflections inappropriately. Speaker's talking pace is often too slow or too fast.	Speaker's talking pace is appropriate.	talking pace is mostly appropriate.	talking pace is consistently appropriate.
Visual Tools	Visual aids demonstrate no creativity or clarity and are often difficult to read. Presentation is weakened by the visual tools.	Visual aids have limited creativity or clarity or are sometimes difficult to read. Presentation is not enhanced by the visual tools.	Visual aids are reasonably creative, clear, and easy to read. Presentation is sometimes enhanced by the visual tools.	Visual aids are usually creative, clear, and easy to read. Presentation is often enhanced by the visual tools.	Visual aids are very creative, clear, and easy to read. Presentation is consistently enhanced by the visual tools.
Appropriate Use of Vocabulary	Few or no terms are included in the presentation. May or may not be used appropriately. Lacks context.	Several terms are included in the presentation. May or may not be used appropriately. May lack context.	Most terms are included in the presentation. Generally used appropriately. Generally used in appropriate context.	All terms are included in the presentation. Used effectively. Used in context.	All terms are included in the presentation. Used in unique and creative ways. Used in context
Precision and Detail in Documents Produced	Written documents have numerous errors and lack detail. Little carte taken in the production.	Documents may have some errors and show some detail. Some care has been taken in production.	Evident that written documents are correct and show a general attention to detail and accuracy. General care has been taken in production.	Clearly evident that written documents are correct, detailed and accurate. Care has been taken in production.	Documents are clear, well-constructed, accurate, and show attention to detail. Extra care has been taken in the production of written documents.
Overall Presentational Effectiveness	The presentation was weak and not effective.	The presentation was average and somewhat effective.	The presentation was good and effective.	The presentation was very good and effective.	The presentation was exceptional and extremely effective.

Empirical and Quantitative Skills RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric

Definition

The ability to formulate an inquiry that is scientific or mathematical in nature, and then manipulate and analyze numerical data and/or follow an investigative process using empirical and/or quantitative reasoning to satisfy the inquiry and create informed conclusions.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Identification	The purpose, components, and variables of the investigation/project are not identified.	The purpose, components, and variables of the investigation/project are somewhat identified.	The purpose, components, and variables of the investigation/project are mostly identified	The purpose, components, and variables of the investigation/project are clearly identified..	The purpose, components, and variables of the investigation/project are clearly identified.
Assimilation	The information that is required for an analysis of all investigative components is not evident. If applicable, values are incorrectly translated into variables and no necessary formulas are present.	The information that is required for an analysis of all investigative components is somewhat evident. If applicable, values are incorrectly translated into variables and some necessary formulas are present.	The information that is required for an analysis of all investigative components is mostly evident. If applicable, some values are correctly translated into variables and most necessary formulas are present.	The information that is required for an analysis of all investigative components is evident. If applicable, most values are correctly translated into variables and all necessary formulas are present.	The information that is required for an analysis of all investigative components is clearly evident. If applicable, values are correctly translated into variables and all necessary formulas are present.
Analysis	Most investigative or quantitative components are not scrutinized. The steps followed are illogical and/or irrelevant to the desired result. The proper tools/ technology were not used and/or integrated	Some investigative or quantitative components are scrutinized. Some steps followed are somewhat logical and relevant to the desired result. The proper tools/ technology were	All investigative or quantitative components are somewhat scrutinized. The steps followed are mostly logical and relevant to the desired result. The proper tools/ technology were mostly	All investigative or quantitative components are scrutinized. The steps followed are logical and relevant to the desired result. The proper tools/ technology were used and mostly integrated into the	All investigative or quantitative components are methodically scrutinized. The steps followed are logical and relevant to the desired result. The proper tools/ technology were used and

	into the final product. Any notation is not consistent and not defined.	somewhat used and not integrated into the final product. Any notation is somewhat consistent but not defined.	used and somewhat integrated into the final product. Any notation is mostly consistent and defined.	final product. Any notation is consistent and well defined.	well integrated into the final product. Any notation is consistent and well defined.
Presentation	A summary of the analysis is either inadequately presented or not presented at all. The presented information is mostly incorrect, and/or of poor quality, and/or the terminology/figures are inaccurate and/or hard to understand. Few or no visual representations of evidence are acceptably scaled/ represent the analysis findings.	A partial summary of the analysis is presented. The presented information is somewhat correct, of adequate quality, and the terminology/figures are somewhat accurate and relatively easy to understand. Some visual representations of evidence are acceptably scaled and represent the analysis findings.	A summary of the analysis is presented. The presented information is mostly correct, of good quality, and the terminology/figures are mostly accurate and easy to understand. Most visual representations of evidence are acceptably scaled and represent the analysis findings.	A good summary of the analysis is presented. The presented information is correct, of good quality, and the terminology/figures are accurate and easy to understand. Most visual representations of evidence are well-scaled and/or well represent the analysis findings..	A concise summary of the analysis is presented. The presented information is correct, of high quality, and the terminology/figures are accurate and easy to understand. All visual representations of evidence are well-scaled and well represent the analysis findings.
Application	The integration does not include all steps of the investigation and does not lead to an accurate, nor complete conclusion that relates to the initial investigative argument.	The integration of most steps of the investigation lead to a somewhat accurate, partially complete conclusion that is relative to the initial investigative statement.	The coherent integration of most steps of the investigation lead to an accurate, mostly complete, acceptable conclusion that is relative to the initial investigative statement.	The coherent integration of all steps of the investigation lead to an accurate, mostly complete, relevant conclusion that is relative to the initial investigative statement.	The coherent integration of all steps of the investigation lead to an accurate, complete, relevant conclusion that is relative to the initial investigative statement.

Teamwork Skills RUBRIC

Adapted for Texarkana College from the AAC&U Critical Thinking VALUE Rubric

Definition

Teamwork is behaviors under the control of individual team members, their manner of interacting with others on team, and the quantity and quality of contributions they make to team discussions.

	Does Not Meet Any Expectations 1	Meets Few Expectations 2	Meets Expectations 3	Exceeds Some Expectations 4	Exceeds All Expectations 5
Contributes to Team Meetings	Does not collect any relevant information; no useful suggestions to address team's needs;	Shares ideas but does not advance the work of the group.	Offers new suggestions to advance the work of the group	Offers alternative solutions or courses of action that build on the ideas of others.	Helps the group move forward by articulating the merits of alternative ideas or proposals
Facilitates the Contributions of Team Members	Often argues with team mates; doesn't let anyone else talk; occasional personal attacks and "put-downs"; wants to have things done his way and does not listen to alternate approaches;	Engages group by taking turns and listening to others without interrupting.	Engages group by restating the views of other members and/or asking questions for clarification.	Engages group by constructively building upon or synthesizing the contributions of others..	Engages group by both constructively building upon and synthesizing the contributions of others as well as noticing when someone is not participating and inviting him/her to engage.
Individual Contributions Outside of Team Meetings	Completes no assigned tasks outside of team meetings.	Completes some assigned tasks by deadline.	Completes all assigned tasks by deadline; work accomplished advances the project.	Completes all assigned tasks by deadline; work accomplished and is thorough, comprehensive, and advances the project.	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project. Proactively helps other team members complete their assigned tasks to a similar level of excellence.

Fosters Constructive Team Climate	Is argumentative and does not work with the team.	Supports a constructive group climate by treating other members respectfully.	Supports a constructive group climate by treating other members respectfully and conveying a positive attitude about the group and its work.	Supports a constructive group climate by treating other members respectfully, conveying a positive attitude about the group and its work, and motivating other group members.	Supports a constructive group climate by treating other members respectfully, conveying a positive attitude about the group and its work, motivating other group members, and providing assistance to group members.
Responds to Conflict	Is not present enough to engage in conflict.	Passively accepts alternate viewpoints/ideas/opinions.	Redirects focus toward common ground, toward task at hand (away from conflict)..	Identifies and acknowledges conflict and stays engaged with it.	Addresses conflict directly and helps to manage/resolve it in a way that strengthens overall group cohesiveness.

Syllabus: Principles of Biology I for Science Majors
Course Number: BIOL 1406
Semester & Year: Fall 2013

Instructor Information

Name: Mark Storey
Office: Chemistry Building Rm. 202
Telephone: 903-823-3298
E-mail: Mark.Storey@texarkanacollege.edu
Office Hours:

Textbook Information

- **Principles of Life**. Hillis, Sadava, Heller and Price 1st ed.(2012) Sinauer Assoc Inc and W.H. Freeman and Co. **ISBN 978-1-4292-5721-3** (required)
- Lab Packet – Prof. STOREY (required)
- Protective clothing - Safety glasses will be required for certain lab activities, lab coat or apron (old work shirt) is encouraged.
- Optional Website: (yourBioPortal.com) http://courses.bfwpub.com/hillis1e.php

Student Learning Outcomes for the Course

*At the conclusion of the **lecture portion** of this course students should be able to:*

1. Describe the characteristics of life.
2. Explain the reasoning used by scientists.
3. Identify the basic properties of substances needed for life.
4. Compare and contrast the structures, reproduction, and characteristics of viruses, prokaryotic cells, and eukaryotic cells.

5. Describe the structure of cell membranes and the movement of molecules across a membrane.
6. Identify the substrates, products, and important chemical pathways in metabolism.
7. Identify the principles of inheritance and solve classical genetic problems.
8. Identify the chemical structures, synthesis, and regulation of nucleic acids and proteins.
9. Describe the unity and diversity of life and the evidence for evolution through natural selection.

*At the conclusion of the **laboratory portion** of this course students should be able to:*

1. Be able to apply scientific reasoning to investigate questions, and utilize scientific tools such as microscopes and laboratory equipment to collect and analyze data.
2. Use critical thinking and scientific problem-solving to make informed decisions in the laboratory.
3. Communicate effectively the results of investigations.
4. Describe the characteristics of life.
5. Explain the reasoning used by scientists.
6. Identify the basic properties of substances needed for life.
7. Compare and contrast the structures, reproduction, and characteristics of viruses, prokaryotic cells, and eukaryotic cells.
8. Describe the structure of cell membranes and the movement of molecules across a membrane.
9. Identify the substrates, products, and important chemical pathways in metabolism.
10. Identify the principles of inheritance and solve classical genetic problems.
11. Identify the chemical structures, synthesis, and regulation of nucleic acids and proteins.
12. Describe the unity and diversity of life and the evidence for evolution through natural selection.

Student Requirements for Completion of the Course

Lecture Topics/ Exams - Biology 1406 Spring 2013

EXAM I

Chapter 1: Principles of Life

Chapter 2: Life Chemistry and Energy

Chapter 3: Nucleic Acids, Proteins and Enzymes

Chapter 4: Cells: The Working Units of Life

EXAM II

Chapter 5: Cell Membranes and Signaling
Chapter 6: Pathways that Harvest and Store Chemical Energy
Chapter 7: The Cell Cycle and Cell Division

Chapter 8: Inheritance, Genes and Chromosomes

EXAM III
Chapter 9: DNA and Its Role in Heredity
Chapter 10: From DNA to Protein: Gene Expression
Chapter 11: Regulation of Gene Expression

Chapter 12: Genomes

FINAL EXAM (Comprehensive) Emphasis on Student Learning Guide Questions Chapters 1-11 and selected essay questions from Exams I, II, and III.

Student Assessment

Three (3) lecture exams will be given over thee units and a comprehensive final exam, for a total of four exams valued at 55% of the course grade. The examination format will include multiple choice, short answer and essay items. Exams will be administered a minimum of one (1) week after being announced. Please inform the instructor ASAP if you know you will miss a lecture exam on the scheduled date and make arrangements to take the exam in advance. Portions of the lecture unit exams will be conducted in the TC testing center.

Course Testing POLICY - TC Testing Center

Lecture Exams are conducted using the TC CMS (Moodle) and administered in the TC testing Center.

Part 1: Section A 40 multiple guess questions (56 points/100)
This part of the exam consists of 40 multiple guess "choice" questions. (each question is valued @ 1.4 points each) This portion is not timed but must be completed in one session, and you only have 1 attempt to complete this 40 question session.

You are also required to take Part I: Section B: 10 question Merit based curve portion of the exam (10 questions @ 1.4 points = 14 points) **during the same testing session in the TC testing center.** **(Failure to complete this portion during the same session will result in a score of zero on Part B of the exam.)**

Part II: Essay/short answer portion of the exam is available by requesting a test booklet from the TC testing center proctor. Write your responses on the test booklet. No outside paper is allowed on this exam. **You are NOT required to take the essays during the same test session as Part I SectionA & Section B**.

EXAM must be completed by _____ before the close of the testing center that evening. (can't start a test after 8PM ... center closes at 8:30PM.)

I understand the course requirement to take the two (2) parts of the remaining lecture exams Part I Section A and Part 1 Section B (Total of 70 points) during the same testing session (no break allowed) on the Moodle Course Management System (TC Online). I understand that I may take the Part II Essay (30 points) during a different testing session. All sections of the exam must be completed prior to the exam deadline. I also understand no outside materials (paper, study materials) are allowed to be brought in to the testing center.

I understand that there are no makeup exams available for these exams.

The course grade will be calculated from the following schedule:

Lecture Exams (3) & Final Exam (1)	**55%**
Online Weekly Quizzes	**10%**
Lab Exams + Participation Lecture & Lab	**20%**
Lab Reports	**15%**
Total	**100%**

Grading Scale

Semester Grade	Course Average
A	90-100
B	80-89
C	70-79
D	60-69
F	59-below

Class Schedule

Chapter 1: Principles of Life
Chapter 2: Life Chemistry and Energy
Chapter 3: Nucleic Acids, Proteins and Enzymes

Chapter 4: Cells: The Working Units of Life

EXAM I (Chapters 1-4) (5th week)

Chapter 5: Cell Membranes and Signaling
Chapter 6: Pathways that Harvest and Store Chemical Energy
Chapter 7: The Cell Cycle and Cell Division

Chapter 8: Inheritance, Genes and Chromosomes
EXAM II (Chapters 5-8) (10th week)

Chapter 9: DNA and Its Role in Heredity
Chapter 10: From DNA to Protein: Gene Expression
Chapter 11: Regulation of Gene Expression

EXAM III (Chapters 9-12) (15th week)

Absentee Policy *(TC Official Policy)*

> *Texarkana College's absentee policy allows instructors to withdraw a student from a course due to excessive absences. If a student leaves and returns during class or leaves the class before the class is over, he/she may be considered absent. Three tardies constitute one absence. Check the syllabus for each class to see how much time you are allowed to be late before the tardy is counted as an absence.* **(10 minutes after class has begun)**
> *Do no stop attending a class without formally withdrawing from the course by the institution's published Last Day to Drop. If a student does not attend class and does not withdraw from the class, the student will receive a grade of F in the class. The published Last Day to Drop applies to students; an instructor may withdraw a student for excessive absences at any time during the semester. Withdrawal from a course(s) may affect a student's current or future financial aid eligibility. Students should consult the Financial Aid Office to learn both short and long term consequences of a withdrawal.*

As an adult learner, you must assume responsibility for attending lecture classes and laboratories. It is to your benefit to be present at each class session. You should make every effort to be present in each class because: the laboratory class is designed to provide hands-on learning experiences. Students will learn basic laboratory skills while reinforcing concepts learned in lecture. To a large extent, grades in the laboratory will reflect participation and laboratory skills acquired, so it is important that students do not miss laboratory exercises.

The maximum number of absences in a MW or T-TR class is four (4) per semester (the equivalent of two (2) weeks of instruction). The only excused absences are for officially recognized TC student club activities or for Texarkana College official business. **Please Note: Illness and doctor appointments do not qualify as an excused absence.**

> ***EXCUSED ABSENCES*** *(TC Official Policy)*
>
> *A student's absence due to school trips and/or school business will not be counted against a student's allowable number of absences. Military duty and absences for Holy Days (FBD LEGAL) are covered in a separate section of the catalog and the student handbook. These are the only types of absences that are considered excused by Texarkana College. Responsibility for work missed for any absence is placed on the student. Instructors are required to allow students to make up work missed if the absence is due to military duty or religious holy days when students follow the correct*

notification procedures. Instructors are not required to allow students to make up work for absences due to other reasons. Make-up policies are listed in each individual instructor's syllabus.

WARNING: If you exceed the maximum number of absences for this course (lecture and lab are counted together you will be dropped (W) from the course. For example if you miss a lecture and attend the lab you will be counted absent for that class session (maximum of 4 sessions) (NO EXCEPTIONS).

Students are required to attend lecture and laboratory classes for the entire period. Students that arrive more than 10 minutes after class has begun or leave early, will be marked as absent. Students that arrive between 1 and 10 minutes after class has begun will be recorded as tardy. **Three tardies will be recorded as an absence**. Students that sleep during class, ignore this class because they are busy texting, chatting, checking social media sites or doing homework for other classes or do not participate in class activities for any other reason, **will be marked as absent!**

If situations make it necessary for missing class or lab you are still responsible for all the work you missed during class and lab. If you miss class, you should let me know ASAP (by TC student e-mail) and in advance if at all possible. I can give you the assignments to help you remain current in the course.

If circumstances develop (e.g. extended illness, moving from the city, etc.) which necessitates your withdrawal from this or any other course be sure to let me know AND officially withdraw in the Director of Admissions office located in the C. M. Nelson Administration building. The date each semester is posted on the inside page of the current Texarkana College Catalog / Website under "Academic Calendar". A grade of W is recorded on your permanent transcript *if you withdraw before the official deadline*.

Make-up Policy

Lecture Exams: The only portions of lecture exams that will be available as a makeup exam (only during final exam week) will those portions of an exam that were administered during a regular classroom session. All portions of exams that were originally administered over a period of time in the college testing center **cannot** be made up. NO EXCEPTIONS will be made to this policy.

IMPORTANT: No class curve (grade adjustment) is applied to make up exams.

Lab Exams: No makeup exams are available for Lab Exams !

Lab Reports and other written assignments in lecture and lab are due at the beginning of the class session (lecture) and will be penalized 10% for being late for the first 24 hours and 20% for the second 24 hours and will not be accepted after 48 hours . Late work can be turned in via e-mail to my e-mail address: *Mark.Storey@texarkanacollege.edu*

Class Conduct

Students are expected to conduct themselves as adults. Any student who acts in such a manner as to disturb the class and interfere with the learning process will be expelled from the course with a grade of "F". **No music players or cellular phones are permitted in my classroom**. **No texting or talking during class...TURN THEM OFF!** (See Absentee Policy above)
If you bring a cell phone (electronic communication device) into my classroom, be sure that it is **turned off and not out on your desk.** If I notice you using your phone during lecture and ask you to turn it off on the first offense the second time **you will be asked to leave and you will be counted absent for that class period.** (You will be free to communicate electronically during breaks during each class session.)

Any student that has a cell phone or any electronic communications device in their possession during any quiz or examination will receive a zero (0) for the quiz or examination. NO EXEPTIONS! You will also be counted absent for that class session.

All electronic devices (e.g. audio recorders, laptop/tablet computers etc.) brought into class must be cleared by the instructor for use for **each** class session.

Academic Integrity Statement

Scholastic dishonesty, involving but not limited to cheating on a test, plagiarism, collusion, or falsification of records will make the student liable for disciplinary action after being investigated by the Dean of Students. Proven violations of this nature will result in the student being dropped from the class with an "F".

This policy applies campus wide, including TC Testing Center, as well as off-campus classroom or lab sites, including dual credit campuses. This information can be found in the Student Handbook at https://texarkanacollege.edu.

Disability Act Statement:

Texarkana College complies with all provisions of the Americans with Disabilities Act and makes reasonable accommodations upon request. Please contact Larry Andrews at 903.823.3283, or go by the Recruitment, Advisement, and Retention Department located in the Administration building for personal assistance.

If you have an accommodation letter from their office indicating that you have a disability which requires academic accommodations, please present it to me so we can discuss the accommodations that you might need for this class. *It is best to request these changes at the beginning if not before the start of class* so there is ample time to make the accommodations..

Financial Aid:

Attention! Dropping this class may affect your funding in a negative way! You could owe money to the college and/or federal government. Please check with the Financial Aid office before making a decision.

Course Continuity Plan

In the case that the college officially closes because of an emergency (inclement weather etc.) which causes a short term disruption of this course, we will use the TC Moodle CMS ("TC Online") and TC student e-mail to continue this course in the short term (1-3 weeks). All students need to use their campus e-mail to receive course related information.

I reserve the right to modify the syllabus at any time during the semester. The online version of this syllabus (*TC Online CMS*) is the official syllabus and supersedes all versions of this document in print.

Current version last updated July 22, 2013

By signing this statement, I agree that I have read and understand what is expected of me to perform satisfactorily in this course of study.

I also understand that any photographic and or audio recordings that are made of students including myself) during this class of are the property of Texarkana College and can be used to promote the educational mission of Texarkana College.

_____

Student Name (**PRINT** First & LAST NAME)

Legal Signature

TC Course Number / Section Number

Date

6B

Enzyme Action: Testing Catalase Activity

Many organisms can decompose hydrogen peroxide (H_2O_2) enzymatically. Enzymes are globular proteins, responsible for most of the chemical activities of living organisms. They act as *catalysts*, substances that speed up chemical reactions without being destroyed or altered during the process. Enzymes are extremely efficient and may be used over and over again. One enzyme may catalyze thousands of reactions every second. Both the temperature and the pH at which enzymes function are extremely important. Most organisms have a preferred temperature range in which they survive, and their enzymes most likely function best within that temperature range. If the environment of the enzyme is too acidic or too basic, the enzyme may irreversibly *denature*, or unravel, until it no longer has the shape necessary for proper functioning.

HzOz is toxic to most living organisms. Many organisms are capable of enzymatically destroying the I-IzOz before it can do much damage. H_2O_2 can be converted to oxygen and water, as follows:

$$2\ HzOz \longrightarrow 2\ HzO + Oz$$

Although this reaction occurs spontaneously, enzymes increase the rate considerably. At least two different enzymes are known to catalyze this reaction: *catalase*, found in animals and protists, and *peroxidase*, found in plants. A great deal can belearned about enzymes by studying the rates of enzyme-catalyzed reactions.

In this experiment, you will measure the rate of enzyme activity under various conditions, such as different enzyme concentrations, pH values, and temperatures. It is possible to measure the pressure of oxygen gas formed as H_2O_2 is destroyed. If a plot is made, it may appear similar to the graph shown.

At the start of the reaction, there is no product, and the pressure is the same as the atmospheric pressure. After a short time, oxygen accumulates at a rather constant rate. The slope of the curve at this initial time is constant and is called the *initial rate*. As the peroxide is destroyed, less of it is available to react and the O_2 is produced at lower rates. When no more peroxide is left, O_2 is no longer produced.

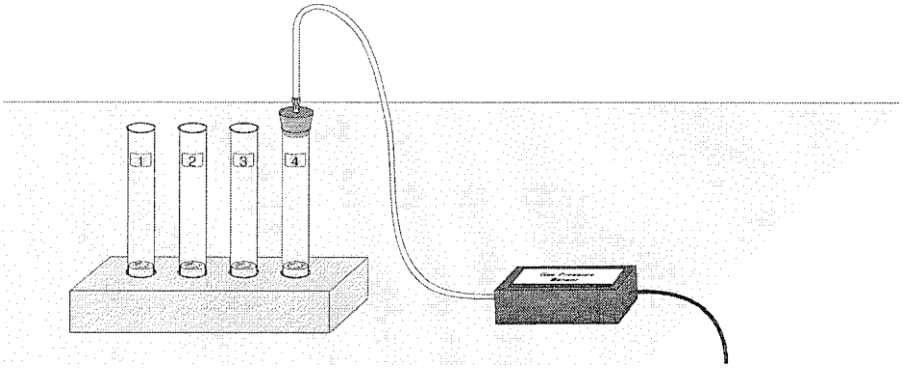


Figure 1

OBJECTIVES

In this experiment you will

- Use a Gas Pressure Sensor to measure the production of oxygen gas as hydrogen peroxide is destroyed by the enzyme catalase or peroxidase at various enzyme concentrations.
- Measure and compare the initial rates of reaction for this enzyme when different concentrations of enzyme react with H_2O_2.
- Measure the production of oxygen gas as hydrogen peroxide is destroyed by the enzyme catalase or peroxidase at various temperatures.
- Measure and compare the initial rates of reaction for the enzyme at each temperature.
- Measure the production of oxygen gas as hydrogen peroxide is destroyed by the enzyme catalase or peroxidase at various pH values.
- Measure and compare the initial rates of reaction for the enzyme at each pH value.

MATERIALS

LabQuest
LabQuest app
Vernier Gas Pressure Sensor
rubber-stopper assembly
10 mL graduated cylinder
250 mL beaker of water
3% l-IzOz
600 mL beaker
enzyme suspension
four 18 x 150 mm test tubes
ICC
pH buffers
test tube rack
thermometer
four dropper pipettes
Logger *Pro(* optional)

PROCEDURE

1. Obtain and wear goggles.
2. Connect the plastic tubing to the valve on the Gas Pressure Sensor.
3. Connect the Gas Pressure Sensor to LabQuest and choose New from the File menu. If you have an older sensor that does not auto-ID, manually set up the sensor.
4. On the Meter screen, tap Rate. Change the data-collection rate to 0.5 samples/second and the data-collection length to 180 seconds.

Part I Testing the Effect of Enzyme Concentration

5. Place four test tubes in a rack and label them 1, 2, 3, and 4.
6. Add 3 mL of 3.0% H_2O_2 and 3 mL of water to each test tube.
7. Use a clean dropper pipette to add 1 drop of enzyme suspension to test tube 1. Note: Be sure not to let the enzyme fall against the side of the test tube.

8. Stopper the test tube and gently swirl to thoroughly mix the contents. The reaction should begin. The next step should be completed as rapidly as possible.
9. Connect the free-end of the plastic tubing to the connector in the rubber stopper as shown in Figure 2. Start data collection. Data collection will end after 3 minutes.
10. Monitor the pressure readings displayed on the handheld screen. If the pressure exceeds 130 kPa, the pressure inside the tube will be too great and the rubber stopper is likely to pop off. Disconnect the plastic tubing from the Gas Pressure Sensor if the pressure exceeds 130 kPa.
11. When data collection has finished, an auto-scaled graph of pressure *vs.* time will be displayed. Disconnect the plastic tubing connector from the rubber stopper. Remove the rubber stopper from the test tube and discard the contents in a waste beaker.

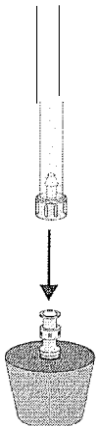


Figure 2

12. To examine the data pairs on the displayed graph, select any data point. As you tap on each data point, the pressure and time values are displayed to the right of the graph.
13. Determine the rate of enzyme activity for the curve of pressure *vs.* time. To help make comparisons between experimental runs, choose your data points at the same time values.
    a. Choose Curve Fit from the Analyze menu.
    b. Select Linear for the Fit Equation. The linear-regression statistics for these two data columns are displayed for the equation in the form
    $$y = mx + b$$
    c. Enter the absolute value of the slope, *m*, as the reaction rate in Table 2.
    d. Select OK.
14. Store the data from the first run by tapping the File Cabinet icon.
15. Find the rate of enzyme activity for test tubes 2, 3 and 4:
    a. Add 2 drops of the enzyme solution to test tube 2. Repeat Steps 8-14.
    b. Add 3 drops of the enzyme solution to test tube 3. Repeat Steps 8-14.
    c. Add 4 drops of the enzyme solution to test tube 4. Repeat Steps 8-13.
16. Graph all four runs of data on a single graph.
    a. Tap Run 4, and select All Runs. All four runs will now be displayed on the same graph axes.
    b. Use the displayed graph and the data in Table 2 to answer the questions for Part I.

Part II **Testing the Effect of Temperature**

17. Place four clean test tubes in a rack and label them T 0-5, T 20-25, T 30-35, and T 50-55.
18. Add 3 mL of 3.0% H_2O_2 and 3 mL of water to each test tube.
19. Tap Table. Choose Clear All Data from the Table menu.
20. Tap Graph to display the graph.

21. Measure the enzyme activity at 0-5°C:

    a. Prepare a water bath at a temperature in the range of 0-5°C by placing ice and water in a 600 mL beaker. Using a thermometer check that the temperature remains in this range throughout this test. See Figure 3.
    b. Place test tube T 0-5 in the cold water bath for 5 minutes so that it reaches a temperature in the 0-5°C range. Record the actual temperature of the test-tube contents in the blank in Table 3.
    c. Add 2 drops of the enzyme solution to test tube T 0-5. Repeat Steps 8-14.

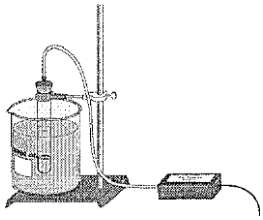


Figure 3

22. Measure the enzyme activity at 30-35°C:

    a. Prepare a water bath at a temperature in the range of 30-35oc by placing warm water in a 600 mL beaker. Using a thermometer check that the temperature remains in this range throughout this test.
    b. Place test tube T 30-35 in the warm water bath for 5 minutes so that it reaches a temperature in the 30-35°C range. Record the actual temperature of the test-tube contents in the blank in Table 3.
    c. Add 2 drops of the enzyme solution to test tube T 30-35. Repeat Steps 8-14.

23. Measure the enzyme activity at 50-55oC:

    a. Prepare a water bath at a temperature in the range of 50-55oC by placing hot water in a 600 mL beaker (hot tap water will probably work fine). Check that the temperature remains in this range throughout this test.
    b. Place test tube T 50-55 in the warm water bath until the temperature of the mixture reaches a temperature in the 50-55°C range. Record the actual temperature of the test-tube contents in the blank in Table 3.
    c. Add 2 drops of the enzyme solution to test tube T 50-55. Repeat Steps 8-14.

24. Measure the enzyme activity at 20-25°C (room temperature):

    a. Record the temperature of test tube T 20-25 in Table 3.
    b. In the tube labeled T 20-25, add 2 drops of the enzyme solution. Repeat Steps 8-13.

Part III Testing the Effect of pH

25. Place three clean test tubes in a rack and label them pH 4, pH 7, and pH 10.

26. Add 3 mL of 3% H_2O_2 and 3 mL of each pH buffer to each test tube, as in Table 1.

Table 1

pH of buffer	Volume of 3% H_2O_2 (ml)	Volume of buffer (ml)
pH 4	3	3
pH 7	3	3
pH 10	3	3

27. Tap Table. Choose Clear All Data from the Table menu.

28. Tap Graph to display the graph.

29. In the tube labeled pH 4, add 2 drops of the enzyme solution. Repeat Steps 8-14.
30. In the tube labeled pH 7, add 2 drops of the enzyme solution. Repeat Steps 8-14.
31. In the tube labeled pH 10, add 2 drops of the enzyme solution. Repeat Steps 8-13.
32. Graph all three runs of data on a single graph.
    a. Tap Run 3 (to the right of the graph), and select All Runs. All three runs will now be displayed on the same graph axes.
    b. Use the displayed graph and the data in Table 2 to answer the questions for Part I.

DATA

Table 2

Label	Rate (kPa/s)
1 Drop	
2 Drops	
3 Drops	
4 Drops	
0-5°C	
20-25°C	
30-35°C	
50-55°C	
pH 4	
pH 7	
pH 10	

Table 3	
Test tube label	Rate (kPa/min)
1 Drop	
2 Drops	
3 Drops	
4 Drops	
0-SOC range: 0C	
20-25°C range: 0C	
30-35°C range: 0C	
SO-SSOC range: 0C	
pH 4	
pH 7	
pH 10	

PROCESSING THE DATA

1. Multiply your rate by 60 s/min to convert to kPa/min. Record the rates in Table 3.

2. For Part I of this experiment, make a graph of the rate of enzyme activity *vs.* enzyme concentration on LabQuest or using Logger *Pro.* Plot the rate values from Table 3 on the y-axis and the number of drops of enzyme on the x-axis.

3. For Part II of this experiment, make a graph of the rate of enzyme activity *vs.* temperature. Plot the rate values from Table 3 on they-axis and the temperature on the x-axis.

4. For Part III of this experiment, make a graph of the rate of enzyme activity *vs.* pH. Plot the rate values from Table 3 on they-axis and the pH on the x-axis.

QUESTIONS

Part I Effect of Enzyme Concentration

1. How does changing the concentration of enzyme affect the rate of decomposition of H202?

2. What do you think will happen to the rate of reaction if the concentration of enzyme is increased to five drops? Predict what the rate would be for 5 drops.

Part II Effect of Temperature

3. At what temperature is the rate of enzyme activity the highest? Lowest? Explain.

4. How does changing the temperature affect the rate of enzyme activity? Does this follow a pattern you anticipated?

5. Why might the enzyme activity decrease at very high temperatures?

Part III Effect of pH

6. At what pH is the rate of enzyme activity the highest? Lowest?

7. How does changing the pH affect the rate of enzyme activity? Does this follow a pattern you anticipated?

EXTENSIONS

1. Different organisms often live in very different habitats. Design a series of experiments to investigate how different types of organisms might affect the rate of enzyme activity. Consider testing a plant, an animal, and a protist.

2. Presumably, at higher concentrations of H_2O_2, there is a greater chance that an enzyme molecule might collide with H_2O_2. If so, the concentration of H_2O_2 might alter the rate of oxygen production. Design a series of experiments to investigate how differing concentrations of the substrate hydrogen peroxide might affect the rate of enzyme activity.

3. Design an experiment to determine the effect of boiling catalase on the reaction rate.

4. Explain how environmental factors affect the rate of enzyme-catalyzed reactions.

Diffusion Through Membranes

Diffusion is a process that allows ions or molecules to move from where they are more concentrated to where they are less concentrated. This process accounts for the movement of many small molecules across a cell membrane. Diffusion allows cells to acquire food and exchange waste products. Oxygen, for instance, might diffuse in pond water for use by fish and other aquatic animals. When animals use oxygen, more oxygen will diffuse to replace it from the neighboring environment. Waste products released by aquatic animals are diluted by diffusion and dispersed throughout the pond.

It is important to consider how the rate of diffusion of particles may be affected or altered.

- Diffusion may be affected by how steep the concentration gradient is. The direction that a diffusing molecule or ion might travel is random. While the particles are diffusing, is there a net movement from where they are concentrated to where they are less concentrated?
- Diffusion may be affected by other different, neighboring particles. For instance, if oxygen diffuses towards a single-celled pond organism at a certain rate, will that rate be altered by the presence of another type of molecule? Would the presence of other molecules block or enhance the diffusion of a molecule? Would the molecule's rate be independent of particles that do not alter the concentration gradient?

One way to measure the rate of diffusion of ions is to monitor their concentration in solution over a period of time. Since ions are electrically charged, water solutions containing ions will conduct electricity. A Conductivity Probe measures the concentration of ions in a solution, but not the concentration of electrically neutral molecules. Salts, such as sodium chloride, produce ions when they dissolve in water. If you place a salt solution inside a selectively permeable membrane such as dialysis tubing, the salt ions can diffuse out of the tubing and into the surrounding water.

OBJECTIVES

In this experiment, you will

- Use a Conductivity Probe to measure the ionic concentration of various solutions.
- Study the effect of temperature on diffusion.
- Study the effect of concentration gradients on the rate of diffusion.
- Determine if the diffusion rate for a molecule is affected by the presence of a second molecule.

MATERIALS

LabQuest
LabQuest App
Vernier Conductivity Probe
three 18 x 150 mm test tubes with rack
1%, 5%, and 10% salt water
400 mL beaker
ring stand and utility clamp
dialysis tubing, 2.5 em x 12 em
dropper pipet or Beral pipet
scissors
stirring rod
5% sucrose (table sugar) solution
dental floss or clamp

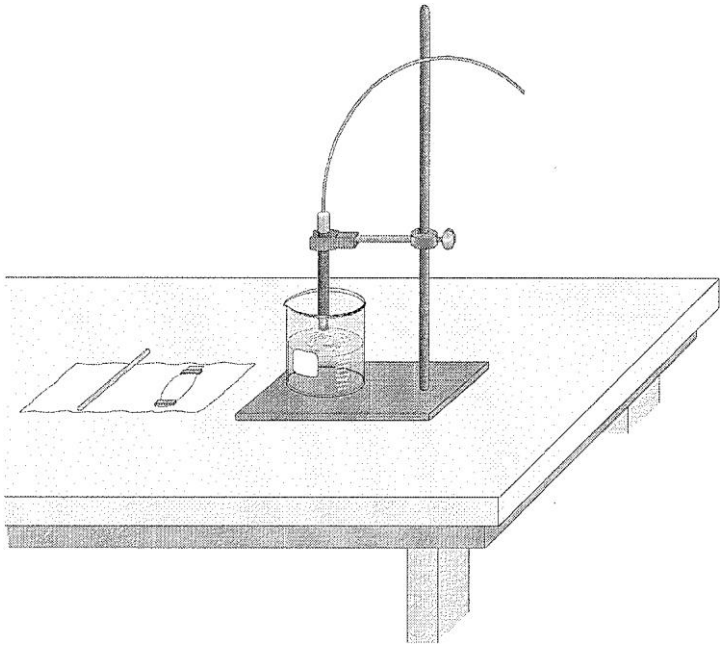


Figure 1

PROCEDURE

1. Set up the utility clamp, and ring stand as shown in Figure 1.

2. Set the selector switch on the side of the Conductivity Probe to the 0-2000 [!S/cm range. Connect the Conductivity Probe to LabQuest and choose New from the File menu. If you have an older sensor that does not auto-ID, manually set up the sensor.

3. On the Meter screen, tap Rate. Change the data-collection rate to 0.2 samples/second and the data-collection length to 60 seconds.

Part I Concentration gradients

4. Test whether different concentration gradients affect the rate of diffusion. To do this, three solutions of differing salt concentrations (1%, 5%, and 10%) will be placed in distilled water. Each salt solution will be placed in a dialysis tube and allowed to diffuse into the surrounding water. When salt diffuses, the conductivity of the water in the beaker will increase.

5. In Table 1, predict what you believe will happen in this set of experiments. How will the rate of diffusion change when a 10% salt solution is placed in contact with pure water compared to when a 1% salt solution is placed in contact with pure water?

6. Prepare the dialysis tubing. Obtain a wet dialysis tube and a dialysis tube clamp or a short length of dental floss. Using the clamp or floss, tie one end of the tube closed about 1 em from the end, as in Figure 2.

7. Place a 1% salt solution into a section of dialysis tubing. To do this,
   a. Obtain about 15 mL of a 1% salt water solution in a test tube.
   b. Using a funnel or Beral pipet, transfer about 10 mL of the 1% salt water into the dialysis tube, as in Figure 2. Note: To open the tube, you may need to rub the tubing between your fingers.
   c. Tie off the top of the dialysis tube with a clamp or a new length of dental floss. Try not to allow any air into the dialysis tube. The tube should be very firm after it is tied or clamped. Trim off any excess dental floss extending more than 1 em from either knot.
   d. Wash the outside of the tubing with tap water thoroughly, so that there is no salt water adhering to the tubing.

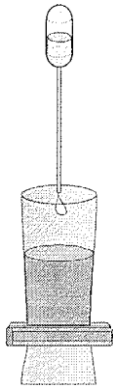


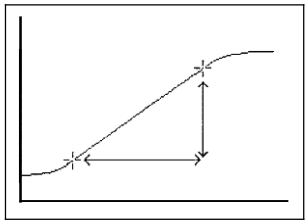
Figure 2

8. Place 300 mL of distilled or deionized water into a 400 mL beaker. Secure the Conductivity Probe with the utility clamp in the water filled beaker as shown in Figure 1.

9. Place the dialysis tube into the water. Be sure the tubing is submerged completely under the water. Important: Position the Conductivity Probe and dialysis tubing the same distance apart in each trial.

10. After stirring the solution for 15 seconds, start data collection. Stir the solution slowly and continuously throughout the one-minute data collection period.

11. Data collection will stop after 60 seconds. Analyze the graph to determine the rate of diffusion for the curve of conductivity *vs.* time:
   a. Examine the graph and identify the most linear region.
   b. Tap and drag your stylus across the most linear region to select these data points.
   c. Choose Curve Fit from the Analyze menu. Select Linear as the Fit Equation.
   d. Record the slope, *m*, as the rate of diffusion in (ftS/cm/s) in Table 2. Select OK.



12. Remove one of the clamps. If the dialysis tubing is tied off with floss, use a pair of scissors and carefully cut one of the dental floss knots and discard the floss. If you accidentally make a cut in the tubing, replace it.

13. Empty all of the liquid out of the dialysis tube. Squeeze the excess liquid out with your fingers.

14. Rinse the Conductivity Probe with distilled water.

15. Store the data from the first run by tapping the File Cabinet icon.

16. Obtain 15 mL of a 5% salt solution in a test tube. Repeat Steps 7-15, substituting this 5% salt solution for the 1% solution.

17. Obtain 15 mL of a 10% salt solution in a test tube. Repeat Steps 7-15, substituting this 10% salt solution for the 1% solution.

18. Graph all three runs of conductivity data on a single graph.
    a. Tap Run 3 and select All Runs. All three runs will now be displayed on the same graph.
    b. Examine the graph closely and make a conclusion. Record your conclusion in Table 1.

19. (Optional) Transfer your data to a computer for later printing per your teacher's instructions.

Part II Effect of other molecules

In this set of experiments you will measure the rate of diffusion of salt while it is in the presence of a non-conducting molecule. Since sugar does not form ions in solution, it should not conduct electricity. Therefore, sugar will be added to the water to determine whether it interferes with the diffusion of salt.

20. In Table 1, predict what you believe will happen in this set of experiments. Will the non-conducting sugar in the water block or reduce the rate of diffusion of salt? Explain your prediction.

Test to determine if water or a sugar solution conducts electricity.

21. Place about 100 mL of distilled or deionized water in a clean 400 mL beaker.

22. Test the conductivity of the water by placing a clean Conductivity Probe into it.

23. Tap Meter. Record the conductivity value in Table 3.

24. Obtain 300 mL of a 5% sugar solution in a clean 400 mL beaker.

25. Test the conductivity of the 5% sugar solution by placing a clean Conductivity Probe into it. Record the conductivity value in Table 3.

Test if 5% sugar interferes with the diffusion of a 5% salt solution.

26. Repeat Steps 6-14, with the following changes:
    a. Substitute a 5% salt solution for the 1% solution in Step 7.
    b. Use 300 mL of 5% sugar water in place of the water in Step 8.
    c. Record the slope, *m,* as the rate of diffusion in (flS/cm/s) in Table 4.

DATA

Table 1	
	Prediction
Part I	
Part II	

Part I

Table 2: Summary of Data	
Salt concentration (%)	Rate of diffusion (tS/cm/s)
1	
5	
10	

Part II

Table 3	
Solution	Conductivity (tS/cm)
Distilled water	
Sugar water	

Table 4: Summary of Data	
Solution	Rate of diffusion (tS/cm/s)
5% salt	
5% salt/ 5% sugar	

QUESTiONS

1. What conclusion can you draw from the data in Table 2?

2. How did your conclusion compare to your prediction for Part I? Can you account for any differences?

3. If the rates in any of the three experiments varied in Part I, calculate how much faster each rate was compared to that for the 1% salt solution. For instance, if the rate of the 1% solution was 1 tS/cm/s and the rate of the 10% solution was 5 S/cm/s, then the rate of diffusion for the 10% solution would be (5/1) five times the rate of the 1% salt solution.

4. Compare the conductivity of pure water with a sugar solution. How do you account for this?

5. What conclusion can you draw from the data in Tables 3 and 4?

EXTENSIONS

1. Make a plot of the rate of diffusion *vs.* the salt concentration. Using your plot, estimate the rate of diffusion of a 3% salt solution.

2. **If** the results of the experiments in Part I can be extrapolated to diffusion in living systems, how would a single-celled organism respond in an oxygen rich pond compared to an oxygen-poor pond? Explain.

3. Design an experiment to determine the effect of temperature on the diffusion of salt. Perform the experiment you designed.

4. Ectotherms are organisms whose body temperatures vary with the surrounding environment.
   On the basis of your data from Extension Question 3, how do you expect the oxygen consumption of ectotherms to vary as the temperature varies? Explain.

5. If waste products of an aquatic single-celled organism were released into a pond, how would that affect the organism's ability to obtain oxygen from the pond water? Explain how your data from Part II supports your answer.

Student Learning Outcomes (SLO) **BIOL 1306**
1. Describe the characteristics of life.
2. Explain the reasoning used by scientists.
3. Identify the basic properties of substances needed for life.
4. Compare and contrast the structures, reproduction, and characteristics of viruses, prokaryotic cells and eukaryotic cells.
5. Describe the structures of cell membranes and the movement of molecules across a membrane.
6. Identify the substrates, products, and important chemical pathways in metabolism.
7. Identify the principles of inheritance and solve classical genetic problems.
8. Identify the chemical structures, synthesis, and regulation of nucleic acids and proteins.
9. Describe the unity and diversity of life and the evidence for evolution through natural selection.