

## Topic 1.1

### Why are cells important?

#### Specific Expectations

- **B2.1** use appropriate terminology related to human cells, tissues, organs, and systems, including, but not limited to: *absorption, anaphase, capillaries, concentration, differentiation, diffusion, interphase, metaphase, osmosis, prophase, red blood cells, regeneration, and telophase*

#### Skills

- formulate scientific questions
- identify and locate relevant research materials
- conduct inquiries
- gather, organize, and draw conclusions from data
- communicate using a variety of formats
- use appropriate units of measurement

#### Materials

Please see the teaching notes for each activity for a list of the materials required. Please see pages TR-38 to TR-41 for a summary of the materials required in this topic.

#### Overview

In this topic, students will appreciate that the cellular components of both plant and animal cells work together to carry out life functions, and that their basic needs can be met through cellular processes such as diffusion and osmosis.

#### Common Misconceptions

- **Students may confuse the terms diffusion and osmosis.** The universal system of diffusion/osmosis controls water balance and transport in plants and animals at the cellular level. Diffusion is the movement of substances across a concentration gradient. It can occur within a cell, across a membrane, and outside a cell in body fluids. Osmosis is the movement of water molecules across a membrane in response to concentration differences. The difference between the two is that osmosis is restricted to the movement of water only, and only occurs across a membrane.
- **Students may think that a body is only the sum of its cells.** Cells are within the body of the organism but do not make up the body. Students will come to understand that the cells that make up their body grow, divide, and die all the time. In fact, all organisms are composed of one or more cells that come from pre-existing cells and are capable of performing life functions.
- **Students may not appreciate that the functioning of their whole body depends on the functioning of individual cells.** Everything that we do, we do by having individual cells perform their specialized functions. Have students suggest an activity, such as breathing, or throwing a ball, and work together to break down the parts of the body that are involved in that activity, including how cells are involved. For example, to throw a ball, nerve cells release chemicals to convey messages to muscle cells, which transport and use energy to contract.

#### Background Knowledge

To understand how organisms function, we must study the individual cell and how it functions in both plants and animals. Any advancement in our knowledge of medical technology is dependent upon our understanding of cellular functions. All life functions are carried out by the cells of the organism working together. Each cellular organelle has a different task to perform for the organism to survive. Cellular processes such as diffusion and osmosis allow the organelles to obtain the materials they need to function, and allow the organism to meet its basic needs such as respiration and digestion.

#### Literacy Strategies

##### Before Reading

- Begin mapping the current knowledge that students have related to cell components by constructing a concept map based on input from the class. You could write “How cells work” in the centre, and connect ideas related to components and their functioning to it. Students could begin on their own concept map, using **BLM G-40 Concept Map**. Then, they could share their ideas with a partner and contribute to a large class map. Note: The Starting Point Activity on page 9, would be a good introduction to building this concept map.
- **ELL** Pair English language learners with students who have strong English skills for this activity. Check that all vocabulary used to describe cellular functions is understood, including verbs. Encourage students to check their notes about organelles and their functions against the class concept map, and to revise their concept maps if necessary.
- **ELL** Preview text features, scanning the headings and highlighted terms as well as talking about visuals.

### During Reading

- An organism is capable of responding to stimulus, reproducing, growing, and maintaining itself. Have students work in pairs to predict what cellular processes are necessary for the survival of an organism based on these basic life functions. As they read, they can confirm, and add to, their list.
- Model thoughtful reading by reading part of the topic aloud, and pausing to share questions or connections that occur to you as you read.

### After Reading

- Have students work in small groups to come up with definitions of osmosis and diffusion in their own words. They can use **BLM G-37 Summarizing**.
  - **DI** **ELL** Students could draw a diagram to summarize the similarities and differences between osmosis and diffusion. Or they could communicate their understanding in another format, such as a skit. Model this for English language learners.
- Reflect and evaluate: Have students reflect on their new-found knowledge and how it may have altered their perception of cellular functions. They can choose a thought to share with a classmate or in a class discussion.
  - **ELL** To include English language learners and others who may be reluctant to volunteer ideas orally, you could write a few common responses on the board, then ask students to indicate which response is closest to their own.
- Ask students to summarize what they have learned by completing **BLM 1-5 Cell Organelles**.

Assessment FOR Learning		
Tool	Evidence of Learning	Supporting Learners
Activity 1.1, page 11 Learning Check, page 11	Students describe concrete benefits of studying cells.	<ul style="list-style-type: none"> <li>• Have students arrange themselves in a line with those who believe studying cells is important at one end, and those who do not think it has measurable benefits at the other. Then “fold” the line in half so that students at one end of the line are facing students at the other, and allow students five minutes to discuss the issue with the classmate standing opposite them.</li> </ul>
Learning Check, page 13	Students use correct terminology to list ways that cell organelles work together to complete life functions and allow for the survival of the organism.	<ul style="list-style-type: none"> <li>• Supply students who need help organizing their responses with <b>BLM 1-4 Why Are Cells Important?</b></li> <li>• Create a word wall to reinforce the names of organelles and the key terms in this unit.</li> <li>• Have students refer to their completed copy of <b>BLM 1-5 Cell Organelles</b> to help them identify or describe the roles various cells parts play in a cell. English language learners can use this blackline master to help them create written responses to questions 3 and 4. Consider providing sentence starters to help them get started. For example, “The _____ supports the life of a cell by _____.”</li> </ul>
Learning Check, page 15	Students describe the importance of diffusion and contrast it with osmosis.	<ul style="list-style-type: none"> <li>• Students could use <b>BLM G-49 Venn Diagram</b> to answer question 2.</li> </ul>
Activity 1.4, page 18	Students construct and interpret a graph showing speed of diffusion.	<ul style="list-style-type: none"> <li>• You can use Numeracy Skills Toolkit 2, Organizing and Communicating Scientific Results with Graphs, on pages 360 to 365, as well as <b>BLM G-34 Constructing Line Graphs</b> and <b>BLM G-35 Reading and Interpreting Line Graphs</b>, to review graphing skills with students.</li> <li>• Students who require support constructing a graph can record their results on <b>BLM 1-6 Diffusion in Action</b>.</li> </ul>

## Topic 1.1 (Student textbook pages 8-19)

### Using the Topic Opener

- Discuss what students know about artificial body parts. Artificial hearts and artificial limbs have become quite sophisticated. Ask students what a successful artificial hand would have to be able to do.
- Invite a volunteer to read the paragraph on page 8, and have all students examine the illustration on pages 8 and 9. Extend the discussion of artificial body parts to artificial cells. Together, create a list of things an artificial blood cell, or another type of cell, would need to be able to do. Students' suggestions should include functions similar to the functions carried out by natural cells of that type. The responses will give you an idea of students' prior knowledge. In addition to supporting the whole organisms activities, all cells are made from pre-existing cells and must undergo changes to survive. Repair, replication, regeneration, and growth are some of these changes. Artificial cells would also need to be able to perform these functions.
- Discuss potential problems that might be caused by the creation of artificial cells.
- As opportunities occur, introduce the key terms for the Topic into the discussion.

### Starting Point Activity (Student textbook page 9)

#### Pedagogical Purpose

Students will have a previous understanding of some cellular components. This activity will help them activate that understanding.

#### Planning

<b>Materials</b>	cell models or diagrams (optional)
<b>Time</b>	25 min in class 5 min preparation

#### Activity Notes and Troubleshooting

- Students with minimal previous knowledge could be paired with other students for this activity. Consider using a think-pair-share strategy, then having pairs compare their ideas with those of another pair.
- You may choose to have students share their previous knowledge of cells in a teacher-led classroom discussion. Write ideas on the chalkboard for the class to see.
- Cell models (magnetic, professional, or made by previous students) and illustrations of cells might facilitate student discussion.

#### Additional Support

- **ELL** Record the names of cell components on the chalkboard as students suggest them. Leave these for students to refer to as they work through this topic. Create simple sentences to incorporate terminology introduced.
  - Determine English language learners' prior knowledge of cell components. Even if they have studied these concepts in another language, they may be missing the English terms. Use **BLM 1-5 Cell Organelles** to review parts of the cell. Alternatively, hide the labels in the BLM diagrams and have students match cell parts with terms or definitions.
- **DI** Invite students to jog on the spot, or do jumping jacks, for a couple of minutes. Then ask them what is happening in their bodies. They may notice their heart rate and breathing rate increasing, and their temperature rising. Elicit, or point out, that red blood cells play an important role in getting oxygen from the air they breathe to their muscles, so that the muscles can function. If they did not have as many red blood cells, they would have to breathe even faster, and their heart would have to pump faster.

## Starting Point Activity Answers

1. Students may recall that red blood cells contain hemoglobin, which binds to oxygen in the lungs, and transports it to cells throughout the body.
2. Answers will vary, but students may recall the functions of the nucleus, cell membrane, cell wall, chloroplasts, vacuole, mitochondria, and cytoplasm from Grade 8.

## Instructional Strategies for Topic 1.1

### Student textbook pages 10–11

- Ensure that all students are familiar with the new terminology introduced in the text and diagrams.
- Encourage students to share other medical breakthroughs that they know about, and explain how the medical advances relate to cells and their effects on our lives.

### Student textbook pages 12–13

- Point out the key term *organelle* and its definition in the margin on page 12. Have students find *organelle* in the glossary on page 432. Point out that the key terms will be defined in the margins, and that students can also look up the definitions in the glossary.

### Student textbook pages 14–15

- Students could read this spread in pairs, with one student reading about each organelle and the other locating that organelle on the diagram.
- Draw a large cell diagram on the chalkboard. Create magnetic cards that name and define each of the new terms introduced and let students take turns using them to explain the inter-connections between cell type and cellular organelles.
- Students could also place the cards on a large Venn diagram to compare plant and animal cells for Learning Check question 2 on page 15. For individual Venn diagrams, students can use **BLM G-49 Venn Diagram**.

### Student textbook pages 16–17

- Before reading, perform a demonstration of diffusion, as shown in Figure 1.3 on page 16. Ask students for their observations, then ask them for predictions about how diffusion might be useful in our bodies.
- Consider demonstrating osmosis by sprinkling salt on some cucumber slices. After a few minutes, beads of water should appear on the cucumbers. Ask students to explain where the water came from and why it appeared.

## Activity 1.1 Why Study Cells? (Student textbook page 11)

### Pedagogical Purpose

People study cells to appreciate the diversity and the various functions of all the different types of cells. We can observe cells to aid in our diagnosis of disease and to find cures. Knowledge of cellular shape, size, and function can aid scientists in their research of medical discoveries and new technologies. In this activity, students use research and summary skills to explore some recent research related to cells.

Planning	
Materials	short articles about recent medical discoveries (optional)
Time	20 min in class 10 min preparation

### Skills Focus

- identify and locate relevant research materials
- conduct inquiries
- gather, organize, and draw conclusions from data
- communicate using a variety of formats

### Activity Notes and Troubleshooting

- Students can use the descriptions of medical discoveries on pages 10 and 11 as models to follow as they summarize their article.
- You may wish to supply simple magazine or newspaper articles that provide information about medical discoveries and technologies. Websites that describe scientific research in lay terms could also be used. Choose articles that are suitable in content and reading level for this activity. See [www.scienceontario.ca](http://www.scienceontario.ca) for some suggestions.
- To ensure that students truly understand the readings, you might distribute copies of **BLM G-37 Summarizing** for them to use as they read.

### Additional Support

- Allow students to discuss their results in a one-on-one scenario, or to present their answers orally or in a diagram instead of in writing.
- **ELL** Have English language learners use a chart to create notes as they are researching. Headings may include “What is the breakthrough/discovery?” “How are cells involved?” “Who does this help?”
- Enrichment—Invite students to speculate about some of the difficulties involved in conducting scientific research when it relates to determining the causes of human disease. Have students research an outbreak of disease and its effects.

### Activity 1.1 Answers

Answers will vary. Students should summarize the article in their own words, and explain how the research relates to cells and helps them, their family, or society.

### Learning Check Answers (Student textbook page 11)

1. We learn about cells to understand how organisms, including humans, function. By learning about cells, we come to understand how we can:
  - protect cells to prevent infection and other harmful effects
  - observe cells to diagnose disease
  - treat cells to heal illnesses
  - stop harming cells through our choices and actions
2. To develop a malaria vaccine, you would have to study cells in both humans and mosquitoes and to understand the single-celled organism that causes malaria.
3. Knowledge of skin and blood cells help doctors create an artificial skin substitute because the nylon-based material contains a substance that works with the blood to heal the wound.
4. An understanding of nerve cell function might help researchers create technologies that alleviate the symptoms of Alzheimer’s disease or multiple sclerosis.

## Activity 1.2 Organelles on Strike (Student textbook page 13)

### Pedagogical Purpose

Students will use their knowledge of organelle function to determine which organelles are involved in transporting substances into and out of the cell and in reproducing.

### Planning

#### Time

25 min in class

### Skills Focus

- make predictions
- draw conclusions

### Activity Notes and Troubleshooting

- You could have students complete “If . . . , then . . . ” statements for this activity.
- Have students create a t-chart and use it to record each organelle that would be involved, and the role that it would play. They could then share their t-charts with a classmate or in a group. Alternatively, have students work in groups to predict the organelles that would be involved a strike and then allow students to circulate to view other groups’ predictions.

### Additional Support

- If students have trouble making predictions, assist them by using Figure 1.1 and Figure 1.2 on pages 14 and 15 to identify one of the organelles and its function.
- **ELL** Ensure students understand what it means to go on strike. Discuss the effects when workers go on strike. Read the activity aloud, using simple language. For example, you could restate the first point as: “moving water and salt into the cell”.
- **DI** Some students may enjoy showing the effects of a strike using a skit or a comic strip. Encourage any effective representation using concepts from drama or art classes.
- Enrichment—Discuss the implications of the strike on other cell functions with students.

### Activity 1.2 Answers

Vesicles, vacuoles, Golgi bodies, and the endoplasmic reticulum all play a role in transporting substances in and out of the cell. The nucleus is responsible for reproduction.

### Learning Check Answers (Student textbook page 13)

1. The basic unit of life is the cell.
2. An organelle is a structure in a cell that performs a specific function.
3. Three ways in which organelles support the life of a cell are by removing wastes, by generating and releasing energy for the cell to use, and by controlling the reproduction of the cell.

### Activity 1.3 Organelle Bingo (Student textbook page 15)

#### Pedagogical Purpose

Organelle Bingo will allow students the opportunity to share their creativity and their scientific knowledge. Creating games to supplement their learning provides students with opportunities for unique expressions of their personalities and shows how they relate to their peers. Bingo, Jeopardy!, Scrabble®, or other games could be used as models.

#### Planning

<b>Materials</b>	chart paper (optional) other materials as required (optional)
<b>Time</b>	60 min in class 20 min preparation

#### Skills Focus

- develop inter-personal and social dynamics skills
- use creativity in science
- apply scientific knowledge

#### Activity Notes and Troubleshooting

- Before students begin, outline the expectations for this activity including classroom behaviours that will be tolerated.
- While some students may want to work alone, many will produce more creative, practical games if they work with a partner. Allow students to work as they feel most comfortable.
- Ensure clean-up is completed in the allotted timeframe.
- Encourage students who wish to create original games, or to pattern games on other games not listed in the activity. Remind students that whatever format they choose, they will need to find a way to use it to achieve the goal of the activity.
- Allow time for students to play some of the games that are produced.

#### Additional Support

- **ELL** Most students will be familiar with the games listed in the textbook. If some are not, play a short game with them to familiarize them with how the game works. Review the basic rules. For example: a bingo card contains some information, other information is called out, and the player tries to match both sets of information to complete a pattern on their card.
  - Creating the game itself may be difficult for an English language learner so partner them or place them in a group of three. Playing games is a terrific way for English language learners to rehearse and review new vocabulary and concepts.
- Before they begin, have students reflect on the outcomes of this activity. Consider having students explain their game plan to you before they begin building it. Be sure they have a clear and effective idea for how playing their game will help them learn about organelles.
- Some students may require assistance getting started; suggesting a simple example question that they might include in their game may solve this roadblock.
- Pair students who require organizational or recording support with students who have strengths in these areas.
- Enrichment—Have students write a statement that briefly describes their game that could be used on the game package.

#### Activity 1.3 Answers

Games will vary. Students should be able to explain how their game helps them learn about cellular organelles and their functions.

## Learning Check Answers (Student textbook page 15)

1. Some cells have more than one type of organelle because different cells perform different roles in an organism. A muscle cell will have many mitochondria because muscle cells need a lot of energy.
2. Answer should include three of the following: plant cells have chloroplasts and animal cells do not, plant cells are rectangular and animal cells have a variety of shapes, plant cells have a cell wall and animal cells do not, plant cells have one large vacuole and animal cells may have several small vacuoles.
3. The person would have no strength in their muscles since mitochondria produce energy for muscle cells. The cells would die.

## Learning Check Answers (Student textbook page 17)

1. In osmosis, water molecules move from an area of high concentration to an area of low concentration until the water molecules are evenly distributed. In diffusion, substances move from an area of high concentration to an area of low concentration gradient until the substances are evenly distributed. Both diffusion and osmosis involve a transportation of substances.
2. My cells require water and nutrients to function. My body requires my cells to perform their tasks in order to survive. I could not survive if diffusion did not bring water and nutrients to the cells.

## Activity 1.4 Diffusion in Action (Student textbook page 18)

### Pedagogical Purpose

By studying diffusion in action, students are exposed to basic scientific research that involves observation and interpretation of results. Students are also asked to identify the dependent and independent variables, and graph and interpret their results.

Planning	
<b>Materials</b>	Per group: 25 mL graduated cylinder    1 mL undiluted blue or red food colouring warm tap water                watch or stopwatch 1 long pipette                   graph paper 1 pipette filler
<b>Time</b>	30 min in class 15 min preparation
<b>Safety</b>	Remind students to use pipette filler not their mouths to fill the pipette. Remind students to be careful with glassware, which can break, and food colouring, which can stain clothing and skin. Have students clean-up any spills or broken glass immediately.

### Skills Focus

- conduct an inquiry, controlling some variables
- use appropriate units of measurement when recording data
- draw and interpret graphs
- communicate using a variety of formats



### Activity Notes and Troubleshooting

- Demonstrate for students how to fill, move, and empty a pipette.
- Read Numeracy Skills Toolkit 2, Organizing and Communicating Scientific Results with Graphs, on pages 360 to 365, with students to remind them of graphing techniques.
- Groups of three are ideal for this activity. Three students can easily share the tasks involved, and can support one another as they record and interpret results. Students should create the graph and answer the What Did You Find Out? questions individually.
- Develop students' responsibility for the management of their workstations by having them do their own set-up and clean-up.
- Support students' problem-solving skills by asking them to list the difficulties they may have encountered in the activity. Have students brainstorm solutions.
- Have students produce a short summary of the activity after completing it.

### Additional Support

- Offer students a choice of completing their own graph or completing the graph as a class on chart paper or the chalkboard.
- Students who require additional support creating graphs can use **BLM G-34 Constructing Line Graphs** and **BLM G-35 Reading and Interpreting Line Graphs** to review graphing techniques. You may wish to make **BLM 1-6 Diffusion in Action** available to some students to record their results.
- **ELL** Place English language learners in groups with students who have strong English skills to help them understand the instructions. Encourage these partners to talk aloud while they are working through the steps of the activity.

### Activity 1.4 Answers

#### What To Do

Students' tables and graphs will vary depending on factors including the temperature of the water. Graphs should show volume in 5 mL intervals on the  $x$ -axis and time on the  $y$ -axis. The colour should move up each 5 cm interval more slowly than the last interval.

#### What Did You Find Out?

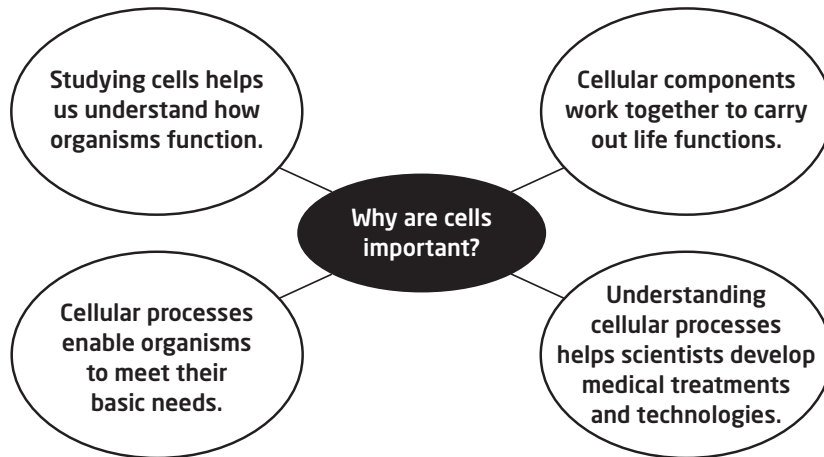
1. The dependent variable is time and the independent variable is the height of the cylinder.
2. The graph should show a smooth curve that becomes steeper as you move from left to right.
3. The rate of diffusion decreases with time and it takes an increased amount of time for the dye to move up the cylinder.
4. Since the rate of diffusion decreases with time, it would take a long time for a substance to reach the centre of a very large cell. It would take a short time for a substance to reach the centre of a very small cell. So very small cells would be more efficient than very large cells at getting energy and expelling waste.

## Topic 1.1 Review (Student textbook page 19)

Please see also **BLM 1-7 Topic 1.1 Review (Alternative Format)**.

### Answers

1. Answers may vary. For example:



2. Three benefits that result from studying cells are diagnosing disease, treating cells to heal illnesses, and stopping harm to cells through our choices and actions.
3. The cell is considered the basic unit of life because all organisms are comprised of one or more cells and all cells are derived from pre-existing cells.
4.
  - a) Provides the energy for cellular functions.
  - b) Controls the movement of materials into and out of the cell.
  - c) Controls all cell activities.
  - d) Contains water and other materials, also used to store or transport small molecules. Plant cells tend to have one large vacuole; animal cells may have several smaller vacuoles.
5. Putting the brush into water represents diffusion because the paint molecules are moving from an area of high concentration (the brush) to an area of low concentration (the water). The water eventually turns green as a balance between the substances is achieved.
6. Examples will vary, and could include chemicals from a spill diffusing into a lake, the smell of dinner cooking diffusing throughout the air of a home, or sugar diffusing in a cup of tea.
7. Answers will vary. Lyrics should mention at least three organelles, their functions, and their roles in the cell.