

Context

All living organisms on Earth are divided in pieces called cells. Cells are small compartments that hold all of the biological equipment necessary to keep an organism alive. The main purpose of a cell is to organize. Each cell has a different set of functions that are interdependent. The trillions of cells in your body make your life possible. Cells are unique to each type of organism.

Essential Questions

- What is a cell? How do cell structures differ?
- What are the functions of cells?
- How can one differentiate between cell types and purposes?
- Why are cellular processes essential to cellular functions?

Enduring Understandings

- Cells are the smallest structural and functional units of an organism. Typically cells are microscopic and consist of cytoplasm and a nucleus enclosed in a membrane.
- All cells have a purpose. A cell's purpose is much more important than acting as individual organizational pieces.
- There are two main types of cells: prokaryotic and eukaryotic.
- Cells manage a wide range of functions. Most of those functions require energy.

Time

These activities can be completed in 1–2 class periods of approximately 50 minutes.

Grade Level

Grades 6–12. Activities can easily be adapted to fit grade and ability levels.

Differentiation

These inquiry activities can be completed as a class guided by the teacher, in groups, pairs, or individually based on students' abilities.

Materials

- Rosen Digital's [Core Concepts: Biology](#) database
- Computers
- Smart Board, iPad, or other computer projection presentation device (optional if Teacher/Librarian wants to demonstrate worksheets and/or have one group worksheet)
- Appropriate Assistive Technology for students with special needs (if applicable)
- Supplement 1 - Look Inside Cells Info Sheets
- Supplement 2 - Look Inside Cells Learning Guide

- Supplement 3 - Cell Parts and Structures Worksheet
- Research materials (access to books and the Internet)
- Paper/pencils
- Scissors and glue
- Index cards (3–4 per student)
- [Extension activity] Supplement 4 - Multimedia Presentation Rubric

Student Learning Objectives

- Students will be able to identify cell parts, cell structures, and the functions of cells.
- Students will be able to describe and differentiate between cell types and purposes.
- Students will be able to describe cellular processes essential to cellular functions.

Next Generation Science Standards Addressed

MS-LS1-1.	Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]
MS-LS1-2.	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]
MS-LS1-3.	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]

MS-LS1-8.	Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. <i>[Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]</i>
HS-LS1-1.	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. <i>[Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]</i>
HS-LS1-2.	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. <i>[Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.]</i> <i>[Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]</i>
HS-LS1-3.	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. <i>[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.]</i> <i>[Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]</i>
HS-LS1-4.	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. <i>[Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]</i>

HS-LS1-5.	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] <i>[Assessment Boundary: Assessment does not include specific biochemical steps.]</i>
HS-LS1-6.	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] <i>[Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]</i>
HS-LS1-7.	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] <i>[Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]</i>

NGSS Science and Engineering Practices Addressed

- Developing and using models
- Planning and carrying out investigations
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

NGSS Crosscutting Concepts Addressed

- Cause and effect. Cause and effect relationships may be used to predict phenomena in natural systems.
- Scale, proportion, and quantity. Phenomena that can be observed at one scale may not be observable at another scale.
- Systems and system models. Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Structure and function. Complex and microscopic structures and systems can be visualized, modeled, and

used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

- Systems and system models. Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
- Energy and matter. Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.
- Structure and function. Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
- Stability and change. Feedback (negative or positive) can stabilize or destabilize a system.

Common Core ELA Standards

[CCSS.ELA-Literacy.RST.6-8.1](#), [9-10.1](#), [11-12.1](#)

Cite specific textual evidence to support analysis of science and technical texts.

[CCSS.ELA-Literacy.RST.6-8.2](#), [9-10.2](#), [11-12.2](#)

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

[CCSS.ELA-Literacy.RST.6-8.4](#), [9-10.4](#), [11-12.4](#)

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8, grades 9-10 texts and topics.

[CCSS.ELA-Literacy.RST.6-8.7](#), [9-10.7](#), [11-12.7](#)

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Activity 1: Cell Parts and Structures, Part 1

Introduction

Observe the parts and structures of an animal cell and a plant cell. Use Supplement 1 (Look Inside Cells Info Sheets) as a class by projecting cell diagrams on a whiteboard or distributing to the class. Identify and review parts of the cells. Introduce the following terms: *cell wall*, *centriole*, *chloroplast*, *cytoplasm*, *endoplasmic reticulum*, *Golgi apparatus*, *lysosome*, *mitochondrion*, *nucleus*, *plasma membrane*, *ribosome*, *vacuole*.

Materials

- Supplement 1 - Look Inside Cells Info Sheets
- Supplement 2 - Look Inside Cells Learning Guide
- Supplement 3 - Cell Parts and Structures Worksheet

- Paper/pencils
- Scissors and glue

Procedure

1. Provide each student with a copy of Supplement 2 (Look Inside Cells Learning Guide) so students may record and chart their progress throughout the lesson. As the class reviews plant and animal cells, have students complete the Learning Guide by filling out three known concepts and three new concepts for each cell. Have students work independently for about five minutes to document three concepts they want to learn more about.
2. Explain that cells come in many shapes and sizes. Some cells are covered by a cell wall, others are not, some have slimy coats or elongated structures that push and pull them through their environment. There are about 200 different types of cells in our bodies. Even our bodies' nonliving materials such as hair, fingernails, and the hard part of bones and teeth are made up of dead cells.
3. Ask students if they have ever wondered what the inside of a cell looks like. Explain that cells are much like the rooms in our homes—the inside of any animal or plant cell has many similar room-like structures called organelles.
4. Have students work in groups or pairs to review the three concept questions they recorded in their Look Inside Cells Learning Guide and identify which of the questions they are most curious about. Instruct students to record that question at the bottom of their learning guide.
5. Keep the learning guide. It will be used in Activity 2.

Activity 1: Cell Parts and Structures, Part 2**Introduction**

Working in pairs or small groups, students will complete Supplement 3 (Cell Parts and Structures Worksheet) by identifying each cell part or structure. When the sheet is completed, students will cut out each part or structure to create individual cards.

Materials

- Supplement 3 - Cell Parts and Structures
- Scissors and glue
- Paper/pencils
- Research materials (access to books and the Internet)

Procedure

1. Students can work individually, in pairs, or in small groups. Give each student the Cell Parts and Structures Worksheet. Using information from Core Concepts: Biology and other reliable print and Internet sources, have students fill in the following for each cell part:
 - a. Description
 - b. Location
 - c. Function

2. When all cards on the sheets are complete, create individual cards by cutting and pasting the image on one side of an index card and the information on the other. Students should look back at their concept questions to determine if any questions were answered with the information they filled in on their cards. While students are working provide assistance as needed.
3. After students have completed making the cell parts and structured cards and reviewed their concept questions, ask students to share one concept question that was answered by the information from a cell part and structure card. If no concept questions were answered, ask if additional questions arose. Have students add those questions to their Learning Guide.

Teacher Tip!

Students can study Quizlet flashcard sets to label a [plant cell](#) or [animal cell](#) on the [Core Concepts: Biology database](#) or by visiting [Rosen Digital's Quizlet page](#).

Activity 2: Cell Structures and Functions**Introduction**

Students will explore the relationship between structure and function in cells by viewing a variety of specialized cells and discussing each part's function. Students can work in pairs, small groups, or as a class to view the photographs and videos and write the answers to each question.

Materials

- o Core Concepts: Biology database
- o Supplement 1 - Look Inside Cells Info Sheets
- o Supplement 2 - Look Inside Cells Learning Guide
- o Supplement 3 - Cell Parts and Structures Worksheet
- o Pencils/paper

Procedure

1. Project on a whiteboard or share photos of cells in Supplement 1 (Look Inside Cells Info Sheets) to explore the variety of specialized cells that exist in organisms. Identify each cell shown.
2. Show the [Binary Fission](#) video (<http://biology.rosendigital.com/article/447/2/prokaryote-division-and-the-eukaryote-cell-cycle>) and discuss.
 - » Compare and contrast prokaryotic division and the eukaryotic cell cycle.
3. Have students watch the [Electrical Impulses](#) video (<http://biology.rosendigital.com/article/446/5/electrical-impulses>). Discuss.
 - » Why is communication between cells important?
 - » What kind of problems can arise in the body if cells are unable to communicate?

4. Show the [How Amebas Move Around](http://biology.rosendigital.com/article/444/5/movement) video (<http://biology.rosendigital.com/article/444/5/movement>). Discuss.
 - » What is the purpose of a cytoskeleton?
 - » What other structures help cells move?
5. Have students explore the photos of cells again, this time looking for similarities and differences in the cells. Make a list of at least three similarities and differences.

Assessment Evidence

Ongoing Assessment

- o Guided Discussions
- o Cell Functions Research

Summative Assessment

- o Look Inside Cells Learning Guide
- o Cell Structures and Functions answers

Extension: Cellular Structure and Function

Introduction

Cells contain many intricate structures inside their membranes. Many of these structures serve specific purposes. These interconnected networks of structures inside of a cell, known as the internal organelles, have to interact to ensure the cell's ultimate success and survival. There are several main functions that the cell has to carry out: molecule transport, reproduction, and energy conversion.

Materials

Share Supplement 4 (Multimedia Presentation Rubric) with students.

Procedure

1. Divide the class into six research groups. Each group will be assigned a cell function to research and prepare a five-minute presentation to share with the class.
 - Group 1 - Molecule transport: exocytosis
 - Group 2 - Molecule transport: endocytosis
 - Group 3 - Reproduction: mitosis
 - Group 4 - Reproduction: meiosis
 - Group 5 - Energy conversion: photosynthesis
 - Group 6 - Energy conversion: cellular respiration
2. Each group's research information must include:
 - a. A clear description of the function
 - b. An explanation of any processes that take place, including any sequential steps or stages
 - c. The importance of the function
 - d. A labeled diagram demonstrating any processes
 - e. An analysis of the implications of abnormal cell functions

3. Students should research their assigned cell function using the Core Concepts: Biology database and other trustworthy online and print resources. Encourage students to be creative in their presentations by using PowerPoint or Keynote, or interactive activities.

Teacher Tip!

Students can use the [Create a Multimedia Presentation](#) interactive activity when planning their presentation.

4. Each student group will present their findings to the class.

Analysis

Use the rubric to assess each group's presentation. As a class, analyze and discuss how cell functions and processes are interdependent.

Suggested Prompts

- Think about the implication of a mutated cell during cellular respiration. How might the process change?
- During the interphase of mitosis the cell replicates all of the genomic and cytoplasmic materials as it prepares for division. What may result if only partial replication took place?
- Cells need to make proteins. Those proteins might be used as enzymes or as support for other cell functions. Explain the outcome if a cell is unable to make protein.