LIFE AND PHYSICAL SCIENCES
Student Learning Outcome Alignment Form

Course Prefix/Number: BIOL 1308

Course Title: Biology for Non-Science Majors I

Core Objective	Course SLO	General Learning Activities	Assessment
Critical Thinking Skills	SLO #1)Distinguish between prokaryotic, eukaryotic, plant and animal cells, and identify major cell structures.	Lab 4—Students study cell components by microscopic observation and compare plant and animal cells drawing each type of cell. Students are required to determine cell size of onion cells by calculation. Students work in groups of four and submit a written lab report. (See Attached Activity)	Report and attached rubric
Communication Skills	SLO #1)Distinguish between prokaryotic, eukaryotic, plant and animal cells, and identify major cell structures.	Lab 4—Students study cell components by microscopic observation and compare plant and animal cells drawing each type of cell. Students are required to determine cell size of onion cells by calculation. Students work in groups of four and submit a written lab report. (See Attached Activity)	Report and attached rubric
Empirical & Quantitative Skills	SLO #1)Distinguish between prokaryotic, eukaryotic, plant and animal cells, and identify major cell structures.	Lab 4—Students study cell components by microscopic observation and compare plant and animal cells drawing each type of cell. Students are required to determine cell size of onion cells by calculation. Students work in groups of four and submit a written lab report. (See Attached Activity)	Report and attached rubric
Teamwork	SLO #1)Distinguish between prokaryotic, eukaryotic, plant and animal cells, and identify major cell structures.	Lab 4—Students study cell components by microscopic observation and compare plant and animal cells drawing each type of cell. Students are required to determine cell size of onion cells by calculation. Students work in groups of four and submit a written lab report. (See Attached Activity)	Report and 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	Speaker's voice is steady, strong, and clear. Speaker often uses inflections to emphasize key points and create interest. Speaker's talking pace is mostly appropriate.	Speaker's voice is very confident, steady, strong, and clear. Speaker consistently uses inflections to emphasize key points or to create interest. Speaker's talking

	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.	interest. Speaker's talking pace is appropriate.		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 into the final product. Any notation is not consistent and not defined.	Some investigative or quantitative components are scrutinized. Some steps followed are somewhat logical and relevant to the desired result. The proper tools/ technology were somewhat used and not integrated into the final product. Any notation is somewhat consistent but not defined.	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 used and somewhat integrated into the final product. Any notation is mostly consistent and defined.	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 final product. Any notation is consistent and well defined.	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 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	Supports a constructive group climate by treating other	Supports a constructive group climate by treating other

			members respectfully and conveying a positive attitude about the group and its work.	members respectfully, conveying a positive attitude about the group and its work, and motivating other group members.	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.

TEXARKANA COLLEGE

Syllabus: Concepts of Biology
Course Number: BIO 1408
Semester & Year: Fall 2012
Instructor Information

Name: Patricia L. Harman
Office: CHEM 225
Telephone: 903-823-3392
E-mail: patricia.harman@texarkanacollege.edu
Office Hours: 9:30-11 a.m. Tuesday/Thursday, 10-12 a.m. Friday

A schedule of my class and office hours is posted next to the door of my office. If I am not in office, check the chemistry labs. I am generally in the chemistry building when not in class. Do not hesitate to come by and see me if you need additional assistance.

Textbook Information

Inquiry into Life, 13th Edition, by Sylvia Mader, ISBN 978-0-07-340344-1
This text is also used for Biology 1409.
Inquiry into Life, 13th Edition Laboratory Manual, by Sylvia Mader, ISBN 978-0-07-729743-5, is **required** (also used both semesters).
Additional learning materials may be provided by instructor.
http://www.mhhe.com/maderinquiry13

Student Learning Outcomes for the Course

1. Develop an understanding of human interrelationships with the environment.
2. Recognize common chemical reactions that occur in extracellular and intracellular environments.
3. Recognize and describe the functional roles of organic molecules associated with living organisms.
4. Demonstrate comprehension of cell structure and function by recognition of cellular components and organelles and their roles in cell physiology.
5. Describe the processes which regulate movements of solute particles into and out of cells.
6. Describe the sequence of activities that occur in the cell cycle.
7. Recognize the activities that occur in mitosis and meiosis and contrast these cellular divisions.
8. Describe the reactants, pathways, and end products that constitute cellular metabolism.
9. Describe the process of photosynthesis in autotrophic organisms.
10. Recognize and describe both morphologically and microscopically the root and stem structures in plants, including complete and incomplete flowers and natural and artificial reproduction methods.
11. Identify the types of tissues found in plants and explain their function.
12. Identify plant growth regulators that occur in plants and give the functions they perform.
13. Give the structural characteristics of viruses and subviroids including life cycles and their impact on cellular organisms.
14. Give the structural characteristics of representatives of viruses and prions, domains, Archae and Bacteria, Eukarya (Protists and Fungi) and describe their life cycles. State the

ecological and economic significance of Kingdom Plantae.
15. Identify and recognize characteristic features of various phyla of the Animal Kingdom and give their impact economically and ecologically.
16. Describe the three basic patterns of interactive behavior that occur in populations and explain the impact that these relationships have within particular ecosystems.
17. Describe the terrestrial biomes found on earth in terms of climatic conditions, location, and species composition.
18. Describe the common aquatic communities by location and composition.
19. Describe the nature and composition of ecosystems and explain the process of energy flow and cycling.
20. Explain the need of environmental awareness on earth today as it relates specifically to resource conservation, population growth, and environmental quality.

Student Requirements for Completion of the Course and Due Dates

Student progress in this course will be based on performance on lecture exams and projects and your laboratory grade.

Lecture grade*:* Lecture exams will cover all material assigned in the textbook, all the material covered in lecture, and any other assigned material. There are normally six major examinations administered during this semester. This includes the final exam and all are equally weighted. They will be comprehensive in nature and will consist of objective questions, short answer, labeling diagrams, and essays. Most exams will be taken in the Testing Center. The lecture component will contribute **70%** of your final grade.
Laboratory grade*:* The laboratory grade will consist of any lab exams, lab reports, and projects. Your laboratory performance accounts for **30%** of your final grade.
Make-up exams & missed assignments: Make-up **lecture** exams will only be given when the student has an excuse deemed acceptable by the instructor. Students will have one week in which to take a make-up examination in the testing center. It is the responsibility of the student to contact the instructor and arrange to make-up any missed work. Work not completed will be assigned a grade of 0. **There are NO dropped exam grades in lecture and students are allowed only one make-up exam.**

Extra credit: There will be opportunities to acquire extra credit in lecture and lab. Special projects or activities will be offered in lecture. Some labs require materials or supplies that students may bring from home for extra credit. All opportunities will be discussed in class.

Exams will be given about every three weeks. The following list indicates what chapters are normally included on each exam.
Test 1 – Chapter 1, The Study of Life and portions of Chapters 33, 34, 35, and 36 (Behavior and Ecology), and Chapter 2, The Molecules of Cells
Test 2 – Chapter 3 (Cell Structure), Chapter 4 (Membrane Structure and Function), and Chapter 5 (Cell Division)
Test 3 –Chapter 6 (Metabolism: Energy and Enzymes), Chapter 7 (Cellular Respiration), and Chapter 8 (Photosynthesis)
Test 4 – Chapters 9, 10, and 29 – All chapters on Kingdom Plantae
Test 5 – Chapter 28 (Microbiology) and Chapters 30 & 31 (Kingdom Animalia)
Test 6 – FINAL EXAM – Comprehensive final that includes all material previously studied.

Student Assessment

Lecture grade: Lecture exams will cover all material assigned in the textbook, all the material covered in lecture, and any other assigned material. There are normally six major examinations administered during this semester. This includes the final exam and all are equally weighted. They will be comprehensive in nature and will consist of objective questions, short answer, labeling diagrams, and essays. Most exams will be taken in the Testing Center. The lecture component will contribute **70%** of your final grade.

Laboratory grade: The laboratory grade will consist of any lab exams, lab reports, and projects. Your laboratory performance accounts for **30%** of your final grade.

Extra credit: There will be opportunities to acquire extra credit in lecture and lab. Special projects or activities will be offered in lecture. Some labs require materials or supplies that students may bring from home for extra credit. All opportunities will be discussed in class.

Grading Scale

A standard grade scale will be used to assign final course grades.
90%+ - A 80% - B 70% - C 60% - D < 60% - F

Class Schedule – this is a tentative schedule and subject to change.

Date	Material to be covered	Assignment
Aug. 22-23	Go over class syllabus, course pre-test	Read chapter 1
Aug. 27-30	Chapter 1 lecture	Read assigned sections
Sept. 3- 11	Chapters 33, 34, 35, & 36 lecture	Read Chapter 2
Sept. 12-20	Chapter 2 lecture	Read Chapter 3 Study for Exam 1
Sept. 24-27	Chapter 3 lecture	Read Chapter 4
Oct. 1-5	Chapter 4 lecture	Read Chapter 5
Oct. 8-12	Chapter 5 lecture	Read Chapter 6 Study for Exam 2
Oct. 15-18	Chapter 6 lecture	Read Chapter 7
Oct. 22-25	Chapter 7 lecture	Read Chapter 8
Oct. 29-Nov. 1	Chapter 8 lecture	Read Chapter 28 Study for Exam 3
TBD	Chapters 9, 10, & 20	Exam 4
Nov. 5-13	Chapter 28 lecture	Read Chapters 30-31
Nov. 14- Dec. 4	Chapters 30-31 lecture	Study for Exam 5
Nov. 19-23	Thanksgiving Holiday	No Classes
Dec. 5/6	Final Review	Study for Final Exam
Dec. 10-13	FINAL EXAMS	

Attendance Policy

As an adult, you are responsible for attending class and laboratories and being there on time. It is to your benefit to be present at each class session. Roll will be checked at the beginning of class. Anyone not present at that time will be counted absent. Students that come in late should remind the instructor after class to mark them tardy instead of absent. Remember that absences in lecture and laboratory **add together**. Refer to your student catalog to determine the maximum allowed absences. **After four unexcused absences in lecture and/or lab, the instructor will contact you concerning your desire to remain in the course. Further absenteeism may result in your being dropped from the course.**

If it is necessary for you to miss class or lab, inform the instructor in advance if possible. You can be given assignments to help keep current. Lab work is hard to make up—often resulting in inconvenience for you and the instructor.

Attention! If you choose to just stop coming to class and choose to make an F, the last date you attended will be listed on the final grade sheet and you will most likely have to pay back money received from grants or scholarships.

Make-up Policy

Make-up **lecture** exams will only be given when the student has an excuse deemed acceptable by the instructor. Students will have one week in which to take a make-up examination in the testing center. It is the responsibility of the student to contact the instructor and arrange to make-up any missed work. Work not completed will be assigned a grade of 0. **There are NO dropped exam grades in lecture and students are allowed only one make-up exam.**

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.

Class Conduct

Students are expected to conduct themselves as adults. Any student who acts in such a manner as to disturb class and interfere with the learning process will be expelled from the course with a grade of "F".

Regulations regarding cell phones and other electronic devices will be enforced. These are a distraction to the learning process and should be turned off BEFORE coming to class. These devices should be out of sight and not accessed during the class period.

Course Objectives

1. *Satisfy the lab science requirement for non-science majors.*
2. *Provide the student with sufficient background and knowledge, which should enable him/her to successfully complete more advanced courses in life science.*
3. *Enable the student to acquire some basic learning processes that may be extended and applied to other disciplines.*
4. *Encourage the development of an appreciation of all living things and the interconnected relationships man has with all living organisms.*
5. *Develop a clear concept of the scientific method and its application in social issues.*

This course examines the process and method of science applied to understanding biological concepts at the molecular, cellular, organism, and community levels. There is a survey of major groups of organisms with respect to their diversity in organization, processes, interactions, and adaptations including human impact on the environment. The scientific method and social applications of scientific information to related human issues are stressed throughout the course. (This course is designed and recommended for non-science majors.)

Instructional Methods and Materials

This course meets for three hours of lecture/discussion and three hours of laboratory each week. A traditional lecture/discussion method will be the primary means of instruction. Supplementary printed materials, audiovisuals, and other "hands-on" materials or activities may be used to enhance learning and understanding. The chapters to be covered in this course are: Chapters 1-10, 28-31 and portions of 33-36. You will need a package of scantrons for lecture exams.

Study guides and printed materials will be delivered to your TC email so you will need to check that account often.

LABORATORY

4

Cell Structure and Function

Learning Outcomes

4.1 Prokaryotic versus Eukaryotic Cells
- Distinguish between prokaryotic and eukaryotic cells by description and examples. 42

4.2 Animal Cell and Plant Cell Structure
- Label an animal cell diagram, and state a function for the structures labeled. 43–44
- Label a plant cell diagram, and state a function for the structures labeled. 45
- Use microscopic techniques to observe plant cell structure. 46

4.3 Diffusion
- Define and describe the process of diffusion as affected by the medium. 47
- Predict and observe which substances will or will not diffuse across a plasma membrane. 48–49

4.4 Osmosis: Diffusion of Water across Plasma Membrane
- Explain an osmosis experiment based on a knowledge of diffusion principles. 49–50
- Define isotonic, hypertonic, and hypotonic solutions, and give examples in terms of NaCl concentrations. 50–51
- Predict the effect of different tonicities on animal (e.g., red blood) cells and on plant (e.g., *Elodea*) cells. 51–53

4.5 pH and Cells
- Predict the change in pH before and after the addition of an acid to nonbuffered and buffered solutions. 54–55
- Suggest a method by which it is possible to test the effectiveness of antacid medications. 55

Introduction

The molecules we studied in Laboratory 3 are not alive—the basic units of life are cells. The **cell theory** states that all living things are composed of cells and that cells come only from other cells. While we are accustomed to considering the heart, the liver, or the intestines as enabling the human body to function, it is actually cells that do the work of these organs.

Figure 2.10 shows human cheek epithelial cells as viewed by an ordinary compound light microscope available in general biology laboratories. It shows that the content of a cell, called the **cytoplasm,** is bounded by a **plasma membrane.** The plasma membrane regulates the movement of molecules into and out of the cytoplasm. In this lab, we will study how the passage of water into a cell depends on the difference in concentration of solutes (particles) between the cytoplasm and the surrounding medium or solution. The well-being of cells also depends upon the pH of the solution surrounding them. We will see how a buffer can maintain the pH within a narrow range and how buffers within cells can protect them against damaging pH changes.

Planning Ahead To save time, your instructor may have you start a boiling water bath (page 49) and the potato strip experiment (page 53) at the beginning of the laboratory.

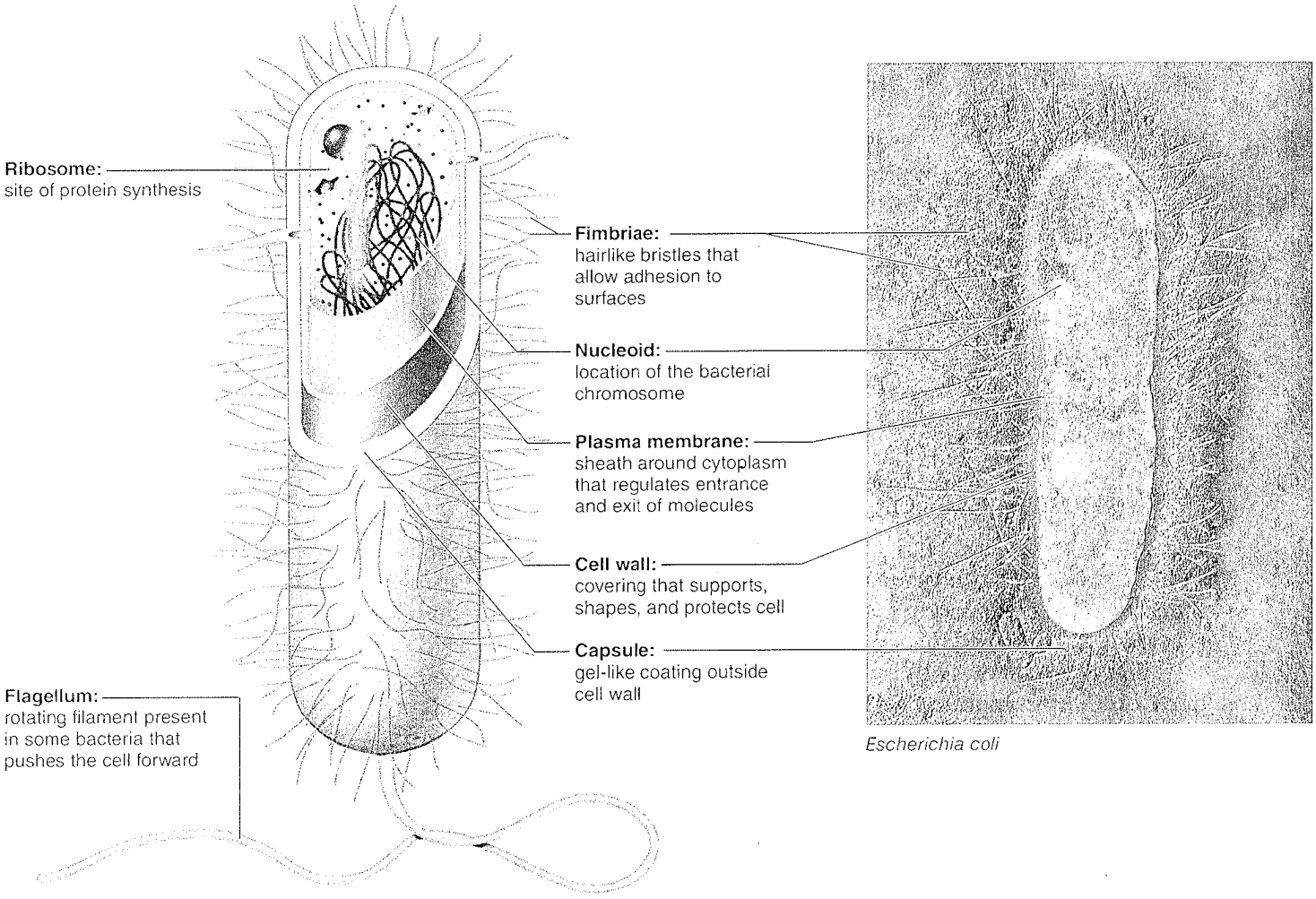
Because a photomicrograph shows only a minimal amount of detail, it is necessary to turn to the electron microscope to study the contents of a cell in greater depth. The models of plant and animal cells available in the laboratory today are based on electron micrographs.

4.1 Prokaryotic versus Eukaryotic Cells

All living cells are classified as either prokaryotic or eukaryotic. One of the basic differences between the two types is that prokaryotic cells do not contain nuclei (*pro* means "before"; *karyote* means "nucleus"), while eukaryotic cells do contain nuclei (*eu* means "true"; *karyote* means "nucleus"). Only bacteria (including cyanobacteria) and archaea are prokaryotes; all other organisms are eukaryotes.

Prokaryotes also don't have the organelles found in eukaryotic cells (Fig. 4.1). **Organelles** are small, membranous bodies, each with a specific structure and function. Prokaryotes do have **cytoplasm,** the material bounded by a plasma membrane and cell wall. The cytoplasm contains ribosomes, small granules that coordinate the synthesis of proteins; thylakoids (only in cyanobacteria) that participate in photosynthesis; and innumerable enzymes. Prokaryotes also have a nucleoid, a region in the bacterial cell interior in which the DNA is physically organized but not enclosed by a membrane.

Figure 4.1 Prokaryotic cell.
Prokaryotic cells lack membrane-bounded organelles, as well as a nucleus. Their DNA is in a nucleoid region.



Observation: Prokaryotic/Eukaryotic Cells

Two microscope slides on display will show you the main difference between prokaryotic and eukaryotic cells.

1. Examine a prepared slide of a bacterium. There are no nuclei in these cells.
2. Examine a prepared slide of cuboidal cells from a human kidney (see page 147). Can you make out a nucleus? _____

4.2 Animal Cell and Plant Cell Structure

Table 4.1 lists the structures found in animal and plant cells. The **nucleus** in a eukaryotic cell is bounded by a **nuclear envelope** and contains **nucleoplasm.** The *cytoplasm,* found between the plasma membrane and the nucleus, consists of a background fluid and the organelles, such as the nucleolus, endoplasmic reticulum, Golgi apparatus, vacuoles and vesicles, lysosomes, peroxisome, mitochondrion, and chloroplast.

Table 4.1 Eukaryotic Structures in Animal Cells and Plant Cells

Name	Composition	Function
Cell wall*	Contains cellulose fibrils	Provides support and protection
Plasma membrane	Phospholipid bilayer with embedded proteins	Outer cell surface that regulates entrance and exit of molecules
Nucleus	Enclosed by nuclear envelope; contains chromatin (threads of DNA and protein)	Storage of genetic information; synthesis of DNA and RNA
Nucleolus	Concentrated area of chromatin	Produces subunits of ribosomes
Ribosome	Protein and RNA in two subunits	Carries out protein synthesis
Endoplasmic reticulum (ER)	Membranous, flattened channels and tubular canals; rough ER and smooth ER	Synthesis and/or modification of proteins and other substances; transport by vesicle formation
Rough ER	Studded with ribosomes	Protein synthesis
Smooth ER	Lacks ribosomes	Synthesis of lipid molecules
Golgi apparatus	Stack of membranous saccules	Processes, packages, and distributes proteins and lipids
Vesicle/vacuole	Membrane-bounded sac; large central vacuole in plant cells*	Stores and transports substances
Lysosome	Vesicle containing hydrolytic enzymes	Digests macromolecules and cell parts
Peroxisome	Vesicle containing specific enzymes	Breaks down fatty acids and converts resulting hydrogen peroxide to water
Mitochondrion	Bounded by double membrane; inner membrane is cristae	Cellular respiration, producing ATP molecules
Chloroplast*	Membranous grana bounded by double membrane	Photosynthesis, producing sugars
Cytoskeleton	Microtubules, intermediate filaments, actin filaments	Maintains cell shape and assists movement of cell parts
Cilia and flagella	Attachments supported by microtubules	Movement of cell
Centrioles** in centrosome	Microtubule-containing, cylindrically shaped organelle in a structure of complex composition.	Centrioles organize microtubules in cilia and flagella; centrosome organizes microtubules in cell

*Plant cells only

**Animal cells only

Study Table 4.1 to determine structures that are unique to plant cells and unique to animal cells, and write them below the examples given.

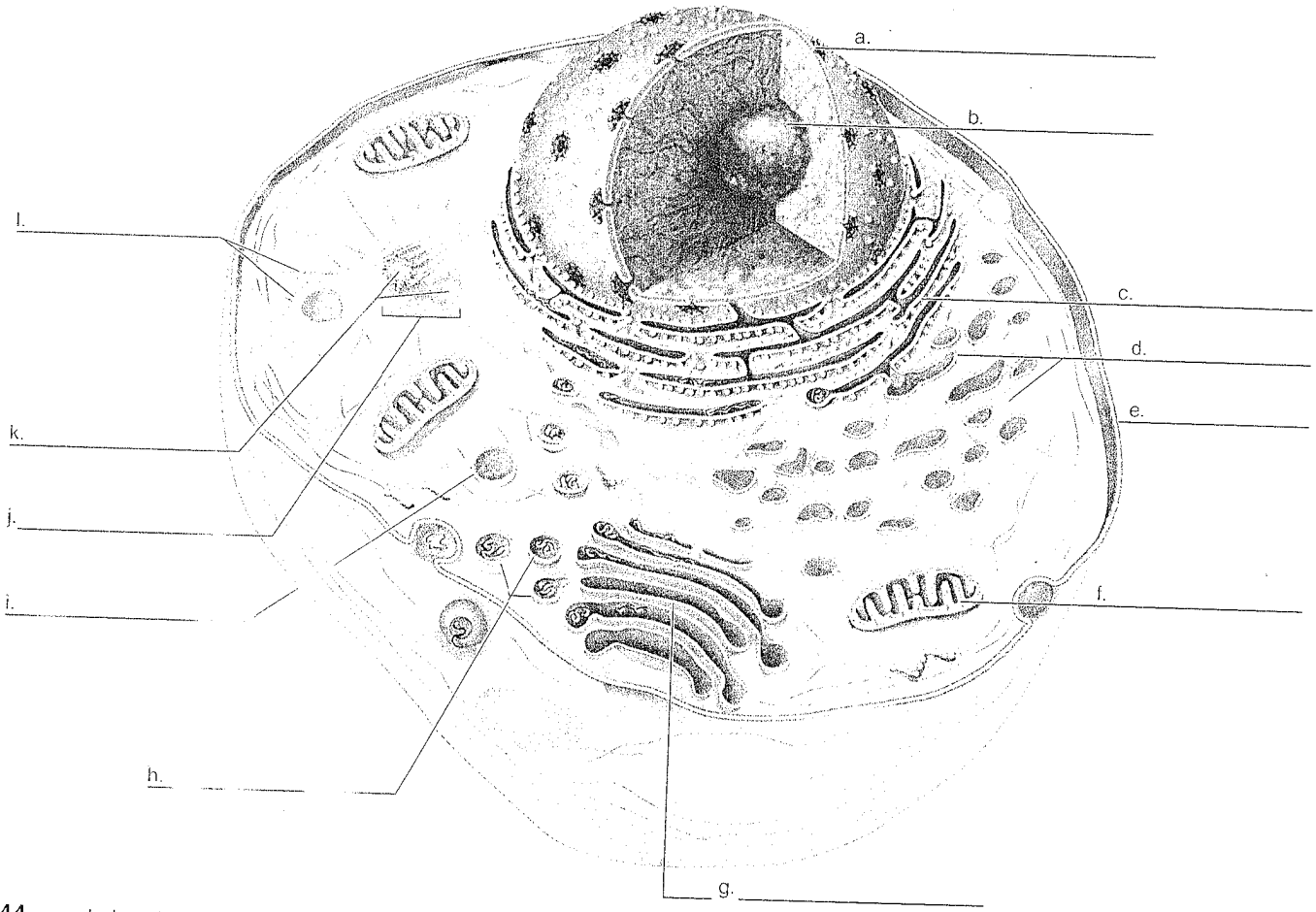
	Plant Cells	Animal Cells
Unique structures:	1. Large central vacuole	1. Small vacuoles
	2. _____	2. _____
	3. _____	

Animal Cell Structure

Label Figure 4.2. With the help of Table 4.1, give a function for each labeled structure.

Structure	Function
Plasma membrane	
Nucleus	
Nucleolus	
Endoplasmic reticulum	
Rough ER	
Smooth ER	
Golgi apparatus	
Vesicle	
Lysosome	
Mitochondrion	
Centrioles in centrosome	
Cytoskeleton	

Figure 4.2 Animal cell structure.

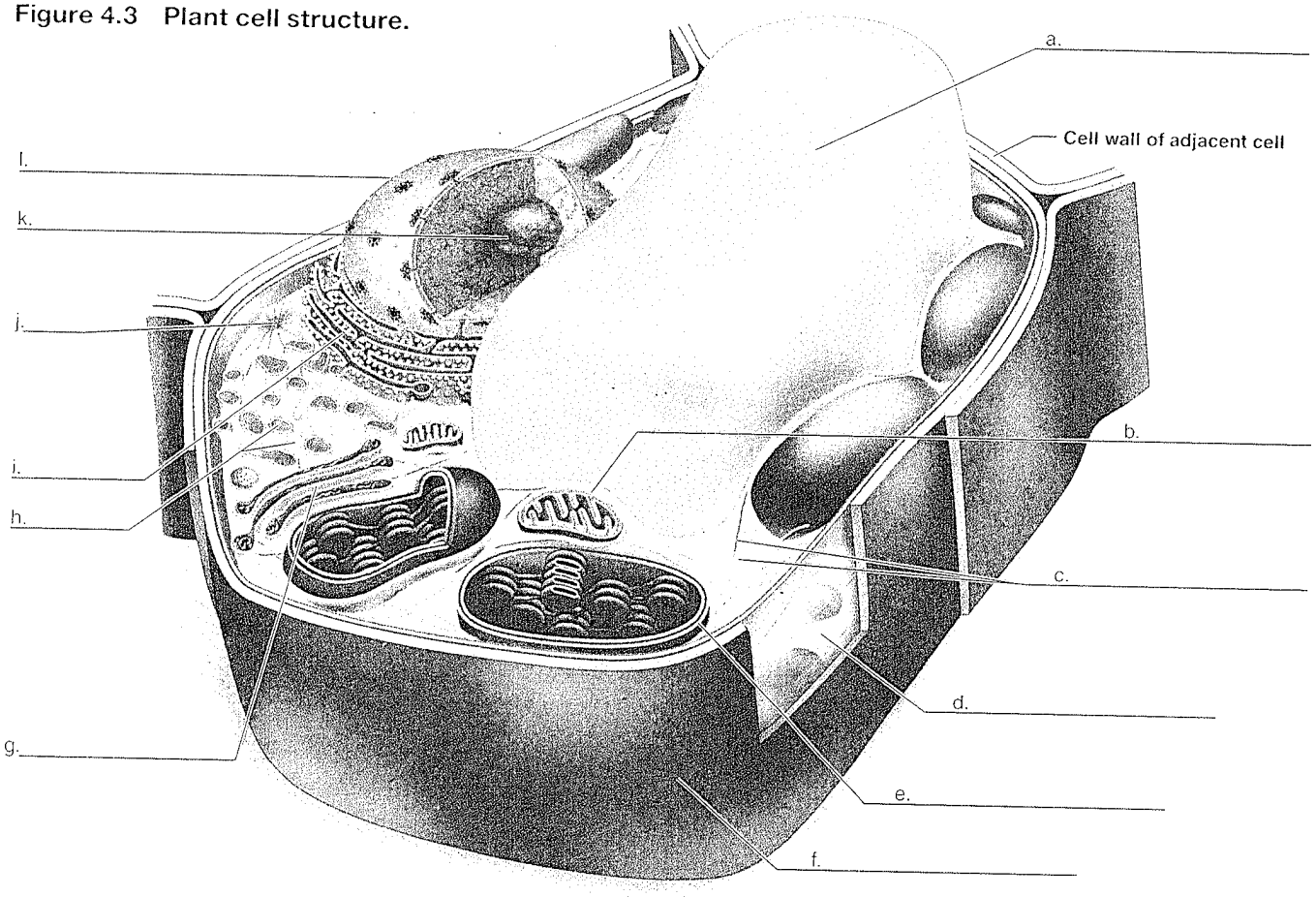


Plant Cell Structure

Label Figure 4.3. With the help of Table 4.1, give a function for each labeled structure unique to plant cells.

Structure	Function
Cell wall	
Central vacuole, large	
Chloroplast	

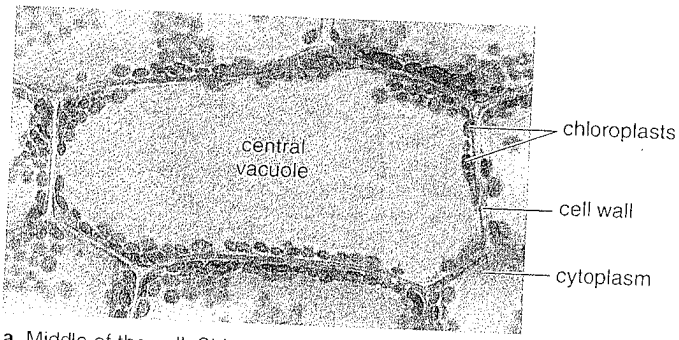
Figure 4.3 Plant cell structure.



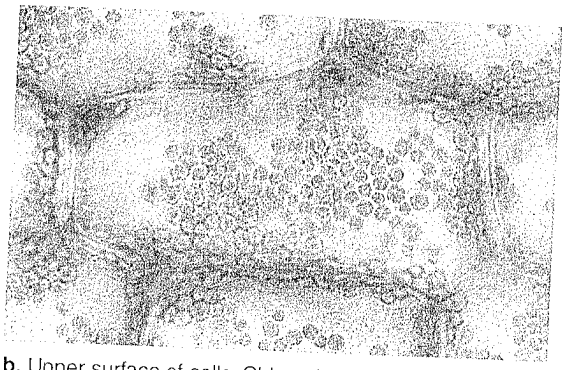
Observation: Plant Cell Structure

1. Prepare a wet mount of a small piece of young *Elodea* leaf in fresh water. *Elodea* is a multicellular, eukaryotic plant found in freshwater ponds and lakes.
2. Have the drop of water ready on your slide so that the leaf does not dry out, even for a few seconds. Take care that the leaf is mounted with its top side up.
3. Using low power bring the leaf surface into focus.
4. Select a cell with numerous chloroplasts for further study, and switch to high power.
5. Carefully focus on the sides of the cell. The chloroplasts appear to be only along the sides of the cell because the large, fluid-filled, membrane-bounded central vacuole pushes the cytoplasm against the cell walls (Fig. 4.4*a*). Then focus on the surface and notice an even distribution of chloroplasts (Fig. 4.4*b*).

Figure 4.4 ***Elodea*** **cell structure.**



a. Middle of the cell. Chloroplasts are visible around the perimeter and not in the center, which is occupied by a membrane-bounded, fluid-filled, central vacuole.



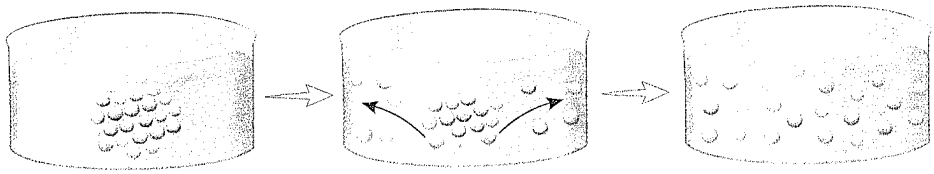
b. Upper surface of cells. Chloroplasts are in the middle, as well as around the perimeter.

6. Can you locate the cell nucleus? _____ It may be hidden by the chloroplasts, but when visible, it appears as a faint, grey lump on one side of the cell.
7. Why can't you see the other organelles featured in Figure 4.3?_____
_____
8. Can you detect movement of chloroplasts in this cell or any other cell? _____ The chloroplasts are not moving under their own power but are being carried by a streaming of the nearly invisible cytoplasm.
9. Save your slide for use later in this laboratory.

4.3 Diffusion

Diffusion is the movement of molecules from a higher to a lower concentration until equilibrium is achieved and the molecules are distributed equally (Fig. 4.5). At equilibrium, molecules may still be moving back and forth, but there is no net movement in any one direction.

Figure 4.5 Process of diffusion.
Diffusion is apparent when dye molecules have equally dispersed.



Diffusion is a general phenomenon in the environment. The speed of diffusion is dependent on such factors as the temperature, the size of the molecule, and the type of medium.

Experimental Procedure: Diffusion

Solute Diffusion Through a Semisolid

> **Potassium permanganate ($KMnO_4$)** $KMnO_4$ is highly poisonous and is a strong oxidizer. Avoid contact with skin and eyes and with combustible materials. If spillage occurs, wash all surfaces thoroughly. $KMnO_4$ will also stain clothing.

1. Observe a petri dish containing 1.5% gelatin (or agar) to which potassium permanganate ($KMnO_4$) was added in the center depression at the beginning of the lab.
2. Complete the first four columns of Table 4.2. Your instructor will supply zero time; final time is the current time.
3. Using a ruler placed over the petri dish, measure (in mm) the movement of color from the center of the depression outward in one direction: _____ mm. Add distance moved to Table 4.2.
4. Calculate the speed of diffusion: _____ mm/60 min = mm/hr.
5. Complete Table 4.2.

Solute Diffusion Through a Liquid

1. Add enough water to cover the bottom of a glass petri dish.
2. Place the petri dish over a thin, flat ruler. Position the petri dish directly over a mm measurement line.
3. With tweezers, add a crystal of potassium permanganate ($KMnO_4$) directly over the mm measurement line. Note how far the dye moves in 10 min _____.
4. Complete all columns of Table 4.2 except the last one.
5. Multiply the length of time and the distance moved by 6 to calculate the speed of diffusion: _____ mm/hr. Record in Table 4.2.

Solute Diffusion Through Air

1. Measure the distance from a spot designated by your instructor to your laboratory work area today. Record this distance under distance moved in Table 4.2.
2. Record time zero in Table 4.2 when a perfume or similar substance is released into the air.
3. Note the time when you can smell the perfume. Record this as the final time in Table 4.2. Calculate the length of time (min) since the perfume was released, and record it in Table 4.2.
4. Calculate the speed of diffusion: _____ mm/hr. Record in Table 4.2.

Table 4.2 Speed of Diffusion

Medium	Time Zero	Final Time	Length of Time (min)	Distance Moved (mm)	Speed of Diffusion (mm/hr)
Semisolid					
Liquid					
Air					

Conclusions: Solute Diffusion

- In which experiment was diffusion the fastest? _____
- What accounts for the difference in speed? _____

Solute Diffusion Across the Plasma Membrane

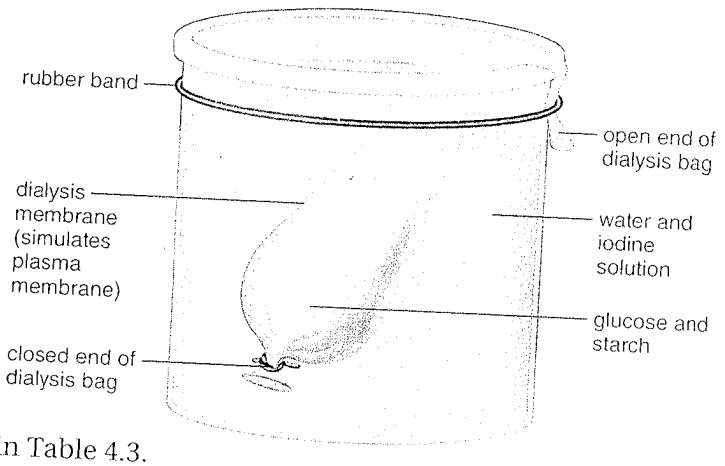
Some molecules can diffuse across a plasma membrane, and some cannot. In general, small, noncharged molecules can cross a membrane by simple diffusion, but large molecules cannot diffuse across a membrane. The dialysis tube membrane in the Experimental Procedure simulates a plasma membrane.

Experimental Procedure: Solute Diffusion Across Plasma Membrane

At the start of the experiment,

1. Cut a piece of dialysis tubing approximately 40 cm (approx. 16 in) long. Soak the tubing in water until it is soft and pliable.
2. Close one end of the dialysis tubing with two knots.
3. Fill the bag halfway with glucose solution.
4. Add 4 full droppers of starch solution to the bag.
5. Hold the open end while you mix the contents of the dialysis bag. Rinse off the outside of the bag with distilled water.
6. Fill a beaker 2/3 full with distilled water.
7. Add droppers of iodine solution (IKI) to the water in the beaker until an amber (tealike) color is apparent.
8. Record the color of the solution in the beaker in Table 4.3.
9. Place the bag in the beaker with the open end hanging over the edge. Secure the open end of the bag to the beaker with a rubber band as shown (Fig. 4.6). Make sure the contents do not spill into the beaker.

Figure 4.6 Placement of dialysis bag in water containing iodine.



After about 5 minutes, at the end of the experiment,

10. You will note a color change. Record the color of the bag contents in Table 4.3.
11. Mark off a test tube at 1 cm and 3 cm.
12. Draw solution from near the bag and at the bottom of the beaker for testing with Benedict's reagent. Fill the test tube to the first mark with this solution. Add Benedict's reagent to the 3 cm mark. Heat in a boiling water bath for 5 to 10 minutes, observe any color change, and record your results as + or – in Table 4.3. (Optional use of glucose test strip: Dip glucose test strip into beaker. Compare stick with chart provided by instructor.)
13. Remove the dialysis bag from the beaker. Dispose of it and the used Benedict's reagent solution in the manner directed by your instructor.

⚠ **Benedict's reagent** Exercise care in using this chemical. It is highly corrosive. If any should spill on your skin, wash the area with mild soap and water. Follow your instructor's directions for its disposal.

Table 4.3 Solute Diffusion Across Plasma Membrane

	At Start of Experiment		At End of Experiment		
	Contents	Color	Color	Benedict's Test	Conclusion
Bag	Glucose Starch				
Beaker	Water Iodine				

Conclusions: Solute Diffusion Across the Plasma Membrane

- Based on the color change noted in the bag, conclude what solute diffused across the dialysis membrane from the beaker to the bag, and record your conclusion in Table 4.3.
- From the results of the Benedict's test on the beaker contents, conclude what solute diffused across the dialysis membrane from the bag to the beaker, and record your conclusion in Table 4.3.
- Which solute did not diffuse across the dialysis membrane from the bag to the beaker? _____

  How do you know? _____

  _____

  _____

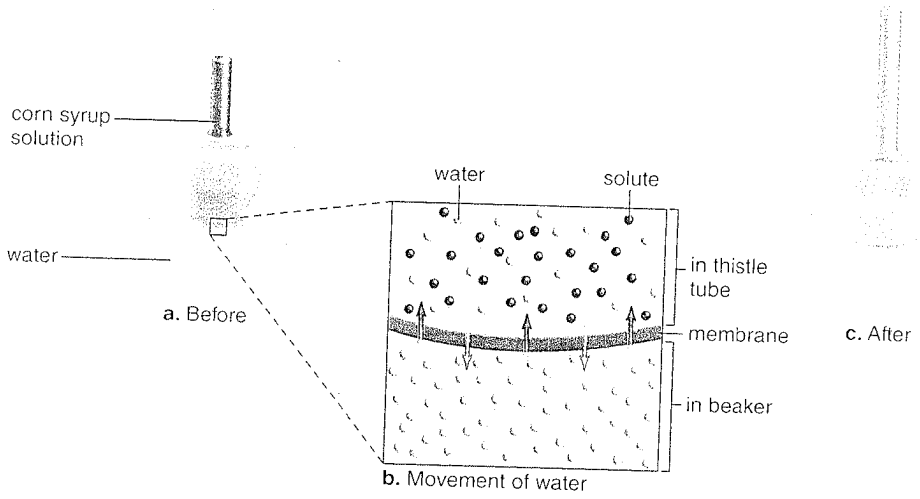
4.4 Osmosis: Diffusion of Water Across Plasma Membrane

Osmosis is the diffusion of water across the plasma membrane of a cell. Just like any other molecule, water follows its concentration gradient and moves from the area of higher concentration to the area of lower concentration.

Experimental Procedure: Osmosis

To demonstrate osmosis, a thistle tube is covered with a membrane at its lower opening and partially filled with 50% corn syrup (starch solution) or a similar substance. The whole apparatus is placed in a beaker containing distilled water (Fig. 4.7). The water concentration in the beaker is 100%. Water molecules can move freely between the thistle tube and the beaker.

Figure 4.7 Osmosis demonstration.
a. A thistle tube, covered at the broad end by a differentially permeable membrane, contains a corn syrup solution. The beaker contains distilled water. **b.** The solute is unable to pass through the membrane, but the water (arrows) passes through in both directions. There is a net movement of water toward the inside of the thistle tube, where there is a lower percentage of water molecules. **c.** Due to the incoming water molecules, the level of the solution rises in the thistle tube.



1. Note the level of liquid in the thistle tube, and measure how far it travels in 10 minutes: _____ mm
2. Calculate the speed of osmosis under these conditions: _____ mm/hr

Conclusions: Osmosis

- In which direction was there a net movement of water? _____
  Explain what is meant by "net movement" after examining the arrows in Figure 4.7*b*.
  _____
- If the starch molecules in corn syrup moved from the thistle tube to the beaker, would there have been a net movement of water into the thistle tube? _____ Why wouldn't large starch molecules be able to move across the membrane from the thistle tube to the beaker?
  _____
- Explain why the water level in the thistle tube rose: In terms of solvent concentration, water moved from the area of _____ water concentration to the area of _____ water concentration across a differentially permeable membrane.

Tonicity In Cells

Tonicity is the relative concentration of solute (particles), and therefore also of solvent (water), outside the cell compared with inside the cell.

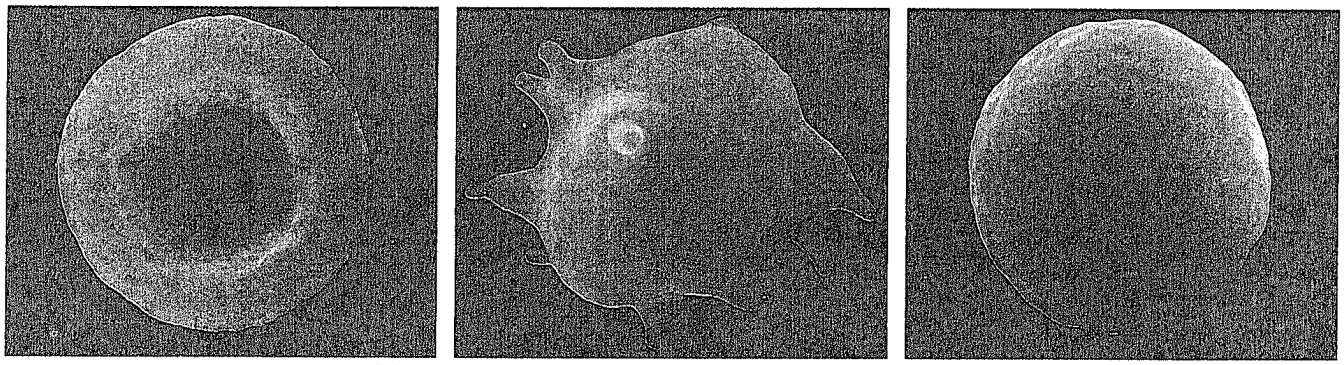
- An **isotonic solution** has the same concentration of solute (and therefore of water) as the cell. When cells are placed in an isotonic solution, there is no net movement of water (see Fig. 4.8*a*).

- A **hypertonic solution** has a higher solute (therefore, lower water) concentration than the cell. When cells are placed in a hypertonic solution, water moves out of the cell into the solution (see Fig. 4.8*b*).
- A **hypotonic solution** has a lower solute (therefore, higher water) concentration than the cell. When cells are placed in a hypotonic solution, water moves from the solution into the cell (see Fig.4.8*c*).

Animal Cells (Red Blood Cells)

A solution of 0.9% NaCl is isotonic to red blood cells (Fig. 4.8*a*). A solution greater than 0.9% NaCl is hypertonic to red blood cells. In such a solution, the cells shrivel up, a process called **crenation** (Fig. 4.8*b*). A solution of less than 0.9% NaCl is hypotonic to red blood cells. In such a solution, the cells swell to bursting, a process called **hemolysis** (Fig. 4.8*c*).

Figure 4.8 Tonicity and red blood cells.



18,000×

a. Isotonic solution.
Red blood cell has normal appearance due to no net gain or loss of water.

18,000×

b. Hypertonic solution.
Red blood cell shrivels due to loss of water.

18,000×

c. Hypotonic solution.
Red blood cell fills to bursting due to gain of water.

Experimental Procedure: Demonstration of Tonicity in Red Blood Cells

Three stoppered test tubes on display have the following contents:

Tube 1: 0.9% NaCl plus a few drops of whole sheep blood
Tube 2: 10% NaCl plus a few drops of whole sheep blood
Tube 3: 0.9% NaCl plus distilled water and a few drops of whole sheep blood

⚠ Do not remove the stoppers of test tubes during this procedure.

1. In the second column of Table 4.4, record the tonicity of each tube in relation to red blood cells.
2. Hold each tube in front of one of the pages of your Lab Manual. Determine whether you can see the print on the page through the tube. Record your findings in the third column of Table 4.4.
3. Explain in the fourth column of Table 4.4 why you can or cannot see the print.

Table 4.4 Effect of Tonicity on Red Blood Cells

Tube	Tonicity	Print Visibility	Explanation
1			
2			
3			

Plant Cells

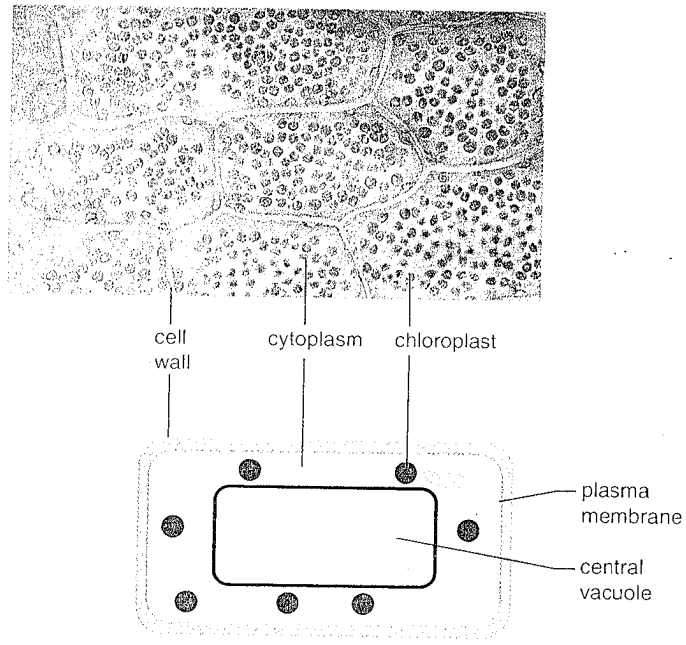
When plant cells are in a hypotonic solution, such as fresh water, the large central vacuole gains water and exerts pressure, called **turgor pressure.** The cytoplasm, including the chloroplasts, is pushed up against the cell wall (Fig. 4.9*a*).

When plant cells are in a hypertonic solution, such as 10% NaCl, the central vacuole loses water, and the cytoplasm, including the chloroplasts, pulls away from the cell wall. This is called **plasmolysis** (Fig. 4.9*b*).

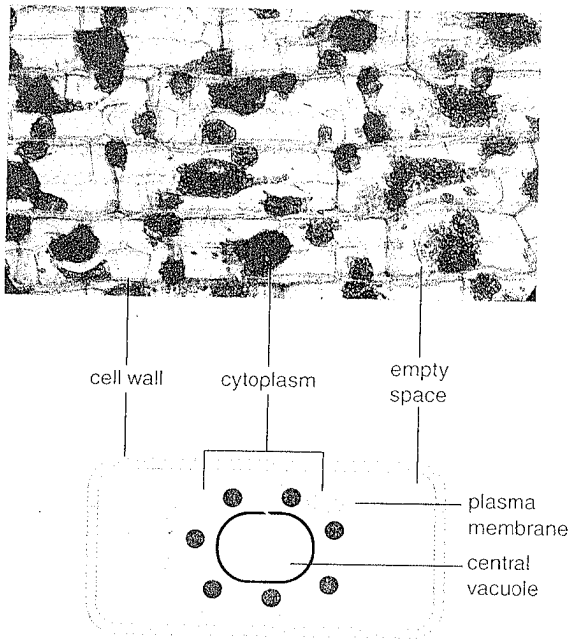
Experimental Procedure: Tonicity in Elodea *Cells*

1. If possible, use the *Elodea* slide you prepared earlier in this laboratory. If not, prepare a new wet mount of a small *Elodea* leaf using fresh water.
2. After several minutes, focus on the surface of the cells, and compare your slide with Figure 4.9*a*.
3. Complete the portion of Table 4.5 that pertains to a hypotonic solution.
4. Prepare a new wet mount of a small *Elodea* leaf using a 10% NaCl solution.
5. After several minutes, focus on the surface of the cells, and compare your slide with Figure 4.9*b*.
6. Complete the portion of Table 4.5 that pertains to a hypertonic solution.

Figure 4.9 ***Elodea*** **cells.**
a. Surface view of cells in a hypotonic solution *(above)* and longitudinal section diagram *(below)*. The large central vacuole, filled with water, pushes the cytoplasm, including the chloroplasts, right up against the cell wall. **b.** Surface view of cells in a hypertonic solution *(above)* and longitudinal section diagram *(below)*. When the central vacuole loses water, cytoplasm, including the chloroplasts, piles up in the center of the cell because the cytoplasm has pulled away from the cell wall. (*a:* Magnification ×400)



a.



b.

Table 4.5 Effect of Tonicity on *Elodea* Cells

Tonicity	Appearance of Cells	Due to (Scientific Term)
Hypotonic		
Hypertonic		

Experimental Procedure: Tonicity in TTw Potato Strips

(This Experimental Procedure runs for one hour. Prior setup can maximize time efficiency.)

1. Cut two strips of potato, each about 7 cm long and 1.5 cm wide.
2. Label two test tubes 1 and 2. Place one potato strip in each tube.
3. Fill tube 1 with water to cover the potato strip.
4. Fill tube 2 with 10% sodium chloride (NaCl) to cover the potato strip.
5. After 1 hour, remove the potato strips from the test tubes and place them on a paper towel. Observe each strip for limpness (water loss) or stiffness (water gain). Which tube has the limp potato strip? _____ Use tonicity to explain why water diffused out of the potato strip in this tube. _____

   _____

   Which tube has the stiff potato strip? _____ Use tonicity to explain why water diffused into the potato strip in this tube. _____

   _____
6. Use this space to create a table to display your results. Give your table a title and columns for tube number and contents, tonicity, results, and explanation.

Conclusions: Tonicity

- In a hypotonic solution, animal cells _____. In red blood cells, this is called _____. In a hypertonic solution, animal cells _____. In red blood cells this is called _____.
- In a hypotonic solution, the central vacuole of *Elodea* cells exerts _____ pressure, and chloroplasts are seen _____. In a hypertonic solution, the central vacuole loses water and _____ occurs. The cytoplasm plus the chloroplasts are seen _____.
- In a hypotonic solution, potato strips _____ water; in a hypertonic solution, potato strips _____ water and become _____.

4.5 pH and Cells

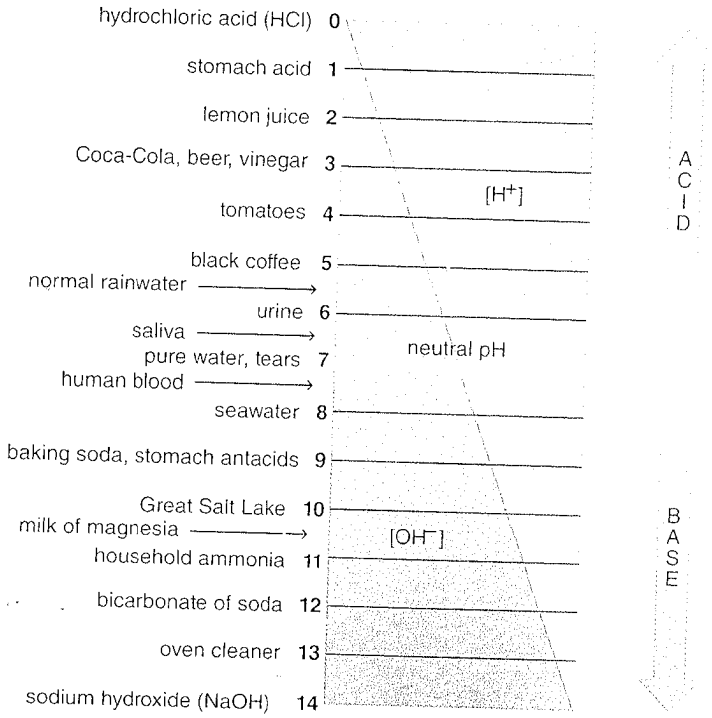
The pH of a solution tells its hydrogen ion concentration [H^+]. The **pH scale** ranges from 0 to 14. A pH of 7 is neutral (Fig. 4.10). A pH lower than 7 indicates that the solution is acidic (has more hydrogen ions than hydroxide ions), whereas a pH greater than 7 indicates that the solution is basic (has more hydroxide ions than hydrogen ions). A **buffer** is a system of chemicals that takes up excess hydrogen ions or hydroxide ions, as appropriate.

The concept of pH is important in biology because living organisms are very sensitive to hydrogen ion concentration. For example, in humans the pH of the blood must be maintained at about 7.4 or we become ill. All living things need to maintain the hydrogen ion concentration, or pH, at a constant level.

Why are cells and organisms buffered? _____

_____

Figure 4.10 The pH scale.
The proportionate amount of hydrogen ions (H^+) to hydroxide ions (OH^-) is indicated by the diagonal line.



Experimental Procedure: pH and Cells

1. Label three test tubes, and fill them to the halfway mark as follows: tube 1: water; tube 2: buffer (inorganic) solution; and tube 3: simulated cytoplasm (buffered protein solution).
2. Use pH paper to determine the pH of each tube. Dip the end of a stirring rod into the solution, and then touch the stirring rod to a 5 cm strip of pH paper. Read the current pH by matching the color observed with the color code on the pH paper package. Record your results in the "pH Before Acid" column in Table 4.6.
3. Add 0.1 N hydrochloric acid (HCl) dropwise to each tube until you have added 5 drops—shake or swirl after each drop. Use pH paper as in step 2 to determine the new pH of each solution. Record your results in the "pH After Acid" column in Table 4.6.

> ⚠ **Hydrochloric acid (HCl)** used to produce an acid pH is a strong, caustic acid. Exercise care in using this chemical. If any HCl spills on your skin, rinse immediately with clear water. Follow your instructor's directions for disposal of tubes that contain HCl.

Table 4.6 pH and Cells

Tube	Contents	pH Before Acid	pH After Acid	Explanation
1	Water			
2	Buffer			
3	Cytoplasm			

Conclusions: pH and Cells

- Enter your explanations in the last column of Table 4.6.
- Why would you expect cytoplasm to be as effective as the buffer in maintaining pH? _____

_____

Experimental Procedure: Effectiveness of Antacids

This procedure tests the ability of commercial products such as Alka-Seltzer, Rolaids, Tums, or antacid tablets to absorb excess H^+.

1. Use a mortar and pestle to grind up the amount of antacid that is listed as one dose.
2. For each antacid tested, use a 100 ml of phenol red solution diluted to a faint pink to wash the antacid into a 250 ml beaker. Phenol red solution is a pH indicator that turns yellow in an acid and red in a base. Use a stirring rod to get the powder to dissolve.
3. Add and count the number of 0.1 N HCl drops it takes for the solution to turn light yellow.
4. Record your results in Table 4.7.

Table 4.7 Effectiveness of Antacids

Antacid	Drops of Acid Needed to Reach End Point	Evaluation
1		
2		
3		

Conclusions: Effectiveness of Antacids

- Participate with others in concluding which of the antacids tested neutralizes the most acid.

_____

- Did dosage in mg have any effect on the results? _____

_____

- Which of the substances on the label could be a buffer? _____

Laboratory Review 4

1. What is the name of the large, often central organelle in eukaryotic cells that contains chromosomes?
2. Prokaryotes have what structures necessary for protein synthesis?
3. What is the function of the nucleus?
4. What is the function of rough endoplasmic reticulum?
5. Which organelle carries on intracellular digestion?
6. Name a structure present in an animal cell but not in a plant cell.
7. Name a structure present in a plant cell but not in an animal cell.
8. What term describes the movement of molecules from an area of higher concentration to one of lower concentration?
9. What is the name for the movement of water across the plasma membrane?
10. In what direction does water move when cells are placed in a hypertonic solution?
11. Is 10% NaCl isotonic, hypertonic, or hypotonic to red blood cells?
12. What appearance will red blood cells have when they are placed in 9.0% NaCl?
13. What scientific term is used to refer to the condition of cells described in question 12?
14. What type of molecule prevents extensive changes in the pH of living organisms?
15. If acid is added to water, does the pH increase or decrease?
16. What is a pH of 7 called?
17. Name two features or cellular components that all cells have in common.

Thought Questions

18. The police are trying to determine whether material removed from a crime scene is plant or animal matter. What would you suggest they look for?

19. Your grandmother asks you to fertilize her favorite plant. Without reading the directions on the box, you pour some fertilizer into the pot and then water the plant. The next time you see your grandmother, she tells you the plant died. In terms of osmosis, explain what happened to the plant.

20. Explain what happens to both plant and animal cells when they are placed into a solution that is hypotonic to the interior of the cell. If the two cells meet different fates, explain why.