Section 1.1 Studying the Structure of Cells

(Student textbook page 7)

Specific Expectations

- **B1.2** assess the importance to human health and/or society of medical imaging technologies used in Canada in diagnosing and treating abnormalities in tissues, organs and/or systems
- **B2.3** examine different plant and animal cells under a microscope or similar instrument, and draw labelled biological diagrams to show how the cells' organelles differ
- **B3.5** explain the interaction of different systems within an organism and why such interactions are necessary for the organism's survival

In this section, students investigate the structure of cells, cell theory, the function of different organelles, and some differences between plant and animal cells. Students will learn the important role of microscopes in the study of cell structure.

Common Misconceptions

- Students may consider cells to be comparable in size to molecules. Use the Sense of Scale on page 11 of the student textbook to facilitate understanding of cell size. Extend this analogy to the size of molecules in comparison to cells (Example: a cell = 10 micrometers = 1.0×10^{-6} m; molecules generally average between 1.0×10^{-12} m to 1.0×10^{-9} m).
- Students may believe that the cell is simply a sac of objects with a membrane holding them in. Discuss the idea of suspensions, and explain that cytosol acts as a jelly-like substance to suspend organelles. Explain that these organelles (molecules) move around using the analogy of a lake or a pond, where some plants are anchored to the bottom but sway freely, some objects like fish or people are suspended, and some objects are attached to lines (like contractile fibres) that they use to move around.
- Students may think that a cell wall is impermeable and thus blocks movement of molecules.
- Students may have assimilated over-simplified analogies from past courses as fact. Continue to expand their understanding with age-appropriate examples, translating earlier analogies into more sophisticated and accurate language. For example, replace "DNA blueprint" with "instruction manual for growth, repair, and division." Or redefine the nucleus from the "control centre" as the "protective sub-container for the critical instruction manual molecules (DNA)."

Background Knowledge

Life is organized into five kingdoms: animals, plants, fungi, protists, and bacteria. Except for bacteria, all kingdoms are composed of organisms with eukaryotic cells. These cells have, or once had, a true nuclear membrane containing nuclear material. Some protists have multiple nuclei (up to 10 000). Bacteria are prokaryotic cells because they do not have a nuclear membrane surrounding their genetic material. Students are asked to investigate prototypical plant and animal cells, which are examples of eukaryotic cells that come from multicellular organisms. Students have explored the differences between unicellular and multicellular organisms in previous studies, and should know example organisms of each.

For reference purposes, cytosol is the fluid and molecular portions of the cytoplasm, exclusive of any membrane-bound organelles. Cytoplasm includes all of the organic and inorganic substances external to the nuclear membrane and includes the cytosol and membrane-bound organelles.

Literacy Support

Using the Text

- ELL Preview the Key Terms with English language learners before reading. Have students highlight key words in their notes and keep a list of the new words with definitions, examples and non-examples, and sketches.

Before Reading

- ELL To help English language learners search for additional context and information, ask them to search upcoming pages for other sources of information on the same topic.
- Have students complete **BLM 1-4 Chapter 1 Anticipation Guide.** Have students revisit their anticipation guides at the end of the chapter to check learning.
- Have students preview the text features, scanning the headings and highlighted terms. Explain to students that they can build a deeper understanding by simultaneously using the images and narrative.
- Students can begin their notebook on this section by generating a table of key terms they can populate with definitions and examples as they go along.
- In pairs, have students predict what the main ideas of the section will be.
- Perform a graffiti activity on what students remember about cells, organelles, and the similarities and differences between plant and animal cells. Divide the class into four groups and set up four chart pages, each with one of the topics above written on it. Have the groups move from chart to chart to write responses to each topic and comment on responses from other groups.

During Reading

- Have students pause and reflect on the cell theory and consider the bigger questions: How did the first cell arise? What conditions are needed for cells to divide into more cells? What kinds of organisms are made of single cells? What organisms are made from multiple cells? What kinds of jobs do cells do?
- Have students note pages that relate to statements on **BLM 1-4 Chapter 1 Anticipation Guide.**

After Reading

- Consolidate connections between the microscope's capabilities and cell/organelle size by having students create a chart showing which microscope permits viewing of what cells or cell organelles.
- Have students use one **BLM G-47 Venn Diagram** to summarize similarities and differences between plant and animal organelles, and another for light and electron microscopes.
- Have students reassess the statements on **BLM 1-4 Chapter 1 Anticipation Guide.** Have their opinions or understanding changed?

Using the Images

- Link each micrograph to the microscope that might have produced it (pages 8 and 9).
- View the images on pages 8 and 9 of the student textbook (Figure 1.2) as a class. Have students look at the images without reading the captions. Then, have each student (or small groups) write their own captions. Next, have students read the textbook's captions and incorporate both captions into one. The last image shown on the monitors is a micrograph (photograph taken with a microscope). Explain that the process of obtaining a micrograph requires two tools: the microscope and a camera attachment, possibly linked to a monitor (third tool).

- Have students create different "timelines" using the information in the *National Geographic* feature (pages 8 and 9 of the student textbook). Some timeline sequences could be: from smallest to largest; from least expensive to most expensive; from smallest magnification to largest magnification; and from smallest range of uses to largest range of uses. **BLM 1-7 Magniline** may help students get started.
- Encourage students to compare and contrast the structures in Figures 1.5 and 1.6. Discuss that a vast number of microslide slices are pieced together to develop a complete three-dimensional image of the inside and outside of a cell. This will help explain why only a small number of organelles are seen in the micrograph compared to the illustration. Have students trade analogies with each other to check for understanding (Example: "If someone cuts an apple, they may or may not also cut through the seeds.").

Assessment FOR Learning		
Tool	**Evidence of Student Understanding**	**Supporting Learners**
Learning Check questions, page 14	Students compare plant and animal cell organelles	Have students complete **BLM 1-6 Organelle Study.** Or, have students draw each structure as you name it or describe its function.
Section 1.1 Review questions, page 15	Students understand and explain the function of different organelles	Have students compare types of cells using **BLM G-47 Venn Diagram.**

Instructional Strategies

- Encourage students to organize information graphically, using labelled diagrams and concept webs. **BLM G-47 Venn Diagram** can be used to compare and contrast: plant and animal cell organelles; light and electron microscopes; cell walls and cell membranes; or nuclear material and cytoplasmic material.
- Have students create jingles, logos, or rhymes to help them remember the cell theory and the extension of the theory's value in the scientific community. Encourage them to start their creations with a question and to end them with a conclusion or response.
- Have students complete **BLM 1-6 Organelle Study.**
- To assess students on their use of Venn Diagrams, refer to **BLM A-15 Venn Diagram Checklist.**

Learning Check Answers (Student textbook page 14)

1. Example:

Function	Plant Cell Organelles	Animals Cell Organelles
Protein production	ribosomes	ribosomes
Food storage	vacuoles	vacuoles
Transportation of substances	endoplasmic reticulum, vesicles	endoplasmic reticulum, vesicles
Maintenance of cell's structure	cytoskeleton, cell walls	cytoskeleton

2. Example:
brightfield/darkfield; object viewed against a bright (or dark) background
transmission electron; aims beam of electrons through microscope
phase-contrast: shows variations in specimen's capacity to bend light

3. All living organisms are made of one or more cells. The cell is the basic organizational unit of life. All cells come from pre-existing cells.

4. Example: Images can only be viewed as photographs or on a computer monitor; too large; too expensive.

Section 1.1 Review Answers (Student textbook page 15)

Please also see **BLM 1-9 Section 1.1 Review (Alternative Format).**

1. Electron microscopes provide greater magnification.

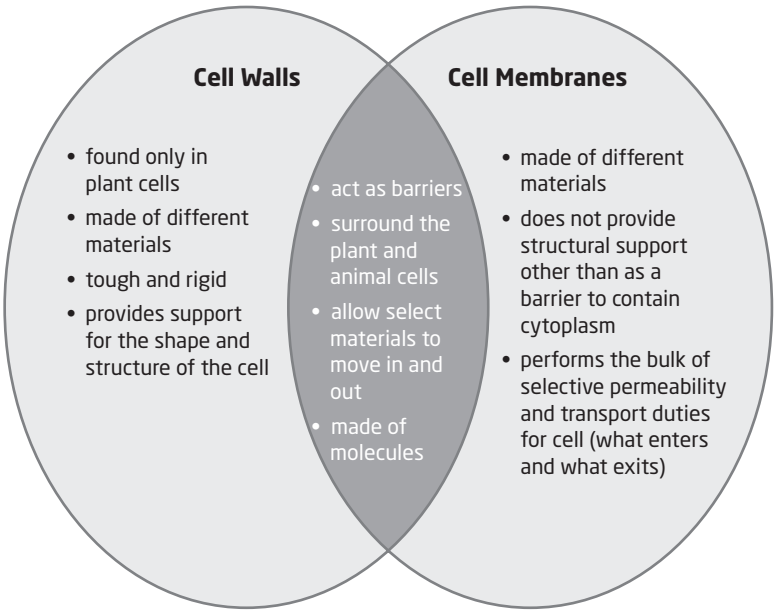
2. Mitochondria: releases energy from glucose, output energy powers cell activities
Nucleolus: manufactures ribosomes, which in turn help produce proteins
Vacuole: stores water and other materials; in plants, when large vacuole is full, it can add support to the cell structure

3. **a.** plant cell

b. D

c. cell wall

4.



5. Example:

Unique Organelles and Features in Animal Cells	Similar Organelles and Features	Unique Organelles and Features in Plant Cells
• Several small vacuoles • Mitochondria release energy stored in glucose that animals digested • Different shapes and sizes of cells, but generally spherical	• Selectively permeable membranes control flow of materials • Cytoplasm–includes cytosol and organelles • Mitochondrion–releases energy from glucose • Ribosomes–protein production • Endoplasmic Reticulum–transportation, connected to nucleus • Vesicles–sacs for transportation and storage • Golgi Body–protein packaging and sorting • Nucleus–controls cell activities • Vacuoles–contain water and other molecules to a lesser degree • Cytoskeleton–skeletal support and tracks of filaments and tubules for molecular movement	• Large primary vacuoles • Cell Wall–tough rigid structure outside cell membrane, providing cellular support • Chloroplasts–trap solar energy to manufacture glucose • Mitochondria release energy stored in glucose that the plant produced itself • Different shapes and sizes, but generally more box-like due to cell wall

6. Example: The mitochondrion room is the synonym for the boiler room. Inside the mitochondrion room, there are multiple mitochondria, for this is a large factory. The mitochondria take one form of energy, like wood or fossil fuel, and burn it. The steam that is produced has a lot of energy and can be used to run the factory through turbines, which will generate power for engines and electricity. As a factory owner, it is goes without saying that such a boiler room is quintessential, and it is equally important to maintain the upkeep of the mitochondria boilers. (Diagram should include a boiler with energy being put in and energy coming out, such as coal in and steam out.)

7. a. sperm cell

b. They do not require as much food (glucose) as the other cell types.

8. Plants have chloroplasts. They trap energy from the Sun to make glucose, which is needed for cellular respiration. Cellular respiration produces energy that can be used by living things.