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## **Project CONN-CEPT Science Units**

Astronomy: Sun, Moon, and Stars (K-2)  
The World of Matter (1)  
Living Things: Changes, Stages and Cycles (2-3)  
Eurekas and Ecosystems (4-5)  
Light: A Rainbow of Explorations (4-5)  
Sound's Story: H-Ear the Pitch (4-5)  
Structure and Function: What's Their Junction? (6)  
Weather: The Never-Ending Story (6)  
Cells: The Story of Life (7)  
Reactions and Interactions (7-8)

## **Project CONN-CEPT Social Studies Units**

Time, Change, and Continuity in History (K)  
Local Government (3)  
What Makes a Region? An Investigation of the Northeast (4)  
Goods, Services, Resources, Scarcity and Systems: An Exploration of State Economics (4-5)  
Concepts and Tools of the Geographer (6)  
With Liberty and Justice for All: A Study of the U.S. Constitution (6-8)

## **Units in Preparation**

Junior Economist: People, Resources, Trade (1-2)  
A Habitat is a Home for Plants and Animals: Needs, Resources, Adaptation and Systems (1-2)  
May the Force Be with You: Forces, Motion and Simple Machines (2-3)  
Comparing Cultures: Traditions, Dwellings, Language, and Cultural Evolution (2-3)  
Peopling of the Americas (4-5)  
Going to the Source: Using Primary Resources in United States History (6-8)  
Exploring the World's Oceans: Chemistry, Geology and Biology (7)  
Reactions and Interactions: Chemical Reactions (7-8)

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## A Shared Story

*The exhibit hall was huge, and publishers' banners, suspended from the ceiling, waved back and forth in the air conditioned room. Hundreds of conference participants filled the aisles. Vendors of curriculum materials, eager to share their colorful and glossy wares with passing teachers and administrators, stood at the edge of their displays offering warm smiles, prizes, and publishers' catalogues.*

*Charlene and Andrew had carefully planned their tour through the aisles and divided up so that they could see all the materials. They looked forward to their time in the vendor area because they needed curriculum materials in social studies and science for their upper elementary and middle school students. They hoped they would find something good. They wanted coherent, comprehensive units that addressed their state and national standards, had good assessments, required students to think their way through content, provided teachers with teaching strategies, and some guidance regarding how to differentiate the curriculum for students with varied learning needs.*

*They looked at many cleverly designed curriculum packages and kits. Most materials were collections of episodic learning activities. Some contained coherent learning activities for students, but did not teach to the critical concepts and principles embedded in state and national standards. Other materials, claiming to be comprehensive, did not contain aligned pre- and post-assessments, user-friendly teacher information, suggestions for teaching, or techniques for differentiating. Several kits attended to concepts and principles, but none was comprehensive enough to address all the standards for a particular grade level. At least two kits would be required to cover the prerequisite standards. Worse, the cost for the two kits would not include the price for the consumables that would have to be purchased each year to keep the kits adequately stocked. They could hardly pay for the cost of one kit!*

*Charlene and Andrew met at the back of the hall and compared notes. They were disappointed because they realized that the high-quality, standards-based curriculum materials they wanted were not in the racks. Now what? Were there other vendors? If so, who were they and how could they be contacted? If there were no vendors with the materials they needed, could they write the needed curriculum themselves? Who could help them? Did the district have money to pay stipends for curriculum development? How could they possibly write all the curricula that was required to address the state assessments?*

We dedicate this curriculum unit, as well as others written under this Javits grant, to all the teachers who have had experiences like Charlene and Andrew. We hope the unit presented here will meet the needs of educators who live in real classrooms, contend with real time constraints, prepare students adequately for high-stakes assessments, seek high-quality curriculum materials, and strive to meet the varied learning needs of all their students.

Deborah E. Burns  
Jeanne H. Purcell

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## PREFACE

In 2002, the Connecticut State Department of Education was awarded a Javits grant from the U.S. Department of Education called Project CONN-CEPT. The major focus of grant activities was the creation of standards-based curriculum units, K-8, in science and social studies. These rigorous curriculum units have been created for all students because every child must have access to the highest quality curriculum. At the same time, the units also have a particular focus on the needs of advanced learners—those who know more, learn more rapidly, think more deeply, or who are more innovative in a particular area of study. It was our goal to embed learning opportunities for advanced learners that were tightly aligned with the concepts and principles that guided the unit.

### **The Parallel Curriculum Model**

This standards-based curriculum unit has been designed using the *Parallel Curriculum Model* (PCM) (Tomlinson, Kaplan, Renzulli, Purcell, Leppien, & Burns, 2002). The *Parallel Curriculum Model* is a set of four interrelated designs that can be used singly, or in combination, to create or revise existing curriculum units, lessons, or tasks. Each of the four parallels offers a unique approach for organizing content, teaching, and learning that is closely aligned to the special purpose of each parallel. The four parallels include: the Core Curriculum Parallel, the Curriculum of Practice, the Curriculum of Connections, and the Curriculum of Identity.

The *Core Curriculum* addresses the core concepts, principles, and skills of a discipline. It is designed to help students understand essential, discipline-based content through the use of representative topics, inductive teaching, and analytic learning activities. The *Curriculum of Connections* builds upon the Core Curriculum. It is a plan that includes a set of guidelines and procedures to help curriculum developers connect overarching concepts, principles, and skills within and across disciplines, time periods, cultures, places, and/or events. This parallel is designed to help students understand overarching concepts, such as change, conflict, cause and effect, and patterns, as they relate to new content and content areas. The *Curriculum of Practice* is a plan that includes a set of guidelines and procedures to help students understand, use, generalize, and transfer essential knowledge, understandings, and skills in a field to authentic questions, practices, and problems. This parallel is designed to help students function with increasing skill and competency as a researcher, creator, producer, problem solver, or practitioner in a field. The *Curriculum of Identity* is a plan that includes a set of guidelines and procedures to assist students in reflecting upon the relationship between the skills and ideas in a discipline and their own lives, personal growth, and development. This parallel is designed to help students explore and participate in a discipline or field as it relates to their own interests, goals, and strengths, both now and in the future.

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The *Parallel Curriculum Model* also contains a new concept called Ascending Intellectual Demand (AID). Ascending Intellectual Demand offers practitioners a way to think about a discipline and each student's steady, progressive movement from novice to expert within that discipline. As students are ready, teachers ask students for increasing levels of cognition, affect, and application. As such, AID is a framework teachers use to increase the challenge level for students by asking them to behave and act in expert-like ways. (Tomlinson, Kaplan, Purcell, Leppien, Burns, & Strickland, 2006).

This unit has been designed using the Core Curriculum Parallel. Core Curriculum addresses the essential concepts, principles, generalizations, and skills of a subject area. It is designed to help students understand essential, discipline-based content through the use of representative topics, inductive teaching, and analytic learning activities. Although the majority of lessons in this unit have been designed using the Core Curriculum Parallel, it also contains several lessons that provide students with opportunities to explore other parallels that are closely connected to the subject matter.

## Our Invitation...

We invite you to peruse and implement this curriculum unit. We believe the use of this unit will be enhanced to the extent that you:

- **Study PCM.** Read the original book, as well as other companion volumes, including *The Parallel Curriculum in the Classroom: Units for Application Across the Content Areas, K-12* and *The Parallel Curriculum in the Classroom: Essays for Application Across the Content Areas, K-12*. By studying the model in depth, teachers and administrators will have a clear sense of its goals and purposes.
- **Join us on our continuing journey to refine these curriculum units.** We know better than to suggest that these units are scripts for total success in the classroom. They are, at best, our most thoughtful thinking to date. They are solid evidence that we need to persevere. In small collaborative and reflective teams of practitioners, we invite you to field test these units and make your own refinements.
- **Raise questions about curriculum materials.** Provocative, compelling and pioneering questions about the quality of curriculum material—and their incumbent learning opportunities—are absolutely essential. Persistent and thoughtful questioning will lead us to the development of strenuous learning opportunities that will contribute to our students' life-long success in the 21<sup>st</sup> century.
- **Compare the units with material developed using other curriculum models.** Through such comparisons, we are better able to make decisions about the use of the model and its related curriculum materials for addressing the unique needs of diverse learners.
- **Examine PCM as one bridge between general and gifted education.** We believe that the rigorousness of PCM has much to offer *all* students, not just those who may already know, do, or understand at very different levels of sophistication.

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## **ACKNOWLEDGEMENTS**

We would like to thank our mentors, Carol Tomlinson and Carolyn Callahan. They have been our constant supporters and guides as we moved into uncharted territory related to curriculum development and differentiation.

Over the years we have been guided by the wise counsel of our curriculum writers: Cheryll Adams, Renee Alister, Karen Berk, Fie Budzinsky, Meagan Bulger, Yvette Cain, Lori Cipollini, Leslie Chislett, Megan Coffey, Edie Doherty, Claire Farley, Kurt Haste, Carla Hill, MaryAnn Iadarolla, Caitlin Johnson, Megan Lamontagne, Donna Leake, Lisa Malina, Kay Rasmussen, Martha Rouleau, Cindy Strickland, Mary Grace Stewart, Kim Turret, Ann Marie Wintenberg, and Karen Zaleski. They have worked tirelessly on their curriculum units and provided us with many insights into the curriculum writing process. Although we had a road map at the outset of the writing process, our writers helped us to craft new roads when the old ones no longer worked. We thank them for their integrity, care, innovativeness, and encouragement.

We thank all of the people who featured into the field testing process. These people include teachers in Cheshire, Hartford and Portland Public Schools. We especially want to thank the following building administrators who supported our work: Tory Niles and John Laverty from Hartford; Linda Cahill and Deborah Granier from Portland; and Steve Proffitt, Diane DiPietro, Sharon Weirsmen, Russ Hinkley, Beverly Scully, and Mary Karas from Cheshire. The insights from teachers and administrators helped to make our curriculum units stronger and more practical.

Kim Allen, from Project LEARN, provided us with assistance and support in all of our endeavors and made sure that we stayed the course in solid financial standing. Nancy Wight and Gail Heigel, from Cheshire Public Schools, spent untold hours formatting, typing, duplicating, collating, and distributing the experimental units and ordering the numerous student materials and teacher resources that supplement these lessons. They are the masters of due diligence and attention to detail. We also wish to thank Eileen Williams and Patricia Johnson, from the State Department of Education, for formatting, typing, and preparing the pre-assessments and post assessments for the units. They worked tirelessly for many hours after work and on weekends to meet our deadlines and never lost their smiles.

We thank Cheshire Public Schools and the Connecticut State Department of Education for allowing us to take on this tremendous task and allowing us the hours within day (and night) to accomplish all that was required.

Our families and friends deserve special recognition because they offered unwavering support and encouragement. We recognize they made personal sacrifices, and we hope that we have grown as a result.

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Most of all, we would like to thank Judy Walsh on whose shoulders these units truly stand. With the greatest of care and unparalleled thoughtfulness and consideration, Judy has edited each manuscript, worked collaboratively with each author to refine each lesson, written lessons when it was necessary, and provided a sense of humor and her wisdom as a teacher. She is selfless and seeks only to advance each author and the project. In every way, she has been our “North Star” on the project.

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### **Format for the Project CONN-CEPT Curriculum Units**

Each Project CONN-CEPT curriculum unit is formatted in the same way and contains four components: an overview, the lessons, a content map, and a comprehensive list of resources required in the unit. The *overview* is a chart that includes the lesson principles, concepts and skills, the time allocation, the standards that are explicitly addressed within each lesson, and a brief description of each lesson. The overview provides potential users with a “snap-shot” of the unit, related standards, and classroom activities.

The *lessons* follow the overview and vary in number depending upon the content area and grade level of the unit. Each lesson is comprehensive and addresses 10 curriculum components: content, assessments, introductory and debriefing activities, teaching strategies, learning activities, grouping strategies, products, resources, extensions, and differentiation activities. For the most part, each lesson provides specific information about each of these components. An aligned pre- and post-assessment is included for the entire unit, and aligned formative assessments are provided at critical junctures in the unit. Additionally, each lesson contains all the required black-line masters and materials.

Many lessons contain two features that are unique to Project CONN-CEPT materials: opportunities for Ascending Intellectual Demands (AID) and talent-spotting activities. Ascending Intellectual Demand is a term used to describe learning opportunities that require students to work at increasing levels of discipline-specific expertise (Tomlinson et al). They are appropriate for any student who demonstrates advanced ability or expertise in a discipline. The AID opportunities are labeled using the acronym AID. Additionally, many lessons contain searchlight opportunities. Searchlight opportunities are rich moments during a lesson for teachers to observe students and note those who appear to have heightened interest in the topic under investigation. To support these students’ emerging interests, extension ideas are provided.

A *content map* comes after the lessons. Like the overview, the content chart is a snap-shot of the important knowledge in a unit: the major and minor principles, concepts, skills, themes and guiding questions. Teachers who want in-depth information about the knowledge contained in the unit will find this chart useful.

A comprehensive list of *resource materials* concludes each unit. Although the required materials are also listed at the beginning of each lesson, the comprehensive listing provides teachers with a one-page summary of all the materials and it facilitates planning.

# CELLS: THE STORY OF LIFE

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## Introduction Cells: The Story of Life – Grade 7

This unit on cells has been designed using the Core Curriculum parallel. Core Curriculum addresses the core concepts, principles, generalizations, and skills of a subject area. It is designed to help students understand essential, discipline-based content through the use of representative topics, inductive teaching, and analytic learning activities. Although the majority of lessons in this unit have been designed using the Core Curriculum parallel, it also contains several lessons that provide grade seven students with opportunities to explore the methodology of the practicing professional (Curriculum of Practice) as well as the chance to reflect on themselves as emerging scientists (Curriculum of Identity).

The unit contains 31 lessons as well as a pre-assessment and a post assessment that are outlined in the chart below. The first column contains the lesson number and the name of the parallel(s) that the lesson addresses. The second column contains a series of numbers. The numbers reflect the national standards—culled from *National Science Education Standards* (National Research Council, 1996) and *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993)—that are addressed in each lesson and that are listed and numbered below. For brevity’s sake, only one or two standards are listed in each row of the chart and represent the major focus of individual sessions. However, the lessons have been designed to build upon each other, and each session builds iteratively upon many of the standards. Connecticut’s standards are also referenced here and are cited in the same column.

Column three contains the principles that guide the lesson. The principles—which state relationships among essential concepts—reflect what we want students to know and be able to do upon completing the lessons. They are derived from the standards, reflect both declarative and procedural knowledge, and illustrate the careful attention that has been given to “teasing apart” the complexity of ideas contained within standard statements.

Column four includes a brief description of the lesson. It provides an overview of some of the teaching and learning activities that are designed to occur within the classroom.

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## National Standards

### Life Science

1. Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems. (*National Science Education Standards*, 5-8)
2. All organisms are composed of cells—the fundamental unit of life. Most organisms are single cells; other organisms, including humans, are multicellular. (NSES\*, 5-8)
3. All living things are composed of cells, from just one to many millions, whose details usually are visible only through a microscope. Different body tissues and organs are made up of different kinds of cells. The cells in similar tissues and organs in other animals are similar to those in human beings but differ somewhat from cells found in plants. (*Benchmarks for Science Literacy\*\**, 6-8)
4. Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organisms needs. (NSES, 5-8)
5. Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together to form larger functional units, called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole. (NSES, 5-8)
6. The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another. (NSES, 5-8)

### Science as Inquiry

7. Scientists differ greatly in what phenomena they study and how they go about their work. Although there is no fixed set of steps that all scientists follow, scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypothesis and explanations to make sense of the collected evidence. (BSL, 6-8)
8. Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models. (NSES, 5-8)
9. Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations. (NSES, 5-8)

# CELLS: THE STORY OF LIFE

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10. Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. The scientific community accepts and uses such explanations until displaced by better scientific ones. (NSES, 5-8)

## **The Scientific Enterprise**

11. Computers have become invaluable in science because they speed up and extend people's ability to collect, store, compile, and analyze data, prepare research reports, and share data and ideas with investigators all over the world. (BSL, The Scientific Enterprise, 6-8)
12. Accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society. (BSL, The Scientific Enterprise, 6-8)

\* American Association for the Advancement of Science. (1993). *Project 2061: Benchmarks for science literacy*. New York: Oxford University Press.

\*\* National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

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## Connecticut Related Content Standards

### Grades 6-8

#### I Scientific Inquiry

*Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.*

*Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.*

*Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.*

#### Scientific Literacy

*Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.*

*Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.*

#### Scientific Numeracy

*Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.*

### Grade 7

#### 7.2 Structure and Function

*How are organisms structured to ensure efficiency and survival?*

**Many organisms, including humans, have specialized organ systems that interact with each other to maintain dynamic internal balance.**

*All organisms are composed of one or more cells; each cell carries on life-sustaining functions.*

*Multicellular organisms need specialized structures and systems to perform basic life functions.*

- Describe the basic structures of an animal cell, including nucleus, cytoplasm, mitochondria and cell membrane, and how they function to support life.

# CELLS: THE STORY OF LIFE

Module & Lessons	Standards	Lesson principles	Lesson description
<p>1  <b>Pre-Assessment</b>  <b>(CORE)</b>  <b>45 minutes</b></p>			<p>This lesson includes a pre-assessment that samples the content in this unit: the characteristics of living organisms, the parts of the cell, differences between plant and animal cells, osmosis, cell reproduction, and the levels of organization of living systems.</p>
<p>Module 1            Lesson 1            (CORE/            PRACTICE/AID)            50 minutes</p>	<p>4, 10             CT Standard:            I (Expected            Performances:             (C INQ 1, 5, 8,            9, 10)            1.1 (Expected            Performances)            (A11)</p>	<ul style="list-style-type: none"> <li>• All living things have five common characteristics for survival.</li> <li>• These five characteristics evolved over time for continuation of a species.</li> </ul>	<p>Students begin the exploration of the characteristics of living things in the first lesson. In small groups and then as a class, students discover the five characteristics of living things that are needed for survival.</p>

<b>Module &amp; Lessons</b>	<b>Standards</b>	<b>Lesson Principles</b>	<b>Lesson description</b>
<p>Module 2 Lessons 2-15 (CORE) 10 hours, 50 minutes</p>	<p>2, 3, 4, 7, 8</p> <p>CT Standards: I (Expected Performances: C INQ 1, 3, 5, 8, 9, 10)</p> <p>7.2 (Expected Performances: C 15)</p>	<ul style="list-style-type: none"> <li>• Cellular survival is dependent on its structures and their functions.</li> <li>• A cell's structure correlates to its job for an organism.</li> </ul>	<p>After an introduction and pre-assessment concept map, students research their assigned organelles by using text and Internet resources in lesson 2.</p> <p>In Lessons 3 &amp; 4 students construct three-dimensional models of both plant and animal cells, including appropriate organelles.</p> <p>Lessons 5 &amp; 6 are used for class presentations of the constructed cells and organelles, emphasizing the importance of the respective organelles.</p> <p>In Lesson 7 students color, label and complete diagram worksheets for both a plant cell and an animal cell. Two versions are available, one has scaffolding and the other requires more independent work.</p> <p>Groups work on a mystery in Lessons 8 &amp; 9. They first examine a plant cell and a scraping that they have taken from the inside of their cheek. Then they examine the two mystery cells samples, complete drawings and questions related to these cell samples, and describe their conclusions.</p> <p>Lessons 10 &amp; 11 involve groups of students creating a collage which features four organelles and their functions.</p> <p>Students create a "Jeopardy" style game in Lessons 12 &amp; 13. Groups create their own questions and answers from the module.</p> <p>Lesson 14 can be used to play the game.</p> <p>In Lesson 15 each student creates a concept map for the module which serves as a post assessment. This activity is followed by a comprehensive debriefing discussion with the entire class.</p>

# CELLS: THE STORY OF LIFE

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<b>Module &amp; Lessons</b>	<b>Standards</b>	<b>Lesson principles</b>	<b>Lesson description</b>
<p>Module 3 Lessons 16 - 24 (CORE/ PRACTICE/ IDENTITY/AID) 6 hours, 25 minutes</p>	<p>4, 7, 8, 12  CT Standards: I (Expected Performances: C INQ 1, 3, 4, 5, 6, 8, 9, 10)  7.2 (Expected Performances: C 15)</p>	<ul style="list-style-type: none"> <li>• The cell's processes guarantee that necessary materials enter and leave the cell.</li> <li>• Anybody can be a scientist.</li> </ul>	<p>Lesson 16 is an introduction and a pre-assessment for the module.</p> <p>In Lesson 17 the class begins with a teacher demonstration lab using water with food coloring. The focus is on the movement of molecules from higher concentration of color to a lower concentration. Students then perform their own experiment, "Egg-speriment," by placing an egg in a beaker of vinegar and recording their observations and their predictions. Students have the opportunity to look at the profession of biological scientist and consider if it would be of interest to them as a future occupation.</p> <p>In lesson 18, small groups begin an experiment "What's up Doc?" which tests the effects of salt water on vegetables. These groups also use the scientific method to create a hypothesis and plan an experiment.</p> <p>In Lesson 19 groups finish the planning and set up individual experiments for the salt water and vegetables. They also continue the experiment begun in Lesson 17 and remove the egg from vinegar and place it in a beaker of corn syrup.</p> <p>Students finish the egg experiment in Lesson 20 when they remove the egg from the syrup and complete their observations and conclusion questions on the worksheet. This activity is followed by a class discussion of the procedure.</p> <p>In Lesson 21 pairs of students observe the effect of salt water on an actual cell membrane by using a microscope. After completing their observations, they draw what they saw and describe their conclusions on their lab sheet, "Osmosis and the Cell Membrane."</p> <p>Students complete the lab, "What's up Doc?" in Lesson 22 by recording results and completing the conclusion and validity sections of the worksheets.</p> <p>Lesson 23 focuses on the cell's need for the process of active transport. Students complete the worksheet, "Diffusion, Osmosis or Active Transport?" either individually or as a class.</p> <p>Lesson 24 is a post assessment of the module in which the class creates a concept map which uses the terms diffusion, osmosis, and active transport. This activity is followed by a comprehensive debriefing of the concepts in Module 3.</p>

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Module & Lessons	Standards	Lesson principles	Lesson description
<p>Module 4 Lessons 25-29 (CORE/AID) 3 hours, 45 minutes</p>	<p>4, 9, 10, 11</p> <p>CT Standards: I (Expected Performances: C INQ 1, 2, 3, 5, 9, 10)</p> <p>7.2 (Expected Performances: C 15)</p>	<ul style="list-style-type: none"> <li>Cellular reproduction continues the species.</li> </ul>	<p>In Lesson 25 pairs or small groups of students plan and research, using texts and the Internet, the materials needed to prepare a flipbook of the process of mitosis.</p> <p>In Lesson 26 small groups actually construct the flip book with an emphasis on continuity and accuracy.</p> <p>Lessons 27 &amp; 28 invite pairs of students to complete a lab “Cell Division” which uses yarn to simulate the process of mitosis. As students see the different stages, they draw and describe their findings.</p> <p>Lesson 29 provides an individual post assessment for the steps of mitosis which is followed by a debriefing and reflection on the module. An AID opportunity invites appropriate students to undertake a lab on onion cell mitosis.</p>
<p>Module 5 Lessons 30-31 (CORE) 1 hour, 30 minutes (2 days)</p>	<p>1, 2, 3, 5, 6</p> <p>CT Standards: I (Expected Performances: C INQ 1, 9, 10)</p> <p>7.2 (Expected Performances: C 15)</p>	<ul style="list-style-type: none"> <li>All life is organized from the most basic level (cells) to the most complex level (organism).</li> <li>Specialized cells perform specialized functions in multicellular organisms.</li> </ul>	<p>In Lessons 30-31 focus on the idea that each level of an advanced organism is made of yet another level. Students choose a body system, such as the digestive system, and draw that system. Then they choose one organ in that system, the tissue that would compose that organ and finally the cells that compose the tissue. A debriefing provides an opportunity for students to share their examples and for the teacher to create a class chart that emphasizes interaction among all the levels.</p>
<p>Post Assessment (CORE) 45 minutes</p>		<p>All principles in the unit</p>	<p>Post assessment</p>

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<b>Module 4: Cell Division (Lessons 25-29)</b>	Page 73
Time Allocation: 3 hours, 45 minutes	
<b>Module 5: Life's Organization (Lessons 30,31)</b>	Page 93
Time Allocation: 1 hour, 30 minutes	
<b>Post Assessment</b>	Page 101
Time Allocation: 45 minutes	
<b>Curriculum Map</b>	Page 111
<b>Materials and Resources List</b>	Page 117



# **“Pre-assessment”**

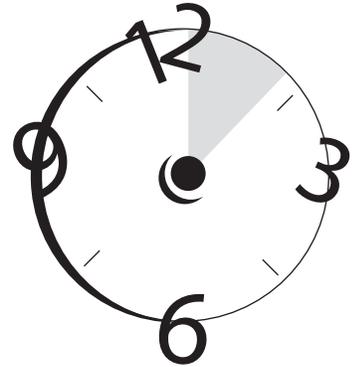


# Pre-assessment

**Core**

Time Allocation: 45 minutes

Required Materials and Resources on Page 117



## Lesson Overview

In this lesson students take the pre-assessment.

### Guiding Questions

What do I know about how organisms are structured to ensure efficiency and survival?

**BIG  IDEA**

**What do I know about cells, their functions, reproduction and organization?**

# CELLS: THE STORY OF LIFE



## Content Goals

### Universal Themes

- Classification
- Differentiation
- Balance
- Cycles
- System

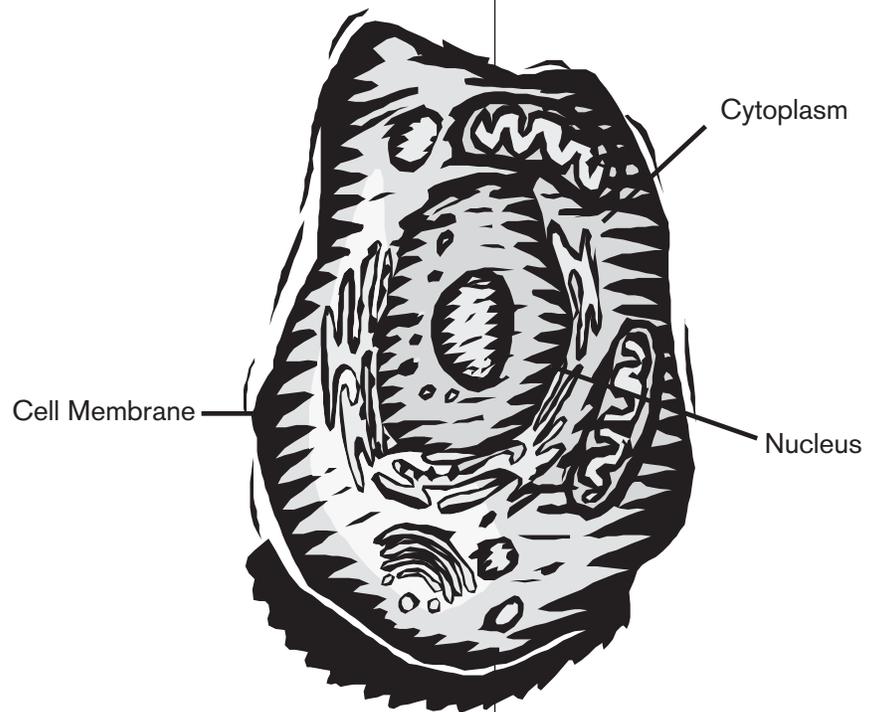
### Principles and Generalizations

- All living things have five common characteristics for survival.
- These five characteristics evolved over time for continuation of a species.
- Cellular survival is dependent on its structures and their functions.
- A cell's structure correlates to its job for an organism.
- The cell's processes guarantee that necessary materials enter and leave the cell.
- Cellular reproduction continues the species.
- All life is organized from the most basic level (cells) to the most complex level (organism).
- Specialized cells perform specialized functions in multicellular organisms.

### Concepts

- Living organism
- Cells
- Reproduction
- Chemical processes
- Growth
- Development
- Response
- Stimulus
- Movement
- Organelles
- Cell wall
- Cell membrane
- Cell nucleus
- Nuclear membrane

- Chromosomes
- Nucleolus
- Cytoplasm
- Photosynthesis
- Mitochondria
- Cellular respiration
- Ribosomes
- Endoplasmic reticulum
- Lysosomes
- Vacuoles
- Cilia
- Flagella
- Diffusion
- Osmosis
- Active transport
- Equilibrium
- Concentration
- Selectively permeable
- Semi-permeable
- Mitosis
- Phases
- Chromatin
- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase
- Tissues
- Organs
- Organs systems
- Organisms
- Unicellular
- Multicellular



## Teacher Information

N/A

# CELLS: THE STORY OF LIFE



## Skills

- Reason deductively
- Infer
- Make Connections
- Organize
- Describe

## Materials and Resources

### Cells: The Story of Life Unit Pre-assessment

## Preparation Activities

Copy **Cells: The Story of Life Unit Pre-assessment** for each student.

## Introductory Activities (2 minutes)

Explain to students that the pre-assessment will be used by you to measure their knowledge about this unit. Emphasize that they should make their best effort on the assessment.

## Pre-assessment

N/A

## Teaching and Learning Activities (43 minutes)

1. Distribute the **Cells: The Story of Life Unit Pre-assessment** to each student.
2. Collect students' pre-assessment at end of lesson.

## Products and Assignments

Students' pre-assessment results

## Extension Activities

N/A

## Post Assessment

N/A

## Debriefing and Reflection Opportunities

N/A

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

**Pre-assessment for Cells: The Story of Life Unit**

**Please answer the following questions as completely as possible in full sentences.**

1. There are certain characteristics of every living organism that prevent it organism from dying and the species from eventually becoming extinct. What are those characteristics and how do they prevent extinction?

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2. If a cell could only have four major parts, what would those parts be and why?

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3. Describe three differences between a plant cell and an animal cell.

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4. Your fingers shrivel in the bathtub because of a process called osmosis. This is similar to the process that causes plants to wilt. Explain what is occurring when this process happens. Would the same thing happen to your fingers in the ocean? Why or why not?

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5. What steps does a cell need to go through in order to produce more cells?

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# CELLS: THE STORY OF LIFE

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6. Describe how your body is organized into levels.

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Student Name \_\_\_\_\_

**Pre-Assessment / Post Assessment Proficiency Rubric**

<b>Question #</b>	<b>Novice</b>	<b>Competent</b>	<b>Proficient</b>	<b>Expert</b>
1	<ul style="list-style-type: none"> <li>• Response reflects no comprehension or comprehension of only one major characteristic of living things.</li> <li>• Response is incorrect.</li> <li>• No elaboration</li> <li>• No examples given</li> </ul>	<ul style="list-style-type: none"> <li>• Response reflects comprehension of two major characteristics of living things.</li> <li>• Response is partially correct</li> <li>• Poor elaboration</li> <li>• Poor choice of examples</li> </ul>	<ul style="list-style-type: none"> <li>• Response reflects comprehension of three major characteristics of living things.</li> <li>• Response is correct</li> <li>• Elaboration and completeness may be lacking some detail.</li> <li>• Uses few examples or uses examples only adequately</li> </ul>	<ul style="list-style-type: none"> <li>• Response reflects comprehension of four or more major characteristics of living things.</li> <li>• Response is correct.</li> <li>• Response is complete and is elaborated well.</li> <li>• Response uses several examples appropriately.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Response lists one major cell part.</li> <li>• Chosen parts reflect no comprehension of importance of parts to cell.</li> <li>• Supporting reasons are incomplete, illogical or lack elaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Response lists two major cell parts.</li> <li>• Chosen parts reflect little comprehension of importance of parts to cell.</li> <li>• Supporting reasons are incomplete, illogical or lack elaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Response lists three major cell parts.</li> <li>• Chosen parts reflect adequate comprehension of importance of parts to cell.</li> <li>• Supporting reasons are generally complete, logical and elaborated.</li> </ul>	<ul style="list-style-type: none"> <li>• Response lists four or more major cell parts.</li> <li>• Chosen parts reflect strong comprehension of importance of parts to cell.</li> <li>• Supporting reasons are complete, logical and well elaborated.</li> </ul>

Student Name \_\_\_\_\_

**Pre-Assessment / Post Assessment Proficiency Rubric**

<b>Question #</b>	<b>Novice</b>	<b>Competent</b>	<b>Proficient</b>	<b>Expert</b>
3	<ul style="list-style-type: none"> <li>• Response demonstrates no comprehension of significant differences between plant and animal cells.</li> <li>• Response is incorrect, incomplete and lacks elaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates minimal comprehension of significant differences between plant and animal cells.</li> <li>• Response is generally correct, but is incomplete or lacks elaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates adequate comprehension of two significant differences between plant and animal cells.</li> <li>• Response is correct, but may be incomplete or elaborately poorly.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates strong comprehension of three or more significant differences between plant and animal cells.</li> <li>• Response is correct, complete and elaborates well.</li> </ul>
4	<ul style="list-style-type: none"> <li>• Response demonstrates no comprehension of the process of osmosis.</li> <li>• Response is incorrect, incomplete.</li> <li>• Response does not discuss movement of molecules.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates minimal comprehension of the process of osmosis.</li> <li>• Response is generally correct but may be incomplete or lack elaboration.</li> <li>• Response discusses molecules but does not refer to concentrations or reasons for movement.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates adequate comprehension of the process of osmosis.</li> <li>• Response is correct, complete and shows some elaboration.</li> <li>• Response discusses movement of molecules but may not refer to concentration or describe reasons for movement.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates strong comprehension of the process of osmosis.</li> <li>• Response is correct, complete and elaborates well.</li> <li>• Response discusses movement of molecules, including concentrations and reasons for movement.</li> </ul>

Question #	Novice	Competent	Proficient	Expert
5	<ul style="list-style-type: none"> <li>• Response demonstrates no comprehension of process of cell division.</li> <li>• Response does not discuss phases of cell division.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates minimal comprehension of process of cell division</li> <li>• Response discusses phases of cell division but does not discuss movement of chromosomes, nucleus and cell membrane.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates an adequate comprehension of process of cell division.</li> <li>• Response discusses some phases of cell division, including movement of chromosomes, nucleus or cell membrane.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates a strong comprehension of process of cell division.</li> <li>• Response discusses all phases of cell division, including movement of chromosomes, nucleus and cell membrane.</li> </ul>
6	<ul style="list-style-type: none"> <li>• Response demonstrates little or no comprehension of levels of organization.</li> <li>• Response draws no connection between levels.</li> <li>• Response offers no examples for levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates a poor comprehension of levels of organization.</li> <li>• Response draws poor connections between levels.</li> <li>• Response offers few if any examples for levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates adequate comprehension of levels of organization but may not address all five levels.</li> <li>• Response draws connections between levels but may be lacking in support.</li> <li>• Response offers some examples for levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates a strong comprehension of all five levels of organization.</li> <li>• Response draws well developed connection between levels.</li> <li>• Response offers examples for all levels.</li> </ul>

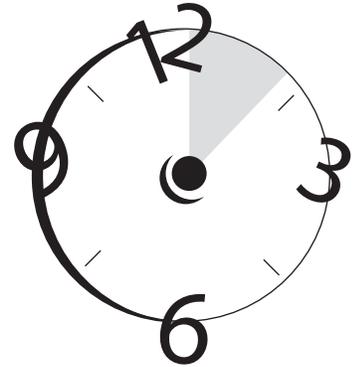


# Characteristics of Life

## Core/Practice/AID

Time Allocation: 50 minutes (1 Day)

Required Materials and Resources on Page 117



### Lesson Overview

In this module, students will explore the characteristics of living things. Students will create their own list of characteristics for living organisms based on group discussions. Then after compiling the lists, the teacher will invite a dialogue among students that focuses on common characteristics for living organisms. The activity reinforces the principle that all living things have five common characteristics for survival: having cells, reproducing, performing complex chemical processes, responding, growing and developing. Students with a scientific aptitude may come up with several of the actual characteristics quickly.

### Guiding Questions

- What are the five characteristics of living things?
- Why are these particular characteristics necessary?

## BIG IDEA

All living things have five common characteristics which have evolved over time for continuation of a species.

# CELLS: THE STORY OF LIFE



## Content Goals

### Universal Theme(s)

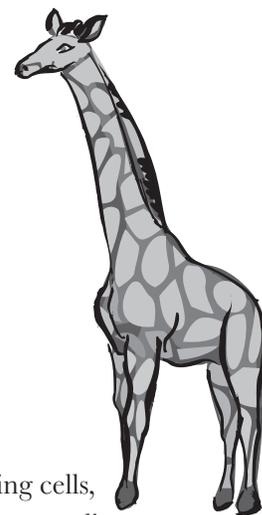
Classification

### Principles and Generalizations

- All living things have five common characteristics for survival.
- These five characteristics evolved over time for continuation of a species.

### Concepts

- Living Organism
- Cells
- Reproduction
- Chemical Processes
- Growth
- Development
- Response
- Stimulus
- Movement



### Teacher Information

- *Living organisms* maintain five major characteristics: having cells, reproducing, performing complex chemical processes, responding, growing and developing. Most also move.
- *Cells* are the basic unit of structure and function in living things.
- Living things *reproduce*, either sexually or asexually, to maintain a species.
- Performing *chemical processes* such as ingestion, digestion, respiration, and excretion build up and break down substances necessary for life.
- *Growth* is the process whereby organisms increase in size while *development* involves the organism becoming more complex.
- A *response* can be any action, movement or a change in an organism's behavior. It is a reaction to a *stimulus*.
- *Movement* occurs in almost all living things in some way.

# Characteristics of Life

## Skills

- Reason deductively
- Communicate
- Evaluate
- Infer
- Observe

## Materials and Resources

1. Magazine pictures of living things (several per group)
2. One picture of an automobile

## Preparation Activities

1. Cut out magazine pictures of living organisms (unless this activity was given to students as homework).
2. Cut out one magazine picture of an automobile.

## Introductory Activity (5 minutes)

As a class, brainstorm what it means to be “alive.” You may choose to record answers on the board or on an overhead, so students may see responses. Cover or remove the list as students continue with the activity.

## Pre-assessment (5 minutes)

Have students make a list of ten living organisms and ten non-living objects.

## Teaching and Learning Activities (20 minutes)

1. Divide the class into groups of three or four. One group member will act as recorder. Distribute the pictures of living organisms to the groups so that each group has a wide array of organisms. Each group of students should decide on only five characteristics of life that apply to all of the examples. Check to make sure that students can apply the characteristics to all of their examples. Challenge students in their reasoning. **SEARCHLIGHT:** Be on the lookout for students who seem insightful about this topic. Invite them to participate in the AID extension activity.
2. As a class, compile the lists on the board or on an overhead. Discuss the most common characteristics identified by the groups. Offer examples that

# CELLS: THE STORY OF LIFE



contradict the characteristics. Remove characteristics from the board as the class eliminates them. Lead the group to reduce the list to only the five major characteristics: having cells, reproducing, performing complex chemical processes, responding, growing and developing.

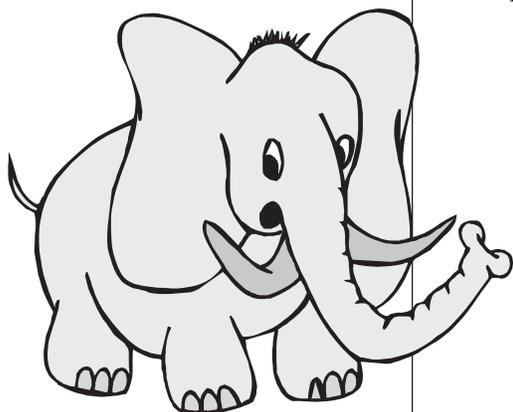
3. Show them the picture of the automobile. Discuss whether the automobile is an example of a living organism or non-living object. Introduce the idea that movement can be a characteristic of life although it may not be noticed, as demonstrated by plants.

## Products and Assignments

- Student generated lists
- Homework for this section could include any appropriate textbook work. Other options can include having the students cut out pictures of living and non-living things prior to class.

## Extension Activities

1. The following articles could be used as sources of discussion regarding life on other planets:
  - On the origin of life:  
Nash, J. Madeleine. (1996). Was the cosmos seeded with life? Time Magazine, 148, 62.
  - On life on Mars:  
Shreeve, James. (1997). Find of the century. Discover Magazine, 18, 40.  
(Both of these articles are available on the magazines' websites if you or your school is a subscriber.)
2. Students may be assigned the task of writing a five paragraph essay defending the opinion that a cloud is or is not alive based on the characteristics of living things as defined in class (AID)



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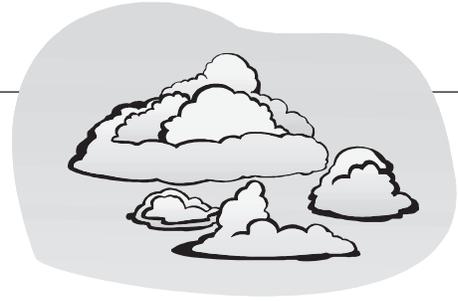
# Characteristics of Life

## **Post Assessment (10 minutes)**

Have students reorganize their original list of ten living organisms and ten non-living objects and explain any changes.

## **Debriefing and Reflection Opportunities (10 minutes)**

1. Refer back to the original brainstorm of what it means to be alive. Discuss how the class's definition of life has changed. Discuss what could occur if any of characteristics were not met in an organism.
2. Close by stating that the focus of the next lesson will be the specific characteristics of organisms having cells.



## Is A Cloud Alive?

- You need to write an essay (minimum of five paragraphs) proving that a cloud is not alive.
- The first paragraph should be a good introduction stating your position (thesis) and listing your supporting reasons.
- Each body paragraph should state a reason and offer support, evidence or examples for the reason. There should be at least three body paragraphs. These reasons should be based on the characteristics of living things we have discussed in class and are listed in your book. Be sure to discuss at least three reasons why a cloud is not alive.
- The last paragraph should be a good conclusion. It should be several sentences long, restate your position/thesis and sum up your argument.
- The essay needs to be typed or neatly handwritten. It should be double-spaced. Please skip lines if you are handwriting, so there is room for me to make comments. If it is typed, it should be in a reasonable 12-point font, preferably Times New Roman. You should maintain good conventions of grammar. (Final Copy Quality)
- **If you would like me to look at your rough draft, please have it to me by \_\_\_\_\_.**  
**The final draft is due \_\_\_\_\_.**

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

**Rubric: Is a Cloud Living? Essay**

	<b>Superior</b>	<b>Good</b>	<b>Fair</b>	<b>Not Done/ Poor</b>
Well written introduction including thesis and three supporting reasons	3	2	1	0
Body paragraph #1 states reason and offers good support	3	2	1	0
Body paragraph #2 states reason and offers good support	3	2	1	0
Body paragraph #3 states reason and offers good support	3	2	1	0
Conclusion includes these statement and sums up paper	3	2	1	0
Overall fluency of the essay is smooth	3	2	1	0
Grammar, punctuation and spelling are correct	3	2	1	0
Arguments are scientifically legitimate	3	2	1	0
Essay addresses at least three of the defined characteristics	3	2	1	0
<b>TOTAL</b>				

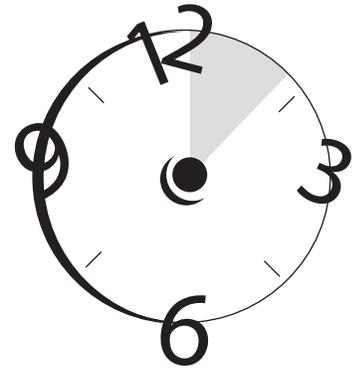


# Organelles of the Cell

## Core/Practice

Time Allocation: 10 hours, 50 minutes

Required Materials and Resources on Page 117



## Module Overview

In this module, students will explore the organelles of the cell by researching, constructing and presenting one organelle. Students will complete worksheets and labs identifying organelles in plant and animal cells. Students will create a collage showing analogies between organelles and words and magazine pictures and create and play a review game. These activities reinforce generalization #2: A cell's structure correlates to its job for an organism. Students with a scientific aptitude may express interest or ask questions about the relationship between diseases and organelle malfunction. Students may also show interest when doing the microscope lab and ask to see other samples of cells.

### Guiding Questions

- What is a cell?
- What are organelles?
- What are the different organelles of the cell and what are their functions?
- What functions of the organelles perform for the cell?
- What are the differences between animal and plant cells?

**BIG IDEA**

What are organelles and what are their functions?

# CELLS: THE STORY OF LIFE



## Content Goals

### Universal Theme

Differentiation

### Principles and Generalizations

- Cellular survival is dependent on its structures and their functions.
- A cell's structure correlates to its job for an organism

### Concepts

- Cell
- Organelle
- Mitochondria
- Nucleus
- Cell membrane
- Nuclear Membrane
- Cell Wall
- Nucleolus
- Endoplasmic reticulum
- Cytoplasm
- Chloroplast
- Chromosomes
- Vacuoles
- Lysosomes
- Ribosomes
- Cilia
- Flagella
- Photosynthesis
- Cellular Respiration

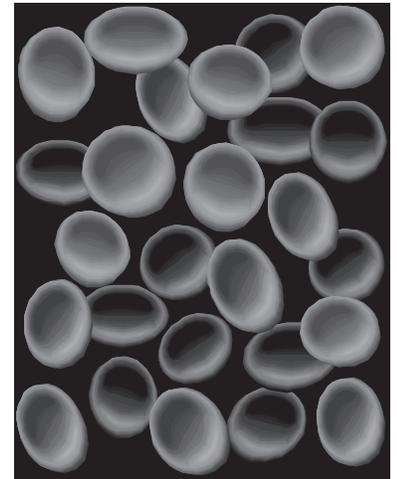
### Teacher Information

- *Cells* are the basic unit of structure and function in living things.
- *Organelles* are the structures that make up a cell.
- The *cell wall's* rigidity determines a plant cell's square shape. It serves as a

# Organelles of the Cell

support structure for the cell as well as preventing expansion when water enters the cell. *It is a main difference between a plant and animal cell.*

- The *cell membrane* is the flexible structure located just inside the cell wall in plants and the outermost structure in animals. Its main jobs are to support an animal cell and to control movement of substances in and out of both plant and animal cells. The cell membrane is selective in its ability to allow materials (such as nutrients and wastes, etc.) to move in or out of a cell.
- The *nucleus* is considered to be the “command center” of the cell. The nucleus serves to regulate the cell’s activities of growth and reproduction. It houses the genetic material in the form of chromosomes. The nucleus is made of three basic parts: the nuclear membrane, the chromosomes, and the nucleolus.
- The *nuclear membrane* is the protective layer that serves as the outside boundary of the nucleus. It is selective in what it allows to pass in or out of the nucleus.
- The *chromosomes* are structures located inside the nucleus and are composed of genetic material in the form of the nucleic acid, DNA. Their main job is to provide instructions for protein production.
- The *nucleolus*, which means “little nucleus” is an organelle located within the nucleus that is responsible for producing ribosomes.
- *Cytoplasm* is a jelly-like substance that suspends the organelles within the cell membrane. It is the site of many cellular chemical reactions.
- *Chloroplasts* are organelles found only in plant cells that perform the process of photosynthesis. They are another major difference between plant and animal cells.
- *Photosynthesis* is a process performed by green plants, which uses the sun’s energy to make food for the plant in the form of sugars.
- *Mitochondria* are considered to be the “powerhouse” organelle because they are responsible for cellular respiration.
- Both plants and animals use *cellular respiration* to break down sugars into a usable form of energy called ATP.
- *Ribosomes* are responsible for the production of proteins. Ribosomes are located either floating freely in the cytoplasm or attached to the endoplasmic reticulum.
- The *endoplasmic reticulum* is a network of tubes that transports proteins throughout the cell.



# CELLS: THE STORY OF LIFE



- *Vacuoles* store food, water, and wastes. In addition to storage, the larger versions called central vacuoles found within plant cells provide support to the cell by working in conjunction with the cell wall. Animal cells tend to have smaller vacuoles, which do not serve as support structures.
- *Lysosomes* are a type of vacuole that digest food particles and break down old organelles or whole cells. They are primarily found in animal cells.
- *Cilia* are short, hair-like extensions that extend out of the cell membrane of some animal cells and are used for transportation.
- *Flagella* are long, whip-like extensions that extend out of the cell membrane of some animal cells and are used for transportation.

## Skills

- Research
- Communicate
- Engage in public speaking
- Make connections
- Follow directions

## Materials and Resources

1. Pre-assessment: white paper for concept maps
2. For Day 1: Textbooks, encyclopedias, access to the Internet or other materials for research, copies of worksheet **Cell Research** (one per group)
3. For Days 2 & 3: Markers, colored pencils, crayons, construction paper, yarn, glue, tape, scissors or other appropriate materials for organelle construction
4. For Days 4 & 5: Copies of worksheet **Organelles** (one per student)
5. For Day 6: Copies of worksheet **Cell Diagram** (one per student)
6. For Days 6-8: Copies of Lab, **Mission Possible**, microscopes, microscope slides, microscope cover slips, samples of cork, onion epidermis and elodea, toothpicks, iodine, knife (for shaving off pieces of onion & cork), markers, colored pencils, or crayons
7. For Days 9 & 10: Magazines, tape, glue
8. For Days 11 & 12: Index cards for *Jeopardy* game
9. Post assessment: white paper for concept maps

# Organelles of the Cell

## Preparation Activities

1. If research resources are not adequate within the classroom, you will need to provide resources for the students to use for their research. If using the Internet as a resource, be aware that many websites provide more detail than is necessary at this level. Suggestions for websites include:

<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/A/AnimalCells.html>

<http://www.cellsalive.com>

<http://personal.tmlp.com/jimr57/textbook/chapter3/chapter3.htm>

<http://www.purchase.com/biology/cells.htm>

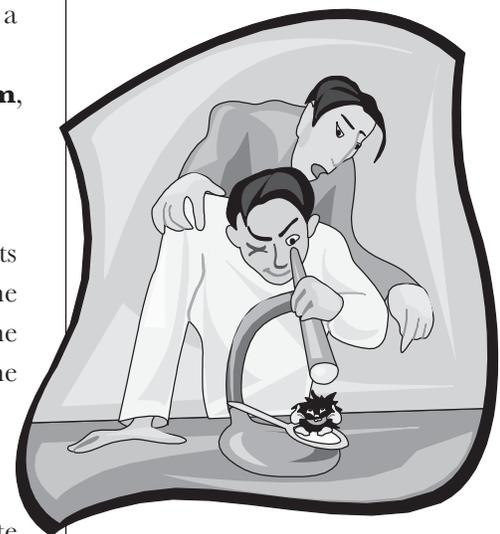
2. For construction of the cell, you may choose to have students bring in materials from home or to have students use materials available at school.
3. It is suggested that you assign organelles. Students can work in groups of two or individually. Arrange the groups so that every organelle is assigned appropriately. Some organelles are more complex and may be assigned to certain students with this in mind. (AID)
4. For lab **Mission Possible**, prepare the known sample 1 (plant cell) using a prepared plant cell slide, cork or elodea if available. Known sample 2 will be the cheek cell from the students. Unknown sample 3 should be onion cells (directions located at [http://enwikibooks.org/wiki/School\\_science/How\\_to\\_prepare\\_an\\_onion\\_cell\\_slide](http://enwikibooks.org/wiki/School_science/How_to_prepare_an_onion_cell_slide) and unknown sample 4 should be a prepared animal cell slide.
5. Copy the worksheets **Cell Research**, **Organelles**, and **Cell Diagram**, as well as the lab **Mission Possible**.

## Introductory Activities (10 minutes)

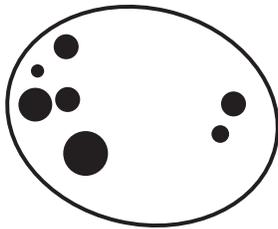
As a class, discuss the concept of the cell. Consider what types of cells students have heard of. Examine the concept of an organelle. Encourage students to name any organelles they can. Explain that they will be responsible for researching one organelle and presenting it to the rest of the class. Share the grading rubric for the organelle presentation with them.

## Pre-assessment (10 minutes)

Students should create a concept map that includes all the words that they associate with cells. This concept map will be revisited several times throughout this study of the cell. Some students will be familiar with making a concept map while others may not be. If necessary, create a concept map as a class on a topic such as “sports”



# CELLS: THE STORY OF LIFE



so the students may see how it is done. A sample concept map has been attached which could be used as a model. Concept maps should include linking words and make as many connections as possible, including cross connections if necessary.

## Teaching and Learning Activities (9 hours, 45 minutes, 13 days, assuming 45 minute periods)

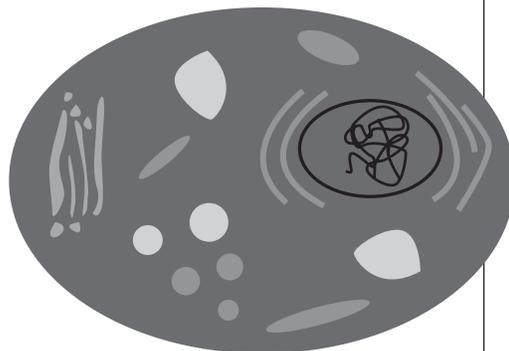
1. Day 1 (Lesson 2): Allow students to research their assigned organelles by using textbooks, encyclopedias, the Internet or any other resources provided. As they work, have them complete the **Cell Research Worksheet**. Circulate to assist those students who need more scaffolding. They also may spend time organizing and practicing for the presentations.
2. Days 2 & 3 (Lessons 3 & 4): Students will need about 90 minutes total to construct the animal and plant cells. Use a wall, the ceiling, the whole classroom, or any area of the room you deem appropriate. The purpose is to create three-dimensional models of both types of cells. Students will be responsible for deciding the size, shape, location and quantity of their organelles in the cells (not all organelles will be in both). Additionally, students should show the action of their organelles in some way. For instance, the mitochondria might display the process of respiration. You will need to adjust the number of cells created based on how many classes have been assigned the activity.
3. Days 4 & 5 (Lessons 5 & 6): Each organelle will be presented to the class using the **Cell Research Worksheet** as the basis of the presentation. Students that are listening to the presentation should add appropriate information to the **Organelles Worksheet**. In addition to presenting the information obtained from research, students should also point out where their organelles are in the classroom's cells and what action their organelle is responsible for performing. Students may also address any major interactions with other organelles and any other information that may be pertinent to the organelle. Lastly, students should make a claim about the importance of their respective organelles. Students may want to start off by stating, "Without my organelle, the cell wouldn't be able to..." After completion of the presentations, students should modify their original concept map. The focus should be on making as many connections between the concepts as possible.

# Organelles of the Cell

4. Day 6 (Lesson 7) (20 minutes): Students should color, label and complete the **Cell Diagram Worksheet**. There are two versions of the worksheet to allow for scaffolding. One worksheet gives the students the opportunity to draw and label their own diagrams (version II) instead of simply labeling the cell (Version I). Teachers may grade this as they see fit. An answer key has been attached.
5. Days 6-8 (Lessons 8 & 9): Divide the class into groups of two or three. Each group should complete the lab **Mission: Possible!!** If the assignment is graded, there is a rubric specific to the lab with the concepts outlined. The teacher will need to fill in the values for each concept to determine how it will count.
6. Days 9 & 10 (Lessons 10 & 11): Students should make modifications to the concept map from day 6. In groups of four, begin the collage activity by having students fold a large piece of paper into four sections. Instruct them to choose four organelles and label each section with the name of one organelle. Students should cut out pictures or words from magazines that represent the function of the organelles and glue them in the appropriate boxes. Share the grading rubric at the end of this lesson with students to ensure that they know the expectations for the collage.
7. Days 11 & 12 (Lessons 12 & 13): Invite students create a “Jeopardy” style game. Each group should write ten questions and answers, half to be used for “Double Jeopardy.” Student groups may come up with their own topics.
8. Day 13 (Lesson 14) can be used to play the game. The teacher may count this as a grade as he/she sees fit.
9. Day 14 (Lesson 15) is the post assessment and the debriefing and reflection activities.

## Products and Assignments

- Large Scale Cell Models
- Organelle Presentations



# CELLS: THE STORY OF LIFE



- Cell Diagram Worksheet
- Lab **Mission Possible!!**
- Concept Map
- Collage
- *Jeopardy* Game
- Homework assignments could include any appropriate textbook work or worksheets. Other assignments can include having students bring in materials from home for building the cells. Modifications to the concept map (Day 4 & 5 after presentations) could also be assigned as homework. A quiz about organelles and their functions would also be appropriate and a version has been included. Studying for the quiz could be done at home. Students may cut out pictures for the collage activity (Day 10 & 11) prior to coming to class.

## Extension Activities

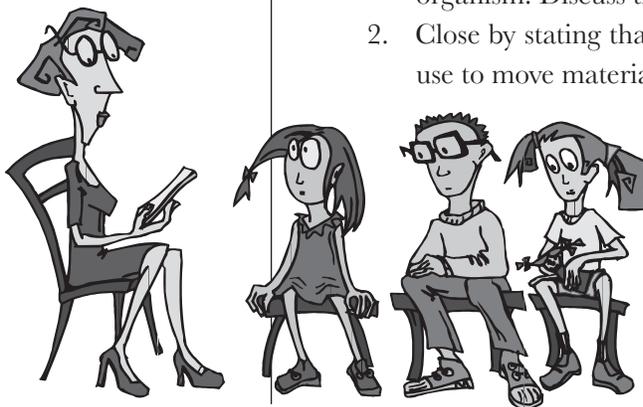
N/A

## Post Assessment (20 minutes)

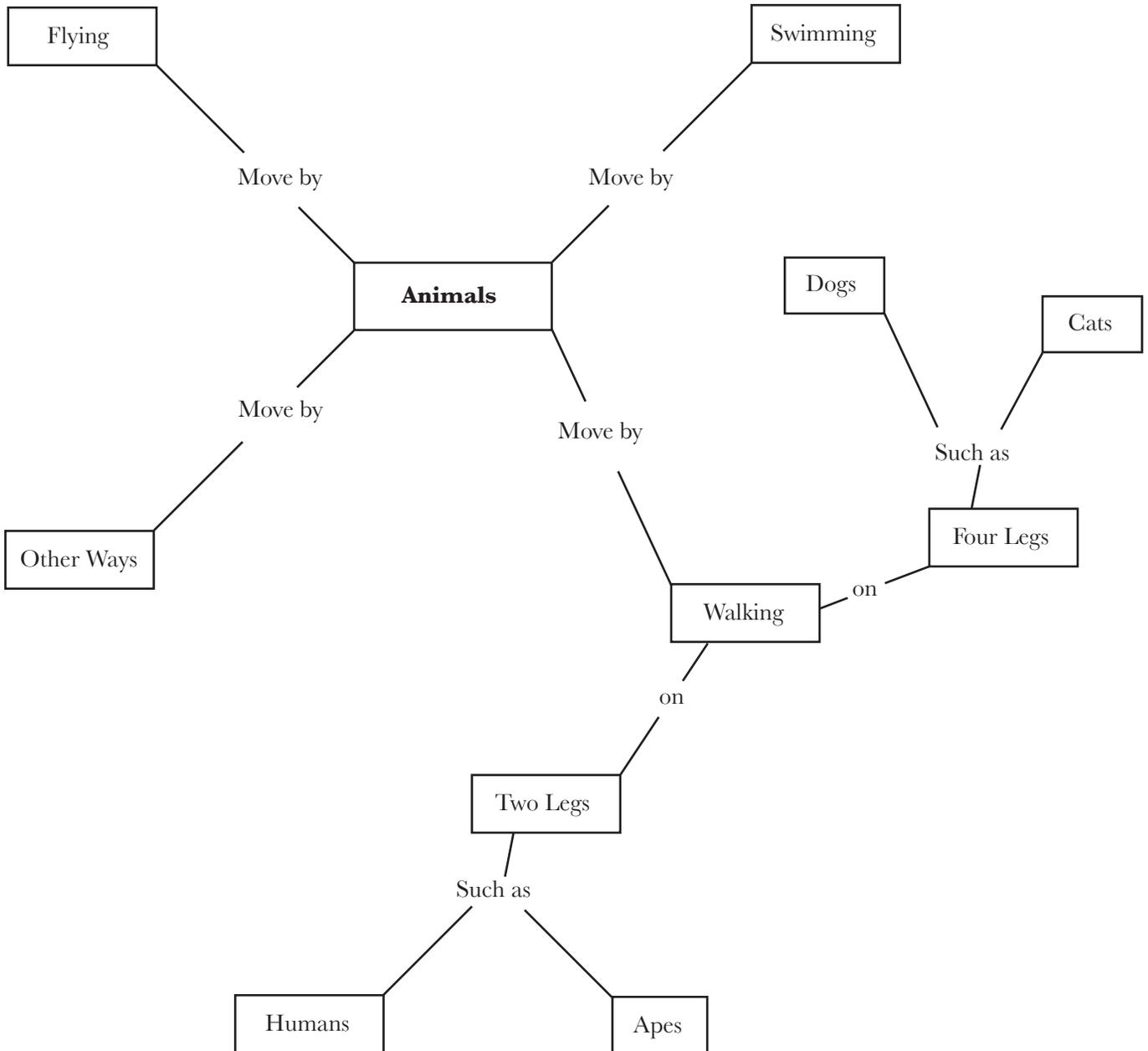
Students should construct a final concept map for this module. The focus should be on making as many connections between the concepts as possible.

## Debriefing and Reflection Opportunities (25 minutes)

1. Facilitate a discussion that gives closure to this module by focusing on the following questions:
  - What similarities and differences do you see between the animal and plant cells in this room?
  - How do you think an actual cell differs from the models that were created?
  - How does a cell function like a business?
  - Some cells are structurally different depending on their function in an organism. Discuss this idea. (Ex: muscle cells contain more mitochondria)
2. Close by stating that in the next lesson the focus will be the processes cells use to move materials across the cell membrane.



**Sample Concept Map**



# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Cell Research Worksheet

Cell Organelle Assigned _____	
<b>Information about the organelle's function</b>	<b>Information about the organelle's structure</b>
<b>Other interesting information</b>	<b>Drawings</b>

Presenter's Name \_\_\_\_\_

Class \_\_\_\_\_

### Teaching Presentation on Organelles

	<b>Superior 3</b>	<b>Good 2</b>	<b>Fair 1</b>	<b>Not Done/ Poor 0</b>
Students were adequately prepared for the presentation.				
Students presented appropriate information about the organelle's function.				
Students presented appropriate information about the organelle's structure.				
Students shared other interesting information pertinent to the organelle.				
Students effectively pointed out the location of their organelle in the classroom's cells.				
Students emphasized the importance of their respective organelle.				
Students made connections between the interaction of their organelle and others.				
The presentation was organized and easy to follow.				
Every group member made an oral contribution to the presentation.				
Presenter spoke loudly and clearly enough to be heard by the entire audience.				
Total Score=				

Comments:

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Worksheet: Organelles

Fill in the boxes with the correct information as you listen to the presentations.

<b>Organelle</b>	<b>Function</b>	<b>Description</b>	<b>Located in: Plant Cell, Animal Cell, Both</b>
Cell Wall			
Cell Membrane			
Nucleus			
Chromosomes			
Nuclear Membrane			
Nucleolus			
Cytoplasm			
Cilia			

<b>Organelle</b>	<b>Function</b>	<b>Description</b>	<b>Located in: Plant Cell, Animal Cell, Both</b>
Flagella			
Ribosomes			
Endoplasmic Reticulum			
Vacuole			
Lysosome			
Mitochondria			
Chloroplast			

**Worksheet: Organelles Answer Key**

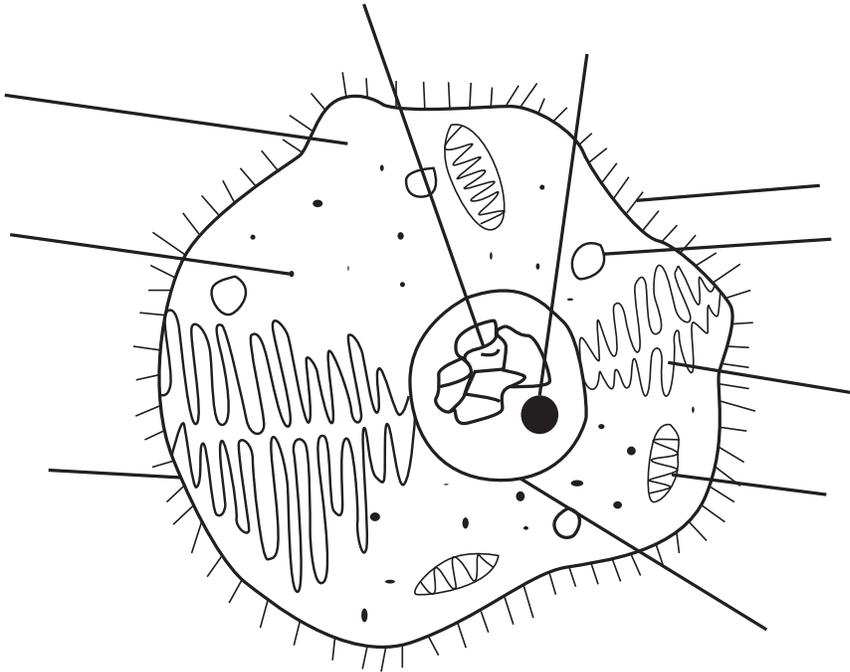
Fill in the boxes with the correct information as you listen to the presentations.

<b>Organelle</b>	<b>Function</b>	<b>Description</b>	<b>Located in: Plant Cell, Animal Cell, Both</b>
Cell Wall	Supports and protects holds plant upright	Stiff, outer wall	Plant
Cell Membrane	Controls what moves in or out of a cell	Outer membrane in animal Inside cell wall of plant Flexible Selectively permeable	Both
Nucleus	Controls all cell activities	Center circular region	Both
Chromosomes	Passes on traits	Short, Rod Shaped Made of DNA	Both
Nuclear Membrane	Controls what moves in and out of nucleus	Membrane around nucleus Flexible Selectively permeable	Both
Nucleolus	Makes ribosomes	Circle inside nucleus	Both
Cytoplasm	Holds organelles in place Shock absorber	Jelly-like substance around all organelles inside the cell	Can be on both
Cilia	Moves cells	Short hairs Attach to outer surface of cell	Can be on both

<b>Organelle</b>	<b>Function</b>	<b>Description</b>	<b>Located in: Plant Cell, Animal Cell, Both</b>
Flagella	Moves cells	Single long whip Attach to outer surface of cell	Can be on both
Ribosomes	Makes Protein	Small dots on E.R. or floating freely in cytoplasm	Both
Endoplasmic Reticulum	Transportations system for proteins messages	Connects cell membrane to nuclear membrane	Both
Vacuole	Storage	Large implants for water storage Smaller in animals	Both
Lysosome	Digestion of old cell parts or whole cells	Small, round	Primarily animals
Mitochondria	Produce energy from digested food (cellular respiration)	Small round (squiggly in middle)	Both
Chloroplast	Produce energy from sunlight (photosynthesis)	Green, round	Plant

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Worksheet: Cell Diagram Version I

ANIMAL CELL
Label and color the parts of the animal cell.


**Give the function of the following organelles:**

Nucleus \_\_\_\_\_

Cell Membrane \_\_\_\_\_

Mitochondria \_\_\_\_\_

Lysosome \_\_\_\_\_

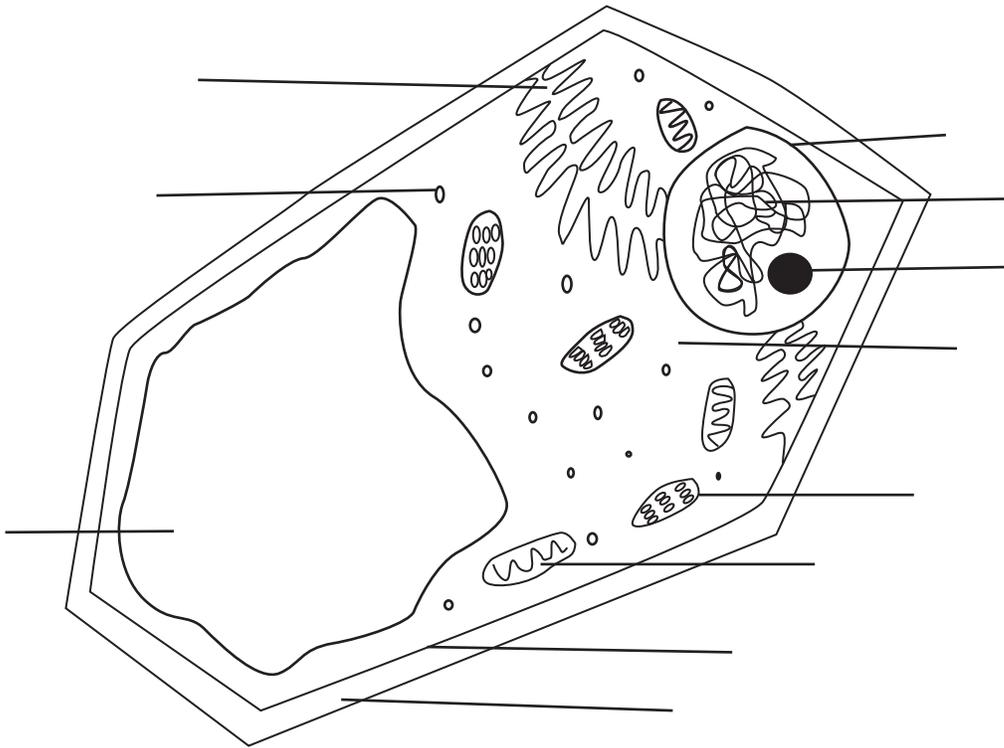
Cilia \_\_\_\_\_

Chromosomes \_\_\_\_\_

Cytoplasm \_\_\_\_\_

PLANT CELL

Label and color the parts of the plant cell.



**Give the function of the following organelles:**

Nuclear Membrane \_\_\_\_\_

Cell Wall \_\_\_\_\_

Chloroplast \_\_\_\_\_

Vacuole \_\_\_\_\_

Ribosome \_\_\_\_\_

Endoplasmic Reticulum \_\_\_\_\_

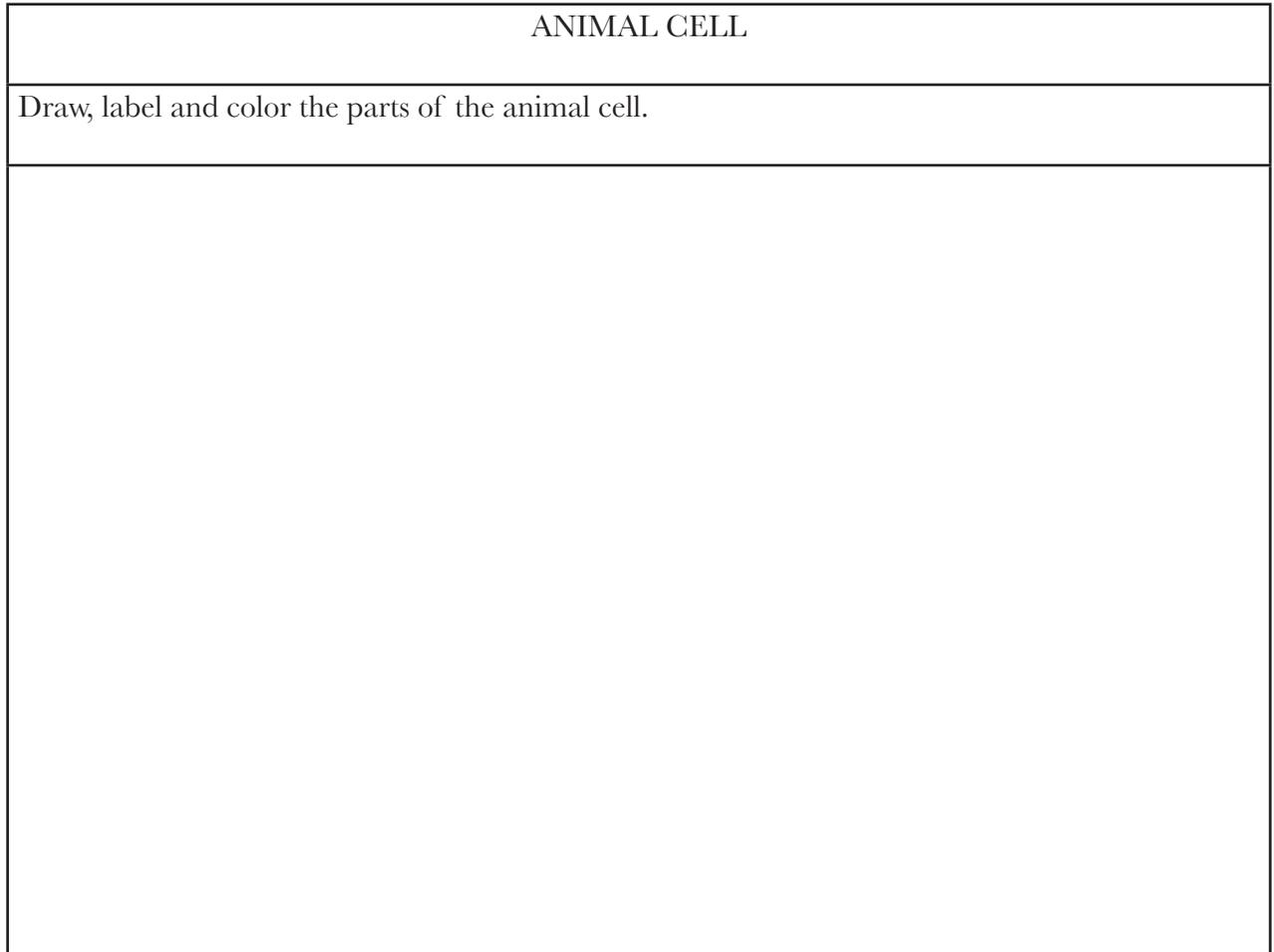
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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

**Worksheet: Cell Diagram Version II**

ANIMAL CELL

Draw, label and color the parts of the animal cell.



**Give the function of the following organelles:**

Nucleus \_\_\_\_\_

Cell Membrane \_\_\_\_\_

Mitochondria \_\_\_\_\_

Lysosome \_\_\_\_\_

Cilia \_\_\_\_\_

Chromosomes \_\_\_\_\_

Cytoplasm \_\_\_\_\_

---

PLANT CELL

Draw, label and color the parts of the plant cell.

**Give the function of the following organelles:**

Nuclear Membrane \_\_\_\_\_

Cell Wall \_\_\_\_\_

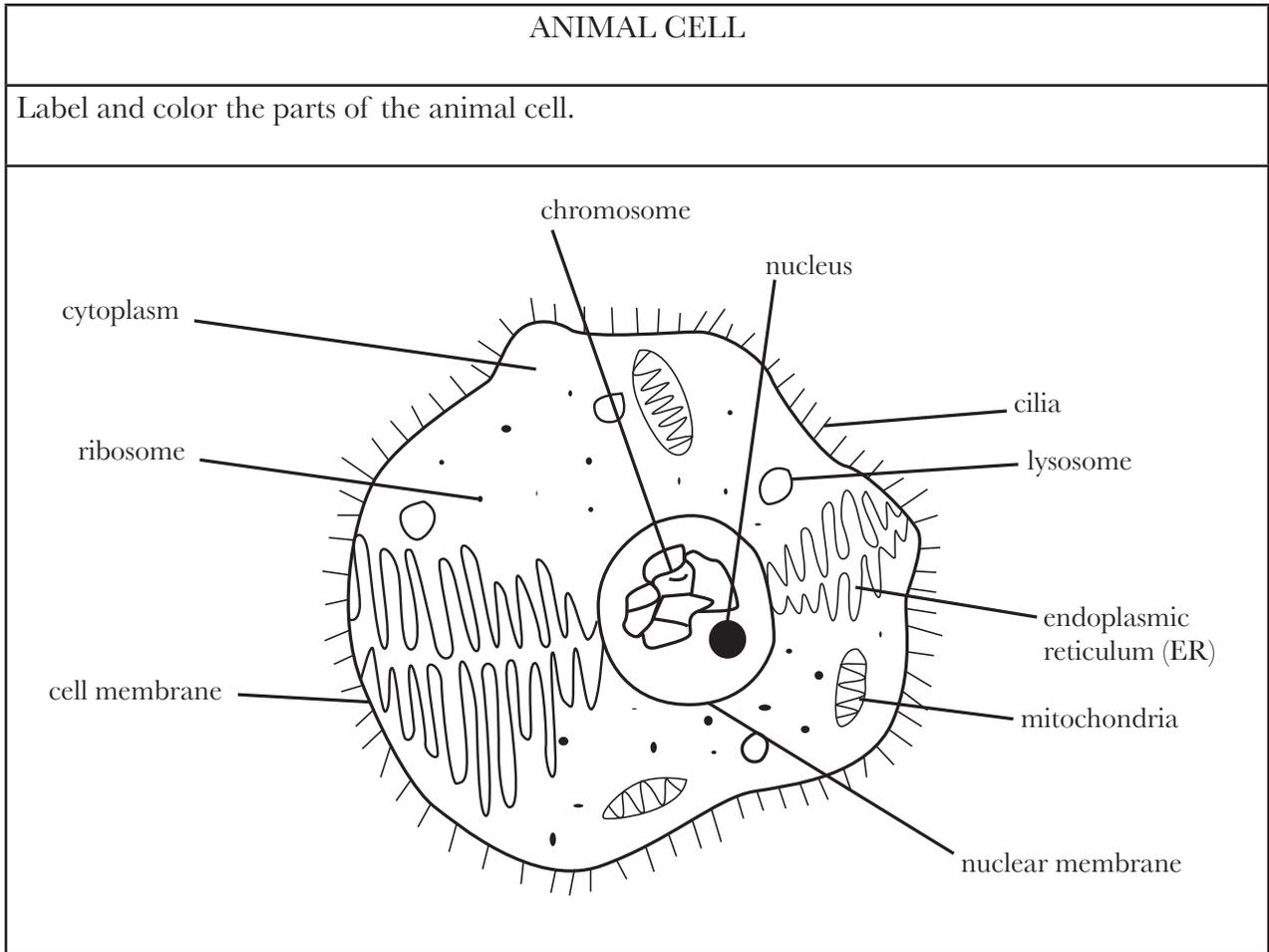
Chloroplast \_\_\_\_\_

Vacuole \_\_\_\_\_

Ribosome \_\_\_\_\_

Endoplasmic Reticulum \_\_\_\_\_

**Worksheet: Cell Diagram**



**Give the function of the following organelles:**

Nucleus controls all cell activities

Cell Membrane controls what goes in and out of the cell.

Mitochondria produce energy in the form of ATP from sugars.

Lysosome digests old cell parts.

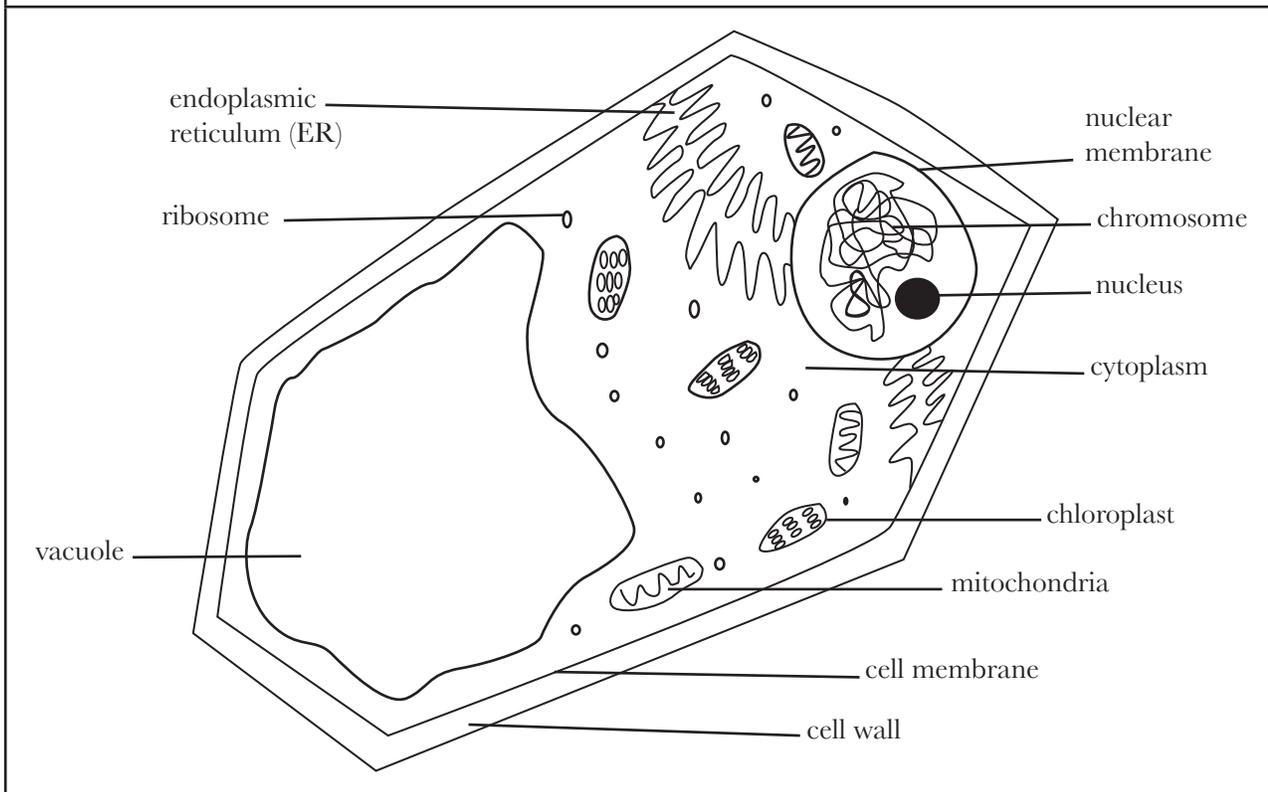
Cilia are responsible for movement of whole cell.

Chromosomes pass down traits and contain genetic material, made of DNA.

Cytoplasm serves as a shock absorber as well as locations of most chemical reactions.

## PLANT CELL

Label and color the parts of the plant cell.



**Give the function of the following organelles:**

Nuclear Membrane controls what moves in and out of the nucleus.

Cell Wall provides support for the plant.

Chloroplast collects sunlight and converts it to sugars through the process of photosynthesis.

Vacuole is a storage tank for cell, in plants primarily for water.

Ribosome produces proteins based on the code in chromosomes.

Endoplasmic Reticulum is the transportation system for proteins.

# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Mission: Possible!!

### Problem:

A crime has been committed and there is one victim at the scene. Two different cell samples were also found at the scene of the crime. Your job is to determine if any of the evidence indicates the presence of a human. Your mission is to observe the two different cell samples that were found at the scene of the crime. You will need to compare them to a known animal and plant cell sample to determine if either of the unknowns could belong to a human. You will need to report your conclusions to your teacher. You will be issued a weapon of truth, the microscope. Any questions?

### Procedure:

#### PART A (Known Plant Cell)

- A. Get the plant cell sample from your teacher.
- B. Focus the slide under low power.
- C. On the observation sheet, make a color drawing of what you see in the appropriate space. Many organelles will be too small to see, such as ribosomes or mitochondria. You might see chloroplasts, a nucleus, cytoplasm, a vacuole, the cell membrane or the cell wall. On your drawing, label any organelles you can identify. Also fill in the *name of the sample* (in this case "Plant Cell") and the *total magnification* used. Remember: total magnification is found by multiplying the magnification of the eyepiece times the objective that you used.
- D. Now switch to high power. Again draw, color and label what you see on your observation sheet.
- E. Answer the questions related to your drawings

#### PART B (Known Animal cell)

- A. Take a toothpick, and *gently* scrape the inside of your cheek in your mouth. Place the end of that toothpick on the center of a slide, and gently rub it around on your slide. Throw out the toothpick when you are done.
- B. Go to your teacher for iodine. Place one drop of stain on your sample. Add a coverslip.  
*Caution: Biological stains can permanently stain your clothing or may stain your skin for several days. Use with care.*
- C. Observe the sample under low and high power. Complete the drawings and questions related to this cell sample.

#### PART C & D (Two unknown cell samples)

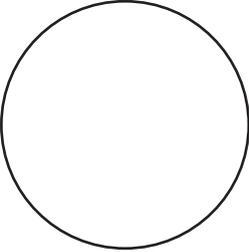
- A. Now get the two unknown cell samples. Complete the drawings and answer the questions relating to these cell samples including the conclusion questions.

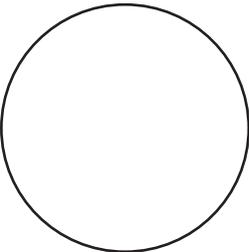
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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

**Observations: Mission Possible**

**PART A**


Name of Sample
Total Magnification:


Name of Sample
Total Magnification:

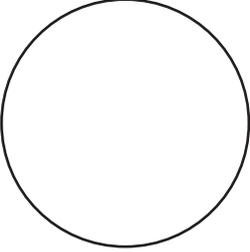
# CELLS: THE STORY OF LIFE

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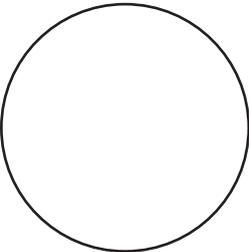
## PART A Continued:

1. Are these cells from a plant or an animal? \_\_\_\_\_
2. Which cell organelles did you see in this sample?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. What characteristics about these cells would help you compare them to other cells? (Think shape, organelles, size)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## PART B


Name of Sample
Total Magnification:

**PART B Continued:**



Name of Sample

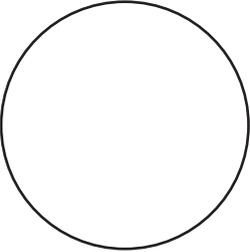
Total Magnification:

1. Are these cells from a plant or an animal? \_\_\_\_\_
2. Which cell organelles did you see in this sample?  
\_\_\_\_\_  
\_\_\_\_\_
3. What characteristics about these cells would help you compare them to other cells? (Think shape, organelles, size)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# CELLS: THE STORY OF LIFE

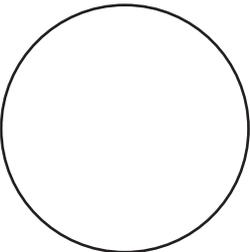
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## PART C

Name of Sample

Total Magnification:

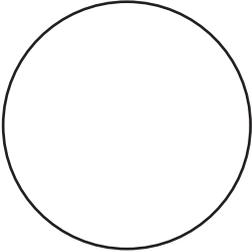
Name of Sample

Total Magnification:

1. Which cell organelles did you see in this sample?  
\_\_\_\_\_  
\_\_\_\_\_
2. What characteristics about these cells would help you compare them to other cells? (Think shape, organelles, size)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

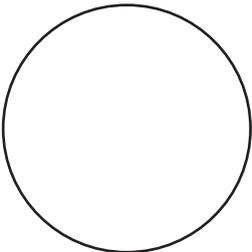
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**PART D**



Name of Sample

Total Magnification:



Name of Sample

Total Magnification:

1. Which cell organelles did you see in this sample?  
\_\_\_\_\_  
\_\_\_\_\_
2. What characteristics about these cells would help you compare them to other cells? (Think shape, organelles, size)  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# CELLS: THE STORY OF LIFE

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## CONCLUSIONS

1. Compare the plant cells with the cells from the first unknown sample. What similarities and differences did you see?

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2. Compare the plant cells with the cells from the first unknown sample. What similarities and differences did you see?

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3. Compare the animal cells with the cells from the first unknown sample. What similarities and differences did you see? \_\_\_\_\_

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4. Compare the animal cells with the cells from the second unknown sample. What similarities and differences do you see? \_\_\_\_\_

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5. Did a human leave any of the unknown cell samples? Why or why not? \_\_\_\_\_

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

**Rubric: Mission Possible**

	<b>Superior</b>	<b>Good</b>	<b>Fair</b>	<b>Poor/ Not Done</b>
<b>Cell Sample 1 (Plant Cell)</b> 2 Drawings of good quality (one in low and one in high power) including labeling appropriate organelles, name of specimen and total magnification	3	2	1	0
All questions answered appropriately and accurately	3	2	1	0
<b>Cell Sample 2 (Animal Cell)</b> 2 Drawings of good quality (one in low and one in high power) including labeling appropriate organelles, name of specimen and total magnification	3	2	1	0
All questions answered appropriately and accurately	3	2	1	0
<b>Cell Sample 3 (Unknown #1)</b> 2 Drawings of good quality (one in low and one in high power) including labeling appropriate organelles, name of specimen and total magnification	3	2	1	0
All questions answered appropriately and accurately	3	2	1	0
<b>Cell Sample 4 (Unknown #2)</b> 2 Drawings of good quality (one in low and one in high power) including labeling appropriate organelles, name of specimen and total magnification	3	2	1	0
All questions answered appropriately and accurately	3	2	1	0
<b>Conclusions</b>				
Question 1 answered appropriately and accurately	3	2	1	0
Question 2 answered appropriately and accurately	3	2	1	0
Question 3 answered appropriately and accurately	3	2	1	0
Question 4 answered appropriately and accurately	3	2	1	0
Question 5 answered appropriately and accurately	3	2	1	0
<b>Other</b>				
Students worked cooperatively and split up work appropriately.	3	2	1	0
Work is neat and maintains good conventions of grammar	3	2	1	0
<b>TOTAL POINTS</b>				

# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Class \_\_\_\_\_

## Rubric: Organelle Collage

	<b>Superior</b>	<b>Good</b>	<b>Fair</b>	<b>Poor/ Not Done</b>
Work is neatly done.				
Correct spelling of organelles				
Four organelles represented				
Pictures/Words connect reasonably to organelles.				

Name \_\_\_\_\_ Class \_\_\_\_\_

## Rubric: Organelle Collage

	<b>Superior</b>	<b>Good</b>	<b>Fair</b>	<b>Poor/ Not Done</b>
Work is neatly done.				
Correct spelling of organelles				
Four organelles represented				
Pictures/Words connect reasonably to organelles.				

---

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

**Quiz: Organelles**

1. What are the three parts of the nucleus?
2. Why is the cell membrane considered a doorway to the cell?
3. Name two organelles that are located only in plant cells.
4. Give the name of one organelle that a cell could not live without and explain why.
5. Name two other organelles in a cell not mentioned already on this quiz and give the function of both organelles.

# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Quiz: Organelles

1. What are the three parts of the nucleus?

**nucleolus                  chromosomes                  nuclear membrane**

2. Why is the cell membrane considered a doorway to the cell?

**It allows movement of material in and out of the cell**

3. Name two organelles that are located only in plant cells.

**chloroplasts and cell wall**

4. Give the name of one organelle that a cell could not live without and explain why.

**Answers may vary. Most students will answer the nucleus because it is the control center of the cell.**

5. Name two other organelles in a cell not mentioned already on this quiz and give the function of both organelles.

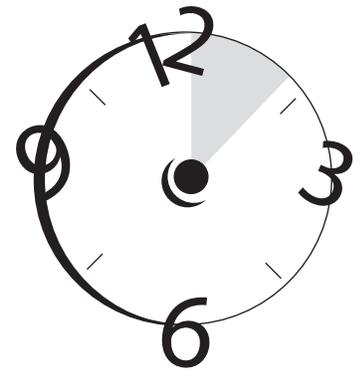
**Answers may vary**

# Cell Processes

Core/Practice/Identity/AID

Time Allocation: 6 hours, 25 minutes

Required Materials and Resources on Page 117



## Module Overview

In these lessons, students will explore the ways the cells move materials across the cell membrane. Students will observe the processes of diffusion and osmosis in carrots, balloons, elodea cells, and eggs through demonstrations and lab work. These activities reinforce the principle: The cell's processes guarantee that necessary materials enter and leave the cell. Students with a scientific aptitude will demonstrate a quick comprehension of the concepts and ask more advanced questions regarding the process.

They may also offer unique examples of the processes presented in the module and as well sharing their findings of an extension lab, **Osmosis and Diffusion through a Semi- Permeable Membrane.**

### Guiding Questions

- How are materials moved in and out of the cell?
- How do different environments affect cells?
- Would you like to be a biological scientist?

**BIG IDEA**

**Necessary materials enter  
and leave the cell.**

## Content Goals

### Universal Theme

Balance

### Principles and Generalizations

- The cell's processes guarantee that necessary materials enter and leave the cell.
- Anybody can be a scientist.

### Concepts

- Diffusion
- Osmosis
- Active transport
- Equilibrium
- Concentration
- Selectively permeable
- Semi-permeable



### Teacher Information

- *Diffusion* is the process of materials moving from an area of greater concentration to an area of lesser concentration without the need of energy until equilibrium is reached.
- *Osmosis* is the diffusion of water.
- *Active transport* is the process of moving materials from an area of lesser concentration to an area of greater concentration while requiring energy.
- *Equilibrium* is a condition whereby the concentrations of materials are equalized both inside and outside of the cell membrane.
- *Concentration* is the amount of a substance in a specified place.
- *Selectively permeable* means that a membrane regulates what goes across it, usually depending on the size of the molecule. Small molecules such as water flow freely across the membrane through the process of osmosis.

### Skills

- Draw conclusions
- Write scientific procedures
- Use the microscope

# Cell Processes

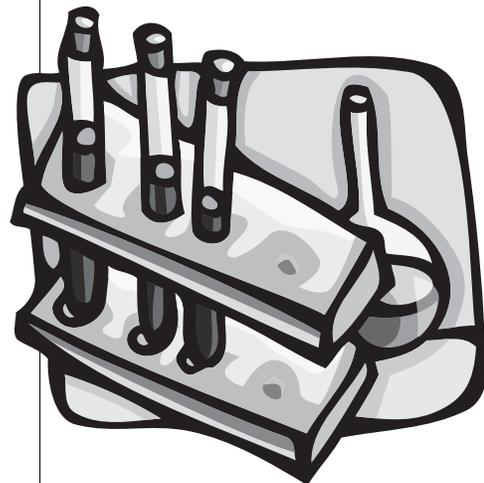
- Observe
- Follow directions

## Materials and Resources

1. Introductory Activity: several balloons, several different flavors of food extract that students will recognize (almond, orange, vanilla, etc.)
2. Day 1 Demonstration: one beaker of water, one container of food coloring, an overhead projector
3. Day 1 Lab: **Egg-speriment** (done as a demonstration): one beaker, one bottle of white vinegar, one raw egg (extra may be necessary if the egg breaks), one bottle light corn syrup, plastic wrap to cover beaker
4. Day 2 Lab: **What's up, Doc?** (materials needed for each group): at least three baby carrots (students may choose to use more based on their experimental design), water, string, spoon for stirring, salt, plastic cups/beakers
5. Day 5 Lab: **Osmosis and the Cell Membrane** (materials needed for each group): elodea leaf, microscope, microscope slide & coverslip, water, salt-water solution, eyedroppers, paper towels
6. AID Lab: **Osmosis and Diffusion through a Semi-Permeable Membrane** (materials needed for each group): two cups, water, salt, two pieces of dialysis tubing, graduated cylinder, food coloring, iodine, starch solution

## Preparation Activities

1. Introduction: Without the students observing you, add a few drops of each type of artificial food flavoring to separate balloons, blow them up and tie them closed.
2. Have enough of the supplies listed above for the Teaching & Learning Activities
3. Copy all worksheets and labs for students.
4. Prepare a strong salt-water solution for **Osmosis and the Cell Membrane** lab.
5. Prepare starch solution for the AID **Osmosis and Diffusion through a Semi- Permeable Membrane** lab.



# CELLS: THE STORY OF LIFE



## Introductory Activities (15 minutes)

- Have students pass the prepared balloons around the room. As they pass them, discuss their observations and what they think is happening.
- Compare these balloons to water balloons. Discuss how the cell membrane is selectively permeable and how this is a simulation of that concept.

## Pre-assessment (10 minutes)

Brainstorm the terms *diffusion*, osmosis and active transport as a class in a concept map or web on the overhead or board.

## Teaching & Learning Activities (6 hours, 25 minutes- 8.5 days, assuming 45 minute periods)

1. Prior to Day 1 (Lesson 16) – Introduction (15 minutes) and pre-assessment (10 minutes) to module
2. Day 1 (Lesson 17):
  - (25 minutes) Place a beaker of water on an overhead. Add one drop of food coloring to the beaker. As students observe the beaker on the overhead, discuss the movement of the molecules from high to low concentration. Discuss the following ideas:
    - o The concept of concentration
    - o Movement of molecules from higher concentration to lower concentration
    - o The fact that the food coloring moves without energy demonstrating the process of diffusion
    - o Any other examples of diffusion students may think of
  - (20 minutes) Using the **Egg-speriment** Worksheet, have the students complete part I observations. Move around the room to make sure the observations are of good quality and are descriptive enough. While observations are being made, place the raw egg into a beaker of vinegar. Students may finish recording observations now that the egg is in vinegar. In the appropriate space on the worksheet, have students record one logical prediction (based on the observations) about what the egg will look like after it sits in the vinegar for two days. If time permits, discuss the predictions



# Cell Processes

and why those predictions were chosen. Cover the beaker and store until Day 3. The beaker may rest longer, such as over a weekend, if necessary.

3. Day 2 (Lesson 18) Start the lab **What's up Doc?** by dividing students into groups of two or three. Each group should then identify a problem, create a hypothesis and plan an experiment to test the problem. The teacher should check procedures for completeness before the students set up and perform the experiment, looking for good experimental design including variables and controls. Students should be reminded that experiment needs to sit for a minimum of 48 hours, but they may take observations throughout that time period. If the teacher feels that students are not familiar enough with writing lab procedure, it can be modeled for them or the class may write on the problem and design a hypothesis and experiment together.
4. Day 3 (Lesson 19):
  - (25 minutes) Continue the lab **What's up Doc?** by having students finish planning and setting up their individual experiments.
  - (20 minutes) Continue the **Egg-speriment** demonstration by removing the egg from the vinegar. Have the students complete part II observations on the worksheet. As observations are made, place the raw egg into a beaker of corn syrup. Students may make observations about the corn syrup as well. Have students record one logical prediction on the worksheet. If time permits, discuss the predictions made and why those predictions were chosen. Cover the beaker and store overnight. The beaker may rest longer, such as over a weekend, if necessary. The work can be collected, reviewed and graded by the teacher for appropriateness of answers.
5. Day 4 (Lesson 20): Remove the egg from the corn syrup. Using the **Egg-speriment** Data worksheet, have the students complete part III observations & conclusion questions. Have student share and explain their answers with one another. Tell students that they are acting like scientists, and that scientists communicate procedures and explanations in experiments. After students have conferred with one another, discuss student answers.



# CELLS: THE STORY OF LIFE



6. Day 5 (Lesson 21): Divide the students into groups of two. Have students complete the lab **Osmosis and the Cell Membrane**. The work can be collected, reviewed and graded by the teacher for appropriateness of answers.
7. Day 6 (Lesson 22): Have the students complete the lab **What's up Doc?** by recording results and completing the conclusion and validity sections of the worksheets. Results can be gone over as a group or can be collected and reviewed by the teacher for a grade.
8. Day 7 (Lesson 23): Discuss the cell's need for the process of active transport. Have students complete the worksheet **Diffusion, Osmosis or Active Transport?** either individually or as a class. An answer key has been included.
9. Day 8 (Lesson 24): Administer Post Assessment (20 minutes). Facilitate Debriefing (25 minutes).

## Products and Assignments

- Lab: **What's up, Doc?**
- Lab: **Egg-speriment**
- Worksheet: **Diffusion, Osmosis and Active Transport**
- Lab: **Osmosis and the Cell Membrane**
- Homework for the module could include applicable textbook work or worksheets. Other possible assignments could include creating flashcards of situations and classifying the scenarios as diffusion, osmosis or active transport. A lab report could also be assigned based on the **Egg-speriment** lab or **What's up Doc?**

## Extension Activities

- Ask students how they liked acting like scientists today when they experimented with the raw egg in the **Egg-speriment** lab. Inform them that scientists who work with cells and study living organisms and their environments are biological scientists. Many of these scientists work in research and try to find the answers to human and animal health problems. Others use research to develop new products, such as crops or

# Cell Processes

fuels. Biological scientists are often identified by the type of life that they study. Just to name a few: marine biologists study salt water creatures; botanists investigate plants; ecologists study relationships between living things and their environments. Write a journal entry in which you explore the possibility of being a biological scientist. Explain what specialty attracts you. Give specific reasons as to why you think you would or would not want to explore such a career.

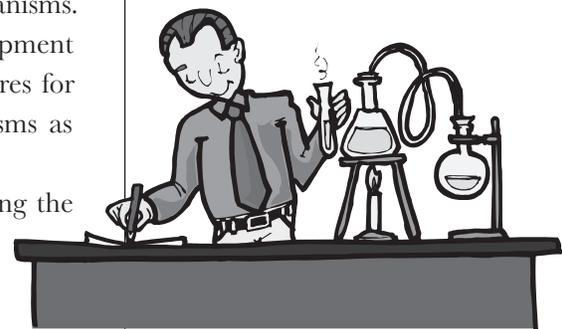
- (AID) Lab: **Osmosis and Diffusion through a Semi-Permeable Membrane**

## Post Assessment (20 minutes)

Brainstorm the terms *diffusion*, *osmosis* and *active transport* as a class in concept map from on the overhead or board. The focus should be on making as many connections between topics as possible.

## Debriefing and Reflection Opportunities (25 minutes)

1. Discuss the lab **What's up, Doc?** in terms of the following questions.
  - a. In which kind of water did the carrots lose water? Why?
  - b. In which kind of water did the carrots gain water? Why?
  - c. What might happen if you place the salt-water carrot in the fresh water now?
  - d. What might happen to human blood cells placed in the different types of water?
  - e. Why are vegetables sprayed at times with fresh water in the supermarket?
  - f. How does osmosis relate to this lab?
  - g. How does this lab relate to the other activities you've seen in this unit?
2. Ask students how they feel about being able to conduct experiments to discover the effects of different environments on living organisms. Explain that biological scientists who work in research and development are exploring all sorts of possibilities, from discovering possible cures for diseases to opening the way of communicating with such organisms as dolphins.
3. Close by stating that in the next lesson the focus will be on studying the process that cells use to create more cells.



# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Lab: Egg-speriment Data

<b>PART I: Observations of the raw egg</b>	
1)	
2)	
3)	
4)	
5)	
6)	
7)	
8)	
9)	
10)	
<b>Prediction (What will happen in the vinegar?)</b>	
_____	
_____	
_____	
<b>Explanation for Prediction</b>	
_____	
_____	
_____	

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**PART II: Observations of raw egg after vinegar**

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

**Prediction (What will happen in the corn syrup?)**

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**Explanation for Prediction**

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# CELLS: THE STORY OF LIFE

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<b>PART III: Observations of raw egg after corn syrup</b>	
1)	
2)	
3)	
4)	
5)	
6)	
7)	
8)	
9)	
10)	

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## CONCLUSIONS

Was your prediction about what would happen in the vinegar correct? Why or why not?

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Explain what happened to the egg when it was in the vinegar.

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Was your prediction about what would happen in the corn syrup correct? Why or why not?

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Explain what happened to the egg when it was in the corn syrup.

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How does the egg demonstrate a selectively permeable membrane?

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# CELLS: THE STORY OF LIFE

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Lab: Egg-speriment Data

### PART I: Observations of the raw egg

**Accept any reasonable answers. Observations may include the size, shape color of the egg. The students might also mass the egg or take its volume. Also have students notice the color and fluidity of the liquid in the beaker.**

Prediction (What will happen in the vinegar?)

**Accept all reasonable answers. These may include that the egg will swell or shrink. Students may offer the idea that the egg will blow up. This is unrealistic as we do not use chemicals that would do that in this class.**

Explanation for Prediction

**This would strictly be based on a student's prior knowledge. Require the students to come up with a reasonable, scientific explanation for their prediction. Accept all reasonable answers.**

### PART II: Observations of raw egg after vinegar

**The egg should have its shell dissolve. You will notice white foam on the top of the liquid. There might be a white film on the egg. This is the shell residue. Over day one, the egg will change minimally in size, if at all. This is because the vinegar dissolves the egg shell since it is a weak acid. This step is necessary to allow the corn syrup, water and vinegar to move into and out of the shell in the rest of the experiment. After two days, the egg will appear shrunken. The membrane may be loose around the egg as the egg has lost water.**

Prediction (What will happen in the corn syrup?)

**Accept all reasonable answers. These may include that the egg will swell or shrink. Students should offer more reasonable explanations after seeing the results with the vinegar.**

Explanation for Prediction

**These predictions should be based more on the scientific principles of diffusion and osmosis. Require the students to come up with a reasonable, scientific explanation for their prediction. Accept all reasonable answers.**

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**PART III: Observations of Raw Egg after corn syrup**

**The egg will be swollen. The membrane will be very tight as the water and sugars from the corn syrup have moved into the egg. It still may smell slightly of vinegar.**

# CELLS: THE STORY OF LIFE

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## CONCLUSIONS

Was your prediction about what would happen in the vinegar correct? Why or why not?

**Students should explain and justify their answers to part I.**

Explain what happened to the egg when it was in the vinegar.

**Over day one, the egg changed minimally in size, if at all. This is because the vinegar dissolves the egg shell since it is a weak acid. This step is necessary to allow the corn syrup, water and vinegar to move into and out of the shell in the rest of the experiment. After two days, the egg will appear shrunken. The membrane may be loose around the egg as the egg has lost water. Students should also recognize that some of the vinegar has entered the egg (notice the smell). Students should relate this to osmosis and diffusion.**

Was your prediction about what would happen in the corn syrup correct? Why or why not?

**Students should explain and justify their answers to part II.**

Explain what happened to the egg when it was in the corn syrup.

**The egg will be swollen. The membrane will be very tight as the water and sugars from the corn syrup have moved into the egg. It still may smell slightly of vinegar.**

How does the egg demonstrate a selectively permeable membrane?

**The substances (vinegar, corn syrup, water) moved both in and out of the cell as appropriate. The cell did not lose the yolk, or all quantity of egg white. This shows how the cell limits what can come in and out.**

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Lab: What's up, Doc?

A grocery store owner wants to make sure that the vegetables in the produce aisle look as appealing to his customers as possible. He thinks that customers will be more likely to buy the carrots if they are crunchy and bright orange in color instead of mushy and discolored. He has several ideas that might work, but is not sure what is the best way to treat the carrots. He thinks that maybe salt or a salt-water solution will work since salt was used to preserve meat years ago. However, he also knows the salt might dry out the carrots. He's not sure what will happen if the carrots are placed in water with no salt.

Your job is to design an experiment that will determine the best way to treat the carrots in the produce aisle and then give the grocery store owner a recommendation as to what he should do to set up the carrots in the produce aisle.

#### Materials at your disposal for this experiment are as follows:

- 3 Baby carrots (more are available if you need them)
- Salt
- Several Plastic cups/beakers
- String
- Spoon
- Water

#### Procedure:

1. As a group, decide on the problem for this experiment. Record it in the appropriate space on the next page.
2. Decide on a hypothesis that will test your problem using the available materials. Record it in the appropriate space on the next page.
3. Decide on a procedure to test your hypothesis. Make sure there is only one independent variable. Don't forget the controls. Be specific in the details of your procedure. Remember to let the carrots **sit over two full days (48 hours)**. Record it in the appropriate space on the next page.
4. Create a data table to record your results when you perform the lab. Draw it in the appropriate space on the next page.
5. Show your work to your teacher. He/she will determine if you are ready to conduct your experiment.

# CELLS: THE STORY OF LIFE

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## **AFTER EXPERIMENTING FOR AT LEAST 48 HOURS:**

6. After your experiment is complete, you will need to write a conclusion. In your conclusion, include the following:

- discuss the data and what it shows
- discuss how this experiment relates to osmosis and diffusion
- refer to your data to support your answers
- tell the grocery store owner the best way to take care of his vegetables
- record your answers in the appropriate space on the following pages

7. Consider how valid your conclusion is. In other words, how much confidence do you have in your results and conclusions? Any factors that contribute to a lack of confidence in the results or conclusions should be discussed. Also, include ways that your experiment could be improved if you were to do it again. Record your answers in the appropriate space on the following pages.

Problem \_\_\_\_\_

\_\_\_\_\_

Hypothesis \_\_\_\_\_

\_\_\_\_\_

Procedure \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### **Data Table**

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Conclusions \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Validity \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Recommendation \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

# CELLS: THE STORY OF LIFE

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Name ANSWER KEY Date \_\_\_\_\_ Class \_\_\_\_\_

## Lab: What's up, Doc?

### Problem

**How should a grocery store owner store his vegetables so they remain crisp and fresh?**

### Hypothesis

**Vegetables sprayed with salt water will remain crisp and fresh.**

### Procedure:

**The basic procedure should involve tying a small piece of string around each of the three carrots so that the string is snug and does not come off. Each cup should be filled to the same amount with plain water. To one cup add one spoonful of salt and stir until dissolved. To another cup add two spoonfuls of salt and stir until dissolved. Do not add anything to the third cup of water. Place one carrot tied with string in each cup.**

	<b>Initial Observations</b>	<b>After one Day</b>	<b>After Two Days</b>
Carrot in Plain water	Carrot is firm. String is tight around the carrot.	Carrot is slightly limp, String is slightly loose	Carrot is limp, String is loose
Carrot in water with 1 spoonful of salt	Carrot is firm. String is tight around the carrot.	Carrot is firm. String is tight around the carrot.	Carrot is firm. String is tight around the carrot.
Carrot in water with 2 spoonfuls of salt	Carrot is firm. String is tight around the carrot.	Carrot is firm. String is tight around the carrot.	Carrot is firm. String is tight around the carrot.

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## **Conclusions**

**Students should address the following:**

- **A discussion of what the data shows**
- **How the data shows diffusion and osmosis**

## **Validity**

**Students should address the following:**

- **With how much confidence can the conclusion be stated?**
- **Are there factors that lead to a lack of confidence? What are they and why are they important?**
- **What improvements could be offered if the experiment were done again?**

## **Recommendation**

**The recommendation should be logical, based on the experimental evidence and conclusions**

# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Lab: Osmosis and the Cell Membrane

Purpose:

**To observe the effect of salt water on an actual cell membrane**

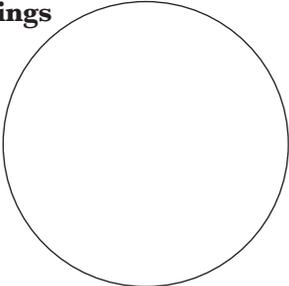
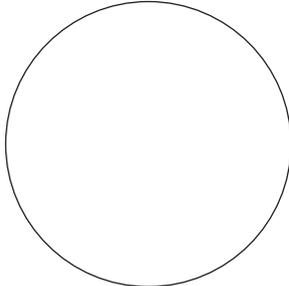
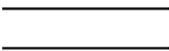
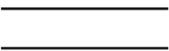
Materials:

- Microscope
- Elodea
- Microscope slides
- Coverslips
- Salt solution
- Water
- Eyedroppers
- Paper towels

Procedure:

### **PART 1:**

1. Put one elodea leaf on a microscope slide. Add a drop of plain water and put the coverslip on.
2. Observe the leaf under the microscope in both low and high power. Draw what you see in the appropriate spaces below. Don't forget to label your drawings with the name of the specimen and the total magnification.

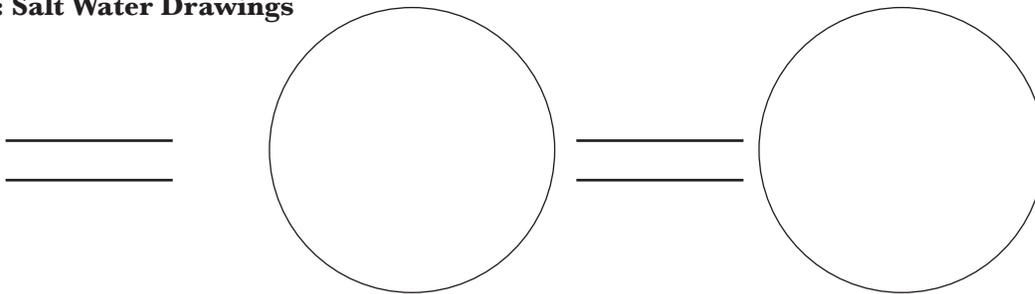
<b>PART 1: Plain Water Drawings</b>		
		

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**PART 2:**

3. Add a couple drops of salt water to one edge of the coverslip. Use a small piece of paper towel at the opposite side of the coverslip to pull the salt water across the slide.
4. Observe the leaf under the microscope in both low and high power. Draw what you see in the appropriate spaces below. Don't forget to label your drawings with the name of the specimen and the total magnification.
5. In all drawings label the cell wall, cell membrane, chloroplasts and cytoplasm.

**Step 2: Salt Water Drawings**



**Answer the following conclusion questions:**

**Describe the effect of the salt water on the plant cell.**

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**Did the cell membrane allow water in or out of the cell? Why did this occur?**

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# CELLS: THE STORY OF LIFE

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**Using what you have learned, what would happen to a plant that was watered with salt water? Why?**

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Name ANSWER KEY Date \_\_\_\_\_ Class \_\_\_\_\_

### Lab "Osmosis and the Cell Membrane"

**PART 1: Plain Water Drawing (Drawings should be detailed, colored, and accurate. They should include the name of the specimen and the total magnification. Drawings should also have the cell wall, cell membrane, chloroplasts and cytoplasm labeled.)**

**PART 2: Salt Water Drawing (Drawings should be detailed, colored, and accurate. They should include the name of the specimen and the total magnification. Drawings should also have the cell wall, cell membrane, chloroplasts and cytoplasm labeled.)**

#### CONCLUSIONS

Answer the following conclusion questions:

Describe the effect of the salt water on the plant cell.

**The salt water will cause the chloroplasts (green circles) to clump in the middle of the cells.**

Did the cell membrane allow water in or out of the cell? Why did this occur?

**The cell membrane allowed water out of the cell moving from high concentration (inside the cell) to lower concentration (outside the cell) because of the salt in the water.**

Based on what you have learned, what would happen to a plant that was watered with salt water? Why?

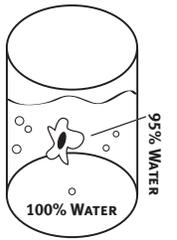
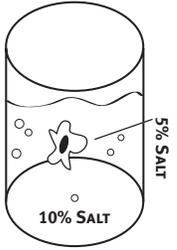
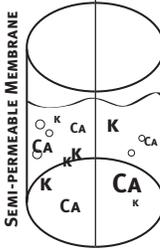
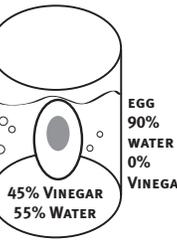
**If a plant were watered with salt water, the plant would shrivel and die. This is because the salt water in the soil would cause the plant to lose water and eventually wilt.**

# CELLS: THE STORY OF LIFE

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Diffusion, Osmosis or Active Transport?

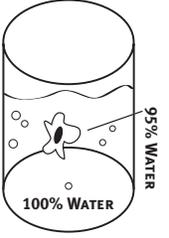
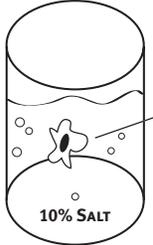
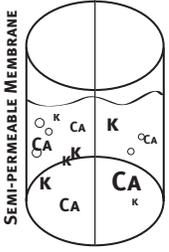
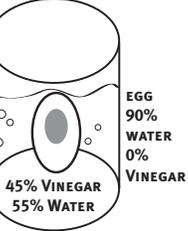
Complete the table by filling in the boxes with the correct answers.

				<p>A cell is put into a sugar solution. The cell is 25% sugar and the solution is 10% sugar.</p>	
Which way will the molecules move?					
What process is being used?					
Does it take energy?					
What is the definition of the processes?					

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Diffusion, Osmosis or Active Transport?

Complete the table by filling in the boxes with the correct answers.

				<p>A cell is put into a sugar solution. The cell is 25% sugar and the solution is 10% sugar.</p>	
<p>Which way will the molecules move?</p>	<p>Water will move into the cell</p>	<p>Salt will move into the cell</p>	<p>Potassium will move to the right</p>	<p>The sugar will move out of the cell</p>	<p>Water will move out of the egg; vinegar will move into the egg.</p>
<p>What process is being used?</p>	<p>Osmosis</p>	<p>Diffusion</p>	<p>Diffusion</p>	<p>Diffusion</p>	<p>Osmosis and Diffusion</p>
<p>Does it take energy?</p>	<p>NO</p>	<p>NO</p>	<p>NO</p>	<p>NO</p>	<p>NO</p>
<p>What is the definition of the processes?</p>	<p><b>Osmosis:</b> movement of water from an area of high concentration to an area of lower concentrations through a semi-permeable membrane without energy  <b>Diffusion:</b> Movement of substances other than water from an area of high concentration to an area of lower concentration through a semi-permeable membrane without energy  <b>Active Transport:</b> movement of substances from low concentrations to high concentration or substances too large to pass through the semi-permeable membrane by using energy</p>				

# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Lab: Osmosis and Diffusion through a Semi-Permeable Membrane (AID)

### Introduction

All substances move into and out of cells based on a concentration gradient. A concentration gradient is caused by an imbalance in the concentration of substances on both sides of a semi-permeable membrane. If molecules move on a concentration gradient, they are said to go up the gradient or down the gradient. Imagine a hill. The top of the hill (the high point) is the top of the gradient. The bottom of the hill (the low point) is the bottom of the gradient. Molecules move down the gradient by diffusion or osmosis very easily, just as running down the hill takes little energy. For example, if there were more salt outside of a cell than inside a cell, a concentration gradient would exist (more on one side, less on the other.) Because of the concentration gradient, the molecules of salt would move from higher to lower concentration by the process of diffusion or down the concentration gradient.

The molecules move from high concentration to low concentration until the molecules reach a point of equilibrium, or when the concentration is the same on both sides of the membranes. Even though there would now be equal concentrations of the substances, movement continues, however there is no net movement. This means that for every molecule that moves one way, the same type of molecule moves the opposite direction canceling out the movement of the first molecule. The molecules continue to stay in movement, but there is no area of higher or lower concentration, so there is not large amount of movement of molecules, as there once was when diffusion began.

This type of movement occurs constantly across the cell membrane. This type of movement is hard to see and therefore can be seen well in a simulation. Dialysis tubing serves as an artificial semi-permeable membrane, but works similarly to the cell membrane.

**Purpose:** To simulate and observe the diffusion of materials across a semi-permeable membrane

### Materials:

- Two cups
- Graduated cylinder
- Water
- Salt
- Two pieces of dialysis tubing
- Food coloring
- Iodine
- Starch solution

## PROCEDURE DAY 1

1. Label one cup "SALT WATER." Fill the cup three-quarters of the way with water. Add salt to the cup, stirring as you go, until no more salt will dissolve. In a clean graduated cylinder, add 2-3 drops of food coloring to 20 ml of water.
2. **To prepare dialysis tubing:** Take a 12 cm piece of dialysis tubing and run it under warm water. To open the bag, rub the ends between your fingers until the edges separate. Tightly tie off one end of the tubing to form a bag.
3. While one partner hold the open end of the tubing, carefully pour the colored water into the tube, leaving enough space at the top to tie off the bag.
4. Tightly tie off the open end of the bag. Run the bag under water and dry it off to get rid of any residue. Make sure the bag does not leak. If it is leaking, re-tie it.
5. Note the color of the water in the cup and in the tubing in your data table in the appropriate space.
6. Weigh the tubing and also record this in the appropriate space in the data table.
7. Label a second cup "IODINE AND WATER." Fill this cup three-quarter full with water. Add iodine to the cup until the water is a dark yellow color.
8. Prepare a second piece of dialysis tubing following the same steps as before. Once one end is tied off, add about 20 ml of starch solution to the tubing.
9. Tightly tie off the open end of the bag. Run the bag under water and dry it off to get rid of any residue. Make sure the bag does not leak. If it is leaking, re-tie it.
10. Again, note the color of the water in the cup and the tubing in your data table in the appropriate space. Also, weigh the tubing and record this in the appropriate space in the data table.
11. Let the cups and tubing sit overnight.

## DATA TABLE

	Color Before	Color After	Weight Before	Weight After
Tubing with colored water				
Salt/water cup				
Tubing with starch				
Iodine/water cup				

# CELLS: THE STORY OF LIFE

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## **PROCEDURE DAY 2**

1. Record the color of the cups and water in the “Color After” column in the appropriate spaces on the data table.
2. Remove the tubing from the cups, rinse and dry it. Record the mass of the tubing in the appropriate spaces in the “Weight After” column.

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**CONCLUSIONS**

**SALT/WATER CUP AND COLORED WATER TUBING**

Which molecule(s) moved into the tubing? How do you know?

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Which molecule(s) moved out of the tubing? How do you know?

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---

Where was there a concentration gradient in this part of the experiment?

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How did the concentration gradient affect the movement of the salt?

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**IODINE/WATER CUP AND STARCH TUBING**

Which molecule(s) moved into the tubing? How do you know?

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Which molecule(s) moved out of the tubing? How do you know?

---

---

Where was there a concentration gradient in this part of the experiment?

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How did the concentration gradient affect the movement of the iodine?

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Why did the salt molecules move, but not the starch molecules?

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# CELLS: THE STORY OF LIFE

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How does the dialysis tubing simulate a cell membrane?

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What osmotic problems does an algal, bacterial or protozoa cell face in a fresh water environment? In a seawater environment?

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Name ANSWER KEY Date \_\_\_\_\_ Class \_\_\_\_\_

### Lab: Osmosis and Diffusion through a Semi-Permeable Membrane

#### DATA TABLE

	Color Before	Color After	Weight Before	Weight After
Tubing with colored water				
Salt/water cup				
Tubing with starch				
Iodine/water cup				

#### CONCLUSIONS

##### SALT/WATER CUP AND COLORED WATER TUBING

Which molecule(s) moved into the tubing? How do you know?

**No molecules will move in. Weight of tubing has decreased**

Which molecule(s) moved out of the tubing? How do you know?

**Water molecule moved out. Weight of tubing decreased. Color change**

Where was there a concentration gradient in this part of the experiment?

**Yes, there was more salt outside than inside the tubing, also more water molecules inside than outside.**

How did the concentration gradient affect the movement of the salt?

**The concentration gradient caused the salt molecule to move down the gradient from higher concentration (outside) to lower concentration (inside). The water did the opposite.**

##### IODINE/WATER CUP AND STARCH TUBING

Which molecule(s) moved into the tubing? How do you know?

**The iodine molecules moved into the tubing. The cup is now clear. Weight of the tubing increased.**

Which molecule(s) moved out of the tubing? How do you know?

# CELLS: THE STORY OF LIFE

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**No molecules moved out. The color of the water in the cup did not change showing that the starch molecules did not move out.**

Where was there a concentration gradient in this part of the experiment?

**There was more iodine outside than inside the tubing.**

How did the concentration gradient affect the movement of the iodine?

**The concentration gradient caused the iodine molecules to move down the gradient from higher concentration (outside) to lower concentration (inside).**

Why did the salt molecules move, but not the starch molecules?

**The salt molecules are much smaller molecules than the starch. The membrane is permeable only to small sized particles. The starch was too large.**

How does the dialysis tubing simulate a cell membrane?

**The dialysis tubing does not allow all materials to pass through as shown by the starch solution. A cell membrane also limits what goes through based on size.**

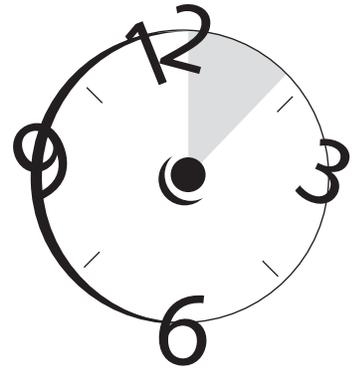
What osmotic problems does an algal, bacterial or protozoa cell face in a fresh water environment? In a seawater environment?

**An organisms living in fresh water needs to control how much water will enter the cells. Too much water would be deadly for the cells. In a seawater environment, the organism needs to control how much water is lost. This can also be deadly.**

# Cell Division

Core/AID

Time Allocation: 3 hours, 45 minutes  
Required Materials and Resources on Page 117



## Module Overview

In these lessons, students will explore the ways that cells reproduce and create more cells. Students will simulate the process of mitosis using yarn and creating a flipbook showing the stages of mitosis. These activities reinforce the principle: Cellular reproduction continues the species. Students with a scientific aptitude may ask questions regarding problems with the process including mutations. They may also discuss heredity and genetics. These students have an opportunity to explore mitosis further with an onion cell lab.

### Guiding Questions

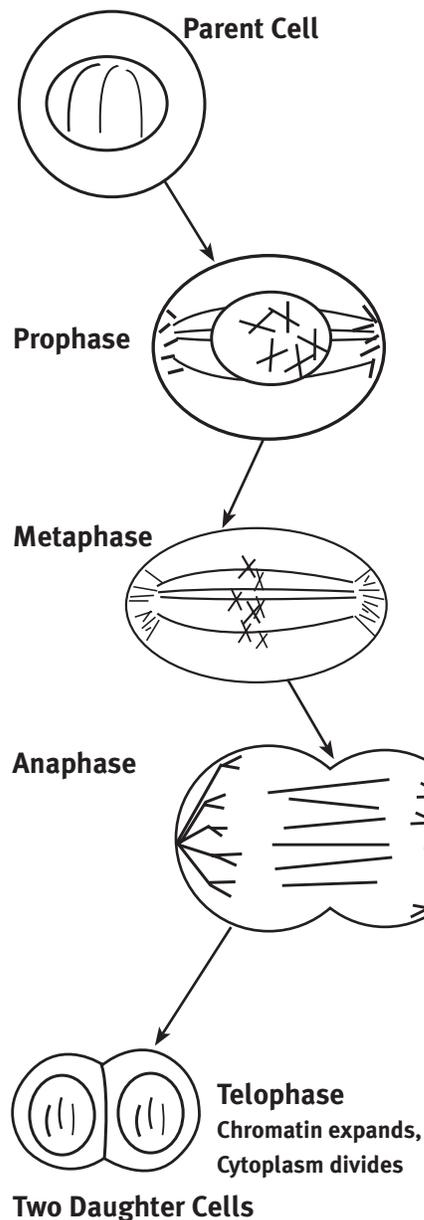
- Why would an organism need to create more cells?
- How does an organism create more cells?

**BIG IDEA**

Reproduction

# CELLS: THE STORY OF LIFE

## Mitosis



## Content Goals

### Universal Theme(s)

Cycles

### Principles and Generalizations

Cellular reproduction continues the species.

### Concepts

- Mitosis
- Replication
- Nucleus
- Chromosomes
- DNA
- Phases
- Growth
- Chromatin
- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase

### Teacher Information

- *Mitosis* is the process whereby cells produce genetically identical new cells.
- *Replication* is the process of producing more cells.
- The *nucleus* is considered to be the “command center” of the cell. The nucleus serves to regulate the cell’s activities of growth and reproduction. It also houses the genetic material in the form of chromosomes. The nucleus is made of three basic parts: the nuclear membrane, the chromosomes, and the nucleolus.
- *Chromosomes* are the rod-shaped structures found in the nucleus composed of DNA.
- *Chromatin* is a fine mass of thin fibers composed of DNA. Chromatin is not visible in a cell until a cell divides.
- *Phases* are the individual stages of the mitosis process. There are five phases: interphase, prophase, metaphase, anaphase and telophase.

# Cell Division

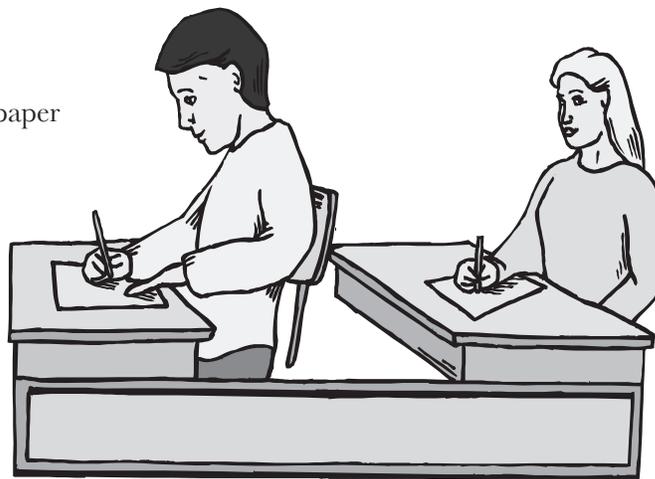
- *Interphase* is the phase of the cell's life cycle where the cell performs its "normal" functions. At the end of this phase, the chromatin replicates itself in preparation for mitosis. It is often considered part of mitosis although it actually occurs prior to the start of the process.
- *Prophase* is the actual first phase of mitosis. The nuclear membrane of the nucleus dissolves, and the replicated chromatin shorten in to recognizable chromosomes.
- *Metaphase* is the second phase of mitosis. The chromosomal pairs align in the middle of the cell and begin their separation.
- *Anaphase* is the third phase of mitosis. The chromosomal pairs separate and move towards the opposite end of the cell.
- *Telophase* is the fourth phase of mitosis. The chromosomes move completely to the opposite ends of the cell and the nuclear membranes reform around the chromosomes. The cell membrane pinches off in animal cells to form two new identical cells, or a cell plate forms in the middle of a plant cell to separate into two new identical cells.

## Skills

- Research
- Draw scientifically
- Organize
- Follow Directions
- Calculate

## Materials and Resources

1. Flip Book Activity:
  - Textbooks, Encyclopedias, Internet or other materials for research
  - Index cards
  - Stapler
2. Lab activity:
  - Yarn
  - Large piece of paper
  - Tape



# CELLS: THE STORY OF LIFE



## Preparation Activities

1. Provide resources for the students' research if classroom sources are not adequate. Arrange Internet access if desired but be aware that many websites provide more detail than is necessary at this level. Good sources include the following sites:

<http://micro.magnet.fsu.edu/cells/mitosisjava/mitosisjava.html>

<http://staff.jccc.net/pdecell/celldivision/mitosis1.html>

<http://www.tqnyc.org/NYC040844/Mitosis.htm>

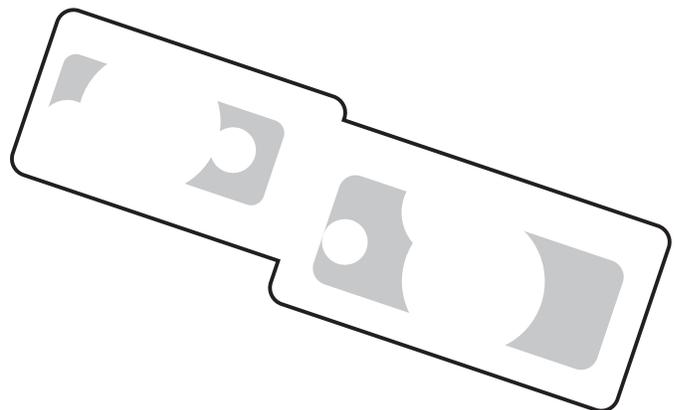
2. A sample flipbook, as well as directions for making them, can be found on the website <http://www.rossonhousemuseum.org/FlipbookSnowman.pdf>
3. Copy the lab: **Cell Division**
4. Copy Post Assessment: **Identification of the Steps of Mitosis**

## Introductory Activities (10 minutes)

- Pose the following problem to the students: Once there was a 7th grader who wanted to increase his allowance. He proposed the following plan to his parents: "Instead of giving me five dollars a week, give me one penny on the first day of the month, two pennies on the second day, four pennies on the third day, eight pennies on the fourth day and so on. Just double the number of pennies you give me each day until the end of two weeks. The parents laughed and agreed to the plan." How much money did the 7th grader have at the end of two weeks? (Answer: 8,192 pennies)
- Discuss the way in which this is similar to the way cells multiply and an example of how bacteria divide and make us sick.
- Tell students that this is how all cells multiply, some at different rates. Discuss the reasons new cells are necessary for an organism.  
**SEARCHLIGHT:** Be on the lookout for students who have above average ability and/or interest in this topic and are able to handle independent research. Suggest to them that they do the AID lab at the end of the lesson.

## Pre-assessment

N/A



# Cell Division

## Teaching and Learning Activities (225 minutes, 5 days assuming 45 minute periods)

1. Day 1 (Lesson 25): Using any references available (text books, Internet, etc.) explain that students will be making a short “movie” of the process of mitosis. They will be responsible for showing the stages of mitosis, either in a plant or animal cell, in flipbook form so that the book shows a seamless movie when flipped through. Students will need to determine how many pages will be necessary to create continuity in the book. It is suggested that students work in pairs or small groups. At some point in the book, students should label the chromosomes, chromatin, nuclear membrane, cell membrane, and cytoplasm (also cell wall if applicable). The majority of the time should be spent on researching and planning.
2. Day 2 (Lesson 26): Have students construct flipbooks. Neatness, continuity and accuracy should be the major focus of the project. Circulate to offer scaffolding to students who need it.
3. Days 3 & 4 (Lessons 27 & 28): Divide students into groups of two and complete the lab **Cell Division**.
4. Day 5 (Lesson 29): Post Assessment and Debriefing activities

## Products and Assignments

- Mitosis Flip Book
- Lab: **Cell Division**
- Homework assignments could include any appropriate textbook work or worksheets. Students may also work on any classwork that needs to be done. Lab conclusion questions could also be assigned individually as homework.

## Extension Activities

- Lab: **Onion Cell Mitosis** (AID)

## Post Assessment (15 minutes)

Worksheet: **Identification of the Steps of Mitosis**

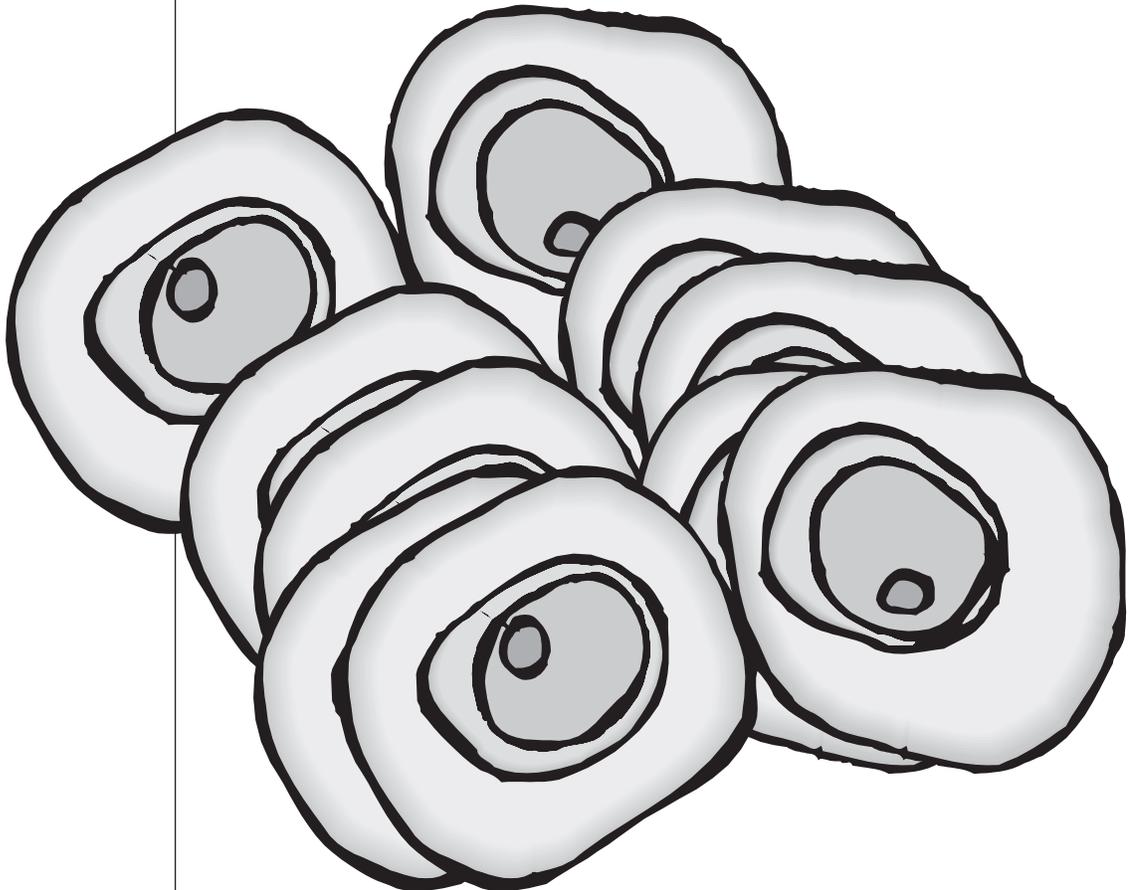
# CELLS: THE STORY OF LIFE



## Debriefing and Reflection Opportunities (20 minutes)

As a class discuss the following ideas:

1. Cell division is a method of reproduction and is a characteristic of life.
2. Cell division is necessary for the following:
  - Replacing dead cells
  - Growth & development
  - Continuation of the species.
3. Single celled organisms divide this way and produce whole other organisms in a process called budding.
4. Exceptions to this process are the following:
  - Sperm & egg cells use a similar process that reduces the number of chromosomes during division.
  - There are cells that do not divide, such as brain and nerve cells.



Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Lab: Cell Division

**Purpose:** To simulate the process of mitosis

**Materials:**

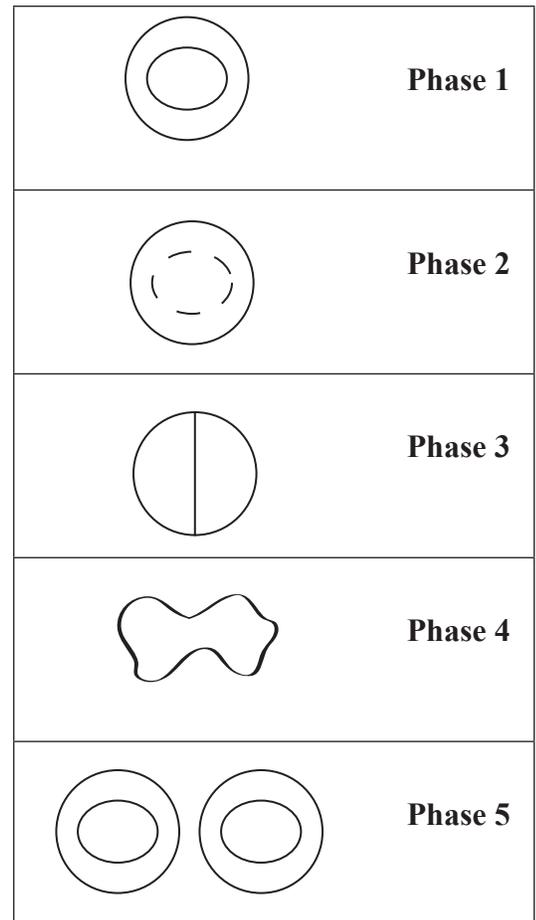
- Four different colors of yarn
- Large piece of drawing paper
- Tape
- Scissors

Procedure:

**PHASE 1 (Interphase)**

Cells spend most of their life in the first phase of cell division called interphase. Some time can be used for growing, but most of the time the cell is at rest.

1. Divide a large piece of paper into five horizontal sections and fill each section as shown in the diagram. Each section represents one phase of mitosis.
2. Cut one piece of yarn about 10 cm long from each color.
3. Place the yarn in the center of the phase one circle. The yarn represents the *chromosomes* of the cell, but they are stretched out in a form called *chromatin*. This is what the cell looks like when it is in interphase.
4. In the space below, draw and color what you see. Label your drawing with the cell membrane, nucleus, and chromatin.

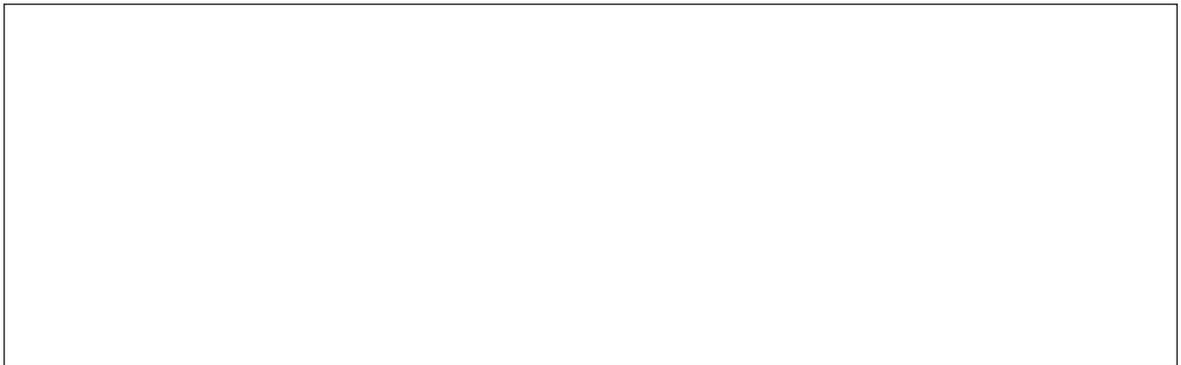


# CELLS: THE STORY OF LIFE

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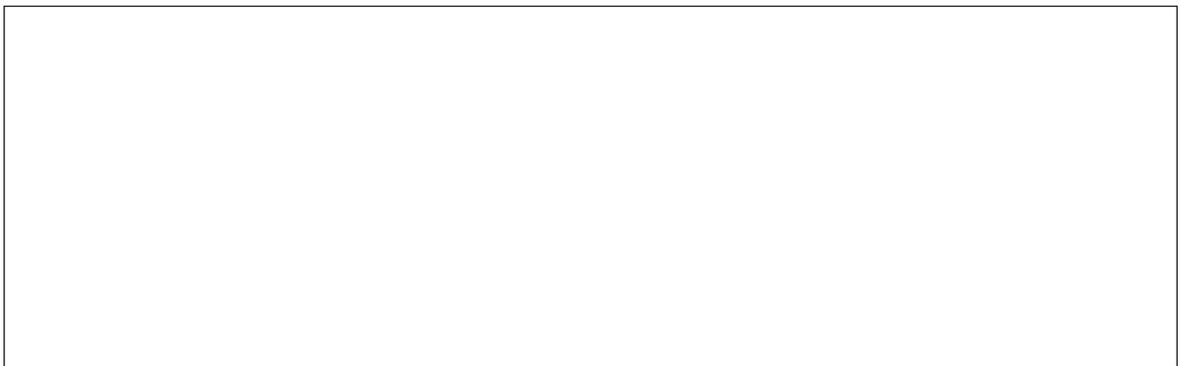
## **PHASE 2 (Prophase)**

1. Move the chromatin to the phase two circle.
2. Now cut a second piece of yarn about 10 cm long from each color.
3. Place this yarn in the center of the phase two circle with the original yarn. This represents the cell doubling its chromosomes by making a copy of each chromosome. Take the chromatin and cut each piece of yarn into two even pieces. This will give you eight yarn “chromosomes.”
4. Match the pieces of yarn by color and tape each match together with a small piece of tape in the center of the chromosome.
5. Put the yarn “chromosomes” into the nucleus of phase 2. Notice the nuclear membrane starting to break apart.
6. In the space below, draw and color what you see. Label your drawing with the cell membrane, nucleus, and chromosomes.



## **PHASE 3 (Metaphase)**

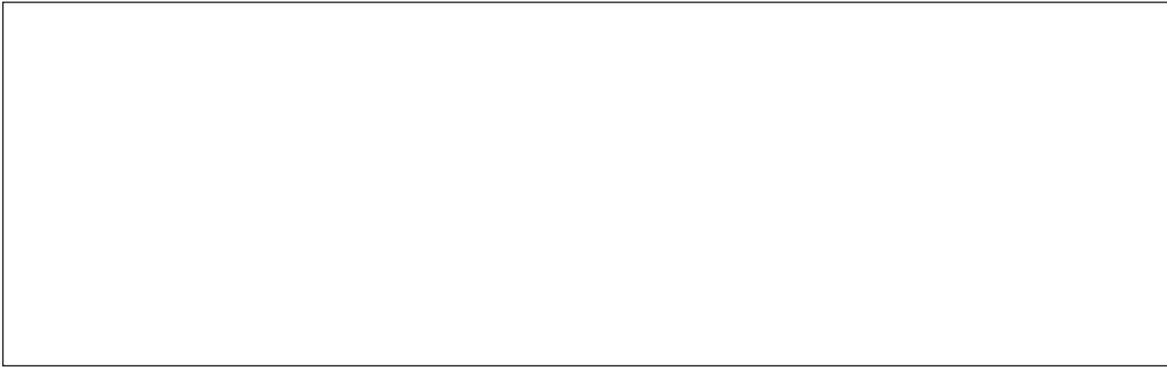
1. Take the yarn “chromosomes” from Phase 2 and place them in phase 3 so the tape is on the center line.
2. In the space below, draw and color what you see. Label your drawing with the cell membrane and chromosomes.



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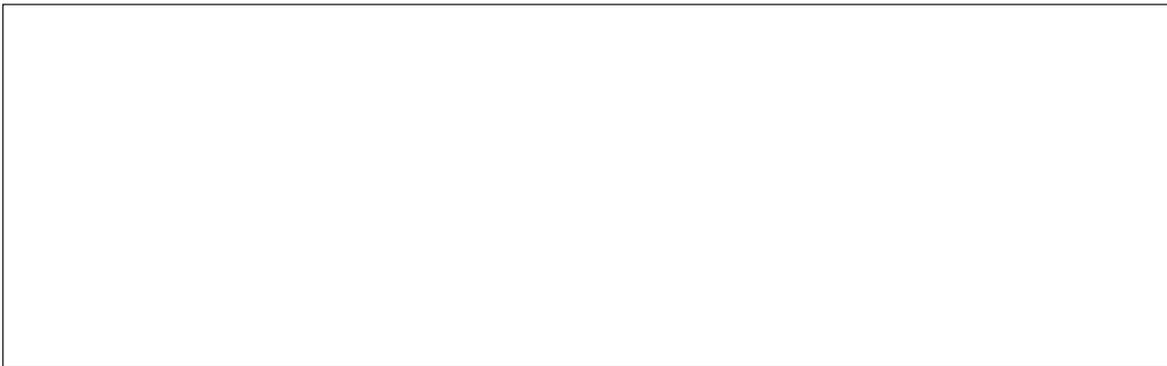
#### **PHASE 4 (Anaphase)**

1. Cut each chromosome pair apart the long way, so they look like they did before they were taped.
2. Pull one half of each pair to the ends of the cell by pulling on the center tape. In a real cell, the cell would send out small fibers to grab the chromosome in the middle, and pull it to the sides.
3. Do this to each set of chromosomes so that there are exactly the same colors and number of chromosomes at each end of the cell.
4. In the space below, draw and color what you see. Label your drawing with the cell membrane and chromosomes.



#### **PHASE 5 (Telophase)**

1. Place each set of chromosomes in the new two resulting cells so that there are exactly the same colors and number of chromosomes in each of the cells.
2. Notice that the nucleus has reformed around the chromosomes. Each chromosome would now stretch out again into chromatin form.
3. In the space below, draw and color what you see. Label your drawing with the cell membrane, nucleus and chromatin.



# CELLS: THE STORY OF LIFE

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## CONCLUSIONS:

1. Explain the difference between chromatin and chromosomes.

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2. What are the similarities between the original cell and the two final cells? What differences are there? \_\_\_\_\_

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3. What would happen if the cell did not make a copy of its DNA (its chromosomes) before it divided? \_\_\_\_\_

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4. The cells of a fully-grown adult still undergo mitosis. Why is this useful? Think about your skin, for example. \_\_\_\_\_

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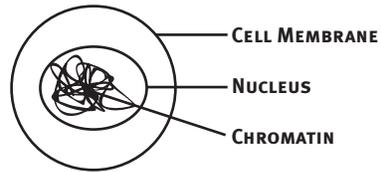
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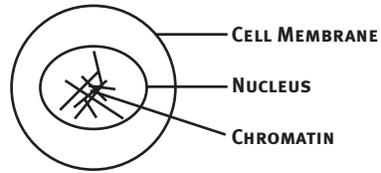
Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Lab: Cell Division

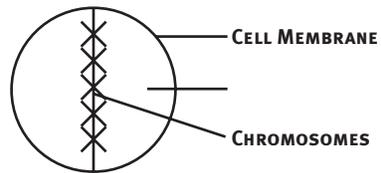
**Phase 1**



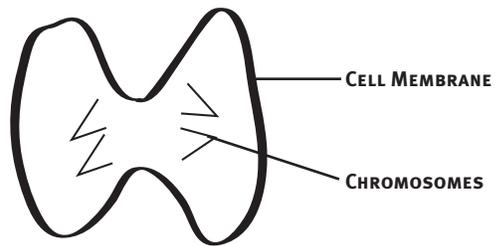
**Phase 2**



**Phase 3**

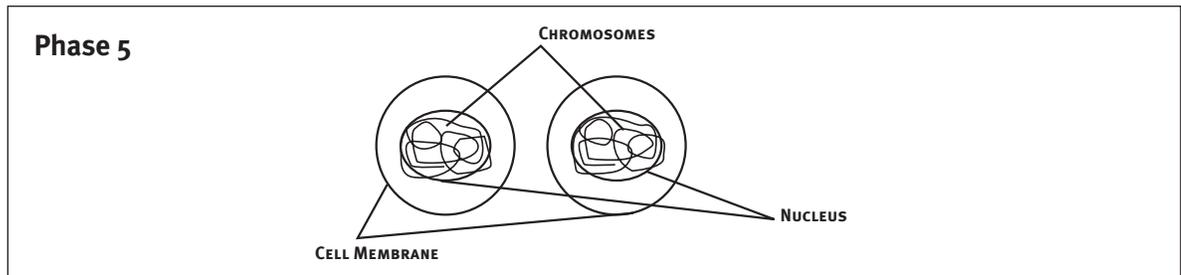


**Phase 4**



# CELLS: THE STORY OF LIFE

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## CONCLUSIONS:

1. Explain the difference between chromatin and chromosomes.

**Chromatin occurs when chromosomes are long and stretched out. It cannot be seen in the cell. When the chromatin shortens up into rod-like structures, it is called chromosomes. These can be seen in the cell. Both are made of the same material (DNA).**

2. What are the similarities between the original cell and the two final cells? What differences are there?

**The two cells contain the same amount of material and structures. The final cells are smaller than the original cells. There is one original cell and two final cells.**

3. What would happen if the cell did not make a copy of its DNA (its chromosomes) before it divided?

**If the cell did not copy its DNA before splitting, the resulting cells would have only half of the chromosomes needed to survive.**

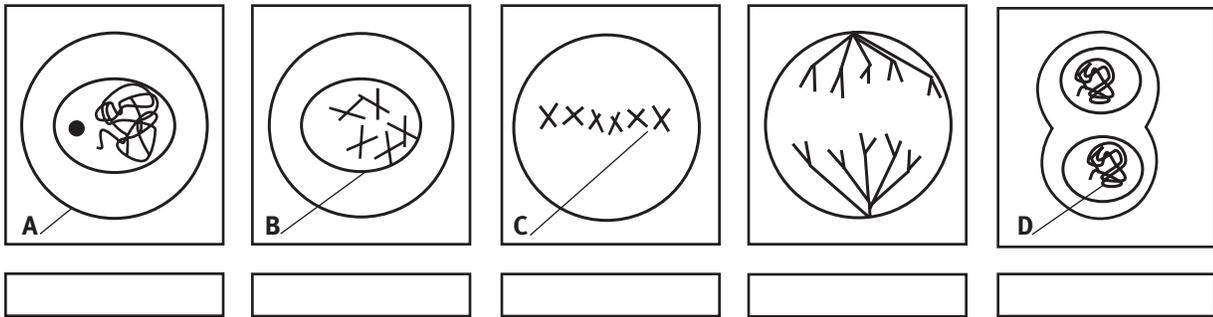
4. The cells of a fully-grown adult still undergo mitosis. Why is this useful? Think about your skin, for example.

**Cells are always dying in your body. Sometimes they wear out from age (like your skin) or sometimes they die because of infections or other reasons. Your body needs to replace the dead cells.**

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Identification of the Steps of Mitosis

Under each drawing, write the name of the phase of mitosis being shown.



Answer the following questions.

What is the structure labeled “A” called? What is its job in a cell? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

What is the structure labeled B called? What is its job in a cell? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

What is the structure labeled C called? What is its job in a cell? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

What is the structure labeled D called? How is it different than structure C? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

# CELLS: THE STORY OF LIFE

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**In paragraph form, describe what happens in each of the steps of mitosis.**

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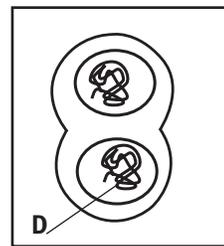
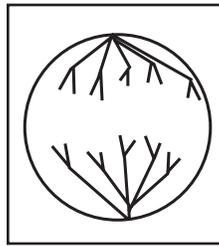
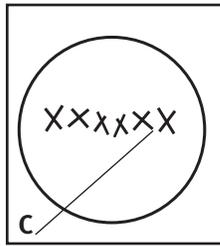
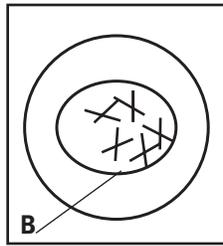
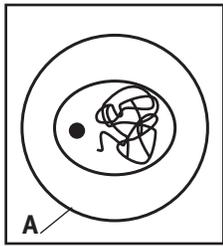
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Name ANSWER KEY Date \_\_\_\_\_ Class \_\_\_\_\_

### Identification of the Steps of Mitosis

Under each drawing, write the name of the phase of mitosis being shown.



Interphase

Prophase

Metaphase

Anaphase

Telophase

Answer the following questions.

What is the structure labeled “A” called? What is its job in a cell?

**Cell membrane – controls movement of substances into and out of the cell**

What is the structure labeled B called? What is its job in a cell?

**Nuclear membrane – controls movement of substances into and out of the nucleus**

What is the structure labeled C called? What is its job in a cell?

**Chromosomes – carry genetic information**

What is the structure labeled D called? How is it different than structure C?

**Chromatin – carries genetic information**

# CELLS: THE STORY OF LIFE

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**In paragraph form, describe what happens in each of the steps of mitosis.**

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Lab: Onion Cell Mitosis (AID)

#### Introduction

There are five stages of cell division: Interphase, Prophase, Metaphase, Anaphase and Telophase. The different stages of cell division can easily be seen in certain types of cells such as the onion cell. At the tips of the onion roots, the cells are dividing rapidly to allow the root to grow. When the cells divide, the chromosome become visible at certain stages. Similar stages happen in the animal cell, although there are a few differences. However, the onion cells will show the basic steps for all cells.

**Problem:** How do the phases of cell division appear under the microscope?

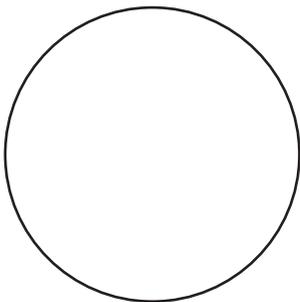
#### Materials:

Microscope

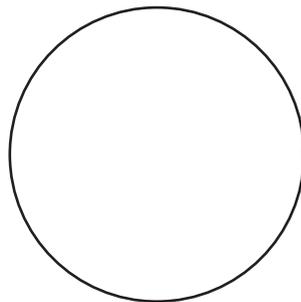
Prepared slide of onion (allium) root tips or other slides of mitosis

#### Procedure:

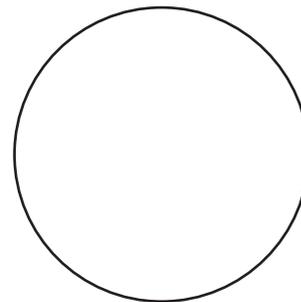
1. Get a microscope for your lab group and carry it carefully to your workspace.
2. Using one of the provided slides, observe the slide under low power. Look at the pointed end of the onion just inside the edge of the root "cap." You should see cells in different stages of division.
3. Find one cell at each stage and draw what you see in the boxes below. Label the stages as well.
4. Label your drawings with the nucleus, cell wall, chromosomes or chromatin.



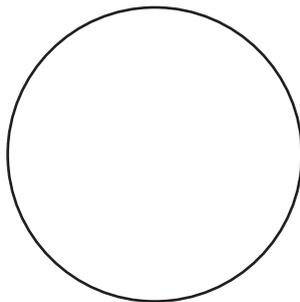
Stage: \_\_\_\_\_



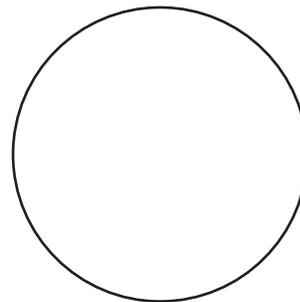
Stage: \_\_\_\_\_



Stage: \_\_\_\_\_



Stage: \_\_\_\_\_



Stage: \_\_\_\_\_

# CELLS: THE STORY OF LIFE

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## CONCLUSIONS

Which stage seems to occur most frequently? Which stage seems to occur least frequently?

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The onion plant began as a single cell. Assuming the original cell had 25 chromosomes, how many chromosomes are in each of the cells you looked at?

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Name the stages of mitosis in order and give one major event for each stage.

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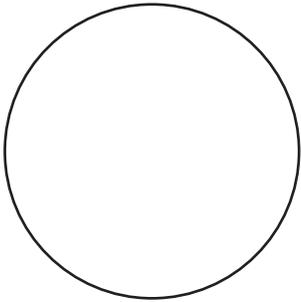
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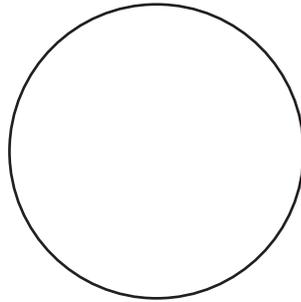
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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

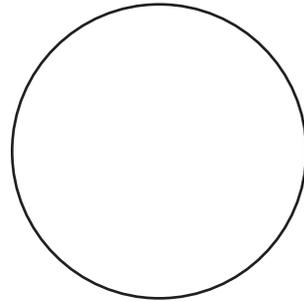
**Lab: Onion Cell Mitosis (AID)**



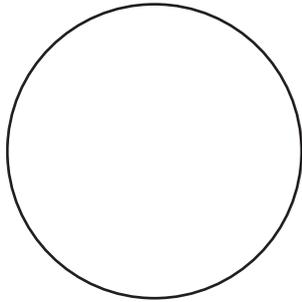
**Stage:** \_\_\_\_\_



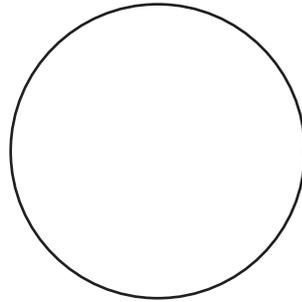
**Stage:** \_\_\_\_\_



**Stage:** \_\_\_\_\_



**Stage:** \_\_\_\_\_



**Stage:** \_\_\_\_\_

**Drawings should show detail and be accurate. Stage of division should be labeled accurately.**

# CELLS: THE STORY OF LIFE

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## CONCLUSIONS

Which stage seems to occur most frequently? Which stage seems to occur least frequently?

**Interphase occurs most frequently (More cells appear to be doing nothing). Other stages occur less frequently.**

The onion plant began as a single cell. Assuming the original cell had 25 chromosomes, how many chromosomes are in each of the cells you looked at?

**Each cell should have 25 chromosomes.**

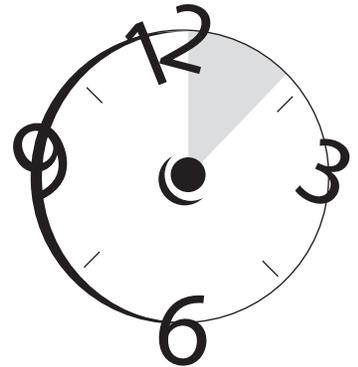
Name the stages of mitosis in order and give one major event for each stage.

**Answers may vary but should list interphase, prophase, metaphase, anaphase and telophase in order.**

# Life's Organization

**Core**

Time Allocation: 1 hours, 30 minutes  
Required Materials and Resources on Page 117



## Lesson Overview

In this module students will explore the levels of organization and create drawings of the different levels of organization within our own bodies. This activity reinforces a basic principle: All life is organized from the most basic level (cells) to the most complex level (organism).

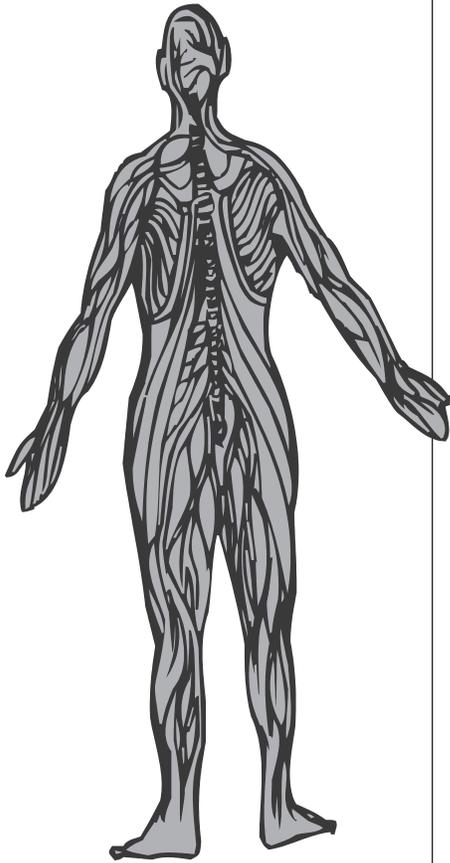
### Guiding Questions

- What are the different levels of organization within an organism?
- How are all of the levels related to each other?

**BIG IDEA**

All life is organized.

# CELLS: THE STORY OF LIFE



## Content Goals

### Universal Theme

System

### Principles and Generalizations

- All life is organized from the most basic level (cells) to the most complex level (organism).
- Specialized cells perform specialized functions in multicellular organisms.

### Concepts

- Cells
- Tissues
- Organs
- Organ systems
- Organisms
- Unicellular
- Multicellular

### Teacher Information

- *Cells* are the most basic units of life.
- *Tissues* are made up of groups of cells that perform a similar function.
- *Organs* are made up of groups of tissues that perform a similar function.
- *Organ systems* are made up of a group of organs that perform a similar function.
- An *organism* is made up of many organ systems that work together to sustain life.
- A *unicellular organism* is made up of one cell, which needs and performs the same major life functions as a multicellular organism. Unicellular organisms are simple organisms that have not developed evolutionarily.
- A *multicellular organism* is a complex organism made of more than one cell that has resulted in the organism having differentiated cells that perform specialized functions.
- If any level of the organism's health is severely affected, that organism may not survive.

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# Life's Organization

## Skills

- Reason deductively
- Classify
- Communicate
- Draw scientifically

## Materials and Resources

1. Markers
2. Colored pencils
3. Crayons
4. Large pieces of drawing paper
5. Worksheet: **Levels of Organization**
6. Index cards

## Preparation Activities

1. Secure ample above materials for all students
2. Copy worksheet: Levels of Organization

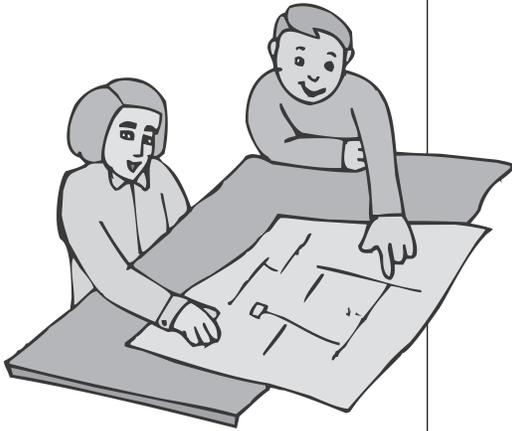
## Introductory Activities (20 minutes)

- Convene a whole class meeting. Explain to the students that they will be thinking about how their body is organized. Use an analogy such as the school building, to generate understanding about the levels of organization. Describe how the body is like the school building. Discuss the biggest parts that make up the school, such as the science department, administrators, maintenance people, etc. Explain that like the school, the organs systems are the biggest levels that make up the human body and just as there are people that make up each department, there are organs that make up each of the organ systems.
- Explain further that organs are made of tissues and tissues are made of cells just as the school is organized into smaller and smaller parts. Involve students in this discussion by asking them for examples of organ systems in the body (digestive, respiratory, circulatory). Explain that the students' job in this lesson is to make detailed and labeled drawings of each level of organization in the human body.

## Pre-assessment

N/A

# CELLS: THE STORY OF LIFE



## Teaching and Learning Activities (45 minutes)

1. Day 1 (Lessons 30 & 31): Complete the worksheet: **Levels of Organization** by having students draw an outline of the human body in the organism box. Students should come into this lesson with a basic working knowledge. Explain that you are only looking for them to show as much as they know and that there may be things they leave out. The focus is not to show every possible detail but to get the understanding that each level is made of another level. They may draw what they think the level looks like, within reason.
2. Have students add to the worksheet by choosing one body system, such as the digestive system, and drawing that system in the appropriate box, labeling as many parts as possible.
3. Then have them complete the rest of the worksheet by drawing one organ from their chosen system in the organ box, the tissue that would compose that organ in the tissue box, and the cells that compose that tissue in the cell box. Each box should have a drawing of what the students believe that level looks like. Accuracy in the drawings is not important as long as students realize that each level is composed of the lower levels. Students should complete drawings and color them.

## Products and Assignments

Worksheet: **Levels of Organization**

## Extension Activities

Discuss how there are levels that are smaller and larger than the ones that have been focused on in class. The levels presented are the focus of a typical life science course. Have students brainstorm what composes the smaller levels (cells, organelles, molecules, atoms, etc.) and the larger levels (organisms, communities, ecosystems, planets, etc.) Discuss how these levels might interact and affect each other.

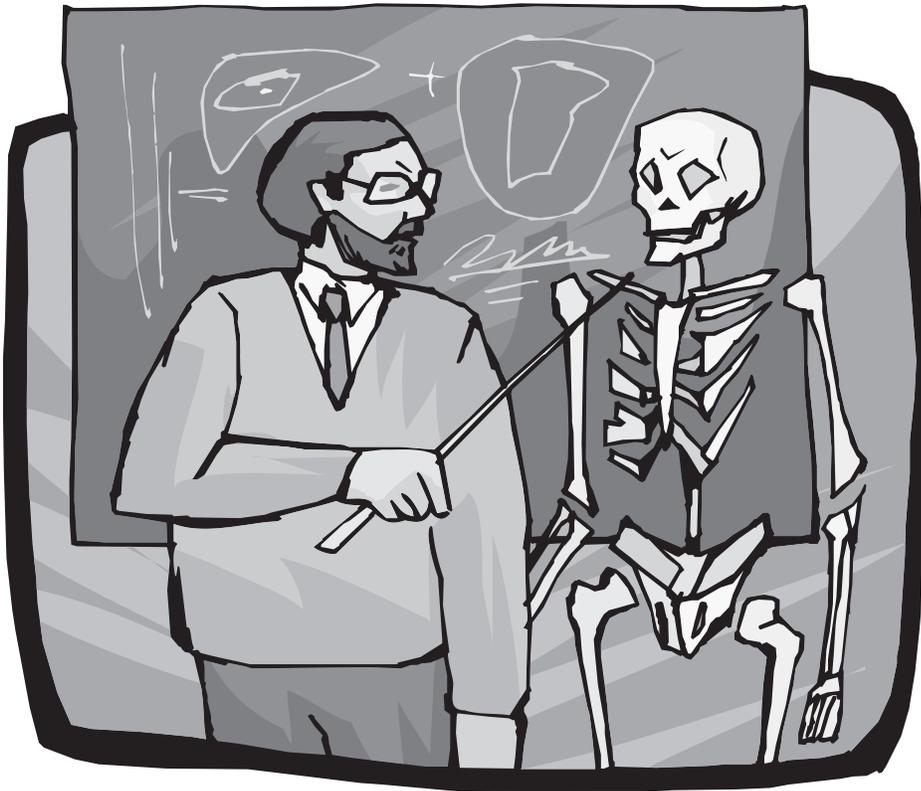
## Post Assessment

N/A

# Life's Organization

## Debriefing and Reflection Opportunities (25 minutes)

1. Have students get into groups of four and discuss similarities and differences in their drawings. On an index card have each group list similar structures that appear in their drawings.
2. For discussion purposes, draw a table of five columns on the board or overhead, heading each column in order with the levels of organization from largest to smallest. Have students offer their examples from the worksheet and write them in the appropriate columns. Discuss the chart you have created, emphasizing the interaction among all the levels. Use several of the students' drawings to illustrate the ways in which the organism may be affected if any of the levels are disrupted.



# CELLS: THE STORY OF LIFE

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Name ANSWER KEY

Date \_\_\_\_\_

Class \_\_\_\_\_

## Levels of Organization

In each box, draw an example of what that level of organization looks like. Color and label your drawings.

### ORGANISM

Students' drawings should show a whole organism, preferably an animal, as they are more familiar with them. One example might be a drawing of a human. A plant has been ignored since most students have more working knowledge of animals.

### ORGAN SYSTEM

Students should choose one organ system found in the organism they drew and draw as many parts of one particular system as possible. For example, the digestive system would include the stomach, mouth, esophagus, small intestine, etc.

### ORGAN

Students' drawings should show one organ, such as a heart, lungs or stomach found in the system they drew in the last box. Students may label any parts of the organ they know. This may be few unless body systems have been covered in another unit.

### ANIMAL CELL

Students drawing should reflect a basic animal cell including labeling the organelles.

### TISSUE

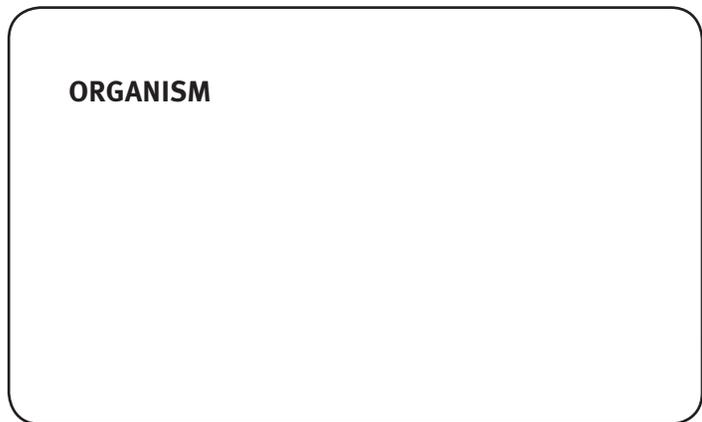
Students' drawings should show a group of cells that would work together in one of the organs, such as stomach tissue. This level may show the least detail, as students are least familiar with the concept of tissues.

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

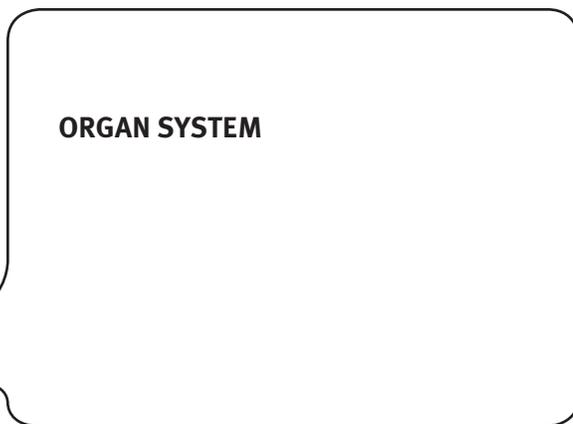
### Levels of Organization

In each box, draw an example of what that level of organization looks like. Color and label your drawings.

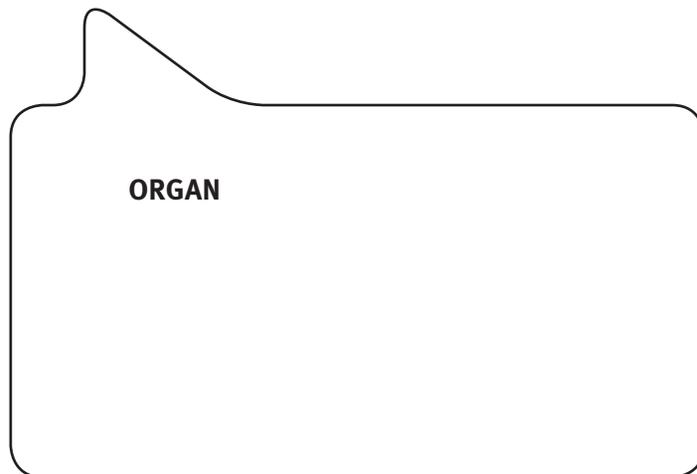
**ORGANISM**



**ORGAN SYSTEM**



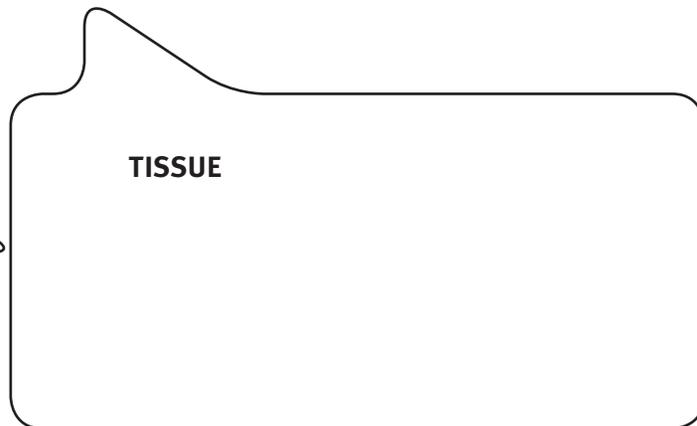
**ORGAN**



**ANIMAL CELL**



**TISSUE**



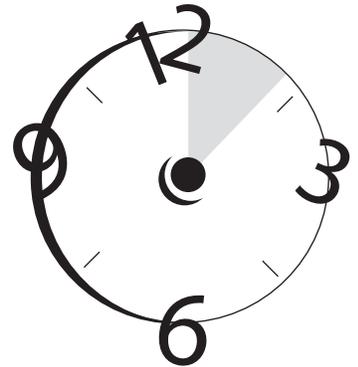


# Post Assessment

Core

Time Allocation: 45 minutes

Required Materials and Resources on Page 117



## Lesson Overview

In this lesson students take the post assessment.

### Guiding Questions

What did I learn about how organisms are structured to ensure efficiency and survival?

**BIG IDEA**

What did I learn about cells, their function, reproduction and organization?

# CELLS: THE STORY OF LIFE



## Content Goals

### Universal Themes

- Classification
- Differentiation
- Balance
- Cycles
- System

### Principles and Generalizations

- All living things have five common characteristics for survival.
- These five characteristics evolved over time for continuation of a species.
- Cellular survival is dependent on its structures and their functions.
- A cell's structure correlates to its job for an organism.
- The cell's processes guarantee that necessary materials enter and leave the cell.
- Cellular reproduction continues the species.
- All life is organized from the most basic level (cells) to the most complex level (organism).
- Specialized cells perform specialized functions in multicellular organisms.

### Concepts

- Living organism
- Cells
- Reproduction
- Chemical processes
- Growth
- Development
- Response
- Stimulus
- Movement
- Organelles
- Cell wall
- Cell membrane
- Cell nucleus
- Nuclear membrane

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# Post Assessment

- Chromosomes
- Nucleolus
- Cytoplasm
- Photosynthesis
- Mitochondria
- Cellular respiration
- Ribosomes
- Endoplasmic reticulum
- Lysosomes
- Vacuoles
- Cilia
- Flagella
- Diffusion
- Osmosis
- Active transport
- Equilibrium
- Concentration
- Selectively permeable
- Mitosis
- Phases
- Chromatin
- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase
- Tissues
- Organs
- Organs systems
- Organisms
- Unicellular
- Multicellular

## Teacher Information

N/A

# CELLS: THE STORY OF LIFE



## Skills

- Reason deductively
- Infer
- Make connections
- Organize
- Describe

## Materials and Resources

### Cells: The Story of Life Unit Post Assessment

## Preparation Activities

Copy **Cells: The Story of Life Unit Post Assessment** for each student.

## Introductory Activities (2 minutes)

Explain to students that the post assessment will be used by you to measure their knowledge about this unit. Emphasize that they should make their best effort on the assessment.

## Pre-assessment

N/A

## Teaching and Learning Activities (43 minutes)

1. Distribute the **Cells: The Story of Life Unit Post Assessment** to each student.
2. Collect students' pre-assessment at end of lesson.

## Products and Assignments

Students' post assessment results

## Extension Activities

N/A

## Post Assessment

Students' post assessment results

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## **Debriefing and Reflection Opportunities**

N/A

# CELLS: THE STORY OF LIFE

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

## Post Assessment for Cells: The Story of Life Unit

Please answer the following questions as completely as possible in full sentences.

1. There are certain characteristics of every living organism that prevent it organism from dying and the species from eventually becoming extinct. What are those characteristics and how do they prevent extinction?

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2. If a cell could only have four major parts, what would those parts be and why?

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3. Describe three differences between a plant cell and an animal cell.

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4. Your fingers shrivel in the bathtub because of a process called osmosis. This is similar to the process that causes plants to wilt. Explain what is occurring when this process happens. Would the same thing happen to your fingers in the ocean? Why or why not?

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5. What steps does a cell need to go through in order to produce more cells?

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6. Describe how your body is organized into levels.

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# CELLS: THE STORY OF LIFE

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Question #	Novice	Competent	Proficient	Expert
1	<ul style="list-style-type: none"> <li>• Response reflects no comprehension or comprehension of only one major characteristic of living things.</li> <li>• Response is incorrect.</li> <li>• No elaboration</li> <li>• No examples given</li> </ul>	<ul style="list-style-type: none"> <li>• Response reflects comprehension of two major characteristics of living things.</li> <li>• Response is partially correct.</li> <li>• Poor elaboration</li> <li>• Poor choice of examples</li> </ul>	<ul style="list-style-type: none"> <li>• Response reflects comprehension of three major characteristics of living things</li> <li>• Response is correct.</li> <li>• Elaboration and completeness may be lacking some detail.</li> <li>• Uses few examples or uses examples only adequately</li> </ul>	<ul style="list-style-type: none"> <li>• Response reflects comprehension of four or more major characteristics of living things.</li> <li>• Response is correct.</li> <li>• Response is complete and is elaborated well.</li> <li>• Response uses several examples appropriately.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Response lists one major cell part.</li> <li>• Chosen parts reflect no comprehension of importance of parts to cell.</li> <li>• Supporting reasons are incomplete, illogical or lack elaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Response lists two major cell parts.</li> <li>• Chosen parts reflect little comprehension of importance of parts to cell.</li> <li>• Supporting reasons are incomplete, illogical or lack elaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Response lists three major cell parts.</li> <li>• Chosen parts reflect adequate comprehension of importance of parts to cell.</li> <li>• Supporting reasons are generally complete, logical and elaborated.</li> </ul>	<ul style="list-style-type: none"> <li>• Response lists four or more major cell parts.</li> <li>• Chosen parts reflect strong comprehension of importance of parts to cell.</li> <li>• Supporting reasons are complete, logical and well elaborated.</li> </ul>

Question #	Novice	Competent	Proficient	Expert
3	<ul style="list-style-type: none"> <li>• Response demonstrates no comprehension of significant differences between plant and animal cells.</li> <li>• Response is incorrect, incomplete and lacks elaboration</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates minimal comprehension of significant differences between plant and animal cells.</li> <li>• Response is generally correct, but is incomplete or lacks elaboration.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates adequate comprehension of two significant differences between plant and animal cells.</li> <li>• Response is correct, but may be incomplete or elaborate poorly.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates strong comprehension of three or more significant differences between plant and animal cells.</li> <li>• Response is correct, complete and elaborates well.</li> </ul>
4	<ul style="list-style-type: none"> <li>• Response demonstrates no comprehension of the process of osmosis.</li> <li>• Response is incorrect and/or incomplete.</li> <li>• Response does not discuss movement of molecules.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates minimal comprehension of the process of osmosis.</li> <li>• Response is generally correct, but may be incomplete or lack elaboration.</li> <li>• Response discusses molecules but does not refer to concentrations or reasons for movement.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates adequate comprehension of the process of osmosis.</li> <li>• Response is correct, complete and shows some elaboration.</li> <li>• Response discusses movement of molecules but may not refer to concentration or describe reasons for movement.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates strong comprehension of the process of osmosis.</li> <li>• Response is correct, complete and elaborates well.</li> <li>• Response discusses movement of molecules, including concentrations and reasons for movement.</li> </ul>

# CELLS: THE STORY OF LIFE

Question #	Novice	Competent	Proficient	Expert
5	<ul style="list-style-type: none"> <li>• Response demonstrates no comprehension of process of cell division.</li> <li>• Response does not discuss phases of cell division.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates minimal comprehension of process of cell division</li> <li>• Response discusses phases of cell division but does not discuss movement of chromosomes, nucleus and cell membrane.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates an adequate comprehension of process of cell division.</li> <li>• Response discusses some phases of cell division including movement of chromosomes, nucleus or cell membrane.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates a strong comprehension of process of cell division.</li> <li>• Response discusses all phases of cell division, including movement of chromosomes, nucleus and cell membrane.</li> </ul>
6	<ul style="list-style-type: none"> <li>• Response demonstrates little or no comprehension of levels of organization.</li> <li>• Response draws no connection between levels.</li> <li>• Response offers no examples for levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates a poor comprehension of levels of organization.</li> <li>• Response draws poor connections between levels.</li> <li>• Response offers few if any examples for levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates adequate comprehension of levels of organization but may not address all five levels.</li> <li>• Response draws connections between levels but may be lacking in support.</li> <li>• Response offers some examples for levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Response demonstrates a strong comprehension of all five levels of organization.</li> <li>• Response draws well developed connection between levels.</li> <li>• Response offers examples for all levels.</li> </ul>

# **“Curriculum Map”**

**Author: : Megan Lamontagne**

**Curriculum Map: Cells: The Story of Life**

**Grade Level: 7**

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
<p>Pre-assessment:</p> <ul style="list-style-type: none"> <li>• All living things have five common characteristics for survival.</li> <li>• Cellular survival is dependent on its structures and their functions.</li> <li>• The cell's processes guarantee that necessary materials enter and leave the cell.</li> <li>• Cellular reproduction continues the species.</li> <li>• All life is organized from the most basic level (cells) to the most complex level (organism).</li> </ul>	<p>CORE</p> <p>45 minutes</p>	<ul style="list-style-type: none"> <li>• These five characteristics evolved over time for continuation of a species.</li> <li>• A cell's structure correlates to its job for an organism</li> <li>• Specialized cells perform specialized functions in multicellular organisms.</li> </ul>	<ul style="list-style-type: none"> <li>• Living organism</li> <li>• Cells</li> <li>• Reproduction</li> <li>• Chemical processes</li> <li>• Growth</li> <li>• Development</li> <li>• Response</li> <li>• Stimulus</li> <li>• Movement</li> <li>• Organelles</li> <li>• Cell wall</li> <li>• Cell membrane</li> <li>• Cell nucleus</li> <li>• Nuclear membrane</li> <li>• Chromosomes</li> <li>• Nucleolus</li> <li>• Cytoplasm</li> <li>• Photosynthesis</li> <li>• Mitochondria</li> <li>• Cellular respiration</li> <li>• Ribosomes</li> <li>• Endoplasmic reticulum</li> <li>• Lysosomes</li> <li>• Vacuoles</li> <li>• Cilia</li> <li>• Flagella</li> <li>• Diffusion</li> <li>• Osmosis</li> <li>• Active transport</li> <li>• Equilibrium</li> <li>• Concentration</li> <li>• Selectively permeable</li> <li>• Semi-permeable</li> <li>• Mitosis</li> <li>• Phases</li> <li>• Chromatin</li> <li>• Interphase</li> <li>• Prophase</li> <li>• Metaphase</li> <li>• Anaphase</li> <li>• Telophase</li> <li>• Tissues</li> <li>• Organs</li> <li>• Organs systems</li> <li>• Organisms</li> <li>• Unicellular</li> <li>• Multicellular</li> </ul>	<ul style="list-style-type: none"> <li>• Reason deductively</li> <li>• Infer</li> <li>• Make connections</li> <li>• Organize</li> <li>• Describe</li> </ul>	<ul style="list-style-type: none"> <li>• Classification</li> <li>• Differentiation</li> <li>• Balance</li> <li>• Cycles</li> <li>• System</li> </ul>	<ul style="list-style-type: none"> <li>• What do I know about how organisms are structured to ensure efficiency and survival?</li> </ul>

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
1. All living things have five common characteristics for survival.	CORE/ PRACTICE/ AID  50 minutes	<ul style="list-style-type: none"> <li>• These five characteristics evolved over time for continuation of a species.</li> </ul>	<ul style="list-style-type: none"> <li>• Living organism</li> <li>• Cells</li> <li>• Reproduction</li> <li>• Chemical processes</li> <li>• Growth</li> <li>• Development</li> <li>• Response</li> <li>• Stimulus</li> <li>• Movement</li> </ul>	<ul style="list-style-type: none"> <li>• Reason deductively</li> <li>• Communicate</li> <li>• Evaluate</li> <li>• Infer</li> <li>• Observe</li> </ul>	<ul style="list-style-type: none"> <li>• Classification</li> </ul>	<ul style="list-style-type: none"> <li>• What are the five characteristics of living things?</li> <li>• Why are these particular characteristics necessary?</li> </ul>
2. Cellular survival is dependent on its structures, and their functions.	CORE/ PRACTICE  10 hours, 50 minutes	<ul style="list-style-type: none"> <li>• A cell's structure correlates to its job for an organism.</li> </ul>	<ul style="list-style-type: none"> <li>• Cell</li> <li>• Organelle</li> <li>• Mitochondria</li> <li>• Nucleus</li> <li>• Cell membrane</li> <li>• Nuclear membrane</li> <li>• Cell wall</li> <li>• Nucleolus</li> <li>• Endoplasmic reticulum</li> <li>• Cytoplasm</li> <li>• Chloroplast</li> <li>• Chromosomes</li> <li>• Vacuoles</li> <li>• Lysosomes</li> <li>• Ribosomes</li> <li>• Cilia</li> <li>• Flagella</li> <li>• Photosynthesis</li> <li>• Cellular respiration</li> </ul>	<ul style="list-style-type: none"> <li>• Research</li> <li>• Communicate</li> <li>• Engage in public speaking</li> <li>• Make connections</li> <li>• Follow directions</li> </ul>	<ul style="list-style-type: none"> <li>• Differentiation</li> </ul>	<ul style="list-style-type: none"> <li>• What is a cell?</li> <li>• What are organelles?</li> <li>• What are the different organelles of the cell and what are their functions?</li> <li>• What functions do the organelles perform for the cell?</li> <li>• What are the differences between plant and animal cells?</li> </ul>
3. The cell's processes guarantee that necessary materials enter and leave the cells.	CORE/ PRACTICE/ IDENTITY/ AID  6 hours, 25 minutes	<ul style="list-style-type: none"> <li>• Anybody can be a scientist.</li> </ul>	<ul style="list-style-type: none"> <li>• Diffusion</li> <li>• Osmosis</li> <li>• Active transport</li> <li>• Equilibrium</li> <li>• Concentration</li> <li>• Selectively permeable</li> </ul>	<ul style="list-style-type: none"> <li>• Draw conclusions</li> <li>• Write scientific procedures</li> <li>• Use the microscope</li> <li>• Observe</li> <li>• Follow directions</li> </ul>	<ul style="list-style-type: none"> <li>• Balance</li> </ul>	<ul style="list-style-type: none"> <li>• How are materials moved in and out of the cell?</li> <li>• How do different environments affect cells?</li> <li>• Would you like to be a biological scientist?</li> </ul>

<b>Major Principles and Generalizations</b>	<b>Time Allocation and Parallel</b>	<b>Minor Principles and Generalizations</b>	<b>Concepts</b>	<b>Skills</b>	<b>Themes</b>	<b>Guiding Questions</b>
4. Cellular reproduction continues the species.	CORE/AID  3 hours, 45 minutes		<ul style="list-style-type: none"> <li>• Mitosis</li> <li>• Replication</li> <li>• Nucleus</li> <li>• Chromosomes</li> <li>• DNA</li> <li>• Phases</li> <li>• Growth</li> <li>• Chromatin</li> <li>• Interphase</li> <li>• Prophase</li> <li>• Metaphase</li> <li>• Anaphase</li> <li>• Telophase</li> </ul>	<ul style="list-style-type: none"> <li>• Research scientifically</li> <li>• Draw scientifically</li> <li>• Organize</li> <li>• Follow directions</li> <li>• Calculate</li> </ul>	• Cycles	<ul style="list-style-type: none"> <li>• Why would an organism need to create more cells?</li> <li>• How does an organism create more cells?</li> </ul>
5. All life is organized from the most basic level (cell) to the most complex level (organism).	CORE  1 hour, 30 minutes	<ul style="list-style-type: none"> <li>• Specialized cells perform specialized functions in multicellular organisms.</li> </ul>	<ul style="list-style-type: none"> <li>• Cells</li> <li>• Tissues</li> <li>• Organs</li> <li>• Organ systems</li> <li>• Organisms</li> <li>• Unicellular</li> <li>• Multicellular</li> </ul>	<ul style="list-style-type: none"> <li>• Reason deductively</li> <li>• Classify</li> <li>• Communicate</li> <li>• Draw scientifically</li> </ul>	• System	<ul style="list-style-type: none"> <li>• What are the different levels of organization within an organism?</li> <li>• How are all of the levels related to each other?</li> </ul>

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
<p>Post assessment:</p> <ul style="list-style-type: none"> <li>• All living things have five common characteristics for survival.</li> <li>• Cellular survival is dependent on its structures and their functions.</li> <li>• The cell's processes guarantee that necessary materials enter and leave the cell.</li> <li>• Cellular reproduction continues the species.</li> <li>• All life is organized from the most basic level (cells) to the most complex level (organism).</li> </ul>	<p>45 minutes CORE</p>	<ul style="list-style-type: none"> <li>• These five characteristics evolved over time for continuation of a species.</li> <li>• A cell's structure correlates to its job for an organism</li> <li>• Specialized cells perform specialized functions in multicellular organisms.</li> </ul>	<ul style="list-style-type: none"> <li>• Living organism</li> <li>• Cells</li> <li>• Reproduction</li> <li>• Chemical processes</li> <li>• Growth</li> <li>• Development</li> <li>• Response</li> <li>• Stimulus</li> <li>• Movement</li> <li>• Organelles</li> <li>• Cell wall</li> <li>• Cell membrane</li> <li>• Cell nucleus</li> <li>• Nuclear membrane</li> <li>• Chromosomes</li> <li>• Nucleolus</li> <li>• Cytoplasm</li> <li>• Photosynthesis</li> <li>• Mitochondria</li> <li>• Cellular respiration</li> <li>• Ribosomes</li> <li>• Endoplasmic reticulum</li> <li>• Lysosomes</li> <li>• Vacuoles</li> <li>• Cilia</li> <li>• Flagella</li> <li>• Diffusion</li> <li>• Osmosis</li> <li>• Active transport</li> <li>• Equilibrium</li> <li>• Concentration</li> <li>• Selectively permeable</li> <li>• Mitosis</li> <li>• Phases</li> <li>• Chromatin</li> <li>• Interphase</li> <li>• Prophase</li> <li>• Metaphase</li> <li>• Anaphase</li> <li>• Telophase</li> <li>• Tissues</li> <li>• Organs</li> <li>• Organs systems</li> <li>• Organisms</li> <li>• Unicellular</li> <li>• Multicellular</li> </ul>	<ul style="list-style-type: none"> <li>• Reason deductively</li> <li>• Infer</li> <li>• Make connections</li> <li>• Organize</li> <li>• Describe</li> </ul>	<ul style="list-style-type: none"> <li>• Classification</li> <li>• Differentiation</li> <li>• Balance</li> <li>• Cycles</li> <li>• System</li> </ul>	<ul style="list-style-type: none"> <li>• What did I learn about how organisms are structured to ensure efficiency and survival?</li> </ul>



# **“Materials and Resources List”**

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher or Students)
Module 1, Lesson 1			Magazine pictures of living things, one picture of an automobile
Module 2, Lessons 2 - 15	White paper for concept maps (2 pieces per student), For each student: markers, colored pencils, crayons, construction paper, yarn, glue, tape, scissors, microscopes, microscope slides, microscope cover slips, samples of cork, onion epidermis and elodea, toothpicks, iodine, tape, glue, index cards for <i>Jeopardy</i> game	Encyclopedias, textbooks, research materials on organelles	Computers with Internet access, knife (for shaving off pieces of onion and cork), appropriate magazines (students will be cutting out pictures and words that represent organelle functions)
Module 3 Lessons 16 - 24	Several balloons, beaker of water, beaker with water and food coloring, beaker, (materials needed for each group): water, string, spoon, salt, plastic cups/beakers, elodea leaf, microscope, microscope slide & coverslip, water, salt-water solution, eyedroppers, paper towels (AID Lab: each group needs: two cups, water, salt, two pieces of dialysis tubing, graduated cylinder, food coloring, iodine, starch solution)		Several different flavors of food extract that students will recognize (almond, orange, vanilla, etc.), overhead projector, food coloring, bottle of white vinegar, at least one raw egg, one bottle of light corn syrup, plastic wrap to cover beaker, baby carrots (at least 3 per student group)
Module 4 Lessons 25 - 29	Index cards (at least 12 per student), staplers, 10 cm pieces of four different colors of yarn pieces for each group, large piece of drawing paper for each group, tape & scissors for each group	Textbooks, encyclopedias, research materials on mitosis	Computers with Internet access
Module 5 Lessons 30 - 31	For each student: markers, colored pencils, crayons, large pieces of drawing paper, index cards		